"D" LINE TRUCK SERVICE MANUAL CT-140

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
180 NORTH MICHIGAN AVE. CHICAGO, ILLINOIS

INTRODUCTION

This Motor Truck Service Manual is for the "D" Line of trucks and when completed will provide a convenient reference for the Serviceman.

It has been compiled in a simple, non-technical manner and every effort has been made to cover, at this time, the most important items.

Wherever possible, repetition of service instruction has been avoided by combining truck or unit models.

As additional data is compiled, new or revised pages will be issued which should be inserted in the proper Group and Section.

An Index at the front of each Group permits locating items covered in a particular Group and the Groups have been subdivided where necessary, into Sections.

REMOVE THE DIRT

Before starting any overhauling work, always remove the dirt that has accumulated around the parts to be disturbed. When parts are taken off, dirt not removed may fall into the units contaminating the lubricating oil and getting into bearings and other working parts. As dirt contains grit and abrasives, considerable unnecessary wear and reduction in efficiency is invariably the result. Play safe by removing the dirt.

WARRANTY

●

THE INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
warrants each new INTERNATIONAL MOTOR TRUCK to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any part or parts thereof which shall be returned to it with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective, provided that such part or parts shall be so returned to it not later than ninety (90) days after delivery of such vehicle to the original purchaser, and that at the time of such return, the said vehicle shall not have been operated in excess of five thousand (5,000) miles. This warranty is expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and it neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale of its vehicles.

This warranty shall not apply to any vehicle which shall have been repaired or altered outside of its factory in any way so as, in its judgment, to affect its stability, or reliability nor which has been subject to misuse, negligence or accident, nor to any commercial vehicle made by it which shall have been operated at a speed exceeding the factory rated speed, or loaded beyond the factory rated load capacity.

It makes no warranty whatever in respect to tires, rims, ignition apparatus, horns or other signaling devices, starting devices, generators, batteries, speedometers or other trade accessories inasmuch as they are usually warranted separately by their respective manufacturers.

General Group

Section A

Complaint Forms — CT-6B

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Complaint Forms

The proper method of filling out and submitting Motor Truck Complaint Forms was definitely outlined in General Letter No. 15, Motor Truck General Letter No. 11 dated November 17, 1936.

Instructions pertaining to Motor Truck Complaints are being quoted in order that these instructions will be available for ready reference.

The necessity for a remedy is based entirely on the seriousness of the complaint. The seriousness of a complaint is based on the number of those complaints received. Therefore, the task of guarding the high quality of our products rests largely with our Branch House Organization; and this task can best be performed by the Branch reporting complaints on the regular Complaint Forms, PROPERLY FILLED IN AND PROMPTLY SUBMITTED.

The following instructions and suggestions are for your assistance in making out and submitting these forms:

1. **ALL COMPLAINTS,** concerning which the territory has **not** been advised of a remedy, must be reported. In other words, you are to continue the reports on all trouble until advised of a remedy or correction.
2. Complaints, concerning which the territory **has** been advised of a remedy, should not be reported; except in cases where the remedy itself fails; and except in such cases where the Service Bulletin, announcing the remedy, advises that Complaint Forms are necessary in order to obtain credit from the Vendor. Then so state under "Remarks."
3. Complaints on each unit must be covered on a separate and proper Complaint Form except in the case of trucks when the same unit fails on several trucks of the same fleet; you may use the same form but list the chassis, engine and unit serial number of each truck involved.
4. When reporting unit failures, fill in such form groups as are designated for that unit. (See instructions on left side of Form CT-6B.)
5. It is important that the unit serial number be given in the space provided on Form CT-6B. Bulletins have advised the location of the serial numbers of the various units.
6. State the complaint clearly on Form CT-6B, under the heading "Complaint Details." For instance if you are reporting the failure of a "Rear Axle Shaft," state "Rear Axle Shaft Failure" (left or right). Do not state just "Rear Axle Failure."
7. If you believe certain material should be returned for inspection, state under "Remarks" the material is being held, and hold the material purchased from vendors for eighteen months, and the material of our own manufacture for thirty days, unless disposition is given in the meantime. This is in accordance with Accounting Department's instructions.
8. All material returned should be properly packed and tagged so that it can be identified and, in addition, should bear the "RETURN TO WORKS TAG" No. 2383, filled in properly and completely.
9. **It has been the practice in the past for the Service Manager to make out the CT-6B Forms, and submit them to the Branch Manager for his signature. This has caused some delay where the Service Manager is in charge of both motor truck and general line service, as it has been necessary for him to spend much time on the territory, resulting in the Complaint Forms not being made out and submitted promptly after the failure occurs. The logical time to determine if a failure should be covered on a CT-6B and to gather the information for the Form is when the truck is in the Service Station and the repairs are being made. Therefore, when the Service Manager is away, the Service Station Foreman should gather the information and make out the CT-6B Forms, in order that they can be submitted as quickly as possible after the failure occurs.**
10. Many times separate letters are written and attached to the Complaint Forms which give valuable information concerning the complaint. Such information should be given under the caption "Remarks" of the CT-6B Form, using reverse side if necessary. Separate letters cause extra work and delay in circulating the complaint, as they have to be copied and circulated with the complaint, to all interested parties.

Much information, which would be valuable in assisting the various Departments in diagnosing and developing remedies for the complaint, can and should be given under the caption "Remarks." For instance; a clear description of the failure; the Service Manager or the Foreman's opinion of the cause of the failure; his idea of a remedy, if any; the results of his remedy if applied; any local climatic conditions that are peculiar and have bearing on the complaint; any unusual operating conditions that might play a part in the complaint; and, in short, any information, additional to that requested on the form, which has any bearing on the complaint, should by all means be given. This means that a thorough investigation of the complaint should be made by the Service Manager or Foreman before they attempt to make out the Complaint Forms.

11. In the past it has been the general practice for the Sub-Branches to make out CT-6B forms and forward them to the parent Branch for the Service Manager to check and for the Branch Manager to sign. This, in some instances has caused considerable

delay in submitting these forms to the Chicago Office. Therefore in the future the Service Station Foreman at each Sub-Branch should make out the Complaint Forms and submit them to the local Sub-Branch Manager for signature and forward direct to the Chicago Office. An extra copy, however, should go to the parent branch for the Branch Manager's files.

12. Copies of the Complaint Reports are to be distributed as follows:

MOTOR TRUCK FORM CT-6-B

1 copy mailed to Engineering Department, Chicago.
1 copy mailed to Motor Truck Sales Department, Chicago.
1 copy mailed to Motor Truck Service Division, Chicago.
1 copy for Branch Manager.

13. The Branch Manager will review his complaint file monthly with the Service Manager and personally follow up with the respective Service Divisions of the Chicago Office all cases where no remedy has been provided.

We cannot emphasize too strongly the importance of making prompt and complete reports on all complaints that should be brought to the attention of the Engineering, Manufacturing or Sales Department at Chicago.

Examples of CT-6B Complaint Forms, properly filled out, and with complete information on the reverse sides, are illustrated on pages 3, 4, 5 and 6.

Form CT-6-B. PRINTED IN U. S. A.

For Engineering Dept. ☐
For Motor Truck Sales ☐
For Service Dept. ☐

MOTOR TRUCK COMPLAINT

INTERNATIONAL HARVESTER COMPANY
Mail to GENERAL OFFICE, CHICAGO, ILL.

Don't fill this space.

Branch House (Branch) Date 1-21-37

Sub-Branch

MAKE AND SERIAL NO. OF UNIT SUCH AS CAB, AXLES, TRANSMISSIONS, ETC., ON WHICH COMPLAINT IS MADE MUST BE GIVEN

GROUPS I, II AND III must be completely filled out when reporting complaints on major units, such as axles, engines, clutches, transmissions, propeller shafts, frames, wheels, bodies, etc.

GROUPS I AND III must be completely filled out when reporting complaints on minor units such as cabs, horns, radiators, windshield wipers, windshield and door glass, sheet metal, instruments, etc.

GROUP I

Complaint Details To provide handle for inside of right rear panel body door - for unlocking lock assembly #50841HA from inside of body.

Owner (Name) Delivery Date 1-19-37 Total Miles To Date 175

City (Address) State

Model C-5 Wheel Base 125" Engine Number 324503 Chassis Number 3223

GROUP II

Tire Size Goodrich Commercial "15's" Single or Dual Single Gear Ratio 4.18

Maximum Pay Load 1200 lbs. % Time Maximum Load Hauled 75%

Body, Cab and Equipment Weight 955 lbs. Size HD-7 Panel

Total Load 2155 lbs. Body Type Panel

Who Mounted Body International Harvester Company Commodity Hauled Laundry Packages

City or Cross Country Service City house-to-house delivery

Number and Type Trailers Used none

Weight of Trailers Including Body Load on Trailers

Who Maintains Repair Service International Harvester Company

GROUP III

Complaint Investigated by (Name) Position Service Manager

Cost of Repairs $2.50 (rear door glass) Labor - Gratised Yes

Remarks (Give full details instead of writing separate letter)

(Over)

(For Additional Remarks, Use Reverse Side of This Sheet)

Signed (Signature)
Branch Manager

1 - Reference is made to HD-7 Panel Body - right rear door.

2 - Right rear door is provided with handle to unlock from outside only.

3 - No provision is made to unlock or open door from inside of body.

4 - Trucks equipped with panel bodies are mostly used for package delivery, in which the packages are stacked several layers high. This type of loading necessitates the installation of a wire screen enclosure at the front end of the body - to prevent the load from sliding forward.

5 - When driver enters the body through the rear door, to obtain packages or rearrange the load, the door is slammed shut by the slightest wind pressure or shaking of truck when the driver throws packages about the inside of the body - especially when the door is equipped with stop straps which prevent 180° openings. Also, when door swings very freely because of the looseness of hinge pins or lubrication of pins.

6 - When the door is slammed shut - there is no escape for the driver - because of the front wire screen enclosure, and the lack of a rear inside door opening handle. Here the driver is forced to shout for assistance to a passerby, to open the door from the outside - and when help cannot be summoned, he is forced to break the rear door glass - to reach out and open the door with the outside handle. The breaking of the rear door glass is difficult, as it is a safety shatterproof glass, and a heavy metal object such as a hammer is needed. As no tools are carried on the inside of the body, the driver is greatly handicapped in emergencies.

7 - Instances have been reported where drivers were held imprisoned as long as an hour and a half.

8 - It is evident and easy to understand the embarrassing and emotional strain of drivers when released from predicaments of this kind.

Suggestion:- The installation of an outside door handle, with a longer or extended square shank - which will protrude far enough inside of the door to attach a simple flat handle, with which the driver can open the door from the inside in emergencies.

Although this complaint may appear minor - it is serious to a fleet operator, as well as exasperating to the driver, whom we try to keep happy and an enthusiastic International Booster.

No Sketch is submitted as it is believed the explanation is clear.

If necessary, further information will be gladly given.

This complaint affects all types and sizes of International Panel Bodies.

Form CT-6-B.

For Engineering Dept. ☐
For Motor Truck Sales ☐
For Service Dept. ☐

MOTOR TRUCK COMPLAINT

INTERNATIONAL HARVESTER COMPANY
Mail to GENERAL OFFICE, CHICAGO, ILL.

Don't fill this space.

SAMPLE

Branch House (Branch) Date 3-4-37

Sub-Branch

MAKE AND SERIAL NO. OF UNIT SUCH AS CAB, AXLES, TRANSMISSIONS, ETC., ON WHICH COMPLAINT IS MADE MUST BE GIVEN

GROUPS I, II AND III must be completely filled out when reporting complaints on major units, such as axles, engines, clutches, transmissions, propeller shafts, frames, wheels, bodies, etc.

GROUPS I AND III must be completely filled out when reporting complaints on minor units such as, cabs, horns, radiators, windshield wipers, windshield and door glass, sheet metal, instruments, etc.

GROUP I

Complaint Details Severe Binding of Clutch Release Sleeve (Catalog Part #59164-H) on main drive gear bearing retainer - #51623-H

Owner (Name) Delivery Date 11-14-36 Total Miles To Date 7,004

City (Address) State

Model C-1 Wheel Base 125" Engine Number 85286 Chassis Number 65338

GROUP II

Tire Size 6.00 x 16 Single or Dual Single Gear Ratio 4.18

Maximum Pay Load 800 lbs. % Time Maximum Load Hauled 50%

Body, Cab and Equipment Weight 975 lbs. Size 7' Panel

Total Load 1775 lbs. Body Type Std. 7' Panel

Who Mounted Body IHC (Springfield Wks.) Commodity Hauled Dairy Products

City or Cross Country Service City house-to-house delivery

Number and Type Trailers Used None

Weight of Trailers Including Body Load on Trailers

Who Maintains Repair Service

GROUP III

Complaint Investigated by (Name) Position Service Manager

Cost of Repairs $3.00 Labor $5.70 Gratised Parts only

Remarks (Give full details instead of writing separate letter) (See Reverse Side. Our Job #1891

(For Additional Remarks, Use Reverse Side of This Sheet)

Signed (Signature)
Branch Manager

COMPLAINT:

1 - EXTREME PHYSICAL FORCE REQUIRED TO RELEASE CLUTCH.

2 - CLUTCH RELEASE MECHANISM IS VERY INACTIVE - OF A RUBBERY FEELING - AND PEDAL WILL REMAIN IN WHATEVER POSITION MOVED TO.

3 - BECAUSE OF THE SEVERE BINDING OF CLUTCH RELEASE MECHANISM, DRIVER IS FORCED TO PHYSICALLY PULL BACK PEDAL, SO AS TO FULLY ENGAGE CLUTCH PEDAL AND PREVENT SLIPPING, AS THE CLUTCH PEDAL WILL NOT RETURN TO ITS ORIGINAL POSITION BY THE NATURAL FREENESS AND SPRING ACTION.

4 - CLUTCH ALSO DOES NOT FULLY DISENGAGE, CAUSING PROLONG CLASHING WHEN SHIFTING GEARS.

AN INVESTIGATION DISCLOSED:

1 - THAT THE CLUTCH RELEASE SLEEVER - #59164-H - IS BINDING VERY SEVERELY ON MAIN DRIVE GEAR RETAINER - #51623-H - CAUSING A DEEP RECESS TO BE WORN IN ON THE UPPER OUTSIDE PART OF MAIN DRIVE GEAR RETAINER.

2 - THE FRICTIONAL DRAG OF THE CLUTCH RELEASE SLEEVE ON THE MAIN DRIVE GEAR BEARING RETAINER WAS SO EXTREME THAT THE HORIZONTAL TUBE OF THE BEARING RETAINER SEPARATED HALF WAY FROM THE FLANGE, THEREBY ALSO WEARING AWAY THE INSIDE OF THE TUBE.

3 - BECAUSE OF THE GREAT FORCE REQUIRED TO RELEASE THE CLUTCH - THE CLUTCH RELEASE SLEEVE PINS THAT FIT INTO THE GROOVES OF THE CLUTCH RELEASE FORK #2031-Y, HAVE FLAT SPOTS WORN INTO THEM WHICH ARE ABOUT 1/8" DEEP.

4 - THE SEPARATION OF THE HORIZONTAL TUBE FROM THE MAIN DRIVE GEAR BEARING RETAINER WAS CAUSED BY THE CIRCULAR MOVEMENT OF THE CLUTCH RELEASE FORK, #2031-Y, WHICH DOES NOT MOVE THE CLUTCH RELEASE SLEEVE IN A TRUE HORIZONTAL DIRECTION. BECAUSE OF THE RESISTANCE OF THE CLUTCH RELEASE SLEEVE, A DOWNWARD MOVEMENT IS EXERTED. THIS IS THE CAUSE OF THE WEAR OF THE OUTSIDE SURFACE OF THE DRIVE GEAR BEARING RETAINER HORIZONTAL TUBE.

5 - GREASE COMPARTMENT IN CLUTCH RELEASE SLEEVE WAS FULLY PACKED WITH LUBRICANT, BUT THIS APPARENTLY DID NOT LEAVE THE GREASE COMPARTMENT, AS VERY LITTLE LUBRICANT WAS PRESENT ON THE TUBE OF THE MAIN DRIVE GEAR BEARING RETAINER.

REMEDY, OR ITS EQUIVALENT:

1 - CHAMFER BOTH SHARP ENDS AND GREASE COMPARTMENT GROOVE SQUARE CORNERS TO ENCOURAGE MOVEMENT OF LUBRICANT FROM GREASE COMPARTMENT, AND PREVENT WIPING OF LUBRICANT FROM MAIN DRIVE GEAR BEARING RETAINER TUBE, BY THE NOW PRESENT SHARP ENDS.

2 - CUT ONE OR TWO LONG GROOVES OR RECESSES ON OUTSIDE OF MAIN DRIVE GEAR BEARING RETAINER, AND PACK WITH LUBRICANT SAME AS GREASE COMPARTMENT IN CLUTCH RELEASE SLEEVE. THIS WILL REDUCE FULL CONTACT OF THE METAL PARTS, WHICH WILL PREVENT BINDING, AND WILL ENCOURAGE MORE ADEQUATE LUBRICATION.

ALSO, PROVIDE GREATER CLEARANCE BETWEEN CLUTCH RELEASE SLEEVE, AND MAIN DRIVE GEAR BEARING RETAINER.

3 - THIS FAILURE IS ONLY EXPERIENCED WITH THE AETNA TYPE PRE-LUBRICATED BEARING, AS PER BULLETIN #68-36.

4 - REFERENCE IS MADE ONLY TO CLUTCH RELEASE SLEEVE AND MAIN DRIVE GEAR BEARING RETAINER, AND NOT CLUTCH RELEASE BEARING. THE BEARING IS IN SERVICEABLE CONDITION, AND WAS USED. NO BEARING FAILURE WAS EXPERIENCED.

ENGINEERING INFORMATION:

1 - TRUCK IS USED IN DELIVERY OF MILK FROM HOUSE-TO-HOUSE. MAKES 165 SINGLE STOPS DAILY.

2 - COVERS A DISTANCE OF APPROXIMATELY 55 MILES DAILY.

3 - CLUTCH IS ENGAGED AND DISENGAGED ABOUT 450 TIMES DAILY.

4 - TRUCK IN OPERATION ABOUT 10 HOURS PER DAY, AND IN USE SEVEN DAYS PER WEEK.

5 - PARTS ARE RETAINED FOR INSPECTION.

6 - TO DATE, THIS SAME FAILURE WAS EXPERIENCED ON THREE SEPARATE MILK DELIVERY TRUCKS.

7 - NO FAILURE EXPERIENCED WITH THE OLD GREASE TUBE CLUTCH RELEASE SLEEVE.

Inspection of New Truck Before Delivery

When trucks come off the assembly line at the factory they have already been given numerous inspections and in addition are subjected to a road test and final inspection; however, Branches or Dealers should have each truck checked over again before delivery is made to the customer. This is particularly necessary if trucks have been driven thru or "double decked" by a driveaway company.

1. Check oil level in engine. Also determine if it is of the proper viscosity for the locality in which the truck will be operated.
2. Check level of lubricant in differential and transmission.
3. Check water in cooling system.
4. Check all instruments to determine if they are operating properly:
   - (a) Horn.
   - (b) Lights
     (Head, Stop, Tail, Dash, Dome, etc.).
   - (c) Windshield Wiper.
   - (d) Ignition Switch.
   - (e) Starting Motor.
   - (f) Generator.
   - (g) Battery
     (Water Level and Specific Gravity).
   - (h) Distributor.
   - (i) Speedometer.
   - (j) Gas Gauge, Oil Gauge, Ammeter, Water Temperature Indicator, etc.
5. Warm up engine to determine if valve tappets are noisy; if so, adjust.
6. Check idling of engine and adjust carburetor if necessary.
7. Examine all wheel lugs and bolts to see that they are tight. Also see that tires are properly mounted and running true.
8. Check speedometer gears and adapter to determine if they are correct for the tire size used. This is very important if tire size has been changed after truck leaves the factory as many complaints of excessive fuel consumption have been traced to incorrect speedometer reading.
9. Check front wheel alignment, also check tie rod to determine if it has been bent, especially if truck has been driven thru or "double decked" by a driveaway company.
10. Be sure that a complete set of tools is delivered with the truck.
11. Give truck a short road test, checking brakes, noises, etc., and see that all controls are functioning properly.
12. Have the truck in perfect operating condition before delivery. This will mean a satisfied owner, and will eliminate unnecessary trips to the Service Station for minor adjustments during the warranty period.

Instructions to Owner at Time of Delivery

It is suggested that the owner be given the following instructions when delivery is made:

1. General information on the construction and operation.
2. Grade of oil to be used in engine and explanation of the function of the oil filter.
3. Care of air cleaner and grade of oil to use.
4. Draining of cooling system and importance of using anti-freeze solutions when necessary.
5. Importance of clutch pedal clearance in prolonging clutch life.
6. Cover lubrication completely, bringing out the hazards of neglect.
7. Call attention to the value of registering with the local Authorized Dealer, such items as Tires, Batteries, Electrical Units, etc.
8. Advise owner that he is to bring truck in for the specified inspections, during the warranty period, at which times there will no doubt be minor adjustments necessary which, if made, will prolong the truck life.
9. Stress the benefits of using only genuine IHC repair parts.

As a rule, the first impression is the lasting one, therefore it can easily be understood that trucks should be in perfect mechanical condition and the operation thoroughly explained before delivery is made.

Free Inspection During Warranty Period

It is recommended that the following items be checked when a truck is brought to the Service Station for the usual inspection during the warranty period:

1. Engine
- (a) Check spark plug gap.
- (b) Check breaker point gap and timing.
- (c) Check and adjust valve tappet clearance (Hot Engine).
- (d) Tighten cylinder head nuts.
- (e) Tighten manifold and carburetor flange nuts.
- (f) Adjust fan belt tension if necessary.
- (g) Check carburetor idling adjustment.
- (h) Tighten all radiator hose connections.
- (i) Check air cleaner for proper oil level.
- (j) Check oil pressure, generator charging rate and heat indicator.
- (k) Clean fuel pump sediment bowl if necessary.

2. Clutch
- (a) Check clutch pedal free movement.
- (b) Check clutch for slippage.
- (c) See that clutch pedal shaft, etc., has sufficient lubrication.

3. Transmission
- (a) Check level of lubricant.
- (b) Examine for leakage.

4. Propeller Shaft, Center Bearing and Joints
- (a) Check lubrication of joints.
- (b) See that cap screws in joints are tight.

5. Rear Axle
- (a) Check level of lubricant in differential.
- (b) Check for leakage.
- (c) Examine vent plug in housing cover and clean if necessary.

6. Wheels and Tires
- (a) Check tires for alignment.
- (b) Check rim clamps and tighten if necessary.
- (c) Check adjustment of wheel bearings.
- (d) Check tire pressure.

7. Brakes
- (a) Check free movement of brake pedal.
- (b) Check movement of pedal required to lock brakes. Adjust if necessary.
- (c) Check fluid level in master cylinder.
- (d) Examine lines and connections for leakage.

8. Battery
- (a) Check level of electrolyte.
- (b) Check cable connections.
- (c) See that battery is mounted solidly in container.

9. Steering
- (a) Check lubrication of all moving parts.
- (b) Check for play in linkage.
- (c) Check front wheel alignment.
- (d) See that all parts are securely locked.
- (e) Check clearance between tire and nearest point on truck when wheels are turned to extreme right or left.

10. General
- (a) Check door action, window regulator, windshield wiper, lights, horn, ventilators, etc.

Give truck a short road test, noting engine performance, steering, brake action, etc., and make minor adjustments when necessary.

Front Axle Group

Section A

Models D-2, D-5 (F-10 Axle), D-15 (F-100 Axle)

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Axle Caster 2

Knuckle Pin Inclination 2

Refitting Knuckle to I-Beam 1

Steering Knuckle Pins and Bearings 1
Steering Knuckle Stop Screws 1

Tie Rod 1

Wheel Alignment 1
Wheel Camber 1
Wheel Toe-In 1

Section B

Models

D-30, DS-30, D-30B, DS-30B (F-300 Axle),
D-300, DS-300 (F-450 Axle),
D-35 DS-35, D-35B, D-186T, DS-186T (F-301 Axle),
D-40, D-216T (F-400 Axle),
D-50, D-246T, D-246F (F-500 Axle),
D-60, DR-60 (F-600 Axle),
DR-70, DR-346T, D-346F (F-700 Axle),
DR-426F (F-800 Axle)

Axle Caster 2

Knuckle Pin Inclination 2

Refitting Knuckle to I-Beam 1

Steering Knuckle, Pins and Bearings 1
Steering Knuckle Stop Screws 1

Tie Rod 1

Wheel Alignment 2
Wheel Camber 2
Wheel Toe-In 2

Front Axle Specifications

Chassis Model	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Axle Model	F-10	F-10	F-100	F-300	F-300	F-300	F-300	F-301	F-301	F-301	F-400	F-500	F-600
I-Beam Sections:													
Web Thickness	1/4"	1/4"	1/4"	7/16"	7/16"	7/16"	7/16"	7/16"	7/16"	7/16"	1/2"	1/2"	5/8"
Flange Width	1 11/16"	1 11/16"	1 11/16"	2 1/4"	2 1/4"	2 1/4"	2 1/4"	2 1/4"	2 1/4"	2 1/4"	2 1/8"	2 1/4"	2 1/2"
Depth	2"	2"	2 1/4"	3"	3"	3"	3"	3"	3"	3"	3 1/4"	3 3/8"	3 3/4"
Tie Rod Diameter	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1"	1 1/8"	1 1/8"	1 1/4"
Steering Arm Ball Diameter	63/64"	63/64"	63/64"	1 3/32"	1 3/32"	1 3/32"	1 3/32"	1 3/32"	1 3/32"	1 3/32"	1 7/32"	1 15/32"	1 15/32"
Knuckle Pin Diameter	3/4"	3/4"	7/8"	1"	1"	1"	1"	1"	1"	1"	1 1/8"	1 1/8"	1 3/8"
Length	5 7/16"	5 7/16"	5 7/16"	6"	6"	6"	6"	6"	6"	6"	6"	7 1/2"	7 1/2"
Knuckle Pin Thrust Bearing	Roller	Roller	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball
Knuckle Pin Bushing Length	1 1/8"	1 1/8"	1 1/8"	1 21/64"	1 21/64"	1 21/64"	1 21/64"	1 21/64"	1 21/64"	1 21/64"	1 21/64"	1 13/16"	1 13/16"
Steering Knuckle Spindle:													
Diameter at Inner Bearing	1 5/16"	1 5/16"	1 5/16"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 5/8"	1 3/4"	2"
Diameter at Outer Bearing	3/4"	3/4"	3/4"	15/16"	15/16"	15/16"	15/16"	15/16"	15/16"	15/16"	1"	1 3/16"	1 3/8"
Alignment (See Illustrations)													
A—Wheel Hub to Spring Pad	2 23/32"	2 23/32"	2 23/32"	7/16"	7/16"	7/16"	7/16"	7/16"	7/16"	7/16"	2 3/8"	2 1/4"	2 11/16"
—Spring Pad to Center	3/4"	3/4"	3/4"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 3/16"	2 13/16"	2 11/16"
B—Spring Centers	26 3/16"	26 3/16"	26 3/16"	30 1/8"	30 1/8"	30 1/8"	30 1/8"	30 1/8"	30 1/8"	30 1/8"	31 5/8"	31 1/8"	31 1/8"
C—Tread at Ground	58 9/32"	58 9/32"	58 1/8"	63 9/16"	63 9/16"	63 9/16"	63 9/16"	63 9/16"	63 9/16"	63 9/16"	66"	70 3/16"	72 1/4"
D—Knuckle Pin— Center Line to Center Line	51 13/32"	51 13/32"	51 13/32"	56 19/32"	56 19/32"	56 19/32"	56 19/32"	56 19/32"	56 19/32"	56 19/32"	59 7/16"	61 7/8"	62 3/4"
E—Camber (At Rim)	2°	2°	2°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°
F—Knuckle Pin Inclination	7° 30′	7° 30′	7° 30′	8°	8°	8°	8°	8°	8°	8°	8°	8°	8°
G—Caster (with Normal Load)	2°—3°	2°—3°	2°—3°	2°—3°	2°—3°	2°—3°	2°—3°	2°—3°	2°—3°	2°—3°	2°—3°	1/2°—2°	1/2°—2°
M minus N—Toe-In	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"

Front Axle Specifications—Continued

Chassis Model	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Axle Model	F-600	F-700	F-450	F-450	F-301	F-301	F-400	F-500	F-500	F-700	F-700	F-800
I-Beam Sections:												
Web Thickness	5/8"	5/8"	1/2"	1/2"	7/16"	7/16"	1/2"	1/2"	1/2"	5/8"	5/8"	5/8"
Flange Width	2 1/2"	2 3/4"	2 1/8"	2 1/8"	2 1/4"	2 1/4"	2 1/8"	2 1/4"	2 1/4"	2 3/4"	2 3/4"	3 1/4"
Depth	3 3/4"	3 3/4"	2 29/32"	2 29/32"	3"	3"	3 1/4"	3 3/8"	3 3/8"	3 3/4"	3 3/4"	4"
Tie Rod Diameter	1 1/4"	1 1/2"	1 1/8"	1 1/8"	1"	1"	1 1/8"	1 1/8"	1 1/8"	1 1/2"	1 1/2"	1 3/4"
Steering Arm Ball Diameter	1 15/32"	1 15/32"	1 7/32"	1 7/32"	1 3/32"	1 3/32"	1 7/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 23/32"
Knuckle Pin Diameter	1 3/8"	1 3/8"	1"	1"	1"	1"	1 1/8"	1 1/8"	1 1/8"	1 3/8"	1 3/8"	1 5/8"
Length	7 1/2"	9 5/8"	7 1/4"	7 1/4"	6"	6"	6"	7 1/2"	7 1/2"	9 5/8"	9 5/8"	9 5/8"
Knuckle Pin Thrust Bearing	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball
Knuckle Pin Bushing Length	1 13/16"	2 3/16"	1 3/4"	1 3/4"	1 21/64"	1 21/64"	1 21/64"	1 13/16"	1 13/16"	2 3/16"	2 3/16"	2 3/16"
Steering Knuckle Spindle:												
Diameter at Inner Bearing	2"	2 1/4"	1 3/4"	1 3/4"	1 1/2"	1 1/2"	1 5/8"	1 3/4"	1 3/4"	2 1/4"	2 1/4"	2 1/2"
Diameter at Outer Bearing	1 3/8"	1 3/4"	1 3/16"	1 3/16"	15/16"	15/16"	1"	1 3/16"	1 3/16"	1 3/4"	1 3/4"	1 3/4"
Alignment (See Illustrations)												
A—Wheel Hub to Spring Pad	2 11/16"	2 1/4"	2 1/32"	2 1/32"	7/16"	7/16"	2 3/8"	2 1/4"	2 1/4"	2 1/4"	2 1/4"	3 5/8"
—Spring Pad to Center	2 11/16"	2 3/8"	1 5/8"	1 5/8"	2 5/16"	2 5/16"	2 3/16"	2 13/16"	2 13/16"	2 3/8"	2 3/8"	7/16"
B—Spring Centers	31 1/8"	31 1/8"	29 3/4"	29 3/4"	30 1/8"	30 1/8"	31 5/8"	31 1/8"	31 1/8"	31 1/8"	31 1/8"	31"
C—Tread at Ground	72 1/4"	72 7/8"	63 3/16"	63 3/16"	63 9/16"	63 9/16"	66"	70 3/16"	70 3/16"	72 7/8"	72 7/8"	72 5/8"
D—Knuckle Pin—Center Line to Center Line	62 3/4"	63"	54 3/8"	54 3/8"	56 19/32"	56 19/32"	59 7/16"	61 7/8"	61 7/8"	63"	63"	62 1/4"
E—Camber (At Rim)	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°
F—Knuckle Pin Inclination	8°	8°	8°	8°	8°	8°	8°	8°	8°	8°	8°	8°
G—Caster (with Normal Load)	1/2°—2°	1/2°—2°	2°—3°	2°—3°	2°—3°	2°—3°	2°—3°	1/2°—2°	1/2°—2°	1/2°—2°	1/2°—2°	1/2°—2°
M minus N—Toe-In	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"	3/16—5/16"

Front Axles—F-10, F-100

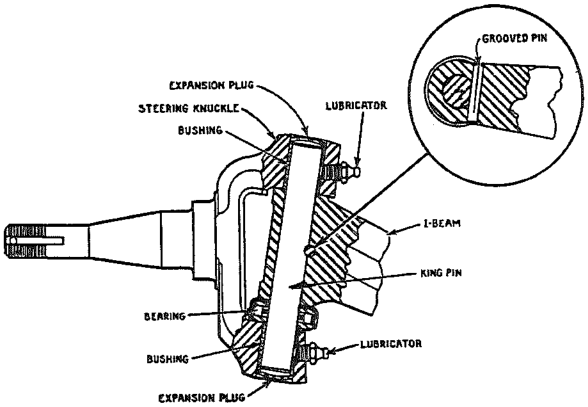

Fig. 1, Steering Knuckle Assembly

Steering Knuckle, Pins and Bearings

Steering knuckle thrust bearing, located between knuckle and lower face of I-beam, supports the entire front end load. A grooved pin holds the knuckle pin rigidly in end of I-beam.

The grooved pin should be inspected occasionally to assure it being tight. If it becomes loosened, knuckle pin hole as well as groove pin hole will become worn and necessitate replacing I-beam.

Bronze bushings are used in steering knuckle at upper and lower ends of knuckle pin. Seals at top and bottom of knuckle for knuckle pin hole consist of expansion plugs pressed into steering knuckle.

Refitting Knuckle to I-Beam

After disassembling knuckle from I-beam, thrust bearing should be cleaned and inspected carefully. Check play in bronze bushings and, if necessary, install new bushings or complete knuckle and bushing assembly.

When installing new bushings care should be used in "lining up" hole in bushing with grease fitting hole in knuckle. Bushing must enter hole straight when pressed in with vise or arbor. Never attempt to drive bushings with hammer.

Line ream, using reamer long enough to ream both bushings at the same time.

Assembly of knuckles and pins to I-beam should be done in the following order, carefully lubricating all parts when assembling:

1. Place thrust bearing assembly in position and insert knuckle pin. See that grooved surface on knuckle pin lines up with draw-pin hole in I-beam.
2. With knuckle pin in place drive groove pin in tight.
3. Install new expansion plugs at top and bottom of steering knuckle, striking them a sharp blow in the center to expand and set them properly.
4. Front hubs should be cleaned thoroughly and packed with fresh grease at this time as recommended in "Lubrication Section."

Steering Knuckle Stop Screws

Adjustable stop screws in steering knuckle limit movement of front wheels when turning and prevent tires from rubbing against nearest point on chassis. These screws should be adjusted so there will be ample clearance between front tires and nearest point on chassis when wheels are turned to extreme right or left under any conditions. **NOTE:** This should be checked when tire size is changed.

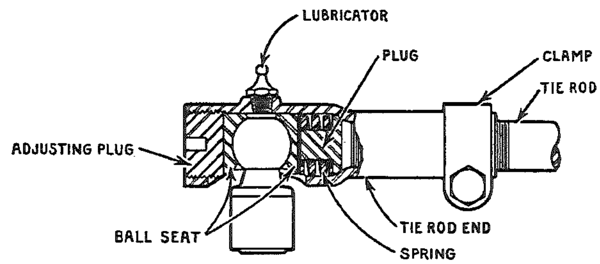

Fig. 2, Tie Rod Assembly

Tie Rod

Tie rod is of three-piece construction, consisting of two rod end assemblies. Rod is threaded into ends and locked with clamp bolts. Right and left-hand threads are provided to facilitate toe-in adjustment. The rod ends are self-adjusting and require no attention in service other than periodic lubrication and occasional inspection to see that ball studs are tight in steering knuckle arms.

Front Wheel Alignment

Front wheels must be kept in proper alignment in order to assure ease of steering and satisfactory tire life. Important factors of front wheel alignment are: Wheel toe-in, Wheel camber, Axle caster and Knuckle pin inclination.

These points should be checked occasionally, especially if front axle has been subjected to hard curb impacts or has been in a collision. When checking wheel alignment the wheel bearing adjustment must be correct and knuckle pins and bushings must not be worn excessively as these conditions will affect reading of instruments.

Wheel Toe-In

Toe-in should be $\frac{3}{16}$ to $\frac{5}{16}$". This is the amount that front wheels are closer together at front of axle than at rear. These measurements should be taken at the center of tire tread and at an equal height from the floor, front and rear.

Wheel Camber

Camber is the angle that front wheels tilt outward at the top and the proper camber angle must be maintained to assure even tire wear.

Camber and wheel toe-in bear a definite relation to each other, therefore both should be checked at the same time.

Axle Caster

Caster is the amount of backward tilt at the top of the steering knuckle pin. When the top of the knuckle pin is tilted to the rear, the caster is positive. When the top of the knuckle pin is tilted to the front, the caster is negative. Negative caster is not conducive to safe steering. The proper degree of caster must be maintained in order to assure correct steering with no "wandering" or pulling to either side.

Knuckle Pin Inclination

Steering knuckle pins are tilted or inclined so that center line of pin and center line of tire will be as close as is practical at the ground line. The distance between these two projected lines, measured on the ground line, is called "tire overhang." The "tire overhang" is proportioned to give normal control without undue road shocks at steering wheel.

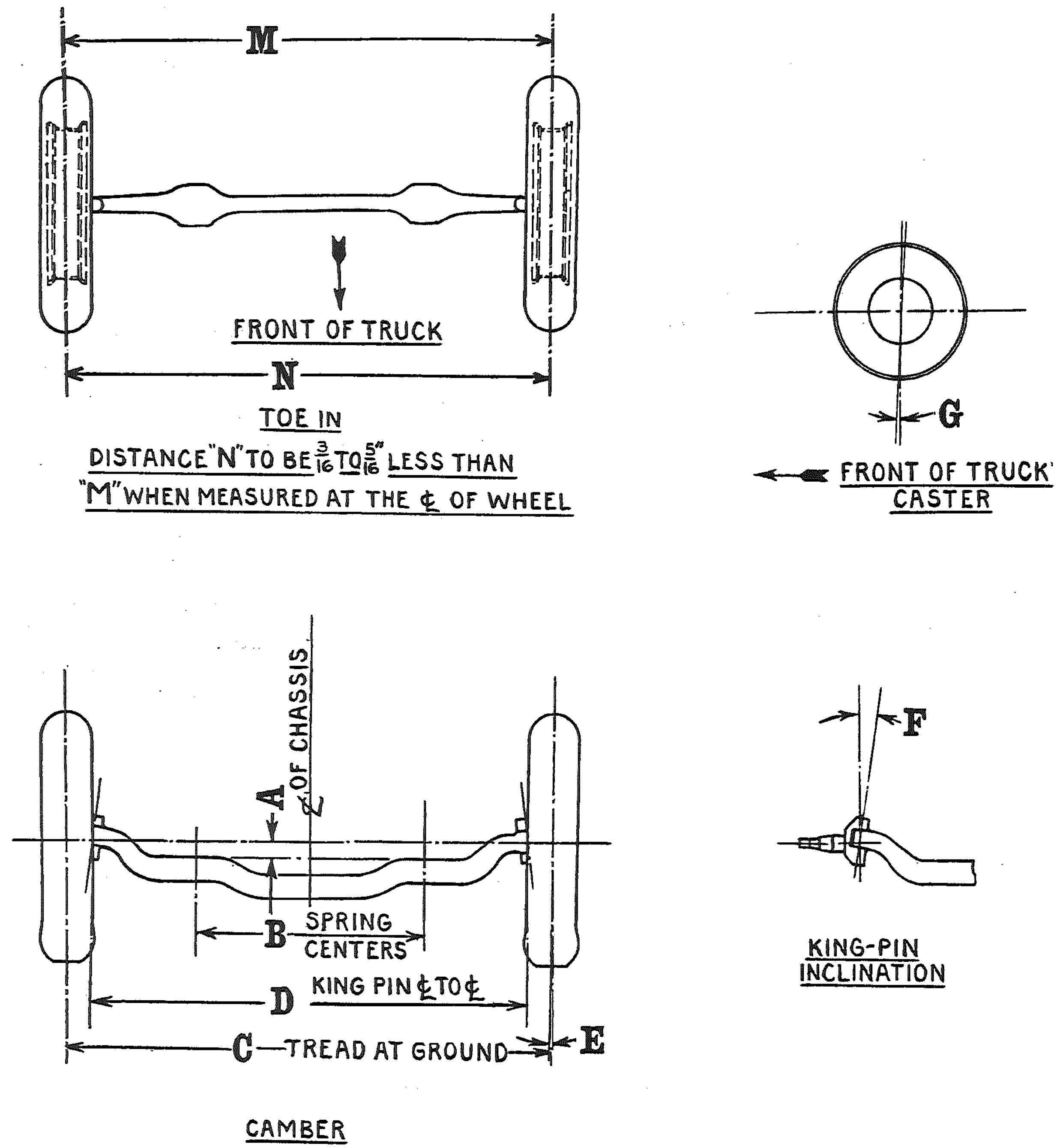

Fig. 3, Front Wheel Alignment (See Specifications)

Front Axles—F-300, F-301, F-400, F-450, F-500, F-600, F-700, F-800

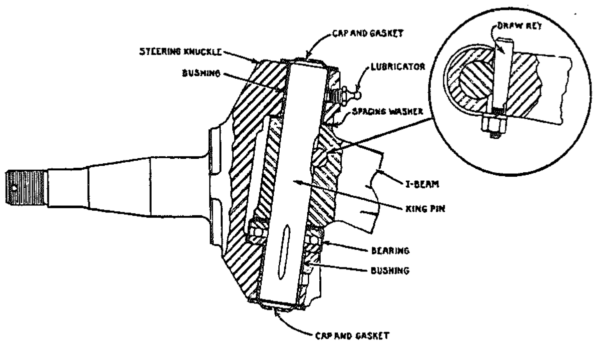

Fig. 1, Steering Knuckle Assembly

Steering Knuckle, Pins and Bearings

Steering knuckle thrust bearing, located between knuckle and lower face of I-beam, supports the entire front end load. The up-and-down movement must be kept within proper limits to prevent excessive wear. The use of spacing washers to correct this condition is described in subsequent paragraphs. A tapered draw pin holds the knuckle pin rigidly in end of I-beam and a tapered flat surface on the side of draw pin engages "flat" milled-in side of knuckle pin.

Draw pin is inserted from rear and is held in place by nut and lockwasher on front side of I-beam. Two draw pins are available, differing in length of taper. If pin with longer flat surface does not hold knuckle pin securely, discard it and use one having a shorter flat surface.

Draw pin should be inspected occasionally to assure it being tight. If it becomes loosened, knuckle pin hole as well as draw pin hole will become worn and necessitate replacing I-beam.

Bronze bushings are used in steering knuckle at upper and lower ends of knuckle pin. Seals at top and bottom of knuckle for knuckle pin hole consist of gasket and plate, held in position by flat head screws and lockwashers.

Refitting Knuckle to I-Beam

After disassembling knuckle from I-beam, thrust bearing should be cleaned and inspected carefully. Check play in bronze bushings and, if necessary, install new bushings or complete knuckle and bushing assembly.

When installing new bushings care should be used in "lining up" hole in bushing with grease fitting hole in knuckle. Bushing must enter hole straight when pressed in with vise or arbor. Never attempt to drive bushings with hammer.

Line ream, using reamer long enough to ream both bushings at the same time.

Assembly of knuckles and pins to I-beam should be done in the following order, carefully lubricating all parts when assembling:

1. Place thrust bearing assembly in position, insert knuckle pin part way, and with wedged shape tool under edge of backing plate raise knuckle just enough to take up all play in thrust bearing.
2. Proper thickness of spacing washer can be determined by trial, bearing in mind that up-and-down movement of axle should be within .003″–.006″. Spacing washers of variable thicknesses are available thru the Repairs Department.
3. When proper washer has been found, withdraw knuckle pin, insert spacing washer, and install knuckle pin, driving it in with a lead hammer. See that milled surface on knuckle pin lines up with draw pin hole in I-beam.
4. With knuckle pin in place insert draw pin from rear and tighten nut, with lockwasher in place. If nut bottoms on shoulder of draw pin before draw pin is tight, replace draw pin with one having a shorter tapered flat surface.
5. Use new gaskets under knuckle caps. Draw cap retaining screws up tight with shakeproof lockwashers under their heads.
6. Front hubs should be cleaned thoroughly and packed with fresh grease at this time as recommended in "Lubrication Section."

Steering Knuckle Stop Screws

Adjustable stop screws in steering knuckle limit movement of front wheels when turning and prevent tires from rubbing against nearest point on chassis. These screws should be adjusted so there will be ample clearance between front tires and nearest point on chassis when wheels are turned to extreme right or left under any conditions. **NOTE:** This should be checked when tire size is changed.

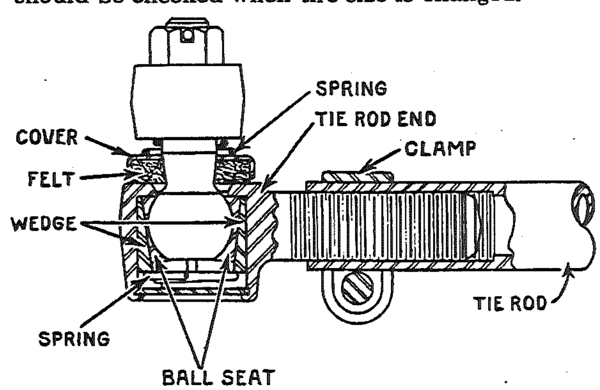

Fig. 2, Tie Rod Assembly—F-300, F-301 Axle

Tie Rod

Tie rod is of three-piece construction, consisting of two rod end assemblies. Rod is threaded into ends and locked with clamp bolts. Right and left-hand threads are provided to facilitate toe-in adjustment. The rod ends are self-adjusting and require no attention in service other than periodic lubrication and occasional inspection to see that ball studs are tight in steering knuckle arms.

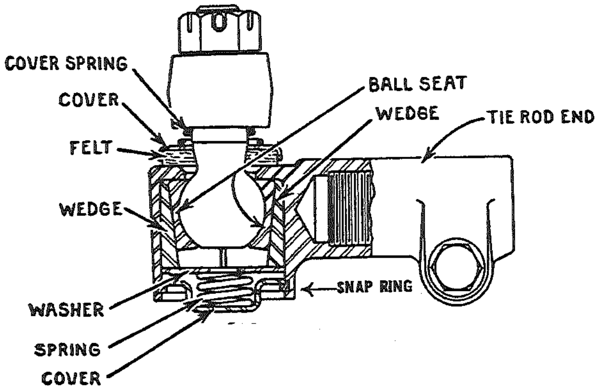

Fig. 3, Tie Rod Assembly—F-400, F-450, F-500, F-600, F-700, F-800 Axle

Front Wheel Alignment

Front wheels must be kept in proper alignment in order to assure ease of steering and satisfactory tire life. Important factors of front wheel alignment are: Wheel toe-in, Wheel camber, Axle caster and Knuckle pin inclination.

These points should be checked occasionally especially if front axle has been subjected to hard curb impacts or has been in a collision. When checking wheel alignment the wheel bearing adjustment must be correct and knuckle pins and bushings must not be worn excessively as these conditions will affect reading of instruments.

Wheel Toe-In

Toe-in should be 3/16 to 5/16". This is the amount that front wheels are closer together at front of axle than at rear. These measurements should be taken at the center of tire tread and at an equal height from the floor, front and rear.

Wheel Camber

Camber is the angle that front wheels tilt outward at the top and the proper camber angle must be maintained to assure even tire wear.

Camber and wheel toe-in bear a definite relation to each other, therefore both should be checked at the same time.

Axle Caster

Caster is the amount of backward tilt at the top of the steering knuckle king pin. When the top of the knuckle pin is tilted to the rear, the caster is positive. When the top of the knuckle pin is tilted to the front, the caster is negative. Negative caster is not conducive to safe steering. The proper degree of caster must be maintained in order to assure correct steering with no "wandering" or pulling to either side.

Knuckle Pin Inclination

Steering knuckle pins are tilted or inclined so that center line of pin and center line of tire will be as close as is practical at the ground line. The distance between these two projected lines, measured on the ground line is called "tire overhang." The "tire overhang" is proportioned to give normal control without undue road shocks at steering wheel.

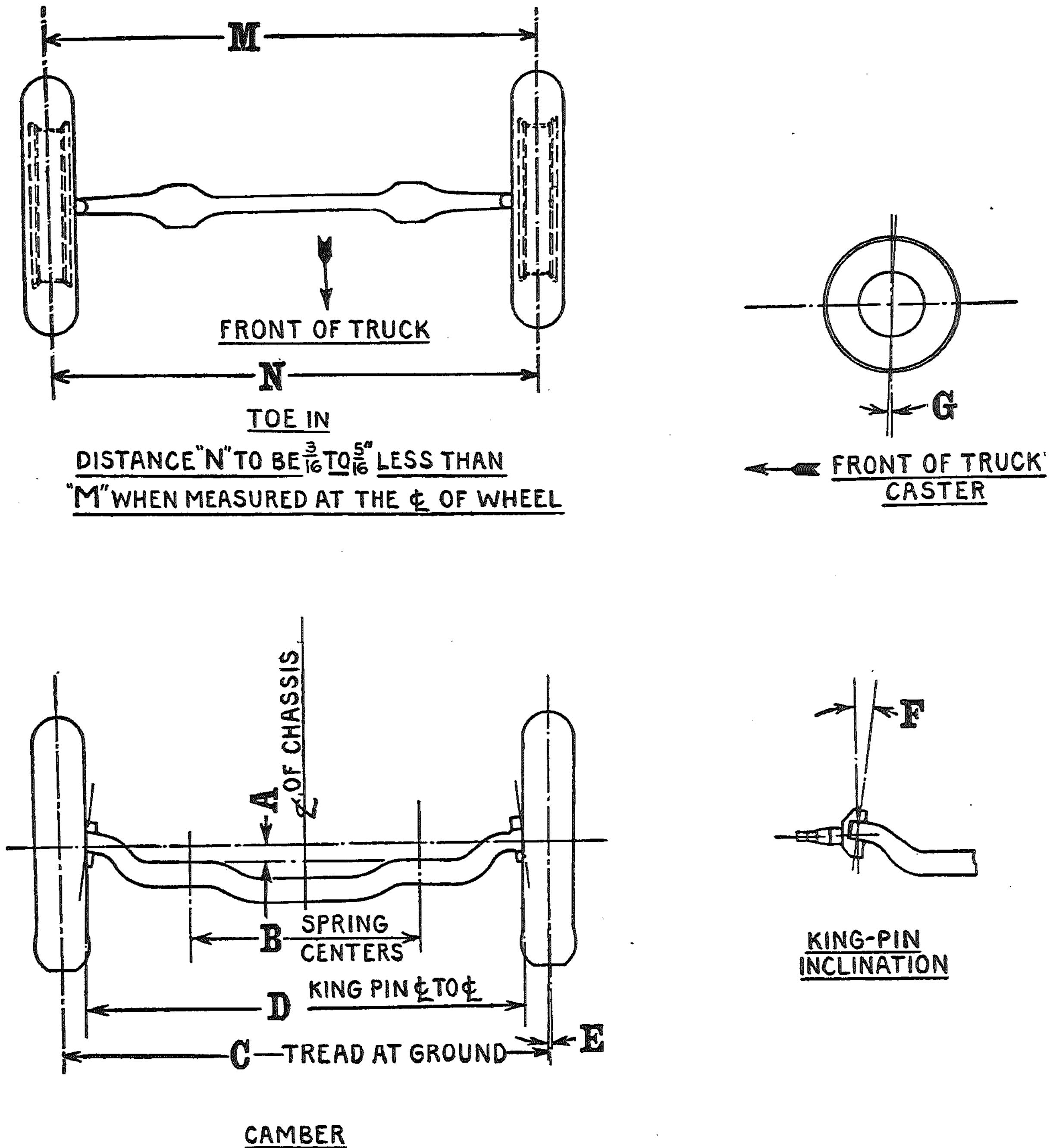

Fig. 4, Front Wheel Alignment (See Specifications)

Rear Axle Group

Section A

Models D-2, D-5 (R-1000 Axle), D-15 (R-1100 Axle)

	Page
Axle Housing Vent Screw	4
Bevel Gear Tooth Contact	1
Installing New Bevel Drive Gear	3
Installation of Wheel Bearings	4
Load Test	3
Rear Axle	1
Removal of Wheels	4
Replacement of Bevel Drive Gear and Pinion	3

Section B

Models D-30, D-300 (R-1200 Axle), D-30B (RB-1200 Axle), D-35 (R-1300 Axle), D-35B (RB-1400 Axle), D-40 (R-1400 Axle), D-50 (R-1500 Axle), D-60 (R-1600 Axle), D-186T (RT-1200 Axle), D-216T (RT-1400 Axle), D-246T (RT-1500 Axle), D-246F (RF-1401 Axle), D-346F (RF-1610 Axle)

Axle Housing Vent Screw	5
Bevel Drive Gear Thrust Button	5
Bevel Gear Tooth Contact	3
Installing New Bevel Drive Gear	5
Load Test	5
Rear Axle	3
Replacement of Bevel Drive Gear and Pinion	4

Section C

Models DR-60 (R-1650 Axle), DR-70 (R-1700 Axle), DR-346T (RT-1660 Axle)

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Bevel Gear Reduction	2
Bevel Gear Shaft and Adjustment	2
Bevel Gear Tooth Contact	2
Bevel Pinion Shaft and Adjustment	2
Differential	2
Herringbone Gear Adjustment	4
Herringbone Gear Reduction	2
Installing New Herringbone Drive Gear	4
Load Test	4
Rear Axle	2

Section D

Model DR-426F (RF-1701 Axle)

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Assembly of Pinion Bearing Cage	2
Adjustment of Pinion Bearing Cage	2
Bevel Gear Reduction	2
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Differential	2
Differential Carrier Assembly	2
Disassembling Differential Carrier	2
Disassembly of Differential	2
Disassembling Pinion Bearing Cage	2
Herringbone Gear Reduction	2
Herringbone Gear Adjustment	4
Installing New Herringbone Drive Gear	4
Load Test	4
Rear Axle	2
Removal of Differential Carrier	2
Vent	4

Section E

Models DS-30, DS-300 (R-2200 Axle), DS-30B (RB-2200 Axle), DS-35 (R-2300 Axle), DS-186T (RT-2200 Axle)

Assembly of Bevel Drive Gear and Differential Unit	3
Assembly of Bevel Drive Pinion	3
Axle Housing Vent Screw	6
Bevel Gear Adjustment	4
Disassembly	3
Gear Shift Lever Connections	5
Increased Power	2
Load Test	5
Lubrication System	2
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Operating Instructions	1
Power and Road Speed	2
Rear Axle	1
Reassembly	3
Removal of Bevel Drive Pinion	3
Shifting Speed	2
Shifting into High	2
Shifting into Low	2
Slow Speed Operation	2
Speedometer Adapter for Low Gear	6
Starting a Loaded Vehicle	2
Successive Gear Changes	2

Section F

Axle Mounting — T and F Models

Models { D-186T, DS-186T, D-216T, D-246T
D-246F, DR-346T, D-346F, DR-426F }

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Axle Mounting 2

Equalizing Beam Ends 3
Equalizing Beam and Spring Saddle 3

Radius Rods 6

Thrust Yokes and Tubes 4
Torque Rods 5

Rear Axle Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Axle Model	R-1000	R-1000	R-1100	R-1200	R-2200	RB-1200	RB-2200	R-1300	R-2300	RB-1400	R-1400	R-1500	R-1600
Type (Semi or Full Floating)	Semi	Semi	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Drive	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel
Pinion Mounting	Overhung	Overhung	Overhung	Straddle	Straddle	Straddle	Straddle	Straddle	Straddle	Straddle	Straddle	Straddle	Straddle
Axle Shaft:													
Diameter of Splines	1 5/16″	1 5/16″	1 3/8″	1 5/8″	1 3/4″	1 5/8″	1 3/4″	1 13/16″	1 3/4″	1 13/16″	1 13/16″	2″	2 1/8″
Number of Splines	10	10	10	16	16	16	16	16	16	16	16	16	16
Runout (Max.)	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″
Bevel Gear Backlash	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″
Bevel Gear Runout	.003″	.003″	.003″	.003″	.003″	.003″	.003″	.003″	.003″	.003″	.003″	.003″	.003″
Axle Ratios:													
Standard	4.18–1	5.11–1	4.875–1	6.166–1	5.14-7.15-1	6.166–1	5.14-7.15-1	6.50–1	5.14-7.15-1	6.50–1	6.50–1	6.43–1	6.43–1
Optional	3.72–1		5.286–1	5.280–1 6.666–1	5.83-8.11-1	5 280–1 6.666–1	5.83-8.11-1	5.625–1 7.166–1	5.83-8.11-1	5.625–1 7.166–1	5.625–1 7.166–1	7.16–1 8.50–1	

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Axle Model	R-1650	R-1700	R-1200	R-2200	RT-1200	RT-2200	RT-1400	RT-1500	RF-1401	RT-1660	RF-1610	RF-1701
Type (Semi or Full Floating)	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Drive	Bevel H-bone	Bevel H-bone	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel H-bone	Bevel	Bevel H-bone
Pinion Mounting	Overhung	Overhung	Straddle	Straddle	Straddle	Straddle	Straddle	Straddle	Straddle	Overhung	Straddle	Overhung
Axle Shaft:												
Diameter of Splines	2 1/8″	2 1/4″	1 5/8″	1 3/4″	1 5/8″	1 3/4″	1 13/16″	2″	1 13/16″	2 1/8″	2 1/8″	2 1/4″
Number of Splines	16	16	16	16	16	16	16	16	16	16	10	16
Runout (Max.)	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″	1/32″
Bevel Gear Backlash	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″	.003″ to .008″
Bevel Gear Runout	.003″	.003″	.003″	.003″	.003″	.003″	.003″	.003″	003″	.003″	.003″	.003″
Axle Ratios:												
Standard	7.10–1	8.05–1	6.166–1	5.14-7.15-1	6.16–1	5.14-7.15-1	6.50–1	6.43–1	6.50–1	8.05–1	7.16–1	8.05–1
Optional	8.05–1 9.03–1	9.03–1	5.280–1 6.666–1	5.83-8.11-1	6.66–1	5.83-8.11-1	7.16–1	7.16–1	7.4–1	9.03–1		9.03–1

Rear Axles—R-1000, R-1100

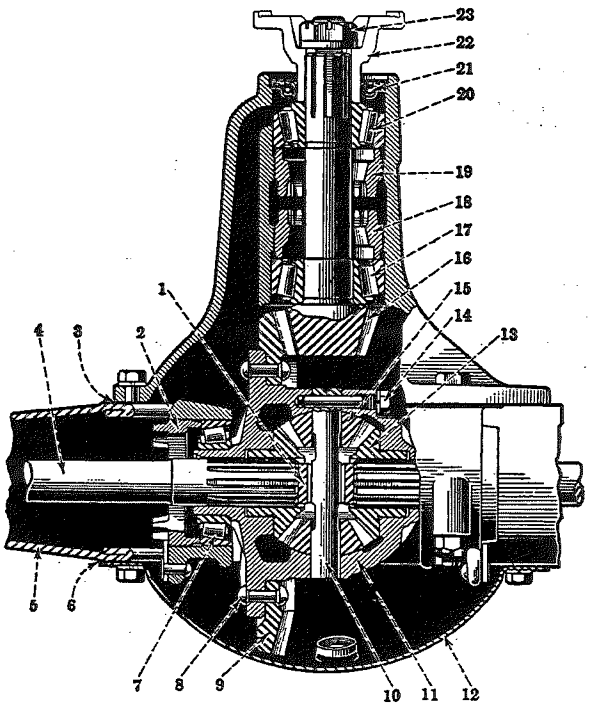


Fig. 1, R-1000 Axle

No.	Description
1.	Differential center block.
2.	Differential bearing adjuster.
3.	Differential carrier to housing gasket.
4.	Axle shaft.
5.	Axle housing.
6.	Axle housing cover gasket.
7.	Differential roller bearing.
8.	Rivet for bevel drive gear.
9.	Bevel drive gear.
10.	Differential cross pin.
11.	Differential case.
12.	Axle housing cover.
13.	Differential side gear.
14.	Differential cross pin retaining screw.
15.	Differential cross pin pinion.
16.	Bevel drive pinion.
17.	Pinion shaft inner roller bearing.
18.	Pinion shaft bearing adjuster.
19.	Pinion shaft bearing adjuster.
20.	Pinion shaft outer roller bearing.
21.	Pinion shaft bearing oil seal.
22.	Companion flange.
23.	Propeller shaft mounting nut.

Rear Axle

The R-1000 rear axle is semi-floating while the R-1100 rear axle is full floating, both having a spiral bevel drive and a one-piece banjo type housing.

Differential is two-pinion type with two-piece case and is supported on two tapered roller bearings controlled by adjusters.

Bevel drive pinion has two opposed tapered roller bearings which are controlled by adjusters.

Bevel Gear Tooth Contact (All Models)

The proper adjustment of bevel gears in assembly is a vital factor in obtaining quiet and durable gears, and the same methods apply both to straight and spiral bevel type.

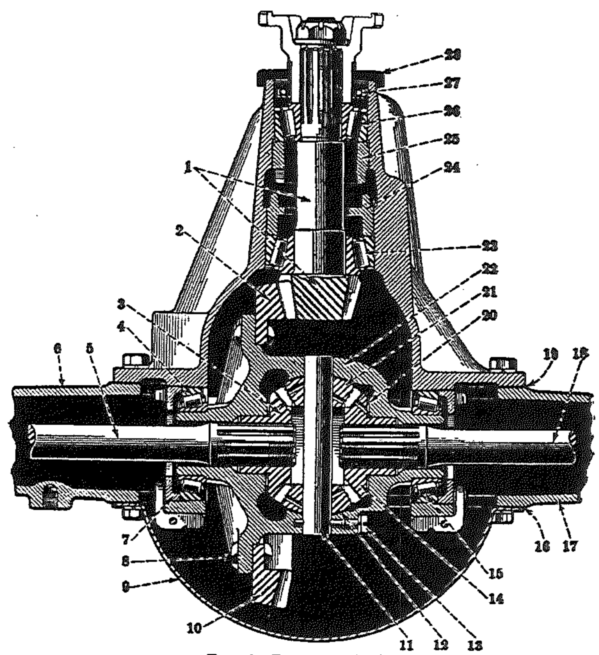


Fig. 2, R-1100 Axle

No.	Description
1.	Bevel drive pinion.
2.	Bevel drive gear.
3.	Differential side gear.
4.	Differential roller bearing.
5.	Axle shaft
6.	Axle housing tube.
7.	Differential bearing adjuster.
8.	Bevel drive gear rivet.
9.	Axle housing cover.
10.	Bevel drive gear.
11.	Differential cross pin.
12.	Differential cross pin pinion.
13.	Differential cross pin lock pin.
14.	Differential side gear.
15.	Differential roller bearing.
16.	Axle housing cover gasket.
17.	Axle housing tube.
18.	Axle shaft.
19.	Differential carrier to housing gasket.
20.	Differential side gear thrust washer.
21.	Differential cross pin pinion.
22.	Differential case.
23.	Pinion shaft inner roller bearing.
24.	Pinion shaft inner bearing adjuster.
25.	Pinion shaft outer bearing adjuster.
26.	Pinion shaft outer roller bearing.
27.	Pinion bearing oil seal.
28.	Companion flange mud slinger.

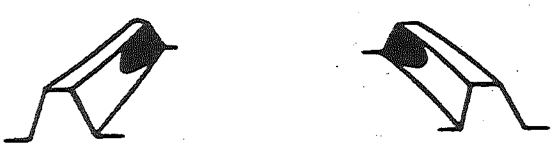
There are two distinct considerations in obtaining the proper tooth contact. The first is along the tooth—a lengthwise bearing, the other up and down the tooth—a profile bearing.

Bevel as well as spur gears are cut with a predetermined amount of backlash, depending upon the size or pitch of the teeth and operating conditions, usually varying from .004″ to .005″ on an eight pitch gear to .012″ on a three pitch gear. Generally the gears are machined to run flush with each other at the outer (heel or large end) of the tooth, and gears should be so set for initial trial.

Bevel gears when mounted should show a bearing toward the toe or small end of the tooth, never at the heel or large end, the reason being that it is practically impossible to make gears and gear mounting rigid enough so that there will not be some slight deflection when full load is applied. This always has a tendency to cause the bearing to come on the heel of the tooth and when gears are adjusted so that the bearing is toward the heel of the tooth it results in a concentration of load on the top corner of the heel and breakage will follow.

DRIVE COAST
CORRECT ADJUSTMENT
Fig. 3

Fig. 3 shows the correct bearing on both drive and coast or reverse side of the tooth. The tooth bearing, both lengthwise and profile of the gear, should appear as shown. The profile bearing should fade out about $\frac{1}{32}$ to $\frac{1}{16}''$ from top of gear tooth. Profile of the tooth bearing on the pinion will extend to the top of the tooth.



DRIVE COAST
TOO MUCH TOE BEARING
Fig. 4

Fig. 4 shows too much toe bearing; gear must be moved away from pinion to increase length of bearing. A slight adjustment of pinion may be required to obtain the proper profile bearing.

DRIVE COAST
TOO MUCH HEEL BEARING
Fig. 5

Fig. 5 shows heel bearing on both sides of tooth; gear must be adjusted toward pinion. Here again a pinion adjustment will be necessary to obtain the proper profile bearing.

DRIVE COAST
BEARING TOO LOW
Fig. 6

Fig. 6 shows low bearing on the tooth (which may show at any point along tooth). The pinion should be moved away from gear and then the gear moved toward pinion to maintain proper backlash.

DRIVE COAST
BEARING TOO HIGH
Fig. 7

Fig. 7 shows high bearing on the tooth (which may show at any point along the tooth). The pinion should be moved toward gear and gear moved away from pinion to maintain proper backlash.

Several adjustments will be necessary to obtain both the proper lengthwise and profile adjustment but by watching tooth bearing shown and adjusting as described above, the proper adjustment can readily be obtained.

There are conditions in each case which cannot be taken care of by adjustment but come from improperly cut gears or incorrect mounting.

DRIVE COAST
CROSS BEARING
Fig. 8

Fig. 8 shows a cross bearing. The gears are serviceable if the toe bearing is on the drive side and extends $\frac{5}{8}$ the length of the tooth.

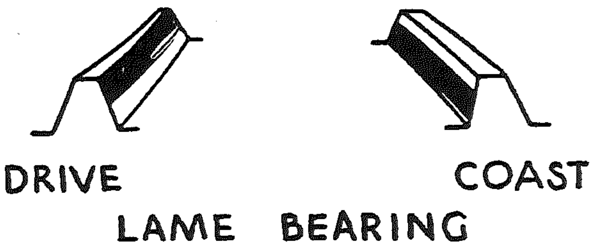


Fig. 9

Fig. 9 shows a lame bearing; gears can be adjusted to obtain a good driving condition but poor coast or reverse.

The last cases cited may occasionally be found in making replacement of original equipment.

Replacement of Bevel Drive Gear and Pinion

An outside or bench assembly should be made of bevel pinion, bearings and adjusters. Assemble inner and outer pinion bearing adjusters in carrier. Next assemble inner pinion bearing on pinion shaft and install shaft in carrier. Draw inner bearing adjuster up snug against inner pinion bearing then back off to first notch. Assembly outer pinion shaft bearing, companion flange, washer and nut.

NOTE: Do not install pinion bearing oil seal until all adjustments have been completed. Then check bearing fit to see that bearings run free without any end movement with flange nut drawn up tight.

Assemble differential and bevel gear assembly and place bearing caps and adjusters in position. Tighten bearing cap bolts and back off slightly to provide sufficient looseness to allow turning the adjusters for a temporary backlash adjustment of approximately .010″. After this adjustment has been made gears should be painted with red lead and rotated to secure proper bearing on teeth (See Figs. 3 to 9). If this is not what is desired, adjust pinion in or out as required by turning pinion shaft bearing adjusters. Backlash should run from .003″ to .008″.

After proper bearing on teeth is secured, tighten adjusters until they are snug against the inner and outer pinion shaft bearings, then back off to first notch. Assemble pinion shaft adjusting hole cover and gasket, making sure the adjusters are locked in place.

After all adjustments have been made a new pinion bearing oil seal assembly must be installed. Replace companion flange and make sure that nut is tight and properly secured with a cotter pin.

IMPORTANT—Bevel drive pinion oil seals must be soft and pliable before being installed. If the seals have become dried out and hard while in stock, use kerosene and work it in thoroughly. When seal has become soft and pliable then dip it in hot oil and work this oil in thoroughly. If the seal has been given the proper oil treatment before installation, prolonged life will be assured.

Load Test

After securing the proper tooth contact by the bench assembly method a final check under load should be made. This is very important as in many instances the tooth bearing will change due to the load imposed upon the gears.

The complete assembly should be nstalled in the axle housing, together with axle shafts, wheels, etc. In other words the axle should be built up complete (less rear cover), just as it will be when the chassis is put into its regular operation.

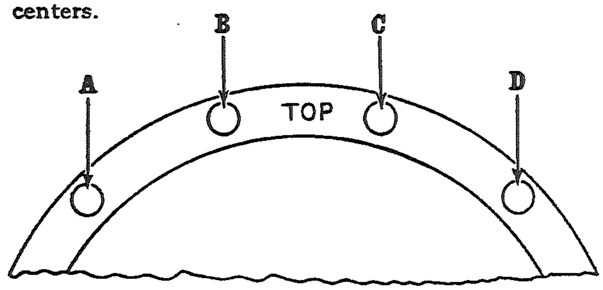
Jack up both rear wheels so they will be free to revolve, then paint the bevel drive teeth with red lead. Start engine and with the service brake applied and transmission in gear, rotate bevel drive gear, forward and reverse.

Examine markings on teeth and if necessary readjust bevel drive gear or pinion to secure the proper tooth contact indicated by Figs. 3 to 9.

Installing New Bevel Drive Gear

If new gears are being installed, the pilot diameter on drive gear flange should be checked to see that it runs true with bearing hubs. If inspection indicates a run-out exceeding .004″, a new differential case should be installed. When assembling drive gear on face of flange, make sure each rivet is tight. Better results will be obtained if a press is used to install rivets. Riveting of this nature should always be done with cold rivets, using sufficient pressure on the rivet so that when the operation is completed the hole in which the rivet is inserted is entirely filled up.

When hot rivets are used the metal shrinks when cool with the result that the hole is not entirely filled and looseness may develop when torque is applied. A similar condition also results when insufficient pressure is applied to the rivet in cold riveting. Drive gear should run true within .003″ total indicator reading, checking from back face of gear and using bearing hubs of case as centers.



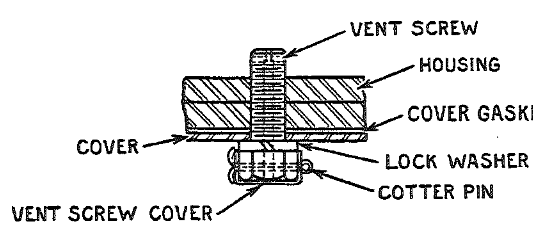


Fig. 10, R-1100 Axle

Axle Housing Vent Screw (R-1100 Axle Only)

When the lubricant in the rear axle becomes warm it expands to a certain extent and in order to prevent leakage at the wheel bearings and relieve the pressure that is built up, one of the axle housing capscrews is drilled to provide a vent. This air vent must be installed at location "C" as indicated in Fig. 10.

The vent should be kept open and clean. Remove the cap, which is held on with a cotter pin and take out the capscrew. Wash all pieces thoroughly in cleaning solution and reassemble to axle. Always be sure to replace this vent in the proper location.

Removal of Rear Wheels (R-1000 Axle Only)

When removing rear wheels always use a wheel puller. Do not use a knock-out type tool as serious damage to the bearings, seals, differential center block, etc., will result if this type tool is used.

Installation of Wheel Bearings (R-1000 Axle Only)

To properly install wheel bearings on the rear axle shaft, they should be heated in **boiling water.** They should then be given a light press on the shaft. This procedure is necessary as the wheel bearings are designed for a shrink fit on the axle shaft.

The recommended end play of the axle shaft is from .004″ to .008″ and this is adjusted by the shims between the end of the axle housing and the backing plate. This will take care of slight manufacturing variations in the shaft and bearing.

When a new axle shaft is installed the end play must be carefully checked and shims added or removed as required.

Rear Axles—R-1200, RB-1200, R-1300, R-1400, RB-1400, R-1500, R-1600, RT-1200, RT-1400, RT-1500, RF-1401, RF-1610

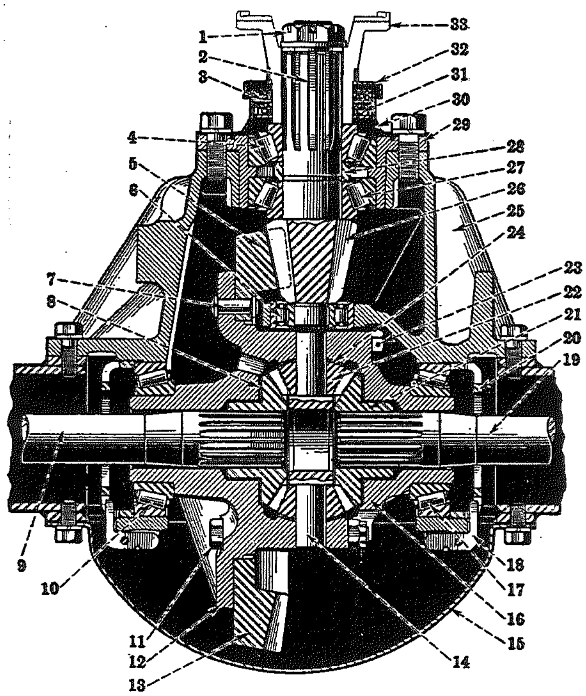


Fig. 1, R-1200, RB-1200, RT-1200 Axle

No.	Description
1.	Propeller shaft mounting nut.
2.	Bevel drive pinion.
3.	Pinion shaft oil seal felt.
4.	Pinion shaft outer roller bearing.
5.	Bevel drive gear.
6.	Pinion shaft inner roller bearing.
7.	Bevel drive gear.
8.	Differential side gear thrust washer.
9.	Axle shaft.
10.	Differential roller bearing.
11.	Differential case capscrew, long.
12.	Differential case.
13.	Bevel drive gear.
14.	Differential spider.
15.	Axle housing cover.
16.	Differential case.
17.	Differential roller bearing.
18.	Differential bearing adjuster lock.
19.	Axle shaft.
20.	Differential bearing adjuster.
21.	Differential side gear.
22.	Differential spider pinion.
23.	Differential case capscrew, short.
24.	Differential spider pinion thrust washer.
25.	Differential carrier.
26.	Bevel drive pinion.
27.	Pinion shaft outer roller bearing.
28.	Pinion shaft outer bearing spacer.
29.	Pinion bearing cage.
30.	Pinion shaft oil seal retainer.
31.	Pinion shaft oil seal.
32.	Companion flange mud slinger.
33.	Companion flange.

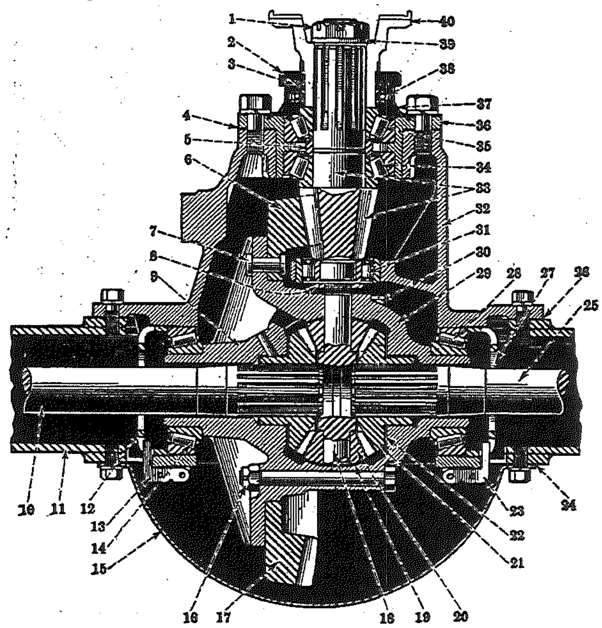


Fig. 2, R-1300, R-1400, RB-1400, RT-1400, RF-1401 Axle

No.	Description
1.	Propeller shaft mounting nut.
2.	Companion flange mud slinger.
3.	Pinion shaft oil seal felt.
4.	Pinion bearing cage shim.
5.	Pinion shaft outer bearing spacer.
6.	Bevel drive gear.
7.	Bevel drive gear rivet.
8.	Pinion shaft inner bearing nut.
9.	Differential case.
10.	Axle shaft.
11.	Axle housing.
12.	Differential bearing adjuster.
13.	Differential bearing adjuster lock.
14.	Differential roller bearing.
15.	Axle housing cover.
16.	Differential case capscrew nut.
17.	Bevel drive gear.
18.	Differential spider.
19.	Differential spider pinion thrust washer.
20.	Differential spider pinion.
21.	Differential side gear.
22.	Differential side gear thrust washer.
23.	Differential bearing adjuster lock.
24.	Axle housing cover gasket.
25.	Axle shaft.
26.	Differential carrier to housing gasket.
27.	Differential bearing adjuster.
28.	Differential roller bearing.
29.	Differential case.
30.	Differential case capscrew, short.
31.	Pinion shaft inner roller bearing.
32.	Differential carrier.
33.	Bevel drive pinion.
34. 35.	Pinion shaft outer bearing.
36.	Pinion bearing cage.
37.	Pinion shaft oil seal retainer.
38.	Pinion shaft oil seal.
39.	Propeller shaft mounting nut washer.
40.	Companion flange.

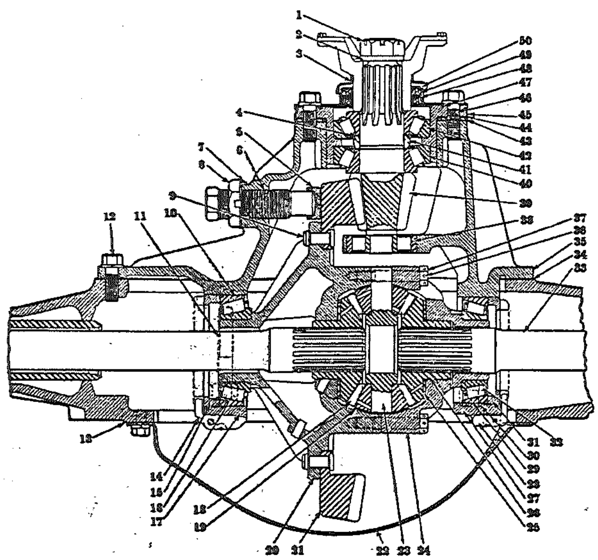


Fig. 3, R-1500, RT-1500 Axle

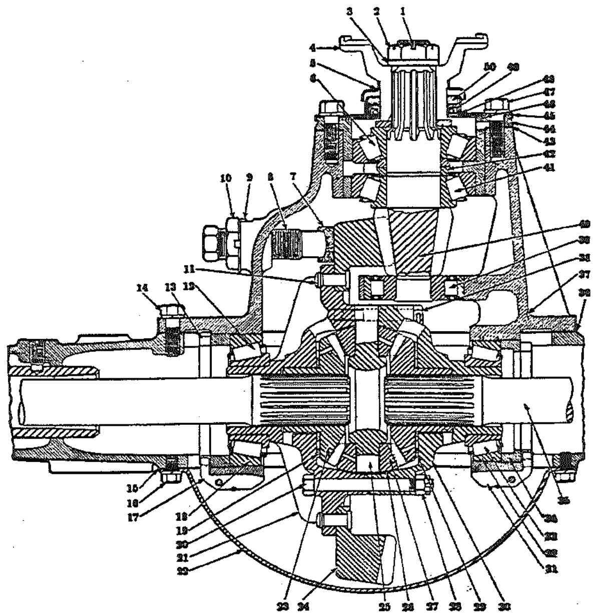


Fig. 4, R-1600, RF-1610 Axle

No.	Description
1.	Pinion shaft end nut.
2.	Pinion shaft end nut washer.
3.	Companion flange mud slinger.
4.	Pinion bearing spacer shims.
5.	Bevel drive gear adjusting screw thrust block.
6.	Bevel drive gear adjusting screw.
7.	Bevel drive gear adjusting screw lock.
8.	Bevel drive gear adjusting screw check nut.
9.	Bevel drive gear rivet.
10.	Differential bearing.
11.	Differential carrier bearing cap capscrew.
12.	Differential carrier to housing capscrew.
13.	Axle Housing cover gasket.
14.	Differential bearing adjusting lock.
15.	Differential bearing adjuster.
16.	Differential bearing cap capscrew lockwire.
17.	Differential carrier bearing cap.
18.	Differential side pinion.
19.	Differential pinion thrust washer.
20.	Differential case—flanged.
21.	Bevel drive gear.
22.	Axle housing cover.
23.	Differential spider.
24.	Differential case—plain.
25.	Differential side gear thrust washer.
26.	Differential side gear.
27.	Differential carrier bearing cap.
28.	Differential bearing adjusting lock.
29.	Differential bearing cap capscrew lockwire.
30.	Differential carrier bearing cap capscrew.
31.	Differential bearing adjuster.
32.	Differential bearing.
33.	Axle shaft.
34.	Differential carrier to housing gasket.
35.	Differential carrier.
36.	Differential case capscrew lockwire.
37.	Differential case capscrew.
38.	Pinion bearing.
39.	Bevel drive pinion.
40.	Pinion bearing (outer).
41.	Pinion bearing spacer.
42.	Pinion bearing (outer).
43.	Pinion bearing cage spacer.
44.	Pinion bearing cage shim.
45.	Pinion bearing cage.
46.	Pinion bearing cage to carrier bolt.
47.	Pinion bearing cage cork.
48.	Oil seal.
49.	Oil seal felt.
50.	Oil seal retainer.

No.	Description
1.	Cotter pin.
2.	Pinion shaft end nut.
3.	Pinion shaft end washer.
4.	Companion flange.
5.	Companion flange mud slinger.
6.	Outer pinion bearing.
7.	Bevel drive gear adjusting screw thrust block.
8.	Bevel drive gear adjusting screw.
9.	Bevel drive gear adjusting screw lock.
10.	Bevel drive gear adjusting screw check nut.
11.	Bevel drive gear rivet.
12.	Differential roller bearing.
13.	Differential bearing adjuster.
14.	Differential carrier to housing capscrew.
15.	Differential housing cover gasket.
16.	Differential cover to housing capscrew.
17.	Differential bearing adjuster lock.
18.	Differential bearing cup.
19.	Differential side gear thrust washer.
20.	Differential case capscrew.
21.	Differential case (left side).
22.	Axle housing cover.
23.	Differential side gear.
24.	Bevel drive gear.
25.	Differential spider.
26.	Differential spider pinion thrust washer.
27.	Differential spider pinion.
28.	Differential case nut.
29.	Differential side gear thrust washer.
30.	Differential case (right side).
31.	Differential bearing adjuster lock.
32.	Differential roller bearing cup.
33.	Differential roller bearing.
34.	Differential bearing adjuster.
35.	Axle shaft.
36.	Differential cover to housing gasket.
37.	Differential carrier.
38.	Differential case capscrew.
39.	Pinion shaft inner roller bearing.
40.	Bevel drive pinion.
41.	Pinion outer bearing.
42.	Pinion bearing spacers and shims.
43.	Pinion bearing cage shim.
44.	Pinion bearing cage.
45.	Pinion bearing cage gasket.
46.	Gasket.
47.	Pinion bearing cage to carrier capscrew.
48.	Pinion bearing oil seal retainer.
49.	Pinion bearing oil seal assembly.
50.	Pinion bearing oil seal felt washer.

Rear Axle

The rear axle is full floating, spiral bevel drive, having a one-piece banjo type housing.

Differential is four-pinion type with two-piece case and is supported on two tapered roller bearings controlled by adjusters.

Bevel drive pinion is straddle-mounted, having two opposed tapered roller bearings ahead of the pinion and a straight roller type bearing behind it.

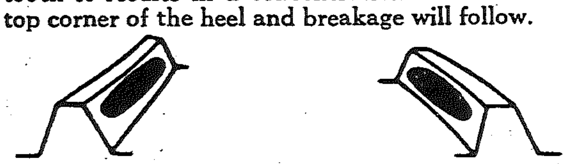
Bevel Gear Tooth Contact

The proper adjustment of bevel gears in assembly is a vital factor in obtaining quiet and durable gears, and the same methods apply both to straight and spiral bevel type.

There are two distinct considerations in obtaining the proper tooth contact. The first is along the tooth—a lengthwise bearing, the other up and down the tooth—a profile bearing.

Bevel as well as spur gears are cut with a predetermined amount of backlash, depending upon the size or pitch of the teeth and operating conditions, usually varying from .004" to .005" on an eight pitch gear to .012" on a three pitch gear. Generally the gears are machined to run flush with each other at the outer (heel or large end) of the tooth, and gears should be so set for initial trial.

Bevel gears when mounted should show a bearing toward the toe or small end of the tooth, never at the heel or large end, the reason being that it is practically impossible to make gears and gear mounting rigid enough so that there will not be some slight deflection when full load is applied. This always has a tendency to cause the bearing to come on the heel of the tooth and when gears are adjusted so that the bearing is toward the heel of the tooth it results in a concentration of load on the top corner of the heel and breakage will follow.

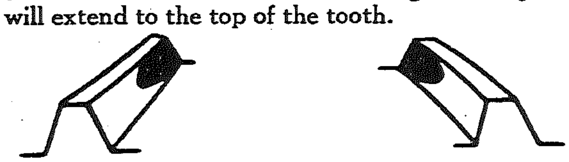


DRIVE COAST

CORRECT ADJUSTMENT

Fig. 5

Fig. 5 shows the correct bearing on both drive and coast or reverse side of the tooth. The tooth bearing, both lengthwise and profile of the gear, should appear as shown. The profile bearing should fade out about 1/32 to 1/16" from top of gear tooth. Profile of the tooth bearing on the pinion will extend to the top of the tooth.



DRIVE COAST

TOO MUCH TOE BEARING

Fig. 6

Fig. 6 shows too much toe bearing; gear must be moved away from pinion to increase length of bearing. A slight adjustment of pinion may be required to obtain the proper profile bearing.

DRIVE COAST

TOO MUCH HEEL BEARING

Fig. 7

Fig. 7 shows heel bearing on both sides of tooth; gear must be adjusted toward pinion. Here again a pinion adjustment will be necessary to obtain the proper profile bearing.

DRIVE COAST

BEARING TOO LOW

Fig. 8

Fig. 8 shows low bearing on the tooth (which may show at any point along tooth). The pinion should be moved away from gear and then the gear moved toward pinion to maintain proper backlash.

DRIVE COAST

BEARING TOO HIGH

Fig. 9

Fig. 9 shows high bearing on the tooth (which may show at any point along the tooth). The pinion should be moved toward gear and gear moved away from pinion to maintain proper backlash.

Several adjustments will be necessary to obtain both the proper lengthwise and profile adjustment but by watching tooth bearing shown and adjusting as described above, the proper adjustment can readily be obtained.

There are conditions in each case which cannot be taken care of by adjustment but come from improperly cut gears or incorrect mounting.

Fig. 10

Fig. 10 shows a cross bearing. The gears are serviceable if the toe bearing is on the drive side and extends ⅝ the length of the tooth.

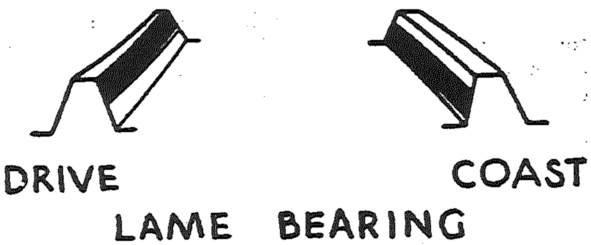


Fig. 11

Fig. 11 shows a lame bearing; gears can be adjusted to obtain a good driving condition but poor coast or reverse.

The last cases cited may occasionally be found in making replacement of original equipment.

Replacement of Bevel Drive Gear and Pinion

An outside or bench assembly should be made of bevel pinion, bearings and cage. With cups assembled in cage, assemble the pinion and inner bearing cone and roller assembly in place, using the proper spacer to space the pinion bearings. Next assemble the outer pinion bearing cone and rollers, spacer, companion flange, washer and nut.

NOTE: Do not install pinion bearing oil seal until all adjustments have been completed. Then check bearing fit to see that bearings have no end movement with flange nut drawn up tight. To secure this fit, proper spacer must be found by trial as follows:

(a) Place assembly in vise in position shown.
(b) Mount indicator on propeller shaft flange with indicator finger resting on upper face of cage. (See A in sketch.)
(c)] With the tips of the fingers grasp the bearing retainer and work bearings up against the back face of pinion. (See B in sketch.)
(d) With the bearings held firmly against the pinion, move the cage up and down, observing the indicator reading. It is impossible to accurately determine the end play unless the bearing is worked loose and up against the pinion. Assemblies having as much as .005″ end play cannot be moved enough to show on the indicator until the bearing has been worked up and away from the cup.

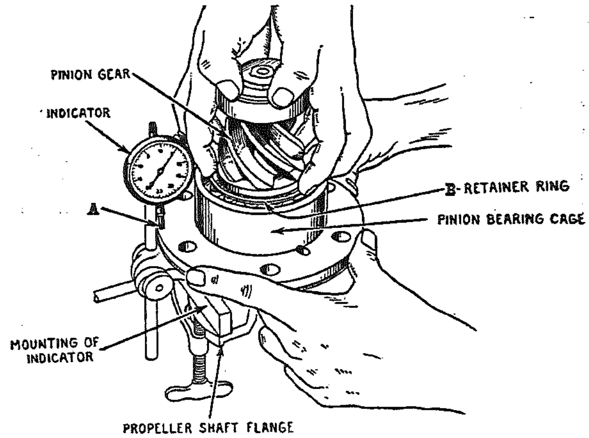


Fig. 12, Checking End Play of Pinion Bearing

Preload the pinion bearings by replacing the spacer between the pinion bearings with one smaller to the extent of the amount of the end play plus .002″ for the loading. For example, should there be .005″ end play as indicated in the sketch in the assembly, replace the spacer with one .007″ smaller. Do not depend upon the spacers to be right according to number but check each and every one with an accurate micrometer. Before reassembling the bearings to the pinion shaft they should be dipped in rear axle lubricant. Propeller shaft flange nut must be pulled down securely to assure tight bearings. A wrench with 30″ of leverage should be used.

In order to determine if insufficient or excessive preload has been applied, make the following test:

(a) Place assembly in vise with jaws clamping together on the flange of the pinion bearing cage and with assembly in a horizontal position.
(b) Grasp the propeller shaft flange with one hand and attempt to turn.
(c) If the pinion turns freely, assembly is too loose. If pinion cannot be turned, assembly is too tight.
(d) The ideal condition is for the pinion to require full hand pressure to move it a ¼ turn.

After proper bearing fit has been obtained, place pinion bearing cage shims approximately .020″ in thickness over end of cage and place cage and pinion assembly in carrier, it being necessary to match flange holes in cage, since one hole is out of equal spacing to assure proper position of cage. Next assemble two cage bolts only until gear setting is completed. Assemble differential and bevel gear assembly and place bearing cap and adjuster in position. Tighten bearing cap bolts and back off slightly to provide sufficient looseness to allow turning the adjuster for a temporary backlash adjustment of approximately .010″. After this adjustment has been made, tighten each bearing adjuster snug then give them a final tightening operation, drawing them up a notch or notch and a half. This is important in order to make certain that the bearings are seating properly.

Paint bevel gear with red lead and rotate to secure proper bearing on teeth. If this is not what is desired, cage shims will have to be added or removed as the case may be. Backlash should run from .003" to .008". The movements necessary to obtain correct tooth contact are shown in Figs. 5 to 11.

After all adjustments have been made a new pinion bearing oil seal assembly must be installed. Replace companion flange and make sure that nut is tight and properly secured with a cotter pin.

IMPORTANT—Bevel drive pinion oil seals must be soft and pliable before being installed. If the seals have become dried out and hard while in stock, use kerosene and work it in thoroughly. When seal has become soft and pliable then dip it in hot oil and work this oil in thoroughly. If the seal has been given the proper oil treatment before installation, prolonged life will be assured.

Load Test

After securing the proper tooth contact by the bench assembly method a final check under load should be made. This is very important as in many instances the tooth bearing will change due to the load imposed upon the gears.

The complete assembly should be installed in the axle housing, together with axle shafts, wheels, etc. In other words the axle should be built up complete (less rear cover), just as it will be when the chassis is put into its regular operation.

Jack up both rear wheels so they will be free to revolve, then paint the bevel drive teeth with red lead. Start engine and with the **service** brake applied and transmission in gear, rotate bevel drive gear, forward and reverse.

Examine markings on teeth and if necessary readjust bevel drive gear or pinion to secure the proper tooth contact indicated by Figs. 5 to 11.

Installing New Bevel Drive Gears

If new gears are being installed, the pilot diameter on drive gear flange should be checked to see that it runs true with bearing hubs. If inspection indicates a runout exceeding .004", a new differential case should be installed.

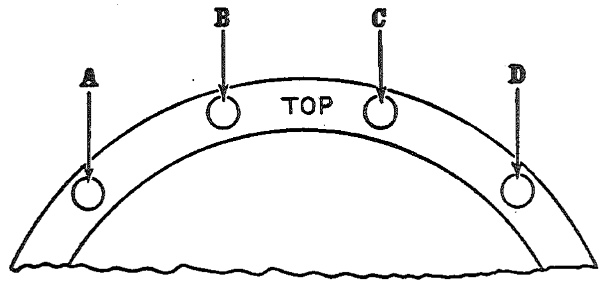
When assembling drive gear on face of flange, make sure each rivet is tight. Better results will be obtained if a press is used to install rivets. Riveting of this nature should always be done with cold rivets, using sufficient pressure on the rivet so that when the operation is completed the hole in which the rivet is inserted is entirely filled up.

When hot rivets are used the metal shrinks when cool with the result that the hole is not entirely filled and looseness may develop when torque is applied. A similar condition also results when insufficient pressure is applied to the rivet in cold riveting. Drive gear should run true within .003" total indicator reading, checking from back of gear and using bearing hubs of case as centers.

Bevel Drive Gear Thrust Button

On axles having a bevel drive gear thrust button and adjusting screw, the screw should be tightened until the thrust button just touches the back of the bevel drive gear. Then back the screw out approximately ¼ turn, which will give from .015" to .020" clearance between the button and bevel drive gear.

After the proper clearance has been obtained, tighten check nut and lock by bending tangs on lockwasher.



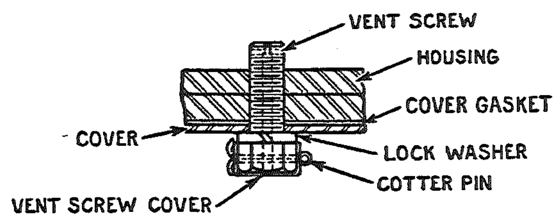


Fig. 13

Axle Housing Vent Screw

When the lubricant in the rear axle becomes warm it expands to a certain extent and in order to prevent leakage at the wheel bearings and relieve the pressure that is built up, one of the axle housing capscrews is drilled to provide a vent. This air vent must be installed at the locations as indicated in Fig. 13.

Axle Series	Vent Screw Location
1200, 1300, 1400	C
1500	B
1600	D

The vent should be kept open and clean. Remove the cap, which is held on with a cotter pin and take out the cap screw. Wash all pieces thoroughly in cleaning solution and reassemble to axle. Always be sure to replace this vent in the proper location.

Rear Axles—R-1650, RT-1660, R-1700

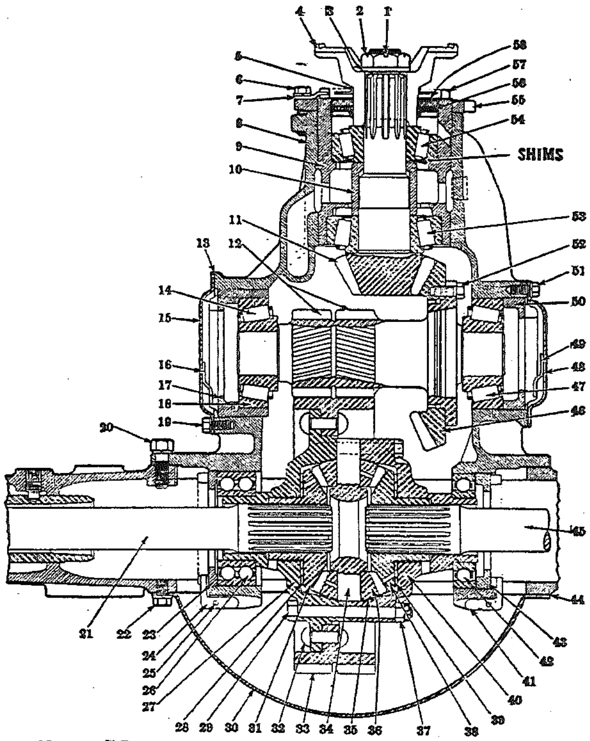


Fig. 1, R-1650, RT-1660 Axle

No.	Description
1.	Cotter pin.
2.	Pinion shaft end nut.
3.	Pinion shaft end washer.
4.	Pinion companion flange.
5.	Pinion mud slinger.
6.	Capscrew.
7.	Bearing cage check nut lock.
8.	Differential carrier.
9.	Bevel drive gear bearing cage.
10.	Bevel drive pinion bearing spacer.
11.	Bevel drive pinion.
12.	Herringbone gear.
13.	Herringbone gear cover gasket.
14.	Herringbone gear roller bearing.
15.	Herringbone gear cover.
16.	Herringbone gear cover adjuster lock.
17.	Herringbone gear bearing cage adjuster.
18.	Herringbone gear bearing cup.
19.	Herringbone gear cover capscrew.
20.	Differential carrier to axle housing capscrew.
21.	Axle shaft.
22.	Differential cover to axle housing capscrew.
23.	Differential bearing adjuster.
24.	Differential bearing adjuster lock.
25.	Differential bearing adjuster lock cotter pin.
26.	Differential ball-bearing assembly.
27.	Differential case (left side).
28.	Differential side gear thrust washer.
29.	Differential case capscrew.
30.	Differential cover.
31.	Differential side gear.
32.	Herringbone gear rivet.
33.	Herringbone gear.
34.	Differential spider.
35.	Differential gear thrust washer.
36.	Differential gear.
37.	Differential case nut.
38.	Differential side gear.
39.	Differential side gear thrust washer.
40.	Differential case (right side).
41.	Differential adjuster lock.
42.	Differential ball-bearing assembly.
43.	Differential bearing adjuster.
44.	Axle housing cover gasket.
45.	Axle shaft.
46.	Bevel drive gear.
47.	Herringbone and bevel drive gear bearing.
48.	Herringbone gear cover.
49.	Herringbone gear adjuster lock.
50.	Herringbone pinion bearing adjuster.
51.	Herringbone gear cover capscrew.
52.	Bevel drive gear capscrew.
53.	Bevel drive pinion inner roller bearing.
54.	Bevel drive pinion outer roller bearing.
55.	Bevel drive pinion cage check nut.
56.	Pinion grease seal.
57.	Bevel drive pinion bearing cage.
58.	Bevel drive pinion bearing felt.

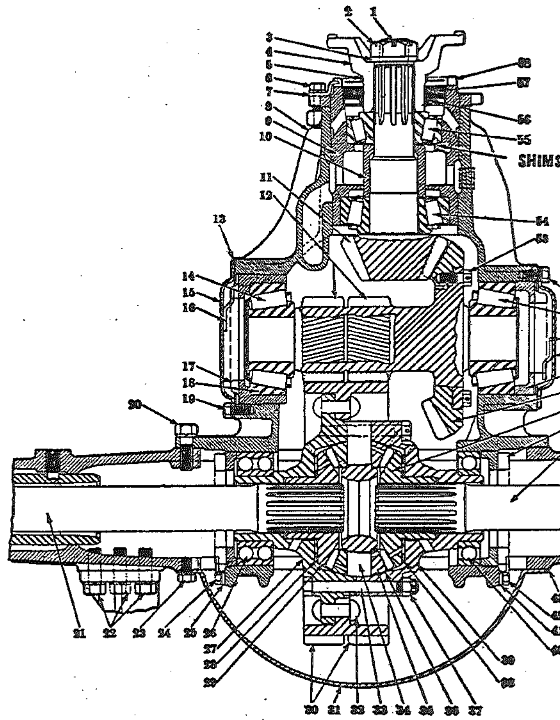


Fig. 2, R-1700 Axle

No.	Description
1.	Cotter pin.
2.	Pinion shaft end nut.
3.	Pinion shaft end nut washer.
4.	Companion flange.
5.	Pinion mud slinger.
6.	Capscrew.
7.	Bearing cage check nut lock.
8.	Differential carrier.
9.	Bevel drive pinion bearing cage.
10.	Bevel drive pinion bearing spacer.
11.	Bevel drive pinion.
12.	Herringbone gear.
13.	Herringbone gear cover gasket.
14.	Herringbone gear roller bearing.
15.	Herringbone gear cover.
16.	Herringbone gear cover adjuster lock.
17.	Herringbone gear bearing case adjuster.
18.	Herringbone gear bearing cup.
19.	Herringbone gear cover capscrew.
20.	Differential carrier to axle housing capscrew.
21.	Axle shaft.
22.	Brake control to housing capscrews.
23.	Differential cover to axle housing capscrews.
24.	Differential adjuster lock capscrew.
25.	Differential adjuster lock.
26.	Differential ball-bearing assembly.
27.	Differential case (left side).
28.	Differential side gear thrust washer.
29.	Differential side gear.
30.	Herringbone gear.
31.	Differential cover.
32.	Herringbone gear rivet.
33.	Differential case capscrew.
34.	Differential spider.
35.	Differential gear.
36.	Differential gear thrust washer.
37.	Differential case nut.
38.	Differential side gear thrust washer.
39.	Differential case (right side).
40.	Differential ball-bearing assembly.
41.	Differential adjuster lock.
42.	Differential adjuster lock capscrew.
43.	Differential cover to axle housing gasket.
44.	Axle shaft.
45.	Differential adjuster.
46.	Differential side gear.
47.	Bevel drive gear.
48.	Herringbone pinion bearing adjuster.
49.	Herringbone pinion cover.
50.	Herringbone pinion adjuster lock.
51.	Herringbone and bevel drive gear bearing.
52.	Herringbone gear cover capscrew.
53.	Bevel drive gear capscrew.
54.	Bevel drive pinion inner roller bearing.
55.	Bevel drive pinion outer roller bearing.
56.	Pinion grease seal.
57.	Pinion grease seal felt.
58.	Bevel drive pinion bearing cage.

Rear Axle

Rear axle is a heavy-duty double reduction type with entire reduction taking place at center of axle housing thru a primary or bevel gear reduction, followed by a secondary or herringbone type gear reduction to axle shafts.

Bevel Gear Reduction

Bevel or primary reduction gears are of conventional spiral type consisting of a bevel pinion mounted on forward end of carrier housing, and meshed with a bevel drive gear which is bolted to an integral flange on bevel gear shaft. This shaft also carries as an integral part the herringbone drive pinion for the secondary reduction.

Herringbone Gear Reduction

Herringbone or secondary reduction gears consist of a drive pinion and mating gear.

Teeth are right and left-hand spiral cut in line with each other forming a "V," the apex of which is at center of gear face. A center cut through the apex breaks the tooth line into two separate and opposed spiral gears, each exerting equal pressure in direct proportion but in opposite direction to the other. Herringbone gear construction makes for comparatively noiseless operation at high speed and also eliminates heavy end thrust reaction.

Differential

Differential is a four pinion type with a two-piece case bolted together. Side gears are provided with a bronze thrust washer to reduce wear and eliminate possibility of scoring case. Final reduction herringbone drive gear is riveted to flanged half of case.

Care should be exercised when adjusting differential bearings to avoid changing relative position of herringbone drive gear and pinion, since incorrect backlash or out-of-alignment condition of these gears will exert considerable thrust action in either direction on differential bearings with possibility of failure inasmuch as these bearings are not designed to carry heavy thrust loads.

Bevel Pinion Shaft and Adjustment

Adjustable bevel pinion bearings are assembled to pinion shaft and retained by universal joint flange and nut on forward end of pinion shaft.

A spacing collar and shims are used to maintain correct distance between front and rear bearings. A bearing cage or sleeve screws into forward end of carrier and is the means of adjusting bevel pinion and ring gear for tooth contact and backlash.

To adjust pinion bearings, first, remove pinion end nut and flange—second, remove cage lock and back out cage—third, remove necessary shims and replace parts.

IMPORTANT—Bevel drive pinion oil seals must be soft and pliable before being installed. If the seals have become dried out and hard while in stock, use kerosene and work it in thoroughly. When seal has become soft and pliable, then dip it in hot oil and work this oil in thoroughly. If the seal has been given the proper oil treatment before installation, prolonged life will be assured.

Bevel Gear Shaft and Adjustment

Bevel gear shaft is mounted at right angles to bevel pinion shaft in carrier housing. This shaft is a one-piece steel forging consisting of an integral flange on one end to which is bolted bevel reduction ring gear, also herringbone reduction drive pinion forming an integral part of shaft at opposite end.

To remove bevel gear shaft it is necessary to, first, remove differential and herringbone gear assembly, second, withdraw bevel pinion and cage assembly a distance sufficient for bevel gear to clear pinion, when being removed. (Do not remove universal joint flange.) Take off bearing covers, which also serve as locks for bearing adjuster cage on left side, and adjusting ring on right side.

Next screw out herringbone pinion bearing cage, left side. This will permit sufficient opening to partly pass shaft thru until bearing is clear of carrier housing at opposite end. Tilt bevel ring gear end of shaft to rear and withdraw from carrier. Bevel gear shaft bearing adjusting rings control backlash and tooth contact of bevel pinion and gear, therefore when adjusting to remove side play, adjusting rings on each end must be turned an equal amount.

Bevel Gear Tooth Contact

The proper adjustment of bevel gears in assembly is a vital factor in obtaining quiet and durable gears, and the same methods apply both to straight and spiral bevel type.

There are two distinct considerations in obtaining the proper tooth contact. The first is along the tooth—a lengthwise bearing, the other up and down the tooth—a profile bearing.

Bevel as well as spur gears are cut with a predetermined amount of backlash, depending upon the size or pitch of the teeth and operating conditions, usually varying from .004″ to .005″ on an eight pitch gear to .012″ on a three pitch gear. Generally the gears are machined to run flush with each other at the outer (heel or large end) of the tooth, and gears should be so set for initial trial.

Bevel gears when mounted should show a bearing toward the toe or small end of the tooth, never at the heel or large end, the reason being that it is practically impossible to make gears and gear mounting rigid enough so that there will not be some slight deflection when full load is applied. This always has a tendency to cause the bearing to come on the heel of the tooth and when gears are adjusted so that the bearing is toward the heel of the tooth it results in a concentration of load on the top corner of the heel and breakage will follow.

DRIVE COAST

CORRECT ADJUSTMENT

Fig. 3

Fig. 3 shows the correct bearing on both drive and coast or reverse side of the tooth. The tooth bearing, both lengthwise and profile of the gear, should appear as shown. The profile bearing should fade out about $1/32$ to $1/16''$ from top of gear tooth. Profile of the tooth bearing on the pinion will extend to the top of the tooth.

DRIVE COAST

TOO MUCH TOE BEARING

Fig. 4

Fig. 4 shows too much toe bearing; gear must be moved away from pinion to increase length of bearing. A slight adjustment of pinion may be required to obtain the proper profile bearing.

DRIVE COAST

TOO MUCH HEEL BEARING

Fig. 5

Fig. 5 shows heel bearing on both sides of tooth; gear must be adjusted toward pinion. Here again a pinion adjustment will be necessary to obtain the proper profile bearing.

DRIVE COAST

BEARING TOO LOW

Fig. 6

Fig. 6 shows low bearing on the tooth (which may show at any point along tooth). The pinion should be moved away from gear and then the gear moved toward pinion to maintain proper backlash.

DRIVE COAST

BEARING TOO HIGH

Fig. 7

Fig. 7 shows high bearing on the tooth (which may show at any point along the tooth). The pinion should be moved toward gear and gear moved away from pinion to maintain proper backlash.

Several adjustments will be necessary to obtain both the proper lengthwise and profile adjustment but by watching tooth bearing shown and adjusting as described above, the proper adjustment can readily be obtained.

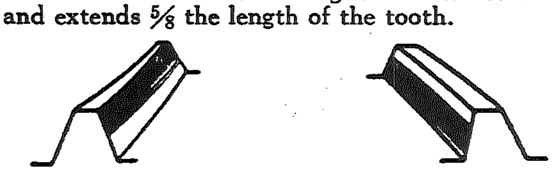
There are conditions in each case which cannot be taken care of by adjustment but come from improperly cut gears or incorrect mounting.

DRIVE COAST

CROSS BEARING

Fig. 8

Fig. 8 shows a cross bearing. The gears are serviceable if the toe bearing is on the drive side and extends $5/8$ the length of the tooth.



DRIVE COAST

LAME BEARING

Fig. 9

Fig. 9 shows a lame bearing; gears can be adjusted to obtain a good driving condition but poor coast or reverse.

The last cases cited may occasionally be found in making replacement of original equipment.

Gears are adjusted for proper contact at factory and their relative location should never be changed except to overcome gear noises that cannot be traced to other causes, such as improper lubrication or incorrect bearing adjustment affecting backlash of pinion and drive gears. Backlash should be from .003" to .008".

To adjust pinion when new gears are installed, obtain a tooth contact impression by painting gears with red lead. Rotate gears and if tooth contact is correct the impression on pinion teeth will begin at toe or small end and extend to approximately ¾ of distance to heel or large end and about equally spaced between top and bottom of tooth (See Figs. 3 to 9).

Load Test

After securing the proper tooth contact by the bench assembly method a final check under load should be made. This is very important as in many instances the tooth bearing will change due to the load imposed upon the gears.

The complete assembly should be installed in the axle housing, together with axle shafts, wheels, etc. In other words the axle should be built up complete (less rear cover), just as it will be when the chassis is put into its regular operation.

Jack up both rear wheels so they will be free to revolve, then paint the bevel drive teeth with red lead. Start engine and with the service brake applied and transmission in gear, rotate bevel drive gear, forward and reverse.

Examine markings on teeth and if necessary readjust bevel drive gear or pinion to secure the proper tooth contact indicated by Figs. 3 to 9.

Herringbone Gear Adjustment

Herringbone gear alignment adjustment should never be altered except after a bevel gear adjustment has been completed and then former adjustment must be effected by means of differential case bearing adjusting rings only.

NEVER ALTER HERRINGBONE GEAR ALIGNMENT BY CHANGING BEVEL DRIVE GEAR SHAFT ADJUSTMENT AS ANY CHANGE ON THIS SHAFT ALSO CHANGES RELATIVE POSITION OF BEVEL GEARS.

Gear adjustments when made necessary by replacement with new parts should first be made at bevel pinion shaft then all other adjustments for backlash, tooth contact and alignment must follow through both gear reductions in direct relation, one to the other, until final setting of differential case bearing adjusting rings is made.

Herringbone gears are not adjustable for backlash. This clearance is taken into account in the construction and remains constant as long as gears are in proper alignment. Ordinary wear in service or out of alignment condition being only factors likely to affect backlash between gear teeth.

To adjust herringbone gears for alignment and tooth contact it is only necessary that tooth ends of pinion at center cut on gear face are flush with corresponding ends of teeth on drive gear.

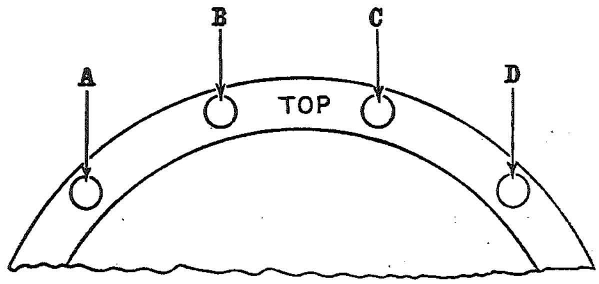
Make this adjustment only after bevel drive gear shaft position has been established and then only by shifting differential laterally in either direction until drive gear is in perfect alignment with pinion as described above.

Oil level in differential housing should be maintained to lower edge of oil hole located in housing cover (See "Lubrication Section").

Installing New Herringbone Drive Gear

If new gears are being installed, the pilot diameter on drive gear flange should be checked to see that it runs true with bearing hubs. If inspection indicates a runout exceeding .004", a new differential case should be installed. When assembling drive gear on face of flange, make sure each rivet is tight. Better results will be obtained if a press is used to install rivets. Riveting of this nature should always be done with cold rivets, using sufficient pressure on the rivet so that when the operation is completed the hole in which the rivet is inserted is entirely filled up.

When hot rivets are used the metal shrinks when cool with the result that the hole is not entirely filled and looseness may develop when torque is applied. A similar condition also results when insufficient pressure is applied to the rivet in cold riveting. Drive gear should run true within .003" total indicator reading, checking from back of gear and using bearing hubs of case as centers.



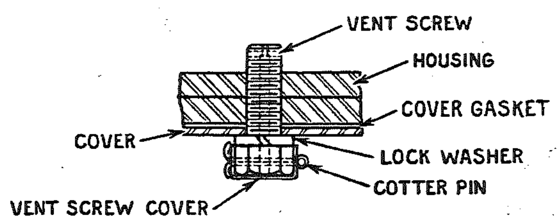


Fig. 10

Axle Housing Vent Screw

When the lubricant in the rear axle becomes warm it expands to a certain extent and in order to prevent leakage at the wheel bearings and relieve the pressure that is built up, one of the axle housing capscrews is drilled to provide a vent. This air vent must be installed at location "A" as indicated in Fig. 10.

The vent should be kept open and clean. Remove the cap, which is held on with a cotter pin, and take out the capscrew. Wash all pieces thoroughly in cleaning solution and reassemble to axle. Always be sure to replace this vent in the proper location.

Rear Axle—RF-1701

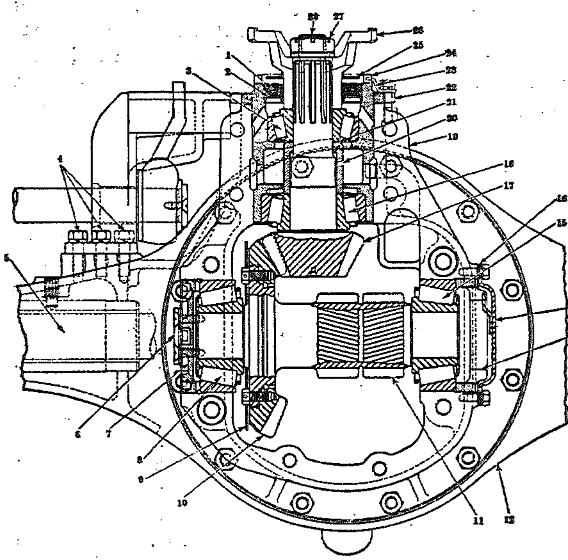


Fig. 1, RF-1701 Axle

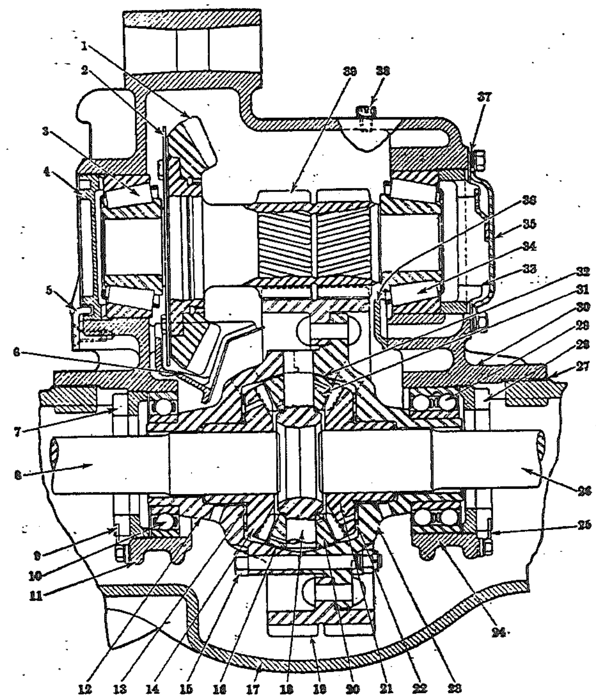


Fig. 2, RF-1701 Axle

No.	Description
1.	Pinion grease seal felt.
2.	Pinion grease seal.
3.	Pinion bearing (outer).
4.	Brake shaft bracket capscrews.
5.	Axle shaft.
6.	Bearing adjuster lock.
7.	Bearing adjuster.
8.	Bearing.
9.	Oil collector disc.
10.	Bevel drive gear.
11.	Herringbone countershaft gear.
12.	Axle housing.
13.	Bearing adjuster.
14.	Bearing cover.
15.	Bearing.
16.	Bearing cover gasket.
17.	Bevel drive pinion.
18.	Pinion bearing (inner).
19.	Pinion carrier.
20.	Pinion bearing spacer.
21.	Pinion bearing shims.
22.	Pinion bearing cage check nut.
23.	Pinion bearing cage check nut lock.
24.	Pinion bearing cage.
25.	Mud slinger.
26.	Companion flange.
27.	Pinion shaft end nut.
28.	Cotter pin.

No.	Description
1.	Bevel drive gear.
2.	Oil collector disc.
3.	Bearing.
4.	Bearing adjuster.
5.	Bearing adjuster lock.
6.	Oil reservoir.
7.	Bearing adjuster.
8.	Axle shaft.
9.	Bearing adjuster lock.
10.	Differential case bearing (left side).
11.	Bearing cap.
12.	Differential case (left side).
13.	Differential side gear thrust washer.
14.	Differential side gear.
15.	Differential case capscrew.
16.	Differential gear thrust washer.
17.	Axle housing.
18.	Differential spider.
19.	Herringbone gear.
20.	Differential gear.
21.	Differential side gear.
22.	Differential side gear thrust washer.
23.	Differential case (right side).
24.	Bearing cap.
25.	Bearing adjuster lock.
26.	Axle shaft.
27.	Gasket.
28.	Bearing adjuster.
29.	Differential case bearing (right side).
30.	Differential carrier.
31.	Differential gear.
32.	Differential gear thrust washer.
33.	Bearing adjuster.
34.	Bearing.
35.	Bearing cover.
36.	Oil dam.
37.	Bearing cover gasket.
38.	Vent.
39.	Herringbone countershaft gear.

Rear Axle

Rear axle is full floating, double reduction type with alloy steel axle shafts and cast one-piece type of housing. The first reduction gears are spiral bevel and second reduction heavy-duty herringbone.

Bevel Gear Reduction

Bevel drive pinion is mounted on opposed type of taper roller bearings in an adjustable cage, forming a complete assembly at front of carrier. Bevel gear is securely mounted on cross shaft, the drive being taken by splines at center of gear and is held in place by cap screws.

Herringbone Gear Reduction

Herringbone pinion is forged integral with cross-shaft, which is carried on taper roller bearings with adjustable nuts provided at each end to permit adjustment for tooth contact.

Herringbone gear is riveted to heat-treated forged steel differential case, and adjustment is made by differential bearing adjusting nuts as described later.

Differential

Differential is conventional four-pinion type with bronze thrust washers back of side gears and pinions. Cases are supported on heavy-duty ball bearings.

Removal of Differential Carrier

Remove plug from bottom of housing and drain out oil. Disconnect propeller shaft at front end of pinion shaft. Remove axle shafts and differential carrier to housing stud nuts, and take out carrier.

Disassembling Differential Carrier

Remove differential side bearing caps and take out differential if it is desired to remove this part.

Disassembly of Differential

Mark each half of cases before tear-down so that they can be reassembled same as before. Wash and inspect all parts and replace any which are at all questionable. Oil all parts with gear oil before reassembly.

To remove cross-shaft and pinion bearing cage, remove carrier bolts which hold two halves of carrier together, remove right hand cross-shaft bearing cover and lift off top half.

Remove cross-shaft and pinion bearing cage. If it is desired to remove pinion bearing cage only, this can be done by loosening check nut and unscrewing cage from carrier without disturbing carrier assembly.

Disassembling Pinion Bearing Cage

Before disassembly of pinion bearing cage, check to see if any bearing wear has developed. This can be determined by trying pinion for end play. Hold bevel pinion in vise jaws, being careful not to mar or distort teeth and remove pinion shaft nut and washer.

Press flange off spline and remove pinion from cage assembly. (Do not lose shims.)

Clean all bearings and inspect all parts to see if in satisfactory condition for continued service.

Inspect oil seal at front end of pinion bearing cage and replace if not in good condition. If either bevel gear or pinion are unfit for service, it is best to replace with a matched set of gears as it is impossible to secure proper tooth contact or obtain quiet gears if only one part is replaced.

Assembly and Adjustment Pinion Bearing Cage

If inspection of cage assembly before tear-down discloses pinion bearing wear, and if same bearings are being replaced, it will be necessary to remove one or more of the thin shims. This can be roughly determined by the amount of end play which has developed in the pinion. If pinion has no end play, the original shims should be used, assuming they are in good condition. Dip pinion bearings in gear oil when assembling, and be sure not to damage oil seal or felt when assembling flange. Pull pinion shaft nut up tightly and check for end play. Pinion should have no end play; a slight preload is permissible. Shims should be removed or added if necessary to obtain this condition.

IMPORTANT: Bevel drive pinion oil seals must be soft and pliable before being installed. If the seals have become dried out and hard while in stock, use kerosene and work it in thoroughly. When seal has become soft and pliable, then dip it in hot oil and work this oil in thoroughly. If the seal has been given the proper oil treatment before installation, prolonged life will be assured.

Differential Carrier Assembly

Paint cross-shaft bearings with gear oil.

Replace cross-shaft and pinion bearing cage in lower half of carrier and position them roughly to secure approximately .008″ or .010″ back lash.

Replace top half of carrier, making sure gaskets are in place and in good condition. Bolt securely in place.

Paint contact surfaces of bevel gear with red lead and turn gear a few revolutions in both directions by hand to show contact.

Bevel Gear Tooth Contact

The proper adjustment of bevel gears in assembly is a vital factor in obtaining quiet and durable gears, and the same methods apply both to straight and spiral bevel type.

There are two distinct considerations in obtaining the proper tooth contact. The first is along the tooth—a lengthwise bearing, the other up and down the tooth—a profile bearing.

Bevel as well as spur gears are cut with a predetermined amount of backlash, depending upon the size or pitch of the teeth and operating conditions, usually varying from .004" to .005" on an eight pitch gear to .012" on a three pitch gear. Generally the gears are machined to run flush with each other at the outer (heel or large) end of the tooth, and gears should be so set for initial trial.

Bevel gears when mounted should show a bearing toward the toe or small end of the tooth, never at the heel or large end, the reason being that it is practically impossible to make gears and gear mounting rigid enough so that there will not be some slight deflection when full load is applied. This always has a tendency to cause the bearing to come on the heel of the tooth and when gears are adjusted so that the bearing is toward the heel of the tooth it results in a concentration of load on the top corner of the heel and breakage will follow.

DRIVE COAST
CORRECT ADJUSTMENT
Fig. 3

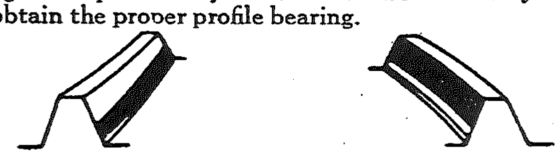
Fig. 3 shows the correct bearing on both drive and coast or reverse side of the tooth. The tooth bearing, both lengthwise and profile of the gear, should appear as shown. The profile bearing should fade out about $\frac{1}{32}$ to $\frac{1}{16}$" from top of gear tooth. Profile of the tooth bearing on the pinion will extend to the top of the tooth.

DRIVE COAST
TOO MUCH TOE BEARING
Fig. 4

Fig. 4 shows too much toe bearing; gear must be moved away from pinion to increase length of bearing. A slight adjustment of pinion may be required to obtain proper profile bearing.

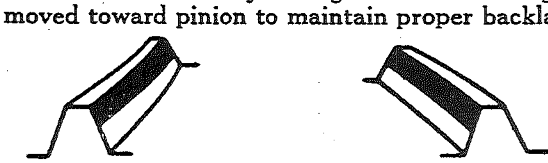
DRIVE COAST
TOO MUCH HEEL BEARING
Fig. 5

Fig. 5 shows heel bearing on both sides of tooth; gear must be adjusted toward pinion. Here again a pinion adjustment will be necessary to obtain the proper profile bearing.



DRIVE COAST
BEARING TOO LOW
Fig. 6

Fig. 6 shows low bearing on the tooth (which may show at any point along tooth). The pinion should be moved away from gear and then the gear moved toward pinion to maintain proper backlash.

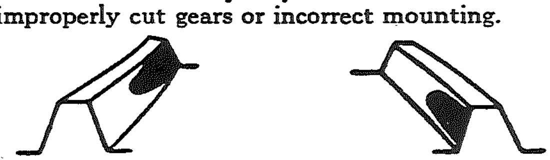


DRIVE COAST
BEARING TOO HIGH
Fig. 7

Fig. 7 shows high bearing on the tooth (which may show at any point along the tooth). The pinion should be moved toward gear and gear moved away from pinion to maintain proper backlash.

Several adjustments will be necessary to obtain both the proper lengthwise and profile adjustment but by watching tooth bearing shown and adjusting as described above, the proper adjustment can readily be obtained.

There are conditions in each case which cannot be taken care of by adjustment but come from improperly cut gears or incorrect mounting.



DRIVE COAST
CROSS BEARING
Fig. 8

Fig. 8 shows a cross bearing. The gears are serviceable if the toe bearing is on the drive side and extends $\frac{5}{8}$ the length of the tooth.

LAME BEARING
Fig. 9

Fig. 9 shows a lame bearing; gears can be adjusted to obtain a good driving condition but poor coast or reverse.

The last cases cited may occasionally be found in making replacement of original equipment.

Gears are adjusted for proper contact at factory and their relative location should never be changed except to overcome gear noises that cannot be traced to other causes, such as improper lubrication or incorrect bearing adjustment affecting backlash of pinion and drive gears. Backlash should be from .003″ to .008″.

To adjust pinion when new gears are installed, obtain a tooth contact impression by painting gears with red lead. Rotate gears and if tooth contact is correct the impression on pinion teeth will begin at toe or small end and extend to approximately ¾ of distance to heel or large end and about equally spaced between top and bottom of tooth (See Figs. 3 to 9).

Make sure that cross-shaft bearings are seated properly and set up without any end play. A slight preload is permissible. See that pinion bearing cage check nut is tightened and locked, also replace countershaft bearing cover on right-hand side. Lock retaining nut at left side of cross-shaft.

Herringbone Gear Adjustment

Replace differential and herringbone gear assembly and position gear central with herringbone pinion, making use of adjusting nuts. Paint a few teeth on gear with red lead and turn gear by hand.

Herringbone gear alignment adjustment should never be altered except after a bevel gear adjustment has been completed and then former adjustment must be effected by means of differential case bearing adjusting rings only.

NEVER ALTER HERRINGBONE GEAR ALIGNMENT BY CHANGING BEVEL DRIVE GEAR SHAFT ADJUSTMENT AS ANY CHANGE ON THIS SHAFT ALSO CHANGES RELATIVE POSITION OF BEVEL GEARS.

Gear adjustments when made necessary by replacement with new parts should first be made at bevel pinion shaft, then all other adjustments for backlash, tooth contact and alignment must follow through both gear reductions in direct relation, one to the other, until final setting of differential case bearing adjusting rings is made.

Herringbone gears are not adjustable for backlash. This clearance is taken into account in the construction and remains constant as long as gears are in proper alignment. Ordinary wear in service or out of alignment condition being only factors likely to affect backlash between gear teeth.

To adjust herringbone gears for alignment and tooth contact it is only necessary that tooth ends of pinion at center cut on gear face are flush with corresponding ends of teeth on drive gear.

Make this adjustment only after bevel drive gear shaft position has been established and then only by shifting differential laterally in either direction until drive gear is in perfect alignment with pinion as described above.

Oil level in differential housing should be maintained to lower edge of oil hole located in housing cover (See "Lubrication Section").

Installing New Herringbone Drive Gear

If new gears are being installed, the pilot diameter on drive gear flange should be checked to see that it runs true with bearing hubs. If inspection indicates a runout exceeding .004″, a new differential case should be installed. When assembling drive gear on face of flange, make sure each rivet is tight. Better results will be obtained if a press is used to install rivets. Riveting of this nature should always be done with cold rivets, using sufficient pressure on the rivet so that when the operation is completed the hole in which the rivet is inserted is entirely filled up.

When hot rivets are used the metal shrinks when cool with the result that the hole is not entirely filled and looseness may develop when torque is applied. A similar condition also results when insufficient pressure is applied to the rivet in cold riveting. Drive gear should run true within .003″ total indicator reading, checking from back of gear and using bearing hubs of case as centers.

After proper tooth contacts have been secured, back off adjusters two notches and lock securely. Side bearing caps should be tight.

Load Test

After securing the proper tooth contact by the bench assembly method a final check under load should be made. This is very important as in many instances the tooth bearing will change due to the load imposed upon the gears.

The complete assembly should be installed in the axle housing, together with axle shafts, wheels, etc. In other words the axle should be built up complete (less rear cover), just as it will be when the chassis is put into its regular operation.

Jack up both rear wheels so they will be free to revolve, then paint the bevel drive teeth with red lead. Start engine and with the service brake applied and transmission in gear, rotate bevel drive gear forward and reverse.

Examine markings on teeth and if necessary readjust bevel drive gear or pinion to secure the proper tooth contact indicated in Figs. 3 to 9.

Vent

A vent is located on top of the bevel drive pinion carrier. This vent must be kept clean and open.

Rear Axle—R-2200, RB-2200, RT-2200, R-2300

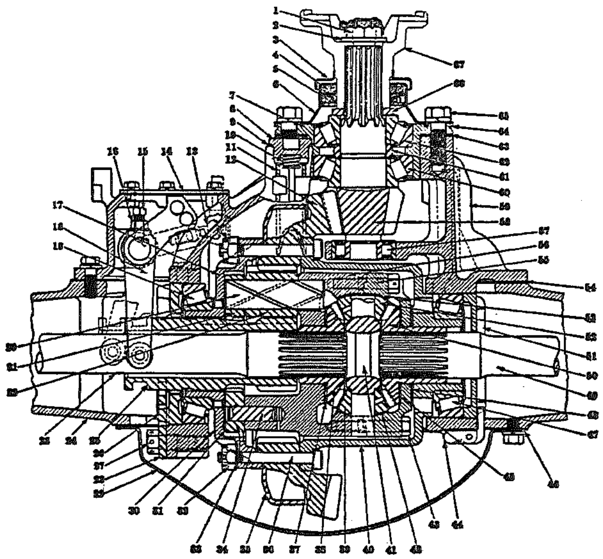


Fig. 1, R-2200, RB-2200, RT-2200, R-2300 Axle

No.	Description
1.	Propeller shaft mounting nut.
2.	Washer.
3.	Companion flange mud slinger.
4.	Pinion shaft oil seal felt.
5.	Pinion shaft oil seal.
6.	Pinion shaft oil seal retainer.
7.	Pinion bearing cage cork.
8.	Oil distributor tube retaining plug.
9.	Gasket.
10.	Oil distributor tube spring.
11.	Oil distributor tube.
12.	Bevel drive gear.
13.	Gear shift rod.
14.	Cover.
15.	Setscrew.
16.	Check nut.
17.	Bevel drive gear support case (left half).
18.	Shifting fork.
19.	Differential roller bearing.
20.	Idler pinion pin.
21.	High speed clutch plate.
22.	Idler pinion.
23.	Axle shaft.
24.	Axle housing.
25.	Sliding clutch.
26.	Differential bearing adjuster (left side).
27.	Capscrew.
28.	Differential bearing adjuster lock (left side).
29.	Axle housing cover.
30.	Bevel drive gear support case (left half).
31.	High speed clutch plate thrust washer.
32.	Nut.
33.	High speed clutch plate.
34.	High speed clutch plate pin.
35.	Oil collector drum.
36.	Capscrew.
37.	Differential side gear thrust washer.
38.	Differential side gear.
39.	Differential spider pinion.
40.	Bevel drive gear support case (right half).
41.	Differential spider.
42.	Differential spider pinion thrust washer.
43.	Capscrew.
44.	Differential bearing adjuster lock (right side).
45.	Differential side gear thrust washer.
46.	Axle housing cover gasket.
47.	Differential roller bearing.
48.	Bevel drive gear support case thrust washer.
49.	Axle shaft.
50.	Differential side gear.
51.	Differential bearing adjuster (right side).
52.	Differential spider pinion.
53.	Differential spider pinion thrust washer.
54.	Differential carrier to housing gasket.
55.	Differential case (right half).
56.	Differential case (left half).
57.	Pinion shaft inner roller bearing.
58.	Bevel drive pinion.
59.	Differential carrier.
60.	Pinion shaft outer bearing.
61.	Pinion shaft outer bearing spacer.
62.	Pinion shaft outer bearing.
63.	Pinion bearing cage shim.
64.	Pinion bearing cage.
65.	Pinion bearing cage capscrew.
66.	Pinion bearing washer.
67.	Companion flange.

Rear Axle

The two-speed rear axle is a full floating, spiral bevel drive type, having four planetary gears which mesh with an internal gear on the bevel drive gear. The planetary gears in turn also mesh with a sliding clutch which is moved in or out to lock or unlock the reduction gear mechanism.

This axle has a one-piece banjo type housing with a four-pinion differential and straddle-mounted bevel drive pinion.

Operating Instructions

The two-speed axle is controlled by a conveniently placed gear shift lever. There are two positions for this lever, forward and back. In the forward position the truck operates as a high speed truck in direct drive and all transmission gear ratios. In the back position the truck operates as a powerful low speed truck in direct drive and all transmission gear ratios.

In order to obtain the greatest efficiency and best performance from trucks equipped with the two-speed axle it is important that the driver know two things:

First —How to use it.
Second—When to use it.

Definite instructions can be given as to how the axle gears should be shifted. However, when to shift to the best advantage can be determined by applying good driving practices along with the instructions given below.

After the driver has operated the truck equipped with this axle for a short time, its operation will become just as natural as that of driving a truck equipped with a conventional axle.

Shifting Speed

It is impossible to specify any vehicle speed at which axle gears can be shifted to best advantage on every truck, because of the many varying conditions under which the truck operates. Road and load condition, as well as different transmissions and axle ratios, must all be taken into consideration.

The speed at which gears can be shifted to best advantage is referred to hereafter as "SHIFTING SPEED."

LOW to HIGH SHIFTING SPEED is reached when gears can be shifted to higher ratio without loss of speed under existing road and load conditions.

HIGH to LOW SHIFTING SPEED is reached when road and load conditions will cause engine to slow down perceptibly. This gear shift should be made before engine starts to labor. Allowing the engine to "lug" along in higher ratios puts undue strain on entire drive line, particularly the engine and clutch. Shift from high to low ratios should be made while engine is still running fast enough to develop a high torque.

LOWER RATIOS ARE provided TO BE USED when necessary, and the BEST DRIVERS SHIFT INTO THESE RATIOS when they are required for most efficient truck operation.

Starting A Loaded Vehicle

Upon starting a heavily loaded vehicle, particularly on an up grade, always move the axle gear shift lever back into low and leave it in this position until shifting speed has been reached. Rear axle should then be shifted into high.

Shifting Into High

When the driver places the shift lever in the forward position the four planetary gears or idler pinions are in the LOCKED POSITION, turning as part of the differential. The truck then operates as a HIGH SPEED truck in all transmission gears.

The shift into high axle gear is accomplished by RELEASING the clutch and moving the axle shifting lever forward as far as possible.

Shifting Into Low

When the driver places the shift lever in the back position the four planetary gears or idler pinions are in the UNLOCKED POSITION, allowing them to rotate around the locking gear, thereby making a silent reduction of axle speed and the truck operates in all transmission gears as a powerful LOW SPEED truck.

When a long hill or heavy going slows the truck down, before the engine starts to labor, in order to maintain speed without undue stress on engine and other driving units, the best manner of shifting under this condition depends upon the speed at which the truck is moving.

At low speeds, it is possible to do this by RELEASING THE CLUTCH and snapping the axle control lever back as quickly as possible—the quicker the better. Generally, however, this shift should be made by double clutching.

To double clutch, release the clutch and move the axle control lever half way back, holding it in this neutral position while the clutch is reengaged and the engine accelerated so that when the clutch is again disengaged and the control lever moved back to "low," the speed of the engaging members in the rear axle will be synchronized.

Power and Road Speed

To maintain power and road speed, it is usually advisable to leave the axle gears in low position until shifting speed is attained with the transmission in high gear. This is the best time to shift into the high axle ratio.

Increased Power

If more power is desired at the wheels while the truck is being operated in "high-high" with both transmission and rear axle in high gears, axle should be shifted to the low ratio.

Slow Speed Operation

When operating in congested city traffic or hauling heavy loads over rough roads, it may be found much more convenient to leave axle control lever in the low position than it will to shift the transmission into second or low speeds.

Neutral

Never "coast" with axle control lever in neutral position. Since there is no definite neutral position for this lever, vibration or road shock may cause it to move forward or back far enough to engage the gears, which under such conditions would cause a terrific shock to the parts and result in a major failure.

Successive Gear Changes

When the driver becomes thoroughly familiar with the use of the dual performance rear axle he will know which transmissions and axle gear combinations give the best truck performance under all conditions.

With the two-speed axle there are twice as many final gear ratios available as there are gear changes in the transmission. The progressive ratios with four-speed main transmission are shown below, starting with the lowest ratio available.

Transmission	Axle Gears
Low	Low Range
Low	High Range
Second	Low Range
Second	High Range
Third	Low Range
Third	High Range
Fourth	Low Range
Fourth	High Range

Lubrication System

Lubrication of the two-speed axle is simple and requires no more attention than should be given the standard axle. The housing enclosing the bevel gears, differential, and planetary gears serves as a reservoir for oil which by a dual system of circulation lubricates all moving parts of the axle. The bevel gear runs through the oil which lubricates the teeth of the gear and pinion. The differential is lubricated by means of a collector drum which, running in the oil, raises it to a spring-loaded distributor tube from whence it is carried by gravity through a channel into and through the right-hand differential bearing. From this point it is circulated through the differential and eventually returned to the axle housing through the left-hand differential bearing.

In addition, lubricant is collected on a shelf by splash and diverted into the same channel and through the differential, so that if for any reason an axle is repaired and any or all of the positive lubrication system is left out, it will still be lubricated by the conventional method.

Disassembly

With the complete differential carrier removed from the axle, all parts can easily be disassembled by following the instructions below.

Removal of Bevel Drive Gear and Differential Unit

(a) Remove oil distributor tube plug, spring, capscrew and tube.
(b) Take off shifter fork cover plate and remove plunger nut and spring assembly, setscrew and check nut.
(c) Disassemble shifter lever arm, fork and spacer and remove sliding clutch.
(d) Remove differential bearing adjusters, caps and bearings. The bevel drive gear, oil collector drum, planetary gear and differential unit may now be removed. It may be necessary to turn the unit so the nuts will clear.
(e) Take out capscrews and pry left-hand support case from bevel drive gear. Take off oil collector drum, then lift entire planetary and differential unit from right-hand support case.
(f) Disassemble pins, pinions and high speed clutch plate. Remove bevel drive gear from right-hand support case and thrust washers from right and left-hand support cases.
(g) Remove capscrews and pry differential cases apart. Disassemble side gears, spider, pinions and thrust washers.

Removal of Bevel Drive Pinion

(a) Take off propeller shaft mounting nut and remove companion flange and mud slinger.
(b) Remove pinion bearing cage capscrews and take off oil seals and retainer.
(c) Lift out bevel drive pinion and cage and disassemble.

Reassembly

Assembly of Bevel Drive Gear and Differential Unit

(a) When reassembling the differential, see that the chamfer in the thrust washers is next to the radius at the side gear hubs. Both sides of the washers should be thoroughly lubricated.
(b) Assemble differential, installing the four short capscrews between the spider arms. Tighten and wire all capscrews securely.
(c) Assemble bevel drive gear to right-hand support case, using two bolts to properly line up holes.
(d) Lubricate right-hand thrust washer and place it over hub of right-hand differential side gear, chamfer to radius.
(e) Place differential in right-hand support case and assemble the four planetary gears and pins, first making sure they are well lubricated. Also see that the pins are installed with the oil holes out.
(f) Install high speed clutch plate with chamfered teeth facing planetary pinions.
(g) Lubricate high speed clutch plate thrust washer and place it in left-hand support case.
(h) Assemble oil collector drum to bevel drive gear, placing the notches between the bolt holes, then place left-hand support case over oil drum and bolt the assembly together, tightening and wiring the nuts securely.
(i) Place complete assembly in carrier. It may be necessary to turn slightly so nuts will clear. Assemble bearing caps and adjusters but do not tighten until proper tooth contact between bevel drive gear and pinion has been secured.

Assembly of Bevel Drive Pinion

An outside or bench assembly should be made of bevel pinion, bearings and cage. With cups assembled in cage, assemble the pinion and inner bearing cone and roller assembly in place, using the proper spacer to space the pinion bearings. Next assemble the outer pinion bearing cone and rollers, spacer, companion flange, washer and nut.

NOTE: Do not install pinion bearing oil seal until all adjustments have been completed.

Check bearing fit to see that bearings have no end movement with flange nut drawn up tight. To secure this fit, proper spacer must be found by trial as follows:

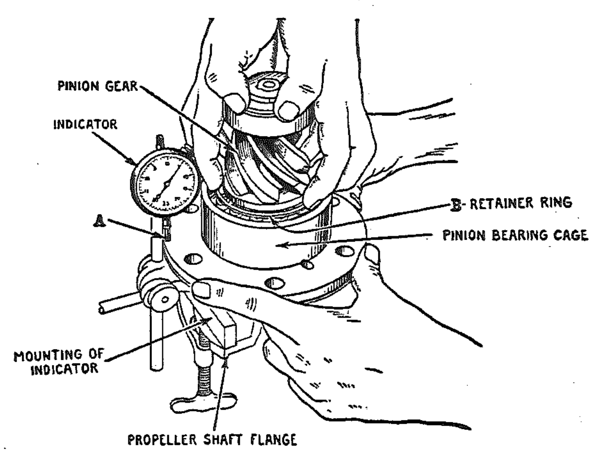


Fig. 2, Checking End Play of Pinion Bearing

(a) Place assembly in vise in position shown.

(b) Mount indicator on propeller shaft flange with indicator finger resting on upper face of cage. (See A in sketch.)

(c) With the tips of the fingers, grasp the bearing retainer and work bearings up against the back face of pinion. (See B in sketch.)

(d) With the bearings held firmly against the pinion, move the cage up and down, observing the indicator reading. It is impossible to accurately determine the end play unless the bearing is worked loose and up against the pinion. Assemblies having as much as .005″ end play cannot be moved enough to show on the indicator until the bearing has been worked up and away from the cup.

Preload the pinion bearings by replacing the spacer between the pinion bearings with one smaller to the extent of the amount of the end play plus .002″ for the loading. For example, should there be .005″ end play as indicated in the sketch in the assembly, replace the spacer with one .007″ smaller. Do not depend upon the spacers to be right according to number but check each and every one with an accurate micrometer. Before reassembling the bearings to the pinion shaft they should be dipped in rear axle lubricant. Propeller shaft flange nut must be pulled down securely to assure tight bearings. A wrench with 30″ of leverage should be used.

In order to determine if insufficient or excessive preload has been applied, make the following test:

(a) Place assembly in vise with jaws clamping together on the flange of the pinion bearing cage and with assembly in a horizontal position.

(b) Grasp the propeller shaft flange with one hand and attempt to turn.

(c) If the pinion turns freely, assembly is too loose. If pinion cannot be turned, assembly is too tight.

(d) The ideal condition is for the pinion to require full hand pressure to move it a ¼ turn.

After proper bearing fit has been obtained, place pinion bearing cage shims approximately .020″ in thickness over end of cage and place cage and pinion assembly in carrier, it being necessary to match flange holes in cage, since one hole is out of equal spacing to assure proper position of cage. Next assemble two cage bolts only until gear setting is completed.

Bevel Gear Adjustment

The proper adjustment of bevel gears in assembly is a vital factor in obtaining quiet and durable gears, and the same methods apply both to straight and spiral bevel type.

There are two distinct considerations in obtaining the proper tooth contact. The first is along the tooth—a lengthwise bearing, the other up and down the tooth—a profile bearing.

Bevel as well as spur gears are cut with a predetermined amount of backlash, depending upon the size or pitch of the teeth and operating conditions, usually varying from .004″ to .005″ on an eight-pitch gear to .012″ on a three-pitch gear. Generally the gears are machined to run flush with each other at the outer (heel or large) end of the tooth, and gears should be so set for initial trial.

Bevel gears when mounted should show a bearing toward the toe or small end of the tooth, never at the heel or large end, the reason being that it is practically impossible to make gears and gear mounting rigid enough so that there will not be some slight deflection when load is applied. This always has a tendency to cause the bearing to come on the heel of the tooth and when gears are adjusted so that the bearing is toward the heel of the tooth it results in a concentration of load on the top corner of the heel and breakage will follow.

Fig. 3

Fig. 3 shows the correct bearing on both drive and coast or reverse side of the tooth. The tooth bearing both lengthwise and profile of the gear, should appear as shown. The profile bearing should fade out about $\frac{1}{32}$ to $\frac{1}{16}$″ from top of gear tooth. Profile of the tooth bearing on the pinion will extend to the top of the tooth.

Fig. 4

Fig. 4 shows too much toe bearing; gear must be moved away from pinion to increase length of bearing. A slight adjustment of pinion may be required to obtain the proper profile bearing.

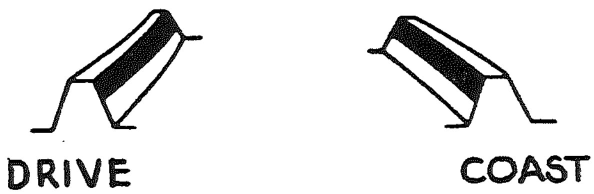
Fig. 5

Fig. 5 shows heel bearing on both sides of tooth; gear must be adjusted toward pinion. Here again a pinion adjustment will be necessary to obtain the proper profile bearing.

BEARING TOO LOW

Fig. 6

Fig. 6 shows low bearing on the tooth (which may show at any point along tooth). The pinion should be moved away from gear and then the gear moved toward pinion to maintain proper backlash.



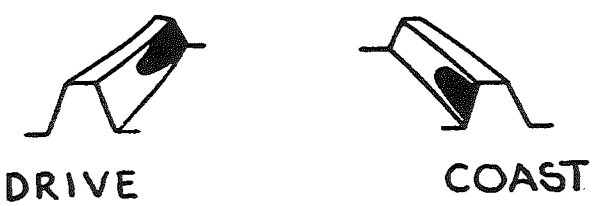
BEARING TOO HIGH

Fig. 7

Fig. 7 shows high bearing on the tooth (which may show at any point along the tooth). The pinion should be moved toward gear and gear moved away from pinion to maintain proper backlash.

Several adjustments will be necessary to obtain both the proper lengthwise and profile adjustment but by watching tooth bearing shown and adjusting as described above, the proper adjustment can readily be obtained.

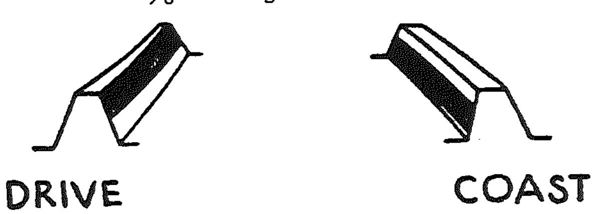
There are conditions in each case which cannot be taken care of by adjustment but come from improperly cut gears or incorrect mounting.



CROSS BEARING

Fig. 8

Fig. 8 shows a cross bearing. The gears are serviceable if the toe bearing is on the drive side and extends ⅝ the length of the tooth.



LAME BEARING

Fig. 9

Fig. 9 shows a lame bearing; gears can be adjusted to obtain a good driving condition but poor coast or reverse.

The last cases cited may occasionally be found in making replacement of original equipment.

Tighten bearing cap bolts and back off slightly to provide sufficient looseness to allow turning the adjuster for a temporary backlash adjustment of approximately .010″. After this adjustment has been made, tighten each bearing adjuster snug, then give them a final tightening operation, drawing them up a notch or notch and a half. This is important in order to make certain that the bearings are seating properly.

Paint bevel gear with red lead and rotate to to secure proper bearing on teeth. If this is not what is desired, cage shims will have to be added or removed as the case may be. Backlash should run from .003″ to .008″. The movements necessary to obtain correct tooth contact are shown in Figs. 3 to 9.

After all adjustments have been made a new pinion bearing oil seal assembly must be installed. Replace companion flange and make sure that nut is tight and properly secured with a cotter pin. **IMPORTANT**—Bevel drive pinion oil seals must be soft and pliable before being installed. If the seals have become dried out and hard while in stock, use kerosene and work it in thoroughly. When seal has become soft and pliable, dip it in hot oil and work this oil in thoroughly. If the seal has been given the proper oil treatment before installation, prolonged life will be assured.

The adjuster locks should be installed and the bearing capscrews tightened and wired securely. Next assemble the sliding clutch and shift mechanism as well as the oil collector tube parts.

Load Test

After securing the proper tooth contact by the bench assembly method a final check under load should be made. This is very important as in many instances the tooth bearing will change due to the load imposed upon the gears.

The complete assembly should be installed in the axle housing, together with axle shafts, wheels, etc. In other words, the axle should be built up complete (less rear cover), just as it will be when the chassis is put into its regular operation.

Jack up both rear wheels so they will be free to revolve, then paint the bevel drive teeth with red lead. Start engine and with the service brake applied and transmission in gear, rotate bevel drive gear, forward and reverse.

Examine markings on teeth and if necessary readjust bevel drive gear or pinion to secure the proper tooth contact indicated by Figs. 3 to 9.

Gear Shift Lever Connections

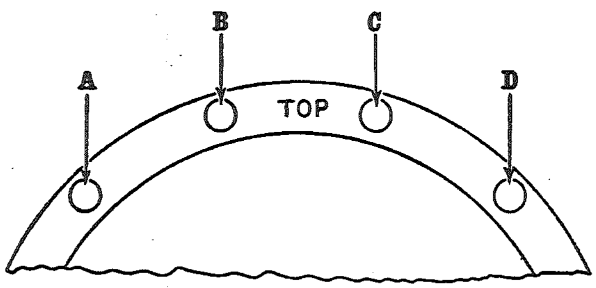
The only adjustment required for the gear shift lever connections is to see that the rods are properly adjusted, by means of the adjustable yokes, so that when the lever is shifted either forward or back, the sliding clutch in the rear axle will make positive engagement in high or low gear.

Speedometer Adapter for Low Gear

In order to provide a correct speedometer reading when the rear axle is shifted into low gear, an adapter is used. When the axle is shifted into low gear, the adapter is also shifted by means of a wire control which is attached to the adapter and the gear shift mechanism.

With the gear shift lever in the neutral position set the wire control clamps so there is approximately $\frac{1}{32}''$ clearance with the adapter shift lever in the neutral position.

It is important, when shifting either forward or back, that the speedometer adapter wire control be in proper adjustment.



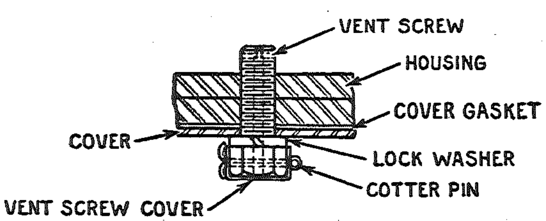


Fig. 10

Axle Housing Vent Screw

When the lubricant in the rear axle becomes warm it expands to a certain extent and in order to prevent leakage at the wheel bearings and relieve the pressure that is built up, one of the axle housing cap screws is drilled to provide a vent. This air vent must be installed at the location "C" as indicated in Fig. 10.

The vent should be kept open and clean. Remove the cap, which is held on with a cotter pin and take out the cap screw. Wash all pieces thoroughly in cleaning solution and reassemble to axle. Always be sure to replace this vent in the proper location.

