

MODEL GP U.S. GOVERNMENT $\frac{1}{4}$ TON, 4 WHEEL DRIVE, 80" WHEELBASE RECONNAISSANCE CAR

Identification Plate and Caution Plate Located on Instrument Panel

OPERATION TIPS

The natural inclination of every motor vehicle operator is to take pride in his vehicle, in its accelerating qualities, smoothness of operation and ability to travel further on less fuel. To a great extent, these factors are subject to the control of the vehicle operator and the following paragraphs point out the precautionary measures which should be followed to secure the most satisfactory results.

"BREAKING IN"

Before attempting to start the engine or operate the vehicle, the careful driver will first make sure that there is sufficient water in the radiator and that the oil level in the crankcase is up to the "Full" mark on the dip stick. He will also examine each tire and see that it is brought up to the recommended tire pressure, if there is any indication of one or more of the tires being low. The good driver will also make certain there is an adequate supply of fuel in the tank.

One of the most important factors in the life of a motor vehicle is the care it receives during the first thousand miles of operation. For the first 300 miles, the new unit should not be driven in excess of 25 miles per hour in direct drive. For the next 700 miles it should not be driven in excess of 35 miles per hour. When operated in the lower range provided by the transfer case, new units should never be driven in excess of 15 miles per hour for the first 300 miles or 20 miles per hour up to 1,000 miles. During the so-called "breaking in" period, the temperature indicator should be watched closely and if there is any tendency toward overheating, the operating speed should be reduced.

LUBRICANT

To avoid excessive or premature wear, clean lubricant of correct specifications must be used at the various points indicated on the lubrication chart.

All Ford products are designed to operate smoothly and without sharp knocks, rattles or metallic noises which indicate friction

in any of the working parts. All unusual noises should therefore be investigated at once so the necessary corrective measures can be taken before serious damage results. If the noise seems due to an internal mechanical fault, the condition should be reported to a mechanic immediately and operation of the vehicle should be avoided until it has been released by a qualified technician.

TESTING BRAKES

The brakes should be tested daily soon after starting. Any faulty condition in the hydraulic brake system is readily apparent to the operator at the first application of the brake pedal, and the matter should be reported at once for correction.

FRONT WHEEL ALIGNMENT CHECK

The proper alignment of the front wheels is a most important factor in the steering of the vehicle. If hard steering is noticed, the first thing to check is inflation of the front tires. If the tires are properly inflated and the vehicle tends to wander to the right or left, or the steering wheel shakes (shimmies) when the vehicle is in motion, have a mechanic inspect and make the necessary repairs.

BATTERY INSPECTION

Battery should be inspected frequently and terminal corrosion removed by scraping or using a solution of baking (bicarbonate) soda and water. After the terminals have been cleaned, they should be coated with vaseline or light grease.

ELECTRIC CIRCUIT TERMINALS

All electrical connections must be kept clean and tight. Bear in mind that corroded terminals, also loose and dirty ground connections will cause ultimate failure of the electrical system.

SPARK PLUGS

Check spark plugs frequently for loose connections or broken porcelain which will usually be indicated by that particular cylinder missing fire when the engine is operating under a heavy load or accelerating with a wide open throttle. Faulty spark plugs and wires should be replaced.

AIR CLEANER

Instructions for cleaning the oil bath type air cleaner are given on the decalcomania on the air cleaner. Under extremely dusty conditions, the air cleaner should be cleaned more frequently and refilled with new oil of the same viscosity as is used in the crankcase.

WORKING UNDER VEHICLE

When working under the vehicle, it is inadvisable to depend only upon a jack to support the weight. Use wooden blocks or wooden jack.

REPORTING MECHANICAL FAULTS

Report any mechanical trouble and have it corrected. Temporary repairs should be used only as an expedient.

REVERSING

Reverse as little as possible. Never reverse without sounding the horn and making absolutely sure that the way is clear.

TIRE INFLATION

Proper tire inflation not only produces the greatest number of miles per tire but helps to avoid accidents. Unequally inflated tires result in poor steering, poor braking and excessive side sway on curves.

CHANGING TIRES

When changing tires, one or more of the wheels resting on the ground should be blocked securely with a rock or other suitable object. Do not depend upon the brakes to hold the vehicle while tires are being changed, since there is always the possibility of the brakes being thoughtlessly released.

SPINNING OF WHEELS

Spinning the drive wheels only digs them deeper into mud and snow. Rock the car forward and backward a few inches repeatedly until sufficient traction can be secured.

RACING THE ENGINE

Racing the engine causes excessive strain on the mechanism and premature wear. This is especially bad in cold weather when the engine is cold because the oil is thickened by low temperatures and does not circulate as rapidly as when warm.

ENGINE ACCELERATION

Accelerate gently. Tramping on the accelerator only forces more gasoline into the cylinders than can be effectively used, and under some conditions might result in the engine stalling.

ENGINE IDLING

Permitting the engine to idle for long periods of time not only wastes gasoline, but has a tendency to foul the spark plugs.

ENGINE OVERHEATING

When engine is overheated, cold water should not be poured into the radiator unless the engine is running so that the water pump will circulate and mix the cold water with the hot water before it strikes the cylinder block and head. When engine overheats, always check the fan belt first for slippage. Tighten the belt if it appears to be too loose. Also check the hose connections to see that they are tight.

SKIDDING

When traveling at high rates of speed on a loose gravel road, motor vehicles sometimes sway or skid dangerously. Loose gravel may be thrown under such conditions and injure pedestrians or break windows of passing vehicles. The brakes should be used with caution to bring the vehicle under control. To apply the brakes abruptly while skidding only increases skidding. Concentrate on steering the vehicle in the event a tire should blow out. Then remove the foot from the accelerator and use the brakes with caution.

APPLYING BRAKES

Applying breaks too rapidly results in excessive tire wear. It may also result in a dangerous skid when on wet or icy pavements.

STOPPING THE VEHICLE

Come to a gradual stop. Sudden stops, the same as sudden starts, waste gasoline and are dangerous to the passengers.

USE OF CLUTCH

Sudden engagement of the clutch, causing jerky starting or killing the engine, increases the strain on the clutch and other parts involved. Release the clutch pedal slowly so as to insure a gradual contact between clutch plates.

USE OF GEARS

Unnecessary speeding of the vehicle while in the lower gears, practically doubles gasoline consumption. Shift to high gear before 25 miles an hour is reached.

LOW GEAR

Low speed gear ratios are provided for use when the going is heavy. The best driver shifts into these lower ratios when necessary for most efficient vehicle operation. Always descend a hill in the same gear used in ascending it.

COASTING

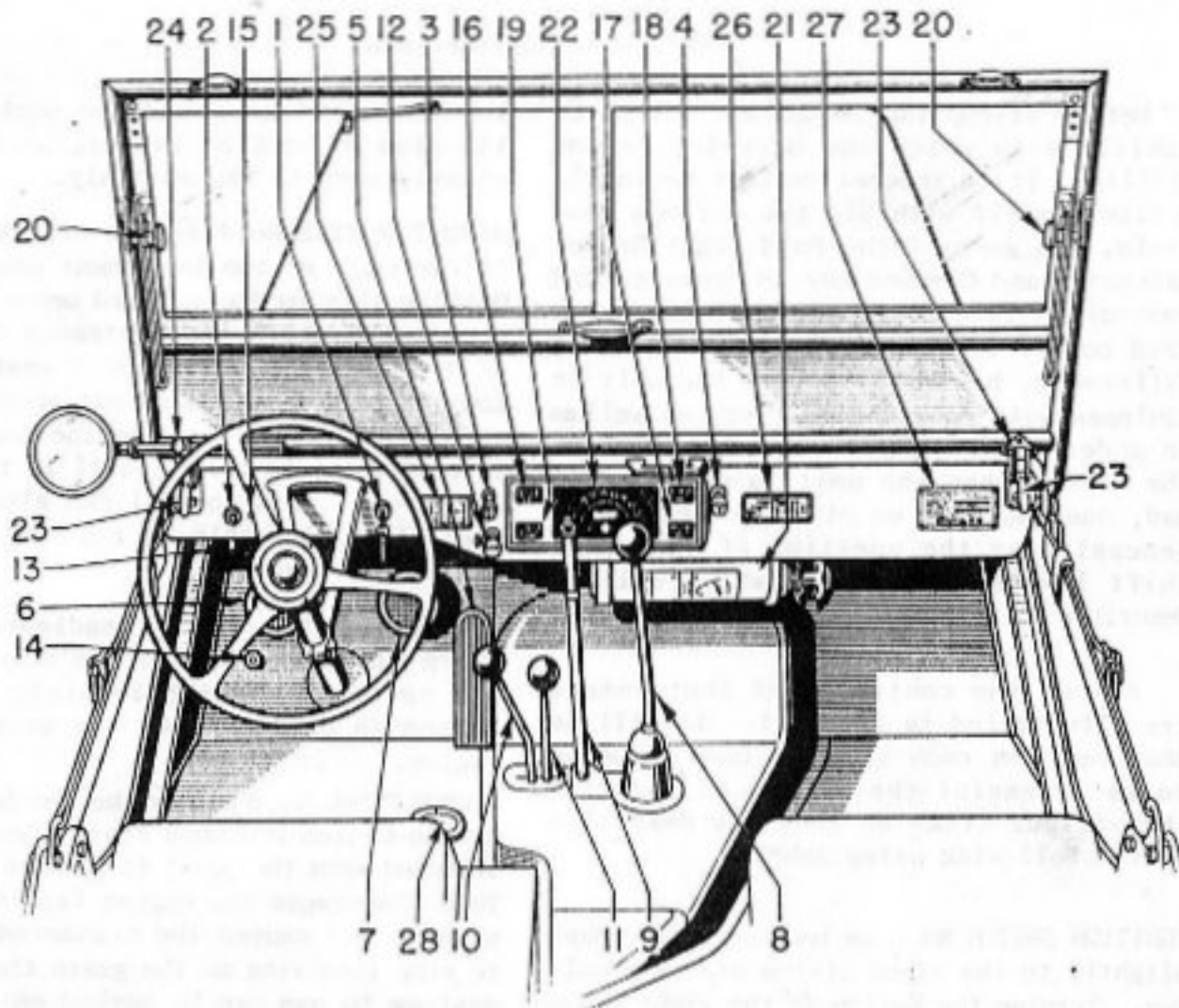
When going down grade, use engine compression to assist in maintaining control. Never disengage the clutch and coast down. This is extremely dangerous when an unforeseen emergency demands prompt stopping of the vehicle. Using the brakes when coasting usually results in burnt linings and, under extreme conditions, might render the brakes useless.

FIRE

A gasoline or oil fire in a motor vehicle must be handled quickly to avoid serious damage. In the event of such a fire, turn off the ignition and light switches immediately. Use the fire extinguisher as quickly as possible to extinguish the flames. If in the engine compartment, avoid raising the hood unless it is impossible to get at the flames in any other manner. If no fire extinguisher is available, smother the flames with a tarpaulin, blanket, coat, sand, dirt or other similar material.

ABUSE AND NEGLECTS

Abuse and neglect of the vehicle entrusted to you will always result in premature repairs. Your efficiency as a driver can be effectively measured by the cost of repairs made and charged to the vehicle.



Instruments and Controls - Fig. 2

- | | |
|---|---------------------------------|
| 1. Ignition Switch | 15. Beam Indicator |
| 2. Starter Button | 16. Fuel Gauge |
| 3. Carburetor Choke | 17. Ammeter |
| 4. Hand Throttle | 18. Oil Gauge |
| 5. Accelerator | 19. Temperature Gauge |
| 6. Clutch Pedal | 20. Windshield Swing Arm Nuts |
| 7. Brake Pedal | 21. Fire Extinguisher |
| 8. Transmission Shift Lever | 22. Speedometer |
| 9. Emergency Brake Lever | 23. Windshield Latches |
| 10. Front Axle Drive Lever | 24. Rear View Mirror |
| 11. Transfer Case Auxiliary Range Lever | 25. Gear Shift Plate |
| 12. Light Switch | 26. Caution Plate |
| 13. Instrument Panel Light Switch | 27. Nomenclature Plate |
| 14. Light Beam Control Switch | 28. Brake Master Cylinder Cover |

OPERATING THE VEHICLE

(Driver's Instructions)

Before attempting to operate any motor vehicle with which the operator is not familiar, it is imperative that he familiarize himself with all the various controls. In general the Ford Light Reconnaissance and Command car is operated and controlled in exactly the same manner as Ford commercial cars. The main point of difference, however, is that the unit is equipped with four-wheel drive, as well as an under drive to provide more power at the wheels when the unit is operated in mud, deep sand or on steep grades. This necessitates the addition of two extra shift levers, the use of which will be described in detail in the following pages.

All of the controls and instruments are illustrated in Figure 1. It will be observed that each item has been numbered so as to assist the reader in locating the various items as they are described in the following paragraphs:

IGNITION SWITCH No. 1 is located on the dash slightly to the right of the steering column. Turning the switch to the right closes the ignition circuit so that current will flow to the ignition coil and distributor. Turning the switch to the left breaks the circuit and will stop the engine.

STARTER BUTTON No. 2 is located at the lower left corner of the instrument panel. When this button is pressed in, current is supplied to the magnetic starter switch which in turn closes the circuit to the starter motor.

CARBURETOR CHOKE No. 3 is the control button in the center of the instrument panel to the left of the instrument group. When this control button is pulled out, it reduces the amount of air going through the carburetor and thus provides a richer mixture. When the engine is warm, it is not necessary to pull out the choke button, in fact, this control should only be used when the weather is sufficiently cold to cause difficulty in starting.

The choke button should be pushed in to its stop as soon as the engine is sufficiently warm to run smoothly.

HAND THROTTLE No. 4 is the control button to the right of the instrument panel group. Pulling this button outward opens the carburetor throttle and increases the speed of the engine. During cold weather this control should be pulled out approximately one-quarter of an inch so the engine will idle somewhat faster until it is thoroughly warmed up. This control can also be used when it is desirable to run the engine at a constant speed.

ACCELERATOR No. 5 is a treadle-type lever which actuates the linkage connected to the carburetor throttle plate and thus increases or decreases the speed of the engine.

CLUTCH PEDAL No. 6 causes the tension exerted by the Clutch Pressure Plate Springs to be released when the pedal is pressed downward. This disengages the engine from the transmission and causes the transmission gears to stop revolving so the gears the operator desires to use can be meshed easily.

It is a good practice to disengage the clutch before starting the engine as this will not only enable the starter to crank the engine more easily in cold weather but will also prevent the vehicle from moving in the event the transmission gear shift lever has been unknowingly left in gear. Do not drive with the foot resting on the clutch pedal as this will cause premature wear of the clutch facings and clutch throw-out bearing.

BRAKE PEDAL No. 7 is connected by a rod to a piston in the Brake Master Cylinder. When pedal is pressed downward the piston forces fluid from the Master Cylinder through connecting tubes to cylinders at each of the four wheels which in turn expand the brake shoes.

TRANSMISSION SHIFT LEVER No. 8 is used in exactly the same manner as the gear shift lever on Ford commercial cars. It provides three forward speeds and one reverse and operates entirely independent

of the two transfer case shift levers. Lever positions for the various gear changes are shown on the plate attached to the instrument panel and are also discussed in detail in a following paragraph.

EMERGENCY BRAKE No. 9 actuates a separate brake shoe located on the rear propeller shaft directly behind the transfer case. This lever should be pulled backward as far as possible whenever the vehicle is parked. After starting the engine and placing the transmission in gear, the brake should be released by pushing the lever forward as far as possible.

FRONT AXLE DRIVE LEVER No. 10 is connected to the transfer case and is used to engage or disengage the front axle drive as desired. When the vehicle is to be operated on smooth hard ground or pavement the lever should be pushed to the forward position so the front axle drive will be disengaged.

TRANSFER CASE AUXILIARY GEAR LEVER No. 11 enables the operator to shift into low speed gears when the vehicle must be operated through mud or sand or in the high speed gears when the vehicle is being operated on pavement or hard ground without pulling a load. The low speed auxiliary range gears cannot be engaged unless the front axle drive is engaged.

LIGHT SWITCH No. 12 is located on the instrument panel directly below the choke button and has two positions. When pulled out to the first position, it turns on the blackout lights only. The button on the side of the switch knob must then be pressed before the switch can be pulled out to a stop in which position it turns on the headlights, tail light and instrument panel light.

This button is a safety feature which prevents accidentally turning on the headlights during a blackout period. Before leaving the vehicle after dark, make sure the light switch is in the "off" position so as to avoid the possibility that the blackout lights may have been left burning.

INSTRUMENT PANEL LIGHT SWITCH No. 13 is controlled by a small toggle switch mounted underneath the instrument panel to the left of the steering column. This will turn the instrument panel lights on or off as desired.

LIGHT BEAM CONTROL SWITCH No. 14 is located on the floor board to the left of the clutch pedal. After the headlights have been turned on, this switch can be operated by the left foot to switch to either the upper or lower beam in the headlights. The upper beam is used for fast driving on country highways while the lower beam is used for driving in traffic.

BEAM INDICATOR No. 15 is a small red light which is turned on when the headlights are switched to the upper beam. When approaching an on-coming car, switch to the lower beam, red light off, by pressing down on the foot switch so as to avoid blinding the approaching driver.

FUEL GAUGE No. 16 is an electrical type gauge which indicates the approximate amount of gasoline in the tank. The gauge does not register except when the ignition is turned on.

AMMETER No. 17 is located in the instrument group. The dial indicates whether current is being charged into or discharged from the battery. The current flow is controlled by the generator regulator and the amount of charge will vary with the load and condition of the battery. When the voltage of the battery reaches a pre-determined value, the indicator hand will drop to a lower charging rate.

A slight fluctuation of the indicator hand at this point is caused by the action of the generator regulator.

OIL GAUGE No. 18 is an electrical type pressure gauge. Normal pressure is approximately 25 pounds, depending of course, upon the condition of the oil in the engine. Heavy or cold oil will result in higher pressure; thin or hot oil will show a lower pressure. The oil pressure gauge merely indicates whether or not the engine oil is circulating and does not show the quantity or quality of the oil.

In the event the indicator hand drops to zero or fluctuates rapidly, the engine should be stopped immediately as this indicates that proper oil pressure is not being maintained and the engine might be damaged.

TEMPERATURE INDICATOR No. 19 is also an electrical type instrument and shows the temperature of the water in the cooling system. The gauge operates only when the

ignition switch is on and points to the hot end of the gauge when the ignition switch is turned off.

WINDSHIELD CLAMPS Nos. 20 and 21: The windshield is so designed that it can be opened forward while in the upright position. This is done by loosening the two knurled clamp nuts and pushing the bottom of the windshield outward to the desired position. The two clamp nuts should then be tightened on the swing arms.

FIRE EXTINGUISHER No. 21 is held in place against the cowl panel by a spring-type clamp. This clamp must be sprung open before the fire extinguisher can be removed. After removing the fire extinguisher from the mounting brackets, it can be operated by turning the handle to the left and then pumping it in and out. Each operator should carefully read the directions on the fire extinguisher so as to familiarize himself with its use.

SPEEDOMETER NO. 22

The speedometer should be used as a guide for correct gear shifting, following the recommendations indicated on the caution plate for each transmission and transfer case gear change.

WINDSHIELD LATCHES NO. 23

Latches are provided at the lower right and left corners of the windshield that, when released, permit the windshield to be folded forward over the hood. When in the lowered position, it is important that the windshield be securely fastened to the hood, using the latches provided for that purpose located on each front corner of the hood.

REAR VIEW MIRROR NO. 24

The rear view mirror, located at the left-hand side of the instrument panel, is adjustable, permitting the mirror to be extended further from the body for better rear view.

GEAR SHIFT PLATE NO. 25

The plate illustrated in Figure 3 is fastened to the instrument panel to assist operators who are not familiar with the

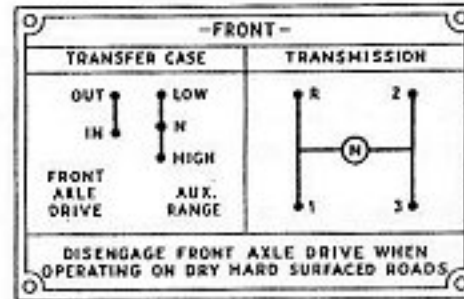


Fig. 3

operation of the vehicle. It shows the correct positions in which to place the transfer case shift levers, as well as the transmission shift lever, for various speeds.

| - CAUTION - | | |
|--|-------------------|-----------|
| MAXIMUM PERMISSIBLE ROAD SPEEDS IN THE FOLLOWING GEAR POSITIONS | | |
| TRANSMISSION IN: | TRANSFER CASE IN: | |
| | HIGH RANGE | LOW RANGE |
| HIGH | 55 M.P.H. | 27 M.P.H. |
| INTERMEDIATE | 32 " | 16 " |
| LOW | 18 " | 9 " |
| REVERSE | 14 " | 7 " |

Fig. 4

CAUTION PLATE NO. 26

The maximum permissible road speeds for the various gear positions are specified on this plate Figure 4. It is very important that the instructions outlined on the caution plate be carefully observed.

| | |
|--|-----------|
| NOMENCLATURE: TRUCK, 1/4 TON, 4x4 | |
| SUPPLY ARM OR SERVICE | |
| MAINTAINING VEHICLE: QUARTERMASTER CORPS | |
| MAKE AND MODEL: | FORD-GP |
| SERIAL NUMBER: | |
| MAXIMUM GROSS WEIGHT: | 2800 LBS. |
| DATE OF DELIVERY: | |
| RECOMMENDED BY MANUFACTURER: | |
| OCTANE RATING OF GASOLINE - MIN. | 68 |
| S.A.E. GRADE OF OIL FOR SUMMER USE | 30 |
| S.A.E. GRADE OF OIL FOR WINTER USE | 20 |

Fig. 5

NOMENCLATURE PLATE NO. 27

This plate, located on the right side of the instrument panel, provides all necessary information for readily identifying the vehicle. An illustration of the plate is shown in Figure 5.

MASTER CYLINDER INSPECTION COVER NO. 28

The master cylinder inspection cover, located in the floor, must be removed before the fluid level in the hydraulic brake master cylinder can be examined.

OPERATING INSTRUCTIONS

STARTING THE ENGINE

1. Be sure transmission gearshift lever is in neutral position, as indicated on the gearshift information plate.
2. If the engine is cold, pull out the hand throttle from 1/4" to 3/8".
3. Pull choke outward slightly in cool weather or almost to the stop in severely cold weather.
4. Turn ignition switch key to the right.
5. Press starter button. It is always advisable to disengage the clutch at the same time. As soon as the engine starts, release the starter button.
6. Push the choke in gradually as far as possible without disturbing the smooth performance of the engine. As soon as the engine is warmed up, push the choke all the way in.
7. Push in the hand throttle after the engine warms up sufficiently to idle smoothly. **AVOID RACING THE ENGINE WHILE IT IS COLD.**

STARTING THE VEHICLE

The following instructions apply to normal operations such as are encountered in driving a vehicle of this type during a training period.

1. Make sure the front axle drive lever is in the forward position so the front axle drive is disengaged.
2. Make sure the transfer case auxiliary range lever is pulled backward to the high speed range as indicated on the instruction plate (Figure 3).
3. Fully depress clutch pedal so the clutch will be completely disengaged.
4. Move transmission gearshift lever to the left and backward into low speed position (See Instruction Plate).
5. Release hand brake lever.

6. Gently depress Accelerator Pedal to speed up engine slightly.

7. As the engine speed increases gradually and smoothly release the clutch pedal. As the clutch engages and the vehicle starts to move, put slightly more pressure on the Accelerator Pedal so the engine will pick up the load smoothly.

8. At a speed of approximately 7 miles per hour, depress clutch pedal and at the same time release pressure on the Accelerator Pedal. As soon as the clutch is disengaged, move the transmission gear shift lever out of the lower gear position into neutral and from there into the second speed position which is to the right and forward (See Instruction Plate). After this shift is completed, the clutch can be released without any hesitancy and at the same time press down on the Accelerator.

9. After the vehicle has attained a speed of approximately 18 miles per hour in second gear, follow the same procedure outlined above to shift the gearshift lever into the third or high speed position. This is done by merely disengaging the clutch pedal, releasing pressure on the accelerator and then moving the transmission gearshift lever straight backward from the second speed gear position to the high speed position.

SHIFTING TRANSFER CASE LEVER

The foregoing instructions cover operation of the vehicle on dry hard surface roads. Under such conditions, the front axle drive should always be disengaged. Operation over muddy roads or in deep sand, of course, necessitates the application of more power to the wheels and this can be accomplished by engaging the front axle drive. To do this proceed as follows:

1. Disengage the clutch and at the same time release pressure on the accelerator.
2. Pull front axle drive lever backward, thus engaging front axle drive gears.

FORD TRUCK 1/4-TON 4 x 4

3. Shift Transmission lever to engage gear considered necessary for the particular type of road.

4. Immediately engage clutch and press down on the foot accelerator.

SHIFTING TRANSFER CASE FROM HIGH TO LOW SPEED RANGE

Occasionally the vehicle must be operated with capacity load in deep mud or sand which cannot be negotiated by using the high speed range of gears. To shift to the low speed range, proceed as follows:

1. Bring the vehicle to a complete stop.
2. Make sure the front axle drive lever is moved backward into the engaged position as the Auxiliary Range gears cannot be engaged unless the front axle drive is connected.
3. With the clutch disengaged, push the transfer case auxiliary range lever all the way forward into the low position as shown on the Instruction Plate.
4. Move transmission gearshift lever to low or second speed as desired and follow the procedure previously outlined for starting the vehicle.

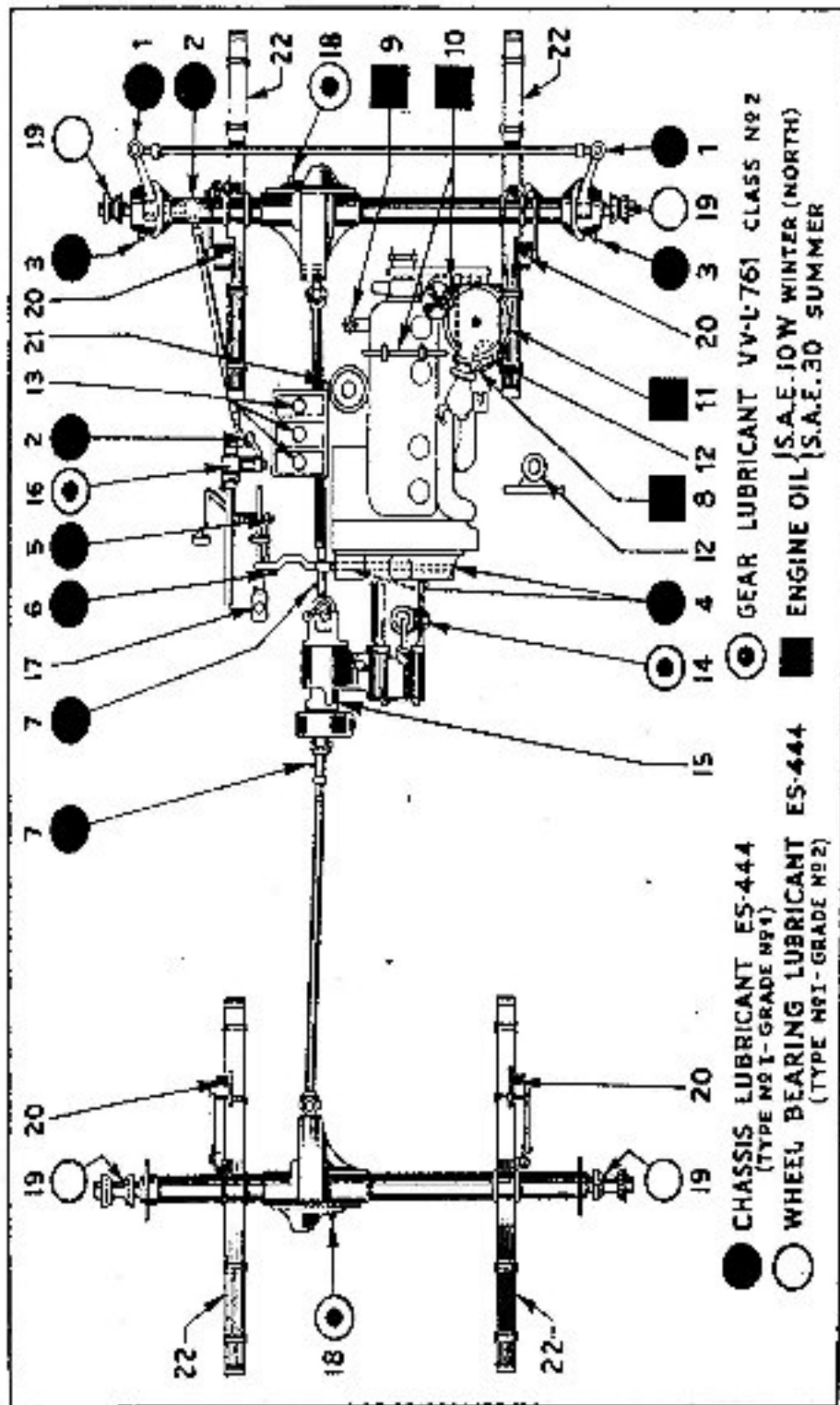
SHIFTING INTO REVERSE

The vehicle must be brought to a complete stop before the transmission can be shifted into reverse gear. To operate in reverse, proceed as follows:

1. Disengage clutch.
2. Move transmission gearshift lever to the left and forward.
3. Speed up the engine slightly by putting a light pressure on the accelerator pedal.
4. Release clutch pedal gently and at the same time exert slightly more pressure on the accelerator pedal so the engine will pick up the load smoothly.

STOPPING THE VEHICLE

1. Remove foot from accelerator pedal. Except in emergency stops, this should be done some distance before reaching the point where the vehicle is to stop so the compression of the engine will slow down the vehicle.
2. Apply brake by pressing down on brake pedal.
3. When speed has been reduced to approximately 7 miles per hour, disengage clutch and move transmission gearshift lever into the neutral position, maintaining pressure on brake pedal until vehicle stops.
4. Apply hand brake.



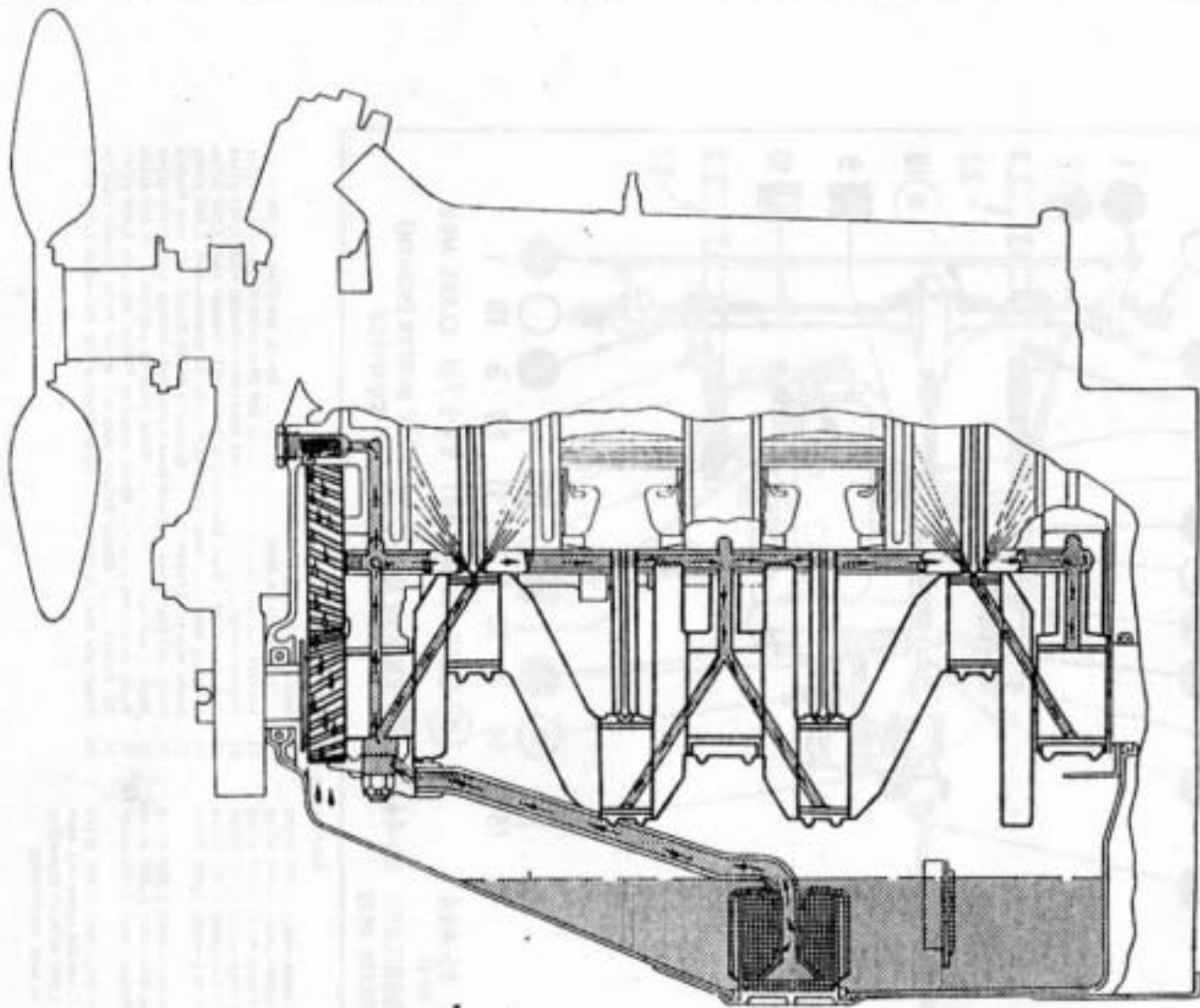
CHASSIS LUBRICANT ES-444
 (TYPE N91-GRADE N91)
 WHEEL BEARING LUBRICANT ES-444
 (TYPE N91-GRADE N92)

GEAR LUBRICANT VV-U-761 CLASS N92
 ENGINE OIL { S.A.E. 10 W WINTER (NORTH)
 { S.A.E. 30 SUMMER

Lubrication points - Fig. 6

- | | | | |
|---|--|--|--|
| <ul style="list-style-type: none"> 1. Spindle Connecting Rod Ends 2. Head Link Ends 3. Steering Knuckle 4. Clutch Release Shaft 5. Brake Pedal Shaft 6. Clutch Pedal Shaft 7. Front and Rear Propeller Shaft Slip Joints 8. Generator Rear Bearing 9. Ancillary Oil Pan 10. Distributor Shaft and Accessory Shaft 11. Oil Bath Air Cleaner | <ul style="list-style-type: none"> 12. Chassis Lubricant—each 1,000 miles 13. Chassis Lubricant—each 1,000 miles 14. Chassis Lubricant—each 1,000 miles 15. Chassis Lubricant—each 1,000 miles 16. Chassis Lubricant—each 1,000 miles 17. Chassis Lubricant—each 1,000 miles 18. Chassis Lubricant—each 1,000 miles 19. Engine Oil—each 2,000 miles 20. Engine Oil—each 2,000 miles 21. Engine Oil—each 2,000 miles 22. Engine Oil—each 2,000 miles | <ul style="list-style-type: none"> 12. Fuel Pump Seal/vent Trip and Fuel Filter on Dash 13. Battery 14. Transm. Oil 15. Transfer Case 16. Steering Gear 17. Brake Master Cylinder 18. Front and Rear Axles 19. Wheel Bearings 20. Shock Absorbers 21. Oil Filter 22. Front and Rear Springs | <ul style="list-style-type: none"> Grease and Clean—5,000 miles add Bleed/Hot Water—1,000 miles Gear Lubricant—change each 2,000 miles Gear Lubricant—change each 2,000 miles Hydraulic Brake Fluid—add when needed Wheel Bearing Lubricant—10,000 miles Snow Grease/Brake Fluid—add each 2,000 miles Change Filter when oil shows dirty between changes Spray Penetrating Oil—each 2,000 miles |
|---|--|--|--|

2,000 miles/2,000 miles/2,000 miles/2,000 miles



Engine Oiling System - Fig. 7

GENERAL LUBRICATION

Before considering the details in connection with lubrication of modern motor vehicles, it is essential to understand some of the conditions which are encountered in such vehicles. In the first place most of the moving parts are manufactured to a high degree of precision and are fitted to very close limits. Lubricants for such parts must be capable of penetrating between these closely fitted parts quickly and maintain their lubricating qualities under high operating temperatures. Different qualities in lubricants are required for different parts of the car due to the varying degrees of pressure, heat or friction.

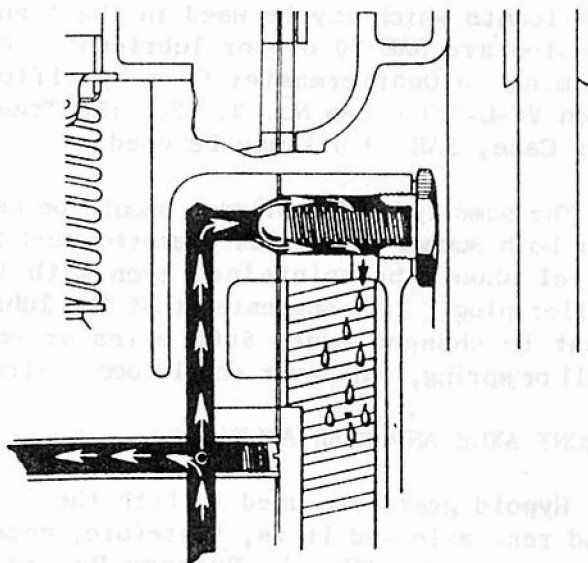
Engineers have made a careful study to determine what type of lubricant will most

effectively combat friction and reduce heat in each of the various units of which a motor vehicle is comprised and the importance of adhering closely to the factory recommendations as to lubricant cannot be over emphasized. To fully appreciate the importance of using the right lubricant in the right place, a motor vehicle should be considered as a group of entirely different mechanical units, many of which perform a different function. For this reason they must be lubricated with a lubricant especially designed to combat a degree of heat, friction or pressure encountered in that particular unit.

The particular type of lubricant for each point is covered in the Lubrication Chart.

ENGINE

As illustrated in Figure 7, the engine is lubricated by pressure feed to the main connecting rod and camshaft bearings and by splash to other parts. The gear-type Oil Pump Housing is cast integral with the front Main Bearing cap and is driven from the crankshaft gear of the timing gear set. The oil pressure relief and regulating valve illustrated in Figure 8 lifts at 30 pound pressure which will show a gauge pressure from 15 to 30 pounds on the instrument panel depending on the temperatures of the oil and speed of the engine. The oil in the engine when shipped from the factory is satisfactory for the first 300 miles. After this period of operation, the engine oil should be drained and replaced with new oil of the correct viscosity as shown below:



Oil Relief Valve - Fig. 8

| PREVAILING TEMPERATURE RANGE: | S.A.E. Viscosity No. |
|--|----------------------|
| Temperatures above 32 degrees Fahrenheit | 30 |
| Temperatures below 32 degrees Fahrenheit | 10 or 10-W |

OIL PAN DRAIN PLUG

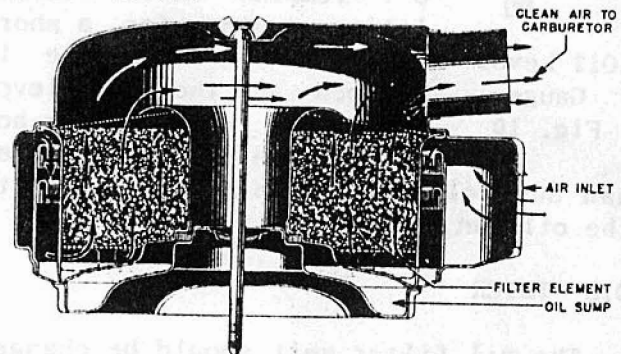
It will be observed that the oil pump screen is an integral part of the oil pan drain plug. Part 6730, Figure 82. As a

precautionary measure toward preventing accumulation of sludge or foreign matter on the screen, it is suggested that this screen be cleaned in gasoline before the plug is replaced.

OIL CHANGES

Under normal driving conditions, the engine oil should be changed every 2,000 miles. By normal driving conditions we mean within temperatures ranging from 32 degrees Fahrenheit to approximately 80 degrees, medium road speed and average dust conditions. In extremely cold weather when condensation and crankcase dilution might cause the formation of sludge in the crankcase, the oil should be changed more frequently.

This procedure should also be followed with units which are operated infrequently and for short periods during cold weather. This type of operation promotes the accumulation of water in the crankcase resulting from condensation and products of combustion within the engine. Such moisture and other contaminants are largely evaporated after the engine becomes thoroughly warmed up but under conditions such as those mentioned above, they can be a source of considerable trouble if precautionary measures are not taken.



Sectional View of Oil Bath Air Cleaner Fig. 9

DUSTY TERRITORY

Notwithstanding the fact that the Ford engine is equipped with an Oil Filter, as well as an Oil Bath Type Air Cleaner, the oil should be changed more frequently when the units are operated under extremely dusty conditions. The Oil Bath Air Cleaner should be cleaned out as often as is necessary to keep the sump free from excessive

accumulations of dirt. Under the most severe conditions this might be necessary every day although such extreme conditions are very infrequently encountered. The engine ventilator screen in the oil filler cap should also be checked to see that it does not become obstructed with dust.

ADDING OIL

The oil level should be kept in the "safe driving range" as marked on the oil level bayonet gauge shown in Figure 10. The five quarts of oil placed in the crankcase when the oil is changed, brings the level slightly above the full mark on the measuring stick. It is not necessary to maintain the level at this point and oil should not necessarily be added until the level is down toward the lower part of the "safe driving range" indicated on the gauge.

It is advisable to wait several minutes after the engine has been stopped before checking the oil level. A considerable quantity of oil remains in the circulating system for a short period after the engine is stopped and the oil level gauge will not register accurately until this oil has

had sufficient time to drain back into the oil pan.

OIL FILTER

The oil filter unit should be changed after 8,000 to 10,000 miles of operation. The cleaner element and case are manufactured as a complete unit and the entire element must be changed (See Figure 11).

To change the oil filter, disconnect the oil line at both top and bottom of the filter unit. Remove the oil gauge unit which is screwed into the top of the oil filter. Loosen the two cap screws which hold the filter bracket to the cylinder block and the clamp screw located between the filter and the cylinder block.

The filter unit can then be pulled upward out of the bracket. Install the new filter unit into the bracket on the engine and tighten the clamp screw. Then install the oil gauge unit in the new filter and connect both the top and bottom oil lines to the connections on the filter unit.



Sectional View of Oil Filter Unit
Fig. 11

TRANSMISSION AND TRANSFER CASE

Both the transmission and transfer case should be lubricated with SAE 90-EP gear oil if such lubricant is available. Since the selection of lubricants is necessarily restricted in field operations, alternative lubricants which may be used in the transmission are SAE 70 oil or lubricants conforming to Quartermaster Corp specification VV-L-761 Class No. 2. For the Transfer Case, SAE 70 oil may be used.

The same type of lubricant should be used for both summer and winter operation and the level should be maintained even with the filler plug. It is suggested that the lubricant be changed every 5000 miles or each fall or spring, whichever should occur first.

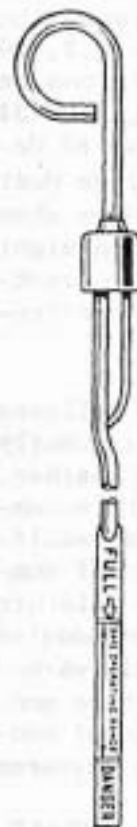
FRONT AXLE AND REAR AXLE

Hypoid gears are used in both the front and rear axle and it is, therefore, necessary to use a "Hypoid Extreme Pressure" type of lubricant. Gear lubricant conforming to Quartermaster Corp specification VV-L-761 Class No. 2 is of this type and should be SAE 90 viscosity.

Avoid mixing various brands of Hypoid lubricants. If the brand is changed, it is essential that the rear axle housings be drained and flushed with light engine oil before installing the new lubricant.

FRONT AXLE UNIVERSAL JOINTS

Chassis Lubricant conforming to Quartermaster Corp specifications ES-444 Type No. 1--Grade No. 1, should be used to lubricate these parts. Approximately 1/2 lb. (1/2 pt.) is required in each steering knuckle joint housing. Remove the plug shown in Figure 6 to inject the lubricant.



Oil Level Gauge
Fig. 10

PERMANENTLY LUBRICATED PARTS

The following parts are packed with lubricant at the factory and will not require the addition of any lubricant unless disassembly of the parts becomes necessary for some other reasons.

Front and rear propeller shaft
Universal joints
Clutch throw-out bearing
Clutch pilot bearing
Water pump

In the event the flywheel is disassembled from the engine for any reason, it will, of course, be necessary to re-pack the pilot bearing with a lubricant having a high melting point, such as ES-444, Type 1, Grade 2.

STEERING GEAR

The level of the lubricant in the steering gear should be checked each 1000 miles and if necessary, add Gear Lubricant VV-L-761, Class No. 2. This will apply to either summer or winter operations.

SHOCK ABSORBERS

The shock absorbers should be refilled every 5,000 miles with Ford Shock Absorber Fluid. When refilling an instrument, clean it thoroughly around the filler plug before removing the plug. An extremely small particle of dirt inside the instrument might cause it to become inoperative.

CHASSIS FITTINGS

The Lubrication Chart, Figure 6, clearly indicates the various fittings to which chassis lubricant should be applied. A semi-fluid lubricant intended for use in a pressure gun should be injected into these particular fittings. Every fitting should be wiped clean before the pressure gun is applied so as to avoid forcing particles of dirt or abrasive into the parts which are to be lubricated.

WHEELS AND TIRES

Pressed steel, drop center rim wheels which were especially designed for this unit, are used on the Ford Reconnaissance and Command Car. The wheels are 16" in diameter, have a 4" rim, 5-1/2" bolt circle and five bolt holes. They are fitted with either 550 x 16 tires or 600 x 16 tires. In either case the correct inflation pressure is 24 pounds.

The most important factor controlling tire life is the air pressure in the tire. Tire inflation should, therefore, be checked at least once each week and every precaution taken to prevent operation of the vehicle with tire pressures less than 20 pounds. Under-inflation not only decreases tire life but also adds to the possibility of a rim bruise.

Rim bruises are caused by the tire hitting a curb or some other object with sufficient force to pinch the tire between the object struck and the rim. Several cords may be broken in the second or third layer of fabric but the tire will not show any outward signs of an injury. These cords will gradually wear on other cords until a break occurs.

One of the most important reasons for close attention to inflation pressures is the fact that this vehicle has four wheel drive. When both front and rear axles are driving, the rolling radius of all wheels must be equal in order to avoid premature or excessive wear in the axle differentials.

CHANGING WHEEL AND TIRE

To change a wheel and tire assembly, the procedure outlined below should be followed:

1. Apply the emergency brake.
2. Block one of the wheels resting on the ground with a large stone or block of wood.

3. Place jack under axle close to the spring seat of the wheel which is to be removed, and jack up car until wheel is at least 1" clear of the ground.

4. Remove the five nuts holding the wheel to the hub. See Figure 12. The wheel can then be removed.

REMOVING TIRE FROM WHEEL



Fig. 12

Deflate the tube completely. Loosen both beads from bead seats on rim. Force the outside bead from the bead seat into the rim well at a point opposite the valve. Be sure the bead is in the rim well, then with two tire tools placed

approximately 4" on each side of the valve, lift the bead closest to you over the rim flange. (See Figure 13.) Follow around the flange with the tire tools until the outside bead is free from the rim. Then force the inside bead into the rim well at the top and pull out the bottom of the tire until it swings clear as shown in Figure 13.

MOUNTING TIRE ON WHEEL:

Inflate the tube until it is fairly rounded out and insert it in the tire. The tube must be placed in the tire with the valve stem at the balance mark. Push the inside bead of the tire into the rim well at the point next to the valve. Force the remaining portion of the bead over the outside flange of the rim. Do not attempt to force too large a portion over the flange at one time. Lift up on the tire, placing the outside bead in rim well at the valve. Starting at either side of the valve, force short length of the bead over the flange, continuing around the wheel

until the entire bead is replaced. Always keep as much of the bead as possible in the rim well while installing the tire.

Before inflating the tube, push the valve stem into the casing as far as possible to make sure that the tube is not

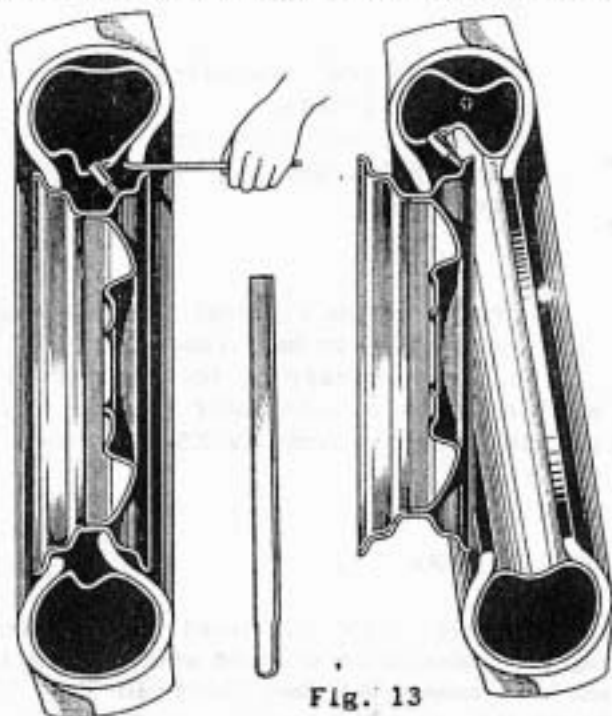


Fig. 13

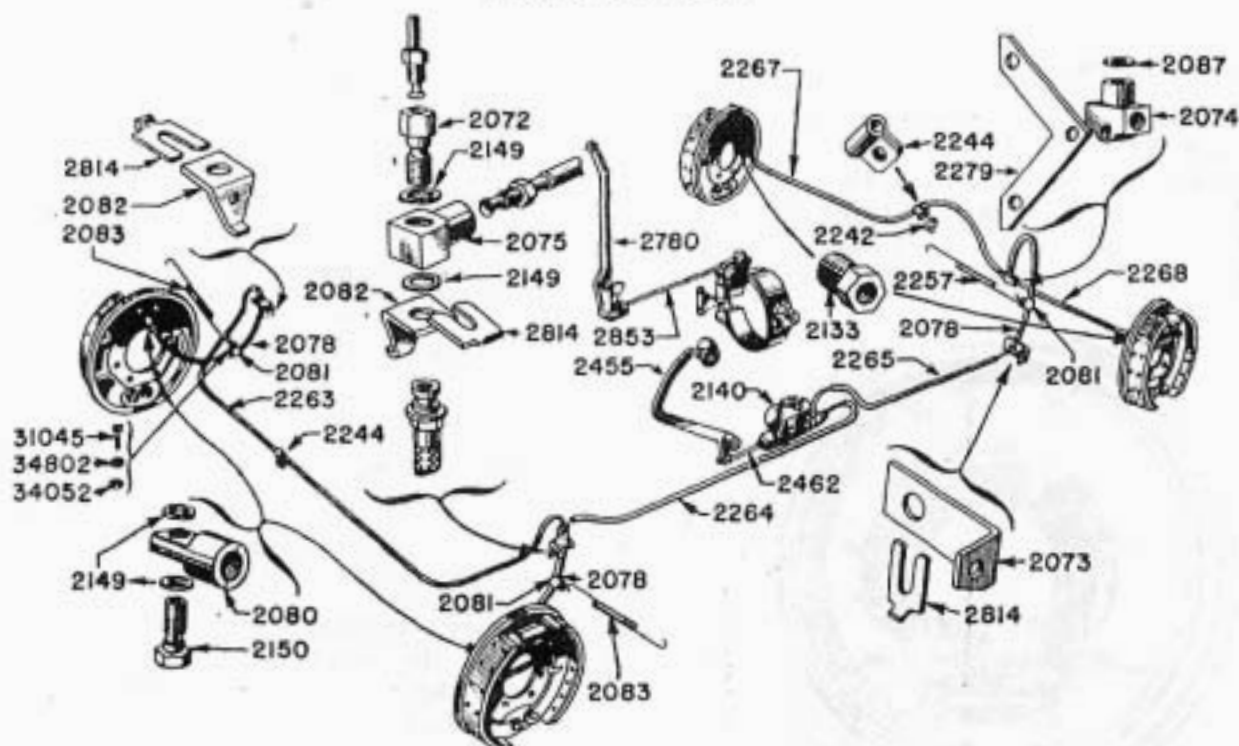
pinched under the tire beads. Do not let go of the valve stem while doing this.

Inflate the tube to not more than 2 pounds pressure, working casing back and forth. Proper fitting of the tire is indicated by the molded line on the side of the tire being equally spaced from the rim at all points.

SPARE TIRE

The spare tire and wheel assembly is mounted on the back of the body and held in place by three nuts. The bottom of the tire rests on a support plate which is bolted to the bumper. This support plate has slotted holes so that it can be adjusted up or down to provide adequate support for either 5.50 or 6.00 size tires.

BRAKE SYSTEM



Brake System - Fig. 14

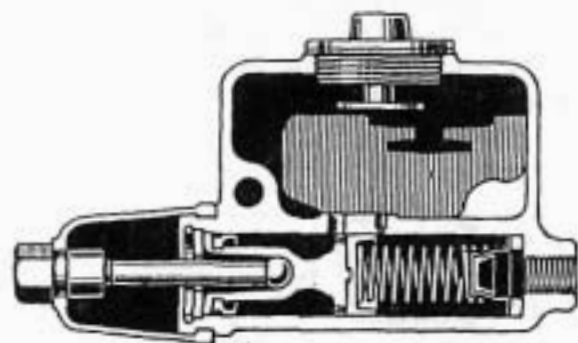
The system consists of a master cylinder in which hydraulic pressure is built up by pressure on the brake pedal, 4 wheel cylinders operating brake shoes against each wheel drum when pressure is applied, and the lines consisting of tubing, flexible hose, brackets and unions, interconnecting the master cylinder and wheel cylinders. See Figure 14.

The master cylinder is fitted with a piston, and the wheel cylinders are each fitted with two opposed pistons, all of which are provided with cup packings, which act as seals to maintain pressure and prevent loss of brake fluid.

The brake pedal, when depressed, moves the piston within the master cylinder; thus, sending the brake fluid from the master cylinder through the tubing and flexible hose to each of the four wheel cylinders.

Brake fluid is placed under pressure at each of the wheel cylinders causing the pistons to move outward against the brake shoes, bringing the shoes into contact with the drums. See Figure 16. As pressure on the brake pedal is increased, greater hydraulic pressure is built up within the wheel cylinders and consequently greater force is exerted against the brake shoes. The system is self equalizing since all pressure is transmitted to the brake shoes by the column of fluid and no pressure can be developed in any of the wheel cylinders or brake lines until the pressure is equally distributed at all points.

When the pressure on the foot pedal is released, the retracting springs on the brake shoes return wheel cylinder pistons to their normal or "off" position thereby, forcing the brake fluid back through the flexible hose and tubing into the master cylinder.

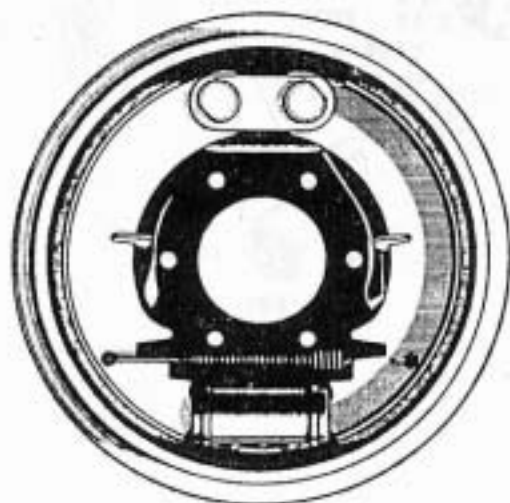


Brake Master Cylinder - Fig. 15

THE MASTER CYLINDER

The compensating-type master cylinder Fig. 15 performs two functions:

1. By means of the supply reservoir in the upper part of the housing, it maintains a constant volume of fluid in the system at all times regardless of expansion, "heating," or contraction, "cooling." It also acts as a pump during the "bleeding" operation.



Wheel Brake Assembly - Fig. 16

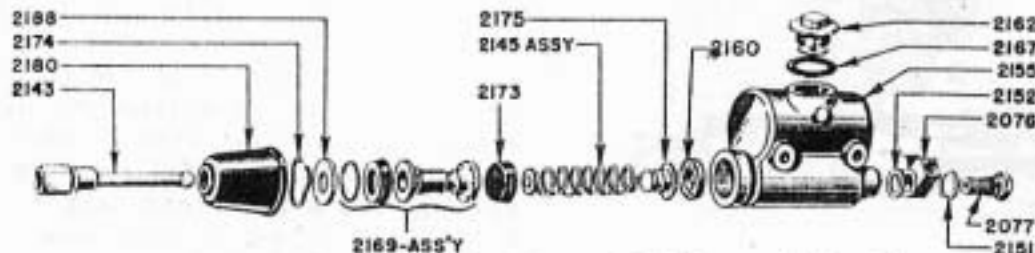
2. It permits additional fluid to enter the system to counterbalance any loss due to gravity seepage.

Piston and cup return to release position much faster than the fluid in the lines. A momentary vacuum is created in the cylinder barrel and additional fluid is drawn into the system from the supply reservoir through the drilled holes in piston and past the lip of cup.

After fluid returns from the wheel cylinders, any excess of fluid in the system is passed through port into the reservoir; thus the cylinder is always full of fluid for the next brake application.

WHEEL BRAKE ASSEMBLIES

The wheel brake units are composed of a



Exploded View of Brake Master Cylinder - Fig. 17

dust shield assembly or support plate, two brake shoes, the wheel cylinder assembly and brake shoe contracting spring. Figure 18 shows all parts of the rear wheel cylinder in their relative assembling positions.

The wheel cylinders, are of the straight bore construction, being 1" diameter on the front wheels and 7/8" on the rear wheels.



Exploded View of Wheel Cylinder-- Fig. 18
TO REMOVE THE WHEEL CYLINDER

Should it become necessary to remove the wheel cylinder for inspection, the following operation should be performed:

Disconnect the cylinder from the system by removing the inlet fitting and the bolts which hold the cylinder to the brake plate. The shoe travel is sufficient to permit the cylinder to be withdrawn without removing the brake shoes, after the retracting spring has been disconnected.

INSPECTION OF WHEEL CYLINDER

After removing the wheel cylinder, from the brake assembly, remove the boots, Part No. 2206, from both ends of the cylinder. The pistons, Part No. 2196 and cups, Part No. 2201, are forced out of the barrel by the return spring pressure, Part No. 2204. Inspect the cups for ragged ends and the bore for smoothness.

Should the bore be scratched or pitted, it will be necessary to replace the cylinder, to prevent loss of fluid or excessive cup wear.

When re-assembling the wheel cylinder, all parts must be first washed in clean alcohol, then dipped in Brake Fluid for lubrication. Re-assemble the cup, Part

2201, piston, Part 2196, and boot, Part 2206, in one end of the casting. The return spring, Part 2204, and other cup, 2201, piston, 2196, and boot, 2206, are then installed in the other end of the wheel cylinder. The unit is now ready for installation. New inlet fitting gaskets must be used when connecting the cylinder to the system.

BLEEDING HYDRAULIC LINES

Whenever a tubing line has been disconnected at the master cylinder, it is necessary to "bleed" the hydraulic system at all four wheels to expel all air. Whenever a line is disconnected from any individual wheel, that wheel cylinder only must be "bled."

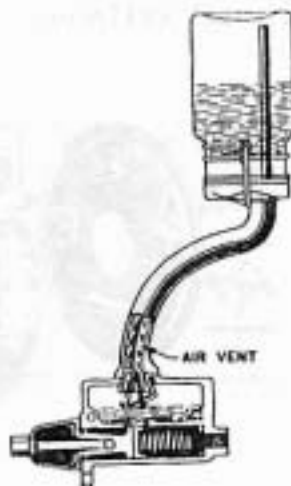
Loosen the bleeder hose fitting, Part 2208, and slip on hose, Figure 19. Allow bleeder hose to hang in clean container, such as pint jar.



Bleeding Wheel Cylinder - Fig. 19

Watch the flow of fluid from hose, the end of which should be kept below the surface of fluid. When all air bubbles cease to appear and when fluid stream is a solid mass, close bleeder connection.

Depress the foot pedal slowly by hand; allow return spring to return pedal "slowly" to "off" position. This produces a pumping action which forces fluid through the tubing and out at the wheel cylinder, carrying with it any air that may be present.



Refilling Master Cylinder during Bleeding Operation Fig. 20

During this operation the master cylinder must be kept filled with Hydraulic Brake Fluid. A master cylinder refiller such as the one illustrated in Figure 20 should be secured in the event a large, air pressure refiller is not available.

Fluid withdrawn in "bleeding" operation should not be used again.

PEDAL ADJUSTMENT

Pedal adjustment is made as follows:

It is important that the link, Part 2143, Figure 17, be adjusted for clearance where it seats in the piston. See sectional view, Figure 15. Should the link, Part 2143, be adjusted tightly against the piston, by-pass port may be blocked by the cup, Part 2173, and compensating action of the master cylinder will be destroyed. The primary cup, Part 2173, must be clear of by-pass port when piston is in its "off" or released position. This may be determined by ascertaining if there is 1/4" to 1/2" free movement of the brake pedal before the piston starts to move.

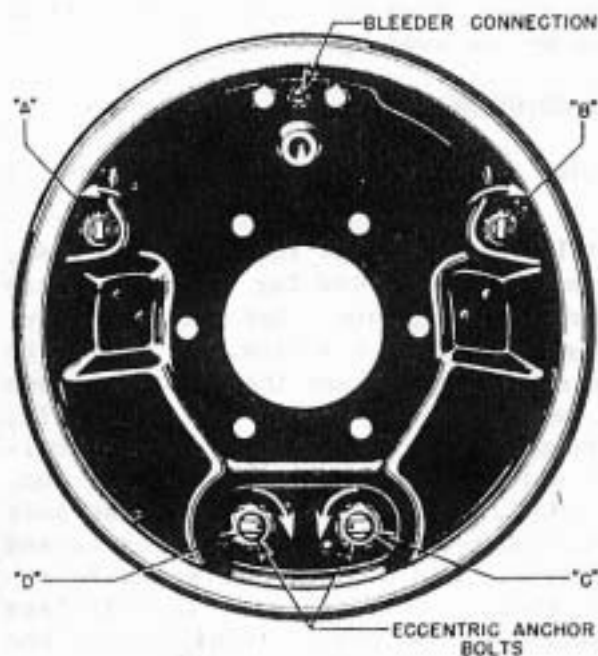
Secondary cup (on 2169 assembly) prevents fluid from leaking out of the master cylinder into the boot.

CAUTION: BEFORE REMOVING SUPPLY TANK FILLER CAP, EXTREME CARE MUST BE USED TO PREVENT DIRT FROM ENTERING THE MASTER CYLINDER. DIRT GETTING LODGED BETWEEN THE PISTONS IN THE SYSTEM AND THE CYLINDER WALLS MAY CAUSE SPASMODIC BRAKE FAILURE.

The use of other than an approved Brake Fluid or the introduction of oil with a mineral base or any unsuitable liquid will cause the rubber parts to swell and become inoperative. Grit and abrasive substances permitted to enter the fluid reservoir will cause the cylinder barrel to become scratched and pitted. When either of these conditions occur, it becomes necessary to remove the master cylinder for inspection and reconditioning.

ADJUSTMENT FOR WEAR

Brakes should be adjusted when the linings have been worn to the extent that the pedal pad travels to within 1" of the toe board on a hard brake application.



Brake Shoe Adjustments - Fig. 21

Brake drums should be approximately at room temperature when making adjustments. If brakes are adjusted when drums are hot or expanded, the shoes may drag when the drums cool and contract.

1. Jack up all four wheels.
2. End play in wheel bearing should be taken up.
3. Check pedal adjustment to make sure that pedal pad travels approximately 1/4" before master cylinder link end play has been taken up and master cylinder piston starts to move.

Repeat the following operations at each wheel.

4. Adjustment is made by turning the cams "A" and "B" (Figure 21) with a wrench, in the direction of arrows, until the shoes come in contact with the drum, then back off the adjustment slightly until the wheel rotates freely in either direction of rotation. Proceed in a like manner on the brake shoes of all wheels.

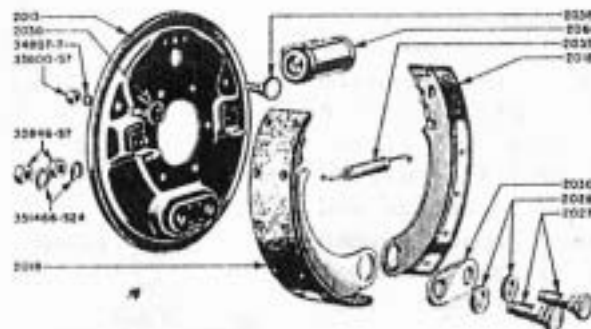
PREPARING PARTS FOR MAJOR BRAKE ADJUSTMENT

When major brake adjustment is required or brake parts renewed, it is recommended that all brake drums be removed and cleaned and brake shoes and parts removed, cleaned and inspected as to condition of lining, shoe return springs, hydraulic wheel cylinders, etc.