Axle Mounting
Trailing and Four-Wheel Drive

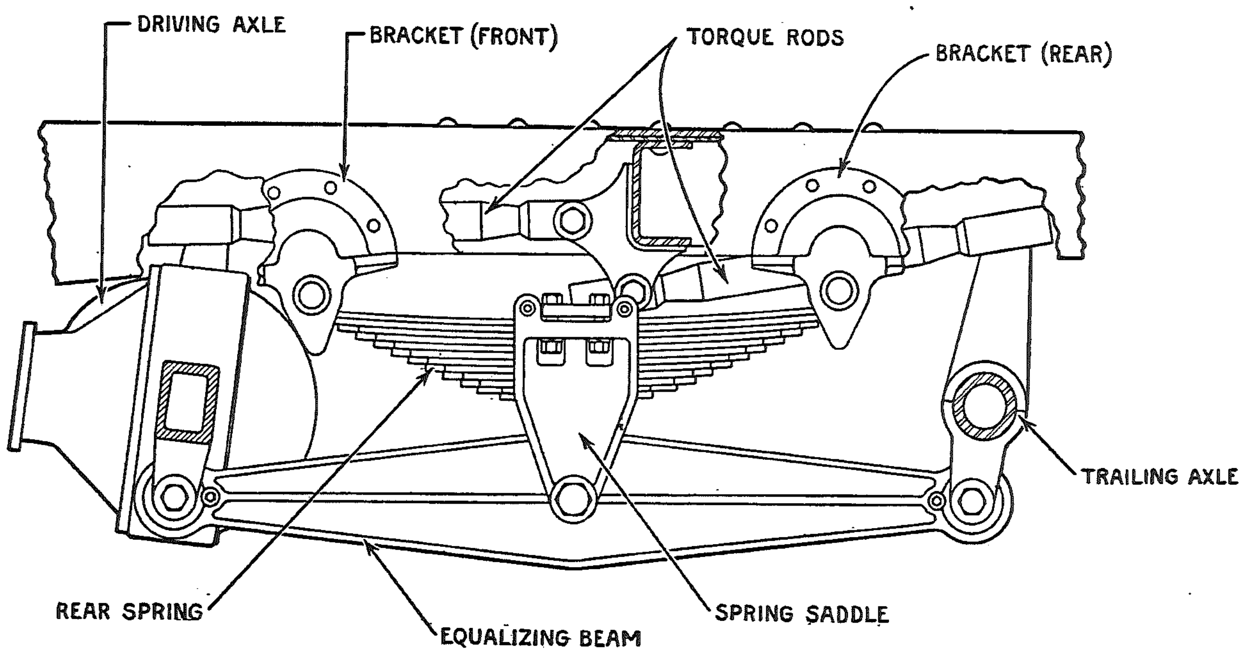


Fig. 1, D-186T, DS-186T, D-216T

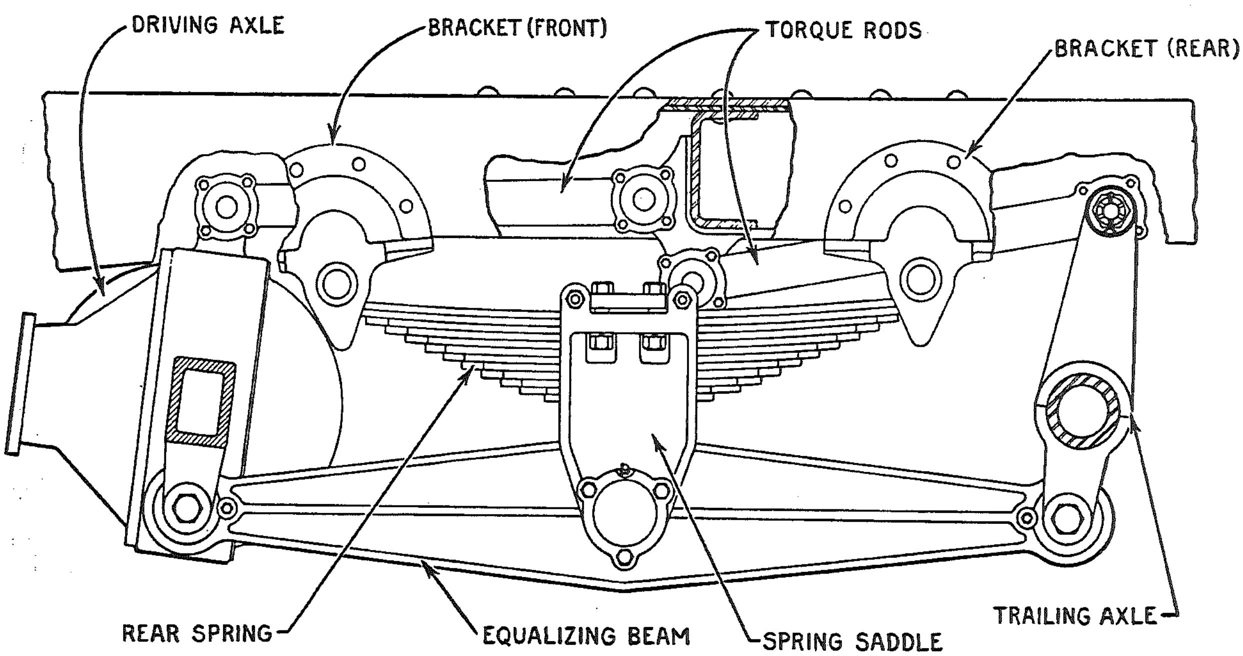


Fig. 2, D-246T, DR-346T

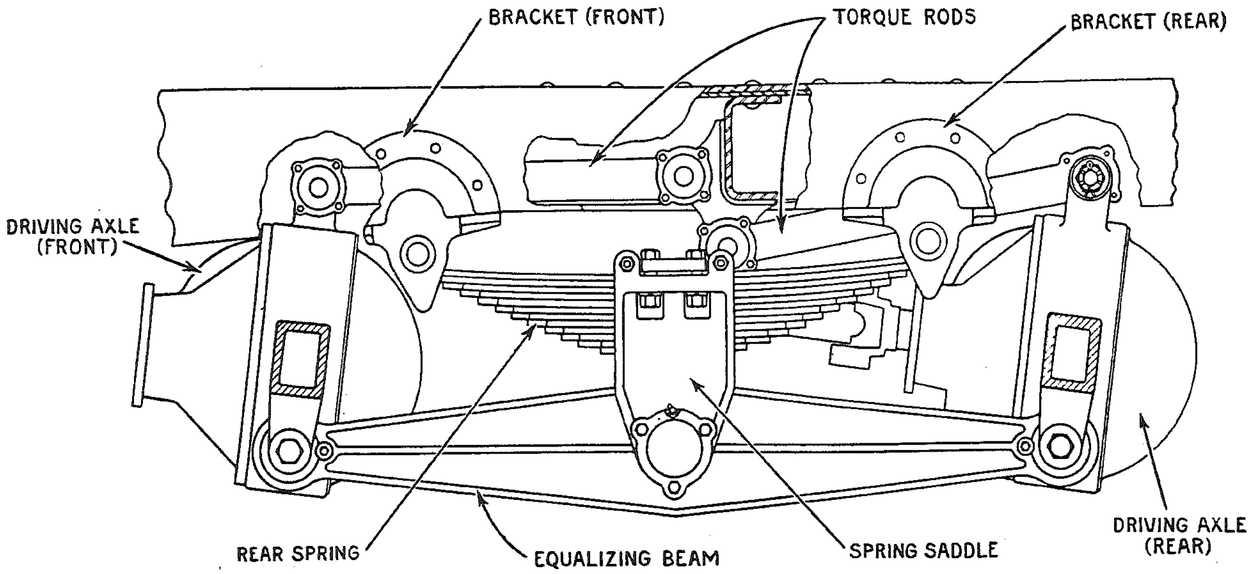


Fig. 3, D-246F, D-346F

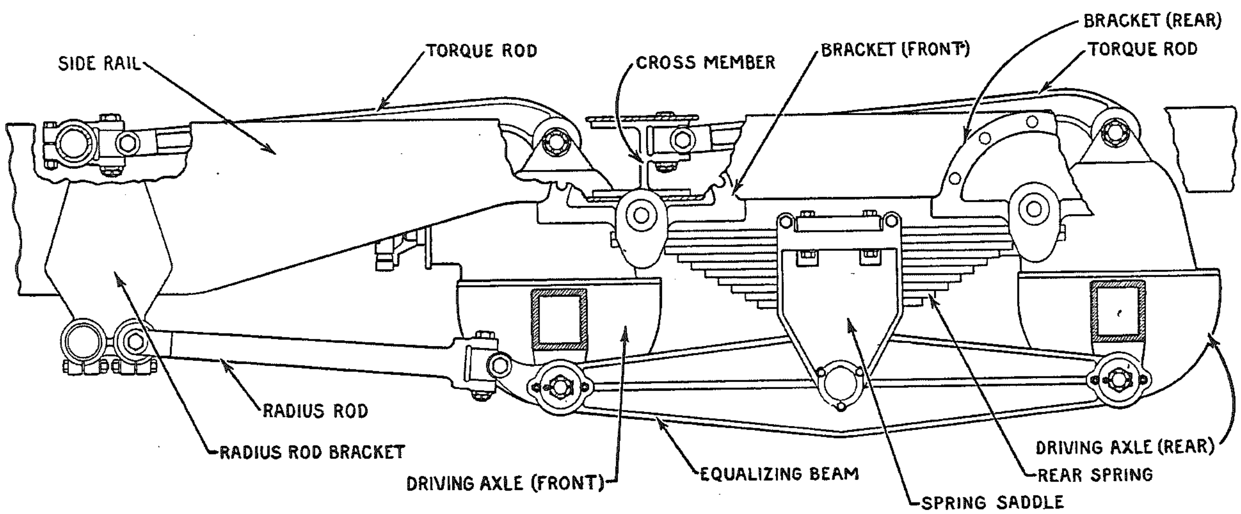


Fig. 4, DR-426F

Rear Axle Mounting

Figures 1, 2, 3 and 4 illustrate the rear axle mounting for the various six-wheel chassis.

Equalizing beams, pivoted at each end with ball and socket joints, are attached to each of the rear axles. The frame is supported on semi-elliptic springs, carried on saddles which are in turn pivoted to the center of the equalizing beams.

Torque and radius rods pivoted with ball and socket joints and attached to the rear axles and cross members, prevent the rear axles from tilting forward or backward.

A thrust yoke and tube assembly attached to the spring saddles assists in keeping the entire unit parallel.

Equalizing Beam and Spring Saddle

Two types of construction are utilized for the center mounting of the equalizing beam to the spring saddle. In Fig. 5 is shown the center assembly for the lighter six-wheel models.

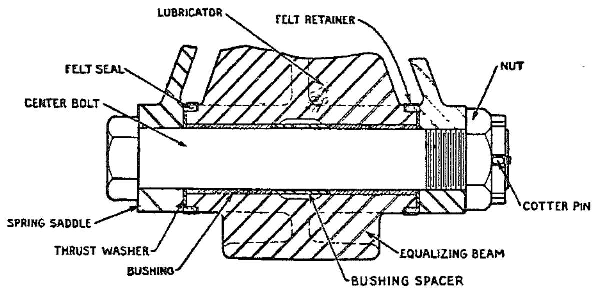


Fig. 5, D-186T, DS-186T, D-216T

In this construction (Fig. 5) a center bolt is used. Two bronze bushings, separated by a steel spacer, are pressed into the equalizing beam, and thrust washers are installed between the spring saddle and beam. Oil seals are assembled at each side to prevent loss of lubricant and to seal against dirt working into the bushings. Center bolt bushings are line-reamed to 1.505—1.506″.

Adjust center bolt nut so that equalizing beam can be moved **freely.** No looseness should exist, neither should there be an **excessive drag.** If nut is drawn up too tight, binding and rapid wear of the thrust washers will occur.

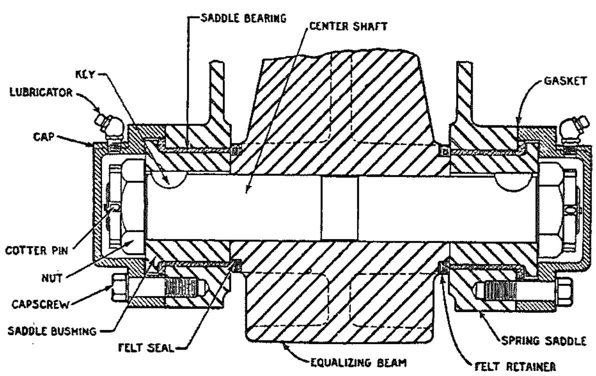


Fig. 6, D-246T, D-246F, DR-346T, D-346F, DR-426F

The construction of the equalizing beam center mounting for the heavy duty six-wheel models is shown in Fig. 6. A bronze bearing is pressed into each side of the spring saddle and steel saddle bushings are keyed to the center shaft, which is threaded at each end to take a castellated nut.

To disassemble this unit, remove both inside and outside saddle bearing caps, then remove cotter pins and nuts from the center shaft.

Tap the center shaft thru the beam just enough so that one key can be removed, then knock the shaft out thru the opposite side. After the center shaft is removed, the steel saddle bushings can be slipped out and the bronze bearings removed.

When reassembling be sure to install the felt seals and retainers on each side of the equalizing beam before assembling the beam to the spring saddle. Also make sure that the steel saddle bushings are locked on the center shaft by keys.

Tighten center shaft nuts **securely** and **lock** with cotter pins. The steel saddle bushings **must be drawn up tight** against equalizing beam.

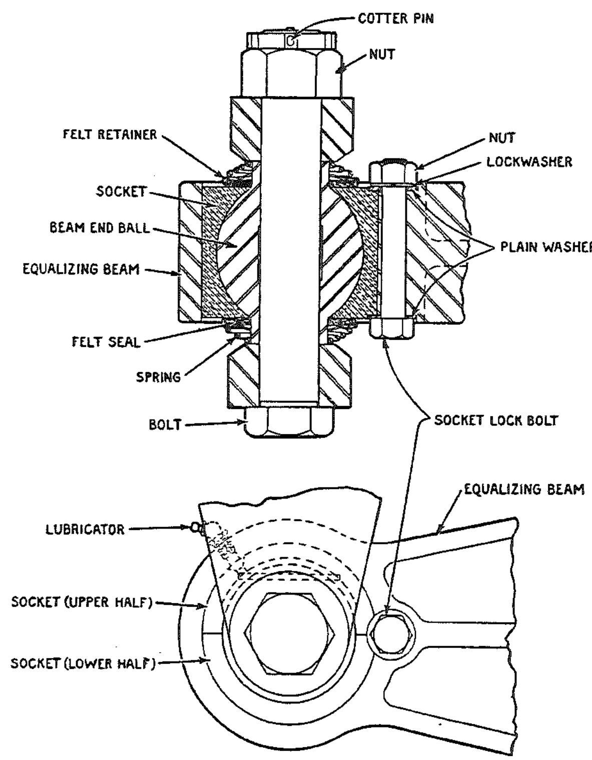


Fig. 7, D-186T, DS-186T, D-216T, D-246T, D-246F, DR-346T, D-346F

Equalizing Beam Ends

Equalizing beam end construction is shown in Figs. 7 and 8. The beam end ball is supported in a two-piece bronze socket which is pressed into the beam end. Lock bolts prevent the sockets from moving and felt seals with spring retainers are used to guard against leakage of lubricant and entrance of dirt.

When replacing a socket or ball, assemble both halves of the socket to the ball and press the assembly into the beam end. Make sure that the grease hole in the socket indexes with the lubricator hole in the beam end—**this is very important.** Both sides of the socket must be counterbored flush with counterbore in beam so that the socket lock bolt and plain washers will prevent the socket from shifting.

Install felt seals and spring retainers before assembling the beam end to the bracket. The beam end bolt nut should be drawn up as **tight as possible** and **securely locked** with a cotter pin.

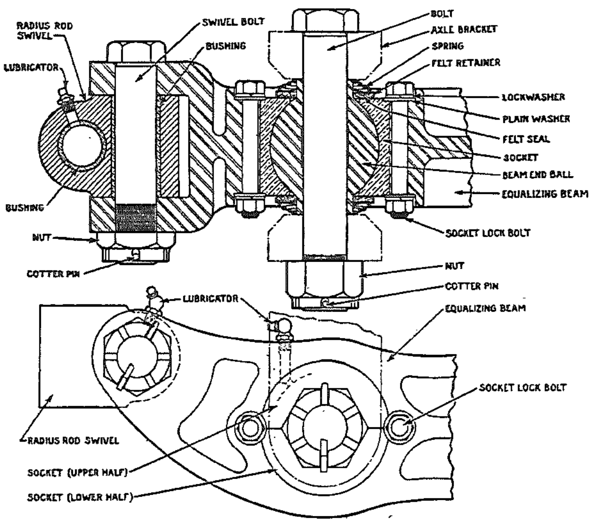


Fig. 8, DR-426F

Thrust Yokes and Tubes

The various assemblies of the thrust yokes and tubes are shown in Figs. 9, 10 and 11. All tubes are locked by a capscrew in the left hand thrust yoke and float in the right hand thrust yoke. Lubrication of the thrust yoke tube (right hand side) is important in order to assure free movement.

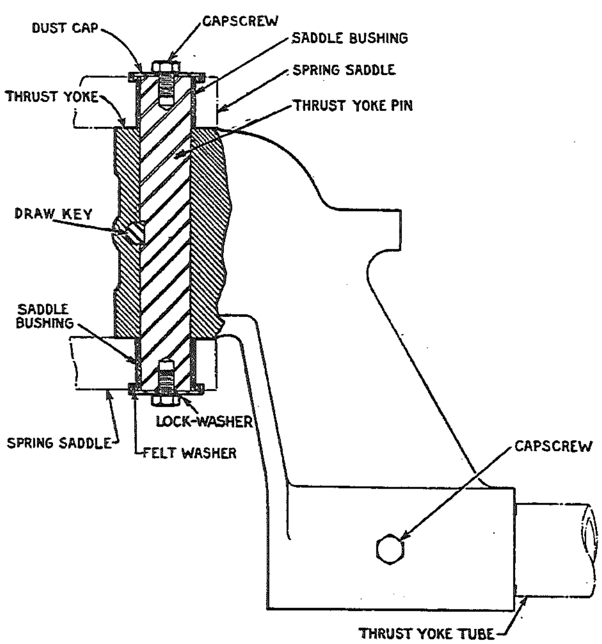


Fig. 9, D-186T, DS-186T, D-216T, D-246T, D-246F

In the construction shown in Fig. 9, the thrust yoke pin is held securely in the thrust yoke by a draw key. Be sure that this key is drawn up **as tight as possible,** otherwise the hole will become enlarged due to wear, necessitating replacement of the thrust yoke and pin.

Bronze bushings are pressed into the spring saddle and must be line-reamed to 1.125—1.126". After installing new bushings and thrust yoke pin, be sure to replace the felt washers, dust caps and capscrews.

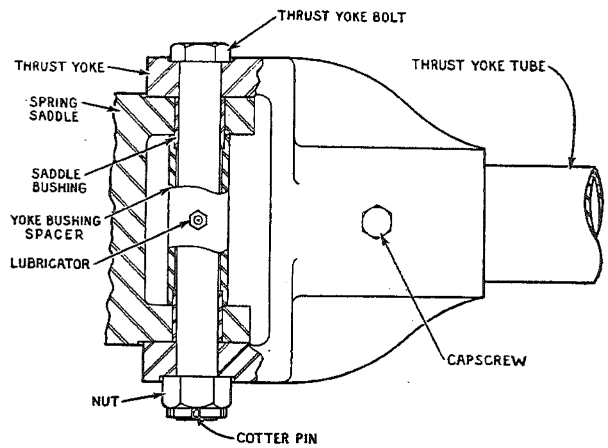


Fig. 10, DR-346T

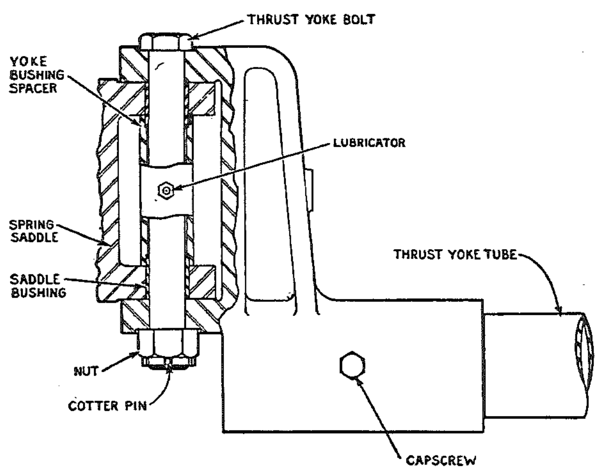


Fig. 11, D-346F, DR-426F

Figs. 10 and 11 illustrate the construction of the thrust yokes for the heavier six-wheel models. A thrust yoke bolt is used which must be **locked securely** with a castellated nut and cotter pin. **Do not tighten the nut excessively**—the thrust yoke assembly should **move freely.** Adjustment should be made so there is only a **perceptible drag.**

Steel bushings, in conjunction with a steel spacer, are used. When installing new bushings be sure that the spacer is properly centered so that the bushings will enter the counterbore in each end.

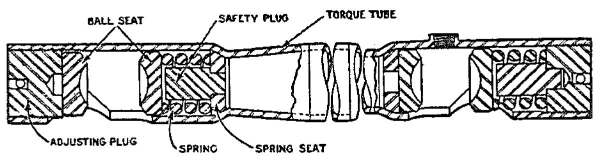


Fig. 12, D-186T, DS-186T, D-216T

Torque Rods

Fig. 12 illustrates the drag link type torque rods used on the lighter six-wheel models. Correct assembly of the ball and spring seats, springs and safety plugs is clearly shown.

Adjustment is made by removing cotter pin and turning adjusting plug in the desired direction. To adjust for wear, turn adjusting plug in until it is tight, then back off one-half turn. Insert a new cotter pin of the correct size and bend ends over **securely.** The ball joint should move with only a **perceptible drag.**

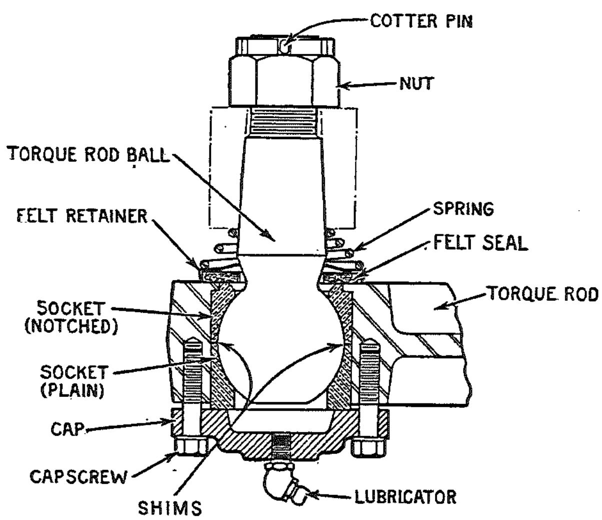


Fig. 13, D-246T, D-246F, DR-346T, D-346F

The torque rod end assembly used on some of the heavier six-wheel models is illustrated by Fig. 13. Shims are used between the notched and plain halves of the ball socket to provide proper adjustment.

To disassemble, remove the torque rod ball cap, then tap the torque rod near the bronze socket and the plain half socket will slip out. The ball stud nut should then be removed and the ball stud driven out. With the plain half socket and ball stud removed, knock out the notched half socket.

Reassembly is accomplished in the reverse manner. Press notched half of socket into torque rod, then insert the ball stud. Install shims (approx. .035″) and insert plain half socket. Assemble cap and tighten capscrews **securely.** Check movement of ball stud using a piece of tubing about 16″ long as a lever. If ball stud moves too freely, remove a .005″ shim and if too tight install another .005″ shim. Only a **slight drag** should be felt.

Be sure that felt seal retainer and spring are replaced to prevent leakage of grease and entrance of dirt.

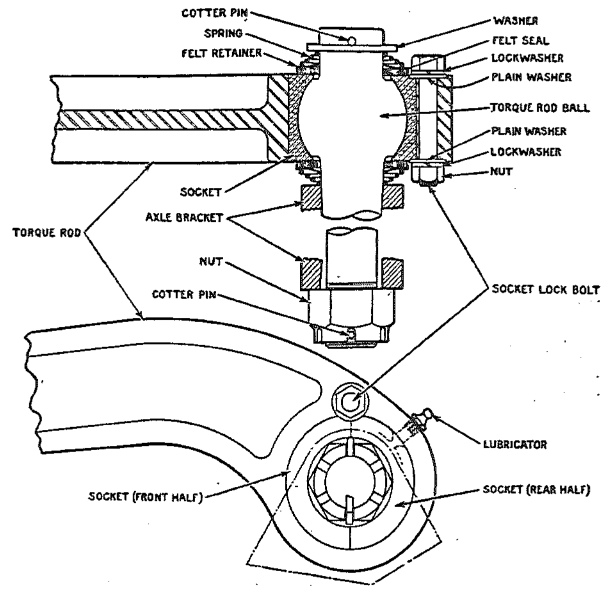


Fig. 14, DR-426F

Fig. 14 shows another type of torque rod end assembly. This is very similar to the construction of the equalizing beam ends.

The torque rod ball stud is supported in a two-piece bronze socket which is pressed into the torque rod end. A lock bolt prevents the two halves of the socket from moving and felt seals with spring retainers guard against leakage of lubricant and entrance of dirt.

When replacing a socket or ball, assemble both halves of the socket to the ball and press the assembly into the torque rod end. Make sure that the grease hole in the socket indexes with the lubricator hole in the torque rod end—**this is very important** Both sides of the socket must be counterbored flush with counterbore in torque rod end so that the socket lock bolt and plain washers will prevent the socket from shifting.

Install felt seal, retainer, retainer spring, washer and cotter pin on one side as illustrated and install seal and retainers on opposite side before assembling the torque rod end to the bracket.

Test movement of the ball stud using a piece of tubing approximately 16″ long as a lever. Only a **slight drag** should be felt.

The forward ends of the torque rods are attached to swivels by special swivel bolts. The swivels in turn are attached to swivel supports mounted on a cross member and cross tube. Bronze bushings are pressed into the swivels and reamed to 1.125—1.126″. The swivel bolts should be tightened just enough to provide a good snug fit of the swivels. Swivels should be **free to move** with only a **perceptible drag.** Lock the swivel bolts with nut and cotter pin. The swivel support should be **securely clamped** to the cross tube.

Radius Rods

Radius rods are used on the Model DR-426F only (see Figs. 4 and 8). These radius rods are attached to swivels at the forward ends of the equalizing beams. The front ends of the radius rods. are attached to ball and socket joints in hangers on either side of the frame.

The swivel at the beam end of the radius rod is equipped with bronze bushings which are reamed to 1.249—1.251" after they are pressed in. Special swivel bolts are used which should be tightened just enough to provide a snug fit of the swivel. The swivel should be free to move with only a **perceptible drag.** Lock the swivel bolts with nut and cotter pin.

The ball and socket construction at the forward end of the radius rod is similar to that used for the beam end. A split bronze socket and steel ball are used with lock bolts to prevent the socket from shifting. Felt seals with spring retainers on either side of the radius rod guard against leakage of lubricant and entrance of dirt.

As in the case of the beam end, both halves of the socket should be assembled to the ball and the assembly inserted in the hanger. Make sure that the grease hole in the socket indexes with the lubricator hole in the hanger—**this is very important.** Both sides of the socket must be counterbored flush with counterbore in hanger so that the socket lock bolt and plain washers will prevent the socket from shifting.

Install felt seals and spring retainers before assembling the radius rod to the hanger. The radius rod socket bolt nut should be drawn up as **tight as possible** and **securely locked** with a cotter pin. The radius rod cross tube should also be **securely clamped** in the hanger.

Cab and Body Group

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Standard Cabs and Bodies

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Cab Door Weather Strips

Rubber weather strips are assembled in metal moldings, welded to the outer edges of the doors and form a weathertight seal when doors are closed. The rubber weather strips can be slipped into the moldings, using a screw driver to push the edges in place.

Cab Door Windlace

The cab door windlace, which extends around the edge of the door opening, is held in place by metal moldings and wire clips which snap into holes in the door opening frame.

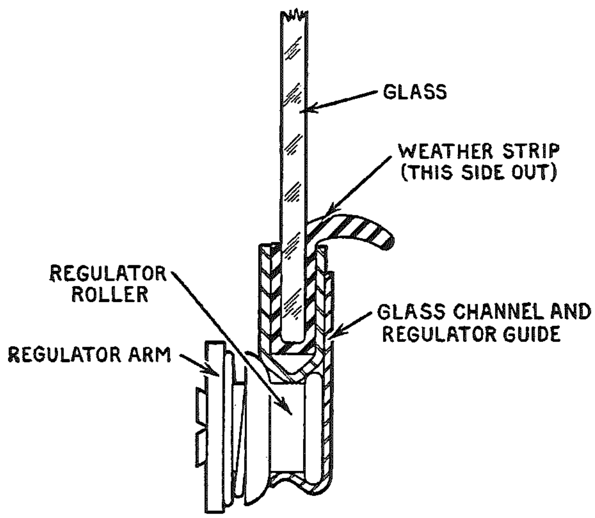

Fig. 1.

Cab Door Glass

The replacement of cab door glass is a simple operation if the following instructions are carried out.

Removal of Glass

(a) The door inner panel cover plate must be removed, which will permit the door glass to be lowered sufficiently to disassemble the door glass regulator channel from the regulator arm.

(b) Lift the glass out thru the door window opening and remove the regulator channel and weather strip.

Installation of Glass

(a) Place weather strip on lower edge of glass, making sure that the lip on the weather strip is to the outside.

(b) Fit the regulator channel over the weather strip with the guide channel openings to the inside as illustrated in Fig. 1.

(c) Place regulator arm in lowest position and insert glass thru door window opening. Crank regulator arm up and, with a screw driver, pry open the rollers on regulator arm so that they will slip into the regulator guide channel. Apply a small quantity of short fiber grease to the guide channels and rollers.

(d) Remove button plug on inside panel of door just below regulator handle and loosen nut on regulator arm. Crank glass up, making sure that it slides freely in glass channel. When door glass is aligned in the window opening, tighten regulator arm nut and replace button plug.

(e) Replace door inner panel cover plate before lowering door glass. This is important as the door glass stop is attached to the cover plate and, if this plate is left off and the glass lowered, there is danger of the regulator arm rollers slipping off the glass channel guides.

(f) Raise and lower the glass several times to ascertain if all parts are operating freely.

Cab Door Glass Window Regulators

When replacing a window regulator, the door glass and channel assembly must first be removed.

Removal of Window Regulator

(a) Remove door inner panel cover plate and lower regulator until regulator rollers slip off the regulator channel guides. Lift glass out thru window opening.

(b) Remove regulator handle, then take out the four mounting screws. Regulator can then be slipped out of the opening in the door inner panel.

Installation of Window Regulator

(a) Before installing the window regulator, coat the sector teeth, rollers and arm swivels with short fiber grease.

(b) Place regulator in position and attach with the four mounting screws, then replace regulator handle.

(c) Complete installation of glass and adjustment of regulator as covered under "Replacement of Cab Door Glass."

Cab Door Glass Run Channels

Cab door glass run channels, in the lower half of the doors, guide the window glass when the regulators are turned to their lowest position. These metal channels are covered with binding strips which cushion the glass.

Replacement of the binding strips is easily accomplished as they merely slip over the metal channels and are held in position by tension. Be sure to install with the cushion side to the glass.

Cab Door Glass Window Channel

The door glass window channel is held in place by clips, which snap into holes in the door frame.

Standard Cab Rear Window Glass

Removal of Glass

(a) Take out screws and remove window glass channel retainer and support.

(b) Remove glass and glass channel.

Installation of Glass

(a) Clean all old sealing compound from rear window frame. Then coat frame with fresh sealing compound.
(b) Install rubber channel around glass and place in window opening.
(c) Place lower channel support in position and install channel retainer.
(d) Smooth up sealing compound, making sure that all openings are filled, to assure a weather-tight seal.

Installation of Panel Body Rear Door Glass

Before starting the replacement of the door glass, remove all old sealing compound from the glass retainer flange and glass opening. It is necessary to have someone hold the glass in place, until the rubber glass retainer is slipped over the retainer flange in the door opening.

(a) Place rubber door glass retainer around glass with thin edge to outside as shown in Fig. 2.

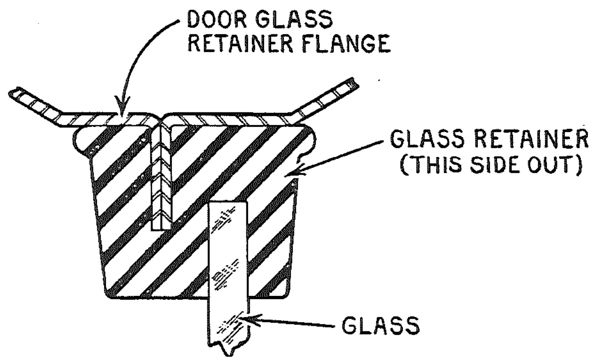

Fig. 2.

(b) Insert a piece of smooth insulated soft wire, or strong cord, approximately 1/8" diameter, around glass retainer groove which fits over metal flange of door glass opening. Cross the wire or cord on the top of the glass so the ends will be on the inside of the door. See Fig. 3.

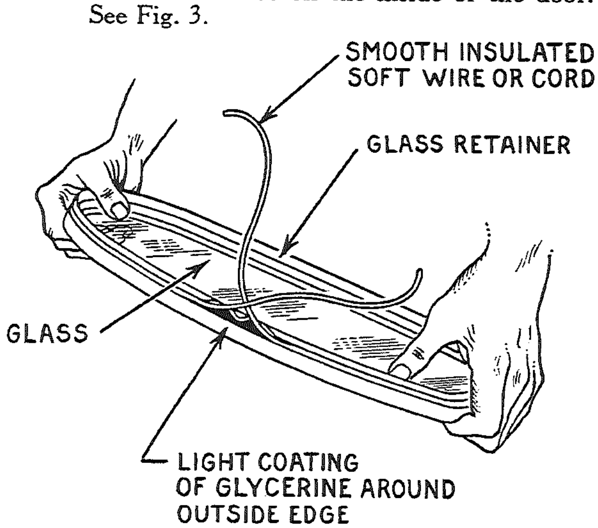

Fig. 3.

(c) Apply a light coat of glycerine around the outside edge of the rubber glass retainer to facilitate installation.
(d) Place the glass in the opening from the outside of the door, as close to the flange as possible, and push the wire or cord ends through to the inside.

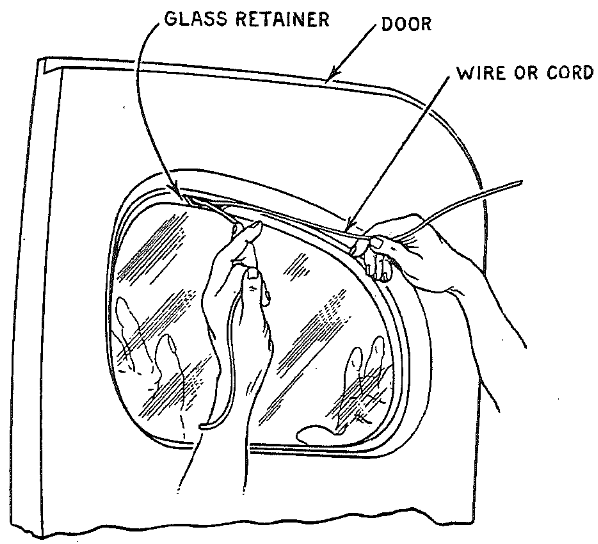

Fig. 4.

(e) By exerting a constant pressure on the outside of the glass and pulling on the wire or cord ends, the lip of the glass retainer will slip over the metal flange at the center as illustrated in Fig. 4.

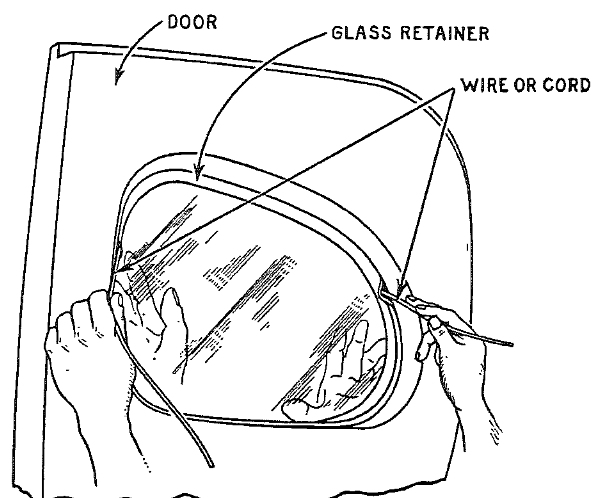

Fig. 5.

(f) Fig. 5 shows the progress of the retainer going into place. The upper left hand corner should go into place next, following with the upper right hand corner. Then work the lower right hand corner into place ahead of the lower left hand corner which should be the last corner to go into place.

(g) By the time the wire or cord ends are pulled to the center at the bottom and out, the retainer will be in place. It may be necessary to work the retainer down on the metal flange, by pressing with the fingers any points that are not quite in place.

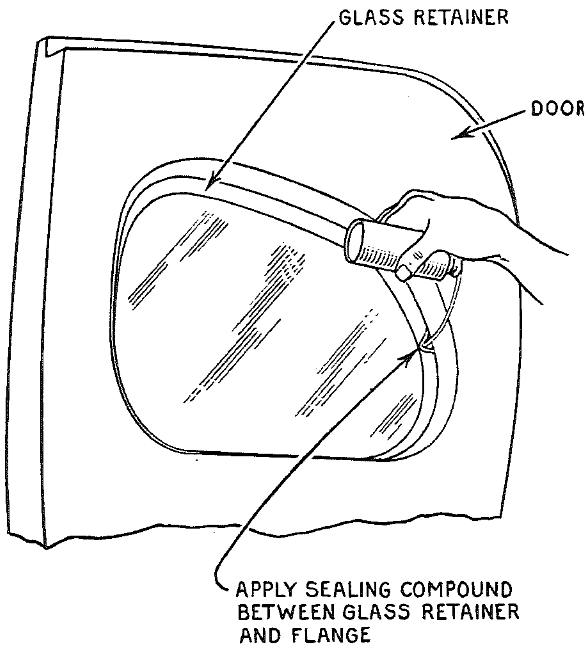

Fig. 6.

(h) A good sealing compound should be inserted between the metal flange and channel of the glass retainer to make a weathertight seal, Fig. 6.

Windshield

Removal of Windshield and Glass

(a) Open windshield and take out regulator arm screws at both sides. Then remove hinge screws at top of windshield.
(b) Place windshield on a bench and remove the six screws holding the upper and lower halves together. Tap lower half with a rubber hammer to separate.
(c) Glass can now be removed by sliding it out of upper half of windshield. It may be necessary to pry out slightly on the outer frame to start the glass.

Installation of Windshield and Glass

(a) Place new sealing strip around glass, if necessary, with fabric side of strip to the glass. Slide glass into upper windshield frame. It may be necessary to spring outer frame slightly.
(b) Assemble lower half of frame, replacing the six screws. Also replace the joint shields.
(c) If necessary to replace the rubber weather strip, use a screw driver or putty knife to slip the strip into the retainer molding.
(d) Attach windshield to upper hinges, then attach the regulator tape brackets. Close windshield and check the alignment. Windshield can be shifted by loosening the hinge adapter screws which are reached thru the windshield header openings. Remove cover plates, loosen screws and align windshield. Tighten hinge adapter screws and replace cover plates.

Windshield Regulator

The windshield regulator and support should be removed as a complete assembly. This permits easy replacement of either right or left tape housing assemblies or the worm housing assembly.

Removal of Regulator

(a) Disconnect windshield and remove instrument panel compartment and regulator handle.
(b) Take out the four regulator support screws and remove the complete assembly. It may be necessary to bend slightly, one of the ears on the regulator tape bracket, to permit withdrawal thru the slots in the windshield opening.

Installation of Regulator

(a) With the regulator support attached, guide both regulator tape arms thru the windshield opening slots. Elongated holes in the support permit shifting the assembly for alignment.
(b) Replace regulator handle, instrument panel compartment and connect tape arm brackets to windshield.

Cab Door Latch and Handles

The replacement of a cab door latch and remote control assembly is a simple operation; however, some difficulty may be experienced in attempting to remove or install the outside door handles. Therefore the following suggestions will be helpful.

Removal of Outside Handle

(a) Remove escutcheon plate screws, then press down slowly on inside handle and at the same time pull out on the outside handle. At a certain point the latch mechanism will be in position so that the outside handle may be withdrawn. **NOTE:** If door handle is being replaced, hold inside handle stationary and insert new outside handle. If inside handle is moved after outside handle is withdrawn, the mechanism will have to be aligned as covered in subsequent paragraphs.

Installation of Outside Handle

(a) A simple tool can be made from an old door handle, which will line up the cam and scissors plate. The illustration shows how to grind the end of the shaft. See Fig. 7.

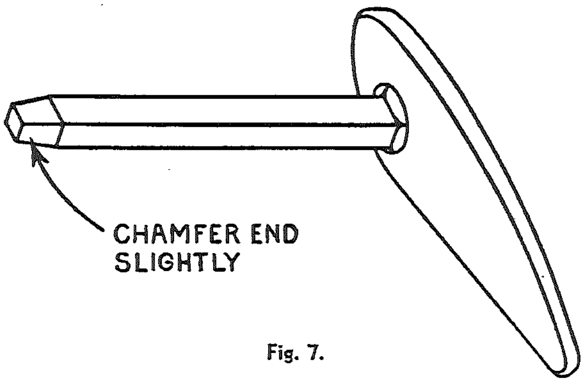

Fig. 7.

(b) Insert the tool in the latch and press down slowly on the inside handle. Keep pressing in on the tool and at a certain point the tool will slip into the scissors and cam plates. **IMPORTANT:** Hold inside handle stationary; withdraw tool and insert door handle. If inside handle is moved after tool is withdrawn, the door handle can not be inserted.

(c) Install escutcheon plate screws.

Lock Cylinders and Keys

Lock cylinders in ignition switch, door handles and spare tire lock are coded so that the ignition key will operate all. The instrument panel compartment lock cylinder requires a separate key.

Key series numbers for ignition switch, doors and spare tire lock run from C-250 to C-499 and for instrument panel compartment, H-601 to H-1100. Key numbers should be recorded to facilitate replacement in case they are lost.

A code number is stamped on the body of the ignition switch and compartment lock cylinders, just back of the cap. The door handle and spare tire lock cylinders do not have a code number stamped on the body inasmuch as the cylinders are coded to the ignition switch key.

To expose the code number on the ignition switch lock, remove the ignition switch cap nut with a small spanner wrench and the number will then be visible. If the compartment keys are lost and the key number is not known, it will be necessary to either drill out the lock cylinder and replace with a new cylinder and keys or replace the complete compartment knob and lock assembly. It is impossible to remove the compartment lock cylinder intact, without the regular key.

All lock cylinders can be removed provided the regular key is used. If keys are lost the cylinders must be drilled out using a $\frac{5}{16}''$ drill, $\frac{1}{2}''$ to $\frac{3}{4}''$ deep. This will permit the tumblers to drop out.

In case it becomes necessary to replace a lock cylinder and it is desired to use the original key, the tumblers on the new lock cylinder can be coded accordingly.

This is accomplished by inserting the original key in the new lock cylinder and filing off the tumblers that protrude from the lock cylinder body. When doing this, make sure that there are no burrs left on the tumblers and that all filings are blown out with air. Apply a small quantity of powdered graphite to the tumblers and insert lock cylinder in receptacle as directed.

Lock cylinders are removed, with keys, as follows:

Ignition Switch

Remove complete ignition switch from instrument panel. Place key in lock cylinder and insert a piece of wire in the small hole in switch body. Turn key to "on" position and press cylinder retainer down with the wire. The lock cylinder can then be slipped out of the ignition switch body.

To install a new lock cylinder simply push cylinder into ignition switch body and turn until cylinder retainer snaps into place.

Instrument Panel Compartment

Open compartment door. Place key in lock cylinder, then raise latch, turn cylinder to right and pull out.

To replace lock cylinder, raise latch, insert cylinder and turn to left, releasing the latch at the same time.

Door Handles and Spare Tire Lock

Place key in lock cylinder and insert a piece of wire thru the hole in the face of the cylinder. Press spring retainer down with wire, turn cylinder slightly to left and pull out.

To replace lock cylinder, insert and turn until retainers snap into place.

Door Take-Up Member

Shims are available in various thicknesses, which provide means of adjusting the door take-up member. The shims should be placed between the take-up member and the bottom of the door.

Check the alignment of the door in the opening and insert the proper thickness shim.

Cowl Ventilator

The cowl ventilator is controlled by a lever and ratchet which are held under tension by a spring attached to the windshield regulator support. A rubber strip cemented in the ventilator trough assures a weathertight seal.

This type ventilator requires no adjustment or attention other than occasional lubrication of the hinge pins and roller.

De Luxe Cab Rear Window Glass

Removal of Glass

(a) Place sliding window in lowest position and remove window pull clip.

(b) Take out back cushion and remove window molding.

(c) Remove screws which attach the sliding glass channel retainers at the top, then remove the two lower capscrews (one to each channel retainer).

(d) Sliding glass channel retainers can now be tilted in at the top, which will permit the sliding window glass to be withdrawn from the bottom.

(e) Remove side glass windows and take out the two sliding window channel retainers.

Installation of Glass

(a) If a new sliding glass is being installed, be sure that the lower channel and weather strip are assembled properly. Glass should be installed with lip of weather strip to outside of cab to assure a weathertight seal.

(b) Examine sliding glass channels and side glass channel weather strips and replace if necessary. See that the sliding glass bumpers are installed in the channel retainers and the bumper strip is in place at the top of the window opening.

(c) Place sliding glass channel retainers with glass channels in position and insert sliding glass in channels from bottom. Install the two channel retainer capscrews, but do not tighten until side glass windows are installed.

(d) Place rubber channel weather strips around side glass, then apply sealer around opening and place glass in position. Tighten the two sliding glass channel retainer capscrews and install the screws at the top.

(e) Install window pull clip, making sure that it fits tightly on edge of sliding window glass.

(f) Replace window molding and sliding glass catch. Install back cushion.

Windshield Wiper

The windshield wiper is electrically operated and is controlled by a toggle switch which extends thru the windshield header cover plate.

A clutch built in as part of the wiper shaft, permits the wiper blade to be moved without damaging the wiper.

In the assembly of the windshield wiper, two bearings are used in the drive housing only. No bearings are used on the commutator end of the armature shaft. The armature shaft is chrome plated, to assure long life without wear on the bearing surfaces.

Testing

If the windshield wiper fails to operate, first make sure that it is properly grounded to the metal supports. Determine if the wiper is receiving current by connecting a volt meter from the terminal of the windshield wiper to the windshield frame. If this tests satisfactorily, and the wiper will not operate, remove the cover and see that the two brushes are touching the commutator when the switch is in the "ON" position. When the armature starts to run, clean the commutator with a piece of fine sandpaper.

Disassembly

To disassemble the wiper, remove the drive housing cover screws and cover. Remove the wiper shaft and clutch assembly, driving sector assembly, drive gear, and worm gear assembly.

Then remove the two screws from the motor cover and remove the cover. Remove the brush holders from the mounting studs, and the armature can then be removed. Do not attempt to remove the armature without first removing the brush holders and worm gear.

Remove the two screws that hold the field coil assembly in the motor housing and the field coils can be removed.

The wiper is now completely dismantled and may be thoroughly cleaned.

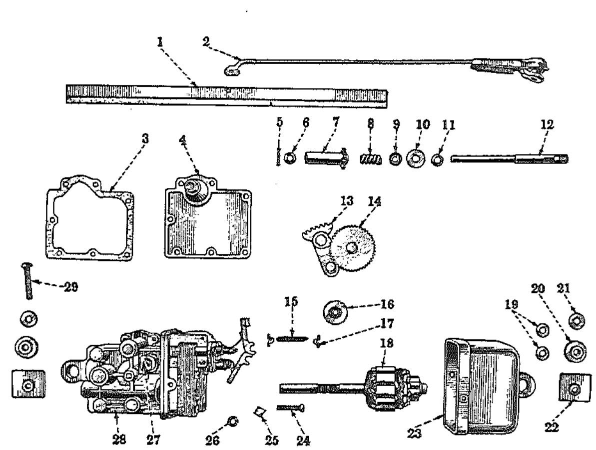

Fig. 8.

No.	Description
1.	Blade.
2.	Arm assembly.
3.	Field support cover gasket.
4.	Field support cover.
5.	Shaft collar pin.
6.	Shaft pinion collar.
7.	Shaft pinion assembly.
8.	Shaft pinion spring.
9.	Shaft leather washer expander.
10.	Shaft (leather) washer.
11.	Shaft (steel) washer.
12.	Shaft.
13.	Driving sector assembly.
14.	Crank gear assembly.
15.	Motor brush spring.
16.	Worm gear assembly.
17.	Motor brush spring anchor.
18.	Motor armature assembly.
19.	Bushing (rubber).
20.	Mounting bushing.
21.	Washer.
22.	Mounting pad.
23.	Motor cover.
24.	Screw.
25.	Motor brush.
26.	Lockwasher.
27.	Switch.
28.	Field support assembly.
29.	Screw.

Reassembly

The reassembly is the reverse of the disassembly operations. When reassembling the windshield wiper, use only a small quantity of good lubricating oil, and oil all the bearing shafts before replacing them in the wiper. Do not use heavy grease in the windshield wiper.

If further adjustments are required, the complete unit should be taken to an Official Auto-Lite (Owen-Dyneto) Service Station.

Cab Mountings

The various mountings for cabs are shown in the illustrations. Mounting pads, spacers, washers and springs should be installed as indicated. Where springs or rubber pads are used, tighten mounting bolt nuts just enough to permit installation of cotter pins.

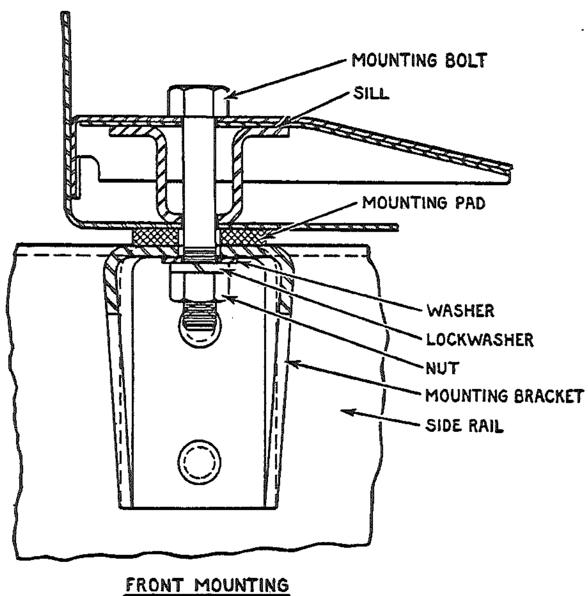

Fig. 9. Front—D-2, D-5, D-15.

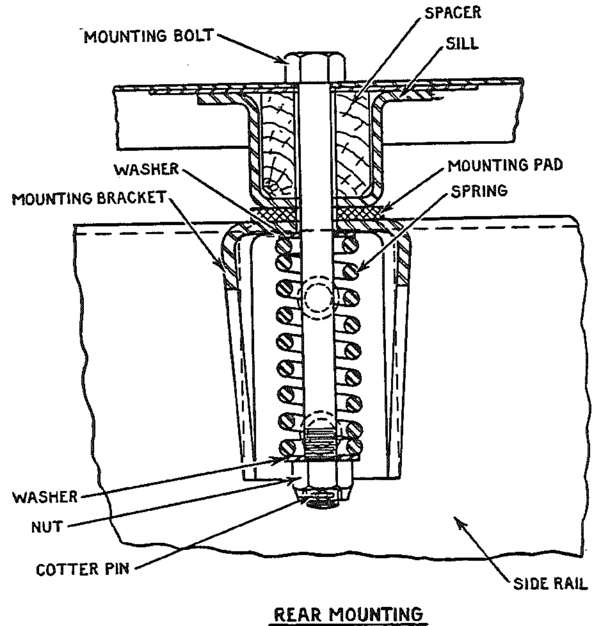

Fig. 11. Rear—D-15.

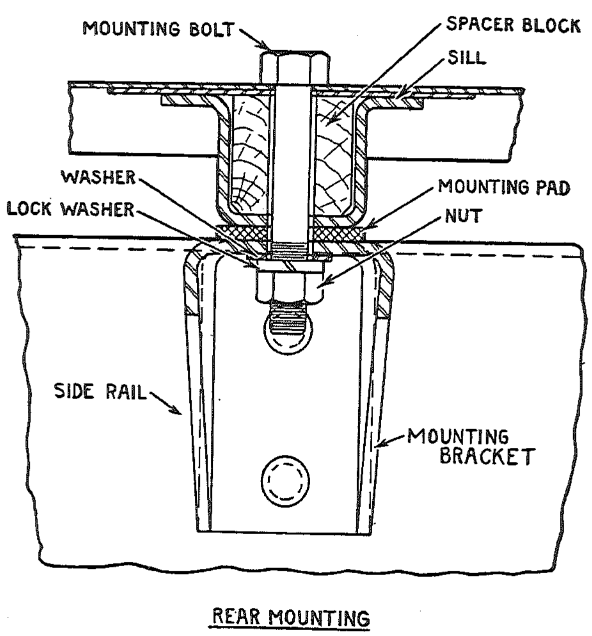

Fig. 10. Rear—D-2, D-5.

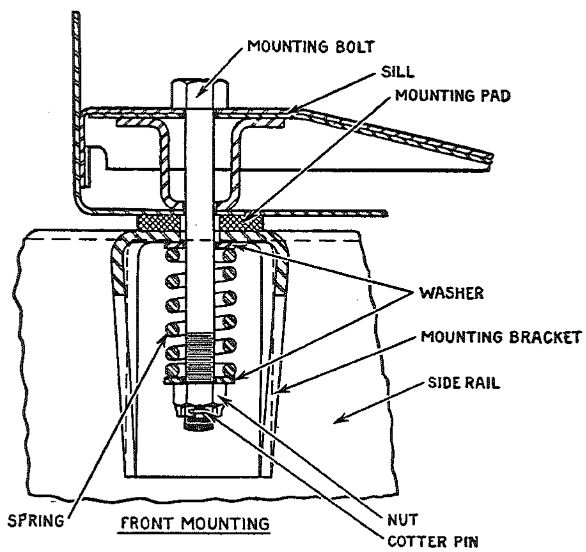

Fig. 12. Front—D-30, DS-30, D-30B, DS-30B, D-35, DS-35, D-35B, D-40, D-50, D-60, DR-60, DR-70, D-186T, DS-186T, D-216T, D-246T, D-246F, DR-346T, D-346F, DR-426F.

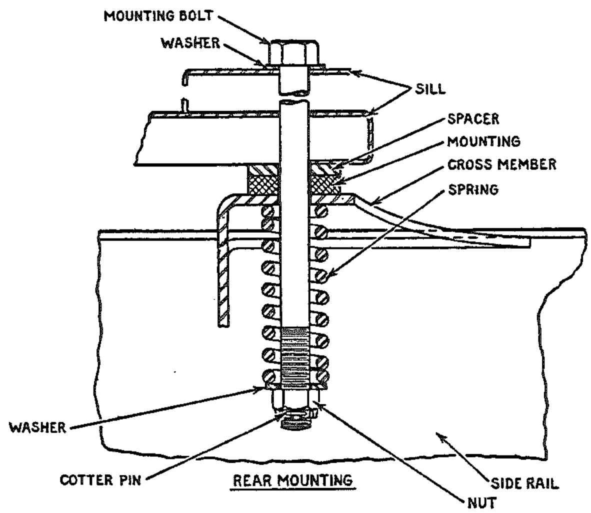

Fig. 13. Rear—D-30, DS-30, D-30B, DS-30B, D-35, DS-35, D-35B, D-186T, DS-186T.

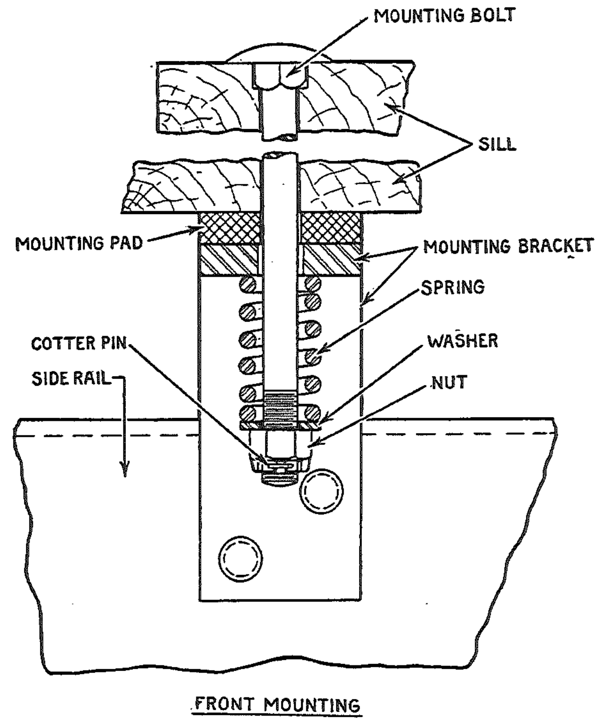

Fig. 15. Front—D-300, DS-300.

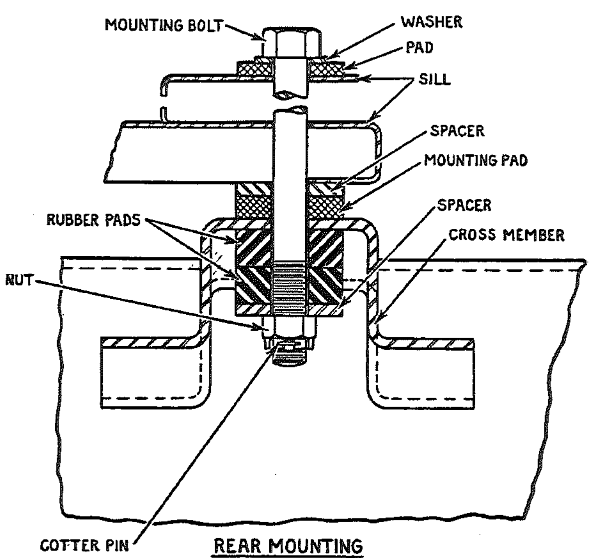

Fig. 14. Rear—D-40, D-50, D-60, DR-60, DR-70, D-216T, D-246T, D-246F, DR-346T, D-346F, DR-426F.

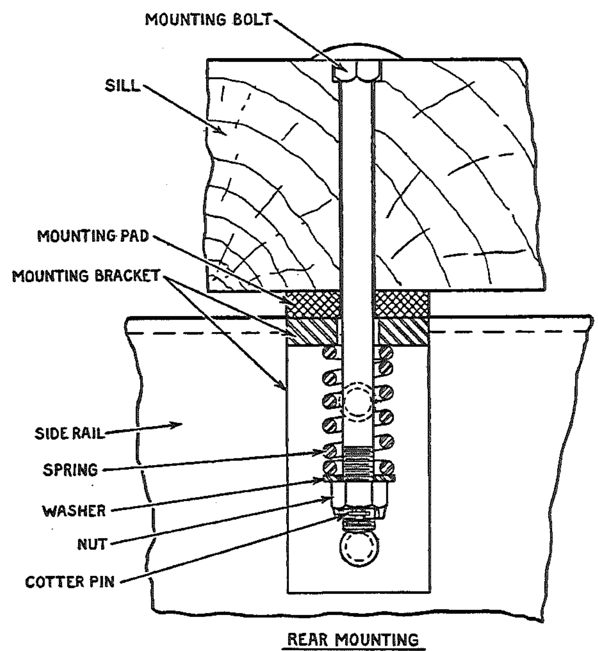

Fig. 16. Rear—D-300, DS-300.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)

SALES CHICAGO, ILLINOIS NOVEMBER 3-1939

SUBJECT: Increased Capacity Brakes D-35, D-40

(B)

M.T.No. 2

To meet severe brake requirements, especially in mountainous, thickly populated sections, increased capacity or mountain type brakes have been made available for Model D-35, DS-35, D-40 and DS-40 trucks. These brakes can be furnished on chassis shipped from the Works when specified on sales orders or can be ordered from the Repairs Department as a changeover kit for chassis already in service.

The increased capacity brakes for D-35 and DS-35 include special lining and high ribbed drums for front wheels and a change in the brake cylinders. Larger brakes and 16x3" high ribbed drums are furnished for the rear wheels. The front lining area is not changed and the rear lining area is increased to 222 square inches.

The increased capacity brakes for D-40 and DS-40 include special front lining and high ribbed brake drums and a change in brake cylinders. Larger brakes and 17x3½" high ribbed brake drums are furnished for the rear wheels. The front lining area is not changed and the rear lining area is increased to 258.5 square inches.

The following net prices apply:

D-35 and DS-35 increased capacity brakes on chassis shipped from Factory..$15.00

D-40 and DS-40 increased capacity brakes on chassis shipped from Factory..$40.00

The following net prices apply on the field changeover packages which are to be ordered from the Repairs Department:

#88805-H Increased capacity kit for field changeover for D-35 and DS-35 .... $50.00

#88806-H Increased capacity kit for field changeover for D-40 and DS-40 .... $75.00

These increased capacity brakes are available only on D-35, DS-35, D-40 and DS-40 chassis equipped with cast spoke type wheels and are not available for production or field changeover on chassis with Budd disc wheels.

A Service Bulletin covering field changeovers will be issued as soon as possible.

A.C.L. Jr. SALES DEPARTMENT

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Major Adjustment 1

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Major Adjustment 1

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Rear Brake Adjustment 2

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Rear Brake Adjustment... 2

Brake Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Service Brake:													
Type	Hyd.	Hyd.	Hyd.	Hyd.	Hyd.	Hyd.	Hyd.	Vac. Hyd.	Vac. Hyd.	Vac. Hyd.	Vac. Hyd.	Vac. Hyd.	Vac. Hyd.
Size—Front	12 x 1¾"	12 x 1¾"	12 x 1¾"	14 x 2"	14 x 2"	14 x 2"	14 x 2"	14 x 2"	14 x 2"	14 x 2"	14 x 2"	15 x 2¼"	16 x 2½"
Size—Rear	12 x 1¾"	12 x 1¾"	14 x 2"	15 x 2½"	15 x 2½"	15 x 2½"	15 x 2½"	15 x 2½"	15 x 2½"	16 x 3"	16 x 3"	17 x 3"	17 x 4"
Number of Shoes	2	2	2	2	2	2	2	2	2	2	2	2	2
Anchor—Front	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single
Anchor—Rear	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single	Double	Double
Wheel Cyl. Diameter—Front	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1⅛"	1⅛"
Wheel Cyl. Diameter—Rear	1"	1"	1¼"	1⅜"	1⅜"	1⅜"	1⅜"	1⅜"	1⅜"	1½"	1½"	1¾"	1¾"
Master Cyl. Diameter	1⅛"	1⅛"	1⅛"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	1¾"	1¾"
Type	Comb.	Comb.	Comb.	Comb.	Comb.	Comb.	Comb.	Comb.	Comb.	Comb.	Comb.	Comb.	Comb.
Vacuum Power Cyl.	....	....	....	....	....	....	....	R-60	R-60	R-60	R-60	R-66	R-66
Hand Brake:													
Type	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.
Location	Rear	Rear	Rear	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft
Size	12 x 1¾"	12 x 1¾"	14 x 2"	8 x 2½"	8 x 2½"	8 x 2½"	8 x 2½"	8 x 2½"	8 x 2½"	9¾ x 4"	9¾ x 4"	9¾ x 4"	12 x 5"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Service Brake:												
Type	Vac. Hyd.	Air	Hyd.	Hyd.	Vac. Hyd.	Vac. Hyd.	Vac. Hyd.	Vac. Hyd.	Vac. Hyd.	Air	Air	Air
Size—Front	16 x 2½"	17¼ x 3"	14 x 2"	14 x 2"	14 x 2"	14 x 2"	14 x 2"	15 x 2¼"	15 x 2¼"	17¼ x 3"	17¼ x 3"	17¼ x 3"
Size—Rear	17 x 4"	17¼x5½"	15 x 2½"	15 x 2½"	15 x 2½"	15 x 2½"	16 x 3"	17 x 3"	16 x 3"	17¼ x 4"	17¼ x 4"	17¼x5½"
Number of Shoes	2	2	2	2	2	2	2	2	2	2	2	2
Anchor—Front	Single	Double	Single	Single	Single	Single	Single	Single	Single	Double	Double	Double
Anchor—Rear	Double	Double	Single	Single	Single	Single	Single	Double	Double	Double	Double	Double
Wheel Cyl. Diameter—Front	1⅛"	....	1⅛"	1⅛"	1"	1"	1"	1⅛"	1⅛"	....	....	....
Wheel Cyl. Diameter—Rear	1¾"	....	1⅜"	1⅜"	1⅜"	1⅜"	1½"	1⅜"	1½"	....	....	....
Master Cyl. Diameter	1¾"	....	1½"	1½"	1¾"	1¾"	1¾"	1¾"	1¾"	....	....	....
Type	Comb.	....	Comb.	Comb.	Comb.	Comb.	Comb.	Box	Box	....	....	....
Vacuum Power Cyl.	R-66	....	....	....	R-66	R-66	R-66	PDL-6	PDL-6	....	....	....
Hand Brake:												
Type	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech.	Mech-dual	Mech.	Mech-dual	Mech-dual
Location	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft	Prop.shaft
Size	12 x 5"	12 x 5"	8 x 2½"	8 x 2½"	8 x 2½"	8 x 2½"	8 x 2½"	9¾ x 4"	8 x 2½"	12 x 5"	8 x 2½"	8 x 2½"

Hydraulic Brakes

Hydraulic Brake System

The hydraulic system used to actuate the brake mechanism consists of a compensating type master cylinder in which the hydraulic pressure is originated; individual wheel cylinders, in which the hydraulic pressure is applied, which serve to actuate the brake shoes against the brake drum of each wheel; and the "Line" consisting of steel tubing, flexible hose, brackets and unions, interconnecting the master cylinder and wheel cylinders. The master cylinder and wheel cylinders are fitted with pistons, all of which are provided with cup packings, which act as a seal to maintain pressure and prevent loss of brake fluid.

Depressing the brake pedal moves the piston within the master cylinder, thus displacing the brake fluid from the master cylinder through its outlet orifices, tubing and flexible hose connections into the wheel cylinders. The brake fluid, being noncompressible, enters each of the wheel cylinders, causing the cylinder pistons to move outward and actuate the brake shoes. As pressure on the pedal is increased, greater hydraulic pressure is built up within the wheel cylinders, and consequently greater force is exerted against the shoes.

When the pressure on the pedal is released, the brake shoe retracting springs return the brake shoes to their normal or released position. The return movement of the brake shoes, in turn, causes movement of the wheel cylinder pistons toward their released position, thus forcing the fluid back thru the tubing into the master cylinder.

Hydraulic Fluid

Always use Genuine Wagner Lockheed No. 21 fluid. The use of other than Genuine Wagner Lockheed fluid or the introduction of mineral base oil into the system will cause rubber parts to swell and become inoperative.

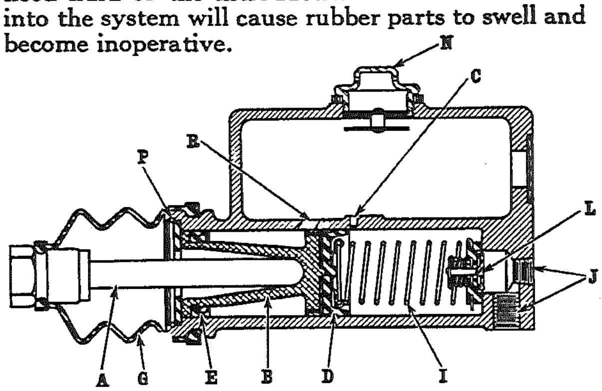

Fig. 1, Typical Combination Type Master Cylinder

Combination Type Master Cylinder

The combination type master cylinder consists of barrel and tank casting, double check valve (L), piston cup return spring (I), piston cup (D), piston (B), piston stop (P), boot (G) and connecting link (A).

The fluid reservoir or supply tank is cast integral over the master cylinder barrel. A combination filler and breather plug (N) permits atmospheric pressure on the reserve fluid at all times.

Depression of the pedal causes piston (B) and cup (D) to move forward in the cylinder barrel. A very small forward movement of cup (D) closes by-pass port (C) and the pressure stroke commences.

Actual pressure is not built up until the fluid displaced has caused all shoes to go into contact with their drums. Additional pressure on the pedal produces hydraulic pressure within the brake system.

Removal of operator's foot from the brake pedal after each brake application permits the brake pedal and push rod (A) to return independently to their off-position.

The return of piston (B) and cup (D) is accomplished by the piston return spring (I).

The piston for this type of unit is designed to carry a primary cup (D) and a secondary cup (E). The construction of the piston is such that reserve fluid from the tank passes through vent (R) in a recessed area. Thus we have fluid on both sides of the primary cup. The secondary cup (E) is merely a seal to prevent loss of reserve fluid into boot (G).

The combination type master cylinder is also known as a compensating type. Its primary compensating function is to maintain a constant volume of fluid in the system at all times, regardless of expansion (heat) or contraction (cold). The secondary compensating function is the replacement of additional fluid into the system to counterbalance any loss due to gravity seepage.

The return to off-position of piston (B) and cup (D) is much faster in displaced volume than the return of the fluid through fitting (J) into the master cylinder. A momentary vacuum is created in the cylinder barrel and additional fluid is drawn into the system through the drilled holes in piston (B) and past the lip of cup (D). The operating fluid returns more slowly from the wheel cylinders and lines back into the master cylinder barrel. Any excess is by-passed by port (C) into the reservoir. Thus we have a cylinder full of fluid for the next brake application.

Box Type Master Cylinder

The master cylinder unit consists of supply tank, or reservoir, master cylinder proper, inside lever, outside lever, brake shaft, and filler cap.

The master cylinder proper consists of the head and barrel (N), piston stop (E), piston (P), piston cup (A), and piston cup return spring (C). This unit is contained within the supply tank.

The supply tank serves as a reservoir to carry the reserve supply of fluid and protects the master cylinder submerged in fluid from taking in air, dirt or water.

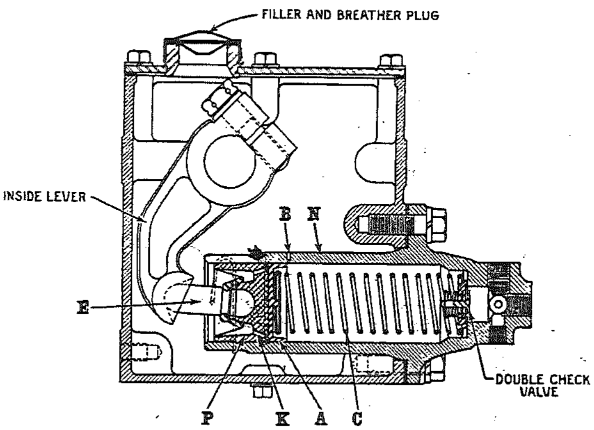

Fig. 2, Typical Box Type Master Cylinder

The complete assembly is mounted to the frame and connected to the brake pedal.

The master cylinder submerged in the fluid is known as the compensating type. Its primary compensating function is to maintain a constant volume of fluid in the system at all times, regardless of expansion or contraction of the fluid, due to temperature changes. The secondary compensating function of this type of unit is the immediate replacement of additional fluid into the system, to counterbalance any loss due to gravity seepage.

The master cylinder is designed to add additional fluid or to supercharge the system on the return stroke of the brake pedal after each brake application (secondary compensating function).

The fast return of piston (P) and cup (A) by return spring (C) and the relative slower return of the fluid from the wheel cylinders causes a vacuum in cylinder (N). The momentary vacuum created pulls fluid through drilled holes (K) in piston and past the lip of cup (A) into the master cylinder proper.

The introduction of additional fluid from the reservoir into the line on each brake application necessitates locating a by-pass port (B) directly ahead of the master cylinder cup (in release position). After each brake application all surplus fluid is released through port (B) into supply tank. **Brakes will drag** if the by-pass port is blocked, either from improperly set brake pedal or swollen cups (caused from mineral oil) and pressure will be built up in the system, thus forcing shoes into contact with drums.

Check Valve

A double check valve is used in all master cylinders of the compensating type. It is held in the closed end of the master cylinder barrel by the piston cup return spring.

The valve performs two functions:

It acts as a seal to prevent fluid or air being drawn into the system through the bleeder screw during the bleeding operation.

Fluid passed through the valve on the pressure stroke can return into the master cylinder barrel only by raising the entire valve from its seat. The valve is held in place by the cup return spring.

When the pressure on the returning fluid drops below 6 to 8 pounds, the spring closes the valve and the system is under a slight pressure. This pressure will not cause the shoes to drag. It is used to assure a positive seal at the wheel cylinder cup packings.

The valve does not control brake pedal movement. Do not try to remedy this complaint by changing the valve.

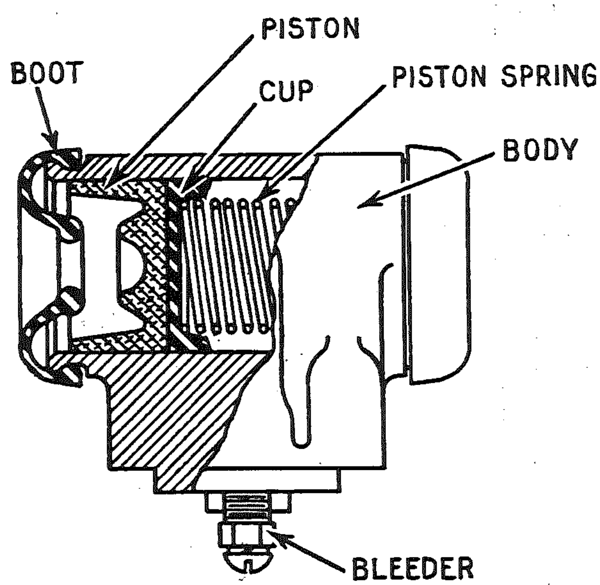

Fig. 3, Typical Wheel Cylinder

Wheel Cylinder

Fig. 3 illustrates the assembly of the wheel cylinder which is the unit that changes the applied hydraulic pressure into mechanical force to actuate the brake shoes.

Repairs to Master and Wheel Cylinders

It is possible to rehone the majority of cylinders and place them in good working condition; however, this requires the use of up-to-date honing equipment and plug gauges. A cylinder hone kit is available under number S.E. 998 and a set of plug gauges under number S.E. 1000.

If this equipment is not available, we recommend that the unit be taken to the nearest Wagner Service Branch or Authorized Service Station for repairing.

Cylinders and parts must **not** be washed in gasoline, kerosene or oil. Use high-grade denatured alcohol.

Care

Keep all lubricant and brake fluid away from brake linings.

Inspect master cylinder each one thousand (1,000) miles for correct fluid level. Fluid should be within 3/8" from bottom of filler neck. Do not fill supply reservoir to top of filler neck. **CAUTION:**

When removing supply reservoir filler cap, extreme care must be used to prevent dirt or moisture from entering master cylinder.

Brake Pedal Adjustment

When brake control system is in release position, foot brake pedal should have ¼″ free travel before the pressure stroke starts. This free travel is required to prevent blocking of by-pass port in master cylinder. **Brakes will drag** if by-pass port becomes blocked due to pressure building up in the system. Should all brakes drag, pressure may be relieved by removing screw from bleeder and unscrewing bleeder ¾ turn. **NOTE:** For brake pedal adjustment on trucks equipped with Vacuum Power units, see "Adjustments" in Vacuum Power Brake Section.

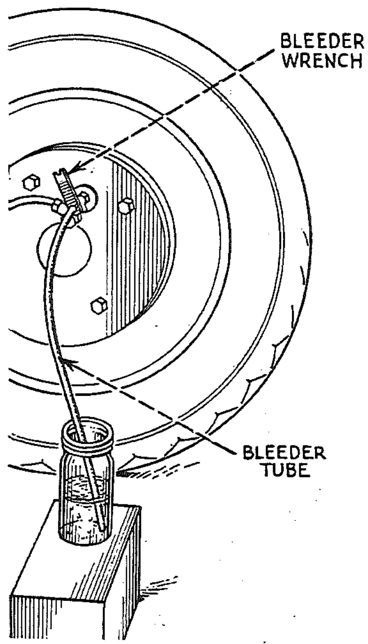

Fig. 4

Bleeding Lines

Any air inside the hydraulic system must be removed. Whenever a line has been disconnected at master cylinder, the entire system must be bled at all wheels until all air is completely expelled. When a line has been disconnected at any wheel cylinder, this cylinder together with the cylinder on the opposite wheel must be bled. Air in the system will cause a springy, rubbery action of the brake pedal. Should a sufficient quantity be introduced into the system, the brake pedal will go to toe board under normal pressure.

Fill master cylinder supply reservoir with Genuine Lockheed fluid and see that it is kept at least half full during entire bleeding operation.

Remove screw from end of bleeder connection and attach bleeder tube. Allow tube to hang in a clean container, such as a pint glass jar. Unscrew bleeder connection ¾ turn and depress brake pedal by hand, using half strokes, allowing pedal to return slowly. Pumping brake pedal forces fluid out into glass jar, and carries with it any air which might be present in the system. Watch flow of fluid from tube, the end of which should be kept below surface of fluid in pint bottle, and when all air bubbles cease to appear or when stream is a solid fluid mass, close bleeder connection.

Fluid withdrawn in bleeding operation should not be used again, unless absolutely certain that it does not contain impurities. Fluid of which the cleanliness is questionable should never be used. Fluid should be replenished in supply reservoir after each cylinder is bled. Should supply reservoir be drained during bleeding operation, air will enter the system and rebleeding will then be necessary.

Maintenance Hints

1. Pedal goes to Floor Board.

Cause

(a) Normal wear of lining.
(b) Brake shoes not properly adjusted.
(c) Leak in system.
(d) Air in system.
(e) Pedal improperly set.
(f) No fluid in supply reservoir.

Remedy

(a) When brake linings become worn it is necessary to set the shoes into closer relation to brake drums. This condition is usually accompanied by the remark that it is necessary to pump the pedal several times before a brake is obtained. Shoes should be set in accordance with instructions on **ADJUSTMENTS FOR WEAR.** Do not disturb anchor pins when making this adjustment. Adjustment must be made while drums are cool.

(b) In cases where the anchor pins have been disturbed and the relation of the arc of the shoes to drums changed, lining will wear rapidly and the braking efficiency of that particular wheel will be reduced. To overcome this condition, follow instructions as outlined in **MAJOR ADJUSTMENTS,** brake shoe adjustment sections.

(c) A leak in the system will allow the pedal, under pressure, to go to toe board gradually. If no leaks are found at wheels or joints, remove master cylinder and check bore of barrel for scores or scratches.

(d) Air in the system will cause a springy, rubbery action of the pedal. Should a sufficient quantity be introduced into the system, the pedal will go to toe board under normal pressure. System should be bled.

(e) Brake pedals should be set to give the correct amount of free movement before the pressure stroke starts. Excessive free movement reduces the active travel of the master cylinder piston, which in turn determines the amount of working fluid to be expelled from the master cylinder into the lines or system.

(f) The fluid level in the supply reservoir should be checked at regular intervals. Should the reservoir become empty, air will be introduced into the system, necessitating bleeding.

2. All Brakes Drag.

Cause

(a) Mineral oil in system.
(b) Pedal improperly set.

Remedy

(a) The introduction of mineral oil, such as engine oil, kerosene, or any fluid with a mineral base, into the system will cause the cups to swell and distort, making it necessary to replace all cups and flush system.
(b) Directly ahead of the master cylinder piston cup (when in normal release position) is a relief port. It is imperative that this port be open when the brakes are released. Brake pedal should be set to give the proper free movement before pressure stroke begins. Should this port be blocked by piston cup not returning to its proper release position, the pressure in the system will gradually build up and brakes drag. Opening the bleeder screw will allow built-up pressure to escape and give temporary relief. Bleeder screw must be secure before vehicle is driven.

3. One Wheel Drags.

Cause

(a) Weak brake shoe return spring.
(b) Brake shoe set too close to drum.
(c) Cups distorted.
(d) Loose wheel bearings.

Remedy

(a) Springs sometimes lose their contracting power and take a set. Replace spring.
(b) Readjust shoes to proper clearance. Do not change anchor pin setting unless necessary.
(c) If in repairing wheel cylinders, kerosene, gasoline and other fluids are used as a cleaner, instead of alcohol, the cups will swell and distort. The return action of the shoes will be retarded and the brake drum will heat. Replace cups and wash unit in alcohol and dip all parts in fluid before reassembling.
(d) Tighten bearings.

4. Truck Pulls To One Side.

Cause

(a) Grease-soaked lining.
(b) Shoes improperly set.
(c) Backing plates loose on axle.
(d) Front spring U-bolts loose.
(e) Different makes of lining.
(f) Tires not properly inflated.

Remedy

(a) Replace with new lining of same make. Grease-soaked linings cannot be salvaged by washing or cleaning.
(b) Refer to MAJOR ADJUSTMENTS, brake shoe adjustment sections.
(c) Loose backing plates permit the brake assembly to shift on the locating bolts. This shifting changes the predetermined centers and causes unequal efficiency. Tighten backing plate and readjust shoes with feeler gauge.
(d) Loose spring U-bolts permit the axle to shift on the springs and run out of line. This is noticed especially when a high braking torque is developed. Tighten U-bolts at their proper location on spring.
(e) Different makes of linings have different braking efficiency. Two different makes, one with high efficiency and one with low efficiency, would cause truck to pull to one side.
(f) All tires should be properly inflated.

5. Springy, Spongy Pedal.

Cause

(a) Brake shoes not properly adjusted.
(b) Air in system.

Remedy

(a) Consult remedy (b) under No. 1.
(b) Consult remedy (d) under No. 1.

6. Excessive Pressure on Pedal, Poor Stop.

Cause

(a) Brake shoes not properly adjusted.
(b) Improper lining.
(c) Oil in lining.
(d) Lining making partial contact.

Remedy

(a) Consult remedy (b) under No. 1.
(b) Specified linings have been developed to give satisfactory service and no changes should be made in the field to other makes of linings.
(c) Replace shoes.
(d) Remove high spots.

7. Light Pressure On Pedal, Severe Brakes.

Cause

(a) Brake shoes not properly adjusted.
(b) Loose backing plate on axles.
(c) Grease-soaked lining.

Remedy

(a) Consult remedy (b) under No. 4.
(b) Consult remedy (c) under No. 4.
(c) Consult remedy (a) under No. 4.

Vacuum Power Brake—D-35, DS-35, D-35B, D-40, D-50, D-60, DR-60, D-186T, DS-186T, D-216T, D-246T, D-246F

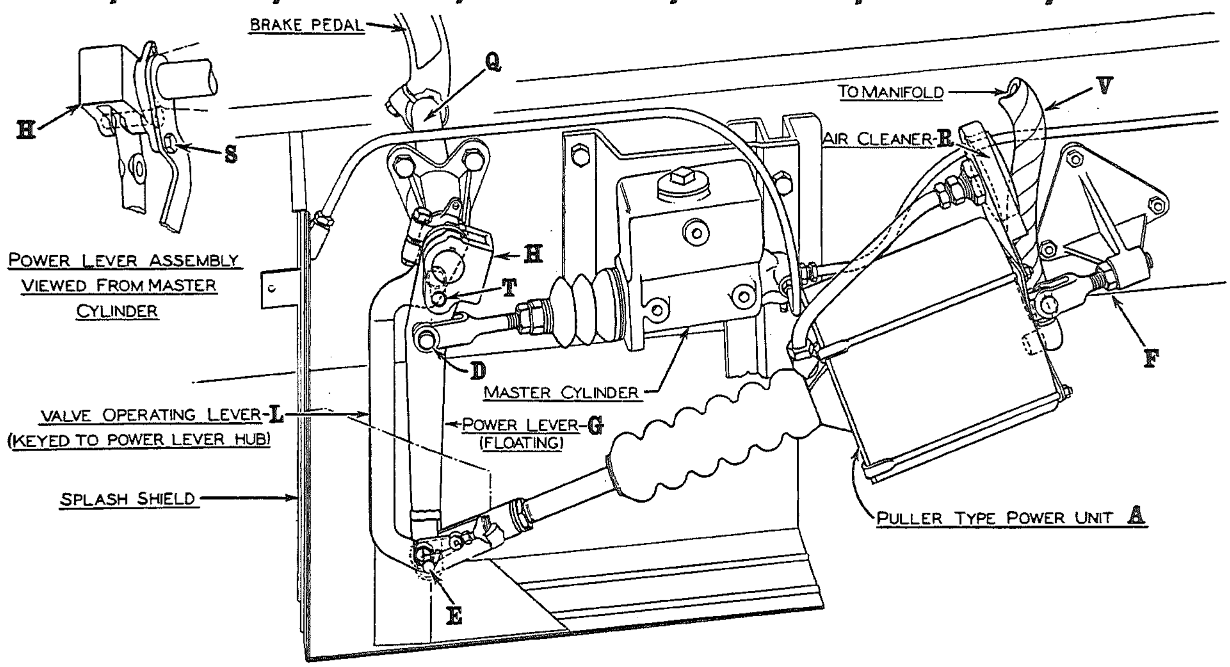

Fig. 1, Vacuum Power Unit Installation—D-35, DS-35, D-35B, D-40, D-50, D-60, DR-60, D-186T, DS-186T, D-216T (See Page 4 for D-246T, D-246F)

Vacuum Power System

The vacuum power unit consists of the following elements: valve operating lever (L), power lever (G), and vacuum power unit (A), the rear end of which is connected to a frame bracket and the forward end to power lever (G).

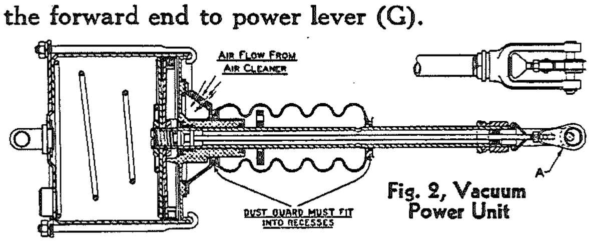

Fig. 2, Vacuum Power Unit

The vacuum power unit is of the vacuum suspended type, with the engine intake manifold the source of vacuum power. Vacuum is present on both sides of the piston at all times when the engine is running and the brakes are in the released position. The vacuum line (V) connects the power unit to the intake manifold.

The power unit installation is of the reactionary type, that is, the power unit is so connected to the brake pedal linkage and master cylinder that a portion of the power derived from the cylinder reacts against the brake pedal, thus giving the pedal a "normal feel" at all times and the operator full control over the rate of stopping the truck.

When the brake pedal is depressed the initial travel operates the internal valve (I) Figs. 3, 4, within the power unit (A). As soon as the internal valve rod has been moved approximately $\frac{5}{32}$", atmosphere is admitted through ports (P) in the piston rod, first passing through air cleaner (R) mounted on the power unit and through the tube to the forward chamber of the cylinder. This atmospheric pressure against piston (K) forces the piston backward, actuating power lever (G), which in turn relays the power through the master cylinder link to the master cylinder piston. However, due to the fact that the power lever (G) has some clearance around pedal shaft (Q) and is pivoted at pivot pin (D), a certain proportion of the power derived from the cylinder is balanced against the brake pedal through pin (T).

A study of Fig. 1 will explain the manner in which the manual and power forces are combined.

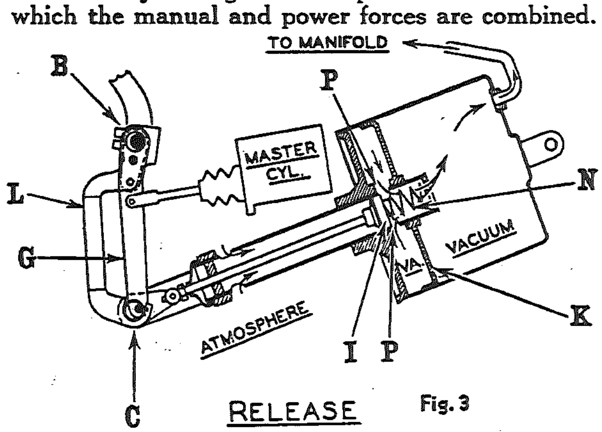

Fig. 3

Fig. 3 illustrates the system with all parts in release position. The valve is held in the open or release position by the valve operating lever (L) and internal valve spring (N). In this position a state of vacuum exists on both sides of the piston as indicated by the directional arrows. It will be noted that the valve rod yoke is attached to the valve operating lever without clearance, so that any movement of the pedal is directly transmitted to the valve.

The valve rod yoke, however, has an oversize hole, to provide clearance around the piston rod clevis pin (E) and permits operation of the valve without disturbing the relative position of the piston.

As the brake pedal is depressed the initial movement actuates the valve, through the lost motion provided about the piston rod pin (E).

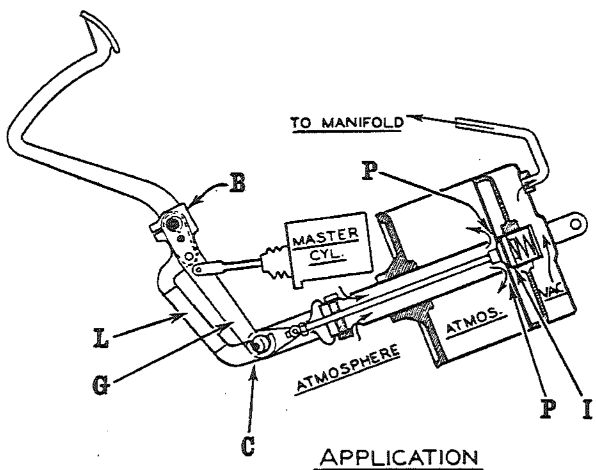

Fig. 4

The valve is now moved to the closed or applied position as shown in Fig. 4. Atmospheric pressure is admitted, through the air cleaner, the connecting tube, the end plate cover, the hollow piston rod, and ports (P) of the valve to the space forward of the piston, partially destroying the vacuum; vacuum is still maintained on the opposite side of the piston. The piston now moves forward due to the difference of pressure.

The force of the piston is now exerted on the power lever (G) through the piston rod clevis and pin.

Since lever (G) has a clearance around the pedal shaft (Q) the force of the power cylinder is balanced against the force on pin (D) as a fulcrum, and when the force from the power unit has built up to a point of balance with the pedal effort through pin (T), the leverage system is held in the lap or "holding" position; that is where the valve is in the mid-position and neither vacuum nor atmospheric pressure are connected to the chamber at the forward side of the piston. In this position the combination of the pedal effort and the power unit force is transmitted to the master cylinder link through pin (D) and from here to the hydraulic brake system.

The valve lever, being pivoted to the power lever at pin (T), has been rotated to a point where the valve is moved to the lap position (with equal clearance on each side of the piston rod pin (E), with both sides of the piston completely sealed.

An increase in braking effort is brought about by a repetition of the above; any increase in pedal pressure again moves the valve to the application position, admitting additional atmospheric pressure until a balance is reached again.

This same proportional balance between foot pedal and power unit is maintained throughout brake release just as on application. Figs. 5 and 6 show the various positions of operation of the valve.

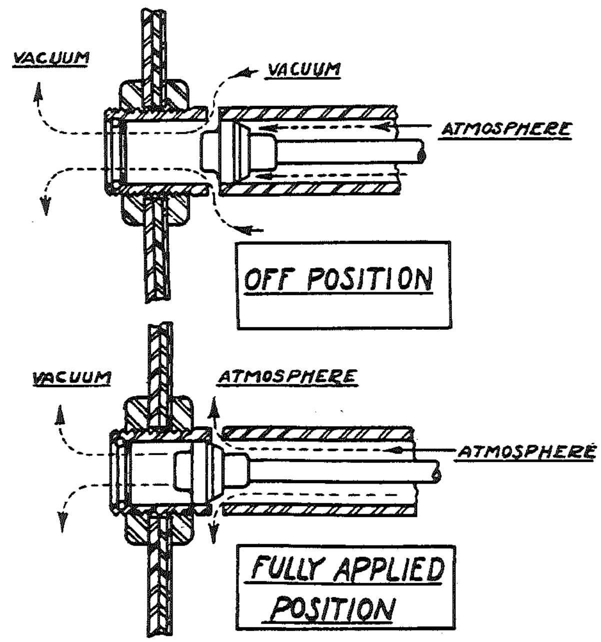

Fig. 5

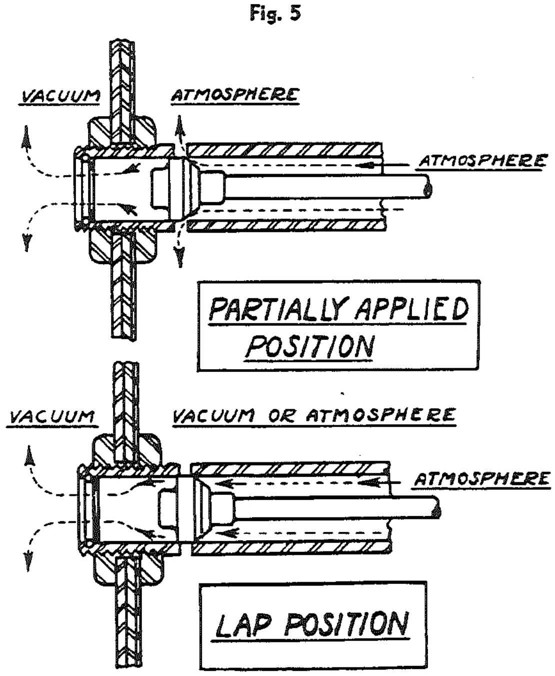

Fig. 6

Adjustments

The power cylinder is a self-contained unit requiring no internal adjustments. The only external adjustments are the positioning of the piston rod yoke in relation to the power lever, and the positioning of the valve rod yoke in relation to the piston rod yoke pin.

With the brakes and brake pedal in the full release position against the release stop, and with power cylinder piston rod fully extended, the lever and yoke settings should be as illustrated in Fig. 3, release position; that is, with the clearance between the power lever pedal shaft hole and the pedal shaft on the forward side as shown at (B). Also piston rod yoke pin should just bear against the rear side of the valve operating lever yoke, as shown in Fig. 3 at (C), which will permit maximum valve rod travel (of ¼") on brake application.

In checking adjustments, shut off the engine and exhaust all vacuum from power unit, then depress the brake pedal slowly. A movement of ⅝" on D-35 and D-40 and ⅜" on D-50 and D-60 of the brake pedal should bring lever and yoke positions as shown in Fig. 4, application; that is, with power lever shaft hole contacting the pedal shaft on the forward side (B) of Fig. 4 and with piston rod yoke pin contacting the forward side of valve operating lever (L) as shown at (C), Fig. 4.

Any improper adjustment of the pedal linkage will directly affect the application and operation of the brakes.

If the operation is not satisfactory then carry out the following adjustment procedure which will simplify the adjustments considerably:

1. Clean reactionary linkage thoroughly.
2. Loosen valve operating lever anchorage screw (S), Fig. 1.
3. Remove master cylinder and power cylinder yoke pins (D) and (E); see that levers and links are free of bind.
4. Block pedal in release position and check to see that clearance between power lever shaft hole and pedal shaft is on the forward side as shown in Fig. 3 at (B).

IMPORTANT—Clearance between power lever hole and pedal shaft must be maintained. Do not permit dirt to accumulate at this point. See that felt seal is installed in power lever hub at the clamp bolt and that keyway opening on the outside is sealed with a hardwood plug.

5. Pull power cylinder piston rod outward until piston bottoms in cylinder, and check alignment of hole in piston rod yoke with power lever hole. If these points do not line up so that the pin can be inserted without movement of either part, then loosen lock nut (F) at the mounting bracket end and make the necessary adjustment on the mounting yoke. **NOTE: DO NOT ATTEMPT TO ADJUST PISTON ROD YOKE as this affects the internal valve action.**
6. When piston rod yoke pin is inserted, the rear side of valve rod yoke bushing should be against pin (E) as shown in Fig. 1. Then tighten valve operating lever anchorage screw (S), being careful not to disturb position of valve. **NOTE: BE SURE VALVE OPERATING LEVER IS CENTRALIZED ON VALVE ROD YOKE BUSHING TO AVOID BINDING OF THE VALVE.**
7. If adjustments are made correctly, depression of the brake pedal, without the engine running, should move the valve rod in ¼" before any movement of the power cylinder piston rod occurs.
8. To adjust master cylinder yoke, depress brake pedal sufficiently to bring the forward wall of the valve rod bushing against the piston rod yoke pin as shown at (C), Fig. 4, and to move the power lever so that the clearance is at the rear side of the pedal shaft as shown at (B), Fig. 4. Holding the levers in this position, align holes in master cylinder yoke and power lever. If lineup is not correct, adjust master cylinder yoke. Then tighten lock nut and insert yoke pin (D) and cotter.
9. Check to see that all cotter pins have been replaced, and lock nuts and capscrews are tightened.

Lubrication

The power unit should be lubricated every 10,000 miles with 2 oz. of Bendix Vacuum Cylinder Oil. To lubricate, remove the pipe plug in the power cylinder end plate and insert 2 oz. of Bendix Vacuum Cylinder Oil, after which the pipe plug should be replaced.

At every chassis lubrication spray the valve and power lever assembly with light oil.

Cleaning

The air cleaner mounted on the power unit should be cleaned at least twice a year or more often, depending upon dust conditions. Remove the air cleaner and wash thoroughly in cleaning solution, dry and then saturate with light machine oil. Clean off all dirt from power unit and check to see that rubber dust guard is in good condition, and properly fitted in the recesses for it at each end. If the rubber guard is damaged it should be replaced.

Testing of the Vacuum Power Unit

In case above adjustments and lubrication fail to correct faulty action, then the following tests should be made:

1. Remove pipe plug in the power cylinder end plate and connect vacuum gauge.
2. Then start engine and note reading on vacuum gauge. It should read from 16 to 20 inches. Next stop engine and note how long vacuum is retained. It should hold vacuum for a reasonable length of time. If gauge shows rapid drop(more than 10 inches in 10 seconds), a leak is indicated. This leakage may be in the power cylinder, in the vacuum lines or fittings.

3. Test the check valve by connecting vacuum gauge to bottom connection of check valve. Start engine, note gauge reading, then stop engine. If gauge shows a drop of more than 10 inches in 1 minute, the valve should be replaced.
4. Before testing vacuum line, inspect all hose and tubes to see that they are in good condition, and check all connections to see that they are tight. Connect vacuum gauge in power cylinder end of vacuum line. Start engine and note gauge reading. Then stop engine and note the drop in vacuum. The drop should not exceed that drop at the check valve.
5. If tests 3 and 4 show no excessive drop in vacuum (more than 10 inches in 1 minute), then connect vacuum gauge back in power cylinder end plate and repeat second test. If gauge still shows drop greater than 10 inches in 10 seconds, the leak is in the power cylinder and it should be serviced or replaced.

In case replacement of internal parts be required; because of wear or abuse, the power units should be taken to an Official Bendix B-K Service Station.

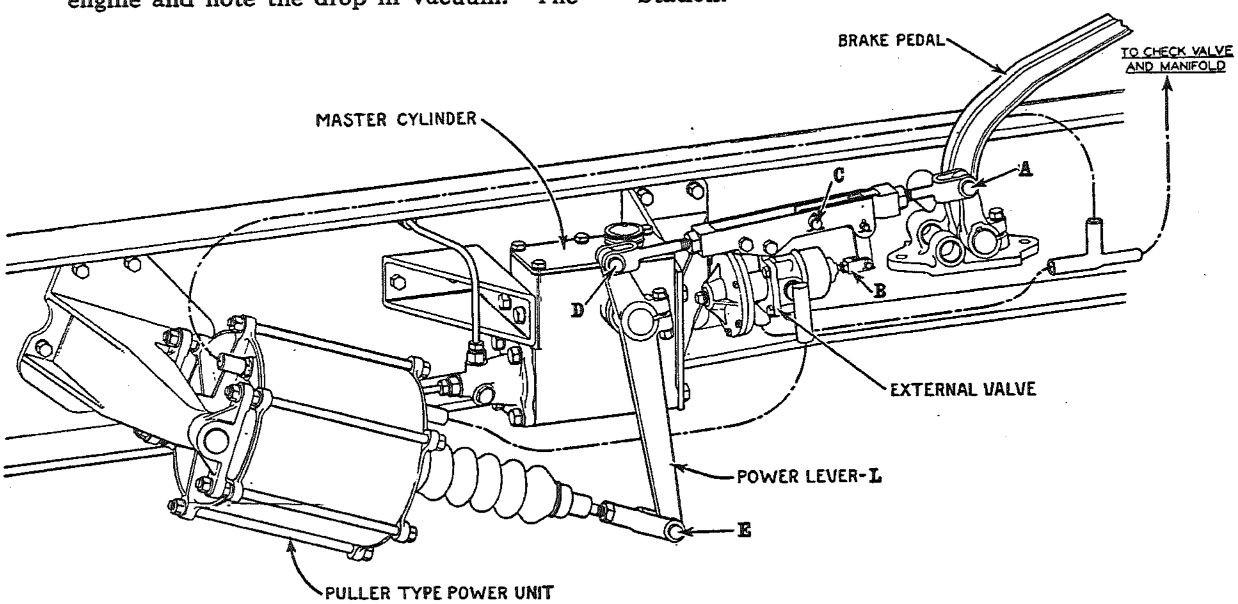

Fig. 7, Vacuum Power Unit Installation—D-246T, D-246F
(See Page 1 for Other Models)

Vacuum Power System

The vacuum power unit consists of a power cylinder, a reactionary valve, the cylinder mounting bracket, the reactionary valve linkage and the hydraulic master cylinder power lever "L". The power cylinder is of the vacuum suspended type, i.e., with both sides of the piston submerged in vacuum when the brakes are in the release position. The external brake valve is so mounted in a special form of brake pedal linkage that the full load on the brake pedal rod is not carried by the valve. The power cylinder is mounted on a swivel bracket with the piston rod connected directly to the hydraulic master cylinder power lever.

When the brake pedal is depressed, the initial pedal travel moves the valve operating linkage to actuate the brake valve. Upon opening the valve, air at atmospheric pressure is admitted through the air cleaner and atmospheric port of the valve to the rear end of the power cylinder. With the admittance of air at atmospheric pressure to the power cylinder, the piston moves backward in the power cylinder applying power to the hydraulic brake system through the power lever to actuate the brakes.

However, since the external brake valve is mounted in the brake pedal to master cylinder linkage, there is a follow-up action taking place which tends to keep closing the brake valve. The follow-up action in the linkage along with the reaction set up within the valve itself retains the normal "feel" in the brake pedal, and assures the operator full control over the vehicle, since deceleration is then in direct proportion to pedal pressure.

Adjustments

If the vacuum power unit is not functioning properly or if it is found necessary to replace any of the power unit parts, the following adjustment procedure should be followed:

1. Remove the clevis pins at (A) and (E).
2. Block brake pedal against the toe board.
3. Pull forward on the lower end of the power lever (L) until it is against its stop.
4. With the power lever (L) held in its fully released position, adjust power cylinder piston rod yoke so that the hole in the power lever and the hole in the piston rod yoke are in line.

5. Pull forward slightly on the valve linkage to remove any lost motion between the master cylinder piston and the internal lever. Adjust valve link (A) to (D) so that clevis pin at (A) can just be inserted. **NOTE:** When making this adjustment clevis pin (C) should rest against the forward side of the clearance hole in the valve yoke link.
6. Insert clevis pin at (A) and (E).
7. Tighten adjustable yoke lock nuts.
   NOTE: Valve rod yoke (B) is correctly set at the time of factory assembly and should not be changed as any change in the setting will seriously affect the operation of the valve.

After completing the above adjustments, depress the brake pedal with the engine shut off. If the adjustments have been made properly, the pedal should have from 3/16 inch to 5/16 inch of free play. This movement should operate the valve but not the complete brake linkage. Upon depressing the brake pedal an additional amount, the entire power linkage should move. Depress the pedal again, removing only the free play and start the engine. If the power unit is operating satisfactorily, the pedal will move down an additional amount as soon as the engine is started. This indicates that the power brake system is functioning properly.

Lubrication

Every 10,000 miles, remove the pipe plug from the piston rod end of the cylinder and inject 2 oz. of Bendix Vacuum Cylinder Oil in the cylinder, after which the pipe plug should be replaced. At every chassis lubrication all clevis pins and lever bearings should be lubricated with light oil.

Cleaning

The air cleaner of the external brake valve should be removed, taken apart and cleaned at least twice a year; oftener if operated in dusty sections or on gravel or dirt roads. Remove the hair cleaning element, wash in cleaning solution and allow to dry, then dip hair cleaning element in light machine oil and allow to drain, after which the air cleaner should be reassembled on the valve. Inspect rubber dust guard on the power cylinder piston rod and if damaged, replace.

Testing of the Vacuum Power Unit

1. Remove the pipe plug from the end plate of the power cylinder and attach a vacuum gauge at this point.
2. Start the engine and note the reading on the vacuum gauge. It should show a reading of between 16 inches and 20 inches. Now stop the engine and note if the vacuum is retained for a reasonable length of time. If the gauge shows a rapid dropping off (more than 10 inches in 10 seconds) it indicates a leak which may be in the cylinder, in the vacuum lines, in the check valve mounted on the dash, or in the external brake valve.
3. Start the engine again and depress the brake pedal. If the vacuum gauge does not drop to zero it indicates that the external brake valve is not functioning properly.
4. To test the external brake valve, disconnect the vacuum line at the brake valve that connects the valve with the piston rod end of the cylinder, and connect the vacuum gauge at this point. Start the engine and note the vacuum gauge reading. Then stop the engine and note if the vacuum is retained for a reasonable length of time. If the vacuum gauge shows a rapid drop of vacuum (more than 10 inches in 10 seconds) it indicates a leak in the check valve. If a vacuum gauge is not available, another test of the external brake valve may be made by disconnecting both vacuum lines from the valve. Close off the port which is connected to the intake manifold with the thumb and suck through the opposite connection. If no air can be drawn through the valve, it does not leak.
5. Test the check valve by connecting the vacuum gauge to the bottom of the check valve. Start the engine and note the vacuum gauge reading. Then stop the engine. If the gauge shows a drop of more than 10 inches in one minute the check valve should be replaced. Another test for the check valve, in case a vacuum gauge is not available, is to remove the line from the check valve to the intake manifold and suck through the opposite connection. If air can be drawn through the check valve it should be replaced.
6. Before testing the vacuum lines, inspect all vacuum hose and copper tubing to see that it is in good condition and check all connections to see that they are tight. Connect the vacuum gauge to the end of the hose which is attached to the cylinder at the end opposite the piston rod. Start the engine, note the vacuum gauge reading, and then stop the engine. If the vacuum line is in good condition and all connections are tight, the drop in vacuum should not exceed 10 inches in one minute.

If leakage is indicated in the power cylinder, the check valve, or the external brake valve, these units should be taken to an Official Bendix B-K Service Station for repairs or replacement.

Air Brakes

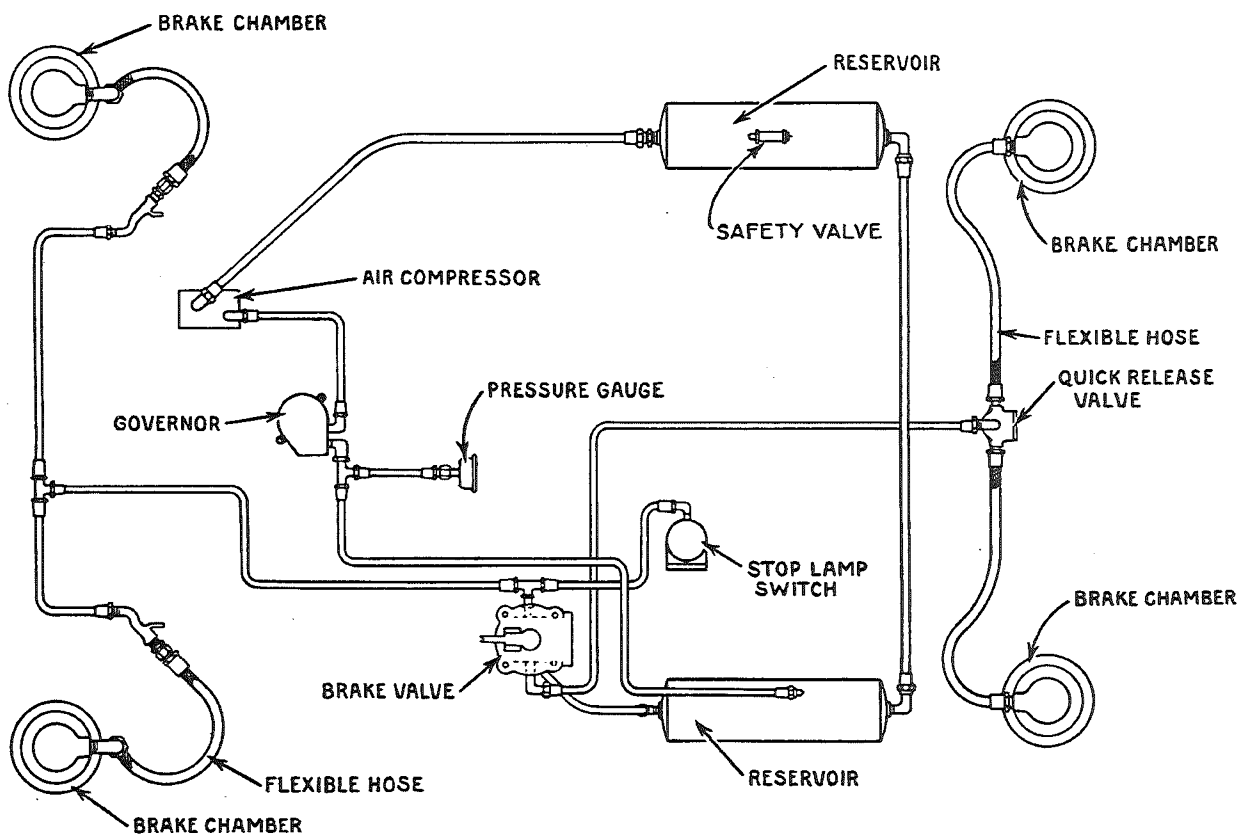

Fig. 1, Typical Air Brake Installation (4-Wheel)

Air Brake System

The principle parts of the air brake system are shown in Figs. 1 and 2.

A **compressor** furnishes compressed air for brake operation.

An **air cleaner,** filled with curled hair and connected to the intake port of the compressor, removes foreign matter from the air.

Reservoirs receive the air from the compressor and store it for use in the brake system.

A **governor** regulates the reservoir pressure between minimum and maximum settings.

A **safety valve,** located on one of the reservoirs, protects against the possibility of excessive pressure in the reservoirs.

A **brake valve,** operated by foot pressure, controls brake operation by controlling the flow of air from reservoir to brake chambers in brake application and from brake chambers to atmosphere in release.

A **quick release valve** (4-wheel trucks) assists the brake valve in release by exhausting the rear brake chambers and thereby producing speedy and simultaneous release on all wheels.

A **relay valve** (6-wheel trucks) located central to the four rear wheels speeds up the application and release of the rear wheel brakes.

An **air gauge,** located on the dash, indicates the air pressure in the reservoir.

Brake chambers, one for each wheel, convert the stored energy of the compressed air into mechanical force to apply the brakes.

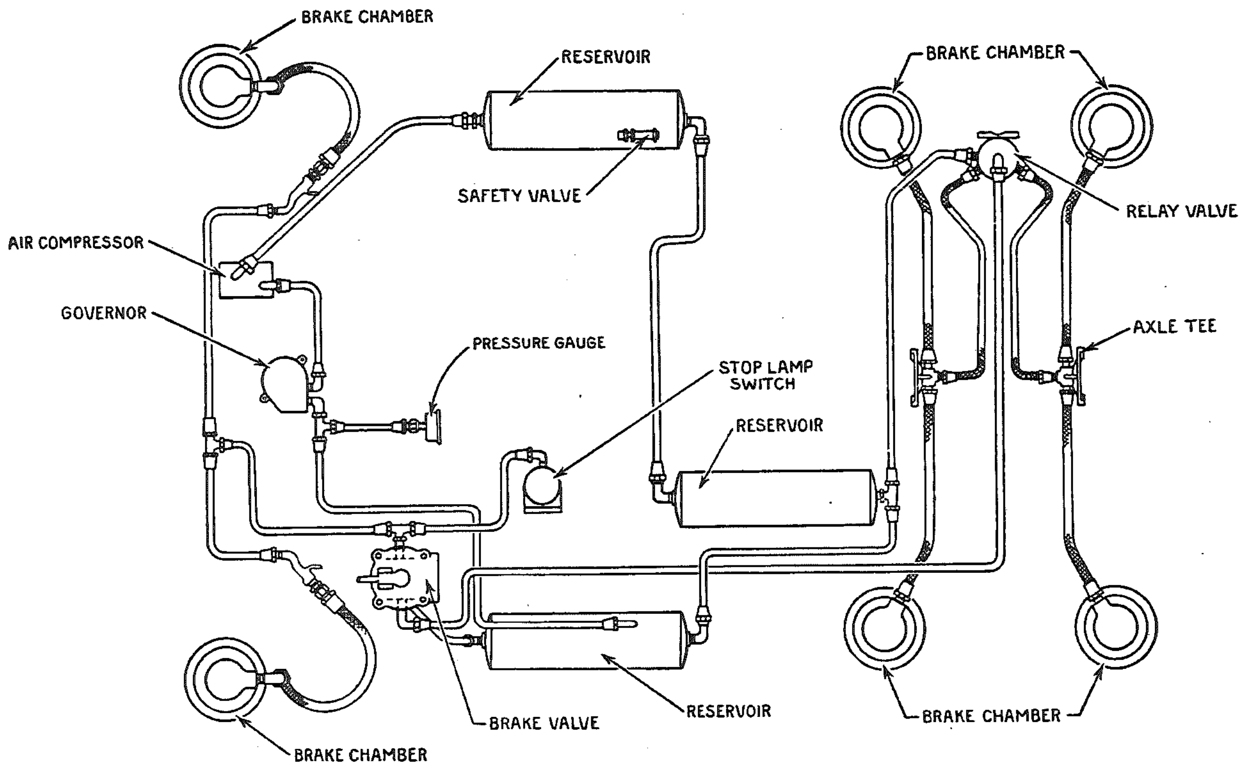

Fig. 2, Typical Air Brake Installation (6-Wheel)

Operation of the Equipment

Charging

The reservoirs are charged with air by the compressor. The reservoir air has access to the inlet valve chamber of the brake valve and the inlet valve is then held closed by the tension of its spring and air pressure.

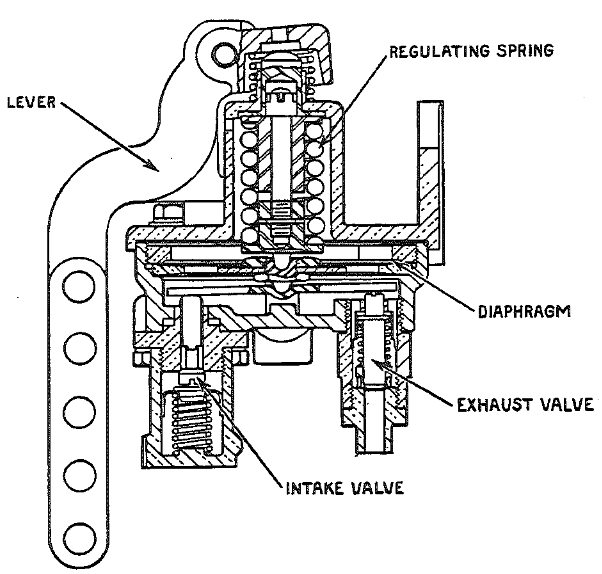

Fig. 3, Brake Valve

Service Application

When it is desired to apply the brakes, foot pressure is applied to the brake pedal, which action is carried through the brake rod pulling up on the lever of the brake valve. This compresses the spring, deflects the diaphragm downward, and through the medium of the rocker arm closes the exhaust valve and opens the inlet valve. Air is thereby admitted from the reservoir to the brake valve, thence out the two side outlets to the front and rear brake chambers. The power thus exerted against the brake chamber diaphragms or pistons forces the push rods out, rotating the cam shafts to apply the brakes.

In flowing to the rear brake chambers the air pressure passes through the quick release valve entering at the top, deflecting the diaphragm and its seat to seal the exhaust opening while the air pressure passes around the diaphragm to the two side connections, each leading to a brake chamber.

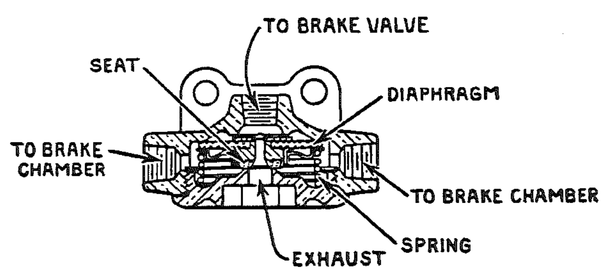

Fig. 4, Quick Release Valve

In the case of the relay valve (6-wheel models), the connections lead to tee connections and from there to each of the four rear brake chambers.

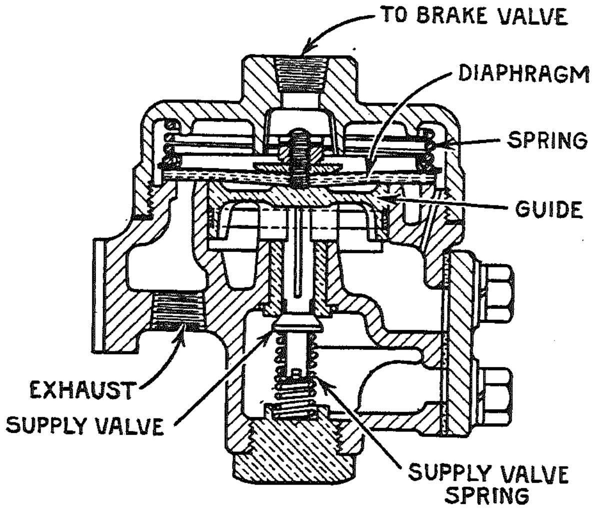

Fig. 5, Relay Valve

When the pressure built up in the brake chambers and acting against the brake valve diaphragm is enough to compress the regulating spring, the diaphragm moves upward, allowing the inlet valve to close by action of its spring.

The exhaust valve remains closed by action of the inlet valve spring and tilting of the rocker arm. Further increase of brake chamber pressure is thus prevented. If, however, there should be leakage from the brake chambers or piping, while the brake valve lever remains in this position, the resulting drop in pressure under the brake valve diaphragm will cause the regulating spring to again unseat the inlet valve and restore the lost pressure.

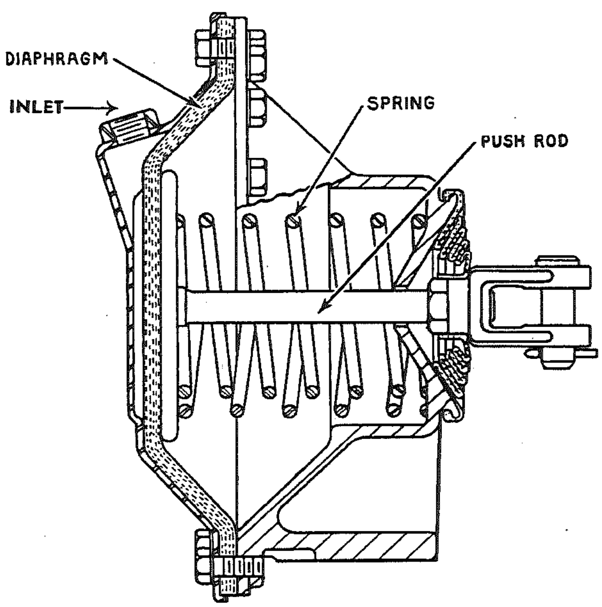

Fig. 6, Typical Brake Chamber (Diaphragm Type)

Release

When the foot is removed from the brake pedal, the brake valve lever is moved back toward normal position again, which relieves the tension on the regulating spring so that the diaphragm will be moved upward to its normal position by brake chamber pressure underneath it. This permits the exhaust valve to be unseated by its spring which opens brake chamber line to atmosphere and allows air to exhaust from the brake chambers.

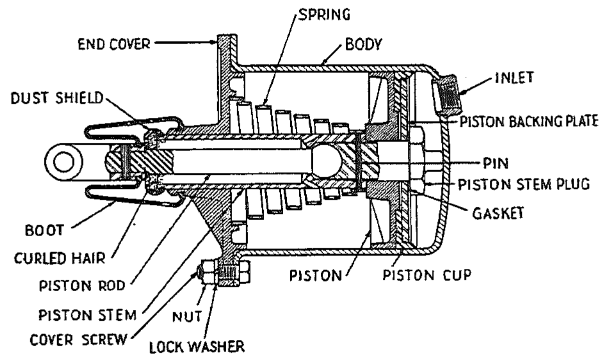

Fig. 7, Typical Brake Chamber (Piston Type)

If the brake valve lever is moved all the way back to normal position and left there (foot entirely removed from brake pedal), the brakes will entirely release, but if moved only part way back (foot pressure eased), the brakes will only partially release, i.e., the exhaust valve will remain open until the brake chamber pressure has reduced to such an amount as will no longer hold the diaphragm up, whereupon the regulating spring will move the diaphragm, with rocker arm, downward again and close the exhaust valve.

The brake chamber line to the rear wheels is released only up to the quick release valve or relay valve. This allows the diaphragm to unseat, uncovering the exhaust port through which the rear brake chambers are then exhausted.

Operating Instructions

The foot pedal is normally held in release position by the action of a spring. To make a light application of the brakes, depress the pedal slightly; to make a heavier application, depress the pedal further. Removing the foot from the pedal automatically releases the brakes.

How heavy an application should be made for ordinary stops depends upon the circumstances in each particular case, such as the speed and load on the vehicle, condition of the roadway, kind of stop desired and regard for comfort.

The air brake is designed so that when the lever of the brake valve is moved to the limit of its stroke an emergency application results, which will stop the vehicle in the shortest possible time.

This heavy application should be reserved for emergencies, and not employed in ordinary service braking.

The retarding effect depends upon the adhesion between the tires and the roadway, and is a maximum when the wheels are just at the point of sliding. If the wheels slide, the retarding effect is, to a large extent, lost.

The retarding effect of any given braking pressure is greater at low than at high speeds, and a heavy application at low speeds may result in sliding the wheels. When running at high speeds, however, a heavy initial application may be made, as it is desirable to obtain the most effective retardation when the speed of the vehicle is greatest.

The best possible stop will be made when the brakes are applied as hard at the very start, as the speed and condition of the road will permit, and then graduated off as the speed is reduced, so that at the end of the stop but little pressure remains in the brake chambers.

Never apply the brakes lightly at first, and increase the pressure as the speed diminishes—it not only makes a longer stop but the final high pressure will be likely to produce a rough stop.

To properly weigh all these varying factors in every stop becomes, after a little practice, an act of subconscious judgment. Careful attention to cause and effect and a desire to improve are the necessary qualifications in order to become expert in handling this equipment.

In making a stop or a slow-down from any speed above the idling speed of the engine, allow the engine to remain in gear with throttle closed to get the full benefit of its retarding effect, disengaging the clutch when the idling speed is reached. With the knowledge of ample braking power in reserve, many slow-downs can be accomplished by drifting and utilizing the retarding effect of the engine, whereas without the air brake it would be necessary to apply brakes much earlier in order to be sure to be able to stop if necessary.

In graduating the brakes off, do not "fan" the brake valve, repeatedly releasing and applying the brakes, as this wastes air pressure.

NOTE: Before starting the vehicle, observe the gauge. This shows the pressure stored in the reservoir. which must be 40 pounds or over, before the air brake can develop its full effectiveness.

Air Compressor Mounting

This unit is attached to the timing gear cover by means of an adapter and is supported at the rear by a bracket that is attached to the crankcase. Fig. 8 illustrates the installation.

The air compressor is gear driven and if removed for any purpose, care must be taken that it is properly timed with the engine when reinstalled. The proper timing of the air compressor with the engine consists of the synchronization of the reciprocating parts of the compressor with those of the engine, which is conducive to longer gear life and quieter compressor operation.

In order to accomplish this, set engine at the position of No. 1 intake valve opening and install compressor with drive gear key, **up.**

If there is excessive backlash between the camshaft and air compressor gears a noise or whine will be heard. This can be eliminated by shifting the compressor slightly toward or away from the engine until the noise or whine disappears.

When the compressor has been set correctly so there is the right amount of gear backlash and no gear noise, tighten all mounting screws securely.

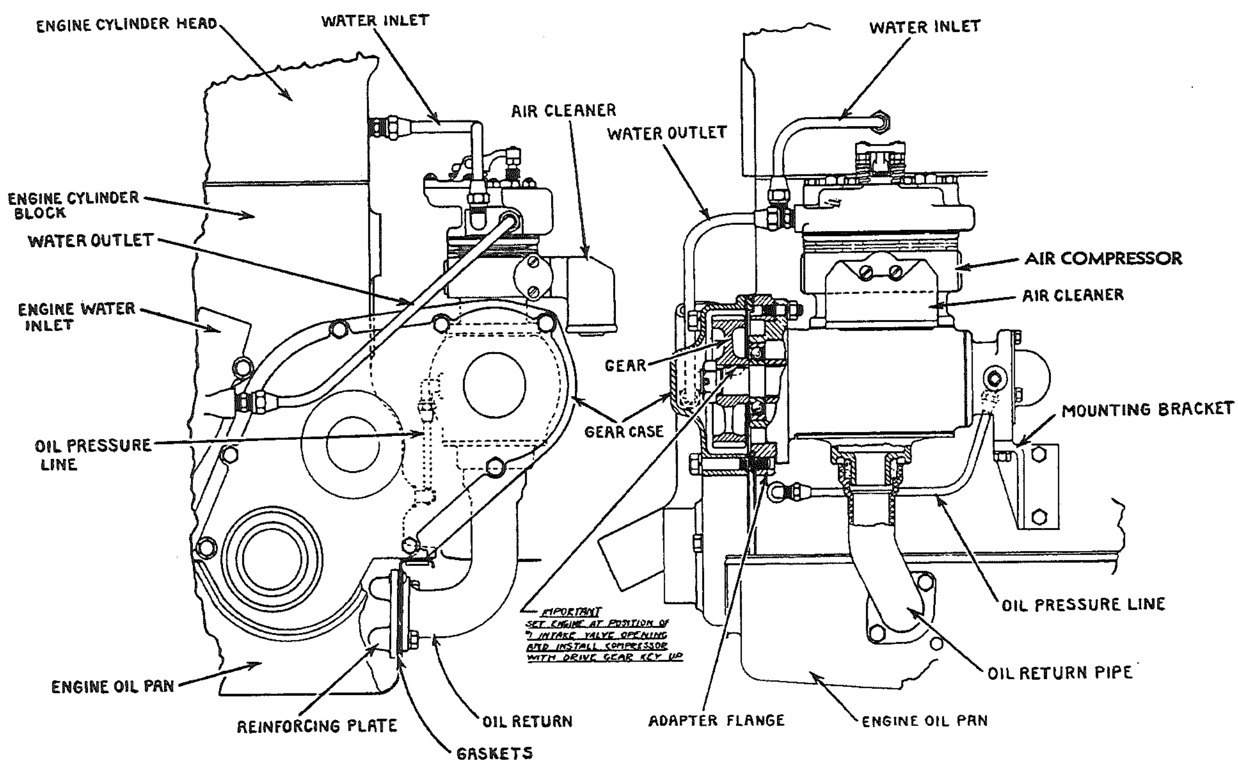

Fig. 8, Air Compressor Installation

Air Compressor Water and Oil Connections

Compressor is cooled by water taken from the engine cylinder head and discharged into the engine water inlet.

Oil is supplied under pressure to the compressor thru a line connected to the main oil line in engine crankcase and to the compressor end bearing. Oil return is thru the pipe attached to the compressor base and engine oil pan.

Fig. 7 illustrates these connections.

Maintenance Instructions

Successful maintenance of air brake equipment depends upon systematic inspection and repair of each device at regular intervals. How long these intervals should be depends largely upon the service and the mileage.

It is recommended that whenever possible, the units to be repaired be taken to the nearest authorized Bendix-Westinghouse Service Station.

Air Compressor

A cross section of the air compressor is shown in Fig. 8.

At the end of every 10,000 miles of operation, or oftener, depending upon the operating conditions, the cylinder head should be removed and carbon cleaned away from the discharge and unloading valves. Adjust unloading valve clearance to .010″–.015″ between top of valve and adjusting screw. Check unloading device by applying 60 pounds of air pressure to the unloading connection, at which the unloading valves should unseat. Test unloading diaphragm cover for leakage with soapsuds. If unloading device does not function, remove and thoroughly clean diaphragm and follower.

Remove curled hair in air cleaner and wash thoroughly in kerosene, then saturate with a light lubricating oil and replace. If operating under extreme dusty conditions the air cleaner should be cleaned more often.

Brake Chamber

With the brakes applied, test the brake chambers for leakage with soapsuds around the outer edge and also around the clamping bolts. The diaphragm should be replaced at least once every year.

Brake Chamber Adjustment

In order to reduce the air consumption, the brakes should be kept in adjustment so that the brake chamber push rod travel is kept to a minimum, which is approximately 7/8″ on rear and 3/4″ on front chambers. In making brake adjustments be sure that the push rod is against the diaphragm in release position.

If the stroke of the rear brake chamber push rod exceeds 1 3/4″ or 1 3/8″ for the front brake chamber push rod, brakes should be adjusted by turning slack adjuster nut, which rotates the brake shoe camshaft and reduces clearance between shoes and drum.

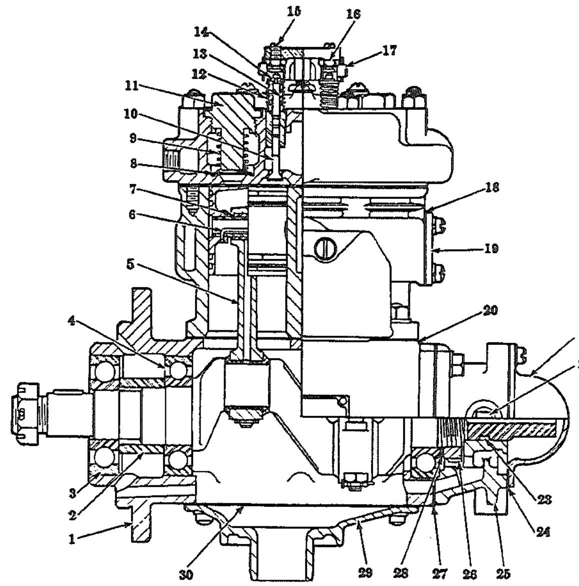

Fig. 9, Air Compressor

No.	Description	No.	Description
1.	Crankcase.	16.	Hex. nut.
2.	Bearing spacer.	17.	Lever pin.
3.	Ball bearing.	18.	Gasket.
4.	Ball bearing.	19.	Cover.
5.	Connecting rod.	20.	Cylinder block gasket.
6.	Lock wire.	21.	End cover.
7.	Bearing bushing.	22.	Pipe plug.
8.	Discharge valve.	23.	Oil seal ring.
9.	Discharge valve spring.	24.	Gasket.
10.	Unloading valve.	25.	End bearing.
11.	Cap nut.	26.	Lock nut.
12.	Unloading valve spring.	27.	Gasket.
13.	Unloading valve stop.	28.	Lockwasher.
14.	Spring retainer ring.	29.	Cover.
15.	Adjusting screw.	30.	Gasket.

Reservoir

Moisture taken in with the air through the compressor inlet valves collects in the reservoirs and necessitates draining the reservoir daily in cold weather and every week in warm weather by opening the drain cock located on the bottom. Be sure to close the drain cock after all moisture has been removed.

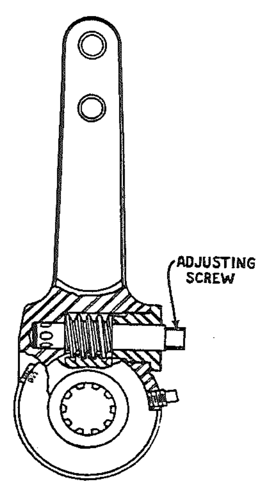

Fig. 10, Slack Adjuster

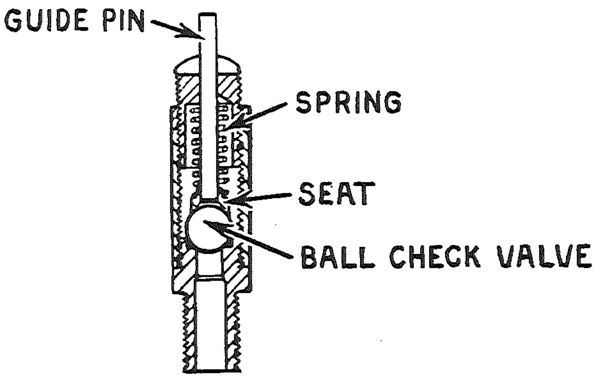

Fig. 11, Safety Valve

Safety Valve

The safety valve should be regularly checked for leakage and thoroughly cleaned once a year and reset to blow off at 150 pounds.

Quick Release Valve and Relay Valve

The valve should be tested at regular intervals for leakage by applying soapsuds on the exhaust port with the brakes applied. On releasing the brakes see that the valve releases immediately with the corresponding return movement of the foot pedal. Leakage may be caused by dirt in the valve or a defective diaphragm. As a rule the diaphragm should be replaced at least once every year.

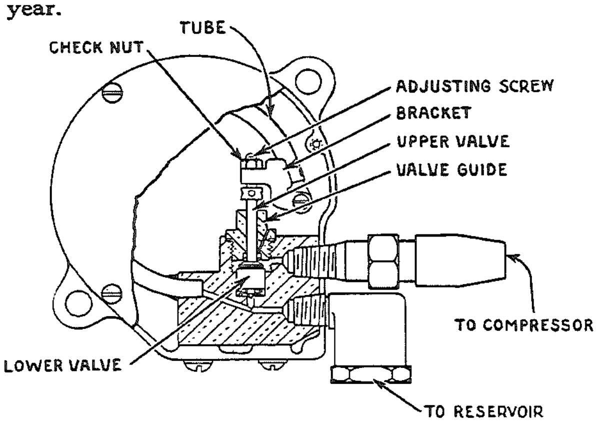

Fig. 12, Governor

Governor

After 10,000 miles of service, the governor should be inspected and adjusted, if necessary, so that the cut-in pressure is 85 pounds and the cut-out pressure is 100–105 pounds. It should also be tested for leakage and if found to be leaking a new or a factory-reconditioned governor should be installed.

To raise the cut-in pressure, increase the tension of the tube on the valve by screwing down the adjusting screw. To raise the cut-in and cut-out range, remove one or more shims from underneath the upper valve nut.

This should be done by an Authorized Bendix-Westinghouse Service Station as special tools are required.

Brake Valve

The brake valve should be tested for leakage and delivery pressure at the end of each 10,000 miles. This can be done without removing it from the truck by having the reservoir fully charged and testing as follows:

1. With the foot pedal in release position, test the intake valve for leakage by applying soapsuds on the exhaust port.
2. With the foot pedal in application position, test the exhaust valve for leakage by applying soapsuds on the exhaust port.
3. Connect a test gauge to any convenient point in the brake chamber line and test the delivered pressure by depressing the foot pedal to the floor or against the stop. If the pressure obtained is less than reservoir pressure at time test is made, the pedal rod should be shortened or the clevis at the brake valve should be connected to one of the upper holes in the brake valve lever. Care should be exercised in making this adjustment that the brake valve lever is not used as a pedal stop, otherwise breakage of the brake valve cover will occur when the first hard brake application is made.

   If either the intake or exhaust valve is found to leak excessively, the brake valve should be replaced.
4. IMPORTANT—After making above adjustments be sure brake valve operating lever returns to its stop or full release position, otherwise the exhaust valve will be held partially closed and slow release of brakes will result.

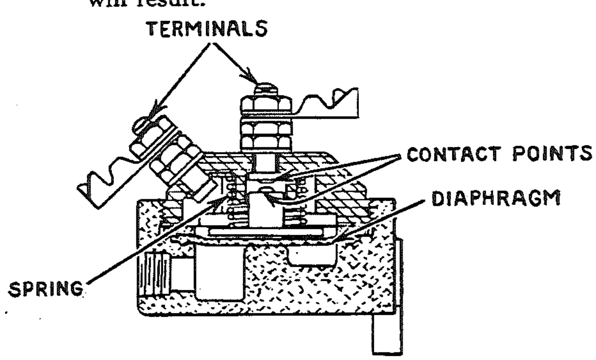

Fig. 13, Stop Light Switch

Stop Light Switch

With brakes applied, test for air leakage using soapsuds around the fitting and terminals. Check to see if stop light circuit is closed when brakes are applied.

Care of Brake Shoes

Keep all lubricant away from brake lining.

Lining for front brake shoe is one piece and is riveted to shoe. Lining for rear brake shoe is two-piece and is bolted to shoe. Be sure rivets or bolts are tight when relining shoes.

"Exchange" replacement shoes with lining assembled are also available.

Models D-2, D-5 — 12 x 1¾", Single Anchor, Hydraulic Brakes — Front and Rear

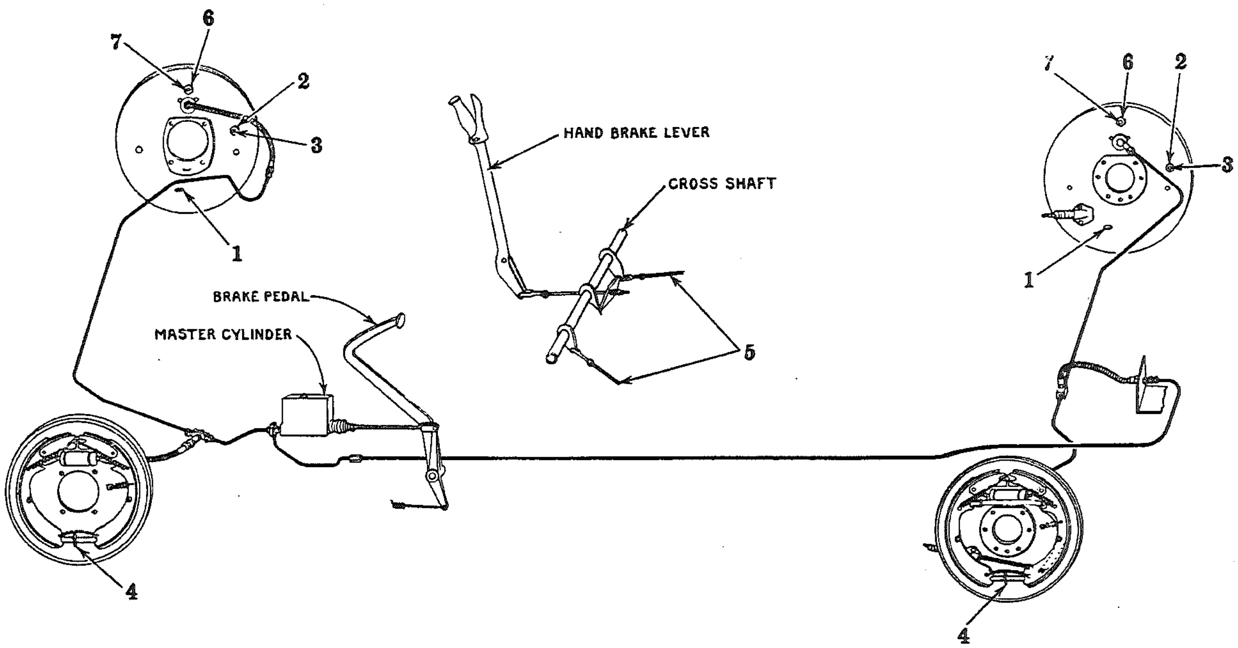

Fig. 1, Brake Adjustment Diagram

Adjustment for Wear

(a) Jack up all wheels and have brake control system in release position. Disconnect hand brake cables to rear wheels at cross shaft.

(b) Remove brake adjusting hole covers (1).
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nut (2) on eccentric adjustment (3).

(d) Turn eccentric adjustment in direction of wheel rotation when truck is moving forward, until a decided drag is felt when wheel is pulled over by hand.

(e) Then turn eccentric adjustment in the opposite direction slowly until wheel is just free of drag.

(f) Hold eccentric in this position and tighten eccentric adjustment lock nut.

(g) Turn adjusting screw (4), using special brake tool or a screw driver until brake shoes are expanded tightly against brake drum.
NOTE: At this time check hand brake cables as covered under paragraph (c), "Hand Brake Cable Adjustment."

(h) Back off adjusting screw (10 to 12 notches) until wheel is free of drag.

(i) Make this adjustment at each of the wheels.

(j) If, after making the above adjustments, brakes are not satisfactory, it will be necessary to follow procedure under "Major Adjustments."

Hand Brake Cable Adjustment

Hand brake cables (5) should be checked, when adjusting brake shoes for wear and adjusted, if necessary.

(a) Remove clevis pins from yoke end of cables and pull hand brake lever back two notches.

(b) Then with brake shoes expanded tight against drum, as in paragraph (g) "Adjustment for Wear," pull cables up by hand, removing all slack.

(c) If cable lengths are correct, the hole in yoke and hole in cross shaft levers will line up so that clevis pin can just be inserted. If holes do not line up, lengthen or shorten cables as required by turning adjustable yokes. Release hand brake lever.

(d) After checking cable adjustments back off adjusting screws on both rear wheels an equal number of notches (10 to 12) until wheels are free of drag.

Major Adjustments

The following instructions are necessary only when fitting replacement shoes or when instructions under "Adjustment for Wear" fail to give satisfactory results. Never reline the brake shoes. Use "Exchange" replacement shoes with lining assembled and burnished to a perfect circle. This will assure a satisfactory job at a cost comparable with that of relining.

During the removal or installation of brake shoes, the position of the hydraulic brake system should not be altered, otherwise bleeding of the lines will be required. **NOTE:** The brake pedal must never be depressed at any time when the brake drums are not in place.

(a) Jack up all wheels and have brake control system in release position. Disconnect both hand brake cables to rear wheels at cross shaft.

(b) Remove brake adjusting hole covers (1).

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nuts (2) on eccentric adjustments (3).

(d) Loosen anchor pin lock nuts (6) one complete turn.

(e) Turn eccentric in direction of wheel rotation when truck is moving forward, until a decided drag is felt when wheel is pulled over by hand, then back off until wheel is free of drag.

(f) Then insert a .010″ feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw and anchor ends of the secondary shoe (shoe against which eccentric operates).

The clearance at both ends of the secondary shoe should be the same within .002″ variation. If variation between the two ends is greater than this or if anchor end clearance is greater than adjusting end clearance, it will then be necessary to change anchor pin position.

(g) Turn anchor pin (7) in direction of wheel rotation to **reduce** lining clearance at anchor end of secondary shoe and in opposite direction to **increase** this clearance. It may be necessary to move both the anchor pin and eccentric adjustment to secure proper clearance.

(h) When recommended shoe clearances are obtained hold anchor pin in this position and tighten anchor pin lock nut as tight as possible, using a 16″ wrench. Also hold eccentric adjustment in position and tighten eccentric lock nut.

(i) Turn adjusting screw (4), using special brake tool or a screw driver, until brake shoes are expanded tight against brake drum.

(j) Connect hand brake cables as outlined under "Hand Brake Cable Adjustment."

(k) Back off adjusting screw 10 to 12 notches.

NOTE: On rear brakes back off an **equal** number of notches on **both** wheels.

(l) Replace adjusting screw hole covers.

(m) Check all wheels to see that they are free of drag and remove jacks.

(n) Road test truck or test brakes on brake tester for balance.

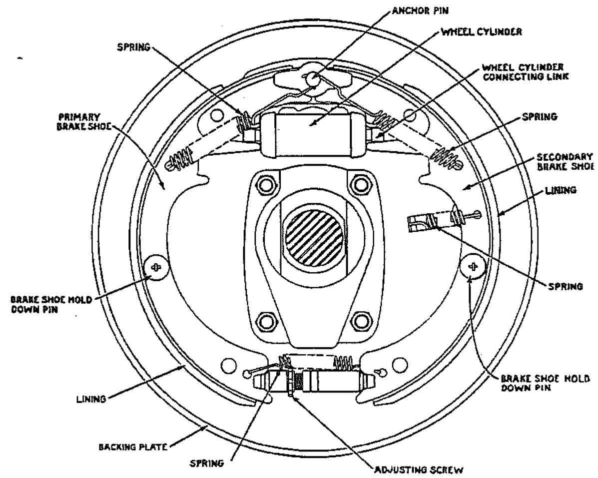

Fig. 2, Front Brake

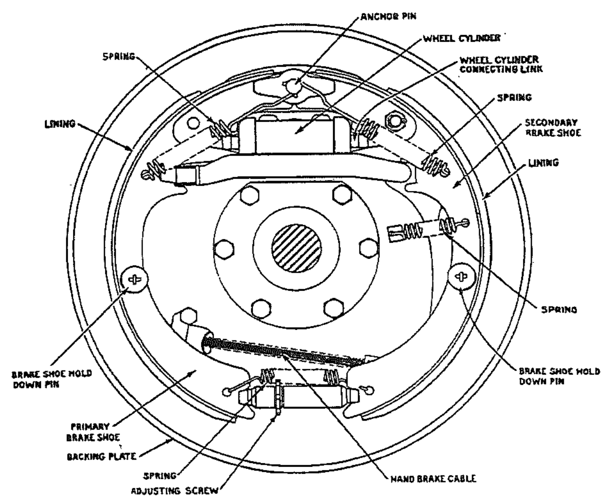

Fig. 3, Rear Brake

Model D-15 { 12 x 1¾" (Front) / 14 x 2" (Rear) } Single Anchor, Hydraulic Brakes

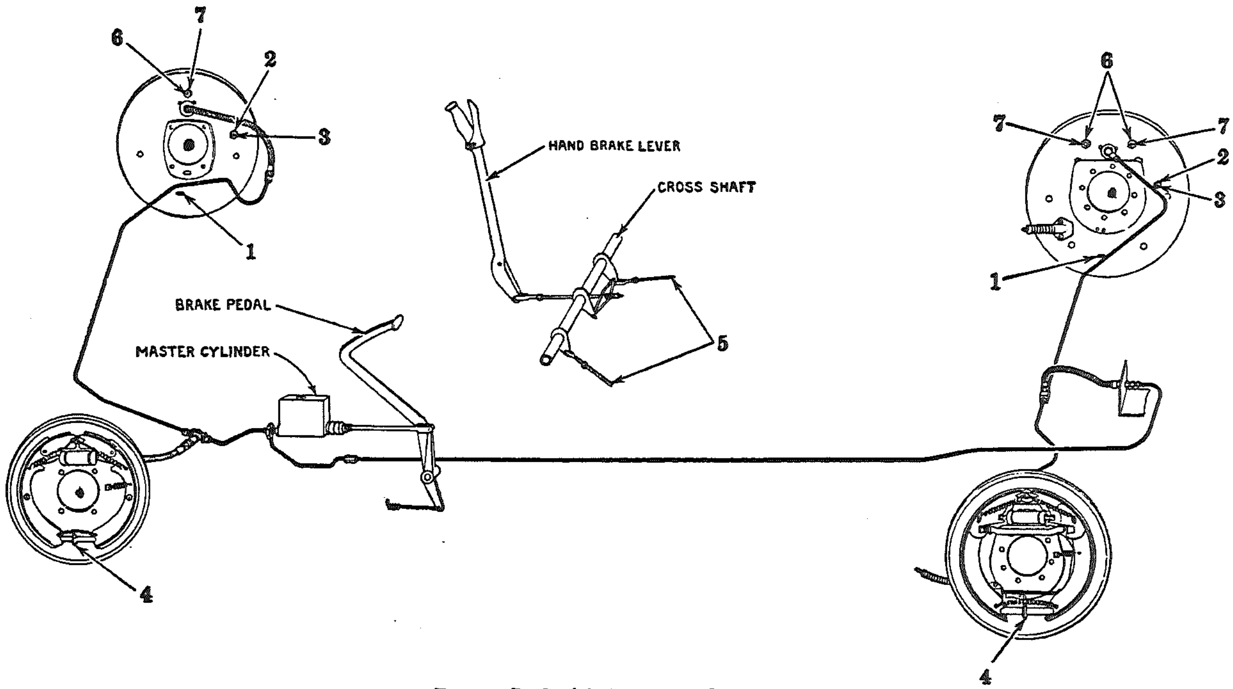

Fig. 1, Brake Adjustment Diagram

Adjustment for Wear

(a) Jack up all wheels and have brake control system in release position. Disconnect hand brake cables to rear wheels at cross shaft.

(b) Remove brake adjusting hole covers (1).

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nut (2) on eccentric adjustment (3).

(d) Turn eccentric adjustment in direction of wheel rotation when truck is moving forward, until a decided drag is felt when wheel is pulled over by hand.

(e) Turn eccentric adjustment in the opposite direction slowly until wheel is just free of drag.

(f) Hold eccentric in this position and tighten eccentric adjustment lock nut.

(g) Turn adjusting screw (4) using special brake tool or a screw driver until brake shoes are expanded tightly against brake drum.

NOTE: At this time check hand brake cables as covered under paragraph (c), "Hand Brake Cable Adjustment."

(h) Back off adjusting screw (10 to 12 notches) until wheel is free of drag.

(i) Make this adjustment at **each** of the wheels.

(j) If, after making the above adjustments, brakes are not satisfactory, it will be necessary to follow procedure under "Major Adjustments."

Hand Brake Cable Adjustment

Hand brake cables (5) should be checked when adjusting brake shoes for wear and adjusted, if necessary.

(a) Remove clevis pins from yoke end of cables and pull hand brake lever back two notches.

(b) Then with brake shoes expanded tightly against drum, as in paragraph (g), "Adjustment for Wear," pull cables up by hand, removing all slack.

(c) If cable lengths are correct, the hole in yoke and hole in cross shaft levers will line up so that clevis pins can just be inserted. If holes do not line up, lengthen or shorten cables as required by turning adjustable yokes. Release hand brake lever.

(d) After checking cable adjustments, back off adjusting screws on **both** rear wheels an **equal** number of notches (10 to 12) until wheels are free of drag.

Major Adjustments

Front Brakes

The following instructions are necessary only when fitting replacement shoes or when instructions under "Adjustment for Wear" fail to give satisfactory results. Never reline the brake shoes. Use "Exchange" replacement shoes with lining assembled and burnished to a perfect circle. This will assure a satisfactory job at a cost comparable with that of relining.

During the removal or installation of brake shoes, the position of the hydraulic brake system should not be altered, otherwise bleeding of the lines will be required. NOTE: The brake pedal must never be depressed at any time when the brake drums are not in place.

(a) Jack up wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1), and drum inspection hole covers.

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nut (2) on eccentric adjustment (3).

(d) Loosen anchor pin lock nut (6) one complete turn.

(e) Turn eccentric in direction of wheel rotation when truck is moving forward, until a decided drag is felt when wheel is pulled over by hand, then back off on adjustment until wheel is just free of drag.

(f) Insert a .010″ feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw and anchor end of the secondary shoe. (Shoe against which eccentric operates.)

The clearance at both ends of secondary shoe should be the same within .002″ variation. If variation between the two ends is greater than this or if the anchor end clearance is greater than the adjusting end, it will then be necessary to change anchor pin position.

(g) Turn anchor pin (7) in direction of wheel rotation to **reduce** lining to drum clearance at anchor end of secondary shoe and in opposite direction to **increase** this clearance. It may be necessary to move both the anchor pin and eccentric adjustment to secure proper clearances.

(h) When recommended shoe clearances are obtained hold anchor pin in this position and tighten anchor pin lock nut as tight as possible, using a 16″ wrench. Also hold eccentric adjustment in position and tighten eccentric lock nut.

(i) Turn adjusting screw (4), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(j) Back off adjusting screw 10 to 12 notches. There should not be any drag if the adjustments were carried out properly.

Rear Brakes

(a) Jack up wheels and have brake control system in release position. Disconnect both hand brake cables to rear wheels at the cross shaft.

(b) Remove brake adjusting hole covers (1), and brake drum inspection covers.

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nut (2) on eccentric adjustment (3).

(d) Loosen both anchor bolt lock nuts (6) one complete turn.

(e) Turn eccentric in direction of wheel rotation when truck is moving forward, until a decided drag is felt when wheel is pulled over by hand, then back off on adjustment until wheel is just free of drag.

(f) Insert a .010″ feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw end and anchor end of the secondary shoe.

The clearance at both ends of the secondary shoes should be the same within .002″ variation. If variation between the two ends is greater than this or if anchor end clearance is greater than the adjusting end clearance, it will then be necessary to change anchor pin position.

(g) Turn adjustable eccentric anchor bolt (7) (marked with an arrow) to secure desired secondary shoe position. Turn arrow head to left to **reduce** lining to drum clearance and in the opposite direction to **increase** the clearance. It may be necessary to move both the anchor pin and the eccentirc adjustment to secure the proper secondary shoe clearances.

NOTE: Always set secondary shoe to specified clearances. The secondary shoe is the one against which the eccentric adjustment operates.

(h) When recommended shoe clearances are obtained, hold eccentric anchor bolt in this position and tighten lock nut as tight as possible, using a 16″ wrench. Also tighten lock nut on anchor pivot bolt.

(i) Turn adjusting screw (4), using special brake adjusting tool or a screw driver, until brakes are expanded tight against brake drum.

(j) Connect hand brake cables as outlined under paragraph (c), "Hand Brake Cable Adjustment."

(k) Back off adjusting screw an **equal** number of notches (10 to 12) on **both** wheels.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel. It is important, when replacing shoes, that the wheel cylinder links be installed with the projecting shoulder nearest the backing plate.

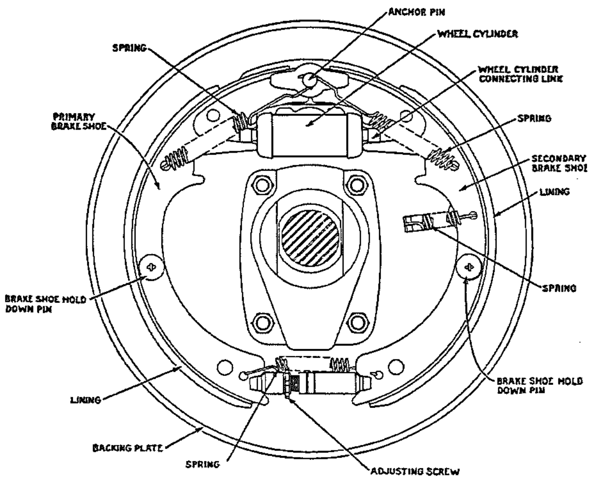

Fig. 2, Front Brake

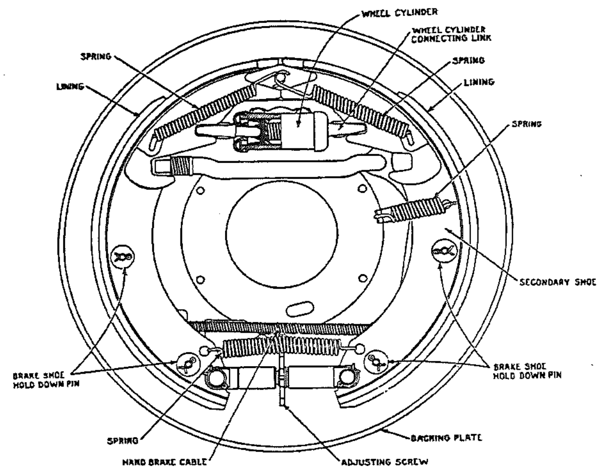

Fig. 3, Rear Brake

Models D-30, DS-30, D-30B, DS-30B, D-35, DS-35 { 14 x 2" (Front) / 15 x 2½" (Rear) } Single Anchor, Hydraulic Brakes

Models D-35B, D-40 { 14 x 2" (Front) / 16 x 3" (Rear) } Single Anchor, Hydraulic Brakes

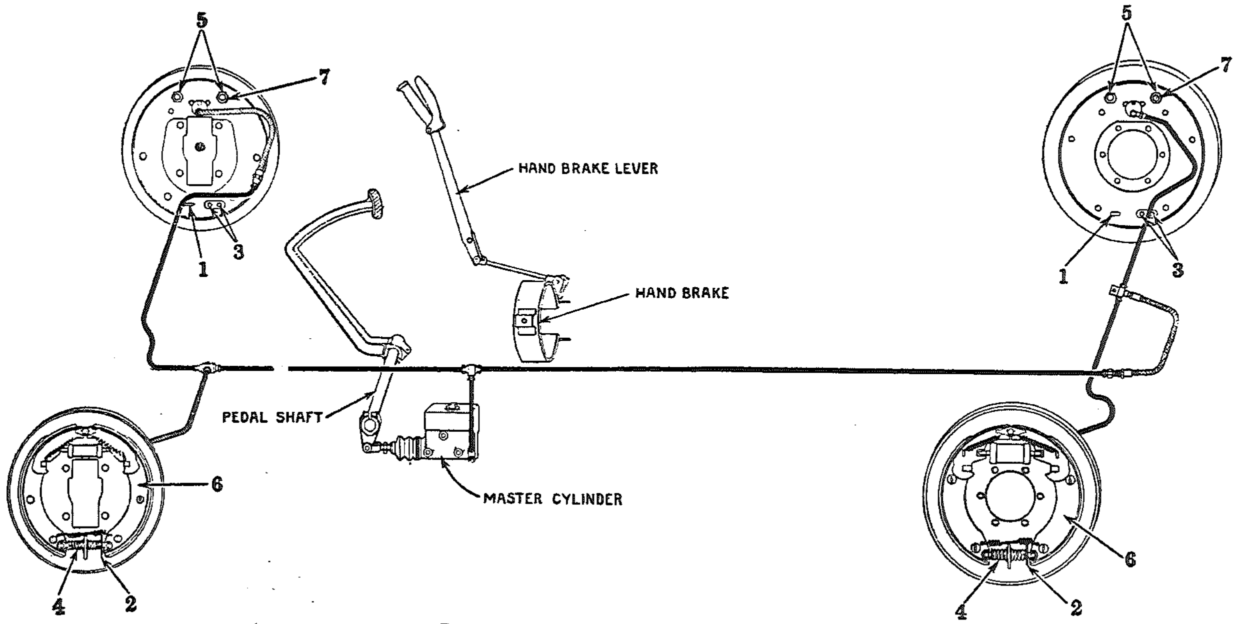

Fig. 1, Brake Adjustment Diagram

Adjustment for Wear

(a) Jack up all wheels and have brake control system in release position.
(b) Remove brake adjusting hole covers (1).
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.
(c) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.
(d) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.
(e) Tap backing plate near centralizer with hammer so that centralizer will take correct position between shoe ends and with shoes still expanded against brake drum tighten lock nuts on centralizer bolts.
(f) Back off adjusting screw (10 to 12 notches) until wheel is free of drag.
(g) Make this adjustment at **each** of the wheels.