During this inspection or disassembly of brakes, the hydraulic portion of the system should be left intact so that bleeding of the lines will not be required. This is readily accomplished by disconnecting the brake shoes from the cylinder at the connecting links, without disturbing the hydraulic connections. The brake pedal must NOT be depressed at any time when brake drums are not in place.

REPLACING BRAKE SHOES

1. Remove wheel and drum assemblies.
2. Remove brake shoe retracting spring, Part 2061, Figure 22. Remove lock nut and washers from eccentric anchor bolts, Part 2027. Remove anchor bolts. Grasp brake shoes at the bottom and pull sidewise to release them from the brake shoe locating lugs and then remove the upper ends from the wheel cylinder.
3. Remove the rubber cups and pistons from the wheel cylinder.



Exploded View of Wheel Brake Assembly - Fig. 22

Examine all parts in the wheel cylinders and reassemble the units as outlined on page 20.

Install the new brake shoes on the brake plate. Be careful that the upper end of the brake shoes are properly placed in the slots in the cylinder pistons. Install the brake shoe anchor bolts, Part 2027, eccentrics, Part 2028, lock washers and nuts. Leave the anchor bolt lock nuts sufficiently loose so the anchor bolts can be turned. Each anchor bolt is provided with a mark on the tang which indicates the high side of the eccentric. Set these two marks toward each other before installing the brake drum. Reinstall brake shoe retracting spring, Part 2035.

The above operation should be performed at all four wheels before proceeding with the work of adjusting the brakes.

After reinstalling the hub and brake drum assemblies and wheels, bleed the braking system at all 4 wheels, as described on page 21.

Apply from 25 to 35 lbs. pressure to the brake pedal. This pressure should be maintained while making the brake adjustment. Applying pressure to the brake pedal expands the brake shoes out to the brake drum. Using a small open end wrench, turn the anchor bolts C&D in the direction of the arrows on Figure 21 until each shoe barely touches the brake drum. Tighten the lock nut on each anchor bolt, making sure that the anchor bolt is held securely while the nut is being tightened, so as not to change the setting.

Remove the pressure from the brake pedal and turn each wheel by hand to make sure that the shoes are not dragging. If there is any indication that a shoe is dragging, repeat the above operation more carefully.

The above operation should be performed for each shoe at all 4 wheels.

After making sure that the eccentric anchor bolts are properly adjusted, as

outlined above, the upper ends of the brake shoes should be adjusted to the correct clearance by turning the adjusting cams "A" and "B", Figure 21, in the directions indicated by the arrows until the shoes touch the drums. Then back them off very slightly so there is clearance between the shoes and the drum. This clearance should be approximately .008".

BRAKE MAINTENANCE HINTS

1. Pedal goes to floor board.

Cause:

- a. Normal wear of lining.
- b. Leak in system.
- c. Air in system.
- d. No fluid in supply tank.

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 from the driver that it is necessary to PUMP the pedal several times before a brake is obtained. Shoes should be set as close to brake drums as possible without drag. Do not disturb anchor pins when making this adjustment. Adjustment must be made while drums are cool.

b. A connection leak in the system will allow the pedal, under pressure, to go to the toe board gradually. A cup leak does not necessarily result in loss of pedal travel, but will be indicated by a loss of fluid in the supply tank. If no leaks are found at wheels or connections, remove master cylinder and check bore of barrel for score or scratches.

c. 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 the toe board under normal pressure. System should be bled.

2. All Brakes Drag.

Cause:

- a. Mineral oil in system.
- b. Port hole closed.

Remedy:

a. The introduction into the system of any oil of a mineral base, such as engine oil, kerosene, or the like, will cause the cups to swell and distort, making it necessary to replace all rubber parts. Flush system with alcohol and refill with Approved Brake Fluid.

b. Directly ahead of the master cylinder piston cup, Part 2173, (when in normal release position) is a relief port. It is imperative that this port be open when the brakes are released. Should this port, Figure 15, be blocked by piston cup not returning to its proper release position, the pressure in the system will gradually build up and cause brakes to drag. Opening a bleeder screw will allow built-up pressure to escape and give temporary relief. Bleeder screw must be tight before car is driven.

3. One Wheel Drags

Cause:

- a. Weak brake shoe return spring.
- b. Brake shoes set too close to drum.
- c. Cups distorted.

Remedy:

a. Springs sometimes lose their contracting power and take a set. Replace spring.

b. Readjust shoes to proper clearance.

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.

4. Car pulls to one side.

Cause:

- a. Oil-soaked lining.
- b. Shoes improperly set.
- c. Backing plate loose on axle.
- d. Different makes of lining.
- e. Tires not properly inflated.
- f. Incorrect caster angle.

Remedy:

a. Replace with new Ford lined brake shoes. Grease-soaked linings cannot be salvaged by washing or cleaning.

b. The construction of the brake is such as to cause a slight pull or drift if shoes are improperly set on the front wheels. On the rear wheels there will be no drift noticed, but one wheel will slide before the other. Re-adjust the shoes to proper clearance.

c. Loose brake support permits the brake assembly to shift on the locating bolts. This shifting changes the predetermined centers and causes unequal efficiency. Tighten backing plates and re-adjust shoes.

d. Different makes of linings have different braking efficiency. Two different makes, one with high efficiency and one with low efficiency, would cause car to pull to one side. Use Genuine Ford brake lining.

e. All tires should be properly inflated.

- f. Check front axle.

5. Springy, Spongy Pedal

Cause:

- a. Brake shoes not properly adjusted.
- b. Air in system.

Remedy:

- a. Adjust brakes.
- b. Bleed brake system.

6. Excessive Pressure on Pedal, Poor Stop.

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Cause:

- a. Brake shoes not properly adjusted.
- b. Improper lining.
- c. Oil on lining.

Remedy:

- a. Adjust brakes.
- b. Replace with new shoes and linings recommended type, as improper grades of brake linings lose their gripping qualities after a few thousand miles.
- c. Install new brake shoes and linings.

ADJUSTING THE EMERGENCY BRAKE

The emergency brake is an external band type mounted at the rear of the transfer case which operates on a drum fastened to the rear propeller shaft. All parts of the brake are shown in their relative assembling position in Figure 23.

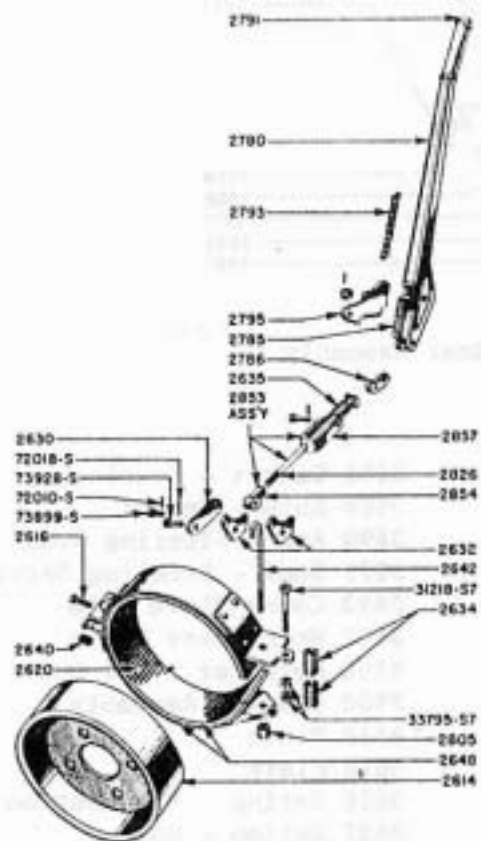


Fig. 23

The various adjustments on the emergency brake are clearly shown in the illustration, Figure 24. The procedure outlined below should be followed in making the adjustments:

1. Set the hand brake lever in full release position.
2. Make sure the flat portion of the cam "F", Part No. 2632, is resting on the ear of the brake band as shown in the illustration, Figure 24. If not, remove pin "G" so the cam will be free.
3. Turn anchor adjusting screw "C" clockwise to move the band in toward the drum until a clearance of .010" is established at this point. Replace the locking wire.
4. Loosen the lock nut "A" and adjust screw "D" to establish .010" clearance for upper half of shoe. Tighten the lock nut.
5. Tighten adjusting nut "B" until a clearance of .010" is likewise established for the lower half of the brake shoe.

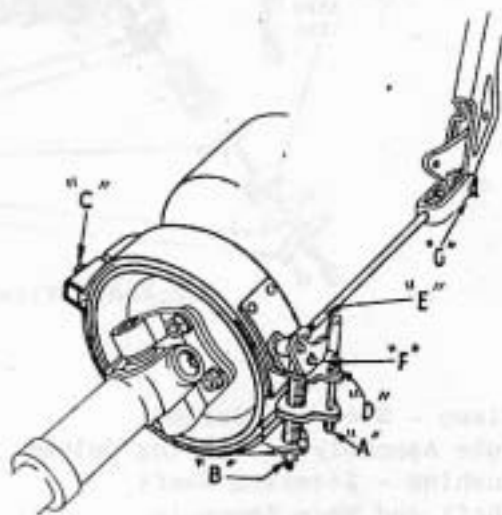
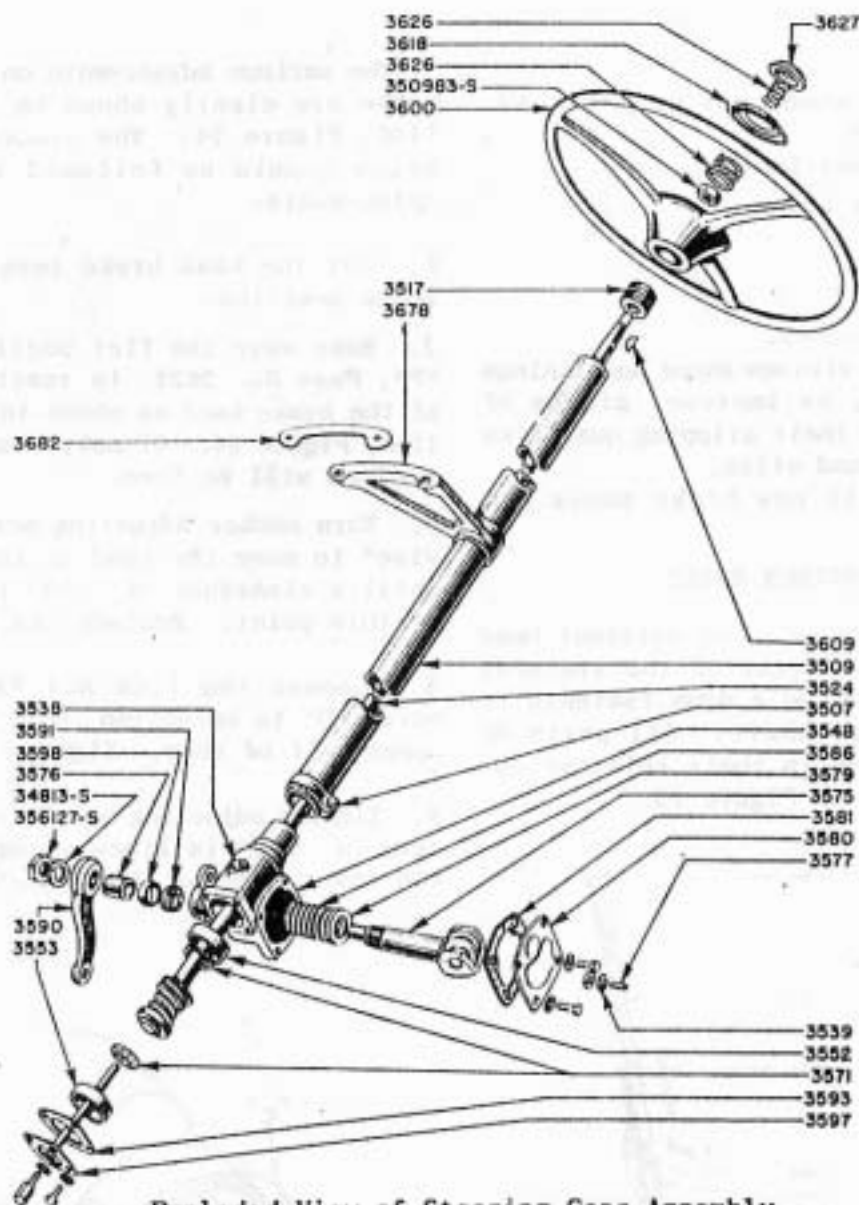


Fig. 24

6. Adjust the clevis on rod "E", Part No. 2826, so that it is exactly the right length with hand lever in full release position and the flat of the cam "F" resting on the ear of the brake band as pointed out in Operation No. 2.
7. Replace pin "G" and cotter pin.

FORD TRUCK 1/4-TON 4 x 4



Exploded View of Steering Gear Assembly
Fig. 25

3507 Clamp - Steering Column
 3509 Tube Assembly - Steering Column
 3517 Bushing - Steering Shaft
 3524 Shaft and Worm Assembly
 3538 Plug
 3539 Nut - Sector Lock
 3548 Housing - Steering Gear
 3552 Cup - Steering Gear Bearing
 3553 Cup - Steering Gear Bearing
 3571 Roller Assembly
 3575 Shaft Assembly - Steering
 3576 Bushing - Steering Sector Shaft
 3577 Screw - Adjusting
 3579 Washer - Thrust
 3580 Cover - Housing

3581 Gasket - Housing
 3586 Shim - Sector
 3590 Arm - Steering Gear
 3591 Seal - Steering Sector
 3593 Cover Plate Shim
 3597 Worm Cover Plate
 3598 Retainer - Oil Seal
 3600 Wheel - Assembly
 3618 Plate
 3618 Plate
 3626 Spring - Horn Button
 3627 Button - Horn
 3678 Bracket - Steering Column
 3682 Shim - Steering Column

STEERING GEAR

The steering gear is the worm and roller type and has a reduction ratio of 18.2 to 1. All parts of the steering gear are shown in Figure 25 in their relative assembling positions and are marked with Part numbers so the parts can be readily identified when referred to in the following instructions.

Means for mechanically eliminating all play within the mechanism have been provided.

In this type of gear, the major adjustments are accomplished with the use of shims. The need for adjustment, however, should present itself only after considerable usage.

Before altering any adjustments, jack up front wheels of car and make sure that cause of complaint is not from some other looseness such as ball sockets, and so forth. Then make the following test.

INSPECTION FOR PROPER WORM BEARING ADJUSTMENT:

Turn hand wheel about one turn to right from straight ahead driving position. Hold securely in this position to prevent any oscillation when front wheels are shaken violently. Now have helper shake front wheels hard sidewise. This will enable any end play in worm bearings, Part 3571, to be felt at wheel hub. If any end play exists, worm bearings need adjusting. Be sure end play is felt, and not be confused with play or give in jacket bushing. Worm bearing adjustment should be correct before further inspection of gear is made.

WORM BEARING ADJUSTMENT:

Loosen four screws which secure worm cover, Part 3597, 1/8 inch. Use a knife to separate the top shim, Part 3593, passing blade all the way around between shims, and taking care not to mutilate the remaining shims. Remove only one shim at a time between inspections, to remove end play. Care should be taken not to set up stiffness in worm bearings.

It is important the drag link be removed from steering gear Pitman arm, Part 3590, in order to effect a satisfactory inspection of other adjustments and alignment of gear in car. Now revolve hand wheel to determine if any stiffness exists. If so, too many shims have been removed or gear is misaligned in car.

CORRECTION OF GEAR MISALIGNMENT

Loosen the frame bracket bolts just enough to allow gear to shift in frame to line up at angle determined by height setting of instrument board gear bracket and retighten frame bracket bolts. Now loosen instrument board gear bracket, Part 3678, and allow it to shift to match gear column position, and retighten. This will correct any possible misalignment of gear column.

INSPECTION FOR END PLAY OF ROLLER SHAFT

Turn hand wheel to either extreme and back an eighth of turn. Gripping Pitman arm, Part 3590, at hub, roller shaft should rotate freely without particle of end play. If any end play exists, adjust as required by means of roller shaft adjustment screw, Part No. 3577, Figure 25, at back of housing. Be sure to lock **SECURELY** with lock nut, Part No. 3539, at back of housing, and reinspect for end play and free rotation throughout whole gear movement.

INSPECTION FOR PROPER MESH OF SHAFT ROLLER IN WORM

(Never make inspection for proper mesh, without first correcting roller shaft and column adjustments described above.) Turn hand wheel to the mid-position of its complete travel or turning limits (drag link previously disconnected), and shake Pitman arm, Part 3590, to determine amount of lost motion. If this lost motion exceeds one-thirty-second of an inch, roller shaft adjustment should be made. In this case, gear must be removed from car.

IMPORTANT NOTE

Before drag link is again connected to steering gear Pitman arm, Part 3590, swing front wheels throughout their turning radius to determine if any tight spots exist. There should not be more than 10 lbs. pull on drag link either fore or aft throughout entire turning radius.

WHEN GEAR IS REMOVED FROM CAR

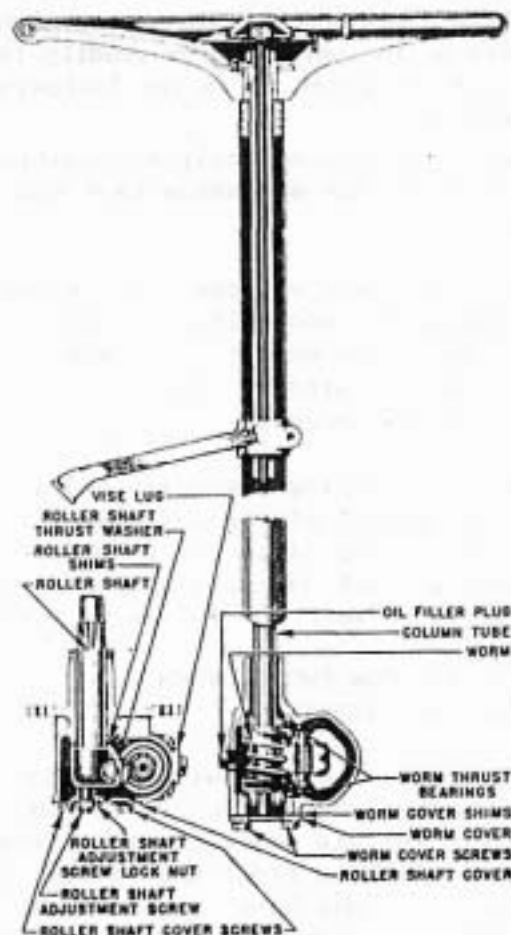
Holding gear in vise and with column to right of vise, remove roller shaft, Part No. 3575, care being taken that all roller shaft shims, Part 3586, remain on roller shaft, so none will drop into housing behind worm, which may cause interference with proper gear operations. Replace hand wheel on column. If proper worm bearing adjustment has not been accomplished, readjust as per previous instructions. Note that roller shaft thrust washer, Part No. 3579, is assembled with chamfered side next to roller shaft thrust face.

ROLLER SHAFT MESH IN WORM

Adjustment for closer mesh of the shaft roller, Part 3575, with the worm or, in other words, elimination of excessive play at this point, is accomplished by the removal of shims which are in place behind the roller shaft thrust washer. See Figure 26. The position of roller contact with worm is offset from the centerline of worm, hence when a shim is removed, the roller is moved into closer mesh with the worm.

Select, through trial, the proper amount of shims to produce not more than .006 inch play measured at end of Pitman arm, and without heavy drag on hand wheel. Remove only one shim, Part No. 3586, from roller shaft, and insert roller shaft in housing. Then turn hand wheel nearly to left stop. Now hold roller shaft in place with thumb pressure on head end of roller shaft, and revolve hand wheel to the right until shaft roller is in center of worm. (Do not reverse turn to left.) Still holding roller shaft with other hand, try to rotate it.

If any play exists remove another shim and repeat operation until play felt by hand in center of gear is removed.



Sectional View of Steering Gear
Fig. 26

When proper amount of shims have been selected, turn hand wheel close to either stop and reassemble roller shaft cover, Part No. 3580. Tighten screws securely. (Drive Pitman arm, Part 3590, on roller shaft.) Now loosen roller shaft adjustment screw lock nut, Part No. 3539, and tighten roller shaft adjustment screw, Part No. 3577, until all end play in roller shaft has been removed, when gear shaft is rotated in this lash position near end of worm. Lock roller shaft adjustment screw lock nut, Part No. 3539, and reinspect gear for freedom of operation throughout and absence of end play in roller shaft adjustment.

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LUBRICATION

Remove oil filler plug and vent hole cover, Part No. 3538. Fill with approved lubricant until it comes out of oil vent. Replace oil filler plug and vent hole cover to prevent dirt from entering housing.

Avoid use of graphite, white lead, or heavy solidified oil.

If these adjustment instructions are followed carefully and CORRECT lubrication used, proper functioning of the steering mechanism will result. Do not deviate from these instructions to correct any erratic action of the front wheels, as evidenced by shimmy or steering wheel fight, but instead see that tires are properly inflated and front axle checked for correct toe-in, camber and caster specifications. Shock absorber adjustment should be at the recommended standard. Tie rod and drag link sockets or connections must also of necessity have no excessive looseness.

WHEEL ALIGNMENT

The proper alignment of the front wheels is essential to insure normal tire life as well as to maintain ease of handling and roadability at the higher speeds. The first three factors which control this are the camber, castor and toe-in of the front wheels.

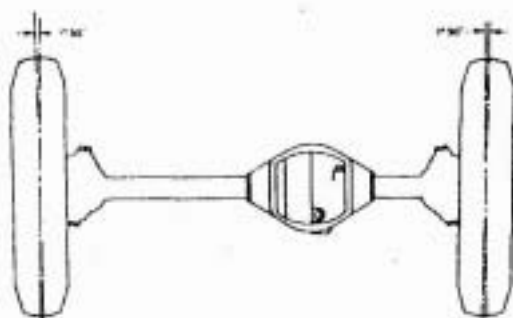


Fig. 27

CAMBER

The angle that the wheel is tilted outward at the top from a vertical line is known as the camber. The purpose of the camber angle is to place the load to a greater extent on the inner wheel bearing. As shown in Figure 27, the correct camber angle of the front wheels on the Ford truck is one deg. 30 min. The camber angle is

not adjustable on this axle, as it is controlled by the manner in which the parts are manufactured. Any change in the camber angle can only be due to a damaged part, and such part should, of course, be replaced.

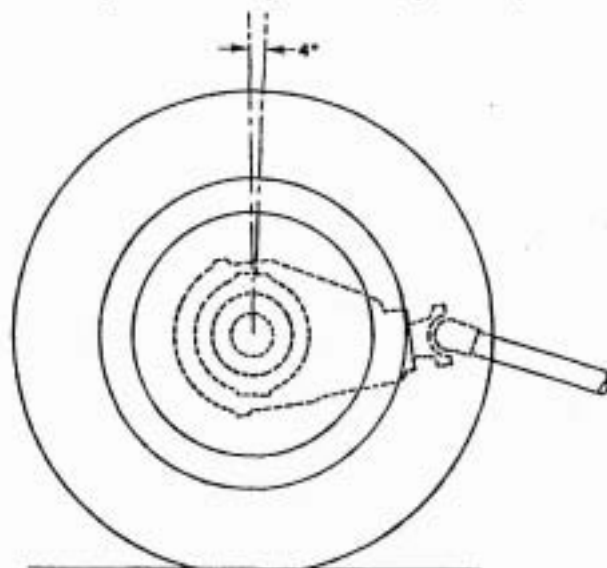


Fig. 28

CASTER

The caster of the front axle is the backward tilt of the top of the front axle or in the case of this particular unit the top steering knuckle bearing. The best example of caster is the front forks and wheel of a bicycle. By placing the top steering knuckle bearing back of the center line of the front wheel, the weight of a vehicle tends to keep the front wheels lined up in the direction of travel. If there is insufficient caster, the front wheels would have a tendency to wander at the higher speeds. If the caster angle is excessive, there is a greater tendency for the wheels to hold in a straight ahead position and it is more difficult to turn the wheels when parking the car.

As shown in Figure 28, the correct caster angle in the Ford truck is 4 degrees.

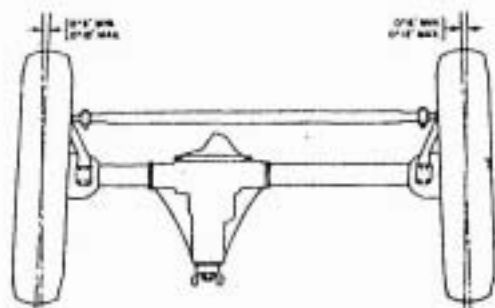


Fig. 29

WHEEL TOE-IN

It is necessary to adjust the front wheels so they turn in slightly at the front, in order to offset the higher wear which would otherwise result from the camber.

A tendency for the wheels to toe-out is created by tilting the top of the wheel outward, and the purpose of toeing the wheels in is to counteract their tendency to toe-out.

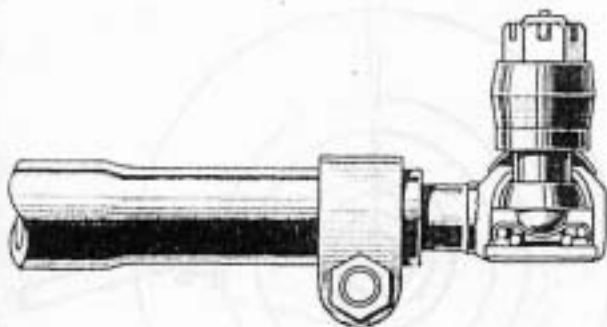
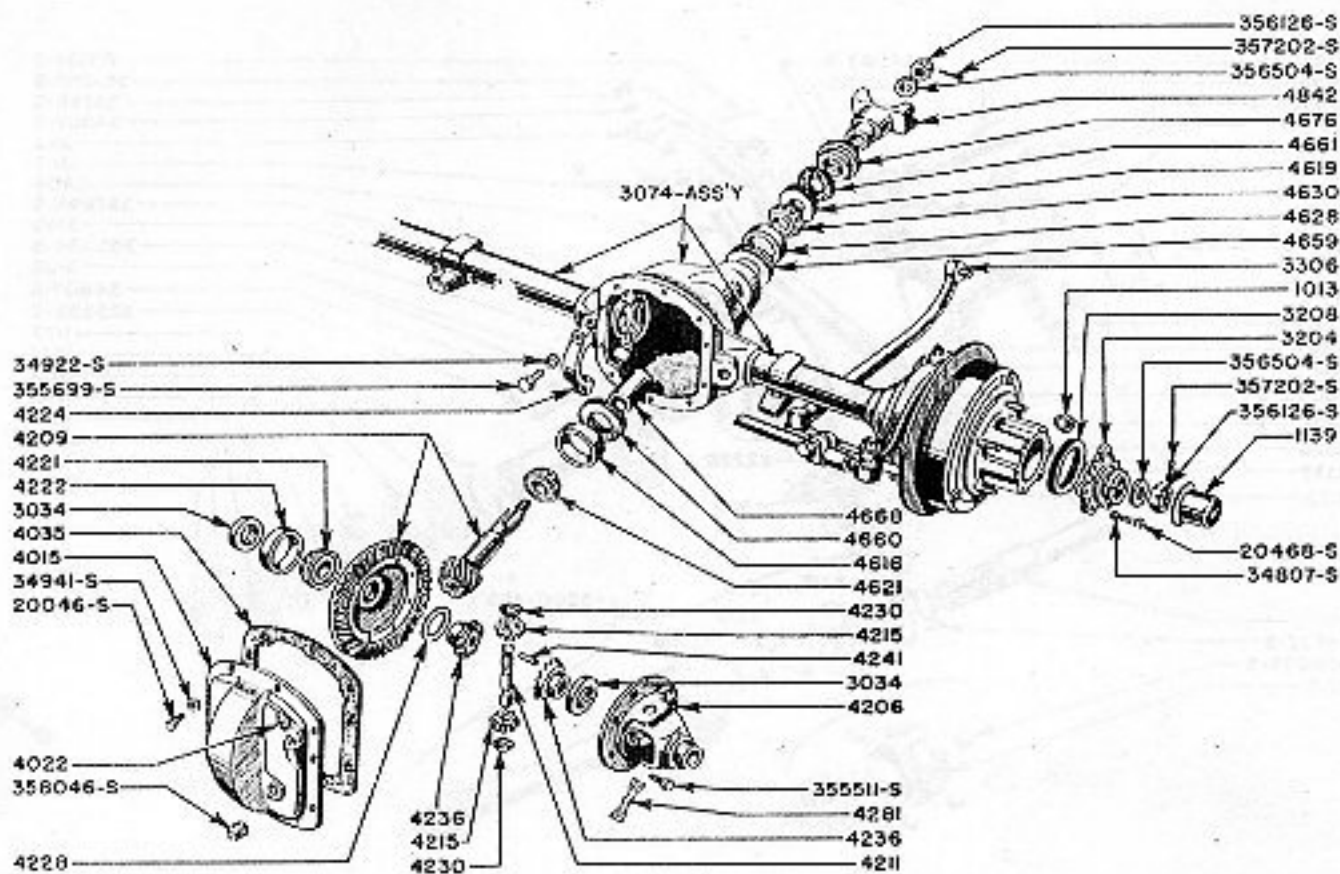


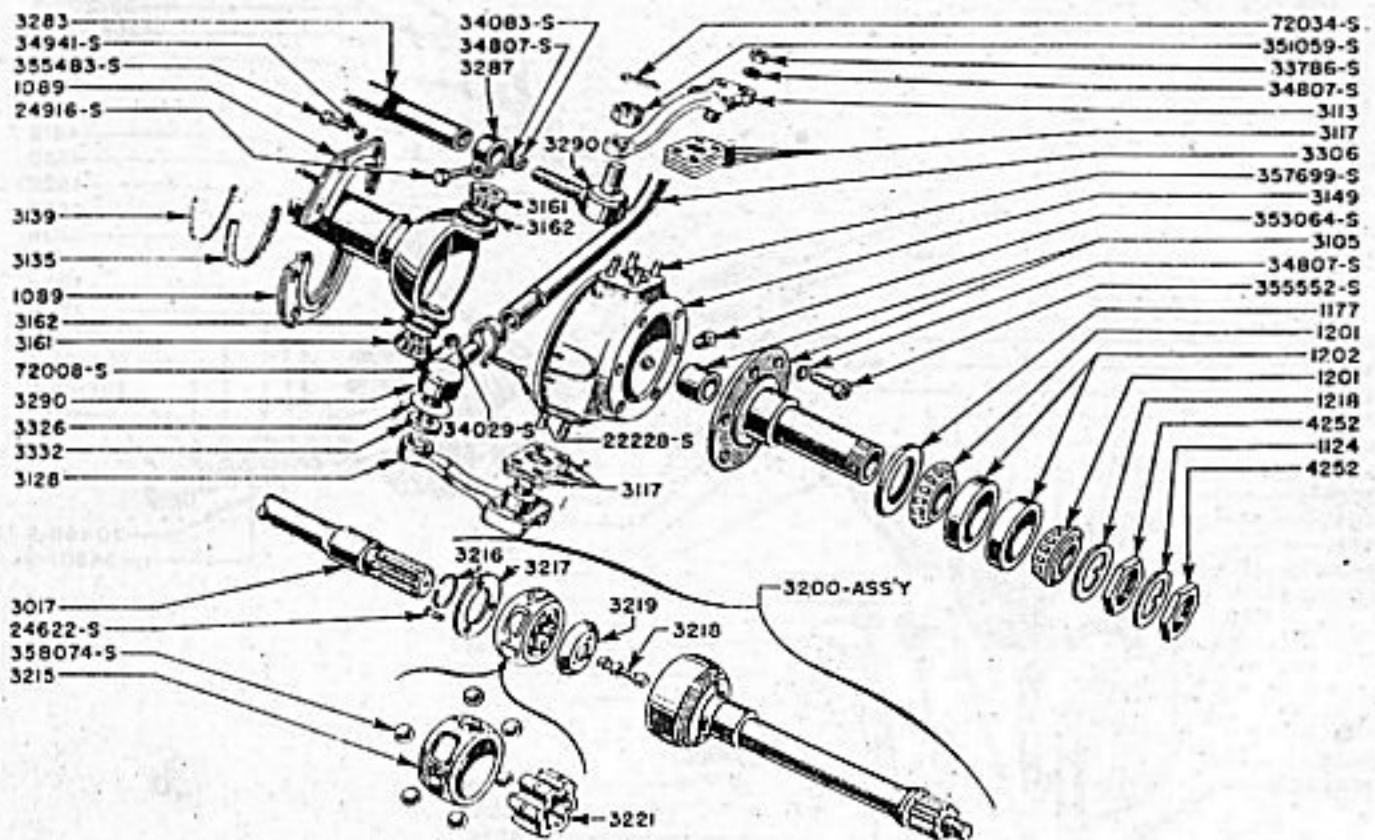
Fig. 30

The adjustment of wheel toe-in, is made by shortening or lengthening the spindle connecting rod. As shown in Figure 29, the correct amount of toe-in is 6 minutes minimum to 12 minutes maximum. The adjustment is made by removing the cotter pin and lock nut which holds the spindle connecting rod to the spindle arm at either end. Disconnect the rod from the arm and loosen the clamp nut, Figure 30. Then screw out the spindle connecting rod end until the correct adjustment is secured.