Major Adjustment

The following instructions are necessary only when fitting replacement shoes or when instructions under "Adjustment for Wear" fail to give satisfactory results. Never reline the brake shoes. Use "Exchange" replacement shoes with lining assembled and burnished to a perfect circle. This will assure a satisfactory job at a cost comparable with that of relining.

During the removal or installation of brake shoes, the position of the hydraulic brake system should not be altered, otherwise bleeding of the lines will be required. NOTE: The brake pedal must never be depressed at any time when the brake drums are not in place.

(a) Jack up all wheels and have brake control system in release position.
(b) Remove brake adjusting hole covers (1) and brake drum inspection hole covers.
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.
(c) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.
(d) Loosen both anchor bolt lock nuts (5) one complete turn.
(e) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(f) Then tap backing plate near centralizer with a hammer so that centralizer will take correct position between shoe ends.

(g) Tighten lock nuts on centralizer bolts and back off adjusting screw until wheel is free of drag.

(h) Insert .010" feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw and anchor end of the secondary shoe (6).

The clearance at both ends of the secondary shoe should be the same within .002" variation. If variation between the two ends is greater than this or if anchor end clearance is greater than adjusting end clearance, it will then be necessary to change anchor pin position.

(i) Turn adjustable eccentric anchor bolt (7) (marked with an arrow) to secure desired shoe position. Turn arrow head to left to **reduce** lining to drum clearance and in opposite direction to **increase** the clearance.

It may be necessary to move both anchor bolt and adjusting screw to secure proper secondary shoe clearances.

NOTE: Always set secondary shoe to specified clearance. The secondary shoe is the one toward the back of the brake assembly.

(j) When recommended secondary shoe clearances are obtained, hold eccentric anchor bolt in this position and tighten lock nut as tight as possible, using a 16" wrench. Also tighten lock nut on anchor pivot bolt.

(k) Recentralize shoes by repeating operations (c), (e), (f) and (g).

(l) Back off adjusting screw (10 to 12 notches) on **both** wheels.

(m) Replace adjusting hole covers and brake drum inspection hole covers.

(n) Check all wheels to see that they are free of drag and remove jacks.

(o) Road test truck or test brakes on brake tester for balance.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel and it is important, when replacing shoes, that the wheel cylinder links be installed with the projecting shoulder nearest the backing plate.

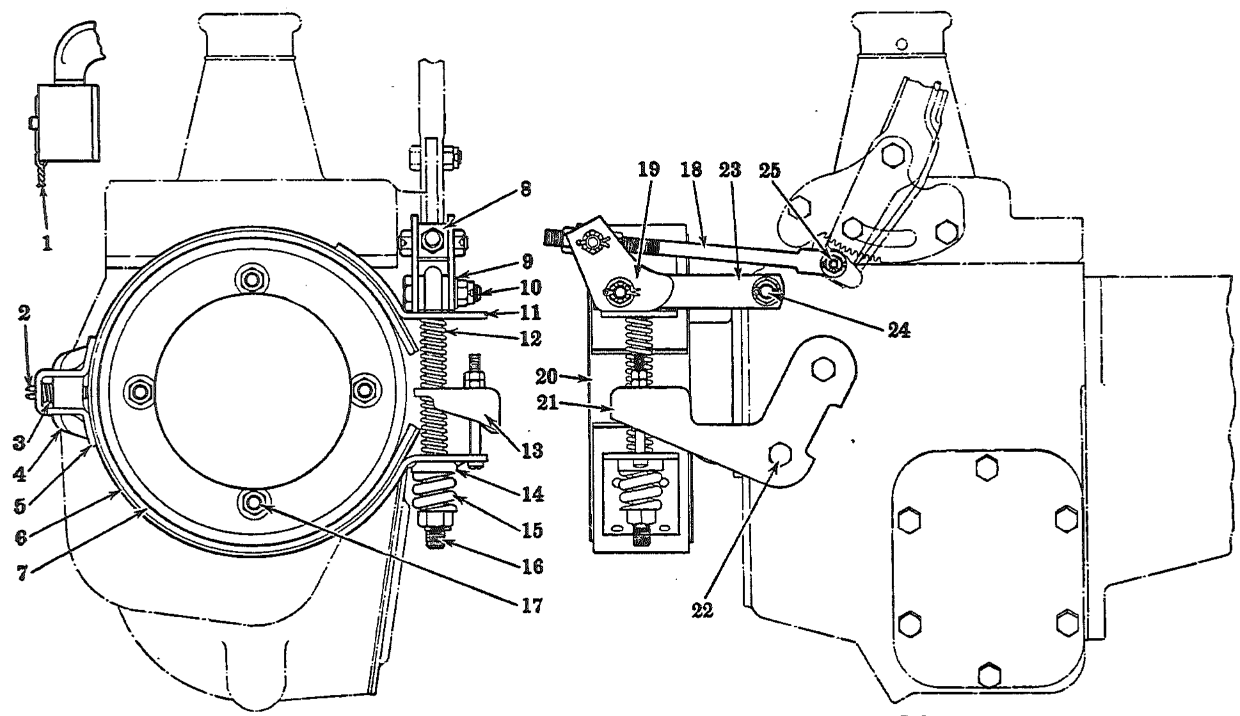

Fig. 2, Hand Brake (D-30, DS-30, D-30B, DS-30B, D-35, DS-35)

No.	Description
1.	Brake band anchor lockwire.
2.	Brake band anchor screw.
3.	Brake band anchor spring.
4.	Brake band anchor support bracket.
5.	Brake band anchor screw bracket.
6.	Brake band.
7.	Brake lining.
8.	Swivel.
9.	Plain washer.
10.	Shoulder bolt (link to cam lever).
11.	Brake band bracket—upper.
12.	Brake releasing spring.
13.	Brake band bracket—lower.
14.	Brake adjusting bolt spring spacer.
15.	Brake adjusting bolt spring.
16.	Brake adjusting bolt.
17.	Capscrew (brake drum).
18.	Brake rod.
19.	Brake cam lever.
20.	Brake drum.
21.	Brake adjusting screw bracket.
22.	Capscrew (brake adjusting screw bracket).
23.	Transmission brake spacer link.
24.	Brake link stud.
25.	Shoulder bolt (rod to hand brake lever).

Hand Brake (D-30, DS-30, D-30B, DS-30B, D-35, DS-35)

The hand brake is an external one-piece band, drum type, mounted at the rear of the transmission.

Adjustment

(a) Place hand brake lever in extreme forward (release) position. The brake cam lever (19) must be in the proper position, i.e.: the flat portion must rest squarely on the upper brake band bracket (11). To correct the position of the brake cam lever, release the check nuts on the brake rod and move swivel (8).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (2) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (16) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

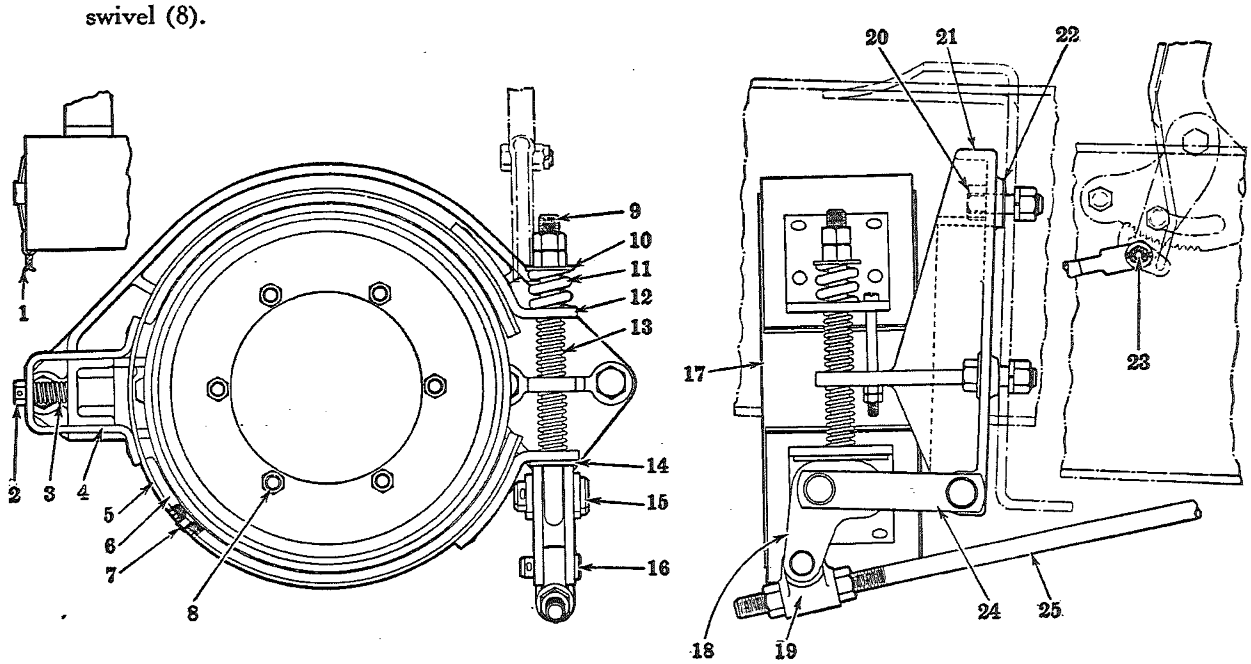

Fig. 3, Hand Brake (D-35B, D-40)

No. Description

1. **Brake band anchor lockwire.**
2. **Brake band anchor screw.**
3. **Brake band anchor spring.**
4. **Brake band anchor screw bracket.**
5. **Brake band.**
6. **Brake band lining.**
7. **Tubular rivet.**
8. **Capscrew.**
9. **Brake adjusting bolt.**
10. **Plain washer.**
11. **Brake adjusting bolt spring.**
12. **Brake band bracket.**
13. **Releasing spring.**
14. **Cam bearing block.**
15. **Brake spacer link pin.**
16. **Yoke pin.**
17. **Brake drum.**
18. **Brake cam lever.**
19. **Offset rod end.**
20. **Capscrew.**
21. **Brake support bracket.**
22. **Brake support bracket spacer.**
23. **Shoulder bolt.**
24. **Brake spacer link.**
25. **Brake rod.**

Hand Brake (D-35B, D-40)

The hand brake is an external one-piece band, drum type, mounted to a cross member at the rear of the transmission.

Adjustment

(a) Place hand lever in extreme forward (release) position. The brake cam lever (18) must be in the proper position, i.e.: the flat portion must rest squarely on the cam bearing block (14). To correct the position of brake cam lever, release the check nuts on the brake rod and move the offset rod end (19).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (2) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (9) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

(f) The brake band assembly and brake drum must be in proper alignment in order that the maximum braking area will be available. Elongated mounting holes in the cross member and spacers (22) permit alignment of these parts.

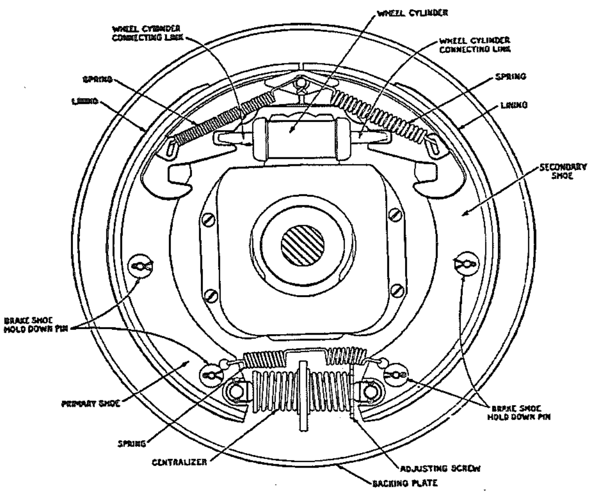

Fig. 4, Front Brake

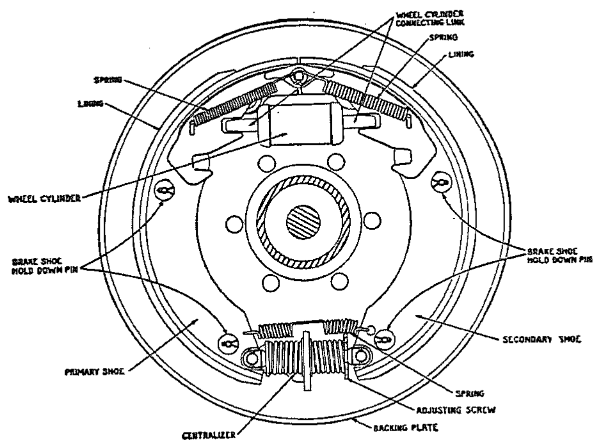

Fig. 5, Rear Brake

Model D-50 { 15 x 2¼" (Front) Single Anchor Hydraulic Brakes / 17 x 3" (Rear) Double Anchor Hydraulic Brakes

Models { D-60 / DR-60 } { 16 x 2½" (Front) Single Anchor Hydraulic Brakes / 17 x 4" (Rear) Double Anchor Hydraulic Brakes

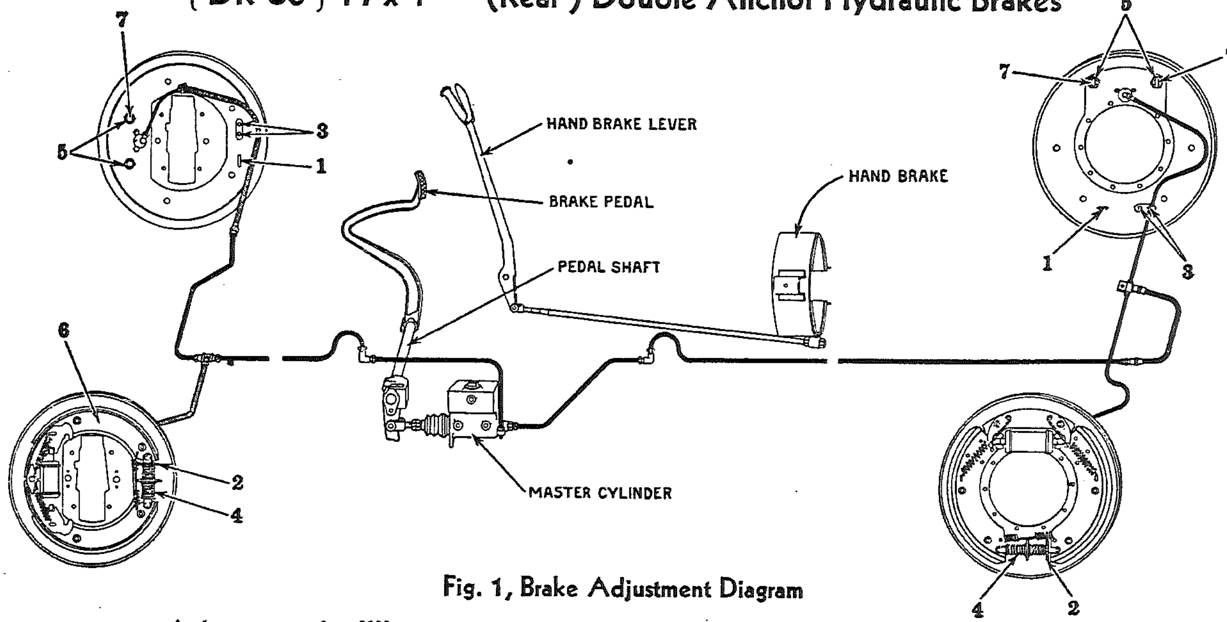

Fig. 1, Brake Adjustment Diagram

Adjustment for Wear

(a) Jack up all wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1).

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(d) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(e) Tap backing plate near centralizer with hammer so that centralizer will take correct position and with shoes still expanded against brake drum tighten lock nuts on centralizer bolts.

(f) Back off adjusting screw (10 to 12 notches front, and 6 to 8 rear) until wheel is free of drag.

(g) Make this adjustment at each of the wheels.

Major Adjustment

Front Brakes

The following instructions are necessary only when fitting replacement shoes or when instructions under "Adjustment for Wear" fail to give satisfactory results. Never reline the brake shoes. Use "Exchange" replacement shoes with lining assembled and burnished to a perfect circle. This will assure a satisfactory job at a cost comparable with that of relining.

During the removal or installation of brake shoes, position of the hydraulic brake system should not be altered, otherwise bleeding of the lines will be required. NOTE: The brake pedal must never be depressed at any time when the brake drums are not in place.

(a) Jack up wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1), and brake drum inspection hole covers.

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(d) Loosen both anchor bolt lock nuts (5) one complete turn.

(e) Turn adjusting screw (2), using a special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(f) Then tap backing plate near centralizer with a hammer so centralizer will take correct position between shoe ends.

(g) Tighten lock nuts on centralizer bolts and back off adjusting screw until wheel is free of drag.

(h) Insert .010" feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw and anchor ends of the secondary shoe (6).

The clearance at both ends of shoe should be the same within .002" variation. If variation between the two ends is greater than this or if anchor end clearance is greater than adjusting end clearance, it will be necessary to change anchor pin position.

(i) Turn adjustable eccentric anchor bolt (7) (marked with an arrow) to secure desired secondary shoe position. Turn arrow to left to **reduce** lining to drum clearance at anchor end and in opposite direction to **increase** clearance at anchor end of secondary shoe. It may be necessary to move both eccentric anchor pin and adjusting screw.

NOTE: Always set secondary shoe to specified clearances.

(j) When recommended shoe clearances are obtained on the secondary shoe, hold eccentric anchor bolt in this position and tighten lock nuts as tight as possible, using a 16″ wrench. Also tighten lock nut on anchor pivot bolt.

(k) Recentralize shoes by repeating operations (c), (e), (f) and (g).

(l) Back off adjusting screw (10 to 12 notches). There should be no drag if adjustments have been carried out properly.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel and it is important, when replacing shoes, that the wheel cylinder links be installed with the projecting shoulder nearest the backing plate.

Rear Brakes

(a) Jack up wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1), and brake drum inspection hole covers.

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(d) Loosen both anchor pin lock nuts (5) one complete turn.

(e) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(f) Tap backing plate near centralizer with a hammer so that centralizer will take correct position between shoe ends.

(g) Tighten lock nuts on centralizer bolts and back off adjusting screw until wheel is free of drag.

(h) Check shoe to drum clearance at ends of both shoes with feeler gauge. There should be .008″ clearance at anchor pin end and .020″ clearance at the notched wheel or adjusting end of both shoes. If these clearances do not exist, it will be necessary to turn both the anchor pins (7) and adjusting screw (2) to properly position the shoes.

(i) The anchor pin ends are marked with arrows to indicate the high side of the eccentric. When reassembling new shoes set anchor pins so that arrows point toward each other. When adjusting anchor pins, the arrows are turned away from the center of the axle to **reduce** the anchor pin end clearance and in the reverse direction to **increase** the anchor pin end clearance.

(j) After the proper shoe clearances have been obtained by positioning each shoe independent of the other, tighten anchor pin locknuts as tightly as possible with a 16″ wrench.

(k) Again loosen centralizer lock nuts.

(l) Turn notched adjusting wheel until shoes are expanded tightly against brake drums to recentralize the shoes. Retighten centralizer lock nuts.

(m) Back off adjusting screw 6 to 8 notches.

(n) Make this adjustment at **both** rear wheels.

(o) Replace adjusting hole covers and brake drum inspection hole covers.

(p) Check all wheels to see that they are free of drag and remove jacks.

(q) Road test truck or test brakes on brake tester for balance.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel and it is important, when replacing shoes, to see that wheel cylinder to shoe links are installed so that the projections on the anchor strut plate fit in the grooves in the shoe links.

Hand Brake (D-50)

The hand brake is an external one-piece band, drum type, mounted to a cross member at the rear of the transmission.

Adjustment

(a) Place hand lever in extreme forward (release) position. The brake cam lever (18) must be in the proper position, i.e.: the flat portion must rest squarely on the cam bearing block (14). To correct the position of brake cam lever, release the check nuts on the brake rod and move the offset rod end (19).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (2) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (9) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

(f) The brake band assembly and brake drum must be in proper alignment in order that the maximum braking area will be available. Elongated mounting holes in the cross member and spacers (22) permit alignment of these parts.

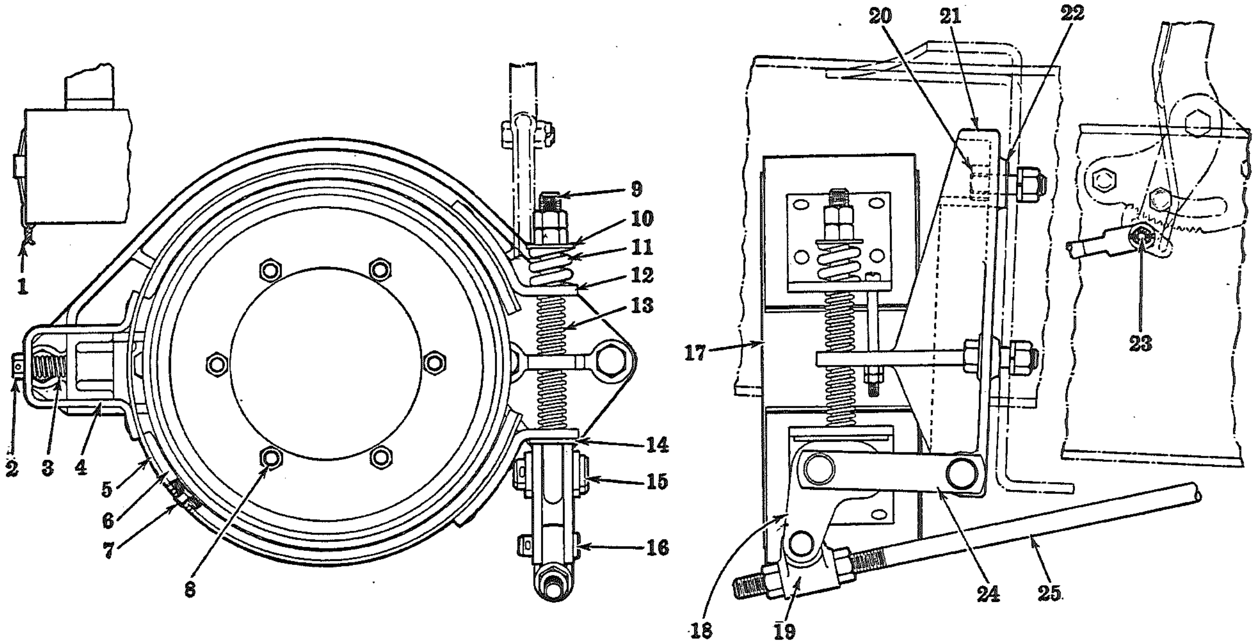

Fig. 2, Hand Brake (D-50)

No.	Description
1.	Brake band anchor lockwire.
2.	Brake band anchor screw.
3.	Brake band anchor spring.
4.	Brake band anchor screw bracket.
5.	Brake band.
6.	Brake band lining.
7.	Tubular rivet.
8.	Capscrew.
9.	Brake adjusting bolt.
10.	Plain washer.
11.	Brake adjusting bolt spring.
12.	Brake band bracket.

No.	Description
13.	Releasing spring.
14.	Cam bearing block.
15.	Brake spacer link pin.
16.	Yoke pin.
17.	Brake drum.
18.	Brake cam lever.
19.	Offset rod end.
20.	Capscrew.
21.	Brake support bracket.
22.	Brake support bracket spacer.
23.	Shoulder bolt.
24.	Brake spacer link.
25.	Brake rod.

Hand Brake (D-60, DR-60)

The hand brake is an external two shoe, drum type, mounted to a cross member at the rear of the transmission.

Adjustment

(a) Place hand lever in extreme forward (release) position. The brake cam lever (21) must be in the proper position, i.e.: the flat portion must rest squarely on the cam bearing block (15). To correct the position of the brake cam lever, release the check nuts on the brake rod and move the offset rod end (22).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) Turn the adjusting bolt (10) and the upper and lower stop screws (18–20) to obtain the desired clearance.

(d) Lock all adjustments, then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

(f) The brake band assembly and brake drum must be in proper alignment in order that the maximum braking area will be available.

(g) Elongated mounting holes in the cross member and spacers (23) permit alignment of these parts.

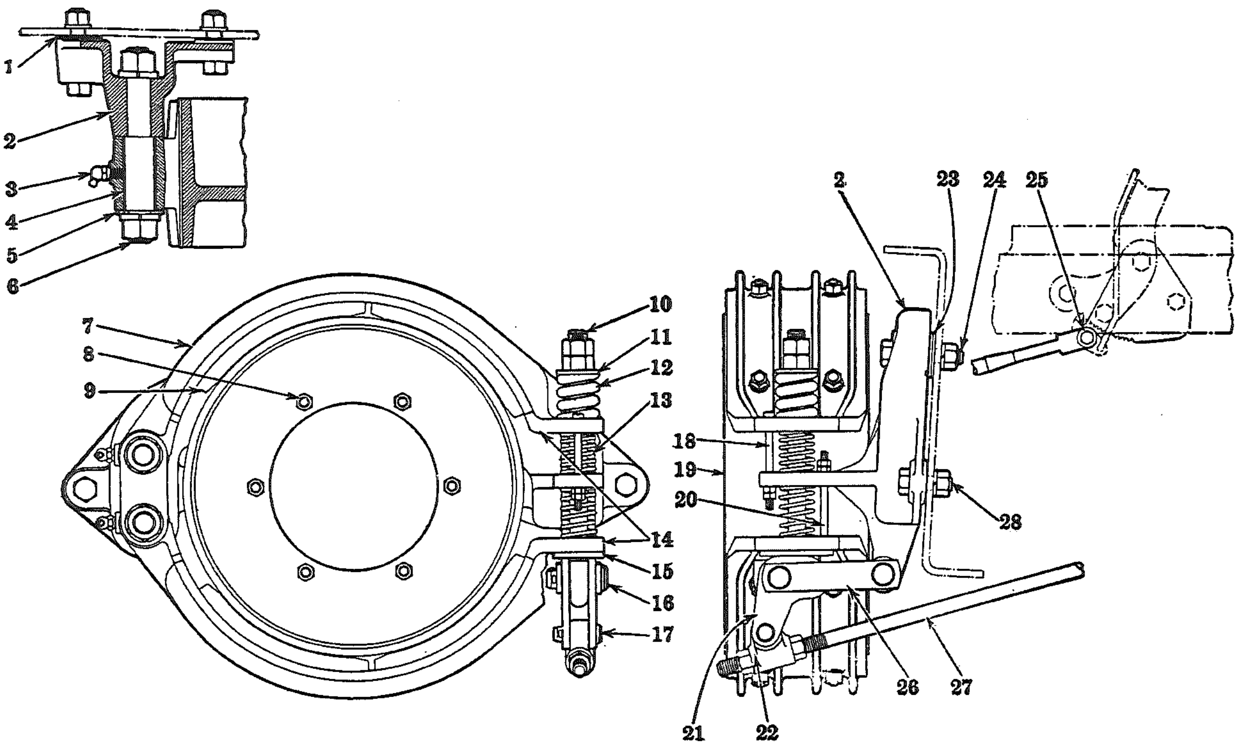

Fig. 3, Hand Brake (D-60, DR-60)

No.	Description
1.	Bracket shim washer.
2.	Brake support bracket.
3.	Lubricator.
4.	Brake shoe bushing.
5.	Anchor pin spacer plate.
6.	Brake anchor pin.
7.	Brake shoe lining bolt.
8.	Capscrew.
9.	Brake shoe lining.
10.	Brake adjusting bolt.
11.	Washer.
12.	Adjusting bolt spring.
13.	Brake shoe equalizing spring.
14.	Brake shoe.
15.	Cam bearing block.
16.	Rod end pin.
17.	Brake operating cam pin.
18.	Stop screw.
19.	Brake drum.
20.	Stop screw.
21.	Brake cam lever.
22.	Offset rod end.
23.	Brake support bracket spacer.
24.	Capscrew.
25.	Shoulder bolt.
26.	Brake spacer link.
27.	Brake rod.
28.	Capscrew.

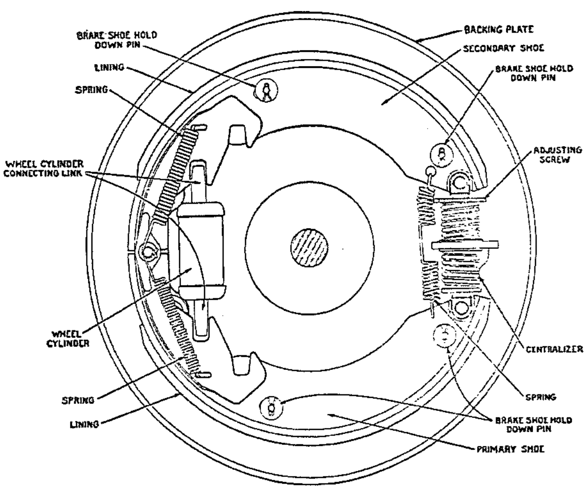

Fig. 4, Front Brake

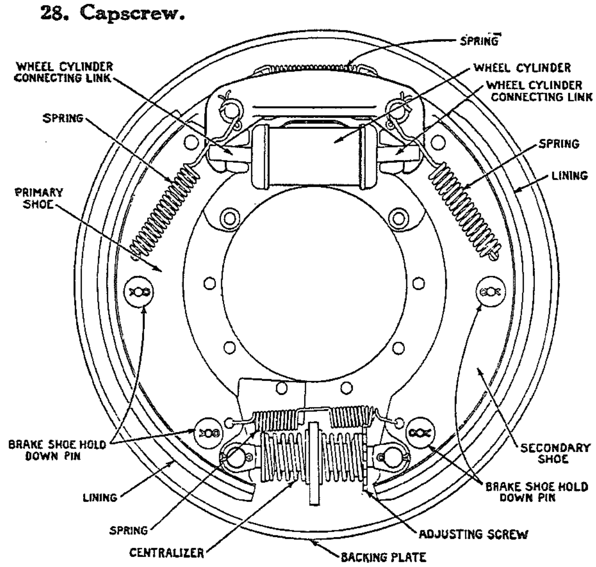

Fig. 5, Rear Brake

Model DR-70 {17¼ x 3″ (Front) / 17¼ x 5½″ (Rear)} Double Anchor Air Brakes

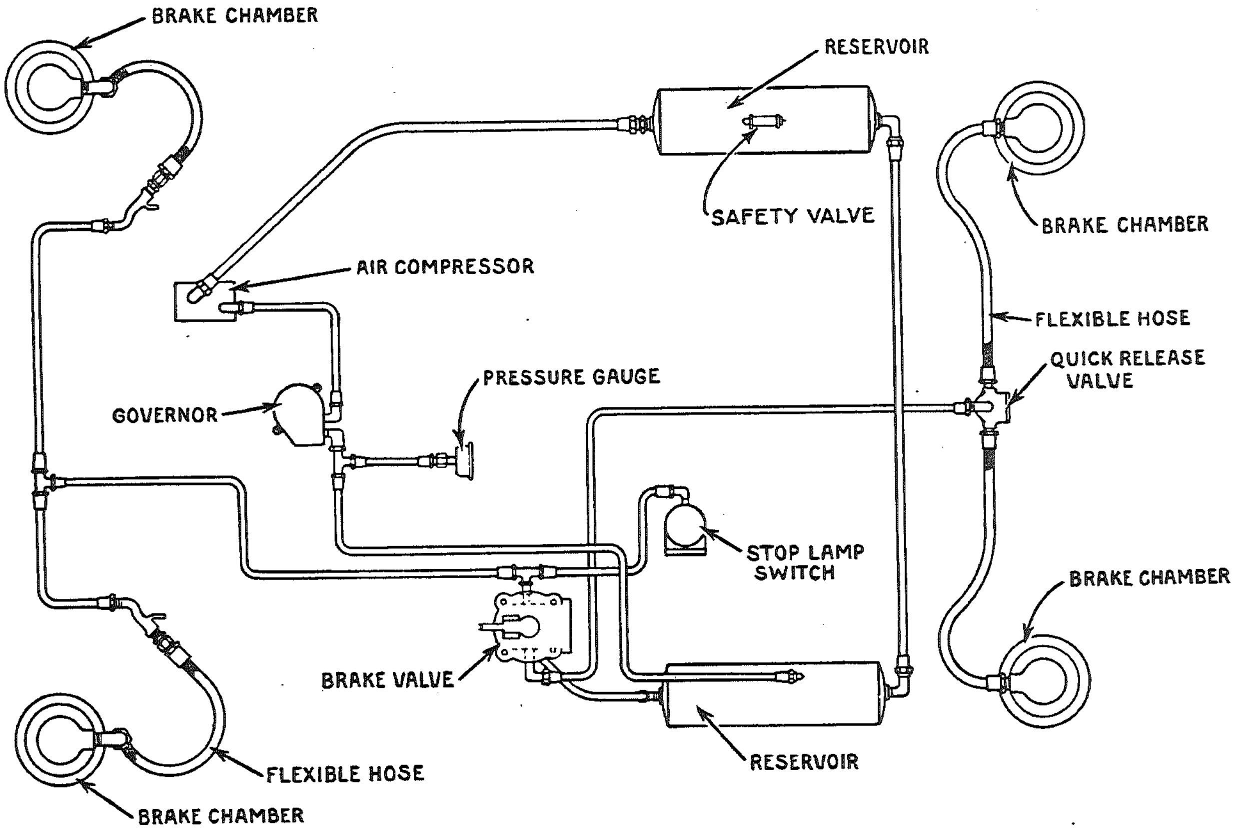

Fig. 1, Air Brake Installation Diagram

Front Wheel Brakes

(a) Jack up wheel and remove brake drum feeler gauge hole cover.
(b) Loosen anchor pin nuts.
(c) Turn slack adjuster screw until there is .010″ lining to drum clearance at the cam end of brake shoes.
(d) Turn anchor pins until there is .010″ lining to drum clearance at the anchor pin end of brake shoes.
(e) Tighten anchor pin nuts.
(f) Make this adjustment at **both** front wheels.

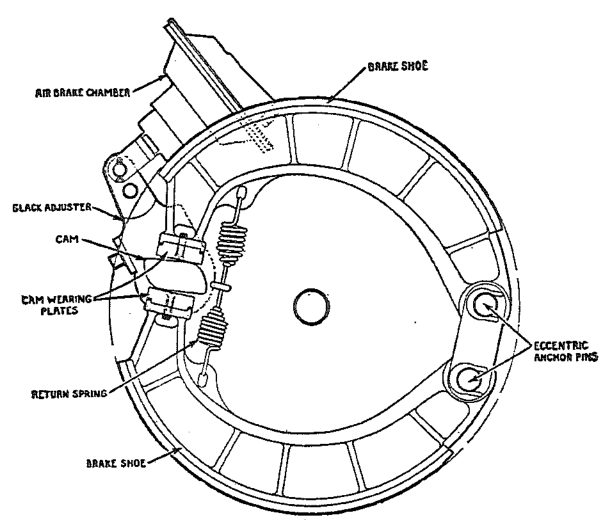

Fig. 2, Front Brake

Rear Wheel Brakes

(a) Jack up wheel and remove brake drum feeler gauge hole cover.
(b) Turn slack adjuster screw until there is .010″ lining to drum clearance at the cam end of brake shoes.
(c) Make this adjustment at each of the rear wheels.

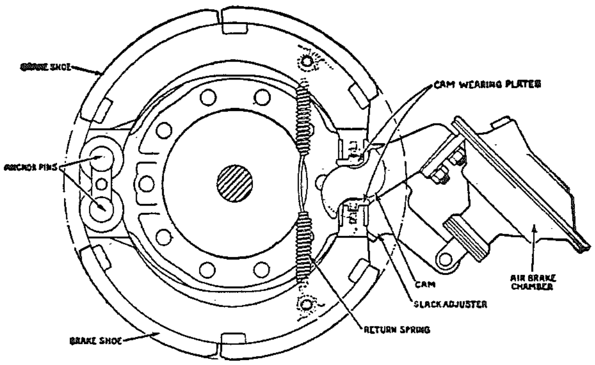

Fig. 3, Rear Brake

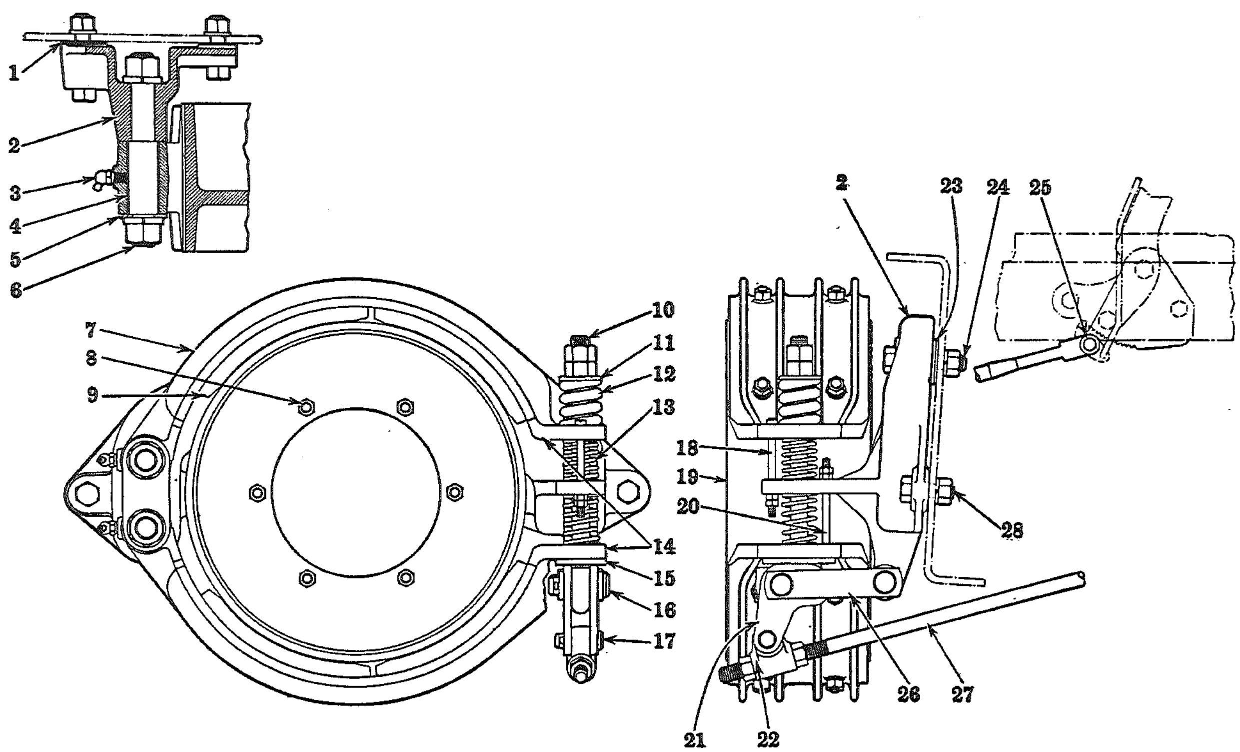

Fig. 4, Hand Brake

No. Description

1. Bracket shim washer.
2. Brake support bracket.
3. Lubricator.
4. Brake shoe bushing.
5. Anchor pin spacer plate.
6. Brake anchor pin.
7. Brake shoe lining bolt.
8. Capscrew.
9. Brake shoe lining.
10. Brake adjusting bolt.
11. Washer.
12. Adjusting bolt spring.
13. Brake shoe equalizing spring.
14. Brake shoe.

No. Description

15. Cam bearing block.
16. Rod end pin.
17. Brake operating cam pin.
18. Stop screw.
19. Brake drum.
20. Stop screw.
21. Brake cam lever.
22. Offset rod end.
23. Brake support bracket spacer.
24. Capscrew.
25. Shoulder bolt.
26. Brake spacer link.
27. Brake rod.
28. Capscrew.

Hand Brake

The hand brake is an external two shoe, drum type, mounted to a cross member at the rear of the transmission.

Adjustment

(a) Place hand lever in extreme forward (release) position. The brake cam lever (21) must be in the proper position, i.e.: the flat portion must rest squarely on the cam bearing block (15). To correct the position of the brake cam lever, release the check nuts on the brake rod and move the offset rod end (22).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) Turn the adjusting bolt (10) and the upper and lower stop screws (18–20) to obtain the desired clearance.

(d) Lock all adjustments, then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

(f) The brake hand assembly and brake drum must be in proper alignment in order that the maximum braking area will be available.

(g) Elongated mounting holes in the cross member and spacers (23) permit alignment of these parts.

Models D-300, DS-300 { 14 x 2" (Front) / 15 x 2½" (Rear) } Single Anchor, Hydraulic Brakes

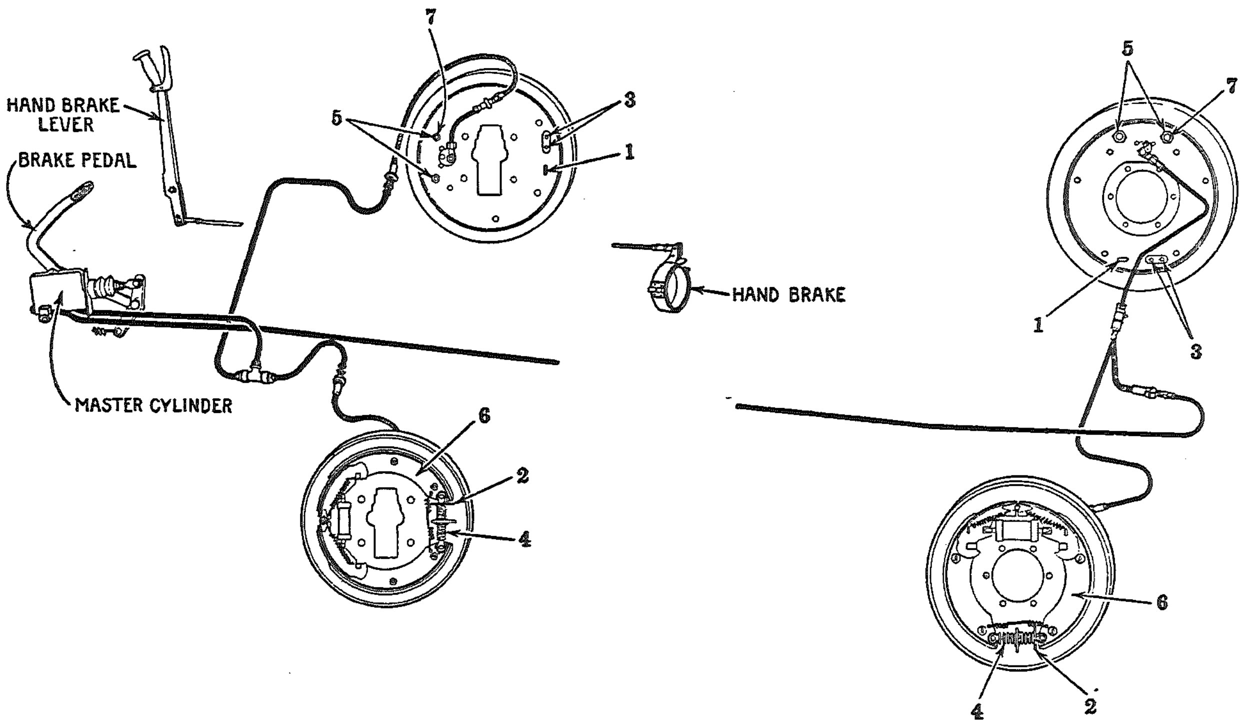

Fig. 1, Brake Adjustment Diagram

Adjustment for Wear

(a) Jack up all wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1).
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(d) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(e) Tap backing plate near centralizer with hammer so that centralizer will take correct position between shoe ends and with shoes still expanded against brake drum tighten lock nuts on centralizer bolts.

(f) Back off adjusting screw (10 to 12 notches) until wheel is free of drag.

(g) Make this adjustment at **each** of the wheels.

Major Adjustment

The following instructions are necessary only when fitting replacement shoes or when instructions under "Adjustment for Wear" fail to give satisfactory results. Never reline the brake shoes. Use "Exchange" replacement shoes with lining assembled and burnished to a perfect circle. This will assure a satisfactory job at a cost comparable with that of relining.

During the removal or installation of brake shoes, the position of the hydraulic brake system should not be altered, otherwise bleeding of the lines will be required. NOTE: The brake pedal must never be depressed at any time when the brake drums are not in place.

(a) Jack up all wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1) and brake drum inspection hole covers.
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(d) Loosen both anchor bolt lock nuts (5) one complete turn.

(e) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(f) Then tap backing plate near entralizer with a hammer so that centralizer will take correct position between shoe ends.

(g) Tighten lock nuts on centralizer bolts and back off adjusting screw until wheel is free of drag.

(h) Insert .010″ feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw and anchor end of the secondary shoe (6).

The clearance at both ends of the secondary shoe should be the same within .002″ variation. If variation between the two ends is greater than this or if anchor end clearance is greater than adjusting end clearance, it will then be necessary to change anchor pin position.

(i) Turn adjustable eccentric anchor bolt (7) (marked with an arrow) to secure desired shoe position. Turn arrow head to left to **reduce** lining to drum clearance and in opposite direction to **increase** the clearance.

It may be necessary to move both anchor bolt and adjusting screw to secure proper secondary shoe clearances.

NOTE: Always set secondary shoe to specified clearance. The secondary shoe is the one toward the back of the brake assembly.

(j) When recommended secondary shoe clearances are obtained, hold eccentric anchor bolt in this position and tighten lock nut as tight as possible, using a 16″ wrench. Also tighten lock nut on anchor pivot bolt.

(k) Recentralize shoes by repeating operations (c), (e), (f) and (g).

(l) Back off adjusting screw (10 to 12 notches) on **both** wheels.

(m) Replace adjusting hole covers and brake drum inspection hole covers.

(n) Check all wheels to see that they are free of drag and remove jacks.

(o) Road test truck or test brakes on brake tester for balance.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel and it is important, when replacing shoes, that the wheel cylinder links be installed with the projecting shoulder nearest the backing plate.

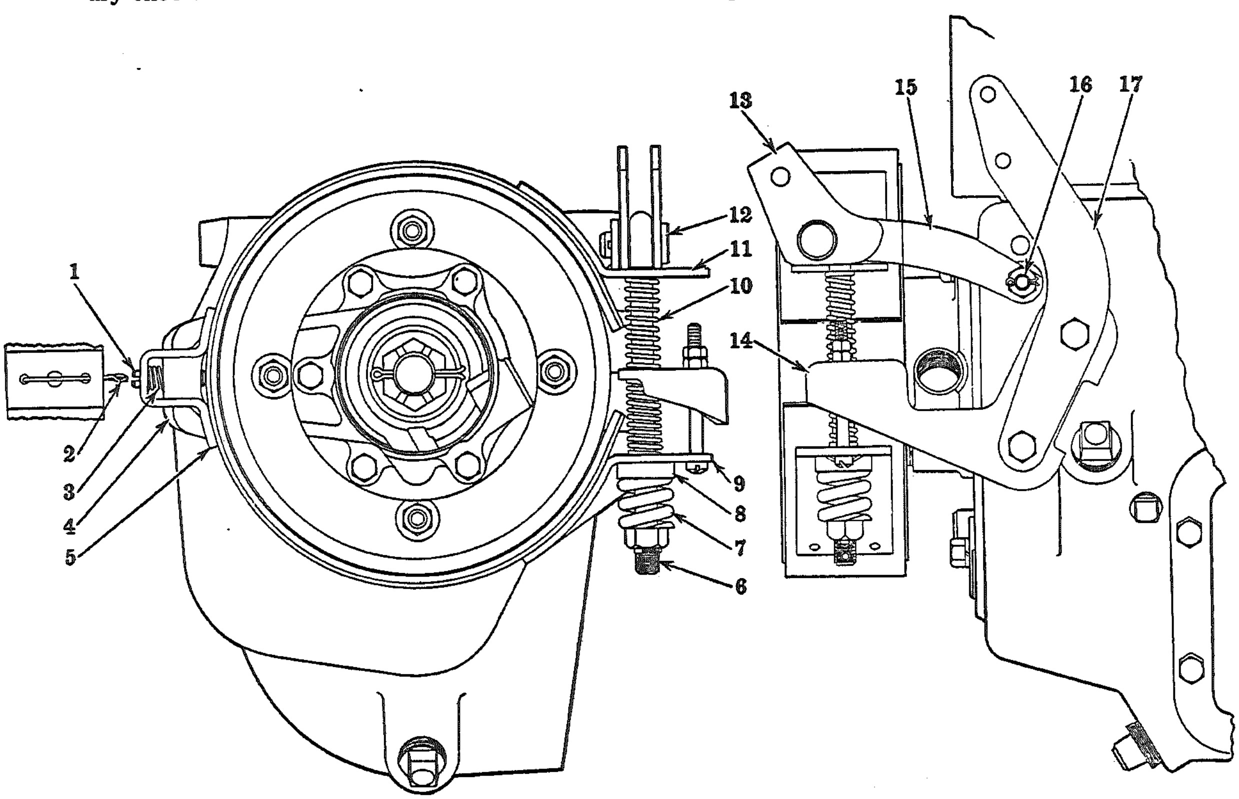

Fig. 2, Hand Brake

No.	Description
1.	Brake band anchor screw.
2.	Lockwire.
3.	Brake band anchor screw spring.
4.	Brake band anchor bracket.
5.	Brake band anchor bracket.
6.	Brake adjusting bolt.
7.	Brake adjusting bolt lower spring.
8.	Brake adjusting bolt spring washer.
9.	Brake band bracket, lower.
10.	Brake release spring.
11.	Brake band bracket, upper.
12.	Brake cam lever yoke pin.
13.	Brake cam lever.
14.	Brake adjusting screw bracket.
15.	Brake spacer link.
16.	Brake spacer link stud.
17.	Brake cable support, rear.

Hand Brake

The hand brake is an external one-piece band, drum type, mounted at the rear of the transmission.

Adjustment

(a) Place hand brake lever in extreme forward (release) position. The brake cam lever (13) must be in the proper position, i.e.: the flat portion must rest squarely on the upper brake band bracket (11). To correct the position of the brake cam lever, release the check nuts on the brake cable and move the adjustable yoke.

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (1) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (6) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

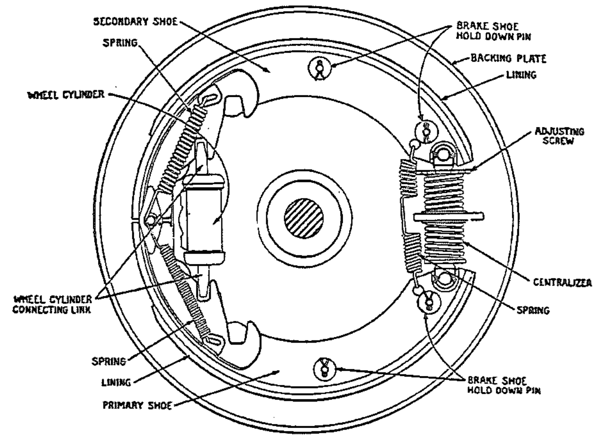

Fig. 3, Front Brake

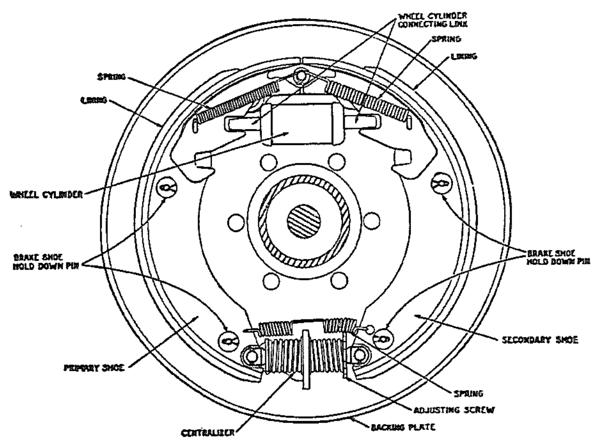

Fig. 4, Rear Brake

Models D-186T, DS-186T {14 x 2" (Front), 15 x 2½" (Rear)} Single Anchor, Hydraulic Brakes

Model D-216T {14 x 2" (Front), 16 x 3" (Rear)} Single Anchor, Hydraulic Brakes

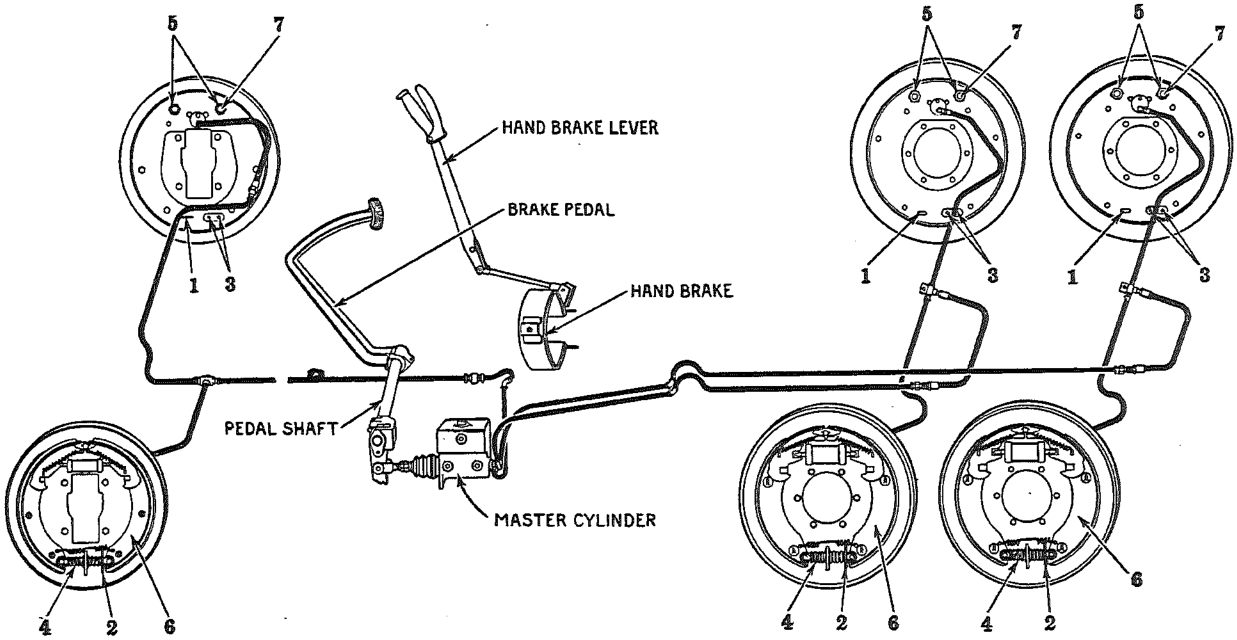

Fig. 1, Brake Adjustment Diagram

Adjustment for Wear

(a) Jack up all wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1).
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(d) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(e) Tap backing plate near centralizer with hammer so that centralizer will take correct position between shoe ends and with shoes still expanded against brake drum tighten lock nuts on centralizer bolts.

(f) Back off adjusting screw (10 to 12 notches) until wheel is free of drag.

(g) Make this adjustment at **each** of the wheels.

Major Adjustment

The following instructions are necessary only when fitting replacement shoes or when instructions under "Adjustment for Wear" fail to give satisfactory results. Never reline the brake shoes. Use "Exchange" replacement shoes with lining assembled and burnished to a perfect circle. This will assure a satisfactory job at a cost comparable with that of relining.

During the removal or installation of brake shoes, the position of the hydraulic brake system should not be altered, otherwise bleeding of the lines will be required. NOTE: The brake pedal must never be depressed at any time when the brake drums are not in place.

(a) Jack up all wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1) and brake drum inspection hole covers.
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(d) Loosen both anchor bolt lock nuts (5) one complete turn.

(e) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(f) Then tap backing plate near centralizer with a hammer so that centralizer will take correct position between shoe ends.

(g) Tighten lock nuts on centralizer bolts and back off adjusting screw until wheel is free of drag.

(h) Insert .010" feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw and anchor end of the secondary shoe (6).

The clearance at both ends of the secondary shoe should be the same within .002" variation. If variation between the two ends is greater than this or if anchor end clearance is greater than adjusting end clearance, it will then be necessary to change anchor pin position.

(i) Turn adjustable eccentric anchor bolt (7) (marked with an arrow) to secure desired shoe position. Turn arrow head to left to **reduce** lining to drum clearance and in opposite direction to **increase** the clearance.

It may be necessary to move both anchor bolt and adjusting screw to secure proper secondary shoe clearances.

NOTE: Always set secondary shoe to specified clearance. The secondary shoe is the one toward the back of the brake assembly.

(j) When recommended secondary shoe clearances are obtained, hold eccentric anchor bolt in this position and tighten lock nut as tight as possible, using a 16" wrench. Also tighten lock nut on anchor pivot bolt.

(k) Recentralize shoes by repeating operations (c), (e), (f) and (g).

(l) Back off adjusting screw (10 to 12 notches) on all wheels.

(m) Replace adjusting hole covers and brake drum inspection hole covers.

(n) Check all wheels to see that they are free of drag and remove jacks.

(o) Road test truck or test brakes on brake tester for balance.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel and it is important, when replacing shoes, that the wheel cylinder links be installed with the projecting shoulder nearest the backing plate.

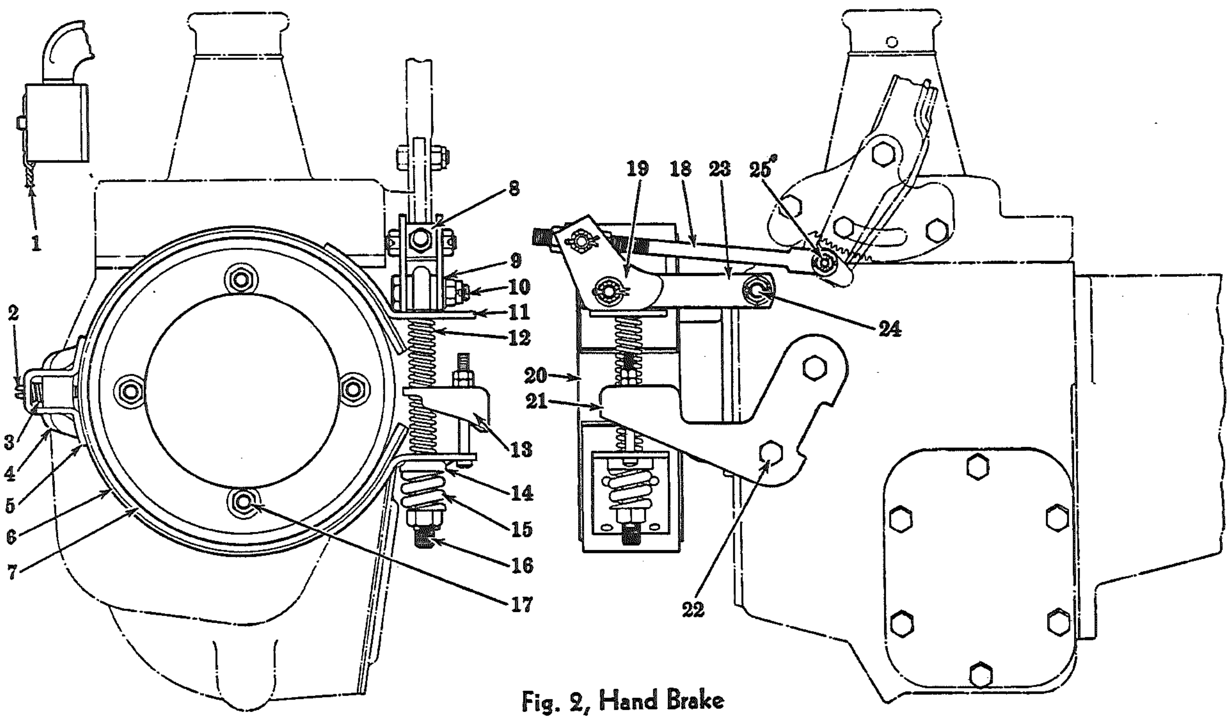

Fig. 2, Hand Brake

No.	Description
1.	Brake band anchor lockwire.
2.	Brake band anchor screw.
3.	Brake band anchor spring.
4.	Brake band anchor support bracket.
5.	Brake band anchor screw bracket.
6.	Brake band.
7.	Brake lining.
8.	Swivel.
9.	Plain washer.
10.	Shoulder bolt (link to cam lever).
11.	Brake band bracket—upper.
12.	Brake releasing spring.

No.	Description
13.	Brake band bracket—lower.
14.	Brake adjusting bolt spring spacer.
15.	Brake adjusting bolt spring.
16.	Brake adjusting bolt.
17.	Cap screw (brake drum).
18.	Brake rod.
19.	Brake cam lever.
20.	Brake drum.
21.	Brake adjusting screw bracket.
22.	Cap screw (brake adjusting screw bracket).
23.	Transmission brake spacer link.
24.	Brake link stud.
25.	Shoulder bolt (rod to hand brake lever).

Hand Brake

The hand brake is an external one-piece band, drum type, mounted at the rear of the transmission.

Adjustment

(a) Place hand brake lever in extreme forward (release) position. The brake cam lever (19) must be in the proper position, i.e.: the flat portion must rest squarely on the upper brake band bracket (11). To correct the position of the brake cam lever, release the check nuts on the brake rod and move swivel (8).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (2) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (16) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

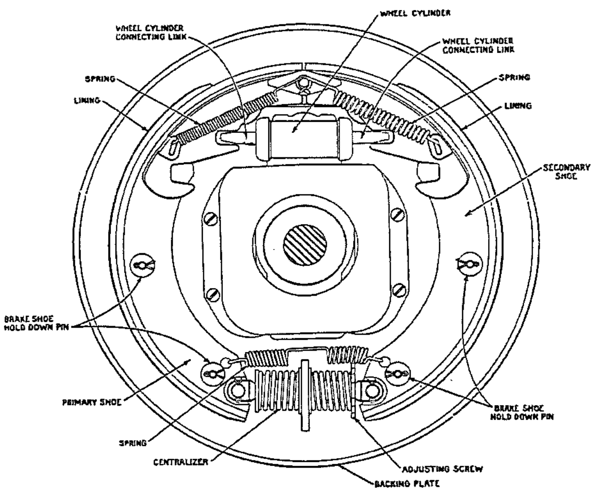

Fig. 3, Front Brake

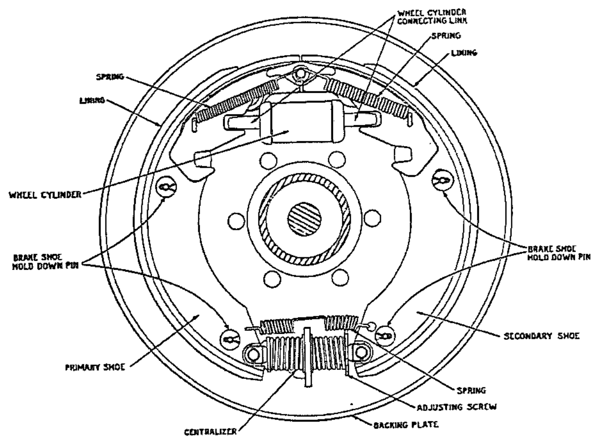

Fig. 4, Rear Brake

Model D-246T { 15 x 2¼" (Front) Single Anchor, Hydraulic Brakes / 17 x 3" (Rear) Double Anchor, Hydraulic Brakes

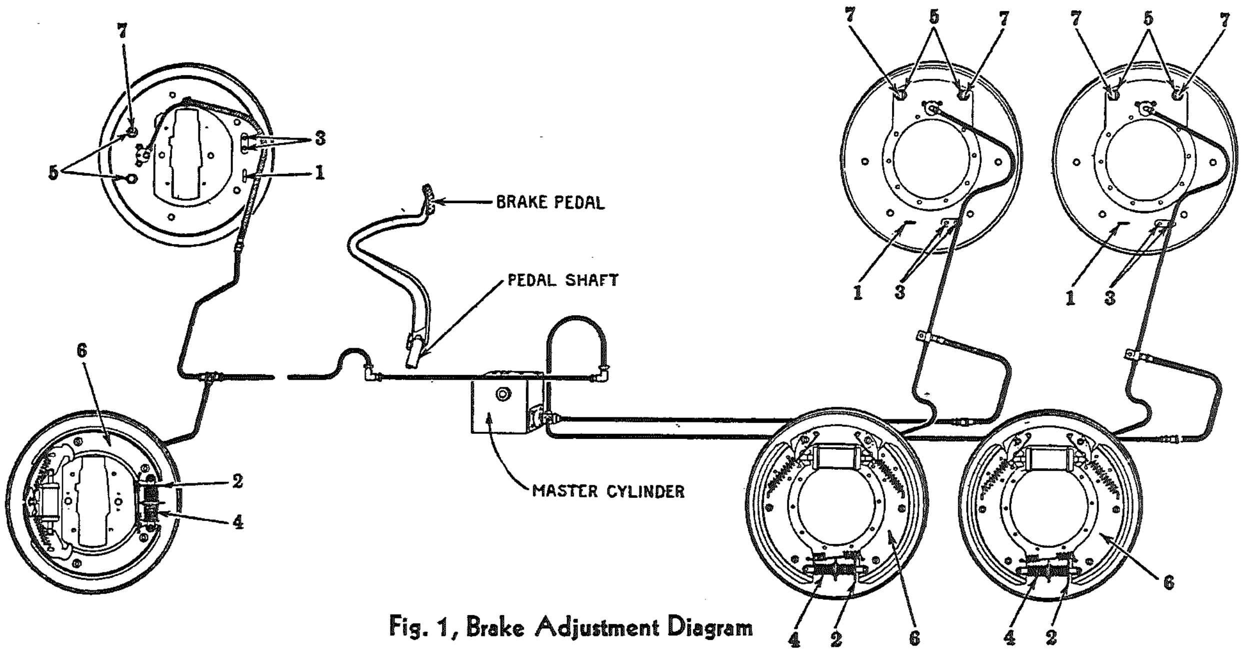

Fig. 1, Brake Adjustment Diagram

Adjustment for Wear

(a) Jack up all wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1).

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(d) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(e) Tap backing plate near centralizer with hammer so that centralizer will take correct position and with shoes still expanded against brake drum tighten lock nuts on centralizer bolts.

(f) Back off adjusting screw (10 to 12 notches front, and 6 to 8 rear) until wheel is free of drag.

(g) Make this adjustment at each of the wheels.

Major Adjustment

Front Brakes

The following instructions are necessary only when fitting replacement shoes or when instructions under "Adjustment for Wear" fail to give satisfactory results. Never reline the brake shoes. Use "Exchange" replacement shoes with lining assembled and burnished to a perfect circle. This will assure a satisfactory job at a cost comparable with that of relining.

During the removal or installation of brake shoes, position of the hydraulic brake system should not be altered, otherwise bleeding of the lines will be required. NOTE: The brake pedal must never be depressed at any time when the brake drums are not in place.

(a) Jack up wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1), and brake drum inspection hole covers.

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(d) Loosen both anchor bolt lock nuts (5) one complete turn.

(e) Turn adjusting screw (2), using a special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(f) Then tap backing plate near centralizer with a hammer so centralizer will take correct position between shoe ends.

(g) Tighten lock nuts on centralizer bolts and back off adjusting screw until wheel is free of drag.

(h) Insert .010" feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw and anchor ends of the secondary shoe (6).

The clearance at both ends of shoe should be the same within .002" variation. If variation between the two ends is greater than this or if anchor end clearance is greater than adjusting end clearance, it will be necessary to change anchor pin position.

(i) Turn adjustable eccentric anchor bolt (7) (marked with an arrow) to secure desired secondary shoe position. Turn arrow to left to **reduce** lining to drum clearance at anchor end and in opposite direction to **increase** clearance at anchor end of secondary shoe. It may be necessary to move both eccentric anchor pin and adjusting screw.

NOTE: Always set secondary shoe to specified clearances.

(j) When recommended shoe clearances are obtained on the secondary shoe, hold eccentric anchor bolt in this position and tighten lock nuts as tight as possible, using a 16″ wrench. Also tighten lock nut on anchor pivot bolt.

(k) Recentralize shoes by repeating operations (c), (e), (f) and (g).

(l) Back off adjusting screw (10 to 12 notches). There should be no drag if adjustments have been carried out properly.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel and it is important, when replacing shoes, that the wheel cylinder links be installed with the projecting shoulder nearest the backing plate.

Rear Brakes

(a) Jack up wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1), and brake drum inspection hole covers.

NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(d) Loosen both anchor pin lock nuts (5) one complete turn.

(e) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(f) Tap backing plate near centralizer with a hammer so that centralizer will take correct position between shoe ends.

(g) Tighten lock nuts on centralizer bolts and back off adjusting screw until wheel is free of drag.

(h) Check shoe to drum clearance at ends of both shoes with feeler gauge. There should be .008″ clearance at anchor pin end and .020″ clearance at the notched wheel or adjusting end of both shoes. If these clearances do not exist, it will be necessary to turn both the anchor pins (7) and adjusting screw (2) to properly position the shoes.

(i) The anchor pin ends are marked with arrows to indicate the high side of the eccentric. When reassembling new shoes set anchor pins so that arrows point toward each other. When adjusting anchor pins, the arrows are turned away from the center of the axle to **reduce** the anchor pin end clearance and in the reverse direction to **increase** the anchor pin end clearance.

(j) After the proper shoe clearances have been obtained by positioning each shoe independent of the other, tighten anchor pin locknuts as tightly as possible with a 16″ wrench.

(k) Again loosen centralizer lock nuts.

(l) Turn notched adjusting wheel until shoes are expanded tightly against brake drums to recentralize the shoes. Retighten centralizer lock nuts.

(m) Back off adjusting screw 6 to 8 notches.

(n) Make this adjustment at **all** rear wheels.

(o) Replace adjusting hole covers and brake drum inspection hole covers.

(p) Check all wheels to see that they are free of drag and remove jacks.

(q) Road test truck or test brakes on brake tester for balance.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel and it is important, when replacing shoes, to see that wheel cylinder to shoe links are installed so that the projections on the anchor strut plate fit in the grooves in the shoe links.

Hand Brake

The hand brake is an external one-piece band, drum type, mounted to a cross member at the rear of the transmission.

Adjustment

(a) Place hand lever in extreme forward (release) position. The brake cam lever (18) must be in the proper position, i.e.: the flat portion must rest squarely on the cam bearing block (14). To correct the position of brake cam lever, release the check nuts on the brake rod and move the offset rod end (19).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (2) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (9) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

(f) The brake band assembly and brake drum must be in proper alignment in order that the maximum braking area will be available. Elongated mounting holes in the cross member and spacers (22) permit alignment of these parts.

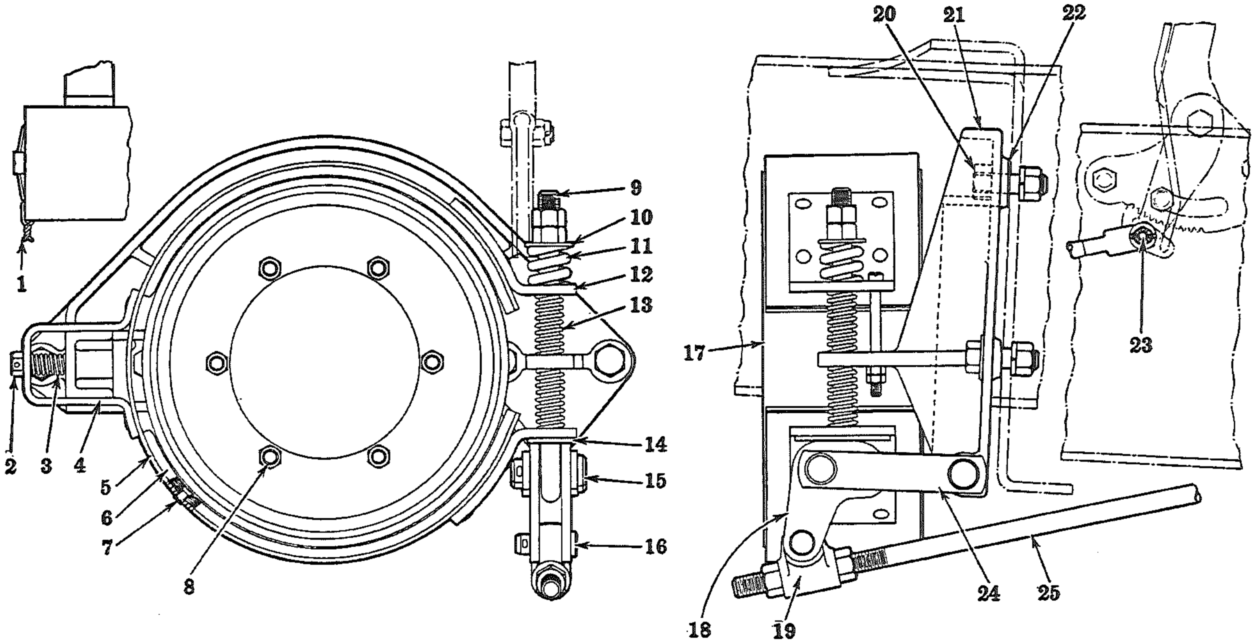

Fig. 2, Hand Brake

No.	Description
1.	Brake band anchor lockwire.
2.	Brake band anchor screw.
3.	Brake band anchor spring.
4.	Brake band anchor screw bracket.
5.	Brake band.
6.	Brake band lining.
7.	Tubular rivet.
8.	Cap screw.
9.	Brake adjusting bolt.
10.	Plain washer.
11.	Brake adjusting bolt spring.
12.	Brake band bracket.
13.	Releasing spring.
14.	Cam bearing block.
15.	Brake spacer link pin.

No.	Description
16.	Yoke pin.
17.	Brake drum.
18.	Brake cam lever.
19.	Offset rod end.
20.	Cap screw.
21.	Brake support bracket.
22.	Brake support bracket spacer.
23.	Shoulder bolt.
24.	Brake spacer link.
25.	Brake rod.

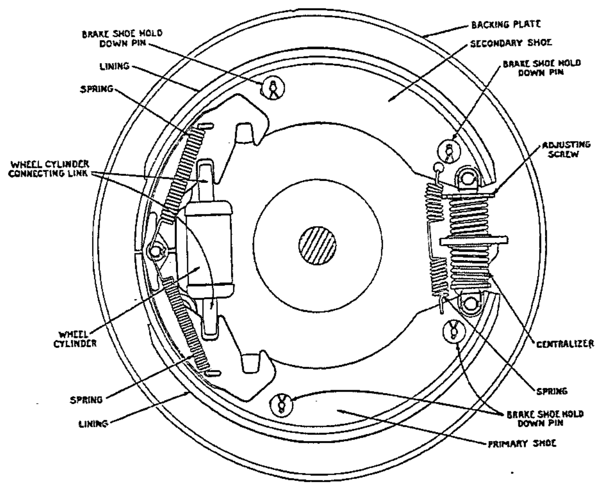

Fig. 3, Front Brake

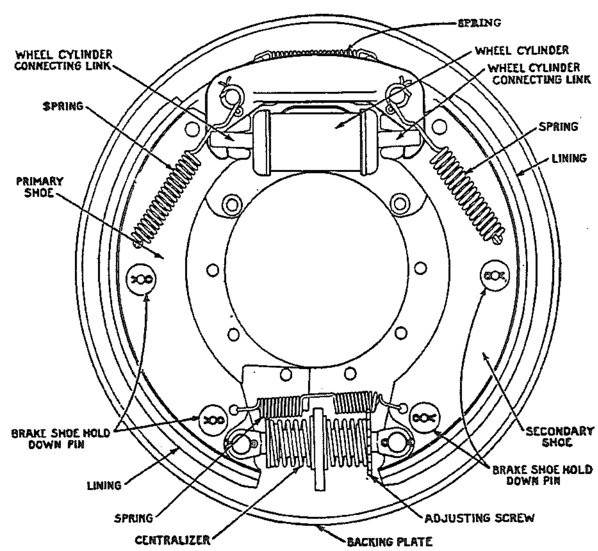

Fig. 4, Rear Brake

Model D-246F { 15 x 2¼" (Front) Single Anchor, Hydraulic Brakes / 16 x 3" (Rear) Double Anchor, Hydraulic Brakes

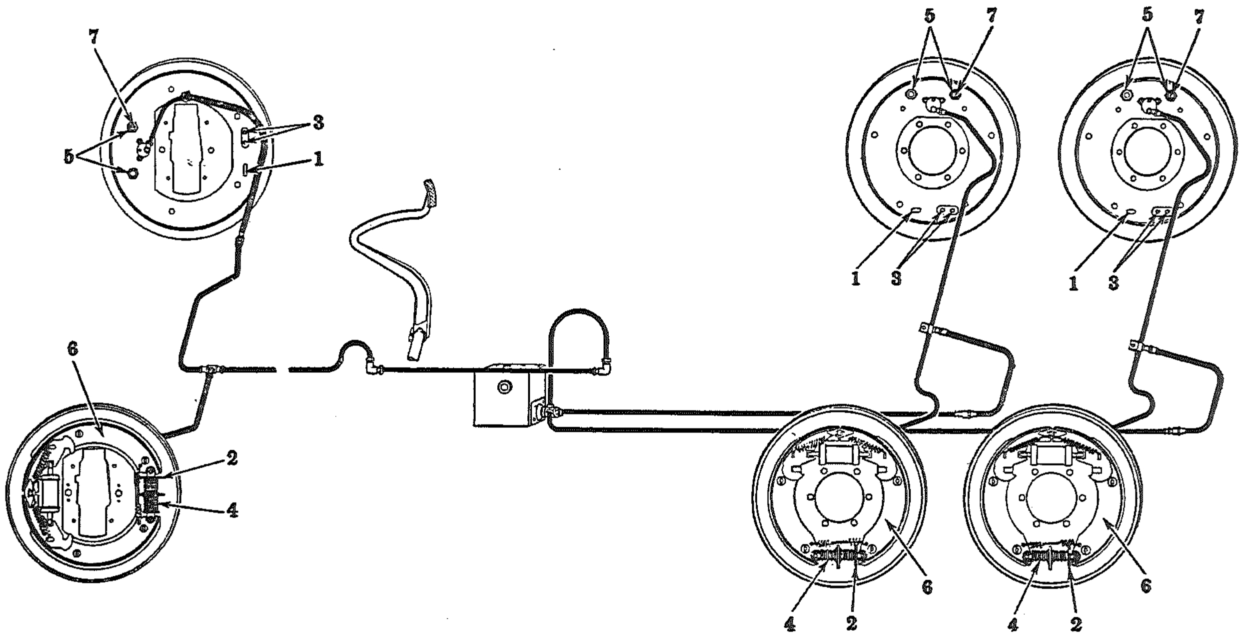

Fig. 1, Brake Adjustment Diagram

Adjustment for Wear

(a) Jack up all wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1).
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(d) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(e) Tap backing plate near centralizer with hammer so that centralizer will take correct position between shoe ends and with shoes still expanded against brake drum tighten lock nuts on centralizer bolts.

(f) Back off adjusting screw (10 to 12 notches) until wheel is free of drag.

(g) Make this adjustment at each of the wheels.

Major Adjustment

The following instructions are necessary only when fitting replacement shoes or when instructions under "Adjustment for Wear" fail to give satisfactory results. Never reline the brake shoes. Use "Exchange" replacement shoes with lining assembled and burnished to a perfect circle. This will assure a satisfactory job at a cost comparable with that of relining.

During the removal or installation of brake shoes, the position of the hydraulic brake system should not be altered, otherwise bleeding of the lines will be required. NOTE: The brake pedal must never be depressed at any time when the brake drums are not in place.

(a) Jack up all wheels and have brake control system in release position.

(b) Remove brake adjusting hole covers (1) and brake drum inspection hole covers.
NOTE: Wheels should be checked for loose bearings or excess end play and corrected, if found necessary, before proceeding with brake adjustments.

(c) Loosen lock nuts (3) on centralizer mounting bolts until they are free of lockwasher tension so that centralizer (4) can float freely.

(d) Loosen both anchor bolt lock nuts (5) one complete turn.

(e) Turn adjusting screw (2), using special brake adjusting tool or a screw driver, until brake shoes are expanded tightly against brake drum.

(f) Then tap backing plate near centralizer with a hammer so that centralizer will take correct position between shoe ends.

(g) Tighten lock nuts on centralizer bolts and back off adjusting screw until wheel is free of drag.

(h) Insert .010″ feeler gauge through inspection hole in brake drum and check lining to drum clearance at adjusting screw and anchor end of the secondary shoe (6).

The clearance at both ends of the secondary shoe should be the same within .002″ variation. If variation between the two ends is greater than this or if anchor end clearance is greater than adjusting end clearance, it will then be necessary to change anchor pin position.

(i) Turn adjustable eccentric anchor bolt (7) (marked with an arrow) to secure desired shoe position. Turn arrow head to left to **reduce** lining to drum clearance and in opposite direction to **increase** the clearance.

It may be necessary to move both anchor bolt and adjusting screw to secure proper secondary shoe clearances.

NOTE: Always set secondary shoe to specified clearance. The secondary shoe is the one toward the back of the brake assembly.

(j) When recommended secondary shoe clearances are obtained, hold eccentric anchor bolt in this position and tighten lock nut as tight as possible, using a 16″ wrench. Also tighten lock nut on anchor pivot bolt.

(k) Recentralize shoes by repeating operations (c), (e), (f) and (g).

(l) Back off adjusting screw (10 to 12 notches) on **both** wheels.

(m) Replace adjusting hole covers and brake drum inspection hole covers.

(n) Check all wheels to see that they are free of drag and remove jacks.

(o) Road test truck or test brakes on brake tester for balance.

NOTE: Wheel cylinder stops are used to limit the amount of piston travel and it is important, when replacing shoes, that the wheel cylinder links be installed with the projecting shoulder nearest the backing plate.

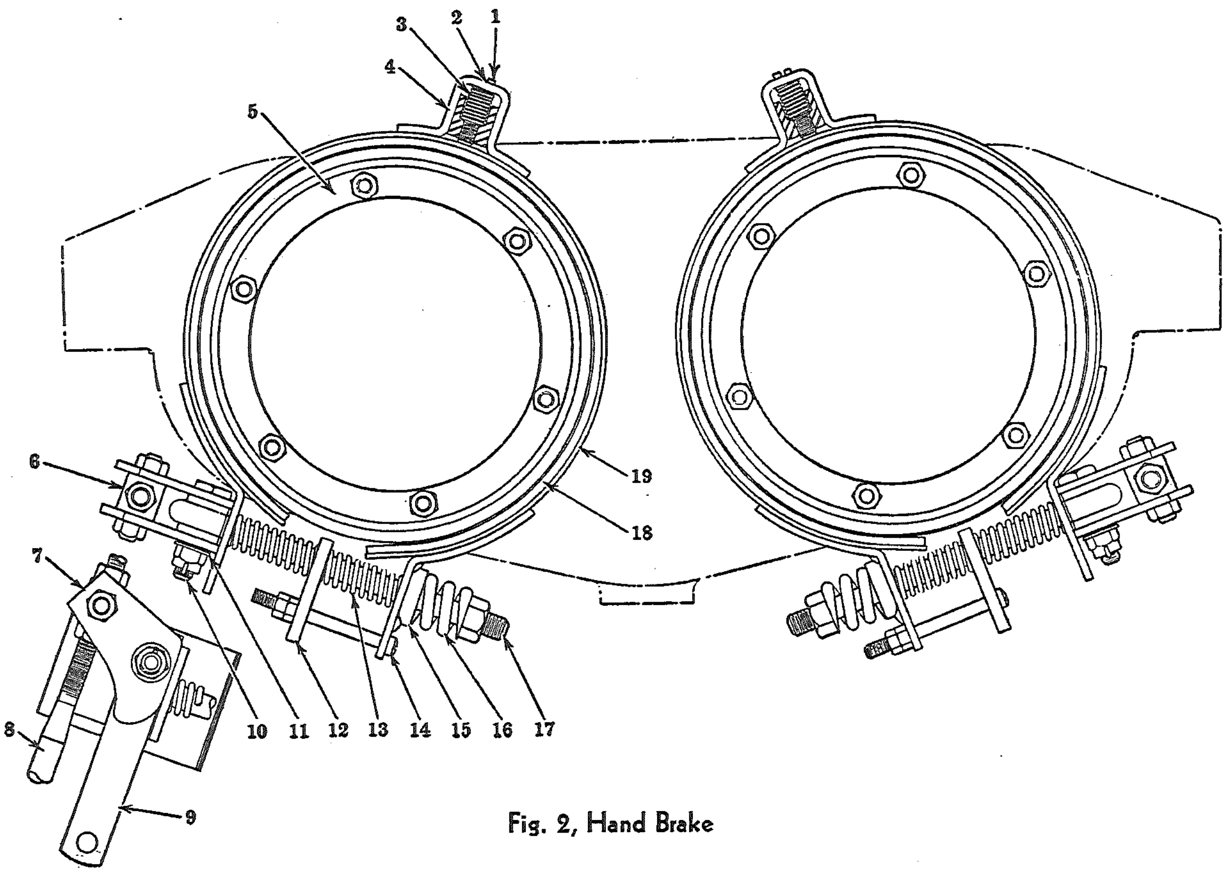

Fig. 2, Hand Brake

No.	Description
1.	Brake band anchor screw.
2.	Lockwire.
3.	Brake band anchor spring.
4.	Brake band anchor.
5.	Brake drum.
6.	Swivel.
7.	Brake cam lever.
8.	Brake rod.
9.	Brake spacer link.
10.	Shoulder bolt.
11.	Washer.
12.	Brake retainer plate.
13.	Brake release spring.
14.	Stop screw.
15.	Brake adjusting bolt spring spacer.
16.	Brake adjusting bolt spring.
17.	Brake adjusting bolt.
18.	Brake lining.
19.	Brake band.

Hand Brake

The hand brake is an external one-piece band, drum type, mounted at the rear of the power divider.

Adjustment

(a) Place hand brake lever in extreme forward (release) position. The brake cam lever (7) must be in the proper position, i.e.: the flat portion must rest squarely on the upper brake band bracket. To correct the position of the brake cam lever, release the check nuts on the brake rod and move swivel (6).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (1) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (17) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

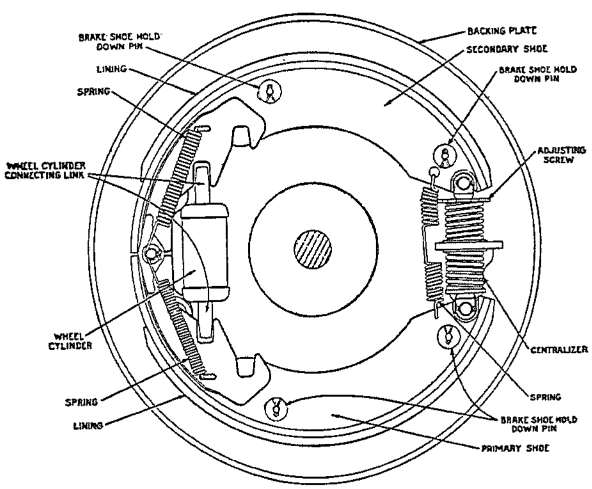

Fig. 3, Front Brake

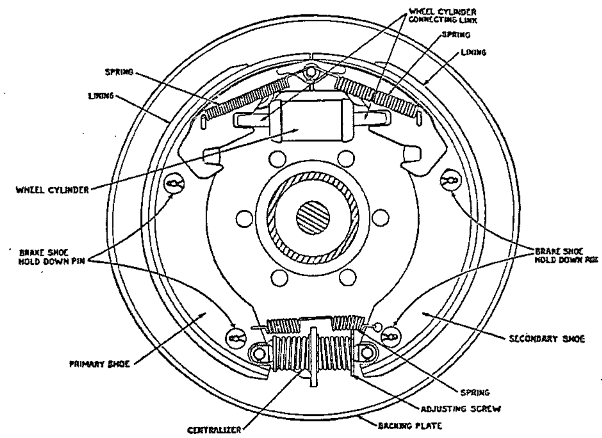

Fig. 4, Rear Brake

Model DR-346T { 17¼ x 3" (Front) / 17¼ x 4" (Rear) } Double Anchor Air Brakes

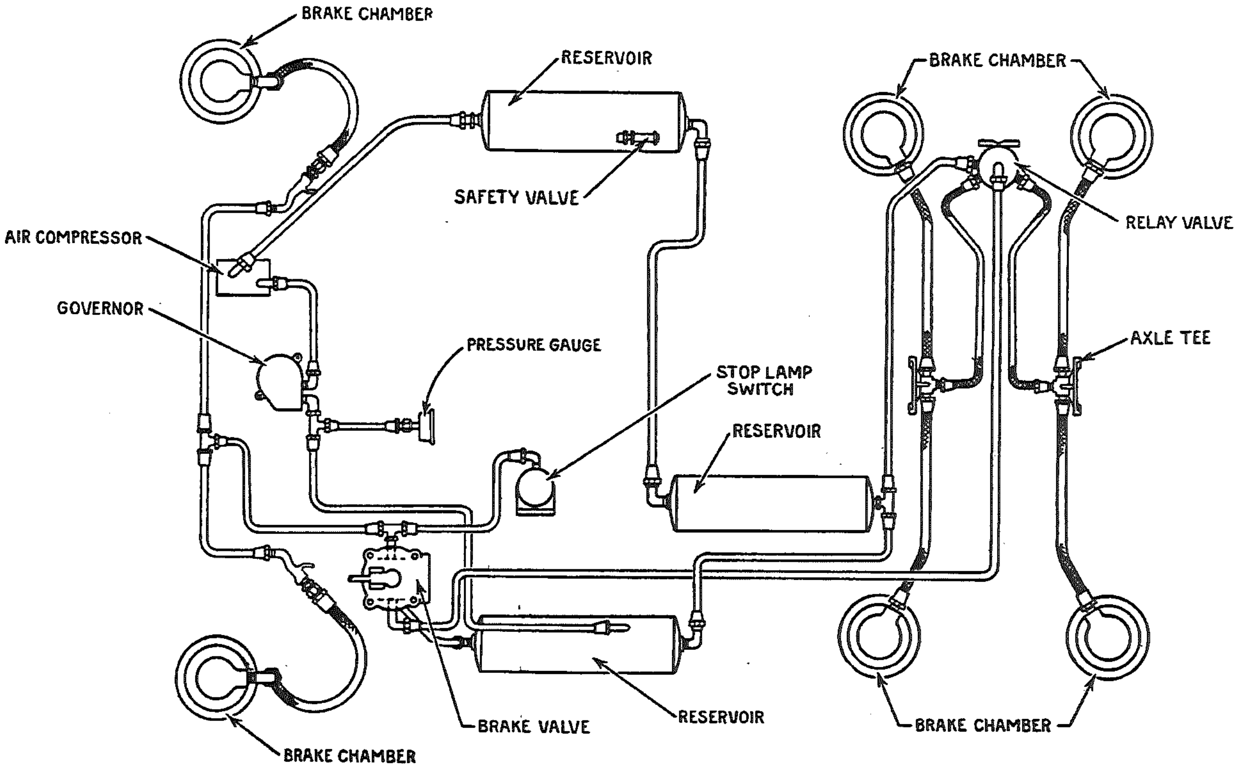

Fig. 1, Air Brake Installation Diagram

Front Wheel Brakes

(a) Jack up wheel and remove brake drum feeler gauge hole cover.
(b) Loosen anchor pin nuts.
(c) Turn slack adjuster screw until there is .010" lining to drum clearance at the cam end of brake shoes.
(d) Turn anchor pins until there is .010" lining to drum clearance at the anchor pin end of brake shoes.
(e) Tighten anchor pin nuts.
(f) Make this adjustment at both front wheels.

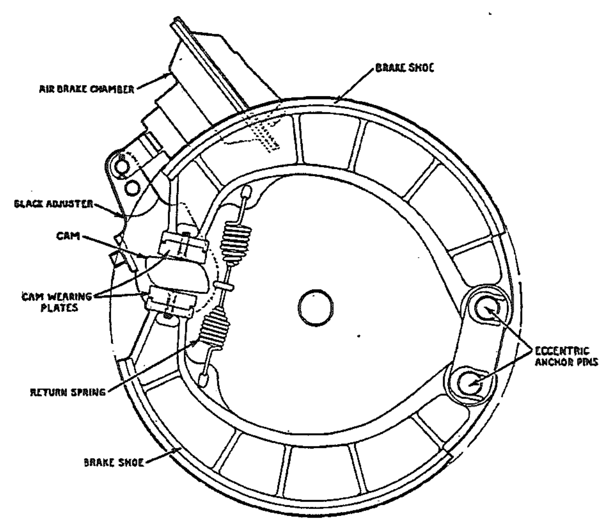

Fig. 2, Front Brake

Rear Wheel Brakes

(a) Jack up wheel and remove brake drum feeler gauge hole cover.
(b) Turn slack adjuster screw until there is .010" lining to drum clearance at the cam end of brake shoes.
(c) Make this adjustment at each of the rear wheels.

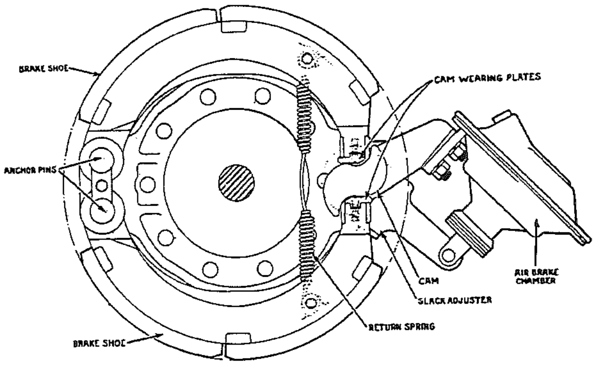

Fig. 3, Rear Brake

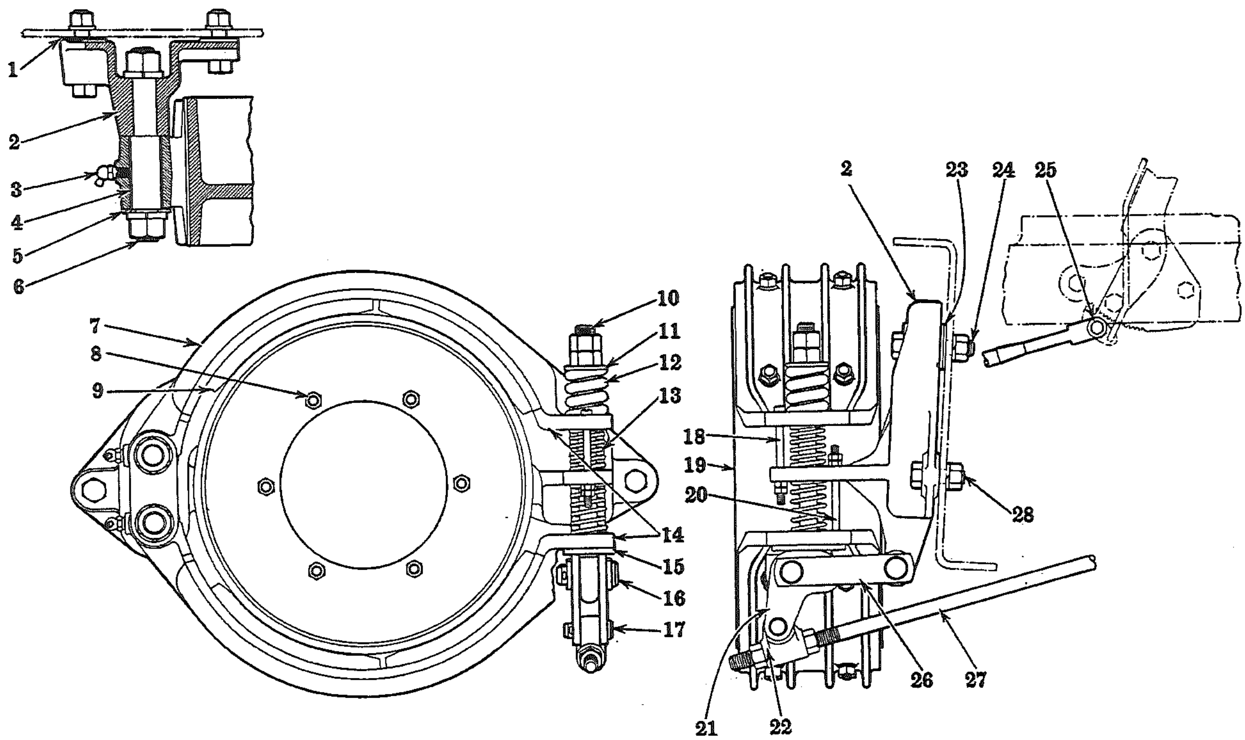

Fig. 4, Hand Brake

No.	Description
1.	Bracket shim washer.
2.	Brake support bracket.
3.	Lubricator.
4.	Brake shoe bushing.
5.	Anchor pin spacer plate.
6.	Brake anchor pin.
7.	Brake shoe lining bolt.
8.	Capscrew.
9.	Brake shoe lining.
10.	Brake adjusting bolt.
11.	Washer.
12.	Adjusting bolt spring.
13.	Brake shoe equalizing spring.
14.	Brake shoe.

No.	Description
15.	Cam bearing block.
16.	Rod end pin.
17.	Brake operating cam pin.
18.	Stop screw.
19.	Brake drum.
20.	Stop screw.
21.	Brake cam lever.
22.	Offset rod end.
23.	Brake support bracket spacer.
24.	Capscrew.
25.	Shoulder bolt.
26.	Brake spacer link.
27.	Brake rod.
28.	Capscrew.

Hand Brake

The hand brake is an external two shoe, drum type, mounted to a cross member at the rear of the transmission.

Adjustment

(a) Place hand lever in extreme forward (release) position. The brake cam lever (21) must be in the proper position, i.e.: the flat portion must rest squarely on the cam bearing block (15). To correct the position of the brake cam lever, release the check nuts on the brake rod and move the offset rod end (22).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) Turn the adjusting bolt (10) and the upper and lower stop screws (18–20) to obtain the desired clearance.

(d) Lock all adjustments, then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

(f) The brake hand assembly and brake drum must be in proper alignment in order that the maximum braking area will be available.

(g) Elongated mounting holes in the cross member and spacers (23) permit alignment of these parts.

Model D-346F { 17¼ x 3" (Front) / 17¼ x 4" (Rear) } Double Anchor Air Brakes

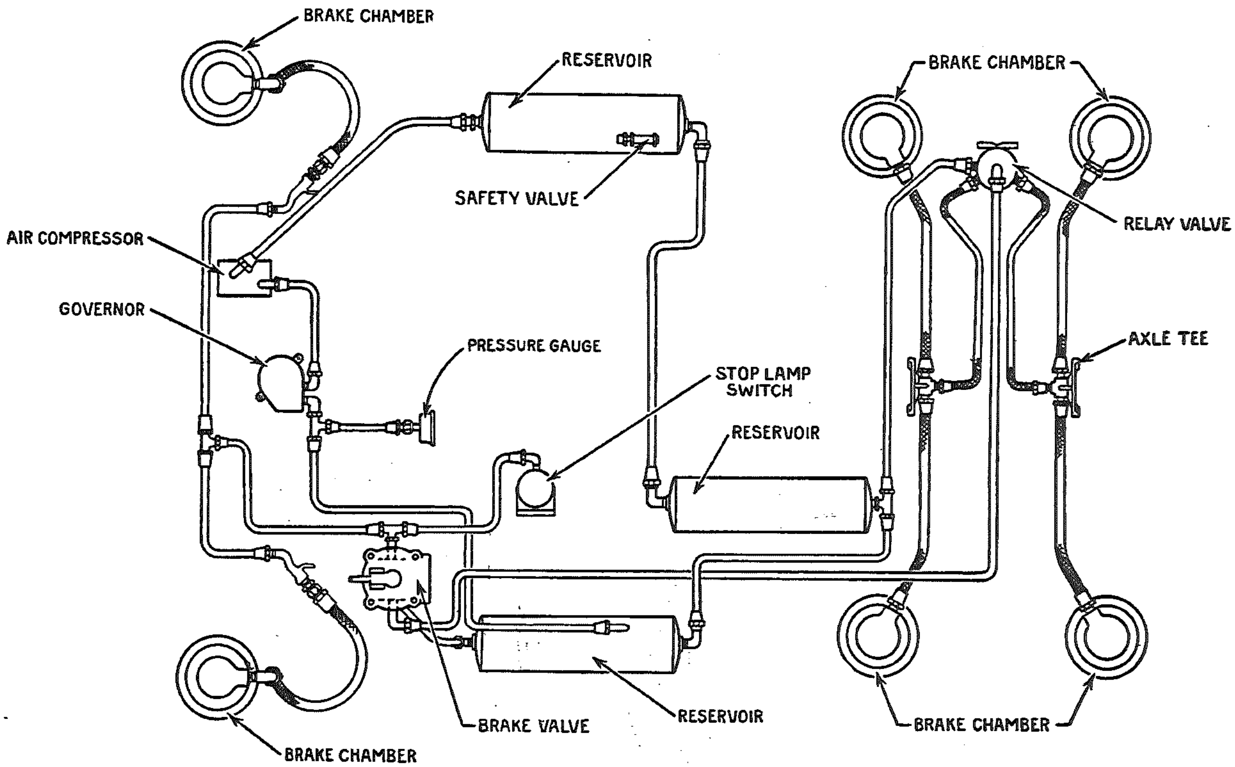

Fig. 1, Air Brake Installation Diagram

Front Wheel Brakes

(a) Jack up wheel and remove brake drum feeler gauge hole cover.
(b) Loosen anchor pin nuts.
(c) Turn slack adjuster screw until there is .010" lining to drum clearance at the cam end of brake shoes.
(d) Turn anchor pins until there is .010" lining to drum clearance at the anchor pin end of brake shoes.
(e) Tighten anchor pin nuts.
(f) Make this adjustment at **both** front wheels.

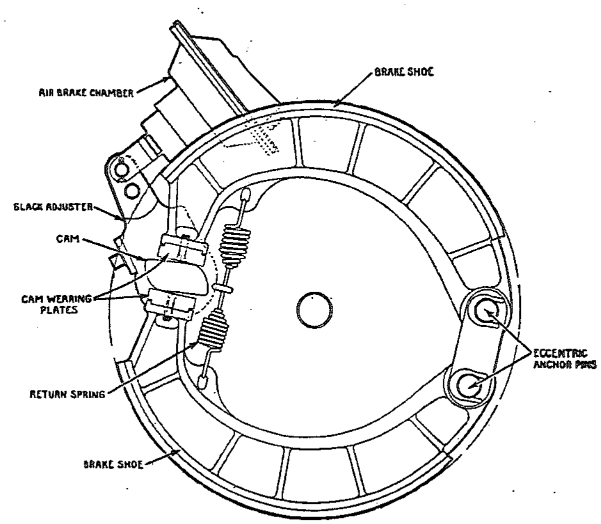

Fig. 2, Front Brake

Rear Wheel Brakes

(a) Jack up wheel and remove brake drum feeler gauge hole cover.
(b) Turn slack adjuster screw until there is .010" lining to drum clearance at the cam end of brake shoes.
(c) Make this adjustment at each of the rear wheels.

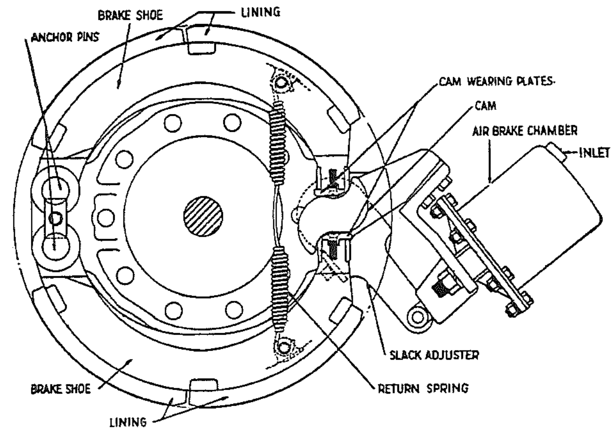

Fig. 3, Rear Brake

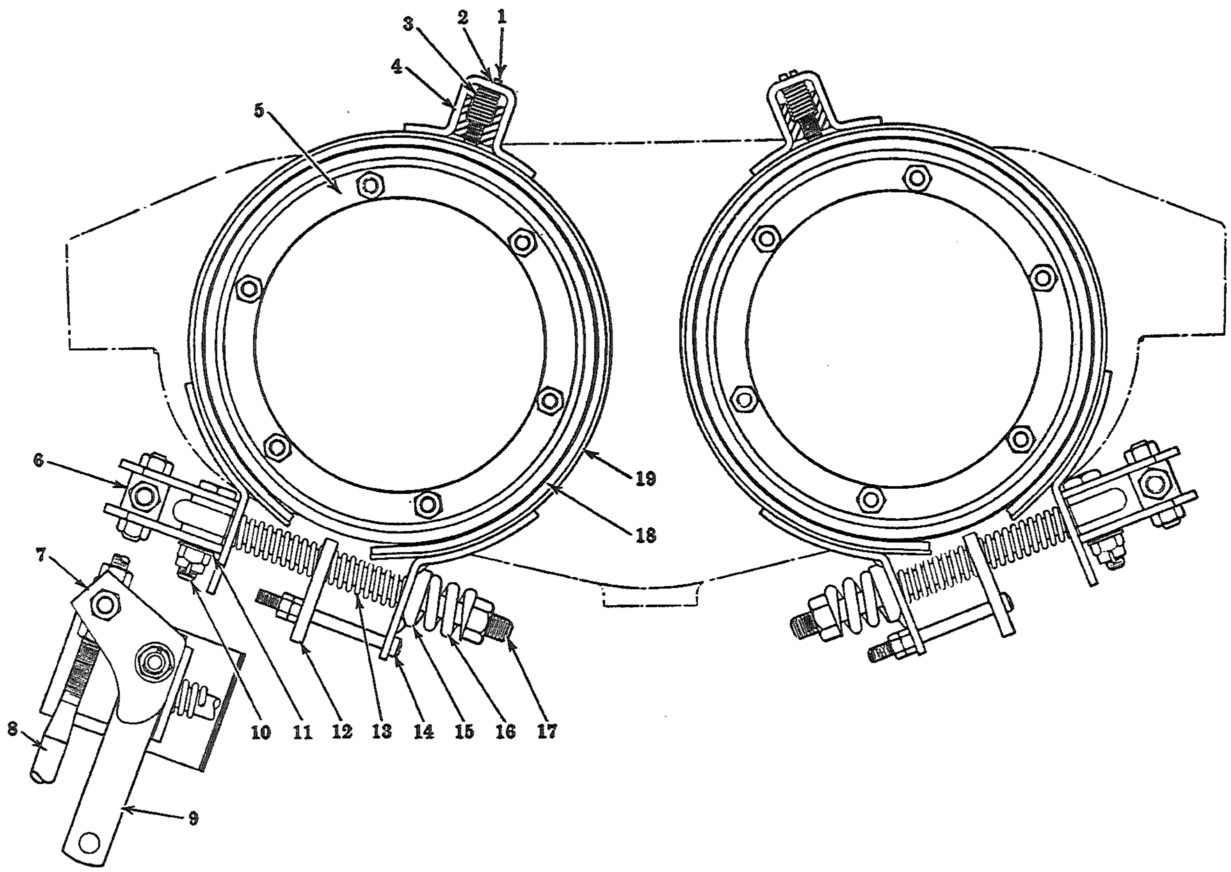

Fig. 4, Hand Brake

No.	Description
1.	Brake band anchor screw.
2.	Lockwire.
3.	Brake band anchor spring.
4.	Brake band anchor.
5.	Brake drum.
6.	Swivel.
7.	Brake cam lever.
8.	Brake rod.
9.	Brake spacer link.
10.	Shoulder bolt.
11.	Washer.
12.	Brake retainer plate.
13.	Brake release spring.
14.	Stop screw.
15.	Brake adjusting bolt spring spacer.
16.	Brake adjusting bolt spring.
17.	Brake adjusting bolt.
18.	Brake lining.
19.	Brake band.

Hand Brake

The hand brake is an external one-piece band, drum type, mounted at the rear of the power divider.

Adjustment

(a) Place hand brake lever in extreme forward (release) position. The brake cam lever (7) must be in the proper position, i.e.: the flat portion must rest squarely on the upper brake band bracket. To correct the position of the brake cam lever, release the check nuts on the brake rod and move swivel (6).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (1) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (17) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

Model DR-426F $\left\{\begin{array}{ll}17\frac{1}{4} \times 3'' & \text{(Front)} \\ 17\frac{1}{4} \times 5\frac{1}{2}'' & \text{(Rear)}\end{array}\right\}$ Double Anchor, Hydraulic Brakes

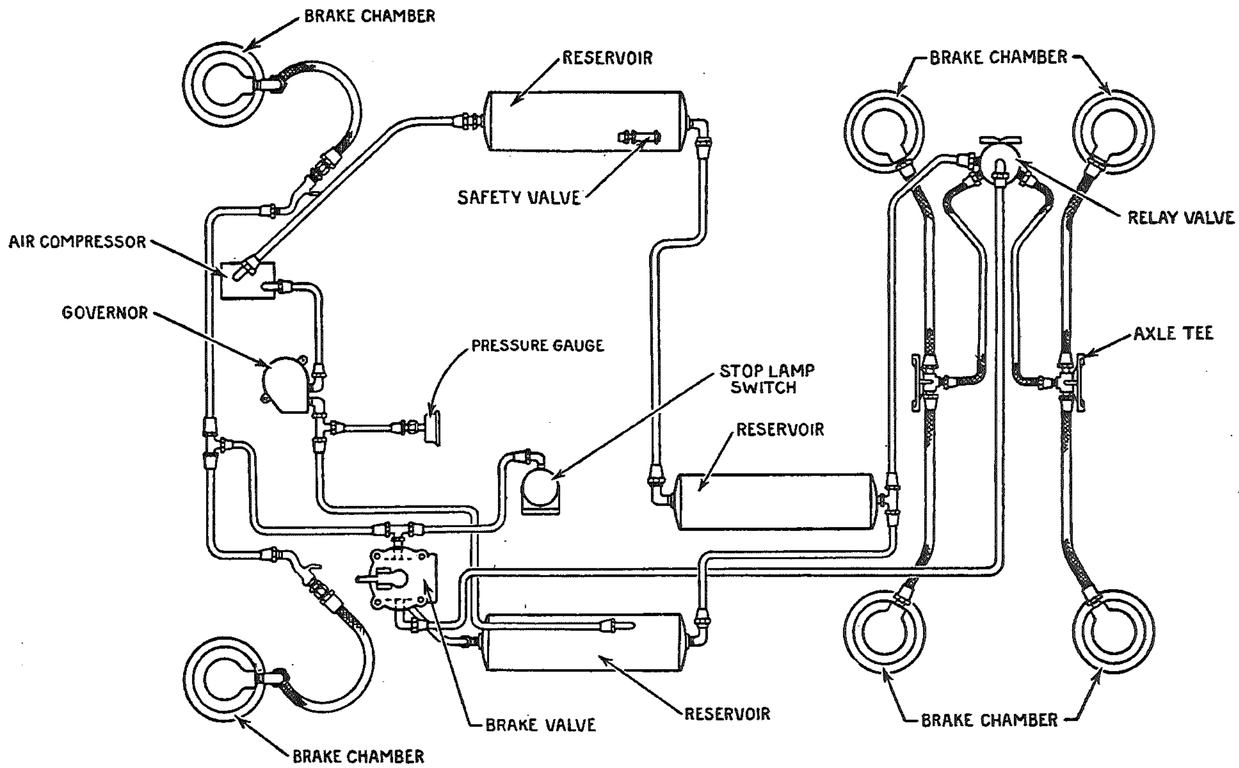

Fig. 1, Air Brake Installation Diagram

Front Wheel Brakes

(a) Jack up wheel and remove brake drum feeler gauge hole cover.
(b) Loosen anchor pin nuts.
(c) Turn slack adjuster screw until there is .010″ lining to drum clearance at the cam end of brake shoes.
(d) Turn anchor pins until there is .010″ lining to drum clearance at the anchor pin end of brake shoes.
(e) Tighten anchor pin nuts.
(f) Make this adjustment at **both** front wheels.

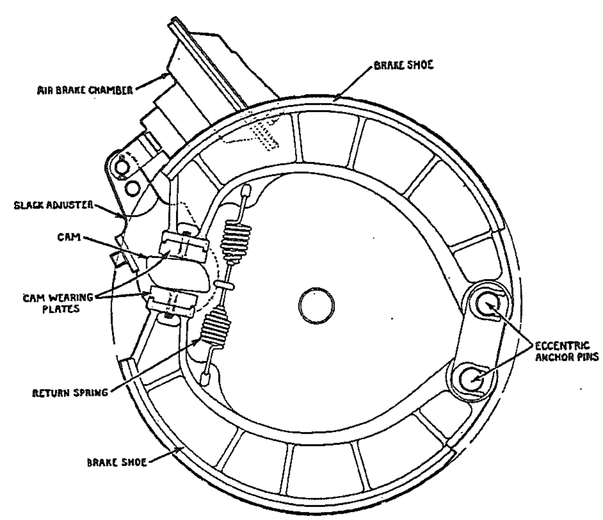

Fig. 2, Front Brake

Rear Wheel Brakes

(a) Jack up wheel and remove brake drum feeler gauge hole cover.

(b) Turn slack adjuster screw until there is .010″ lining to drum clearance at the cam end of brake shoes.

(c) Make this adjustment at each of the rear wheels.

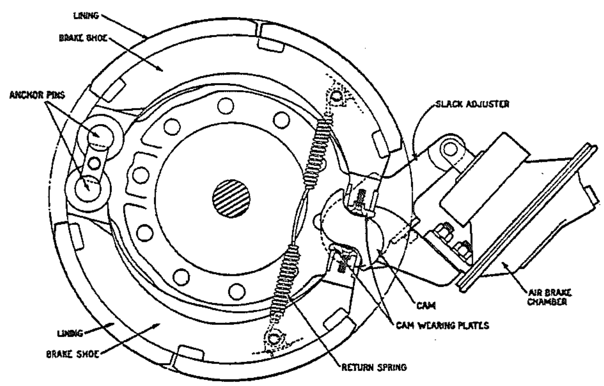

Fig. 3, Rear Brake

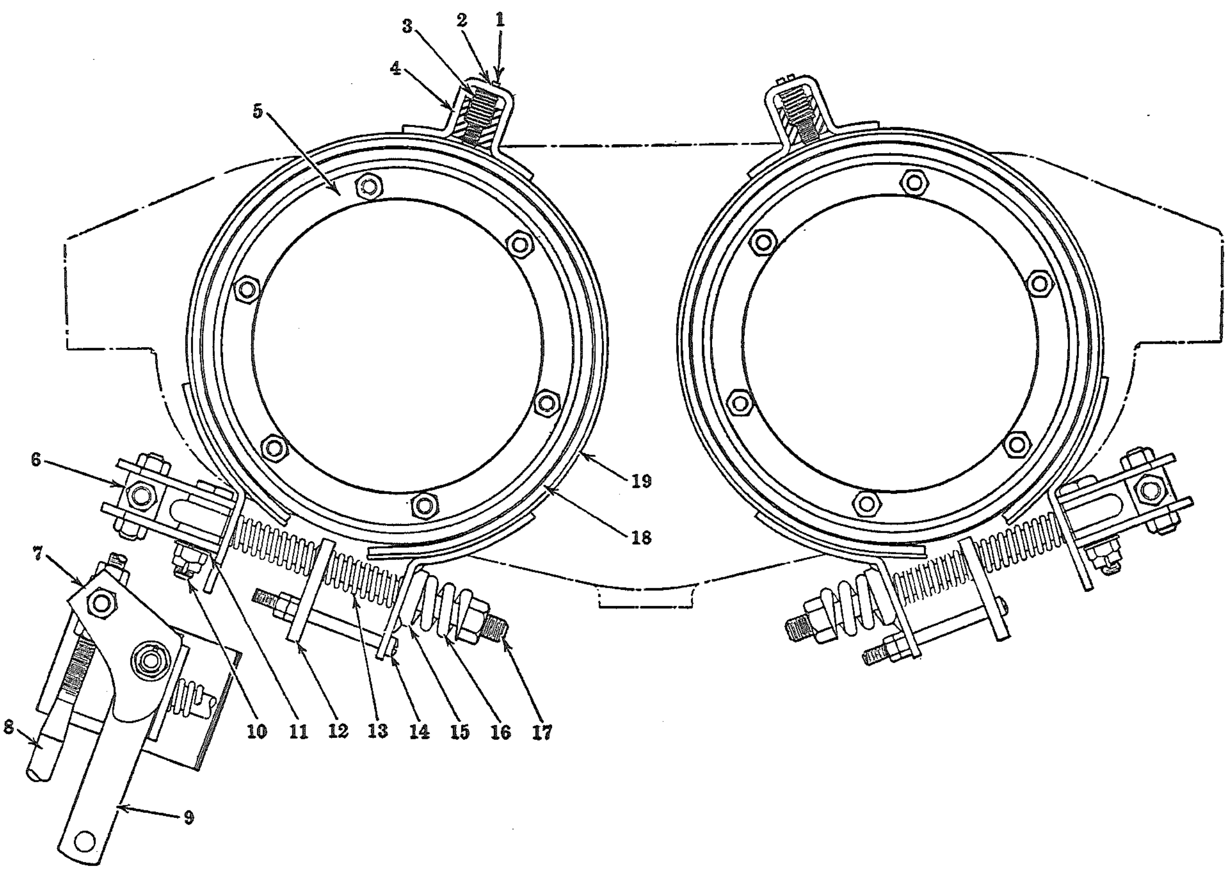

Fig. 4, Hand Brake

No.	Description
1.	Brake band anchor screw.
2.	Lockwire.
3.	Brake band anchor spring.
4.	Brake band anchor.
5.	Brake drum.
6.	Swivel.
7.	Brake cam lever.
8.	Brake rod.
9.	Brake spacer link.

No.	Description
10.	Shoulder bolt.
11.	Washer.
12.	Brake retainer plate.
13.	Brake release spring.
14.	Stop screw.
15.	Brake adjusting bolt spring spacer.
16.	Brake adjusting bolt spring.
17.	Brake adjusting bolt.
18.	Brake lining.
19.	Brake band.

Hand Brake

The hand brake is an external one-piece band, drum type, mounted at the rear of the power divider.

Adjustment

(a) Place hand brake lever in extreme forward (release) position. The brake cam lever (7) must be in the proper position, i.e.: the flat portion must rest squarely on the upper brake band bracket. To correct the position of the brake cam lever, release the check nuts on the brake rod and move swivel (6).

(b) The lining to drum clearance should be from .020″ to .030″ and adjustment is made at three points.

(c) The anchor screw (1) should be turned until this clearance is obtained at each side of the screw then the adjusting bolt (17) and stop screw should be turned to obtain the desired clearance at the ends of the brake band.

(d) Lock all adjustments and then recheck the lining to drum clearance as it may be necessary to readjust at some point in order to secure maximum lining to drum contact.

(e) Be sure that all adjustments are locked; that all linkage operates freely and that there is no drag with hand lever in release position.

Clutch Group

Section A

Models
- D-5 (R-9 Clutch)
- D-2, D-15, D-30, DS-30, D-30B, DS-30B, D-300, DS-300, D-186T, DS-186T (R-10 Clutch)
- D-35, DS-35, D-35B, D-40, D-216T (R-11 Clutch)
- D-50, D-60, DR-60, D-246T, D-246F (R-12 Clutch)
- DR-70 , DR-346T, D-346F, DR-426F (R-14 Clutch)

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Clutch Pedal and Release Sleeve Adjustment............................ 4
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Clutch Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Clutch	R-10	R-9	R-10	R-10	R-10	R-10	R-10	R-11	R-11	R-11	R-11	R-12	R-12
Size	10"	9"	10"	10"	10"	10"	10"	11"	11"	11"	11"	12"	12"
Pressure Springs	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical
Number Used	12	12	12	12	12	12	12	12	12	12	12	15	15
Pounds Pressure	125	112½	125	125	125	125	125	145	145	145	145	145	145
At	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"
Number of Splines	10	10	10	10	10	10	10	10	10	10	10	10	10
Driven Member Runout	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"
Lever Adjustment:													
Pressure Plate to Levers	1 19/32"	1 19/32"	1 19/32"	1 19/32"	1 19/32"	1 19/32"	1 19/32"	1 21/32"	1 21/32"	1 21/32"	1 21/32"	1 3/4"	1 3/4"
Clutch Pedal Free Movement	1 1/4 to 1 3/4"	1 1/2 to 2 1/2"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"
Capscrews for Removal and Installation	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 2"	3/8"–16 x 2"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Clutch	R-12	R-14	R-10	R-10	R-10	R-10	R-11	R-12	R-12	R-14	R-14	R-14
Size	12"	14"	10"	10"	10"	10"	11"	12"	12"	14"	14"	14"
Pressure Springs	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical	Helical
Number Used	15	12	12	12	12	12	12	15	15	12	12	12
Pounds Pressure	145	175	125	125	125	125	145	145	145	175	175	175
At	1 7/16"	1 13/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 13/16"	1 13/16"	1 13/16"
Number of Splines	10	10	10	10	10	10	10	10	10	10	10	10
Driven Member Runout	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"	.015"
Lever Adjustment:												
Pressure Plate to Levers	1 3/4"	2 1/8"	1 19/32"	1 19/32"	1 19/32"	1 19/32"	1 21/32"	1 3/4"	1 3/4"	2 1/8"	2 1/8"	2 1/8"
Clutch Pedal Free Movement	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"	1 1/4 to 1 3/4"
Capscrews for Removal and Installation	3/8"–16 x 2"	3/8"–16 x 2 1/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 1 3/4"	3/8"–16 x 2"	3/8"–16 x 2"	3/8"–16 x 2 1/4"	3/8"–16 x 2 1/4"	3/8"–16 x 2 1/4"

Clutches—R-9, R-10, R-11, R-12, R-14

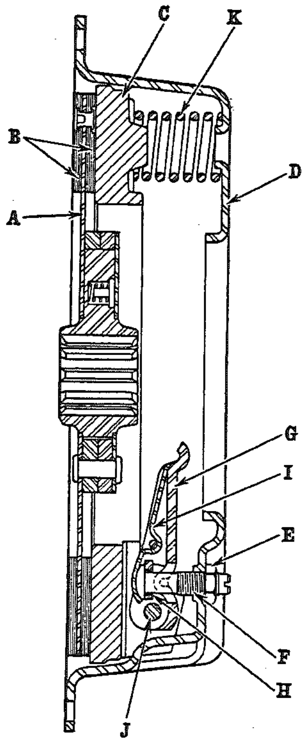

Fig. 1, Clutch (9") R-9

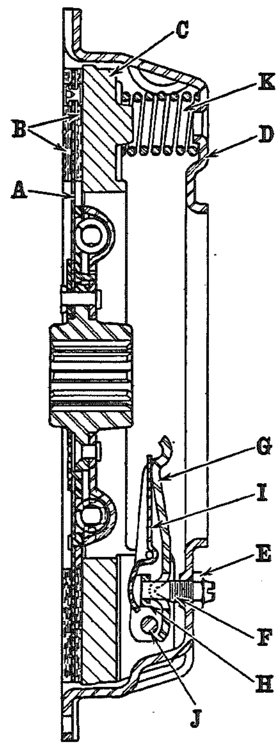

Fig. 2, Clutch (10, 11"), R-10, R-11

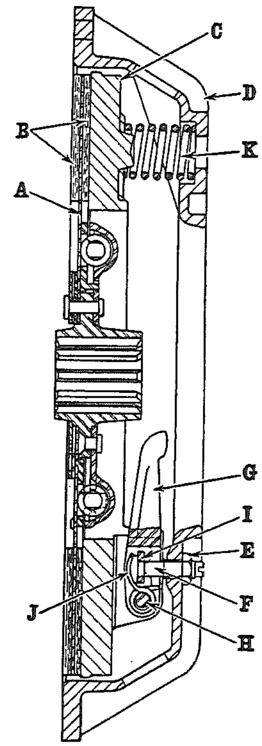

Fig. 3, Clutch (12"), R-12

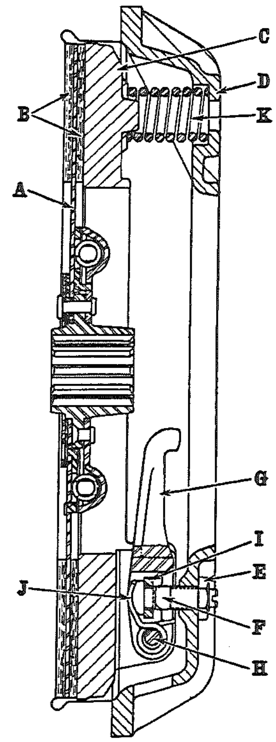

Fig. 4, Clutch (14"), R-14

Clutches

These clutches are of the single dry plate type, and no adjustments are required during the normal life of the clutch driven plate facings. As pedal free play is reduced by wear of the clutch driven plate facings, the correct amount of pedal free play should be restored by means of the pedal adjustment, which will also give the proper clearance between clutch release levers and the release bearing. It is extremely important that there be free play of the pedal at all times to avoid clutch slippage.

Whenever it is necessary to do any service work on the clutch, advantage should be taken of the opportunity to thoroughly recondition it. This is a comparatively short job and will assure satisfactory operation over a long period of time, whereas neglecting to do this may necessitate another tear-down within a short time.

Removal of Clutch

When removing transmission for the purpose of gaining access to the clutch, or for any other reason, extreme care should be taken to support the weight of the transmission until it is completely removed. If this is neglected, there is a possibility of creating an out-of-line condition in the clutch driven plate which may later cause a "drag" in the clutch.

The clutch pressure plate is drilled and tapped so that three capscrews (See specifications for sizes) with washers under the heads may be inserted thru the cover plate, thereby holding the clutch assembly compressed when it is removed from the flywheel. With the three capscrews holding the assembly compressed, remove clutch from flywheel by backing out the capscrews which hold it in place. All capscrews should be backed out gradually to avoid damage to the clutch cover or back plate.

If the surface on flywheel contacted by the clutch driven plate is not smooth, remove flywheel, mount it in lathe, and smooth the surface with emery cloth, first using coarse emery cloth and finishing the job with fine emery cloth. If the surface is extremely rough, a thin cut should be taken on the face of flywheel in lathe, and the surface then polished with emery cloth.

NOTE: In the case of the 14" clutch which is used with a counterbored flywheel, if a cut is taken on the face a similar amount should be cut from the flange of flywheel to which the clutch cover or back plate is bolted, so as to maintain a distance of $1\frac{3}{16}$" from flywheel flange to face of flywheel. If this distance is not maintained, an unsatisfactory condition will be created in the clutch.

Servicing Driven Plate Assembly

The clutch driven plate (A) should be carefully inspected. Facings (B) showing considerable wear, or facings that are rough or oil soaked, should be replaced, assuming the balance of the plate is in good condition. Otherwise replace the old plate with a new one and thus be sure of satisfactory performance.

After removal of old facings and before installing new ones, the clutch driven plate should be checked for runout at point where facings are later to be located. This may be done by mounting it on a spare transmission shaft placed between centers in a lathe. Then gauge the runout with a standard dial indicator.

If the runout is greater than .015″, it should be replaced with a new one.

9-in., 10-in. and 11-in. Clutch Facings

When installing new facings, which are in segment form and of two different thicknesses, care should be taken to install a thick segment directly opposite a thin segment on the other side of the plate. Also be sure that the different thicknesses are alternated around each side of the plate. If these segment facings are not installed correctly, as outlined above, satisfactory clutch operation will not be secured.

12-in. and 14-in. Clutch Facings

When installing new facings of the continuous ring type and in cases where two different thicknesses are used on each plate, the thick facing should be installed on the side of the clutch driven plate that contacts the clutch pressure plate, which is also the side on which the vibration dampening device is located. The thin facing is installed on the side of clutch driven plate that contacts the face of flywheel.

Servicing Cover Assembly

The cover assembly is dismantled by placing it on a drill press or arbor press with 1″ high blocks of wood or metal under the pressure plate. These blocks should not extend out beyond the outside edges of the pressure plate. A bar is then placed across the top of the cover assembly and the drill press or arbor press spindle brought down to a point where the assembly is compressed slightly.

Take out the three capscrews used to hold the assembly when removing it from flywheel and remove the adjustment lock nuts (E). The three lever adjusting screws (F) are next backed out or down about five turns by means of a screwdriver, turning it clockwise to do so. After turning each adjusting screw out approximately five turns, the cover should be released a small amount by means of the press spindle, and the screws backed out another five turns. This should be repeated until the screws are entirely free from the cover or back plate. This procedure of gradually releasing the assembly and backing out the screws must be followed in order to avoid damage to the lever assemblies.

The clutch may then be fully released, after which all parts are readily dismantled for inspection, and replacement if necessary.

A pressure plate that is badly scored should be replaced, as it will not perform satisfactorily, and in addition will damage the clutch driven plate. A pressure plate that is heat checked or warped due to heat should be replaced.

Clutch pressure springs that have seen considerable service should be replaced, as it is possible they have lost their original tension (See specifications) and may therefore permit the clutch to slip under load. Springs that are discolored due to heat should always be replaced.

Release levers that show considerable wear at the release bearing contact points as well as at the pivot points should be replaced, as should worn lever pins. The lever spring should hold the lever adjusting screw and pivot block up firmly against the pivot points on the release lever. If this condition does not exist on the old levers, it is sufficient reason for replacement with new lever assemblies.

Assembling Clutch

9-in., 10-in. and 11-in. Clutch

Place the clutch pressure plate (C) on top of the 1″ high blocks on drill or arbor press, first having mounted the release lever assemblies, which include the lever (G), lever pivot block (H), lever adjusting screw (F) and lever spring (I) on the pressure plate by means of lever pins (J). Note that lever pins are held in place by means of cotter pin. Then install pressure springs (K) in position on pressure plate.

Place clutch cover or back plate over springs, making sure that springs are seated properly both above and below, and that the adjusting screw holes in cover are directly over the clutch lever adjusting screws.

12-in. and 14-in. Clutch

Place the clutch pressure plate (C) on top of the 1″ high blocks on drill or arbor press, first having mounted the release levers (G) on the pressure plate by means of lever pins (H). Assemble lever pivot block (I), adjusting screw (F) and spring (J) to release lever and insert a "dummy" pin to hold these parts together before mounting the assembly to the pressure plate. The "dummy" pin should be cut off flush with the outer sides of the lever. Be sure that chamfered side of hole in lever block is toward head of adjusting screw and that narrow side of lever block is toward the rear of release lever.

Place the release levers in position and insert the regular lever pins thru the lever bosses in the pressure plate, tapping with a hammer so that as the regular lever pin goes into position the "dummy" pin will be driven out from the other side without disturbing the assembly. Insert cotter pins to hold the regular lever pins in place. Then install pressure springs (K) in position on pressure plate.

Place clutch cover or back plate over springs, making sure that springs are seated properly both above and below, and that the adjusting screw holes in cover are directly over the clutch lever adjusting screws.

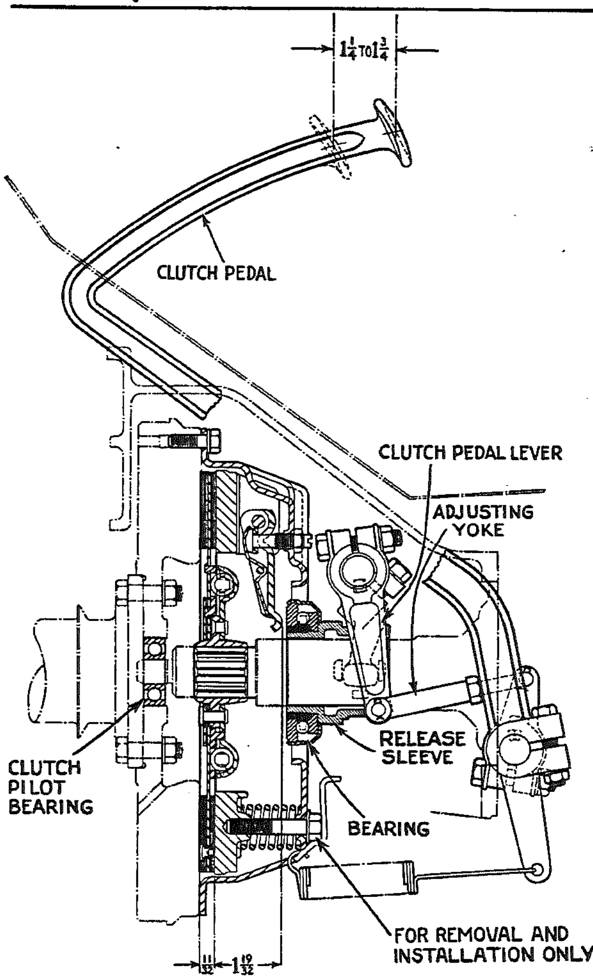

Fig. 5, Clutch Control (D-2, D-5, D-15)

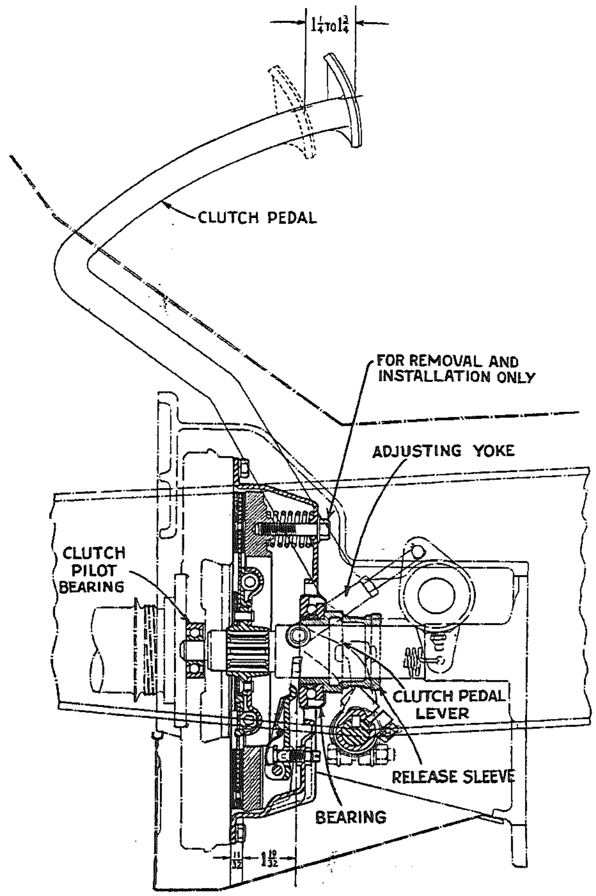

Fig. 6, Clutch Control (D-30, D-30B, DS-30, DS-30B, D-186, DS-186T)

All Clutches

A bar is now placed across the clutch cover or back plate so as not to interfere with the lever adjusting screw holes, and by means of drill press or arbor press spindle, the assembly should be compressed slowly until the top unthreaded portion of each adjusting screw can be guided by hand up through the tapped holes in cover plate. At this point care should be taken to see that both pressure plate and cover are lined up correctly, so as to permit free entry of the three drive lugs.

Turn each adjusting screw up into the cover or back plate approximately five turns at a time (turning screwdriver anticlockwise) and after each five turns compress the assembly a small amount. Insert the three capscrews with washers under the heads and compress the assembly until a dimension as shown in Figs 5, 6, 7, 8, 9, 10 measured from the bottom face of the cover plate to the bottom or finished surface of the pressure plate is secured. This may be accurately measured by placing a straight edge across the bottom of the cover plate. Check this dimension at the three points directly under each release lever. Turn the three capscrews in to hold this dimension, then release spindle of press and remove cross-bar. The release levers may now be adjusted to the correct setting as follows.

Adjustment

The release levers should be set to the dimension shown in Figs. 5, 6, 7, 8, 9, 10 measured from a straight edge placed across the finished surface of the pressure plate, up to the bearing contact points of the release levers. It is very important that all three levers be set to exactly the same height. After levers are set to the correct height, the adjustment lock nuts are installed and tightened securely. Care should be taken not to upset the adjustment when tightening the lock nuts.

Installing Clutch

When installing the clutch on flywheel in truck, care should be taken to see that the clutch-driven plate is aligned properly by inserting a transmission stub shaft or aligning bar through the driven plate splines and into pilot bearing. Have dampener mechanism of clutch driven plate toward the transmission. IMPORTANT—An inspection mark is stamped on the outer flange of the clutch cover which indicates the heavy side of the clutch assembly. The clutch should be assembled to the flywheel so that this mark is adjacent to the mark "L," stamped on the flywheel which indicates the light side.

Bolt clutch assembly to flywheel, making sure that the marks on the flywheel and outer flange of the clutch cover match as nearly as possible. This is important in order to maintain the correct balance of the flywheel and clutch assembly.

Remove the three capscrews holding the assembly compressed. The transmission stub shaft or aligning bar is also removed, as the driven plate will now be held in position by the clutch pressure plate. Care should be exercised when installing the transmission, so as not to permit the transmission to hang by the clutch shaft, which would bend the hub of clutch-driven plate, creating misalignment, with resultant clutch "drag."

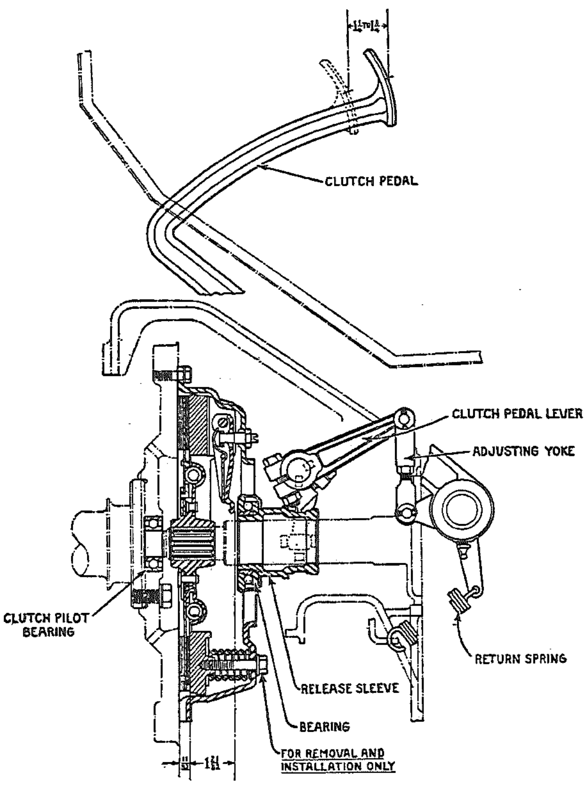

Fig. 7, Clutch Control (D-35, D-35B, DS-35, D-40, D-216T)

With transmission installed and floor boards in place, make correct pedal adjustments. Do not adjust the clutch release levers, which were previously set to the correct height and require no further adjustment during the life of the clutch-driven plate facings. Pedal adjustments only are required to maintain the recommended amount of pedal free play.

Important

Oil and grease should be kept off the driven plate facings. The clutch release bearing is lubricated at assembly and should require no further lubrication during the life of the truck. If this bearing is removed for any reason it should be examined and replaced if it shows signs of lack of

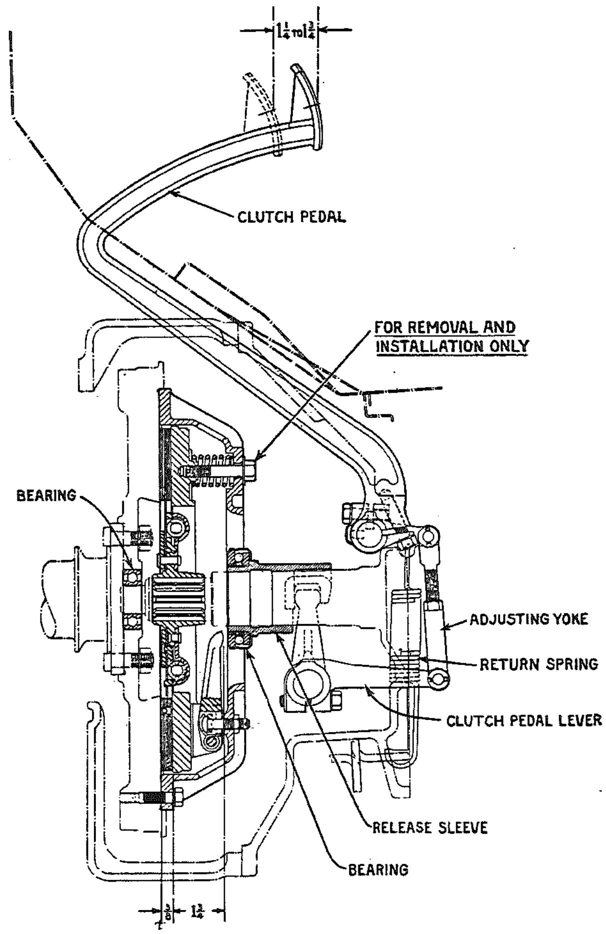

Fig. 8, Clutch Control (D-50, D-60, DR-60, D-246T, D-246F)

lubrication. Do not ride the clutch pedal with foot while driving and refrain from slipping clutch excessively instead of shifting gears, which will cause undue wear of driven plate facings.

Clutch Pedal and Release Sleeve Adjustment

Figs. 5, 6, 7, 8, 9, 10 illustrate the assembly of the clutch control mechanism.

The clutch pedal should have 1¼″ to 1¾″ free movement before clutch pressure is felt. The clutch release bearing will just touch the clutch release levers when the clutch pedal is depressed the above amount. If clutch pedal free movement is 1″ or less, adjustment will be necessary.

As wear of the clutch facing takes place, the clutch release levers move outward, reducing the clearance between the clutch release levers and clutch release bearing. The adjustable yoke on clutch release rod provides means of adjusting the clearance.

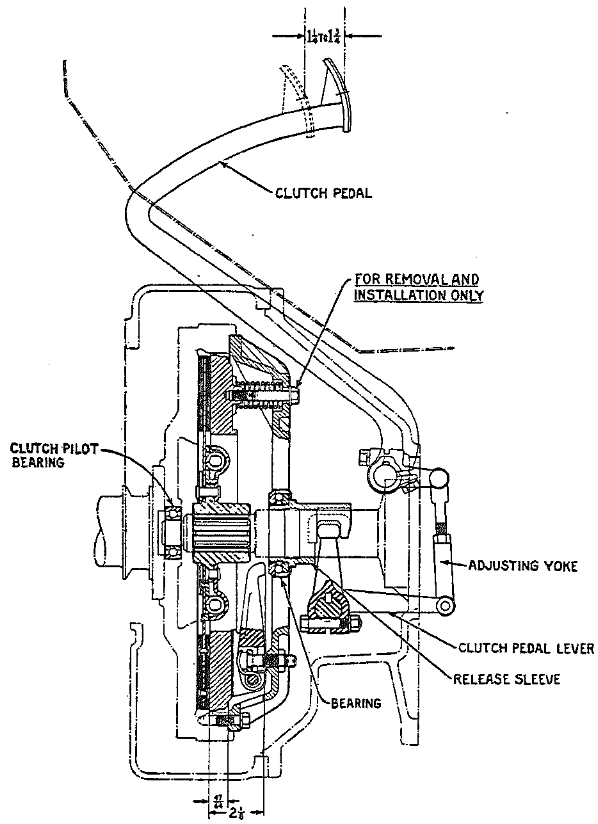

Fig. 9, Clutch Control (DR-70, DR-346T, D-346F, DR-426F)

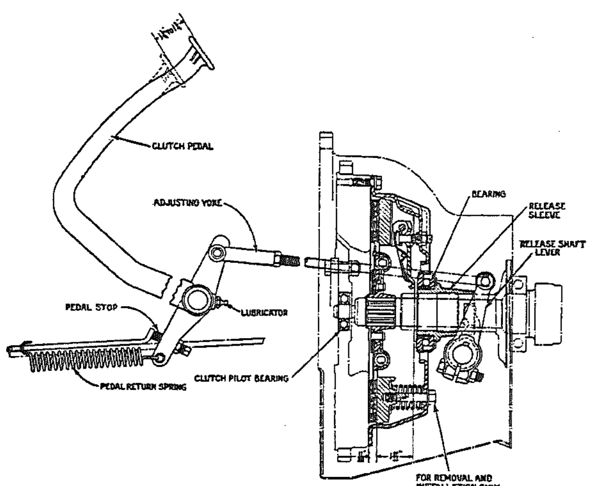

Fig. 10, Clutch Control (D-300, DS-300)

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)

October 25, 1939

SUBJECT:

TO ALL DEALERS:

There seem to be many complaints from customers and dealers' organizations with reference to spark plugs missing and spark plugs having a tendency to foul.

On September 19th, we wrote you a letter, also sending you a chart giving the spark plug recommendations for our different trucks. The intention of this letter is to go deeper into the spark plug situation.

The factory sometimes puts oil in the cylinder combustion chambers when shipment is made from the factory, also from this branch, so that in case the truck is stored or sits around for any length of time, there will be no rust accumulate inside of the motor, cylinder walls, pistons, etc. This is done to preserve the motor when not being run, as moisture will accumulate from condensation, and this oil has a tendency to keep the motor in good condition. However, if this motor is run for a short time, it may foul the spark plugs.

It has been a practice in the past to take out the spark plugs that are in the truck, condemn them and even put in another make or different heat range. However, this is not necessary, as the motor should be run for approximately one half hour, either by idling or the truck could be taken on a short run, brought back to the shop, remove the spark plugs and thoroughly clean before delivery is made to the customer. If this procedure is followed, we are sure that the trucks will perform much better when placed in the hands of the customer.

In order for anything to operate smoothly, things have to operate uniformly and efficiently. We believe that from time to time when trucks are brought into your shops for repairs that the thermostats should be checked according to page 15 under engines in your Motor Truck Service Manual, as an improper working thermostat will effect the spark plugs.

Would suggest that your sales organization, parts men and service men read this letter.

Yours truly,

INTERNATIONAL HARVESTER COMPANY

B. E. McDonell

B. E. McDonell

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)

September 19, 1939.

SUBJECT:

TO ALL DEALERS:

We have received many complaints from our customers with reference to generator failures on our trucks. We believe that most of these complaints are caused by not fully analyzing the customers lighting requirements before the purchase is made.

In our truck price book, CT-150, under Miscellaneous special Equipment, Section 8, you will find an application chart for standard and special generators. This chart explains fully the requirements and capacity of each generator furnished by the Harvester Company. In order to help you understand this chart, we shall give you an example so it can be easily read.

We will take for example our Model D-30, which chart shows standard generator of 63 watts. Under amperes, hot out-put, the chart shows nine. This is the capacity of the generator without the motor running. In the next column amperes available in day time, begin with seven amperes, which is the capacity of the generator with the motor running. In the third column, amperes available at night shows one, which is the extra ampere if the head lights and tail-lights are in use. In the upper right hand corner of this chart, you will notice Lamp Data Chart, giving the candle power, watts and amperes required. If the operator has to install marker lights, ascertain the candle power of each light and multiply it by the amperes that each light uses, and this will tell you how large a generator a customer will require.

We believe it is worth while studying this chart and having your entire organization study same; and if this is done, our equipment will go out in a more satisfactory manner.

It would be our suggestion that you file this letter in your CT-150 price book on top of the application chart for standard and special generators.

Yours truly,

INTERNATIONAL HARVESTER COMPANY

B. E. McDonell

B.E.McDonell

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Coil (Delco-Remy)	528-C	528-C	528-C	528-C	528-C	528-C	528-C	528-C	528-C	528-C	528-C	528-C	528-C
Distributor (Delco-Remy)	622-R	625-F	622-R	622-R	622-R	622-R	622-R	623-G	623-G	623-G	623-G	649-T	649-S
Type	Vac. Auto.	Auto.	Vac. Auto.	Vac. Auto.	Vac. Auto.	Vac. Auto.	Vac. Auto.	Auto.	Auto.	Auto.	Auto.	Auto.	Auto.
Initial Setting	4° BTC	TC	4° BTC	TC	TC	TC	TC	3° BTC	3° BTC	3° BTC	3° BTC	10° BTC	10° BTC
Vacuum Advance	10°	....	10°	10°	10°	10°	10°	....	....	....	....	....	....
Automatic Advance	12°	21°	12°	12°	12°	12°	12°	27°	27°	27°	27°	35°	20°
Total Advance	26°	21°	26°	22°	22°	22°	22°	30°	30°	30°	30°	45°	30°
Breaker Point Adjustment	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"
Rotation (viewed from top)	CCW	CCW	CCW	CCW	CCW	CCW	CCW	CW	CW	CW	CW	CW	CW
Firing Order	1-5-3-6-2-4	1-3-4-2	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Distributor Vacuum Control (Delco-Remy)	681-E	....	681-E	681-E	681-E	681-E	681-E	....	....	....	....	....	....
Dimmer Switch (Delco-Remy)	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P
Generator (Delco-Remy)	946-P	968-H	946-N	946-N	946-N	946-N	946-N	948-G	948-G	948-G	948-G	948-H	948-H
Hot Output (Amperes)	9	15	9	9	9	9	9	15	15	15	15	15	15
Volts	6	6	6	6	6	6	6	6	6	6	6	6	6
Regulation	3rd Brush	3rd Brush	3rd Brush	3rd Brush	3rd Brush	3rd Brush	3rd Brush	Voltage Reg.	Voltage Reg.	Voltage Reg.	Voltage Reg.	Voltage Reg.	Voltage Reg.
Bearings:													
Commutator End	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze
Drive End	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball
Rotation (viewed from Drive End)	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW
Type of Drive	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt
Head Lamps (Guide)	877-A	877-A	877-A	877-A	877-A	877-A	877-A	877-A	877-A	877-A	877-A	877-A	877-A
Horn (Delco-Remy)	K-16-2002	K-16-2002	K-16-2002	K-16-2002	K-16-2002	K-16-2002	K-16-2002	K-16-2002	K-16-2002	K-16-2002	K-16-2002	K-26L-1611	K-26L-1611
Ignition Switch (Delco-Remy)	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V
Lighting Switch (Delco-Remy)	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W
Lamp Bulbs:													
Head—No. used	2	2	2	2	2	2	2	2	2	2	2	2	2
Voltage	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8
C. P.	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21
Contact	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC
Mfgr's No.	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L
Stop and Tail—No. Used	1	1	1	1	1	1	1	1	1	1	1	1	1
Voltage	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8
C. P.	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3
Contact	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC
Mfgr's No.	1158	1158	1158	1158	1158	1158	1158	1158	1158	1158	1158	1158	1158

Electrical Specifications—Continued

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Coil (Delco-Remy)	528-C	528-C	528-A	528-A	528-C	528-C	528-C	528-C	528-C	528-C	528-C	528-C
Distributor (Delco-Remy)	649-S	649-R	622-R	622-R	622-R	622-R	623-G	649-T	649-T	649-R	649-R	649-C
Type	Auto.	Auto.	Vac. Auto.	Vac. Auto.	Vac. Auto.	Vac. Auto.	Auto.	Auto.	Auto.	Auto.	Auto.	Auto.
Initial Setting	10° BTC	6° BTC	TC	TC	TC	TC	3° BTC	10° BTC	10° BTC	6° BTC	6° BTC	10°
Vacuum Advance	....	....	10°	10°	10°	10°	....	....	....	....	....	....
Automatic Advance	20°	24°	12°	12°	12°	12°	27°	35°	35°	24°	24°	25°
Total Advance	30°	30°	22°	22°	22°	22°	30°	45°	45°	30°	30°	35°
Breaker Point Adjustment	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"	.018"-.024"
Rotation (viewed from top)	CW	CW	CCW	CCW	CCW	CCW	CW	CW	CW	CW	CW	CW
Firing Order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Distributor Vacuum Control (Delco-Remy)	....	....	681-E	681-E	681-E	681-E	....	....	....	....	....	....
Dimmer Switch (Delco-Remy)	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P	471-P
Generator (Delco-Remy)	948-H	948-H	946-S	946-S	946-N	946-N	948-G	948-H	948-H	948-H	948-H	948-H
Hot Output (Amperes)	15	15	9	9	9	9	15	15	15	15	15	15
Volts	6	6	6	6	6	6	6	6	6	6	6	6
Regulation	Voltage Reg.	Voltage Reg.	3rd Brush	3rd Brush	3rd Brush	3rd Brush	Voltage Reg.	Voltage Reg.	Voltage Reg.	Voltage Reg.	Voltage Reg.	Voltage Reg.
Bearings:												
Commutator End	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze
Drive End	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball
Rotation (viewed from Drive End)	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW
Type of Drive	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt
Head Lamps (Guide)	877-A	877-A	* 535-V	* 535-V	877-A	877-A	877-A	877-A	877-A	877-A	877-A	877-A
Horn (Delco-Remy)	K-26L-1611	K-26L-1611	K-26L-1624	K-26L-1624	K-16-2002	K-16-2002	K-16-2002	K-26L-1611	K-26L-1611	K-26L-1611	K-26L-1611	K-26L-1611
Ignition Switch (Delco-Remy)	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V	429-V
Lighting Switch (Delco-Remy)	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W	481-W
Lamp Bulbs:												
Head—No. used	2	2	2	2	2	2	2	2	2	2	2	2
Voltage	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8
C. P.	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21	32—21
Contact	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC
Mfgr's No.	2320-L	2320-L	1116	1116	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L	2320-L
Stop and Tail—No. Used	1	1	1	1	1	1	1	1	1	1	1	1
Voltage	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8
C. P.	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3	21—3
Contact	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC
Mfgr's No.	1158	1158	1158	1158	1158	1158	1158	1158	1158	1158	1158	1158

* 828-M on Model HDM (Burkett) Cab

Electrical Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Instrument—No. Used	1	1	1	1	1	1	1	1	1	1	1	1	1
Voltage	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8
C. P.	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½
Contact	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC
Mfgr's No.	55	55	55	55	55	55	55	55	55	55	55	55	55
Relay (Delco-Remy)	265-H	....	265-H	265-H	265-H	265-H	265-H	....	....	....	....	....	....
Spark Plugs:													
Moderate Service:													
AC	D-7	D-9	D-7	D-7	D-7	D-7	D-7	A-6	A-6	A-6	A-6	A-9	A-9
Champion	C-7	C-7	C-7	C-7	C-7	C-7	C-7	O-COM	O-COM	O-COM	O-COM	C-1	C-1
Edison-Splitdorf	X-2	....	X-2	X-2	X-2	X-2	X-2	X-104	X-104	X-104	X-104	....	....
Standard Service:													
AC	D-7	D-9	D-7	D-7	D-7	D-7	D-7	A-6	A-6	A-6	A-6	A-8	A-8
Champion	C-7	C-7	C-7	C-7	C-7	C-7	C-7	O-COM	O-COM	O-COM	O-COM	O-COM	O-COM
Edison-Splitdorf	X-2	....	X-2	X-2	X-2	X-2	X-2	X-104	X-104	X-104	X-104	X-104	X-104

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Instrument—No. Used	1	1	1	1	1	1	1	1	1	1	1	1
Voltage	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8	6—8
C. P.	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½
Contact	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC
Mfgr's No.	55	55	55	55	55	55	55	55	55	55	55	55
Relay (Delco-Remy)	....	....	265-H	265-H	265-H	265-H	....	....	....	....	....	....
Spark Plugs:												
Moderate Service:												
AC	A-9	A-9	D-7	D-7	D-7	D-7	A-6	A-9	A-9	A-9	A-9	A-9
Champion	C-1	C-1	C-7	C-7	C-7	C-7	O-COM	C-1	C-1	C-1	C-1	C-1
Edison-Splitdorf	....	....	X-2	X-2	X-2	X-2	X-104	....	....	....	....	....
Standard Service:												
AC	A-8	A-8	D-7	D-7	D-7	D-7	A-6	A-8	A-8	A-8	A-8	A-8
Champion	O-COM	O-COM	C-7	C-7	C-7	C-7	O-COM	O-COM	O-COM	O-COM	O-COM	O-COM
Edison-Splitdorf	X-104	X-104	X-2	X-2	X-2	X-2	X-104	X-104	X-104	X-104	X-104	X-104

Electrical Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Severe Service:													
AC	D-6	D-7	D-6	D-6	D-6	D-6	D-6	A-4½	A-4½	A-4½	A-4½	A-6	A-6
Champion	7	C-7	7	7	7	7	7	OO-COM	OO-COM	OO-COM	OO-COM	OO-COM	OO-COM
Edison-Splitdorf	X-8	....	X-8	X-8	X-8	X-8	X-8	....	....	....	....	....	....
Spark Plug Gap	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"
Spark Plug Size	18 MM	18 MM	18 MM	18 MM	18 MM	18 MM	18 MM	⅞"–18	⅞"–18	⅞"–18	⅞"–18	⅞"–18	⅞"–18
Starting Switch (Delco-Remy)	405-C	405-C	405-C	405-C	405-C	405-C	405-C	405-C	405-C	405-C	405-C	405-C	405-C
Starting Motor (Delco-Remy)	739-H	738-N	739-H	739-H	739-H	739-H	739-H	737-Z	737-Z	737-Z	737-Z	721-K	721-K
Voltage	6	6	6	6	6	6	6	6	6	6	6	6	6
Number of Poles	2	2	2	2	2	2	2	4	4	4	4	4	4
Bearings:													
Commutator End	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron
Center	....	....	....	....	....	....	....	....	....	....	....	Grey Iron	Grey Iron
Drive End	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze
Teeth on Pinion	9	10	9	9	9	9	9	10	10	10	10	10	10
Teeth on Flywheel	133	97	133	133	133	133	133	126	126	126	126	138	138
Bendix Drive Number	A-1718	RCD-11-FX-10	A-1718	A-1718	A-1718	A-1718	A-1718	RCD-11-FX-10	RCD-11-FX-10	RCD-11-FX-10	RCD-11-FX-10	RDC-11-FXV-10	RCD-11-FXV-10

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Severe Service:												
AC	A-6	A-6	D-6	D-6	D-6	D-6	A-4½	A-6	A-6	A-6	A-6	A-6
Champion	OO-COM	OO-COM	7	7	7	7	OO-COM	OO-COM	OO-COM	OO-COM	OO-COM	OO-COM
Edison-Splitdorf	....	....	X-8	X-8	X-8	X-8	....	....	....	....	....	....
Spark Plug Gap	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"	.020" to .025"
Spark Plug Size	⅞"–18	⅞"–18	18 MM	18 MM	18 MM	18 MM	⅞"–18	⅞"–18	⅞"–18	⅞"–18	⅞"–18	⅞"–18
Starting Switch (Delco-Remy)	405-C	405-C	1385	1385	405-C	405-C	405-C	405-C	405-C	405-C	405-C	405-C
Starting Motor (Delco-Remy)	721-K	704	739-E	739-E	739-H	739-H	737-Z	721-K	721-K	704	704	704
Voltage	6	6	6	6	6	6	6	6	6	6	6	6
Number of Poles	4	6	2	2	2	2	4	4	4	6	6	6
Bearings:												
Commutator End	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron
Center	Grey Iron	Grey Iron	....	....	....	....	....	Grey Iron	Grey Iron	Grey Iron	Grey Iron	Grey Iron
Drive End	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze
Teeth on Pinion	10	13	10	10	9	9	10	10	10	13	13	13
Teeth on Flywheel	138	138	105	105	133	133	126	138	138	138	138	138
Bendix Drive Number	RCD-11-FXV-10	RBCD-11-FXX-13	LCD-11-F-10	LCD-11-F-10	A-1718	A-1718	RCD-11-FX-10	RCD-11-FXV-10	RCD-11-FXV-10	RBCD-11-FXX-13	RBCD-11-FXX-13	RBCD-11-FXX-13

Electrical Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Stop and Tail Lamp (Guide)	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R
Stop Light Switch:													
(Motometer)	58012	58012	58012	58012	58012	58012	58012	58012	58012	58012	58012	58012	58012
(Westinghouse)	....	....	....	....	....	....	....	....	....	....	....	....	....
Storage Battery (P.O.L.)	613-BE	613-BE	613-BE	613-BE	613-BE	613-BE	613-BE	615-SF	615-SF	615-SF	615-SF	617-SF	617-SF
Specific Gravity:													
Fully Charged at	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275
	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300
Recharge at	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225
Voltage	6	6	6	6	6	6	6	6	6	6	6	6	6
Ampere Hours:													
At 20-Hour Rate	88	88	88	88	88	88	88	127	127	127	127	145	145
Terminal Grounded	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.
Voltage Regulator (Delco-Remy)	....	5542	....	....	....	....	....	5820	5820	5820	5820	5820	5820
Type	....	Step-Volt.	....	....	....	....	....	Vibrating	Vibrating	Vibrating	Vibrating	Vibrating	Vibrating
Mounting	....	Generator	....	....	....	....	....	Dash	Dash	Dash	Dash	Dash	Dash

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Stop and Tail Lamp (Guide)	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R	268-R
Stop Light Switch:												
(Motometer)	58012	....	58012	58012	58012	58012	58012	58012	58012	....	....	....
(Westinghouse)	....	215537	....	....	....	....	....	....	....	215537	215537	215537
Storage Battery (P.O.L.)	617-SF	617-SF	615-BE	615-BE	613-BE	613-BE	615-SF	617-SF	617-SF	617-SF	617-SF	617-SF
Specific Gravity:												
Fully Charged at	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275	1.275
	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300
Recharge at	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225
Voltage	6	6	6	6	6	6	6	6	6	6	6	6
Ampere Hours:												
At 20-Hour Rate	145	145	88	88	88	88	127	145	145	145	145	145
Terminal Grounded	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.	Pos.
Voltage Regulator (Delco-Remy)	5820	5820	....	....	....	....	5820	5820	5820	5820	5820	5820
Type	Vibrating	Vibrating	....	....	....	....	Vibrating	Vibrating	Vibrating	Vibrating	Vibrating	Vibrating
Mounting	Dash	Dash	....	....	....	....	Dash	Dash	Dash	Dash	Dash	Dash

Electrical System

Electrical circuits for the various D-line trucks are illustrated.

Wires are protected wherever necessary by loom or conduit and by rubber grommets, to prevent chafing where contact is made with the chassis, cab or body. Wires are also securely clipped at important points and connectors are used to facilitate inspection and servicing.

All electrical connections must be kept tight and clean.

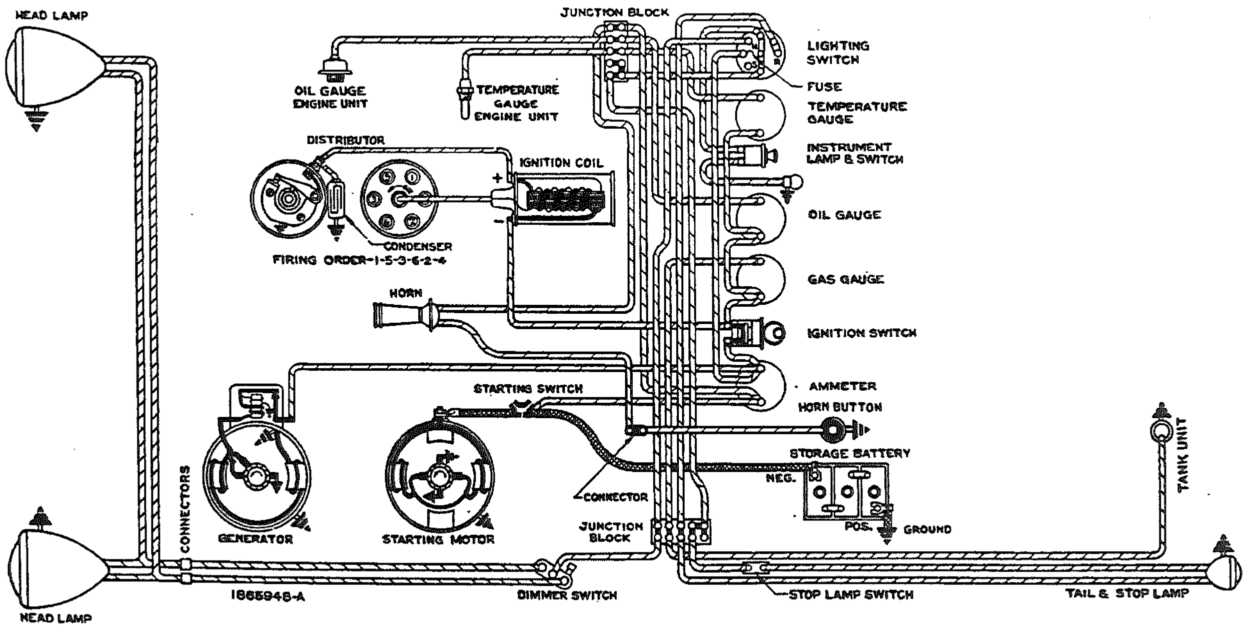

Fig. 1, Circuit Diagram (D-2, D-15, D-30, D-30B, DS-30, DS-30B, D-186T, DS-186T)

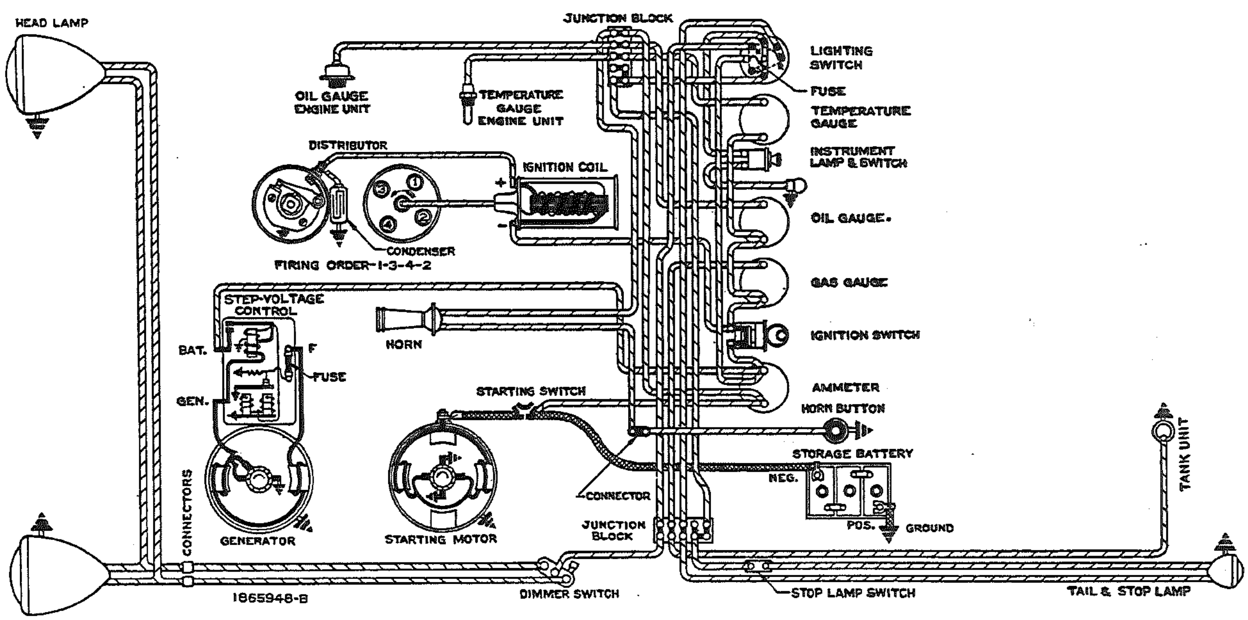

Fig. 2, Circuit Diagram (D-5)

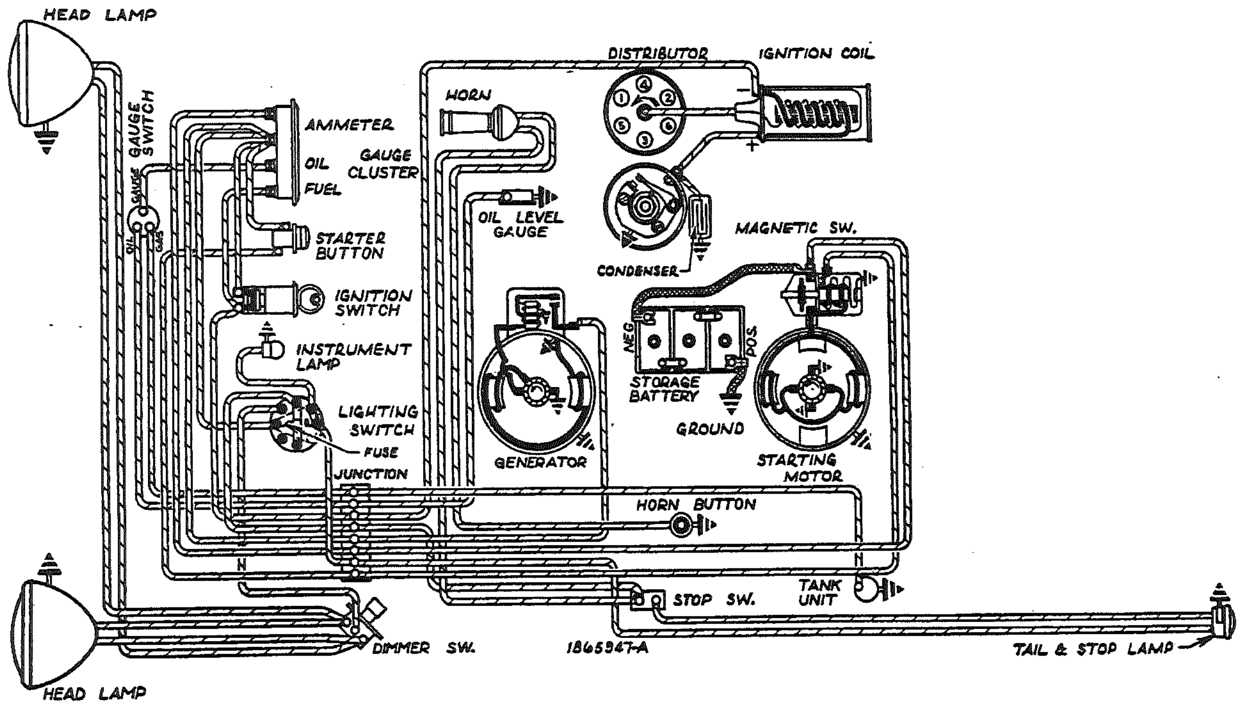

Fig. 3, Circuit Diagram (D-300, DS-300, Model HDM Cab-Burkett)

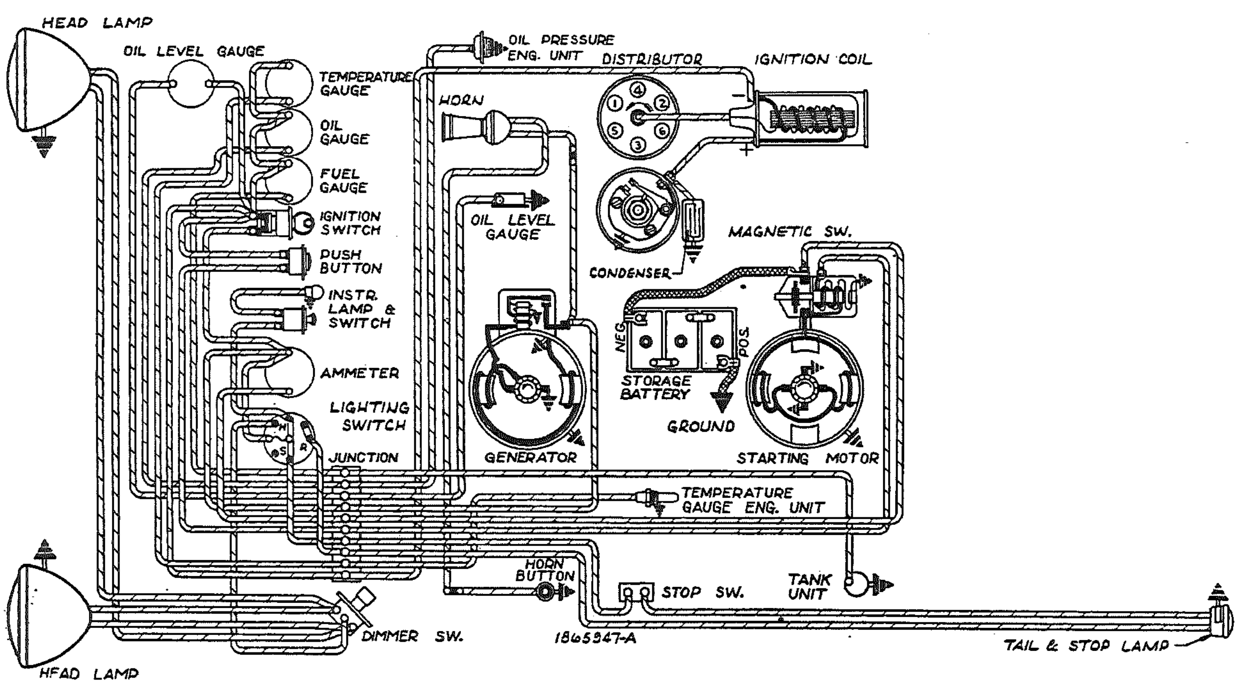

Fig. 4, Circuit Diagram (D-300, DS-300, Model HEF Cab-Murray)

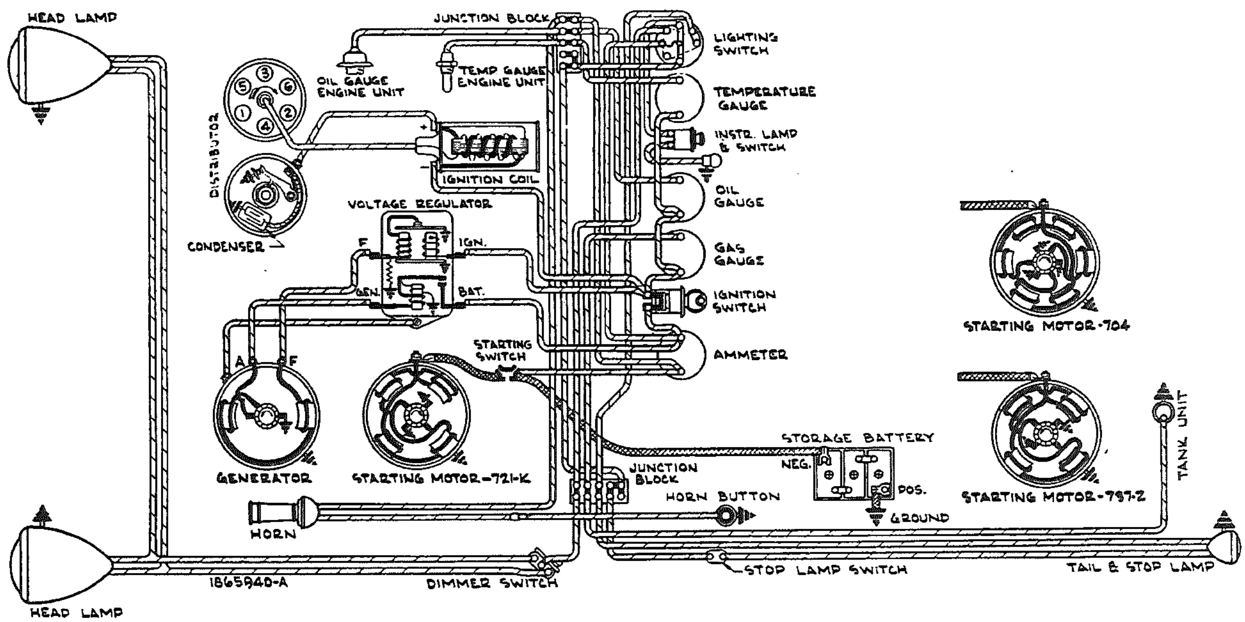

Fig. 5, Circuit Diagram (D-35, DS-35, D-35B, D-40, D-50, D-60, DR-60, DR-70, D-216T, D-246T, D-246F, DR-346T, D-346F, DR-426F)

Starting Motors

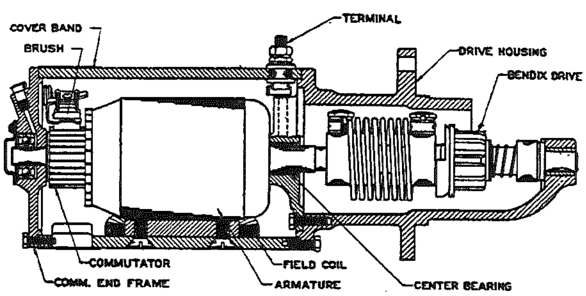

Fig. 1, DR-703

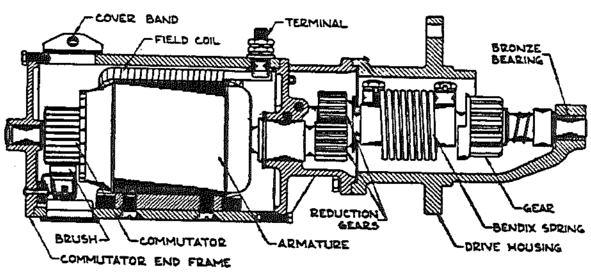

Fig. 2, DR-704

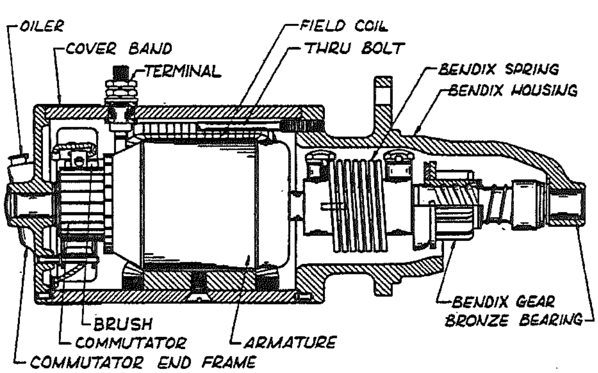

Fig. 3, DR-737Z

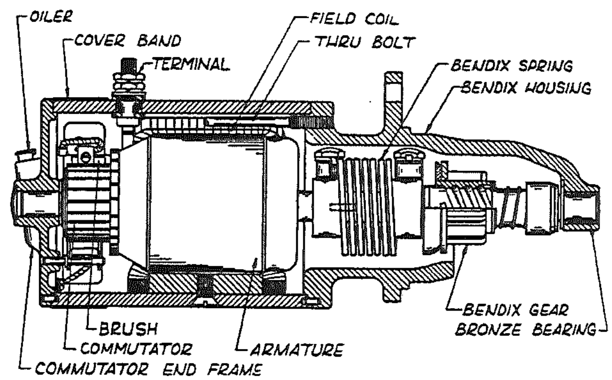

Fig. 4, DR-738N

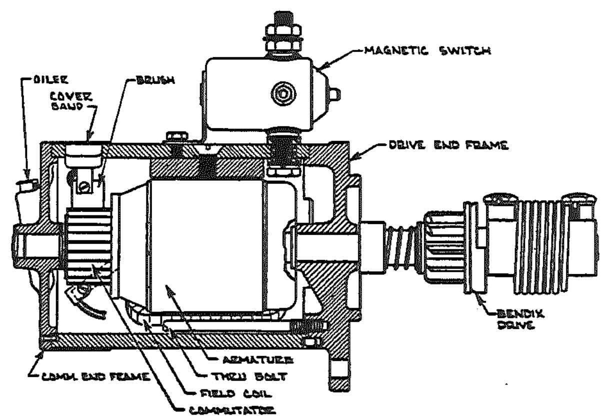

Fig. 5, DR-739E

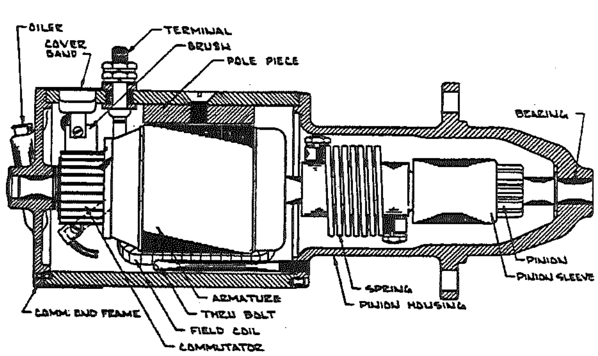

Fig. 6, DR-739H

Starting Motor and Drive

The starting motor drive is a vital part of the starting motor since it is through the drive that the pinion on the starting motor is meshed with the flywheel on the engine and through which the actual cranking occurs. The action of the drive must be positive so that the engagement and disengagement with the flywheel is certain and it must be strong enough to withstand the torque of cranking. The pinion of the Bendix drive is mounted on a threaded sleeve in such a manner that when the armature revolves, the threaded sleeve turns within the gear, moving it endwise, causing it to mesh with the teeth in the flywheel and crank the engine. When the engine runs under its own power, the flywheel drives the Bendix gear at a higher speed than the threaded shaft is revolving, causing the gear to be turned in the opposite direction on the threaded or spiral shaft. The gear, therefore, automatically disengages from the flywheel. A spring is arranged to take the sudden shock when the gear meshes with the flywheel. The spiral upon which the Bendix gear operates should be kept free from oil, grease and dirt.

Starting Motor Fails to Operate

If starting motor will not crank engine, check the following:

(a) Battery weak or completely discharged.
(b) Wiring loose or dirty battery connections.
(c) Starting switch contact points burned and pitted.
(d) Poor ground contact between engine and frame of truck.
(e) Bendix Pinion Gear and Shaft, dirty or gummy. Clean thoroughly so that gear will slide freely on shaft. **Do not oil.**

Check Starting Motor on Truck

If a starting motor is not operating properly and it has been determined that the trouble is in the starting motor or the starting motor control, a series of checks should be made to determine the trouble and possible remedy.

It is often possible to correct starting motor trouble without removing the unit from the truck. It is a good policy to remove the cover band on the starting motor and inspect the brushes and commutator at least once a year.

Brushes

If the brushes are badly worn, they should be replaced. If the brushes are not seating properly on the commutator, they should be "worn in" to the contour of the commutator. This can be done by using a strip of No. 00 sandpaper between the brush and commutator. The rough side of the sandpaper should be towards the brush. When sanding the brush the sandpaper should conform with the contour of the commutator.

The brush arms should be inspected to see that they are not sticking, thus preventing the brushes from making good contact with the commutator. The brush spring tension should be checked. Weak brush spring tension causes arcing, due to poor contact between the commutator and brushes. This action may result in short brush life and more or less burning of the commutator. Excessive spring tension causes abnormal wear of the commutator, due to the increased friction between the brushes and the commutator.

Commutator

It can usually be determined by an inspection with the cover band removed whether the commutator is dirty or rough. If the commutator is dirty or slightly burred, it can be polished with No. 00 sandpaper. This can be done by placing a strip of sandpaper between the brush and the commutator while the armature is revolving. After the polishing operation, the dust from the sandpaper should be removed from the commutator and brushes. If it is rough or badly worn, it should be removed from the unit and turned in a lathe to true it.

No Load Test

A bench test of a starting motor without load may be made by connecting the motor in circuit with a storage battery of voltage specified for the unit, and an ammeter capable of reading about 100 amperes.

The average starting motor will use from 40-70 amperes without load.

In case the bearings are tight or the armature rubs the pole pieces, a greater current will be required. Instead of 40-70 amperes at no load, the starting motor speed and voltage will be decreased, causing it to consume more current, depending upon the degree of tightness or the amount of rubbing.

Although an armature may be turned freely by hand in a motor with worn bearings, the same armature may rub the field poles heavily when the current is applied to the starting motor.

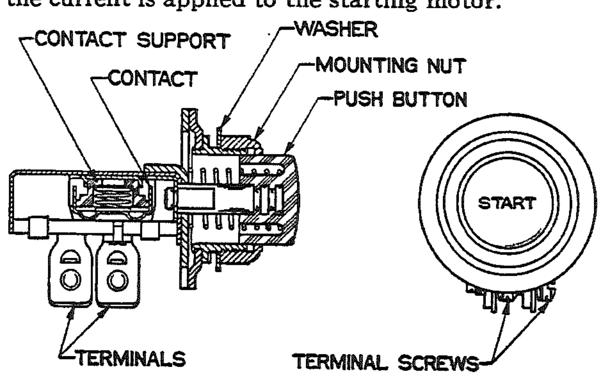

Fig. 7, Starter Switch Button (DR-1385)

Starting Motor Switch

All D-line trucks with the exception of Models D-300 and DS-300 have a conventional foot operated starting motor switch. The D-300 and DS-300 models have a push-button type switch in the instrument panel which controls a magnetic switch located at the starting motor.

Both types of switches require little attention in service other than maintaining good wiring connections.

Ignition Distributors

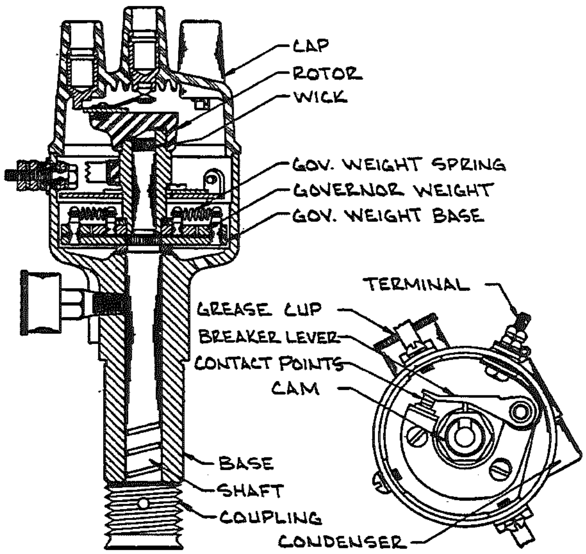

Fig. 1, DR-622R

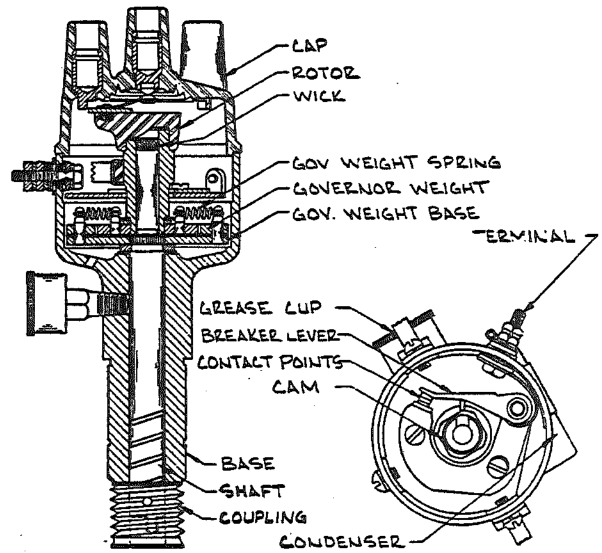

Fig. 3, DR-625F

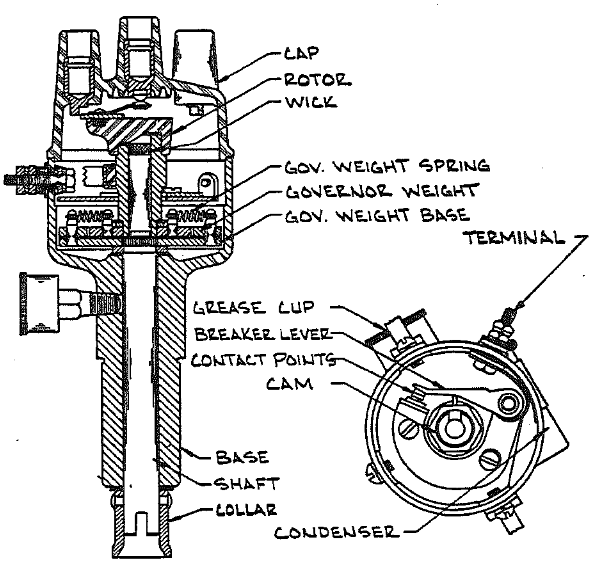

Fig. 2, DR-623G

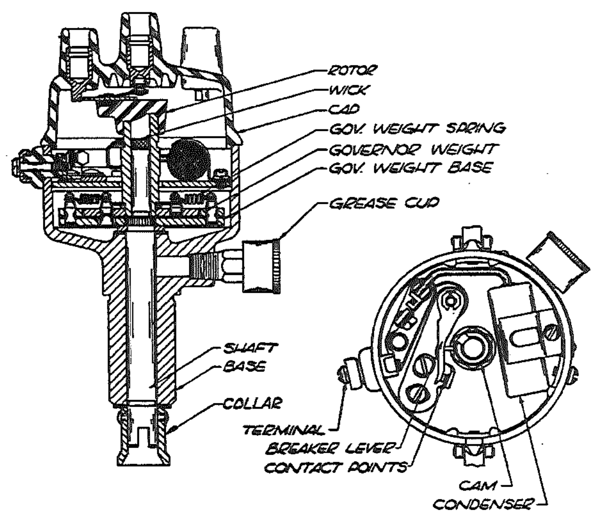

Fig. 4, DR-649 C-R-S-T

Ignition Distributor

All ignition distributors are essentially high speed switches which are timed with an engine to distribute a high tension spark to each of the cylinders, at the proper interval. Low tension current is interrupted by the circuit breaker mechanism and the high tension spark from the ignition coil is distributed to the spark plugs in the cylinders by means of a jump spark type rotor and distributor cap. High tension cables connect the spark plugs with the distributor cap.

An ignition condenser is used in connection with the distributor and is connected electrically across or in parallel with the contact points. The function of the condenser is to decrease the amount of arcing at the breaker points and aid the voltage "build up" in the ignition coil.

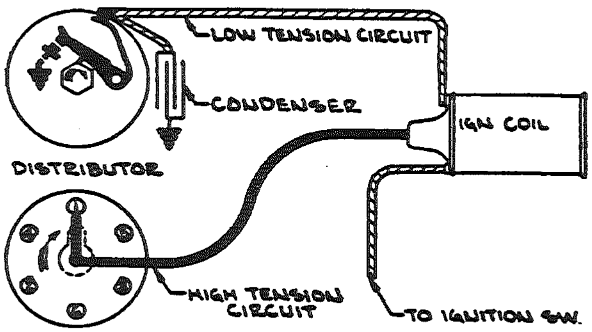

Fig. 5

Circuit Breaker Arrangement

The circuit breaker arrangement consists of a four- or six-lobe cam and a single breaker arm. With this type it is only necessary to time the instant of break of the contact points with the proper cylinder on the firing point. When this is properly set, all other cylinders will be timed. One ignition coil is required.

Vacuum Automatic

Vacuum controlled spark is combined with centrifugal-automatic type distributors to obtain greater economy and improved engine performance. The centrifugal-automatic spark mechanism is calibrated to give proper spark advance for the full load, wide-open throttle requirements of the particular engine.

The use of the vacuum unit is accomplished by mounting it to the distributor clamp arm assembly. The diaphragm in the unit is linked to the distributor so that advance and retard is obtained by moving the distributor in its mounting. The movement of the diaphragm is actuated by vacuum from the engine manifold and a calibrated return spring.

When the engine is idling the vacuum unit has no action on the distributor. When the throttle

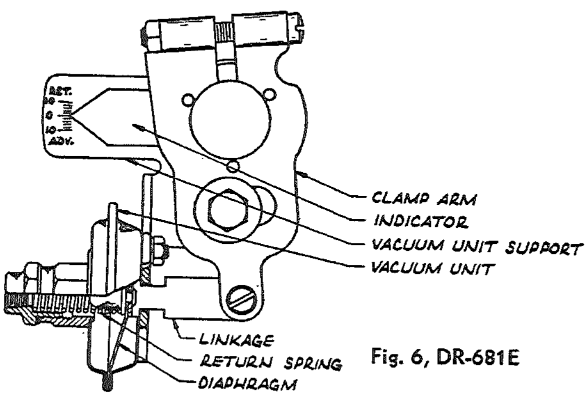

Fig. 6, DR-681E

is opened slowly the vacuum is high and spark will be given additional advance to that of the centrifugal advance. On full load wide-open throttle when the vacuum is low or at high speed, the vacuum unit will not advance the spark. Under these low vacuum conditions spark advance depends upon the centrifugal mechanism in the distributor.

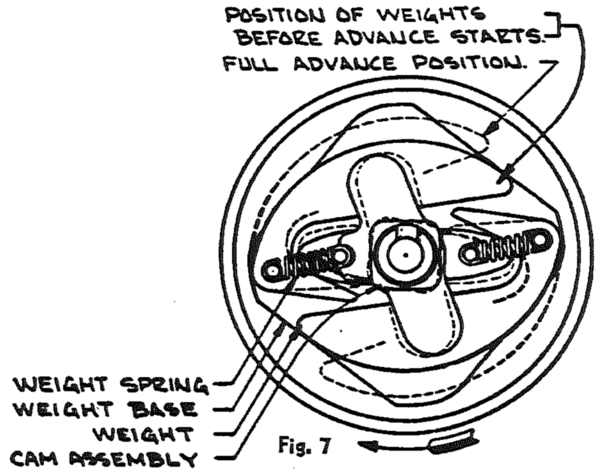

Fig. 7

Full Automatic

There is no manually operated spark advance with this type of spark control, thus making the variation of the spark dependent entirely upon the centrifugal automatic mechanism.

Contact Points

Contact surfaces, after considerable use, may not appear smooth and bright, but this is not necessarily an indication that they are not functioning properly and giving good ignition, and they should not be disturbed as long as proper operation is obtained.

Should the points become pitted or burned in operation, rub lightly with a dry oil stone. Points can also be dressed with a clean ignition file without removing them from the distributor. In dressing points, it is not necessary to remove all trace of pits as this only wastes the tungsten metal. Simply brighten the surface of the pitted point and remove the small raised portion from the surface of the opposite point.

It is important that the contact point opening be set to the proper limits in order to get good performance and prolonged point life. Points set too close will tend to burn and pit rapidly, while points with too much separation will tend to cause ignition failure at high speeds. The contact point opening can be checked with an indicator or feeler gauge. This should be .018" to .024".

Condenser

A condenser should be proven defective before being replaced. It is seldom true that burned or oxidized contact points is due to a defective condenser. High voltage, overcharged battery, an excessive oil·vapor or oil on the contact surface has the effect of increasing the normal rate of wear on the contacts. A short circuited condenser will cause complete failure of the ignition system.

Inspection

The life of any unit can often be prolonged indefinitely by inspecting and repairing at definite intervals. Usually an inspection of the distributor once a year is sufficient, but if the mileage is high it is advisable to inspect the distributor once every five thousand (5000) miles. In each inspection, contact points, breaker levers, timing, and worn parts should be covered.

Ignition Timing

Before checking ignition timing, the distributor breaker points should be cleaned and seating squarely on each other. Gap between breaker points should be checked and adjusted to .018" to .024".

Check cap, rotor and wires. Make sure that internal mechanism is free from dirt, oil or water.

The procedure outlined below should be followed when checking ignition timing.

(a) If a test lamp is available, connect one wire to the primary terminal on distributor and ground the other wire to a convenient point on the engine. Turn on ignition switch.

(b) Set distributor advance arm pointer to zero mark and crank engine until No. 1 cylinder is on compression stroke and breaker points are about ready to open. Then continue to crank very slowly, stopping the instant lamp lights. This indicates points are just open.

(c) Check ignition location mark on fan drive pulley or flywheel to see if it indexes with pointer.

(d) If a correction is necessary, loosen distributor clamp arm bolt and turn distributor in proper direction to advance or retard, whichever is necessary. Distributor breaker points should just start to open.

(e) Tighten distributor clamp arm bolt and re-check timing.

After ignition has been properly timed the spark may be advanced or retarded from the normal setting, which is zero on indicator plate, to accommodate the grade of fuel regularly used.

NOTE: When oil pump has been removed from the engine, it will be necessary to retime the ignition. (Not FC-132 Engine.)

Generators

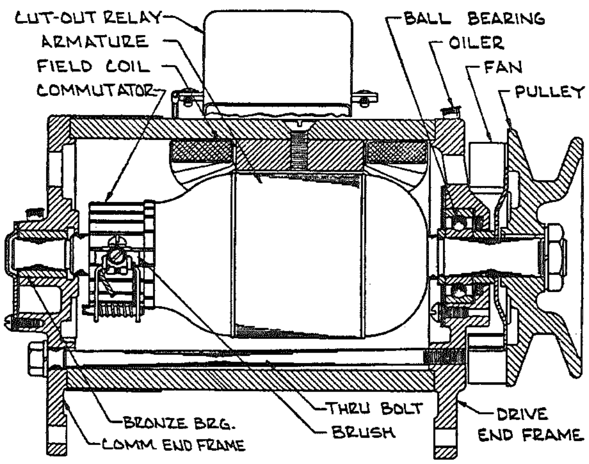

Fig. 1 (DR-946 N-P-S)

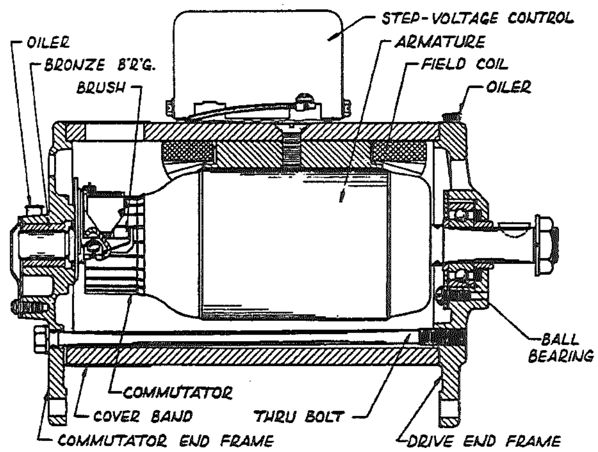

Fig. 3 (DR-968H)

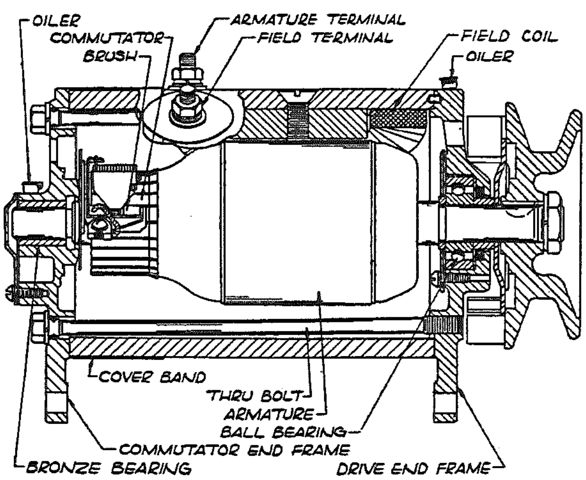

Fig. 2 (DR-948 G-H)

Generators

A generator is a machine used to convert mechanical energy into electrical energy. The automotive generators are of the direct current type.

The purpose of a generator is to supply current for the lights, ignition, heater, radio and other connected electrical loads and to keep the battery in a properly charged condition for starting. The surplus electrical energy is stored as chemical energy in the battery for use when cranking the engine, or when the consumption of electrical energy by the connected electrical load exceeds the generator output.

Generators are designed to take care of a particular kind of service. The total current output required and the operating conditions determine the type of regulation needed to supply the necessary current without damage to any part of the electrical system. A generator is only capable of producing safely a certain maximum output for which it was designed. To determine the type or size of generator needed for an installation, it is necessary to consider the total amount of connected electrical load in amperes and the type of service in which the vehicle is operated.

Every generator, regardless of the type of regulation used, is equipped with a cut-out relay. Where regulators are used, the cut-out relay is usually mounted on the same base as the regulator unit. If a regulator is not used, the cut-out relay is normally mounted on the frame of the generator. The purpose of a cut-out relay is to open and close the circuit between the generator and the battery. When the generator voltage exceeds battery voltage, the cutout relay contact points close to enable the generator current to flow to the battery and connected electrical load. When the battery voltage exceeds generator voltage, the cut-out relay contact points open to prevent the battery from discharging through the generator windings.

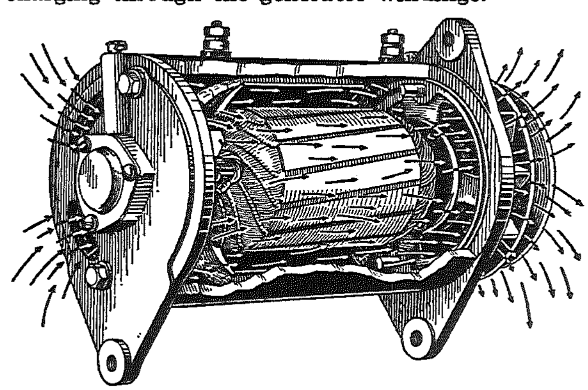

Fig. 4

Generator Ventilation

Fig. 4 illustrates the ventilation of the generator. Air cooling the generator allows it to carry a heavier load without danger of overheating. A generator ventilated in this manner will carry a greater load than a nonventilated unit and still run 80° F. to 100° F. cooler.

Third Brush Current Regulation

The third brush method of regulating the current output is used extensively because of its simplicity of operation and adjustment. It meets the average driving requirements as it produces the maximum generator output at normal driving speeds. This system of current regulation involves the variation of the field strength and it accomplishes this result without any external apparatus. The operation depends on the reaction of the magnetic field produced by the armature on the normal field from the poles. When the generator is cold, the output will be somewhat higher than after it becomes warm. Also, at speeds beyond the maximum output range, the output will be reduced or will taper off, due to the normal action of the third brush.

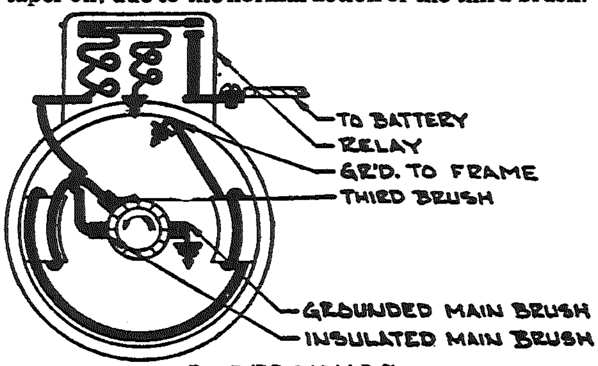

Fig. 5 (DR-946 N-P-S)

Field Circuit Grounded Directly to Generator Frame

With this type of field circuit connection, it is necessary to shift the third brush to vary the output in accordance with driving requirements and the condition of charge of the battery. With this type of regulation, there is a tendency for the charging rate to increase as the battery becomes fully charged. This is caused by the rise in the terminal voltage of the battery as it becomes fully charged. Any rise in battery voltage causes an increase in generator voltage, thus increasing the current in the field coils. When the field coil current is increased, the output of the generator is increased by a proportionate amount.

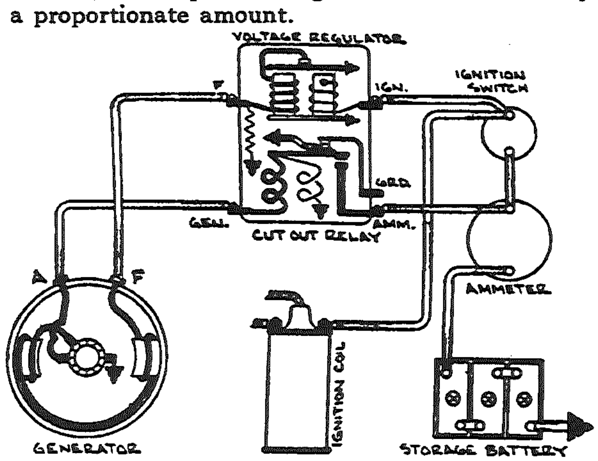

Fig. 6 (DR-935 G-H)

Vibrating Voltage Regulator

Generators used with this type of regulator usually have the third brush in a fixed or stationary position. The operation of this regulator is explained in "Voltage Regulator" section. This type of regulator will not increase the output of a generator as this is dependent upon the original design of the generator and the location of the third brush. It will, however, control the output of the generator by automatically decreasing the charging rate to a low safe value when the battery approaches a fully charged condition. When the lights or other electrical loads are turned on, the charging rate will increase to take care of the load, up to the maximum rated output of the generator, if necessary.

With this type of regulator, the third brush should not be shifted as the regulator will automatically control the output under all conditions.

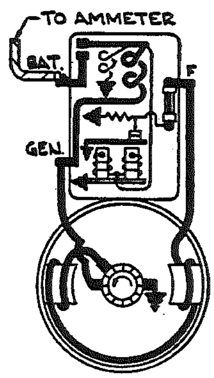

Fig. 7 (DR-968 H)

Step-Voltage Control

The third brush type of generator without some means of automatic voltage control has a tendency to further increase its maximum output as the battery approaches a fully charged condition. This condition may result in an overcharged battery and high voltages within the electrical system.

The purpose of the step-voltage unit is to increase or decrease the generator output in accordance with the requirements of the battery and the connected electrical load. When the battery becomes properly charged, a set of contact points in the control unit opens and shunts the generator field circuit through a resistance unit to ground. With the resistance unit in the field circuit, the generator maximum output is reduced approximately 5-6 amperes. If the battery should become partially discharged, the contact points in the control unit close, removing the resistance from the field circuit and the generator output increases to its maximum, depending upon the setting of the third brush.

When a sufficient electrical load is connected, such as lights, radio, heater, etc., to require a higher generator output, the voltage control contact points will be closed and the generator will produce its maximum output, depending upon the position of the third brush and carry the added load without drawing current from the battery.

The voltage control unit does not increase the maximum output of the generator as this is dependent entirely upon the design of the generator and the position of the third brush. In cases where the driving is confined to daytime operation and there is no connected electrical load (except instruments), the generator output may be too high. With this condition, the output should be reduced by adjusting the third brush to just meet the driving requirements. The voltage control unit will then reduce the output to a safe value when the battery becomes fully charged and prevent high voltages within the electrical system.

Generator Not Charging

If ammeter shows that generator is not charging the following should be checked:

(a) Inspect for broken wires, loose terminals and worn or dirty brushes.
(b) Clean commutator with No. 00 sandpaper.
(c) Check cable connections at starting switch and battery.
(d) Charging rate set too low.
(e) Relay or Regulator contact points dirty or pitted.

Brushes

In case the brush spring tension becomes weak, the charging rate will be reduced and more or less arcing and burning of the commutator will result because of poor contact of the brushes. Excessive spring tension will cause the commutator and brushes to wear faster, reducing the amount of service to be obtained from them. Brushes should be removed and checked to determine if they are seating properly. The "pigtail" lead connection at the brush should be checked to see that it is tight. A loose connection at this point causes a high resistance, forcing the generator to build up its voltage to a dangerously high value.

Special equipment is necessary to test armature and fields.

Relay and Regulators

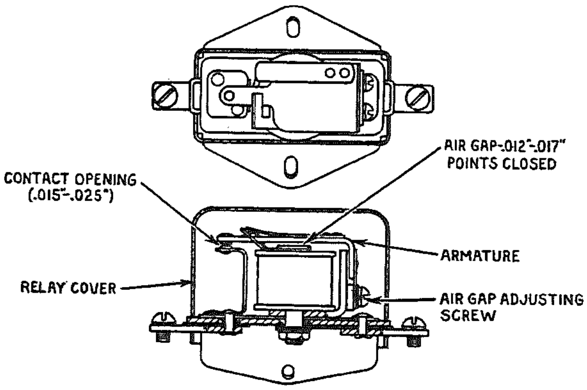

Fig. 1 (DR-265 H) Relay

Relay

A relay can be generally described as a unit that opens and closes an electrical circuit. A cutout relay is used to complete the circuit between the generator and battery. When the generator voltage exceeds the battery voltage, the contact points in the relay close and the circuit between the generator and battery is completed. When the battery voltage exceeds the generator voltage, the contact points open to prevent the battery from discharging through the generator field windings. This unit is mounted on the generator frame.

The relay consists essentially of a set of contact points and a coil winding. The relay coil consists of a heavy series (current) winding and a shunt (voltage) winding. The shunt winding is connected to the "GEN" terminal of the relay and is grounded to the base of the relay. The actual closing of the contact points is caused by the magnetism created by the shunt winding when the generator operates at a sufficient speed to charge the battery. The series winding is connected in series with the contact points in the charging circuit and current flows only in this winding when the contact points are in a closed position. When the battery voltage exceeds the generator voltage, the current flows in a reverse direction (from battery to generator) in the series winding to oppose the pull of the shunt winding and cause the contact points to open.

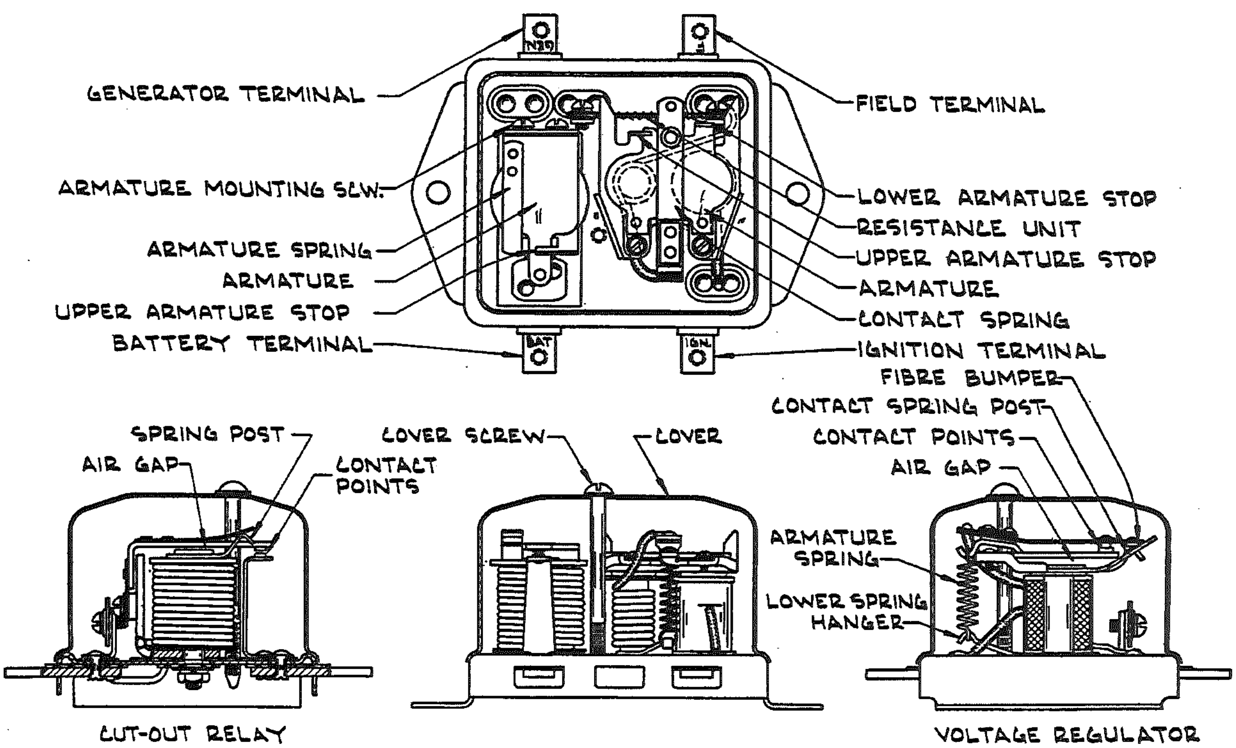

Fig. 2 (DR-5820) Voltage Regulator

Voltage Regulator

The vibrating voltage regulator is mounted on the driver's side of the dash and is used in conjunction with the third brush type of generator to control the voltage within the electrical system to a safe value.

Operation

The vibrating voltage regulator consists of a conventional cutout relay and a vibrating voltage regulator unit. The cutout relay is of the standard type excepting that it has an improved series winding to adequately provide for the high output of the generator. The vibrating voltage regulator will not increase the capacity of a generator as this is determined by the original design of the generator and the location of the third brush. It will, however, control the output of the generator by automatically decreasing the charging rate when the battery approaches a charged condition. When the lights or other electrical loads are turned on, the charging rate will increase to take care of the load, up to the rated output of the generator.

With generators having a fixed third brush, the generator output is dependent upon the voltage setting of the regulator, the connected load, and the condition of charge of the battery. A low output with a fully charged battery indicates that the regulator is working properly.

The contact points of the regulator are composed of dissimilar metals and the correct regulator must be used in accordance with the polarity of the battery if proper performance of the regulator unit is to be obtained.

The Voltage Regulator unit consists of two cores which, with their windings, form an electromagnet. One core is wound with numerous turns of fine wire and is connected as illustrated in wiring diagram. As the battery voltage increases to a predetermined value, the magnetic pull on the regulator armature increases until the armature is attracted toward the core, against a restraining spring tension. A pair of contacts in series with the generator field are opened and a resistance shunting these contacts is inserted in the field circuit. This resistance is sufficient to reduce the generator voltage below that necessary to open the contacts and they immediately close, eliminating the resistance, thus increasing the voltage of the generator. This cycle occurs many times per second, resulting in a battery voltage that is held practically constant.

The second core is wound with a few turns of larger wire in series with the generator field and aids the main winding of the regulator unit. When the contacts break, the current in this circuit is instantly reduced and likewise, the magnetic pull on the armature, thus allowing quicker closing of the contacts and more rapid vibration of the armature.

The regulators are over-compensated for temperature so that they have a lower voltage when hot. This compensation for temperature is necessary as a cold battery requires a higher charging voltage than one that is warm, consequently, it is necessary to vary the charging voltage in accordance with battery requirements.

The compensation is accomplished by the use of a bi-metal hinge on the regulator armature. It is not necessary to change the voltage setting for winter and summer driving.

Checking Voltage Regulators

In case there is trouble and you believe that the voltage regulator or generator is not functioning properly the following tests should be made. Unless the voltage regulator adjustments have been tampered with or the unit having been in an accident the only probable service required in the field will be to clean the contact points.

Generator Not Charging

1. Be sure that base of regulator is satisfactorily grounded.
2. Ground the (F) terminal of regulator while the engine is running at a speed equivalent to 25 M.P.H. If generator now charges, the trouble is in the voltage regulator. If generator does not charge, ground (F) terminal on generator. If generator now charges, the trouble is due to an open circuit between (F) terminal on generator and (F) terminal on voltage regulator.
3. If generator does not charge with either (F) terminal grounded, remove the generator armature lead from the regulator and strike it against a grounded part such as the motor block while the (F) terminal is still grounded. If a spark occurs, the trouble is in the voltage regulator. If no spark occurs, the trouble is in the generator.

Generator Always Charging Too High

This will be indicated by the burning out of lamp bulbs.

1. Check battery gravity and if all three cells do not check reasonably close together, correct trouble with the battery. If battery gravity is less than 1.275, install a fully-charged battery for this test.
2. Run engine at a speed equivalent to 25 M.P.H. for 15 minutes with the lights off. At the end of this time, the ammeter should show a charge of between 0 and 10 amperes. If such is not the case, the regulator is set for too high a voltage or the (F) lead may be grounded.

Generator Always Charging Too Low

1. Put truck in gear, engage clutch, apply brake and engage starter for ten seconds. This procedure locks the starting motor and gives a maximum battery discharge, thus dropping the battery voltage below the regulator setting.
2. Put gear shift in neutral, start engine, and adjust engine speed so that ammeter indicates maximum charge. If this is not less than 14 amperes the generator is functioning satisfactorily.
3. If output is lower than 14 amperes, ground the (F) terminal on the generator. If the charging rate increases when this is done, it indicates that the trouble is in the voltage regulator in a high resistance, loose, or open circuit connection, between the regulator and battery or at the battery terminals. A badly sulphated battery will also give this effect, but it will only be temporary, since the

sulphate will soon be broken down. If the charging rate does not increase when the (F) terminal is grounded, it indicates the trouble is in the generator.

4. To check regulator points for oxidation, adjust the speed of the engine so the charging rate is five amperes. Ground the field terminal on the regulator or on the generator. If there is an increase of two amperes or more in the charging rate, the points are oxidized. The speed must be kept constant while making this check, which can be made on the truck. If it is impossible to get any charge of the generator at any speed and the generator charges normally after grounding the field terminal, the regulator points are oxidized.

Contacts should be cleaned with a thin fine-cut contact file. The contact file should not be allowed to become greasy and should not be used to file other metals. The contact points can be cleaned without disturbing the regulator setting, if care is taken to avoid bending the contact spring excessively.

CAUTION: DO NOT USE FILE EXCESSIVELY ON THE SMALL CONTACT AS THE ACTUAL CONTACT MATERIAL IS ONLY A FEW THOUSANDTHS OF AN INCH THICK. NEVER USE SANDPAPER OR EMERY CLOTH TO CLEAN CONTACTS.

These tests should be regarded as preliminary tests only and if there is any indication of improper adjustment or other trouble, the units should be adjusted or repaired in accordance with the detailed information given on each type. An accurate ammeter and voltmeter must be used in setting the units. If you do not have the equipment for this work it should be serviced by United Motors Service or one of their authorized electrical service stations.

Radio Condensers

If radio by-pass condensers are used, they should be connected at the generator terminal marked (A) and never at the (F) terminal of either the generator or regulator.

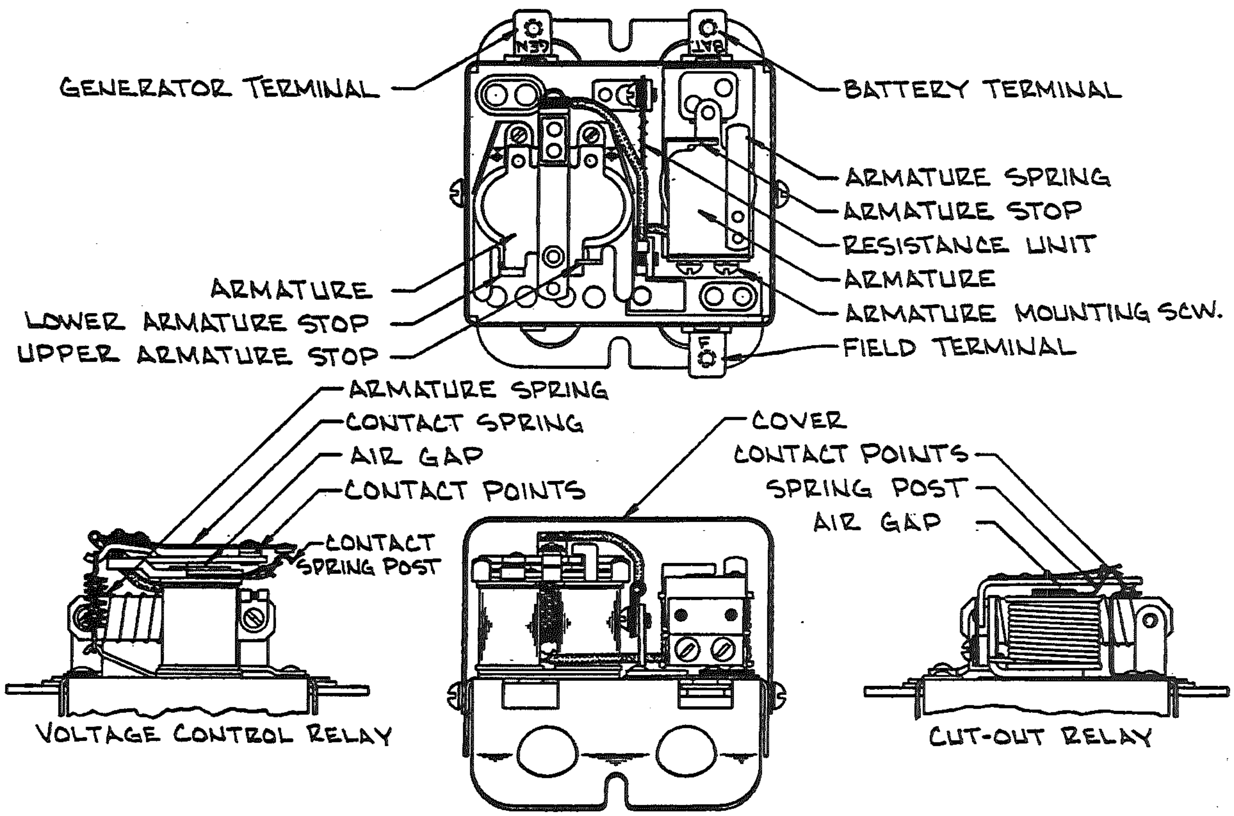

Fig. 3 (DR-5542) Step-Voltage Control Unit

Step-Voltage Control

The Step-Voltage Control, composed of a voltage control unit and a cut-out relay, is mounted on the generator. The function of the cut-out relay is to close the circuit between the generator and the battery at a predetermined generator voltage and open the circuit with a small reverse current flowing. The function of the voltage control unit is to decrease the maximum generator output when the battery reaches a fully charged condition.

Relay

The relay is of the conventional type, consisting of a pair of contact points and two windings wound on a single core which, together, form an electromagnet. One of the two windings is a series winding of a few turns of heavy wire which carries the entire generator output, and the other is a shunt winding of many turns of fine wire which is shunted across the generator so that full generator voltage is impressed upon it.

With the generator at rest, the contact points are held open by spring tension. When the generator begins to operate and generator terminal voltage increases to a value sufficient to charge the battery, a magnetic field of sufficient strength has been created in the relay shunt winding to overcome the spring tension and close the contact points. Current now flows from the generator to the battery, passing through the relay series winding in the right direction to add to the magnetic field holding the points closed. Should the generator slow to below generating speed or stop, current will begin to flow from the battery to the generator. This reverses the direction of current flow and thus the direction of the magnetic field in the relay series winding. The magnetic fields of the two windings buck each other, reducing the total magnetic field to a value no longer able to hold the contact points together and they open, preventing the battery from discharging back through the generator.

Voltage Control Unit

The voltage control unit, consisting of a pair of contact points, a resistance and two shunt windings, is also an electromagnetic device which increases or decreases the generator output in accordance with battery requirements and the connected electrical load. The two shunt windings are composed of many turns of fine wire which, together, form an electromagnet. These windings are shunted across the generator and generator voltage is impressed upon them. Above the winding cores is an armature, normally held away from the cores by a spiral spring. In this position the two contact points are together and the generator field circuit is conducted directly to ground through the points.

It is characteristic of the automotive type battery to increase in voltage as it approaches a fully charged condition. This increasing voltage, which produces a corresponding voltage increase at the generator, becomes great enough when the battery is sufficiently charged, to cause the voltage control unit to operate.

At this point the magnetic field created by the voltage acting on the voltage control windings has increased to a value sufficient to overcome the armature spring tension. The armature is attracted to the winding cores, the points are opened, and the resistance unit is inserted into the generator field circuit. This reduces the current flow in the generator field windings and thus the generator output.

So long as the battery remains at full charge and the line voltage is high, the resistance remains in the generator field circuit. But when the battery becomes partly discharged, or enough electrical accessories are turned on to cause the line voltage to drop below the predetermined value, the lowered voltage becomes insufficient to create a strong enough magnetic field in the voltage control unit windings to retain the armature in the down position. The armature is pulled up by its spring tension, the points close, and the generator then delivers normal output.

There are in effect two generators. One, the standard, normal output generator when the line voltage and the battery are low, and the other, the reduced output generator when the line voltage is high and the battery fully charged and a high charging rate is not needed. The voltage control unit cannot increase the generator output beyond the value for which the generator is designed.

Checking Voltage Control Unit

Unless the Step-Voltage Control has been tampered with by unauthorized persons so that the adjustments have been thrown off, cleaning the contact points is usually the only service required in the field. Clean the contacts with a thin, fine-cut contact file. The file should not be allowed to become greasy and should not be used on other metals. Care must be taken not to disturb the voltage control settings by excessively bending the contact spring. **DO NOT USE FILE EXCESSIVELY. NEVER USE SANDPAPER OR EMERY CLOTH TO CLEAN CONTACT POINTS.**

The following checks will enable the operator to determine if the control unit is functioning properly.

(1) A **FULLY CHARGED BATTERY AND A LOW CHARGING RATE** indicates the control unit is functioning properly, since it is the function of the voltage control unit to reduce the charging rate as the battery comes up to charge. To check the operation of the voltage control unit under these conditions, remove the control cover. Increase engine speed to a value equivalent to 2000-2200 generator R.P.M. The voltage control unit armature should be in the down position and the points open, causing a reduced generator output. Now ground the (F) terminal temporarily with a screw driver. The points should remain open, but the generator output should show an increase.

(2) A **FULLY CHARGED BATTERY AND A HIGH CHARGING RATE** indicates, with a minimum electrical load, the voltage control unit is not reducing the generator output as it should. With the engine running at a speed equivalent to 2000-2200 generator R.P.M., disconnect the lead from the (F) terminal of the voltage control. If the output does not drop off, it indicates there is a ground in the generator field circuit, either in the wiring harness or in the generator. Disconnect the field lead at the (F) terminal of the generator to determine location of the ground.

If the output does drop off as the (F) lead is disconnected from the voltage control, connect the (F) terminal lead and remove the cover. If the armature is up and the points closed with a high charging rate being produced the voltage control must be checked further and adjusted.

(3) **WITH A LOW BATTERY AND A LOW OR NO CHARGING RATE,** check the circuit for loose connections, frayed or damaged wires, since these would cause high resistance which would reduce the generator output, even though the battery was in a partly discharged condition. Ground the (F) terminal of the voltage control temporarily with a screw driver and increase generator speed. One of three things will happen with the (F) terminal grounded:

(a) The generator output will increase to its specified rate, which indicates the voltage control unit is at fault and it must be checked and adjusted.

(b) The generator output does not increase to its specified rate, which indicates the generator is at fault and it must be checked and adjusted.

(c) The generator does not charge at all, either with or without the (F) terminal grounded. This indicates either the cut-out relay or the generator is at fault. Remove the lead from the "GEN" terminal of the voltage control and strike it against a convenient ground, such as the generator frame, to see if a spark occurs. Do not operate the generator for any length of time with the "GEN" terminal disconnected since this allows the generator to operate on open circuit and will cause the generator to build up a dangerously high voltage. If a spark does **not** occur, the generator is definitely known to be at fault and it must be removed for further check and adjustment. If a spark does occur, the trouble is now known to be in the cut-out relay and the Step-Voltage Control must be removed so that the cut-out relay may be checked further and adjusted.

These tests should be regarded as preliminary tests only and if there is any indication of improper adjustment or other trouble, the units should be adjusted or repaired in accordance with the detailed information applicable to this type of unit. A variable resistance (¼ ohm maximum) of sufficient current carrying capacity and an accurate ammeter and voltmeter must be used for checking the units. If this equipment or proper information is not available, this work should be done by United Motors Service or one of their authorized electrical service stations.

Radio Condensers

If radio by-pass condensers are used, they should be connected at the generator terminal marked (A) and never at the (F) terminal of either the generator or regulator.

Ignition Coil

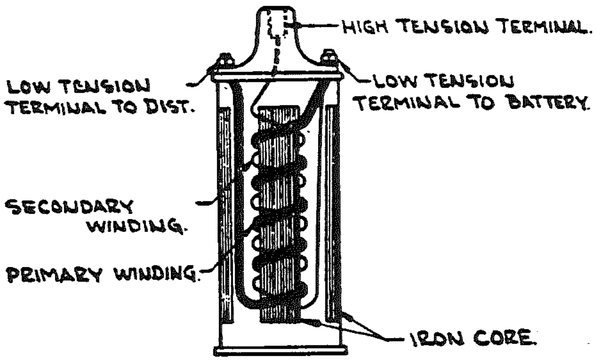

Fig. 1

Ignition Coil

The purpose of the ignition coil is to transform energy from the low voltage source (generator or battery) into energy at sufficiently high voltage to jump the gap at the spark plug. It is required that the coil fire the engine under cold weather starting, normal operating, and high speed conditions, when the engine and other parts of the ignition system are normal.

There are two electrical circuits within the coil, namely, the primary and the secondary. The primary is wound with comparatively few turns of heavy wire usually on the outside of the secondary. Each end of the primary winding is connected to a low tension terminal. The secondary is wound with many layers of fine wire around the iron core. Each layer is insulated from the adjacent layer. Most coils have one end of the secondary winding connected to the primary and the other end connected to the high tension terminal.

When the contact points in the distributor close, current from the generator or battery flows through the primary circuit, creating a magnetic field about the windings and core. The current does not instantly reach its highest value due to the inductive effect of the magnetic field. A definite time is, therefore, required for the field to "build up." As the magnetic field is greatest when the current reaches its highest value, it is necessary that the coil and distributor be designed to allow sufficient "build-up" time to obtain adequate spark at the highest engine speed.

When the distributor contact points open, the current in the primary does not stop flowing instantly, but flows into the condenser which is connected in parallel with the contacts. This action prevents arcing and assures a quick collapse of the magnetic field without the loss of energy through an arc at the contacts. The quick collapse of the magnetic field induces a voltage in the primary as well as in the secondary windings. This voltage increases until it is sufficiently high in the secondary to produce a spark at the spark plug. Since there are 60 to 100 times as many turns in the secondary as there are in the primary, the induced voltage in the secondary will be 60 to 100 times that of the primary. A secondary voltage varying from 4,000 to 15,000 volts is required to produce the spark at the plug. Variations in the amount of secondary voltage required are due to such factors as engine compression, engine speed, spark plug temperature, condition of the spark plug electrodes and width of the spark gap.

Storage Battery

Storage Battery

The treatment given a storage battery between the time it leaves the manufacturer and the time it goes into the service of the customer, has an important bearing upon its life and performance. With this in mind, we wish to again emphasize the instructions which pertain to the proper care of batteries in stock.

Wet Batteries

Remove batteries from trucks as they are received from the factory and place them in the Attachment Room. Enter the date received, battery type, and code marking on the Storage Battery Record Card. Read the specific gravity of each cell and record it, with the inspector's initials on the card under "Test Record." **Recharge the battery at once if specific gravity reads 1.225 or less.**

Make subsequent inspections every 30 days, taking hydrometer readings of **each cell.** Record the specific gravity readings and date of inspection under "Test Record." Any battery showing a specific gravity of 1.225 or less must be placed on the charging line at once and brought to a fully charged condition.

Batteries **must** be properly rotated. Use the oldest batteries first, and make certain that each truck is equipped with a fully charged battery when it is delivered.

Upon sale, complete the Storage Battery Record Card showing delivery date, truck model, chassis number and purchaser's name; also, the specific gravity reading of each cell. File the battery record card for future reference. Instruct the purchaser to have his battery service regularly.

Dry Batteries

Follow carefully the instructions on Prest-O-Lite Form No. M-99-D which accompanies each dry battery.

Be sure the vent caps are screwed tight and kept that way.

When preparing for service, follow the instructions, noting the difference in treatment between warm and cold climates.

General

To read cell voltages of undercover connector type batteries, contact the lead tabs directly under the cover vents with your voltmeter prods. These tabs project from the plate straps. The voltage reading of the center cell is obtained by inserting the voltmeter between tabs in the end cells.

The factory shipping code date on undercover connector types is stamped in the top edge of the container at the positive cell end.

Do not add **anything** other than distilled water or drinking water free from iron or other impurities to a storage battery. The use of patent electrolytes or battery "dopes" are injurious and void the guarantee.

Keep in mind the effect of cold temperature upon battery efficiency. A fully charged battery has only about 40% of the starting power at zero that it has at 80°.

A discharged battery can freeze in cold weather, ruining the battery. Electrolyte of 1.150 sp. gr. will freeze at 5° above zero; 1.200 sp. gr. at 16° below zero; 1.220 sp. gr. at 30° below zero.

Use a strong solution of soda and hot water for removing terminal corrosion and cleaning the battery. To prevent corrosion apply vaseline or cup grease to the terminals.

Adjust the generator charging rate to the individual customer's driving habits to avoid overcharging (and overheating), or undercharging. Excessive evaporation of water from the battery indicates overcharging. Necessity for frequent recharging indicates undercharging. Correct these conditions when they exist to insure maximum battery life and performance.

Horns

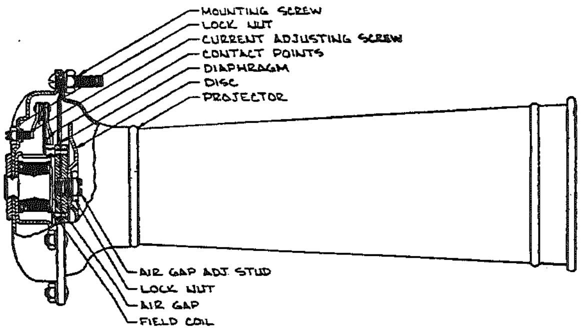

Fig. 1 (DR-K-16-2002)

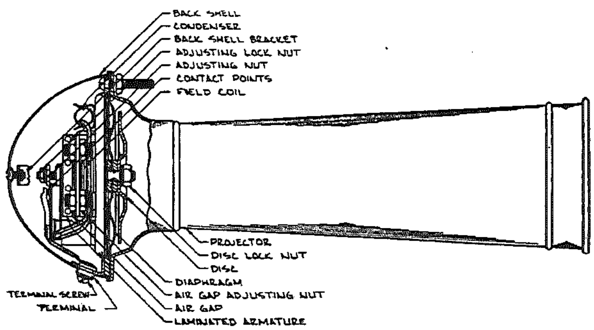

Fig. 2 (DR-K-26L-1611 and DR-K-26L-1624)

Electrically Operated Horn

The electrically operated horns are vibrating type units that operate on a magnetic principle to produce the warning signal. Current from the battery flows through the windings within the horn power plant when the circuit is completed at the horn push-button switch. The magnetic attraction of the armature toward the pole causes a tension and slight movement of the diaphragm. This movement opens the contact points in series with the horn windings, breaking the circuit. When the current is interrupted, the armature returns to its original position, relieving the tension of the diaphragm. The slight return movement of the armature and diaphragm allows the contact points to close, completing the circuit. This cycle is repeated a great many times per second, resulting in a rapid vibration of the diaphragm. Each horn is designed to operate at a predetermined number of cycles per second to produce its characteristic warning signal. The pitch of the horns depends upon the number of vibrations per second, the high note horns having the greater frequency.

Conditions Affecting Horn Performance

The following conditions affect the performance of the horns and should be checked before attempting to make any adjustments to the instruments:

Low Horn Voltage

If the horn produces a weak signal, the voltage at the horn should be noted. Connect a voltmeter from the horn terminal to ground when checking horns having one terminal. Connect the voltmeter across the horn terminals when checking horns having two terminals. The voltage readings should not be less than 5.25 volts (six volt system) or 11 volts (twelve volt system). A lower reading would indicate either a low battery or a high resistance in the horn circuit.

Low Battery

Check the battery with a voltmeter or hydrometer for condition of charge. If low, the battery should be recharged.

Loose or Corroded Connections in Horn Circuit

Clean and tighten connections wherever necessary. Check for defective wiring by connecting separate test leads from the horn to the battery. A loose connection or poor contact at the horn push-button switch may cause the horn to operate intermittently. Shunt around the horn button to determine whether there is poor contact at the push-button switch.

Lighting

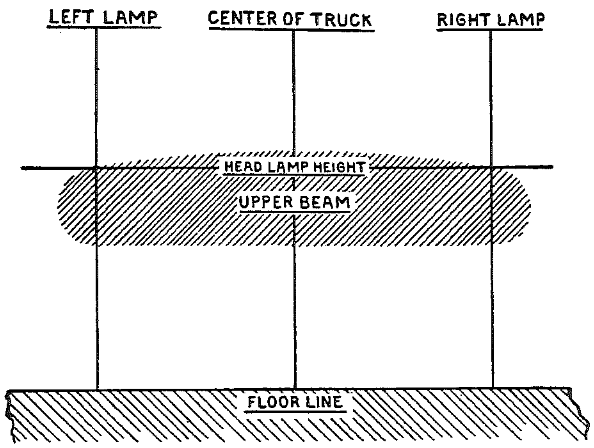

Fig. 1

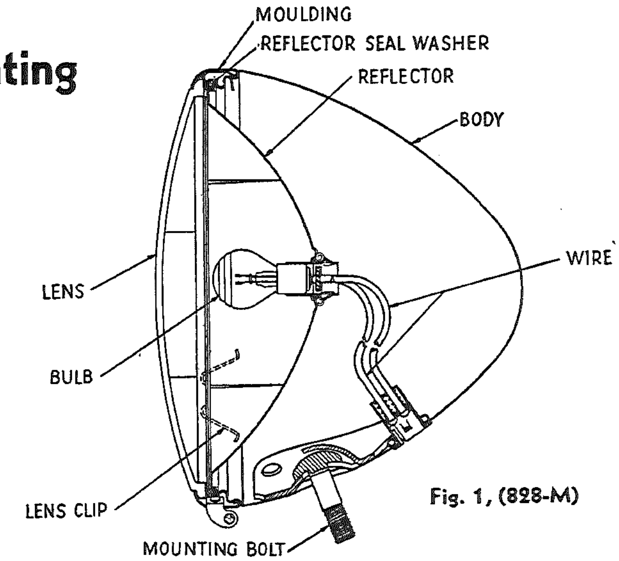

Fig. 1, (828-M)

Head Lamps

Head lamps are the depressed beam type, consisting of a special lens operating in conjunction with a special reflector and a prefocused two-filament bulb. This type lamp permits two separate and distinct beams of light; the upper or driving beam being produced by the lower filament and the lower or passing beam being produced by the upper filament. A foot-operated switch controls the upper and lower beams after lights are turned on at the instrument panel.

If a lens or reflector is damaged or a bulb is burned out or broken, the replacement part must be of the correct design in order to insure proper focus.

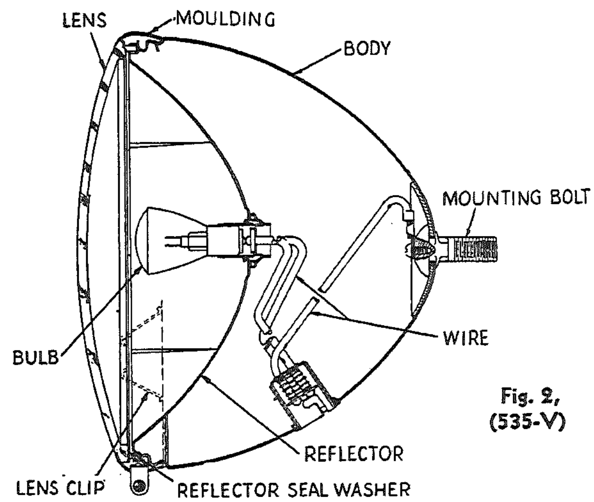

Fig. 2, (535-V)

Adjustment

Inasmuch as the lamps are prefocused, the only adjustment necessary is to see that they are correctly aimed. The usual procedure is to place the truck on level floor so that head lamps are 25 feet from a light colored wall or other vertical surface.

Draw a horizontal line on the wall below lamp centers (the height depends upon State regulations) and draw vertical lines, thru the horizontal line, directly in front of the head lamps.

Turn on lights and operate foot switch, illuminating the lower filament which produces the upper beam.

Cover one head lamp to obscure the light beam and loosen head lamp mounting nut. Aim head lamp, centering the beam on the vertical line directly ahead of it and with the upper boundary of the beam just touching the horizontal line.

Tighten mounting nut securely and repeat the above operation for the other lamp. Take care when tightening mounting nuts not to move the head lamp, otherwise the aim will be disturbed.

The load on truck, changed tire sizes and tire pressure have an effect on the aiming of head lamps. These points should be kept in mind when making adjustments.

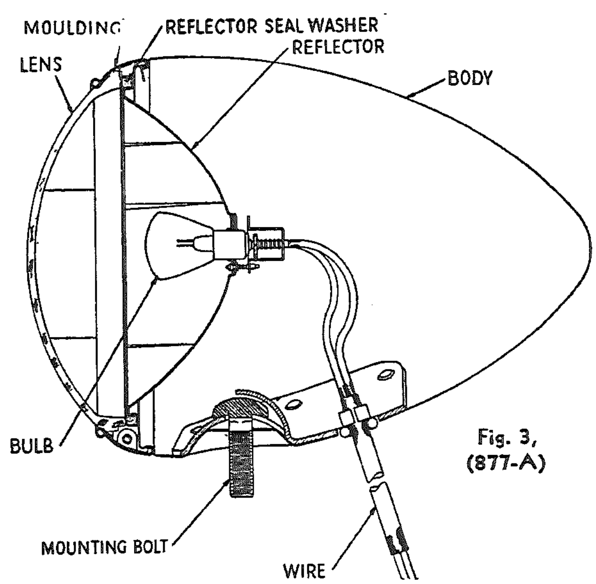

Fig. 3, (877-A)

Spark Plugs

Spark Plugs

Spark plugs, to give good performance in an engine, must operate within a certain temperature range (not too hot and not too cool). The degree of heat generated at the plug varies according to the service in which it is used. Therefore different types of plugs are required and it is important that the correct one be selected.

Spark plugs specified for International truck engines have been thoroughly tested to determine their performance characteristics under various operating conditions. However, it is impossible, in many cases, for the factory to determine whether a truck is to be used in moderate or severe service and it is recommended that a study be made of the operation of each truck sold so that spark plugs having the proper temperature range can be installed.

Spark plugs installed at the factory as standard equipment will be found suitable for average operating conditions.

Optional plugs, having different heat range characteristics, are listed in the "Specifications" under two classifications—Moderate and Severe Service. These plugs are available thru the Repairs Department and should be used only after a thorough investigation indicates that a "colder" or "hotter" spark plug is required.

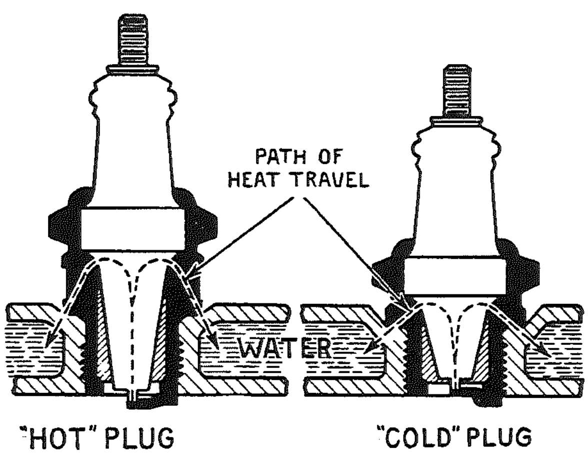

Fig. 1

Use spark plugs listed under the "Moderate Service" classification to overcome fouling. These plugs have a higher temperature range than those listed under the 'Severe Service" classification.

To remedy pre-ignition, rapid burning of electrodes or chronic oxide coatings, spark plugs having a lower temperature range should be used. Such plugs are listed under the "Severe Service" classification.

Various conditions affecting spark plug performance are shown in the following illustrations. Spark plugs must be serviced the same as any other unit in the truck. It is reasonable to expect about 10,000 miles of operation from a spark plug, but operating conditions govern this entirely. Several times during this period the plugs should be cleaned, preferably by the sand blast method, and the gap adjusted.

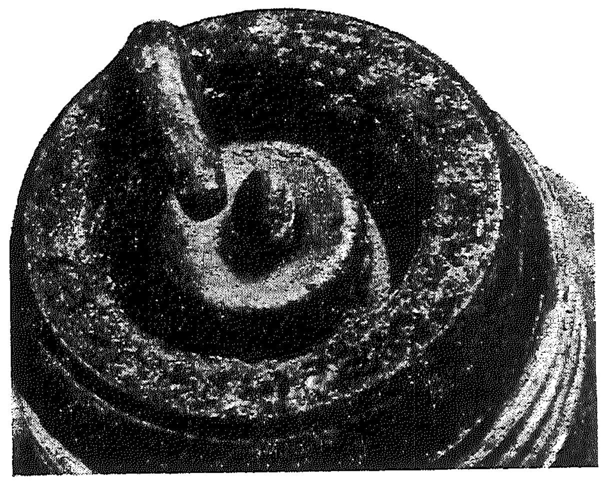

Fig. 2

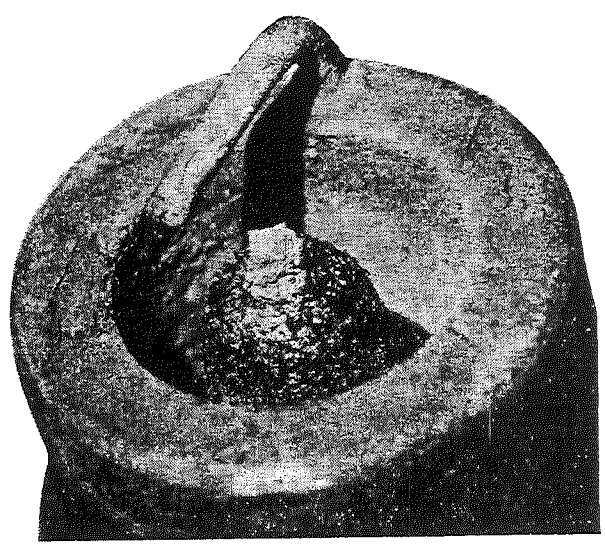

Fig. 3

Figures 2 and 3 illustrate spark plugs which can no longer give profitable service. The only remedy is a replacement.

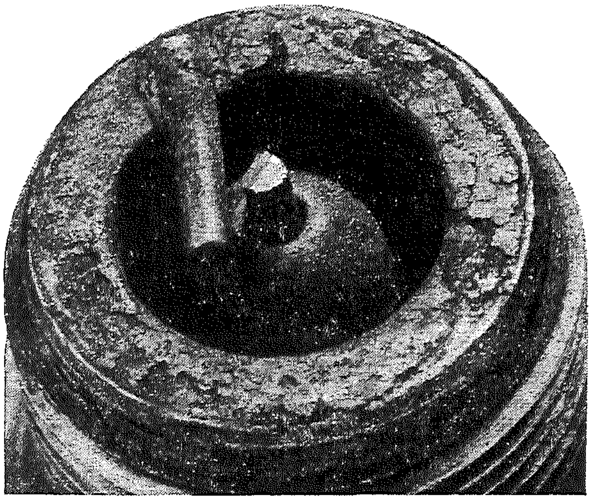

Fig. 4

Figure 4 illustrates carbon or soot deposits which often occur during the "breaking in" period of the truck, due to the low operating speed of the engine. This condition is also caused by over-rich carburetion, worn pistons, rings or faulty ignition. Carbon deposits will also form on a spark plug that is too "cool".

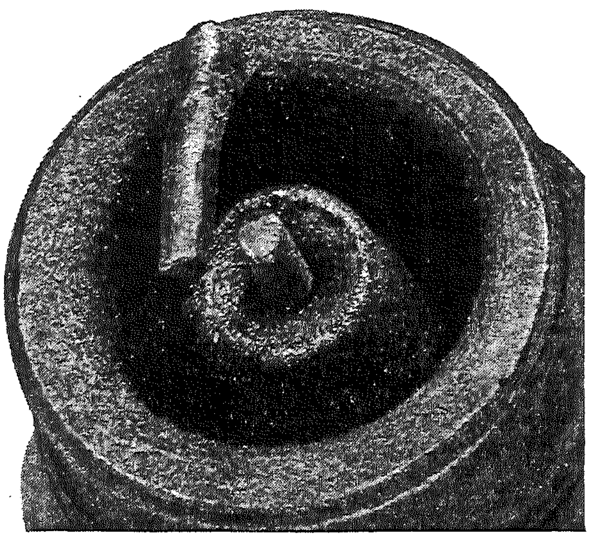

Fig. 5

Figure 5 illustrates a plug having blistered deposits. These are oxide deposits and are the most prevalent cause of plug failures under present-day operating conditions. Oxide coating causes intermittent missing, especially at high speeds and on hard pulls, and often complete failure because this coating is a conductor of electricity, particularly when hot.

Figure 6 shows typical normal wear of the electrodes. The gap will gradually widen after several thousand miles of normal service.

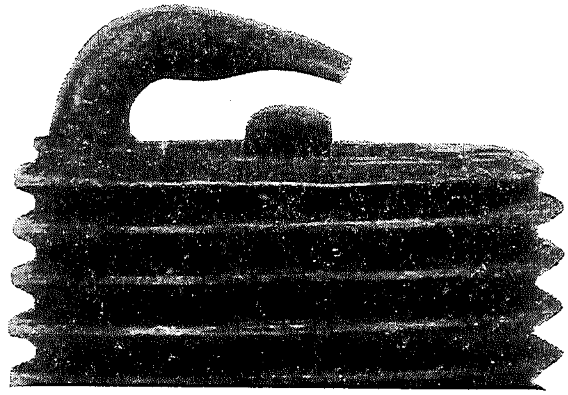

Fig. 6

Fig. 7

Figure 7 illustrates a spark plug that is operating too "hot" (wrong type of plug). The gap will widen or wear quickly at low mileage.

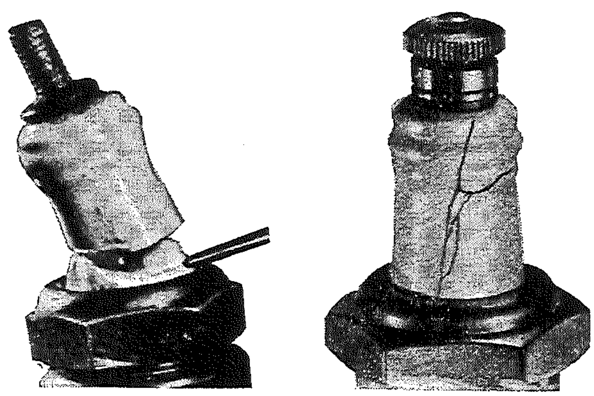

Fig. 8

Figure 8 illustrates broken insulators which are never caused by the engine or operating conditions. An outside blow or a poor fitting wrench is the usual cause of broken insulators. A newly broken insulator may not cause missing immediately, but as soon as oil or moisture penetrates the fracture, the plug will "cut out".

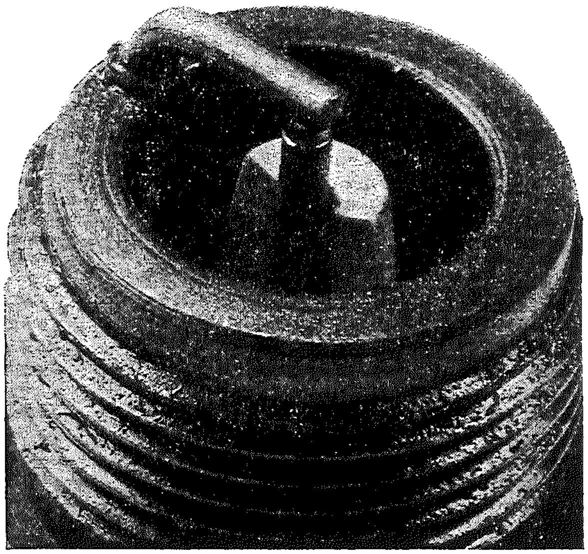

Fig. 9

Figure 9 illustrates breakage of the insulator at the end. This breakage may occur when operating conditions are abnormally severe or when the wrong type of plug (too hot) is used. Breakage may also occur when adjusting the gap, due to bending or straining the center electrode. Never move or bend the center electrode.

Gap between electrodes should be set to specified limits, using an accurate round wire feeler gauge. Use new gaskets when reinstalling spark plugs.

Engine Group

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- D-15 (HD-213A Engine)
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- D-300, DS-300 (HD-232A Engine)

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Bulletin Number	Models Affected	Subject

Engine Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Model	HD-213	FC-132	HD-213A	HD-232	HD-232	HD-232	HD-232	FAB-241	FAB-241	FAB-241	FAB-259	FBB-298	FBB-361
Number of Cylinders	6	4	6	6	6	6	6	6	6	6	6	6	6
Bore	3 5/16"	3¼"	3 5/16"	3 5/16"	3 5/16"	3 5/16"	3 5/16"	3⅜"	3⅜"	3⅜"	3½"	3¾"	4⅛"
Stroke	4⅛"	4"	4⅛"	4½"	4½"	4½"	4½"	4½"	4½"	4½"	4½"	4½"	4½"
Displacement (cu. in.)	213.24	132.73	213.24	232.65	232.65	232.65	232.65	241.54	241.54	241.54	259.76	298.20	360.82
Rated H.P. (A.M.A.)	26.3	16.8	26.3	26.3	26.3	26.3	26.3	27.3	27.3	27.3	29.4	33.7	40.8
Brake H.P. (Max.)	78.2	33	78.2	81	81	81	81	84	84	84	89.1	93.7	111.4
At R.P.M.	3400	2800	3400	3200	3200	3200	3200	3200	3200	3200	3200	2800	2700
Max. Torque (lb.-ft.)	155	89.5	155	170	170	170	170	175.5	175.5	175.5	192	218	268
At R.P.M.	1000	1200	1000	1000	1000	1000	1000	800	800	800	800	1600	1500
Torque (lb.-ft.) (Net)	153.8	87	153.8	165.5	165.5	165.5	165.5	171	171	171	186	206	260
At R.P.M.	1000	1200	1000	1000	1000	1000	1000	800	800	800	800	1000	1000
Governed Speed	None	None	None	None	None	None	None	None	None	None	None	2700	2600
Compression Ratio	6.3	6.0	6.3	6.0	6.0	6.0	6.0	5.8	5.8	5.8	5.74	5.7	5.2
Clearance Volume (cu. in.)	6.66	6.63	6.66	7.76	7.76	7.76	7.76	8.26	8.26	8.26	9.13	10.51	14.08
Compression (Gauge) (lb. to sq. in.)	93½	96	93½	93½	93½	93½	93½	94½	94½	94½	99	92	89
At R.P.M.	160	150	160	160	160	160	160	160	160	160	160	160	160
Firing Order	1-5-3-6-2-4	1-3-4-2	1-5-3-6-2-4	1-5-3-6 2-4	1-5-3-6-2-4	1-5 3-6-2-4	1-5 3-6 2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Crankcase Capacity (Refill)	6 Qts.	4 Qts.	6 Qts.	6 Qts.	6 Qts.	6 Qts.	6 Qts.	6½ Qts.	6½ Qts.	6½ Qts.	6½ Qts.	8½ Qts.	8½ Qts.

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Model	FBB-361	FBB-401	HD-232-A	HD-232-A	HD-232	HD-232	FAB-241	FBB-298	FBB-298	FBB-401	FBB-401	FBB-450A
Number of Cylinders	6	6	6	6	6	6	6	6	6	6	6	6
Bore	4⅛"	4⅛"	3 5/16"	3 5/16"	3 5/16"	3 5/16"	3⅜"	3¾"	3¾"	4⅛"	4⅛"	4⅜"
Stroke	4½"	5"	4½"	4½"	4½"	4½"	4½"	4½"	4½"	5"	5"	5"
Displacement (cu. in.)	360.82	400.92	232.65	232.65	232.65	232.65	241.54	298.20	298.20	400.92	400.92	450.99
Rated H.P. (A.M.A.)	40.8	40.8	26.3	26.3	26.3	26.3	27.3	33.7	33.7	40.8	40.8	45.9
Brake H.P. (Max.)	111.4	114.2	81	81	81	81	84	93.7	93.7	114.2	114.2	120
At R.P.M.	2700	2600	3200	3200	3200	3200	3200	2800	2800	2600	2600	2400
Max. Torque (lb.-ft.)	268	308	170	170	170	170	175.5	218	218	308	308	331
At R.P.M.	1500	800	1000	1000	1000	1000	800	1600	1600	800	800	800
Torque (lb.-ft.) (Net)	260	298	165.5	165.5	165.5	165.5	171	206	206	298	298	320
At R.P.M.	1000	700	1000	1000	1000	1000	800	1000	1000	700	700	800
Governed Speed	2600	2500	None	None	None	None	None	2700	2700	2500	2500	2400
Compression Ratio	5.2	5.2	6.0	6.0	6.0	6.0	5.8	5.7	5.7	5.2	5.2	5.2
Clearance Volume (cu. in.)	14.08	15.58	7.76	7.76	7.76	7.76	8.26	10.51	10.51	15.58	15.58	17.74
Compression (Gauge) (lb. to sq. in.)	89	99½	93½	93½	93½	93½	94½	92	92	99½	99½	89
At R.P.M.	160	160	160	160	160	160	160	160	160	160	160	160
Firing Order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6 2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3 6-2-4
Crankcase Capacity (Refill)	8½ Qts.	8½ Qts.	6 Qts.	6 Qts.	6 Qts.	6 Qts.	6½ Qts.	8½ Qts.	8½ Qts.	8½ Qts.	8½ Qts.	8½ Qts.

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Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Crankshaft Bearing Diameters (Standard):													
Mains	2.635"—2.636"	2.124"—2.125"	2.635"—2.636"	2.635"—2.636"	2.635"—2.636"	2.635"—2.636"	2.635"—2.636"	2.372"—2.373"	2.372"—2.373"	2.372"—2.373	2.372"—2.373"	2.7005"—2.7015"	2.7005"—2.7015"
Crank Pins	2.000"—2.001"	1.749"—1.750"	2.000"—2.001"	2.000"—2.001"	2.000"—2.001"	2.000"—2.001"	2.000"—2.001"	2.122"—2.123"	2.122"—2.123"	2.122"—2.123"	2.122"—2.123"	2.247"—2.248"	2.247"—2.248"
Crankshaft Clearance	.0015" to .003"	.001" to .0025"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .004"	.0015" to .004"	.0015" to .004"	.0015" to .004"	.0015" to .004"	.0015" to .004"
Crankshaft Runout (max. on indicator)	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Crankshaft Bearing Diameters (Standard):												
Mains	2.7005"—2.7015"	2.7005"—2.7015"	2.635"—2.636"	2.635"—2.636"	2.635"—2.636"	2.635"—2.636"	2.372"—2.373"	2.7005"—2.7015"	2.7005"—2.7015"	2.7005"—2.7015"	2.7005"—2.7015"	2.7005"—2.7015"
Crank Pins	2.247"—2.248"	2.247"—2.248"	2.000"—2.001"	2.000"—2.001"	2.000"—2.001"	2.000"—2.001"	2.122"—2.123"	2.247"—2.248"	2.247"—2.248"	2.247"—2.248"	2.247"—2.248"	2.247"—2.248"
Crankshaft Clearance	.0015" to .004"	.0015" to .004"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .004"	.0015" to .004"	.0015" to .004"	.0015" to .004"	.0015" to .004"	.0015" to .004"
Crankshaft Runout (max. on indicator)	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"	.004"

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Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Model	HD-213	FC-132	HD-213A	HD-232	HD-232	HD-232	HD-232	FAB-241	FAB-241	FAB-241	FAB-259	FBB-298	FBB-361
Crankshaft End Play	.0035" to .0075"	.0025" to .0065"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"
Camshaft Bearing Diameters (Standard):													
Front	2.1855"—2.1860"	2.1230"—2.1235"	2.1855"—2.1860"	2.1855"—2.1860"	2.1855"—2.1860"	2.1855"—2.1860"	2.1855"—2.1860"	1.811"—1.812"	1.811"—1.812"	1.811"—1.812"	1.811"—1.812"	2.109"—2.110"	2.109"—2.110"
No. 2	1.9335"—1.9340"	1.8730"—1.8735"	1.9335"—1.9340"	1.9335"—1.9340"	1.9335"—1.9340"	1.9335"—1.9340"	1.9335"—1.9340"	1.577"—1.578"	1.577"—1.578"	1.577"—1.578"	1.577"—1.578"	2.089"—2.090"	2.089"—2.090"
No. 3	1.9135"—1.9140"	....	1.9135"—1.9140"	1.9135"—1.9140"	1.9135"—1.9140"	1.9135"—1.9140"	1.9135"—1.9140"	1.562"—1.563"	1.562"—1.563"	1.562"—1.563"	1.562"—1.563"	2.069"—2.070"	2.069"—2.070"
Rear	1.6225"—1.6220"	1.4980"—1.4985"	1.6225"—1.6220"	1.6225"—1.6220"	1.6225"—1.6220"	1.6225"—1.6220"	1.6225"—1.6220"	1.499"—1.500"	1.499"—1.500"	1.499"—1.500"	1.499"—1.500"	1.4995"—1.5005"	1.4995"—1.5005"
Camshaft Clearance	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.002" to .0035"	.002" to .0035"	.002" to .0035"	.002" to .0035"	.002" to .0035"	.002" to .0035"
Camshaft End Play	Spring Loaded	.002" to .006"	Spring Loaded	Spring Loaded	Spring Loaded	Spring Loaded	Spring Loaded	.002" to .008"	.002" to .008"	.002" to .008"	.002" to .008"	.002" to .008"	.002" to .008"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426-F
Model	FBB-361	FBB-401	HD-232A	HD-232A	HD-232	HD-232	FAB-241	FBB-298	FBB-298	FBB-401	FBB-401	FBB-450A
Crankshaft End Play	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"	.0035" to .0075"
Camshaft Bearing Diameters (Standard):												
Front	2.109"—2.110"	2.109"—2.110"	2.1855"—2.1860"	2.1855"—2.1860"	2.1855"—2.1860"	2.1855"—2.1860"	1.811"—1.812"	2.109"—2.110"	2.109"—2.110"	2.109"—2.110"	2.109"—2.110"	2.109"—2.110"
No. 2	2.089"—2.090"	2.089"—2.090"	1.9335"—1.9340"	1.9335"—1.9340"	1.9335"—1.9340"	1.9335"—1.9340"	1.577"—1.578"	2.089"—2.090"	2.089"—2.090"	2.089"—2.090"	2.089"—2.090"	2.089"—2.090"
No. 3	2.069"—2.070"	2.069"—2.070"	1.9135"—1.9140"	1.9135"—1.9140"	1.9135"—1.9140"	1.9135"—1.9140"	1.562"—1.563"	2.069"—2.070"	2.069"—2.070"	2.069"—2.070"	2.069"—2.070"	2.069"—2.070"
Rear	1.4995"—1.5005"	1.4995"—1.5005"	1.6225"—1.6230"	1.6225"—1.6230"	1.6225"—1.6230"	1.6225"—1.6230"	1.499"—1.500"	1.4995"—1.5005"	1.4995"—1.5005"	1.4995"—1.5005"	1.4995"—1.5005"	1.4995"—1.5005"
Camshaft Clearance	.002" to .0035"	.002" to .0035"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.002" to .0035"	.002" to .0035"	.002" to .0035"	.002" to .0035"	.002" to .0035"	.002" to .0035"
Camshaft End Play	.002" to .008"	.002" to .008"	Spring Loaded	Spring Loaded	Spring Loaded	Spring Loaded	.002" to .008"	.002" to .008"	.002" to .008"	.002" to .008"	.002" to .008"	.002" to .008"

Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Camshaft Gear Blacklash	Sprocket	.001" to .0035"	Sprocket	Sprocket	Sprocket	Sprocket	Sprocket	.000" to .0015"	.000" to .0015"	.000" to .0015"	.000" to .0015"	.005" to .007"	.005" to .007"
Connecting-Rod Bearing Side Play	.005" to .009"	.005" to .009"	.005" to .009"	.005" to .009"	.005" to .009"	.005" to .009"	.005" to .009"	.007" to .013"	.007" to .013"	.007" to .013"	.007" to .013"	.007" to .013"	.007" to .013"
Connecting-Rod Bearing Clearance	.001" to .0025"	.001" to .003"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.0015" to .0035"	.0015" to .0035"	.0015" to .0035"	.0015" to .0035"	.0015" to .0035"	.0015" to .0035"
Cylinder Bore Out of Round or Taper	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"
Piston Clearance	.0035"	.003" to .004"	.0035"	.004"	.004"	.004"	.004"	.003" to .004"	.003" to .004"	.003" to .004"	.003" to .004"	.004"	.0015" to .002"
Ribbon (For Clearance Check):													
Width	⅜"	⅜"	⅜"	⅜"	⅜"	⅜"	⅜"	½"	½"	½"	½"	½"	½"
Thickness	.0035"	.0035"	.0035"	.004"	.004"	.004"	.004"	.0035"	.0035"	.0035"	.0035"	.004"	.0015"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Camshaft Gear Blacklash	.005" to .007"	.005" to .007"	Sprocket	Sprocket	Sprocket	Sprocket	.000" to .0015"	.005" to .007"	.005" to .007"	.005" to .007"	.005" to .007"	.005" to .007"
Connecting-Rod Bearing Side Play	.007" to .013"	.007" to .013"	.005" to .009"	.005" to .009"	.005" to .009"	.005" to .009"	.007" to .013"	.007" to .013"	.007" to .013"	.007" to .013"	.007" to .013"	.007" to .013"
Connecting-Rod Bearing Clearance	.0015" to .0035"	.0015" to .0035"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.0015" to .0035"	.0015" to .0035"	.0015" to .0035"	.0015" to .0035"	.0015" to .0035"	.0015" to .0035"
Cylinder Bore Out of Round or Taper	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"	.002"
Piston Clearance	.0015" to .002"	.0015" to .002"	.004"	.004"	.004"	.004"	.003" to .004"	.004"	.004"	.0015" to .002"	.0015" to .002"	.0015" to .002"
Ribbon (For Clearance Check):												
Width	½"	½"	⅜"	⅜"	⅜"	⅜"	½"	½"	½"	½"	½"	½"
Thickness	.0015"	.0015"	.004"	.004"	.004"	.004"	.0035"	.004"	.004"	.0015"	.0015"	.0015"

Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Model	HD-213	FC-132	HD-213A	HD-232	HD-232	HD-232	HD-232	FAB-241	FAB-241	FAB-241	FAB-259	FBB-298	FBB 361
Tension (lb. on Scale):													
Limits	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12
Desired	8	8	8	8	8	8	8	8	8	8	8	8	8
Piston Rings (No. each Piston):													
Compression	3	2	3	3	3	3	3	2	2	2	2	3	3
Type	3/32"–Plain	1-1/8"-Plain 1–1/8"–70	3/32"–Plain	1-3/32"-Plain 2–3/32"–70	1–3/32"–Plain 2–3/32"–70	1–3/32"–Plain 2–3/32"–70	1–3/32"–Plain 2–3/32"–70	1–1/8"–200 1–1/8"–70	1–1/8"–200 1–1/8"–70	1–1/8"–200 1–1/8"–70	1-1/8"-200 1–1/8"–70	1/8"–Plain	1-1/8"-Plain 2–1/8"–70
Oil Control	1	1	1	1	1	1	1	2	2	2	2	1	1
Type	3/16"–85	3/16"–85	3/16"–85	3/16"-X-90	3/16"-X-90	3/16"-X-90	3/16"-X-90	1–1/8"–85 1–3/16"–85	1–1/8"–85 1–3/16"–85	1–1/8"–85 1–3/16"–85	1–1/8"–85 1–3/16"–85	3/16"–85	3/16"–85
Piston Ring Gap:													
Compression (Nominal)	.012"	.012"	.012"	.012"	.012"	.012"	.012"	.015"	015"	.015"	.015"	.015"	.015"
Oil Control (Nominal)	.012"	.012"	.012"	.012"	.012"	.012"	.012"	.015"	.015"	.015"	.015"	.015"	.015"
Allowable Variation	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	– 005" +.010"
Piston Ring Clearance in Groove:													
Compression	.0015" to .003"	.001" to .0025"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"
Oil Control	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Model	FBB-361	FBB-401	HD-232-A	H D232-A	HD-232	HD-232	FAB 241	FBB-298	FBB 298	FBB-401	FBB-401	FBB-450A
Tension (lb. on Scale):												
Limits	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12	5 to 12
Desired	8	8	8	8	8	8	8	8	8	8	8	8
Piston Rings (No. each Piston):												
Compression	3	3	3	3	3	3	2	3	3	3	3	3
Type	1-1/8"-Plain 2–1/8"–70	1-1/8"-Plain 2–1/8"–70	1–3/32"–Plain 2–3/32"–70	1–3/32"–Plain 2–3/32"–70	1–3/32"–Plain 2–3/32"–70	1–3/32"–Plain 2–3/32"–70	1–1/8"–200 1–1/8"–70	1/8"–Plain	1/8"–Plain	1-1/8"-Plain 2–1/8"–70	1–1/8"–Plain 2–1/8"–70	1-1/8"-Plain 2–1/8"–70
Oil Control	1	1	1	1	1	1	1	1	1	1	1	1
Type	3/16"–85	3/16"–85	3/16"-X-90	3/16"-X-90	3/16"-X-90	3/16"-X-90	1–1/8"–85 1–3/16"–85	3/16"–85	3/16"–85	3/16"–85	3/16"–85	3/16"–85
Piston Ring Gap:												
Compression (Nominal)	.015"	.015"	.012"	.012"	.012"	.012"	.015"	.015"	.015"	.015"	.015"	.015"
Oil Control (Nominal)	.015"	.015"	.012"	.012"	.012"	.012"	.015"	.015"	.015"	.015"	.015"	.015"
Allowable Variation	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"	–.005" +.010"
Piston Ring Clearance in Groove:												
Compression	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"	.0015" to .003"
Oil Control	.0005" to .0015"	.0005" to .0015"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.001" to .0025"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"

Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Piston Pin Fit (Room Temp. 70°F.):													
In Rod	.0003″	.0007″	.0003″	.0003″	.0003″	.0003″	.0003″	.0005″	.0005″	.0005″	.0005″	.0005″	.0005″
In Piston	.0001″ to .0002″	.0003″ to .0005″	.0001″ to .0002″	.0001″ to .0002″	.0001″ to .0002″	.0001″ to .0002″	.0001″ to .0002″	.0001″ to .0003″	.0001″ to .0003″	.0001″ to .0003″	.0001″ to .0003″	.0001″ Loose to .0001″ Tight	.0001″ Loose to .0001″ Tight
Intake Valves:													
Head Diameter	1 11/16″	1 11/32″	1 11/16″	1 11/16″	1 11/16″	1 11/16″	1 11/16″	1 11/16″	1 11/16″	1 11/16″	1 11/16″	1 7/8″	2 1/4″
Stem Diameter	.372″	.311″	.372″	.372″	.372″	.372″	.372″	342″	.342″	.342″	.342″	.372″	.372″
Tappet Clearance (Hot)	.010″	.007″	.010″	.010″	.010″	.010″	.010″	.015″	.015″	.015″	.015″	.015″	.015″
Stem Clearance	.002″ to .003″	.001″ to .003″	.002″ to .003″	.002″ to .003″	.002″ to .003″	.002″ to .003″	.002″ to .003″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″
Angle of Valve Face	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°
Valve Seat Contact Surface Width	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″
Valve Tappet Clearance in Guide	.0005″ to .0015″	.0005″ to .002″	.0005″ to .0015″	.0005″ to .0015″	.0005″ to .0015″	.0005″ to .0015″	.0005″ to .0015″	.0005″ to .003″	.0005″ to .003″	.0005″ to .003″	.0005″ to .003″	.0005″ to .0015″	.0005″ to .0015″

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Piston Pin Fit (Room Temp. 70°F.):												
In Rod	.0005″	.0005″	.0003″	.0003″	.0003″	.0003″	.0005″	.0005″	.0005″	.0005″	.0005″	.0005″
In Piston	.0001″ Loose to .0001″ Tight	.0001″ Loose to .0001″ Tight	.0001″ to .0002″	.0001″ to .C002″	.0001″ to .0002″	.0001″ to .0002″	.0001″ to .0003″	.0001″ Loose to .0001″ Tight	.0001″ Loose to .0001″ Tight	.0001″ Loose to .0001″ Tight	.0001″ Loose to .0001″ Tight	.0001″ Loose to .0001″ Tight
Intake Valves:												
Head Diameter	2 1/4″	2 1/4″	1 11/16″	1 11/16″	1 11/16″	1 11/16″	1 11/16″	1 7/8″	1 7/8″	2 1/4″	2 1/4″	2 1/4″
Stem Diameter	.372″	.372″	.372″	.372″	.372″	.372″	.342″	.372″	.372″	.372″	.372″	.372″
Tappet Clearance (Hot)	.015″	.015″	.010″	.010″	.010″	.010″	.015″	.015″	.015″	.015″	.015″	.015″
Stem Clearance	.0015″ to .0025″	.0015″ to .0025″	.002″ to .003″	.002″ to .003″	.002″ to .003″	.002″ to .003″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″
Angle of Valve Face	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°
Valve Seat Contact Surface Width	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″	1/16—3/32″
Valve Tappet Clearance in Guide	.0005″ to .0015″	.0C05″ to .0015″	.C005″ to .C015″	.C005″ to .0015″	.0005″ to .0015″	.0005″ to .0015″	.0005″ to .003″	.0005″ to .0015″	.0005″ to .0015″	.0005″ to .0015″	.0005″ to .0015″	.0005″ to .0015″

Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Model	HD-213	FC-132	HD-213A	HD-232	HD-232	HD-232	HD-232	FAB-241	FAB-241	FAB-241	FAB-259	FBB-298	FBB-361
Exhaust Valves:													
Head Diameter	1 15/33"	1 11/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 3/4"	1 5/8"
Stem Diameter	.371"	.310"	.371"	.371"	.371"	.371"	.371"	.342"	.342"	.342"	.342"	.372"	.372"
Tappet Clearance (Hot)	:010"	.011"	.010"	.010"	.010"	.010"	.010"	.015"	.015"	.015"	.015"	.015"	.015"
Stem Clearance	.003" to .004"	.002" to .004"	.003" to .004"	.003" to .004"	.003" to .004"	.003" to .004"	.003" to .004"	.002" to .003"	.002" to .003"	.002" to .003"	.002" to .003"	.002" to .003"	.002" to .003"
Angle of Valve Face	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°
Valve Seat Contact Surface Width	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"
Valve Tappet Clearance in Guide	.0005" to .0015"	.0005" to .002"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .003"	.0005" to .003"	.0005" to .003"	.0005" to .003"	.0005" to .0015"	.0005" to .0015"
Valve Springs:													
Free Length	2 11/16"	2 9/32"	2 11/16"	2 11/16"	2 11/16"	2 11/16"	2 11/16"	2 33/64"	2 33/64"	2 33/64"	2 33/64"	2 9/32" Inner 2 15/32" Outer	2 17/32"
Valve Open (lb. pressure)	85½	66	85½	85½	85½	85½	85½	93	93	93	93	46 Inner 90 Outer	145

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Model	FBB-361	FBB-401	HD-232-A	HD-232-A	HD-232	HD-232	FAB 241	FBB-298	FBB-298	FBB-401	FBB-401	FBB-450A
Exhaust Valves:												
Head Diameter	1 5/8"	1 5/8"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 3/4"	1 3/4"	1 5/8"	1 5/8"	1 5/8"
Stem Diameter	.372"	.372"	.371"	.371"	.371"	.371"	.342"	.372"	.372"	.372"	.372"	.372"
Tappet Clearance (Hot)	.015"	.015"	.010"	.010"	.010"	.010"	.015"	.015"	.015"	.015"	.015"	.015"
Stem Clearance	.002" to .003"	.002" to .003"	.003" to .004"	.003" to .004"	.003" to .004"	.003" to .004"	.002" to .003"	.002" to .003"	.002" to .003"	.002" to .003"	.002" to .003"	.002" to .003"
Angle of Valve Face	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°
Valve Seat Contact Surface Width	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"	1/16—3/32"
Valve Tappet Clearance in Guide	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .003"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"	.0005" to .0015"
Valve Springs:												
Free Length	2 17/32"	2 17/32"	2 11/16"	2 11/16"	2 11/16"	2 11/16"	2 33/64"	2 9/32" Inner 2 15/32" Outer	2 9/32" Inner 2 15/32" Outer	2 17/32"	2 17/32"	2 17/32"
Valve Open (lb. pressure)	145	145	85½	85½	85½	85½	93	46 Inner 90 Outer	46 Inner 90 Outer	145	145	145

Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Valve Open (lb. pressure)—Cont. At	1 15/16"	1 5/8"	1 15/16"	1 15/16"	1 15/16"	15/16"	1 15/16"	1.707"	1.707"	1.707"	1.707"	1 17/32" Inner 1 23/32" Outer	1.656"
Valve Closed (lb. pressure)	46½	36	46½	46½	46½	46½	46½	56	56	56	56	25 Inner 49 Outer	77
At	2¼"	1 29/32"	2¼"	2¼"	2¼"	2¼"	2¼"	2"	2"	2"	2"	1 7/8" Inner 2 1/16" Outer	2 1/16"
Rocker Arm Clearance on Shaft	....	....	....	....	....	....	....	.002" to .004"	.002" to .004"	.002" to .004"	.002" to .004"	.002" to .004"	.002" to .004"
Oil Pump:													
Body Gear End Clearance	.003" max.	.003" to .006"	.003" max.	.003" max.	.003" max.	.003" max.	.003" max.	.0035" to .006"	.0035" to .006"	.0035" to .006"	.0035" to .006"	.0035" to .006"	.0035" to .006"
Body Gear Back Lash	.005" to .007"	.010" to .013"	.005" to .007"	.005" to .007"	.005" to .007"	.005" to .007"	.005" to .007"	.003" to .009"	.003" to .009"	.003" to .009"	.003" to .009"	.003" to .009"	.003" to .009"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Valve Open (lb. pressure)—Cont. At	1.656"	1.656"	1 15/16	1 15/16"	1 15/16"	1 15/16"	1.707"	1 17/32" Inner 1 23/32" Outer	1 17/32" Inner 1 23/32" Outer	1.656"	1.656"	1.656"
Valve Closed (lb. pressure)	77	77	46½	46½	46½	46½	56	25 Inner 49 Outer	25 Inner 49 Outer	77	77	77
At	2 1/16"	2 1/16"	2¼"	2¼"	2¼"	2¼"	2"	1 7/8" Inner 2 1/16" Outer	1 7/8" Inner 2 1/16" Outer	2 1/16"	2 1/16"	2 1/16"
Rocker Arm Clearance on Shaft	.002" to .004"	.002" to .004"	....	....	....	....	.002" to .004"	.002" to .004"	.002" to .004"	.002" to .004"	.002" to .004"	.002" to .004"
Oil Pump:												
Body Gear End Clearance	.0035" to .006"	.0035" to .006"	.003" Max.	.003" Max.	.003" max.	.003" max.	.0035" to .006"	.0035" to .006"	.0035" to .006"	.0035" to .006"	.0035" to .006"	.0035" to .006"
Body Gear Back Lash	.003" to .009"	.003" to .009"	.005" to .007"	.005" to .007"	.005" to .007"	.005" to .007"	.003" to .009"	.003" to .009"	.003" to .009"	.003" to .009"	.003" to .009"	.003" to .009"

INTERNATIONAL

Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Model	HD-213	FC-132	HD-213A	HD-232	HD-232	HD-232	HD-232	FAB-241	FAB-241	FAB-241	FAB-259	FBB-298	FBB-361
Oil Pressure:													
Min. (lb.)	5–10	5–10	5–10	5-10	5-10	5-10	5-10	10-15	10-15	10-15	10-15	10-15	10-15
At R.P.M.	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300
Max. (lb.)	25–30	20–25	25–30	25-30	25-30	25-30	25-30	40-45	40-45	40-45	40-45	40-45	40-45
At R.P.M.	500 to 600	500to1600	500 to 600	500 to 600	500 to 600	500 to 600	500 to 600	1500 to 1800	1500 to 1800	1500 to 1800	1500 to 1800	1500 to 1800	1500 to 1800
Breaker Point Gap	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Model	FBB-361	FBB-401	HD-232A	HD-232A	HD-232	HD-232	FAB-241	FBB-298	FBB-298	FBB-401	FBB-401	FBB-450A
Oil Pressure:												
Min. (lb.)	10-15	10-15	5–10	5–10	5-10	5-10	10-15	10-15	10-15	10-15	10-15	10–15
At R.P.M.	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300	200 to 300
Max. (lb.)	40-45	40-45	25–30	25–30	25-30	25-30	40-45	40-45	40-45	40-45	40-45	40–45
At R.P.M.	1500 to 1800	1500 to 1800	500to1600	500to1600	500 to 600	500 to 600	1500 to 1800	1500 to 1800	1500 to 1800	1500 to 1800	1500 to 1800	1500 to 1800
Breaker Point Gap	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"	.018" to .024"

Engine Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Valve Timing:													
Intake Opens (After T.D.C.)	0°	5°	0°	0°	0°	0°	0°	10°	10°	10°	10°	10°	5°
Intake Closes (After L.D.C.)	38°	40°	38°	38°	38°	38°	38°	40°	40°	40°	40°	40°	45°
Exhaust Opens (Before L.D.C.)	34°	45°	34°	34°	34°	34°	34°	40°	40°	40°	40°	40°	40°
Exhaust Closes (After T.D.C.)	4°	5°	4°	4°	4°	4°	4°	15°	15°	15°	15°	15°	10°
Intake Valve Clearance	.010″	.005″	.010″	.010″	.010″	.010″	.010″	.024″	.024″	.024″	.024″	.016″	.016″
Water Pump End Play	.003″ to .005″	.005″ to .020″	.003″ to .005″	.003″ to .005″	.003″ to .005″	.003″ to .005″	.003″ to .005″	.002″ to .004″	.002″ to .004″	.002″ to .004″	.002″ to .004″	.002″ to .004″	.002″ to .004″
Water Pump Shaft Clearance	.0015″ to .0025″	.001″ to .002″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″
Water Thermostat:													
Start to Open—°F	145-150	150–153	145-150	145-150	145-150	145-150	145-150	145-150	145-150	145-150	145-150	145-150	145-150
Fully Open—°F	175-185	175–185	175-185	175-185	175-185	175-185	175-185	175-185	175-185	175-185	175-185	175-185	175-185

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Valve Timing:												
Intake Opens (After T.D.C.)	5°	5°	0°	0°	0°	0°	10°	10°	10°	5°	5°	5°
Intake Closes (After L.D.C.)	45°	45°	38°	38°	38°	38°	40°	40°	40°	45°	45°	45°
Exhaust Opens (Before L.D.C.)	40°	40°	34°	34°	34°	34°	40°	40°	40°	40°	40°	40°
Exhaust Closes (After T.D.C.)	10°	10°	4°	4°	4°	4°	15°	15°	15°	10°	10°	10°
Intake Valve Clearance	.016″	.016″	.010″	.010″	.010″	.010″	.024″	.016″	.016″	.016″	.016″	.016″
Water Pump End Play	.002″ to .004″	.002″ to .004″	.003″ to .005″	.003″ to .005″	.003″ to .005″	.003″ to .005″	.002″ to .004″	.002″ to .004″	.002″ to .004″	.002″ to .004″	.002″ to .004″	.002″ to .004″
Water Pump Shaft Clearance	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″	.0015″ to .0025″
Water Thermostat:												
Start to Open—°F	145-150	145-150	Adjustable	Adjustable	145-150	145-150	145-150	145-150	145-150	145-150	145-150	145–150
Fully Open—°F	175-185	175-185	125–180 Range	125–180 Range	175-185	175-185	175-185	175-185	175-185	175-185	175-185	175–185

Engines—HD-213, HD-213A, HD-232, HD-232A

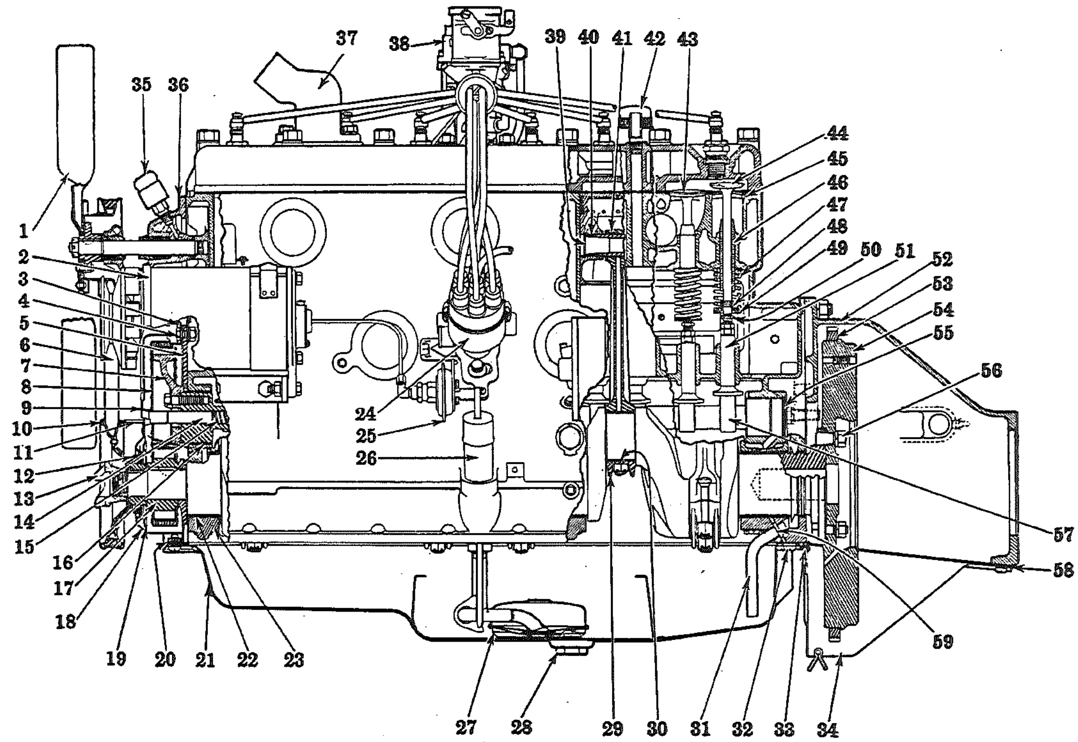


Fig. 1, HD-213, HD-213A Engine

No.	Description
1.	Fan.
2.	Generator.
3.	Gear cover gasket.
4.	Capscrew.
5.	Cover plate.
6.	Fan belt.
7.	Camshaft sprocket.
8.	Timing chain.
9.	Gear cover.
10.	Fan drive pulley.
11.	Timing indicator.
12.	Crankshaft oil seal.
13.	Starting crank jaw nut.
14.	Camshaft thrust plunger.
15.	Camshaft thrust plunger spring.
16.	Camshaft bearing.
17.	Crankshaft sprocket.
18.	Front cover.
19.	Oil slinger.
20.	Gasket.
21.	Oil pan.
22.	Main bearing.
23.	Main bearing cap.
24.	Ignition distributor.
25.	Vacuum spark advance.
26.	Oil filler.
27.	Oil screen and float.
28.	Drain plug.
29.	Connecting-rod bearing cap.
30.	Connecting-rod bearing.
31.	Oil drain tube.
32.	Gasket.
33.	Flywheel housing cover seal.
34.	Flywheel housing cover.
35.	Grease cup.
36.	Water pump.
37.	Water outlet.
38.	Carburetor.
39.	Piston pin retainer ring.
40.	Piston pin.
41.	Piston pin bushing.
42.	Breather.
43.	Intake valve.
44.	Exhaust valve.
45.	Valve-seat insert.
46.	Valve guide.
47.	Valve spring.
48.	Valve spring lock.
49.	Valve spring retainer.
50.	Valve tappet adjusting screw
51.	Valve tappet.
52.	Flywheel housing.
53.	Flywheel ring gear.
54.	Flywheel.
55.	Expansion plug.
56.	Flywheel dowel.
57.	Camshaft.
58.	Gasket.
59.	Oil drain tube pin.

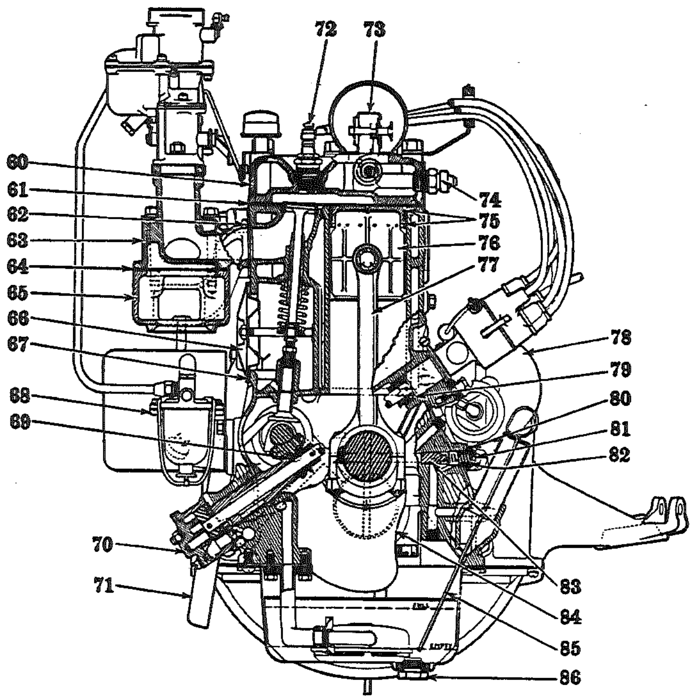


Fig. 2, HD-213, HD-213A Engine

No.	Description
60.	Cylinder head.
61.	Cylinder head gasket.
62.	Manifold gasket.
63.	Intake manifold.
64.	Intake and exhaust manifold gasket.
65.	Exhaust manifold.
66.	Valve tappet cover.
67.	Valve tappet cover gasket.
68.	Fuel pump.
69.	Oil pump drive gear.
70.	Oil pump.
71.	Cylinder block ventilator.
72.	Spark plug.
73.	Water thermostat.
74.	Water temperature indicator sender.
75.	Piston rings.
76.	Piston.
77.	Connecting rod.
78.	Starting motor.
79.	Ignition distributor drive gear.
80.	Oil pressure regulator gasket.
81.	Oil pressure regulator nut.
82.	Oil pressure regulator spring.
83.	Oil pressure regulator piston.
84.	Crankshaft.
85.	Oil gauge.
86.	Drain plug.

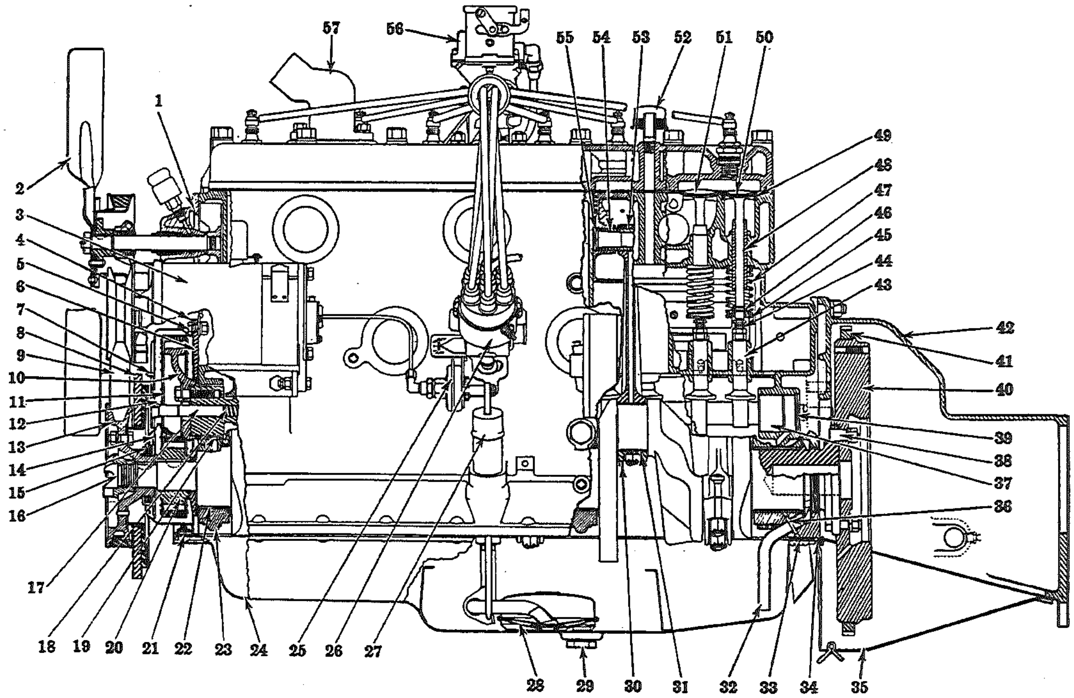


Fig. 3, HD-232 Engine

No.	Description
1.	Water pump.
2.	Fan.
3.	Generator.
4.	Cover plate gasket.
5.	Capscrew.
6.	Cover plate.
7.	Timing indicator.
8.	Vibration dampener.
9.	Fan belt.
10.	Camshaft sprocket.
11.	Timing chain.
12.	Timing chain cover.
13.	Fan pulley.
14.	Oil slinger.
15.	Crankshaft oil seal.
16.	Starting crank jaw nut.
17.	Camshaft thrust plunger.
18.	Camshaft thrust plunger spring.
19.	Camshaft bearing.
20.	Crankshaft sprocket.
21.	Oil pan gasket.
22.	Main bearing.
23.	Main bearing cap.
24.	Oil pan.
25.	Vacuum spark advance.
26.	Ignition distributor.
27.	Oil filler.
28.	Oil screen and float.

No.	Description
29.	Drain plug.
30.	Connecting-rod bearing cap.
31.	Connecting-rod bearing.
32.	Oil drain tube.
33.	Gasket.
34.	Flywheel housing cover seal.
35.	Flywheel housing cover.
36.	Oil drain tube pin.
37.	Camshaft.
38.	Flywheel dowel.
39.	Expansion plug.
40.	Flywheel.
41.	Flywheel ring gear.
42.	Flywheel housing.
43.	Valve tappet.
44.	Valve tappet adjusting screw.
45.	Valve spring retainer.
46.	Valve spring lock.
47.	Valve spring.
48.	Valve guide.
49.	Valve-seat insert.
50.	Exhaust valve.
51.	Intake valve.
52.	Breather.
53.	Piston pin bushing.
54.	Piston pin.
55.	Piston pin retainer ring.
56.	Carburetor.
57.	Water outlet.

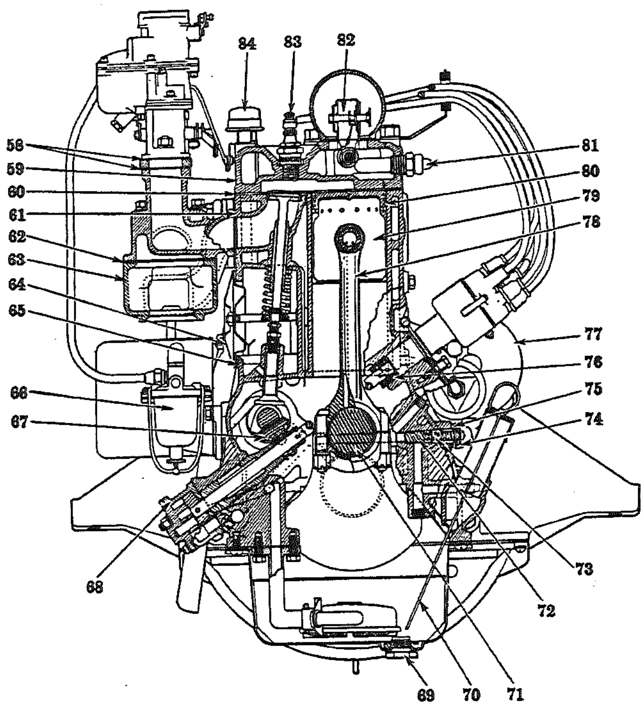


Fig. 4, HD-232 Engine

No. Description

58. Gasket.
59. Cylinder head.
60. Cylinder head gasket.
61. Manifold gasket.
62. Exhaust and intake manifold gasket.
63. Exhaust manifold.
64. Valve tappet cover.
65. Valve tappet cover gasket.
66. Fuel pump
67. Oil pump drive gear.
68. Oil pump.
69. Drain plug.
70. Oil gauge.
71. Crankshaft.
72. Oil pressure regulator piston.
73. Oil pressure regulator spring.
74. Oil pressure regulator nut.
75. Oil pressure regulator gasket.
76. Ignition distributor drive gear.
77. Starting motor.
78. Connecting rod.
79. Piston.
80. Piston rings.
81. Water temperature indicator sender.
82. Water thermostat.
83. Spark plug.
84. Breather.

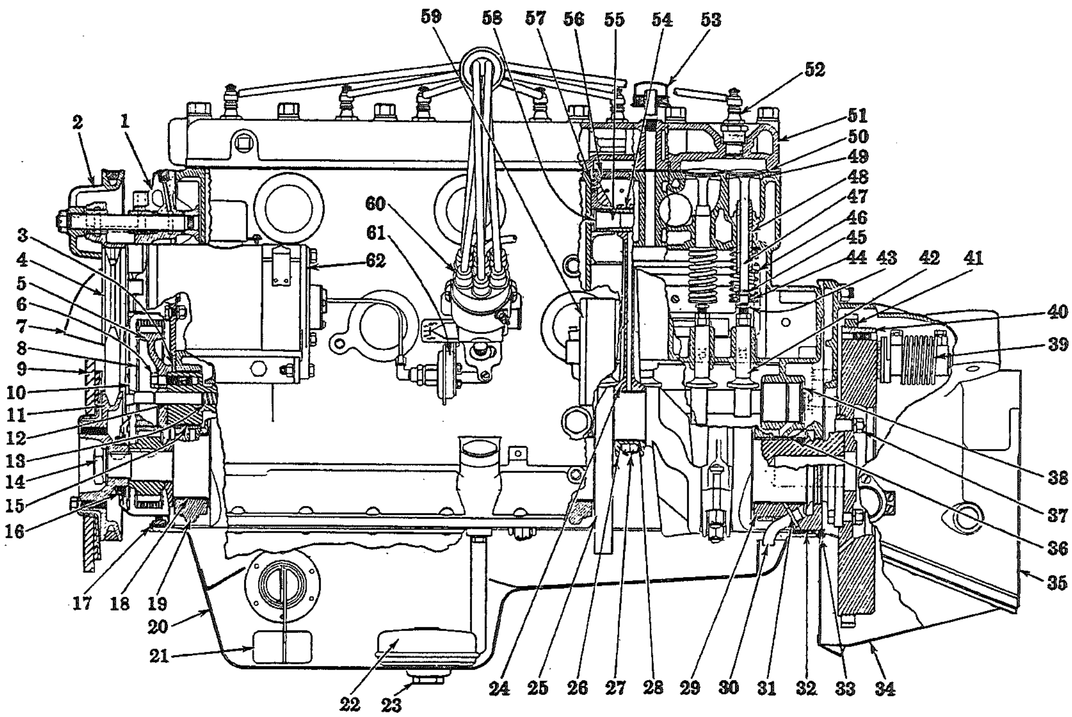


Fig. 5, HD-232A Engine

No.	Description
1.	Water pump.
2.	Water pump pulley.
3.	Camshaft thrust washer.
4.	Water pump drive belt.
5.	Camshaft sprocket.
6.	Camshaft sprocket caps crew.
7.	Water inlet.
8.	Timing chain.
9.	Vibration dampener.
10.	Gear cover.
11.	Water pump drive pulley.
12.	Camshaft thrust plunger.
13.	Camshaft thrust plunger spring.
14.	Crankshaft nut.
15.	Camshaft front bearing.
16.	Crankshaft front oil seal.
17.	Oil pan gasket.
18.	Main bearing.
19.	Main bearing cap.
20.	Oil pan.
21.	Oil level gauge float.
22.	Oil screen and float.
23.	Drain plug.
24.	Connecting rod.
25.	Crankshaft.
26.	Connecting rod bearing cap.
27.	Connecting rod bolt.
28.	Connecting rod bearing.
29.	Rear main bearing cap.
30.	Oil drain tube.
31.	Oil drain tube pin.

No.	Description
32.	Oil pan gasket.
33.	Flywheel housing cover seal.
34.	Flywheel housing cover.
35.	Flywheel housing.
36.	Rear main bearing.
37.	Flywheel dowel.
38.	Expansion plug.
39.	Starting motor drive.
40.	Flywheel.
41.	Flywheel ring gear.
42.	Valve tappet.
43.	Valve tappet adjusting screw.
44.	Valve spring retainer.
45.	Valve spring lock.
46.	Valve spring.
47.	Exhaust valve.
48.	Valve guide
49.	Valve seat insert.
50.	Cylinder head gasket.
51.	Cylinder head.
52.	Spark plug.
53.	Breather.
54.	Piston pin bushing.
55.	Piston pin.
56.	Piston.
57.	Piston rings.
58.	Piston pin retainer ring.
59.	Starting motor.
60.	Ignition distributor.
61.	Vacuum spark advance.
62.	Generator.

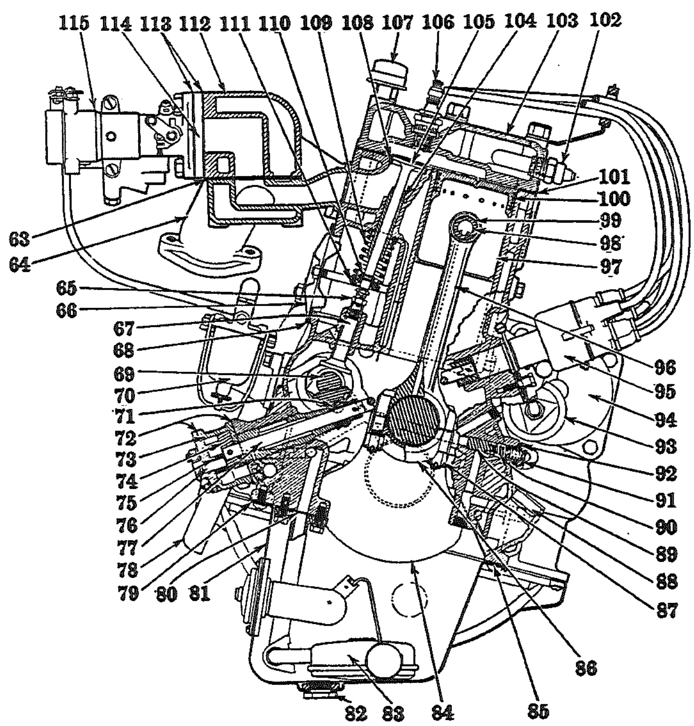


Fig. 6, HD-232A Engine

No.	Description
63.	Intake to exhaust manifold gasket.
64.	Exhaust manifold.
65.	Valve tappet adjusting screw.
66.	Valve tappet cover.
67.	Valve tappet.
68.	Valve tappet cover gasket.
69.	Camshaft.
70.	Fuel pump.
71.	Oil pump drive gear.
72.	Oil pump gasket.
73.	Oil pump body.
74.	Oil pump rotor.
75.	Oil pump pinion.
76.	Oil pump pinion pin.
77.	Oil pump drive shaft.
78.	Cylinder block ventilator.
79.	Oil pan gasket.
80.	Oil float support gasket.
81.	Oil pan.
82.	Drain plug.
83.	Oil screen and float.
84.	Crankshaft.
85.	Oil pan gasket.
86.	Connecting-rod bearing cap.
87.	Connecting-rod bolt nut.
88.	Oil filler.
89.	Oil pressure regulator piston.
90.	Oil pressure regulator spring.
91.	Oil pressure regulator nut.
92.	Oil pressure regulator gasket.
93.	Vacuum spark control.
94.	Starting motor.
95.	Ignition distributor.
96.	Connecting rod.
97.	Piston.
98.	Piston pin.
99.	Piston pin bushing.
100.	Piston rings.
101.	Cylinder head gasket.
102.	Water temperature indicator sender.
103.	Cylinder head.
104.	Valve guide.
105.	Exhaust valve.
106.	Spark plug.
107.	Breather.
108.	Valve seat insert.
109.	Valve spring.
110.	Valve spring lock.
111.	Valve spring retainer.
112.	Intake manifold.
113.	Carburetor gasket.
114.	Insulator.
115.	Carburetor.

Best Results from Reconditioned Engines

For best results when an engine is reconditioned, and particularly when new pistons are installed, the following items should be observed:

1. Lubricating-oil compartments and passages must be thoroughly cleaned of sludge, dirt and abrasive material, and the oil filter placed in efficient operating condition. Working parts should be lubricated well with clean oil at time of assembly.
2. Air cleaner must be placed in efficient operating condition and all connections between cleaner and carburetor must be air-tight.
3. All engine gaskets must be tight.
4. See that engine is free, start it, and let run idle, beginning at slow speed and gradually increasing to maximum idling governed speed. Tighten cylinder head and readjust valve clearance after engine is warmed up. During the break-in period it is recommended that a good quality light oil (S.A.E. 10 or 20) be used, care being taken to inspect oil level frequently and to maintain it at proper height.

Cylinder Block

When reconditioning cylinder bores it is important that they be held to the specified limits. Bore sizes should be checked with an accurate gauge.

After honing, cylinder bores should be thoroughly cleaned to remove all abrasive material (See "Cleaning of Engines").

Pistons

Pistons are cast iron and should be fitted to specified clearances, using a ⅜" wide ribbon with from 5 to 12 pounds tension on a scale. Under no circumstances should tension on scale exceed 12 pounds. **NOTE:** 8 pounds tension for HD-232 and HD-232A engines. Insert ribbon between piston and cylinder 90° from piston pin hole and in line with thrust face of piston.

A feeler gauge set and tension scale combination is available which if used properly will facilitate the fitting of pistons. This tool is carried under S.E. 1007.

Piston Rings

HD-213 and HD-213A pistons have three plain compression and one No. 85 oil control ring with the oil control ring in the bottom groove.

HD-232 and HD-232A pistons have one plain and two X-70 compression rings and one X-90 oil control ring. Service Bulletin 48-37 calls particular attention to the importance of correctly installing the X-90 oil control ring.

Examine cylinder bores before installing new pistons and rings. If necessary, the bores should be reconditioned especially if they are out of round or tapered or have a ridge at the top. If the ridge is not removed when new piston rings are installed trouble may be experienced with the top rings striking. It is always the best policy to recondition cylinder bores before installing new pistons or rings.

If new rings are being installed on old pistons the ring grooves should be thoroughly cleaned out to remove all carbon.

The ring clearance in the groove is checked by rolling the ring around the piston and checking the clearance between ring and ring land with a feeler gauge of the specified thickness.

New rings should be fitted into the cylinders in which they are to be used before assembling on pistons. Put piston in cylinder then insert piston ring, pushing it against head of piston to square it with cylinder. This check should be made with piston near bottom of cylinder where there usually is the minimum wear. Measure ring gap with thickness gauge. Another method of checking ring gap is to insert piston ring in cylinder, then use a piston to force ring down into lower portion of cylinder. This squares piston ring with cylinder. Then piston can be removed and the ring gap checked with the proper thickness gauge.

Install piston rings with the gaps staggered around the circumference of the piston.

Care should be exercised when removing or installing piston rings to prevent distortion. Suitable tools should be used during this operation.

X-90 Piston Ring

The installation of the X-90 oil control ring differs somewhat from that of the conventional type oil ring. This oil ring has a spring expander that is assembled between the piston and ring. Detailed installation instructions follow:

1. Place expander in oil ring groove with the number that is stamped on it, right side up. Joint of expander should be placed at right angles to the piston pin on valve side of engine.
2. Carefully slip oil control ring over piston and insert in oil ring groove. The ring joint must be opposite the expander joint so the expander number will be visible as illustrated at "A" in Fig. 7.

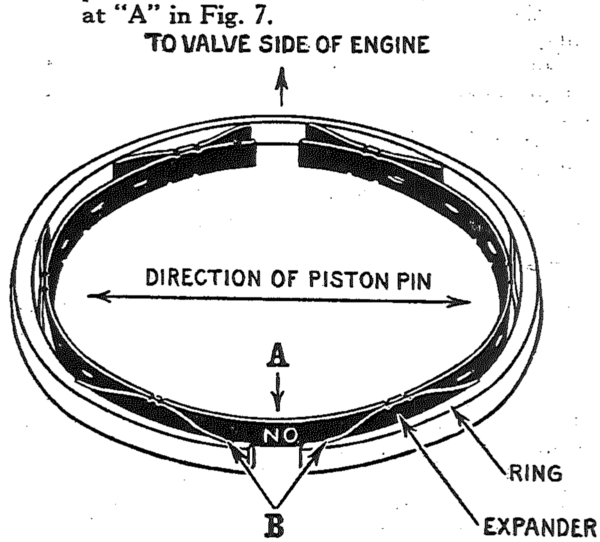


Fig. 7, X-90 Ring

3. Compress ring with fingers so that ends of expander springs, on each side of the number, snap into the notches next to the ring joint as shown at "B" in Fig. 7
4. When installing piston in cylinder, compress rings carefully so that expander springs will not slip out of the notches and into the ring joint. Do not release ring compressor once tension has been applied and make sure that the piston is inserted in the cylinder with the slots of the expander and ring located as shown.

Piston Pins

Clearances specified for fitting pins in rods and pistons are based on a room temperature of 70° F. The general practice is to select pins that can be installed by pushing with palm of hand, first making sure that pin and bore are smooth and clean.

Piston pins float in rod and piston and are held in piston by retainer rings that fit into grooves in piston pin bosses.

Piston pin bushing should be burnished and reamed to give clearances specified. Make sure that oil hole in rod indexes with oil hole in bushing.

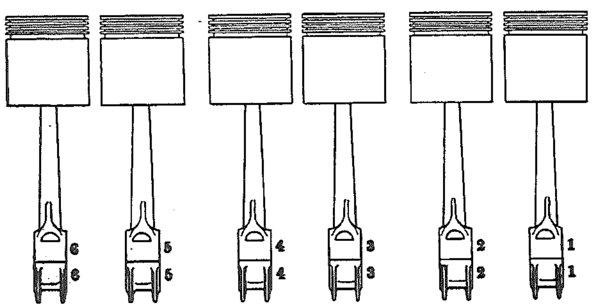


Fig. 8

Connecting Rods

Cylinder numbers are stamped on a flat space on rod and cap and rods should always be assembled with these numbers toward camshaft side of crankcase.

Connecting-rod bearings are installed flush with the face of connecting rod and cap on both sides.

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run thru the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

When replacing connecting-rod bearings be sure that rods and caps as well as backs of bearing shells are clean and smooth and **free from oil.** This is of extreme importance as bearings will not seat perfectly if there is any dirt or oil between bearing shells and rods or caps. Wash rods and caps in a good cleaning solution and **dry thoroughly.** This will remove oil as well as dirt and insure proper contact between backs of bearing shells and rods.

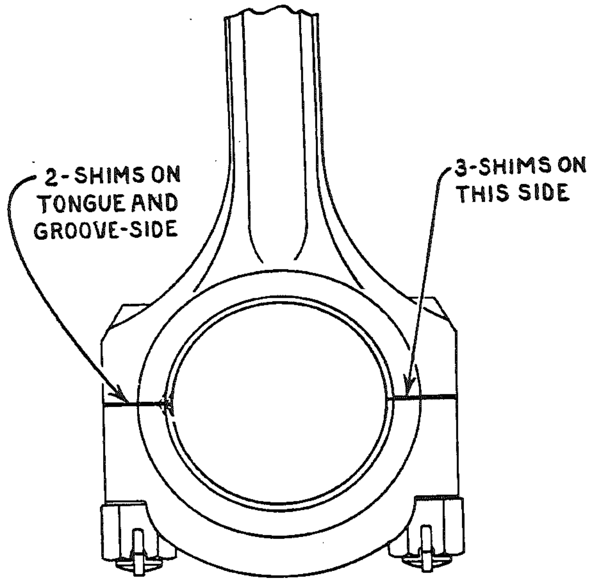


Fig. 9

Connecting-rod bearing shims are assembled as shown in Fig. 9; three .003″ shims opposite tongue and groove side and two .003″ shims on tongue and groove side. If bearing wear cannot be adjusted to specified clearances by removal of shims, new bearing must be installed. Never file connecting rod or cap.

Be sure that shims are properly aligned so they do not touch the bearing shell when cap half is tightened down. It is particularly important that the shims do not get between the small tongues in the bearings and the grooves in rod and cap. When assembling the cap the shims can easily be lined up by using two fingers.