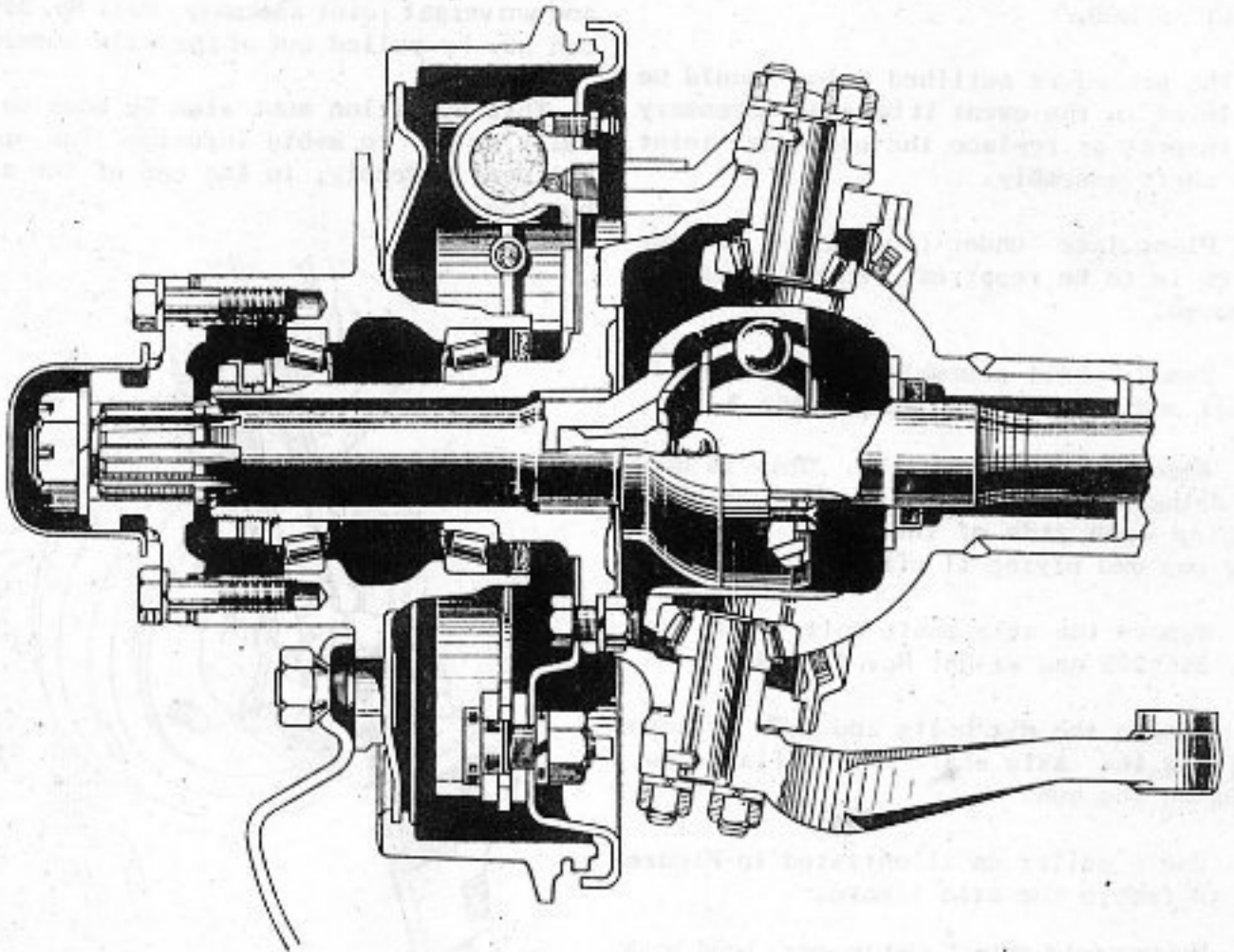
Front Axle Assembly - Fig. 31

- | | | | |
|------|---|------|-------------------------------------|
| 1013 | Nut - Wheel Hub | 4230 | Washer - Differential Pinion Thrust |
| 1139 | Cap - Hub | 4236 | Gear - Differential |
| 3034 | Retainer - Grease | 4241 | Differential Shaft Lock Pin |
| 3074 | Housing, Differential and Front Axle Assembly | 4281 | Lock Strap |
| 3204 | Hub Driving Flange | | |
| 3208 | Shim | 4616 | Pinion Bearing Cup - Rear |
| 3306 | Drag Link | 4619 | Oil Slinger |
| 4015 | Cover Assembly | 4621 | Pinion Bearing Cone & Roller |
| 4022 | Plug - Cover Vent. | 4628 | Pinion Bearing Cup - Front |
| 4035 | Gasket | 4630 | Pinion Bearing Cone & Roller |
| 4206 | Differential Gear Case | | |
| 4209 | Ring Gear and Pinion - Driving | 4659 | Shim |
| 4211 | Differential Pinion Shaft | 4660 | Shim |
| 4215 | Pinion - Differential | 4661 | Gasket |
| 4221 | Cone & Roller Assembly | 4668 | Bearing Spacer |
| 4222 | Cup Axle | 4676 | Grease Retainer |
| 4224 | Cap - Differential Bearing | 4842 | Universal Joint End Flange |
| 4228 | Washer - Thrust | | |



Steering Knuckle and Universal Joint Assembly Fig. 32

| | |
|---|--|
| 1089 Retainer - Oil Seal | 3162 Cup - Spindle Bearing |
| 1124 Lockwasher - Lock Nut | 3200 Joint - Assembly |
| 1177 Retainer - Wheel Grease | 3215 Cage |
| 1201 Cone & Roller Assembly | 3216 Ring - Universal Joint Shaft Retainer |
| 1202 Cup - Wheel Bearing | 3217 Retainer - Wheel Bearing |
| 1218 Lockwasher - Wheel Bearing | 3218 Pin - Universal Joint Pilot |
| 3017 Shaft - Front Axle | 3219 Pilot - Universal Joint |
| 3105 Spindle - Front Wheel Bearing Assembly | 3221 Race - Universal Joint-Inner |
| 3113 Arm - Steering Pivot - Assembly | 3283 Tube - Spindle Connecting Rod |
| 3117 Shim | 3287 Clamp - Spindle Connecting Rod |
| 3128 Arm - Lower Steering | 3290 End Assembly |
| 3135 Seal - Front Axle | 3306 Link Assembly |
| 3139 Strip - Pivot Oil Seal | 3326 Spring Seat for Drag Link |
| 3149 Knuckle - Steering | 3332 Seal - Spindle Connecting Rod |
| 3161 Roller & Cone Assembly | 4252 Nut - Wheel Bearing Lock |



FRONT AXLE:

Fig. 33

The front axle is especially designed for this unit and has steering drive ends of the constant velocity, Rzeppa type. The differential is mounted in a banjo type housing and is driven by hypoid type gears. The various parts of the axle are shown in their relative assembly position in Figure 31. The driving ends are shown in Figure 32 and have been segregated so

that each part can be more clearly illustrated. We believe these illustrations, together with the sectional view of the axle assembly shown in Figure 33 will convey a very clear picture as to the design and construction of the axle. The parts referred to in the following text by part number can be identified by referring to the above mentioned illustrations.

REPLACING AXLE UNIVERSAL JOINT AND SHAFT ASSEMBLY:

The procedure outlined below should be followed in the event it becomes necessary to inspect or replace the universal joint and shaft assembly.

1. Place jack under front axle at side which is to be repaired, so wheel can be removed.
2. Remove wheel assembly as outlined in wheel and tire section, page 1000-2
3. Remove hub cap No. 1139. This is done by using 2 tire irons, inserting one blade behind each side of the inner flange of the cap and prying it off.
4. Remove the axle shaft cotter pin, nut No. 356126S and washer No. 356504S.
5. Remove the six bolts and lock washers holding the axle shaft drive flange No. 3204 to the hub.
6. Use a puller as illustrated in Figure 34 to remove the axle flange.
7. Using a cold chisel and hammer, bend back the lip of the lock washer, Part 1124, which holds the wheel bearing assembly nut, Part No. 4252 in place. The wheel bearing lock nut can then be removed after which the lock washer can be taken off and the wheel bearing adjusting nut removed.
8. Remove the wheel hub, assembly including bearings. This should be done carefully so as to avoid damaging the oil seal in the hub.
9. Remove the brake plate screws, Part 35552S, and lock washers, Figure 32, thus permitting the brake plate assembly to swing to one side, suspended by the flexible brake tubing.
10. Remove the wheel bearing spindle assembly, Part No. 3105.

11. The complete axle shaft, Part No. 3017 and universal joint assembly, Part No. 3200, can now be pulled out of the axle housing.

This operation must also be done carefully so as to avoid injuring the outer oil seal assembly, in the end of the axle housing.

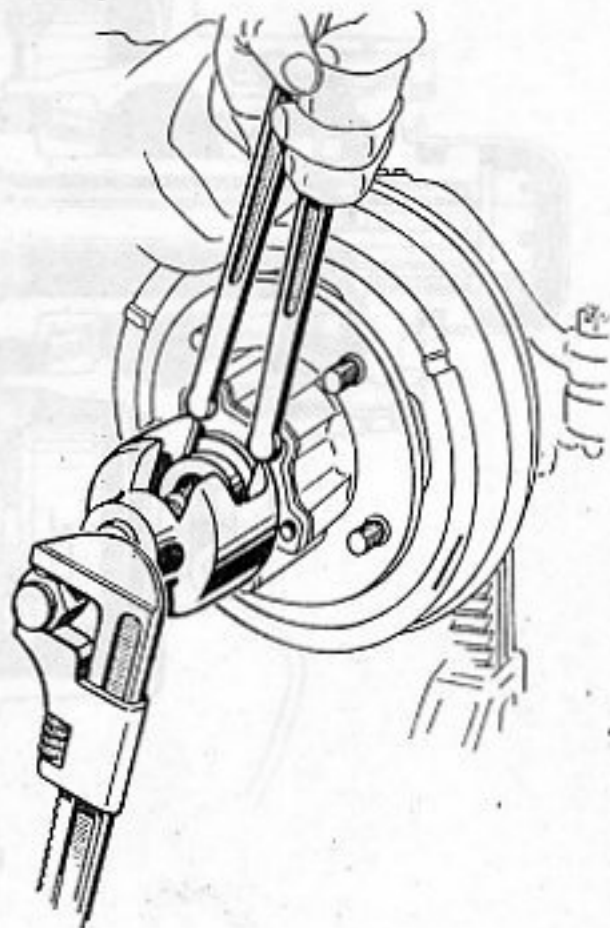


Fig. 34

REINSTALLING UNIVERSAL JOINT AND SHAFT ASSEMBLY:

1. Make sure that all parts are free from dust and other foreign substances.
2. Slide wheel bearing spindle assembly, Part No. 3105 over outer end of universal joint and axle shaft assembly.
3. Carefully insert universal joint and shaft assembly into the housing, being careful to avoid injuring the oil seal.

Enter the spline end of the axle into the differential and push inward until the pilot flange on the wheel bearing spindle, Part No. 3105 is securely fitted into the recess in the steering knuckle Part No. 3149.

4. Place the brake plate assembly into position and install the six bolts which fasten this assembly, as well as the wheel spindle, Part No. 3105 to the steering knuckle, Part No. 3149.

5. Pack wheel bearings with grease and assemble bearings, wheel hub and drum assembly, into place on the wheel bearing spindle. Install bearing washer adjusting nut, lock washer and lock nut. Run the adjusting nut up until there is a slight drag on the bearing when the wheel is turned and then back off approximately one-quarter turn. Tighten lock nut, then bend one edge of the lock washer over the lock nut so it cannot come loose.

6. Assemble the axle drive flange, Part No. 3204 and shims, Part No. 3208. A driver such as that shown in Figure 35 must be used to force the drive flange up to the shoulder on the shaft assembly. Be sure the original number of shims are in position before the drive flange is pressed on; then bolt the drive flange to the wheel hub.

7. Assemble the axle shaft washer, Part No. 356504S, nut, Part No. 357202S, and cotter.

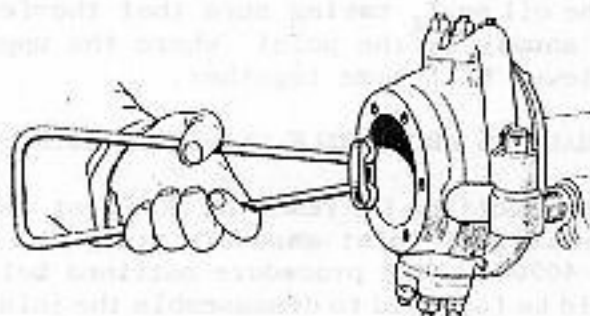
8. Press on the hub cap.

9. Assemble wheel.

10. Make certain the steering knuckle joint housing is filled with lubricant (1/2-pound) before running the vehicle.

AXLE SHAFT OIL SEAL:

In the event it should be necessary to replace an axle shaft oil seal, Part No. 3034, remove the axle shaft and universal joint as described above. The oil seal is a light pressed fit into the housing and will require a tool of the type shown in Figure 36 to be removed. Insert the ends of the puller behind the grease seal and tap the end of the puller lightly with a hammer.



Removing Axle Shaft Oil Seal - Fig. 36

Before installing a new oil seal, make sure it has been soaked thoroughly in oil; this will not only make the leather more pliable but will avoid it being burned by friction with the axle shaft when the vehicle is driven.

After placing the new oil seal in position in the housing, it can be driven in place by using a driver such as the one illustrated in Figure 37.

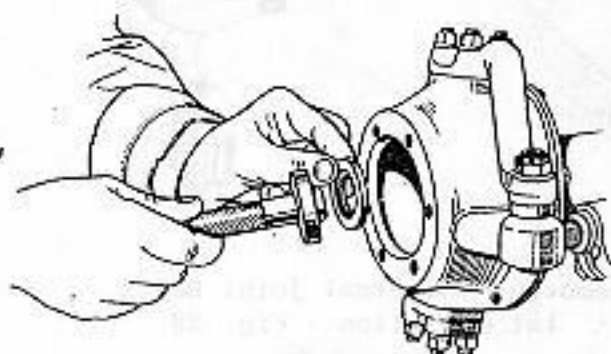
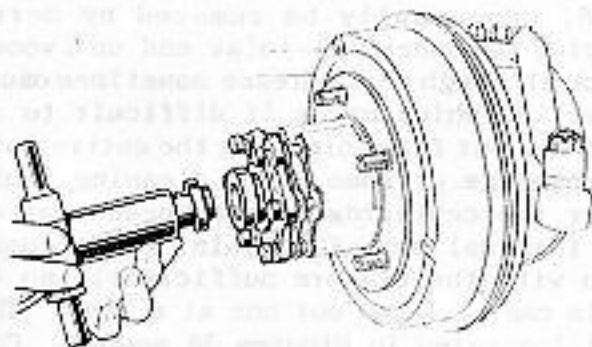


Fig. 37



Installing Axle Drive Flange - Fig. 35

STEERING KNUCKLE OIL SEAL:

Replacement of the outer seal can be made very easily by merely removing the eight screws which hold the oil seal retainer in place. The oil seal retainer consists of an upper and lower half, Part No. 1089 into which is inserted the special felt material, Part No. 3135 and a rubber strip Part 3139 which exerts constant tension on the felt.

Before re-installing the retainer, examine the spherical surface for scores or scratches which might damage the felt seal. Roughness of any kind should be smoothed down with emery cloth.

Re-install both upper and lower halves of the oil seal, making sure that the felt fits snugly at the point where the upper and lower half come together.

OVERHAULING FRONT AXLE UNIVERSAL JOINT:

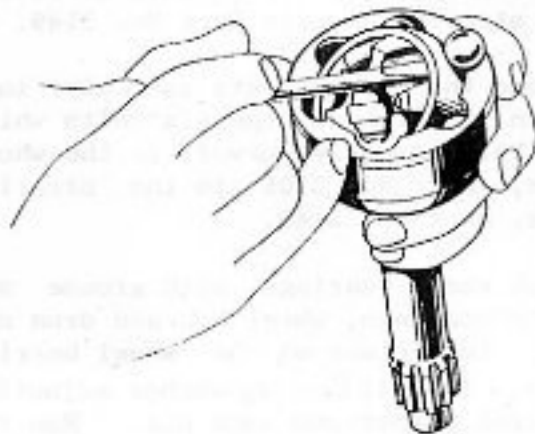
Instructions for removing the front axle and universal joint assembly are given on Page 4000-4. The procedure outlined below should be followed to disassemble the joint:

1. Remove the three screws, Part No. 24622F Figure 32 which hold the front axle shaft to the joint.
2. The axle shaft, 3017, is merely a slip fit in the spline in the internal part of



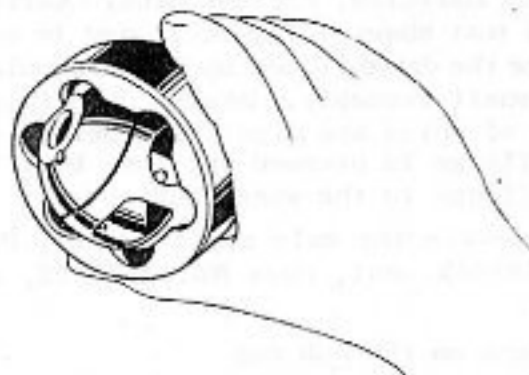
Removing Universal Joint Balls -
1st Operation - Fig. 38

the joint, Part No. 3221. After the three screws have been removed as described above, the axle shaft can be pulled out of the joint.



Removing Universal Joint Balls -
2nd Operation - Fig. 39

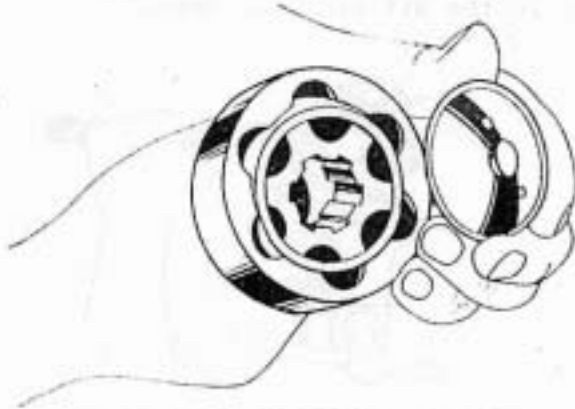
3. In the event it is necessary to replace the ring, Part 3217, merely remove the wire retaining ring, Part No. 3210. The ring can then be slipped off the axle shaft.



Removing Universal Joint Cup -
1st Operation - Fig. 40

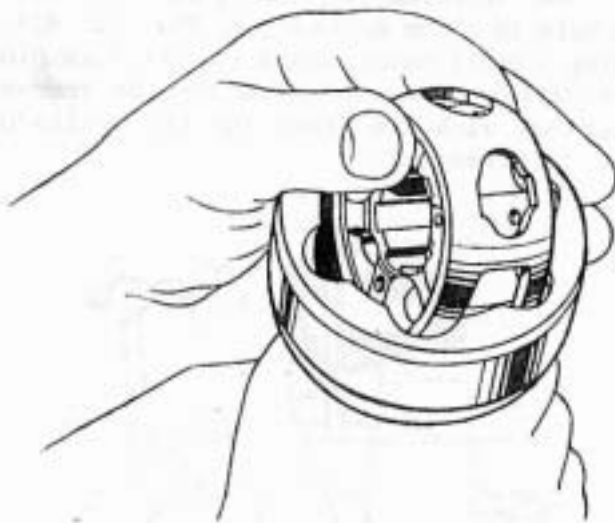
4. The axle shaft centering pin, Part No. 3218, can usually be removed by merely tapping the spherical joint end on a wooden block although thick grease sometimes causes a suction which makes it difficult to remove without first cleaning the entire joint in kerosene or some other cleaning fluid. After the centering pin has been removed, the internal part of the joint can be pushed down with the fingers sufficiently so the balls can be taken out one at a time. This is illustrated in Figures 38 and 39. Con-

tinue pressing down at various points on the internal part, until each ball can be removed. This operation is facilitated by



Removing Universal Joint Cup -
2nd Operation - Fig. 41

using a screwdriver in the manner illustrated in Figure 39. Do not exert the slightest amount of force as the purpose

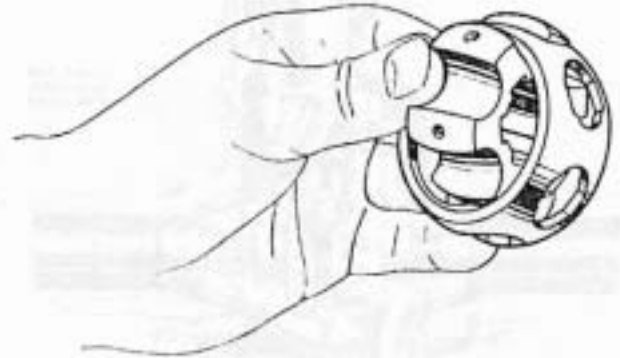


Removing Universal Joint Cage
Fig. 42

is merely to overcome the suction of the grease.

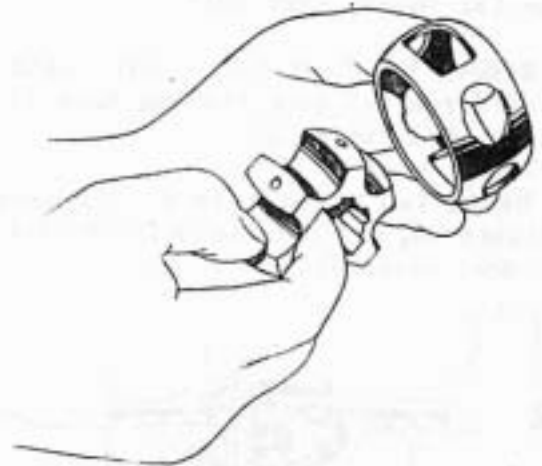
After all the balls have been taken out, the inner part of the assembly can be turned freely. Push down on one edge of part 3215 so the cup, part 3219 will be on top, (Figure 40) and then remove the cup.

There are two long, elongated holes in the cage, Part 3215, in addition to four smaller holes. Turn this part as shown in Figure 42 so the two elongated holes are in the position illustrated. This will permit the cage to be lifted out of the outer housing.



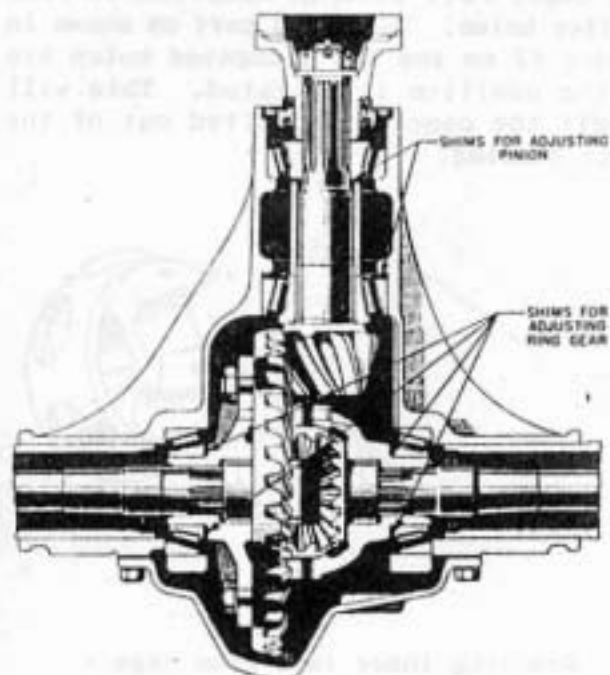
Removing inner race from cage -
1st Operation - Fig. 43

To disassemble Parts 3215 and 3221 turn Part 3221 so one section can be pushed up into one of the elongated holes of Part 3215 as shown in Figure 43. The bottom part can then be swung out of the outer ring as shown in Figure 44.



Removing inner race from cage -
2nd Operation - Fig. 44

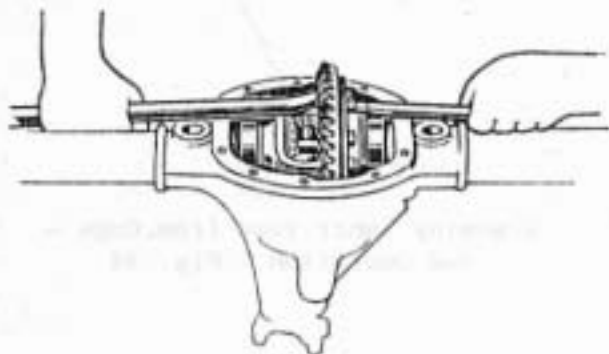
REMOVING AND OVERHAULING DIFFERENTIAL



Sectional View of Differential
Fig. 45

To remove the differential assembly, the procedure outlined below should be followed:

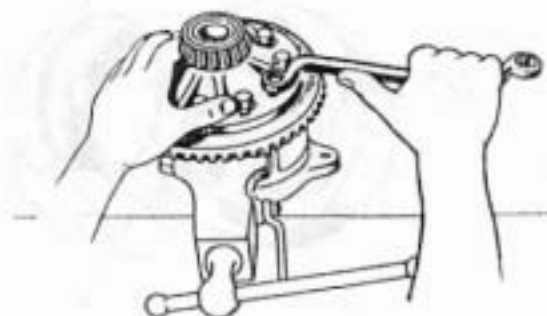
1. Remove axle shafts.
2. Drain differential and remove the differential cover, Part 4015.
3. Remove the four bolts which hold the two differential side bearing caps in position. See Figure 55.
4. Using two pinch bars as illustrated in Figure 46, pry out the differential and ring gear assembly.



Removing Differential Assembly
Fig. 46

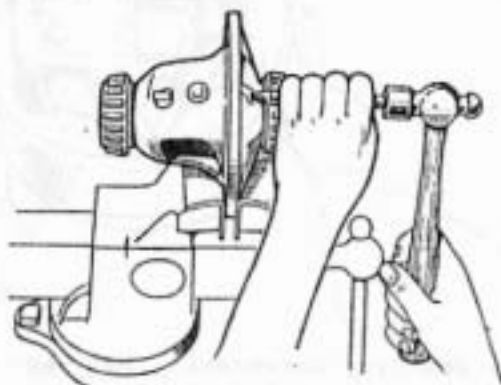
DISASSEMBLING DIFFERENTIAL ASSEMBLY

1. Remove the cap screws holding the ring gear to the differential case.



Removing Differential Gear
Fig. 47

2. Remove the ring gear from the differential case by tapping it lightly with a lead hammer.
3. The differential shaft, Part No. 4211 is held in place by lock pin, Part No. 4241. Using a small punch, drive out the lock pin. The differential shaft can then be removed together with the other internal parts of the differential.



Removing Differential Shaft Lock Pin
Fig. 48

REASSEMBLING DIFFERENTIAL

Carefully examine the surface of the differential case on which the ring gear seats, as well as the ring gear to make sure there are no foreign particles or burrs on the two contacting surfaces. Line up the cap screw holes in the ring gear with those in the differential case and then drive the gear into position on the case by tapping it lightly with a lead hammer.

The relative assembling position of the internal parts of the differential are shown in Figure 31. Reassemble the differential pinions and thrust washers in place and install differential shaft lock pin. In order to prevent the lock pin from working out, use a punch to peen over some of the metal of the differential case as illustrated in Figure 49.

Reinstall the cap screws which hold the ring gear to the differential case. After the cap screws have been tightened uniformly, make certain that the cap screw locks are bent securely around the cap screw heads so there is no possibility of the screws working loose.

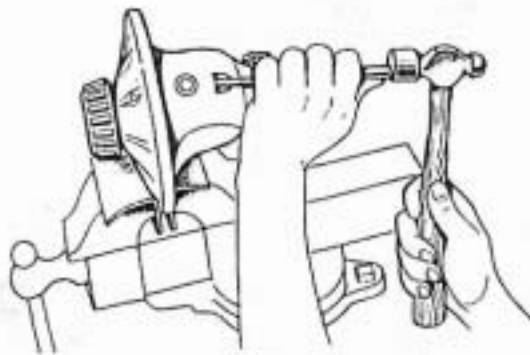


Fig. 49

DIFFERENTIAL CASE BEARINGS

There should be a tight fit of .008" between the axle housing and the differential bearing cup. This clearance should be checked as illustrated in Figure 50 by installing the ring gear and differential assembly in the housing. If the clearance between the bearing cup and housing is incorrect, remove the differential case bearings with a puller such as that illustrated in Figure 51.

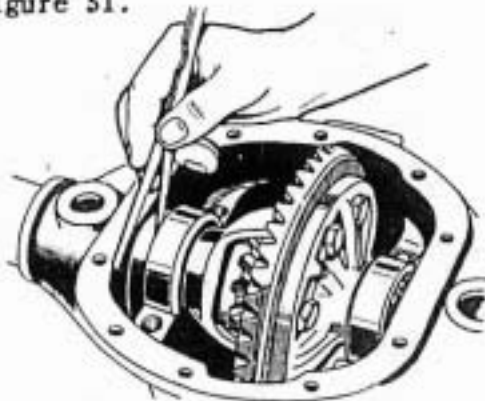


Fig. 50

The fit of the differential bearing cups is controlled by the use of shims, Figure

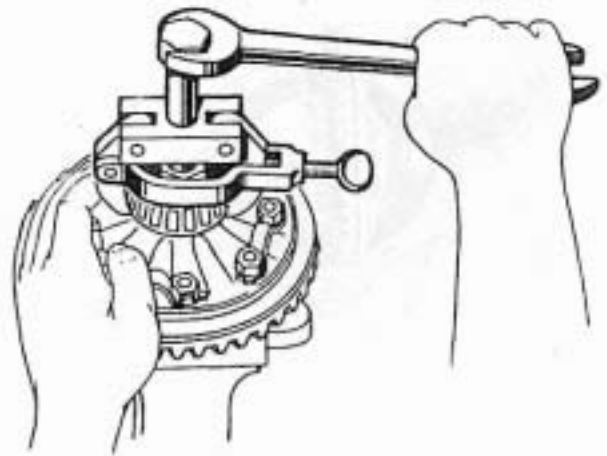


Fig. 51

52. These shims are supplied in thicknesses of .003", .005", .010 and .030". After removing the bearings as described above, measure the thickness of the shims and add or subtract a sufficient number to obtain a snug .008" fit in the housing.



Fig. 52

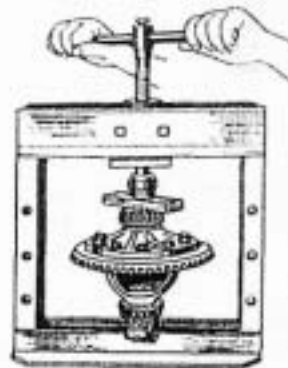


Fig. 53

After the required thickness of shims has been determined, install the shims and bearing cone on the differential case, using an arbor press as illustrated in Figure 53.

Reinstall the differential assembly in the housing. This operation can be facilitated by cocking the bearing cups slightly as shown in Figure 54 when the differential is placed in the housing and then tapping them lightly with a lead hammer. After the bearing cups are firmly in place in the housing, reinstall the differential bearing caps. It is important that the caps be reinstalled in the same position

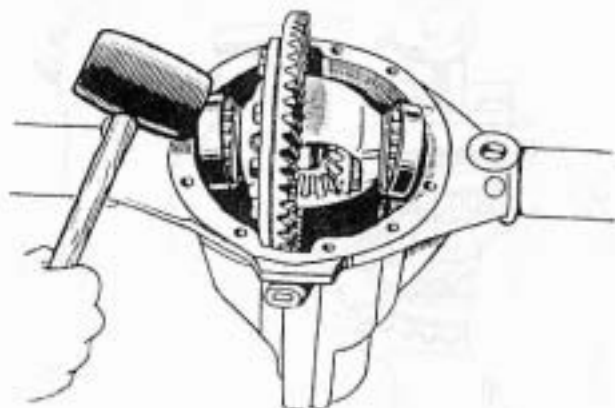


Fig. 54

in which they were originally assembled. This can be determined by observing the position of the numerals in each cap as illustrated in Figure 55. Each cap should be installed with the numerals on the corresponding side of the housing.