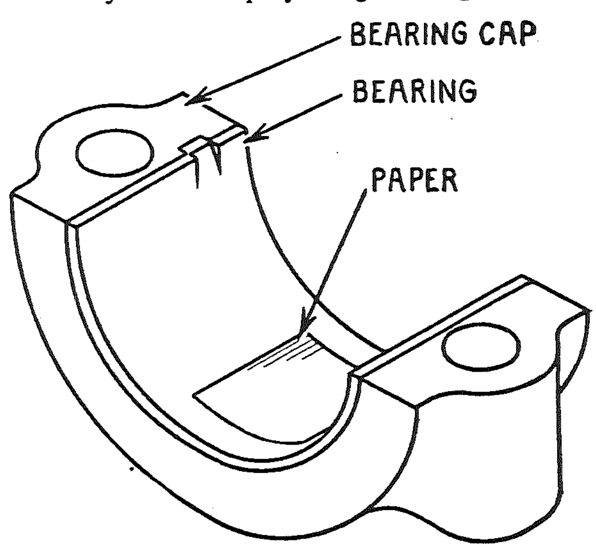


Fig. 10

When assembling new connecting-rod bearings always start out with the specified quantity of shims in place. Then if bearing is loose, remove shims as required. Never build up clearance by adding shims, but reduce clearance by removing shims. This will prevent damaging bearing shells, by crushing, due to insufficient clearance.

The usual practice is to remove shims until bearing is tight, then replace one shim on each side, which should give the proper clearance. A further check can be made using a piece of paper .0015″ to .0025″ thick, approximately 1″ square. Place the piece of paper between bearing and crankshaft and tighten cap. This thickness of paper should lock the bearing.

Connecting rod and piston assembly is removed thru top of cylinder block.

Main Bearings

Numbers stamped on bearing cap bosses indicate position for installation. Numbers should face camshaft side of crankcase. The small tongues on main bearings should fit snugly into grooves in crankcase and main bearing caps.

Two shims each .003″ thick, are used on each side of main bearing.

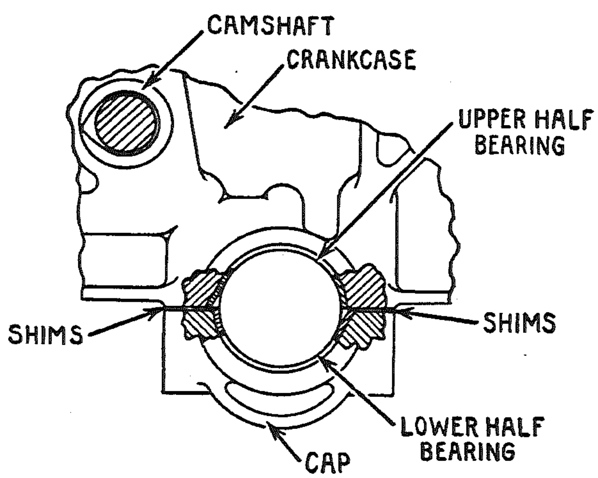


Fig. 11

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run thru the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

It is recommended that a complete set of main bearings be used when replacement is made.

Main bearings can be replaced without removing the crankshaft, although it will be necessary to remove timing chain so that crankshaft can be dropped. All main bearing caps should be loosened slightly.

Remove No. 1 bearing cap and by lightly tapping the plain edge of the upper half bearing, and in some cases turning the crankshaft in the direction of rotation, the bearing shell is easily removed. Installation is accomplished in reverse manner.

The balance of main bearings are removed and installed in the same manner.

As mentioned under "Connecting Rods" do not add shims after bearing shells have been compressed. Instead, use the specified quantity of shims and remove as required to obtain the proper clearance. This prevents damaging the shells by crushing.

Be sure that the seats for the bearings as well as the backs of the bearing shells are clean and free from oil. A good contact is absolutely essential.

Camshaft Bearings

Camshaft bearings must be installed so oil hole indexes with oil supply hole in cylinder block. This is important to insure sufficient lubricant to bearings.

Bearings are line-reamed to size after installation in crankcase.

Vibration Dampener (HD-232 Engine)

This unit is attached to the rear of the fan drive pulley by six capscrews. Be sure the nuts and lockwashers on the capscrews are tight.

If necessary to remove the fan drive pulley and vibration dampener assembly the starting jaw nut should first be removed, then insert two long capscrews in the holes in pulley and use a puller to remove the assembly.

By unscrewing the nuts from the six capscrews the pulley and vibration dampener can be disassembled.

A locating dowel in the fan drive pulley insures correct reassembly in relation to the ignition timing notch which is on the outer rim of the vibration dampener. It is important that the pulley and vibration dampener be assembled correctly in order that the ignition timing notch will be in the proper position.

CAUTION: Do not wash the vibration dampener in kerosene or any other fluid that is injurious to rubber.

Do not permit this unit to become saturated with oil or grease, otherwise rapid deterioration of the rubber will result.

Vibration Dampener (HD-232A Engine)

The vibration dampener used on the HD-232A engine is similar in construction to that used on the HD-232 engine, the main difference being in the assembly to the water pump drive pulley.

This unit is assembled to the front of the water pump drive pulley by means of three cap screws and three fan shaft driving studs. See Fig. 23.

Removal from the pulley is accomplished by loosening the fan drive shaft spider cap screw and removing the driving stud nuts. Tap the spider to move it forward sufficiently to permit removal of the driving studs. Take out the three cap screws and remove the vibration dampener from the water pump drive pulley.

When reassembling, be sure to use new lockwashers under the driving studs and cap screws and also see that the driving stud nuts are secured with cotter pins. Tighten the fan drive shaft spider cap screw, first making sure that the key has been replaced.

CAUTION: Do not wash the vibration dampener in kerosene or any other fluid that is injurious to rubber.

Do not permit this unit to become saturated with oil or grease, otherwise rapid deterioration of the rubber will result.

Flywheel and Clutch Housing

Proper alignment of flywheel and clutch housing is of extreme importance.

To check alignment and make adjustments the following method should be employed:

1. Remove floor boards, disconnect pedals and propeller shaft.
2. Remove transmission and throw-out shaft, bearing and clutch.
3. Engine must be supported before removing these parts.
4. Attach indicator as shown and check bore "A." Flywheel and clutch housing is doweled to crankcase at "X" and when correctly aligned runout of bore "A" should not exceed .005″ total indicator reading.

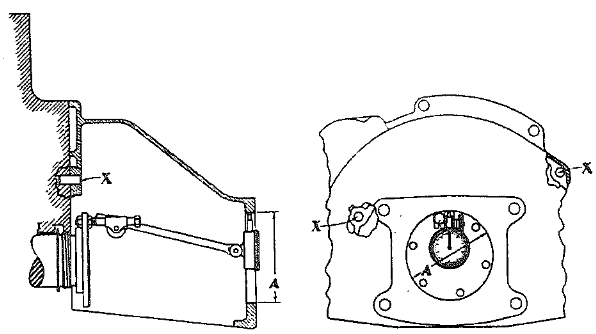


Fig. 12

5. If reading indicates misalignment beyond recommended limits, remove dowel pins and loosen housing attaching bolts sufficiently to permit movement by tapping lightly with a hammer.
6. Set indicator in position showing maximum runout and tap housing slightly to shift its position until indicator reading is ½ of maximum reading. Recheck runout by rotating crank. The resultant reading should approach .000″ or at most, less than .005″ runout.
7. Tighten attaching bolts and reindicate. Re-ream dowel holes, using an oversize reamer that will produce a .001″ to .002″ drive fit of an oversize dowel.
8. Install oversize dowels and reindicate. If these are not available, they can be made from a piece of drill rod the desired size.

Reconditioning Valves and Seats

Clean and polish valve stems and if warped or badly burned, install new valves.

If valve faces are pitted or grooved, reface in refacing machine before grinding. Valve seats should not be refaced unless absolutely necessary. If valve seat is not concentric with valve stem guide hole or if seat is too wide, then refacing is necessary. Valve face contact surface width should be 1/16″ to 3/32″.

After grinding, remove all traces of grinding compound. Check seating of valves by making a number of marks with a soft lead pencil around the valve seat, then insert valve and give ¼ turn. Remove valve and if all lines are broken the valve seat is satisfactory.

Valve Clearance Adjustment

Proper clearance between valve stems and valve tappet adjusting screws must be maintained in order to obtain satisfactory operation.

Before making an adjustment, run engine sufficiently to thoroughly warm it up. This is important. Engine should be run at least 15 minutes after water temperature has reached its normal point. If necessary, cover radiator.

Remove manifolds and valve spring cover and adjust valves while engine is hot.

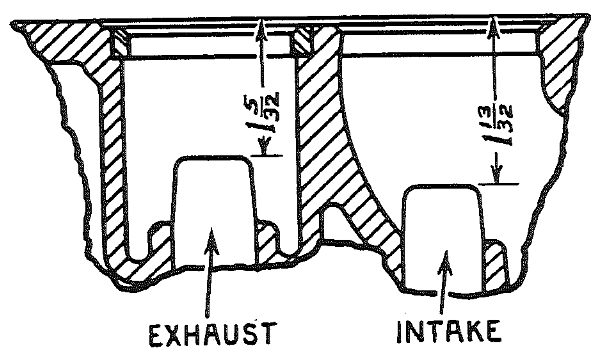


Fig. 13

Valve Stem Guides

Press valve stem guides in from top of cylinder block to dimension shown with tapered end up.

After installation, ream valve guides to .3745″–.3755″. Reaming should be done carefully and slowly—do not force reamer. A smooth finish is essential as the amount of bearing surface between valve stem and guide is dependent upon finish of guide bore.

After reaming valve guides, check valve seats and if runout exceeds .002″ to .003″, seats should be refaced. When refacing valve seats the tool must be piloted in valve guide.

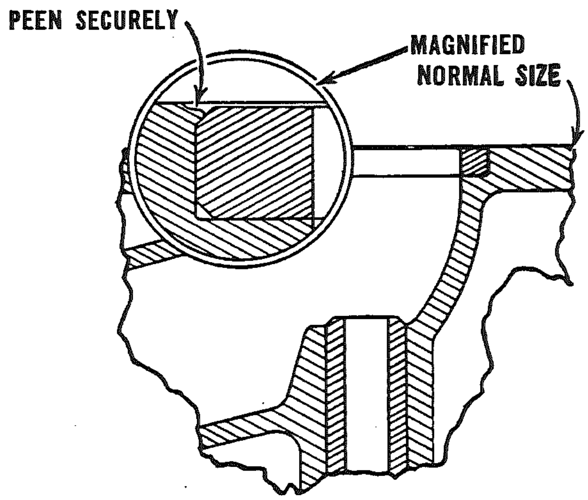


Fig. 14

Valve-Seat Inserts

Necessity for replacing valve-seat inserts should be very rare; however, if a replacement is made it is important that new inserts be peened securely in place. A dull pointed chisel, ¼" wide, is used to peen cylinder block metal over outer edge of valve-seat insert.

Valve-seat inserts supplied for service are .010" larger diameter than those used in production, which permits a good tight fit in cylinder block. Letter "M" is stamped on top of insert. Install with this side out.

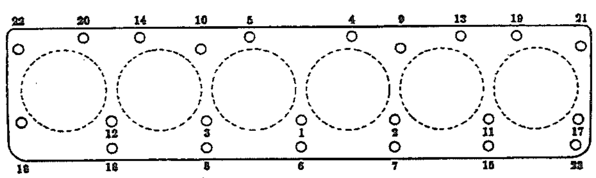


Fig. 15

Cylinder Head

Fig. 15 illustrates correct order in which cylinder head should be tightened. This is important to assure a good seal between cylinder head, cylinder head gasket and cylinder block and will also avoid strains in cylinder head casting.

When cylinder head has been removed it is a good plan to install a new head gasket. In some cases the old gasket may be entirely satisfactory, however, to avoid the possibility of water or gas leakage a new gasket is recommended.

To guard against compression or water leaks, coat both sides of the cylinder head gasket with a suitable, clear sealing compound, such as shellac. Let gasket dry until the coating becomes tacky, then install with smooth side up, as stamped, first making sure that block and head are smooth and clean. Any foreign matter between gasket and head or block will result in early gasket failure.

After cylinder head has been tightened, run engine for a few minutes, and retighten.

Valve Tappets and Guides

Valve tappet guides are integral with crankcase. Camshaft must be removed to disassemble valve tappets.

Valve Springs

Valve springs should be square in their seats and also should be checked with Valve Spring Tester S.E. 809 to determine if they meet specifications. This should be done at every valve grind and replacement made when necessary.

Install valve springs with close coiled end to cylinder block.

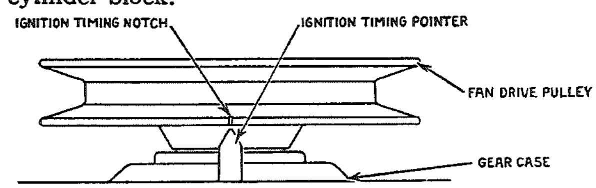


Fig. 16

Ignition Timing Marks

On all HD series engines, with the exception of Model HD-232A, an ignition timing indicator or pointer is attached to the front gear cover, just above the fan drive pulley. See Fig. 16. This pointer, when opposite the notch in fan drive pulley, or vibration dampener, indicates the correct ignition timing position. There are no timing marks on the flywheels of engines having the pointer on the front gear cover.

The timing marks are on the flywheel of the HD-232A engine as illustrated in Fig. 17. See "Electrical System" for ignition timing data.

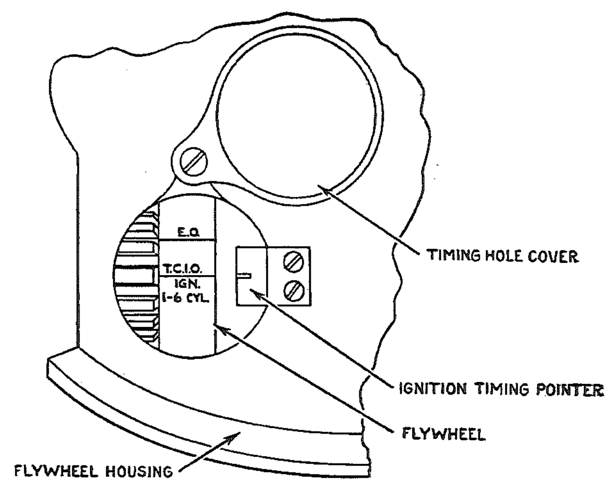


Fig. 17

Timing Chain and Sprockets

HD series camshaft is chain driven.

Sprockets should be removed or installed, using a puller or pusher tool.

They must be installed so that the crankshaft and camshaft are in correct relation to each other.

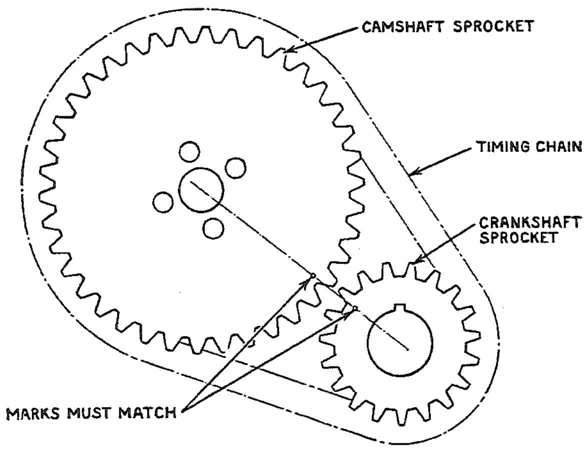


Fig. 18

The sprockets are marked and should be installed so that the marks on camshaft and crankshaft sprockets match. Engine timing diagram is shown in Fig. 19.

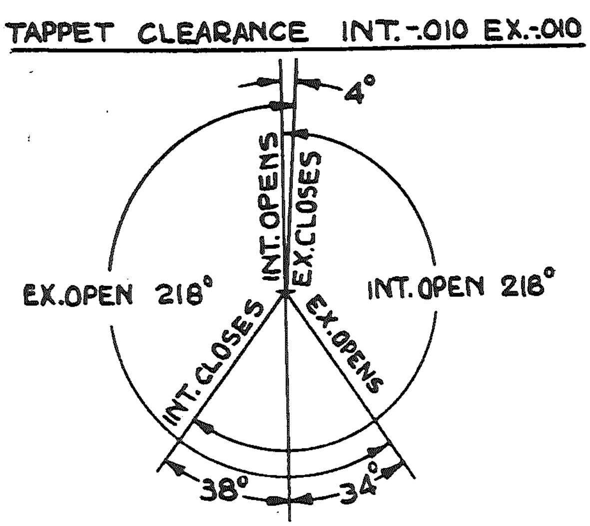


Fig. 19

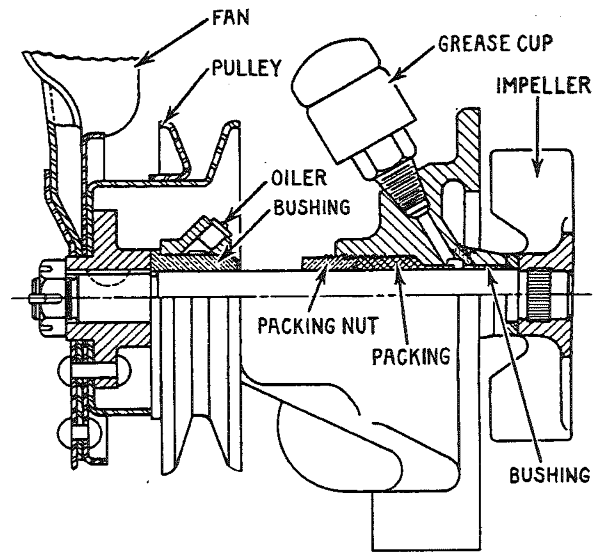


Fig. 20

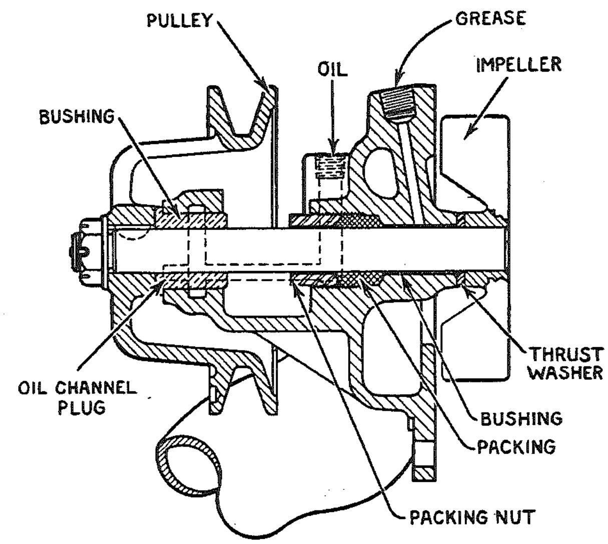


Fig. 21

Water Pumps

Water pump used on HD-213, HD-213A and HD-232 engines is illustrated by Fig. 20. The water pump used on HD-232A engine is shown in Fig. 21.

Disassembly

Special tools have been made available for servicing these water pumps and if these tools are used correctly the pumps can easily be reconditioned.

1. After removing pump assembly from engine, remove fan pulley with a suitable puller. Do not attempt to pry or knock pulley off of impeller shaft. **Always use a puller.**
2. Remove packing nut and packing and slip impeller shaft out of water pump body.
3. If bushings are to be replaced press out the **rear** (split) bushing first. Place water pump body on bushing support plate (SE-968) and press out the bushing, using SE-963 arbor.
4. After removing the rear bushing, place the **small** washer (included with the tools) on arbor and press out **front** (flanged) bushing.
5. Check impeller shaft for excessive wear and examine thrust washer and replace parts that do not meet specifications.

Reassembly

1. The **front** bushing is of the porous type and should be soaked in light (SAE-10) engine oil before assembly. Note that there is no oil hole in this bushing as it will absorb oil from the oil cup and channel in the water pump body.

2. Place water pump body on support plate, SE-968, then using arbor SE-963 with the **large** washer, press in the **front** (flanged) bushing.
3. Reverse position of water pump body, placing the **front** bushing on support plate SE-968, and press in the **rear** (split) bushing. No washers are used on the arbor when installing the rear bushing. **Caution:** The oil hole in this bushing must line up with the oil channel in water pump body.
4. The next operation is to burnish the **rear** (split) bushing. Place water pump body on support plate SE-968 with **rear** bushing to bottom and burnish with bar SE-964. Use lard oil on the burnishing bar. The **front** (flanged) bushing has already been properly sized by arbor SE-963 and therefore requires no burnishing or reaming.
5. Clean all parts thoroughly, then complete the pump assembly by inserting impeller shaft assembly with thrust washer, repacking and tightening packing nut. Packing nut should be tightened just enough to stop leakage with engine standing still. If packing is compressed excessively, a scored shaft will result. Packing nut wrench SE-969 is available for this purpose.
6. Install pulley with key and adjust shaft end play with fan hub nut. Lock nut with new cotter pin.
7. Be sure that water pump assembly is thoroughly lubricated as recommended in "Lubrication Section."

Fan Belt Adjustment

Fan belt should run under proper tension. Adjustment is made by loosening generator mounting screws and generator brace capscrew, after which generator can be moved in or out as required.

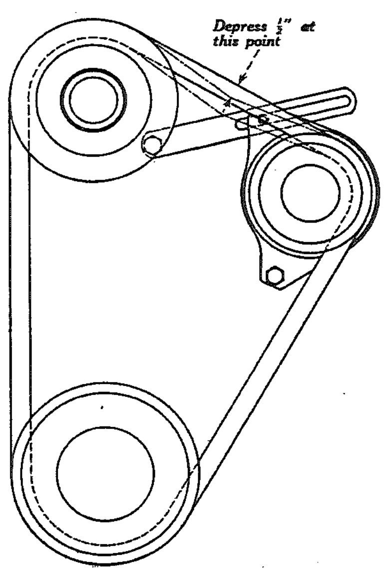


Fig. 22

Proper tension is obtained when belt can be depressed approximately ½" as shown in Fig. 22.

After adjustment has been made be sure to tighten all capscrews.

Fan

The fan and drive of all HD series engines, excepting HD-232A, is of the conventional type, the fan blade assembly being attached to the water pump and driven by the water pump drive belt.

On the HD-232A engine the fan is driven by a drive shaft that is connected to the water pump drive pulley on the crankshaft. The assembly of the fan and driving mechanism is illustrated in Fig. 23.

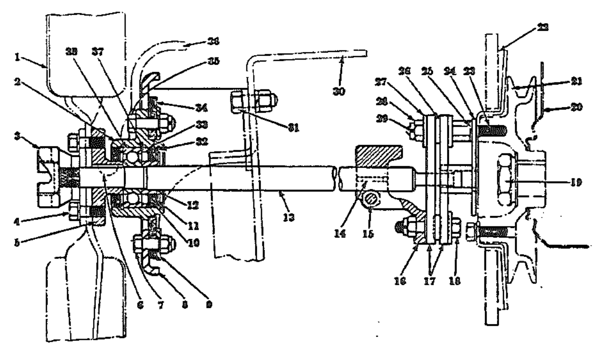


Fig. 23

No.	Description
1.	Fan assembly.
2.	Fan bearing housing.
3.	Starting crank nut.
4.	Cap screw.
5.	Fan hub.
6.	Key.
7.	Fan bearing housing (to mounting bracket) cap screw.
8.	Fan drive mounting bracket.
9.	Fan drive mounting disc washer.
10.	Fan bearing grease retainer felt.
11.	Fan bearing grease retainer cup.
12.	Fan drive shaft collar.
13.	Fan drive shaft.
14.	Key.
15.	Cap screw.
16.	Fan drive shaft spider.
17.	Fan drive shaft disc.
18.	Fan drive shaft spider (to disc) cap screw.
19.	Crankshaft nut.
20.	Engine front cover.
21.	Drive pulley
22.	Vibration dampener.
23.	Fan shaft driving stud.
24.	Fan drive shaft pilot plate assembly.
25.	Lock washer.
26.	Fan drive disc spacer.
27.	Fan drive shaft disc washer.
28.	Castle nut.
29.	Cotter pin.
30.	Crossmember.
31.	Cap screw.
32.	Fan bearing snap ring.
33.	Fan bearing grease retainer plate.
34.	Fan drive mounting disc.
35.	Fan drive mounting bracket cap screw.
36.	Fan bearing grease tube.
37.	Fan drive shaft bearing spacer.
38.	Fan bearing.

Disassembly

1. It is recommended that the complete drive assembly be removed from the engine before attempting to dismantle this unit.
2. Remove starting crank nut (3) and take off the fan and hub assembly (1-5), using a suitable puller.
3. The fan bearing housing assembly (2) can then be slipped off the drive shaft (13) and the bearing, seals, retainers, snap rings, etc., removed from the housing.

Reassembly

1. Examine all parts and replace those showing evidence of excessive wear.
2. Fig. 23 clearly shows the assembly of all parts and no difficulty should be experienced in installing them correctly.
3. The method of lubricating the fan bearing is illustrated in Fig. 24. See "Lubrication Group" for type of lubricant.

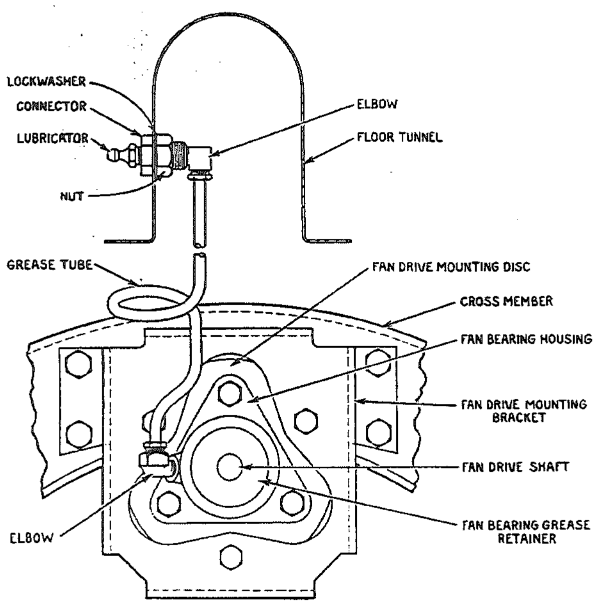


Fig. 24

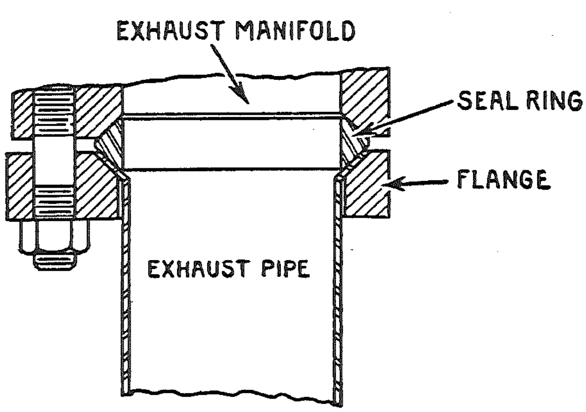


Fig. 25

Exhaust Pipe Seal Ring

The assembly of the exhaust pipe seal ring is shown in Fig. 25.

Be sure that seal ring seats squarely against exhaust manifold, exhaust pipe and flange and tighten stud nuts evenly in order to prevent distortion of exhaust pipe and possible breakage of exhaust pipe flange.

If the seal ring is assembled properly no exhaust leakage will occur.

Oil Seals and Gaskets

Correct assembly of oil seals, retainers and gaskets is of extreme importance in preventing oil leaks.

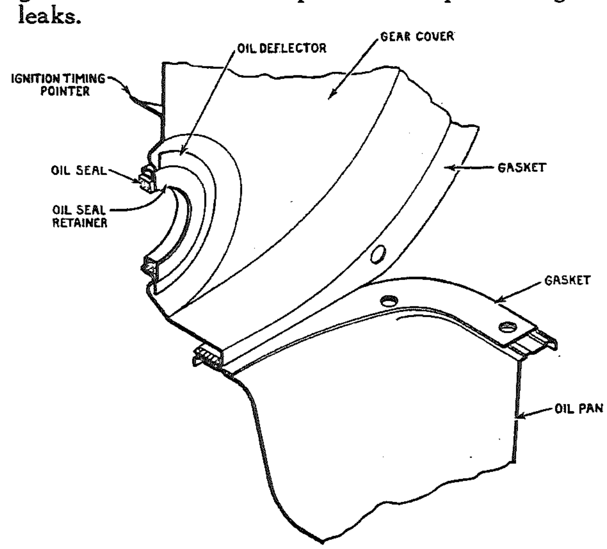


Fig. 26

Fig. 26 illustrates the assembly of the crankshaft front seal, retainers and oil pan gaskets and Fig. 27 illustrates the rear assembly.

NOTE: There is no ignition timing pointer on the front gear cover of HD-232A engines. Timing marks are on flywheel.

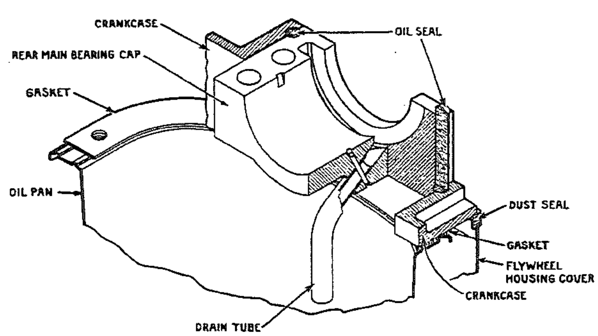


Fig. 27

Make sure when replacing seals or gaskets that no foreign matter is adhering to the surfaces, which would prevent proper contact.

Dip felt seals in oil before assembly.

Flywheel and Crankshaft Assembly

The flywheel is assembled to the crankshaft with four capscrews and two tapered dowels.

All holes in the flange of new crankshafts or flywheels are straight, therefore it is necessary to taper ream the two large holes that are directly opposite each other, using reamer tool S.E. 860, in order to permit the installation of the tapered dowels.

The two holes to be reamed should match on flywheel and crankshaft flange. Be sure nuts on tapered dowels as well as on the capscrews are drawn up tight.

Pack hole in end of crankshaft with heavy cup grease.

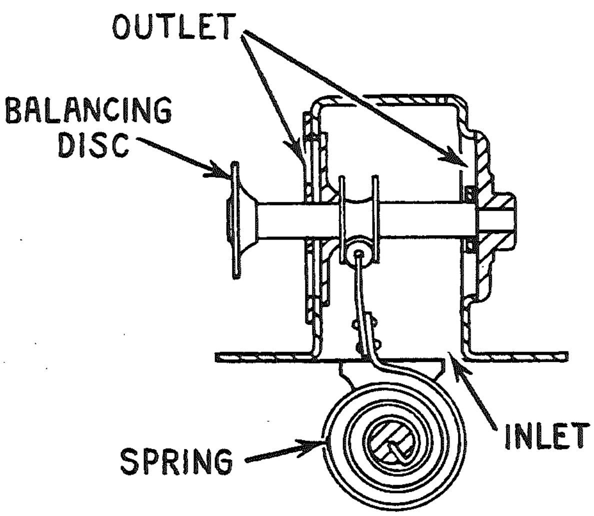


Fig. 28, HD-213, HD-213A, HD-232

Water Thermostat

The water thermostat is a balanced valve type having two outlets which are controlled by two valve discs mounted on a common shaft and incorporating one external balancing disc to prevent water pressure from disturbing the true temperature control during the opening and closing cycles.

This thermostat is nonadjustable and is set to start to open at 145 to 150° F. The use of the thermostat shortens the warm-up period and reduces to a minimum crankcase condensation and dilution.

The operation of the thermostat can be checked by placing it in still water and heating the water. A reliable thermometer should be used and at a temperature of approximately 145 to 150° F. the valves should start to open and be fully opened (¼" approx.) at around 200 to 205° F. This applies only to a still water test.

If the thermostat does not function as outlined above a new one should be installed.

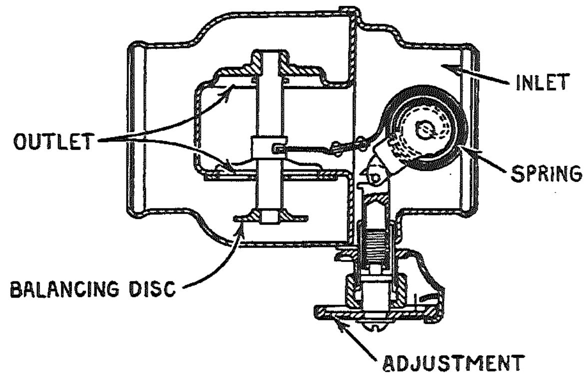


Fig. 29, HD-232A

Water Thermostat

The water thermostat used with the HD-232A engine operates on the same general principle as that used in the other HD series engines. This thermostat is adjustable, with a range of 125 to 180°F; however, the minimum recommended temperature is 150°F. The ideal condition for winter operation is the highest temperature obtainable without boiling of anti-freeze solutions.

Engine Mounting

Figs. 30 and 31 illustrate the front and rear engine mounting for D-2 and D-15; Figs. 32 and 33 illustrate mounting for D-30, DS-30, D-30B, DS-30B.

Front and rear mountings for D-300 and DS-300 are shown in Fig. 34.

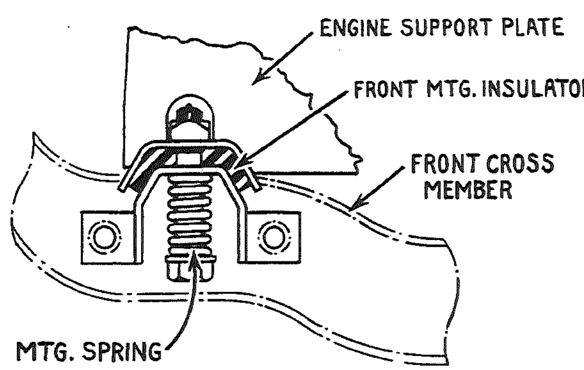


Fig. 30, D-2, D-15

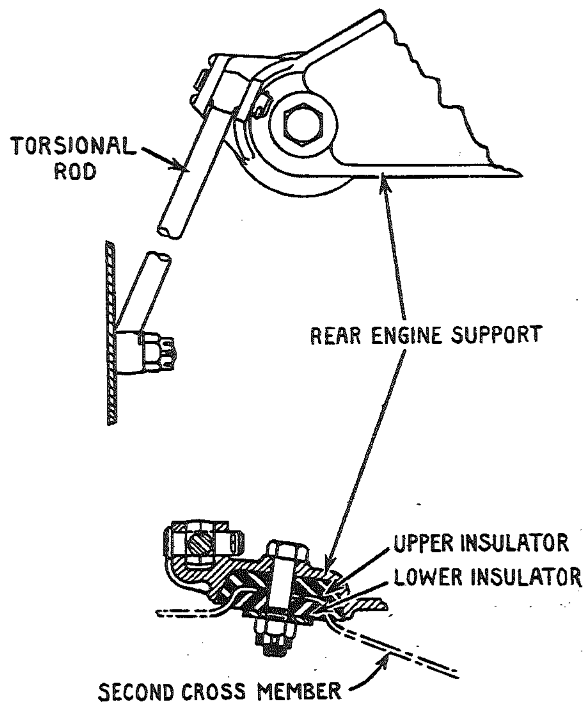


Fig. 31, D-2, D-15

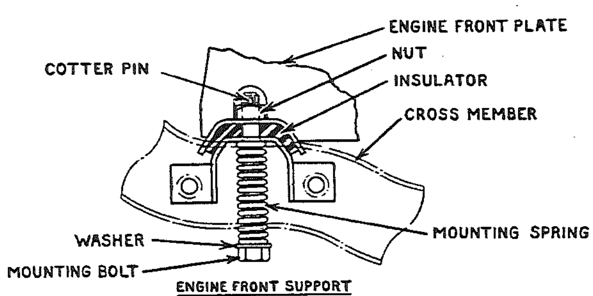


Fig. 32, D-30, DS-30, D-30B, DS-30B, D-186T, DS-186T

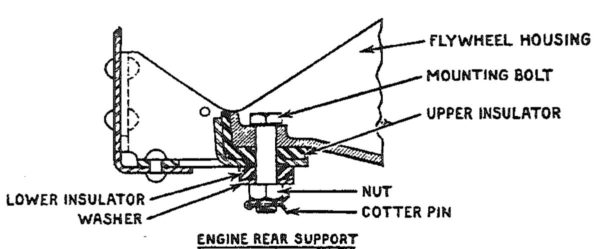


Fig. 33, D-30, DS-30, D-30B, DS-30B, D-186T, DS-186T

Check mounting screws occasionally to be sure the mountings are not loose and that the capscrews are secured with cotter pins.

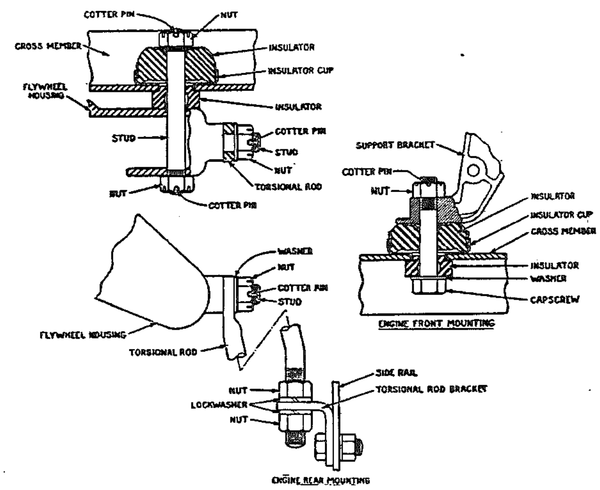


Fig. 34, D-300, DS-300

Oil Pump Installation

If oil pump has been removed, the ignition distributor must also be removed before reinstalling the pump. This is due to the fact that the slot in the end of the oil pump drive shaft is off center and this slot must match the tang on the ignition distributor shaft. If an attempt is made to install the oil pump assembly without first removing the distributor it will be impossible to align the slot and tang, with the result that the pump will be damaged when the pump mounting bolts are tightened.

After installing the oil pump assembly it is an easy matter to align the ignition distributor and oil pump shafts.

NOTE: When oil pump has been removed from the engine, it will be necessary to retime the ignition.

Oil Consumption

High oil consumption is usually attributed to worn piston rings and cylinders; however, in many cases it will be found that the main, rod or camshaft bearings have worn, permitting excessive spray off of oil, which results in overlubrication of cylinder walls.

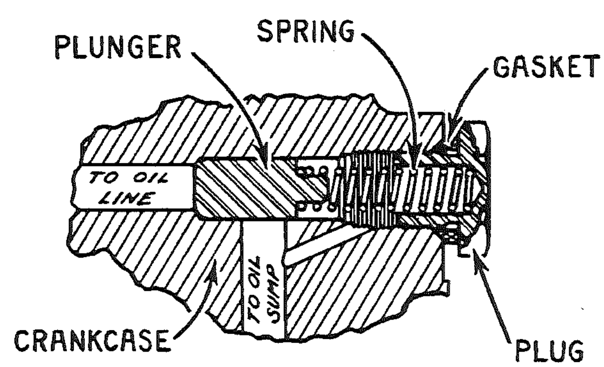


Fig. 35

It is recommended that the bearings be given an oil pressure test, as outlined in following paragraphs, before disturbing the piston and ring assembly.

Oil pressure is controlled by the pressure valve spring located in the oil pressure regulator. Oil pressure should be checked when engine is hot and oil is warm.

When low oil pressure is encountered, a systematic and thorough investigation is necessary in order to determine the cause.

The following are the principal causes for this condition and it is recommended that these be thoroughly checked in the order named, which in all probability will result in the definite cause being determined.

Oil Supply

Excessively diluted condition or insufficient amount in crankcase.

Oil Pressure Gauge

Improper registration of gauge.
Loose connections.

Oil Pressure Regulator or Oil Filter (When Used)

Clogged condition of filter element.
Pressure valve not holding.
Weak pressure valve spring. Check by installing spacers in back of spring. Free length of spring should be 1⅜″.

Oil Pump

Clogged condition of screen.
Gear cover gasket faulty.
Excessive clearance between gears and cover plate.
Specified gasket thickness, .004″ to .006″.
Worn condition of gears, allowing loose mesh.

Main, Connecting Rod and Camshaft Bearings

Excessive running or end clearances.
Out of round condition of bearings or journals.
Imperfect bearings—badly pitted or chipped.

In order to check main, connecting rod and camshaft bearing clearances to determine if they are excessive and the cause of low oil pressure, the following equipment and method has been found effective.

A test tank can be made from a piece of 4″ pipe approximately 24″ long. Weld a plate or base on one end and thread the other end to take a cap. Drill and tap the cap to take a tee connection and in one side insert a tire valve and in the other a pressure gauge registering to at least 75 pounds.

Drill and tap a hole near the bottom of the pipe so that a valve can be installed and to the valve attach a flexible hose.

This test fixture can be made from a small tank, if one is available, or any other suitable material.

The tank should not be more than half full of S.A.E. 10 or a heavier grade of heated oil and in the case of the tank described above, 2 or 3 quarts will be sufficient. Tank can be filled by removing tee connection.

The flexible hose should be connected to the oil pressure connection in the engine.

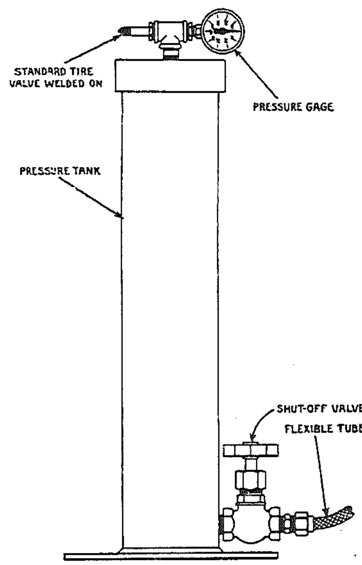


Fig. 36, Test Tank

Apply air pressure to about 50 pounds then open valve in bottom so that oil will be forced into oil channels and bearings. Inspect for excessive leakage and spray off, which denotes excessive clearance and likewise pressure loss.

If oil filter is used, remove filtering element and clean out base so that dirt collected in filter will not be forced into oil channels of engine. The filter element should be left out when making this test.

Breathers

Two-cup type breathers, filled with crimped copper wire to prevent any possibility of dirt entering, are installed in the cylinder head. An opening, thru the head and block, into the valve spring compartment permits gasoline and water vapors to escape, thereby eliminating condensation and corrosion of valve springs.

A breather pipe at the rear end of cylinder block permits the escape of these vapors from the crankcase.

Cleaning of Engines

The importance of having an engine, or any other unit in the truck, clean and free from dirt, sludge, abrasives, etc., cannot be too strongly stressed. While every effort is made by the manufacturer to prevent dirt from entering an engine or other unit, nevertheless a certain amount will possibly accumulate after the job has been in service for a period of time. For this reason it is recommended that whenever any work is being done, the parts removed be thoroughly cleaned before they are reassembled.

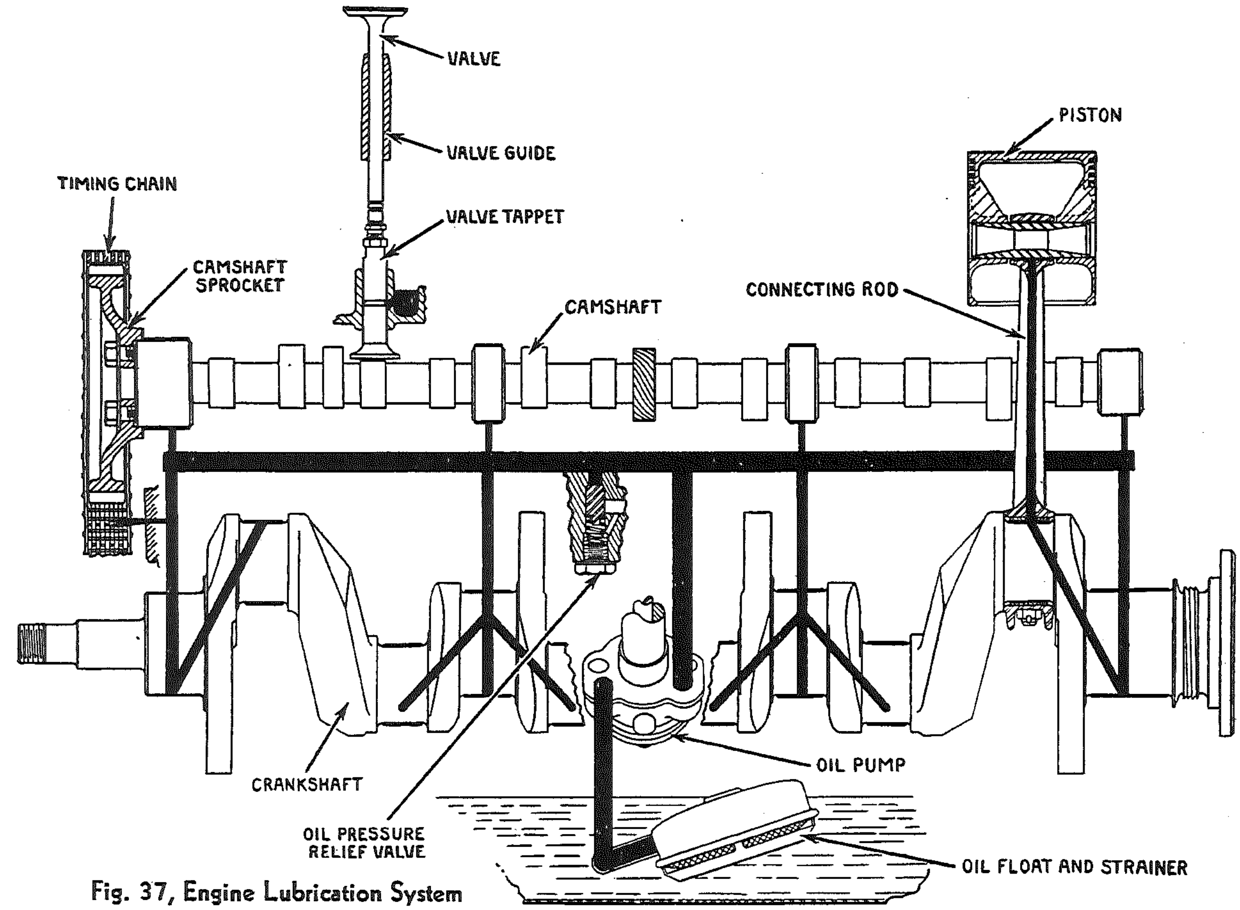


Fig. 37, Engine Lubrication System

The entire cylinder block casting should be thoroughly washed with a strong cleaning solution which will remove dirt, sludge and carbon formations that may have accumulated. If Stoddard Solvent or kerosene is used, wash again, using hot soapy water and rinse with clear water under pressure. Dry thoroughly and coat with light oil to prevent rusting. Particular attention should be paid to any recesses in the cylinder block and crankcase where an accumulation of dirt, sludge or carbon might be found.

If the cylinder block is not thoroughly cleaned before reassembling there will be the possibility of dirt and carbon jarring loose. when engine is being run-in. . This accumulation will be circulated thru the oiling system with the result that bearings, crankshaft, camshaft, pistons, valve stems, etc., will be damaged.

It is recommended that all pipe plugs be removed from the drilled oil lines in cylinder block. A good way to clean out the drilled oil lines is by using a long handled rifle barrel brush. This type of brush will run thru the main drilled oil line in the side of the cylinder block.

Cylinder blocks should be immersed in a large cleaning tank and if such equipment is not available at the Branch this work should be sent to a reputable concern that specializes in cleaning such parts.

After cleaning, the entire casting should be thoroughly dried, especially the drilled oil lines and all finished surfaces should be lubrciated to prevent rust formation.

The oil filter should be thoroughly cleaned out, removing any accumulation of sludge and dirt from the sump in the base. Replace filtering element if necessary.

It is a good policy to disassemble and thoroughly clean all parts of the oil pump. This will permit checking fits and enable the mechanics to determine the parts needing replacement.

Fuel pump should be thoroughly cleaned out, especially the small breather located in the body. This breather can be removed and flushed around in a cleaning fluid which will remove all dirt. If examination reveals excessive dirt, disassemble fuel pump and clean all parts.

Oil in air cleaner should be changed every time crankcase is drained. Clean out air cleaner cup. Make sure all connections are tight so that dust and dirt cannot enter. See detailed instructions under "Air Cleaner."

Disassemble carburetor and clean out thoroughly. Do not run a wire thru jets as this will enlarge the holes, thereby disturbing the calibration, which will result in poor fuel economy and engine performance.

If an engine has been properly overhauled with all parts fitted to specified clearances and assembled properly and **all parts thoroughly cleaned,** its performance and life will be increased materially.

Engines—FAB-241, FAB-259

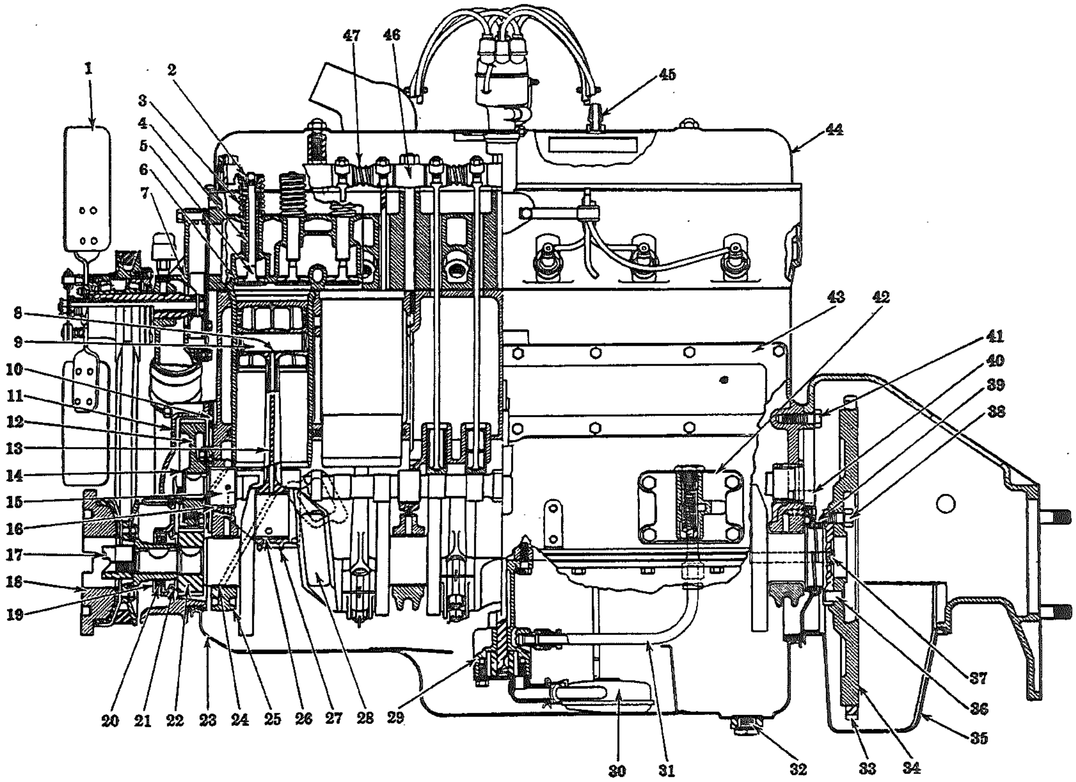


Fig. 1, FAB Engine

No.	Description
1.	Fan.
2.	Valve spring lock.
3.	Valve spring.
4.	Exhaust valve guide.
5.	Exhaust valve.
6.	Exhaust valve-seat insert.
7.	Water pump.
8.	Piston pin bushing.
9.	Piston pin.
10.	Gear cover plate.
11.	Gear cover.
12.	Camshaft gear.
13.	Connecting rod
14.	Camshaft gear lock.
15.	Camshaft.
16.	Camshaft bushing.
17.	Starting crank jaw nut.
18.	Vibration dampener.
19.	Felt retainer.
20.	Felt seal.
21.	Oil slinger.
22.	Crankshaft gear.
23.	Oil pan.

No.	Description
24.	Main bearing.
25.	Main bearing cap.
26.	Connecting-rod bearing.
27.	Connecting-rod bearing cap.
28.	Crankshaft.
29.	Oil pump.
30.	Oil screen and float.
31.	Oil line.
32.	Drain plug.
33.	Flywheel ring gear.
34.	Flywheel.
35.	Flywheel cover.
36.	Flywheel to crankshaft dowel.
37.	Clutch pilot bearing oil wick.
38.	Flywheel capscrew.
39.	Crankshaft rear oil seal retainer.
40.	Flywheel and clutch housing dowel.
41.	Flywheel and clutch housing capscrew.
42.	Oil pressure regulator.
43.	Valve push rod cover.
44.	Valve cover.
45.	Valve cover to air cleaner breather fitting.
46.	Valve rocker arm shaft bracket.
47.	Valve rocker arm spring.

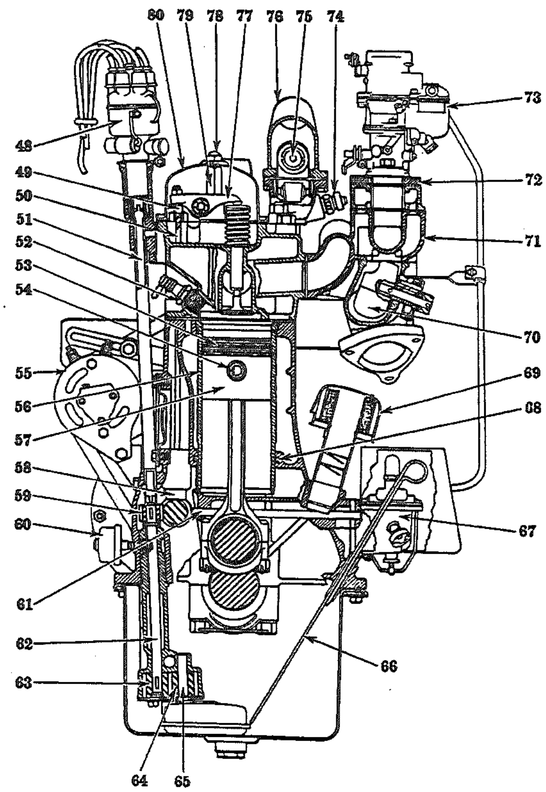


Fig. 2, FAB Engine

No. Description

48. Ignition distributor.
49. Valve tappet adjusting screw.
50. Valve push rod.
51. Distributor drive shaft.
52. Spark plug.
53. Piston rings.
54. Piston pin retainer.
55. Generator.
56. Cylinder sleeve.
57. Piston.
58. Valve tappet.
59. Oil pump and distributor drive gear.
60. Oil pressure gauge sender unit.
61. Fuel pump push rod.
62. Oil pump drive shaft.
63. Oil pump body gear.
64. Oil pump idler gear.
65. Oil pump idler gear shaft.
66. Oil gauge stick.
67. Fuel pump.
68. Cylinder sleeve rubber seal ring.
69. Oil filler and breather cap.
70. Manifold heat control valve.
71. Manifold.
72. Carburetor insulator.
73. Carburetor.
74. Temperature indicator sender unit.
75. Water outlet thermostat.
76. Water outlet connection.
77. Valve rocker arm.
78. Valve cover nut.
79. Valve cover spacer nut.
80. Valve cover.

Best Results from Reconditioned Engines

For best results when an engine is reconditioned, and particularly when new sleeves and pistons are installed, the following items should be observed:

1. Lubricating-oil compartments and passages must be thoroughly cleaned of sludge, dirt and abrasive material, and the oil filter placed in efficient operating condition. Working parts should be lubricated well with clean oil at time of assembly.
2. Air cleaner must be placed in efficient operating condition and all connections between cleaner and carburetor must be air-tight.
3. All engine gaskets must be tight.
4. See that engine is free, start it, and let run idle, beginning at slow speed and gradually increasing to maximum idling governed speed. Tighten cylinder head and re-adjust valve clearance after engine is warmed up. During the break-in period it is recommended that a good quality light oil (S.A.E. 10 or 20) be used, care being taken to inspect oil level frequently and to maintain it at proper height.

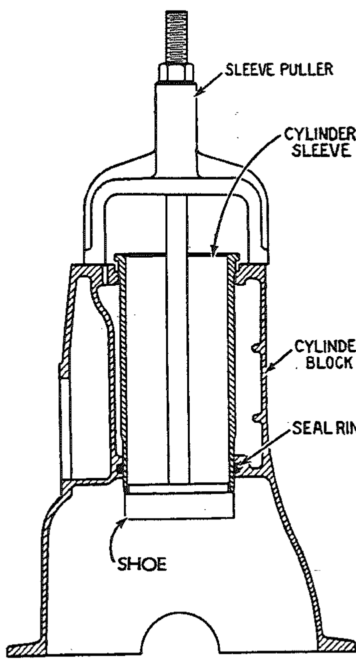


Fig. 3

Cylinder Sleeves

Cylinder sleeves can be removed, using Sleeve Puller S.E. 654 with the proper Sleeve Puller Head.

When replacing cylinder sleeve be sure there is no dirt under sleeve flange which would cause distortion. Before installing the rubber seal ring, see that sleeve revolves freely in cylinder block bore.

Always use new cylinder sleeve seal rings when replacing cylinder sleeves. Seal ring groove must be thoroughly clean and free from grease or oil. Seal ring is assembled in ring groove and no oil or grease should be used when installing cylinder sleeve. Oil and grease is detrimental to the rubber seal rings and care should be taken that they are kept clean and dry when in repair bins.

If difficulty is experienced in installing a cylinder sleeve with a dry seal ring, a solution consisting of two tablespoonfuls of Ivory soap flakes dissolved in one quart of hot water with one ounce of glycerine added, can be prepared. The seal ring can then be dipped into this solution which will aid in assembling and prevent possible searing of the ring.

Pistons

Pistons are cast iron and should be fitted to specified clearances, using a ½" wide ribbon with from 5 to 12 pounds tension on a scale. Under no circumstances should tension on scale exceed 12 pounds. Insert ribbon between piston and cylinder 90° from piston pin hole and in line with thrust face of piston.

Piston and connecting rod assembly is removed thru top of cylinder block.

Piston Rings

FAB piston uses two compression and two oil control rings with oil control rings in bottom grooves.

Clearance in groove as well as ring gap mus tbe held to specified clearances. Make sure that ring grooves are free from carbon when checking clearance between ring and piston.

Care should be exercised when removing or installing piston rings to prevent distortion. Suitable tools should be used during this operation.

New rings should be fitted into the cylinders in which they are to be used before assembling on pistons. Put piston in cylinder (in block) then insert piston ring, pushing it against head of piston to square it with cylinder. This check should be made with piston near bottom of cylinder where there usually is the minimum wear. Measure ring gap with thickness gauge. Another method of checking ring gap is to insert piston ring in cylinder then use a piston to force ring down into lower portion of cylinder. This squares piston ring with cylinder. Then piston can be removed and the ring gap checked with the proper thickness gauge.

Side clearance in ring grooves is checked by rolling ring around groove and checking with feeler gauge of proper thickness before assembling. Piston rings should be installed with the gaps staggered around the circumference of the piston.

Piston Pins

Clearances specified for fitting pins in rods and pistons are based on a room temperature of 70° F. The general practice is to select pins that can be installed by pushing with palm of hand, first making sure that pin and bore are smooth and clean.

Piston pins float in rod and piston and are held in piston by retainer rings that fit into grooves in piston pin bosses.

Piston pin bushing should be burnished and reamed to give clearances specified. Make sure that oil hole in rod indexes with oil hole in bushing.

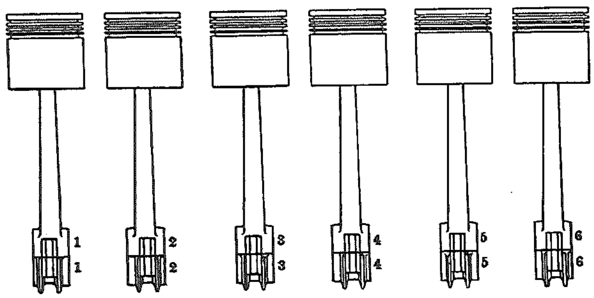


Fig. 4

Connecting Rods

Cylinder numbers are stamped on a flat space on rod and cap and rods should always be assembled with these numbers toward camshaft side of crankcase.

Connecting-rod bearings are installed flush with face of connecting rod and cap at tongue and groove side which permits the lower half bearing to extend above face of bearing cap on opposite side.

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run thru the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

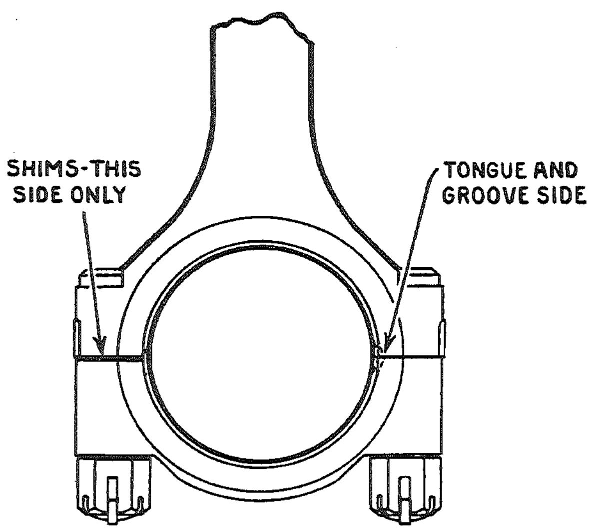


Fig. 5

When replacing connecting-rod bearings be sure that rods and caps as well as backs of bearing shells are clean and smooth and **free from oil.** This is of extreme importance as bearings will not seat properly if there is any dirt or oil between bearing shells and rods or caps. Wash rods and caps in a good cleaning solution and **dry thoroughly.** This will remove oil as well as any dirt and insure proper contact between backs of bearing shells and rods.

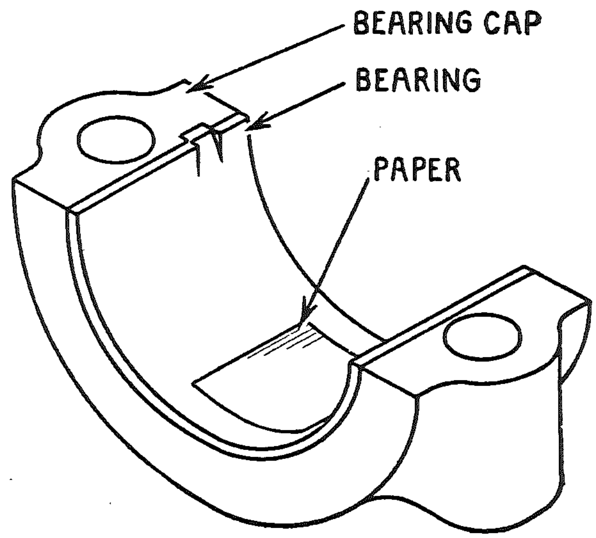


Fig. 6

Connecting-rod bearing shims are assembled on side opposite tongue and groove side and is only side on which shims are used. Four .003″ shims (two .006″–laminated–later models), are used (one side only) and if bearing wear cannot be adjusted to specified clearances by removal of shims, new bearing must be installed. Never file connecting rod or cap.

Be sure that shims are properly aligned so they do not touch the bearing shell when cap half is tightened down. When assembling connecting rod cap, the shims can easily be lined up by using two fingers.

When installing new connecting-rod bearings always start out with the specified quantity of shims in place. Then if bearing is loose, remove shims as required. Never build up clearance by adding shims but reduce clearance by removing shims. This will prevent damaging bearing shells, by crushing, due to insufficient clearance.

The usual practice is to remove shims until bearing is tight, then replace one .003″ shim which should give the proper clearance. A further clearance check can be made using a piece of paper .0015″ to .0025″ thick, approximately 1″ square. Place the piece of paper between bearing and crankshaft and tighten cap. This thickness of paper should lock the bearing.

Connecting rod and piston assembly is removed thru top of cylinder block.

Main Bearings

Numbers stamped on bearing cap bosses indicate position for installation. Numbers should face camshaft side of crankcase. The small tongues on main bearings should fit snugly into grooves in crankcase and main bearing caps.

Care must be used when assembling shims to see that they clear the bearing locating tongues. Certain types of shims have a relief, or cut-out, which provides clearance for these tongues. If shims are installed incorrectly the bearing shells will be crushed excessively. Shims should not contact the bearing shells at any point.

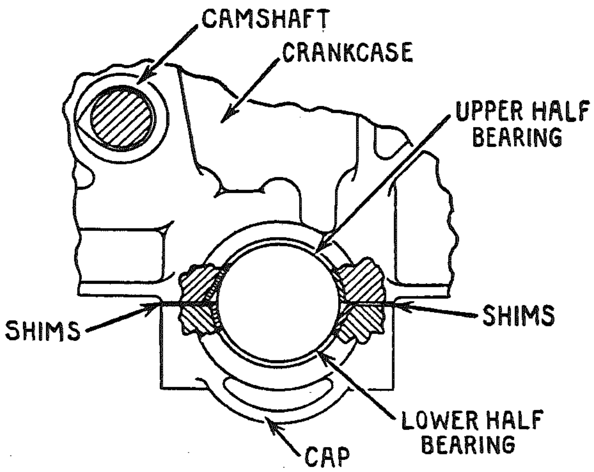


Fig. 7

Two shims each .003″ thick, are used on each side of main bearing, making a total shim thickness of .006″.

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run thru the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

It is recommended that a complete set of main bearings be used when replacement is made.

Main bearings can be replaced without removing the crankshaft. All main bearing caps should be loosened slightly, care being taken that the crankshaft and camshaft gears are not demeshed.

Remove No. 1 bearing cap and by lightly tapping the plain edge of the upper half bearing, and in some cases turning the crankshaft in the direction of rotation, the bearing shell is easily removed. Installation is accomplished in reverse manner.

The balance of main bearings are removed and installed in the same manner.

As mentioned under "Connecting Rods," do not add shims after bearing shells have been compressed. Instead, use the specified quantity of shims and remove as required to obtain the proper clearance. This prevents damaging the shells by crushing.

Be sure that the seats for the bearings as well as the backs of the bearing shells are clean and free from oil. A good contact is absolutely essential.

Camshaft Bearings

Camshaft bearings must be installed so oil hole indexes with oil supply hole in cylinder block. This is important to insure sufficient lubricant to bearings.

Bearings are line-reamed to size after installation in crankcase.

Vibration Dampener

This unit is attached to the fan drive pulley by six capscrews and forms the outer flange of the pulley. Be sure the nuts and lockwashers on the capscrews are tight. If necessary to remove the vibration dampener and fan drive pulley hub assembly, the vibration dampener unit should first be disassembled from the fan drive pulley hub. This is accomplished by removing the six nuts, using an offset box wrench.

After vibration dampener unit has been disassembled the fan drive pulley hub can be removed, using a puller attached to two long capscrews inserted in the hub.

Do not use a claw type puller to remove vibration dampener and fan drive pulley hub as an assembly. This will damage the vibration dampener. These units must be disassembled for removal. Do not use a pry bar or strike with a hammer in an attempt to drive off this assembly.

To reinstall, make a bench assembly of the vibration dampener and fan drive pulley hub. This is important in order to securely fasten the two units together. Then install as one unit, using a pusher tool. Make sure that the assembly is a tight fit on the crankshaft, also tighten starting crank jaw nut securely.

CAUTION: Do not wash the vibration dampener in kerosene or any other fluid that is injurious to rubber.

Do not let this unit become saturated with oil or grease, otherwise rapid deterioration of the rubber will result.

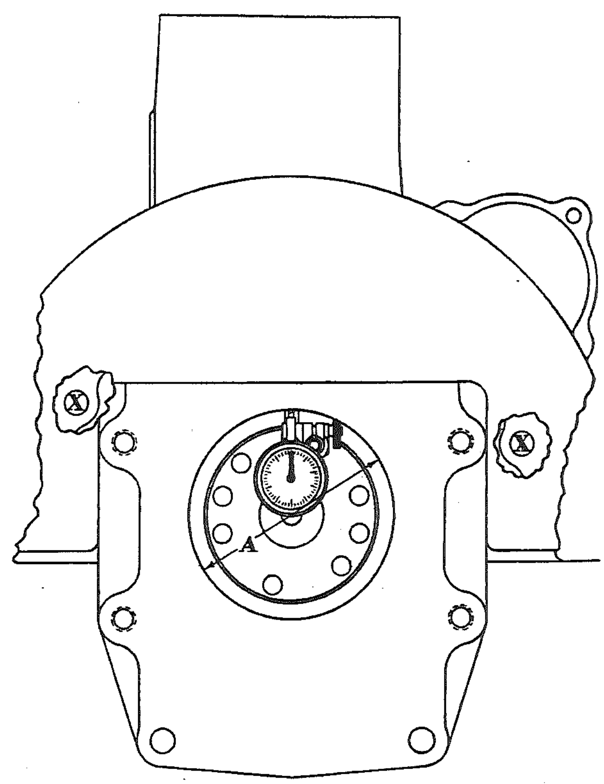


Fig. 8

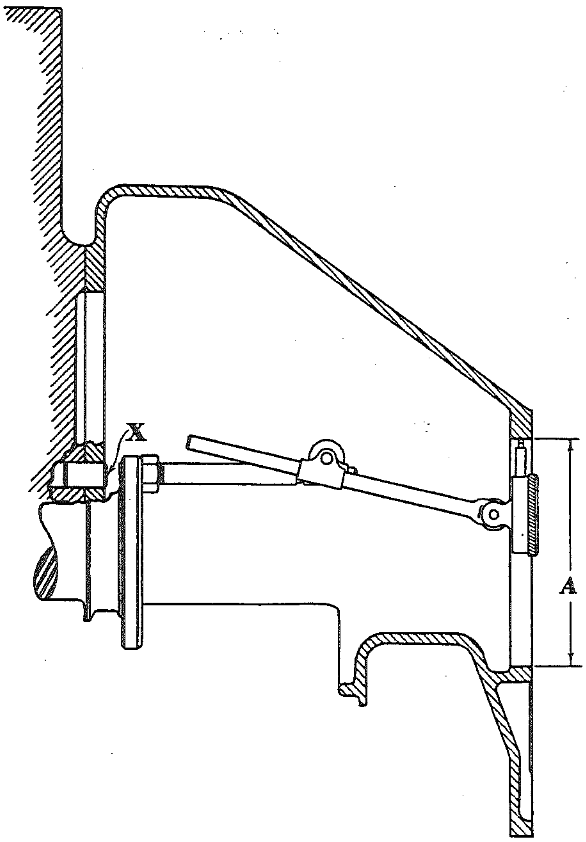


Fig. 9

Flywheel and Clutch Housing

Proper alignment of flywheel and clutch housing is of extreme importance.

To check alignment and make adjustments the following method should be employed:

1. Remove floor boards, disconnect pedals and propeller shaft.
2. Remove transmission and throw-out shaft, bearing and clutch.
3. Engine must be supported before removing these parts.
4. Attach indicator as shown and check bore "A." Flywheel and clutch housing is doweled to crankcase at "X" and when correctly aligned runout of bore "A" should not exceed .005″ total indicator reading.
5. If reading indicates misalignment beyond recommended limits, remove dowel pins and loosen housing attaching bolts sufficiently to permit movement by tapping lightly with a hammer.
6. Set indicator in position showing maximum runout and tap housing slightly to shift its position until indicator reading is ½ of maximum reading. Recheck runout by rotating crank. The resultant reading should approach .000″ or at most, less than .005″ runout.
7. Tighten attaching bolts and reindicate. Ream dowel holes, using an oversize reamer that will produce a .001″ to .002″ drive fit of an oversize dowel.
8. Install oversize dowels and reindicate. If these are not available, they can be made from a piece of drill rod the desired size.

Reconditioning Valves and Seats

Clean and polish valve stems and if warped or badly burned, install new valves.

If valve faces are pitted or grooved, reface in refacing machine before grinding. Valve **seats** should not be refaced unless absolutely necessary. If valve seat is not concentric with valve stem guide hole or if seat is too wide, then refacing is necessary. Valve face contact surface width should be 1⁄16″ to 3⁄32″.

After grinding, remove all traces of grinding compound. Check seating of valves by making a number of marks with a soft lead pencil around the valve seat, then insert valve and give ¼ turn. Remove valve and if all lines are broken the valve seat is satisfactory.

In some cases it will be possible to touch up the valve stem and rockerarm end contact surfaces in order to assure proper contact and quiet operation at the maximum clearance. However, **it is recommended** that whenever possible, **new parts** be installed.

The valve stem and rockerarm ends are case-hardened, therefore if too much metal should be ground off, the contact surfaces will be soft, which will result in rapid wear. Also the valve stem end must be square with the valve stem and the radius on the rockerarm end **must be held** to .485″–.515″. The rockerarm end must be parallel with the bushing bore within .002″ indicator reading at 2″.

If the valve stem and rockerarm ends are not in the proper relation to each other, rapid wear of the valve guides will result, due to the valve stem being forced to one side.

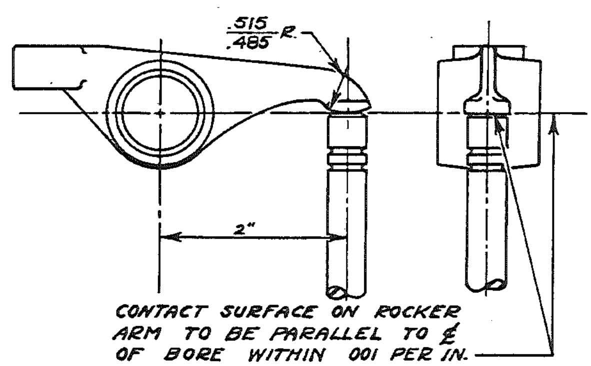


Fig. 10

Fig. 10 illustrates the correct contact between valve and rockerarm end. The radius on rockerarm end must be held and **under no circumstances** should the end be ground off **more than .010″.** The relation of the rockerarm end to the rockerarm bushing is also shown.

Valve Clearance Adjustment

Proper clearance between valve rocker arms and ends of valve stems must be maintained in order to obtain satisfactory operation.

Before making an adjustment run engine sufficiently to **thoroughly** warm it up. This is important. Engine should be run at least 15 minutes after water temperature has reached its normal point. If necessary, cover radiator.

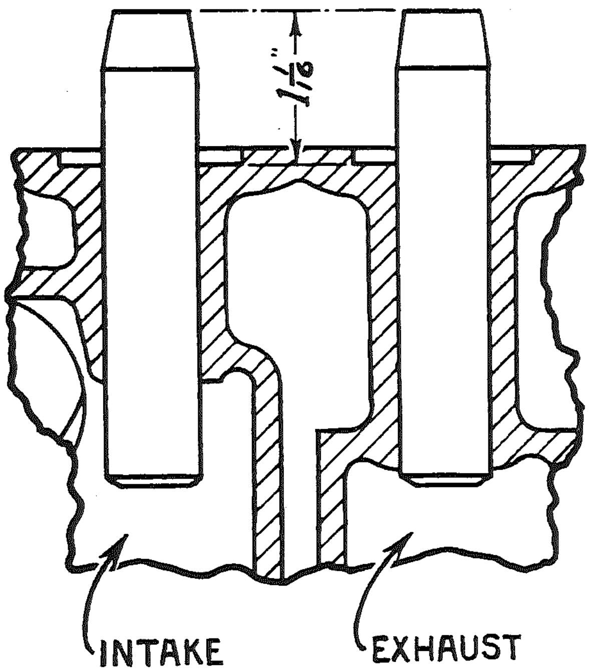


Fig. 11

Valve Stem Guides

Press valve stem guides in from valve spring side of cylinder head to dimension shown with tapered end up. A 1 1/16" high sleeve should be placed over guide when making installation to provide a positive stop when correct position is reached.

After installation, ream valve guides to .344". Reaming should be done carefully and slowly—do not force reamer. A smooth finish is essential as the amount of bearing surface between valve stem and guide is dependent upon finish of guide bore.

After reaming valve guides, check valve seats and if runout exceeds .002" to .003", seats should be refaced. When refacing valve seats the tool must be piloted in valve guide.

Valve-Seat Inserts

Necessity for replacing valve-seat inserts should be very rare, however, if a replacement is made it is important that new inserts be peened securely in place. A dull pointed chisel, 1/4" wide, is used to peen cylinder head metal over outer edge of valve-seat insert.

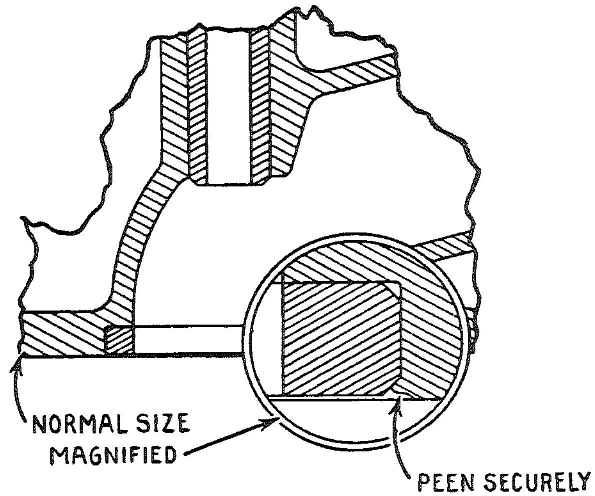


Fig. 12

Valve-seat inserts supplied for service are .010" larger diameter than those used in production which permits a good tight fit in cylinder head. Letter "M" is stamped on top of insert. Install with this side out.

Cylinder Head

Fig. 13 illustrates correct order in which cylinder head should be tightened. This is important to assure a good seal between cylinder head, cylinder head gasket and cylinder block and will also avoid strains in cylinder head casting.

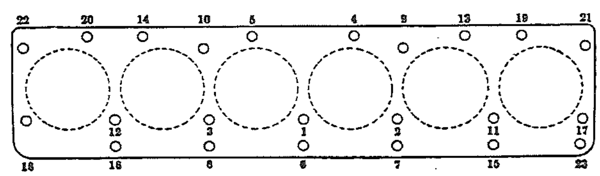


Fig. 13

When cylinder head has been removed it is a good plan to install a new head gasket. In some cases the old gasket may be entirely satisfactory; however, to avoid the possibility of water or gas leagage a new gasket is recommended.

To guard against compression or water leaks, coat both sides of the cylinder head gasket with a suitable, clear sealing compound, such as shellac. Let gasket dry until the coating becomes tacky, then install with beaded side up as stamped, first making sure that block and head are smooth and clean. Any foreign matter between gasket and head or block will result in early gasket failure.

After cylinder head has been tightened, run engine for a few minutes, and retighten.

Valve Rocker Arms and Shafts

Assembly of valve rocker arms, springs, brackets and washers on valve rockerarm shafts is shown in Fig. 14.

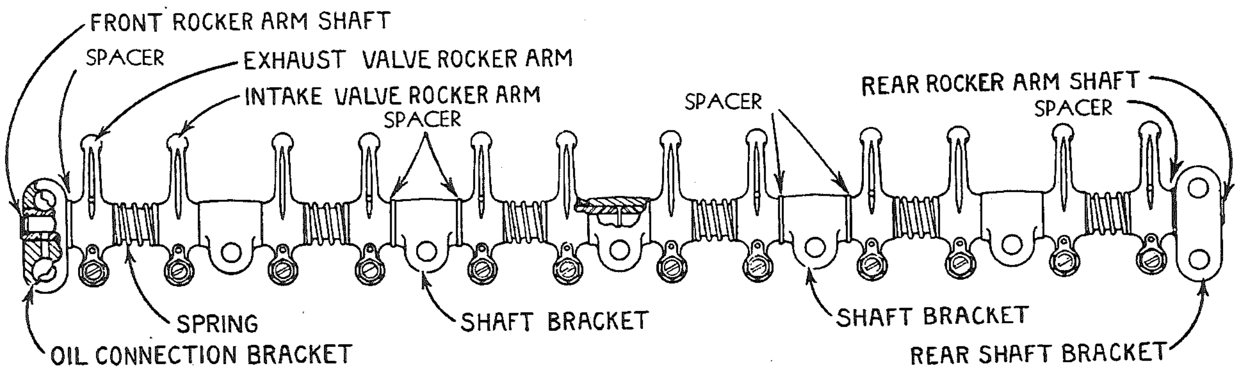


Fig. 14

Note that exhaust valve rocker arms are drilled for additional lubrication to exhaust valve stems and guides while intake valve rocker arms are not drilled.

The valve rockerarm shafts are prevented from turning by a rockerarm shaft bracket mounting stud, front and rear, which fits into a notch or groove in the shaft.

The oil holes in rockerarm shafts, which supply lubrication to the rocker arms, should be **up,** hence it is important that the front and rear shafts are not reversed.

It is important that gaskets be installed on each side of the oil connection bracket.

Rockerarm bushings are burnished and reamed at assembly to .875″–.876″. Oil holes in bushings must line up with holes in rocker arms. Assemble rocker arms on shafts in the proper positions—exhaust valve rocker arms have the extra oil hole.

Valve Tappets and Guides

Valve tappet guides are integral with crankcase.

Valve tappets, or lifters, can be removed from engine by taking off cover on side of cylinder block. Tappets can then be lifted out, which will permit easy removal of camshaft.

Valve Springs

Valve springs should be square in their seats and also should be checked with Valve Spring Tester S.E. 809 to determine if they meet specifications. This should be done at every valve grind and replacement made when necessary.

Install valve springs with close coiled end to cylinder head.

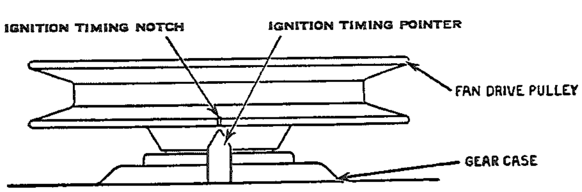


Fig. 15

Ignition Timing Indicator

An ignition timing indicator or pointer is attached to the front gear cover just above the fan drive pulley. This pointer, when opposite the notch in the rear flange of the fan drive pulley, indicates the correct ignition timing position.

There are no timing marks on the flywheel.

Timing Gears

Use suitable pullers or pushers to remove or install timing gears. Do not drive gears on or off.

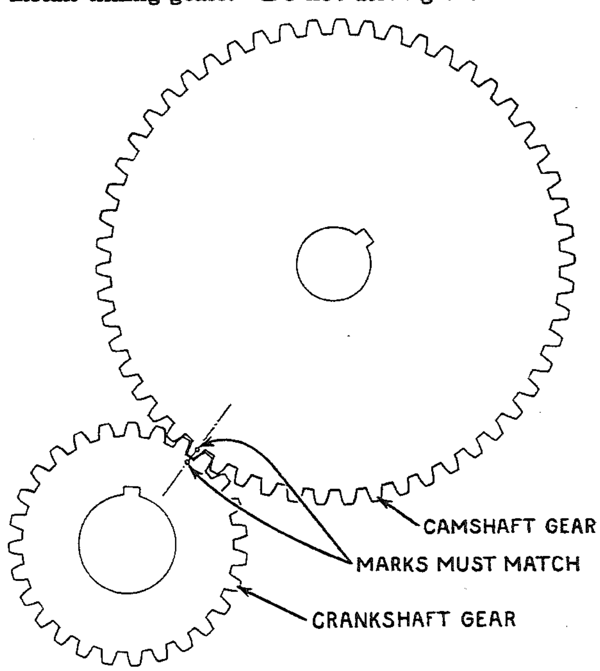


Fig. 16

Timing gears must be installed so that the crankshaft and camshaft are in correct relation to each other. Gears are marked and should be installed so that marks on camshaft and crankshaft gears match. Engine timing diagram is shown in Fig. 17.

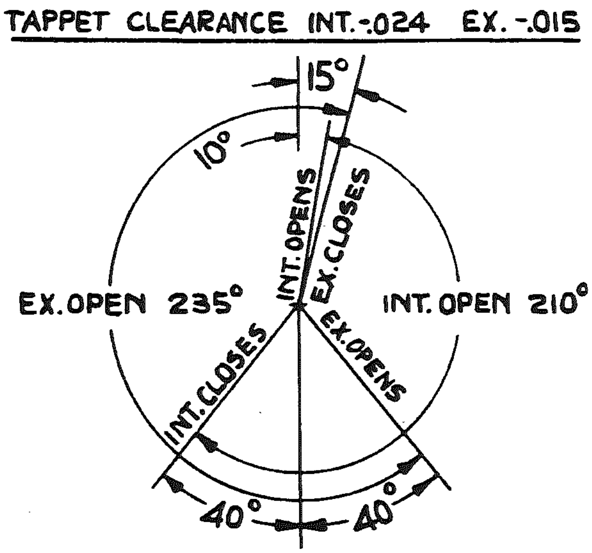


Fig. 17

Exhaust Pipe Seal Ring

The assembly of the exhaust pipe seal ring is shown in Fig. 18.

Be sure that seal ring seats squarely against exhaust manifold, exhaust pipe and flange, and tighten stud nuts evenly in order to prevent distortion of exhaust pipe and possible breakage of exhaust pipe flange.

If the seal ring is assembled properly no exhaust leakage will occur.

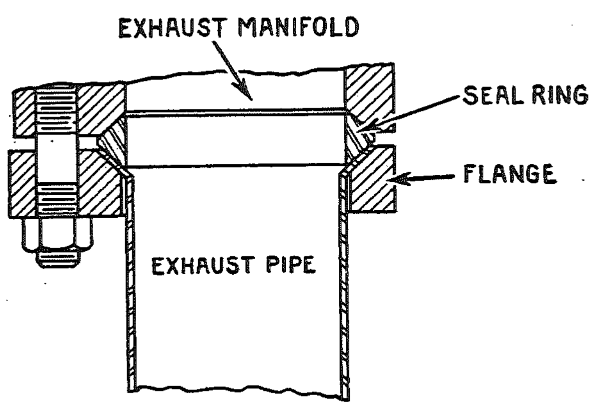


Fig. 18

Water Thermostat

The water thermostat is a balanced valve type having two outlets which are controlled by two valve discs mounted on a common shaft and incorporating one external balancing disc to prevent water pressure from disturbing the true temperature control during the opening and closing cycles.

This thermostat is nonadjustable and is set to start to open at 145 to 150° F. The use of the thermostat shortens the warm-up period and reduces to a minimum crankcase condensation and dilution. The operation of the thermostat can be checked by placing it in still water and heating the water. A reliable thermometer should be used and at a temperature of approximately 145 to 150° F. the valves should start to open and be fully opened (1/4" approx.) at around 200 to 205° F. This applies only to a still water test.

If the thermostat does not function as outlined above a new one should be installed.

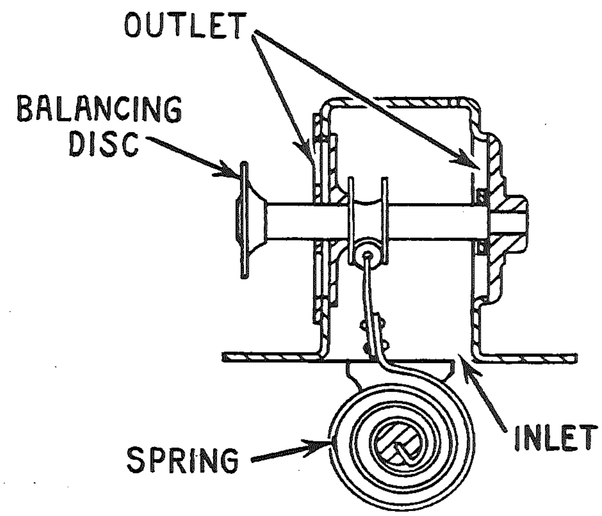


Fig. 19

Fan Belt Adjustment

Fan belt should run under proper tension. Adjustment is made by loosening generator mounting screws and generator brace capscrew, after which generator can be moved in or out as required.

Proper tension is obtained when belt can be depressed approximately 1/2" as shown in Fig 20.

After adjustment has been made be sure to tighten all capscrews.

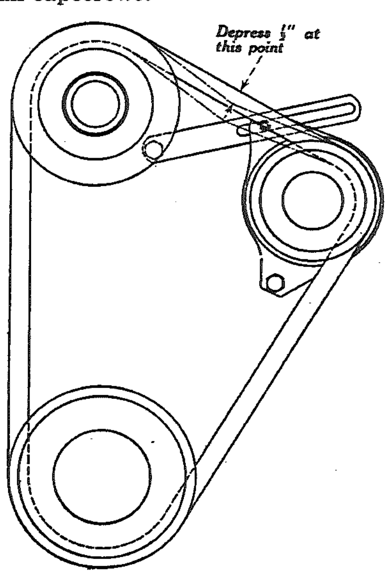


Fig. 20

Installation of Fan Belt

Due to the limited clearance between the fan shroud and vibration dampener the installation or removal of fan belt must be accomplished in the following manner:

(a) Slip fan belt over fan and on to fan pulley.
(b) Insert fan belt in groove in front face of vibration dampener.
(c) Turn engine with starting crank and guide fan belt over edge of dampener.
(d) To remove, reverse the above procedure.

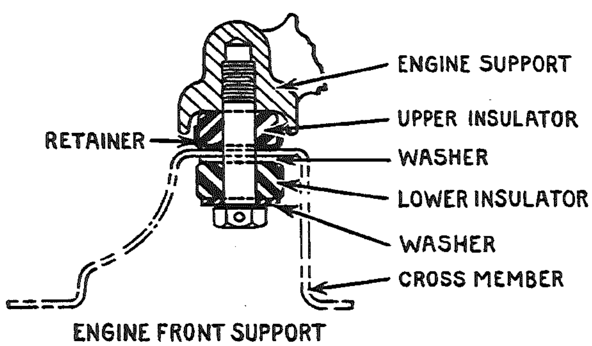


Fig. 21

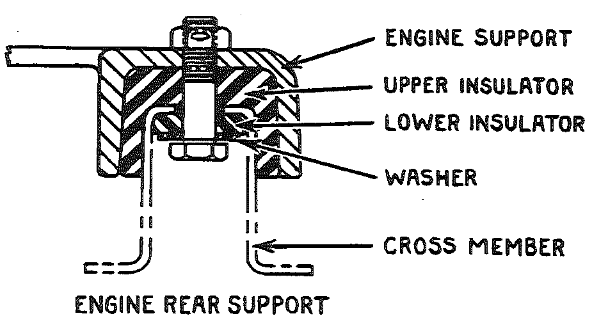


Fig. 22

Engine Mounting

Figs. 21 and 22 illustrate the front and rear engine mounting.

Check mounting screws occasionally to be sure the mountings are not loose and that the capscrews are secured with cotter pins.

Water Pump

The water pump is driven by a V-belt from a pulley on the engine crankshaft. The water pump pulley operates on two tapered roller bearings mounted on a sleeve thru which the water pump shaft runs. The water pump shaft is driven by the water pump driver (14). This construction relieves the water pump shaft of the fan and fan belt loads.

Water Pump Packing

A water pump packing nut (18) provides means of keeping the packing tight. Tighten packing nut just enough to stop leakage with engine not operating. If packing is compressed excessively a scored shaft will result.

When necessary to add packing the water pump driver (14) must be removed, after which the packing nut can be unscrewed and packing rings added as required.

Adjustment of Fan Pulley Bearings

It is essential that the front and rear roller bearings (3 and 7) have sufficient clearance, otherwise early bearing failures will occur.

After assembling the front bearing (3), center spacer (6), rear bearing (7) and front and rear seals, assemble the fan bearing retainer (31) and shims (8). All parts must be clean and **free from grease.**

The next step is to make sure that the rear roller bearing cup is against the fan bearing retainer. Tap the fan pulley assembly against a work bench or block of wood so that the bearing cup will be jarred down against the retainer.

Then check the clearance between the center spacer and bearing cones to determine if there is proper clearance (See Specifications). The best way to check this is by feel. If the center spacer is tight, install another shim between the bearing retainer and pulley and if the clearance is excessive, remove shims as required.

Each time a shim is added or removed, tap the pulley assembly against a block of wood so that the bearing cup will be forced against the retainer. This is important in order to secure an accurate clearance check.

After it has been determined that the fan pulley bearings have the correct amount of clearance, complete the assembly of the fan pulley and water pump. Remove the pipe plug (4) and pack with grease as covered in Lubrication Section.

Water Pump Body Plate

If water pump body plate (12) has been removed the threads of mounting screws should be dipped in white lead before reassembling to prevent water leakage.

Crankshaft Oil Wick

Be sure that the oil wick is properly installed. Do not use a screw driver or other tool to force wick into the hole as this will cut the felt and cause oil leakage. The best method of installation is by using a cork extractor (similar to that used to remove corks from the inside of bottles). This device is inserted thru the hole and hooked onto the end of the wick. Start the wick squarely, and pull thru, leaving $\frac{1}{16}$ to $\frac{1}{8}''$ projecting on the connecting rod journal side. Cut off surplus on the flywheel side.

If a bottle cork extractor cannot be obtained, a piece of wire may be wrapped around one end and the wick pulled thru. Dipping the wick in light oil will assist in the assembly.

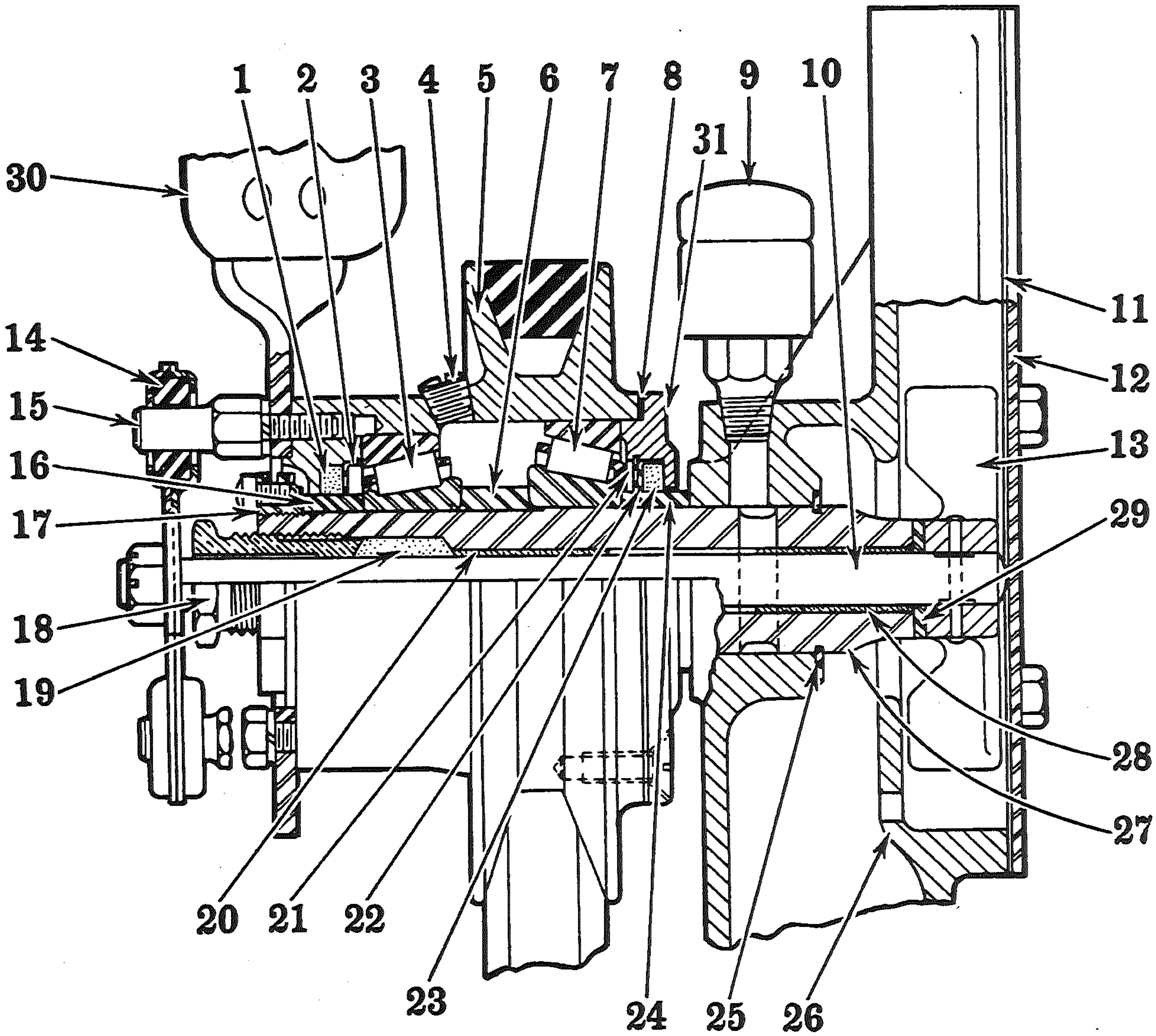


Fig. 23

No.	Description
1.	Bearing felt seal (front and rear).
2.	Bearing felt seal retainer cup.
3.	Fan bearing assembly (front).
4.	Slotted pipe plug.
5.	Fan pulley.
6.	Fan bearing spacer (center).
7.	Fan bearing assembly (rear).
8.	Fan bearing retainer shim.
9.	Water pump shaft grease cup.
10.	Water pump shaft.
11.	Water pump body plate gasket.
12.	Water pump body plate.
13.	Water pump impeller.
14.	Water pump driver.
15.	Water pump driver screw.

No.	Description
16.	Fan bearing spacer (front).
17.	Fan bearing lock nut.
18.	Water pump packing nut.
19.	Water pump packing.
20.	Water pump shaft bushing.
21.	Bearing retainer cup lock ring.
22.	Bearing felt seal retainer cup.
23.	Bearing felt seal (front and rear).
24.	Fan bearing spacer (rear).
25.	Water pump sleeve lock ring.
26.	Water pump body.
27.	Water pump shaft sleeve.
28.	Water pump shaft bushing.
29.	Water pump thrust washer.
30.	Fan.
31.	Fan bearing retainer.

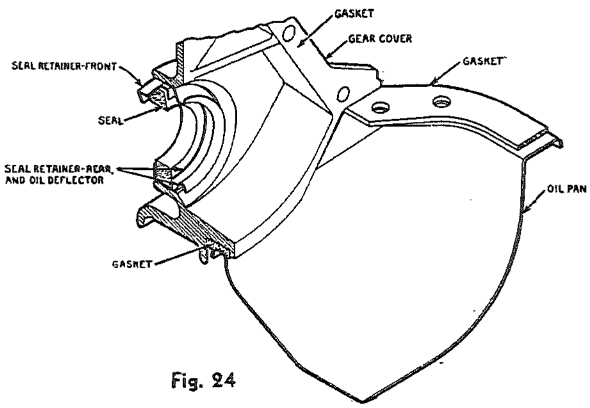


Fig. 24

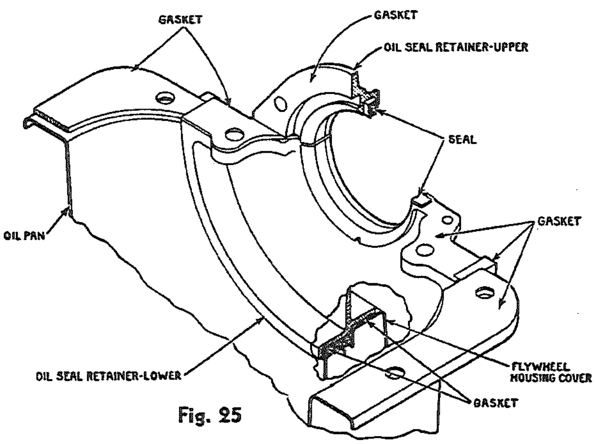


Fig. 25

Oil Seals and Gaskets

Correct assembly of oil seals, retainers and gaskets is of extreme importance in preventing oil leaks.

Fig. 24 illustrates the assembly of the crankshaft front seal, retainers and oil pan gaskets and Fig. 25 illustrates the rear assembly.

Make sure when replacing seals or gaskets that no foreign matter is adhering to the surfaces, which would prevent proper contact.

Dip felt seals in oil before assembly.

Oil Pump Installation

If oil pump has been removed, the ignition distributor must also be removed before reinstalling the pump. This is due to the fact that the slots in the ends of the oil pump drive shaft and ignition distributor shaft must match the tangs on the ends of the distributor drive shaft. If an attempt is made to install the oil pump assembly without first removing the distributor it will be difficult to align the slots and tangs with the result that the pump will be damaged when the pump mounting bolts are tightened.

After installing the oil pump assembly it is an easy matter to align the shafts.

NOTE: When oil pump has been removed from the engine, it will be necessary to retime the ignition.

Oil Consumption

High oil consumption is usually attributed to worn piston rings and cylinders; however, in many cases it will be found that the main, rod or camshaft bearings have worn, permitting excessive spray off of oil which results in overlubrication of cylinder walls.

It is recommended that the bearings be given an oil pressure test, as outlined in following paragraphs, before disturbing the piston and ring assembly.

Oil pressure is controlled by the pressure valve spring located in the oil pressure regulator. Oil pressure should be checked when engine is hot and oil is warm.

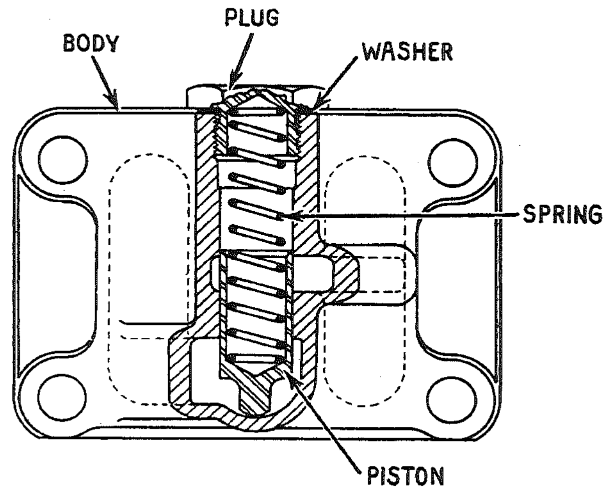


Fig. 26

When low oil pressure is encountered, a systematic and thorough investigation is necessary in order to determine the cause.

The following are the principal causes for this condition and it is recommended that these be thoroughly checked in the order named, which in all probability will result in the definite cause being determined.

Oil Supply

Excessively diluted condition or insufficient amount in crankcase.

Oil Pressure Gauge

Improper registration of gauge.
Loose connections.

Oil Pressure Regulator or Oil Filter (When Used)

Clogged condition of filter element.
Pressure valve not holding.
Weak pressure valve spring. Check by installing spacers in back of spring. Free length of spring should be 2½″.

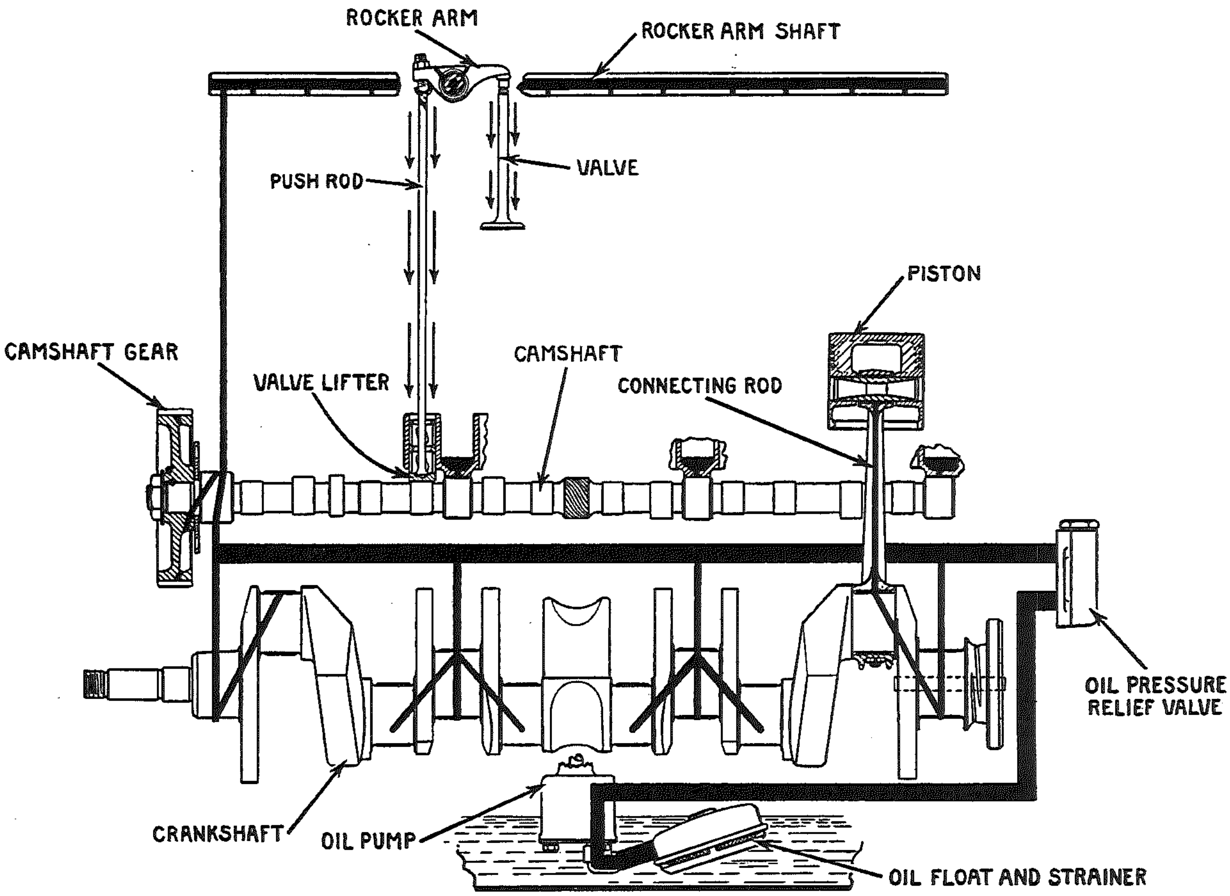


Fig. 27, Engine Lubrication System

Oil Pump

Clogged condition of screen.
Gear cover gasket faulty.
Excessive clearance between gears and cover plate.
Specified gasket thickness, .004″ to .006″.
Worn condition of gears, allowing loose mesh.

Main Connecting Rod and Camshaft Bearings

Excessive running or end clearances.
Out-of-round condition of bearings or journals.
Imperfect bearings—badly pitted or chipped.

In order to check main, connecting rod and camshaft bearing clearances to determine if they are excessive and the cause of low oil pressure, the following equipment and method has been found effective:

A test tank can be made from a piece of 4″ pipe approximately 24″ long. Weld a plate or base on one end and thread the other end to take a cap. Drill and tap the cap to take a tee connection and in one side insert a tire valve and in the other a pressure gauge registering to at least 75 pounds.

Drill and tap a hole near the bottom of the pipe so that a valve can be installed and to the valve attach a flexible hose.

This test fixture can be made from a small tank, if one is available, or any other suitable material.

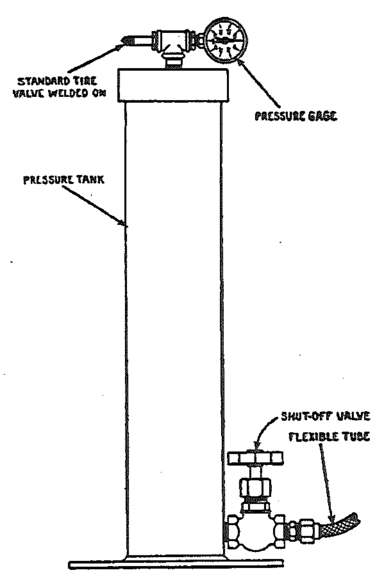


Fig. 28, Test Tank

The tank should not be more than half full of S.A.E. 10 or a heavier grade of heated oil and in the case of the tank described above, 2 or 3 quarts of oil will be sufficient. Tank can be filled by removing tee connection.

The flexible hose should be connected to the oil pressure connection in the engine.

Apply air pressure to about 50 pounds then open valve in bottom so that oil will be forced into oil channels and bearings. Inspect for excessive leakage and spray off, which denotes excessive clearance and likewise pressure loss.

If oil filter is used, remove filtering element and clean out base so that dirt collected in filter will not be forced into oil channels of engine. The filter element should be left out when making this test.

Cleaning of Engines

The importance of having an engine, or any other unit in the truck, clean and free from dirt, sludge, abrasives, etc., cannot be too strongly stressed. While every effort is made by the manufacturer to prevent dirt from entering an engine or other unit, nevertheless a certain amount will possibly accumulate after the job has been in service for a period of time. For this reason it is recommended that whenever any work is being done, the parts removed be thoroughly cleaned before they are reassembled.

The entire cylinder block casting should be thoroughly washed with a strong cleaning solution which will remove dirt, sludge and carbon formations that may have accumulated. If Stoddard Solvent or kerosene is used, wash again, using hot soapy water and rinse with clear water under pressure. Dry thoroughly and coat with light oil to prevent rusting. Particular attention should be paid to any recesses in the cylinder block and crankcase where an accumulation of dirt, sludge or carbon might be found.

If the cylinder block is not thoroughly cleaned before reassembling there will be the possibility of dirt and carbon jarring loose, when engine is being run-in. This accumulation will be circulated thru the oiling system with the result that bearings, crankshaft, camshaft, pistons, valve stems, etc., will be damaged.

It is recommended that all pipe plugs be removed from the drilled oil lines in cylinder block. A good way to clean out the drilled oil lines is by using a long handled rifle barrel brush. This type of brush will run thru the main drilled oil line in the side of the cylinder block.

Cylinder blocks should be immersed in a large cleaning tank and if such equipment is not available at the Branch this work should be sent to a reputable concern that specializes in cleaning such parts.

After cleaning, the entire casting should be thoroughly dried, especially the drilled oil lines and all finished surfaces should be lubricated to prevent rust formations.

The oil filter should be thoroughly cleaned out, removing any accumulation of sludge and dirt from the sump in the base. Replace filtering element if necessary.

It is a good policy to disassemble and thoroughly clean all parts of the oil pump. This will permit checking fits and enable the mechanics to determine the parts needing replacement.

The oil filler or breather cap should be removed and the wire mesh thoroughly washed out.

Fuel pump should be thoroughly cleaned out, especially the small breather located in the body. This breather can be removed and slushed around in a cleaning fluid which will remove all dirt. If examination reveals excessive dirt, disassemble fuel pump and clean all parts.

Oil in air cleaner should be changed every time crankcase is drained. Clean out air cleaner cup. Make sure all connections are tight so that dust and dirt cannot enter. See detailed instructions under "Air Cleaner."

Disassemble carburetor and clean out thoroughly. Do not run a wire thru jets as this will enlarge the holes, thereby disturbing the calibration, which will result in poor fuel economy and engine performance.

If an engine has been properly overhauled with all parts fitted to specified clearances and assembled properly and **all parts thoroughly cleaned,** its performance and life will be increased materially.

Engines—FBB-298, FBB-361, FBB-401, FBB-450A

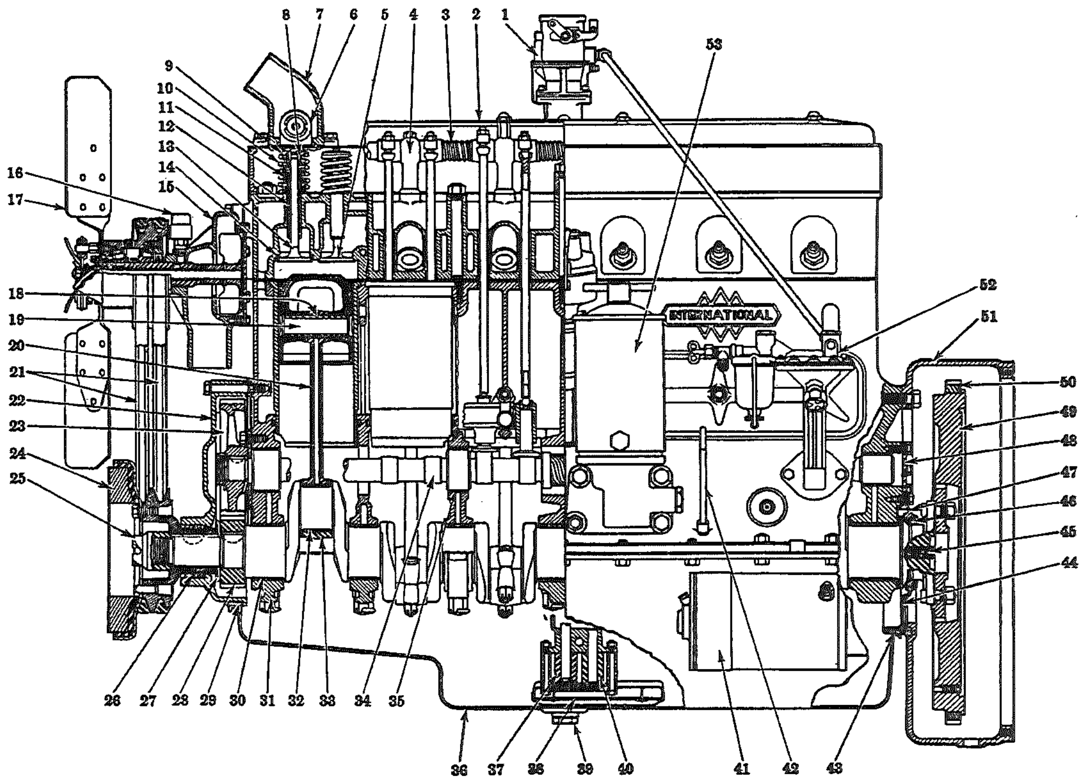


Fig. 1, FBB-298 Engine

No.	Description
1.	Carburetor.
2.	Rocker arm cover.
3.	Rocker arm shaft spring.
4.	Rocker arm shaft bracket.
5.	Intake valve.
6.	Water thermostat.
7.	Water outlet.
8.	Valve spring lock.
9.	Valve spring retainer.
10.	Valve spring—outer.
11.	Valve spring—inner.
12.	Valve guide.
13.	Exhaust valve.
14.	Valve-seat insert.
15.	Water pump.
16.	Grease cup.
17.	Fan.
18.	Piston pin bushing.
19.	Piston pin.
20.	Connecting rod.
21.	Fan belts.
22.	Gear cover.
23.	Camshaft gear.
24.	Vibration dampener.
25.	Starting crank jaw nut.
26.	Crankshaft oil seal.

No.	Description
27.	Crankshaft oil slinger.
28.	Crankshaft gear.
29.	Oil pan gasket.
30.	Main bearing.
31.	Main bearing cap.
32.	Connecting-rod bearing.
33.	Connecting-rod bearing cap.
34.	Camshaft.
35.	Camshaft bearing.
36.	Oil pan.
37.	Oil pump body gear.
38.	Oil pump screen.
39.	Drain plug.
40.	Oil pump idler gear.
41.	Starting motor.
42.	Oil gauge.
43.	Oil pan gasket.
44.	Crankshaft rear oil seal retainer—lower.
45.	Crankshaft oil wick.
46.	Crankshaft rear oil seal.
47.	Crankshaft rear oil seal retainer—upper.
48.	Crankshaft rear bearing cover plate.
49.	Flywheel.
50.	Flywheel ring gear.
51.	Flywheel housing.
52.	Fuel pump.
53.	Oil filter.

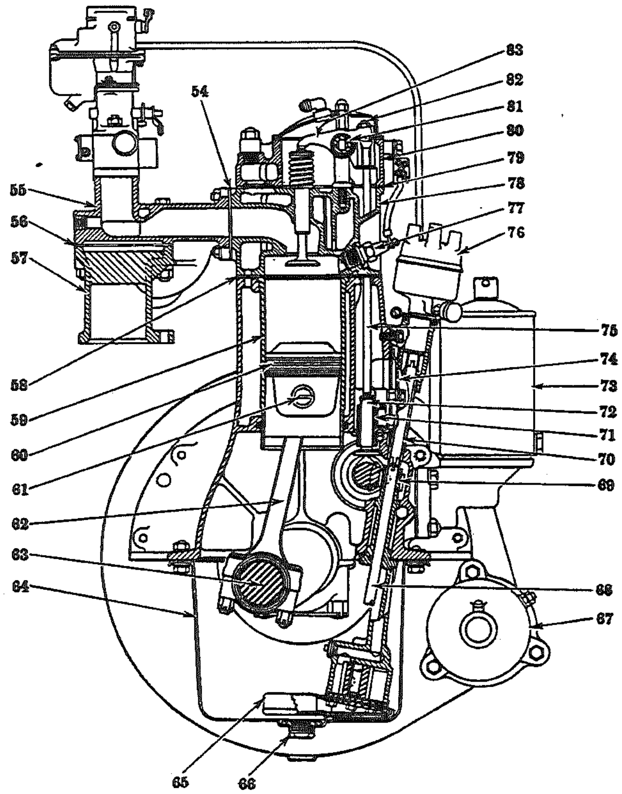


Fig. 2, FBB-298 Engine

No.	Description
54.	Manifold gasket.
55.	Intake manifold.
56.	Exhaust and intake manifold gasket.
57.	Exhaust manifold.
58.	Cylinder head gasket—lower.
59.	Cylinder sleeve.
60.	Piston rings.
61.	Piston pin retainer ring.
62.	Connecting rod.
63.	Crankshaft.
64.	Oil pan.
65.	Oil pump and screen.
66.	Drain plug.
67.	Starting motor.
68.	Oil pump drive shaft.
69.	Oil pump drive gear.
70.	Ignition distributor drive shaft.
71.	Valve tappet guide.
72.	Valve tappet.
73.	Oil filter.
74.	Valve tappet cover.
75.	Push rod.
76.	Ignition distributor.
77.	Spark plug.
78.	Cylinder head—lower.
79.	Cylinder head gasket—upper.
80.	Cylinder head—upper.
81.	Rocker arm shaft.
82.	Valve tappet adjusting screw.
83.	Rocker arm.

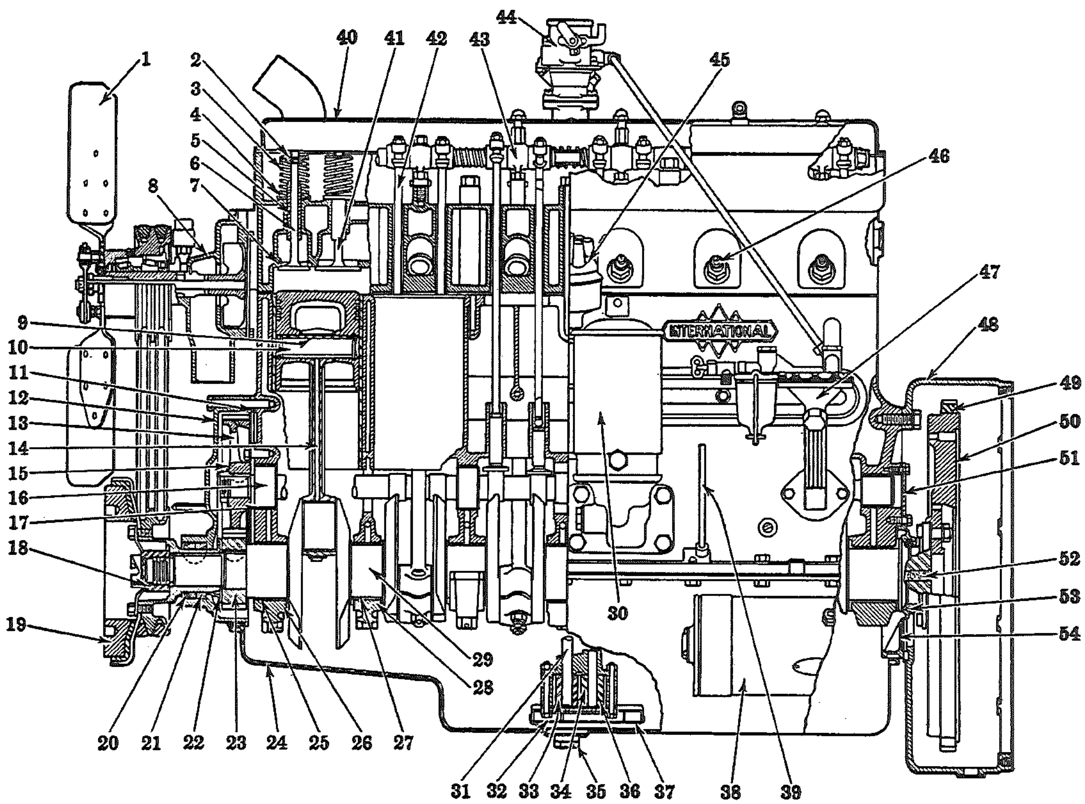


Fig. 3, FBB-361, FBB-401, FBB-450A Engine

No.	Description
1.	Fan.
2.	Valve spring lock.
3:	Valve spring.
4.	Valve spring spacer.
5.	Valve guide.
6.	Exhaust valve.
7.	Exhaust valve-seat insert.
8.	Water pump.
9.	Piston pin bushing.
10.	Piston pin.
11.	Gear cover plate.
12.	Gear cover.
13.	Camshaft gear.
14.	Connecting rod.
15.	Camshaft gear lock.
16.	Camshaft.
17.	Camshaft bushing.
18.	Starting crank jaw nut.
19.	Vibration dampener.
20.	Felt retainer.
21.	Felt seals.
22.	Oil slinger.
23.	Crankshaft gear.
24.	Oil pan.
25.	Main bearing.
26.	Main bearing cap.
27.	Connecting-rod bearing.

No.	Description
28.	Connecting-rod bearing cap.
29.	Crankshaft.
30.	Oil filter.
31.	Oil pump shaft.
32.	Oil pump.
33.	Oil pump gear.
34.	Oil pump idler shaft.
35.	Drain plug.
36.	Oil pump idler gear.
37.	Oil pump shroud.
38.	Starting motor.
39.	Oil gauge stick.
40.	Valve rocker arm cover.
41.	Intake valve.
42.	Push rod.
43.	Rocker arm shaft bracket.
44.	Carburetor.
45.	Ignition distributor.
46.	Spark plug.
47.	Fuel pump.
48.	Flywheel housing.
49.	Flywheel ring gear.
50.	Flywheel.
51.	Camshaft rear bearing cover plate.
52.	Crankshaft oil wick.
53.	Crankshaft rear oil seal.
54.	Rear oil seal retainer.

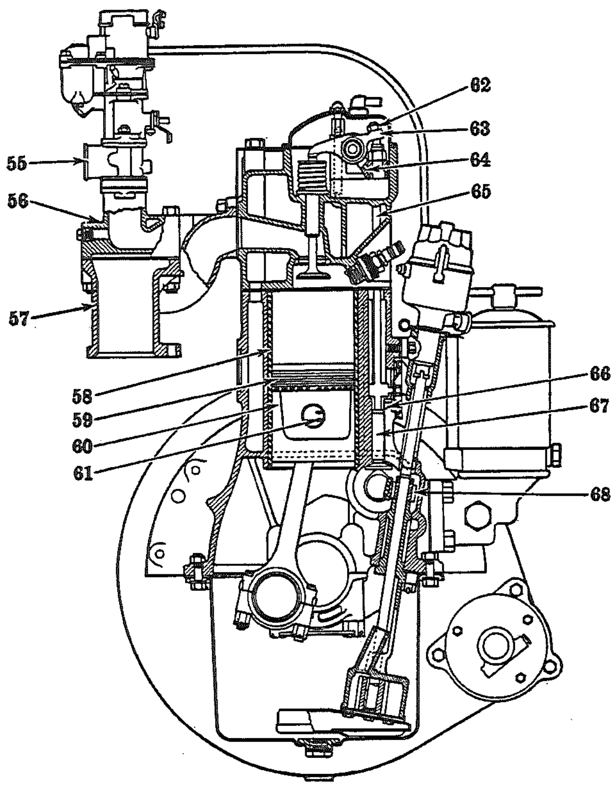


Fig. 4, FBB-361, FBB-401, FBB-450A Engine

No. Description
55. Governor.
56. Intake manifold.
57. Exhaust manifold.
58. Cylinder sleeve.
59. Piston rings.
60. Piston.
61. Piston pin retainer.
62. Valve tappet adjusting screw.
63. Rocker arm.
64. Rocker arm shaft oil connection bracket.
65. Push rod.
66. Valve tappet retainer.
67. Valve tappet.
68. Oil pump and distributor drive gear.

Best Results from Reconditioned Engines

For best results when an engine is reconditioned, and particularly when new cylinder sleeves or liners and pistons are installed, the following items should be observed:

1. Lubricating-oil compartments and passages must be thoroughly cleaned of sludge, dirt and abrasive material, and the oil filter placed in efficient operating condition. Working parts should be lubricated well with clean oil at time of assembly.
2. Air cleaner must be placed in efficient operating condition and all connections between cleaner and carburetor must be air-tight.
3. All engine gaskets must be tight.
4. See that engine is free, start it, and let run idle, beginning at slow speed and gradually increasing to maximum idling governed speed. Tighten cylinder head and readjust valve clearance after engine is warmed up. During the break-in period it is recommended that a good quality light oil (S.A.E. 10 or 20) be used, care being taken to inspect oil level frequently and to maintain it at proper height.

Cylinder Sleeves

Cylinder sleeves can be removed, using Sleeve Puller S.E. 654 with the proper Sleeve Puller Shoe.

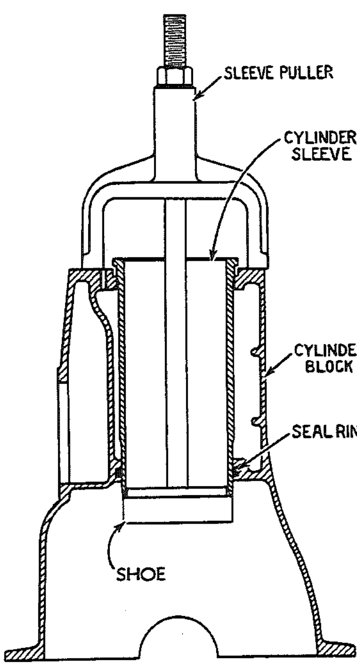


Fig. 5

When replacing cylinder sleeve be sure there is no dirt under sleeve flange which would cause distortion. Before installing rubber seal ring, see that sleeve revolves freely in cylinder block bore.

Always use new cylinder sleeve seal rings when replacing cylinder sleeves. Seal ring groove must be thoroughly clean and free from grease or oil. Seal ring is assembled in ring groove and no oil or grease should be used when installing cylinder sleeve. Oil and grease is detrimental to the rubber seal rings and care should be taken that they are kept clean and dry when in repair bins.

If difficulty is experienced in installing a cylinder sleeve with a dry seal ring, a solution consisting of two tablespoonfuls of Ivory soap flakes dissolved in one quart of hot water with one ounce of glycerine added, can be prepared. The seal ring can then be dipped into this solution which will aid in assembling and prevent possible searing of the ring.

Cylinder Liners

Cylinder liners can be rehoned to take .010", .020" or .030" oversize pistons. If necessary to go over .030" oversize, cylinder liners should be replaced.

Fig. 6 illustrates tool S.E. 950 and method of removing cylinder liner from cylinder block.

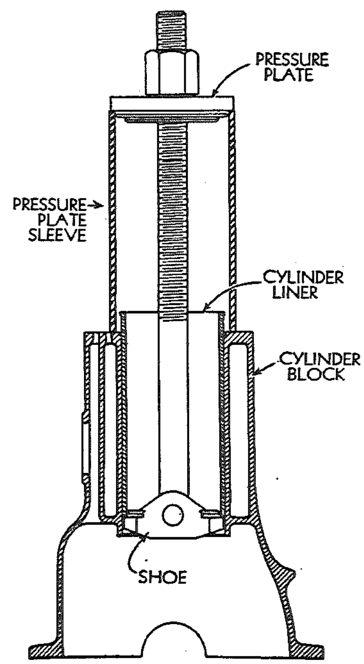


Fig. 6

Removal

1. Place S.E. 9503 or S.E. 9509 shoe on S.E. 9501 screw. Place S.E. 9501 screw in pressure plate S.E. 9504 and install ratchet nut and bearing S.E. 9507. Place S.E. 9506 pressure plate sleeve over liner to be removed and pass shoe, screw and plate assembly down through the sleeve. The pressure plate S.E. 9504 will rest on top of the large sleeve S.E. 9506. Shoulder the shoe up into the cylinder liner and run nut down to the plate, making sure that the entire assembly is centered over the liner to be removed.

2. Have the S.E. 9507 nut and bearing greased and then using ratchet wrench S.E. 9508, tighten the nut. Before starting removal of cylinder liner, make sure that the shoe is straight on the sleeve. Tightening the nut will pull the sleeve out of the cylinder bore.

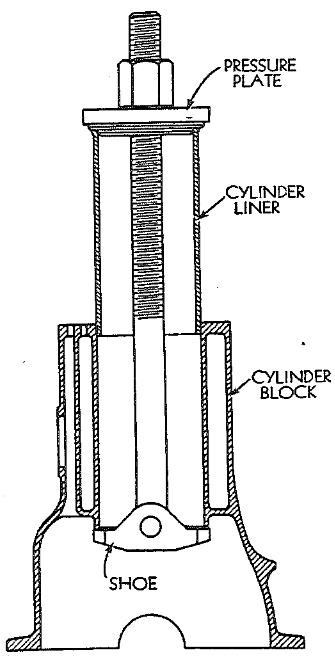


Fig. 7

Installation

1. Ascertain the size of the liner removed by the size marked on the O.D. of the liner. **Be sure and install the same size liner as the one removed.**
2. **Thoroughly clean** the bore of the block as well as the O.D. of the liner to be installed.
3. Coat the cylinder liner with a light mixture of white lead and oil to facilitate installation.
4. Install S.E. 9502 shoe on the S.E. 9501 screw.
5. Place the cylinder liner in the bore of the block, centering it as carefully as possible.
6. Pass the screw and shoe assembly down through the liner and bore, and place shoe S.E. 9502 on the boss or wall of the cylinder bore. Turn the shoe on an angle to obtain maximum bearing.
7. After carefully placing the pressure plate S.E. 9504 on top of the liner, the nut should be run down to the plate. It will be possible to start the liner into position by hand pressure on the nut.
8. After the sleeve has safely and smoothly started into the bore, use ratchet wrench S.E. 9508. Continue operation until the liner is almost in its final position, then release pressure on the nut and check to see that shoe has not slipped and that it is still well supported on the boss of the cylinder bore.

Honing Liners

After cylinder liners have been installed they require special servicing to remove any distortion that may have taken place and to properly size them for the pistons to be used.

1. Special tools required are S.E. 784 Grinder equipped with Special Stones for Steel Cylinders, S.E. 1012; S.E. 785 Grit Remover, and S.E. 786 Grinder Stand.
2. Ascertain size of liner and pistons and check for distortion.
3. Mount S.E. 786 Grinding Stand and attach S.E. 785 Grit Remover and S.E. 784 Hone to a ½" or ⅝" electric drill.
4. Set hone firmly in liner so that stones will take hold, and hone out cylinders to proper size, using fine grade stones for finishing. See "Specifications" for clearances.
5. The block should be carefully inspected for dirt and abrasives and **thoroughly cleaned.**

Pistons

Aluminum alloy pistons are fitted to specified clearances, using a ½" wide ribbon with from 5 to 12 pounds tension on a scale. Under no circumstances should tension on scale exceed 12 pounds. Insert ribbon between piston and cylinder 90° from piston pin hole and in line with thrust face of piston.

Pistons are assembled to connecting rod with vertical slot toward camshaft.

Piston and connecting-rod assembly is removed thru top of cylinder block.

Piston Rings

FBB-298 piston uses three compression and one oil control ring with oil control ring in bottom groove. Models FBB-361, FBB-401 and FBB-450A pistons use a plain compression ring in top groove, offset compression rings in second and third grooves and an oil control ring in bottom groove. Offset side of second and third compression rings must be down, towards skirt of piston.

Clearance in groove as well as ring gap must be held to specified clearances. Make sure that ring grooves are free from carbon when checking clearance between ring and piston.

Care should be exercised when removing or installing piston rings to prevent distortion. Suitable tools should be used during this operation.

New rings should be fitted into the cylinders in which they are to be used before assembling on pistons. Put piston in cylinder (in block) then insert piston ring, pushing it against head of piston to square it with cylinder. This check should be made with piston near bottom of cylinder where there usually is the minimum wear. Measure ring gap with thickness gauge.

Another method of checking ring gap is to insert piston ring in cylinder then use a piston to force ring down into lower portion of cylinder. This squares piston ring with cylinder. Then piston can be removed and the ring gap checked with the proper thickness gauge.

Side clearance in ring grooves is checked by rolling ring around groove and checking with feeler gauge of proper thickness before assembling. Piston rings should be installed with the gaps staggered around the circumference of the piston.

Piston Pins

Clearances specified for fitting pins in rods and pistons are based on a room temperature of 70° F. The general practice is to select pins that can be installed by pushing with palm of hand, first making sure that pin and bore are smooth and clean.

Piston pins float in rod and piston and are held in piston by retainer rings that fit into grooves in piston pin bosses.

Piston pin bushing should be burnished and reamed to give clearances specified. Make sure that oil hole in rod indexes with oil hole in bushing.

Connecting Rods

Cylinder numbers are stamped on a flat space on rod and cap and rods should always be assembled with these numbers toward camshaft side of crankcase. Connecting rods for FBB-361, FBB-401, and FBB-450A engines are offset and must be installed as shown in Fig. 8.

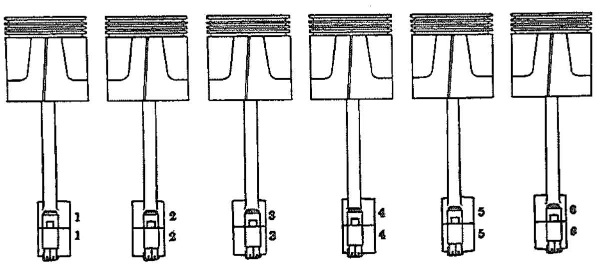


Fig. 8

Connecting-rod bearings are installed flush with face of connecting rod and cap at tongue and groove side, which permits the lower half bearing to extend above face of bearing cap on opposite side.

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run thru the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

When replacing connecting-rod bearings be sure that rods and caps as well as backs of bearing shells are clean and smooth and **free from oil.** This is of extreme importance as bearings will not seat properly if there is any dirt or oil between bearing shells and rods or caps. Wash rods and caps in a good cleaning solution and **dry thoroughly.** This will remove oil as well as any dirt and insure proper contact between backs of bearing shells and rods.

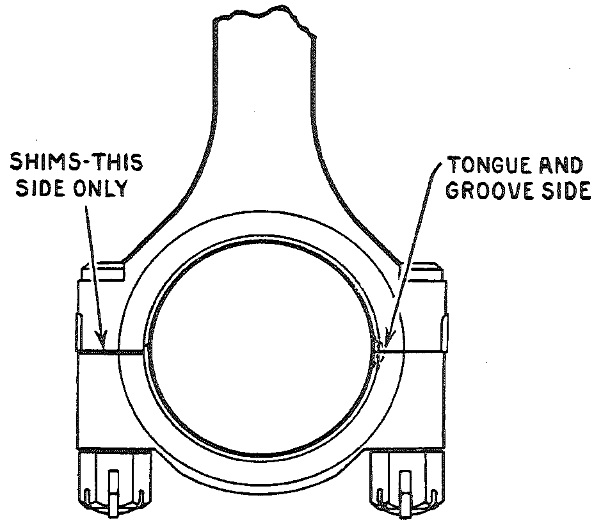


Fig. 9

Connecting-rod bearing shims are assembled on side opposite tongue and groove side and is only side on which shims are used. Four .003″ shims are used (one side only) and if bearing wear cannot be adjusted to specified clearances by removal of shims, new bearing must be installed. Never file connecting rod or cap.

Be sure that shims are properly aligned so they do not touch the bearing shell when cap half is tightened down. When assembling connecting rod cap, the shims can easily be lined up by using two fingers.

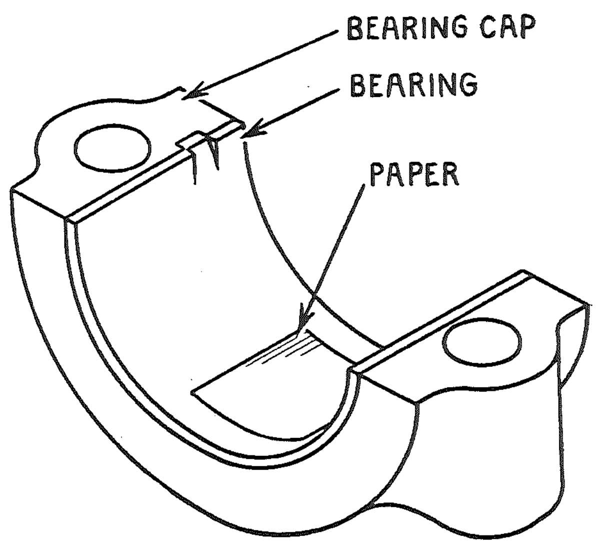


Fig. 10

When installing new connecting-rod bearings always start out with the specified quantity of shims in place. Then if bearing is loose, remove shims as required. Never build up clearance by adding shims but reduce clearance by removing shims. This will prevent damaging bearing shells, by crushing, due to insufficient clearance.

The usual practice is to remove shims until bearing is tight, then replace one .003″ shim which should give the proper clearance. A further clearance check can be made using a piece of paper .0015″ to .0025″ thick, approximately 1″ square. Place the piece of paper between bearing and crankshaft and tighten cap. This thickness of paper should lock the bearing.

Connecting rod and piston assembly is removed thru top of cylinder block.

Main Bearings

Numbers stamped on bearing cap bosses indicate position for installation. Numbers should face camshaft side of crankcase. The small tongues on main bearings should fit snugly into grooves in crankcase and main bearing caps.

Two shims each .003″ thick are used on each side of main bearing, making a total shim thickness of .006″.

Care must be used when assembling shims to see that they clear the bearing locating tongues. Certain types of shims have a relief, or cut-out, which provides clearance for these tongues. If shims are installed incorrectly the bearing shells will be crushed excessively. Shims should not contact the bearing shells at any point.

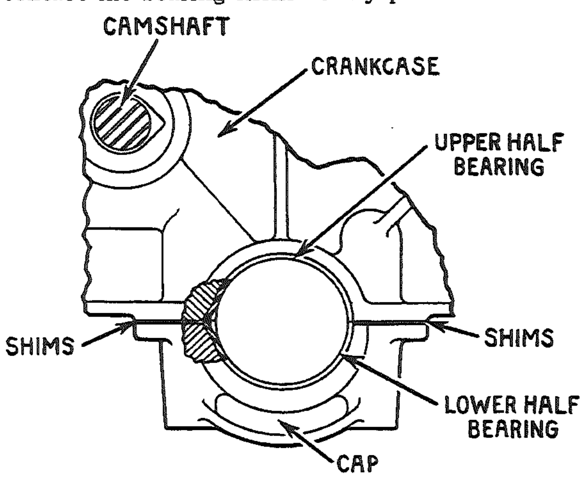


Fig. 11

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run thru the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

It is recommended that a complete set of main bearings be used when replacement is made.

Main bearings can be replaced without removing the crankshaft. All main bearing caps should be loosened slightly, care being taken that the crankshaft and camshaft gears are not demeshed.

Remove No. 1 bearing cap and by lightly tapping the plain edge of the upper half bearing, and in some cases turning the crankshaft in the direction of rotation, the bearing shell is easily removed. Installation is accomplished in reverse manner.

The balance of main bearings are removed and installed in the same manner.

As mentioned under "Connecting Rods" do not add shims after bearing shells have been compressed. Instead, use the specified quantity of shims and remove as required to obtain the proper clearance. This prevents damaging the shells by crushing.

Be sure that the seats for the bearings as well as the backs of the bearing shells are clean and free from oil. A good contact is absolutely essential.

Camshaft Bearings

Camshaft bearings must be installed so oil hole indexes with oil supply hole in cylinder block. This is important to insure sufficient lubricant to bearings.

Bearings are line-reamed to size after installation in crankcase.

Vibration Dampener

This unit is attached to the fan drive pulley by six capscrews and forms the outer flange of the pulley. Two dowel holes are reamed at assembly to .43775″–.43675″ and dowels are pressed in, which help take the load from the capscrews.

These dowels as well as the capscrews must be tight and in the event the vibration dampener is removed from the fan drive pulley and a new dampener installed, oversize dowels should be used.

If necessary to remove the fan drive pulley and vibration dampener assembly, it should be removed as a unit. Two capscrews, directly opposite, should be taken out and replaced with capscrews, the heads of which will extend sufficiently to permit attaching a claw or bar type puller. Do not attempt to drive this assembly off by striking with a hammer or prying with a bar.

When reassembling, be sure that starting crank jaw nut as well as the dowels and capscrews holding the vibration dampener, are tight. This is very important.

CAUTION: Do not wash the vibration dampener in kerosene or any other fluid that is injurious to rubber.

Do not let this unit become saturated with oil or grease, otherwise rapid deterioration of the rubber will result.

Flywheel and Clutch Housing

Proper alignment of flywheel and clutch housing is of extreme importance.

To check alignment and make adjustments the following method should be employed:

1. Remove floor boards, disconnect pedals and propeller shaft.
2. Remove transmission and clutch housing, as one unit, from flywheel housing. Remove clutch.

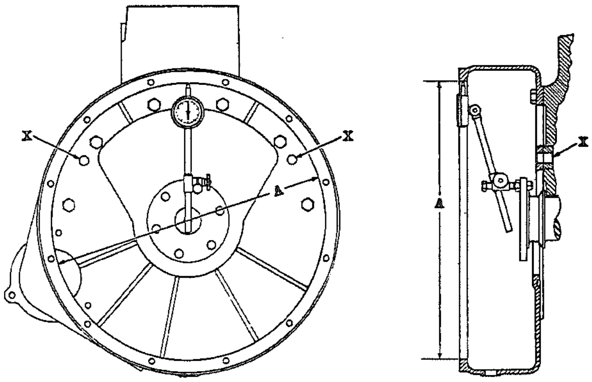


Fig. 12

3. Engine must be supported before removing these parts.
4. Attach indicator as shown and check bore "A." Flywheel housing is doweled to crankcase at "X" and, when correctly aligned, runout of bore "A" should not exceed .005″ total indicator reading.
5. If reading indicates misalignment beyond recommended limits, remove dowel pins and loosen housing attaching bolts sufficiently to permit movement by tapping lightly with a hammer.
6. Set indicator in position showing maximum runout and tap housing slightly to shift its position until indicator reading is ½ of maximum reading. Recheck runout by rotating crank. The resultant reading should approach .000″ or at most, less than .005″ runout.
7. Tighten attaching bolts and reindicate. Re-ream dowel holes, using an oversize reamer that will produce a .001″ to .002″ drive fit of an oversize dowel.
8. Install oversize dowels and reindicate. If these are not available, they can be made from a piece of drill rod the desired size.

Reconditioning Valves and Seats

Clean and polish valve stems and if warped or badly burned, install new valves.

If valve faces are pitted or grooved, reface in refacing machine before grinding. Valve **seats** should not be refaced unless absolutely necessary. If valve seat is not concentric with valve stem guide hole or if seat is too wide, then refacing is necessary. Valve face contact surface width should be 1⁄16″ to 3⁄32″.

After grinding, remove all traces of grinding compound. Check seating of valves by making a number of marks with a soft lead pencil around the valve seat then insert valve and give ¼ turn. Remove valve and if all lines are broken the valve seat is satisfactory.

In some cases it will be possible to touch up the valve stem and rocker arm end contact surfaces in order to assure proper contact and quiet operation at the maximum clearance. However, **it is recommended** that whenever possible, **new parts** be installed.

The valve stem and rocker arm ends are case-hardened, therefore if too much metal should be ground off, the contact surfaces will be soft, which will result in rapid wear. Also the valve stem end must be square with the valve stem and the radius on the rocker arm end **must be held** to .485″–.515″. The rocker arm end must be parallel with the bushing bore within .002″ indicator reading at 2″.

If the valve stem and rocker arm ends are not in the proper relation to each other, rapid wear of the valve guides will result, due to the valve stem being forced to one side.

Fig. 13 illustrates the correct contact between valve and rocker arm end. The radius on rocker arm end must be held and **under no circumstances** should the end be ground off **more than .010″.** The relation of the rocker arm end to the rocker arm bushing is also shown.

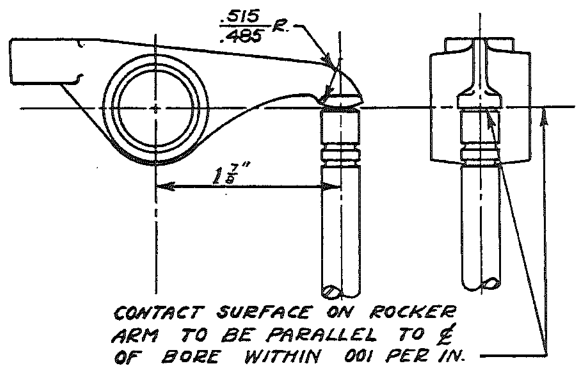


Fig. 13

Valve Clearance Adjustment

Proper clearance between valve rocker arms and ends of valve stems must be maintained in order to obtain satisfactory operation.

Before making an adjustment run engine sufficiently to **thoroughly** warm it up. This is important. Engine should be run at least 15 minutes after water temperature has reached its normal point. If necessary, cover radiator.

Valve Stem Guides

Press valve stem guides in from valve spring side of cylinder head to dimension shown, with tapered end up. A 1 1⁄16″ high sleeve should be placed over guide when making installation to provide a positive stop when correct position is reached.

After installation, ream valve guides to .374″. Reaming should be done carefully and slowly—do not force reamer. A smooth finish is essential as the amount of bearing surface between valve stem and guide is dependent upon finish of guide bore.

After reaming valve guides, check valve seats and if runout exceeds .002″ to .003″, seats should be refaced. When refacing valve seats the tool must be piloted in valve guide.

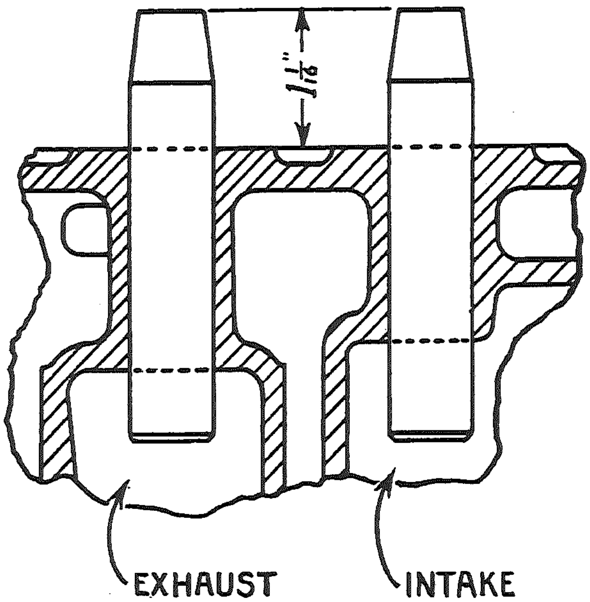


Fig. 14, FBB-298 Engine

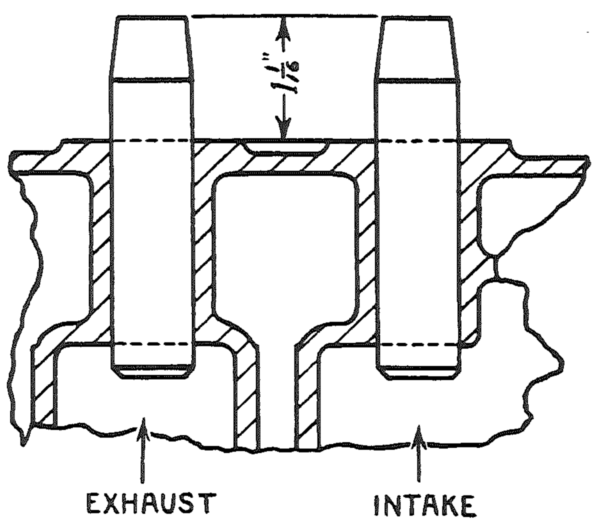


Fig. 15, FBB-361, FBB-401, FBB-450A Engine

Valve-Seat Inserts

Necessity for replacing valve-seat inserts should be very rare; however, if a replacement is made it is important that new inserts be peened securely in place. A dull pointed chisel, ¼″ wide, is used to peen cylinder head metal over outer edge of valve-seat insert.

Valve-seat inserts supplied for service are .010″ larger diameter than those used in production, which permits a good tight fit in cylinder head. Letter "M" is stamped on top of insert. Install with this side out.

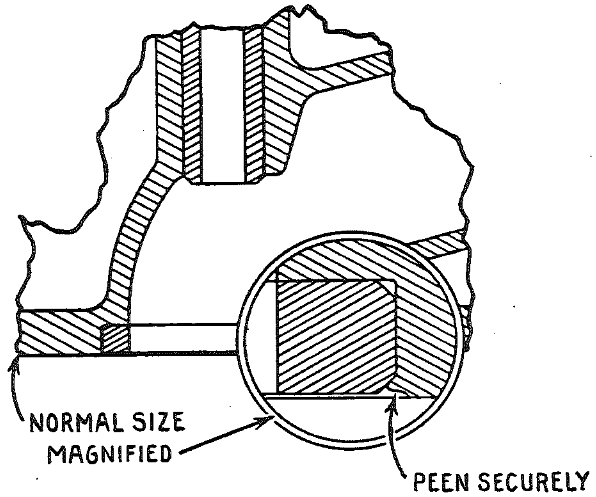


Fig. 16, Valve Seat Insert

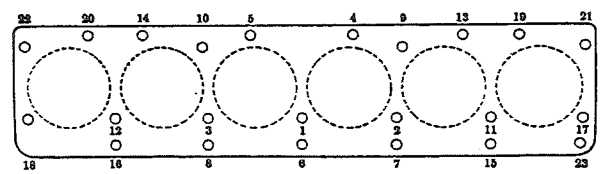


Fig. 17

Cylinder Head

Fig. 17 illustrates the correct order in which cylinder head should be tightened. This is important to assure a good seal between cylinder head, cylinder head gasket and cylinder block and will also avoid strains in cylinder head casting.

When cylinder head has been removed, it is a good plan to install a new head gasket. In some cases the old gasket may be entirely satisfactory; however, to avoid the possibility of water or gas leakage a new gasket is recommended.

To guard against compression or water leaks, coat both sides of the cylinder head gasket with a suitable, clear sealing compound, such as shellac. Let gasket dry until the coating becomes tacky, then install with beaded side up as stamped, first making sure that block and head are smooth and clean. Any foreign matter between gasket and head or block will result in early gasket failure.

After cylinder head has been tightened, run engine for a few minutes, and retighten.

Valve Tappets and Guides

Model FBB-298

Valve tappet guides are separate from crankcase and are in two sections, each section taking six tappets.

Valve tappets are held in guides by small lock rings fitted into a groove at end of tappets. The lock rings prevent tappets from falling out when camshaft is removed.

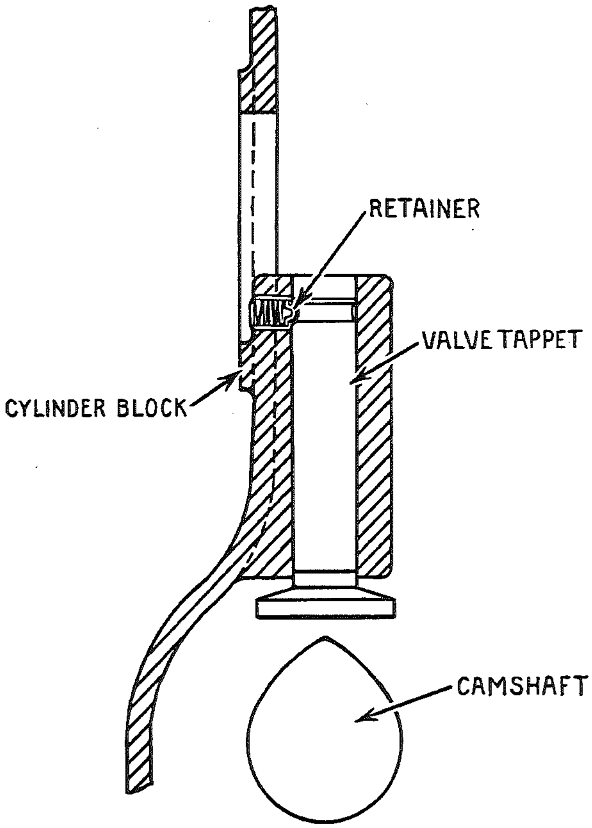


Fig. 18, FBB-361, FBB-401, FBB-450A Engine

Models FBB-361, FBB-401, FBB-450A

Valve tappet guides are integral with crankcase and have valve tappet retainers pressed into place.

To remove camshaft, valve tappets are pushed upward which permits valve tappet retainers to snap into grooves at end of tappets. Camshaft can then be removed without danger of tappets falling out.

After reassembling camshaft, tappets can be pushed down into position by the push rods.

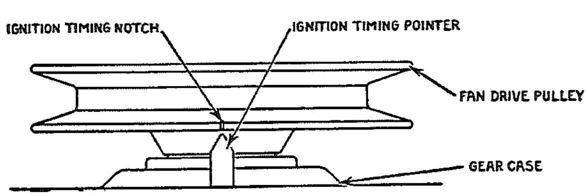


Fig. 19

Ignition Timing Indicator

An ignition timing indicator or pointer is attached to the front gear cover just above the fan drive pulley. This pointer, when opposite the notch in the rear flange of the fan drive pulley, indicates the correct ignition timing position.

There are no timing marks on the flywheel.

Timing Gears

Use suitable pullers or pushers to remove or install timing gears. Do not drive gears on or off.

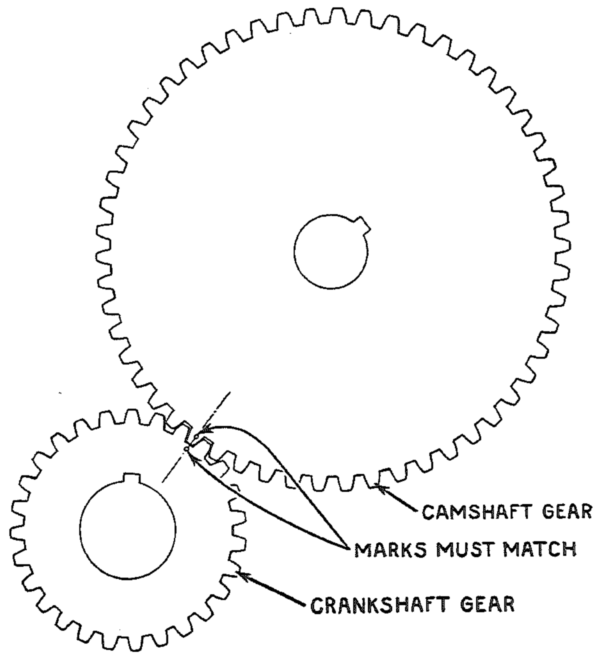


Fig. 20

Timing gears must be installed so that the crankshaft and camshaft are in correct relation to each other. Gears are marked and should be installed so that marks on camshaft and crankshaft gears match. Engine timing diagram is shown in Figs. 21 and 22.