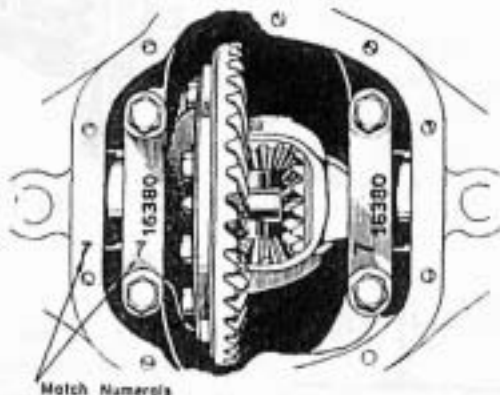


Fig. 55

After securely tightening the differential bearing caps, check the back face of the ring gear for run out in the manner shown in Figure 57. A total indicator reading in excess of .003 indicates a sprung differential case or an improperly installed ring gear. In either case, the assembly should be taken apart and re-checked thoroughly.

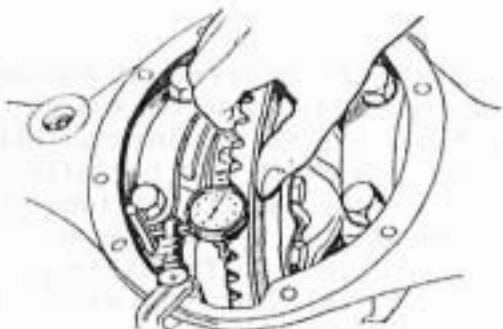


Fig. 56

Total back lash between the ring gear and pinion should be within .005" to .007". This can be checked by mounting a dial indicator on the rear axle housing as shown in Illustration 56 with the button of the indicator against one of the gear teeth. Moving the ring gear by hand will indicate the amount of back lash.

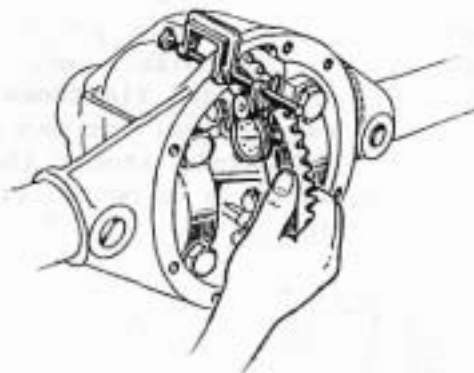


Fig. 57

In the event the back lash is not within the limits mentioned above, it will be necessary to change the shims back of the differential case bearings. Figure 52 shows the shims which should be changed to secure the desired amount of back lash. Changing the position of the ring gear .005 to one side or the other will change the amount of back lash approximately the same amount. In order to assist in determining whether the gears are properly adjusted, paint the ring gear with red lead or some other substance of this kind and turn the ring gear so the pinion will make an impression on the teeth. The correct procedure to follow in the event of an unsatisfactory tooth contact is shown in the Chart Figure 59.

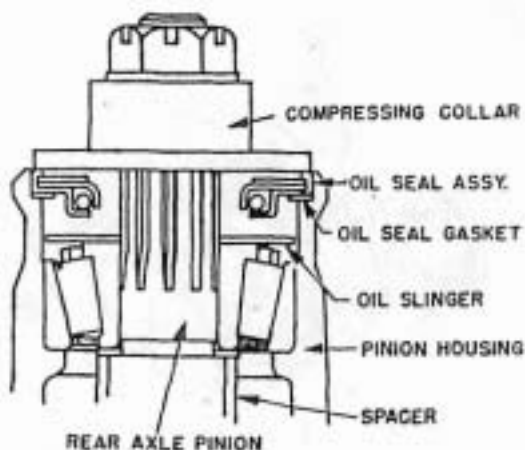


Fig. 58

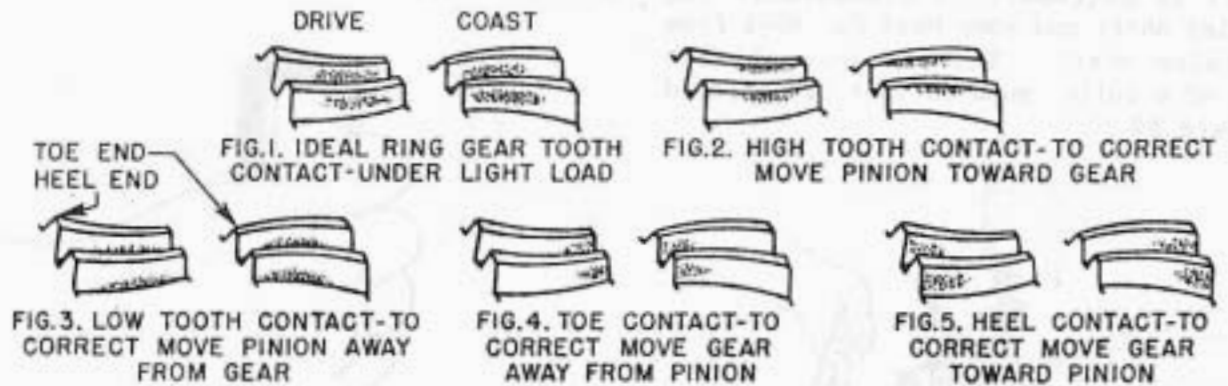


Fig. 59

After the gears have been properly assembled and adjusted, the pinion shaft oil seal, Part No. 4676 should be installed. A satisfactory tool for installing this oil seal can be secured from Hinckley Meyers Co., Jackson, Michigan. As illustrated in Figure 58, the pinion shaft nut, together with this tool, is used to press the new oil seal into place, after the universal joint end yoke has been removed. The end yoke, Part No. 4842, should then be reinstalled.

ADJUSTING PINION BEARINGS

Before attempting to adjust the ring gear or differential parts, the rear axle pinion should be carefully checked and adjusted. Adjustment of the pinion is accomplished by the use of shims between the

Proper adjustment of the rear axle pinion necessitates the use of a precision tool such as that illustrated in Figure 60. This pinion setting gauge (HM J-5895) is fitted with a micrometer for measuring the thickness of the shims required to properly locate the pinion in the differential housing so it will have correct tooth contact with the differential gear.

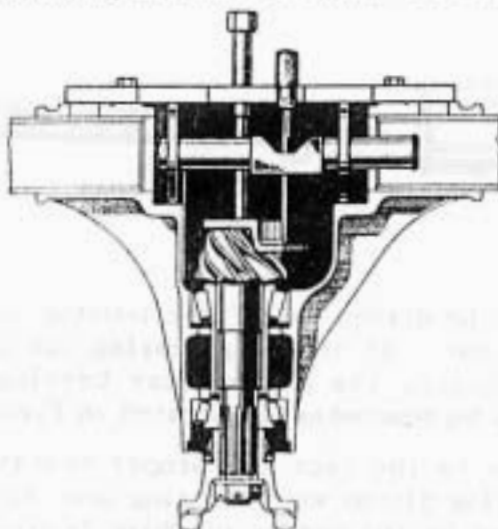


Fig. 60

bearing cups and the housing. See Figure 45. These shims are available in thicknesses of .003, .005 and .010.

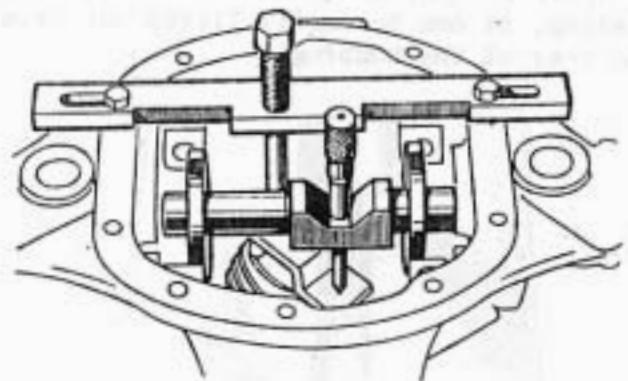
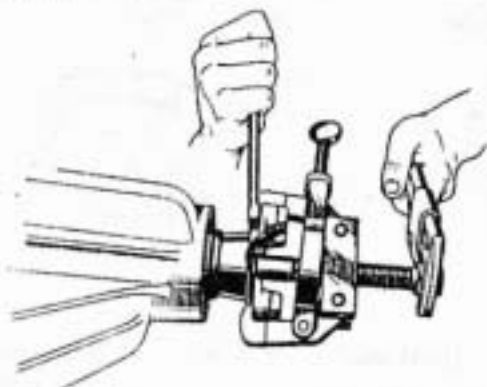


Fig. 61

All axle pinions are marked with an electric needle on the ground surface on the ends of the pinions to show the correct setting. A pinion marked zero (0) will show a reading of .719" on the micrometer, when properly adjusted. (The dimension .719 merely represents the zero cone setting when this particular micrometer gauge is used.) Therefore, a pinion marked "Plus 2" is .002 longer than the mean dimension and will show a micrometer reading of .717 when properly adjusted. Likewise, a pinion marked Minus 4 is .004 shorter than the mean dimension and will show a micrometer reading of .723" when properly adjusted.

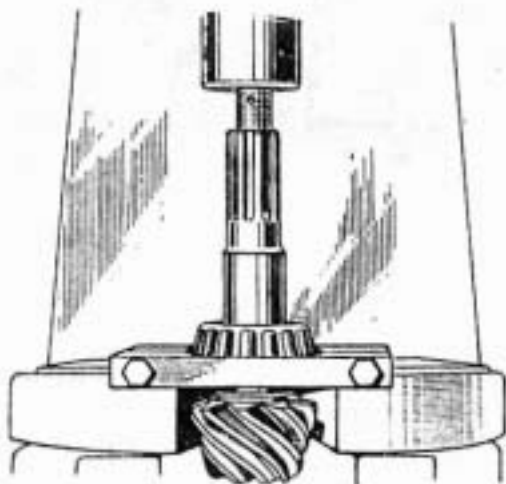
In order to remove the axle drive pinion, it is necessary to disassemble the propeller shaft end yoke Part No. 4842 from the pinion shaft. This is accomplished by use of a puller such as that illustrated in Figure 62.



Pinion Shaft End Yoke Puller
Fig. 62

The pinion is removed from the housing by placing a brass drift on the forward end of the pinion shaft and driving it out of the forward bearings with a hammer.

After the pinion is free of the forward bearing, it can be easily lifted out from the rear of the housing.



Removing Pinion Shaft Rear Bearing
Fig. 63

The rear bearing can be removed from the pinion shaft by using a bearing remover such as that illustrated in Figure 63, and pressing it off on an arbor press. To reinstall the rear bearing cone, use a length of pipe of suitable diameter so it will press against the bearing cone and not against the retainer. It can then be

pressed on in an arbor press as illustrated in Figure 64.

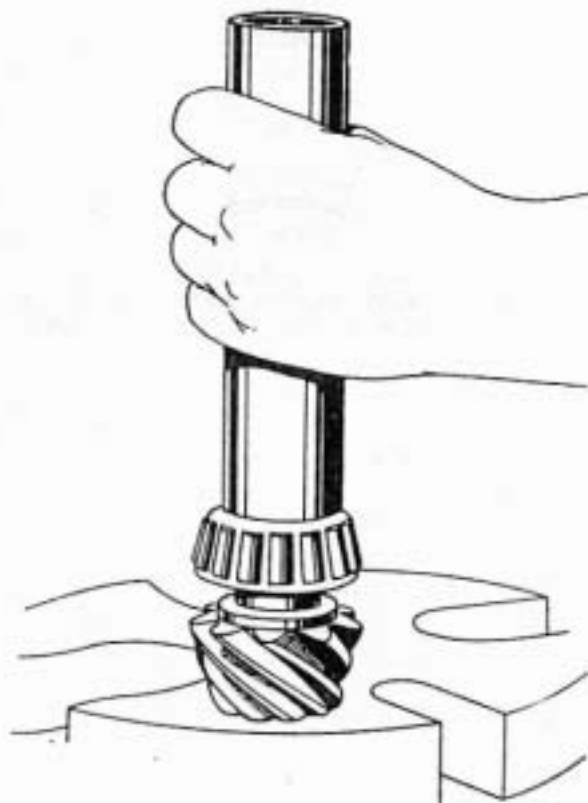


Fig. 64

A suitable tool for removing and installing the bearing cups in the differential housing is illustrated in Figure 65. The forward bearing cone and oil seal assembly

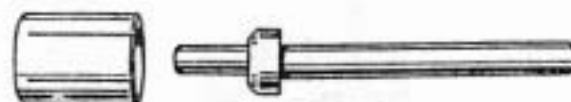


Fig. 65

should be driven out of the housing toward the front. If the rear bearing cup is to be changed, the pinion rear bearing cup should be removed as illustrated in Figure 66

Due to the fact the proper meshing of the drive pinion with the ring gear is controlled by the number of shims behind the rear bearing cup, it is imperative that the correct thickness of the required shims be determined with a micrometer. By using the pinion setting fixture described on

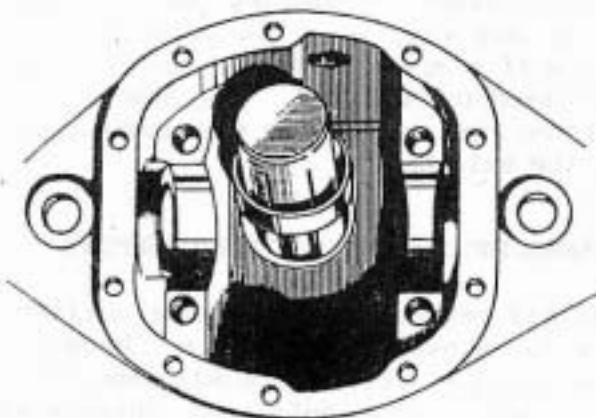


Fig. 66

Page 40, the thickness of the shims necessary to secure proper pinion setting, was previously determined. After measuring the thickness of the shims as shown in Figure 68, place them in the differential housing and replace the rear bearing cup as shown in Figure 67.

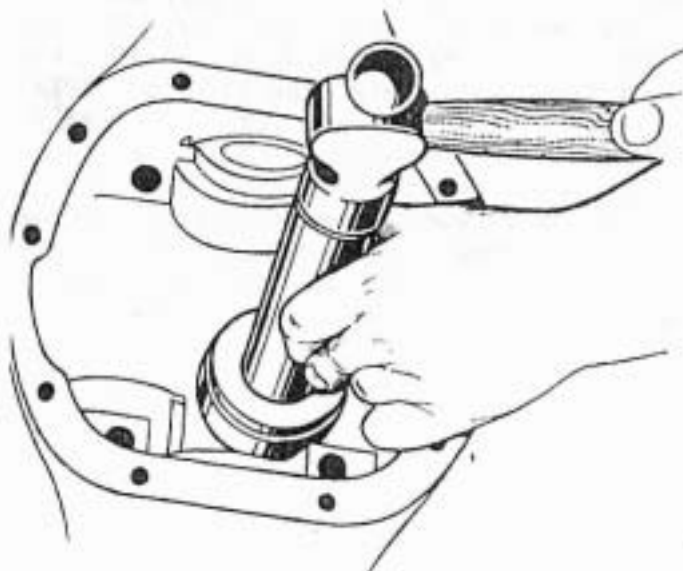


Fig. 67

The correct pinion bearing adjustment is obtained by using shims between the pinion bearing spacer, Part No. 4668, and the front bearing cone. These shims must be of the same thickness as the shims placed behind the rear bearing cup and should be measured carefully as shown in Figure 68.

Reinstall the pinion and rear bearing in the housing, place the front bearing in position and then reinstall the propeller shaft end yoke. This operation can be performed very easily by using a block of wood

to support the pinion as illustrated in Figure 69. Do not install the pinion oil seal until the pinion setting has been

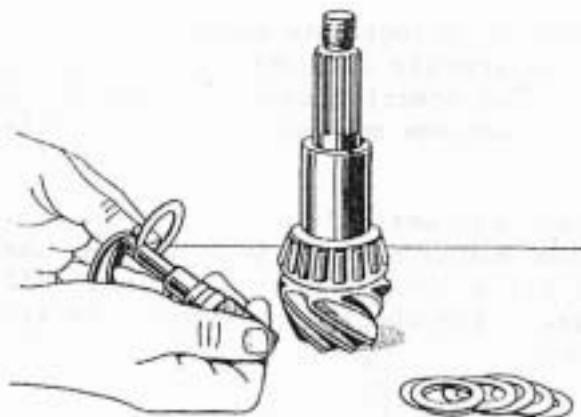


Fig. 68

re-checked with the pinion setting fixture, previously described and illustrated in Figure 60.

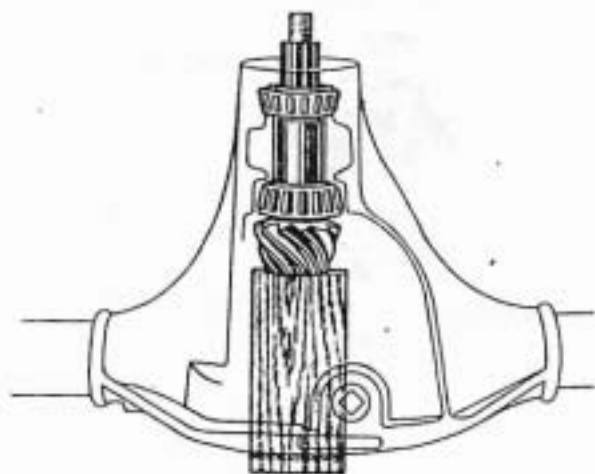


Fig. 69

REPLACING STEERING KNUCKLE BEARINGS

Replacement of the bearings or bearing cups in the steering knuckle necessitates removal of the hub and brake drum assembly, wheel bearing spindle, axle shaft and universal joint assembly, as well as the steering knuckle. Follow the procedure outlined on Page 4000-4 for removal of all parts up to the steering knuckle. The steering knuckle should be disassembled as outlined below:

1. Remove the eight screws which hold the oil seal retainer in place, Part No. 1089.

2. Remove the four nuts holding the lower cap and arm assembly, Part No. 3128, to the steering knuckle.
3. Remove the four nuts holding the upper steering knuckle cap, Part No. 3113, in place. The steering knuckle support and bearings can now be removed from the axle end.
4. Wash all parts in gasoline or other cleaning solution and inspect bearing and races for scores, cracks or chips. All damaged parts should, of course, be replaced.

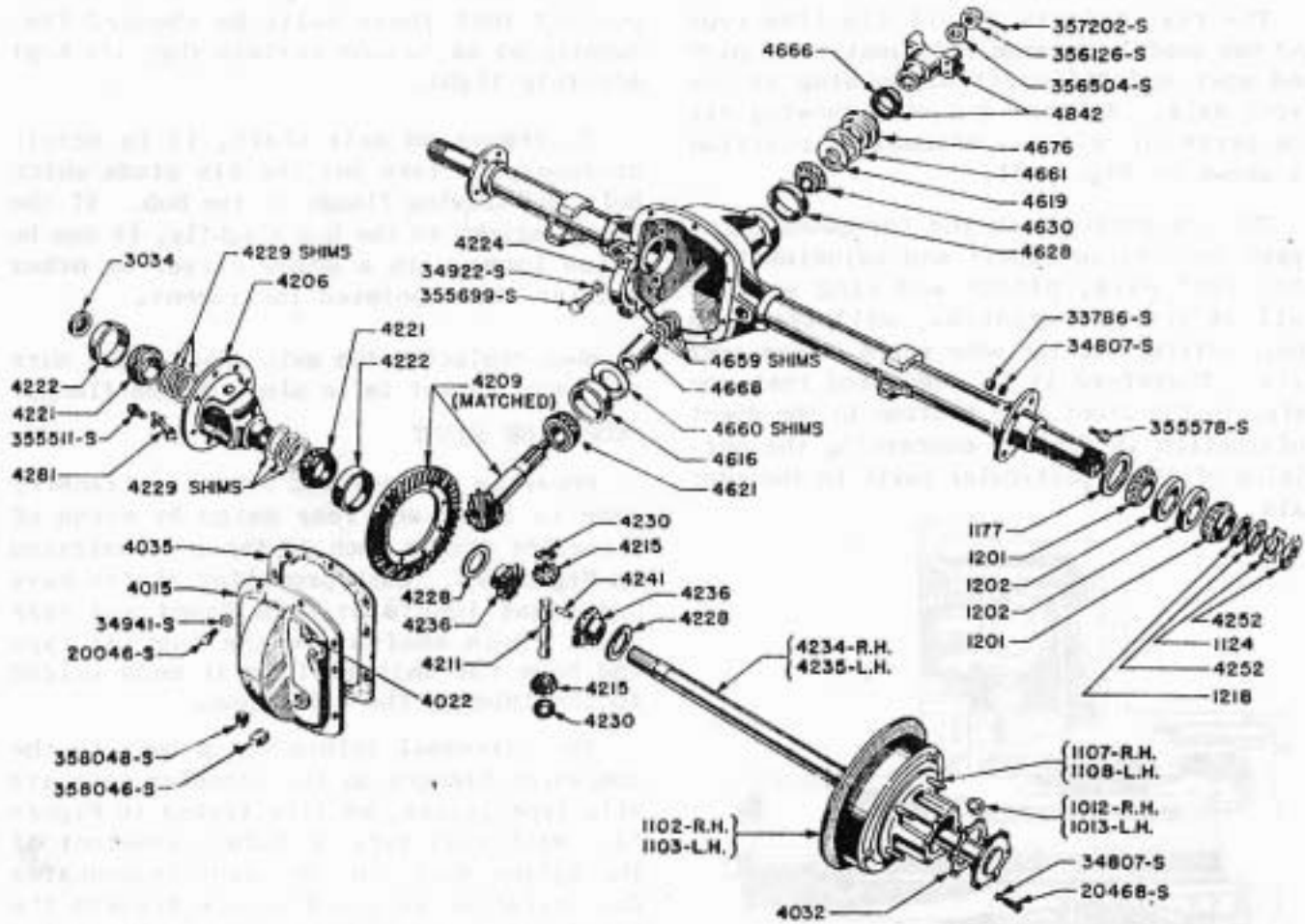


Replacing pivot bearing cups.
Fig. 70

In the event the bearing cups are damaged in any way, they can be removed by the use of a suitable driver such as that illustrated in Figure 70. The same driver should be used for driving the bearing cups into the axle end.

REASSEMBLING STEERING KNUCKLE SUPPORT

Merely reverse the procedure outlined above to reassemble the units. When re-installing the steering knuckle caps, Part Nos. 3140 and 3112, sufficient shims must be installed between the cup and steering knuckle support so the proper tension will be maintained on the steering knuckle bearing. The shims are available in thicknesses of .003, .005, .010 and .030. Ordinarily it is merely necessary to replace the shims which were originally installed in the axle at the factory. This can be checked, however, by using a checking scale of the type illustrated in Figure 87. Install one each of the .003, .005, .010 and .030" shims over the studs on the steering knuckle. Install the caps (3113 and 3128) lockwashers and nuts and tighten securely. Check the tension on the bearings by hooking the checking scale into the hole in arm (3128). Add or remove shims until the load is approximately 4-1/2 to 6 lbs. Make sure there are the same number of shims under both the top and bottom caps.

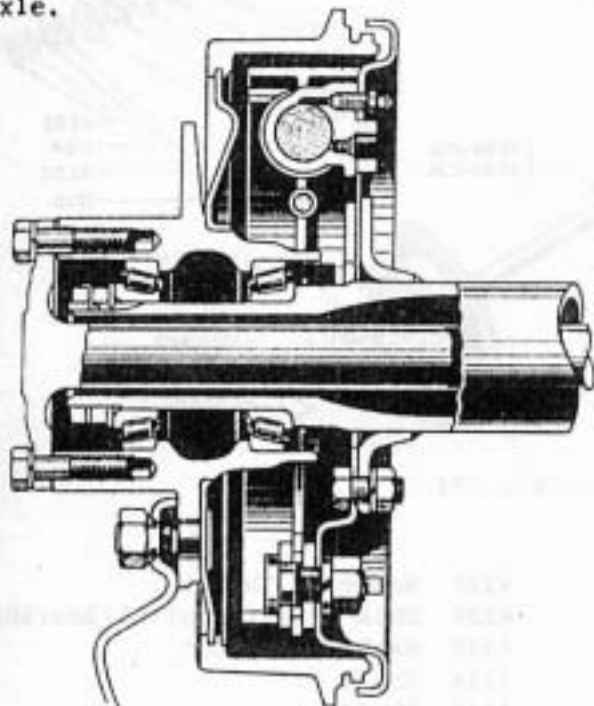


Rear Axle Assembly - Fig. 71

- | | | | |
|------|-----------------------------|------|-----------------------------|
| 1012 | Nut - Wheel Hub R.H. | 4228 | Washer - Thrust |
| 1013 | Nut - Wheel Hub L.H. | 4229 | Shim - Differential Bearing |
| 1102 | Hub & Drum Assembly | 4230 | Washer - Thrust |
| 1103 | Hub & Drum Assembly | 4234 | Shaft |
| 1107 | Bolt - Wheel Hub R.H. | 4235 | Shaft |
| 1108 | Bolt - Wheel Hub L.H. | 4236 | Gear - Differential |
| 1124 | Lockwasher | 4241 | Pin - Lock |
| 1177 | Retainer | 4281 | Strap - Screw Lock |
| 1201 | Cone & Roller Assembly | 4616 | Cup - Pinion Bearing Rear |
| 1202 | Cup - Wheel Bearing | 4621 | Cone and Roller Assembly |
| 1218 | Lockwasher. | 4628 | Cup - Driving Pinion |
| 3034 | Retainer | 4630 | Cone and Roller Assembly |
| 4022 | Plug - Cover Vent. | 4659 | Shim |
| 4206 | Case - Differential Gear | 4660 | Shim |
| 4209 | Ring Gear and Pinion | 4661 | Gasket - Oil Seal |
| 4211 | Shaft - Differential Pinion | 4666 | Shield - Dust |
| 4215 | Pinion - Differential | 4668 | Spacer - Pinion Bearing |
| 4221 | Cone and Roller Assembly | 4676 | Retainer |
| 4222 | Cup - Differential Bearing | 4842 | Flange - Axle End |
| 4224 | Cap - Differential Bearing | | |

The rear axle is a full floating type and has exactly the same differential, pinion and gear and differential housing as the front axle. An exploded view showing all the parts in relative assembling position is shown in Figure 71.

The instructions in the foregoing paragraph concerning repair and adjustment of the front axle, pinion and ring gear as well as the differential, will apply in their entirety to the same parts in the rear axle. Therefore it is suggested that you refer to the front axle section in the event information is desired concerning the servicing of these particular parts in the rear axle.



Sectional View of Rear Hub and Brake Assembly - Fig. 72

AXLE SHAFT

The rear axle shafts are the full floating type, which means that the load is carried entirely on the axle housing. The only purpose of the axle shaft in this type axle is to turn the wheel hub, and this is accomplished by splines on the inner end of the shaft which fit into the differential, and a flange on the outer end which is bolted to the hub by six cap screws.

The axle shaft flange bolts take the driving thrust and are therefore a very close fit in both the axle shaft flange and the bolt holes in the hub. The bolts are secured by lockwashers, but it is highly im-

portant that these bolts be checked frequently so as to make certain they are kept securely tight.

To remove an axle shaft, it is merely necessary to take out the six studs which bolt the driving flange to the hub. If the flange sticks to the hub slightly, it can be pried loose with a screw driver or other similar sharp pointed instrument.

When replacing the axle shaft, make sure the paper gasket is in place on the flange.

PROPELLER SHAFT

Power is transmitted from the transfer case to front and rear axles by means of propeller shafts such as those illustrated in Figure 73. Both propeller shafts have universal joints at both front and rear ends. Both shafts are the tubular type and have the universal joint ends welded to the tube on the axle ends.

The universal joints which bolt to the companion flanges on the transfer case are slip type joints, as illustrated in Figure 73. With this type of joint, movement of the spline shaft in the joint compensates for variation in the distance between the transfer case and the axles as the axles move up and down.

Each universal joint consists of two yokes, a cross, needle bearings and cap. As illustrated in Figure 73, the needle bearings are held in place by snap rings and can be replaced as described below.

The propeller shaft is removed from the vehicle by taking out the four bolts at the transfer case end which hold the universal joint to the companion flange and the four U-clamps on the universal joint at the rear axle end. This applies to both the front and rear propeller shaft.

DISASSEMBLING PROPELLER SHAFT UNIVERSAL JOINT:

Remove the snap rings, Part No. 7096, by pinching the ends together with a pair of pliers. If a ring tends to stick in the groove, tap the end of the bearing, Part No. 7074, lightly so as to relieve pressure against the ring.

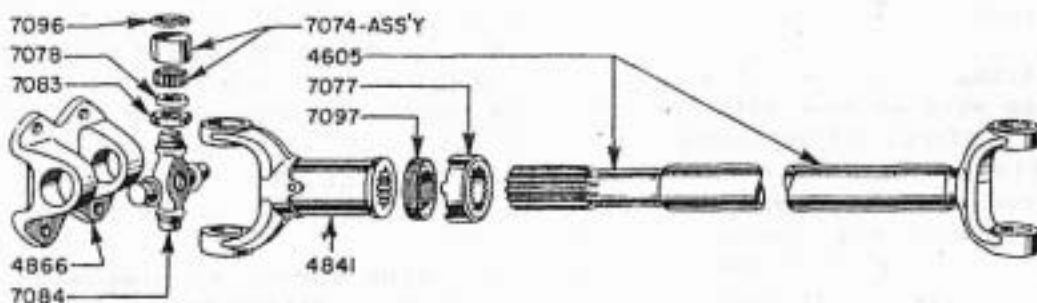
Use a soft round drift with a face about 1/32 of an inch smaller in diameter than the hole in the yoke to drive out the

bearing. Hold the universal joint yoke in a vice and drive on the upper bearing until the lower bearing is pushed out of the yoke. Then turn the joint over in the vice and drive on the exposed end of the journal cross, Part No. 7084, to push the other bearing out of the yoke.

Repeat the above operation to remove the other two bearings. The journal cross assembly can then be lifted out by tilting it toward the open end of the yoke.

Wash all parts in gasoline and if there is no evidence of wear, repack with a good grade of semi-fluid lubricant (140 S.A.E.). Make sure the reservoir in each journal trunnion is filled. With the rollers in the race, fill the race about one-third full.

As a precautionary measure, it is advisable to install new oil seal, Part No. 7078, on the journal cross assembly.



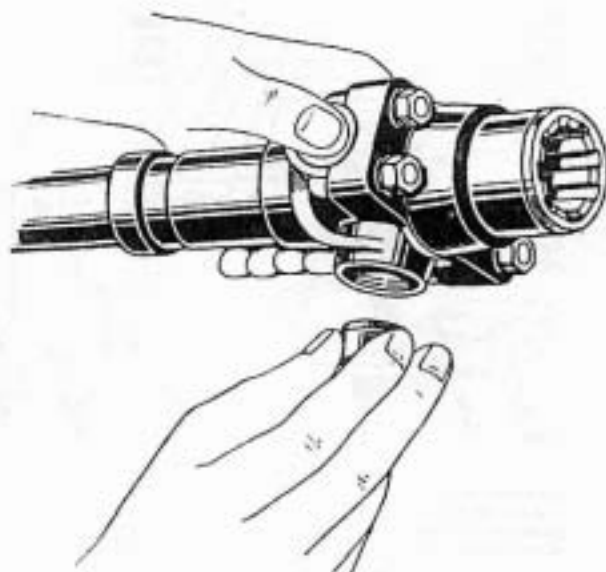
Exploded View Propeller Shaft and Universal Joint
Fig. 73

REASSEMBLING UNIVERSAL JOINT:

Reinstall the journal cross assembly in the yoke by inserting one end in the bottom hole in a tilted position and then slide the upper part of the yoke over the upper part of the cross. In order to prevent the needle rolls from dropping out of the bearing race, hold the bearing in a vertical position as illustrated in Figure 74, and insert it in the yoke from the bottom. As soon as the bearing is in place, install the split ring retainer, making sure it is firmly seated in the groove. Repeat this operation until all four bearings are in place.

If the joint appears to bind after being assembled, tap the lugs lightly with a hammer so as to relieve any pressure of the bearings on the end of the journal.

The instructions given above apply primarily to the slip type joints used at the



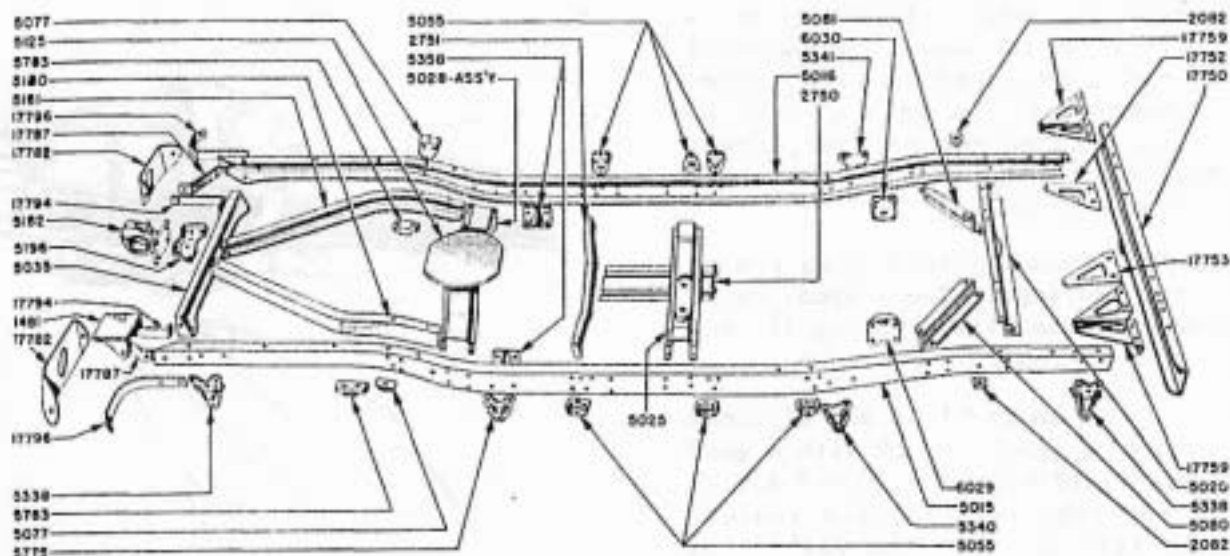
Installing Universal Joint Bearing
Fig. 74

transfer case ends of the propeller shaft. The joints at the axle ends of the propel-

ler shaft are the U-bolt type. With this type of joint, two of the needle bearings can be readily removed by merely taking off the four nuts and lockwashers which hold the U-bolt to the universal joint. The other two bearings must, of course, be driven out of the holes in the yoke by following the procedure described above.

FRAME AND SPRINGS

Due to the special requirements of a vehicle of this type, the frame incorporates a number of special features. The side members are "U" sections and are made of high tensile strength steel. The impact bar actually acts as an extra cross member. The same is true of the skid plate which is riveted to the frame in front of the transmission and transfer case as well as the gun amount support. Additional rigidity is provided by the pintle hook brace and rear cross member assembly.



Exploded View of Frame Assembly
Fig. 75

The various parts of the frame are cold riveted together.

When repairing the frame, it is advisable that this work be done with the conventional body and frame straightening tools. The application of heat to straighten a frame is not recommended. When straightened cold, the metal does not lose any of its essential characteristics unless the bend or buckles are extreme. If such a condition exists, the parts should be replaced rather than straightened.

FRAME ALIGNMENT

The frame is the foundation of the vehicle and in addition to carrying the load, must also keep the various units in correct alignment. Misalignment of the frame might cause difficulty in handling the vehicle at high speeds. It might also cause difficulty in shifting gears or keeping the transmission gears in mesh. It is therefore extremely important that every precaution be taken to insure correct alignment of any new side members or cross members which may require replacement as a result of an accident. Checking alignment of the Ford frame is a comparatively simple matter, due to the fact that the width of the frame is the same throughout its entire length. In other words, the frame should measure 26-1/2" from the outside of the right side member to the outside of the left side member at all points.

Another factor which will facilitate checking the Ford frame is that there is the same amount of upward curve (kick-up) at both the front and rear end of the frame. The highest points of the raised portion of the frame at both front and rear are 3-1/2" higher than the top of the flange in the center part of the frame.

Knowing these two dimensions, there should be no difficulty whatsoever in determining whether or not the frame is out of alignment.

PINTLE HOOK

An illustration of the pintle hook is shown in Figure 76. To open the hook, lift up on the latch and at the same time raise the upper part of the hook. The upper part automatically becomes locked in place when permitted to drop back into the normal towing position.

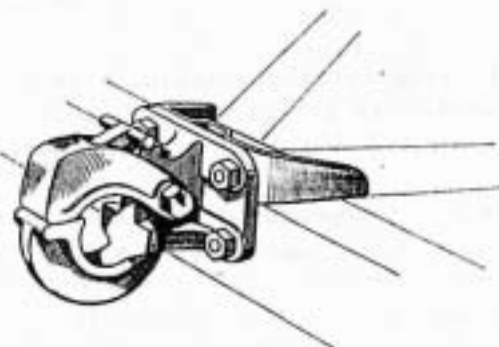
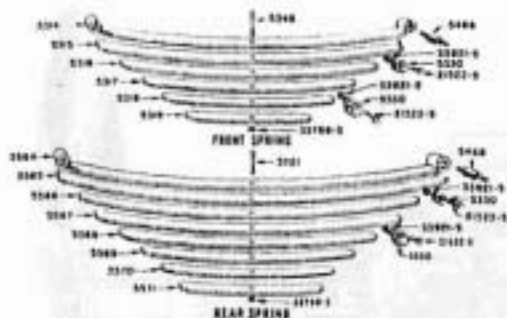


Fig. 76

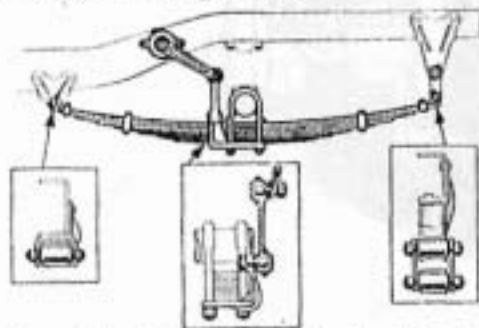
SPRINGS

Both front and rear springs are the semi-elliptic type. The front springs have 6 leaves and the rear springs have 8 leaves



Exploded View of Front and Rear Springs
Fig. 77

as shown in the exploded view of the springs in Figure 77. The front springs are secured to the front end of the frame by shackles and mounted in a stationary bracket on the frame at the rear end. The axles are bolted to the springs by clamps as illustrated in Figure 78.



Spring, Shackles and Shock Absorber Linkage - Fig. 78

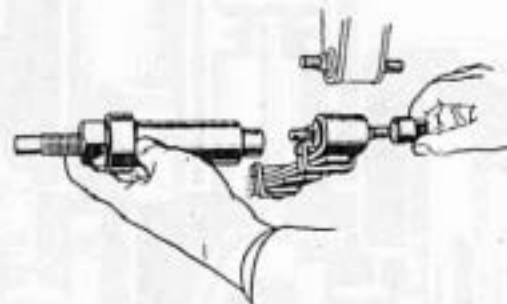
The spring shackle studs are the pre-lubricated type and do not require any additional lubrication throughout the life of the parts. With this type of shackle stud, the outer shell of the stud must be held firmly in the spring eye so that all movement is taken up by the center part of the shackle stud. It is, therefore, necessary to use special shackle stud pullers and replacing tools such as those illustrated in Figure 79 for the removal and replacement of the shackle studs when changing front or rear springs.

To remove any one of the four springs, the procedure outlined below should be followed:

Raise the end of the vehicle on which

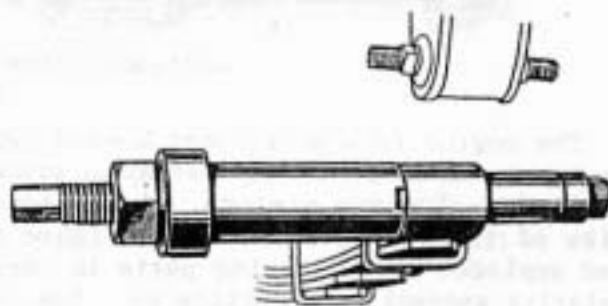
the spring is to be changed and support it underneath the frame so the wheels are clear of the floor. If available, a chain fall hooked to the end of the frame is the most advisable method of raising the vehicle.

Remove the four nuts holding the spring clips to the spring seats and remove the spring seats. It is not necessary to disconnect the shock absorber link unless this part is also to be replaced. Remove the cotter pins from the castellated nuts and take off the shackle bar, Part No. 5468, at the shackle end of the spring. Removal of the shackle stud nuts at the other end disconnects the spring from the frame.



Removing Shackle Stud - Fig. 79

To remove the shackle studs from the spring eyes, screw the puller on one end of the shackle stud and the acorn nut on the other end. Then use a large wrench to tighten the puller nut until the stud is withdrawn from the eye. This procedure is illustrated in Figure 79.

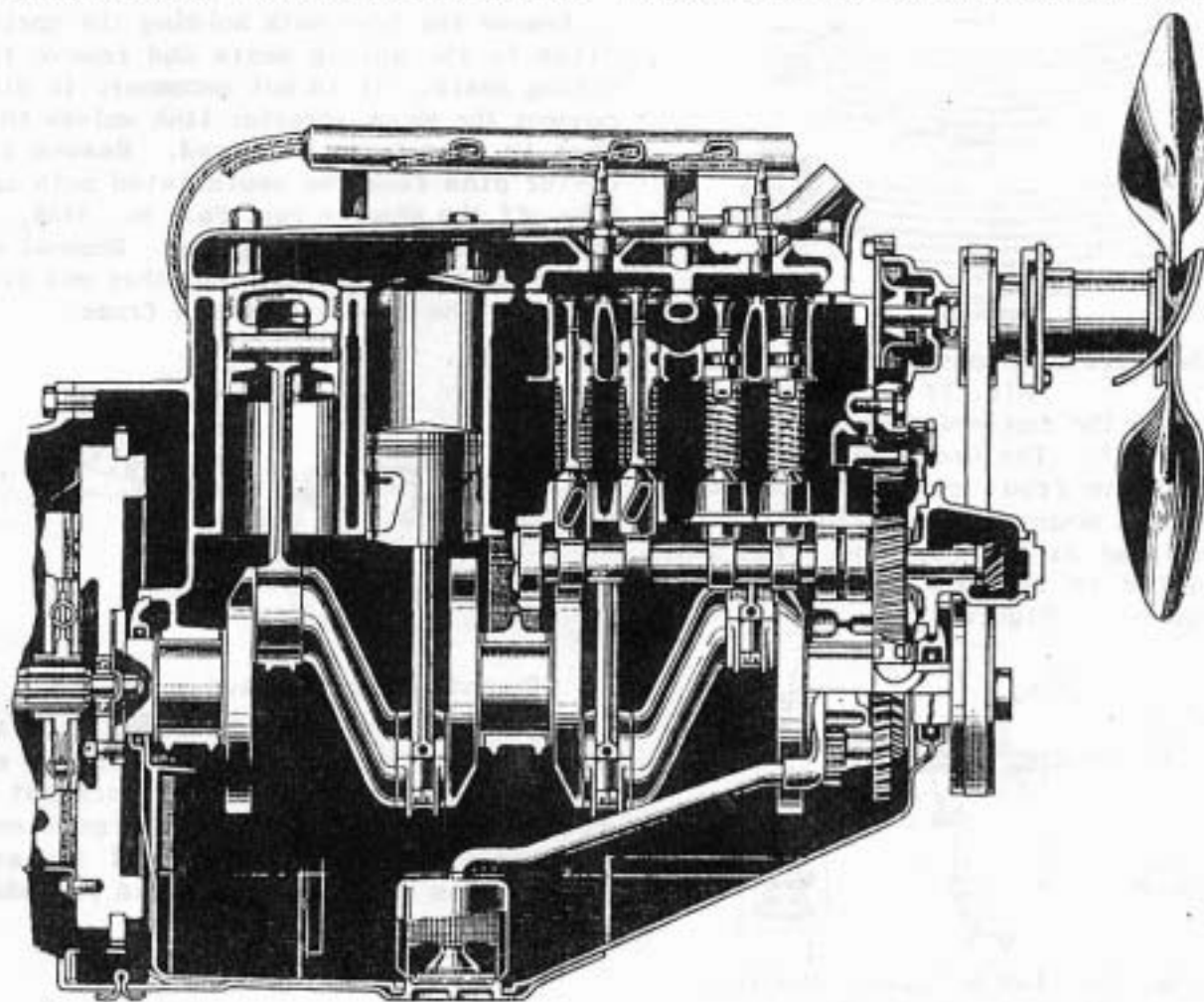


Installing Shackle Stud - Fig. 80

The same tool is used for reinstalling the shackle studs as illustrated in Figure 80. It will be observed that there is a slot in the edge of the puller for the purpose of determining when the stud is properly positioned in the spring eye. Continue drawing the shackle stud in until an equal amount of the stud is visible on each side of the spring leaf.

After installing the new shackle bolts and hanger bars, make sure cotter pins are in place and securely fastened in the castellated nuts. Then install the spring seats and spring clips, making sure the head of

the spring center bolt enters the hole in the spring seat. It is also imperative that every precaution be taken against damaging the hydraulic brake tube on the rear axle when placing the spring clips over the axle.



Sectional View of Engine - Fig. 81
ENGINE

The engine is a 4-cylinder L-Head type having a counter-balanced, cast alloy crankshaft and aluminum pistons. A sectional view of the engine is shown in Figure 81 and exploded views showing parts in their relative assembling positions are shown in Figures 82 and 83.

In this section the various parts of the engine will be described in detail with the exception that manufacturing limits, etc. of the various parts will be omitted. These limits will be found in the Specification Section of this book.

Complete assemblies such as distributor, carburetor, starting motor, generator, etc., are usually described as engine accessories and a separate section is devoted to each of these units.

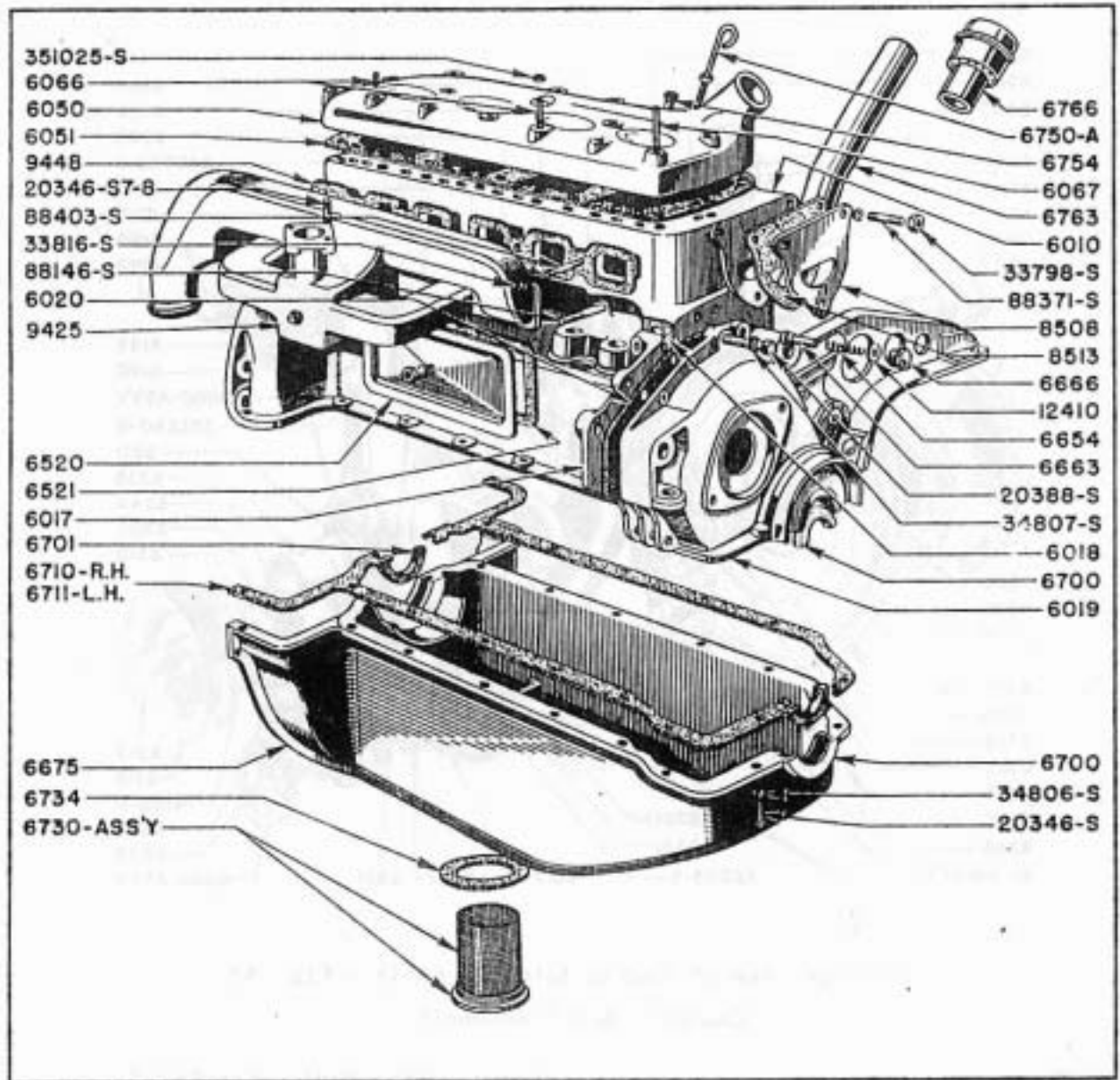
CYLINDER BLOCK

The cylinder block, upper half of the crankcase and flywheel housing are cast in one piece. Water jackets are full length, extending completely around each cylinder and to the bottom of the cylinder walls.

The main bearing caps are bored with each individual block and must be kept intact with that particular block. The oil pump housing is an integral part of the front main bearing cap.

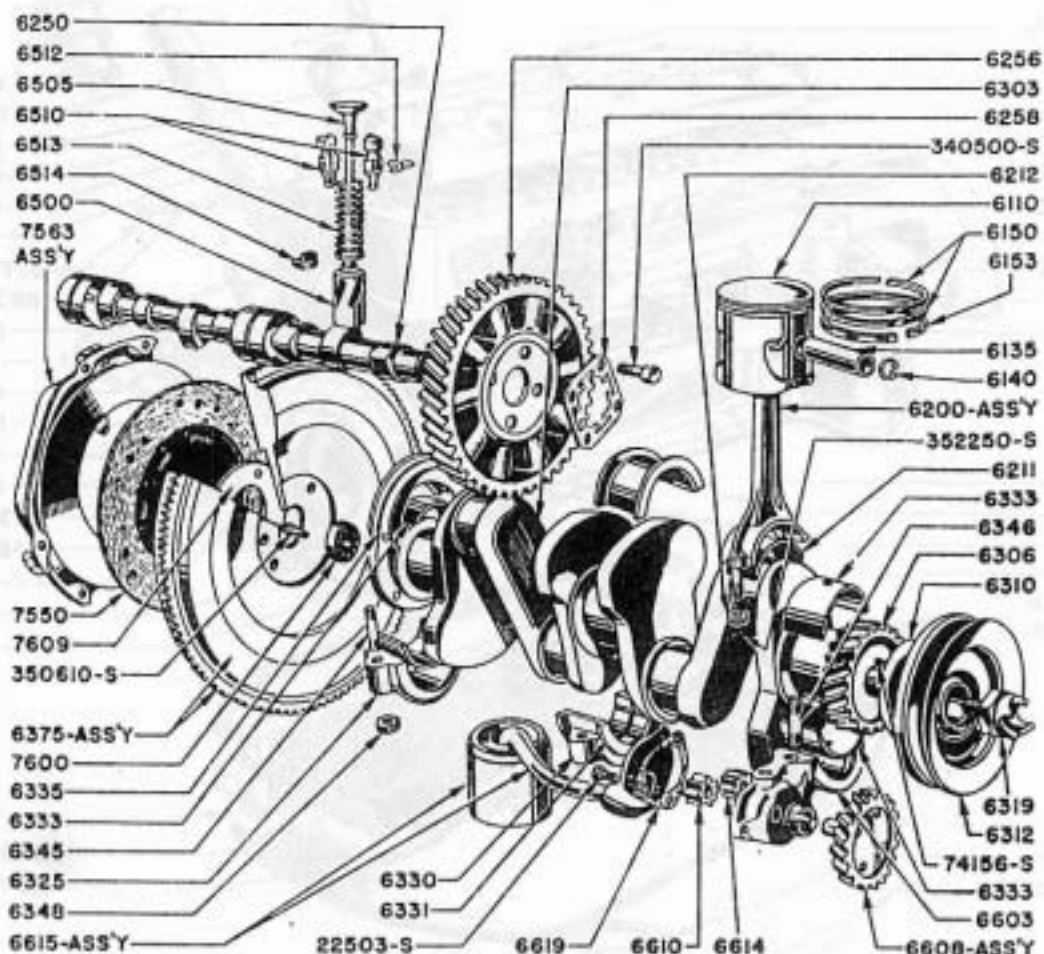
CYLINDER HEAD

The cylinder head is cast iron and is held in place on the cylinder block by 15 short, 1 medium and 2 long studs. A steel covered asbestos cylinder head gasket is



Exploded View Engine Assembly - Fig. 82
Engine Block Etc.

- | | |
|------------------------------------|---|
| 6010 Block - Cylinder - Assy. | 6700 Packing - Oil Pan |
| 6017 Cover - Cyl. Timing Gear Side | 6701 Crankshaft Packing - Rear |
| 6018 Gasket | 6710 Gasket - Oil Pan R.H. |
| 6019 Cover - Cyl. Front | 6711 Gasket - Oil Pan L.H. |
| 6020 Gasket | 6750 Plug and Screen Assembly |
| 6050 Cylinder Head | 6734 Gasket |
| 6051 Gasket | 6750 Indicator - Oil Level |
| 6066 Stud - Medium | 6754 Tube - Indicator |
| 6067 Stud - Long | 6763 Pipe Assembly- Oil Filler |
| 6520 Cover - Valve Chamber | 6766 Cap Assembly - Oil Filler |
| 6521 Gasket | 8508 Cover - Water Pump |
| 6654 Spring - Oil Relief Valve | 8513 Gasket - Water Pump |
| 6663 Plunger - Oil Relief Valve | 9425 Manifold - Intake and Exhaust |
| 6666 Nut - Relief Valve | 9448 Gasket - Intake and exhaust Manifo |
| 6675 Oil Pan Assembly | 12410 Gasket |



Exploded View of Engine Internal Parts - Fig. 83

Camshaft and Crankshaft

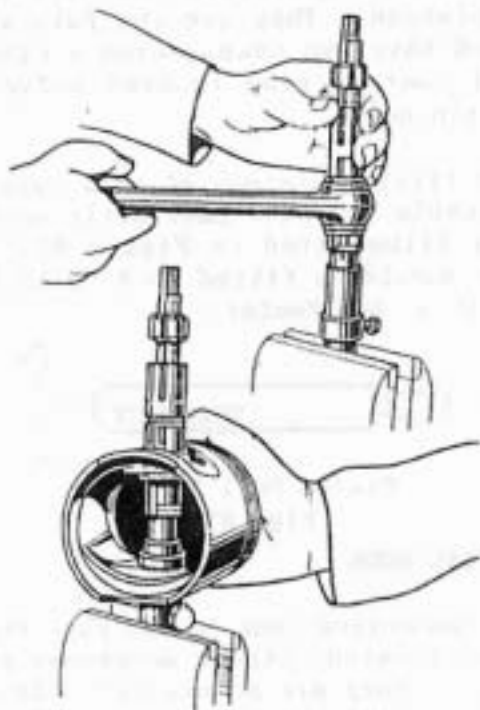
| | | | |
|--------|---|--------|---|
| 6110 | Piston | 6335 | Oil - Seal - Crankshaft - Rear Bearing |
| 6135 | Pin - Piston | 6345 | Stud - Crankshaft - Bearing Cap - Short |
| 6150 | Ring - Piston | 6346 | Stud - Crankshaft - Bearing Cap - Long |
| 6200 | Rod Assembly - Connecting | 6348 | Castle Nut - Special |
| 6211 | Liner - Connecting Rod Bearing | 6375 | Flywheel Assembly |
| 6212 | Nut - Connecting Rod | 6500-A | Rod - Valve Push |
| 6250 | Camshaft | 6505 | Valve |
| 6256-A | Gear - Camshaft | 6510-B | Bushing - Valve Guide |
| 6258 | Ring - Camshaft Gear Locking | 6512 | Retainer - Valve Guide Bushing |
| 6303 | Crankshaft | 6513 | Spring - Valve |
| 6306 | Gear - Crankshaft | 6514-B | Retainer - Valve Spring |
| 6310 | Oil Slinger - Crankshaft | 6603 | Body Assembly - Oil Pump |
| 6312 | Pulley Assembly - Crankshaft | 6614 | Gear - Oil Pump Driving |
| 6319-A | Ratchet - Crankshaft | 6615 | Tube Assembly - Oil Pump Inlet and Screen Cover , |
| 6325 | Bearing Cap - Crankshaft - Rear | 6619 | Gasket - Oil Pump Cover |
| 6330 | Bearing Cap - Crankshaft - Center | | |
| 6331 | Liner - Crankshaft - Bearing - Center | | |
| 6333 | Liner - Crankshaft - Bearing - Front and Rear | | |

used and a new gasket should be installed whenever the cylinder head is removed for any reason. The cylinder head nuts should be tightened with a torque indicating wrench when the engine is warm to 50-foot pound tension.

PISTON PIN

The piston pins used in Ford four-cylinder engines are manufactured to extremely close limits of precision. This is also true of the piston pin hole in the piston, as well as in the connecting rod. Consequently, any standard piston pin may be assembled with any standard connecting rod or piston with entirely satisfactory results.

End play of the piston pin is controlled by means of wire retainers which are expanded into grooves in the piston pin bore of the piston.



Reaming Piston and Rod to fit pin
Fig. 84

Ford piston pins are available .002" oversize. In cases where this oversize piston pin is to be installed, it is also necessary to re-work the piston and connecting rod bushings. A combination expansion reamer and burnisher (K.R.W. No. V-75) illustrated in Figure 84, should be used for this operation.

The piston pin should drop through the pin hole in the piston with a total clearance not to exceed .0007" assuming, of course, that parts are clean and pin and piston are approximately the same temperature.

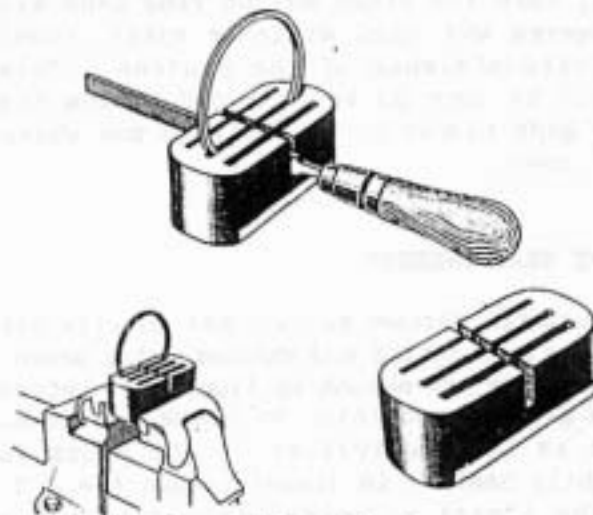
The proper fit of the connecting rod bushings to the pin can be checked by the following procedure:

Hold the piston or pin in the hand with connecting rod extended downward in a vertical position. Turn the piston, or pin, in a direction calculated to cause the connecting rod to move with the pin as the axis. This motion should cause the lower end of the connecting rod to move upward through approximately but not more than 1/2" arc before dropping back to a vertical position.

In production standard piston pins are fitted in .0006" slip fit in the piston and .00025" slip fit in the rod.

PISTON RING

There are two compression rings and one oil control ring on each piston. The lower compression ring and the oil control ring are of the expander spring type. When



Ring Filing Block
Fig. 85

fitting new piston rings, it is important that the ring gap should be checked at the point in the cylinder bore, within the ring travel, where the cylinder diameter is smaller. The ring should also be square in the cylinder bore.

The correct gap is from .012" to .017" and this should be checked by inserting a feeler gauge between the ends of the piston ring.

In most cases it will be necessary to file the end of the ring slightly to secure the correct gap and a ring filing block such as that illustrated in Figure 85 will facilitate this operation. The tool can be secured from K. R. Wilson, Buffalo, New York, under the No. V-109-B.

In every case the piston rings should be fitted in the particular cylinder bore in which they are to be installed. After fitting the rings so they have the proper gap, each ring should be checked in its respective ring groove on the piston to make sure it is free in the groove but does not have excessive clearance; this can be done by rolling the back side of the ring around the piston ring groove. Total side clearance in the groove should not exceed .003".

After installing the rings on the pistons, turn the rings so the ring gaps are staggered and equal distance apart around the circumference of the pistons. This should be done so as to avoid having the ring gaps in a vertical position one above the other.

VALVE SEAT INSERTS

Tungsten chrome alloy steel inserts are used for both intake and exhaust valve seats. The inserts are shrunk by liquid air before they are pressed into the block and inasmuch as the counterbore in the block is slightly smaller in diameter than the O.D. of the insert at normal temperatures, a permanently tight fit is insured.

Because of their extreme hardness and ability to withstand high temperatures without becoming oxidized or pitted, it is rarely necessary to replace these inserts. Service equipment for this operation is, therefore, not considered essential for

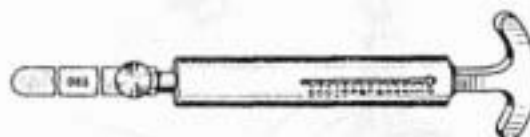


Sectional View
of Piston
Fig. 86

PISTONS

The aluminum pistons used in the Ford four-cylinder engines are wing type steel strut pistons. They are the full skirt type and have two compression rings and one oil control ring located above the piston pin hole.

When fitting pistons of this type, it is advisable to use a pull scale such as the one illustrated in Figure 87. The pistons should be fitted to 8 to 12 lbs. pull with a .003 Feeler.



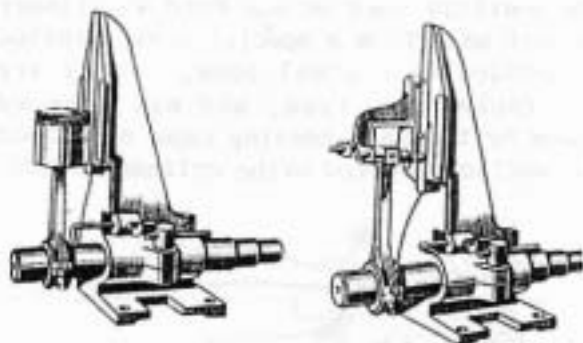
Piston Pull Scale
Fig. 87

CONNECTING RODS

The connecting rods in the Ford engine are heat treated, carbon manganese steel forgings. They are accurately held to a specified weight so as to reduce vibration and lessen wear on bearings and pistons. The piston pin bushing in the connecting rod is of special bronze.

The correct procedure for fitting the piston pin in the connecting rod bushing is described in the foregoing section covering piston pins. After installing a new piston or pin on a connecting rod, it is essential that the assembly be rechecked for alignment as illustrated in Figure 88.

ordinary service stations. Cylinder blocks which require replacement of a valve seat insert are ordinarily returned to the factory for such work but in those rare instances where it is decided to equip a shop to handle this type of repair, the valve seat replacing machine manufactured by Hall Manufacturing Company, Toledo, Ohio, is suggested.



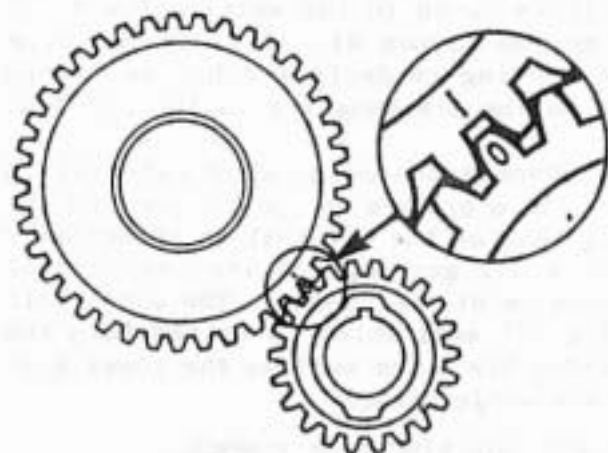
Checking Connecting Rod Alignment
Fig. 88

CONNECTING ROD BEARINGS

The connecting rod bearings in the Ford four-cylinder engine are of the steel back replacable type with each half locked in position in the connecting rods. The bearings are made of special bearing alloy, having high structural strength which is bonded to a steel core.