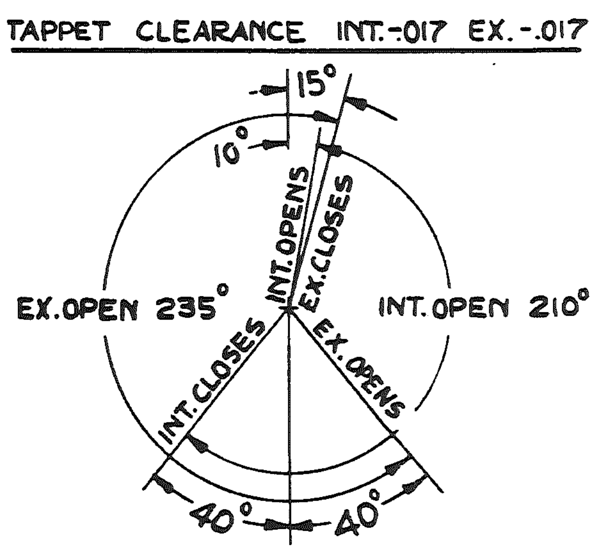


Fig. 21, FBB-298 Engine

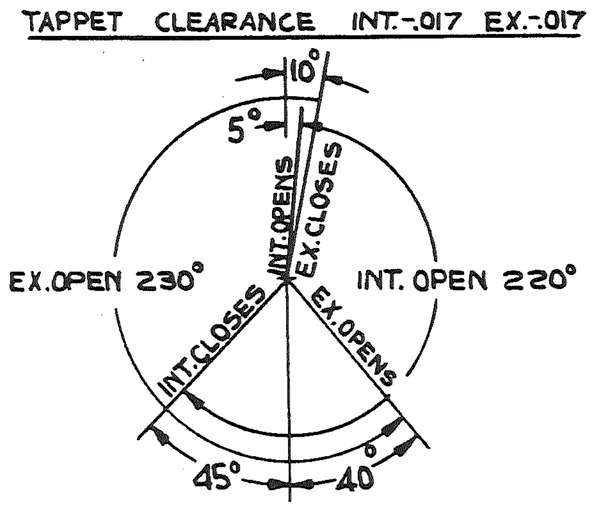


Fig. 22, FBB-361, FBB-401, FBB-450A Engine

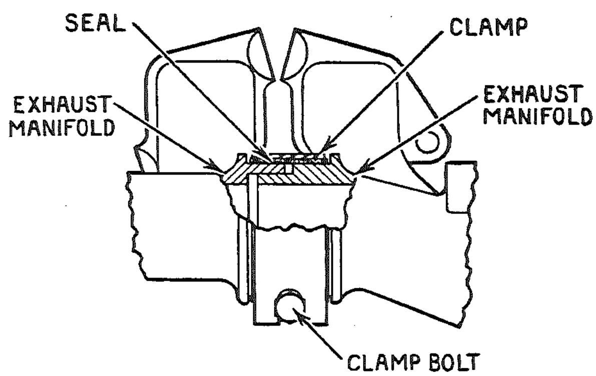


Fig. 23

Exhaust Manifold Seals

The two clamp type seals where front and rear sections join center section must be kept tight in order to prevent escape of exhaust gases. If leakage develops, check seal material under clamps and replace if necessary. Be sure clamp bolts are pulled down tight so clamps compress seal, thereby insuring a gas-tight joint.

Exhaust Pipe Seal Ring

The assembly of the exhaust pipe seal ring is shown in Fig. 24.

Be sure that seal ring seats squarely against exhaust manifold, exhaust pipe and flange, and tighten stud nuts evenly in order to prevent distortion of exhaust pipe and possible breakage of exhaust pipe flange.

If the seal ring is assembled properly no exhaust leakage will occur.

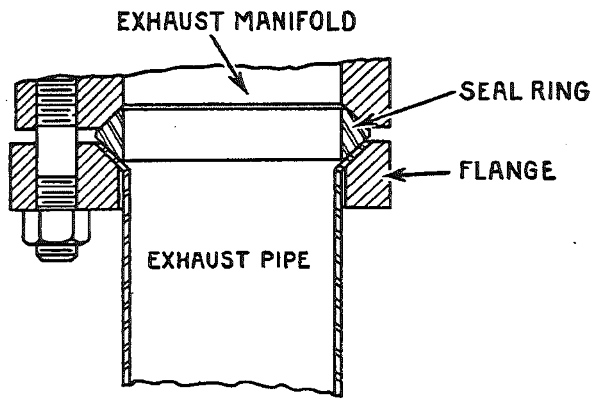


Fig. 24

Fan Belt Adjustment

Fan belts are furnished in matched sets and it is recommended that when replacement is necessary both belts be replaced.

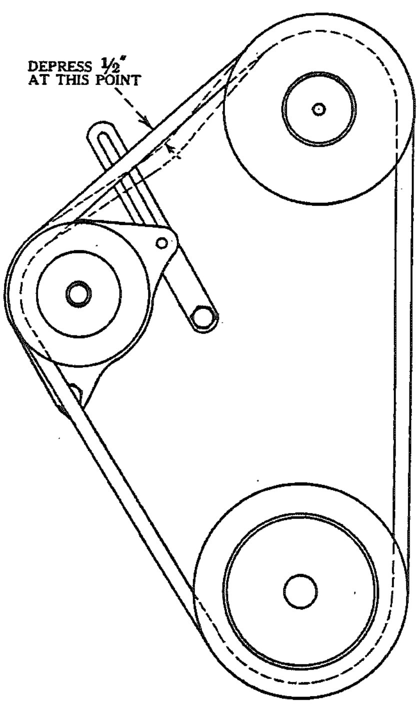


Fig. 25

Belts should run under proper tension. Adjustment is made by loosening generator mounting screws and generator brace capscrew, after which generator can be moved in or out as required.

Proper tension is obtained when belts can be depressed approximately ½" as shown in Fig. 25.

After adjustment has been made be sure to tighten all capscrews.

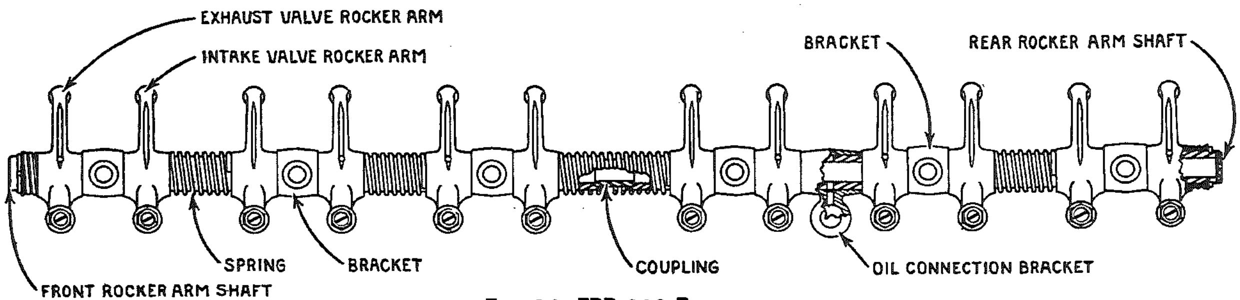


Fig. 26, FBB-298 Engine

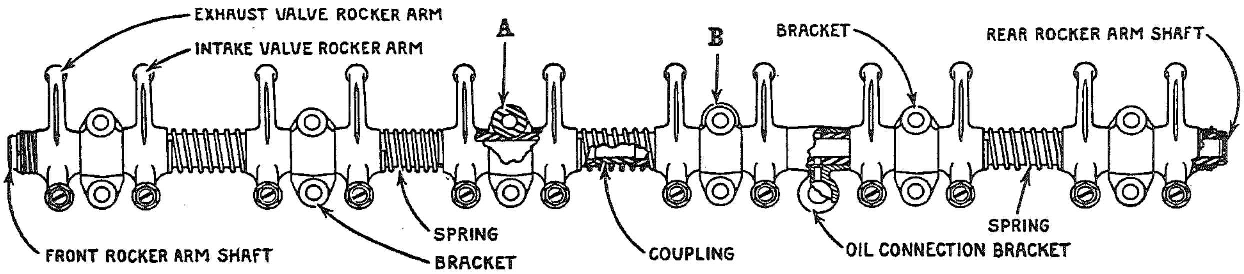


Fig. 27, FBB-361, FBB-401, FBB-450A Engine

Valve Rocker Arms and Shafts

Assembly of valve rocker arms, springs and brackets on valve rocker arm shafts is shown in Fig. 26 for FBB-298 engine and Fig. 27 for FBB-361, FBB-401, and FBB-450A engines.

Note that exhaust valve rocker arms are drilled for additional lubrication to exhaust valve stems and guides while intake valve rocker arms are not drilled.

On FBB-298 engines valve rocker arm shafts are prevented from turning by the rocker arm shaft bracket mounting studs which go directly thru valve rocker arm shafts.

Valve rocker arm shafts on FBB-361, FBB-401, and FBB-450A engines are prevented from turning by washers in center brackets, which fit into grooves in rocker arm shafts.

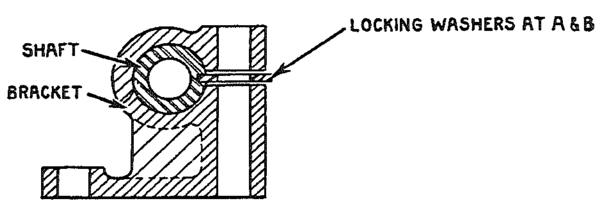


Fig. 28, FBB-361, FBB-401, FBB-450A Engine

Be sure washers are assembled in grooves. If washers are not assembled in grooves, the oil holes in rocker arm shafts will not line up properly, which will result in insufficient lubrication and oil leakage.

When assembling rocker arm shafts make sure the rocker arm shaft oil connection bracket, which supplies oil to rocker arms, valve stems and guides, lines up with oil hole in **rear** rocker arm shaft.

It is important that gaskets be installed on each side of the oil connection bracket.

Rocker arm bushings are burnished and reamed at assembly to .875″–.876″. Oil holes in bushings must line up with holes in rocker arms. Assemble rocker arms on shafts in the proper positions—exhaust valve rocker arms have the extra oil hole.

Valve Springs

Valve springs should be square in their seats and also should be checked with Valve Spring Tester S. E. 809 to determine if they meet specifications. This should be done at every valve grind and replacement made when necessary. Install valve springs with close coiled end to cylinder head.

Crankshaft Oil Wick

Be sure that the oil wick is properly installed. Do not use a screw driver or other tool to force wick into the hole as this will cut the felt and cause oil leakage. The best method of installation is by using a cork extractor (similar to that used to remove corks from the inside of bottles). This device is inserted thru the hole and hooked onto the end of the wick. Start the wick squarely, and pull thru, leaving $\frac{1}{16}$″ to ⅛″ projecting on the connecting rod journal side. Cut off surplus on the flywheel side.

If a bottle cork extractor cannot be obtained, a piece of wire may be wrapped around one end and the wick pulled thru. Dipping the wick in light oil will assist in the assembly.

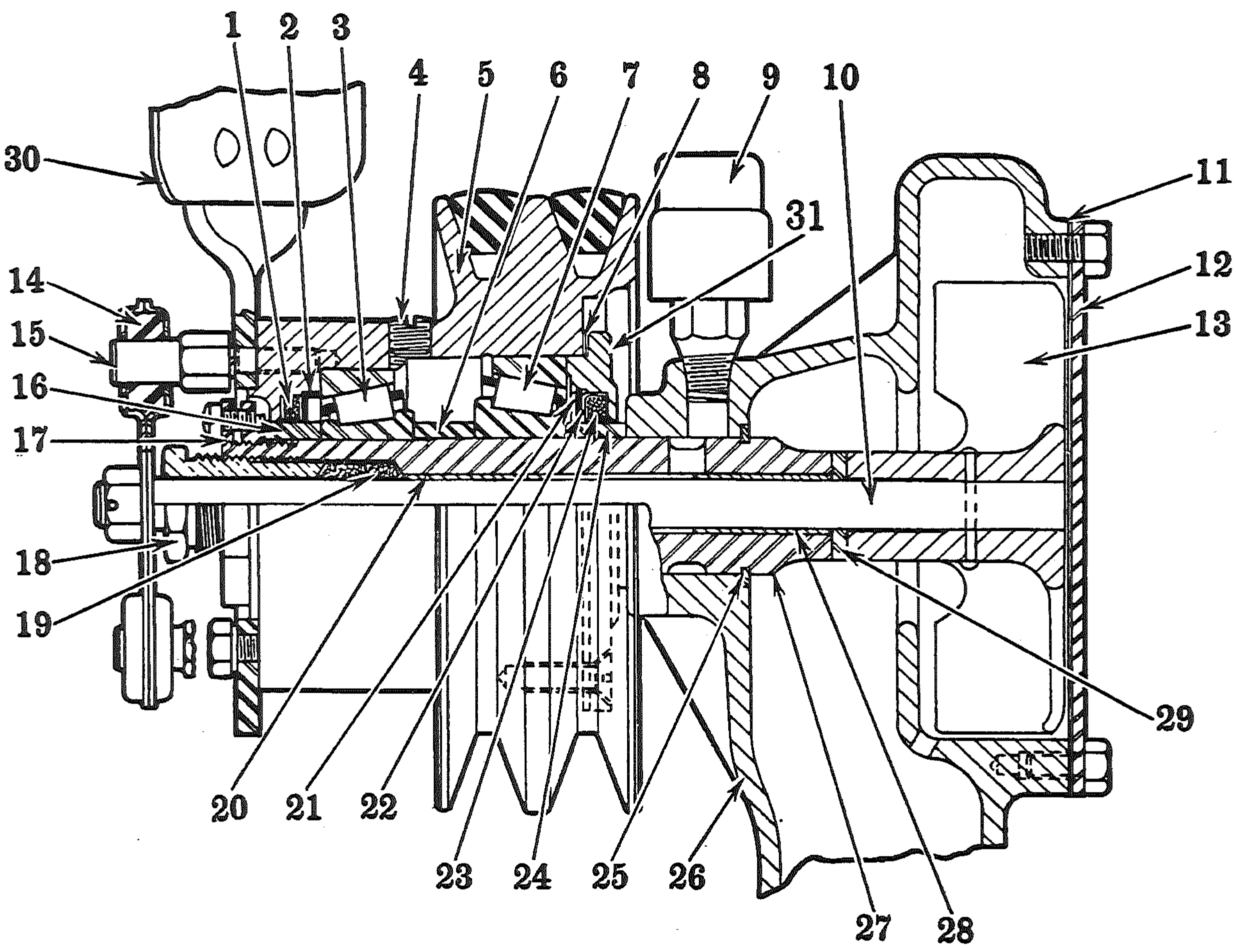


Fig. 29

No.	Description
1.	Bearing felt seal (front and rear).
2.	Bearing felt seal retainer cup.
3.	Fan bearing assembly (front).
4.	Slotted pipe plug.
5.	Fan pulley.
6.	Fan bearing spacer (center).
7.	Fan bearing assembly (rear).
8.	Fan bearing retainer shim.
9.	Water pump shaft grease cup.
10.	Water pump shaft.
11.	Water pump body plate gasket.
12.	Water pump body plate.
13.	Water pump impeller.
14.	Water pump driver.
15.	Water pump driver screw.
16.	Fan bearing spacer (front).
17.	Fan bearing lock nut.
18.	Water pump packing nut.
19.	Water pump packing.
20.	Water pump shaft bushing.
21.	Bearing retainer cup lock ring.
22.	Bearing felt seal retainer cup.
23.	Front felt seal (front and rear).
24.	Fan bearing spacer (rear).
25.	Water pump sleeve lock ring.
26.	Water pump body.
27.	Water pump shaft sleeve.
28.	Water pump shaft bushing.
29.	Water pump thrust washer.
30.	Fan.
31.	Fan bearing retainer.

Water Pump

The water pump is driven by V-belts from a pulley on the engine crankshaft. The water pump pulley operates on two tapered roller bearings mounted on a sleeve thru which the water pump shaft runs. The water pump shaft is driven by the water pump driver (14). This construction relieves the water pump shaft of the fan and fan belt loads.

Water Pump Packing

A water pump packing nut (18) provides means of keeping the packing tight. Tighten packing nut just enough to stop leakage with engine not operating. If packing is compressed excessively a scored shaft will result.

When necessary to add packing the water pump driver (14) must be removed after which the packing nut can be unscrewed and packing rings added as required.

Adjustment of Fan Pulley Bearings

It is essential that the front and rear roller bearings (3 and 7) have sufficient clearance, otherwise early bearing failures will occur.

After assembling the front bearing (3), center spacer (6), rear bearing (7) and front and rear seals, assemble the fan bearing retainer (31) and shims (8). All parts must be clean and **free from grease.**

The next step is to make sure that the rear roller bearing cup is against the fan bearing retainer. Tap the fan pulley assembly against a work bench or block of wood so that the bearing cup will be jarred down against the retainer.

Then check the clearance between the center spacer and bearing cones to determine if there is proper clearance (See Specifications). The best way to check this is by feel. If the center spacer is tight, install another shim between the bearing retainer and pulley and if the clearance is excessive remove shims as required.

Each time a shim is added or removed, tap the pulley assembly against a block of wood so that the bearing cup will be forced against the retainer. This is important in order to secure an accurate clearance check.

After it has been determined that the fan pulley bearings have the correct amount of clearance, complete the assembly of the fan pulley and water pump. Remove the pipe plug (4) and pack with grease as covered in Lubrication Section.

Water Pump Body Plate

If water pump body plate (12) has been removed the threads of mounting screws should be dipped in white lead before reassembling to prevent water leakage.

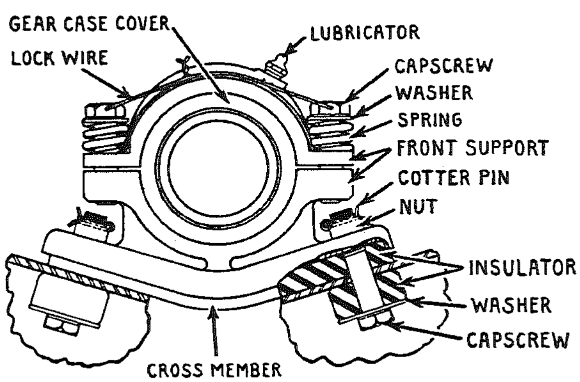


Fig. 30

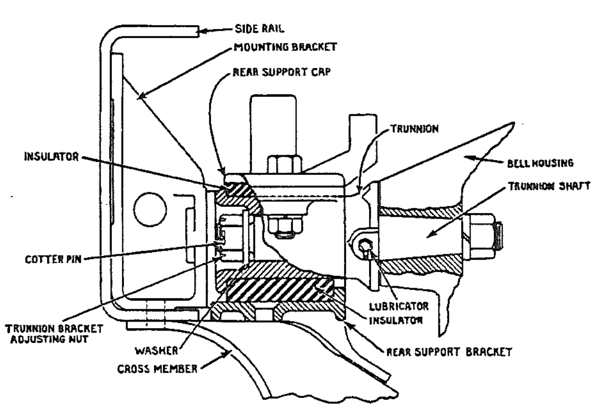


Fig. 31

Engine Mounting

Fig. 30 and Fig. 31 illustrate front and rear engine mounting.

Check front mounting attaching screws occasionally to determine if they are tight and springs are under tension. Be sure engine support cap capscrews are securely locked with lock wire and cross member support capscrews are properly secured with cotter pins.

When reassembling rear mounting trunnion, tighten nut while rotating trunnion slowly. When tightening of trunnion shaft nut just stops trunnion, back nut off 1/6 turn or to next cotter pin hole. Trunnion should be free to move on trunnion shaft but not be loose.

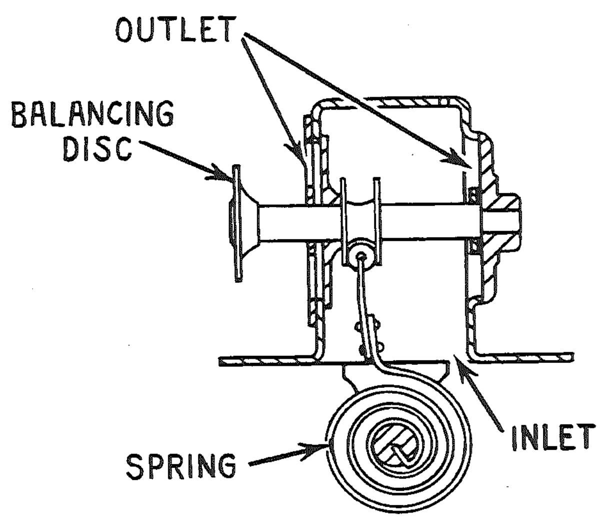


Fig. 32

Water Thermostat

The water thermostat is a balanced valve type having two outlets which are controlled by two valve discs mounted on a common shaft and incorporating one external balancing disc to prevent water pressure from disturbing the true temperature control during the opening and closing cycles.

This thermostat is nonadjustable and is set to start to open at 145 to 150° F. The use of the thermostat shortens the warm-up period and reduces to a minimum crankcase condensation and dilution.

The operation of the thermostat can be checked by placing it in still water and heating the water. A reliable thermometer should be used and at a temperature of approximately 145 to 150° F. the valves should start to open and be fully opened (1/4" approx.) at around 200 to 205° F. This applies only to a still water test.

If the thermostat does not function as outlined above a new one should be installed.

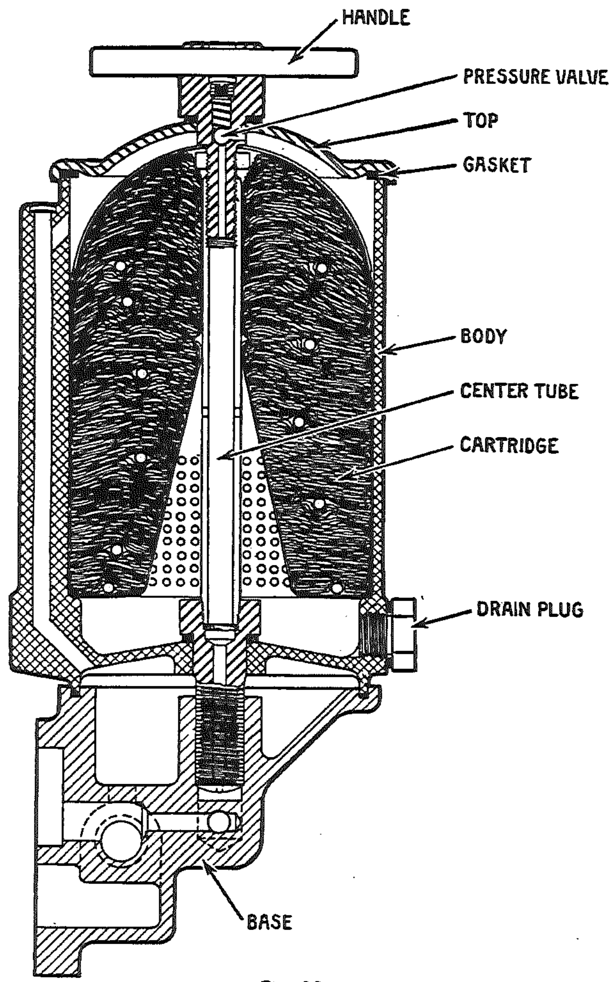


Fig. 33

Oil Filter

The construction of the oil filter is shown in Fig. 33.

Oil from the engine is discharged into the center tube, or pressure control chamber. Pressure at which the oil is discharged into the filter element is controlled by the pressure valve at the top of the center tube while the inlet adapter at the bottom of the center tube regulates the volume of oil entering the filter.

After the volume of oil and the pressure has been regulated in the center tube, it is discharged into the filter thru holes in the center tube at the top of the perforated inner cone.

The action of the oil washing over the inner cone removes large and heavy particles which are deposited in the sump.

Oil circulates thru the filtering element and is then discharged back into the engine.

The filtering element or cartridge should be replaced when the oil **becomes** of a **smoky** or **black color.** Cartridge is replaced by unscrewing handle at the top of filter and lifting the cover off. The old cartridge can then be removed and a new one installed. **Do not attempt to wash out old cartridge** as this cannot be done. Replace with a new one.

Remove drain plug in sump, whenever a new cartridge is installed, and drain sump.

Oil Pump Installation

If oil pump has been removed, the ignition distributor must also be removed before reinstalling the pump. This is due to the fact that the slots in the ends of the oil pump drive shaft and ignition distributor shaft must match the tangs on the ends of the distributor drive shaft. If an attempt is made to install the oil pump assembly without first removing the distributor it will be difficult to align the slots and tangs with the result that the pump will be damaged when the pump mounting bolts are tightened.

After installing the oil pump assembly it is an easy matter to align the shafts.

NOTE: When oil pump has been removed from the engine, it will be necessary to retime the ignition.

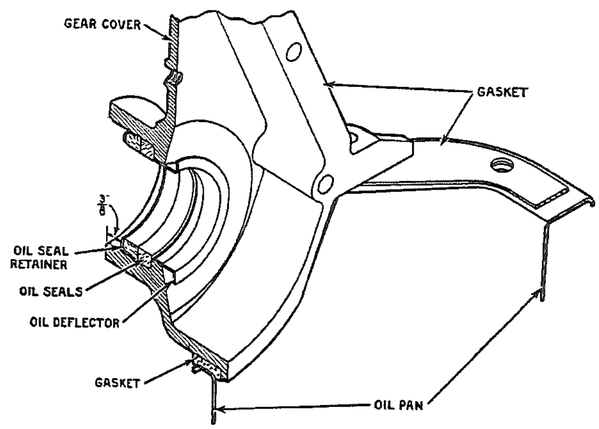


Fig. 34

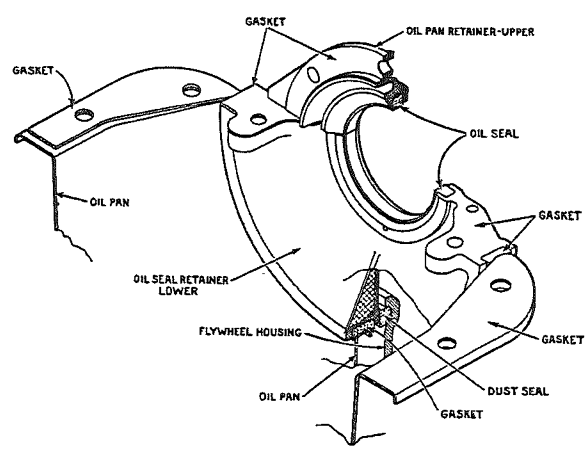


Fig. 35

Oil Seals and Gaskets

Correct assembly of oil seals, retainers, and gaskets is of extreme importance in preventing oil leaks.

Fig. 34 illustrates the assembly of the crankshaft front seal, retainers and oil pan gaskets, and Fig. 35 illustrates the rear assembly.

Make sure when replacing seals or gaskets that no foreign matter is adhering to the surfaces, which would prevent proper contact.

Dip felt seals in oil before assembly.

Oil Consumption

High oil consumption is usually attributed to worn piston rings and cylinders; however, in many cases it will be found that the main, rod or camshaft bearings have worn, permitting excessive spray off of oil which results in overlubrication of cylinder walls.

It is recommended that the bearings be given an oil pressure test, as outlined in following paragraphs, before disturbing the piston and ring assembly.

Oil pressure is controlled by the pressure valve spring located in the oil filter base. Oil pressure should be checked when engine is hot and oil is warm.

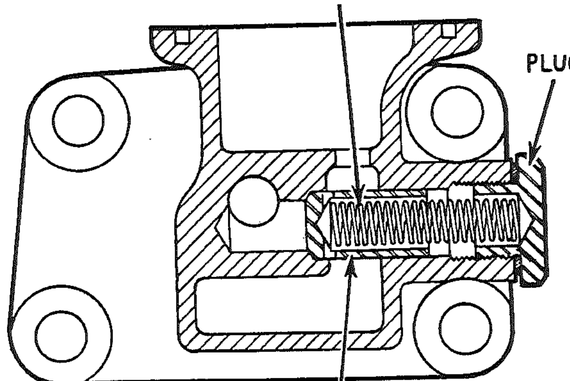


Fig. 36

When low oil pressure is encountered, a systematic and thorough investigation is necessary in order to determine the cause.

The following are the principal causes for this condition and it is recommended that these be thoroughly checked in the order named, which in all probability will result in the definite cause being determined.

Oil Supply

Excessively diluted condition or insufficient amount in crankcase.

Oil Pressure Gauge

Improper registration of gauge.
Loose connections.

Oil Filter

Clogged condition of filter element.
Pressure valve not holding.
Weak pressure valve spring. Check by installing spacers in back of spring. Free length of spring should be 3″.

Oil Pump

Clogged condition of screen.
Gear cover gasket faulty.
Excessive clearance between gears and cover plate.
Specified gasket thickness, .004″ to .006″.
Worn condition of gears, allowing loose mesh.

Main Connecting Rod and Camshaft Bearings

Excessive running or end clearances.
Out-of-round condition of bearings or journals.
Imperfect bearings—badly pitted or chipped.

In order to check main, connecting rod and camshaft bearing clearances to determine if they are excessive and the cause of low oil pressure, the following equipment and method has been found effective.

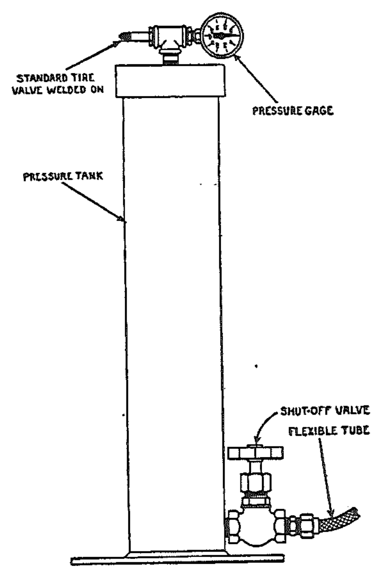


Fig. 37, Test Tank

A test can be made from a piece of 4″ pipe approximately 24″ long. Weld a plate or base on one end and thread the other end to take a cap. Drill and tap the cap to take a tee connection and in one side insert a tire valve and in the other a pressure gauge registering to at least 75 pounds.

Drill and tap a hole near the bottom of the pipe so that a valve can be installed and to the valve attach a flexible hose.

This test fixture can be made from a small tank, if one is available, or any other suitable material.

The tank should not be more than half full of S.A.E. 10 or a heavier grade of heated oil and in the case of the tank described above, 2 or 3 quarts of oil will be sufficient. Tank can be filled by removing tee connection. The flexible hose should be connected to the oil pressure connection in the engine.

Apply air pressure to about 50 pounds, then open valve in bottom so that oil will be forced into oil channels and bearings. Inspect for excessive leakage and spray off, which denotes excessive clearance and likewise pressure loss.

If oil filter is used, remove filtering element and clean out base so that dirt collected in filter will not be forced into oil channels of engine. The filter element should be left out when making this test.

Cleaning of Engines

The importance of having an engine, or any other unit in the truck, clean and free from dirt, sludge, abrasives, etc., cannot be too strongly stressed. While every effort is made by the manufacturer to prevent dirt from entering an engine or other unit, nevertheless a certain amount will possibly accumulate after the job has been in service for a period of time. For this reason it is recommended that whenever any work is being done, the parts removed be thoroughly cleaned before they are reassembled.

The entire cylinder block casting should be thoroughly washed with a strong cleaning solution which will remove dirt, sludge and carbon formations that may have accumulated. If Stoddard Solvent or kerosene is used, wash again, using hot soapy water and rinse with clear water under pressure. Dry thoroughly and coat with light oil to prevent rusting. Particular attention should be paid to any recesses in the cylinder block and crankcase where an accumulation of dirt, sludge or carbon might be found.

If the cylinder block is not thoroughly cleaned before reassembling there will be the possibility of dirt and carbon jarring loose, when engine is being run-in. This accumulation will be circulated thru the oiling system with the result that bearings, crankshaft, camshaft, pistons, valve stems, etc., will be damaged.

It is recommended that all pipe plugs be removed from the drilled oil lines in cylinder block. A good way to clean out the drilled oil lines is by using a long handled rifle barrel brush. This type of brush will run thru the main drilled oil line in the side of the cylinder block.

Cylinder blocks should be immersed in a large cleaning tank and if such equipment is not available at the Branch this work should be sent to a reputable concern that specializes in cleaning such parts.

After cleaning, the entire casting should be thoroughly dried, especially the drilled oil lines and all finished surfaces should be lubricated to prevent rust formations.

The oil filter should be thoroughly cleaned out, removing any accumulation of sludge and dirt from the sump in the base. Replace filtering element if necessary.

It is a good policy to disassemble and thoroughly clean all parts of the oil pump. This will permit checking fits and enable the mechanics to determine the parts needing replacement.

The oil filler or breather cap should be removed and the wire mesh thoroughly washed out.

Fuel pump should be thoroughly cleaned out, especially the small breather located in the body. This breather can be removed and slushed around in a cleaning fluid which will remove all dirt. If examination reveals excessive dirt, disassemble fuel pump and clean all parts.

Oil in air cleaner should be changed every time crankcase is drained. Clean out air cleaner cup. Make sure all connections are tight so that dust and dirt cannot enter. See detailed instructions under "Air Cleaner."

Disassemble carburetor and clean out thoroughly. Do not run a wire thru jets as this will enlarge the holes, thereby disturbing the calibration, which will result in poor fuel economy and engine performance.

If an engine has been properly overhauled with all parts fitted to specified clearances and assembled properly and **all parts thoroughly cleaned,** its performance and life will be increased materially.

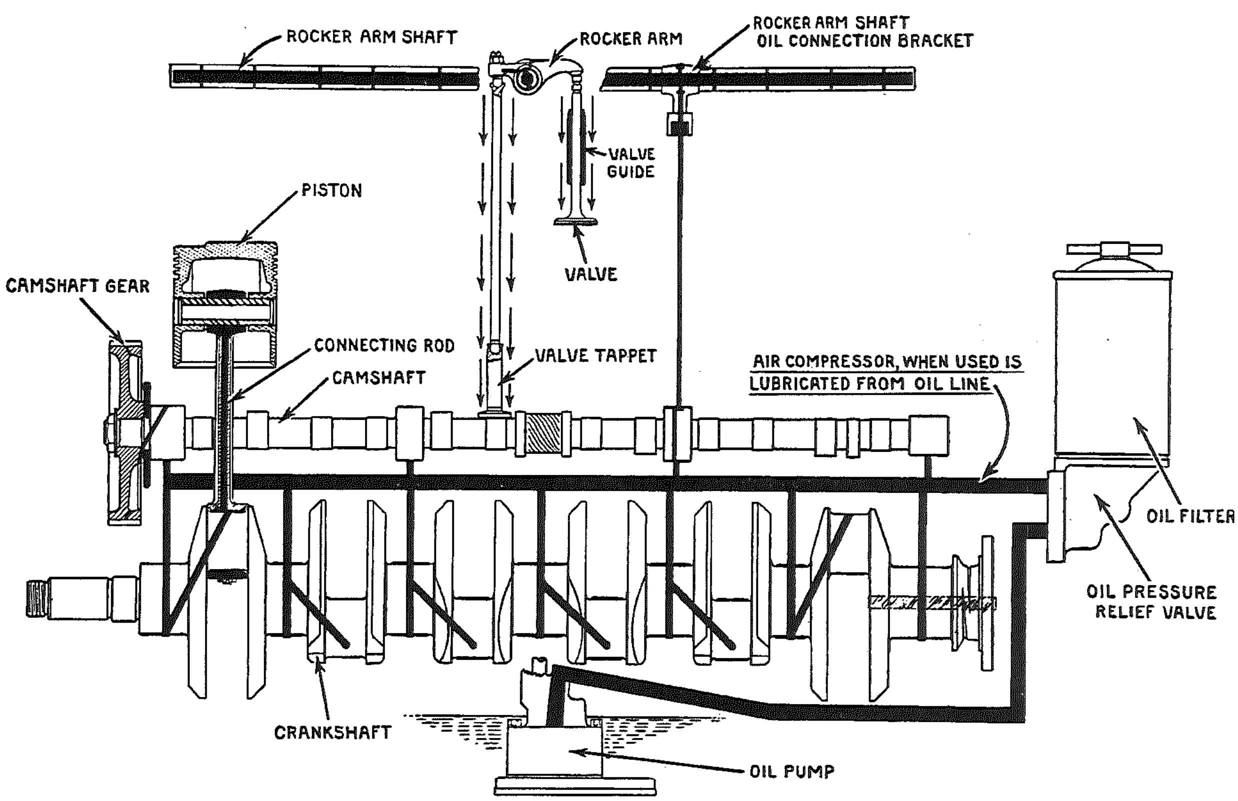


Fig. 38, Engine Lubrication System

Engine—FC-132

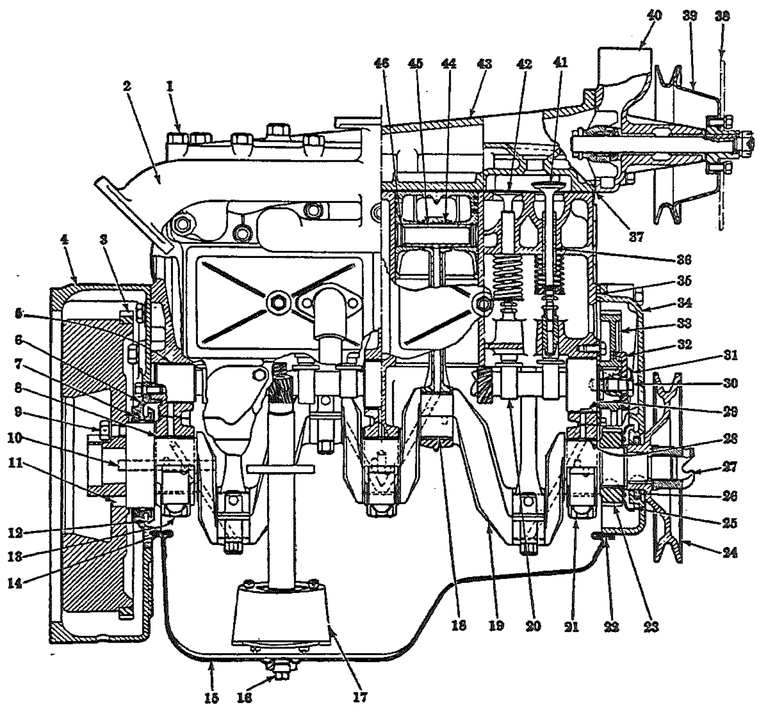


Fig. 1, FC-132 Engine

No.	Description
1.	Cylinder head capscrew.
2.	Intake and exhaust manifold.
3.	Flywheel ring gear.
4.	Flywheel housing.
5.	Camshaft rear bearing.
6.	Crankshaft oil seal retainer.
7.	Crankshaft oil seal retainer felt.
8.	Crankshaft rear bearing.
9.	Flywheel and crankshaft mounting capscrew.
10.	Crankshaft oil wick.
11.	Flywheel and crankshaft dowel.
12.	Crankshaft rear oil slinger.
13.	Crankshaft bearing cap capscrew.
14.	Oil pan gasket.
15.	Oil pan.
16.	Oil pan drain plug.
17.	Oil pump.
18.	Connecting-rod bearing.
19.	Crankshaft.
20.	Camshaft.
21.	Crankshaft bearing cap capscrew.
22.	Oil pan gasket.
23.	Crankshaft gear.

No.	Description
24.	Fan drive pulley.
25.	Crankshaft oil slinger.
26.	Gear cover felt.
27.	Starting crank jaw nut.
28.	Crankshaft front bearing.
29.	Camshaft front bearing
30.	Camshaft gear lock screw.
31.	Camshaft gear lock screw lock.
32.	Camshaft gear lock.
33.	Camshaft gear.
34.	Gear cover.
35.	Gear cover plate.
36.	Valve guide.
37.	Water pump gasket.
38.	Fan.
39.	Fan pulley.
40.	Water pump.
41.	Exhaust valve.
42.	Intake valve.
43.	Cylinder head.
44.	Piston pin bushing.
45.	Piston pin.
46.	Piston pin retainer.

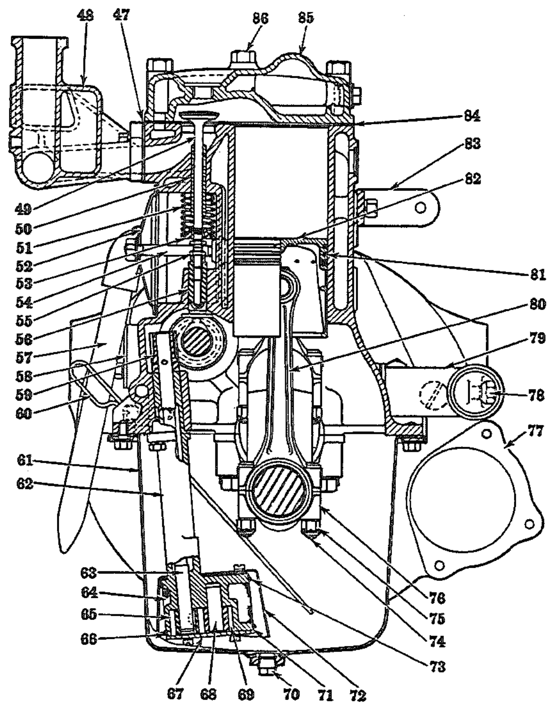


Fig. 2, FC-132 Engine

No. Description

47. Intake and exhaust manifold gaske'.
48. Intake and exhaust manifold.
49. Valve.
50. Valve guide.
51. Valve spring.
52. Valve cover plate.
53. Valve spring retainer and lock.
54. Valve cover plate stud.
55. Valve tappet adjusting screw.
56. Valve tappet.
57. Crankcase breather tube.
58. Fuel pump mounting pad.
59. Oil pump shaft drive gear.
60. Oil level gauge.
61. Oil pan.
62. Oil pump body.
63. Oil pump drive shaft.
64. Oil pump screen.
65. Oil pump body gear.
66. Oil pump screen clamp wire.
67. Oil pump body cover.
68. Oil pump idler gear shaft.
69. Oil pump idler gear.
70. Oil pan drain plug.
71. Oil pump body cover gasket.
72. Oil pump baffle.
73. Oil pump screen clamp wire.
74. Connecting rod bolt.
75. Connecting rod bolt nut.
76. Connecting rod bearing cap.
77. Starter mounting pad.
78. Water inlet elbow screw.
79. Water inlet elbow.
80. Connecting rod.
81. Piston rings.
82. Piston.
83. Generator mounting bracket.
84. Cylinder head gasket.
85. Cylinder head.
86. Cylinder head capscrew.

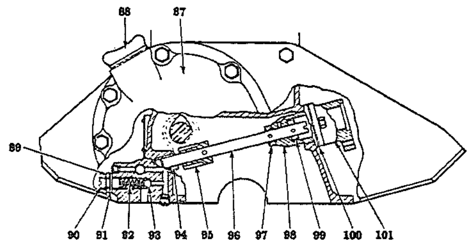


Fig. 3, FC-132 Engine

No. Description
87. Gear cover.
88. Oil filler cap.
89. Oil relief valve adjusting screw lock nut.
90. Oil relief valve adjusting screw.
91. Lock nut washer.
92. Oil relief valve spring.
93. Oil relief valve ball.
94. Ignition distributor drive shaft bushing.
95. Ignition distributor drive shaft gear.
96. Ignition distributor drive shaft.
97. Ignition distributor drive shaft collar.
98. Ignition distributor drive shaft housing.
99. Ignition distributor drive shaft collar.
100. Gasket.
101. Ignition distributor drive shaft housing.

Best Results from Reconditioned Engines

For best results when an engine is reconditioned, and particularly when new pistons are installed, the following items should be observed:

1. Lubricating-oil compartments and passages must be thoroughly cleaned of sludge, dirt and abrasive material, and the oil filter placed in efficient operating condition. Working parts should be lubricated well with clean oil at time of assembly.
2. Air cleaner must be placed in efficient operating condition and all connections between cleaner and carburetor must be airtight.
3. All engine gaskets must be tight.
4. See that engine is free, start it, and let run idle, beginning at slow speed and gradually increasing to maximum idling governed speed. Tighten cylinder head and readjust valve clearance after engine is warmed up. During the break-in period it is recommended that a good quality light oil (S.A.E. 10 or 20) be used, care being taken to inspect oil level frequently and to maintain it at proper height.

Cylinder Block

When reconditioning cylinder bores it is important that they be held to the specified limits. Bore sizes should be checked with an accurate gauge.

After honing, cylinder bores should be thoroughly cleaned to remove all abrasive material (See "Cleaning of Engines").

Pistons

Pistons are cast iron and should be fitted to specified clearances, using a 3/8" wide ribbon with from 5 to 12 pounds tension on a scale. Under no circumstances should tension on scale exceed 12 pounds. Insert ribbon between piston and cylinder 90° from piston pin hole and in line with thrust face of piston.

A feeler gauge set and tension scale combination is available which if used properly will facilitate the fitting of pistons. This tool is carried under S.E. 1007.

Piston Rings

FC-132 pistons have one plain and one No. 70 compression and one No. 85 oil control ring with the oil control ring in the bottom groove.

Examine cylinder bores before installing new pistons and rings. If necessary, the bores should be reconditioned especially if they are out of round or tapered or have a ridge at the top. If the ridge is not removed when new piston rings are installed trouble may be experienced with the top rings striking. It is always the best policy to recondition cylinder bores before installing new pistons or rings.

If new rings are being installed on old pistons the ring grooves should be thoroughly cleaned out to remove all carbon.

The ring clearance in the groove is checked by rolling the ring around the piston and checking the clearance between ring and ring land with a feeler gauge of the specified thickness.

New rings should be fitted into the cylinders in which they are to be used before assembling on pistons. Put piston in cylinder then insert piston ring, pushing it against head of piston to square it with cylinder. This check should be made with piston near bottom of cylinder where there usually is the minimum wear. Measure ring gap with thickness gauge. Another method of checking ring gap is to insert piston ring in cylinder, then use a piston to force ring down into lower portion of cylinder. This squares piston ring with cylinder. Then piston can be removed and the ring gap checked with the proper thickness gauge.

Install piston rings with the gaps staggered around the circumference of the piston.

Care should be exercised when removing or installing piston rings to prevent distortion. Suitable tools should be used during this operation.

Piston Pins

Clearances specified for fitting pins in rods and pistons are based on a room temperature of 70° F. The general practice is to select pins that can be installed by pushing with palm of hand, first making sure that pin and bore are smooth and clean.

Piston pins float in rod and piston and are held in piston by retainer rings that fit into grooves in piston pin bosses.

Piston pin bushing should be burnished and reamed to give clearances specified. Make sure that oil hole in rod indexes with oil hole in bushing.

Connecting Rods

Connecting-rod bearings are installed flush with the face of connecting rod and cap on both sides.

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run thru the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

When replacing connecting-rod bearings be sure that rods and caps as well as backs of bearing shells are clean and smooth and **free from oil.** This is of extreme importance as bearings will not seat perfectly if there is any dirt or oil between bearing shells and rods or caps. Wash rods and caps in a good cleaning solution and **dry thoroughly.** This will remove oil as well as dirt and insure proper contact between backs of bearing shells and rods.

Connecting-rod bearing shims .006″ thick are assembled on each side of the rod. If bearing wear cannot be adjusted to specified clearances by removal of shims, new bearing must be installed. Never file connecting rod or cap.

Be sure that shims are properly aligned so they do not touch the bearing shell when cap half is tightened down. It is particularly important that the shims do not get between the small tongues in the bearings and the grooves in rod and cap. When assembling the cap the shims can easily be lined up by using two fingers.

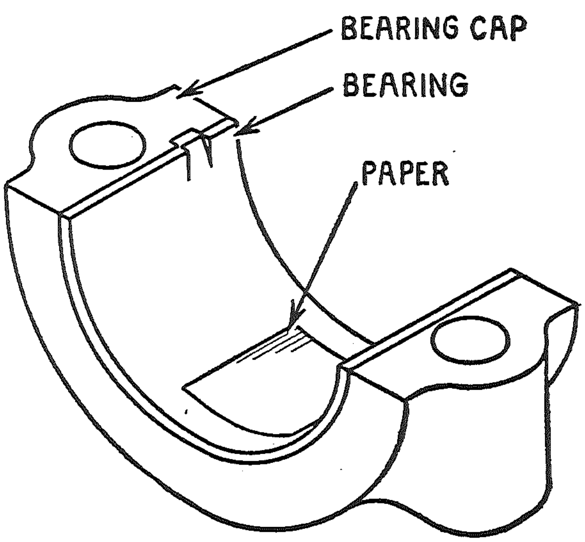


Fig. 4

When assembling new connecting-rod bearings always start out with the specified quantity of shims in place. Then if bearing is loose, remove shims as required. Never build up clearance by adding shims, but reduce clearance by removing shims. This will prevent damaging bearing shells, by crushing, due to insufficient clearance.

The usual practice is to remove shims until bearing is tight, then replace one shim on each side, which should give the proper clearance. A further check can be made using a piece of paper .0015″ to .0025″ thick, approximately 1″ square. Place the piece of paper between bearing and crankshaft and tighten cap. This thickness of paper should lock the bearing.

Connecting rod and piston assembly is removed thru top of cylinder block.

Main Bearings

Numbers stamped on bearing cap bosses indicate position for installation. Numbers should face camshaft side of crankcase. The small tongues on main bearings should fit snugly into grooves in crankcase and main bearing caps.

Shims .006″ thick are used on each side of main bearing.

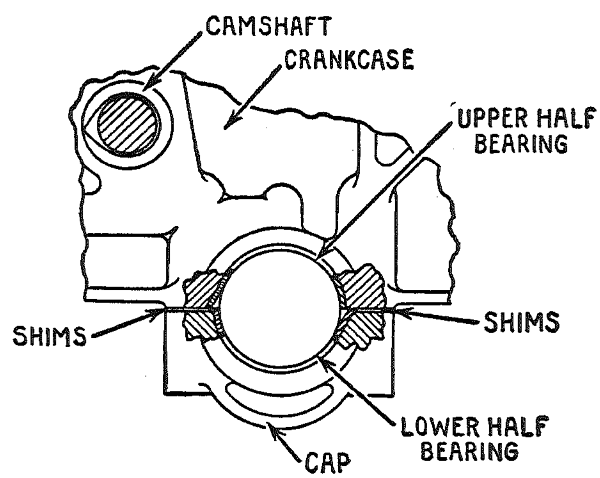


Fig. 5

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run thru the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

It is recommended that a complete set of main bearings be used when replacement is made.

Main bearings can be replaced without removing the crankshaft. All main bearing caps should be loosened slightly, care being taken that the crankshaft and camshaft gears are not demeshed.

Remove No. 1 bearing cap and by lightly tapping the plain edge of the upper half bearing, and in some cases turning the crankshaft in the direction of rotation, the bearing shell is easily removed. Installation is accomplished in reverse manner.

The balance of main bearings are removed and installed in the same manner.

As mentioned under "Connecting Rods" do not add shims after bearing shells have been compressed. Instead, use the specified quantity of shims and remove as required to obtain the proper clearance. This prevents damaging the shells by crushing.

Be sure that the seats for the bearings as well as the backs of the bearing shells are clean and free from oil. A good contact is absolutely essential.

Care must be used when assembling shims to see that they clear the bearing locating tongues. Certain types of shims have a relief, or cut-out which provides clearance for these tongues. If shims are installed incorrectly the bearing shells will be crushed excessively. Shims should not contact the bearing shells at any point.

Camshaft Bearings

Camshaft bearings must be installed so oil hole indexes with oil supply hole in cylinder block. This is important to insure sufficient lubricant to bearings.

Bearings are line-reamed to size after installation in crankcase.

Reconditioning Valves and Seats

Clean and polish valve stems and if warped or badly burned, install new valves.

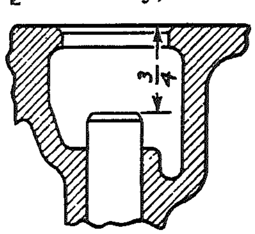
If valve faces are pitted or grooved, reface in refacing machine before grinding. Valve seats should not be refaced unless absolutely necessary. If valve seat is not concentric with valve stem guide hole or if seat is too wide, then refacing is necessary. Valve face contact surface width should be 1/16" to 3/32".

After grinding, remove all traces of grinding compound. Check seating of valves by making a number of marks with a soft lead pencil around the valve seat, then insert valve and give 1/4 turn. Remove valve and if all lines are broken the valve seat is satisfactory.

Valve Clearance Adjustment

Proper clearance between valve stems and valve tappet adjusting screws must be maintained in order to obtain satisfactory operation.

Before making an adjustment, run engine sufficiently to thoroughly warm it up. This is important. Engine should be run at least 15 minutes after water temperature has reached its normal point. If necessary, cover radiator.



INTAKE AND EXHAUST

Fig. 6

Valve Stem Guides

Press valve stem guides in from top of cylinder block to dimension shown (Fig. 6) with tapered end up.

After installation, ream valve guides to .312"–.313". Reaming should be done carefully and slowly—do not force reamer. A smooth finish is essential as the amount of bearing surface between valve stem and guide is dependent upon finish of guide bore.

After reaming valve guides, check valve seats and if runout exceeds .002" to .003", seats should be refaced. When refacing valve seats the tool must be piloted in valve guide.

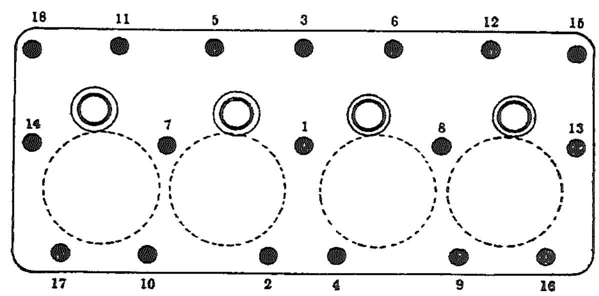


Fig. 7

Cylinder Head

Fig. 7 illustrates correct order in which cylinder head should be tightened. This is important to assure a good seal between cylinder head, cylinder head gasket and cylinder block and will also avoid strains in cylinder head casting.

When cylinder head has been removed it is a good plan to install a new head gasket. In some cases the old gasket may be entirely satisfactory; however, to avoid the possibility of water or gas leakage a new gasket is recommended.

To guard against compression or water leaks, coat both sides of the cylinder head gasket with a suitable, clear sealing compound, such as shellac. Let gasket dry until the coating becomes tacky, then install with beaded side up, as stamped, first making sure that block and head are smooth and clean. Any foreign matter between gasket and head or block will result in early gasket failure.

After cylinder head has been tightened, run engine for a few minutes, and retighten.

Valve Tappets and Guides

Valve tappet guides are integral with crankcase. Camshaft must be removed to disassemble valve tappets.

Valve Springs

Valve springs should be square in their seats and also should be checked with Valve Spring Tester S.E. 809 to determine if they meet specifications. This should be done at every valve grind and replacement made when necessary.

Install valve springs with close coiled end to cylinder block.

Fan Belt Adjustment

Fan belt should run under proper tension. Adjustment is made by loosening generator mounting screws and generator brace capscrew, after which generator can be moved in or out as required.

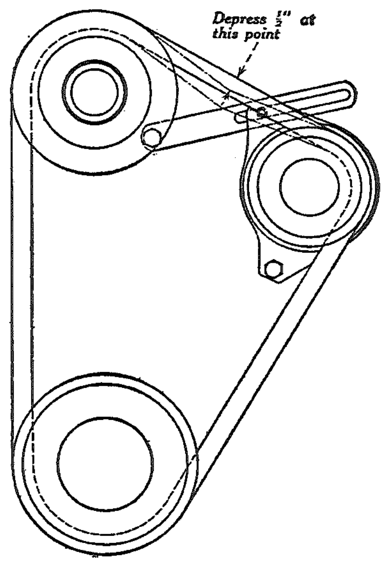


Fig. 8

Proper tension is obtained when belt can be depressed approximately ½" as shown in Fig 8.

After adjustment has been made be sure to tighten all capscrews.

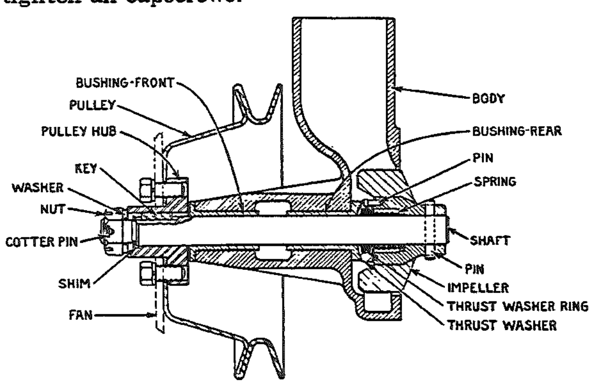


Fig. 9

Water Pump

The water pump assembly is illustrated in Fig. 9. This type water pump does not require packing, the water seal being a thrust washer held under spring tension against the thrust surface of the rear bushing.

Disassembly

1. After removing pump assembly from engine, take off the fan pulley and hub assembly.
2. Remove shims and slip impeller shaft assembly out of water pump body.
3. Water pump bushing tools, SE-1027, **must** be used when removing or installing bushings.
4. Insert expansion sleeve SE-10275 in the **front** bushing, then place expansion sleeve punch SE-10276 thru **rear** bushing into the expansion sleeve. Press out **front** bushing, using an arbor press.
5. The **rear** bushing is removed in the same manner as the **front.**

Reassembly

1. Both front and rear bushings are of the porous type and therefore should be soaked in light (SAE-10) engine oil before assembly in the water pump body.
2. Insert bushing arbor pilot sleeve SE-10272 in **front** bushing bore in body then place the **convex** washer SE-10274 on the bushing arbor SE-10271.
3. The **rear** bushing (having **concave** thrust surface) is then installed on the arbor and with the arbor piloted in the pilot sleeve, pressed into place. An arbor press should be used for this operation.
4. To install the **front** bushing, assemble **flat** washer SE-10273 to the arbor SE-10271, then place the bushing (having **flat** thrust surface) on the arbor and press in, using the **rear** bushing as a pilot for the arbor.
5. Check water pump shaft and impeller assembly, also thrust washer and tension spring, and replace any parts that show evidence of excessive wear.
6. Insert impeller shaft assembly and install shims to give from .005" to .020" clearance between bushing and fan hub. **This clearance must be maintained.**
7. Assemble pulley and hub assembly, making sure that the hub key has been replaced.
8. **IMPORTANT: Do not drill or groove** the front or rear bushings. This is entirely unnecessary as they will absorb lubricant from the reservoir in the water pump body.

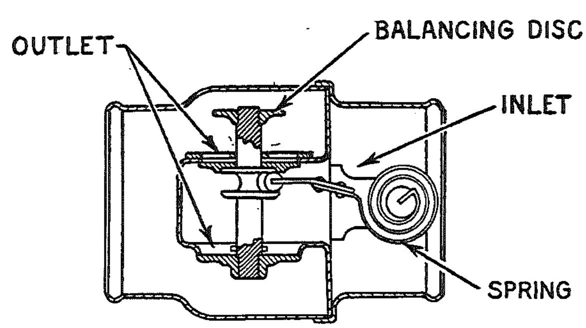


Fig. 10

Water Thermostat

The water thermostat (Fig. 10) is a balanced valve type having two outlets which are controlled by two valve discs mounted on a common shaft and incorporating one external balancing disc to prevent water pressure from disturbing the true temperature control during the opening and closing cycles.

This thermostat is nonadjustable and is set to start to open at 150 to 153° F. The use of the thermostat shortens the warm-up period and reduces to a minimum crankcase condensation and dilution.

The operation of the thermostat can be checked by placing it in still water and heating the water. A reliable thermometer should be used and at a temperature of approximately 145 to 150° F. the valves should start to open and be fully opened (¼" approx.) at around 200 to 205° F. This applies only to a still water test.

If the thermostat does not function as outlined above, a new one should be installed.

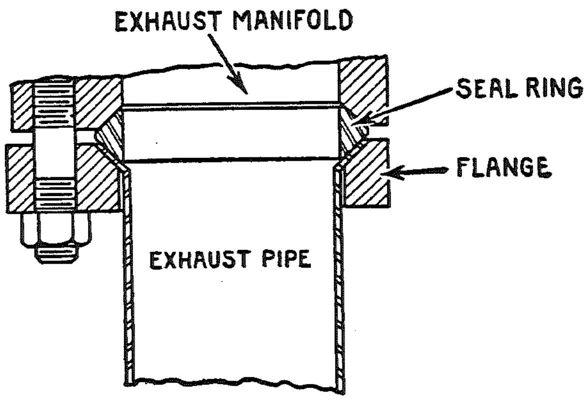


Fig. 11

Exhaust Pipe Seal Ring

The assembly of the exhaust pipe seal ring is shown in Fig. 11.

Be sure that seal ring seats squarely against exhaust manifold, exhaust pipe and flange and tighten stud nuts evenly in order to prevent distortion of exhaust pipe and possible breakage of exhaust pipe flange.

If the seal ring is assembled properly no exhaust leakage will occur.

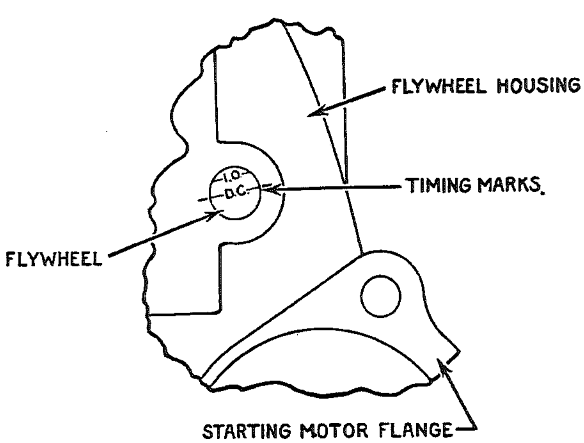


Fig. 12

Ignition Timing Marks

Timing marks are on the flywheel as illustrated in Fig. 12. See "Electrical System" for ignition timing data. Engine timing diagram is illustrated in Fig. 13.

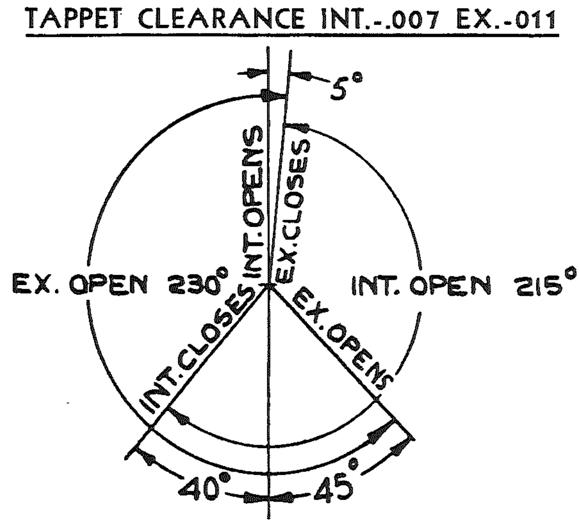


Fig. 13

Oil Seals and Gaskets

Correct assembly of oil seals, retainers and gaskets is of extreme importance in preventing oil leakage and entrance of dirt.

When reassembling an engine, new gaskets and seals should be used. Make sure that no foreign matter is adhering to the surfaces which would prevent proper contact. Dip felt seals in light oil before assembly.

Engine Mounting

Front and rear engine mountings are shown in Figs. 14 and 15. Check mounting screws occasionally to be sure that the mountings are not loose and that the mounting nuts are secured with cotter pins.

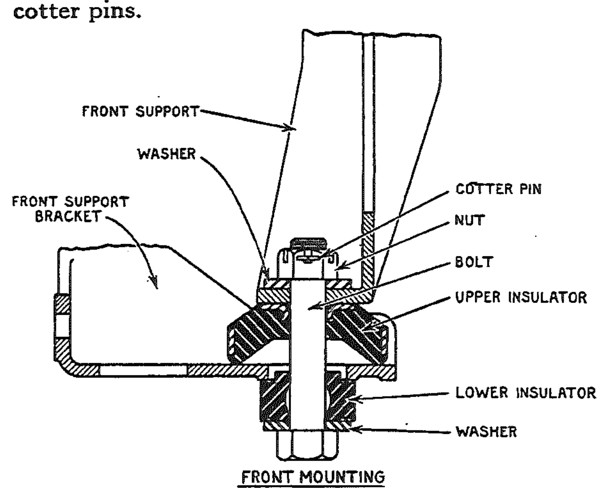


Fig. 14

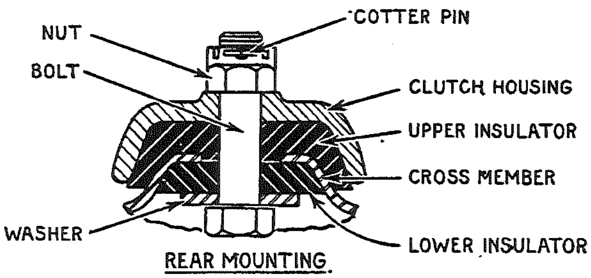


Fig. 15

Oil Consumption

High oil consumption is usually attributed to worn piston rings and cylinders; however, in many cases it will be found that the main, rod or camshaft bearings have worn, permitting excessive spray off of oil, which results in overlubrication of cylinder walls.

It is recommended that the bearings be given an oil pressure test, as outlined in following paragraphs, before disturbing the piston and ring assembly.

Oil pressure is controlled by the pressure valve spring located in the oil pressure regulator. Oil pressure should be checked when engine is hot and oil is warm.

When low oil pressure is encountered, a systematic and thorough investigation is necessary in order to determine the cause.

The following are the principal causes for this condition and it is recommended that these be thoroughly checked in the order named, which in all probability will result in the definite cause being determined.

Oil Supply

Excessively diluted condition or insufficient amount in crankcase.

Oil Pressure Gauge

Improper registration of gauge.
Loose connections.

Oil Pressure Regulator or Oil Filter (When Used)

Clogged condition of filter element.
Pressure valve not holding.
Weak pressure valve spring. Check by installing spacers in back of spring. Free length of spring should be 1⅜″.

Oil Pump

Clogged condition of screen.
Gear cover gasket faulty.
Excessive clearance between gears and cover plate.
Specified gasket thickness, .003″.
Worn condition of gears, allowing loose mesh

Main, Connecting Rod and Camshaft Bearings

Excessive running or end clearances.
Out of round condition of bearings or journals.
Imperfect bearings—badly pitted or chipped.

In order to check main, connecting rod and camshaft bearing clearances to determine if they are excessive and the cause of low oil pressure, the following equipment and method has been found effective.

A test tank can be made from a piece of 4″ pipe approximately 24″ long. Weld a plate or base on one end and thread the other end to take a cap. Drill and tap the cap to take a tee connection and in one side insert a tire valve and in the other a pressure gauge registering to at least 75 pounds.

Drill and tap a hole near the bottom of the pipe so that a valve can be installed and to the valve attach a flexible hose.

This test fixture can be made from a small tank, if one is available, or any other suitable material.

The tank should not be more than half full of S.A.E. 10 or a heavier grade of heated oil and in the case of the tank described above, 2 or 3 quarts will be sufficient. Tank can be filled by removing tee connection.

The flexible hose should be connected to the oil pressure connection in the engine.

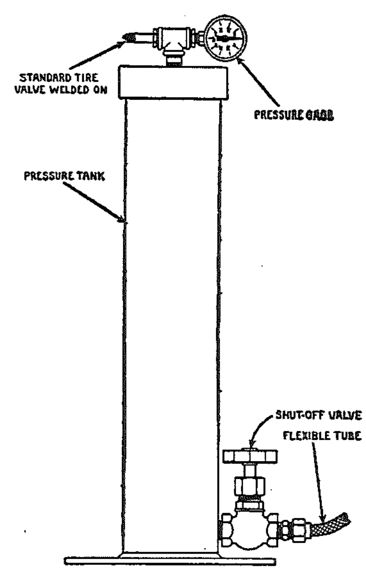


Fig. 16, Test Tank

Apply air pressure to about 50 pounds, then open valve in bottom so that oil will be forced into oil channels and bearings. Inspect for excessive leakage and spray off, which denotes excessive clearance and likewise pressure loss.

If oil filter is used, remove filtering element and clean out base so that dirt collected in filter will not be forced into oil channels of engine. The filter element should be left out when making this test.

Cleaning of Engines

The importance of having an engine, or any other unit in the truck, clean and free from dirt, sludge, abrasives, etc., cannot be too strongly stressed. While every effort is made by the manufacturer to prevent dirt from entering an engine or

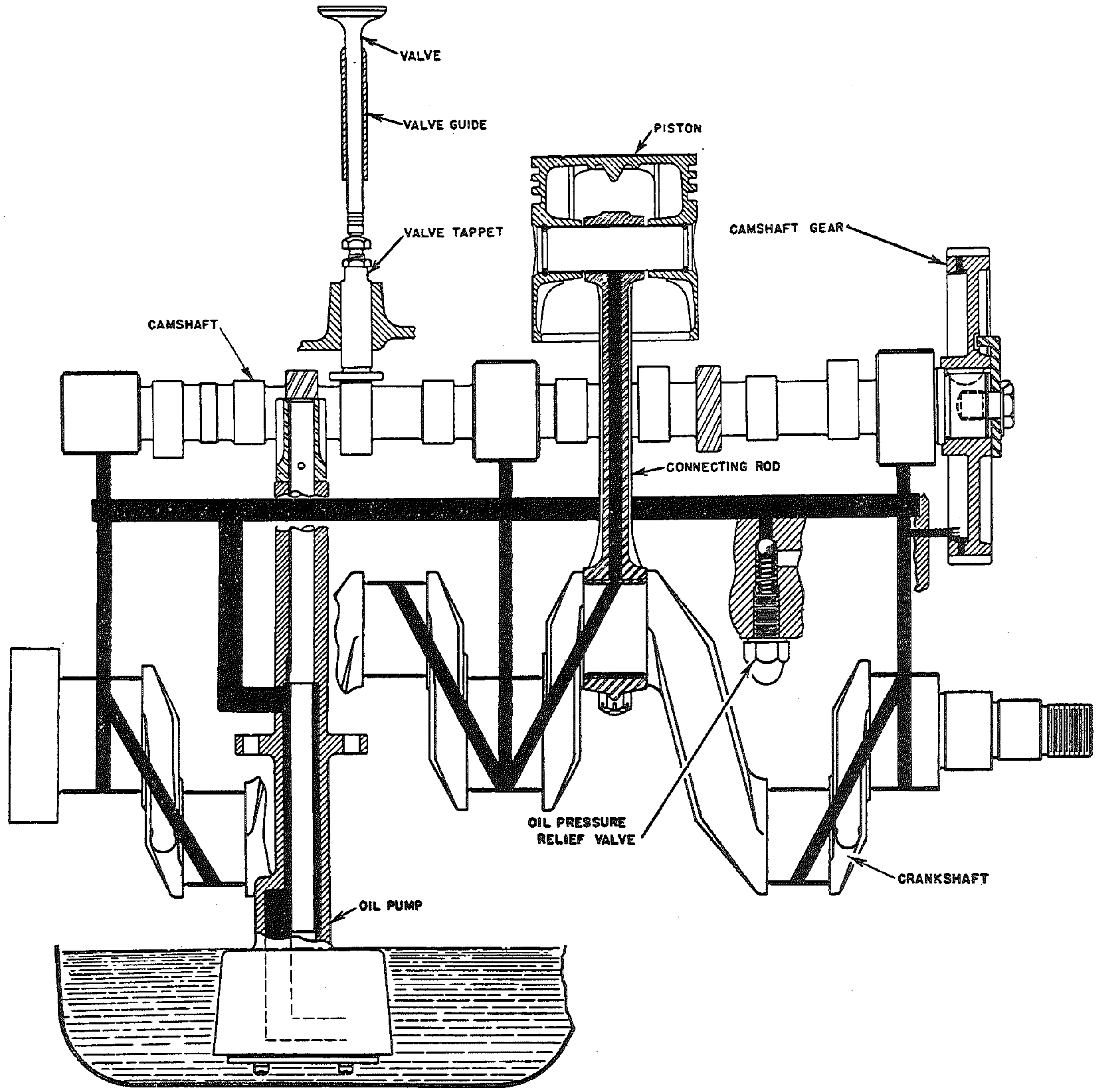


Fig. 17, Engine Lubrication System

other unit, nevertheless a certain amount will possibly accumulate after the job has been in service for a period of time. For this reason it is recommended that whenever any work is being done, the parts removed be thoroughly cleaned before they are reassembled.

The entire cylinder block casting should be thoroughly washed with a strong cleaning solution which will remove dirt, sludge and carbon formations that may have accumulated. If Stoddard Solvent or kerosene is used, wash again, using hot soapy water and rinse with clear water under pressure. Dry thoroughly and coat with light oil to prevent rusting. Particular attention should be paid to any recesses in the cylinder block and crankcase where an accumulation of dirt, sludge or carbon might be found.

If the cylinder block is not thoroughly cleaned before reassembling there will be the possibility of dirt and carbon jarring loose, when engine is being run-in. This accumulation will be circulated thru the oiling system with the result that bearings, crankshaft, camshaft, pistons, valve stems, etc., will be damaged.

It is recommended that all pipe plugs be removed from the drilled oil lines in cylinder block. A good way to clean out the drilled oil lines is by using a long handled rifle barrel brush. This type of brush will run thru the main drilled oil line in the side of the cylinder block.

Cylinder blocks should be immersed in a large cleaning tank and if such equipment is not available at the Branch this work should be sent to a reputable concern that specializes in cleaning such parts.

After cleaning, the entire casting should be thoroughly dried, especially the drilled oil lines and all finished surfaces should be lubricated to prevent rust formation.

The oil filter should be thoroughly cleaned out, removing any accumulation of sludge and dirt from the sump in the base. Replace filtering element if necessary.

It is a good policy to disassemble and thoroughly clean all parts of the oil pump. This will permit checking fits and enable the mechanics to determine the parts needing replacement.

Fuel pump should be thoroughly cleaned out, especially the small breather located in the body. This breather can be removed and flushed around in a cleaning fluid which will remove all dirt. If examination reveals excessive dirt, disassemble fuel pump and clean all parts.

Oil in air cleaner should be changed every time crankcase is drained. Clean out air cleaner cup. Make sure all connections are tight so that dust and dirt cannot enter. See detailed instructions under "Air Cleaner."

Disassemble carburetor and clean out thoroughly. Do not run a wire thru jets as this will enlarge the holes, thereby disturbing the calibration, which will result in poor fuel economy and engine performance.

If an engine has been properly overhauled with all parts fitted to specified clearances and assembled properly and **all parts thoroughly cleaned,** its performance and life will be increased materially.

Frame Group

Section A

Frame Page

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Frame Specifications

Model	D-2 D-5	D-2 D-5	D-15	D-15	D-30 DS-30	D-30 DS-30	D-30 DS-30	D-30B DS-30B	D-30B DS-30B	D-35 DS-35	D-35 DS-35	D-35 DS-35	D-35 DS-35	D-35B	D-40	D-40	D-40
Wheel Base	113"	125"	113"	130"	128"	155"	173"	155"	173"	137"	149"	161"	179"	179"	134"	146"	158"
S	25 1/16"	25 3/32"	25 5/32"	25 5/32"	....	....	....	....	....	....	....	....	....	....	....	....	....
V	....	39 9/32"	....	39 11/32"	....	....	....	....	....	....	....	....	....	....	....	....	....
W	43 1/4"	43 9/32"	43 11/32"	43 11/32"	31 31/32"	32"	32 1/32"	32 1/32"	32 1/32"	32 1/32"	32 1/32"	32 1/32"	32 1/32"	32 1/32"	34"	34"	34"
X	....	78 1/4"	....	78 1/4"	....	....	....	....	....	....	....	....	....	....	....	....	....
Y	100 1/8"	113 1/4"	100 1/8"	113 1/4"	....	....	....	....	....	....	....	....	....	....	....	....	....
K	4 21/64"	4 11/32"	4 13/32"	4 13/32"	4 45/64"	4 23/32"	4 47/64"	4 47/64"	4 47/64"	4 47/64"	4 47/64"	4 47/64"	4 47/64"	4 47/64"	5 29/32"	5 29/32"	5 29/32"
L	8"	8 1/32"	8 5/16"	8 5/16"	8 1/2"	8 17/32"	8 9/16"	9 19/32"	9 19/32"	8 9/16"	8 9/16"	8 9/16"	8 9/16"	9 19/32"	10 1/8"	10 1/8"	10 1/8"
M	34 13/16"	34 13/16"	34 13/16"	34 13/16"	35 1/64"	35 1/64"	35 1/64"	35"	35"	35 1/64"	35 1/64"	35 1/64"	35 1/64"	35"	41 1/32"	41 1/32"	41 1/32"
N	8 27/32"	8 7/8"	8 1/2"	8 1/2"	4 3/4"	4 25/32"	4 13/16"	8 1/32"	8 1/32"	4 13/16"	4 13/16"	4 13/16"	4 13/16"	8 1/32"	3 5/32"	3 5/32"	3 5/32"
P	4 3/4"	4 25/32"	4 15/16"	4 15/16"	2"	2 1/32"	2 1/16"	5 29/32"	5 29/32"	2 1/16"	2 1/16"	2 1/16"	2 1/16"	5 29/32"	6 5/8"	6 5/8"	6 5/8"
R	49"	49"	52"	52"	44 3/4"	44 3/4"	44 3/4"	50"	50"	46 13/16"	46 13/16"	46 13/16"	46 13/16"	50"	53 5/8"	53 5/8"	53 5/8"

Model	D-40	D-50	D-50	D-50	D-50	D-60	D-60	D-60	D-60	DR-60	DR-60	DR-60	DR-60	DR-70	DR-70	DR-70	DR-70
Wheel Base	176"	137"	149"	161"	179"	149"	161"	179"	197"	149"	161"	179"	197"	149"	161"	179"	197"
S	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
V	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
W	34"	33 15/16"	33 15/16"	33 15/16"	34"	34 1/8"	34 1/8"	34 1/8"	34 1/8"	34 1/8"	34 1/8"	34 1/8"	34 1/8"	34 1/8"	34 1/8"	34 1/8"	34 1/8"
X	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Y	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
K	5 29/32"	5 19/32"	5 19/32"	5 19/32"	5 5/8"	5 11/16"	5 11/16"	5 11/16"	5 11/16"	5 11/16"	5 11/16"	5 11/16"	5 11/16"	5 11/16"	5 11/16"	5 11/16"	5 11/16"
L	10 1/8"	9 29/32"	9 29/32"	9 29/32"	9 31/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"	10 3/32"
M	41 1/32"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"
N	3 3/16"	3 3/16"	3 3/16"	3 3/16"	3 1/4"	3 9/32"	3 9/32"	3 9/32"	3 9/32"	3 9/32"	3 9/32"	3 9/32"	3 9/32"	3 1/8"	3 1/8"	3 1/8"	3 1/8"
P	6 5/8"	6 5/8"	6 5/8"	6 5/8"	6 11/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	7 5/16"
R	53 5/8"	53 5/8"	53 5/8"	53 5/8"	53 5/8"	53 9/16"	53 9/16"	53 9/16"	53 9/16"	53 9/16"	53 9/16"	53 9/16"	53 9/16"	55 11/16"	55 11/16"	55 11/16"	55 11/16"

Model	D-300 DS-300	D-300 DS-300	D-186T DS-186T	D-186T DS-186T	D-216T	D-216T	D-246T D-246F	D-246T D-246F	D-246T D-246F	D-246T D-246F	DR-346T D-346F	DR-346T D-346F	DR-346T D-346F	DR-426F	DR-426F	DR-426F
Wheel Base	99"	117"	173"	191"	176"	194"	161"	179"	197"	215"	161"	197"	215"	161"	215"	233"
S	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
V	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
W	32"	32"	32 7/32"	32 7/32"	34 3/16"	34 3/16"	34 1/4"	34 1/4"	34 1/4"	34 1/4"	34 1/4"	34 1/4"	34 1/4"	34 1/4"	34 1/4"	34 1/4"
X	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Y	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
K	5 15/16"	5 15/16"	4 11/16"	4 11/16"	5 3/4"	5 3/4"	5 3/4"	5 3/4"	5 3/4"	5 3/4"	5 3/4"	5 3/4"	5 3/4"	5 3/4"	5 3/4"	5 3/4"
L	6 9/16"	6 9/16"	9 13/32"	9 13/32"	11 1/16"	11 1/16"	11 1/16"	11 1/16"	11 1/16"	11 1/16"	11 1/16"	11 1/16"	11 1/16"	11 1/16"	11 1/16"	11 1/16"
M	42 1/2"	42 1/2"	35 3/16"	35 3/16"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"	43"
N	4 1/16"	4 1/16"	8 5/8"	8 5/8"	9 3/8"	9 3/8"	9 3/8"	9 3/8"	9 3/8"	9 3/8"	10 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"
P	2 9/16"	2 9/16"	7 7/8"	7 7/8"	8 7/8"	8 7/8"	8 7/8"	8 7/8"	8 7/8"	8 7/8"	9 7/8"	9 7/8"	9 7/8"	9 7/8"	9 7/8"	9 7/8"
R	48 9/16"	48 9/16"	30"	30"	30"	30"	30"	30"	30"	30"	34"	34"	34"	34"	34"	34"

Frame Alignment

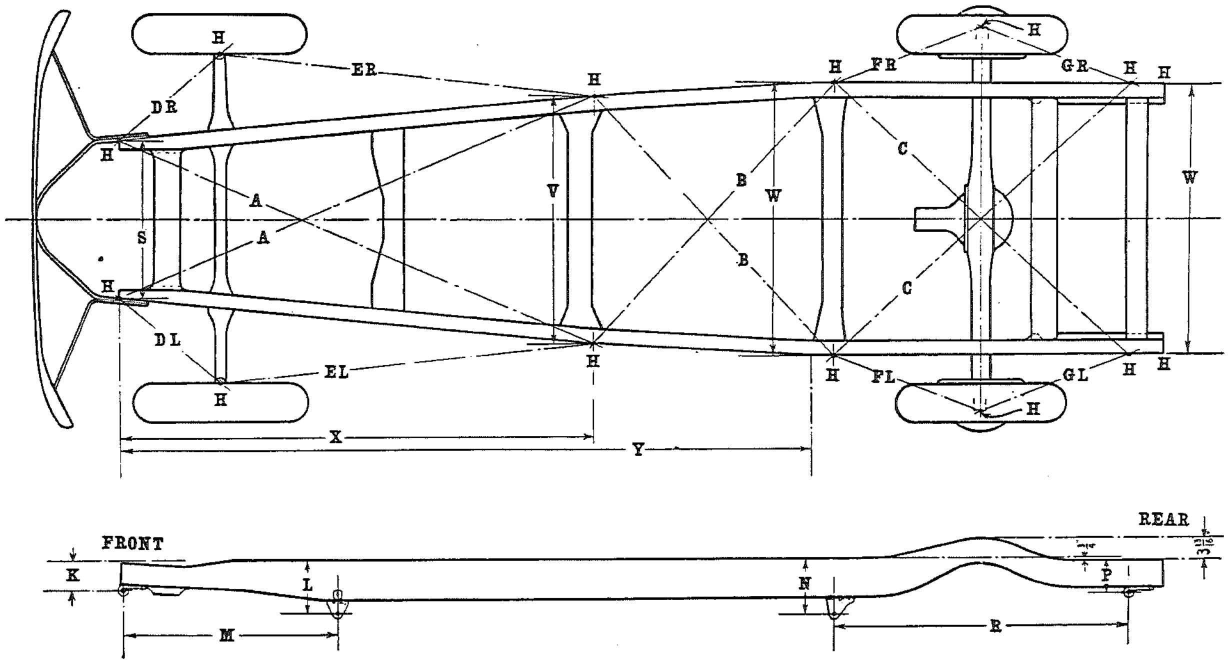

Fig. 1, D-2, D-5, D-15 Alignment Diagram (See Specifications)

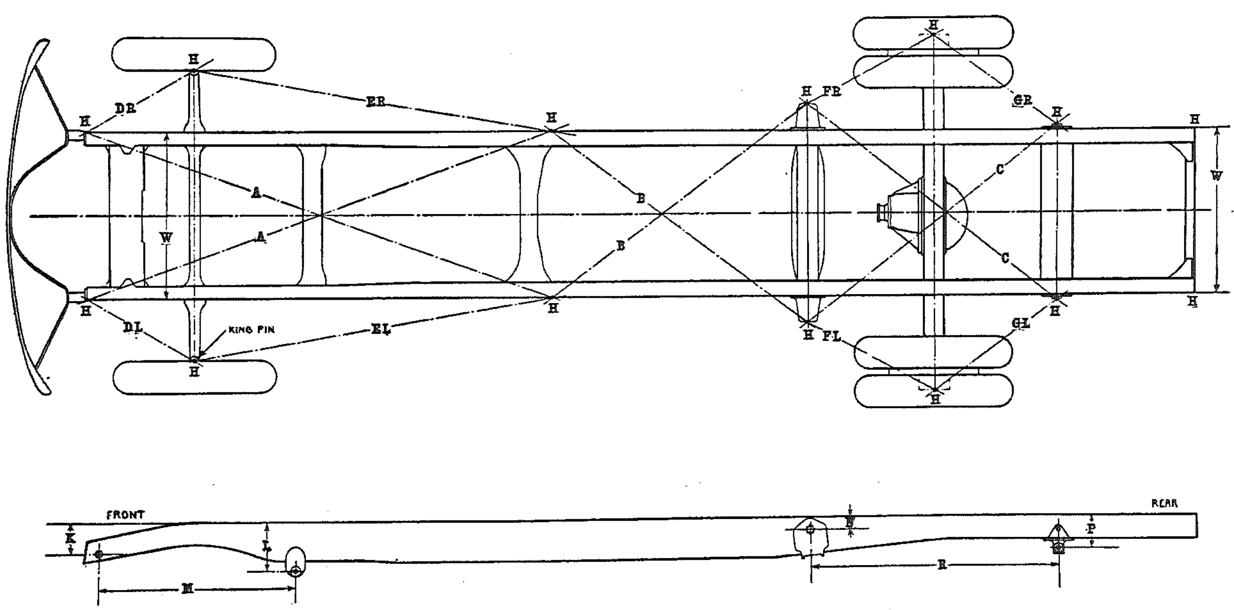

Fig. 2, D-30, DS-30, D-35, DS-35, D-40, D-50, D-60, DR-60, DR-70, D-300, DS-300 Alignment Diagram (See Specifications)

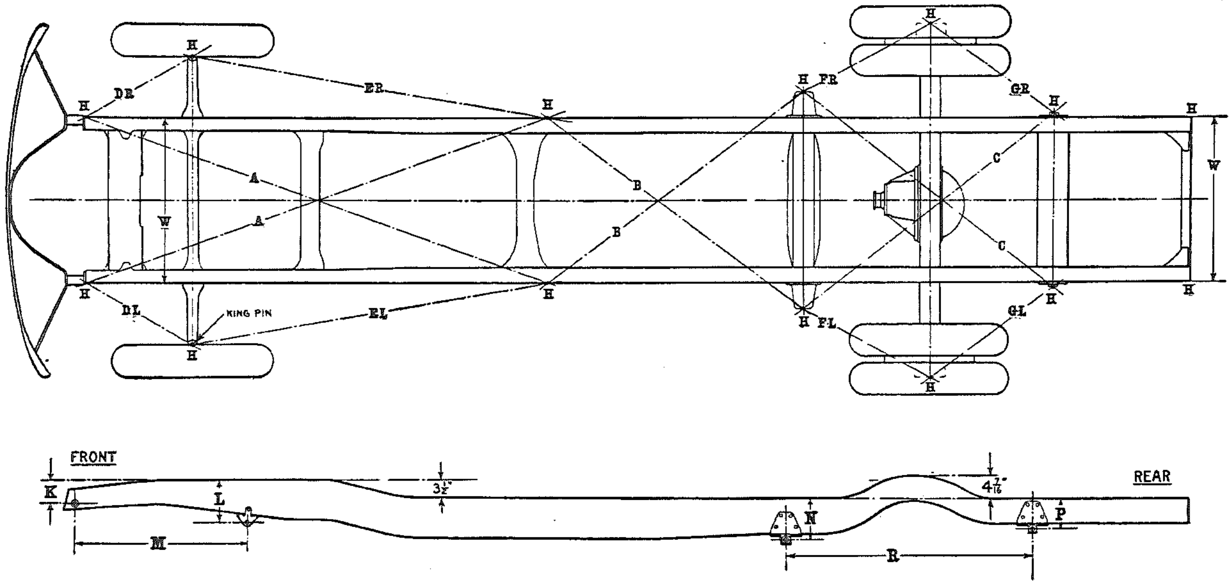

Fig. 3, D-30B, DS-30B, D-35B Alignment Diagram (See Specifications)

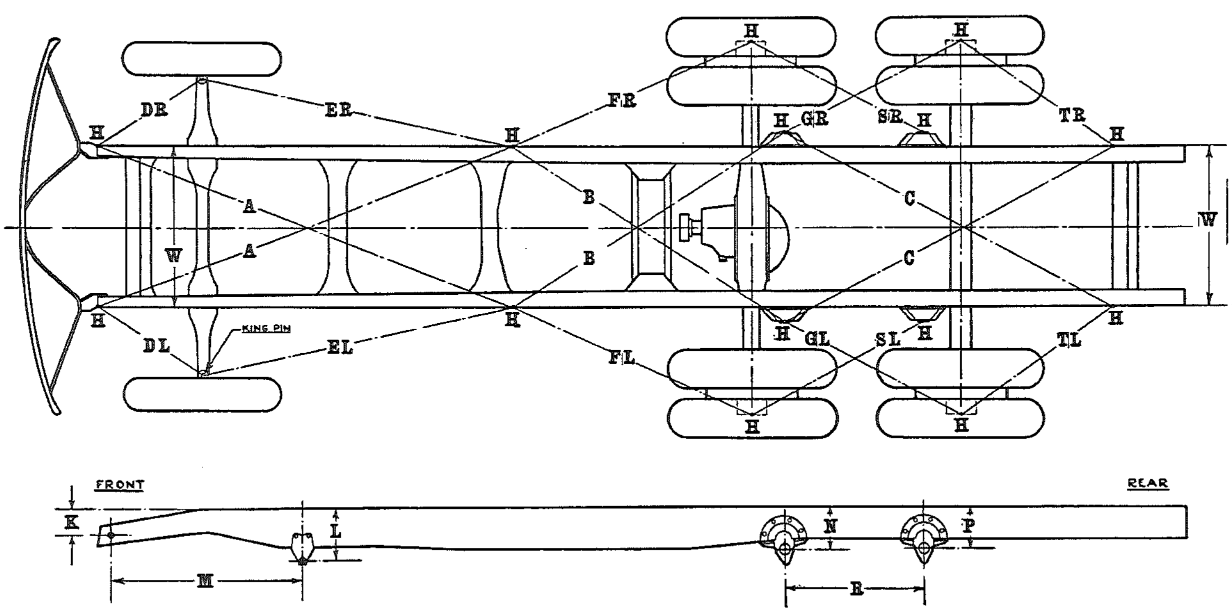

Fig. 4, All Six-Wheel Models (See Specifications)

Frame Alignment

Any vehicle that has been in an accident which might result in a bent or sprung frame should have the frame and axle alignment carefully checked.

Checking Frame Alignment

A satisfactory method of checking the frame and axle alignment, particularly when a body and cab is on a chassis is to mark on a level floor all points at which measurements are to be taken. Tack or cement pieces of paper to the floor directly under each point of measurement on the chassis as indicated by the letter "H", in the various figures. The points of measurement must be accurately marked in relation to the frame in order to obtain a satisfactory alignment check.

After each measurement point has been carefully marked on the floor, proceed as follows:

1. Locate center line of chassis by measuring front and rear end widths, using marks on floor. If frame widths check, draw center line on floor, full length of chassis. If frame widths do not check, lay out center line as follows:
2. Center line can be drawn thru the intersection of any one pair of equal diagonals (A-A, B-B, C-C) and center point of one end of frame or thru points of intersection of any two pairs of equal diagonals.
3. Measure distance from center line to opposite points marked over entire length of frame. Measurements should not vary more than 1/8" at any point.
4. Measuring diagonals, A-A, B-B, C-C will indicate point where misalignment occurs. If diagonals in each pair check within 1/8", that part of frame included between points of measurement may be considered in satisfactory alignment. These diagonals should intersect within 1/8" of center line.

Axle Alignment with Frame

After determining that frame is properly aligned, the axle alignment with the frame should be checked.

Front axle is square with frame if DR equals DL and ER equals EL.

Front axle has shifted sideways if ER is less than EL and DR is less than DL or vice versa.

Front axle is bent, twisted or one end shifted if ER is less than EL and DR is greater than DL or vice versa.

Rear axle alignment is checked in same manner by comparing measurements.

Dimensions for side elevation of frame should be checked at the points indicated and should not vary more than 1/8".

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Fuel System Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Engine Series	HD	FC	HD	HD	HD	HD	HD	FAB	FAB	FAB	FAB	FBB	FBB
Carburetor	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith
Model	23AV10	TU3½x1	23AV10	23AV10	23AV10	23AV10	23AV10	23AV11	23AV11	23AV11	23AV11	23AV11	23AV11
Venturi	26	19	26	28	28	28	28	30	30	30	30	30	31
Main Jet	15	16	15	16	16	16	16	19	19	19	18	19	20
Compensating Jet	20	13	20	23	23	23	23	23	23	23	25	24	25
Power Jet	17	....	17	17	17	17	17	17	17	17	16	16	16
Power Jet Regulator	13	....	13	12	12	12	12	12	12	12	13	13	12
Idling Jet	13	12	13	13	13	13	13	13	13	13	13	13	13
Accelerating Jet	13	....	13	14	14	14	14	14	14	14	14	14	14
Cap Jet	4-D	....	4-D	5-D	5-D	5-D	5-D	6-D	6-D	6-D	5-D	5-D	5-D
Cap Jet Base	1	60	1	1	1	1	1	1	1	1	1	1	1
Fuel Valve Seat	35	30	35	35	35	35	35	40	40	40	40	45	45
Float Level	1½" ± 3/64"	1 21/64" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"
High Altitude:													
Main Jet Adj. Needle	10	16–12	10	11	11	11	11	15	15	15	12	15	16

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Engine Series	FBB	FBB	HD	HD	HD	HD	FAB	FBB	FBB	FBB	FBB	FBB
Carburetor	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith	Zenith
Model	23AV11	23AV11	82BV10	82BV10	23AV10	23AV10	23AV11	23AV11	23AV11	23AV11	23AV11	23AV12
Venturi	31	31	30	30	28	28	30	30	30	31	31	32
Main Jet	20	20	22	22	16	16	19	19	19	20	20	19
Compensating Jet	25	27	23	23	23	23	23	24	24	27	27	26
Power Jet	16	15	24	24	17	17	17	16	16	15	15	17
Power Jet Regulator	12	12	....	....	12	12	12	13	13	12	12	16
Idling Jet	13	13	15	15	13	13	13	13	13	13	13	13
Accelerating Jet	14	14	14	14	14	14	14	14	14	14	14	14
Cap Jet	5-D	6-S	4-W	4-W	5-D	5-D	6-D	5-D	5-D	6-S	6-S	5-D
Cap Jet Base	1	1	2	2	1	1	1	1	1	1	1	1
Fuel Valve Seat	45	45	35	35	35	35	40	45	45	45	45	45
Float Level	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"	1½" ± 3/64"
High Altitude:												
Main Jet Adj. Needle	16	16	18	18	11	11	15	15	15	16	16	16

Fuel System Specifications—Continued

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Fuel Pump	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC
Capacity (Minimum) (Using Fuel Pump Analyzer)	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.
Pressure (lb.)	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3
Air Cleaner—Type	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil
Governor	......	......	......	......	......	......	......	......	......	......	......	B2½W	D2½
Speed Range (Engine R.P.M.)	......	......	......	......	......	......	......	......	......	......	......	1750-3000	2000-2800
Fuel Tank Capacity: Gallons	13½	13½	13½	21	21	31	31	21	21	31	21	21	21
Fuel Tank Location	Rear	Rear	Rear	Under Seat	Under Seat	Right Side	Right Side	Under Seat	Under Seat	Right Side	Under Seat	Under Seat	Under Seat

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Fuel Pump	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC
Capacity (Minimum) (Using Fuel Pump Analyzer)	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.	1-Pt. in 1-Min.
Pressure (lb.)	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3	1½—3
Air Cleaner—Type	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil
Governor	D2½	D2½	......	......	......	......	......	B2½W	B2½W	D2½	D2½	B3W
Speed Range (Engine R.P.M.)	2000-2800	2000-2800	......	......	......	......	......	1750-3000	1750-3000	2000-2800	2000-2800	2000-2400
Fuel Tank Capacity: Gallons	21	21	18½	18½	21	21	21	Short-24 Long-32	Short-24 Long-32	Short-24 Long-32	Short-24 Long-32	Short-24 Long-32
Fuel Tank Location	Under Seat	Under Seat	Right Side	Right Side	Under Seat	Under Seat	Under Seat	Right Side	Right Side	Right Side	Right Side	Right Side

Fuel System — General

Vapor Lock

The Repairs Department has available an electric fuel pump for use on trucks which have given trouble with vapor lock. They cannot furnish material other than shown in Fig. 1 as the installation will have to conform to individual requirements.

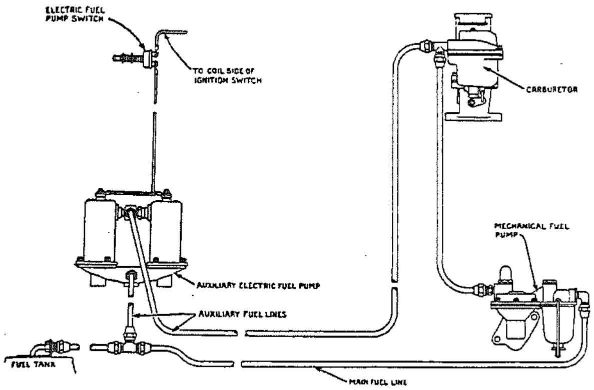

Fig. 1

Installation Data

1. Fig. 1 illustrates a hook-up that is adaptable to any type of fuel system.
2. The location of the fuel line from the electric pump should be on the outside of the frame rail opposite the exhaust system and if necessary carried across the front cross member to the carburetor. Considerable freedom can be exercised in locating the lines, always keeping in mind that they should be away from the exhaust system and not exposed to hazards that will result in their being damaged. The use of loom is recommended where protection from radiated heat is desired.

   Should the electric pump be located where it may be damaged from stones, etc., a simple shield can be readily installed to supply the necessary protection.

The following discussion is for the purpose of providing the necessary information to enable the Branches to readily diagnose and supply a solution to the problem.

What is Vapor Lock?

1. When a section of the fuel system becomes filled with gasoline vapor causing either partial or total disruption of fuel service to the carburetor, it is said to be vapor locked.

Principal Sources of Heat

2. The fuel pump is generally the part of the fuel system where the greatest rise in fuel temperature occurs because of heat derived from the following sources:
   (a) Heat conducted from crankcase and camshaft.
   (b) Heat received from hot oil splashed into pump body for lubricating purposes.
   (c) Radiated heat from exhaust manifold.
   (d) Heat received from under hood air.

   It is for these reasons that the electric fuel pump is mounted on the outside of the frame rail.

   The fuel line from the fuel tank to the regular mechanical pump is under a depression or more commonly known as suction which lowers the vaporizing or boiling point of a liquid. This makes it particularly bad to have it located close to the exhaust system. By locating the electric fuel pump close to the fuel tank a greater percentage of the system is under pressure, which increases the vaporizing or boiling temperature of the gasoline.

When and Why of Vapor Lock

3. Vapor lock occurs in hot weather with a hot engine when the fuel requirements are at minimum, such as idling after a hard run. When the maximum amount of fuel is again required, the fuel pump must first expell the vapor during which time the following cycle is being established:
   (a) Reduced engine speed because of lack of fuel.
   (b) Reduced fuel pump speed with proportional loss of pumping ability.
   (c) Increased fuel temperatures and resultant increase in vapor formation resulting in reduced fuel delivery and further reduction of engine speed.

   The continuation of the cycle will ultimately result in the complete cessation of gasoline delivery.

Type of Fuel

4. The use of a highly volatile gasoline such as furnished in "Winter" weather will produce vapor lock under conditions where a less volatile or "Summer" gasoline would be satisfactory.

How to Diagnose Vapor Lock

5. A vapor lock in the system permits the **gasoline level in the float bowl to become low or even dry,** causing a lean mixture, which is evidenced by the following operating characteristics:
   (a) Lack of power on full throttle or softness and flat spots on part throttle operation.
   (b) Stalling on idle when engine is hot.
   (c) Inability to start a hot engine.

Proper Use of Electric Fuel Pump

6. The use of the electric fuel pump will disrupt the formation of phases No. 2 and No. 3 in the aforementioned cycle.

   When the first indications of vapor lock are observed, the electric pump should be brought into operation and upon regaining the lost engine speed, should be shut off, thus giving the standard mechanical pump an opportunity to rid the regular fuel system of vapor. This method of operation will have to be repeated several times before the mechanical pump will supply sufficient fuel, after which the use of the electric pump is not required; however, in stubborn cases continuous operation may be necessary. It should be noted that "shut off" valves are not shown on the sketch as it is desired to make the auxiliary system as flexible as possible to accommodate either continuous or intermittent operation.

   Should the use of the electric pump not be required regularly, it is recommended that it be operated every few days to prevent the stagnant gasoline from forming gum.

Gasoline Gum

Most gasolines, when they stand for a long time in contact with air, oxidize to a small degree. This oxidation is similar to what happens to linseed oil and other "drying" oils when they are exposed to air, only in the case of gasoline it proceeds very slowly. The result of such oxidation is to form compounds in the gasoline which are so complex that they do not evaporate along with the rest of the gasoline later on when it goes into the engine. Instead, they are left behind or deposited wherever the gasoline evaporates.

At first, this deposited material is sticky like molasses; but, as it oxidizes further in the place where it has been left by gasoline evaporation, it gradually becomes hard like a varnish. This varnishlike gum sticks throttles, carburetors, fuel pumps, intake valves, and coats the inner surface of inlet manifolds. Also, so much gum may be formed in some gasolines on long standing that it can no longer be held in solution, but separates from the liquid and coats the inside of the fuel-handling system as well. After a truck with gasoline in the tank has stood in storage long enough to permit the formation of considerable amounts of gum in the gasoline that is there, it may then be possible to drive the truck only a very few miles until it has become inoperative from the gumming and sticking of the parts mentioned above. Once such a condition has been reached, the job of cleaning up and reconditioning the parts is a very difficult one. This is aside from the danger of doing damage to the truck from such resulting difficulties as inability to get badly gummed intake valves out of their guides, sticking piston rings, etc.

The formation of gum in gasoline is accelerated by three conditions:

(a) By temperature. On this account, the danger of gumming is worse in the summertime or in a heated building than when the truck is stored in a cold place.

(b) By intimate contact with air. This means that a gallon or so of gasoline spread over the bottom of the fuel tank of a truck may oxidize or gum worse than would be the case if the tank were full of gasoline. In draining it is accordingly important to get all the gasoline out—and this includes the fuel pump and the carburetor.

(c) By the presence of some materials, such as bright copper and some soldering fluxes. For this reason, it is especially important to see that new trucks are not left in storage for a long time with gasoline in them.

All of the difficulties mentioned above can be avoided by taking the precaution of draining the gasoline completely from trucks which are left in storage. The exact time that it is safe to leave the gasoline in a truck cannot be given, because it varies considerably from one gasoline to another. It is suggested, however, that the gasoline be drained out if the truck is to be left in storage for a month or more.

Cleaning Gasoline Gum from Fuel System

The job of reconditioning or cleaning parts which have become gummed up as described above, may be lessened considerably if the cleaning is done by washing them with a liquid which will dissolve the gummy deposits. Acetone is good for this purpose. Or, if acetone is not available, then some other solvent, such as a half-and-half mixture of benzol and denatured alcohol, may be used.

Acetone, benzol and alcohol, are all volatile and inflammable. They should, therefore, be handled with the same precautions against fire as are used in the case of gasoline. It should be noted also that these liquids will damage the truck finish.

Fuel Pumps

Fuel Pumps

Fuel pumps are bolted to a pad on the crankcase and are operated by an eccentric on the engine camshaft.

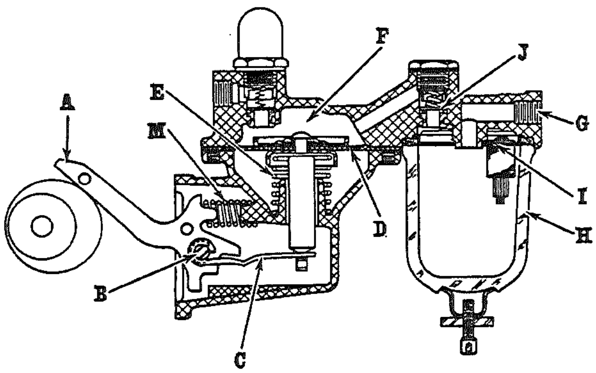

Fig. 1, Fuel Pump (HD Series Engines)

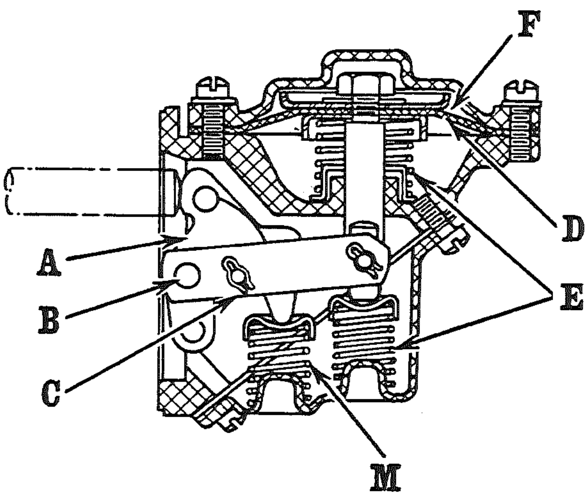

Fig. 2, Fuel Pump (FAB Series Engines)

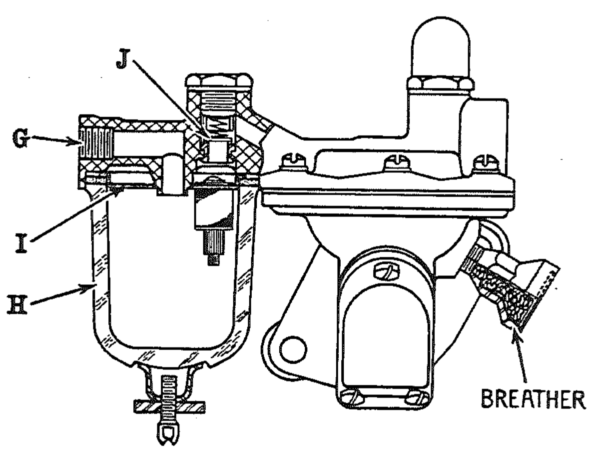

Fig. 3, Fuel Pump (FAB Series Engines)

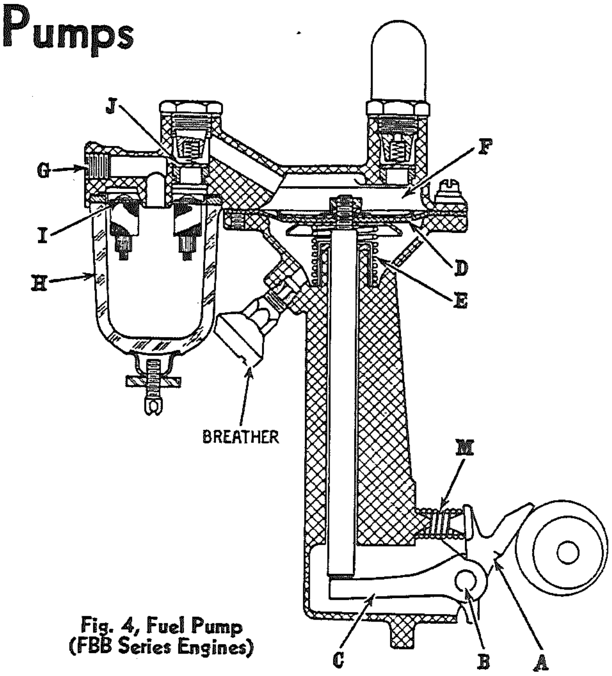

Fig. 4, Fuel Pump (FBB Series Engines)

Operation (All Models)

The rotation of camshaft eccentric actuates rocker arm (A) pivoted at (B) which pushes link (C) and diaphragm (D) downward against spring pressure (E), which creates a vacuum in pump chamber (F).

On the suction stroke of the pump, fuel from the rear tank enters inlet (G) into sediment bowl (H) and passes through filter (I) and inlet valve (J) into pump chamber (F). On the return stroke, spring pressure (E) pushes diaphragm assembly (D) upward, forcing fuel from chamber (F) through outlet valve to the carburetor.

When the carburetor bowl is filled, the float in the carburetor will shut off the needle valve, thus creating a pressure in pump chamber (F). This pressure will hold diaphragm (D) downward against spring pressure (E) where it will remain inoperative in the downward position until the carburetor requires further fuel and the needle valve opens. Spring (M) is merely for the purpose of keeping the rocker arm in constant contact with eccentric or push rod.

Fuel Pump Troubles (All Models)

In some instances trouble is attributed to the fuel pump, when in reality it is caused by some other condition. A careful check should be made to avoid needless replacement of the pump.

Lack of fuel at the carburetor is caused by the following:

- Main fuel tank empty.
- Leaky fuel pipe or connections.
- Fuel filter bowl loose or broken gasket.
- Dirty filtering element.
- Loose valve plug.
- Fuel leakage at diaphragm.
- Valves sticking. Check for dirt under seat.

Remove fuel pipe at carburetor and run starting motor. If fuel spurts out, the fuel pump is working.

If leakage of fuel at the diaphragm is detected, loosen cover screws; then tighten them alternately and securely.

Sometimes there appears to be a leak at the diaphragm, whereas the leak actually exists at one of the pipe fittings and fuel has run down the pump to the diaphragm flange.

If fuel pump has been removed from engine, care should be used in reassembling so that the cam surface of the rocker arm rests against the eccentric and not under it. If the cam surface of the rocker arm is placed under the eccentric, breakage of the rocker arm will result.

Special Tools (All Models)

Ordinarily, any trouble in the fuel pump will be found to be in the diaphragm, the linkage springs or the valves. The valves and springs may be serviced without difficulty, but servicing the diaphragm requires the use of a diaphragm locating ring, S.E. 8701 and wrench S.E. 8702.

Testing (All Models)

The first step in checking the operation of the fuel pump should be an inspection of the pump inlet valve. Remove the screw plug in the top cover of the pump above the strainer bowl, and take out the spring and fiber valve. Make sure that no dirt or foreign matter is holding the valve open and that the fiber valve is flat and free from cracks. Then reinstall the valve assembly, or replace with new, if needed. Next, remove the air dome from the boss above the pump body and inspect the outlet valve at this point.

Pressure Test (S.E. 870 Gauge)

The pressure gauge should then be attached, screwing a connection nipple into the boss where the air dome has been removed and screwing the gauge into the connection. It is important that the spring and fiber valve be in place when this test is made. Start the engine and note the pressure. If the diaphragm is not cracked or broken and the linkage springs have sufficient tension, the gauge should indicate from 1½ to 3 pounds (the average is about 2¾ pounds) with the engine running. If the pressure is less than 1½ pounds, the pump should be removed from the engine, disassembled and the diaphragm and springs inspected.

Fuel Pump Analyzer

A fuel pump analyzer is available which permits testing the flow as well as the pressure. This complete unit is carried under S.E. 1018.

Installation

If one of these units is used the following instructions should be followed:

1. Disconnect gas line between fuel pump and carburetor at the **fuel pump outlet only.**
2. Remove fitting in the fuel pump outlet and replace with the proper outlet valve plug adapter.
3. Attach the tee connection to the adapter and install analyzer to the side outlet of the tee.
4. Attach the rubber tube to the end of the tee, then loop it and slip the opposite end over the free end of gas line running to carburetor.

Capacity or Flow Test

Have shut-off valve open and engine operating at a speed comparable to 30-35 M.P.H. road speed. Check length of time required to deliver **one pint** of fuel into the pint measuring can.

It is important that the position of the fuel "bleed" should be level with the carburetor bowl or slightly higher, this referring particularly to downdraft carburetors to compensate for the difference in level between the fuel pump position and the carburetor position.

In making the capacity test, there should be no need for referring to the pressure gauge, as this test is simply to determine that a sufficient amount of fuel is flowing. In making this capacity test, determine that a flow of **one pint** is obtained in **one minute.** If a pint or more is delivered in one minute, it is assurance that the carburetor will never starve for fuel at any speed. In many instances the test may disclose that more than a pint of fuel will flow in the time specified. This is not an indication that the fuel pump is defective. Rather it shows that the fuel pump is most efficient. Where the flow is, however, greater than the minimum required, it is always then advisable to make the pressure test to insure against excessive pressure.

Pressure Test

Have shut-off valve closed and engine idling at the lowest possible speed in order to get a true static pressure reading. This test is only for the purpose of checking for pumps that may have over pressure to the extent that they may be causing a rich fuel mixture condition with possible poor economy, and in extreme cases may be sufficiently over pressure to cause carburetor flooding. This test has nothing to do with the output or yield of the fuel pump.

The pressure gauge should indicate from 1½ to 3 pounds (the average is about 2¾ pounds). If the pressure is less than 1½ pounds, remove pump from engine and inspect diaphragm and springs.

Diaphragm Service

To remove the diaphragm after the pump has been removed from the engine, first mark the top cover and pump body so that they can be aligned properly when reassembling; then remove the screws in the top cover and take off the cover. If the diaphragm is cracked or broken or shows signs of excessive wear it should be replaced. If the diaphragm is in good condition, the spring (E) should be replaced to correct insufficient pressure.

HD Series Engines

The diaphragm and pull rod must be removed as an assembly. With the top cover off, twist the diaphragm and pull rod assembly ¼ turn, which will permit the pull rod to disengage from the rocker arm link. To reassemble, hold rocker-arm link up so that end of pull rod will go in slot in link. If diaphragm requires replacement, the complete assembly of diaphragm and pull rod must be installed.

FAB Series Engines

The diaphragm may be removed from the pull rod by removing the hex. nut, the lockwasher, the hexagonal alignment washer and the upper protector washer. To remove the pull rod assembly, it will be necessary to remove the three screws in the bottom cover, remove the cover, remove the springs, remove one of the clips in the pin holding the pull rod to the operating levers, and pull out the entire diaphragm and pull rod assembly from above.

FBB Series Engines

Remove the diaphragm and pull rod as an assembly by twisting ¼ turn to disengage end of pull rod from slot in rocker-arm link. Then remove diaphragm from pull rod as outlined under FAB engine paragraph.

FAB and FBB Series Engines

Installing the diaphragm and reassembling the pump requires particular care. If the diaphragm is not in the proper position when the top cover is installed, it will not be possible to line up the screw holes without twisting the diaphragm cloths which would cause excessive wear and breakage. The offset wrench and locating ring are provided to aid in the proper installation.

To install the diaphragm, place one of the flanges of the fuel pump body in a bench vise. Place the small copper washer over the threaded end of the pull rod and place the lower (smaller) diaphragm protector washer, cup side **down,** over the copper washer. The five diaphragm cloths should then be dipped in kerosene or gasoline and placed over the smaller protector washer. Line up the holes in the layers of the diaphragm cloth, using the locating ring. Place the upper (larger) diaphragm protector washer over the diaphragm cloths with the cup side **up.** Make sure that the cup side of both the upper and lower protector washers face away from the diaphragm cloth to prevent cutting.

Alignment

Place the hexagonal alignment washer over the upper protector washer; then install the lockwasher and pull rod nut, but do not tighten securely. To tighten the assembly, use the offset wrench to hold the diaphragm alignment washer stationary and prevent the diaphragm from turning; and with the locating ring still in place, tighten the pull rod nut securely. The locating ring may then be removed.

It is extremely important that the diaphragm be held exactly in alignment while the pull rod nut is being tightened. If it is allowed to twist or become distorted the life of the diaphragm will be considerably shortened. In this connection, if the entire diaphragm assembly, including the push rod, is replaced, it may be necessary to loosen the pull rod nut, place the diaphragm cloth in the proper position and, holding it with the locating ring, tighten the pull rod nut in the same manner as above before installing the top cover.

When installing the top cover, after the diaphragm has been installed, it is important that the diaphragm be in the extreme up position. If the bottom cover of the pump is in place (FAB Engines) the disphragm will be in the extreme up position; but if the bottom cover has been removed to install the entire pull rod and diaphragm assembly, it will be necessary either to install the bottom cover with the springs before installing the top cover, or to place the pull rod in the extreme up position with the end of a wrench and holding it in this position while the top cover is being installed.

Top Cover Installation

To install the top cover, lay the cover on the pump in the proper position determined by the marks made before the pump was disassembled, and with the diaphragm in the extreme up position, insert the screws with lockwashers from the top through the cover and diaphragm into the pump body. Do not tighten the screws immediately: first install all the screws, drawing them up evenly but not tightly, then tighten them securely but in alternate order so that there will be no chance for bunching or stripping at any point.

FAB Engines

When installing the bottom cover make sure that the proper spring is used at the proper point and that the springs and spring caps are in place. The shorter spring should be placed over the boss at the shallow end of the bottom cover to bear against the rocker arm while the longer spring should be placed over the boss in the deep end of the cover to bear against the diaphragm pull rod. Particular care should be taken to make sure that the springs and spring caps remain in their proper positions while the bottom cover is being put in place and the screws installed and tightened.

Final Check

A simple check of the suction and pressure should be made before installing the pump on the engine. This can be done by holding the fingers over the inlet and outlet openings of the pump and manipulating the rocker arm by hand. The pump may then be reinstalled on the engine and tested. It should prime itself, that is, fill the filter bowl, in about 30 seconds with the starter button depressed. If it fails to provide sufficient pressure, the diaphragm has been incorrectly installed, preventing the full stroke of the push rod, or the springs do not have sufficient tension; and it will be necessary to disassemble the pump to reinstall the diaphragm correctly or to replace the linkage springs if this has not been done.

Installation of Fuel Pump Assembly

Use a new gasket between fuel pump mounting flange and pad on crankcase and tighten capscrews securely.

Connect fuel lines, first making sure that there is no dirt on the fittings which might be drawn into the system.

If carburetor has not been removed there will usually be sufficient fuel in it to run the engine long enough to fill the fuel pump filter bowl. If there is an air leak between filter bowl and gasket the pump cannot draw fuel into the bowl. To remedy this, install a new gasket and see that bowl seats squarely. Tighten clamp screw securely with the fingers only.

If fuel pump bowl still does not fill the trouble may be due to an air bound condition. In this case the bowl should be loosened slightly so that air can escape and, by blowing in the gasoline tank filler neck, fuel will be forced into the pump. Then tighten bowl securely and start engine.

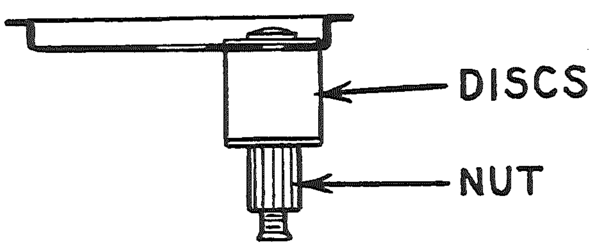

Fig. 5

Fuel Filter Element

This filter element should be cleaned periodically and the sediment removed from the filter bowl. To clean the filter element, loosen the serrated nut so that the filter discs are free, and blow out with air. Be sure to tighten serrated nut which holds discs in place. On the larger model trucks a double filtering element is used.

CAUTION: The serrated nut should be tightened with the fingers only. Do not use pliers.

Carburetors—23, 80 and TU Series

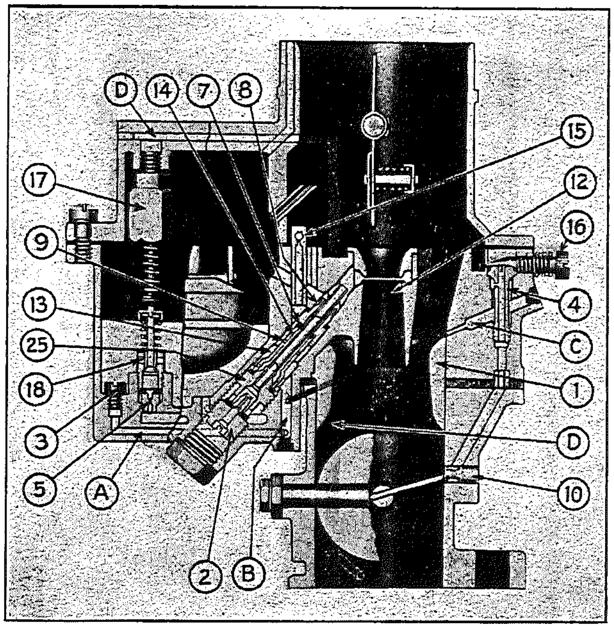

Fig. 1, Carburetor (23 Series)

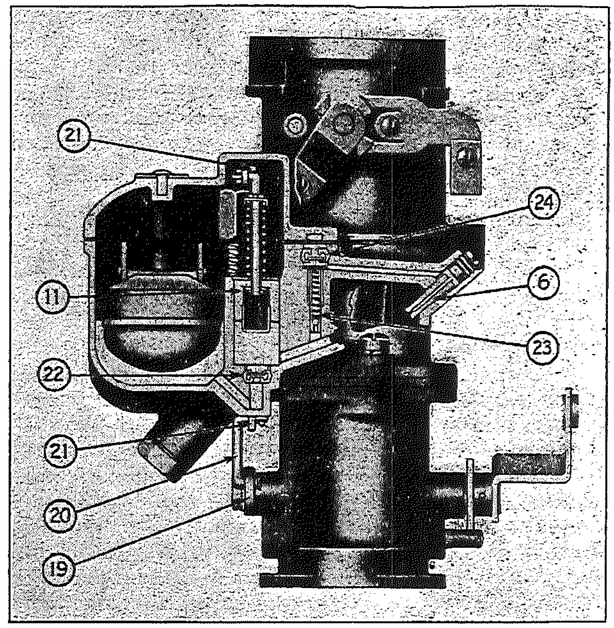

Fig. 2, Carburetor (23 Series)

Carburetor—23-AV-10, 23-AV-11 and 23-AV-12

The carburetor is a downdraft, double-venturi, balanced type, which maintains equal depression ratios between air intake and fuel bowl, regardless of the air cleaner used. All openings such as bowl vent, well vent, idle air, etc., are protected from dirt and abrasives by the air cleaner. The carburetor is provided with a vacuum operated economizer which produces maximum economy at part throttle operation, while at full throttle operation the full power mixture is maintained. The accelerating pump is mechanically operated from the throttle and insures a perfect control of the charge. The construction of the carburetor is such that the well, cap jet calibration and main jet are all accessible from the same external location.

Idling System

Consists of the idling jet (4), which measures the fuel and the idling adjusting needle (16) which regulates the air. The idling jet calibration is on the side of the idling jet. The idling jet receives fuel from the compensator (3) and through channels A, B and C. The fuel then goes through the small calibration in idle jet (4) where it is mixed with air going through the center of the idling jet. The idling system functions only at idling and speeds below 20 miles per hour. At these speeds the throttle plate is almost closed and there is a very strong suction past the edge of the throttle plate. The mixture of fuel and air from the idling jet is discharged through the priming plug (10). There is no gasket used under the idling jet. **IMPORTANT:** The priming plug is never to be removed.

Compensating System

The compensating jet (3) discharges fuel through channels A and B into the well (13) and through the holes in the cap jet base (9) into the space (14) between the cap jet base and the main jet tube. The fuel is then mixed with air admitted through the ventilating plug (15). As the throttle is opened the air and fuel mixture then passes through the cap jet calibrations (7) and the cap jet tip (8) and is discharged through the secondary venturi (12).

NOTICE: Should the cap jet assembly be removed make sure, when reassembling, that the gaskets are installed. There must also be a gasket under the compensator jet. **IMPORTANT:** The ventilating plug (15) is never to be removed.

Accelerating System

The accelerating system consists of the accelerating pump piston which is actuated by the movement of the throttle, a series of channels, check valves and an accelerating jet which controls rate of fuel discharge.

When the throttle is opened it causes a downward stroke of the pump lever (19). Through the link (20) and accelerating pump rod (21) the accelerating pump piston (11) is forced downward in its cylinder. Fuel from the carburetor bowl has previously entered the cylinder through the check valve (22). As the pump piston starts its downward stroke it applies a pressure upon the fuel which closes the lower check valve (22) and causes displacement of the fuel from the pump cylinder through the ball check valve (23). This closes the upper check valve (24), causing the fuel to be discharged into the air stream through the accelerating jet (6).

When the fuel has been discharged from the pump cylinder there is no longer any pressure against the ball check valve (23) or the upper check valve (24). Therefore the needle valve drops back on its seat and the upper check valve (24) opens. This admits air and eliminates any direct suction on the fuel. No further fuel discharge comes from the accelerating jet until the throttle is closed and the accelerating procedure is repeated.

NOTICE: Due to its tapered seat, no gasket is used under the accelerating jet. **IMPORTANT:** The accelerating check valves (22), (23) and (24) are never to be removed.

Power Jet System

The power jet system consists of the power jet (5) to regulate the volume of fuel and the power jet vacuum piston (17) which, actuated by the manifold vacuum, causes the power jet valve (18) to open. A series of channels (D) connect the power jet vacuum piston with the carburetor barrel below the throttle plate. At normal driving speeds, the manifold vacuum is sufficient to overcome the spring tension and to hold the vacuum piston up, but at low speed, lugging with wide-open throttle, or at sustained high speeds, due to the reduced manifold vacuum, the piston drops in its cylinder. This opens the power jet valve (18) and fuel from the bowl is measured through the power jet (5). This, added to the normal fuel supply, furnishes just enough extra fuel to provide full power development.

Should the power jet valve and jet be removed be sure and insert copper gasket between top of jet and valve when reinstalling.

NOTICE: No gasket is used under power jet, due to tapered seat on same. **CAUTION:** Never change the spring tension on power jet vacuum piston and valve.

Main Jet System

The principal influence of the main jet system is exerted at the higher engine speeds. Fuel is discharged into the air stream through the secondary venturi (12).

The main jet (2) is of a two-piece construction; the upper part or main jet tube (25) retains the cap jet base (9) and the lower part (2) is the calibration, or main jet proper.

NOTICE: Should the main jet be removed for cleaning purposes, it is unnecessary to unscrew the upper part. When reassembling make sure that the gasket is between the upper and lower parts.

Carburetor—82-BV-10

The carburetor is a horizontal type with double venturi and is balanced in order to maintain equal depression ratio between air intake and fuel bowl regardless of the air cleaner used. All openings such as bowl vent, well vent and idle air, are protected from dirt and abrasives by the air cleaner.

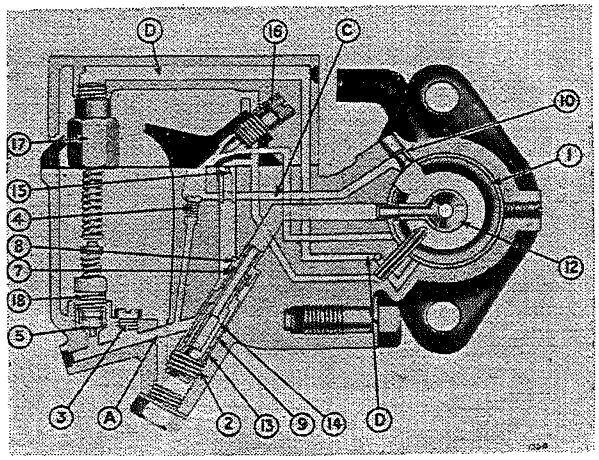

Fig. 3, Carburetor (80 Series)

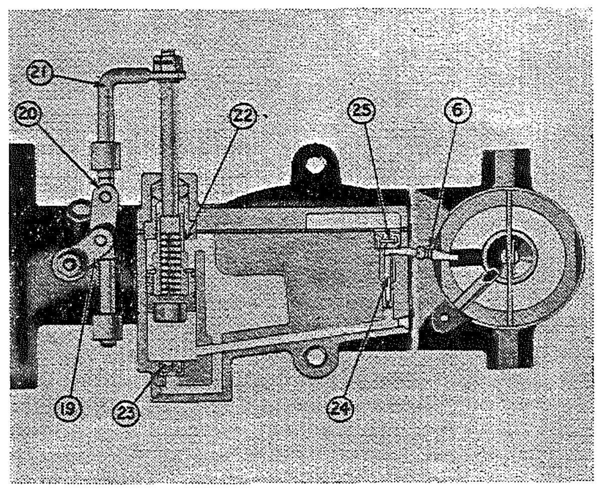

Fig. 4, Carburetor (80 Series)

The main venturi (1) measures the volume of air which is passed through the carburetor.

The secondary venturi (12) increases the suction and breaks the fuel into small particles. This improves the fuel distribution.

Idling System

The idling system consists of the idling jet (4) and the idling adjusting needle (16). The idling jet receives its fuel from the compensator (3). After being measured through the idling jet, the fuel is mixed with air, the amount of air being regulated by the idling adjusting needle.

The idling jet system functions only at idling speeds and speeds below 20 M.P.H.

At these speeds the throttle plate is only cracked open and there is a strong suction past the edge of the throttle plate. The mixture of fuel and air from the idling system is carried through various channels and discharged through the priming plug (10). **IMPORTANT:** The priming plug is never to be removed.

Compensating System

The compensator (3) discharges its fuel into the well (13) and through holes in the cap jet base (9) into the space between the cap jet base and the main jet.

As the throttle is opened this fuel is discharged into the air stream through the secondary venturi, after passing through the cap jet calibration (7) and the cap jet tip (8).

Air is admitted through the well ventilation plug (15) to mix with the fuel from the compensator. **IMPORTANT:** The well ventilation plug is never to be removed nor its size altered.

Power Jet System

The power jet system consists of the power jet (5), the power jet vacuum piston (17) and the power jet valve (18).

At low speeds lugging with wide-open throttle or at high speeds, additional fuel is required for full power development. When such a condition exists, the manifold vacuum is low. The vacuum piston (17), which is connected to the carburetor barrel between the throttle plate and manifold flange by a series of channels, drops in its cylinder due to the reduced vacuum. This opens the power jet valve (18) and fuel from the bowl is measured through the power jet (5) and this additional fuel, added to the normal fuel supply, furnishes just enough extra fuel for full power development. At normal driving speeds, the manifold vacuum is sufficient to overcome the spring tension and hold the power jet vacuum piston up. This keeps the power jet valve closed and assures maximum economy for part throttle performance. **IMPORTANT:** The spring tension of the power jet vacuum piston and of the power jet regulator valve is never to be altered.

Accelerating System

The accelerating system consists of the accelerating pump piston (22) which is actuated by the movement of the throttle, a series of channels, check valves and an accelerating jet which controls the rate of fuel discharge.

When the throttle is opened it causes a downward stroke of the pump lever (19). Through the link (20) and accelerating pump rod (21) the accelerating pump is forced downward in its cylinder. Fuel from the carburetor bowl has previously entered the cylinder through the check valve (23). As the pump piston starts its downward stroke it applies a pressure upon the fuel which closes the check valve (23) and causes displacement of the fuel through the ball check valve (24). This closes the check valve (25), causing the fuel to be discharged into the air stream through the accelerating jet (6). **IMPORTANT:** Do not remove the accelerating check valves.

Main Jet System

The principal influence of the main jet is exerted at the higher engine speeds.

The main jet (2) discharges its fuel into the secondary venturi through a series of channels.

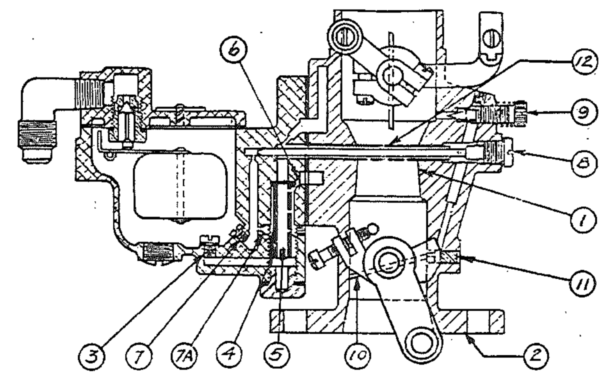

Fig. 5, Carburetor (TU Series)

The main jet, accessible from the outside, serves as a holder for the cap jet base assembly. **IMPORTANT:** When replacing main jet, make sure that the gaskets are in their proper place.

Carburetor—TU-3½-X1

The carburetor is a downdraft, single venturi balanced type which maintains equal depression ratio between air intake and fuel bowl, regardless of the air cleaner. All openings such as bowl vent, well vent and idle air are protected from dirt and abrasives by the air cleaner.

The venturi (1) is cast integrally with the carburetor and measures the volume of air which is passed through the carburetor. The venturi size used is the smallest one which will permit full power development. The venturi size is indicated by figures stamped on the face of the carburetor flange (2).

Idling System

The idling system consists of the idling jet (8) which measures the fuel and the idling adjusting needle (9) which regulates the air. The idling jet calibration is at the end of the idling jet tube. The size of the idling jet is stamped on the head and the idling jet is accessible from the outside of the carburetor.

The idling jet system functions only at idling speeds and speeds below 20 M.P.H.

At these speeds the throttle plate (10) is only cracked open and there is a strong suction past the edge of the throttle plate. The mixture of fuel and air from the idling system is carried through a channel and discharged through the priming plug (11). **IMPORTANT:** The priming plug is never to be removed.

Compensating System

The metering well (4) controls the ratio characteristics by means of the indirect suction by-pass holes in side of metering well. The size of these by-passes influences the rate of fuel flow from the main jet. The diameter of the hole (5) in the metering well is selected to balance the main jet and venturi sizes. It regulates the suction on the main jet and influences the mixture ratio at all speeds except idling.

The well addition jet (7) controls the rate of fuel flow into the well reservoir (7a). The fuel in this reservoir provides a reserve which is available as an accelerating charge when the throttle is opened quickly. The size of the well addition jet also has an effect on the mixture ratio at part throttle position—just above the idling range. Too large a jet would cause a richness and too small a jet would cause a leanness at this point.

The size of the high speed bleed (6) controls the rate of air flow into the metering well channels. **IMPORTANT:** This size is determined by test and should not be altered.

Main Jet System

The principal influence of the main jet system is exerted at the higher engine speeds.

The main jet (3) is located in the fuel bowl and its fuel passes through the metering well (4) and is discharged into the venturi through the holes in the discharge bar (12). **IMPORTANT:** The discharge bar is never to be removed.

General Service Hints

Hard Starting

Check the following points in locating cause of hard starting:

(a) Is there fuel in carburetor?
(b) Does the air shutter or choke close completely?
(c) Are the intake manifold and carburetor flange gaskets leaking air?
(d) Is the idling jet clean?
(e) Has the throttle been partly opened as this is very essential for easy starting?
(f) Is the ignition system functioning properly?

Cold Weather Starting

(a) Pull out choke control (full travel).
(b) Move accelerator pedal in and out three or four times to operate accelerating pump.
(c) Start engine and after first explosions push in choke slightly and allow motor to run on approximately ¼ throttle until warmed up.
(d) After motor has properly warmed up, push choke into off position.

Poor Acceleration

Fuel for acceleration is provided not only from the accelerating jet but also through the entire jet system.

(a) First check accelerating jet for dirt.
(b) Inspect the pump check valve (24) to be certain it closes properly on its seat, using the following method:
(c) Remove carburetor top, fill fuel bowl approximately ⅔ and work the accelerating piston up and down. If the fuel squirts through the check valve when the piston goes down it is then necessary to clean check valve with air pressure.
(d) Check the entire jet system.

Lack of Speed or Power—Poor Economy

Remember that many things besides the carburetor determine the amount of fuel used, such as low compression, incorrect ignition timing, defective ignition, dragging brakes, clutch slippage, insufficient tire pressures, overloads, extremely dirty air cleaners, etc. All these affect directly the performance of the engine.

(a) Check compression.
(b) Check ignition and timing adjustments.
(c) Check for dragging brake.
(d) Check tire pressures.
(e) Check condition of air cleaner.
(f) Check condition and density of oil and lubricants in motor, transmission, rear axle, etc.
(g) Check gas line, fuel pumps, etc., for leaks.
(h) Check choke valve for complete opening.
(i) Check carburetor jet sizes against factory specifications and unless the owner has specific reason for using a special setting, always use the standard specifications.
(j) Check the carburetor jets for dirt and carefully blow them out but never clean them by using acid dipping process or by running wires, etc., through the metering orifices.

Poor Idling

For good idling all parts of the engine must be in perfect adjustment.

(a) Check possible obstructions of idling jet and compensator jet.
(b) With the engine in good adjustment and with the carburetor in good condition, set the stop screw on the throttle lever so the engine will run sufficiently fast to prevent stalling.
(c) Turn the idling adjusting needle towards or away from its seat until the engine hits evenly without "rolling" (rich) or "skipping" (lean), then back off on the stop screw until desired engine speed is obtained. During this latter operation it sometimes happens that another slight idling adjustment is necessary.
(d) Have engine at normal operating temperatures when setting the idle.

Carburetor Floods or Leaks

(a) Check fuel valve needle and seat for dirt or wear (when replacing always replace both at same time).
(b) Check gasket under fuel valve seat.
(c) Check gaskets and connections.
(d) Check proper position of float (See Figs. 6, 7 and 8).

When checking float dimension, be sure that bottom of float is parallel with face of fuel bowl cover, otherwise an incorrect reading will be secured. Lay a six-inch scale across bottom of float and check at both ends.

(e) If fuel level is too high, check fuel pump for too high pressure, or fuel valve seat and needle for wear. **NOTE:** When it becomes necessary to replace either the fuel valve or the seat, be sure to replace both parts and the gasket.
(f) If level is too low the float hinge doubtless is bent, in which case, install a new float.

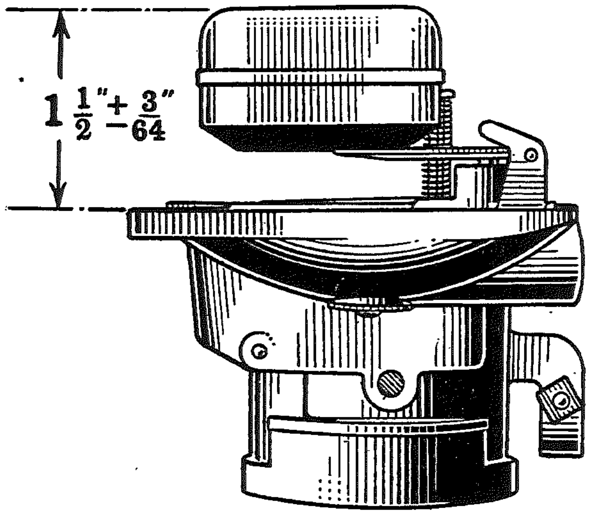

Fig. 6, 23 Series Carburetors

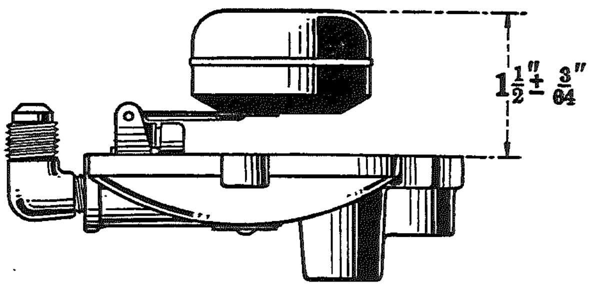

Fig. 7, 80 Series Carburetors

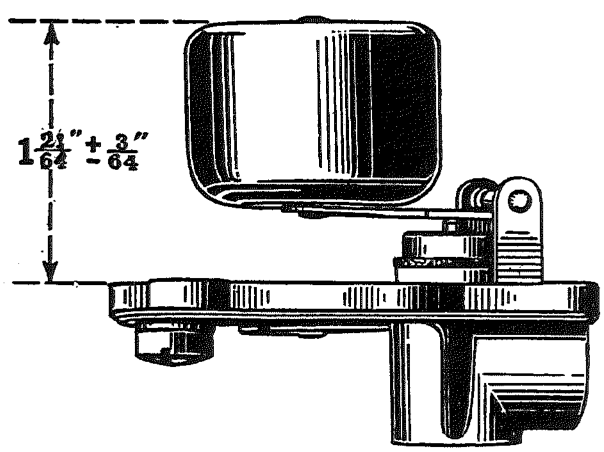

Fig. 8, TU Series Carburetors

Stalling Following Deceleration

If stalling occurs when coming to a stop it is probably caused by:

(a) An obstructed idling jet or idle speed set too low.

(b) Occasionally a driver, while waiting to start again following a stop, will "play the throttle" by repeatedly touching the accelerator pedal. This motion causes an accelerative discharge to puddle and load the intake manifold. This will often cause stalling.

Air Cleaners

Air Cleaners

The air cleaners are of the oil-washed type. The cleaning element is continually being washed with oil that is agitated by the incoming air. Dust removed by the oil-washed element is deposited in the base and settles to the bottom.

The necessity for cleaning the air cleaners depends entirely upon dust and operating conditions.

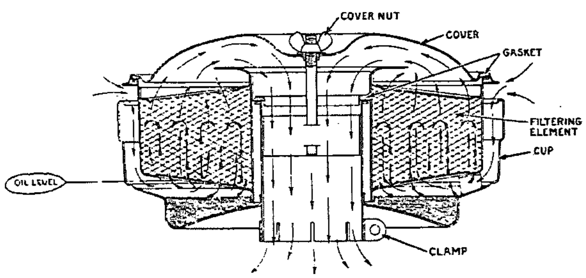

Fig. 1, Air Cleaner (D-2, D-15, D-30, DS-30, D-30B, DS-30B, D-186T, DS-186T)

Servicing

D-2, D-15, D-30, DS-30, D-30B, DS-30B, D-186T, DS-186T

Under normal conditions the cleaner element should be removed and washed in kerosene every 5,000 miles. It may be necessary to clean the air cleaner more often under severe conditions.

Clean out oil base and refill with 1 pint of oil: S.A.E. 50 for warm weather and lighter grades for cold weather. The oil level is marked on the side of the air cleaner body.

Replace cleaner element and top cover and tighten wing nut by hand only.

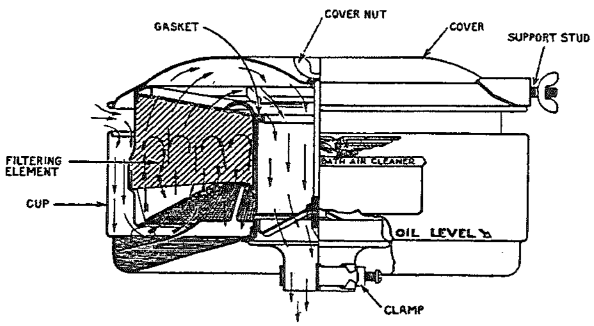

Fig. 2, Air Cleaner (D-5)

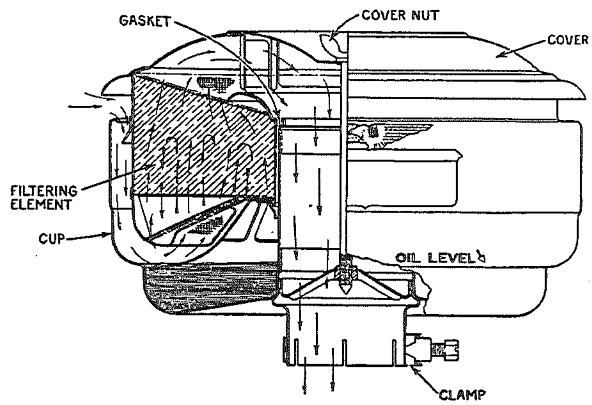

Fig. 3, Air Cleaner (D-300, DS-300)

D-5, D-300, DS-300

These air cleaners should be serviced each time the engine crankcase oil is changed or more frequently under severe dust conditions. Use SAE 50 oil for warm weather and lighter grades for cold weather. Fill oil cup to level indicated on side of cleaner (1 pint for D-5, 1 quart for D-300, DS-300).

Occasionally the cleaner element should be washed out in kerosene and permitted to drain thoroughly before reinstalling.

The top cover wing nut should be tightened by hand only—do not use tools.

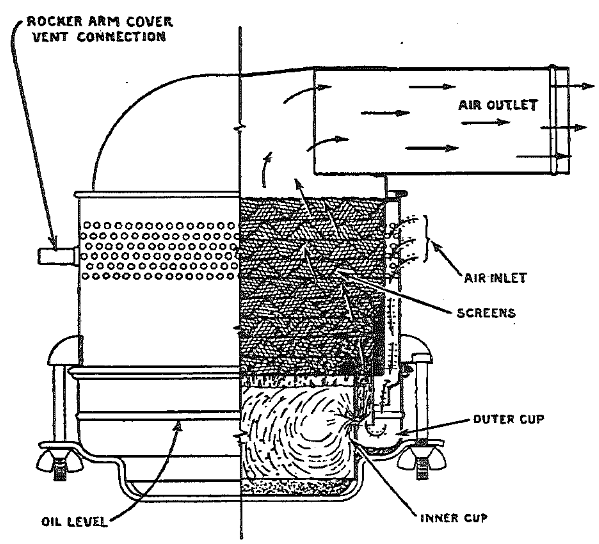

Fig. 4, Air Cleaner (D-35, DS-35, D-35B, D-40, D-216T)

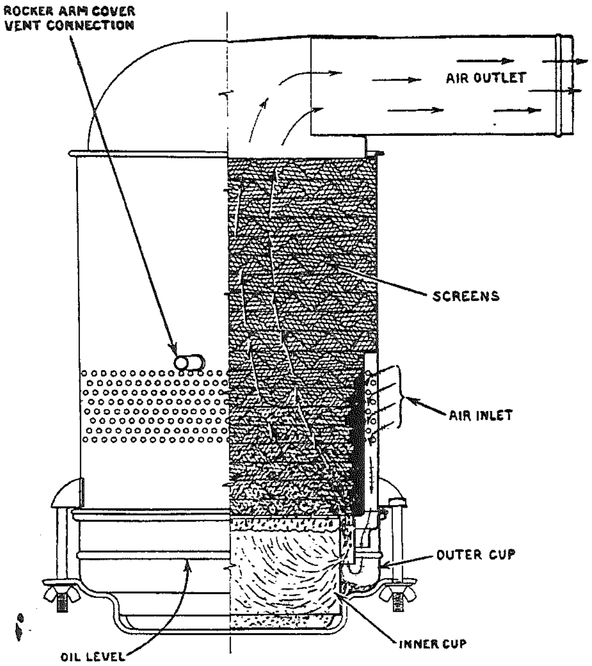

Fig. 5, Air Cleaner (D-50, D-60, DR-60, DR-70, D-246T, D-246F, DR-346T, D-346F, DR-426F)

D-35, DS-35, D-35B, D-40, D-50, D-60, DR-60, DR-70, D-216T, D-246T, D-246F, DR-346T, D-346F, DR-426F

The air cleaner should be serviced at least once a week and daily under extremely dusty conditions.

To service air cleaners, remove oil cup and clean out all dirt from both inner and outer cups. Examine air intake openings and passage and clean out if necessary. Refill inner and outer oil cups to oil level beads with 1¼ quarts of same grade of oil that is used in engine crankcase.

Replace oil cup and tighten wing nuts by hand only. Inspect and tighten connections at air cleaner and carburetor, also remove and inspect rocker arm cover vent line to make sure that it is open.

Governors

Governors

The governor is the velocity type and is adjusted for correct speed and sealed at the factory. The maximum engine speed specified should not under any circumstances be increased. Check governor setting at regular intervals and if found to exceed the maximum speed the governor should be adjusted to limit the speed.

A tachometer having an extension long enough to reach the end of the crankshaft should be used to check the engine revolutions.

Installation

The governor must be right side up. On one flange of each governor the words "ENG. SIDE" are cast in. This flange must be against the manifold.

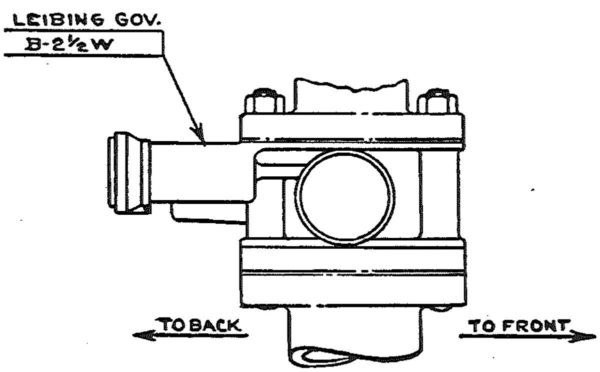

Fig. 1, Governor Installation (B-2½-W and B-3-W)

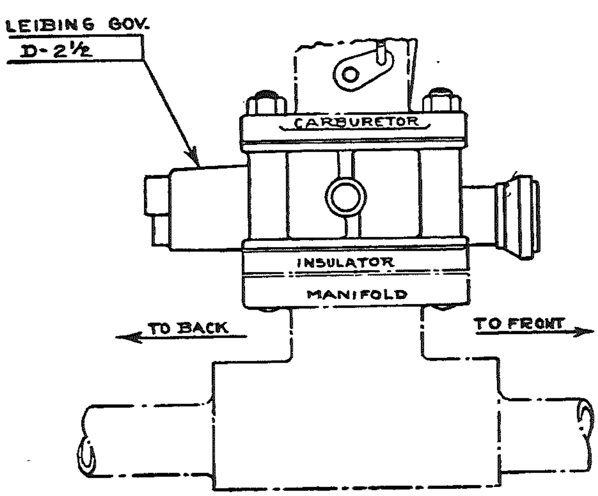

Fig. 2, Governor Installation (D-2½)

The governor must be right-end to, i.e., it must be installed so that the carburetor throttle valve and the governor blades are in the proper relation. (See Fig. 3.) The edge of the carburetor throttle nearest the flange must point into the concave part of the curved governor blade. If the governor is wrong-end to the slip stream will be directed onto the straight, or stabilizing, blade and governing power will be at a minimum. Wrong-side-to installation will result in poor regulation and also throttle steal because of the reduced governing power.

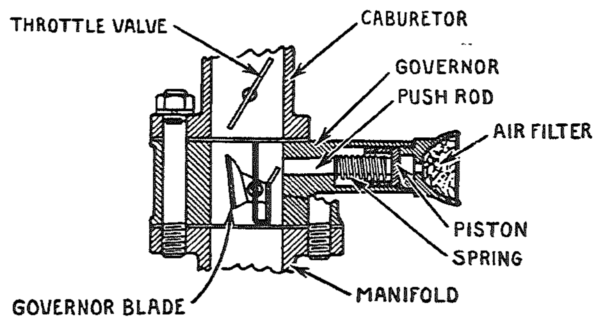

Fig. 3, Governor Installation

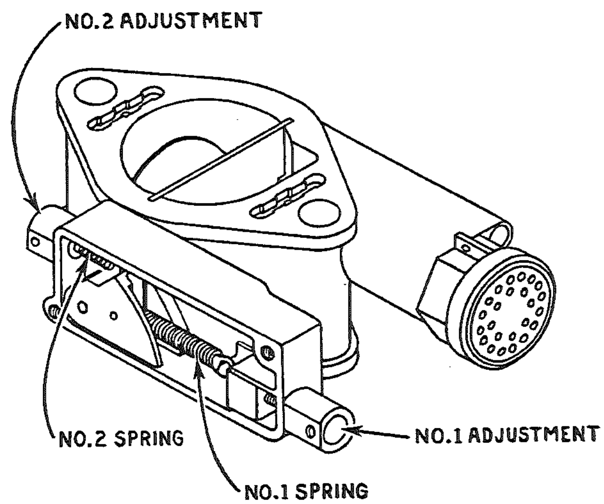

Fig. 4, Governor (B-2½-W and B-3-W)

Adjustment Models B-2½-W and B-3-W Governors

Fig. 4 shows the governor with spring box cover removed. The boss on the right hand end is for the speed adjusting screw, sometimes called the No. 1 adjustment. Screwing in on this screw increases the tension of the No. 1 spring (the long tension spring extending from the adjustment block to the lever). This increased tension results in higher engine speed because it takes more mixture velocity to overcome it. Vice versa, unscrewing this speed adjusting screw reduces the tension of the No. 1 spring and, because it requires less mixture velocity to overcome it, the engine speed is reduced.

At the other end of the housing is seen the short compression spring behind the lever. This spring is not fastened to the lever but is held on the No. 2 adjusting screw. As the governor blade approaches the closed, or governing, position a pointed dot on the lever picks up this spring and compresses it.

The function of this No. 2 spring is to "sharpen" governing, i.e., allow the engine to carry its regular ungoverned power right up to the governed speed. If the tension of this spring is too great governing will be "flat," i.e., the governor blade will start to close too soon and then move slowly to the governed speed. This, as will be seen, means the engine will leave its ungoverned power curve too soon and thus will have less power below the governed speed.

If the No. 2 spring tension is too weak the result will be surging governor.

In case No. 2 adjustment is necessary, be guided by the foregoing. In other words, if the governing is flat, unscrew the No. 2 adjusting screw one-half turn at a time until properly set. If there is a surge, screw it in one-half turn at a time until the surge disappears. The sharpest governing will be obtained by unscrewing the No. 2 adjustment until a surge comes in, then turn back one-half turn.

NOTE: If speed has been adjusted to the desired point by the No. 1 adjustment and the No. 2 is changed afterwards it will become necessary to readjust the No. 1 or speed adjusting screw. Screwing in on the No. 2 will increase the total tension and speed will be increased. Therefore back off on the No. 1 adjustment to bring speed back to desired point. Vice versa, if the No. 2 is unscrewed the total tension will be reduced and the speed will fall off accordingly. Screw in on No. 1 to compensate.

After adjusting No. 2, be sure to put the locking pin through the boss and the slot in the No. 2 screw. The cover plate, when assembled, holds this locking pin in place and prevents tampering with the adjustment.

When adjusting the No. 2 spring the cover plate should be removed so that the lever may be moved away from the spring before turning the adjusting screw. As the spring turns with the screw it might be damaged if it is pressing against the lever at the time.

The engine should be stopped before assembling the cover plate and gasket as otherwise the engine suction might draw the gasket into the housing before the cover plate could be tightened down.

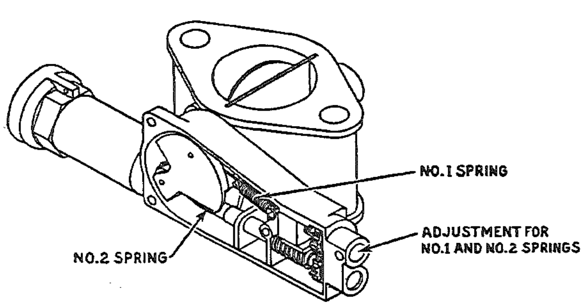

Fig. 5, Governor (D-2½)

Adjustment—Model D-2½ Governor

In this governor there is only one adjustment which is shown in Fig. 5. This works directly on the No. 1 spring and, through gears, on the No. 2 spring so that both are affected when this adjustment is turned. The pitch of the threads on the No. 2 adjustment rod is such as to give the proper ratio of No. 2 to No. 1 adjustment.

Turning in on the adjusting screw increases the speed. Turning out reduces the speed.

In making adjustments be certain the adjusting screw is at the bottom of the serrations which are plainly felt when turning. Otherwise the adjustment screw may stop at the top and then slip off under vibration and make a considerable change in the speed adjustment.

Service

In case of governor failure the following points should be checked in order:

First, before removing from engine, take out the cheat filter cap and press the piston in with the finger and note if it moves freely and is returned to its neutral position by the spring. If at all sluggish remove piston and push rod and clean.

Second, remove the governor and feel the action of the blades by closing them by hand. If any friction is present, determine the cause, which might be dirt between blade and housing, carbon, or the blade rubbing against some surface.

NOTE: Such friction will cause a surge.

Third, remove the spring box cover plate and check for damaged or tampered springs and mechanism.