CAMSHAFT AND GEAR ASSEMBLY

A special alloy iron developed by Ford engineers is used in casting these Ford camshafts. This metal is highly wear-re-



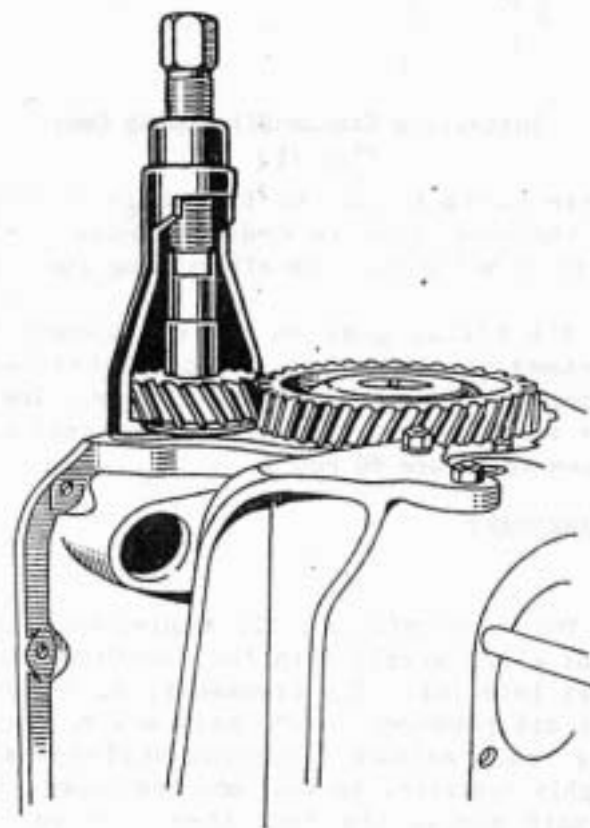
Timing Gear Marks
Fig. 89

istant and gives the shaft greater rigidity. The three hardened camshaft bearings are

supported in the bearing holes bored in the cast iron block.

A silent operating, durable camshaft gear made of aluminum is pressed on the camshaft. Replacement of this gear is seldom necessary and for that reason, the camshaft and gear assembly is ordinarily supplied as a complete unit. It is not advisable to attempt changing the gear on the camshaft without a fixture which has been especially designed for this purpose. Such a fixture is available from K. R. Wilson, Buffalo, New York and complete instructions as to procedure for changing the gear accompanies the fixture.

When installing a new camshaft and gear assembly, the timing mark on the camshaft gear must be matched with the timing mark on the crankshaft

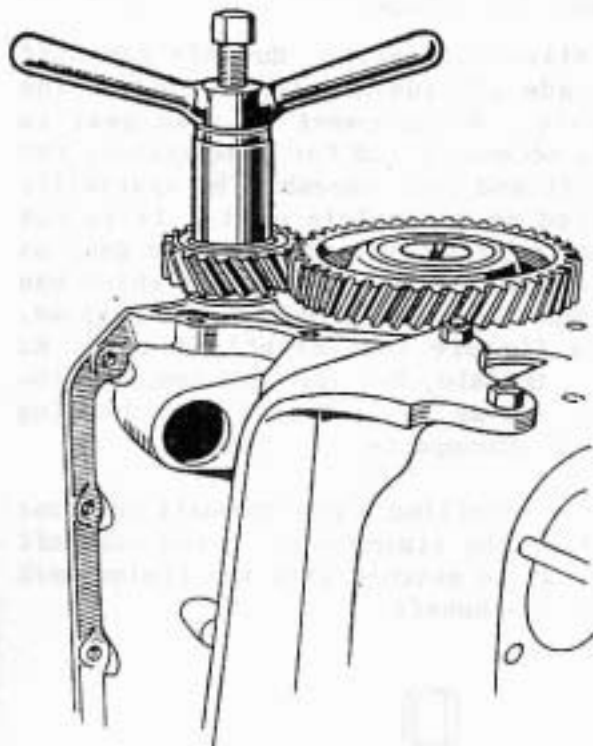


Removing Crankshaft Timing Gear
Fig. 90

To replace the camshaft and gear assembly, remove the cylinder front cover (6019) Figure 82, and valve chamber cover plate (6520). Then remove each of the valve guide bushing retainers (6512) and insert

CRANKSHAFT BEARINGS

The bearings used in the Ford 4-cylinder engine are made from a special anti-friction alloy bonded to a steel back. These are of the replacable type, and are clamped in place by the main bearing caps described in the section devoted to the cylinder block.



Installing Crankshaft Timing Gear
Fig. 91

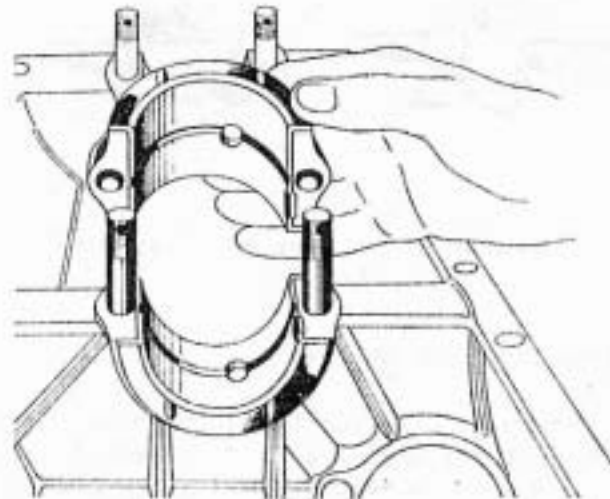
these parts in one of the slots in each of the push rods in order to hold these parts up while the camshaft is being removed.

The timing gear on the crankshaft is pressed on the end of the crankshaft and secured in place by a Woodruff Key. Tools for removing and installing this gear are shown in Figure 90 and 91.

CRANKSHAFT

The crankshaft is fully counter-balanced, cast alloy steel, with the counterweights cast integral. The crankshaft is drilled for oil passages to the main and connecting rod bearings. Bearing surfaces are highly resistant to wear and are especially smooth due to the fact they receive two polishing operations after they are finish ground. The crankshaft is balanced within 3/10 of an ounce inch.

There are three main bearings which support the crankshaft and end thrust is taken by the flanges on the replacable center main bearing.



Crankshaft Main Bearing - Fig. 92

Each bearing has a small lobe pressed out of one side, which is designed to fit into a recess of similar size in the bearing cap. When fitted in place, these lobes prevent the bearings from moving. See Figure 92.

REAR BEARING OIL SEAL

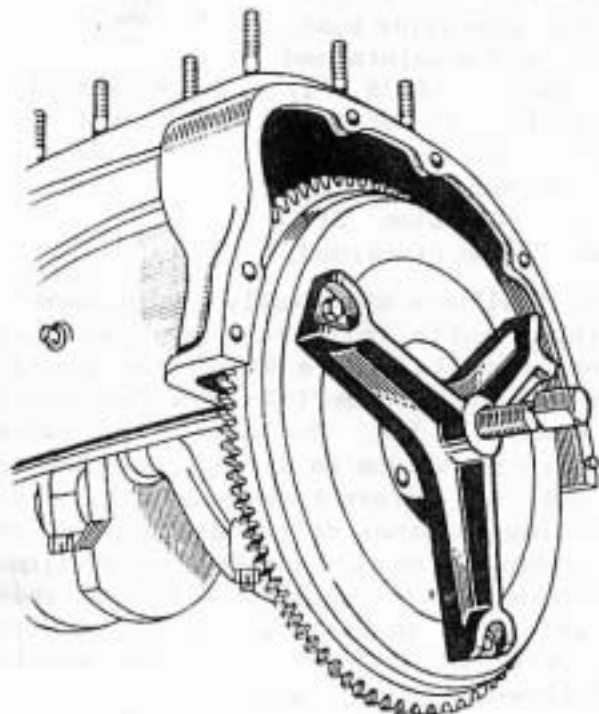
Details of the rear bearing oil seal are illustrated in the sectional view of the engine Figure 81. Oil flowing from rear bearing is deflected by the flange part on the crankshaft into the oil pan.

A woven asbestos packing material is fitted into grooves in the oil pan and the upper part of the oil seal to effectively prevent oil getting out the rear end of the engine at that point. The upper half of the oil seal which is fitted into the cylinder block, as well as the lower half are removable pieces.

FLYWHEEL AND RING GEAR ASSEMBLY

The cast iron flywheel used on Ford four-cylinder engines is very carefully machined and balanced so as to reduce vibration to the minimum. The steel starter ring gear is shrunk on the flywheel.

When changing a flywheel ring gear, it is particularly important that the ring gear be heated sufficiently to expand it to a diameter larger than the diameter of the shoulder on the flywheel. A suitable gas heater for this operation is available from K. R. Wilson, Buffalo, New York, under the No. V-91.



Puller for Removing Flywheel
Fig. 93

The operation of removing the flywheel from an engine is facilitated by the puller illustrated in Figure 93 (K.R.W. No. TR-11). If a puller of this type is not available, however, a flywheel can be removed by striking it first on one side and then the other with a Rawhide hammer.

In addition to the four bolts, there are two dowels in the crankshaft which hold the flywheel in place. The four bolts which hold the flywheel to the crankshaft must be carefully wired after they have been pulled up tightly. It is also suggested that the flywheel be checked for run out after installation; this can be done by fixing a dial indicator to the flywheel-housing so the point of the indicator touches the flywheel approximately 1/4" from the beveled edge.

Total run out should not exceed .010".

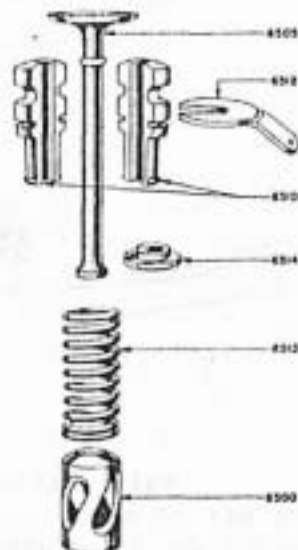
VALVE PUSH RODS

The one-piece Valve Push Rods illustrated in Figure 94, are cast from a special wear resisting alloy iron developed by the Ford Motor Company for this particular purpose. Being hollow, they are light in weight and the spiral openings in the side help to provide sufficient lubrication. All surfaces are hardened and these wear resisting surfaces in combination with the other parts of the valve mechanism, make it possible to retain practically constant valve clearances. The customary valve adjusting lock nuts and screws are not required with the Ford design valve mechanism.

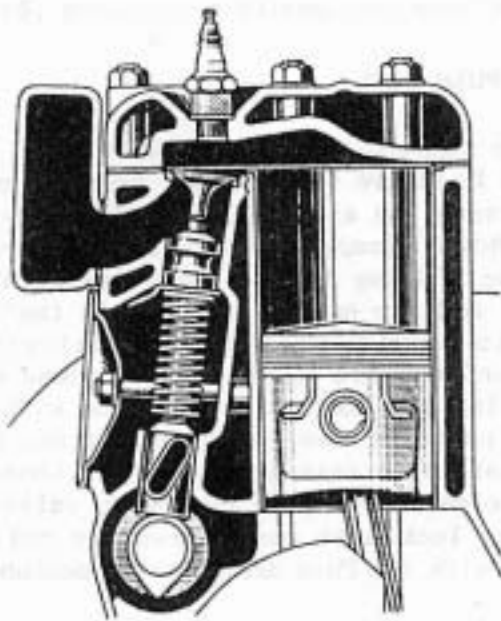
VALVES

The Ford valves are high chrome nickel alloy steel because of the ability of this metal to withstand high temperatures and corrosion. They do not warp, burn or pit readily. This is true of both the intake and exhaust valve as the same metal is used for both.

The lower end of the valve stems have an area more than three times that of the stem cross section. This large hardened area reduces wear on these surfaces to such an extent that valve clearances remain constant over a long period of time. The stem surfaces are also hardened to prolong the quiet action of the valve and to reduce leakage of intake and exhaust gases through wear in service.



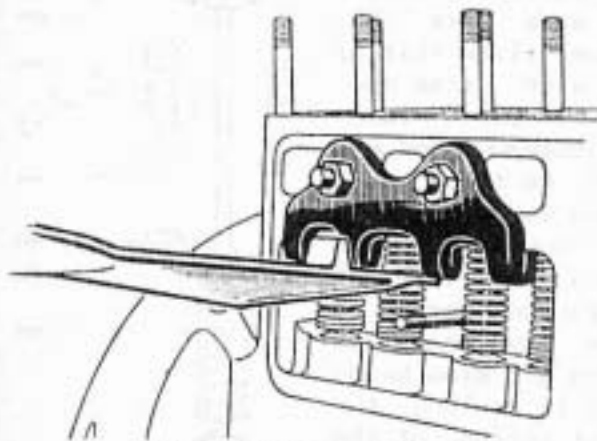
Exploded Valve Assem.
Fig. 94



Sectional View of Valve Mechanism
Fig. 95

The valve, valve guide, spring and retainer are assembled and installed in the engine as a unit. This assembly is illustrated in Figure 94.

A cross sectional view of the engine showing the unit valve assembly in position is illustrated in Figure 95. Removal of the complete unit is accomplished by



Valve Lifter - Fig. 96

the use of a bar-type valve lifter and bracket as illustrated in Figure 96. After assembling the bracket to the side of the block as shown in the illustration, insert the valve lifter through the valve spring to the flange on the lower end of the valve guide bushing as illustrated in Figure 96. This permits the valve guide bushing Part 6510 (Figure 94) to be pulled down suf-

ufficiently to remove the valve guide bushing retainer, Part 6512, after which the assembly can be withdrawn up through the valve port.

The clearance between the valve stem and the valve guide bushing should be maintained at .0015 to .0035. If the inside diameter of a valve guide bushing becomes worn in excess of the dimension .314, it should be discarded.



Valve Assembly
Fixture
Fig. 97

To facilitate disassembly and reassembly of these units, a fixture such as that illustrated in Figure 97 can be secured from K. R. Wilson, Buffalo, New York under the Tool No. V-130. The angle of the valve seat on Ford valves is 45 degrees. Due to the numerous different makes of valve seat re-facing machines on the market, we are not attempting to give detailed instructions concerning the re-facing of valves in this booklet. The instructions supplied with the particular machine being used, should be followed in every case.

Do not re-install in an engine any valves which have been re-faced so many times that the edges are thin; such valves should be discarded and replaced with new ones.

Eccentric grinding is the only method of re-facing hardened valve seat inserts which is approved by the Ford Motor Company. Instructions for using a grinder of this type ordinarily accompany these machines.

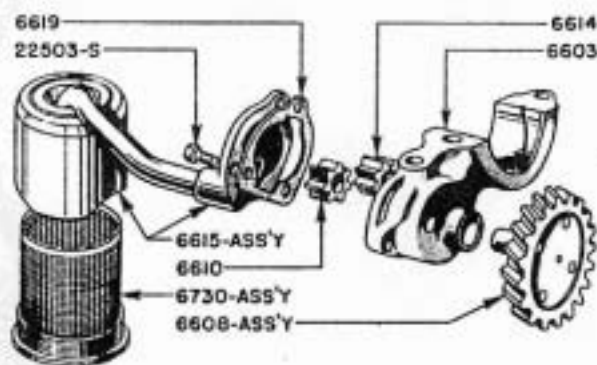
VALVE GUIDE BUSHING

The Ford valve guide bushings are made in two pieces and when removed from an engine for any purpose, they must be kept in pairs exactly as removed from the engine. The relationship between the outside diameter of the valve guide bushing and the inside diameter is held to very close limits and if the valve guides are not kept in pairs as originally manufactured, excessive clearance around the valve stems might result. Excessive clearance at this point is sometimes the cause of noisy valves, lack of power and excessive oil consumption.

OIL PUMP:

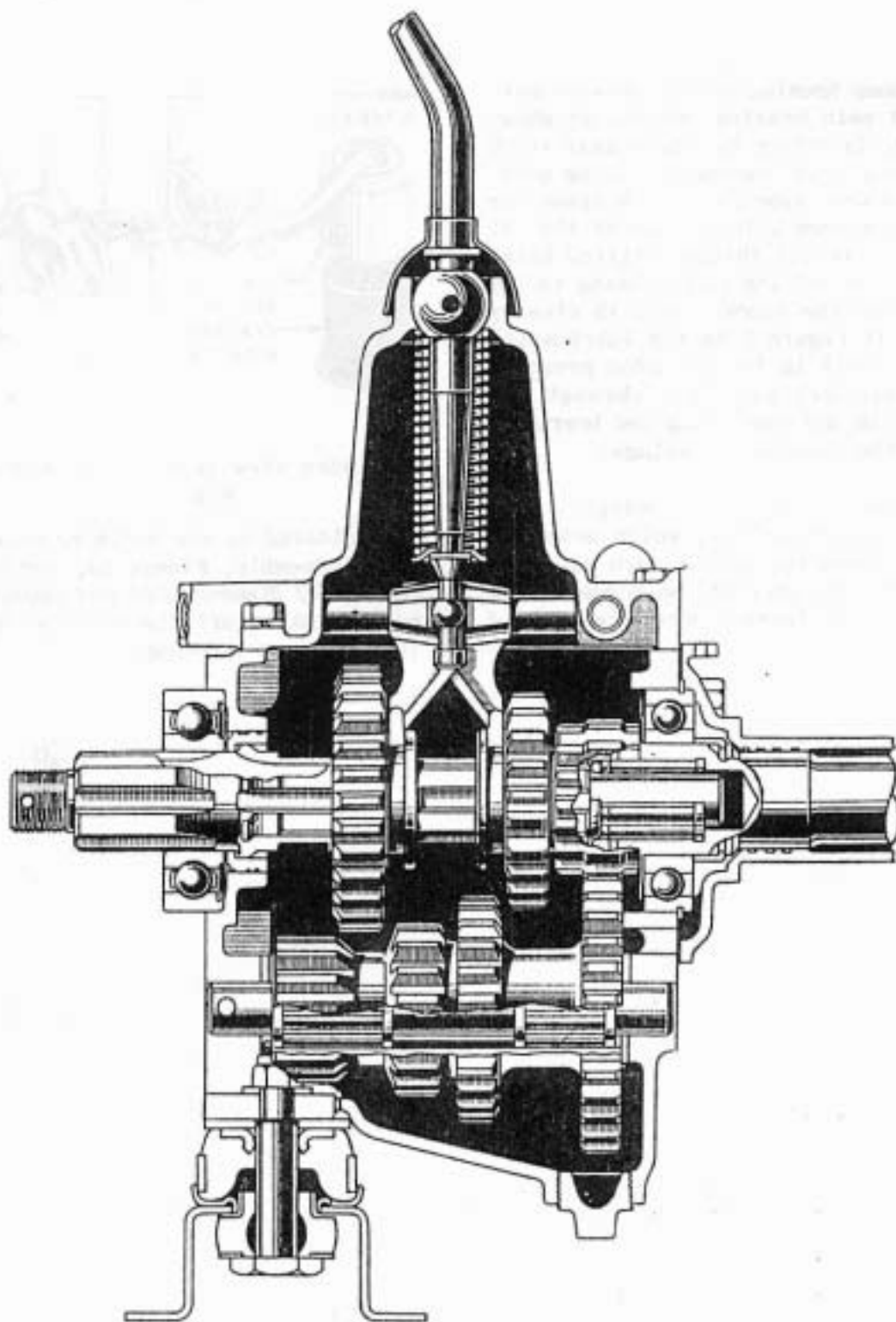
The oil pump housing is an integral part of the front main bearing cap and as shown in Figure 98, is driven by a fiber gear which meshes directly with crankshaft timing gear. The pump is a gear type pump which draws the oil through a screen in the bottom of the oil pan and circulates it through drilled holes in the upper part of the pump housing to the oil passages in the block. This is clearly illustrated in Figure 7 in the lubrication section. The oil is forced under pressure from the main oil passages through the crankshaft main and connecting rod bearings, as well as the camshaft bearings.

The oil pump screen is an integral part of the oil pan drain plug which makes it possible to clean the screen each time the oil is drained and prevents an accumulation of sludge or other foreign substances around the oil sump.



Exploded View of Oil Pump Assembly
Fig. 98

As indicated in the exploded view of the oil pump assembly, Figure 98, the pump can be completely disassembled and reconditioned by merely taking off the cover at the back of the oil pump housing.



Sectional View of Transmission
Fig. 99

TRANSMISSION

The transmission is of the standard selective sliding gear type and all moving parts with the exception of the reverse idler gear which rotates on a bronze bushing, are carried on ball and roller bearings. A cross sectional view of the transmission is shown in Figure 99. In addition to the cross sectional view mentioned above, an illustration of all parts in their relative assembly position is shown in Figure 100.

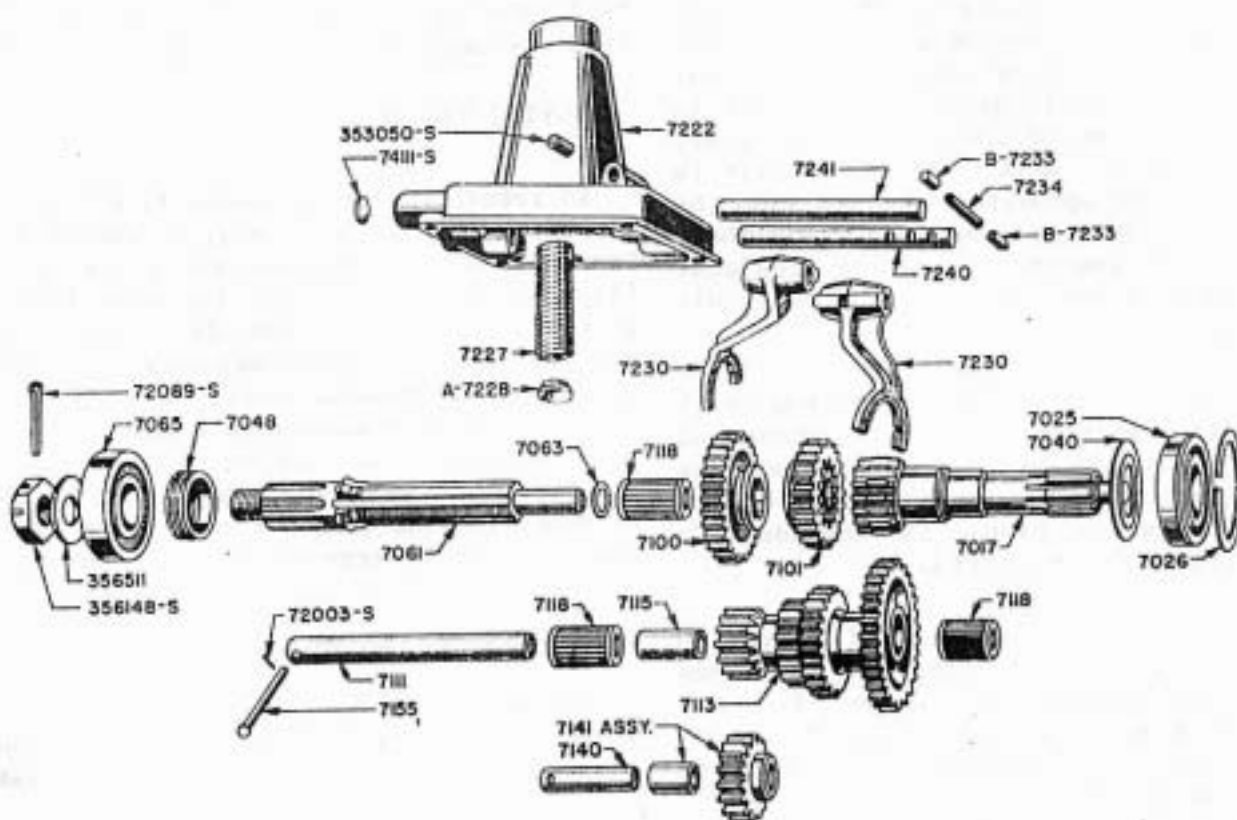


Fig. 100

Transmission

| | | | |
|--------|---|------|--|
| 7017 | Gear - Trans. Main Drive | 7140 | Shaft - Trans. Reverse Idler |
| 7025-A | Ball Bearing - Trans. Main Drive Gear | 7141 | Gear and Bushing Assembly - Trans. Idler Gear |
| 7026 | Snap Ring Trans. Main Drive Gear - Bearing Retainer | 7155 | Pin - Trans. Countershaft and Reverse Idler Shaft Retainer |
| 7040 | Baffle - Trans. Main Drive Gear Oil | 7222 | Housing - Gear Shift |
| 7048 | Oil Seal Trans. Main Shaft | 7227 | Spring - Gear Shift Lever |
| 7061 | Shaft Trans. Main | 7228 | Seat - Gear Shift Lever |
| 7065 | Bearing - Trans. Main Shaft Ball | 7230 | Fork - Gear Shifter |
| 7100 | Gear - Trans. Low and Reverse Sliding | 7233 | Plunger - Trans. Gear Shifter Shaft Lock |
| 7101 | Gear - Trans. High and Inter. Sliding - | 7234 | Spring - Trans. Gear Shifter Shaft Lock Plunger |
| 7111 | Countershaft - Trans. | 7240 | Shaft - Gear Shifter, Low and Reverse |
| 7113 | Gear - Trans. Countershaft | 7241 | Shaft - Gear Shifter, High and Intermediate. |
| 7115 | Spacer - Trans. Countershaft Gear Bearing | | |
| 7118 | Bearing - Long Roller | | |

When the transmission gearshift lever is moved to the reverse gear position, the low and reverse sliding gear, Part No. 7100, meshes with the reverse idler gear, Part No. 7141. This idler gear is in constant mesh with the small gear (extreme left in the illustration) of the countershaft gear, Part No. 7113. Since the idler gear is turning in the opposite direction from the countershaft gear, it causes the main shaft to which the low and reverse sliding gear is splined to revolve in the opposite direction.

In order to visualize the action which takes place as described in the above and following paragraphs, it is suggested that the reader refer to the exploded view of the transmission, Figure 100, and identify each part as it is mentioned.

When the transmission shift lever is moved to the low speed position, it causes the low and reverse sliding gear, Part No. 7100, to mesh with the low speed gear on the countershaft, Part No. 7113 (second gear from the left in the illustration). The flow of power is then from the transmission main drive shaft, Part 7017, to the large gear on the countershaft with which it is meshed, through the low speed gear on the countershaft to the low and reverse sliding gear, Part 7100, and then to the main shaft, Part 7061, on which the sliding gear is splined.

Movement of the transmission shift lever to the second speed position causes the intermediate and high sliding gear, Part No. 7101, to engage with the intermediate gear on the countershaft, Part No. 7113 (third gear from the left in the illustration). The driving power is then transmitted from the main driving gear, Part 7017, to the main driving gear on the countershaft, Part 7113, through the intermediate gear on the countershaft to the intermediate gear, Part 7101, on the main shaft and then through the spline to the main shaft, Part 7061.

In high gear the intermediate and high sliding gear, Part No. 7101, is moved forward so that the internal teeth in this gear engage the teeth on the end of the main driving gear, Part No. 7017. Inas-

much as the intermediate and high gear Part No. 7101 is splined to the main shaft, Part 7061, the flow of power is then directly from the main drive gear to the main shaft.

REMOVING TRANSMISSION

To remove the transmission from the vehicle, it is first necessary to remove the transfer case. The main shaft gear must first be removed through the hole in the rear of the transfer case after taking off the cotter pin, nut and washer which holds it to the transmission shaft. The propeller shafts are then disconnected from the transfer case after which the cap screws holding the transfer case to the transmission should be removed. The transfer case assembly is then free to be removed from the vehicle.

DISASSEMBLING TRANSMISSION

To facilitate removal of the transmission assembly from the vehicle it is advisable to remove the gear shifter housing which is held to the transmission case by six cap screws, Part No. 20346-F. Removal of these cap screws permits disassembly of the complete housing, including the shifter shafts and shifter yokes.

The transmission and clutch housing should be disassembled from the engine as a unit by removing the bolts holding the clutch housing to the flywheel housing.

Disconnect the clutch housing from the transmission case by screwing out the four bolts which hold the transmission case to the clutch housing.

The transmission main drive shaft, Part No. 7017, together with the bearing, Part No. 7025, retainer and oil seal, can now be lifted out of the housing. The transmission main shaft, Part No. 7061, can also be withdrawn from the other end of the transmission case, together with the bearing, Part No. 7065, and oil seal, No. 7048. This permits the transmission low and reverse gear, as well as the high and intermediate gear to be lifted out of the transmission case.

Remove the cotter pin and locking pin No. 7155, and withdraw the countershaft, Part No. 7111. A hammer and brass drift may be used to tap this part out of the transmission case. The transmission countershaft gear can then be lifted out of the housing and the two countershaft bearings, Part No. 7118, and spacer, Part No. 7115, removed from the gear. Next, withdraw the transmission reverse idler shaft assembly from the transmission housing and lift out the reverse idler gear.

The parts should now be washed in kerosene and each part carefully examined. If it is necessary to replace the ball bearings, they can be pressed off the shaft on an arbor press and new bearings pressed on. Before assembling, thoroughly lubricate all moving parts. Draw all bolts, nuts and cap screws down tightly, making sure to replace lock washers and cotter pins as required.

ASSEMBLING TRANSMISSION

Place the reverse idler gear in transmission case with the flush side of the gear to the rear of the case. Next, insert the transmission reverse idler shaft through case and gear, turning the shaft so the locking pin hole in the shaft lines up with the hole in the case.

Next, grease the two countershaft bearings, Part No. 7118, and install them in the gear with the spacer, Part No. 7115, in between the two bearings; then place the assembly in the transmission case, meshing the small countershaft gear with the reverse idler gear, Part No. 7141. The countershaft, Part No. 7111, should then be installed, using a small drift through the opposite end to line up the spacer in the middle with the holes in the bearing. The shaft is tapped into place with a brass hammer and should be turned so that the locking pin hole lines up with the locking pin hole in the reverse idler shaft as well as the holes in the case.

Now insert the locking pin No. 7155, through the hole in the case, through the reverse idler shaft, countershaft and the opposite side of the transmission case: then see that it is secured by inserting a cotter pin in the hole in the locking pin.

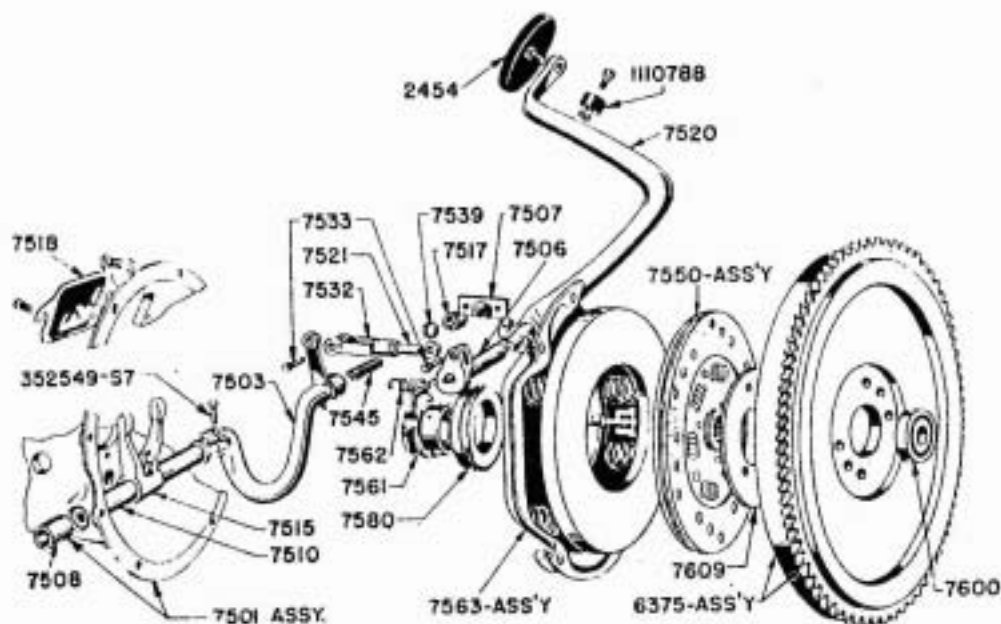
Turn the transmission housing so the reverse idler gear end is up and place the transmission low and reverse sliding gear and the high and intermediate sliding gear inside the case in position for assembling. Make sure the grooved collars for the shifter yokes come together and have the smaller gear, Part No. 7101, on the bottom so it will be to the front of the case when returned to its normal operating position.

If a new main shaft or a high and intermediate sliding gear are to be installed, the parts should be selected so the gear is a snug sliding fit on the shaft. The clearance between the gear and the shaft should not be in excess of .002". This should be checked with a feeler gauge. The clearance may vary from .002" down to a point where the gear will just slide on the shaft of its own weight or with a slight pressure of the fingers when the shaft is held vertically.