Maintenance

If the governor is properly installed, adjusted and sealed, very little maintenance is necessary. Periodic inspection should be made to see that seals are not broken, or the governor tampered with. The push rod and piston should be removed periodically and cleaned. The air filter should be cleaned and dried with an air hose before replacing on the governor.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)

S A L E S

CHICAGO, ILLINOIS AUGUST 4-1939

SUBJECT: TACHOMETERS ON D-35 AND LARGER CHASSIS

(B)
M.T.NO.86

Tachometers are now available as an attachment on all chassis shipped from Fort Wayne Works when so specified on your orders. The list prices below also apply on all chassis equipped with Diesel Engines.

	List Price, Installed At Factory, Including Federal Excise Tax
Tachometer, Plain Type...........	$35.00
Tachometer, Maximum Recording Hand and Lock and Key............	$60.00

Branch and Dealers' Discount 20%.

The plain tachometer is installed on the instrument panel and indicates the R.P.M. of the engine in the same manner the speedometer registers miles per hour.

The tachometer with the maximum hand and lock and key is also installed on the instrument panel and records the R.P.M.'s of the engine. The maximum hand indicates the maximum speed of the engine on any one trip or setting. By means of the lock and key the hand may be reset, and thus the maximum speed of the engine is registered on each trip or between each setting.

As each engine has a safe or recommended operating speed, and as this speed is correctly registered only by means of a tachometer, we feel that its installation will materially lengthen the life of any engine - - when the driver conscientiously uses this instrument. An engine is more economical when driven in its recommended speed range than if driven at the maximum speed. We also urge that each chassis powered with a Diesel engine be equipped with a tachometer.

A.C.L. SALES DEPARTMENT

Instrument Group

Section A

Instruments — Page

Ammeter 2
Equipment for Checking 2
Gasoline Gauge 1
Method of Checking 2
Oil Level Gauge 3
Oil Pressure Gauge 1
Service Instructions 2
Water Temperature Gauge 2

INTERNATIONAL

MOTOR TRUCK SERVICE MANUAL

Bulletin Number	Models Affected	Subject

MOTOR TRUCK SERVICE MANUAL

INTERNATIONAL

Bulletin Number	Models Affected	Subject

Instruments

The Gasoline Gauge, Oil Pressure Gauge and Water Temperature Gauge are electrically operated and consist of a Sender and Receiver unit.

The diagrams illustrate the major parts of each unit and the principle of operation is as follows:

Gasoline Gauge

When tank is empty the two contacts in Tank Sender unit are just touching. With the ignition switch on, current flows through the circuit, warming up the heater wires which causes the bi-metals to bend. This bending of bi-metal in Tank Sender unit opens the contacts and circuit is broken—the heater wire then cools and the bi-metal returns to its former position. Contact is then again made and the procedure is repeated at the rate of approximately once per second.

Since both heater wires are in the same circuit, a similar slight bending of the bi-metal in the Dash Receiver unit occurs, which is just sufficient to make the needle register zero.

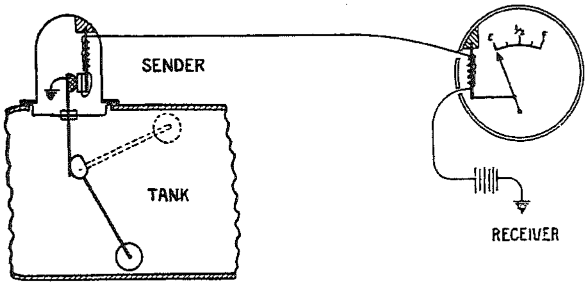

Fig. 1, Gas Gauge—Tank Empty

When the tank is filled with gasoline, however, the action of the float and cam as shown pushes the grounded contact against the insulated bi-metal contact, bending the bi-metal in the Tank Sender unit. Now if the ignition switch is on, the action described in the preceding paragraph occurs but because the bi-metal is already under strain a much greater amount of current is required to bend the bi-metal sufficiently to break contact in this position. A similar greater bending of the bi-metal in the Dash Receiver unit occurs and this action pulls the needle over to the full point.

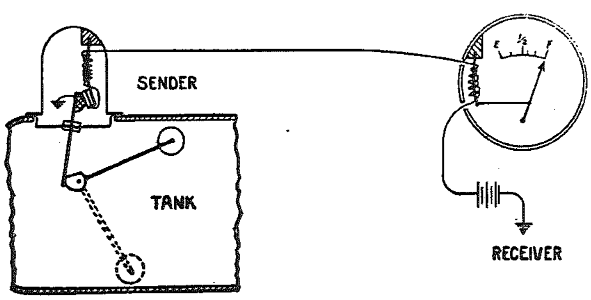

Fig. 2, Gas Gauge—Tank Full

The movement of the needle in any position caused by the make and break of the circuit is so minute that it can not be detected.

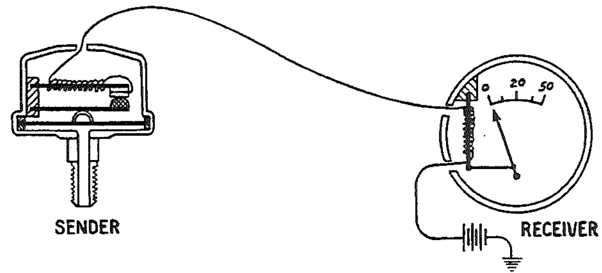

Fig. 3, Oil Pressure Gauge—No Pressure

Oil Pressure Gauge

The operation of the Oil Pressure Gauge Sender unit is similiar to the Gasoline Gauge Sender unit except that instead of a cam, a diaphragm is used as a means of moving the grounded contact. The Receiver units operate exactly the same.

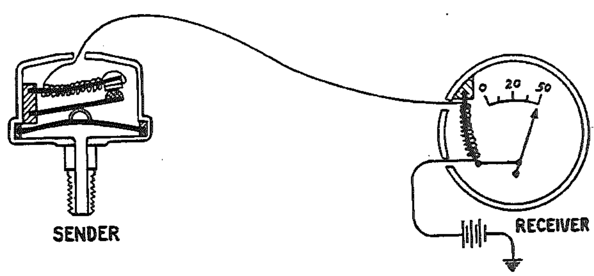

Fig. 4, Oil Pressure Gauge—With Pressure

Note that the deflection of the diaphragm pushes the grounded contact against the insulated bi-metal contact, bending the bi-metal in the Sender unit.

Warning

Always have ignition switch in "OFF" position when working on instruments to avoid the possibility of a short circuit.

Both Sender and Receiver units must be of the same type. Do not attempt to use a Sender unit of one manufacture with a Receiver unit of another, or vice versa.

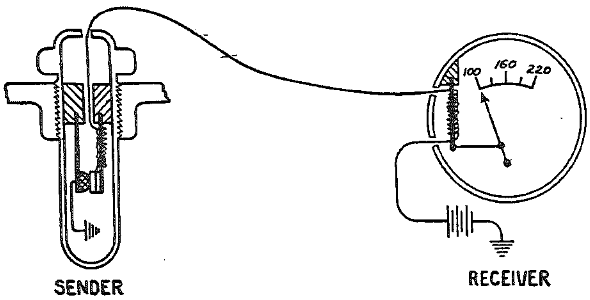

Fig. 5, Water Temperature Gauge—Cold

Water Temperature Gauge

This Sender unit is also similar to the Gasoline Gauge Sender unit except that it has an additional bi-metal on which is mounted the grounded contact. The Receiver units operate exactly the same.

The bi-metal with the grounded contact deflects in accordance with the temperature of the cooling water.

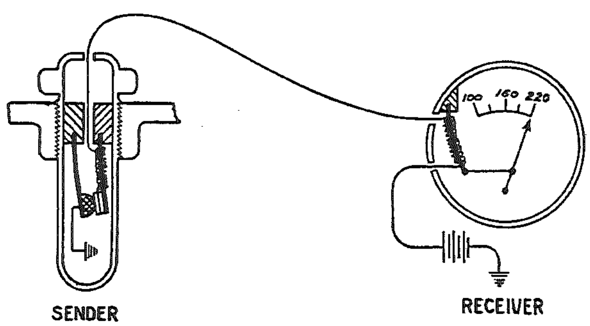

Fig. 6, Water Temperature Gauge—Hot

Ammeter

Due to the intricate construction no attempt should be made to repair an ammeter should it fail to register properly.

Service Instructions

These service instructions apply to fuel level, oil pressure or water temperature gauges.

IMPORTANT: Do not disconnect instruments with ignition switch "on" as there is danger of causing a short circuit which will damage instruments. Always turn ignition switch "off" before changing or working on instruments.

WARNING: Do not apply 6 volts direct to Receiver (Dash Unit) as this will burn it out.

NOTE: If necessary to replace the Receiver because it has been burned out, then check wiring, sender and condenser, if any, for a short, and correct this condition. Otherwise, new Receiver will also burn out. A short in the gauge circuit is easily recognizable because it will cause Receiver to over-read and in most cases beyond full scale.

Necessary Equipment for Checking

1. One new Tank unit. If there is any question about the new Tank unit being correct, then hook it up in series with a Receiver unit known to be satisfactory and apply 6 volts of current. Operate Tank unit by hand and see if Receiver unit reads zero with Tank Unit Float in bottom position and full with Tank Unit Float in top position.

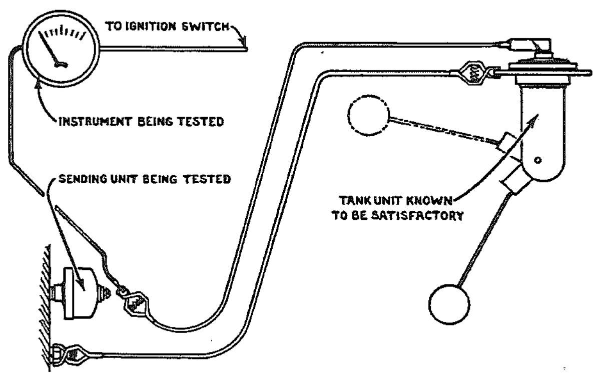

Fig. 7

2. Two ten-foot lengths of insulated wire equipped with clip terminals at each end. These long lengths will in practically all instances permit individual making check to sit in seat of truck and observe gauge being checked.

Method of Checking

(No units to be removed from truck until check has been completed which shows such units to be damaged or defective.)

1. Disconnect Sender unit being checked and hook in Tank unit as shown in Fig. 7. Turn on ignition switch and operate float rod of Tank unit by hand. With float of Tank unit at bottom position, Receiver unit being checked should register at bottom mark on dial. Next, move float rod up to top position, then Receiver unit being checked should move to top mark on dial (allow one minute for Receiver to come to rest).

   Exceptions to this are the Oil Pressure and Water Temperature Gauges. The Oil Pressure Gauge should register at the 50-pound mark with the float rod at top position. This is the mark just below the top mark on this gauge. The Water Temperature Gauge should register at the bottom of the red block just below the 220° mark, which is the 212° mark on this gauge.
2. If Receiver unit operates correctly, then check Sender unit on truck to see if it is properly grounded. Also (a) if truck is radio-equipped check condenser on Sender unit. If condenser is shorted, it will cause Receiver unit to overread. When replacing condenser, it is preferable to use one of .10 or .20 microfarad capacity, but up to .50 can be used if necessary to cut out radio interference. (b)

If ground and condenser are satisfactory, then replace Sender unit and check to see if this has corrected the difficulty.

3. If Receiver does not operate or fails to operate correctly then check wire lead to Receiver unit and replace wire if faulty. If wiring is satisfactory then replace Receiver unit and check again with Tank unit.

Do not attempt the repair or calibration of any Receiver or Sending unit in the field as this is not practical. Replacement with a new unit is the only practical means of servicing these gauges.

Oil Level Gauge

On certain models an oil level gauge is used. This is electrically operated and consists of a Sender or Tank unit and Receiving gauge.

Operation

HDM (Burkett) Cab

The oil level gauge is combined with the fuel gauge located on the instrument panel. To obtain reading for oil level, turn on ignition switch and depress the push type switch on instrument panel.

HEF (Murray) Cab

The oil level gauge is an independent unit and indicates the oil level whenever the ignition switch is turned on.

Checking

The following suggestions will be found helpful in checking the units, should they fail to operate properly.

Gauge Fails to Register

If the gauge (panel unit) fails to register when the ignition switch is turned on, the trouble may be due to:

1. A poor connection in the line leading to the Sender unit.
2. The resistance wire in the Sender unit may be broken or burned out.
3. The Receiver gauge may be defective.

Checking Sender Unit

Check connections and tighten the screws holding the unit to the oil pan, then test by grounding the terminal of the Sender unit. If this causes the gauge to register, the Sender unit is defective and should be replaced. If the Receiver gauge still does not register, the fault is in the gauge and it should be replaced.

Receiver Gauge Indicates Full all the Time

This may be due to the following causes:

1. Ground in the line or in the Sender unit.
2. Poor ground connection between Receiver gauge and chassis.
3. A defect in the gauge itself.

Checking Receiver Gauge

Make sure that the gauge is securely clamped to the instrument panel. Test by disconnecting the line at the Sender unit. If this causes the gauge to register properly, the Sender unit is defective and should be replaced.

If this test does not clear the trouble, disconnect the line from the terminal marked "TANK" on the gauge. If this causes the gauge to register properly, the line to the engine is grounded and should be overhauled.

If both the above tests fail to cause the gauge to register, the gauge itself is defective and should be replaced.

CAUTION: Make sure that the battery connection is attached to the terminal of the gauge marked "IGN" and that the line from the Sender unit is attached to the terminal marked "TANK."

Lubrication Group

Section A

Lubrication Page

Chassis Lubricant or Gear Oil 1

Engine Oils 1

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Lubrication 1

Transmission and Differential Gear Oil 1

Model D-2—Lubrication Chart—Section B

Model D-5—Lubrication Chart—Section C

Model D-15—Lubrication Chart—Section D

Models D-30, DS-30, D-30B, DS-30B—Lubrication Chart—Section E

Models D-35, DS-35, D-35B, D-40—Lubrication Chart—Section F

Models D-50, D-60, DR-60—Lubrication Chart—Section G

Model DR-70—Lubrication Chart—Section H

Models D-300, DS-300—Lubrication Chart—Section I

Models D-186T, DS-186T—Lubrication Chart—Section J

Model D-216T—Lubrication Chart—Section K

Model D-246T—Lubrication Chart—Section L

Model D-246F—Lubrication Chart—Section M

Model DR-346T—Lubrication Chart—Section N

Model D-346F—Lubrication Chart—Section O

Model DR-426F—Lubrication Chart—Section P

INTERNATIONAL

MOTOR TRUCK SERVICE MANUAL

Bulletin Number	Models Affected	Subject

MOTOR TRUCK SERVICE MANUAL

INTERNATIONAL

Bulletin Number	Models Affected	Subject

Oil and Grease Capacities

	*ENGINE	TRANSMISSION	REAR AXLE
D-2	6 Quarts	3 Pints	4 Pints
D-5	4 Quarts	3 Pints	4 Pints
D-15	6 Quarts	3 Pints	4½ Pints
D-30	6 Quarts	5½ Pints	7 Pints
D-30B	6 Quarts	5½ Pints	7 Pints
DS-30	6 Quarts	5½ Pints	17 Pints
DS-30B	6 Quarts	5½ Pints	17 Pints
D-35	6½ Quarts	5½ Pints	10 Pints
D-35B	6½ Quarts	14 Pints	10 Pints
DS-35	6½ Quarts	5½ Pints	17 Pints
D-40	6½ Quarts	14 Pints	10 Pints
D-50	8½ Quarts	14 Pints	16 Pints
D-60	8½ Quarts	19 Pints	16 Pints
DR-60	8½ Quarts	19 Pints	16 Pints
DR-70	8½ Quarts	19 Pints	16 Pints
D-300	6 Quarts	5½ Pints	7 Pints
DS-300	6 Quarts	5½ Pints	17 Pints
D-186T	6 Quarts	5½ Pints	7 Pints
DS-186T	6 Quarts	5½ Pints	17 Pints
D-216T	6½ Quarts	5½ Pints	10 Pints
D-246T	8½ Quarts	14 Pints	16 Pints
D-246F	8½ Quarts	***14 Pints	**15 Pints
DR-346T	8½ Quarts	19 Pints	16 Pints
D-346F	8½ Quarts	***19 Pints	**12 Pints
DR-426F	8½ Quarts	***24 Pints	**16 Pints

* Refill only—check oil level after operating truck for a short period and add oil as required to bring level to correct position on gauge.

** Each axle.

*** Main transmission only—auxiliary transmission and power divider requires 17 pints.

Lubrication

Thorough lubrication at definite intervals, with a good lubricant, will aid greatly in prolonging the life of the truck and in the reduction of operating expense. The interval between lubrication periods depends entirely upon operating conditions. The loads carried, speed, road and weather conditions all have a bearing on the frequency of lubrication periods.

In the lubrication charts, the mileage recommendations are approximate, being based on average conditions. The type of operation, loads carried, road and weather conditions should be the deciding factor as to when lubrication is necessary. For some types of operations it will be necessary to figure the lubrication periods upon an hourly basis and where operating conditions are extremely severe the truck should be lubricated after every twenty-four hours of operation.

Only lubricants of the best quality, manufactured by a reputable concern, should be used. The better grade lubricants may cost slightly more than inferior products; however, the benefits obtained will, over a period of time, offset the cost.

We do not attempt to specify any particular manufacturer's products, as high-grade lubricants can be secured from any reputable oil company.

One of the most important items in the lubrication of a truck is the selection of lubricants having the proper body or viscosity that are best adapted to meet the particular operating and climatic conditions. It is obviously impossible to definitely specify the viscosity of the lubricant to be used; however, the following recommendations will be found generally satisfactory. The viscosity numbers used are those adopted by the Society of Automotive Engineers to classify lubricants according to body or thickness and do not cover any other properties.

Engine Oils

For Summer Weather:
- Moderate Service............Use SAE 30–40.
- Severe or High Speed Service..Use SAE 40–50.

For Winter Weather (All Classes of Service):
- Temperatures down to 20° above zero (F.)...........Use SAE 20–30.
- Temperatures lower than 20° above zero (F.)...........Use SAE 10.

Transmission and Differential Gear Oil

For Summer Weather........Use SAE 160.
For Winter Weather.........Use SAE 90–110.

Chassis Lubricant or Gear Oil

A high-grade viscous chassis lubricant will, except in extreme cases, be satisfactory for year-around use. If gear oil is used to lubricate chassis, SAE 160 is the proper viscosity.

General

Wheel bearings should be carefully lubricated. If too much grease is used there will be the possibility of brake linings becoming soaked.

Clutch release bearing is lubricated at assembly and should require no attention.

Propeller shaft center bearing when used should not be lubricated with gear oil. Use chassis lubricant only.

When changing engine oil, clean and refill air cleaner, also clean oil filter if used.

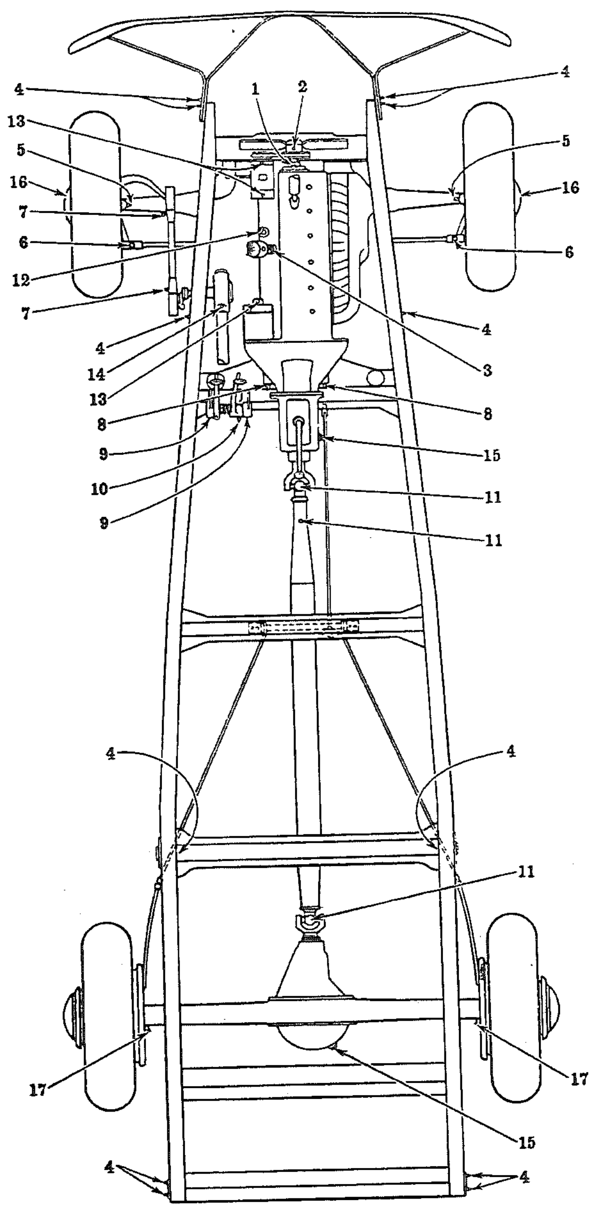
When greasing the chassis, it is good practice to force lubricant into the bearings until all old lubricant is forced out and the new appears. This will have a tendency to clean out any dirt or abrasives that may have accumulated and will also assure thorough greasing.

D-2 Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.

Paragraphs are numbered to correspond with numbers on the illustration.



Every 500 Miles

1. Water Pump and Fan Rear Bearing.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one-half turn.
2. Fan Front Bearing.
   8 drops of ENGINE OIL in oiler.

Every 500 to 1000 Miles

3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Brake and Clutch Pedal Shaft.
10. Brake Pedal.
11. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.

12. Engine.
    Drain and refill with new ENGINE OIL. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil. If oil filter is used, change element when oil becomes darkened.
    For summer weather:
    Moderate Service............Use SAE 30–40.
    Severe or high speed service....Use SAE 40–50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit) Use SAE 20–30.
    Temperatures lower than 20 degrees above zero (Fahrenheit) Use SAE 10.
13. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
14. Steering Gear Case.
    Use GEAR OIL.
15. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with new GEAR OIL every 10,000 miles.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

16. Front Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.
17. Rear Wheel, or Axle Shaft Bearings.
    Use CHASSIS LUBRICANT. Do not force too much grease into bearings.

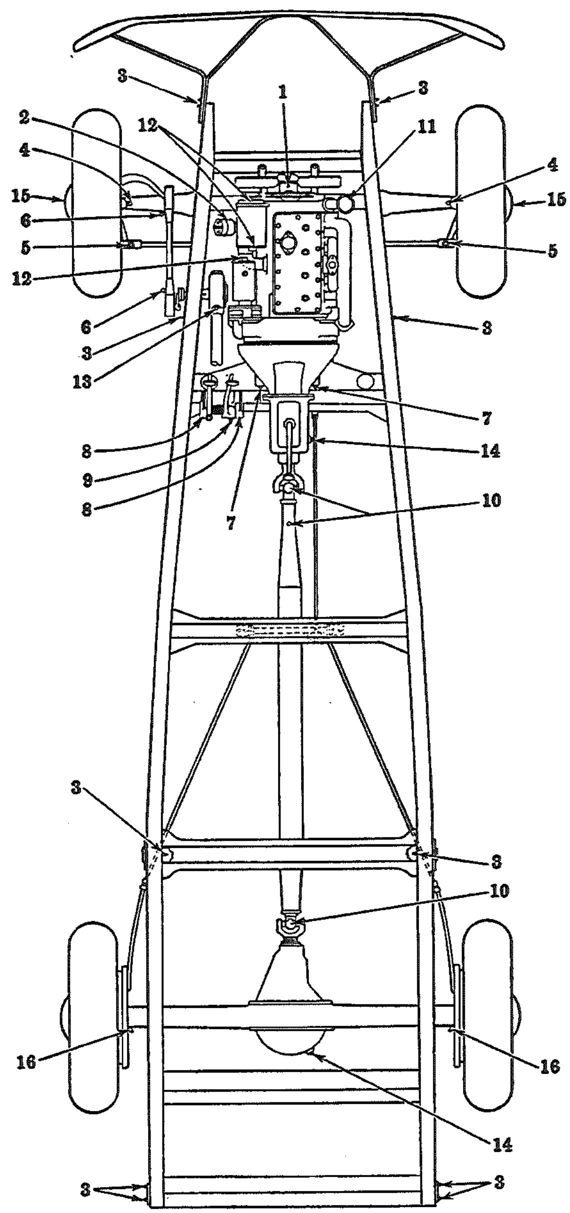
... Shock Absorbers.
    Keep filled with genuine SHOCK ABSORBER FLUID.

D-5 Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.

Paragraphs are numbered to correspond with numbers on the illustration.



Every 500 Miles

1. Fan Hub.
   Drain and refill with medium ENGINE OIL to bottom of spindle. Do not use grease. Replace and tighten oil hole plug.

Every 500 to 1000 Miles

2. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

3. Spring Pins and Shackle Bolts.
4. Steering Knuckles (upper and lower).
5. Tie Rod Ends.
6. Drag Link Ends.
7. Clutch Release Shaft.
8. Brake and Clutch Pedal Shaft.
9. Brake Pedal.
10. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
11. Engine.
    Drain and refill with new ENGINE OIL. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil. If oil filter is used, change element when oil becomes darkened.
    For summer weather:
    Moderate Service............. Use SAE 30–40.
    Severe or high speed service.... Use SAE 40–50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit) Use SAE 20–30.
    Temperatures lower than 20 degrees above zero (Fahrenheit) Use SAE 10.
12. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
13. Steering Gear Case.
    Use GEAR OIL.
14. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with new GEAR OIL every 10,000 miles.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

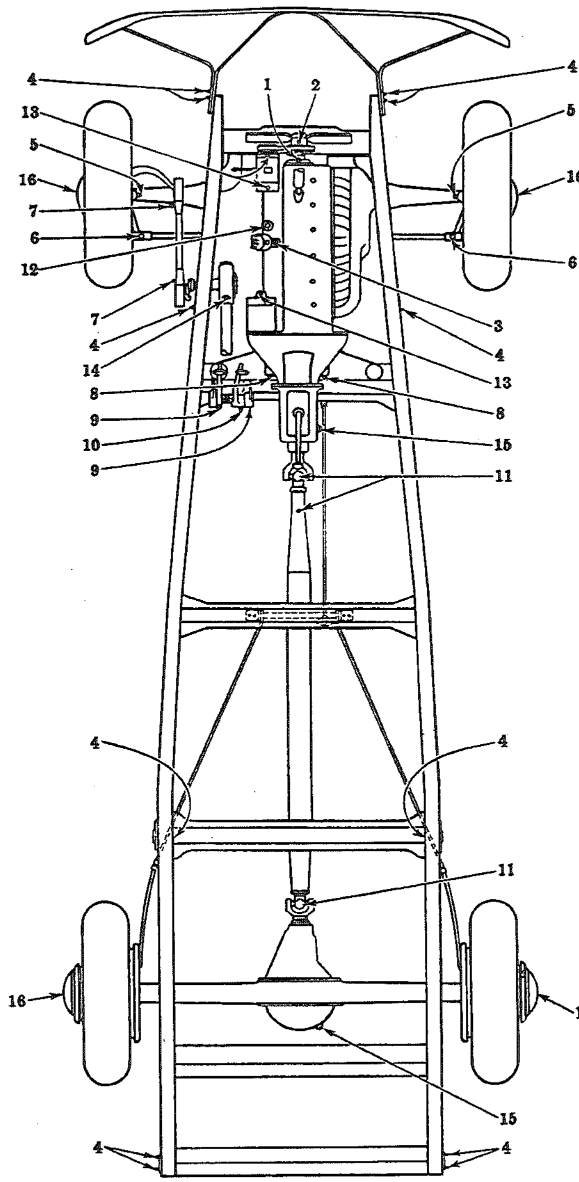
15. Front Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.
16. Rear Wheel, or Axle Shaft Bearings.
    Use CHASSIS LUBRICANT. Do not force too much grease into bearings.

... Shock Absorbers.
    Keep filled with genuine SHOCK ABSORBER FLUID.

D-15 Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump and Fan Rear Bearing.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one-half turn.
2. Fan Front Bearing.
   8 drops of ENGINE OIL in oiler.

Every 500 to 1000 Miles

3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Brake and Clutch Pedal Shaft.
10. Brake Pedal.
11. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.

12. Engine.
    Drain and refill with new ENGINE OIL. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil. If oil filter is used, change element when oil becomes darkened.
    For summer weather:
    Moderate Service ....Use SAE 30–40.
    Severe or high speed service....Use SAE 40–50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit). Use SAE 20–30.
    Temperatures lower than 20 degrees above zero (Fahrenheit)...Use SAE 10.
13. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
14. Steering Gear Case.
    Use GEAR OIL.
15. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with new GEAR OIL every 10,000 miles.

... Spring Leaves.
Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

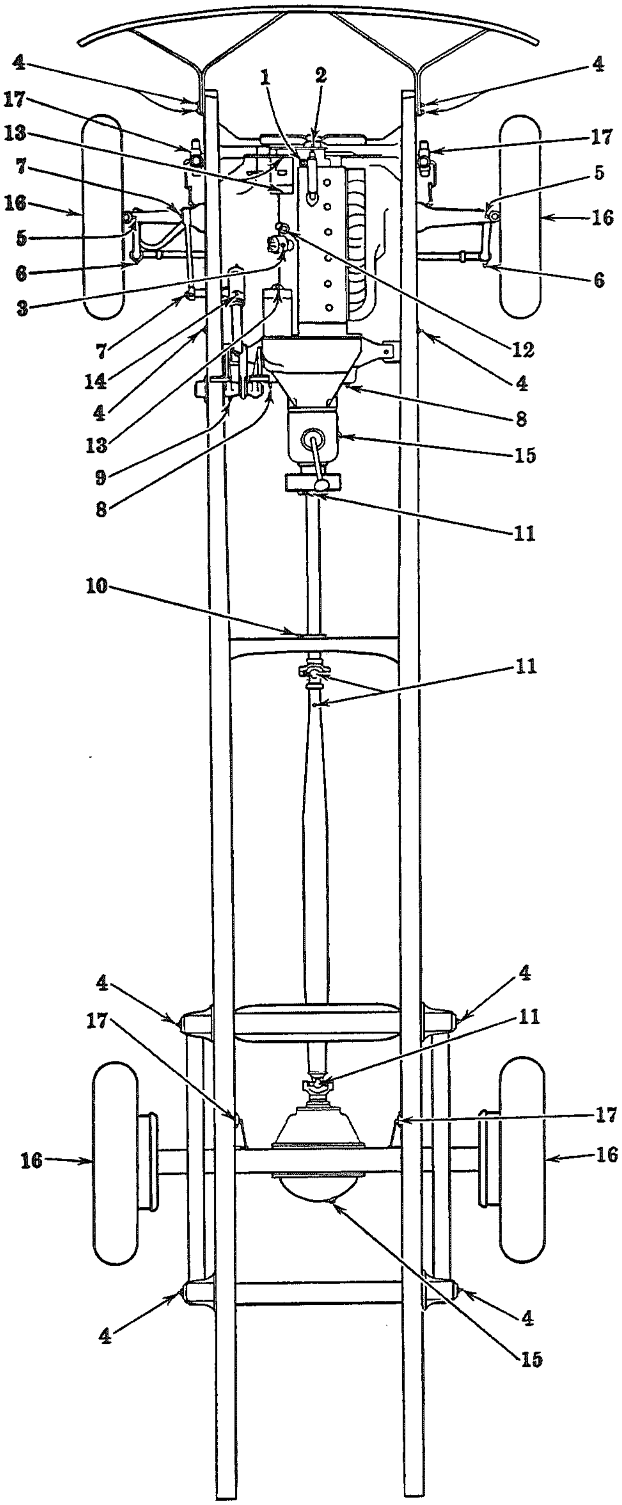
16. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

... Shock Absorbers.
Keep filled with genuine SHOCK ABSORBER FLUID.

D-30, DS-30, D-30B, DS-30B Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump and Fan Rear Bearing.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one-half turn.
2. Fan Front Bearing.
   8 drops of ENGINE OIL in oiler.

Every 500 to 1000 Miles

3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Clutch Pedal.
10. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
11. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
12. Engine.
    Drain and refill with new ENGINE OIL. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil. If oil filter is used, change element when oil becomes darkened.
    For summer weather:
    Moderate Service ....Use SAE 30–40.
    Severe or high speed service....Use SAE 40–50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit) Use SAE 20–30.
    Temperatures lower than 20 degrees above zero (Fahrenheit) Use SAE 10.
13. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
14. Steering Gear Case.
    Use GEAR OIL.
15. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with new GEAR OIL every 10,000 miles.
    For single speed axle use SAE 160 for warm climate and SAE 90-110 for cold climate.
    For two speed axle use E.P. Lubricant, SAE 160 for warm climate and SAE 90-110 for cold climate. Do not mix E.P. Lubricants—drain and refill with new or add lubricant of same grade and manufacture.

.. Spring Leaves.
   Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

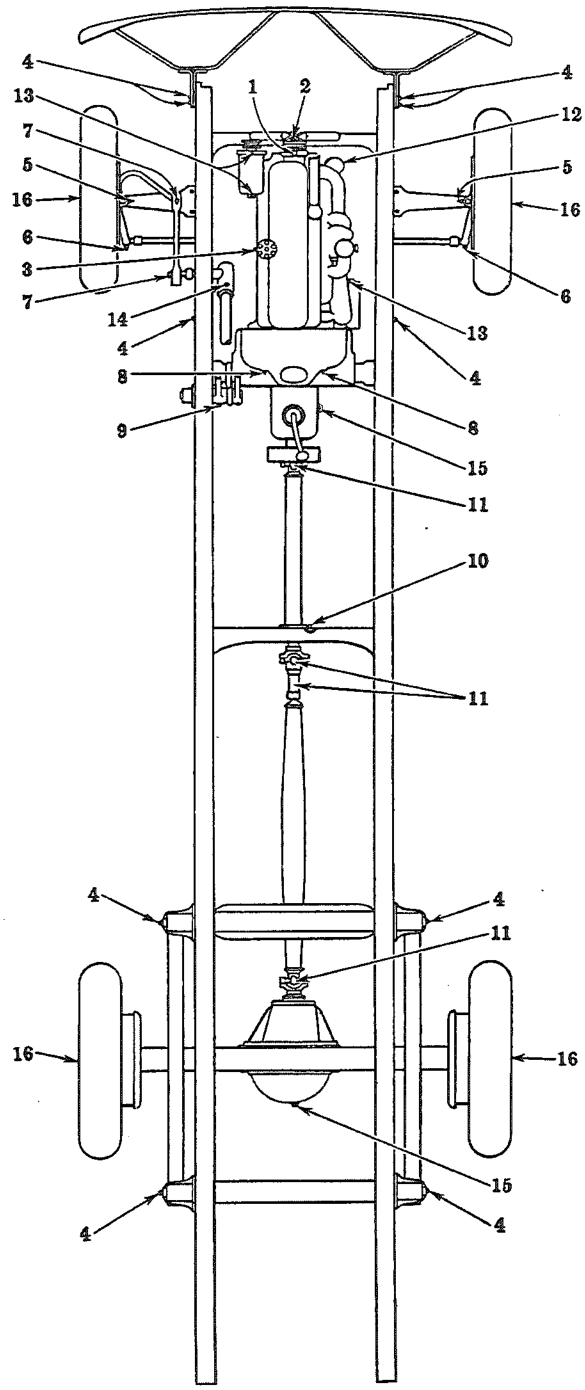
Every 10,000 Miles

16. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.
17. Shock Absorbers.
    Keep filled with genuine SHOCK ABSORBER FLUID.

D-35, DS-35, D-35B, D-40 Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Clutch Pedal.
10. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
11. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
12. Engine.
    Drain and refill with new ENGINE OIL. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil. If oil filter is used, change element when oil becomes darkened.
    For summer weather:
    Moderate Service............Use SAE 30–40.
    Severe or high speed service....Use SAE 40–50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit) Use SAE 20–30.
    Temperatures lower than 20 degrees above zero (Fahrenheit) Use SAE 10.
13. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
14. Steering Gear Case.
    Use GEAR OIL.
15. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with new GEAR OIL every 10,000 miles.
    For single speed axle use SAE 160 for warm climate and SAE 90-110 for cold climate.
    For two speed axle use E.P. Lubricant, SAE 160 for warm climate and SAE 90-110 for cold climate. Do not mix E.P. Lubricants—drain and refill with new or add lubricant of same grade and manufacture.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

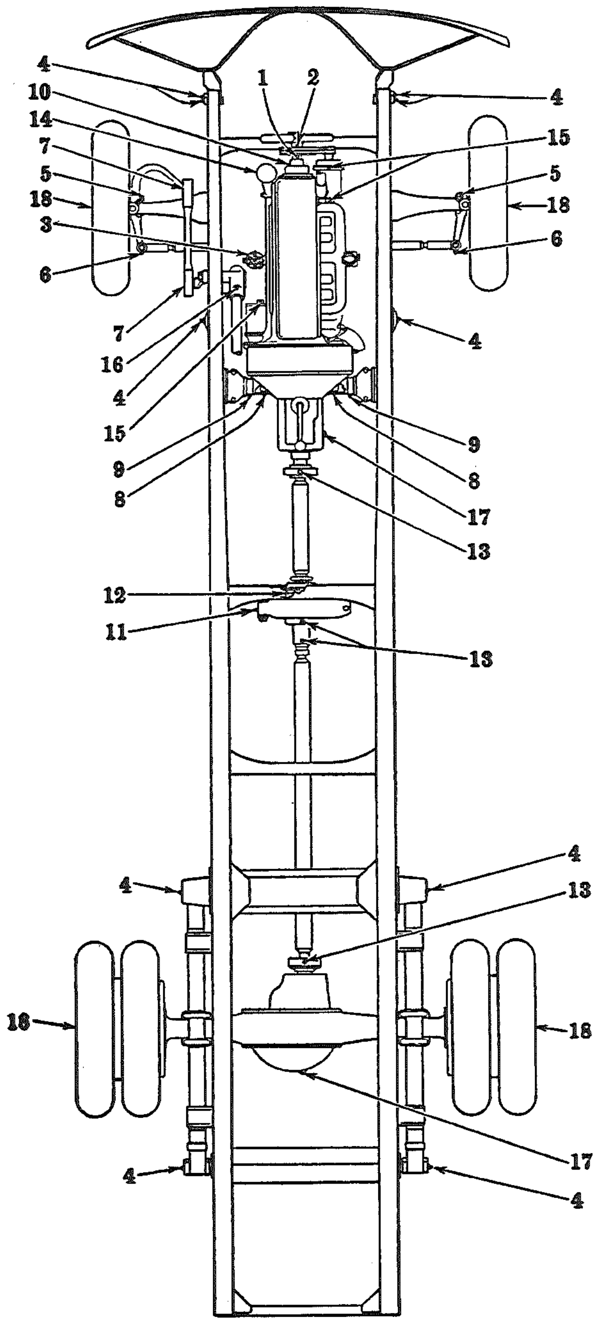
16. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

NOTE: Vacuum power unit should be lubricated every 10,000 miles with 2 ounces of Bendix Vacuum Cylinder Oil. Remove pipe plug in power cylinder end plate, and lubricate. Spray valve and power lever assembly with light oil each time chassis is lubricated.

D-50, D-60, DR-60 Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Engine Rear Support Trunnion.
10. Engine Front Support.
11. Propeller Shaft Brake (D-60, DR-60 Only).
12. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
13. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
14. Engine. (Above mileage is approximate.)
    Check appearance of oil and if thin or gritty, drain and refill with new ENGINE OIL. Change oil filter element when oil becomes darkened. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil.
    For summer weather:
    Moderate Service.............Use SAE 30–40.
    Severe or high speed service....Use SAE 40–50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit) Use SAE 20–30.
    Temperatures lower than 20 degrees above zero (Fahrenheit) Use SAE 10.
15. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
16. Steering Gear Case.
    Use GEAR OIL.
17. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with a new GEAR OIL every 10,000 miles.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

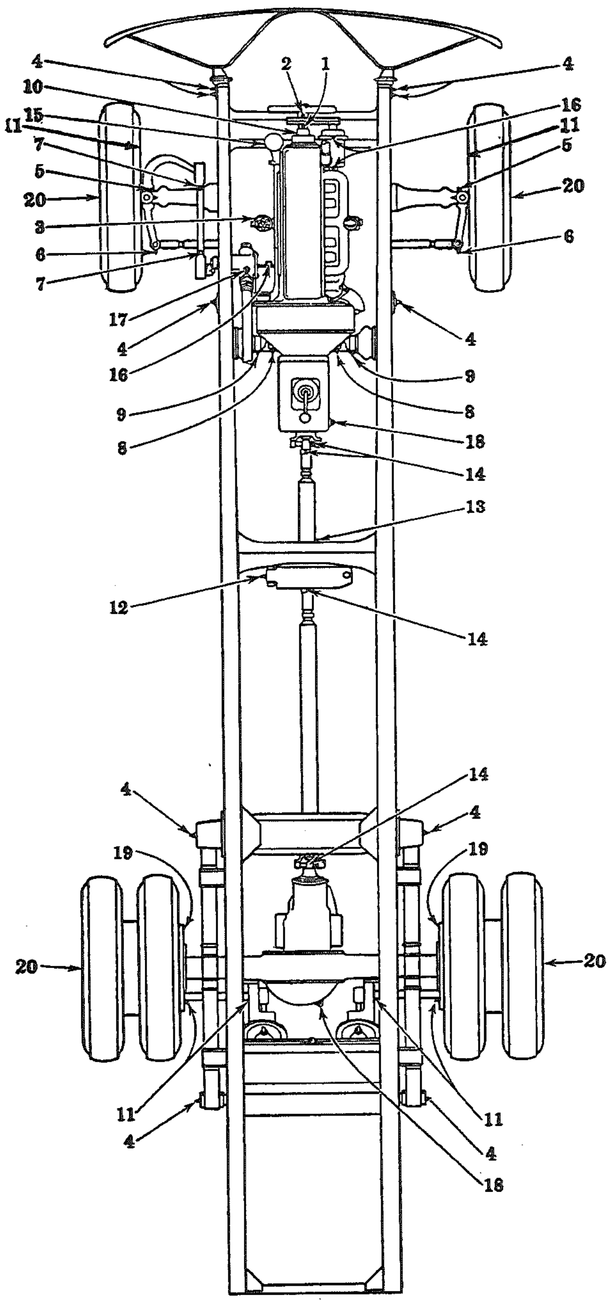
18. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

NOTE: Vacuum power unit should be lubricated every 10,000 miles with 2 ounces of Bendix Vacuum Cylinder Oil. Remove pipe plug in power cylinder end plate, and lubricate. Spray valve and power lever assembly with light oil each time chassis is lubricated.

DR-70 Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade of WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Engine Rear Support Trunnion.
10. Engine Front Support.
11. Brake Camshaft.
12. Propeller Shaft Brake.
13. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
14. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
15. Engine. (Above mileage is approximate.)
    Check appearance of oil and if thin or gritty, drain and refill with new ENGINE OIL. Change oil filter element when oil becomes darkened. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil.
    For summer weather:
    Moderate Service.............Use SAE 30–40.
    Severe or high speed service....Use SAE 40–50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit).....Use SAE 20–30.
    Temperatures lower than 20 degrees above zero (Fahrenheit).......Use SAE 10.
16. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
17. Steering Gear Case.
    Use GEAR OIL.
18. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with new GEAR OIL every 10,000 miles.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

19. Rear Brake Shoe Anchor Pins (do not overlubricate).

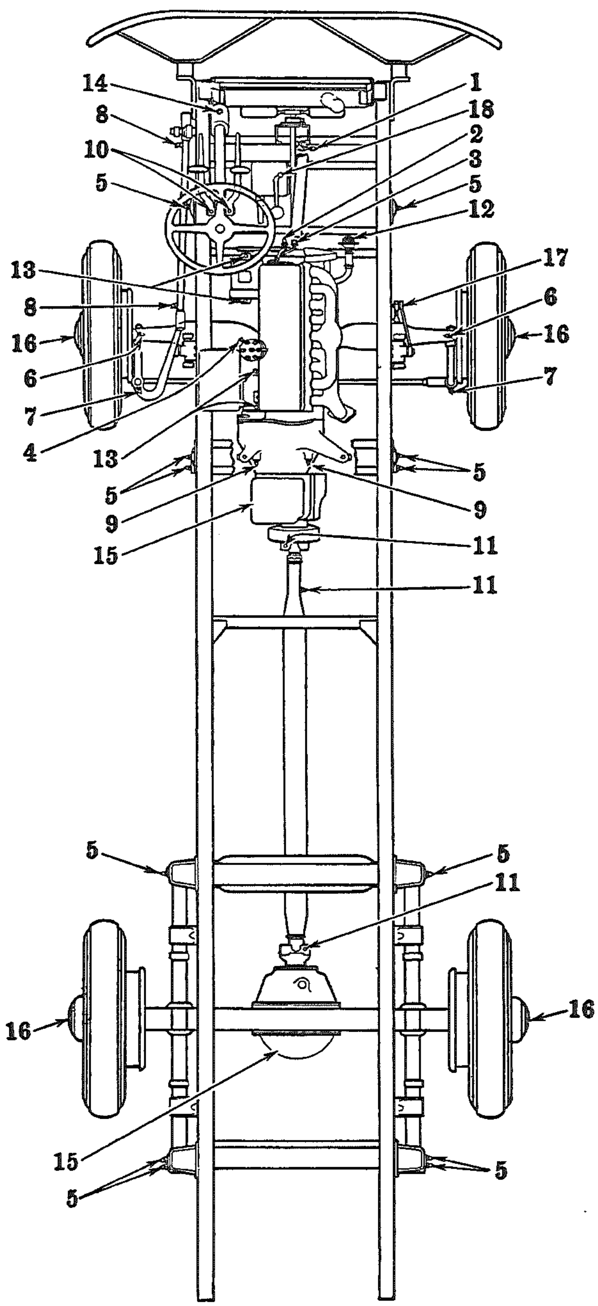
Every 10,000 Miles

20. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

D-300, DS-300 Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Fan Bearing.
   Use CHASSIS LUBRICANT.
2. Water Pump Rear Bearing.
   Use good grade of WATER PUMP GREASE.
3. Water Pump Front Bearing.
   8 drops of ENGINE OIL in oiler.

Every 500 to 1000 Miles

4. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

5. Spring Pins and Shackle Bolts.
6. Steering Knuckles (upper and lower).
7. Tie Rod Ends.
8. Drag Link Ends.
9. Clutch Release Shaft.
10. Clutch and Brake Pedal.
11. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant. Replace pipe plug.
12. Engine.
    Drain and refill with new ENGINE OIL. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil. If oil filter is used, change element when oil becomes darkened.
    For summer weather:
    Moderate Service............ Use SAE 30–40.
    Severe or high speed service....Use SAE 40–50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit) Use SAE 20–30.
    Temperatures lower than 20 degrees above zero (Fahrenheit) Use SAE 10.
13. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
14. Steering Gear Case.
    Use GEAR OIL.
15. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain, flush and refill with new GEAR OIL every 10,000 miles.
    For single speed axle use SAE 160 for warm climate and SAE 90-110 for cold climate.
    For two speed axle use E.P. Lubricant, SAE 160 for warm climate and SAE 90-110 for cold climate. Do not mix E.P. Lubricants—drain and refill with new or add lubricant of same grade and manufacture.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

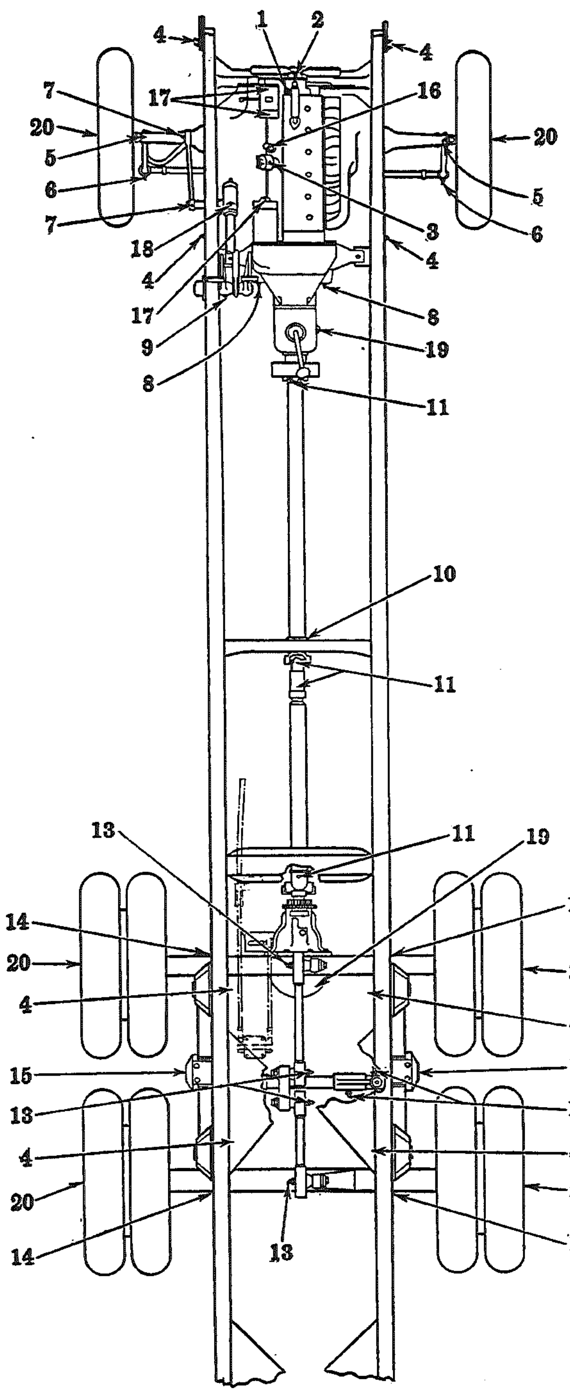
16. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.
17. Shock Absorbers.
    Keep filled with genuine SHOCK ABSORBER FLUID.
18. Transmission Remote Control Housing.
    Remove cover plate and coat joints with SHORT FIBER wheel bearing GREASE.

... Hand Brake Cable.
    Remove pipe plug, insert pressure gun fitting and fill cable conduit with GRAPHITE GREASE. Replace pipe plug.

D-186T, DS-186T Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump and Fan Rear Bearing.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one-half turn.
2. Fan Front Bearing.
   8 drops of ENGINE OIL in oiler.

Every 500 to 1000 Miles

3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Clutch Pedal.
10. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
11. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
12. Thrust Yoke and Tube.
13. Torque Rods.
14. Equalizing Beam Ends.
15. Equalizing Beam Center.
16. Engine.
    Drain and refill with new ENGINE OIL. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil. If oil filter is used, change element when oil becomes darkened.

    For summer weather:
    Moderate Service............ Use SAE 30-40.
    Severe or high speed service... Use SAE 40-50.

    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit) Use SAE 20-30.
    Temperatures lower than 20 degrees above zero (Fahrenheit) Use SAE 10.
17. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
18. Steering Gear Case.
    Use GEAR OIL.
19. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain, flush and refill with new GEAR OIL every 10,000 miles.

    For single speed axle use SAE 160 for warm climate and SAE 90-110 for cold climate.

    For two speed axle use E.P. Lubricant, SAE 160 for warm climate and SAE 90-110 for cold climate. Do not mix E.P. Lubricants—drain and refill with new or add lubricant of same grade and manufacture.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

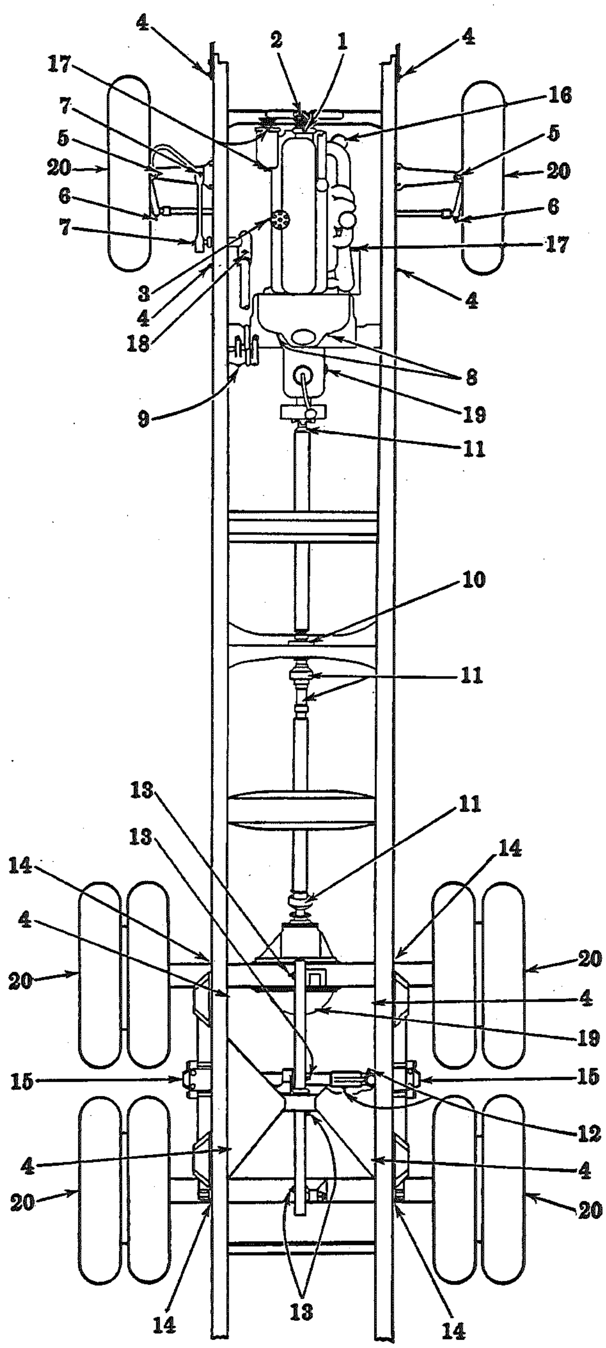
20. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

NOTE: Vacuum power unit should be lubricated every 10,000 miles with 2 ounces of Bendix Vacuum Cylinder Oil. Remove pipe plug in power cylinder end plate, and lubricate. Spray valve and power lever assembly with light oil each time chassis is lubricated.

D-216T Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Clutch Pedal.
10. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT only).
11. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
12. Thrust Yoke and Tube.
13. Torque Rods.
14. Equalizing Beam Ends.
15. Equalizing Beam Center.
16. Engine.
    Drain and refill with new ENGINE OIL. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil. If oil filter is used, change element when oil becomes darkened.
    For summer weather:
    Moderate Service.............Use SAE 30-40.
    Severe or high speed service....Use SAE 40-50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit). Use SAE 20-30.
    Temperatures lower than 20 degrees above zero (Fahrenheit). Use SAE 10.
17. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
18. Steering Gear Case.
    Use GEAR OIL.
19. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain, flush and refill with new GEAR OIL every 10,000 miles.
    For single speed axle use SAE 160 for warm climate and SAE 90-110 for cold climate.
    For two speed axle use E.P. Lubricant, SAE 160 for warm climate and SAE 90-110 for cold climate. Do not mix E.P. Lubricants—drain and refill with new or add lubricant of same grade and manufacture.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

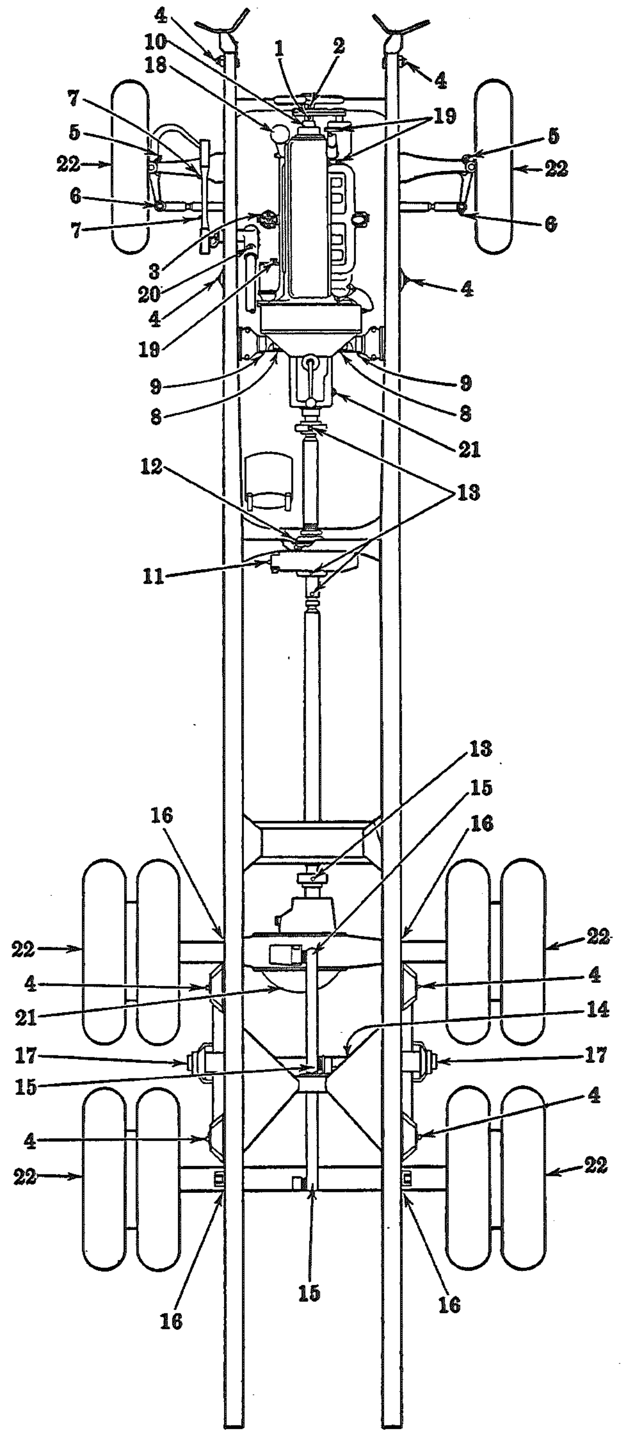
20. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

NOTE: Vacuum power unit should be lubricated every 10,000 miles with 2 ounces of Bendix Vacuum Cylinder Oil. Remove pipe plug in power cylinder end plate, and lubricate. Spray valve and power lever assembly with light oil each time chassis is lubricated.

D-246T Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Engine Rear Support Trunnion.
10. Engine Front Support.
11. Propeller Shaft Brake.
12. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
13. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
14. Thrust Yoke and Tube.
15. Torque Rods.
16. Equalizing Beam Ends.
17. Equalizing Beam Center.
18. Engine. (Above mileage is approximate.)
    Check appearance of oil and if thin or gritty, drain and refill with new ENGINE OIL. Change oil filter element when oil becomes darkened. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil.
    For summer weather:
    Moderate Service..............Use SAE 30-40.
    Severe or high speed service....Use SAE 40-50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit). Use SAE 20-30.
    Temperatures lower than 20 degrees above zero (Fahrenheit). Use SAE 10.
19. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
20. Steering Gear case.
    Use GEAR OIL.
21. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with a new GEAR OIL every 10,000 miles.

... Spring Leaves.
Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

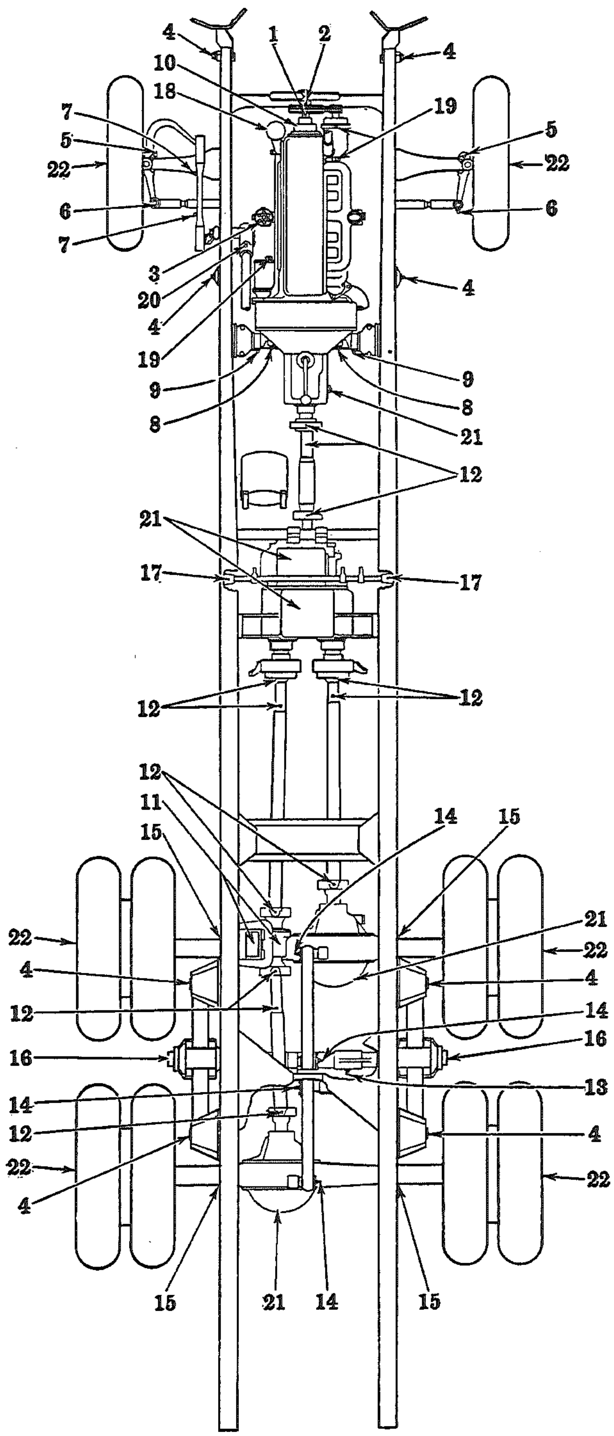
22. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

NOTE: Vacuum power unit should be lubricated every 10,000 miles with 2 ounces of Bendix Vacuum Cylinder Oil. Remove pipe plug in power cylinder end plate, and lubricate. Spray valve and power lever assembly with light oil each time chassis is lubricated.

D-246F Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Engine Rear Support Trunnion.
10. Engine Front Support.
11. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
12. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
13. Thrust Yoke and Tube.
14. Torque Rods.
15. Equalizing Beam Ends.
16. Equalizing Beam Center.
17. Brake Cross Shaft.
18. Engine. (Above mileage is approximate.)
    Check appearance of oil and if thin or gritty, drain and refill with new ENGINE OIL. Change oil filter element when oil becomes darkened. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil.
    For summer weather:
    Moderate Service.............Use SAE 30-40.
    Severe or high speed service....Use SAE 40-50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit). Use SAE 20-30.
    Temperatures lower than 20 degrees above zero (Fahrenheit). Use SAE 10.
19. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
20. Steering Gear Case.
    Use GEAR OIL.
21. Main Transmission, Auxiliary Transmission and Power Divider, and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain and refill with a new GEAR OIL every 10,000 miles.

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

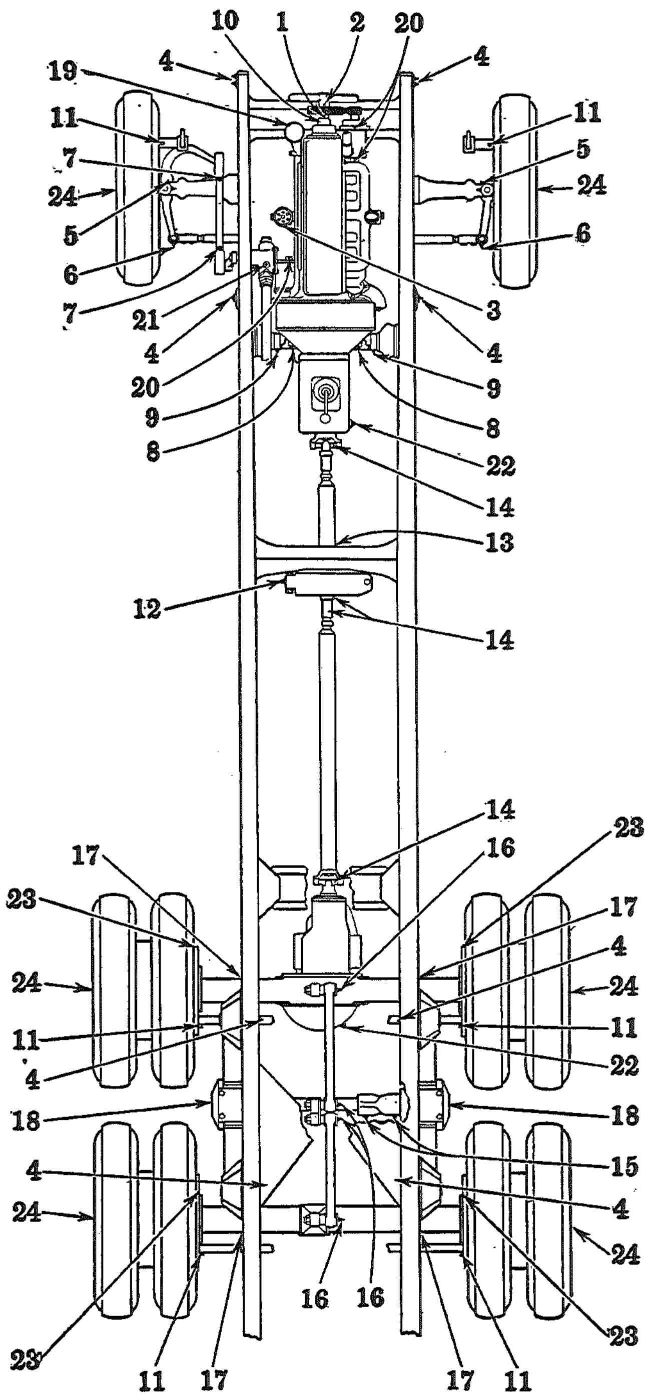
22. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

NOTE: Vacuum power unit should be lubricated every 10,000 miles with 2 ounces of Bendix Vacuum Cylinder Oil. Remove pipe plug in power cylinder end plate, and lubricate. Spray valve and power lever assembly with light oil each time chassis is lubricated.

DR-346T Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade of WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Engine Rear Support Trunnion.
10. Engine Front Support.
11. Brake Camshaft.
12. Propeller Shaft Brake.
13. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
14. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
15. Thrust Yoke and Tube.
16. Torque Rods.
17. Equalizing Beam Ends.
18. Equalizing Beam Center.
19. Engine. (Above mileage is approximate.)
    Check appearance of oil and if thin or gritty, drain and refill with new ENGINE OIL. Change oil filter element when oil becomes darkened. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil.
    For summer weather:
    Moderate Service.............Use SAE 30-40.
    Severe or high speed service....Use SAE 40-50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit).Use SAE 20-30.
    Temperatures lower than 20 degrees above zero (Fahrenheit).Use SAE 10.
20. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
21. Steering Gear Case.
    Use GEAR OIL.
22. Transmission and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain, flush and refill with new GEAR OIL every 10,000 miles.
23. Rear Brake Shoe Anchor Pins (do not over-lubricate).

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

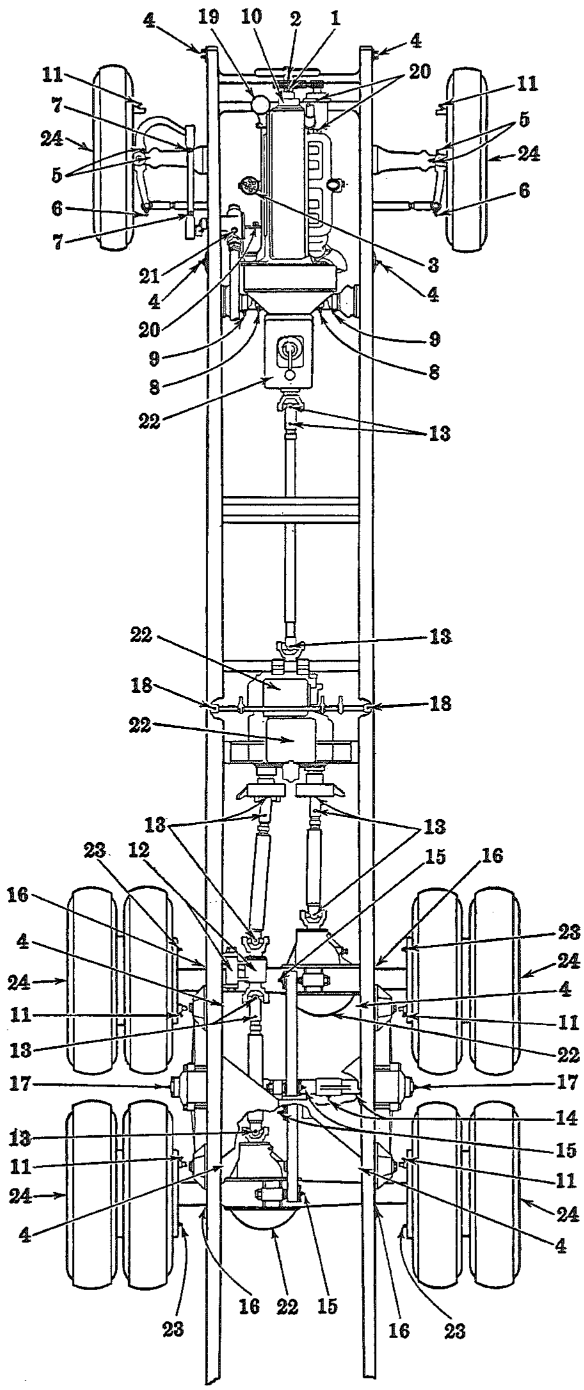
Every 10,000 Miles

24. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

D-346F Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade of WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drops of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Engine Rear Support Trunnion.
10. Engine Front Support.
11. Brake Camshaft.
12. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
13. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
14. Thrust Yoke and Tube.
15. Torque Rods.
16. Equalizing Beam Ends.
17. Equalizing Beam Center.
18. Brake Cross Shaft.
19. Engine. (Above mileage is approximate.)
    Check appearance of oil and if thin or gritty, drain and refill with new ENGINE OIL. Change oil filter element when oil becomes darkened. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil.
    For summer weather:
    - Moderate Service.............Use SAE 30-40.
    - Severe or high speed service....Use SAE 40-50.

    For winter weather (all classes of service):
    - Temperatures down to 20 degrees above zero (Fahrenheit). Use SAE 20-30.
    - Temperatures lower than 20 degrees above zero (Fahrenheit). Use SAE 10.
20. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
21. Steering Gear Case.
    Use GEAR OIL.
22. Main Transmission, Auxiliary Transmission and Power Divider, and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain, flush and refill with new GEAR OIL every 10,000 miles.
23. Rear Brake Shoe Anchor Pins (do not overlubricate).

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

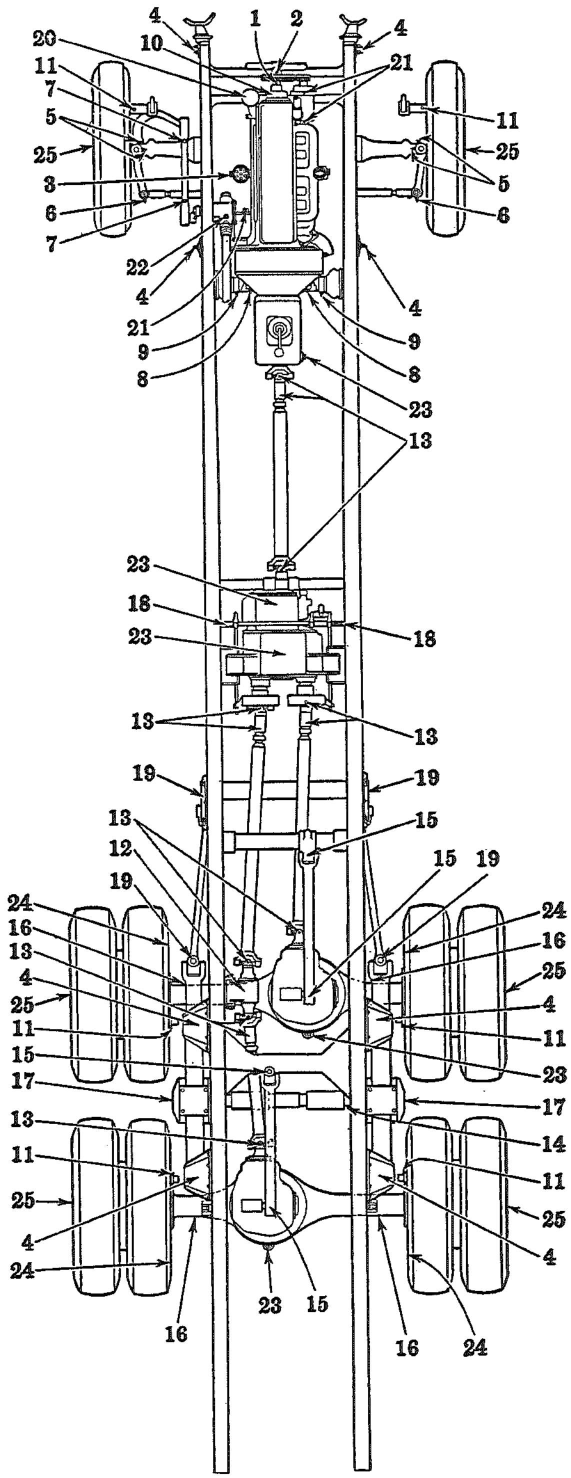
Every 10,000 Miles

24. Front and Rear Wheel Bearings.
    Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

DR-426F Lubrication Chart

NOTE: USE ONLY HIGH QUALITY LUBRICATING OILS AND GREASE. SELECT ONLY THOSE OF RECOGNIZED MANUFACTURE.

IMPORTANT: Mileage recommendations are approximate. Operating conditions govern interval between lubrication periods which should be figured either on an hourly or mileage basis, dependent upon type of operation.



Paragraphs are numbered to correspond with numbers on the illustration.

Every 500 Miles

1. Water Pump.
   Fill grease cup with a good grade of WATER PUMP GREASE and turn down one turn.

Every 500 to 1000 Miles

2. Fan Hub.
   Remove pipe plug; insert lubrication fitting and fill with SHORT FIBER wheel bearing GREASE.
3. Distributor.
   Fill grease cup with CHASSIS LUBRICANT and turn down one turn. Apply drop of ENGINE OIL to breaker arm pivot, also to oil wick under rotor. Apply light coat of VASELINE to breaker arm rubbing block.

Use a VISCOUS CHASSIS LUBRICANT or SAE 160 GEAR OIL for:

4. Spring Pins and Shackle Bolts.
5. Steering Knuckles (upper and lower).
6. Tie Rod Ends.
7. Drag Link Ends.
8. Clutch Release Shaft.
9. Engine Rear Support Trunnion.
10. Engine Front Support.
11. Brake Camshaft.
12. Propeller Shaft Center Bearing (Use CHASSIS LUBRICANT Only).
13. Propeller Shaft Slip Yoke and Universal Joints.
    Remove pipe plug, insert pressure gun fitting and fill with lubricant.
14. Thrust Yoke and Tube.
15. Torque Rods.
16. Equalizing Beam Ends.
17. Equalizing Beam Center.
18. Brake Cross Shaft.
19. Radius Rods.
20. Engine. (Above mileage is approximate.)
    Check appearance of oil and if thin or gritty, drain and refill with new ENGINE OIL. Change oil filter element when oil becomes darkened. Keep oil to proper level. Cold weather requires new oil more often because of using choke, which thins oil.
    For summer weather:
    Moderate Service.............Use SAE 30-40.
    Severe or high speed service.....Use SAE 40-50.
    For winter weather (all classes of service):
    Temperatures down to 20 degrees above zero (Fahrenheit). Use SAE 20-30.
    Temperatures lower than 20 degrees above zero (Fahrenheit). Use SAE 10.
21. Generator and Starting Motor.
    4 to 5 drops of light ENGINE OIL in oilers.
22. Steering Gear Case.
    Use GEAR OIL.
23. Main Transmission, Auxiliary Transmission and Power Divider, and Differential.
    Keep GEAR OIL up to level of oil filler plug. Drain, flush and refill with new GEAR OIL every 10,000 miles.
24. Rear Brake Shoe Anchor Pins (do not over-lubricate).

... Spring Leaves.
    Use ENGINE OIL. Paint edges with small stiff brush or use a spray gun.

Every 10,000 Miles

25 Front and Rear Wheel Bearings.
   Remove wheels, clean hubs and repack with a SHORT FIBER wheel bearing GREASE.

Propeller Shaft Group

Section A

Propeller Shaft

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Disassembling 1

Propeller Shaft and Universal Joints 1

Reassembling 1

Slip Yoke Grease Seals 1

Section B

Center Bearing

Propeller Shaft Center Bearing 1

INTERNATIONAL

MOTOR TRUCK SERVICE MANUAL

Bulletin Number	Models Affected	Subject

MOTOR TRUCK SERVICE MANUAL

INTERNATIONAL

Bulletin Number	Models Affected	Subject

Propeller Shaft Specifications

Model	Wheel Base	Type	Location	Outside Diameter	Diameter of Spline	No. Splines	No. Joints
D-2, D-5	113″	3-CH	One Piece	2½″	1¼″	10	2
	125″	3-CH	One Piece	3½″	1¼″	10	2
D-15	113″	3-CH	One Piece	2½″	1¼″	10	2
	130″	3-CH	One Piece	3½″	1⅞″	36	2
D-30, DS-30, (All W.B.) D-30B, DS-30B (155″ and 173″ W.B. only)	128″	4-CH	One Piece	3½″	1⅞″	36	2
	155″	4-CH	Front	2½″	1⅜″	10	1
	155″	4-CH	Rear	3½″	1⅞″	36	2
	173″	4-CH	Front	2½″	1⅜″	10	1
	173″	4-CH	Rear	2½″	1⅜″	10	2
D-300, DS-300	99″	4-CH	One Piece	2½″	1⅜″	10	2
	117″	4-CH	One Piece	3½″	1⅞″	36	2
D-35, DS-35, (All W.B.) D-35B (179″ W.B. only)	All	5-C	Front	2½″	1⅜″	10	1
	137″	5-C	Rear	2½″	1½″	10	2
	149″	5-C	Rear	3″	1½″	10	2
	161″	5-C	Rear	3½″	1½″	10	2
	179″	5-C	Rear	3″	1½″	10	2
D-40	All	5-C	Front	2½″	1½″	10	1
	134″	5-C	Rear	2½″	1½″	10	2
	146″	5-C	Rear	3″	1½″	10	2
	158″	5-C	Rear	3½″	1½″	10	2
	176″	5-C	Rear	3″	1½″	10	2
D-50	All	6-C	Front	3″	1¾″	10	1
	All	6-C	Rear	3″	1¾″	10	2
D-60, DR-60	All	6-C	Front	3″	1¾″	10	1
	All	6-C	Rear	3″	1¾″	10	2
DR-70	All	6-C	Front	3″	1¾″	10	1
	All	6-C	Rear	3″	1¾″	10	2
D-186T, DS-186T	173″	4-CH	Front	2½″	1⅜″	10	1
	173″	4-CH	Rear	2½″	1⅜″	10	2
	191″	4-CH	Front	2½″	1⅜″	10	1
	191″	4-CH	Rear	3½″	1⅜″	10	2
D-216T	176″	5-C	Front	2½″	1½″	10	1
	176″	5-C	Rear	2½″	1½″	10	2
	194″	5-C	Front	2½″	1½″	10	1
	194″	5-C	Rear	3″	1½″	10	2
D-246T	161″	6-C	Front	3″	1¾″	10	1
	161″	6-C	Rear	3″	1¾″	10	2
	179″	6-C	Front	3″	1¾″	10	1
	179″	6-C	Rear	3″	1¾″	10	2
	197″	6-C	Front	3″	1¾″	10	1
	197″	6-C	Rear	3″	1¾″	10	2
	215″	6-C	Front	3″	1¾″	10	1
	215″	6-C	Rear	3″	1¾″	10	2
DR-346T	161″	6-C	Front	3″	1¾″	10	1
	161″	6-C	Rear	3″	1¾″	10	2
	197″	6-C	Front	3″	1¾″	10	1
	197″	6-C	Rear	3″	1¾″	10	2
	215″	6-C	Front	3″	1¾″	10	1
	215″	6-C	Rear	3″	1¾″	10	2

Propeller Shaft Specifications—Continued

Model	Wheel Base	Type	Location	Outside Diameter	Diameter of Spline	No. Splines	No. Joints
D-246F	All	6-C	*1	3"	1¾"	10	2
	All	5-C	*2	2½"	1½"	10	2
	All	5-C	*3	2½"	1½"	10	2
	All	5-C	*4	2½"	1½"	10	2
D-346F	161"	6-C	*1	3"	1¾"	10	2
	197"	6-C	*1	3"	1¾"	10	2
	215"	6-C	*1	3½"	1¾"	10	2
	All	6-C	*2	3"	1¾"	10	2
	All	6-C	*3	3"	1¾"	10	2
	All	6-C	*4	3"	1¾"	10	2
DR-426F	161"	7-C	*1	3"	2"	10	2
	161"	6-C	*2	3"	1¾"	10	2
	161"	6-C	*3	3"	1¾"	10	2
	161"	6-C	*4	3"	1¾"	10	2
	215"	7-C	*1	3"	2"	10	2
	215"	6-C	*2	3"	1¾"	10	2
	215"	6-C	*3	3"	1¾"	10	2
	215"	6-C	*4	3"	1¾"	10	2
	233"	7-C	*1	3"	2"	10	2
	233"	6-C	*2	3"	1¾"	10	2
	233"	6-C	*3	3"	1¾"	10	2
	233"	6-C	*4	3"	1¾"	10	2

*1 Main Transmission to Power Divider Unit.
*2 Power Divider to Forward Drive Axle.
*3 Power Divider to Center Bearing.
*4 Center Bearing to Rear Drive Axle.

Propeller Shaft

Propeller Shaft and Universal Joints

The propeller shafts are of tubular construction, having splined slip yokes and universal joints with steel roller bearings. Front propeller shafts have fixed joints while rear propeller shafts have the slip yoke which allows for variations in distance between rear axle and transmission or center bearing.

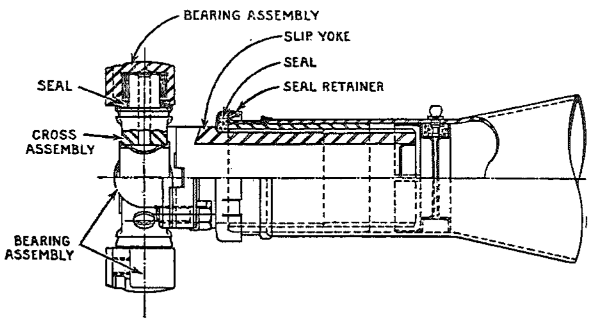

Fig. 1, 36 Splines on Slip Yoke

Slip Yoke Grease Seals

Fig. 1

A cork seal and a metal cap or seal retainer prevents grease from leaking out of the slip yoke. The seal retainer is held in place by tangs which are bent over a small flange at the end of the propeller shaft tube. The seal retainer must be locked securely in place.

In this type of slip yoke the splines are on the yoke which slips into the propeller shaft tube.

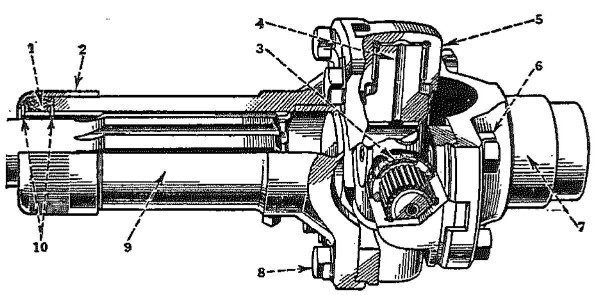

Fig. 2, 10 Splines on Propeller Shaft

No. Description

1. Felt.
2. Felt retainer.
3. Trunnion washer.
4. Cross.
5. Trunnion bearing.
6. Companion flange capscrew lock.
7. Companion flange.
8. Companion flange capscrew.
9. Slip yoke.
10. Felt retainer washer.

Fig. 2

A felt seal between retaining washers and a threaded grease seal retainer prevents grease from leaking out of this type slip joint. The threaded retainer screws on to the propeller shaft slip yoke tube. This seal retainer must be tightened securely.

Note that in this construction the splines are on the propeller shaft end which slips into the slip yoke tube.

Disassembling

To take a joint and shaft assembly out of a chassis, it is necessary only to remove eight capscrews; the four screws that hold the two bearings to the transmission fitting, whether it be fitting yoke or brake flange fitting, or the center joint fitting on a long wheelbase chassis and the four screws that hold the two bearings to the pinion shaft fitting. To disengage the bearings from the end fittings, compress the slip joint.

Care is to be taken to prevent the bearings from falling off the journals of the spider when they have been disengaged from the fitting yokes. This precaution should be taken to eliminate the possibility of dirt or other foreign matter from entering the bearings, providing they are to be used again. It requires but very little dirt or other foreign matter in a bearing to cause considerable damage to a joint. It is a good idea to tie the bearings together in place on the spider while the other bearings are being disengaged from the slip yoke and propeller shaft yoke.

Unless the propeller shaft or the slip yoke are to be replaced, it is best not to disassemble these two parts. They are balanced in the position in which they are found, and should remain in that position.

When a bearing is removed from the spider, the cork packing washer usually comes off with, and remains in, the bearing. If the joint has given considerable service, the cork packing washers should be removed from the bearing and discarded.

Reassembling

All parts should be thoroughly cleaned before they are reassembled, and each bearing should be packed with a small amount of clean lubricant. (Use a high grade light weight semi-fluid chassis lubricant.)

Before assembling the bearings to the spider, make sure the four dust shields are in place on the shoulders of the journals of the spider. Place a new cork packing washer on each journal and push it up to the shoulder. Then place the bearing on the journal.

Due to new packing washers having been used, and also a possible air-lock in the bearings, it is necessary to compress the bearings in order to get them in the proper location for assembling to the yokes and fittings. After opposite bearings have been compressed as much as possible, a tie wire is to be used to keep them in the compressed position. When all four bearings have been compressed tightly in place on each of the two spiders, these spider and bearing assemblies are then ready for attaching to the propeller shaft yoke and slip yoke.

Sometimes due to the air-lock in the bearings not having been entirely eliminated by compressing the bearings, it is necessary to tap the ends of the bearings lightly with a hammer. This will relieve the air-lock and permit the assembly of the bearings to the yoke without further difficulty.

When the key of a bearing is seated properly in the keyway of the yoke, the entire face of the bearing will be flat on the face of the yoke. Be sure the entire face of each bearing is flush on the face of the yoke before inserting the capscrews. The draw-up of the screws might not correct a cocked bearing condition.

A single lock plate is used for locking each set of two screws. The screws are to be assembled in the holes of the lock plates before they are inserted in the yoke screw holes. After the screws have been drawn up as tightly as possible, one of the two projecting lips at each end of the lock plate is to be turned up tightly against a flat side of the lock head. It is very important that each screw be securely locked.

It is necessary to have perfect alignment of the front and rear joints. Therefore, if either the slip yoke or propeller shaft has been replaced, be sure when assembling these two items that the bearing keyway of the slip yoke is in alignment with the bearing keyway of the propeller shaft yoke.

Due to the design and construction of the drive shaft and universal joint assembly, the replacement of any part or parts can be accomplished without special tools or garage equipment. Replacements can be made without removing the propeller shaft assembly from the chassis. If a joint fails on the highway, and the necessary parts can be brought to the place where the truck is tied up, replacements can be made without difficulty.

If a failure occurs in the rear joints, the bearing capscrews can be removed, and the propeller shaft pushed forward in the slip yoke, thereby disengaging the bearings from both the propeller shaft yoke and the pinion shaft yoke. The reassembling of the joint is no more difficult than disassembling. Less difficulty will be experienced in the reassembly if the bearings are assembled to the propeller shaft yoke first.

The same procedure is to be followed in disassembling, replacing parts and reassembling the front slip joint, the only difference being that the slip yoke is pushed back on the propeller shaft. The best results will be obtained in the reassembly of this joint if the bearings are first assembled to the slip yoke.

If the slip yoke or propeller shaft has been damaged and must be replaced, these two parts can be disassembled merely by removing the slip yoke grease retainer or cap. In such instances it is necessary to be very careful when reassembling the shaft and slip yoke that the bearing keyway of the slip yoke is directly in line with the bearing keyway of the propeller shaft yoke. Arrows stamped on the propeller shaft and slip yoke indicate the correct position for assembly. **THESE ARROWS MUST MATCH.**

Propeller Shaft Center Bearing

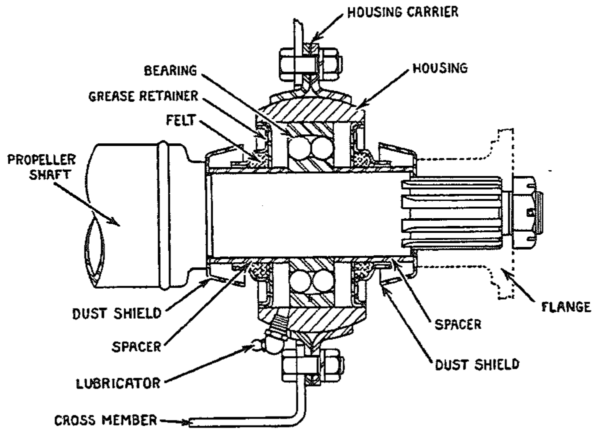

Fig. 1

Propeller Shaft Center Bearing (Not Six-Wheel Models)

This unit requires very little care, except for lubrication as recommended in "Lubrication Section."

The shaft assembly must be correctly lined up in relation to the center bearing housing before final tightening of the carrier housing bolts. When correctly assembled, the distance between the rear shaft front flange and the bearing carrier must be the same all around. This should be checked with calipers. An incorrect assembly will cause the grease seals to rub on the spacers, resulting in destruction of the seals and loss of lubricant.

The bearing outer race must be a sliding fit in the housing in order to limit the thrust load on the bearing.

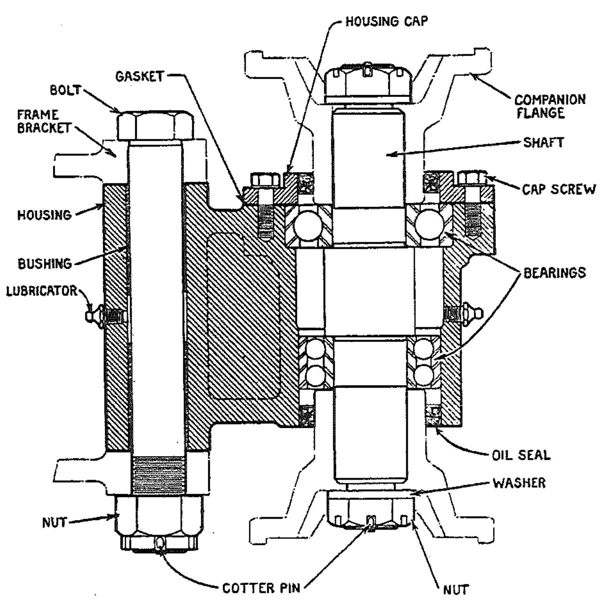

Fig. 2

When assembling the bearing in the housing it may be necessary to tap the outer race slightly to start it in the housing bore. After the bearing race is installed, a slight pressure should move it freely. If any binding is felt, scrape or lap the housing bore to obtain the proper fit.

Propeller Shaft Center Bearing (Six-Wheel Models)

Fig. 2 illustrates the propeller shaft center bearing assembly used for the dual drive, six-wheel models.

The center bearing housing is attached to a frame bracket by means of a pivot bolt. A tension bolt and spring, between the housing and frame bracket, eliminates any tendency of the unit to vibrate.

The two bronze pivot bolt bushings are staked into the housing at each end to prevent them from shifting. These bushings must be installed with the oil grooves to the bottom in order to provide sufficient lubrication for the pivot bolt. After they are pressed into place they should be line-reamed to 1.253—1.254".

The short center bearing propeller shaft is mounted in two ball bearings—one single and one double row. By removing the companion flanges and center bearing housing cap the shaft and bearings can be disassembled. Tap the end of the shaft opposite the housing cap side and the assembly will slip out of the housing.

When reassembling, press both bearings on the shaft first, then install the assembly in the housing. Replace oil seals and housing cap gasket and install companion flanges. Tighten shaft nuts **securely** and lock with cotter pins.

In addition to the pressure gun lubrication fitting in the housing, there is an oil cup which serves as a vent. Do not lubricate thru this oil cup as its purpose is to relieve the pressure that is built up when lubricant is applied thru the pressure gun fitting. This vent should be inspected occasionally to make sure it is open and clean.

Radiator Group

Section A

Radiator and Cooling System

Page

Anti-freeze Solutions .... 1 & 2
Cleaning Cooling System 1
Draining Cooling System 1

*Standard Radiator and Cooling System Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Water Capacity:													
Complete System (Quarts)	15 1/2	14 1/4	15 1/2	18	18	18	18	18 3/4	18 3/4	18 3/4	21 3/4	24 3/4	28
Radiator Only (Quarts)	8 1/2	8	8 1/2	9 1/4	9 1/4	9 1/4	9 1/4	9 1/4	9 1/4	9 1/4	11 1/4	13 1/4	13 1/4
Radiator Size:													
Height	22 1/2"	22"	22 1/2"	24"	24"	24"	24"	24"	24"	24"	22 1/2"	25 3/4"	25 3/4"
Width	18 9/16"	18 3/8"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	24"	24"	24"
Depth	2 9/32"	1 3/4"	2 9/32"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 9/32"	2 9/32"	2 5/16"
Fins per inch	7	4	7	9	9	9	9	9 1/2	9 1/2	9 1/2	7	6	9
Rows of Tubes	3	2	3	3	3	3	3	3	3	3	3	3	3
Radiator Hose Sizes:													
Upper or Inlet—I.D. x Length	1 9/16 x 10"	2 x 2"	1 9/16 x 10"	1 9/16 x 10"	1 9/16 x 10"	1 9/16 x 10"	1 9/16 x 10"	2 x 10 1/8"	2 x 10 1/8"	2 x 10 1/8"	2 x 9 7/16"	2 x 7 1/2"	2 x 7 1/2"
Lower or Outlet—I.D. x Length	1 9/16 x 3"	2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	2 x 2 1/2" 2 x 3 1/4"	2 x 2 1/2" 2 x 3 1/4"	2 x 2 1/2" 2 x 3 1/4"	2 x 2 1/2" 2 x 3 1/4"	2 1/8 x 3 1/2" 2 1/8 x 2 3/8"	2 1/8 x 3 1/2" 2 1/8 x 2 3/8"
Number of Plies	3	3	3	3	3	3	3	3	3	3	3	3	3
Fan Diameter	15"	15"	17"	17"	17"	17"	17"	17 3/4"	17 3/4"	17 3/4"	17 3/4"	20"	20"
No. of Blades	4	4	4	4	4	4	4	4	4	4	4	4	4
Angle of Blades	32°	32°	32°	32°	32°	32°	32°	32°	32°	32°	42°	42°	42°
Shroud	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fan Belt Type	V	V	V	V	V	V	V	V	V	V	V	V	V
No. Used	1	1	1	1	1	1	1	1	1	1	1	2	2

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Water Capacity:												
Complete System (Quarts)	28	31	19 1/4	19 1/4	18	18	18 3/4	24 3/4	24 3/4	31	31	31
Radiator Only (Quarts)	13 1/4	14	11 1/2	11 1/2	9 1/4	9 1/4	9 1/4	13 1/4	13 1/4	14	14	14
Radiator Size:												
Height	25 3/4"	25 3/4"	22"	22"	24"	24"	24"	25 3/4"	25 3/4"	25 3/4"	25 3/4"	25 3/4"
Width	24"	24"	24"	24"	18 9/16"	18 9/16"	18 9/16"	24"	24"	24"	24"	24"
Depth	2 5/16"	3"	1 3/4"	1 3/4"	2 5/16"	2 5/16"	2 5/16"	2 9/32"	2 9/32"	3"	3"	3"
Fins per inch	9	7	9	9	9	9	9 1/2	6	6	7	7	9 1/2
Rows of Tubes	3	4	2	2	3	3	3	3	3	4	4	3
Radiator Hose Sizes:												
Upper or Inlet—I.D. x Length	2 x 7 1/2"	2 x 7 1/2"	2 x 3"	2 x 3"	1 9/16 x 10"	1 9/16 x 10"	2 x 10 1/8"	2 x 7 1/2"	2 x 7 1/2"	2 x 7 1/2"	2 x 7 1/2"	2 x 7 1/2"
Lower or Outlet—I.D. x Length	2 1/8 x 3 1/2" 2 1/8 x 2 3/8"	2 1/8 x 3 1/2" 2 1/8 x 2 3/8"	2 x 3"	2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	2 x 2 1/2" 2 x 3 1/4"	2 1/8 x 3 1/2" 2 1/8 x 2 3/8"	2 1/8 x 3 1/2" 2 1/8 x 2 3/8"	2 1/8 x 3 1/2" 2 1/8 x 2 3/8"	2 1/8 x 3 1/2" 2 1/8 x 2 3/8"	2 1/8 x 2 3/8" 2 1/8 x 3 1/2"
Number of Plies	3	3	3	3	3	3	3	3	3	3	3	3
Fan Diameter	20"	20"	18"	18"	17"	17"	17 3/4"	20"	20"	20"	20"	21"
No. of Blades	4	4	4	4	4	4	4	4	4	4	4	4
Angle of Blades	42°	42°	42°	42°	32°	32°	32°	42°	42°	42°	42°	42°
Shroud	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Fan Belt Type	V	V	Direct	Direct	V	V	V	V	V	V	V	V
No. Used	2	2	Drive	Drive	1	1	1	2	2	2	2	2

* See page 2 for "Hot Climate" specifications.

*Hot Climate Radiator and Cooling System Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Water Capacity:													
Complete System (Quarts)	15½	15	15½	18	18	18	18	18¾	18¾	18¾	21¾	24¾	31
Radiator Only (Quarts)	8½	8½	8½	9¼	9¼	9¼	9¼	9¼	9¼	9¼	11¼	13¼	14
Radiator Size:													
Height	22½"	22"	22½"	24"	24"	24"	24"	24"	24"	24"	22½"	25¾"	25¾"
Width	18 9/16"	18⅜"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	18 9/16"	24"	24"	24"
Depth	2 5/16"	2 9/32"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 5/16"	2 9/16"	3"
Fins per inch	9½	4	9½	11	11	11	11	9½	9½	9½	9½	9	9½
Rows of Tubes	3	2	3	3	3	3	3	3	3	3	3	3	3
Radiator Hose Sizes:													
Upper or Inlet—I.D. x Length	1 9/16 x 10"	2 x 2"	1 9/16 x 10"	1 9/16 x 10"	1 9/16 x 10"	1 9/16 x 10"	1 9/16 x 10"	2 x 10⅛"	2 x 10⅛"	2 x 10⅛"	2 x 9 7/16"	2 x 7½"	2 x 7½"
Lower or Outlet—I.D. x Length	1 9/16 x 3"	2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	2 x 2½" 2 x 3¼"	2 x 2½" 2 x 3¼"	2 x 2½" 2 x 3¼"	2 x 2½" 2 x 3¼"	2⅛ x 2⅜" 2⅛ x 3½"	2⅛ x 2⅜" 2⅛ x 3½"
Number of Plies	3	3	3	3	3	3	3	3	3	3	3	3	3
Fan Diameter	17"	15"	17"	17"	17"	17"	17"	17¾"	17¾"	17¾"	17¾"	20"	20"
No. of Blades	4	4	4	4	4	4	4	4	4	4	4	4	4
Angle of Blades	32°	32°	32°	32°	32°	32°	32°	42°	42°	42°	42°	42°	42°
Shroud	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fan Belt Type	V	V	V	V	V	V	V	V	V	V	V	V	V
No. Used	1	1	1	1	1	1	1	1	1	1	1	2	2

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Water Capacity:												
Complete System (Quarts)	31	31	20½	20½	18	18	18¾	24¾	24¾	31	31	31
Radiator Only (Quarts)	14	14	12¾	12¾	9¼	9¼	9¼	13¼	13¼	14	14	14
Radiator Size:												
Height	25¾"	25¾"	22"	22"	24"	24"	24"	25¾"	25¾"	25¾"	25¾"	25¾"
Width	24"	24"	24"	24"	18 9/16"	18 9/16"	18 9/16"	24"	24"	24"	24"	24"
Depth	3"	3"	2 9/32"	2 9/32"	2 5/16"	2 5/16"	2 5/16"	2 9/16"	2 9/16"	3"	3"	3"
Fins per inch	9½	7	8	8	11	11	9½	9	9	7	7	9½
Rows of Tubes	3	4	2	2	3	3	3	3	3	4	4	3
Radiator Hose Sizes:												
Upper or Inlet—I.D. x Length	2 x 7½"	2 x 7½"	2 x 3"	2 x 3"	1 9/16 x 10"	1 9/16 x 10"	2 x 10⅛"	2 x 7½"	2 x 7½"	2 x 7½"	2 x 7½"	2 x 7½"
Lower or Outlet—I.D. x Length	2⅛ x 2⅜" 2⅛ x 3½"	2⅛ x 2⅜" 2⅛ x 3½"	2 x 3"	2 x 3"	1 9/16 x 3" 2 x 3"	1 9/16 x 3" 2 x 3"	2 x 2½" 2 x 3¼"	2⅛ x 2⅜" 2⅛ x 3½"	2⅛ x 2⅜" 2⅛ x 3½"	2⅛ x 2⅜" 2⅛ x 3½"	2⅛ x 2⅜" 2⅛ x 3½"	2⅛ x 2⅜" 2⅛ x 3½"
Number of Plies	3	3	3	3	3	3	3	3	3	3	3	3
Fan Diameter	20"	22"	19"	19"	17"	17"	17¾"	20"	20"	22"	22"	22"
No. of Blades	4	4	4	4	4	4	4	4	4	4	4	4
Angle of Blades	42°	42°	42°	42°	32°	32°	42°	42°	42°	42°	42°	42°
Shroud	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Fan Belt Type	V	V	Direct	Direct	V	V	V	V	V	V	V	V
No. Used	2	2	Drive	Drive	1	1	1	2	2	2	2	2

* See page 1 for "Standard" specifications.

Radiator

Cleaning Cooling System

Approximately twice a year, or oftener, depending upon kind of cooling water used, the cooling system should be drained and thoroughly flushed out. This is particularly important before using an anti-freeze solution.

Unless the cooling water is treated with a corrosion preventive, rust and scale will eventually clog up passages in radiator and water jackets. This condition is aggravated in some localities by the formation of insoluble salts from the water used.

Cleaning solutions are available which have proven very successful in removing the accumulation of rust, scale, sludge and grease. These solutions should be used according to the manufacturer's recommendation.

If no commercial cleaning solution is available, a solution of one pound of lye to seven gallons of hot water may be used. When using this solution, run engine for about ten minutes, then drain and flush out cooling system thoroughly, using clean water. When draining the cleaning solution, disconnect the radiator outlet hose as large particles of sediment will not pass thru the drain cock.

Another solution while not as strong as the lye water is as follows: dissolve about 4 pounds of ordinary washing soda in sufficient water to fill the complete cooling system. Leave radiator filler cap off and run engine for about ½ hour or until engine gets hot. Then drain and flush thoroughly with clean water.

A still stronger treatment is the use of hydrochloric acid (commercial muriatic). This acid, however, is a solvent of the metals of which the radiator is made and it is extremely important that the following instructions be carefully followed.

Make a solution of one part muriatic acid and seven parts of rain water. Allow to stand for 24 hours without running engine. Then drain and refill with clean water, adding 2 or 3 handfulls of washing soda. Run engine for a few moments in order to circulate the water and drain, flush out and refill with clean water.

If radiator is clogged with insoluble salt formations it should be taken to a reputable concern specializing in the removal of such formations. Reliable radiator service stations are familiar with local conditions and are equipped to apply the proper treatment.

Draining Cooling System

During freezing weather, if anti-freeze solutions are not used, the entire cooling system should be drained when truck is not in use.

On the HD series engines it is necessary to remove the pipe plug (drain cock on later models), located on the left side of the crankcase between the generator and distributor. Fig. 1 shows the location of this drain. This is in addition to the radiator drain cock.

Opening the radiator drain cock on these engines will only drain the water that is in the radiator and cylinder head, leaving the water jackets in the cylinder block, full, and if freezing occurs damage to the block will result. Be sure and replace plug (or close drain cock) before refilling system.

The complete cooling systems of FAB and FBB series engines can be thoroughly drained by merely opening the radiator drain cock.

Engines should be level when drained in order that all water in the system can flow out.

Be sure to refill cooling system before starting engine.

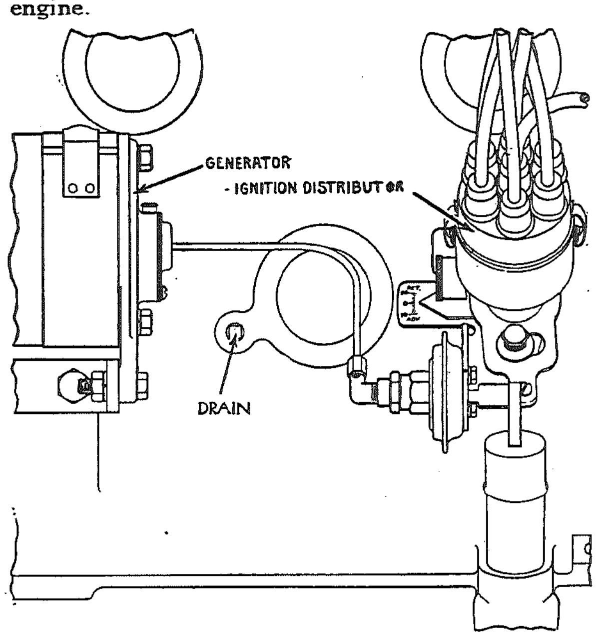

Fig. 1, HD Engines

PROPERTIES OF ANTI-FREEZE SOLUTIONS												
% By Volume	Denatured Alcohol			Menthanol (Wood Alcohol)			Distilled Glycerine			Ethylene Glycol (Prestone)		
	Freezing Point		Specific Gravity	Freezing Point		Specific Gravity	Freezing Point		Specific Gravity	Freezing Point		Specific Gravity
	°C	°F		°C	°F		°C	°F		°C	°F	
0%	0	32	1.000	0	32	1.000	0	32	1.000	0	32	1.000
10%	–3	27	.988	–5	23	.987	–2	29	1.029	–3	26	1.016
20%	–7	19	.978	–12	10	.975	–6	21	1.057	–9	16	1.031
30%	–12	10	.968	–19	–2	.963	–11	12	1.085	–16	3	1.045
40%	–19	–2	.957	–29	–20	.952	–18	0	1.112	–24	–11	1.058
50%	–28	–18	.943	–40	–40	.937	–26	–15	1.140	–35	–31	1.070

Anti-Freeze Solutions

IMPORTANT

Do not under any circumstances use any of the following in the cooling water as an anti-freeze:

Honey—Salt—Kerosene—Glucose or Sugar.

These at the best are poor substitutes and will cause trouble due to corrosion, clogging of the system and deterioration of the rubber hose connections.

Use only anti-freeze solutions manufactured by a reputable concern.

Before installing any anti-freeze solution the following items should be checked:

1. Tighten all water connections. Hose connections should be in good condition inside and out.
2. Inspect water pump for leaks. Tighten packing gland nut or repack if necessary.
3. Adjust fan belt to proper tension. Replace if necessary.
4. Drain and clean cooling system.

Spring Group

Section A

Springs—General

Page

Auxiliary Spring Mounting.......... 5

Care.......... 5

Front Spring Mounting.......... 5

Rear Spring Mounting.......... 5

Shackles, Pins and Brackets.......... 5
Shock Absorbers.......... 5

INTERNATIONAL

MOTOR TRUCK SERVICE MANUAL

Bulletin Number	Models Affected	Subject

MOTOR TRUCK SERVICE MANUAL

INTERNATIONAL

Bulletin Number	Models Affected	Subject

Spring Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Front Spring:													
Leaves	7	7	9	9	9	9	9	11	11	11	11	10	11
Thickness	2 at .259" 5 at .238"	2 at .259" 5 at .238"	2 at .259" 7 at .238"	2 at .284" 7 at .259"	2 at .284" 7 at .259"	2 at .284" 7 at .259"	2 at .284" 7 at .259"	2 at .284" 9 at .259"	2 at .284" 9 at .259"	2 at .284" 9 at .259"	3 at .3125" 8 at .284"	5 at .3125" 5 at .284"	6 at .3125" 6 at .284"
Width	1¾"	1¾"	1¾"	2"	2"	2"	2"	2"	2"	2"	2½"	3"	3"
Length (Flat):													
Center to Center of Eyes	36"	36"	36"	36½"	36½"	36½"	36½"	36½"	36½"	36½"	42⅜"	44½"	44½"
Center of Front Eye to Seat Center	17"	17"	17"	18½"	18½"	18½"	18½"	18½"	18½"	18½"	21⅜"	22½"	22½"
Free Opening:													
Eye Center Line to Main Leaf	3.4375"	3.4375"	3.161"	3.125"	3.125"	3.125"	3.125"	2.875"	2.875"	2.875"	3.1875"	3.5625"	3.5312"
Spring Pin Bushings (Ream)	.563"-.566"	.563"-.566"	.563"-.566"	.749"-.753"	.749"-.753"	.749"-.753"	.749"-.753"	.749"-.753"	.749"-.753"	.749"-.753"	.749"-.753"	.874"-.878"	.874"-.878"
Shackle Location	Front	Front	Front	Front	Front	Front	Front	Front	Front	Front	Front	Front	Front
Rear Spring:													
Leaves	9	9	10	8	8	13	13	10	10	14	11	12	13
Thickness	.284"	.284"	.3125"	.375"	.375"	.375"	.375"	.375"	.375"	.375"	2 at .4375" 9 at .375"	7 at .4375" 5 at .375"	.4375"
Width	1¾"	1¾"	2¼"	2½"	2½"	2½"	2½"	2½"	2½"	2½"	3"	3"	3"
Length (Flat):													
Center to Center of Eyes	51"	51"	54"	46"	46"	52"	52"	48"	48"	52"	54"	54"	54"
Center of Front Eye to Seat Center	24½"	24½"	26"	23"	23"	26"	26"	24"	24"	26"	27"	27"	27"
Free Opening:													
Eye Center Line to Main Leaf	6.6875"	6.6875"	8.3125"	4.4375"	4.4375"	7.375"	7.375"	4.5625"	4.5625"	7.500"	5.5312"	5.5625"	4.75"
Spring Pin Bushings (Ream)	.563"—.566"	.563"—.566"	.749"—.753"	.749"—.753"	.749"—.753"	.874"—.878"	.874"—.878"	.999"—1.003"	.999"—1.003"	.874"—.878"	1.124"—1.128"	1.124"—1.128"	1.249"—1.253"
Shackle Location	Rear	Rear	Rear	Rear	Rear	Rear	Rear	Rear	Rear	Rear	Rear	Rear	Rear
Auxiliary Springs:													
Leaves	....	....	....	....	....	....	....	8	8	....	7	8	8
Thickness	....	....	....	....	....	....	....	.284"	.284"	....	.284"	.284"	.3125"
Width	....	....	....	....	....	....	....	2½"	2½"	....	3"	3"	3"
Length (Flat)	....	....	....	....	....	....	....	36"	36"	....	39"	39"	41"
Free Opening	....	....	....	....	....	....	....	2.25"	2.25"	....	2.75"	2.625"	2.125"

Spring Specifications—Continued

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Front Spring:												
Leaves	11	12	10	10	12	12	12	12	12	12	12	14
Thickness	6 at .3125" 6 at .284"	6 at .3125" 6 at .284"	.312"	.312"	.284"	.284"	8 at .284" 4 at .3125"	5 at .284" 7 at .3125"	5 at .284" 7 at .3125"	7 at .3125" 5 at .375"	7 at .3125" 5 at .375"	7 at .3125" 7 at .375"
Width	3"	3"	2½"	2½"	2"	2"	2½"	3"	3"	3"	3"	3"
Length (Flat):												
Center to Center of Eyes	44½"	44½"	44"	44"	40"	40"	42⅜"	44½"	44½"	44½"	44½"	44½"
Center of Front Eye to Seat Center	22½"	22½"	22"	22"	18½"	18½"	21⅜"	22½"	22½"	22½"	22½"	22½"
Free Opening:												
Eye Center Line to Main Leaf	3.5312"	3.5937"	3.750"	3.750"	2.9375"	2.9375"	2.9375"	3.0625"	3.0625"	2.9375"	2.9375"	2.9375"
Spring Pin Bushings (Ream) Front	.874"-.878"	.874"-.878"	.749"-.753"	.749"-.753"	.749"-.753"	.749"-.753"	.749"-.753"	.874"-.878"	.874"-.878"	.874"-.878"	.874"-.878"	.874"-.878"
Spring Pin Bushings (Ream) Rear	.874"-.878"	.874"-.878"	.749"-.753"	.749"-.753"	.874"-.878"	.874"-.878"	.874"-.878"	.999"-1.003"	.999"-1.003"	.999"-1.003"	.999"-1 003"	.999"-1 003"
Shackle Location	Front	Front	Rear	Rear	Front	Front	Front	Front	Front	Front	Front	Front
Rear Spring:												
Leaves	13	16	10	10	10	10	10	12	12	14	14	12
Thickness	.4375"	.4375"	2 at .3125" 8 at .375"	2 at .3125" 8 at .375"	.4375"	.4375"	.4375"	.4375"	.4375"	.4375"	.4375"	.500" ....
Width	3"	3"	2½"	2½"	3"	3"	3"	3"	3"	4"	4"	4"
Length (Flat):												
Center to Center of Eyes	54"	56"	50"	50"	32¼"	32¼"	32¼"	32¼"	32¼"	36¼"	36¼"	39"
Center of Front Eye to Seat Center	27"	28"	25"	25"	15"	15"	15"	15"	15"	17"	17"	19"
Free Opening:												
Eye Center Line to Main Leaf	4.75"	4.9687"	4.625"	4.625"	1.6875"	1.6875"	1.625"	1.5937"	1.5937"	1.875"	1.875"	2.3125"
Spring Pin Bushings (Ream)	1.249"—1.253"	1.499"—1.503"	.749"-.753"	.749"-.753"	1.124"-1.128"	1.124"-1.128"	1.124"-1.128"	1.124"-1.128"	1.124"-1.128"	1.249"-1.253"	1.249"-1.253"	....
Shackle Location	Rear	Rear	Rear	Rear	....	....	....	....	....	....	....	....
Auxiliary Springs:												
Leaves	8	10	8	8	....	....	....	....	....	....	....	....
Thickness	.3125"	.3125"	.284"	.284"	....	....	....	....	....	....	....	....
Width	3"	3"	2½"	2½"	....	....	....	....	....	....	....	....
Length (Flat)	41"	43"	33"	33"	....	....	....	....	....	....	....	....
Free Opening	2.125"	1.8125"	1.0312"	1.0312"	....	....	....	....	....	....	....	....

Springs and Mountings

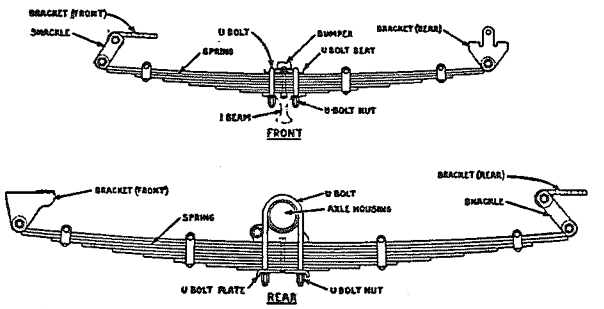

Fig. 1, D-2, D-5

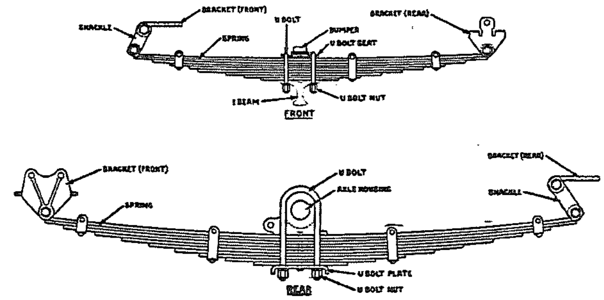

Fig. 2, D-15

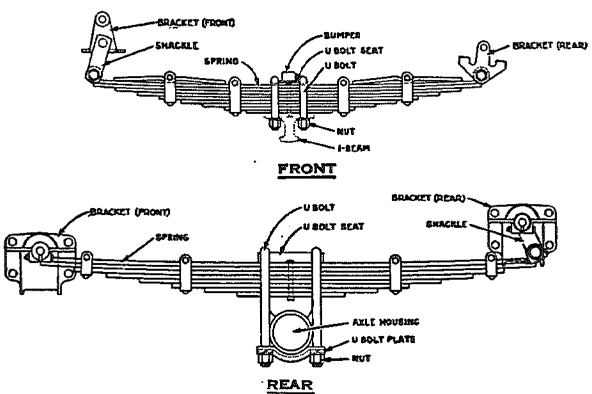

Fig. 3, D-30, DS-30

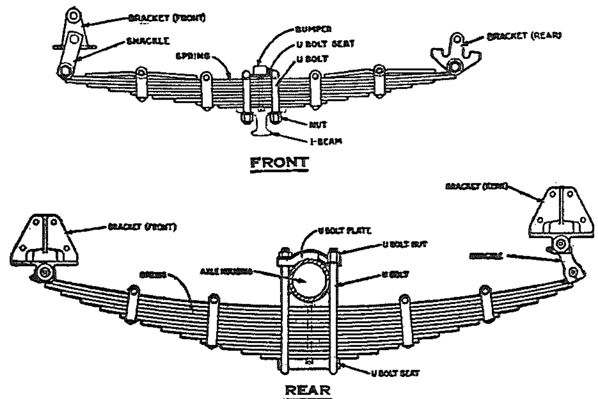

Fig. 4, D-30B, DS-30B

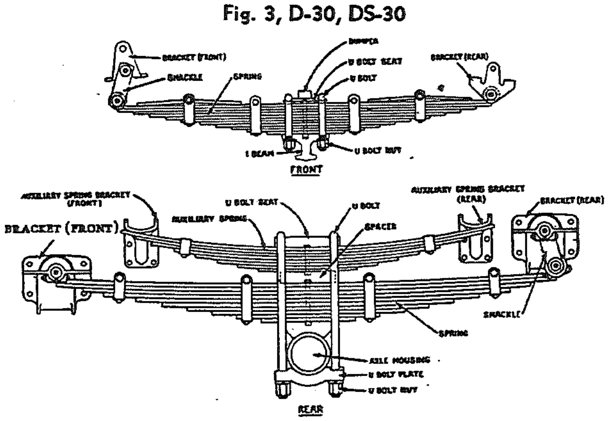

Fig. 5, D-35, DS-35

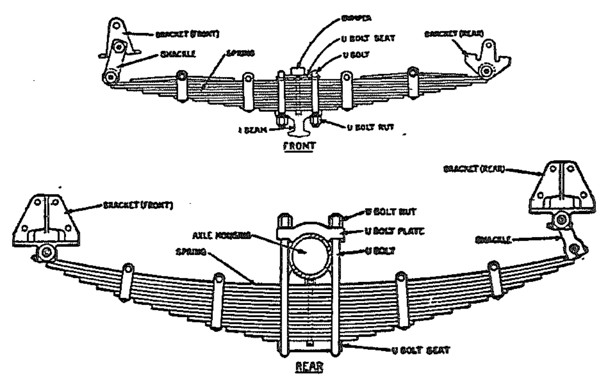

Fig. 6, D-35B

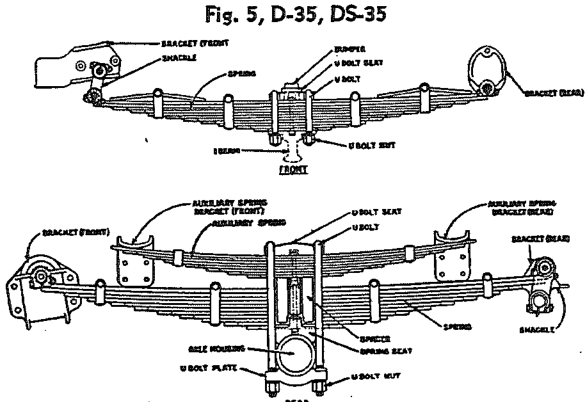

Fig. 7, D-40

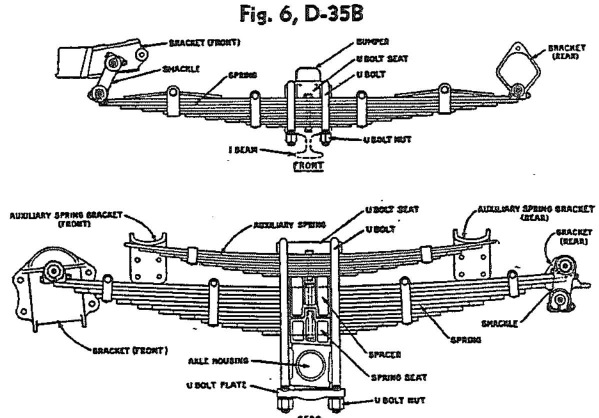

Fig. 8, D-50

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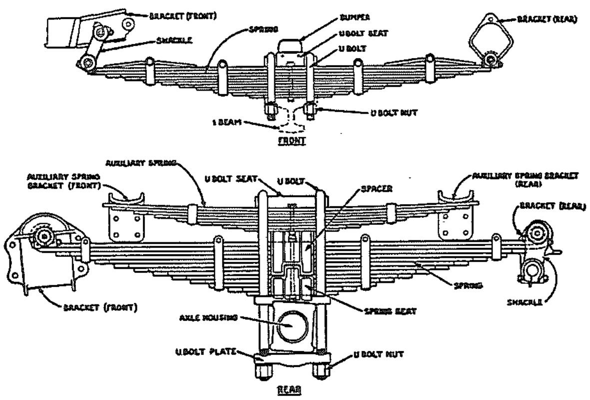


Fig, 9, D-60, DR-60

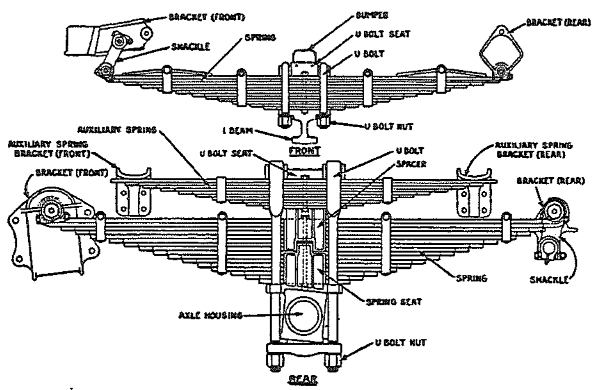


Fig. 10, DR-70

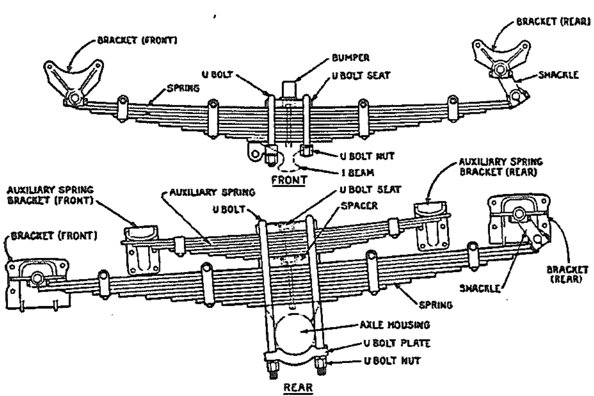


Fig. 11, D-300, DS-300

Front Springs—6-Wheel Models

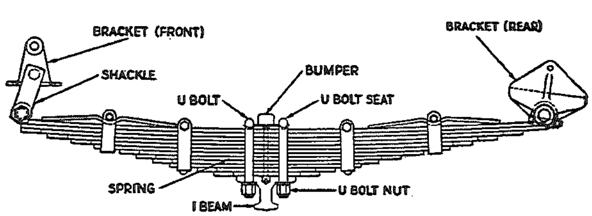


Fig. 12, D-186T, DS-186T (Front)

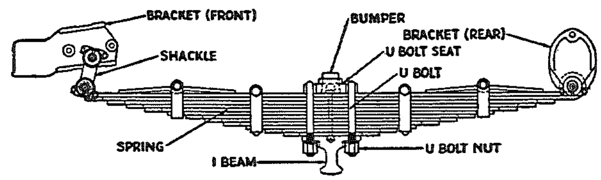


Fig. 13, D-216T (Front)

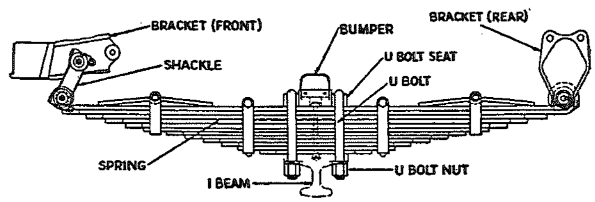


Fig. 14, D-246T, D-246F, DR-346T, D-346F (Front)

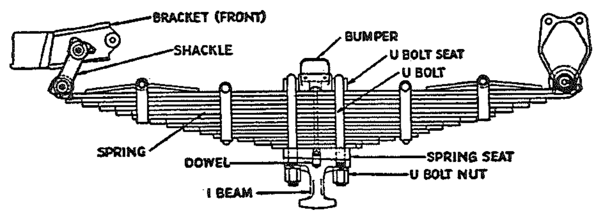


Fig. 15, DR-426F (Front)

Rear Springs—6-Wheel Models

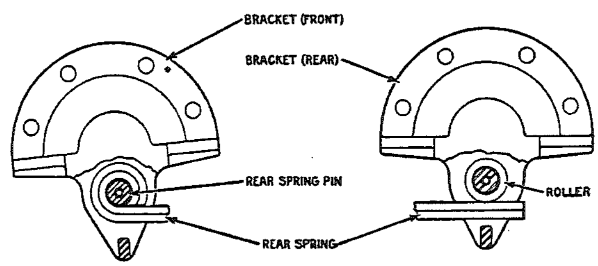


Fig. 16, D-186T, DS-186T, D-216T, D-286T, D-246F, DR-346T, D-346F (Rear)

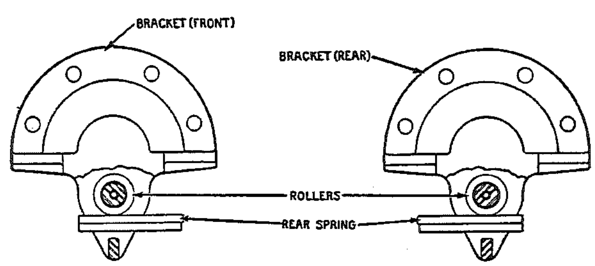


Fig. 17, DR-426F (Rear)

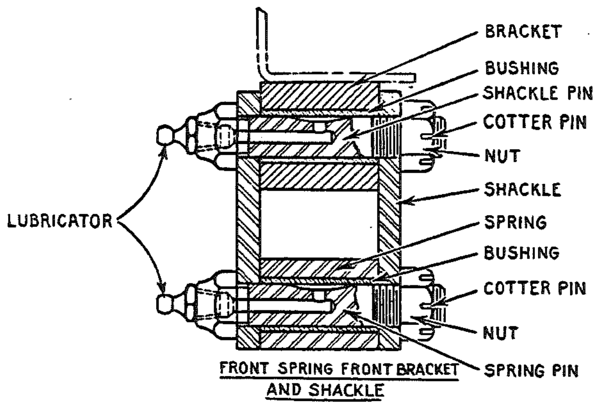


Fig. 18, D-2, D-5, D-15

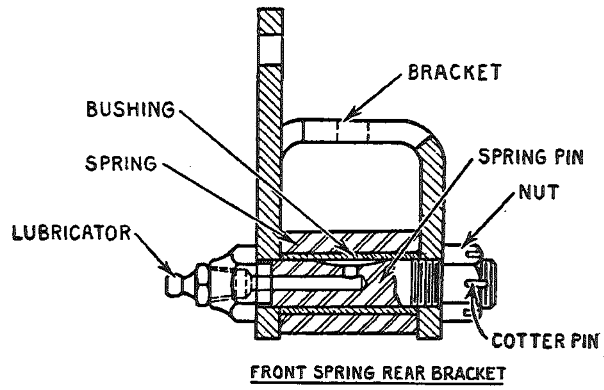


Fig. 19, D-2, D-5, D-15

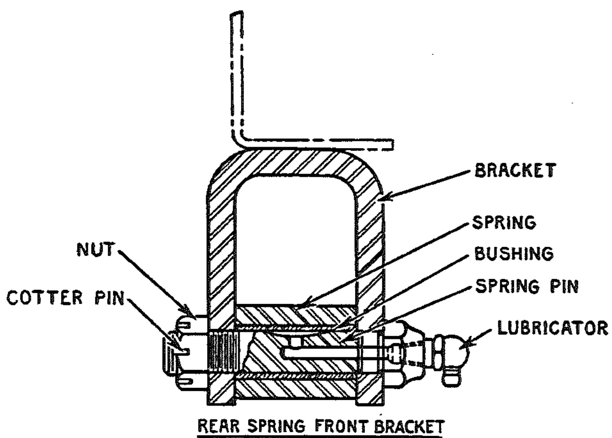


Fig. 20, D-2, D-5, D-15

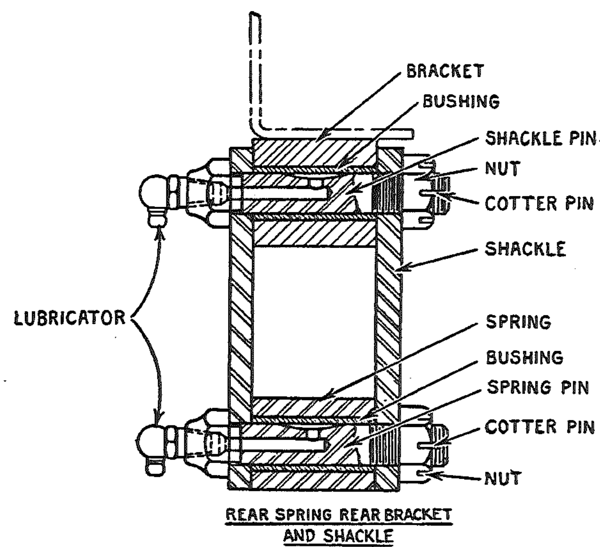


Fig. 21, D-2, D-5, D-15

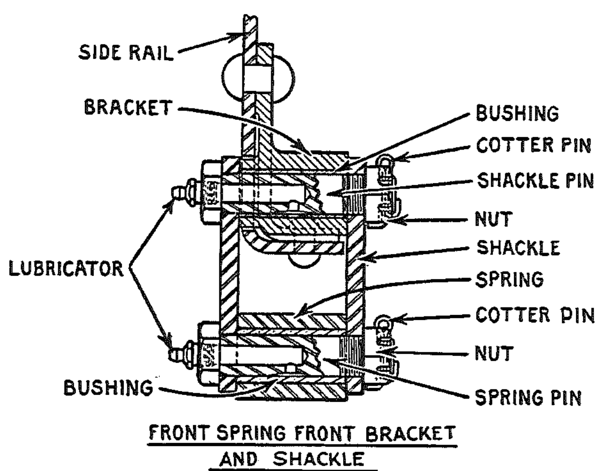


Fig. 22, D-30, DS-30, D-30B, DS-30B, D-35, DS-35, D-35B, D-186T, DS-186T

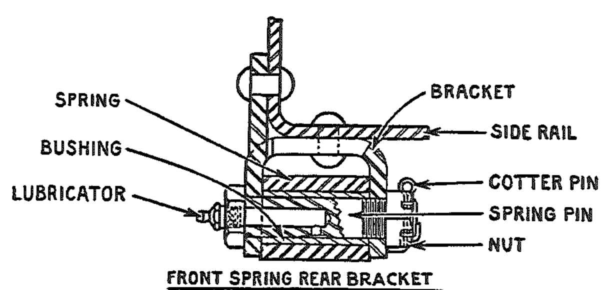
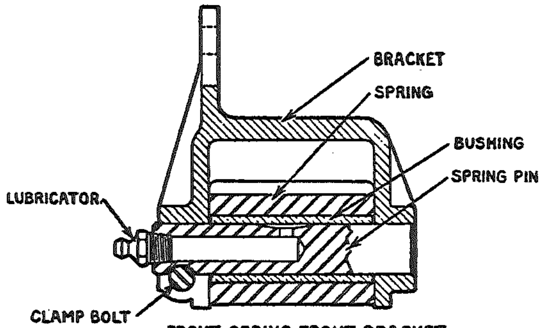
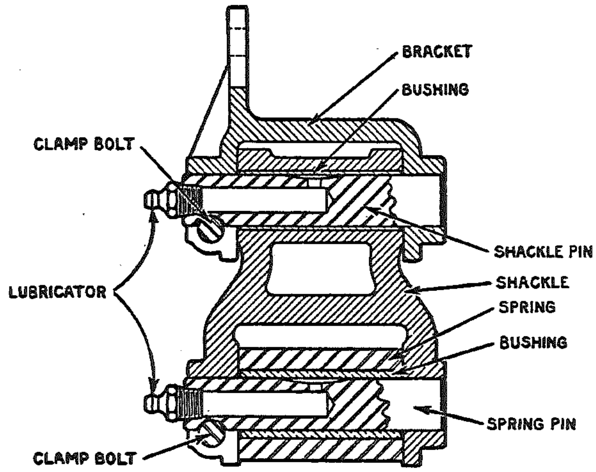


Fig. 23, D-30, DS-30, D-30B, DS-30B, D-35, DS-35, D-35B



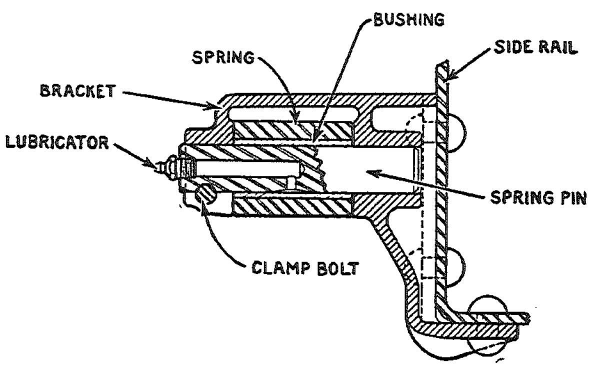
FRONT SPRING FRONT BRACKET

Fig. 24, D-300, DS-300



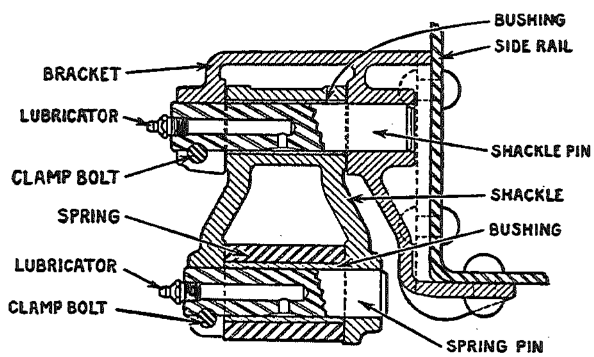
FRONT SPRING REAR BRACKET AND SHACKLE

Fig. 25, D-300, DS-300



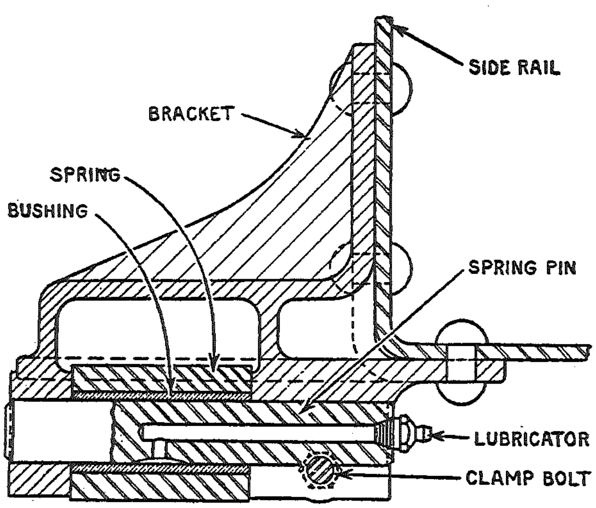
REAR SPRING FRONT BRACKET

Fig. 26, D-30, DS-30, D-35, DS-35, D-300, DS-300



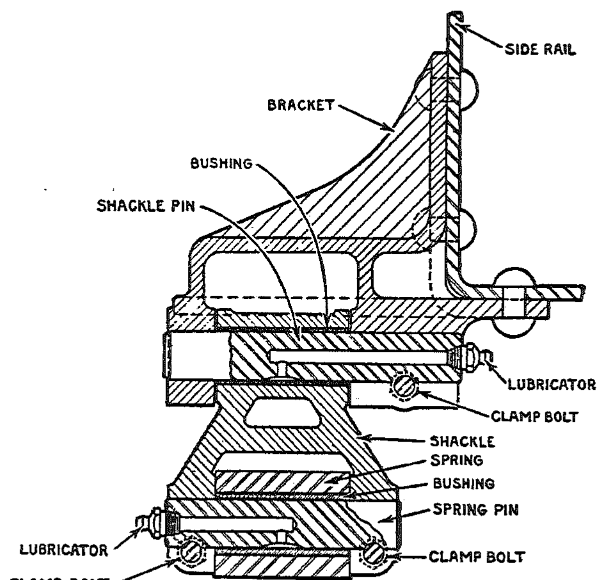
REAR SPRING REAR BRACKET AND SHACKLE

Fig. 27, D-30, DS-30, D-35, DS-35, D-300, DS-300



REAR SPRING FRONT BRACKET

Fig. 28, D-30B, DS-30B, D-35B



REAR SPRING REAR BRACKET AND SHACKLE

Fig. 29, D-30B, DS-30B, D-35B

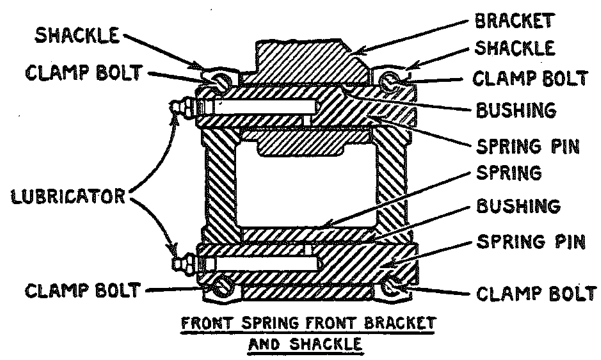


Fig. 30, D-40, D-50, D-60, DR-60, DR-70, D-216T, D-246T, D-246F, DR-346T, D-346F, DR-426F

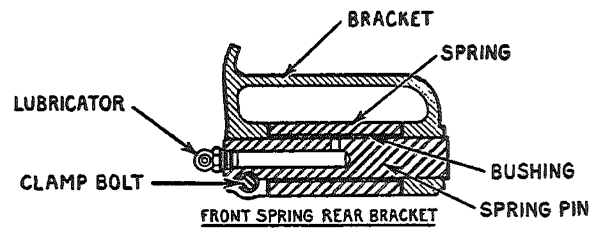


Fig. 31, D-40, D-50, D-60, DR-60, DR-70, D-186T, DS-186T, D-216T, D-246T, D-246F, DR-346T, D-346F, DR-426F

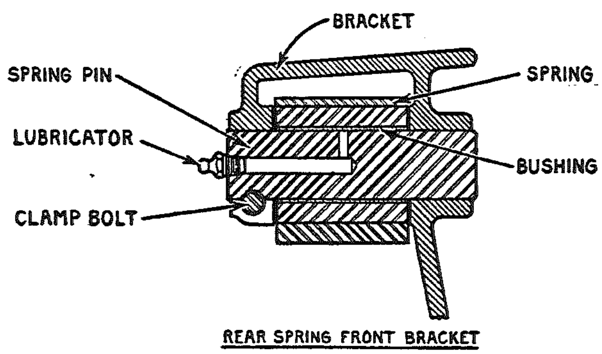


Fig. 32, D-40, D-50, D-60, DR-60, DR-70

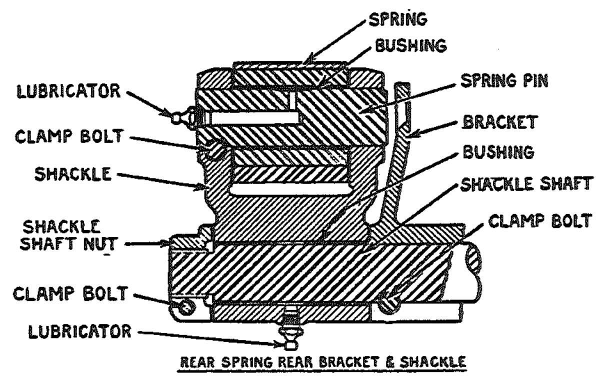


Fig. 33, D-40, D-50, D-60, DR-60, DR-70

Front Spring Mounting

Front springs are mounted in shackles at the forward end (not D-300, DS-300) and are supported in stationary brackets at the rear end.

Rear Spring Mounting

Rear springs are mounted in stationary brackets at the front end and in shackles at the rear end.

On the six-wheel models the rear springs are carried in saddles that are pivoted to the equalizing beams. All six-wheel models except DR-426F have the front end of the spring mounted to a bracket by means of the conventional spring pin. The rear end of the spring is straight and contacts a roller. (See Fig. 16.)

Both ends of the rear spring for Model DR-426F are straight and rollers are utilized (Fig. 17) in place of the usual spring pins and shackles.

Auxiliary Spring Mounting

Auxiliary springs are mounted on top of the main rear springs and under load the spring ends contact brackets attached to the side rails.

Shackles, Pins and Brackets

The spring mounting, shackle and pin arrangements are shown in the various illustrations.

Springs, spring pins and shackle pins should be lubricated regularly. (See Lubrication Section.)

Care

Check U-bolts and tighten nuts, also see that spring and shackle pins, clamp bolts and nuts are tight and securely locked with cotter pins. This will prevent pins and shafts from turning which would result in rapid bushing wear. Keep shackles drawn up enough to prevent side sway but not tight enough to permit binding.

Shock Absorbers

Always use Genuine Lovejoy Shock Absorber Fluid which can be obtained at all United Motors Service Branches and Service Stations.

Check of fluid level should be made every 10,000 miles. Fluid should be kept up to bottom of filler plug hole. An actual leak will cause a shortage of fluid, which can easily be determined by disconnecting the arm linkage and pulling the arm down. If the arm moves easily a part of the stroke, then comes to a stop and moves slowly for the remainder of the stroke, there is not enough fluid in the absorber.

When replenishing fluid wipe around the filler opening to remove all dirt; should dirt enter, it will impair operation, and complete removal and disassembly will be necessary to remove all trace of dirt. Disconnect link between axle and absorber arm. Fill absorber to the proper level with Genuine Lovejoy Shock Absorber Fluid, moving the arm up and down several times, forcing out any air in the cylinder. Add fluid and repeat operations until no more fluid can be added.

Steering Gear Group

Section A

Models D-2, D-5, D-15 (RS-14 Steering Gear)

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Section B

Models D-30, DS-30, D-30B, DS-30B, D-35, DS-35, D-35B (RT-14 Steering Gear); D-40, D-186T, DS-186T (RT-21 Steering Gear); D-216T (RT-26 Steering Gear)

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Models D-50, D-60, DR-60, D-246T, D-246F (R-300 Steering Gear)

Cam End Play Adjustment	1
Drag Link	2
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Steering Gear Group—Continued

Section D
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Models DR-346T, D-346F, DR-426F (R-720 Steering Gear)

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Installation of Steering Wheel	2
Lever Shaft Stud Adjustment	1
Removal of Steering Wheel	2
Steering Column Alignment	2
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Section F
Models D-300, DS-300 (R-260 Steering Gear)

Cam End Play Adjustment	1
Drag Link	2
Drag Link Dust Sheild	2
Installation of Steering Wheel	2
Lever Shaft Stud Adjustment	1
Removal of Steering Wheel	2
Steering Column Alignment	2
Steering Gear Connection with Front Wheels	2

INTERNATIONAL

MOTOR TRUCK SERVICE MANUAL

Bulletin Number	Models Affected	Subject

MOTOR TRUCK SERVICE MANUAL

INTERNATIONAL

Bulletin Number	Models Affected	Subject

Steering Gear and Drag Link Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Steering Gear	RS-14	RS-14	RS-14	RT-14	RT-14	RT-14	RT-14	RT-14	RT-14	RT-14	RT-21	R-300	R-300
Type of Gear:													
Cam and Lever	X	X	X									X	X
Cam and Twin Lever				X	X	X	X	X	X	X	X		
Wheel Diameter	17"	17"	17"	17"	17"	17"	17"	18"	18"	18"	18"	20"	20"
Steering Arm Length	8"	8"	8"	7"	7"	7"	7"	7"	7"	7"	7"	10 1/2"	10 1/2"
Total Travel	80°	80°	80°	100°	100°	100°	100°	100°	100°	100°	95°	76°	76°
Diameter of Lever Shaft	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"	1 1/8"	1 1/2"	1 1/2"
Cam Bearings	2	2	2	2	2	2	2	2	2	2	2	2	2
Type	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball
Steering Arm Ball Diameter	31/32"	31/32"	31/32"	1 3/32"	1 3/32"	1 3/32"	1 3/32"	1 3/32"	1 3/32"	1 3/32"	1 7/32"	1 15/32"	1 15/32"
Ratio	15:1	15:1	15:1	17:15:17	17:15:17	17:15:17	17:15:17	17:15:17	17:15:17	17:15:17	18:16:18	18:22:18	18:22:18
Drag Link:													
Diameter	5/8"	5/8"	5/8"	3/4"	3/4"	3/4	3/4	3/4"	3/4"	3/4"	1"	1 1/2"	1 1/2"
Length (Center to Center of Balls)	15 27/32"	15 27/32"	15 27/32"	12 13/16"	12 13/16"	12 13/16"	12 13/16"	12 13/16"	12 13/16"	12 13/16"	13 5/8"	14 5/8"	14 5/8"

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	D-246F	DR-346T	D-346F	DR-426F
Steering Gear	R-300	R-320	R-260	R-260	RT-21	RT-21	RT-26	R-300	R-300	R-720	R-720	R-720
Type of Gear:												
Cam and Lever	X	X	X	X				X	X	X	X	X
Cam and Twin Lever					X	X	X					
Wheel Diameter	20"	20"	18"	18"	18"	18"	18"	20"	20"	20"	20"	20"
Steering Arm Length	10 1/2"	10 1/2"	7"	7"	7"	7"	7"	10 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"
Total Travel	76°	77°	80°	80°	95°	95°	95°	76°	76°	78°	78°	78°
Diameter of Lever Shaft	1 1/2"	1 3/4"	1 1/4"	1 1/4"	1 1/8"	1 1/8"	1 3/8"	1 1/2"	1 1/2"	1 3/4"	1 3/4"	1 3/4"
Cam Bearings	2	2	2	2	2	2	2	2	2	2	2	2
Type	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball	Ball
Steering Arm Ball Diameter	1 15/32"	1 15/32"	1 7/32"	1 7/32"	1 7/32"	1 7/32"	1 7/32"	1 15/32"	1 15/32"	1 15/32"	1 15/32"	1 3/4"
Ratio	18:22:18	20:25:20	16:1	16:1	18:16:18	18:16:18	19:17:19	18:22:18	18:22:18	20:25:20	20:25:20	20:25:20
Drag Link:												
Diameter	1 1/2"	1 1/2"	1 1/4"	1 1/4"	3/4"	3/4"	1"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
Length (Center to Center of Balls)	14 5/8"	14 5/8"	35 1/16"	35 1/16"	12 13/16"	12 13/16"	13 7/8"	14 5/8"	14 5/8"	14 5/8"	14 5/8"	14 13/16"

Steering Gear—RS-14

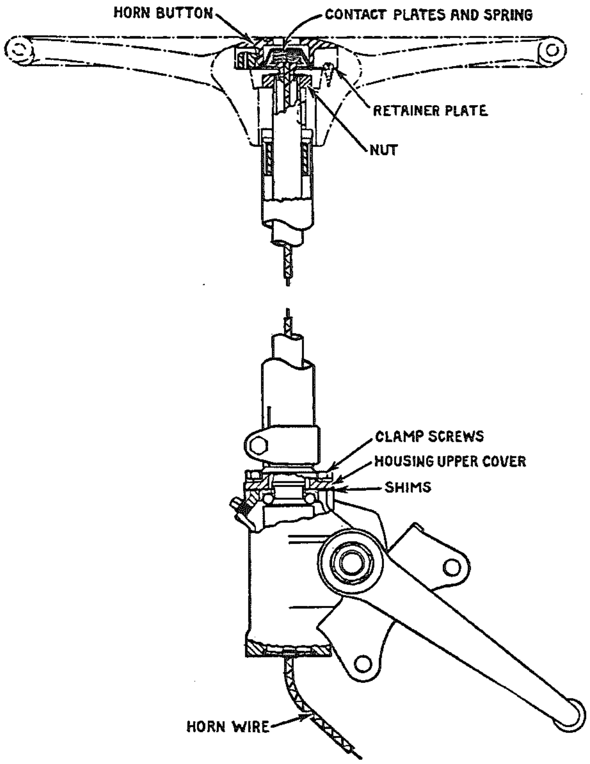

Fig. 1, RS-14 Steering Gear

Steering Gear

When making adjustments, free steering gear of all load, preferably by disconnecting drag link from steering arm. Loosen instrument panel bracket clamp on steering gear jacket tube.

ALWAYS MAKE ADJUSTMENT 1 FIRST

1. **Adjust Ball Thrust Bearings to Take Up End Play of Cam.**

(a) End play of cam shows up as end play of steering wheel tube indicated by up-and-down movement of steering wheel. A small amount of play may not be detected at steering wheel.

(b) Before making this adjustment, loosen the housing side plate adjusting screw to free the stud in the cam groove to relieve bearings of side thrust.

(c) Adjust to a barely perceptible drag so that the steering wheel can be turned freely (with the thumb and forefinger lightly gripping the rim) without any up-and-down movement of the wheel tube.

(d) Unscrew the four clamp screws and move up housing upper cover as far as possible —about ¼″ to permit removal of shims.

(e) Separate top metal shim with blade of knife. (.003″ shims are on top; .003″, 010″ and .030″ shims are used in between paper gaskets.)

(f) Clip and remove a .003″ shim. Reassemble clamp screws and tighten. Draw screws down tight.

(g) Test adjustment as outlined in paragraph (c), and if necessary, remove additional shims until adjustment is correct.

2. **Adjust Lever Shaft Stud in Cam Groove for Backlash.**

(a) Backlash at this point shows up as end play of lever shaft, also as backlash of steering wheel.

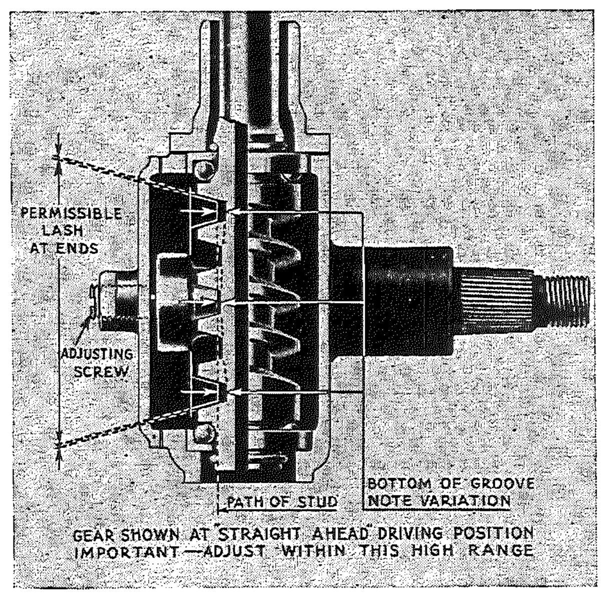

Fig. 2

(b) Note that the groove is purposely cut deeper in the ends of the cam than in the mid-position. This produces a high range through mid-position and makes the groove narrower through this range. This permits take-up of backlash in the mid-position, after normal wear of the groove, without causing a bind in the ends.

(c) Adjust to this mid-position high range. Do not adjust in the end positions. Play in the end positions is not objectionable.

(d) Tighten side cover adjusting screw until a very slight drag is felt through the mid-position high range when turning the steering wheel slowly from one extreme to the other.

(e) IMPORTANT—The gear must not bind any place. **Only a very slight drag** should be felt. A closer adjustment will not correct any steering condition, but will damage and wear the parts and impair operation.

(f) When the proper adjustment has been made, tighten the lock nut and then give the gear a final test.

(g) Make sure steering gear ball arm is tight on the splined shaft and that the lock-washer and nut are tight also.

3. Steering Column Alignment.

(a) Tighten instrument panel bracket clamp. Turn steering wheel to see if any stiffness exists. If so, the gear has been adjusted too tight or the steering column is out of alignment. **THE STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION.**

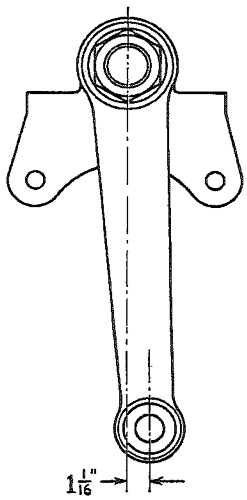

Fig. 3

4. Steering Gear Connection with Front Wheels.

(a) Turn the steering wheel as far to the right as possible, then rotate the wheel in the opposite direction as far as possible and note the total number of turns. Turn the wheel back just one-half of this total movement, thus placing the stud lever in the mid-position. Steering arm ball should then be approximately $1\frac{1}{16}$" back of center line of steering arm shaft and with front wheels in position for straight-ahead driving, it should be possible to connect drag link to the ball on the end of the steering gear arm without moving the gear to any appreciable extent. If this cannot be done, remove the arm from the steering gear and place it on the splined shaft in the proper position. Otherwise it will not permit the front wheels to swing equally to the left and right. Check steering knuckle stops on front axle to make sure that there is proper clearance for tire when turning at maximum angle.

See that steering gear housing is filled with lubricant as recommended in "Lubrication Section."

5. To Remove Steering Wheel.

(a) Disconnect horn wire at bottom of steering gear.

(b) Remove horn button by twisting with palm of hand. Hold steering wheel stationary.

(c) Remove contact plates and spring.

(d) Take out the three screws holding the horn button retainer plate and remove this plate and horn wire.

(e) Remove steering wheel nut and take off steering wheel, using a suitable puller.

6. To Install Steering Wheel.

(a) Place steering wheel in correct position on shaft. Wheel should be installed so that spokes are in shape of a "Y" when seated in driver's seat and with front wheels straight ahead. This will permit the driver to read instruments thru the top of steering wheel.

(b) Install steering wheel nut and tighten securely. Do not forget to install Woodruff key.

(c) Insert horn wire and thread thru hole in cover plate at bottom of steering gear housing. Attach horn button retainer plate with three screws.

(d) Install contact plates, spring and horn button. Horn button should be twisted until it locks in the rubber retainers on retainer plate.

(e) Connect horn wire at bottom of steering gear.

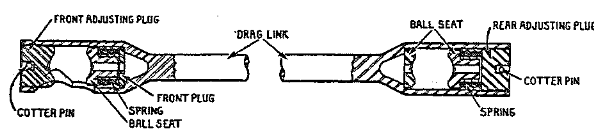

Fig. 4

Drag Link

The drag link assembly is illustrated in Fig. 4. This type of drag link requires very little care other than periodical lubrication and occasional inspection to make sure that it is properly adjusted.

Adjustment is made by removing cotter pin and turning adjusting plug in the desired direction. To adjust for wear, turn adjusting plug in until it is tight, then back off one-half turn. Insert a new cotter pin of the correct size and bend ends over securely. Drag link should not be adjusted too tight, otherwise steering will be affected.

Steering Gears—RT-14, RT-21, RT-26

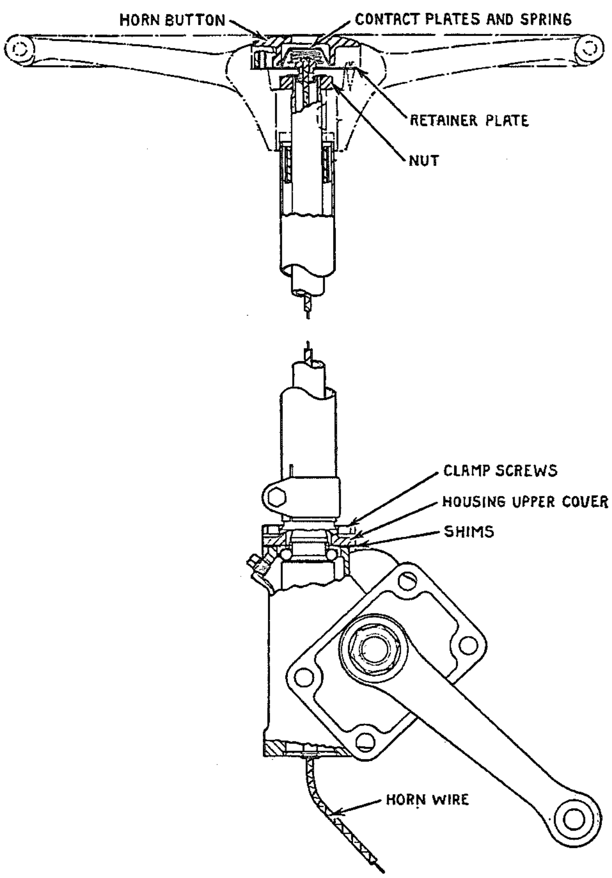

Fig. 1, RT-14, RT-21, RT-26 Steering Gears

Steering Gear

When making adjustments, free the steering gear of all load, preferably by disconnecting drag link from steering arm. Loosen instrument panel bracket clamp on steering gear jacket tube.

ALWAYS MAKE ADJUSTMENT 1 FIRST

1. **Adjust Ball Thrust Bearings to Take Up End Play of Cam.**

(a) Before making this adjustment, loosen the housing side cover adjusting screw to free the pins in the cam groove.

(b) Adjust to a barely perceptible drag so that the steering wheel can be turned freely (with the thumb and forefinger lightly gripping the rim).

(c) Unscrew the four clamp screws and move up the housing upper cover as far as possible —about ¼″—to permit removal of shims. (Combination of .003″, .010″, and .030″ shims are used in between paper gaskets.)

(d) Clip and remove a .003″ shim or more as required. Reassemble clamp screws and tighten. Draw screws down tight.

(e) Test adjustment as outlined in paragraph (b) and if necessary, remove or replace shims until adjustment is correct.

2. **Adjust for Proper Mesh of Lever Shaft Pins in Cam Groove.**

(a) Backlash of pins in the groove shows up as end play of lever shaft, also as backlash at steering wheel and at ball on arm.

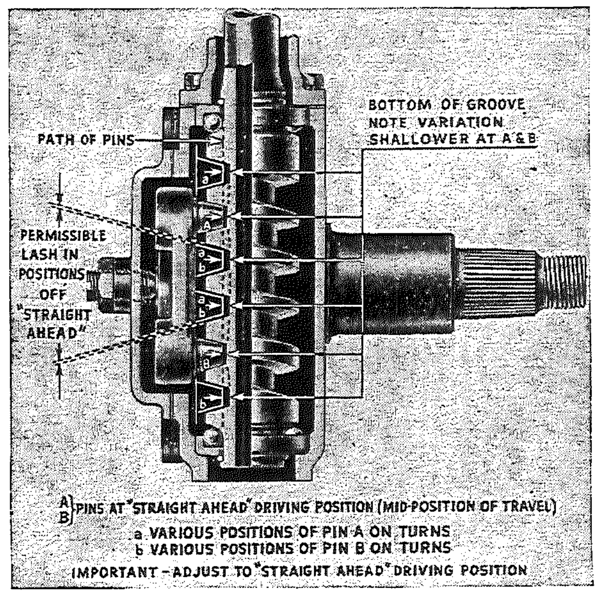

Fig. 2

(b) Note that the groove is purposely cut shallower in the straight-ahead driving position of each pin. This produces a high range in the groove (equal at each pin) that causes closer mesh of the pins in the groove through the mid-position of travel of each pin. This feature permits a close adjustment for normal straight-ahead driving and also permits take-up of backlash at this point, after normal wear of the groove, without causing a bind elsewhere.

(c) Adjust within the high range through the mid-position of pin travel.

(d) Do not adjust in positions off "straight ahead." Backlash at these turn positions is not objectionable.

(e) Tighten side cover adjusting screw until a very slight drag is felt through the mid-position high range when turning the steering wheel slowly from one extreme to the other.

(f) IMPORTANT—The gear must not bind any place. **Only a very slight drag** should be felt. A closer adjustment will not correct any steering condition, but will damage and wear the parts and impair operation.

(g) When the proper adjustment has been made, tighten the lock nut and then give the gear a final test.

(h) Make sure steering gear ball arm is tight on the splined shaft and that the lockwasher and nut are tight also.

3. Steering Column Alignment.

(a) Tighten instrument panel bracket clamp on column. Turn steering wheel to see if any stiffness exists. If so, the gear has been adjusted too tight or the steering column is out of alignment. THE STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION.

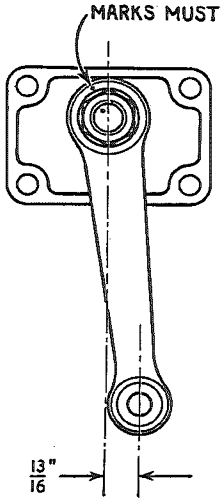

Fig. 3, RT-14

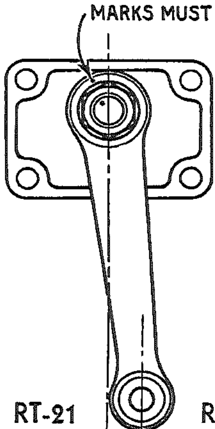

Fig. 4, RT-21, RT-26

4. Steering Gear Connection with Front Wheels.

(a) Turn the steering wheel as far to the right as possible, then rotate the wheel in the opposite direction as far as possible and note the total number of turns. Turn the wheel back just one-half of this total movement, thus placing the gear in the mid-position. Steering arm ball should then be back of center line of steering arm shaft, approximately 13/16" for RT-14; 3/4" for RT-21 and 5/8" for RT-26 gears, and with the front wheels in position for straight-ahead driving, it should then be possible to connect the drag link to the ball on the end of the steering gear arm without moving the gear to any appreciable extent. If this cannot be done, remove the arm from the steering gear and place it on the splined shaft in the proper position. Otherwise it will not permit the front wheels to swing equally to the left and right. Check steering knuckle stop on front axle to make sure that there is proper clearance for the tire when turning at maximum angle.

See that steering gear housing is filled with lubricant as recommended in "Lubrication Section."

5. To Remove Steering Wheel.

(a) Disconnect horn wire at bottom of steering gear.

(b) Remove horn button by twisting with palm of hand. Hold steering wheel stationary.

(c) Remove contact plates and spring.

(d) Take out the three screws holding the horn button retainer plate and remove this plate and horn wire.

(e) Remove steering wheel nut and take off steering wheel, using a suitable puller.

6. To Install Steering Wheel.

(a) Place steering wheel in correct position on shaft. Wheel should be installed so that spokes are in shape of a "Y" when seated in driver's seat and with front wheels straight ahead. This will permit the driver to read instruments thru the top of steering wheel.

(b) Install steering wheel nut and tighten securely. Do not forget to install Woodruff key.

(c) Insert horn wire and thread thru hole in cover plate at bottom of steering gear housing. Attach horn button retainer plate with three screws.

(d) Install contact plates, spring and horn button. Horn button should be twisted until it locks in the rubber retainers on retainer plate.

(e) Connect horn wire at bottom of steering gear.

Drag Link

The drag link assemblies are illustrated in Figs. 5 and 6. This type of drag link requires very little care other than periodical lubrication and occasional inspection to make sure that it is properly adjusted.

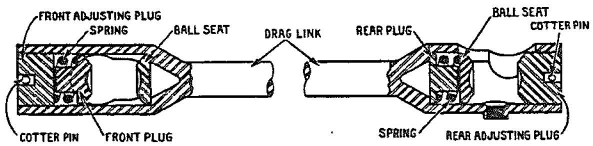

Fig. 5

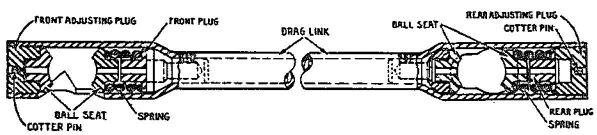

Fig. 6

Adjustment is made by removing cotter pin and turning adjusting plug in the desired direction. To adjust for wear, turn adjusting plug in until it is tight then back off one-half turn. Insert a new cotter pin of the correct size and bend ends over securely. Drag link should not be adjusted too tight, otherwise steering will be affected.

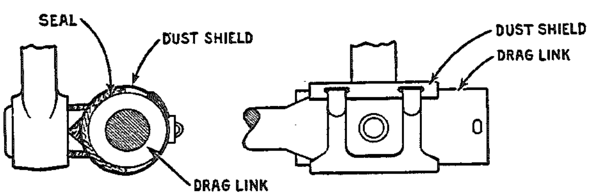

Fig. 7

Dust Shield

On some models a dust shield, consisting of a felt seal, held in place by a metal clamp is assembled at each end of the drag link. This shield prevents, dust, mud, etc., from working into the drag link ends and causing abnormal wear.

Steering Gear—R-300

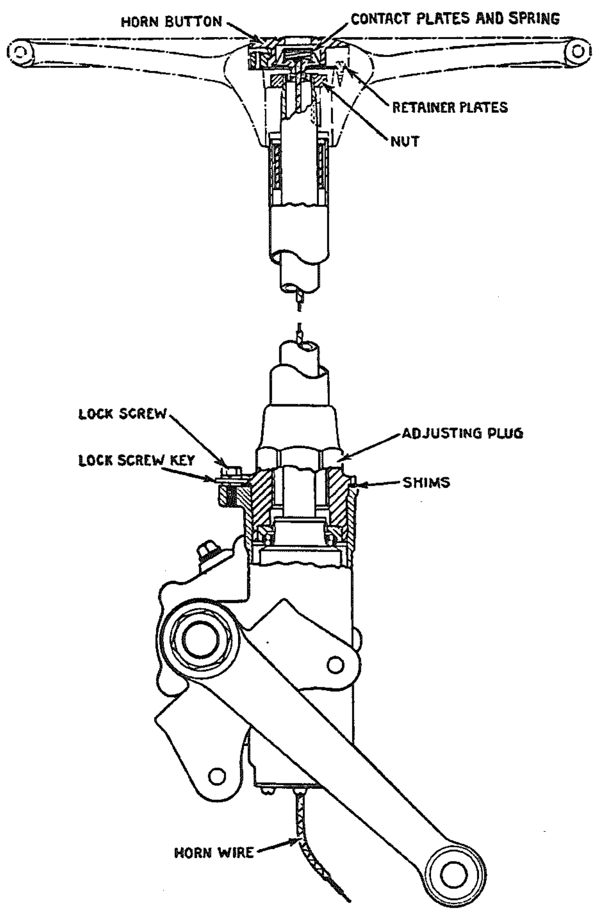

Fig. 1, R-300 Steering Gear

Steering Gear

When making adjustments, free steering gear of all load, preferably by disconnecting drag link from steering arm. Loosen adjusting plug.

ALWAYS MAKE ADJUSTMENT 1 FIRST

1. **Adjust Ball Thrust Bearing to Take Up End Play of Cam.**
   (a) Before making this adjustment loosen housing side plate adjusting screw to free stud in cam groove.
   (b) Adjustment should be made so there is a very slight drag but not so much that steering wheel cannot be turned from extreme to extreme by lightly gripping rim with thumb and forefinger.
   (c) Back off lock screw to release lock key from adjusting plug. Unscrew adjusting plug to permit removal of shims. (.003" and .007" shims are used.)
   (d) Clip and remove a .003" shim, or more as required, and screw adjusting plug down tight against shims (use a three-foot wrench).
   (e) Test as outlined in paragraph (b) and if necessary remove or replace shims until adjustment is correct.
   (f) Set lock key in place and tighten lock screw.
2. **Adjust Lever Shaft Stud in Cam Groove for Backlash.**
   (a) Backlash at this point shows up as end play of lever shaft, also as backlash at steering wheel and at ball on steering arm.

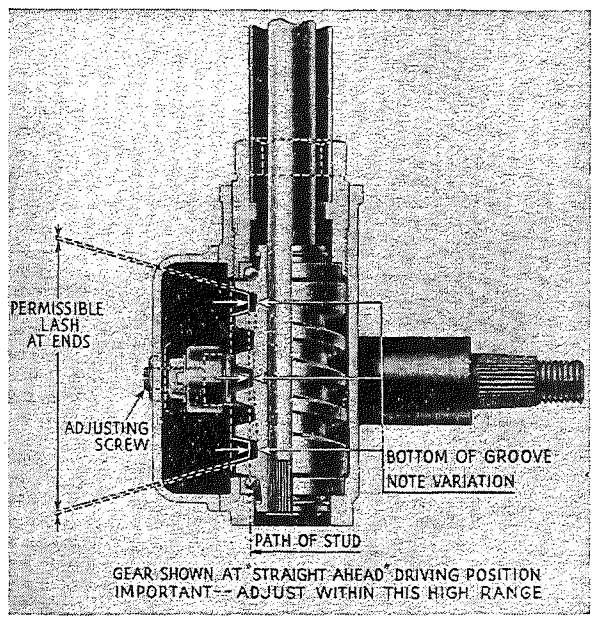

Fig. 2

   (b) Note that groove is purposely cut deeper in ends of cam than in mid-position. This produces a high range thru mid-position and makes groove narrower thru this range. This permits take-up of backlash in mid-position, after normal wear of groove, without causing a bind in ends.
   (c) Adjust to this mid-position high range. Do not adjust in end positions. Play in end positions is not objectionable.
   (d) Tighten side cover adjusting screw until a very slight drag is felt thru mid-position high range when turning steering wheel slowly from extreme to extreme position.
   (e) IMPORTANT—Steering gear must not bind any place. **Only a very slight drag** should be felt. A closer adjustment will not correct any steering condition, but will damage and wear parts and impair operation.
   (f) When proper adjustment has been made, tighten lock nut and then give gear a final test.
   (g) Make sure steering gear ball arm is tight on splined shaft and that lockwasher and nut are tight also.

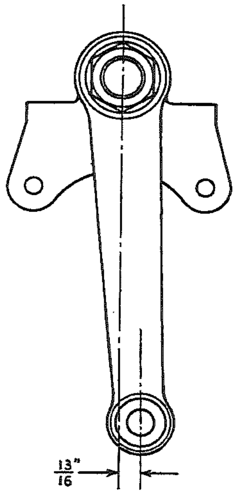

Fig. 3

3. Steering Column Alignment.

(a) After adjustments have been made and adjusting plug lock screw tightened, turn steering wheel to see if any stiffness exists. If so, steering gear has been adjusted too tight or steering column is out of alignment. **STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION.**

4. Steering Gear Connection with Front Wheels.

(a) Turn steering wheel as far to right as possible, then rotate wheel in opposite direction as far as possible, noting total number of turns. Turn steering wheel back exactly one-half of this total movement, thus placing stud lever in mid-position. Steering arm ball should then be approximately $\frac{13}{16}''$ back of center line of steering arm shaft and with front wheels in position for straight-ahead driving, it should be possible to connect drag link to steering arm ball without moving steering wheel to any appreciable extent. If this cannot be done, remove steering arm from steering gear and place arm in proper position on splined shaft. Check steering knuckle stops on front axle to make sure that there is proper clearance for tire when turning at maximum angle.

See that steering gear housing is filled with lubricant as recommended in "Lubrication Section."

5. To Remove Steering Wheel.

(a) Disconnect horn wire at bottom of steering gear.
(b) Remove horn button by twisting with palm of hand. Hold steering wheel stationary.
(c) Remove contact plates and spring.
(d) Take out the three screws holding the horn button retainer plate and remove this plate and horn wire.
(e) Remove steering wheel nut and take-off steering wheel, using a suitable puller.

6. To Install Steering Wheel.

(a) Place steering wheel in correct position on shaft. Wheel should be installed so that spokes are in shape of a "Y" or "X" (according to style of wheel), when seated in driver's seat and with front wheels straight ahead. This will permit the driver to read instruments thru the top of steering wheel.
(b) Install steering wheel nut and tighten securely. Do not forget to install Woodruff key.
(c) Insert horn wire and thread thru hole in cover plate at bottom of steering gear housing. Attach horn button retainer plate with three screws.
(d) Install contact plates, spring and horn button. Horn button should be twisted until it locks in the rubber retainers on retainer plate.
(e) Connect horn wire at bottom of steering gear.

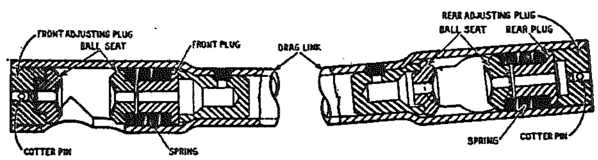

Fig. 4

Drag Link

The drag link assembly is illustrated in Fig. 4. This type of drag link requires very little care other than periodical lubrication and occasional inspection to make sure that it is properly adjusted.

Adjustment is made by removing cotter pin and turning adjusting plug in the desired direction. To adjust for wear, turn adjusting plug in until it is tight then back off one-half turn. Insert a new cotter pin of the correct size and bend ends over securely. Drag link should not be adjusted too tight, otherwise steering will be affected.

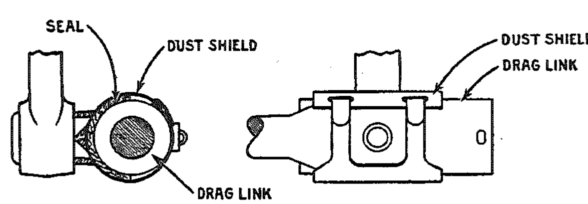

Fig. 5

Dust Shield

A dust shield consisting of a felt seal, held in place by a metal clamp is assembled at each end of the drag link. This shield prevents dust, mud, etc., from working into the drag link ends and causing abnormal wear.

Steering Gear—R-320

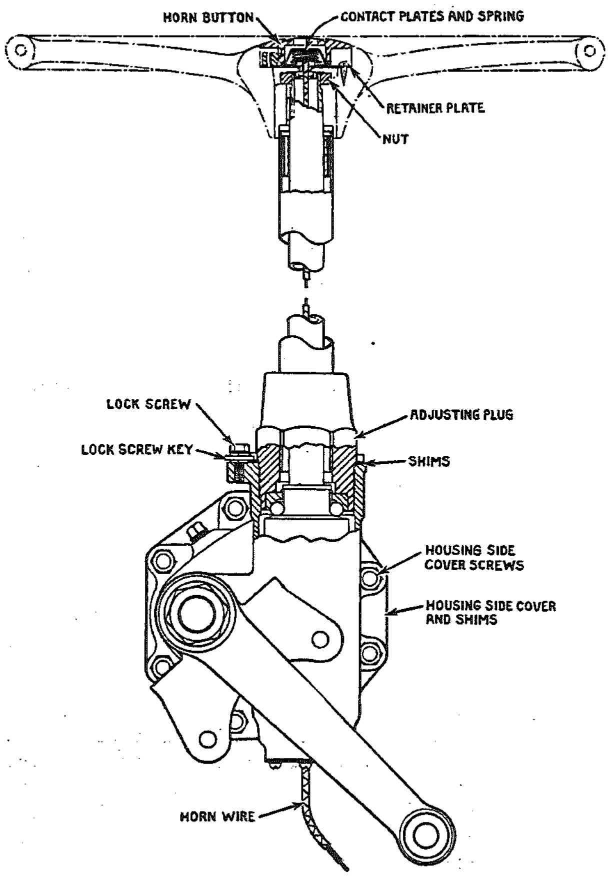

Fig. 1, R-320 Steering Gear

Steering Gear

When making adjustments, free steering gear of all load, preferably by disconnecting drag link from steering arm. Loosen adjusting plug lock screw.

ALWAYS MAKE ADJUSTMENT 1 FIRST

1. Adjust Ball Thrust Bearing to Take Up End Play of Cam.

(a) Before making this adjustment, loosen housing side cover by backing off screws a few turns.

(b) Adjustment should be made so there is a very slight drag but not so much that steering wheel cannot be turned from extreme to extreme by lightly gripping rim with thumb and forefinger.

(c) Back off lock screw to release lock key from adjusting plug to permit removal of shims. (.003″ and .007″ shims are used.)

(d) Clip and remove a .003″ shim, or more as required, and screw adjusting plug down **tight** against shims. (Use a three-foot wrench.)

(e) Test as outlined in paragraph (b) and if necessary remove or replace shims until adjustment is correct.

(f) Set lock key in place and tighten lock screw.

2. Adjust Lever Shaft Stud in Cam Groove for Backlash.

(a) Backlash at this point shows up as end play of lever shaft, also as backlash at steering wheel and at ball on steering arm.

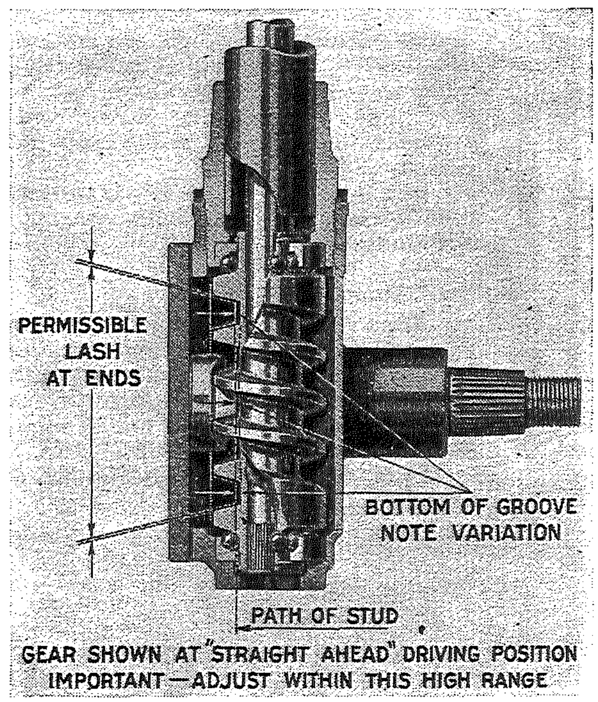

Fig. 2

(b) Note that groove is cut deeper in the ends of cam than in mid-position. This provides closer mesh of the stud through mid-position range of stud travel. This provides closer adjustment in mid-position (straight-ahead driving position) and permits subsequent adjustments, after normal wear, at this position without binding elsewhere.

(c) Adjust to this mid-position. Do not adjust in the end positions. Play in end positions is not objectionable.

(d) Adjust until a very slight drag is felt thru mid-position range when turning steering wheel slowly from extreme to extreme positions.

(e) IMPORTANT—Steering gear must not bind any place. **Only a very slight drag** should be felt. A closer adjustment will not correct any steering condition, but will damage and wear parts and impair operation.

(f) Remove all but two diagonally opposite housing side cover screws.

(g) Remove the two screws and the side cover, gaskets and shims altogether.

(h) Turn steering wheel to either extreme position so that stud is in end position of cam groove when side cover is drawn down tight.

(i) Remove a .003" shim, or more as required and reassemble side cover, shims and gaskets, using the two screws to draw side cover down tight against the housing.

(j) Test adjustment as outlined in paragraph (d) and if necessary remove or replace shims until adjustment is correct.

(k) Assemble remaining side cover screws (with a lockwasher under head of each screw). Then test again per paragraph (d), as tightening all screws may make the adjustment too tight, in which case put back in a .003" shim.

(l) Make sure steering gear ball arm is tight on splined shaft and that lockwasher and nut are tight also.

3. Steering Column Alignment.

(a) After adjustments have been made and adjusting plug lock screw tightened, turn steering wheel to see if any stiffness exists. If so, steering gear has been adjusted too tight or steering column is out of alignment. STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION.

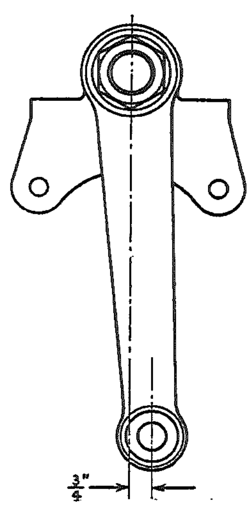

Fig. 3

4. Steering Gear Connection with Front Wheels.

(a) Turn steering wheel as far to right as possible, then rotate wheel in opposite direction as far as possible, noting total number of turns. Turn steering wheel back exactly one-half of this total movement, thus placing stud lever in mid-position. Steering arm ball should then be approximately ¾" back of center line of steering arm shaft and with front wheels in position for straight-ahead driving, it should be possible to connect drag link to steering arm ball without moving steering wheel to any appreciable extent. If this cannot be done, remove steering arm from steering gear and place arm in proper position on splined shaft. Check steering knuckle stops on front axle to make sure that there is proper clearance for tire when turning at maximum angle.

See that steering gear housing is filled with lubricant as recommended in "Lubrication Section."

5. To Remove Steering Wheel.

(a) Disconnect horn wire at bottom of steering gear.

(b) Remove horn button by twisting with palm of hand. Hold steering wheel stationary.

(c) Remove contact plates and spring.

(d) Take out the three screws holding the horn button retainer plate and remove this plate and horn wire.

(e) Remove steering wheel nut and take off steering wheel using a suitable puller.

6. To Install Steering Wheel.

(a) Place steering wheel in correct position on shaft. Wheel should be installed so that spokes are in shape of an (X) when seated in driver's seat and with front wheels straight ahead. This will permit the driver to read instruments thru top of steering wheel.

(b) Install steering wheel nut and tighten securely. Do not forget to install Woodruff key.

(c) Insert horn wire and thread thru hole in cover plate at bottom of steering gear housing. Attach horn button retainer plate with three screws.

(d) Install contact plates, spring and horn button. Horn button should be twisted until it locks in the rubber retainers on retainer plate.

(e) Connect horn wire at bottom of steering gear.

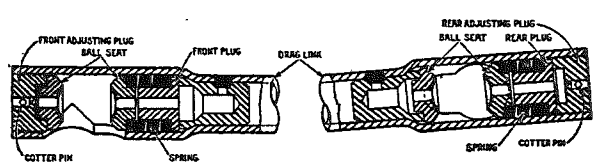

Fig. 4

Drag Link

The drag link assembly is illustrated in Fig 4. This type of drag link requires very little care other than periodical lubrication and occasional inspection to make sure that it is properly adjusted.

Adjustment is made by removing cotter pin and turning adjusting plug in the desired direction. To adjust for wear, turn adjusting plug in until it is tight, then back off one-half turn. Insert a new cotter pin of the correct size and bend ends over securely. Drag link should not be adjusted too tight, otherwise steering will be affected.

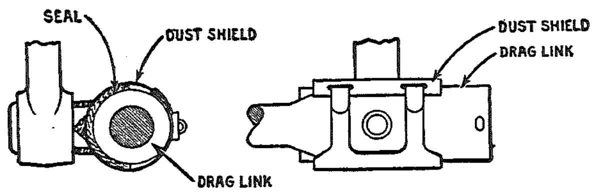

Fig. 5

Dust Shield

A dust shield, consisting of a felt seal, held in place by a metal clamp, is assembled at each end of the drag link. This shield prevents dust, mud, etc., from working into the drag link ends and causing abnormal wear.

Steering Gear—R-720

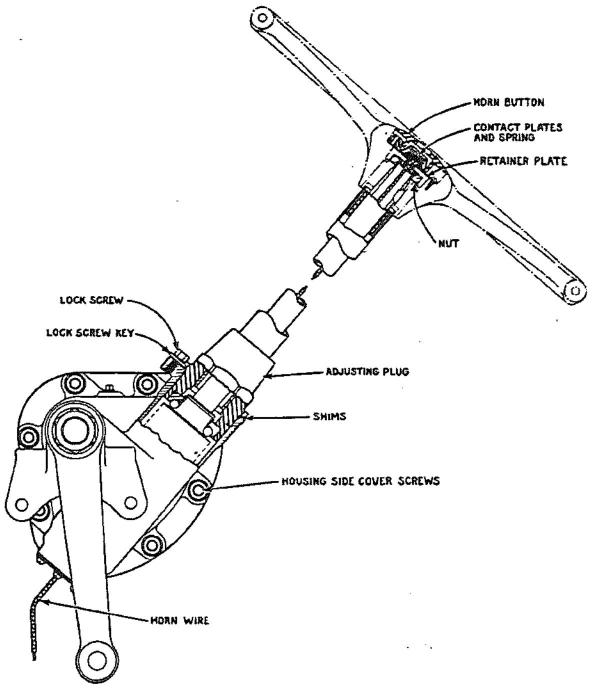

Fig. 1, R-720 Steering Gear

Steering Gear

When making adjustments, free steering gear of all load, preferably by disconnecting drag link from steering arm. Loosen adjusting plug.

ALWAYS MAKE ADJUSTMENT 1 FIRST

1. **Adjust Ball Thrust Bearing to Take Up End Play of Cam.**
   (a) Before making this adjustment loosen housing side plate adjusting screw to free stud in cam groove.
   (b) Adjustment should be made so there is a very slight drag but not so much that steering wheel cannot be turned from extreme to extreme by lightly gripping rim with thumb and forefinger.
   (c) Back off lock screw to release lock key from adjusting plug. Unscrew adjusting plug to permit removal of shims. (.003″ and .007″ shims are used.)
   (d) Clip and remove a .003″ shim, or more as required, and screw adjusting plug down **tight** against shims (use a three-foot wrench).
   (e) Test as outlined in paragraph (b) and if necessary remove or replace shims until adjustment is correct.
   (f) Set lock key in place and tighten lock screw.

2. **Adjust Lever Shaft Stud in Cam Groove for Backlash.**
   (a) Backlash at this point shows up as end play of lever shaft, also as backlash at steering wheel and at ball on steering arm.

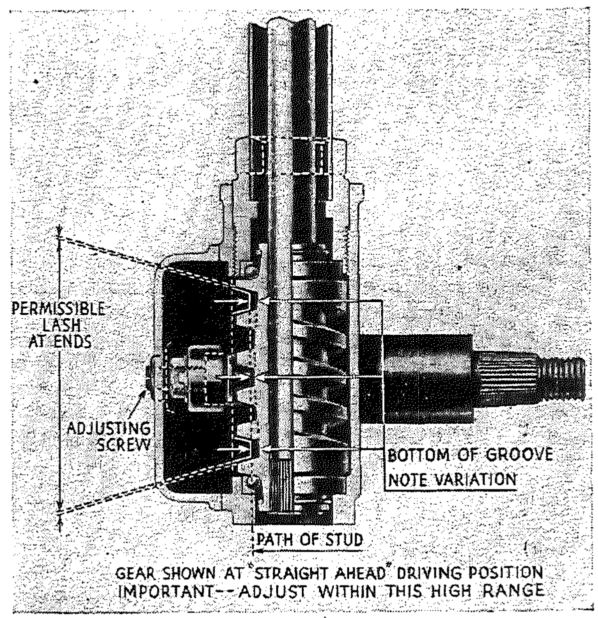

Fig. 2

   (b) Note that groove is purposely cut deeper in ends of cam than in mid-position. This produces a high range thru mid-position and makes groove narrower thru this range. This permits take-up of backlash in mid-position, after normal wear of groove, without causing a bind in ends.
   (c) Adjust to this mid-position high range. Do not adjust in end positions. Play in end positions is not objectionable.
   (d) Tighten side cover adjusting screw until a very slight drag is felt thru mid-position high range when turning steering wheel slowly from extreme to extreme position.
   (e) **IMPORTANT**—Steering gear must not bind any place. **Only a very slight drag** should be felt. A closer adjustment will not correct any steering condition, but will damage and wear parts and impair operation.
   (f) When proper adjustment has been made, tighten lock nut and then give gear a final test.
   (g) Make sure steering gear ball arm is tight on splined shaft and that lockwasher and nut are tight also.

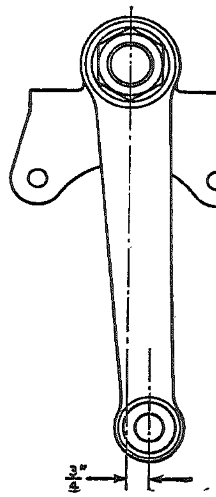

Fig. 3

3. Steering Column Alignment.

(a) After adjustments have been made and adjusting plug lock screw tightened, turn steering wheel to see if any stiffness exists. If so, steering gear has been adjusted too tight or steering column is out of alignment. **STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION.**

4. Steering Gear Connection with Front Wheels.

(a) Turn steering wheel as far to right as possible, then rotate wheel in opposite direction as far as possible, noting total number of turns. Turn steering wheel back exactly one-half of this total movement, thus placing stud lever in mid-position. Steering arm ball should then be approximately ¾" back of center line of steering arm shaft and with front wheels in position for straight-ahead driving, it should be possibleto connect drag link to steering arm ball without moving steering wheel to any appreciable extent. If this cannot be done, remove steering arm from steering gear and place arm in proper position on splined shaft. Check steering knuckle stops on front axle to make sure that there is proper clearance for tire when turning at maximum angle.

See that steering gear housing is filled with lubricant as recommended in "Lubrication Section."

5. To Remove Steering Wheel.

(a) Disconnect horn wire at bottom of steering gear.
(b) Remove horn button by twisting with palm of hand. Hold steering wheel stationary.
(c) Remove contact plates and spring.
(d) Take out the three screws holding the horn button retainer plate and remove this plate and horn wire.
(e) Remove steering wheel nut and take-off steering wheel, using a suitable puller.

6. To Install Steering Wheel.

(a) Place steering wheel in correct position on shaft. Wheel should be installed so that spokes are in shape of a "Y" or "X" (according to style of wheel), when seated in driver's seat and with front wheels straight ahead. This will permit the driver to read instruments thru the top of steering wheel.
(b) Install steering wheel nut and tighten securely. Do not forget to install Woodruff key.
(c) Insert horn wire and thread thru hole in cover plate at bottom of steering gear housing. Attach horn button retainer plate with three screws.
(d) Install contact plates, spring and horn button. Horn button should be twisted until it locks in the rubber retainers on retainer plate.
(e) Connect horn wire at bottom of steering gear.

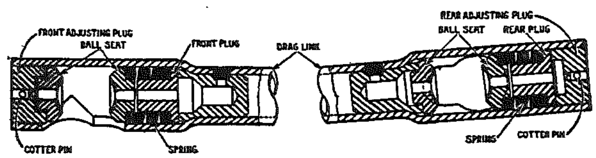

Fig. 4

Drag Link

The drag link assembly is illustrated in Fig. 4. This type of drag link requires very little care other than periodical lubrication and occasional inspection to make sure that it is properly adjusted.

Adjustment is made by removing cotter pin and turning adjusting plug in the desired direction. To adjust for wear, turn adjusting plug in until it is tight then back off one-half turn. Insert a new cotter pin of the correct size and bend ends over securely. Drag link should not be adjusted too tight, otherwise steering will be affected.

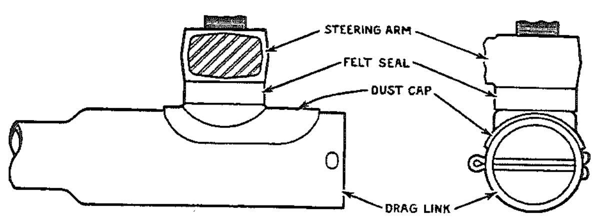

Fig. 5

Dust Shield

A dust shield consisting of a metal cap with sealing washer is assembled to each end of the drag link. This shield prevents dust, mud, etc., from working into the drag link ends and causing abnormal wear.

Steering Gear—RT-260

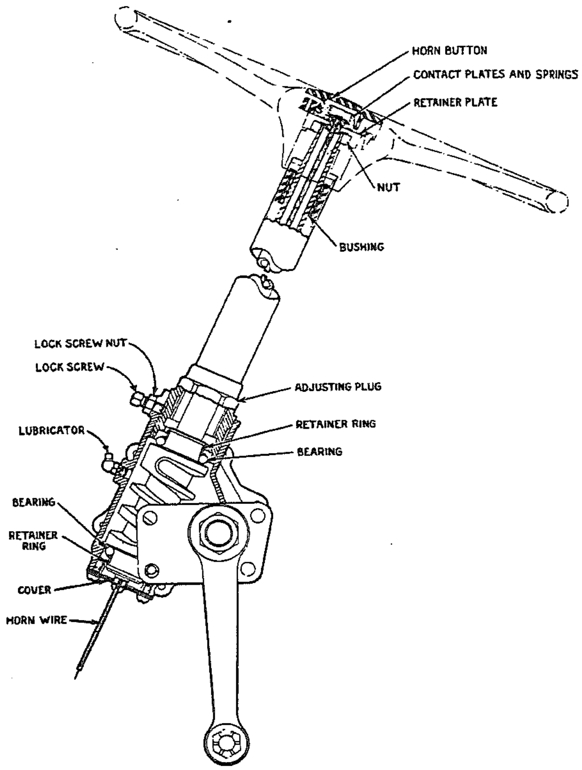

Fig. 1, RT-260 Steering Gear

Steering Gear

When making adjustments, free the steering gear of all load, preferably by disconnecting drag link from steering arm. Loosen instrument panel bracket clamp on steering gear jacket tube.

Always Make Adjustment 1 First

1. **Adjust Ball Thrust Bearings to Take Up End Play of Cam.**
   (a) Before making this adjustment, loosen the housing side cover adjusting screw to free the stud in the cam groove.
   (b) Back off lock screw and turn down adjusting plug to adjust to a barely perceptible drag so that the steering wheel can be turned freely (with the thumb and forefinger lightly gripping the rim). Tighten lock screw and nut.

2. **Adjust Lever Shaft in Cam Groove for Backlash.**
   (a) Backlash at this point shows up as end play of lever shaft, also as backlash at steering wheel and at ball on steering arm.
   (b) Note that the groove is purposely cut deeper in the ends of the cam than in the mid-position. This produces a high range thru mid-position and makes the groove narrower thru this range. This permits take-up of backlash in the mid-position, after normal wear of the groove, without causing a bind in the ends.
   (c) Adjust to this mid-position high range. Do not adjust in the end positions. Play in the end positions is not objectionable.

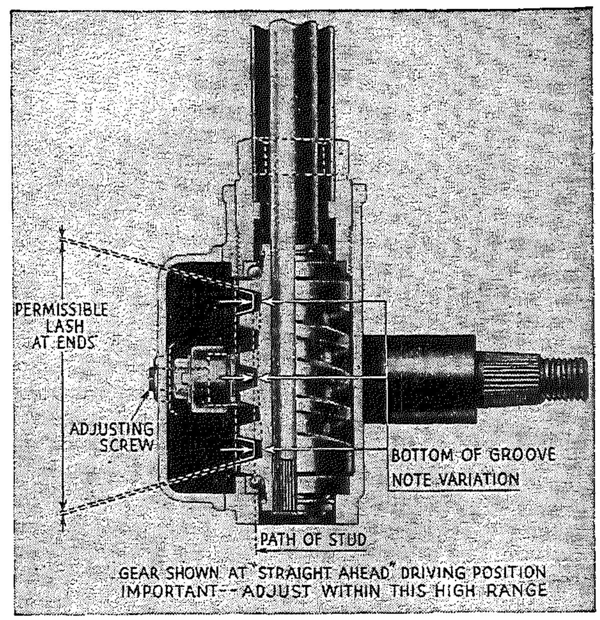

Fig. 2

   (d) Tighten side cover adjusting screw until a very slight drag is felt through the mid-position high range when turning the steering wheel slowly from one extreme to the other.
   (e) **IMPORTANT**—The gear must not bind any place. **Only a very slight drag** should be felt. A closer adjustment will not correct any steering condition, but will damage and wear the parts and impair operation.
   (f) When the proper adjustment has been made, tighten the lock nut and then give the gear a final test.
   (g) Make sure steering gear ball arm is tight on the splined shaft and that the lockwasher and nut are tight also.

3. Steering Column Alignment.

(a) Tighten instrument panel bracket clamp on column. Turn steering wheel to see if any stiffness exists. If so, the gear has been adjusted too tight or the steering column is out of alignment. THE STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION.

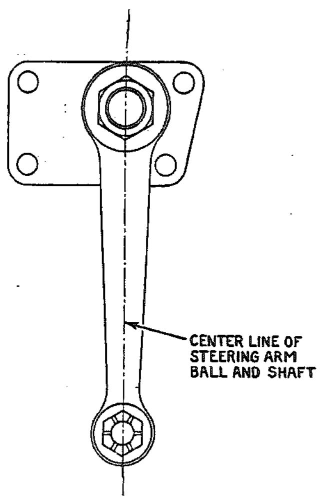

Fig 3, RT-260

4. Steering Gear Connection with Front Wheels.

(a) Turn the steering wheel as far to the right as possible, then rotate the wheel in the opposite direction as far as possible and note the total number of turns. Turn the wheel back just one-half of this total movement, thus placing the gear in the mid-position. Steering arm ball should then be in line with center line of steering arm shaft, and with the front wheels in position for straight-ahead driving, it should then be possible to connect the drag link to the ball on the end of the steering gear arm without moving the gear to any appreciable extent. If this cannot be done, remove the arm from the steering gear and place it on the splined shaft in the proper position. Otherwise it will not permit the front wheels to swing equally to the left and right. Check steering knuckle stop on front axle to make sure that there is proper clearance for the tire when turning at maximum angle.

See that steering gear housing is filled with lubricant as recommended in "Lubrication Section."

5. To Remove Steering Wheel.

(a) Disconnect horn wire at bottom of steering gear.
(b) Remove horn button by twisting with palm of hand. Hold steering wheel stationary.
(c) Remove contact plates and spring.
(d) Take out the three screws holding the horn button retainer plate and remove this plate and horn wire.
(e) Remove steering wheel nut and take off steering wheel, using a suitable puller.

6. To Install Steering Wheel.

(a) Place steering wheel in correct position on shaft. Wheel should be installed so that spokes are in shape of a "Y" when seated in driver's seat and with front wheels straight ahead. This will permit the driver to read instruments thru the top of steering wheel.
(b) Install steering wheel nut and tighten securely. Do not forget to install Woodruff key.
(c) Insert horn wire and thread thru hole in cover plate at bottom of steering gear housing. Attach horn button retainer plate with three screws.
(d) Install contact plates, spring and horn button. Horn button should be twisted until it locks in the rubber retainers on retainer plate.
(e) Connect horn wire at bottom of steering gear.

Drag Link

The drag link assembly is illustrated in Fig. 4. This type of drag link requires very little care other than periodical lubrication and occasional inspection to make sure that it is properly adjusted.

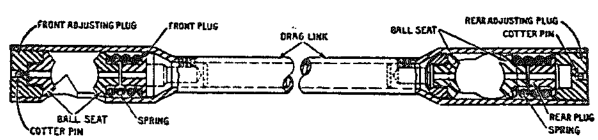

Fig. 4

Adjustment is made by removing cotter pin and turning adjusting plug in the desired direction. To adjust for wear, turn adjusting plug in until it is tight then back off one-half turn. Insert a new cotter pin of the correct size and bend ends over securely. Drag link should not be adjusted too tight, otherwise steering will be affected.

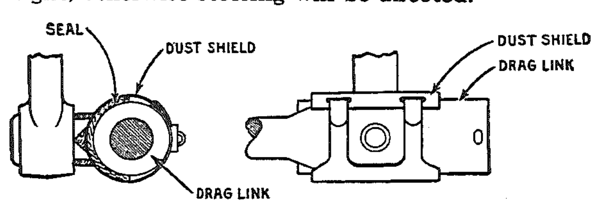

Fig. 5

Dust Shield

On some models a dust shield, consisting of a felt seal, held in place by a metal clamp, is assembled at each end of the drag link. This shield prevents dust, mud, etc., from working into the drag link ends and causing abnormal wear.

Transmission Group

Section A

Models D-2, D-5, D-15 (HDS Transmission)

Page

Disassembling 2
Gear Shift 2
Reassembling 2

Section B

Models { D-30, DS-30, D-30-B, DS-30-B, D-186T, DS-186T (H-41 Transmission) / D-35, DS-35, D-216T (W-42 Transmission) }

Disassembling 2
Gear Shift 2
Reassembling 2

Section C

Models D-35B, D-40, D-50, D-246T, D-246F (F-51 Transmission)

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Reassembling 2

Section D

Models D-60, DR-60, DR-70, DR-346T, D-346F (F-52 Transmission)

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Transmission Group—Continued

Section E

Model DR-426F (F-54 Transmission)

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Reassembling 2-3

Section F

Models D-300, DS-300 (H-4A Transmission)

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Gear Shift 2
Reassembling 2-3

Section G

Models D-246F, D-346F, DR-426F (FPD-45 Auxiliary Transmission and Power Divider)

Disassembling 3
Gear Shift 3
Reassembling 3

Main Transmission Specifications

Chassis	D-2	D-5	D-15	D-30	DS-30	D-30B	DS-30B	D-35	DS-35	D-35B	D-40	D-50	D-60
Transmission	HDS	HDS	HDS	H-41	H-41	H-41	H-41	W-42	W-42	F-51	F-51	F-51	F-52
No. Speeds—Forward	3	3	3	4	4	4	4	4	4	5	5	5	5
Reverse	1	1	1	1	1	1	1	1	1	1	1	1	1
Ratios:													
First	3.053	3.053	3.053	6.40	6.40	6.40	6.40	5.90	5.90	6.100	6.100	6.100	6.52
Second	1.481	1.481	1.481	3.09	3.09	3.09	3.09	3.09	3.09	3.480	3.480	3.480	3.33
Third	1.000	1.000	1.000	1.69	1.69	1.69	1.69	1.69	1.69	1.795	1.795	1.795	1.77
Fourth	....	....	....	1.00	1.00	1.00	1.00	1.00	1.00	1.000	1.000	1.000	1.00
Fifth	....	....	....	....	....	....	....	....	....	.768	.768	.768	.772
Reverse (High)	....	....	....	....	....	....	....	....	....	....	....	....	....
Reverse (Low)	3.707	3.707	3.707	7.82	7.82	7.82	7.82	7.22	7.22	5.96	5.96	5.96	6.50
No. of Bearings:													
Ball	2	2	2	2	2	2	2	2	2	4	4	4	3
Roller	3	3	3	3	3	3	3	3	3	2	2	2	3

Chassis	DR-60	DR-70	D-300	DS-300	D-186T	DS-186T	D-216T	D-246T	*D-246F	DR-346T	*D-346F	*DR-426F	
Transmission	F-52	F-52	H-4-A	H-4-A	H-41	H-41	W-42	F-51	F-51	F-52	F-52	F-54	
No. Speeds—Forward	5	5	4	4	4	4	4	5	5	5	5	5	
Reverse	1	1	1	1	1	1	1	1	1	1	1	2	
Ratios:													
First	6.52	6.52	6.40	6.40	6.40	6.40	5.90	6.100	6.100	6.52	6.52	7.07	
Second	3.33	3.33	3.09	3.09	3.09	3.09	3.09	3.480	3.480	3.33	3.33	3.50	
Third	1.77	1.77	1.69	1.69	1.69	1.69	1.69	1.795	1.795	1.77	1.77	1.72	
Fourth	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000	1.000	1.00	1.00	1.00	
Fifth	.772	.772	....	....	....	....	....	.768	.768	.772	.772	.776	
Reverse (High)	....	....	....	....	....	....	....	....	....	....	....	3.55	
Reverse (Low)	6.50	6.50	7.82	7.82	7.82	7.82	7.22	5.96	5.96	6.50	6.50	7.11	
No. of Bearings:													
Ball	3	3	2	2	2	2	2	4	4	3	3	3	
Roller	3	3	3	3	3	3	3	2	2	3	3	4	

*See Page 2 for Auxiliary Transmission and Power Divider Specifications.

Auxiliary Transmission and Power Divider Specifications

Chassis	D-246F	D-346F	DR-426F
Transmission and Power Divider	FPD-45	FPD-45	FPD-45
No. Speeds	2	2	2
Ratios:			
Low	1.77	1.77	1.77
Direct	1.107	1.107	1.107
No. of Bearings:			
Single Row—Ball	6	6	6
Double Row—Ball	4	4	4

Transmission — HDS

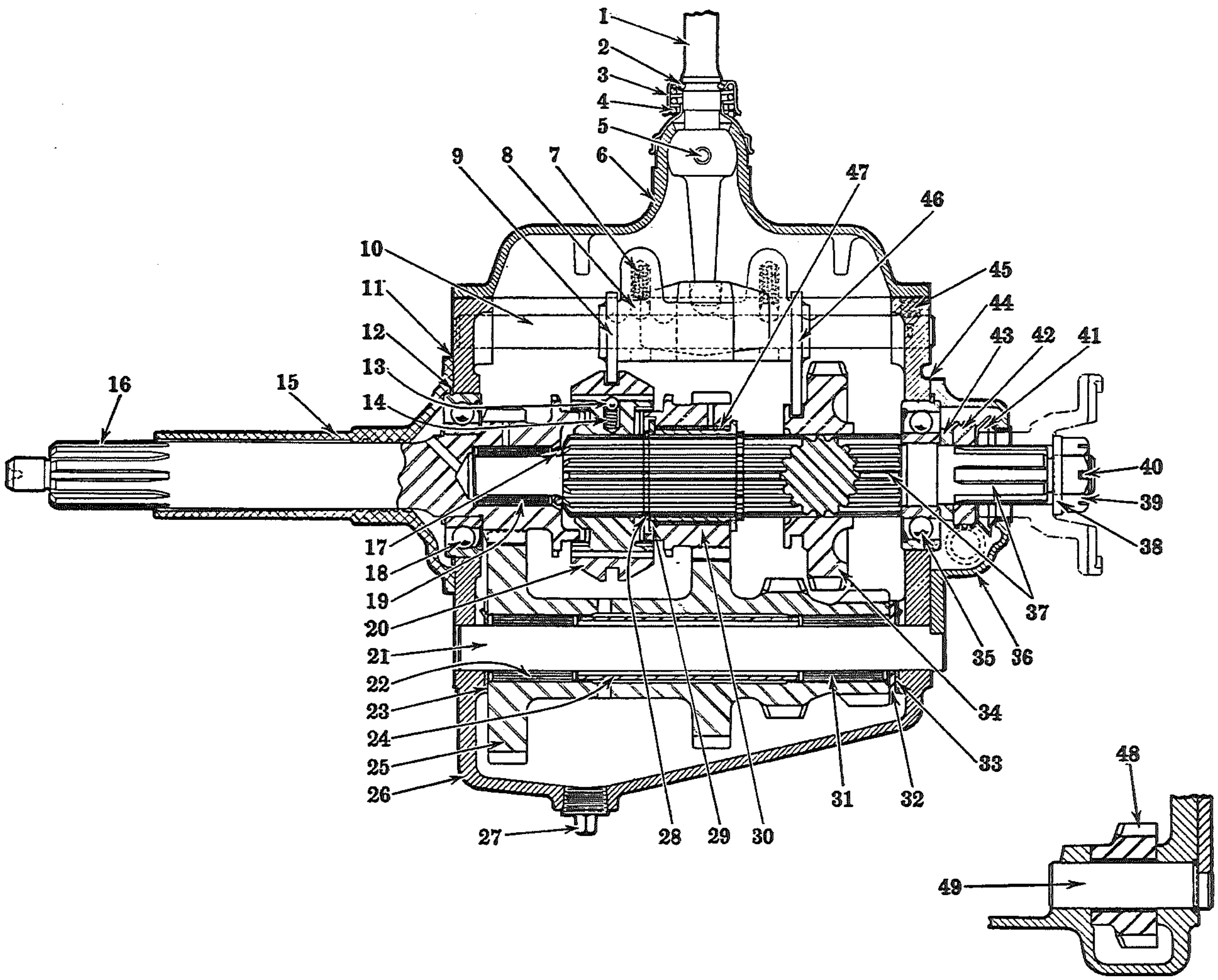

Fig. 1, HDS Transmission

No.	Description
1.	Shift lever.
2.	Shift lever retainer lock ring.
3.	Shift lever housing cap.
4.	Shift lever spring.
5.	Shift lever fulcrum ball pin.
6.	Shift lever cover.
7.	Shifter fork poppet spring.
8.	Shifter fork poppet ball.
9.	High and intermediate shifter fork.
10.	Shifter shaft.
11.	Main drive gear bearing retainer gasket.
12.	Main drive gear bearing lock ring.
13.	Main shaft clutch poppet ball.
14.	Main shaft clutch poppet spring.
15.	Main drive gear bearing retainer.
16.	Main drive gear and clutch shaft.
17.	Main shaft pilot bearing spacer.
18.	Main drive gear ball bearing.
19.	Main shaft pilot roller bearing.
20.	Main clutch shaft sleeve.
21.	Countershaft.
22.	Countershaft roller bearing.
23.	Countershaft gear thrust washer (bronze).
24.	Countershaft bearing spacer.

No.	Description
25.	Countershaft gear cluster.
26.	Transmission case.
27.	Drain plug.
28.	Second speed gear lock ring.
29.	Second speed gear thrust washer.
30.	Second speed gear.
31.	Countershaft roller bearing.
32.	Countershaft gear thrust washer (steel).
33.	Countershaft gear thrust washer (bronze).
34.	Main shaft sliding gear (low and reverse).
35.	Main shaft rear bearing.
36.	Main shaft rear bearing retainer.
37.	Main shaft.
38.	Main shaft washer.
39.	Main shaft nut.
40.	Main shaft cotter pin.
41.	Main shaft rear grease slinger.
42.	Speedometer drive gear.
43.	Speedometer gear spacer.
44.	Rear bearing retainer gasket.
45.	Shifter shaft lock screws.
46.	Low and reverse speed shifter fork.
47.	Main shaft second speed gear bushing.
48.	Reverse idler gear.
49.	Reverse idler gear shaft.

Transmission

Transmission has three speeds forward and one reverse. Fig. 2 illustrates gear shift which is as follows:

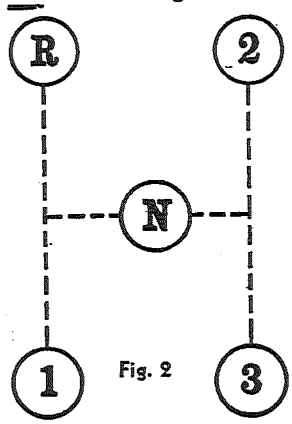

Fig. 2

First Speed

Move control lever to left and pull back to position (1).

Second Speed

Move control lever forward from position (1) and to right thru (N), then forward to position (2).

Third Speed

Pull control lever back to position (3).

Reverse

From position (N) move control lever to left and push forward to (R).

Disassembling and Reassembling

With a few minor exceptions the assembling is simply the reverse of disassembling. Therefore the following disassembling instructions will also serve as reference for assembling.

1. Clean the outside of the transmission particularly around the control and bearing covers.
2. Shift lever to neutral position, remove the holding screws and then remove the control cover.
3. To disassemble the control cover assembly.
   (a) Remove lock ring that retains tension spring and cap on shift lever.
   (b) Remove shift lever ball and lift off caps and tension spring.
   (c) Drive out shift lever fulcrum ball pin and remove shift lever thru bottom of cover.
4. Disassembling shifter forks and shafts.
   (a) Remove slotted head shaft lockscrews located on top flange at rear of case.
   (b) Remove shifter shafts, being careful that shifter fork, poppet balls and springs are not lost. Shifter forks may then be removed.
5. Removing main drive gear assembly.
   (a) First remove companion flange and main shaft bearing retainer, then drive out countershaft thru rear of case. This permits countershaft gear cluster to drop down in case, allowing clearance for removal of main drive gear.
   (b) Remove main drive gear bearing retainer and take out main drive gear.
   CAUTION: Care must be exercised in driving off bearing to prevent damaging it.
6. Removal of main shaft assembly.
   (a) With companion flange and main shaft bearing retainer removed, slip off oil thrower, speedometer drive gear and spacing washer from main shaft assembly.
   (b) Remove main shaft bearing. **CAUTION:** Care must be exercised in driving off bearing to prevent damaging it.
   (c) Main shaft assembly can then be lifted out thru top of case. **NOTE:** Main drive gear assembly must be removed first as outlined in paragraph 5.
7. Removal of countershaft gear cluster.
   (a) As countershaft has already been removed for disassembly of main drive gear, the countershaft gear cluster is merely lifted out thru top of case. Be sure to pick up the bronze washer at front end as well as the bronze washer and steel thrust washer at rear end of gear cluster.
8. Removal of reverse idler gear and shaft.
   (a) The shaft is driven out to the **rear** of case and then gear may be removed.

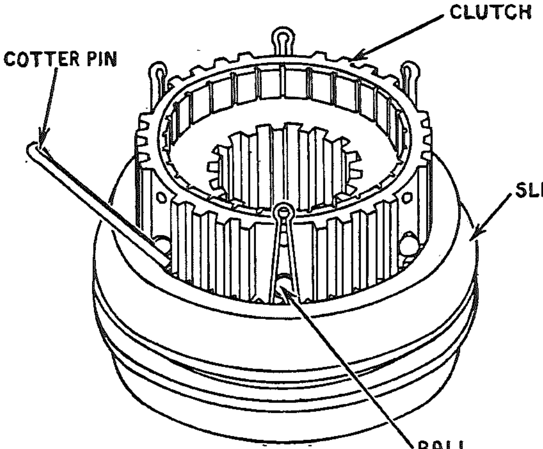

Fig. 3

9. Disassembly of main shaft clutch assembly.
   (a) Main shaft clutch and sleeve are held together by poppet springs and balls. Main shaft clutch can be removed from sleeve by supporting outer diameter of sleeve and pressing on clutch. Use care when disassembling as poppet balls are under spring tension and may fly out when sleeve is removed. It is suggested that a cloth be wrapped around the assembly to guard against this.
   A special tool, S.E. 920, is available which, if used, will facilitate disassembly and reassembly. If you do not have this tool on hand, follow instructions outlined in paragraph (b).
   (b) To reassemble, insert clutch partially in sleeve and install springs and balls. Then insert cotter pins (1/8 x 2″) having the ends spread slightly as shown in Fig. 3. The cotter pins when pressed between the splines force the balls into the clutch and after clutch is pressed into sleeve cotter pins can be removed.

Transmissions—H-41, W-42

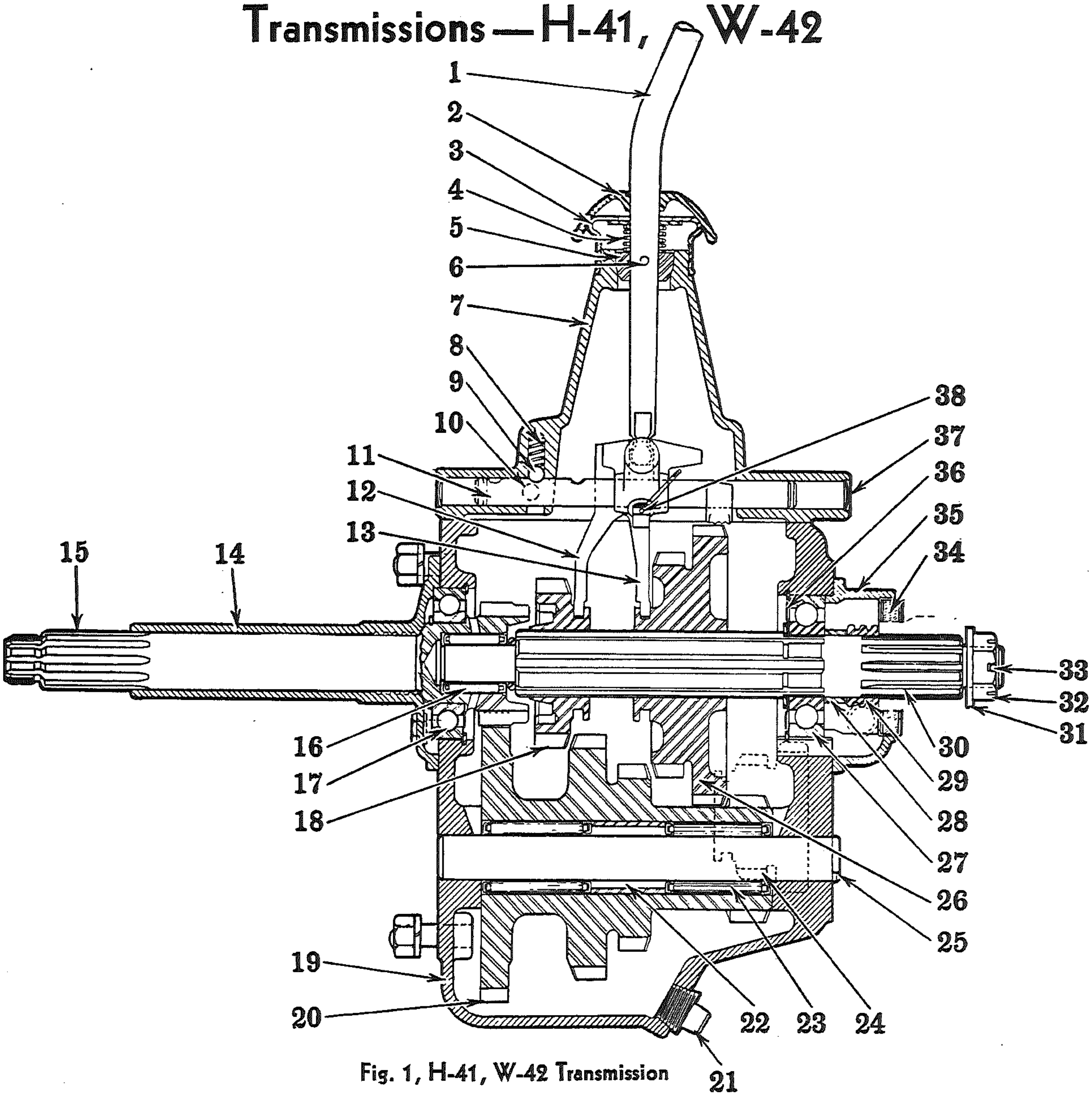

Fig. 1, H-41, W-42 Transmission

No.	Description
1.	Shift lever.
2.	Dust cover.
3.	Retainer.
4.	Spring.
5.	Fulcrum ball.
6.	Pin.
7.	Control cover.
8.	Poppet spring.
9.	Poppet ball.
10.	Interlock pin.
11.	Shifter shaft.
12.	Shift fork (3rd and direct).
13.	Shift fork (1st and 2nd).
14.	Main drive gear bearing retainer.
15.	Main drive gear.
16.	Main shaft pilot bearing.
17.	Main drive gear bearing.
18.	Main shaft gear (3rd and direct).
19.	Transmission case.

No.	Description
20.	Countershaft gear cluster.
21.	Drain plug.
22.	Bearing spacer.
23.	Countershaft bearing.
24.	Reverse idle gear.
25.	Countershaft.
26.	Main shaft gear (low and second).
27.	Main shaft rear bearing.
28.	Spacer.
29.	Speedometer drive gear.
30.	Main shaft.
31.	Washer.
32.	Nut.
33.	Cotter pin.
34.	Grease seal.
35.	Rear bearing retainer.
36.	Grease slinger.
37.	Expansion plug.
38.	Shifter fork lock screw.

Transmission

Transmission has four speeds forward and one reverse. Fig. 2 illustrates gear shift, which is as follows:

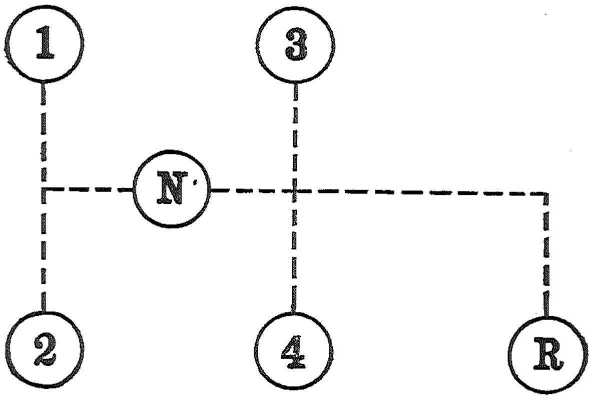

Fig. 2

First Speed

Move control lever to left and push forward to position (1).

Second Speed

Pull control lever straight back from position (1) to position (2).

Third Speed

Move control lever forward from position (2) and right thru (N), then forward to position (3).

Fourth Speed

Pull control lever straight back from position (3) to position (4).

Reverse

From position (N) push control lever, hard, to right and pull back to position (R).

Disassembling and Reassembling

With a few minor exceptions, the assembling is simply the reverse of disassembling. Therefore the following disassembling instructions will also serve as reference for assembling.

1. Clean the outside of the transmission, particularly around the control and bearing covers.
2. Shift lever to neutral position, remove the holding screws and then remove the control cover.
3. To disassemble the control cover assembly:
   (a) Remove locking wires and yoke screws.
   (b) Start with one of the outside bars and drive bars from control cover. **NOTE:** This must be done from neutral position.
   (c) Remove gear shift lever by unscrewing cap at top of transmission cover. This cap retains the spring and ball assembly that is attached to lower end of lever.
   (d) Remove control lever fulcrum ball pin, using a punch to drive pin out. The entire shift lever assembly can then be lifted out of the cover.
4. Remove mainshaft assembly:
   (a) Remove rear bearing covers.
   (b) Lock the gears and remove companion flange nut.
   (c) Slide main shaft assembly to rear while holding the two sliding gears in position.
   (d) The main shaft can then be removed thru the rear opening in the case and the two sliding gears can be removed thru top opening in case.
5. To disassemble the mainshaft:
   (a) Remove nut and companion flange, then remove rear cover, speedometer drive gear, spacer and bearing.
6. Remove front bearing cover and withdraw clutch shaft and drive gear thru front opening in case, tapping face of gear lightly with babbitt or rawhide hammer.
7. Removing the countershaft assembly:
   (a) Remove countershaft and reverse idler shaft lockscrew and plate. Insert screw driver in lockplate groove and pry out countershaft.
   (b) Lift out countershaft assembly, with bearings and spacer, thru top opening of case.
8. Removing the reverse idler gear and shaft assembly:
   (a) Insert screw driver in lockplate groove and pry out shaft. Reverse idler gear can then be lifted out thru top of case.
9. When reassembling the top cover assembly, make sure that shifter forks are not sprung and engage properly with sliding gears.

Transmission — F-51

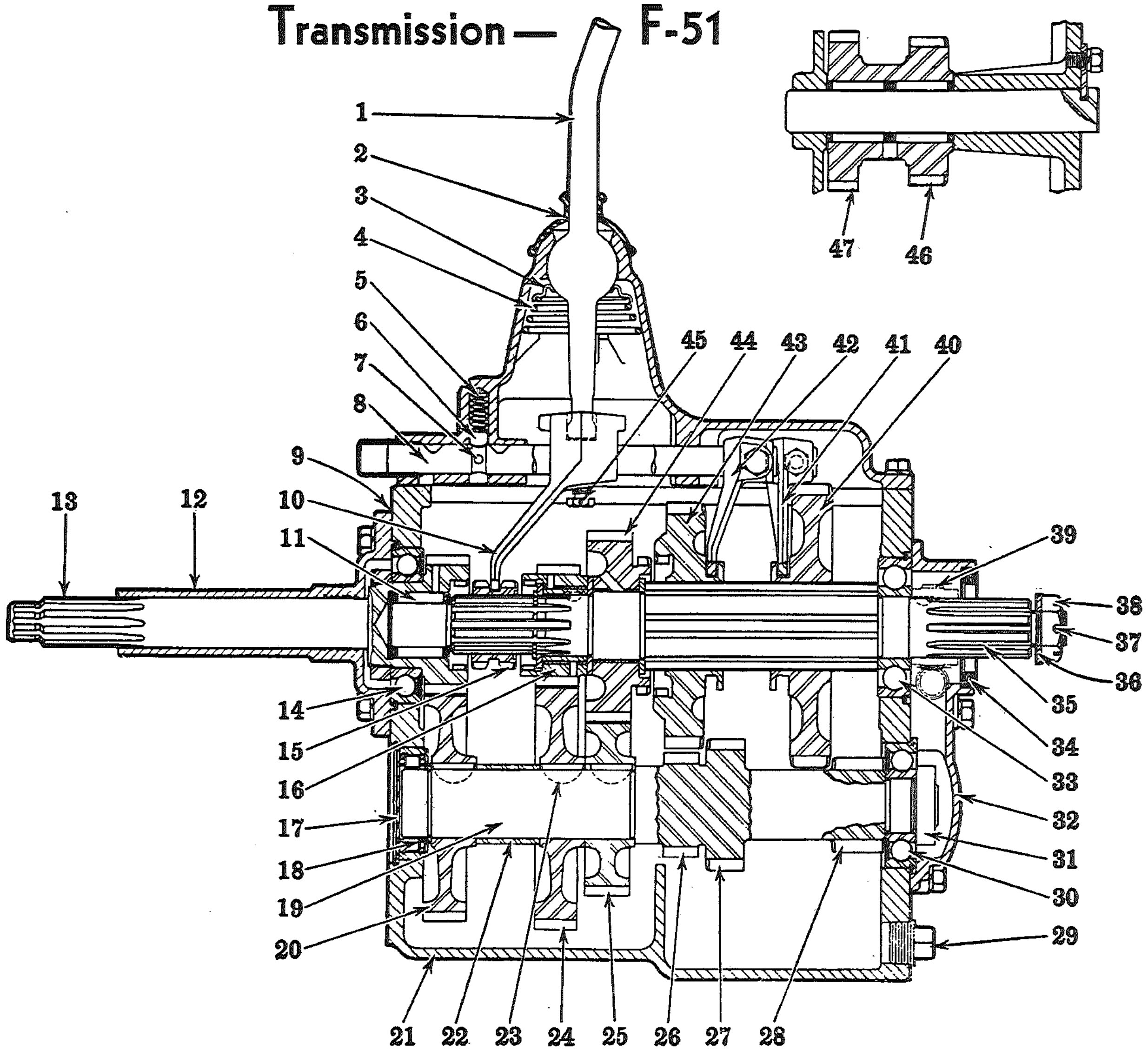

Fig. 1, F-51 Transmission

No.	Description
1.	Shift lever.
2.	Dust cover.
3.	Retainer.
4.	Spring.
5.	Poppet spring.
6.	Poppet ball.
7.	Interlock pin.
8.	Shifter shaft.
9.	Retainer gasket.
10.	Shifter fork (direct and overdrive).
11.	Main shaft pilot bearing.
12.	Main drive gear bearing retainer.
13.	Main drive gear.
14.	Main drive gear bearing.
15.	Main shaft sliding clutch.
16.	Main shaft overdrive gear.
17.	Countershaft bearing retainer.
18.	Countershaft front bearing.
19.	Countershaft.
20.	Countershaft drive gear.
21.	Transmission case.
22.	Spacer.
23.	Key.

No.	Description
24.	Countershaft overdrive gear.
25.	Countershaft 3rd speed drive gear.
26.	Countershaft reverse drive gear.
27.	Countershaft 2nd speed drive gear.
28.	Countershaft low speed drive gear.
29.	Drain plug.
30.	Countershaft rear bearing.
31.	Countershaft rear bearing lock nut.
32.	Countershaft rear bearing retainer.
33.	Main shaft rear bearing.
34.	Main shaft rear grease seal.
35.	Main shaft.
36.	Washer.
37.	Cotter pin.
38.	Nut.
39.	Speedometer drive gear.
40.	Main shaft low and reverse sliding gear.
41.	Shifter fork (low and reverse).
42.	Shifter fork (2nd and 3rd speed).
43.	Main shaft 2nd and 3rd speed sliding gear.
44.	3rd speed constant mesh gear.
45.	Shifter fork lock screw.
46.	Reverse drive gear.
47.	Constant mesh reverse idle gear.

Transmission

Transmission has five speeds forward and one reverse. Fig. 2 illustrates gear shift which is as follows:

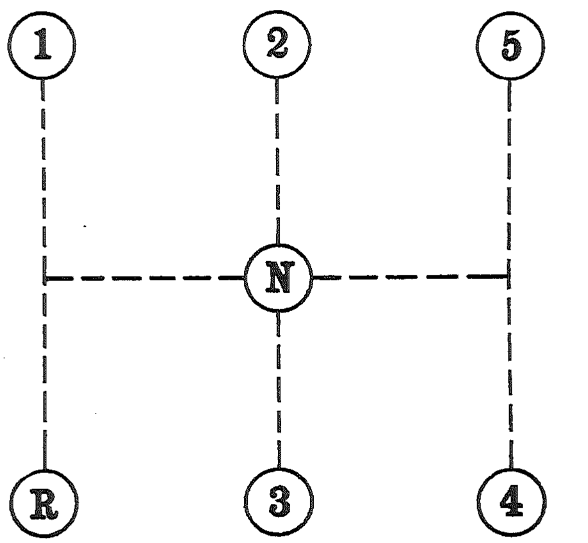

Fig. 2

First Speed

Move control lever hard to left and push forward to position (1).

Second Speed

Pull control lever back from position (1) and to right to position (N), then straight ahead to position (2).

Third Speed

Pull control lever straight back from position (2) thru (N) to position (3).

Fourth or Direct Speed

Push control lever ahead to (N), then to right and pull back to position (4).

Fifth Speed or Overdrive

Push control lever straight ahead to position (5).

Reverse

From position (N) move control lever, hard, to left and pull straight back to position (R).

Disassembling and Reassembling

With a few minor exceptions, the assembling is simply the reverse of disassembling. Therefore the following disassembling instructions will also serve as reference for assembling.

1. Clean the outside of the transmission, particularly around the control and bearing covers.
2. Shift lever to neutral position, remove the holding screws and then remove the control cover.
3. To disassemble the control cover assembly:
   (a) Remove locking wires and yoke screws.
   (b) Start with one of the outside bars and drive bars from control cover. **NOTE:** This must be done from neutral position.
   (c) Remove gear shift lever tension spring and washer from the inside of the cover.
   (d) Remove the shift lever hand grip and rubber dust bell.
   (e) Remove shift lever by drawing it through the bottom of the cover. **CAUTION:** In reassembling the control cover, care should be taken that all parts are replaced in their proper positions.
4. Remove mainshaft assembly:
   (a) Remove rear bearing covers.
   (b) Lock the gears and remove countershaft rear bearing lock nut.
   (c) Slide mainshaft assembly to the rear.
   (d) Remove mainshaft rear bearing.
   (e) Remove mainshaft assembly through the top of the case by raising the front end of the assembly and drawing the shaft through the two spur type low speed gears.
   (f) Remove spur gears from the case.
5. To disassemble the main shaft:
   (a) Remove the snap ring with snap ring pliers, or a similar tool, and remove helical gears, washers and sleeves. **NOTE:** The overdrive gear sleeve and key must be removed first to release the third speed mainshaft gear and washers. In reassembling the main shaft, use new snap ring and be sure the gears are neither too loose nor too tight on the shaft.
6. Remove front bearing cover and withdraw clutch shaft and drive gear.
7. Withdraw the reverse idler pin and lift reverse idler and bearings from the case.
8. Pull countershaft assembly to the rear and remove countershaft rear bearing.
9. Lift countershaft assembly out through the top of the case.
10. Remove gear retaining snap ring from the front of the countershaft and press gears from shaft.

Transmission — F-52

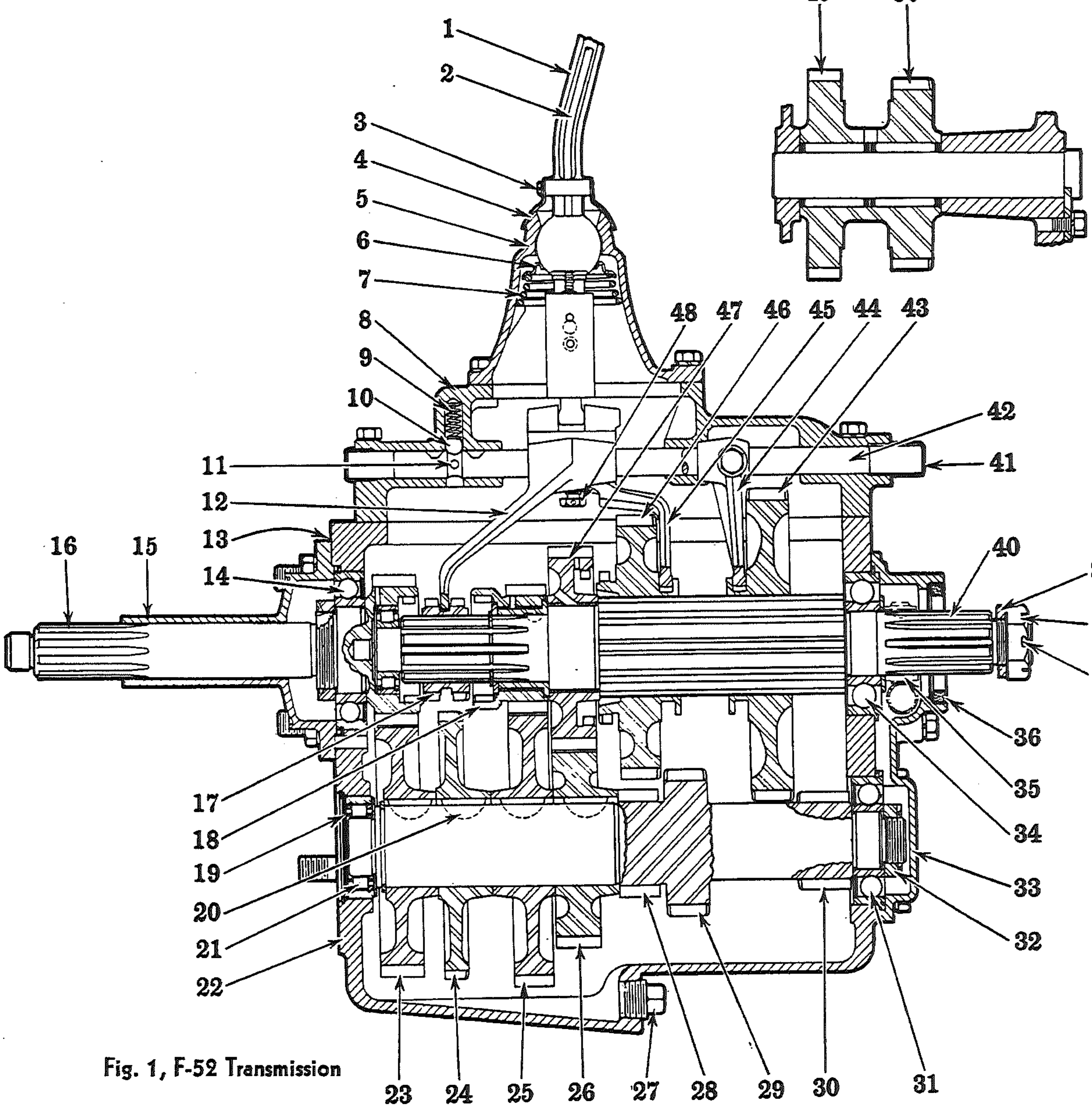

Fig. 1, F-52 Transmission

No.	Description
1.	Shift lever.
2.	Reverse latch rod.
3.	Dust cover screw.
4.	Dust cover.
5.	Shift lever cover.
6.	Spring retainer.
7.	Spring.
8.	Control cover.
9.	Poppet spring.
10.	Poppet ball.
11.	Interlock pin.
12.	Shifter fork (direct and overdrive).
13.	Retainer gasket.
14.	Main drive gear bearing.
15.	Main drive gear bearing retainer.
16.	Main drive gear.
17.	Main shaft sliding clutch.
18.	Main shaft overdrive gear.
19.	Countershaft bearing retainer.
20.	Countershaft gear key.
21.	Countershaft front bearing.
22.	Transmission case.
23.	Countershaft drive gear.
24.	Power take-off drive gear (right side).
25.	Countershaft overdrive gear.
26.	Countershaft 3rd speed drive gear.
27.	Drain plug.
28.	Reverse drive gear.
29.	Countershaft 2nd speed drive gear.
30.	Countershaft low speed drive gear.
31.	Countershaft rear bearing.
32.	Countershaft rear bearing lock nut.
33.	Rear bearing retainer.
34.	Main shaft rear bearing.
35.	Speedometer drive gear.
36.	Main shaft rear grease seal.
37.	Cotter pin.
38.	Nut.
39.	Washer.
40.	Main shaft.
41.	Shifter shaft rear cover.
42.	Shifter shafts.
43.	Main shaft low and reverse sliding gear.
44.	Shifter fork (low and reverse).
45.	Shifter fork (2nd and 3rd speed).
46.	Main shaft 2nd and 3rd speed sliding gear.
47.	Main shaft 3rd speed constant mesh gear.
48.	Shifter shaft lock screw.
49.	Constant mesh reverse idle gear.
50.	Reverse drive gear.

Transmission

Transmission has five speeds forward and one reverse. Fig. 2 illustrates gear shift which is as follows:

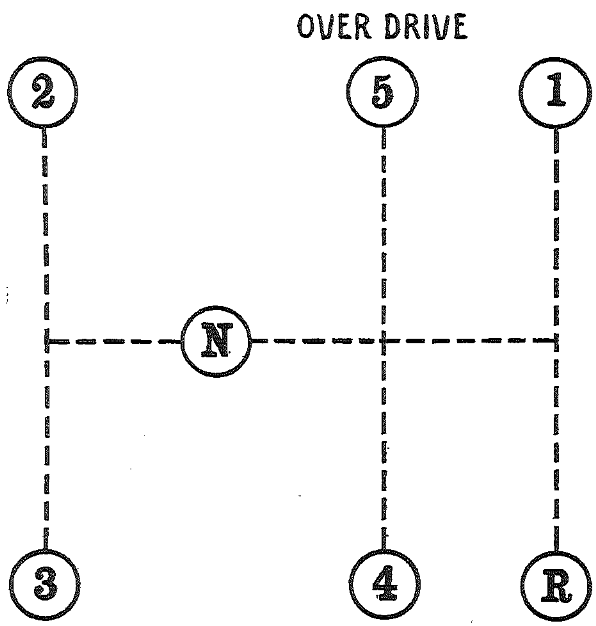

Fig. 2

First Speed

Press down on control lever latch and move control lever to right, then forward to position (1).

Second Speed

Pull control lever back and to left thru (N), then forward to position (2).

Third Speed

Move control lever straight back from position (2) into position (3).

Fourth or Direct Speed

Push control lever ahead and to right thru position (N), then pull back to position (4).

Fifth Speed or Overdrive

Push control lever straight ahead from position (4) into position (5).

Reverse

Press down on control lever latch and move control lever to right, then pull back to position (R).

Disassembling and Reassembling

With a few minor exceptions, the assembling is simply the reverse of disassembling. Therefore the following disassembling instructions will also serve as reference for assembling.

1. Clean the outside of the transmission, particularly around the control and bearing covers.
2. Move shift lever to neutral position, then remove the holding screws and then remove the control assembly. **CAUTION:** Do not try to force the cover off, as you may spring the shifting yokes and cause gear interference.
3. Disassemble the control cover assembly.
   (a) Remove the shift lever cover assembly.
   (b) Remove the locking wires and loosen the cap screws which hold the shifting yokes to the bars.
   (c) Remove the shifter shaft rear cover from one end.
   (d) Start with one of the outside bars and drive the bars out. **CAUTION:** In reassembling the control cover, care must be taken to see that all parts are replaced in their correct positions.
4. Disassemble the shift lever cover assembly.
   (a) Remove the shift lever hand grip.
   (b) Remove the spoon latch which operates the latch rod.
   (c) Remove the dust bell.
   (d) Remove the tension spring and washer from the inside of the cover.
   (e) Remove the shift lever by withdrawing it through the bottom of the cover.
   (f) Remove the latch control parts from shift lever. **CAUTION:** In reassembling the shift lever, care must be taken to see that the clip for the reverse sleeve and the reverse sleeve pin are replaced in their proper positions.
5. Remove the mainshaft assembly.
   (a) Remove both mainshaft and countershaft rear bearing covers.
   (b) Lock the gears and then remove the countershaft rear bearing lock nut.
   (c) Slide mainshaft to the rear.
   (d) Remove the mainshaft rear bearing.
   (e) Remove the mainshaft assembly through the top of the transmission by raising the front end of the shaft first and sliding the shaft out of the two spur type low speed gears.
   (f) Remove the two low speed spur gears from the case. **CAUTION:** In reassembling the mainshaft, care should be taken to see that all parts are replaced in their correct positions and drawn up together properly.
6. To disassemble the mainshaft, remove the snap ring with snap ring pliers, or a similar tool and slide the gears and other parts off. **CAUTION:** Always replace the snap ring when reassembling the gears on the mainshaft. Also, be sure the gears are neither tight nor loose after they are assembled.
7. Remove the clutch shaft and drive gear.
   (a) Remove the front bearing cover and then withdraw the clutch shaft and drive gear.
8. Remove the countershaft assembly.
   (a) Remove the reverse idler gear assembly.
   (b) Remove the countershaft rear bearing and lift the countershaft assembly out of the case.

Transmission — F-54

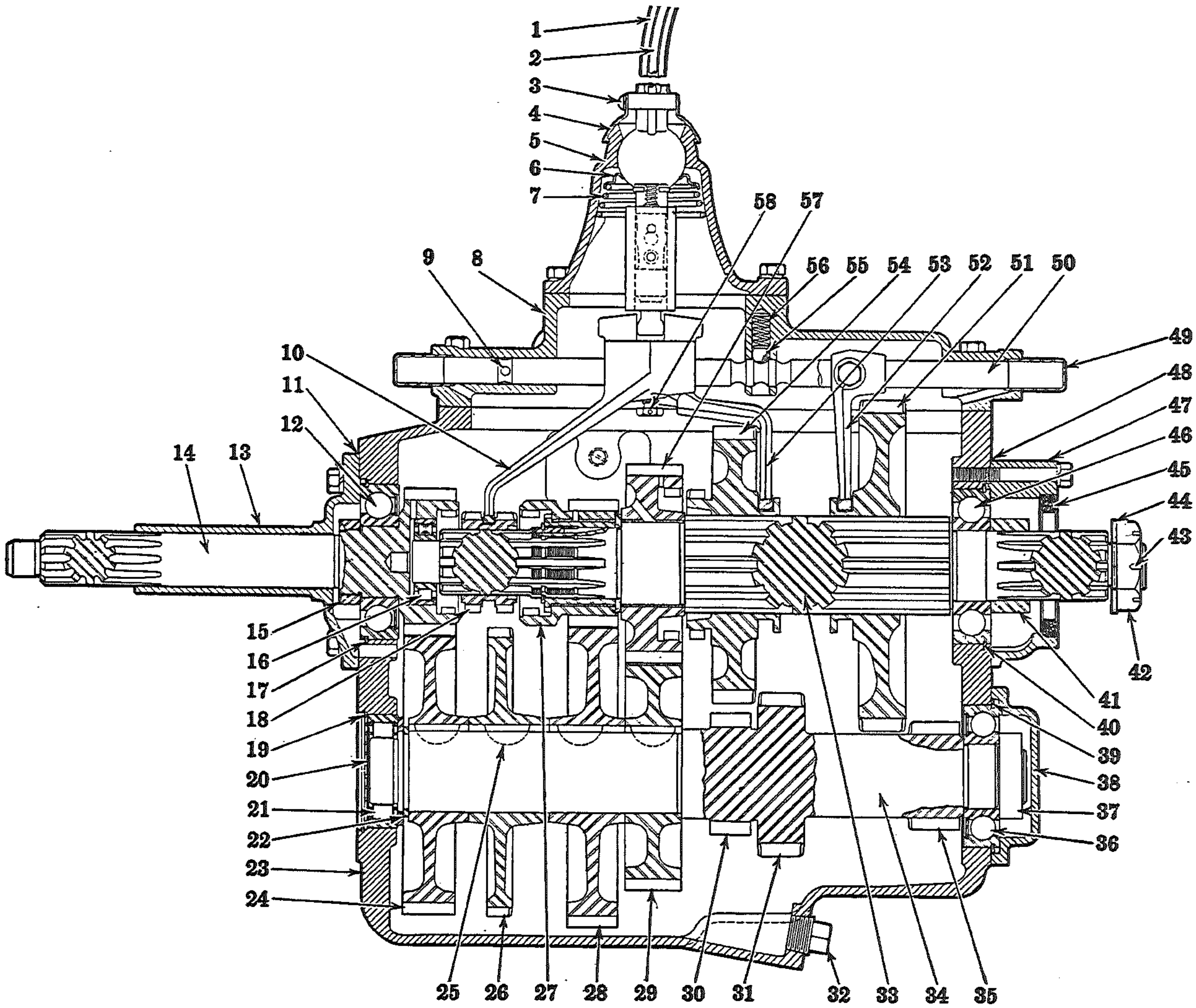

Fig. 1, F-54 Transmission

No.	Description
1.	Shift lever.
2.	Low and reverse latch rod.
3.	Dust cover screw.
4.	Dust cover.
5.	Shift lever cover.
6.	Spring retainer.
7.	Spring.
8.	Control cover.
9.	Interlock pin.
10.	Shifter fork (direct and overdrive).
11.	Retainer gasket.
12.	Main drive gear bearing.
13.	Main drive gear bearing retainer.
14.	Main drive gear.
15.	Main drive gear bearing retaining nut.
16.	Main shaft front bearing.
17.	Snap ring.
18.	Main shaft sliding clutch.
19.	Snap ring.
20.	Expansion plug.
21.	Countershaft front bearing.
22.	Spacer.
23.	Transmission case.
24.	Countershaft drive gear.
25.	Key.
26.	Power take-off drive gear.
27.	Main shaft overdrive gear.
28.	Countershaft overdrive gear.
29.	Countershaft 3rd speed drive gear.
30.	Reverse drive gear.
31.	Countershaft 2nd speed drive gear.
32.	Drain plug.
33.	Main shaft.
34.	Countershaft.
35.	Countershaft low speed drive gear.
36.	Countershaft rear bearing.
37.	Countershaft rear bearing lock nut.
38.	Countershaft rear bearing retainer.
39.	Snap ring.
40.	Snap ring.
41.	Speedometer drive gear.
42.	Nut.
43.	Cotter pin.
44.	Washer.
45.	Main shaft rear grease seal.
46.	Main shaft rear bearing.
47.	Rear bearing cover and speedometer housing.
48.	Gasket.
49.	Shifter shaft rear cover.
50.	Shifter shafts.
51.	Main shaft low and reverse sliding gear.
52.	Shifter fork (low and reverse).
53.	Shifter fork (2nd and 3rd speed).
54.	Main shaft 2nd and 3rd speed sliding gear.
55.	Poppet ball.
56.	Poppet spring.
57.	Main shaft 3rd speed constant mesh gear.
58.	Shifter shaft lock screw.

Transmission

Transmission has five speeds forward and two reverse. Fig. 2 illustrates gear shift which is as follows:

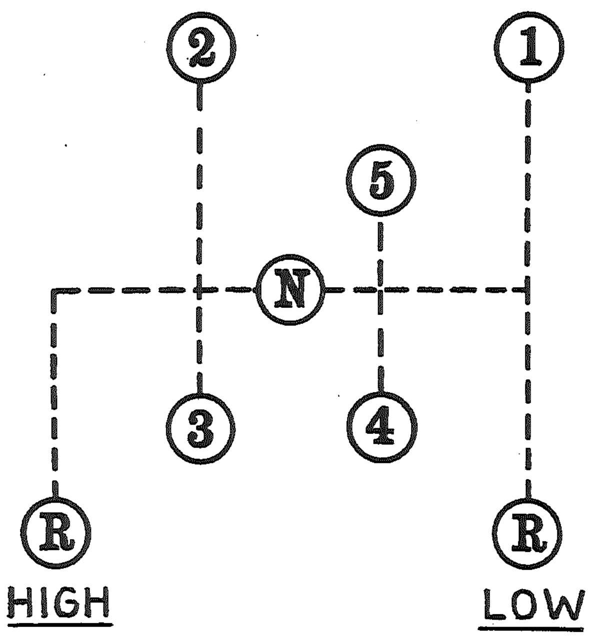

Fig. 2

First Speed

Press down on control lever latch and move control lever to right, then forward to position (1).

Second Speed

Pull control lever back and to left thru (N), then forward to position (2).

Third Speed

Move control lever straight back from position (2) into position (3).

Fourth or Direct Speed

Push control lever ahead and to right thru position (N), then pull back to position (4).

Fifth Speed or Overdrive

Push control lever straight ahead from position (4) into position (5).

Reverse (Low)

Press down on control lever latch and move control lever to right, then pull back to position (R-LOW).

Reverse (High)

Press down on control lever latch and move control lever to left, then pull back to position (R-HIGH).

Disassembling and Reassembling

With a few minor exceptions, the assembling is simply the reverse of disassembling. Therefore, the following disassembling instructions will also serve as reference for assembling.

1. Clean the outside of the transmission, particularly around the control and bearing covers.
2. Remove gear shift lever housing assembly.
   (a) Remove gear shift lever tension spring from inside of housing.
   (b) Remove spoon latch at the top of the gear shift lever by withdrawing the two rivets.
   (c) Remove gear shift lever thru opening at bottom of housing.
3. To dismantle gear shift lever assembly:
   (a) Remove latch rod end.
   (b) Remove the clip just above the reverse sleeve.
   (c) Push the reverse sleeve forward until the large hole in the side of the sleeve coincides with the end of the pin which has been inserted into the gear shift lever thru this large hole. Insert a small punch in the small hole in the sleeve and remove pin.
   (d) Pull both sleeve and latch rod from the lever.
4. Remove brake hand lever assembly.
5. Shift into neutral position and remove shifting bar housing assembly.
   (a) Shift into neutral position.
   (b) Remove shifting yoke locking screws.
   (c) Place a short bar in the yoke screw holes in the shifting bars and drive bars from housing, **starting with an outside bar.**
   (d) The thimbles will be removed from the housing by the bars as they are driven out.

   NOTE: All parts of this assembly should be laid on a clean bench in the order removed to facilitate assembly. **Care should be taken that none of the small interlocking parts are lost or omitted.**
6. Remove countershaft rear bearing cover.
7. Lock transmission by shifting into two speeds at the same time and remove countershaft rear bearing retaining nut.
8. Remove clutch shaft and drive gear bearing cover.
9. Withdraw clutch shaft and drive gear and all parts assembled to it.
   (a) Remove bearing retaining nut.
   (b) Press bearing from gear.
10. Remove mainshaft rear bearing cover and speedometer housing.
11. Remove mainshaft rear bearing.
12. Tilt the mainshaft assembly and remove it thru top of case, leaving sliding gears in case.
   (a) Remove mainshaft sleeve key retaining snap ring.
   (b) Remove mainshaft sleeve key.
   (c) Turn mainshaft overdrive gear until spaces between the internal teeth coincide with

notches in the flange on top of the main shaft sleeve. Insert two small rods so that they are in these spaces on both gear and flange. Thus locked, the gear and sleeve may be unscrewed from the shaft.

(d) Remove the remaining gear and washer.

13. Lift sliding gears from the case.
14. Remove the low reverse idler shaft lock and reverse idler shaft.
15. Lift low reverse idler gear and bearings from the case.
16. Drop the countershaft assembly and remove the rear bearing.
17. Remove countershaft assembly:
    (a) Remove gear retaining snap ring.
    (b) Press gears from shaft.
18. Remove expansion plug snap ring from countershaft front bearing bore.
19. Working from the interior of the case, force expansion plug from case and remove countershaft front bearing.

CAUTION: In reassembling, new snap rings should be used throughout the unit. This also applies to the expansion plug in the front countershaft bearing bore provided it has been necessary to remove the part from the case.

Transmission—H-4-A

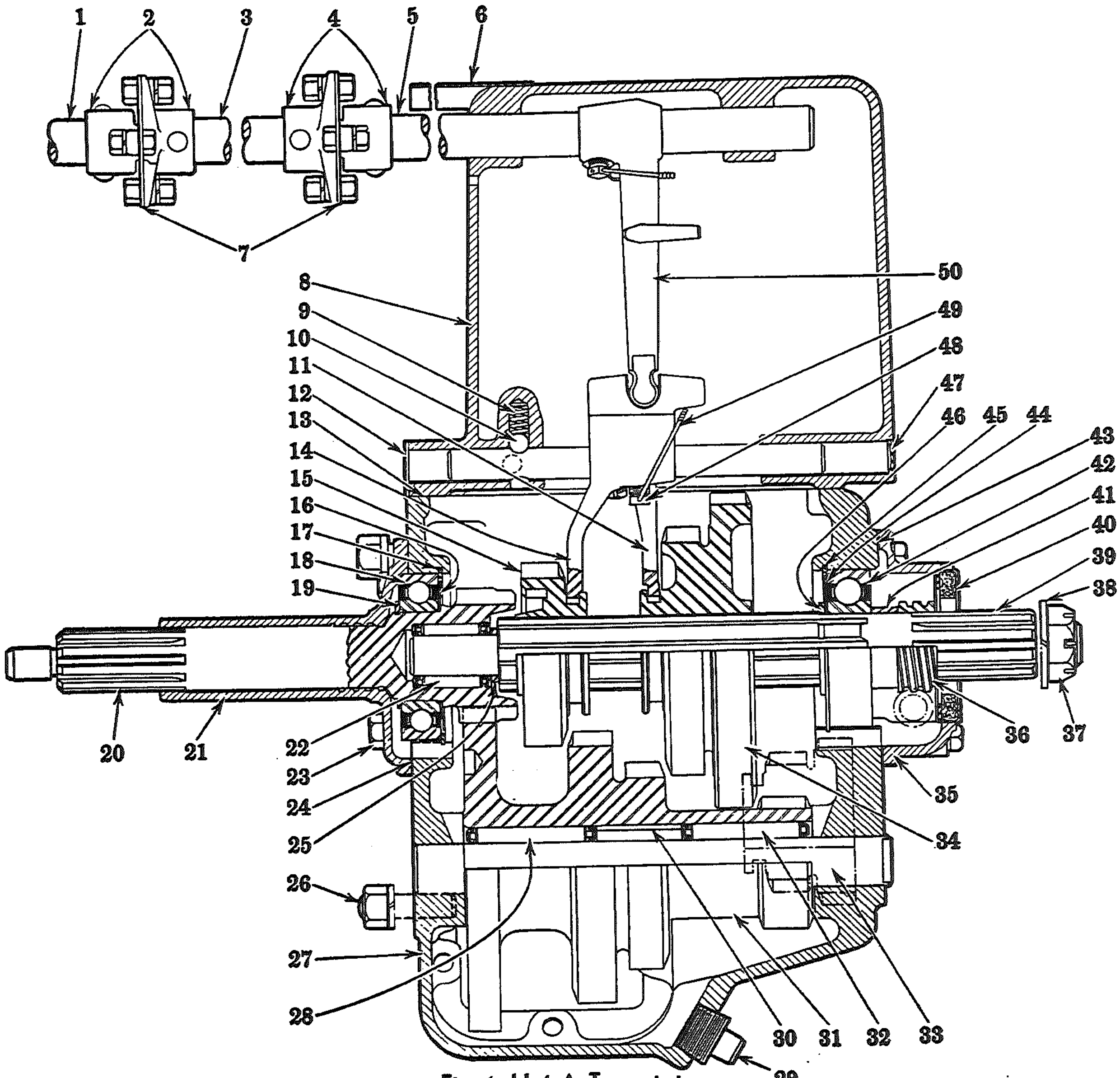

Fig. 1, H-4-A Transmission

No.	Description
1.	Remote control shaft, front.
2.	Control shaft joint flange.
3.	Remote control shaft, center.
4.	Control shaft joint flange.
5.	Control lever shaft.
6.	Control lever shaft shield.
7.	Control shaft joint disc.
8.	Control housing.
9.	Shift rail poppet spring.
10.	Shift rail poppet ball.
11.	Shift fork (first and second).
12.	Control housing to bell housing cork.
13.	Control housing gasket.
14.	Shift fork (third and direct).
15.	Main shaft gear (third and direct).
16.	Main shaft gear oil slinger.
17.	Main shaft gear bearing retainer snap ring, inner.
18.	Main drive gear ball bearing.
19.	Main drive gear bearing snap ring, outer.
20.	Main drive gear.
21.	Main drive gear bearing retainer.
22.	Main shaft pilot bearing.
23.	Transmission to bell housing stud.
24.	Main drive gear bearing retainer gasket.
25.	Main shaft pilot bearing spacer ring.
26.	Transmission bell housing stud.
27.	Transmission case.
28.	Countershaft roller bearing.
29.	Drain plug.
30.	Countershaft bearing spacer.
31.	Countershaft gear.
32.	Countershaft roller bearing.
33.	Countershaft.
34.	Main shaft gear (first, second and reverse).
35.	Main shaft bearing retainer.
36.	Speedometer drive gear.
37.	Nut.
38.	Washer.
39.	Main shaft.
40.	Main shaft oil retainer.
41.	Speedometer drive gear spacer.
42.	Main shaft ball bearing.
43.	Main shaft bearing retainer gasket.
44.	Main shaft bearing oil slinger.
45.	Main shaft bearing snap ring.
46.	Main shaft bearing thrust washer.
47.	Expansion plug.
48.	Reverse idler gear shaft.
49.	Lockwire.
50.	Shift fork control lever.

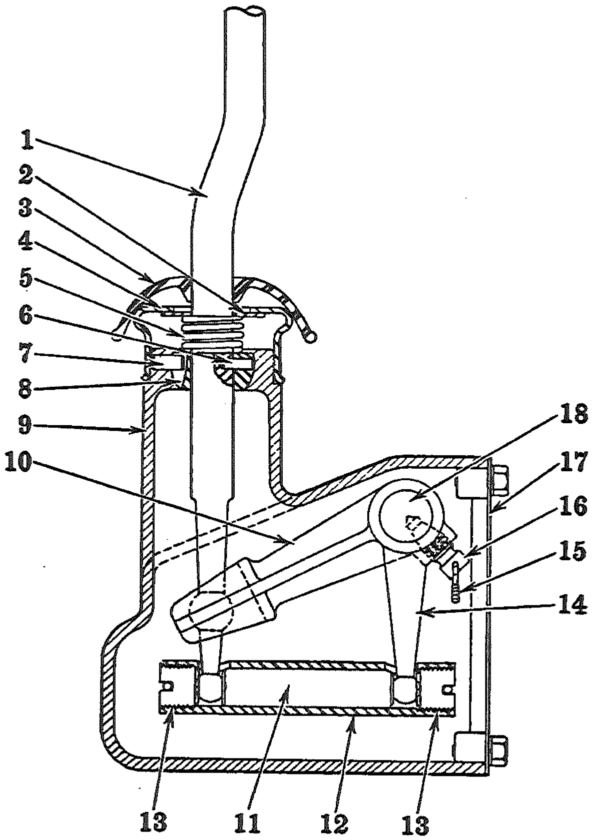

Fig. 2, Remote Control

No.	Description
1.	Control lever assembly.
2.	Control lever cap washer.
3.	Control housing dust cover.
4.	Control lever support cap.
5.	Control lever cap spring.
6.	Control lever ball pin.
7.	Control lever dust cap pin.
8.	Control lever fulcrum ball.
9.	Remote control housing.
10.	Remote control shift lever.
11.	Selector tube center plug.
12.	Remote control selector tube.
13.	Selector tube end plug.
14.	Remote control selector lever.
15.	Lock wire.
16.	Selector and shift lever lock screws.
17.	Remote control housing cover.
18.	Remote control shaft.

Transmission

Transmission has four speeds forward and one reverse. Fig. 3 illustrates gear shift, which is as follows:

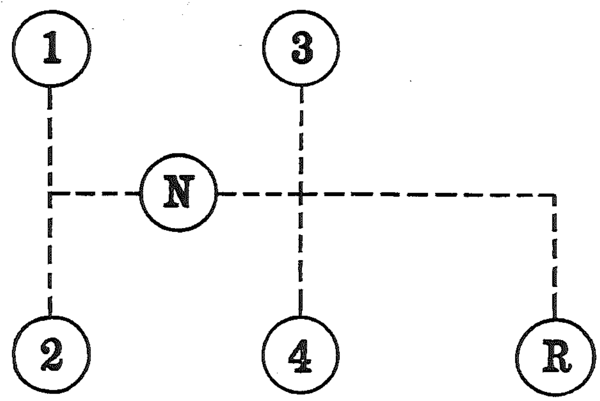

Fig. 3

First Speed

Move control lever to left and push forward to position (1).

Second Speed

Pull control lever straight back from position (1) to position (2).

Third Speed

Move control lever forward from position (2) and right thru (N), then forward to position (3).

Fourth Speed

Pull control lever straight back from position (3) to position (4).

Reverse

From position (N) push control lever, hard, to right and pull back to position (R).

Disassembling and Reassembling

With a few minor exceptions, the assembling is simply the reverse of disassembling. Therefore the following disassembling instructions will also serve as reference for assembling.

1. Clean the outside of the transmission, particularly around the control and bearing covers.
2. Shift lever to neutral position, remove the holding screws and then remove the transmission control housing.
3. To disassemble the transmission control housing assembly:
   (a) Remove locking wires and yoke screws.
   (b) Start with one of the outside bars and drive bars from control cover. **NOTE:** This must be done from neutral position.
   (c) Remove shift fork control lever and take out control lever shaft.
4. Remove mainshaft assembly:
   (a) Remove rear bearing covers.
   (b) Lock the gears and remove companion flange nut.

(c) Slide main shaft assembly to rear while holding the two sliding gears in position.
(d) The main shaft can then be removed thru the rear opening in the case and the two sliding gears can be removed thru top opening in case.

5. To disassemble the main shaft:
   (a) Remove nut and companion flange, then remove rear cover, speedometer drive gear, spacer and bearing.
6. Remove front bearing cover and withdraw clutch shaft and drive gear thru front opening in case, tapping face of gear lightly with babbitt or rawhide hammer.
7. Removing the countershaft assembly:
   (a) Remove countershaft and reverse idler shaft lockscrew and plate. Insert screw driver in lockplate groove and pry out countershaft.
   (b) Lift out countershaft assembly, with bearings and spacer, thru top opening of case.
8. Removing the reverse idler gear and shaft assembly:
   (a) Insert screw driver in lockplate groove and pry out shaft. Reverse idler gear can then be lifted out thru top of case.
9. When reassembling the top cover assembly, make sure that shifter forks are not sprung and engage properly with sliding gears.
10. To disassemble the remote control housing:
    (a) Remove gear shift lever by unscrewing cap at top of transmission cover. This cap retains the spring and ball assembly that is attached to lower end of lever.
    (b) Remove control lever fulcrum ball pin, using a punch to drive pin out. Disconnect selector tube and remove shift and selector levers.

Auxiliary Transmission and Power Divider—FPD-45

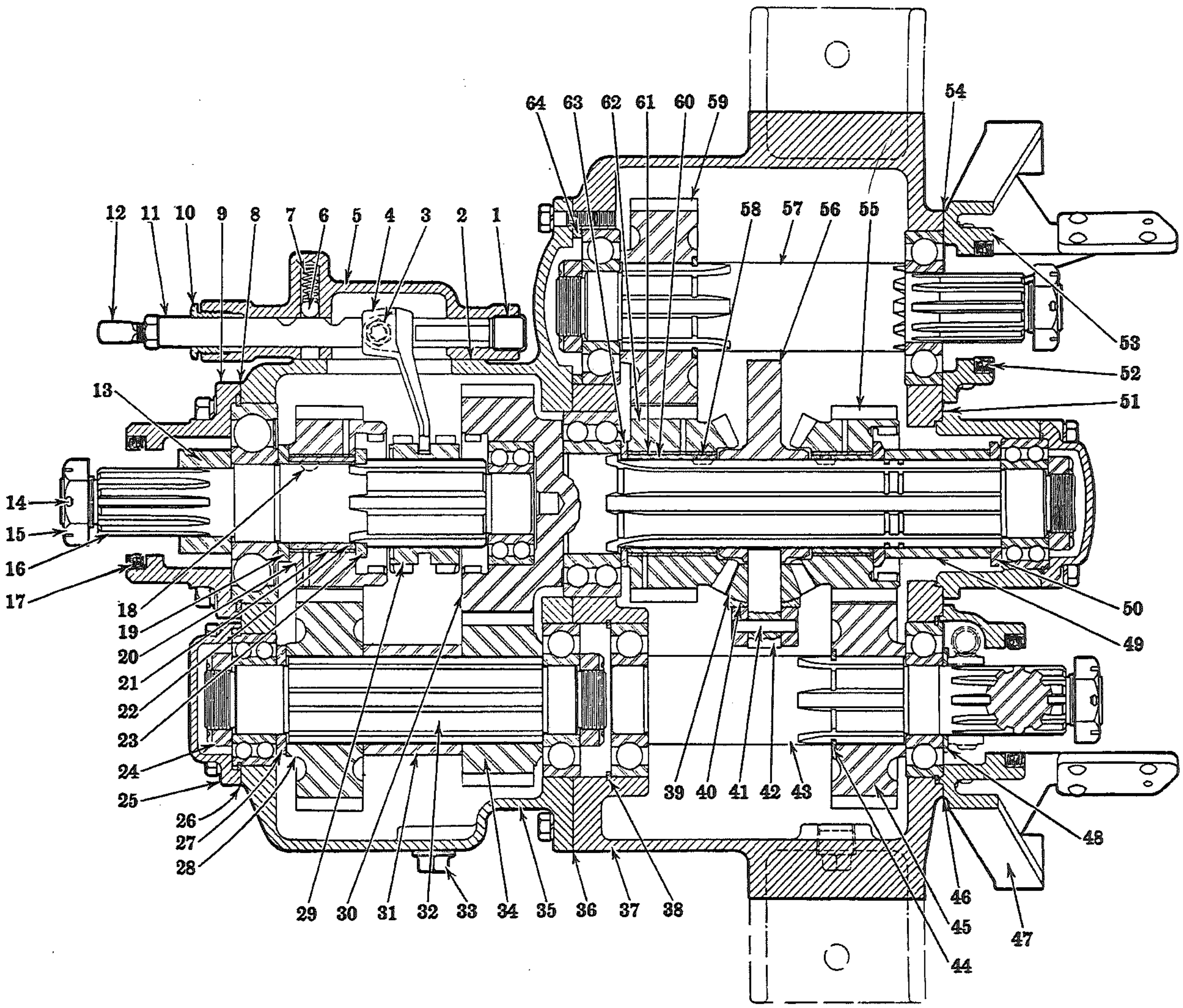

Fig. 1, FPD-45 Auxiliary Transmission and Power Divider

No.	Description
1.	Auxiliary shifting bar housing thimble.
2.	Auxiliary shifting bar housing gasket.
3.	Auxiliary shifting yoke screw.
4.	Auxiliary shifting yoke.
5.	Auxiliary shifting bar housing.
6.	Position finder spring ball.
7.	Position finder spring.
8.	Main shaft trunnion cover gasket.
9.	Main shaft trunnion cover.
10.	Auxiliary shifting bar packing nut.
11.	Auxiliary shifting bar.
12.	Auxiliary shifting bar eyebolt.
13.	Companion flange spacer.
14.	Cotter pin.
15.	Mainshaft nut.
16.	Auxiliary splined main shaft.
17.	Oil seal.
18.	Key.
19.	Mainshaft low speed gear thrust washer.
20.	Mainshaft low speed gear.
21.	Mainshaft gear bushing.
22.	Mainshaft low speed gear sleeve.
23.	Mainshaft low speed gear washer.
24.	Countershaft and auxiliary drive gear nut.
25.	Auxiliary countershaft bearing cover.
26.	Auxiliary countershaft bearing cover gasket.
27.	Auxiliary countershaft washer.
28.	Auxiliary countershaft low speed gear.
29.	Mainshaft sliding clutch.
30.	Auxiliary drive gear.
31.	Auxiliary countershaft gear spacer.
32.	Auxiliary countershaft.
33.	Drain plug.
34.	Auxiliary countershaft drive gear.
35.	Auxiliary transmission case.
36.	Transmission case gasket.
37.	Transmission case.
38.	Snap ring.
39.	Differential pinion.
40.	Differential pinion washer.
41.	Differential shaft pin.
42.	Differential pinion shaft.
43.	Power divider countershaft, L.H.
44.	Snap ring.
45.	Power divider countershaft gear, L.H.
46.	Speedometer housing and brake bracket gasket.
47.	Speedometer housing and brake bracket.
48.	Power divider countershaft bearing spacer, L.H.
49.	Differential thrust sleeve.
50.	Auxiliary drive gear splined thrust washer.
51.	Differential lock control housing gasket.
52.	Oil seal.
53.	Rear bearing cover and brake bracket.
54.	Rear bearing cover and brake bracket gasket.
55.	Differential drive gear, rear.
56.	Differential spider.
57.	Power divider countershaft, R.H.
58.	Differential drive gear sleeve pin.
59.	Countershaft gear, R.H.
60.	Differential front drive gear sleeve.
61.	Mainshaft drive gear bushing.
62.	Differential drive gear, front.
63.	Auxiliary drive gear front thrust washer.
64.	Countershaft front bearing spacer, R.H.

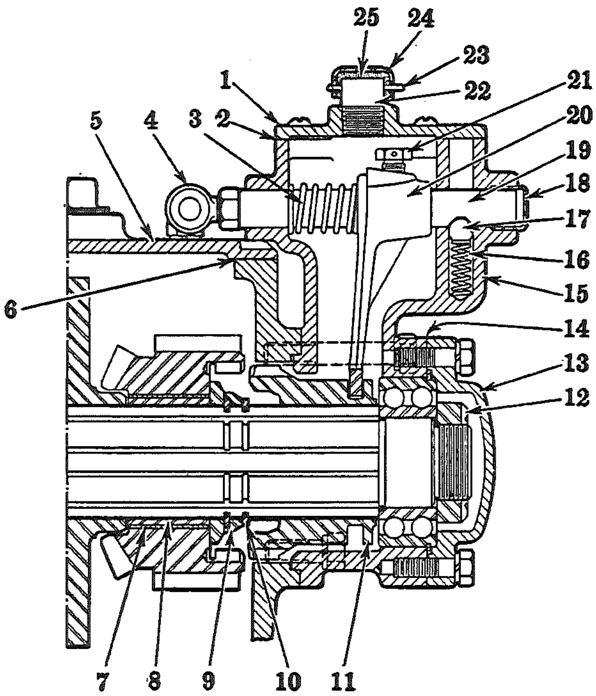

Fig. 2, Differential Lock

No. Description

1. Differential lock control housing cover.
2. Differential lock control housing cover gasket.
3. Differential lock kick-out spring.
4. Shifting yoke bar eyebolt.
5. Power divider case cover.
6. Power divider case cover gasket.
7. Differential rear drive gear sleeve bushing.
8. Differential rear drive gear sleeve.
9. Snap ring retainer.
10. Rear drive gear snap ring.
11. Differential lock sliding gear.
12. Countershaft and auxiliary drive gear nut.
13. Auxiliary drive gear rear bearing cover.
14. Auxiliary drive gear rear bearing cover gasket.
15. Differential lock control housing.
16. Position finder spring.
17. Position finder spring ball.
18. Differential lock control housing thimble.
19. Shifting yoke bar.
20. Shifting yoke.
21. Shifting yoke locking screw.
22. Breather pipe.
23. Cotter pin.
24. Breather pipe cover.
25. Breather pipe cover felt.

Auxiliary Transmission and Power Divider

The FPD-45 Power Divider is composed of two sub units, namely, the front section or the auxiliary unit and the rear section or the power divider unit, which are bolted together to form the complete power divider.

Two speeds are provided in the auxiliary transmission unit; low and direct. To shift from direct into low speed, pull shift lever back. To shift from low speed into direct, push shift lever forward.

In order to disassemble the power divider it is always necessary to completely separate the two sub units except when it is necessary to remove the auxiliary mainshaft assembly which can be easily withdrawn from the case after the mainshaft front bearing cover and the shifting bar housing have been removed.

After the two sub units have been completely separated they are disassembled separately.

Disassembling and Reassembling

With few exceptions the assembling of the power divider is the reverse of the disassembling process; therefore, the following brief instructions for disassembling will also serve as reference for assembling:

Separating Auxiliary Transmission and Power Divider

1. Remove top covers from both the auxiliary and power divider sections.
2. Remove, from both inside and outside of the cases, the cap screws which hold the two units together.
3. Remove main drive gear bearing cover from the differential lock housing at the rear of power divider section.
4. Lock gears and remove the bearing lock nut.
5. Separate the two units by forcing the main drive gear thru the power divider section. (Insert a bar in the space between the cases and pry them apart.)
6. Pull on either of the two units until they are completely disengaged.

NOTE: If the power divider is equipped with the differential lock it is necessary to proceed as follows:

   1. Remove differential lock housing assembly. (This operation will also remove the main drive gear rear bearing and the differential lock sliding gear.)
   2. Remove the snap ring exposed by operation 1.
   3. Remove snap ring retainer.
   4. Remove second snap ring.
   5. Continue as in paragraph 5.

Auxiliary Transmission

1. Remove shifting bar housing assembly. (This assembly can be easily dismantled by removing the shifting yoke locking screw and driving the bar from the housing.)
2. Remove all bearing covers.
3. Withdraw mainshaft assembly thru the front bearing bore. (The mainshaft can now be disassembled by pulling all parts toward the splined end of the shaft.)
4. Lock gears and remove countershaft rear bearing retaining nut.
5. Force countershaft thru gears and out of case thru front bearing bore.
6. Remove gears and spacers from case.
7. Remove main drive gear and such parts that are still assembled to it.

NOTE: Keep main drive gear bearing tight against the shoulder of the gear when removing gear from the auxiliary case.

8. If the mainshaft low speed gear and gear sleeve are replaced, the mainshaft and all parts should be assembled completely with bearing cover and joint yoke. The nut must be pulled up tight. A .004″ feeler gauge must be free at all points between washer (19) and gear (20). The assembly can then be put into the case.
9. When reassembling the mainshaft low speed gear thrust washer, be sure that the oil grooves are next to the gear.

Power Divider

1. Remove R.H. and L.H. rear bearing covers.
2. Remove all parts freed by removal of main drive gear.
3. Remove R.H. countershaft rear bearing.
4. Lift R.H. countershaft assembly from case.
5. Remove snap ring from L.H. countershaft front bearing bore.
6. Force L.H. countershaft thru gear and bearing and out of the case thru front bearing bore.

IMPORTANT: In reassembling, use new snap rings throughout. Also make sure that all parts are re-installed in their proper positions, making doubly sure that no small parts are omitted or left in the case.

7. The auxiliary drive gear thrust washer must be installed with the oil grooves to the gear.

Differential Lock Installation

1. Remove top cover of auxiliary transmission and power divider.
2. Lock gears in auxiliary transmission.
3. Remove main drive gear rear bearing cover from differential lock housing.
4. Remove main drive gear bearing retaining nut.
5. Remove differential lock housing. (This will also remove the main drive gear rear bearing.)
6. Remove rear thrust washer.
7. Remove differential thrust sleeve. (Note that there is now one thrust washer left on the shaft and that there are two snap ring grooves exposed.)
8. Install snap ring in front groove.
9. Install snap ring retainer over snap ring.

10. Install snap ring in rear groove.
11. Install differential lock sliding gear.
12. Install differential lock housing.
13. Install shifting parts in differential lock housing.
14. Install main drive gear rear bearing, rear bearing lock nut and rear bearing cover.

Lubrication

The oil capacity of the complete unit is 17 pints when the oil is up to the level holes. It is very important that this level be maintained.

The reservoir type cover is designed so that a portion of the lubricant is carried in this cover at high speeds only. This prevents overheating. At low speeds this oil drains back into the main case to provide ample lubrication for heavy-duty service.

Wheel Group

Section A

Wheels

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Drums and Hub (D-2, D-5)	3
Front Wheel Bearings	1
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INTERNATIONAL

MOTOR TRUCK SERVICE MANUAL

Bulletin Number	Models Affected	Subject

MOTOR TRUCK SERVICE MANUAL

INTERNATIONAL

Bulletin Number	Models Affected	Subject

Tire Inflation Pressures

30 x 5 TT	70 lbs.
30 x 5 HD	75 lbs.
32 x 5 TT	75 lbs.
32 x 6 HD	80 lbs.
32 x 7 HD	85 lbs.
34 x 7 HD	85 lbs.
36 x 8 HD	90 lbs.
38 x 9 HD	95 lbs.
40 x 10 HD	100 lbs.
5.25–18 (4-Ply Bal.)	32 lbs.
5.25–19 (4-Ply Bal.)	32 lbs.
5.50–18 (6-Ply Bal.)	40 lbs.
5.50–19 (6-Ply Bal.)	36 lbs.
5.50–20 (6-Ply Bal.)	45 lbs.
6.00–16 (4-Ply Bal.)	32 lbs.
6.00–16 (6-Ply Bal.)	40 lbs.
6.00–18 (6-Ply Bal.)	40 lbs.
6.00–19 (6-Ply Bal.)	36 lbs.
6.00–20 (6-Ply Bal.)	45 lbs.
6.50–16 (6-Ply Bal.)	40 lbs.
6.50–18 (6-Ply Bal.)	40 lbs.
6.50–20 (6-Ply Bal.)	50 lbs.
7.00–15 (6-Ply Bal.)	36 lbs.
7.00–16 (6-Ply Bal.)	40 lbs.
7.00–20 (8-Ply Bal.)	55 lbs.
7.50–15 Jumbo	24 lbs.
7.50–16 (6-Ply Bal.)	40 lbs.
7.50–18 (8-Ply Bal.)	55 lbs.
7.50–20 (8-Ply Bal.)	55 lbs.
8.25–18 (10-Ply Bal.)	60 lbs.
8.25–20 (10-Ply Bal.)	60 lbs.
9.00–20 (10-Ply Bal.)	65 lbs.
9.75–20 (12-Ply Bal.)	70 lbs.
10.50–20 (12-Ply Bal.)	75 lbs.
11.25–20 (14-Ply Bal.)	80 lbs.
12.00–20 (14-Ply Bal.)	85 lbs.
12.75–20 (16-Ply Bal.)	90 lbs.
13.50–20 (16-Ply Bal.)	95 lbs.

Wheels

Tapered roller bearings carry the wheels and are adjustable. Satisfactory operation and life depends upon correct adjustment and proper lubrication. The arrangement of bearings, grease seals and retainers is illustrated.

Wheel Bearing Adjustments

Brakes must be in proper adjustment and fully released, otherwise it will be impossible to check and adjust bearings properly.

Wheels should be jacked up, one at a time, and checked for loose bearings by shaking wheel endwise or by slippping a long bar under the tire and prying. Observe the movement of the brake drum in relation to the backing plate. With bearings correctly adjusted the movement will just be perceptible and wheel will turn freely with no drag. If movement appears excessive, bearing adjustment should be made. Wheel bearings that are adjusted too tight will overheat, causing lubricant to thin and boil out. If too loose they will pound and chip.

Front Wheel Bearings

Rotate wheel and tighten adjusting nut until a slight drag or bind is felt, then back off nut about 1/6 turn (more if necessary) until wheel turns freely. Insert cotter pin and check adjustment as covered above.

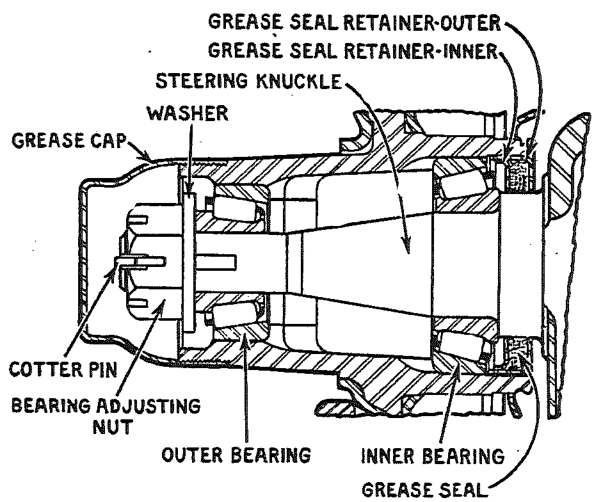

Fig. 1, D-2, D-5 Front

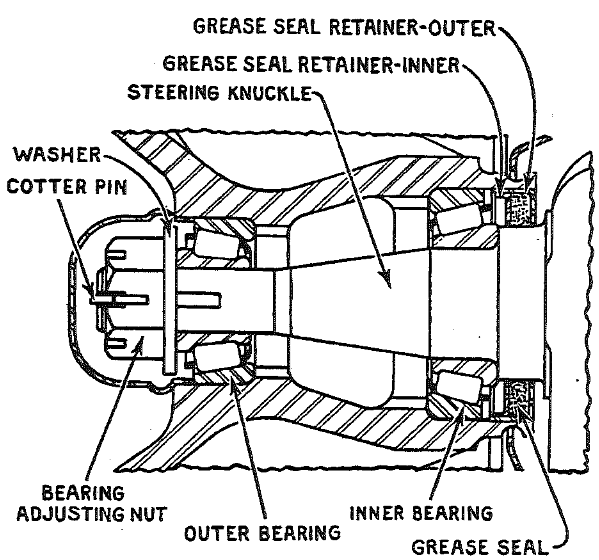

Fig. 2, D-15 Front

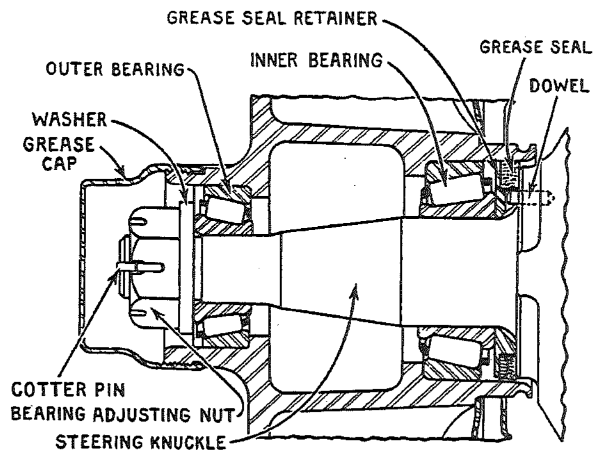

Fig. 3, D-30, DS-30, D-30B, DS-30B, D-35, DS-35, D-35B, D-40, D-186T, DS-186T, D-216T Front

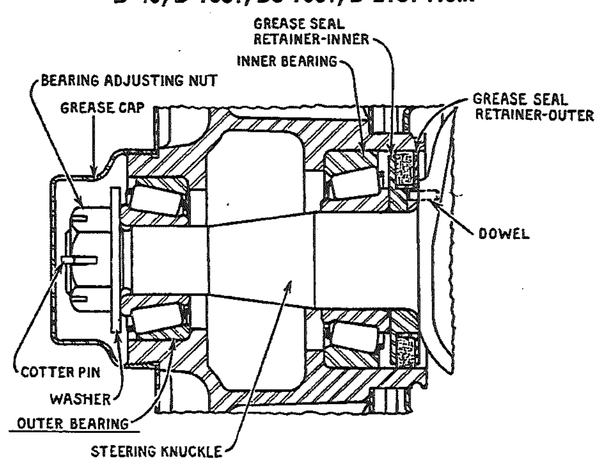

Fig. 4, D-300, DS-300, D-50, D-60, DR-60, D-246T, D-246F Front

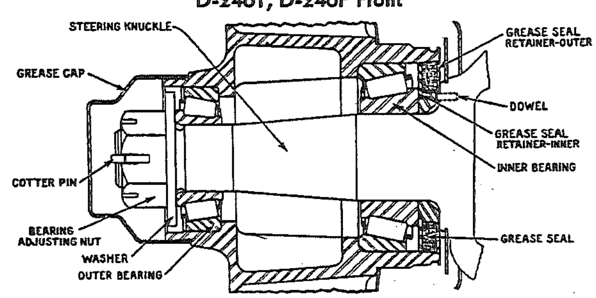

Fig. 5, DR-70, DR-346T, D-346F Front

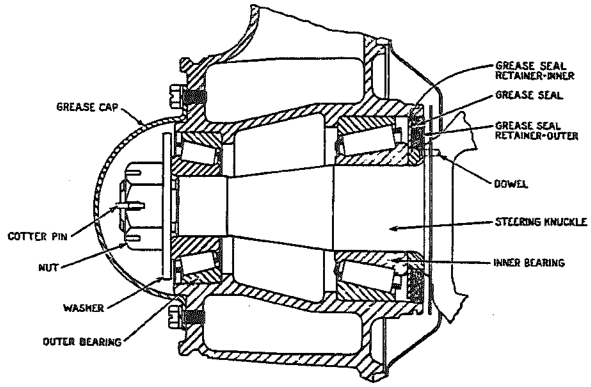

Fig. 6, DR-426F Front

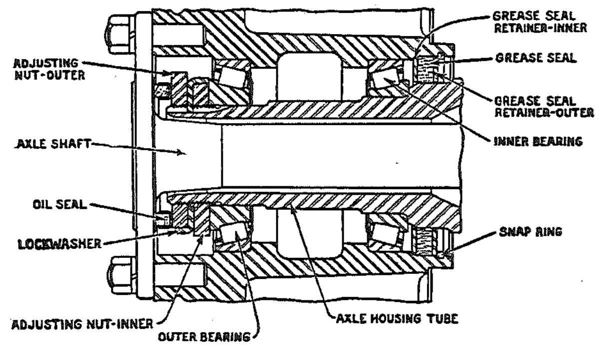

Fig. 9, D-30, DS-30, D-30B, DS-30B, D-300, DS-300, D-186T, DS-186T Rear

Rear Wheel Bearings

Rotate wheel and tighten inner adjusting nut until a slight drag or bind is felt, then back off nut about 1/8 turn. Install lockwasher and outer nut and after tightening securely, check the adjustment. There should be a very slight shake in the wheel (with axle shaft removed) if the adjustment is correct.

NOTE: D-2 and D-5 rear wheel bearings are adjusted by shims located between backing plate and end of axle housing.

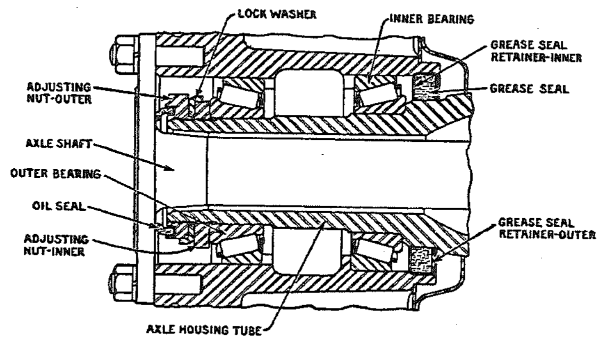

Fig. 10, D-35, DS-35, D-35B, D-40, D-216T, D-246F Rear

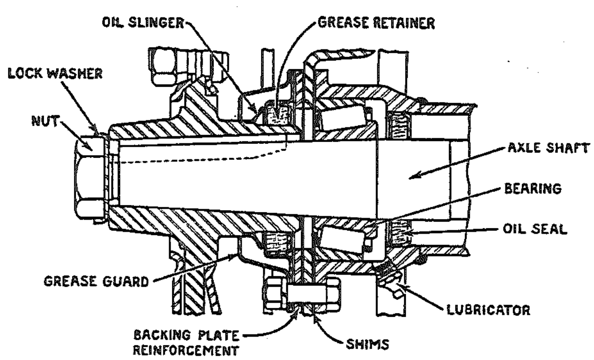

Fig. 7, D-2, D-5 Rear

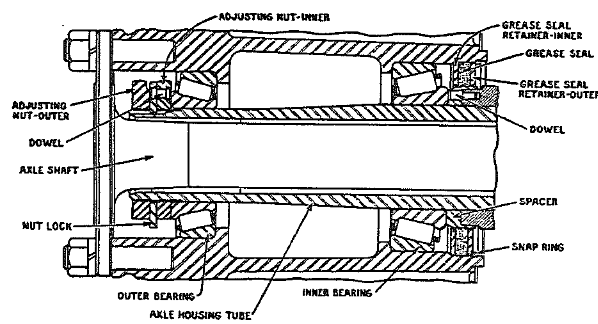

Fig. 11, D-50, D-246T Rear

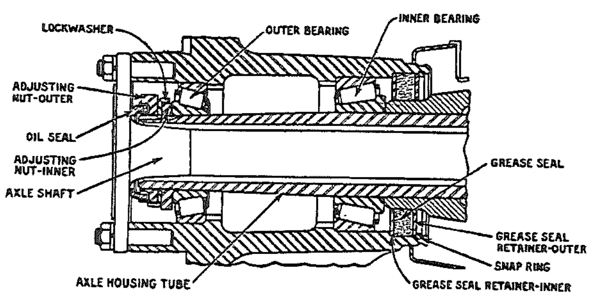

Fig. 8, D-15, Rear

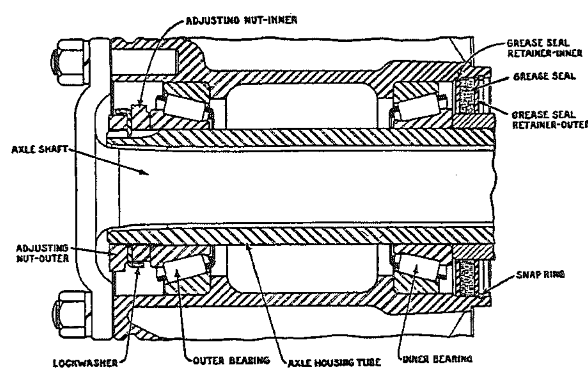

Fig. 12, D-60, DR-60, DR-70, DR-346T, D-346F, DR-426F Rear

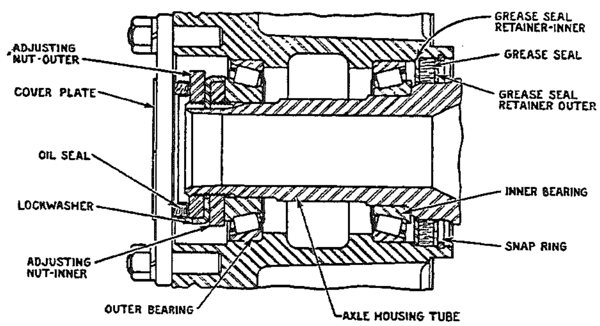

Fig. 13, D-186T, DS-186T Rear, Trailing

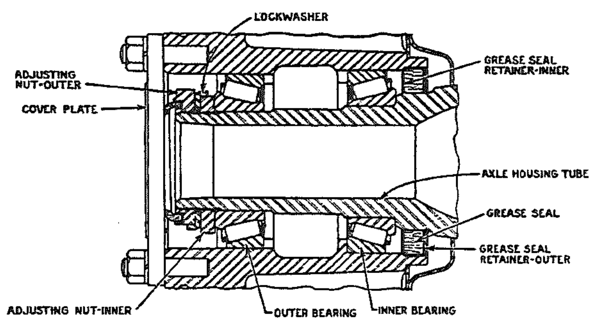

Fig. 14, D-216T Rear, Trailing

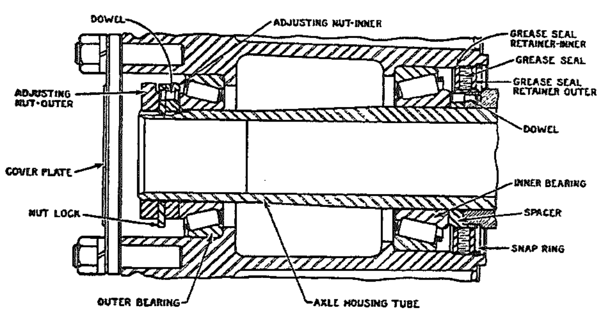

Fig. 15, D-246T Rear, Trailing

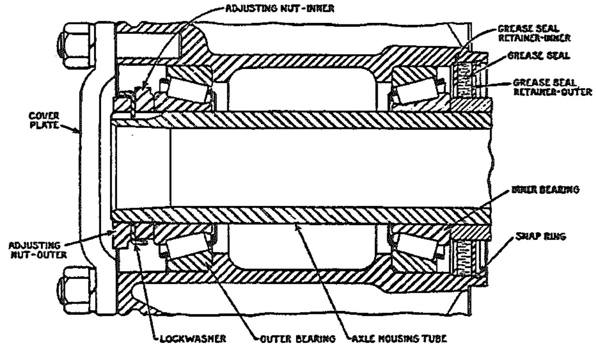

Fig. 16, DR-346T Rear, Trailing

Oil Seals

Front and rear wheel oil seals should be inspected when hub or wheel is removed and replaced if necessary. When installing rear felt seals, dip them in light oil first and make sure that retainers are properly assembled.

Wheels, Rims and Tires

Wheel stud nuts should be inspected and tightened at regular intervals. Rim clamp nuts should be kept tight and the rim and tire alignment in relation to the wheel should be checked to make sure tire is running true.

Model D-2 and D-5 wheels are designed to provide a spring locking action when stud nuts are tightened.

Early production models had wheel stud nuts with flats on the surface contacting the wheel, which provided a cam locking feature. Where this type nut is used, be sure that the flats are not worn or have been removed, as this would destroy the cam locking feature.

Later models do not use nuts with the cam locking feature, as changes were made in the wheel to provide greater spring locking action. Also left- and right-hand thread studs and nuts are used. The left-hand thread nuts can be identified by a small groove machined around the flats and the studs, by a letter "L" stamped on the head.

When tightening nuts of either type **do not** use excessive leverage. Use a wrench of the same length as that furnished in the tool kit. If a larger wrench is used the increased leverage will cause the nuts to be drawn too tight, thereby destroying the spring action in the wheel and losing the locking effect.

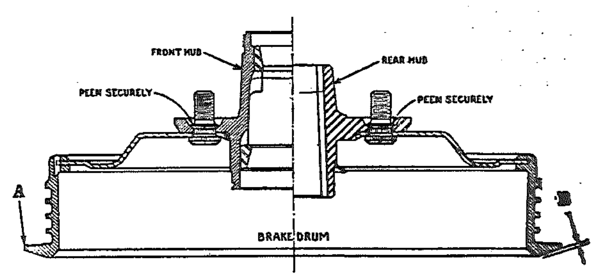

Fig. 17

Drum and Hub (D-2, D-5)

Fig. 17 illustrates the assembly of the brake drum and hub of front and rear wheels.

The hub bolts are machined with a shoulder between the threaded section and the head. The shoulder extends thru the hub and must be peened securely to hold it firmly in position. This is accomplished with Hub and Drum Bolt Peening Tool No. SE. 855.

Check brake drum flange (A) after assembly. Total indicator reading must not show over .032" variation at this surface when assembled on wheel.

Brake drum must not be out of true (B) after assembly, over $\frac{1}{32}''$ total indicator reading.

Diameter of braking surface must be concentric with bearing cups within .010″ total indicator reading after assembly.

Assembling Drum and Hub

To operate, first use the counterbore cutter SE-8559 to remove the shoulders from the old studs. Place the assembly on the fixture and knock out the old studs, using the hollow anvil SE-8552 for this purpose, and using the solid anvil SE-8553 as a rest.

When ready to reassemble, drive the new studs into place, using the wheel nuts and the countersunk spacer washers.

Next, adjust the anvil blocks an equal distance from the center hole in the fixture so that the anvil heads line up with the stud heads and tighten the slides securely. Test the stud alignment with the SE-1015 gauge.

Place the drum assembly on the anvils and adjust the locator slides SE-8558 so the pins will guide on the inside of the drum. The pins should then be adjusted to a height slightly less than the anvil height. Proper adjustment of the four slides will expedite the shifting of the drum from stud to stud and will steady the assembly during the peening operation.

With all adjustments made, remove the nut and washer from the first stud over the solid anvil, and peen the shoulder into its recess with the peening tool SE-8557. Shift the drum assembly to the next position and repeat the operation. Removing the nuts and washers one at a time in this manner will prevent springing of the drum and flange.

After the operation has been completed, the studs should again be checked for perfect alignment by using the stud locating gauge SE-1015. If it is found that studs are not in perfect alignment it will be necessary to make the needed corrections.

CONVERSION TABLE

FRACTIONS, DECIMALS, MILLIMETERS

INCHES		
Fractions	Decimals	M/M
	.003 94	.1
	.007 87	.2
	.01	.254
	.011 81	.3
1/64	.015 625	.3969
	.015 75	.4
	.019 69	.5
	.02	.508
	.023 62	.6
	.027 56	.7
	.03	.762
1/32	.031 25	.7938
	.031 5	.8
	.035 43	.9
	.039 37	1.0
	.04	1.016
	.043 31	1.1
3/64	.046 875	1.1906
	.047 24	1.2
	.05	1.27
	.051 18	1.3
	.055 12	1.4
	.059 06	1.5
	.06	1.524
1/16	.062 5	1.5875
	.062 99	1.6
	.066 93	1.7
	.07	1.778
	.070 87	1.8
	.074 80	1.9
5/64	.078 125	1.9844
	.078 74	2.0
	.08	2.032
	.082 68	2.1
	.086 61	2.2
	.09	2.286
	.090 55	2.3
3/32	.093 75	2.3813
	.094 49	2.4
	.098 43	2.5
	.1	2.54
	.102 36	2.6
	.106 30	2.7
7/64	.109 375	2.7781
	.11	2.794
	.110 24	2.8
	.114 17	2.9
	.118 11	3.0
	.12	3.048
	.122 05	3.1
1/8	.125	3.175
	.125 98	3.2
	.129 92	3.3
	.13	3.302
	.133 86	3.4
	.137 80	3.5
	.14	3.556
9/64	.140 625	3.5719
	.141 73	3.6
	.145 67	3.7
	.149 61	3.8
	.15	3.810
	.153 54	3.9
5/32	.156 25	3.9688
	.157 48	4.0
	.16	4.064
	.161 42	4.1
	.165 35	4.2
	.169 29	4.3

INCHES		
Fractions	Decimals	M/M
	.17	4.318
11/64	.171 875	4.3656
	.173 23	4.4
	.177 17	4.5
	.18	4.572
	.181 10	4.6
	.185 04	4.7
3/16	.187 5	4.7625
	.188 98	4.8
	.19	4.826
	.192 91	4.9
	.196 85	5.0
	.2	5.08
	.200 79	5.1
13/64	.203 125	5.1594
	.204 72	5.2
	.208 66	5.3
	.21	5.334
	.212 60	5.4
	.216 54	5.5
7/32	.218 75	5.5563
	.22	5.588
	.220 47	5.6
	.224 41	5.7
	.228 35	5.8
	.23	5.842
	.232 28	5.9
15/64	.234 375	5.9531
	.236 22	6.0
	.24	6.096
	.240 16	6.1
	.244 09	6.2
	.248 03	6.3
1/4	.25	6.35
	.251 97	6.4
	.255 91	6.5
	.259 84	6.6
	.26	6.604
	.263 78	6.7
17/64	.265 625	6.7469
	.267 72	6.8
	.27	6.858
	.271 65	6.9
	.275 59	7.0
	.279 53	7.1
	.28	7.112
9/32	.281 25	7.1438
	.283 46	7.2
	.287 40	7.3
	.29	7.366
	.291 34	7.4
	.295 28	7.5
19/64	.296 875	7.5406
	.299 21	7.6
	.30	7.62
	.303 15	7.7
	.307 09	7.8
	.31	7.874
	.311 02	7.9
5/16	.312 5	7.9375
	.314 96	8.0
	.318 90	8.1
	.32	8.128
	.322 83	8.2
	.326 77	8.3
21/64	.328 125	8.3344
	.33	8.382
	.330 71	8.4
	.334 65	8.5
	.338 58	8.6

INCHES		
Fractions	Decimals	M/M
	.34	8.636
	.342 52	8.7
11/32	.343 75	8.7313
	.346 46	8.8
	.35	8.89
	.350 39	8.9
	.354 33	9.0
	.358 27	9.1
23/64	.359 375	9.1281
	.36	9.144
	.362 20	9.2
	.366 14	9.3
	.37	9.398
	.370 08	9.4
	.374 02	9.5
3/8	.375	9.525
	.377 95	9.6
	.38	9.652
	.381 89	9.7
	.385 83	9.8
	.389 76	9.9
	.39	9.906
25/64	.390 625	9.9219
	.393 70	10.0
	.397 64	10.1
	.40	10.16
	.401 57	10.2
	.405 51	10.3
13/32	.406 25	10.3188
	.409 45	10.4
	.41	10.414
	.413 39	10.5
	.417 32	10.6
	.42	10.668
	.421 26	10.7
27/64	.421 875	10.7156
	.425 20	10.8
	.429 13	10.9
	.43	10.922
	.433 07	11.0
	.437 01	11.1
7/16	.437 5	11.1125
	.44	11.176
	.440 94	11.2
	.444 88	11.3
	.448 82	11.4
	.45	11.430
	.452 76	11.5
29/64	.453 125	11.5094
	.456 69	11.6
	.46	11.684
	.460 63	11.7
	.464 57	11.8
	.468 50	11.9
15/32	.468 75	11.9063
	.47	11.938
	.472 44	12.0
	.476 38	12.1
	.48	12.192
	.480 31	12.2
	.484 25	12.3
31/64	.484 375	12.3031
	.488 19	12.4
	.49	12.446
	.492 13	12.5
	.496 06	12.6
1/2	.50	12.7
	.503 94	12.8
	.507 87	12.9
	.51	12.954

INCHES		
Fractions	Decimals	M/M
	.511 81	13.0
33/64	.515 625	13.0969
	.515 75	13.1
	.519 68	13.2
	.52	13.208
	.523 62	13.3
	.527 56	13.4
	.53	13.462
17/32	.531 25	13.4938
	.531 50	13.5
	.535 43	13.6
	.539 37	13.7
	.54	13.716
	.543 31	13.8
35/64	.546 875	13.8907
	.547 24	13.9
	.55	13.970
	.551 18	14.0
	.555 12	14.1
	.559 05	14.2
	.56	14.224
9/16	.562 5	14.2875
	.562 99	14.3
	.566 93	14.4
	.57	14.478
	.570 87	14.5
	.574 80	14.6
37/64	.578 125	14.6844
	.578 74	14.7
	.58	14.732
	.582 68	14.8
	.586 61	14.9
	.59	14.986
	.590 55	15.0
19/32	.593 75	15.0813
	.594 49	15.1
	.598 42	15.2
	.60	15.24
	.602 36	15.3
	.606 30	15.4
39/64	.609 375	15.4782
	.61	15.494
	.610 24	15.5
	.614 17	15.6
	.618 11	15.7
	.62	15.748
	.622 05	15.8
5/8	.625	15.875
	.625 98	15.9
	.629 92	16.0
	.63	16.002
	.633 86	16.1
	.637 79	16.2
	.64	16.256
41/64	.640 625	16.2719
	.641 73	16.3
	.645 67	16.4
	.649 61	16.5
	.65	16.510
	.653 54	16.6
21/32	.656 25	16.6688
	.657 48	16.7
	.66	16.764
	.661 42	16.8
	.665 35	16.9
	.669 29	17.0
	.67	17.018
43/64	.671 875	17.0657
	.673 23	17.1
	.677 16	17.2
	.68	17.272
	.681 10	17.3
	.685 04	17.4
11/16	.687 50	17.4625

INCHES		
Fractions	Decimals	M/M
	.688 98	17.5
	.69	17.526
	.692 91	17.6
	.696 85	17.7
	.70	17.78
	.700 79	17.8
45/64	.703 125	17.8594
	.704 72	17.9
	.708 66	18.0
	.71	18.034
	.712 60	18.1
	.716 53	18.2
23/32	.718 75	18.2563
	.72	18.288
	.720 47	18.3
	.724 41	18.4
	.728 35	18.5
	.73	18.542
	.732 28	18.6
47/64	.734 375	18.6532
	.736 22	18.7
	.74	18.796
	.740 16	18.8
	.744 09	18.9
	.748 03	19.0
3/4	.75	19.050
	.751 97	19.1
	.755 90	19.2
	.759 84	19.3
	.76	19.304
	.763 78	19.4
49/64	.765 625	19.4469
	.767 72	19.5
	.77	19.558
	.771 65	19.6
	.775 59	19.7
	.779 53	19.8
	.78	19.812
25/32	.781 25	19.8438
	.783 46	19.9
	.787 40	20.0
	.79	20.066
	.791 34	20.1
	.795 27	20.2
51/64	.796 875	20.2407
	.799 21	20.3
	.80	20.320
	.803 15	20.4
	.807 09	20.5
	.81	20.574
	.811 02	20.6
13/16	.812 5	20.6375
	.814 96	20.7
	.818 90	20.8
	.82	20.828
	.822 83	20.9
	.826 77	21.0
53/64	.828 125	21.0344
	.83	21.082
	.830 71	21.1
	.834 64	21.2
	.838 58	21.3
	.84	21.336
	.842 52	21.4
27/32	.843 75	21.4313
	.846 46	21.5
	.85	21.590
	.850 39	21.6
	.854 33	21.7
	.858 27	21.8
55/64	.859 375	21.8282
	.86	21.844
	.862 20	21.9
	.866 14	22.0

INCHES		
Fractions	Decimals	M/M
	.87	22.098
	.870 08	22.1
	.874 01	22.2
7/8	.875	22.225
	.877 95	22.3
	.88	22.352
	.881 89	22.4
	.885 83	22.5
	.889 76	22.6
	.89	22.606
57/64	.890 625	22.6219
	.893 70	22.7
	.897 64	22.8
	.90	22.860
	.901 57	22.9
	.905 51	23.0
29/32	.906 25	23.0188
	.909 45	23.1
	.91	23.114
	.913 38	23.2
	.917 32	23.3
	.92	23.368
	.921 26	23.4
59/64	.921 875	23.4157
	.925 20	23.5
	.929 13	23.6
	.93	23.622
	.933 07	23.7
	.937 01	23.8
15/16	.937 5	23.8125
	.94	23.876
	.940 94	23.9
	.944 88	24.0
	.948 82	24.1
	.95	24.130
	.952 75	24.2
61/64	.953 125	24.2094
	.956 69	24.3
	.96	24.384
	.960 63	24.4
	.964 57	24.5
	.968 50	24.6
31/32	.968 75	24.6063
	.97	24.638
	.972 44	24.7
	.976 38	24.8
	.98	24.892
	.980 31	24.9
	.984 25	25.0
63/64	.984 375	25.0032
	.988 19	25.1
	.99	25.146
	.992 12	25.2
	.996 06	25.3
1"	1.000 00	25.400
1 1/4	1.25	31.7501
1 1/2	1.5	38.1001
1 3/4	1.75	44.4501
2"	2.000 00	50.8001
2 1/2	2.5	63.5001
3"	3.000 00	76.2002
3 1/2	3.5	88.9002
4"	4.000 00	101.6002
4 1/2	4.5	114.3002
5	5.000 00	127.0003
6	6.000 00	152.4003
7	7.000 00	177.8004
8	8.000 00	203.2004
9	9.000 00	228.6005
10	10.000 00	254.0005

* Cleaning Solution for Service Stations

General Letter # 173, Motor Truck General Letter # 104, issued 9-25-29, was in direct reference to the prohibited use of gasoline for cleaning purposes in Service Stations. This letter was quoted in its entirety in the Shop Section of the Service Station Manual, Page 32.

Motor Truck Service Bulletin # 110-31 was issued July 3, 1931, and advised that carbon tetrachloride should be used for cleaning such parts as electrical equipment, and where kerosene was not efficient or satisfactory. It was realized that carbon tetrachloride is expensive material for use in cleaning and also that it evaporates at a rapid rate. A search was therefore instigated for the purpose of finding a satisfactory, efficient, and safe substitute for the expensive cleaning material.

A fluid known as "STODDARD'S SOLVENT" has been decided upon for use in the service stations as a substitute for carbon tetrachloride. "Stoddard's Solvent" is used by the Cleaners and Dyers Industry for the purpose of cleaning and is adjudged entirely safe by the insurance companies and by the underwriters.

The cost of "Stoddard's Solvent" will be found to be but very little greater than that of gasoline. The trade name of the product in the locality in which you are located will doubtless be given you upon request to your local fuel supply dealer. This product is sold under a variety of trades names, usually depending upon the locality and the manufacturer of the product. The chief characteristics of the material are:

Initial Boiling Point	300 degrees	F. plus
Maximum " "	410 "	F. minus
Flash Point	104 "	F. or above

We recommend and urge that you contact your local fuel supply dealer and ask him to arrange to carry this material on hand for you. He will gladly supply you with the trade name under which the material is sold in that territory.

* Reference—S.B. 193-31.

Mathematical Formulae used in Transportation Engineering

$$BHP = 0.00019 \times N \times P \times r$$

$$BHP = \frac{2 \times N \times n \times T \text{ (lb.-in.)}}{33000}$$

$$BHP = \frac{T \times N}{5252.1}$$

$$BHP = \frac{D \times N \times 0.625}{5252.1}$$

$$BHP = D \times N \times 0.000107$$

$$BHP = \frac{BMEP \times A \times S \times C}{33000 \times 4}$$

$$BHP = IHP \times E$$

$$IHP = \frac{MEP \times A \times S \times C}{33000 \times 4}$$

$$T = \frac{D \times BMEP}{150.8} = \text{lb.-ft.}$$

$$T = D \times 0.625 = \text{lb.-ft.}$$

$$T = \frac{BHP \times 5252.1}{N} = \text{lb.-ft.}$$

$$T = \frac{BHP \times 63025}{N} = \text{lb.-in.}$$

$$BMEP = MEP \times E$$

$$BMEP = \frac{T}{D} \times 150.8$$

$$MPH = \frac{N \times d}{R \times 336}$$

$$DBP = TE - RR$$
of powered unit

$$N = \frac{MPH \times R \times 336}{d}$$

$$TE = \frac{T \times 12 \times R \times E}{\frac{d}{2}}$$

$$T = \frac{TE \times \frac{d}{2}}{12 \times R \times E}$$

$$TF = \frac{T \times 12 \times R \times E}{\frac{d}{2} \times GW}$$

$$G\% = 100\,(TF - RR)$$

$$\text{Clutch T Capacity} = \left\{ \begin{array}{l} \text{Total spring pressure x mean} \\ \text{radius of lining x 2 faces x .25} \\ \text{coefficient of friction} \div 12. \end{array} \right.$$

Key to Symbols Used Above

A	= Area of piston head in sq. in.
BHP	= Brake horsepower.
IHP	= Indicated horsepower.
BMEP	= Brake mean effective pressure.
C	= Number of cylinders.
D	= Piston displacement in cu. in.
d	= Effective tire diameter (loaded).
E	= Mechanical efficiency.
G%	= Grade ability, per cent.
GW	= Gross weight, lb.
MEP	= Mean effective pressure.
N	= Engine speed revolutions per min. (r.p.m.).
P	= Load in pounds, end of dynamometer arm.
R	= Total reduction to 1.00.
r	= Length of dynamometer arm (1.75 ft.).
RR	= Rolling or road resistance (0.015 lb. per lb.).
S	= Piston speed in feet per minute.
T	= Torque—lb.-ft. or lb.-in.
TE	= Tractive effort in pounds.
TF	= Tractive factor, lb. per hundred lb. gross.
DBP	= Drawbar pull.
MPH	= Miles per hour.
n	= Pi = 3.1416; ratio of diameter to circumference of circle.