After lining up the gears as described above, insert the transmission main shaft, Part No. 7061 with bearing No. 7065 and oil seal No. 7048 assembled, through the rear end of the case and through the low and reverse and high and intermediate sliding gears. Guide the shaft downward until the transmission main shaft ball bearing, Part No. 7065, seats firmly in the bearing seat in the case.

The transmission assembly should then be turned to the horizontal position and the main shaft pilot bearing spacer, Part No. 7063 and bearing No. 7118, installed. Then place the transmission main drive gear, Part No. 7017, together with the bearing No. 7025, and oil seal over the bearing on the transmission main shaft, making sure that the main drive shaft ball bearing seats in the ball bearing seat in the transmission case.

Place the transmission case gasket in position and assemble the clutch housing to the transmission case by installing the four cap screws. The assembly is now ready to be installed in the car which should be done by merely reversing the procedure outlined in the foregoing paragraphs for removing.



Exploded View of Clutch Assembly
Figure 101

Clutch

| | | |
|-----------------------|----------------------------------|------------------------------|
| 2454 Clutch Pedal Pad | 7515 Release Shaft Fork | 7545 Spring |
| 6375 Flywheel | 7517 Equalizer Shaft Socket | 7550 Clutch Disc |
| 7501 Clutch Housing | 7518 Inspection Cover | 7561 Release Bearing Hub |
| 7503 Equalizer Shaft | 7520 Clutch Pedal | 7562 Release Bearing Spring |
| 7506 Pedal Shaft | 7521 Clutch Pedal Rod | 7563 Pressure Plate Assembly |
| 7507 Bracket | 7532 Clutch Pedal Rod Clevis | 7580 Release Bearing |
| 7508 Bushing | 7533 Clutch Pedal Rod Clevis Pin | 7600 Pilot Bearing |
| 7510 Release Shaft | 7539 Washer | 7609 Retainer |

CLUTCH

The clutch is a single plate, dry disc type, as illustrated in the sectional drawing, Figure 104. An exploded view showing the various parts of the clutch in relative assembly position, is shown in Figure 101.

The clutch pressure plate is a centrifugal type, having weighted levers which add to the pressure on the disc as engine

speeds are increased. It is attached directly to the fly-wheel surface by means of six pilot cap screws. These are special cap screws, Part No. 350433S, and under no circumstances should ordinary cap screws be used.

The three weighted release levers are mounted on needle roller bearings and due to the weight at the outer end, each lever is to some extent actuated by centrifugal force. The faster the clutch revolves the more the levers try to throw out and the greater the pressure they exert on the pressure plate.

The purpose of this design is to secure light pedal pressure for normal operating speeds and high pressure on the clutch disc when engine speeds are increased.

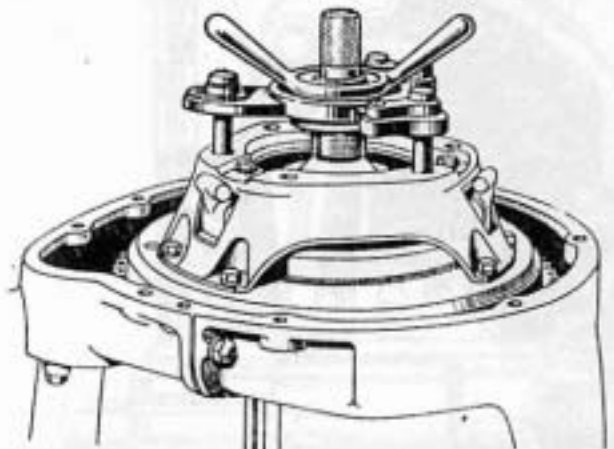
It is very important that a clutch compressor such as that illustrated in Figure 103 be used for installing and removing this type of clutch. If a compressor is not used, the cover plate may be distorted while being assembled or disassembled.

CLUTCH DISC

The driven member of the clutch incorporates a vibration damper of the spring and friction type. There are six of these springs of sufficient size and capacity to take care of the maximum engine torque. The springs compress both when accelerating and decelerating.

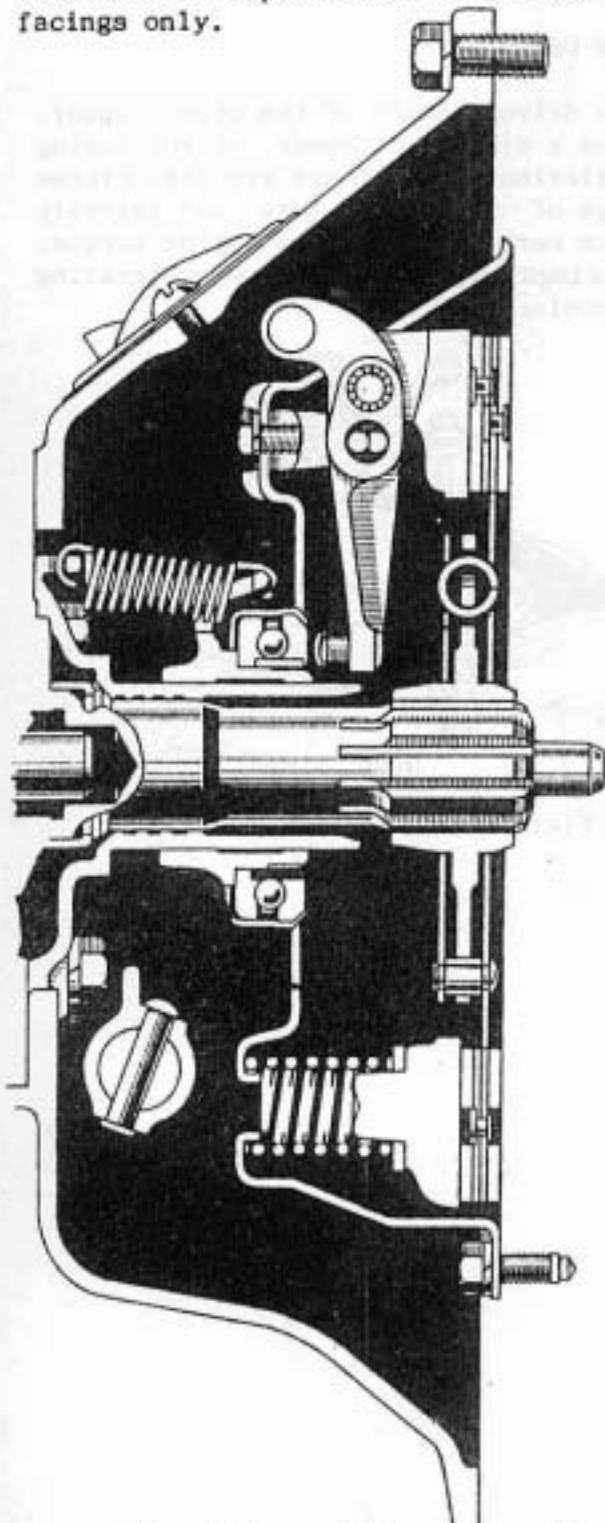


Sectional View of Clutch Disc Fig. 102



Fixture for Compressing Clutch Fig. 103

The only repair which should be attempted to the clutch disc is replacement of the facings. When sufficient wear takes place as to necessitate replacement of springs or other parts of the clutch hub, it is unlikely that any part of the clutch hub can be reconditioned satisfactorily. Reconditioning work should, therefore, be confined to replacement of clutch disc facings only.

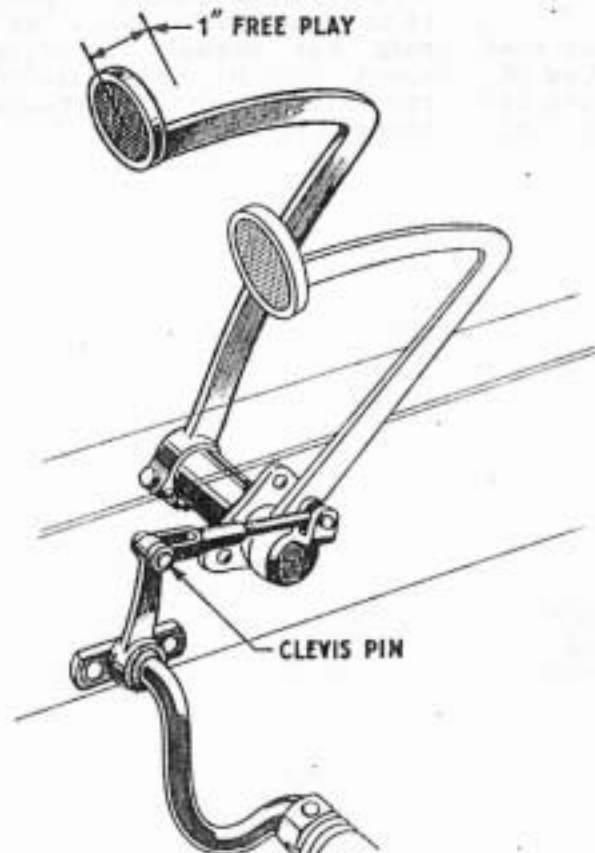


Sectional View of Clutch Assembly
Fig. 104

Cushion springs are riveted to the clutch facing on the pressure plate side of the clutch disc. Since it is impracticable to salvage these cushioning plates from the old disc, facings having the cushion plate springs riveted to them should be secured from the manufacturer. The facing nearest the flywheel is a plain facing which is assembled directly to the clutch disc. The rivets which hold the plain facing to the disc also hold the facing with the cushion plate springs assembled to the disc so that removal of these six rivets and installation of new facings and rivets will be the only reconditioning work to be done on clutch discs.

CLUTCH RELEASE BEARING

The clutch release bearing is the pre-lubricated type. It is carried on the release bearing hub, Part No. 7561, and is actuated by the release shaft fork, Part No. 7515. When necessary to replace any of these parts, the transfer case and transmission must be removed. Instructions for disassembling both the transfer case and the transmission are covered in the fore-



Clutch Pedal Adjustments
Fig. 105

going sections of the book covering those particular assemblies.

CLUTCH PILOT BEARING

The clutch pilot bearing is a ball bearing carried in a recess in the flywheel. It is lubricated before assembly with the same lubricant which is used for wheel bearings because of the very high melting point possessed by this lubricant. It is essential that a lubricant of this type be used whenever a pilot bearing is replaced for any reason as an unsuitable lubricant might melt out and not only cause the clutch to slip but also result in failure of the pilot bearing.

CLUTCH PEDAL ADJUSTMENT

The clearance between the clutch release bearing and the clutch plate release fingers must be maintained at all times and is indicated by the amount of free travel of the clutch pedal. This should be 1".

As indicated in Figure 105, adjustment is easily made by removing the clevis pin and turning the release arm rod. Screwing the rod out decreases the clutch pedal free movement. Screwing the rod in increases the amount of free movement.

After making the adjustment be sure to replace the clevis pin and cotter key.

TRANSFER CASE

In a vehicle of this type it is essen-

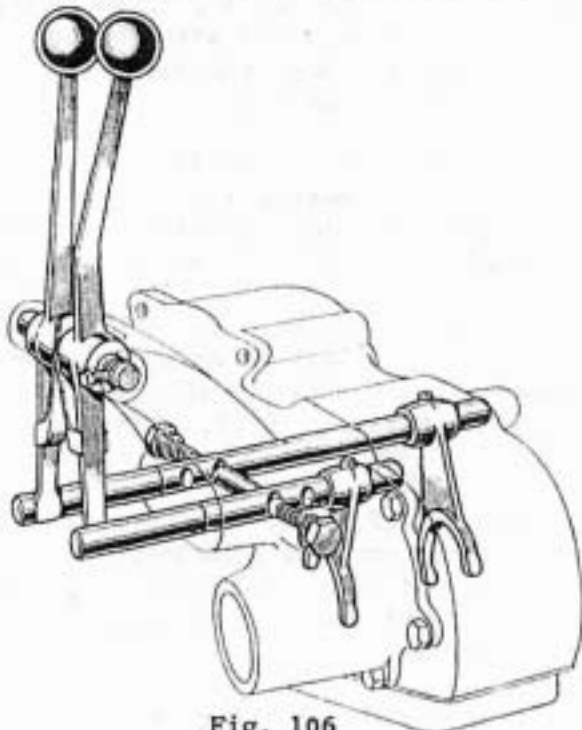


Fig. 106

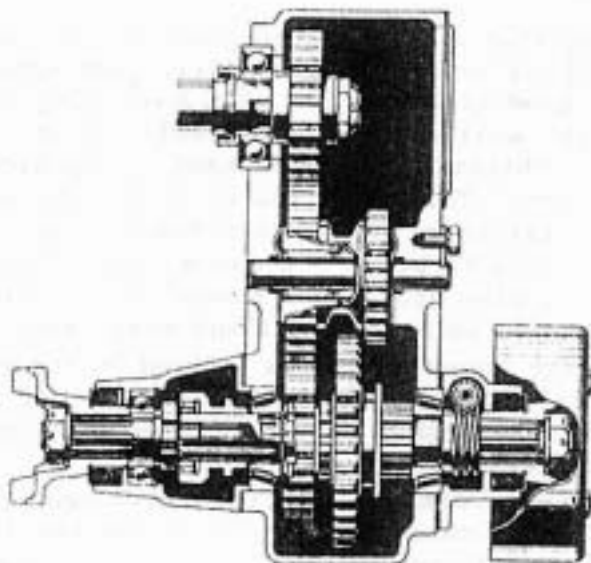
tial that a means be provided whereby the unit can be operated at fairly high speeds on good highways and also have adequate power available at the wheels to propel the vehicle through mud, sand and up steep grades. This requirement is met by installation of a transfer case which, in addition to being a 2-speed transmission unit, also provides a means of supplying power to both the front and rear axle.

The transfer case is located in the approximate center of the chassis and is bolted directly to the end of the transmission.

There are two shifter levers on the transfer case, one of which enables the operator to connect or disconnect the front axle drive, while the other controls engagement of the reduction gear. The action of these levers is clearly illustrated in Figure 106.

The transfer case main drive gear is bolted to the main shaft extending from the transmission. This shaft is supported by a ball bearing in the transfer case housing. The main drive gear, Part 7722 (Figure 109) meshes with the intermediate gear, Part 7742, which is actually two gears manufactured in one piece. The larger gear on the intermediate gear is constantly meshed with the main drive gear, as well as output shaft gear, Part 7766. The smaller gear on the intermediate gear meshes with the sliding gear on the output shaft, Part 7765, when high speed ratios are desired. The output gear, Part 7766, can revolve freely on the output shaft, so that when engaged in the high speed gears the power flow is from the main drive gear to the intermediate gear, through the small intermediate gear to the sliding gear which, being splined to the output shaft, causes the shaft to turn. When more power is desired at the wheels, movement of the shift lever causes the sliding gear to disengage from the small intermediate gear and engage with the output gear so that the flow of power is from the main drive gear to the large gear of the intermediate gear through the output gear to internal spline of the sliding gear and then to the output shaft.

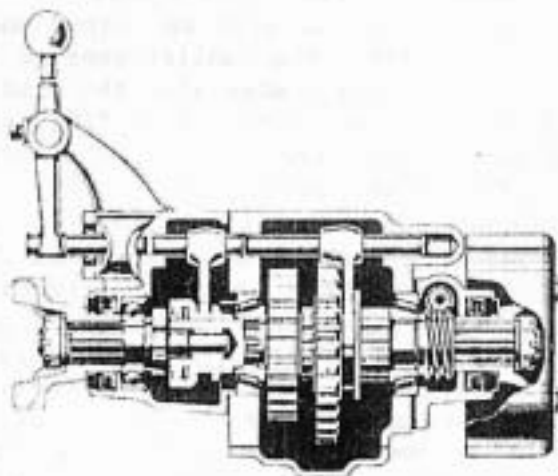
Movement of the front axle drive shift lever engages the clutch gear, Part 7762, with the clutch shaft, Part 7761, which in turn causes the front propeller shaft to revolve.



Sectional View of Transfer Case
Fig. 107

The intermediate gear is carried on two roller bearings, while the output shaft is supported by two tapered roller bearings.

By referring to the sectional drawing Figure 107, the above explanation of the workings of the transfer case should be clearly understood.



Side, Sectional View of Transfer Case
Fig. 108

DISASSEMBLING TRANSFER CASE

To remove the transfer case assembly from the vehicle, the procedure outlined below should be followed: Refer to Figure 109 to identify the parts as they are mentioned.

Remove the cotter pin from the clevis pin holding the emergency brake rod to the operating cam on the emergency brake. Remove the five cap screws and lock washer holding the main drive gear cover, Part No. 7706 to the housing. Remove the cotter pin, nut and washer, Part No. 356148S and take off the main shaft gear, Part No. 7722, through the hole in the rear of the transfer case.

Disconnect both front and rear propeller shafts from the transfer case. This is done by merely removing the four nuts and lock washers holding each universal joint to the companion flanges. For detailed instructions concerning disconnecting the propeller shaft, refer to Page 4006-16.

Remove the four cap screws and lock washers holding the transfer case to the transmission which will permit removal of the transfer case from the vehicle.

The first step in disassembling the transfer case is to remove the cap screws and lock washers which hold the bottom cover, Part No. 7708, to the case. Next, remove the lock plate screw, which holds the intermediate gear shift lock plate washer and lock plate, Part 7767, in place. The intermediate gear shaft can then be removed from the case by using a brass drift and light hammer. Removal of the intermediate gear shaft permits the intermediate gear, together with thrust washers and roller bearings to be taken out through the bottom of the case.

Disassemble the shifting levers and springs, by removing the set screw, Part No. 355378, and driving out the shaft lever pivot pin, Part No. 7796, with a brass drift.

The front cap, Part No. 7774, should be removed as a complete assembly which includes the cap, clutch shaft, Part No. 7761, bearing, Part No. 7719, universal joint yoke, Part No. 7729, clutch bearing, Part No. 7723, fork, Part No. 7711, shift rod, Part No. 7787, plugs, interlock and oil seal. When removing this assembly be careful to avoid losing the poppet balls, which will drop out when the cap comes free from the housing.

Remove front bearing, Part No. 7723,

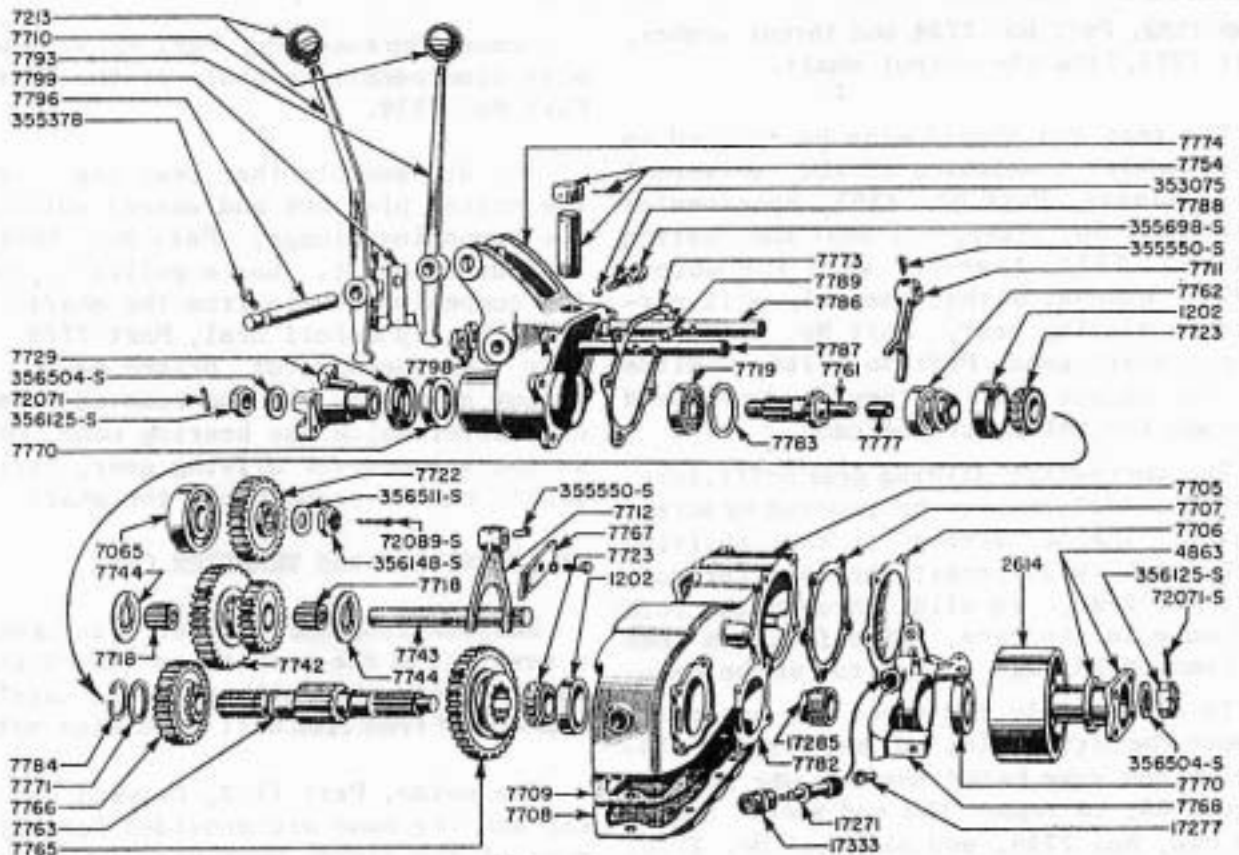


Fig. 109

Transfer Case

- | | |
|---------------------------------|--------------------------------|
| 1202 Bearing Cup | 7744 Thrust Washer |
| 2614 Brake Drum | 7754 Breather |
| 4863 Coupling Flange | 7761 Clutch Shaft |
| 7065 Main Shaft Bearing | 7762 Clutch Gear |
| 7213 Shift Lever Ball | 7763 Output Shaft |
| | 7765 Output Shaft Gear - Rear |
| | 7766 Output Shaft Gear - Front |
| 7705 Transfer Case | 7767 Lock Plate |
| 7706 Rear Cover | 7768 Output Shaft Cap - Rear |
| 7707 Rear Cover Gasket | 7770 Output Shaft Retainer |
| 7708 Bottom Cover | 7771 Thrust Washer |
| 7709 Bottom Cover Gasket | 7773 Gasket |
| 7710 Shift Lever | 7774 Front Bearing Cap |
| 7711 Shift Fork - Front Axle | 7777 Bushing |
| 7712 Shift Fork - Underdrive | 7782 Shim |
| | 7783 Snap Ring - Front |
| | 7784 Snap Ring - Rear |
| 7718 Inter-shaft Bearing | 7786 Underdrive Shifter Shaft |
| 7719 Output Shaft Bearing | 7787 Front Drive Shifter Shaft |
| 7722 Main Shaft Gear | 7788 Spring |
| 7723 Output Shaft Cone & Roller | 7789 Interlock |
| | 7793 Underdrive Shift Lever |
| 7729 Univ. Joint Front Flange | 7796 Pivot Pin |
| | 7798 Oil Seal |
| | 7799 Shift Lever Spring |
| 7742 Intermediate Gear | 17271 Speedometer Driven Gear |
| 7743 Idler Gear Shaft | 17285 Speedometer Drive Gear |
| | 17333 Speedometer Sleeve |

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snap ring, Part No. 7784, and thrust washer, Part 7771, from the output shaft.

The rear cap should also be removed as an assembly consisting of the universal joint flange, Part No. 4863, speedometer gear, Part No. 17285, oil seal and bearing, Part No. 7723, together with the output shaft. Removal of this assembly will permit the sliding gear, Part No. 7765, and output shaft gear, Part No. 7766, to slide off the output shaft so they can be removed through the bottom of the case.

The underdrive sliding gear shift fork, Part No. 7712, cannot be removed by screwing out the set screws in the shifting fork which will permit the shifter rod, Part No. 7786, to slide through the fork and hole in the case. The fork can then be removed through the bottom of the case.

To disassemble the front cap assembly, remove the cotter pin, nut and washer holding the end yoke to the shaft. Use puller, Figure 62, to remove the end yoke. Remove the cap, No. 7729, and oil seal No. 7770. Remove the set screw from the fork, Part No. 7711. This will permit removal of the shift rod, Part No. 7787. Taking out this rod releases the poppet ball and spring and precaution should be taken to prevent losing these parts.

Remove the clutch gear and fork together.

Remove the output clutch shaft, Part No. 7761, by carefully pressing it through the bearing.

Remove the snap ring, Part No. 7783, which will also permit removal of the bearing, Part No. 7719.

To disassemble the rear cap, remove the cotter pin, nut and washer which hold the companion flange, Part No. 4863, to the output shaft. Use a puller to remove the companion flange from the shaft. Remove the cap and oil seal, Part 7770. Remove the speedometer driven gear. The output shaft can then be removed from the cap, after which the bearing cone, as well as the speedometer driving gear, Part No. 17285, can be pressed off the shaft.

RE-ASSEMBLING THE TRANSFER CASE

Reassembling the transfer case is merely a reversal of the operations listed above. Make certain that all parts are carefully washed and free from dirt or foreign matter.

The shims, Part 7782, between the rear cap and the case are provided for adjustment of the Timken Bearings. The bearing should be adjusted so there is not more than .003" end movement of the shaft. Ordinarily it will only be necessary to make certain that the same shims which were removed during the disassembly operation are reinstalled when building up the case. In the event there is a question as to one or more of the shims having become displaced, however, it will merely be necessary to check end movement of the shaft and make sure that sufficient shims are installed so the maximum amount of movement is .003".

COOLING SYSTEM

One of the most important factors in obtaining efficient performance and maximum life from an automobile engine is keeping the operating temperature of the engine at the point where the engine operates most efficiently. This depends upon adequate water jackets around the cylinder bores, as well as a radiator and fan of suitable capacity to dissipate the heat as it is carried away from the cylinders by the circulating water. The water must be kept circulating after the engine temperature has been brought up to the efficient operating point and an impeller type water pump is included in the cooling system for that purpose. Since it is desirable to restrict the flow of the water to the radiator until the cold engine has warmed up to an efficient operating temperature, a thermostat is placed in the hose connection leading from the cylinder head to the radiator. The thermostat consists of a butterfly valve, actuated by a bimetal spring, which remains closed until the water reaches a temperature of approximately 145 degrees, at which point the spring contracts and opens the valve so the water can flow to the radiator.

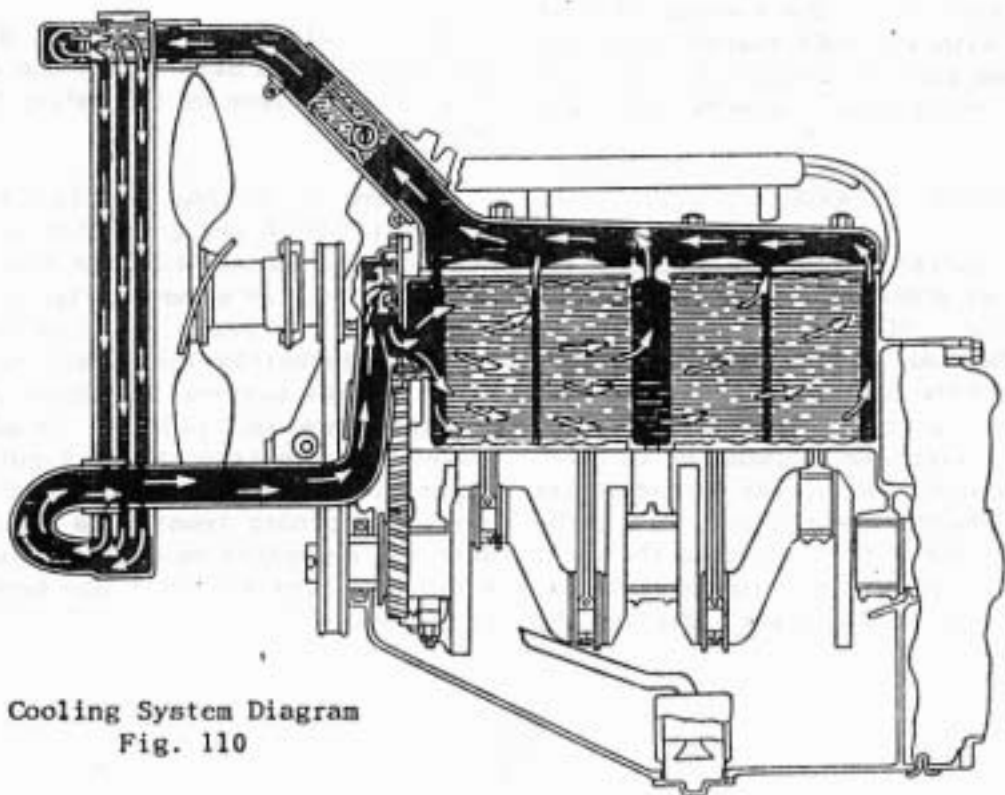
A diagram showing the functioning of the Ford Cooling System is shown in Figure 110.

To drain the cooling system, open the drain cock located in the radiator bottom tank. There is also a drain cock on the left side of the cylinder block toward the rear which must be opened in order to completely drain the block. 10 quarts are required to refill the system after draining.

RADIATOR:

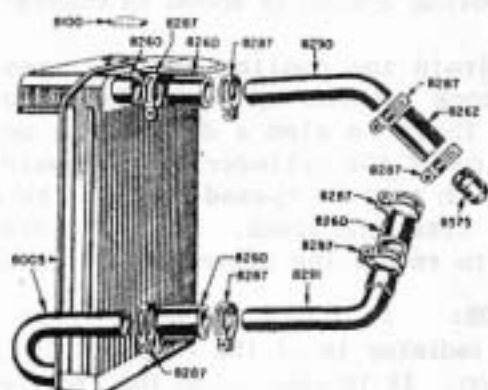
The radiator is of the tube and fin construction. It is mounted on the front cross member and is protected from excessive road shocks by rubber insulating washers. There are only two bolts holding the radiator to the cross member since it is desirable in this type of unit to have a flexible mounting which will not transmit strains and shocks to the radiator core.

To remove the radiator core it is merely necessary to drain the water from the radiator by opening the drain cock in the bottom tank. Disconnect both the upper and lower hose connections. Remove the lock washers and two nuts on the radiator support bolts.



Cooling System Diagram
Fig. 110

The radiator can then be lifted up out of the vehicle.



Exploded View of Cooling System
Fig. 111

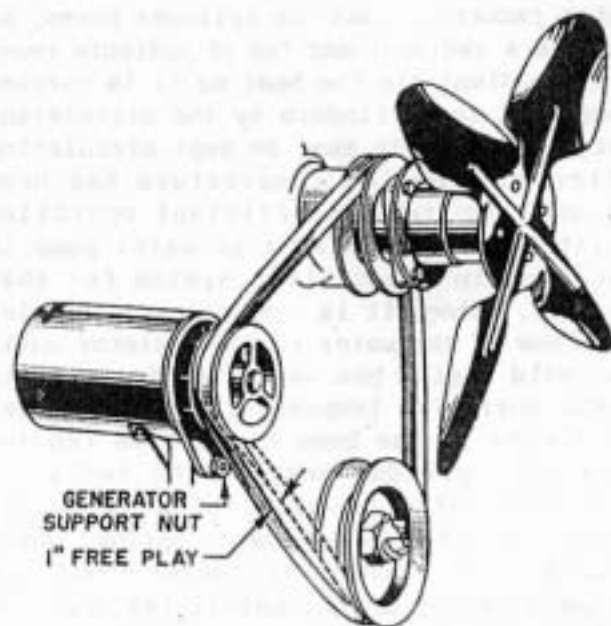
THERMOSTAT

As illustrated in Figure 111, a thermostat is located in the upper hose connection. The bimetal unit consists of two layers of metal, each having a different coefficient of expansion, which are bonded together and formed into a coil. This coil is installed in the thermostat housing with one end solidly anchored and the other end attached to the butterfly valve. Any temperature change will cause the coil to wind or unwind and change position of the butterfly valve which will in turn meter the water flow to maintain a constant temperature in the cylinder block. The thermostat must be assembled with the coil towards the cylinder block so that it is readily affected by any water temperature change in the block.

CHECKING THERMOSTAT RANGE:

To check operation of the thermostat, the thermostat should be removed from the hose connection. Disconnect the upper hose connection, Part No. 8262, Figure 111, at both ends and remove the thermostat from the hose. Heat a pail of water to 145 degrees Fahrenheit, using an accurate thermometer to check the temperature. When the temperature reaches 145 degrees Fahrenheit, place the thermostat in the water, stirring the water constantly to maintain an even temperature. A slight movement of the valve indicates the

start to open setting is correct. To check the full flow position of the thermostat, raise the temperature of the water to 185 degrees Fahrenheit, always stirring to hold a constant temperature.

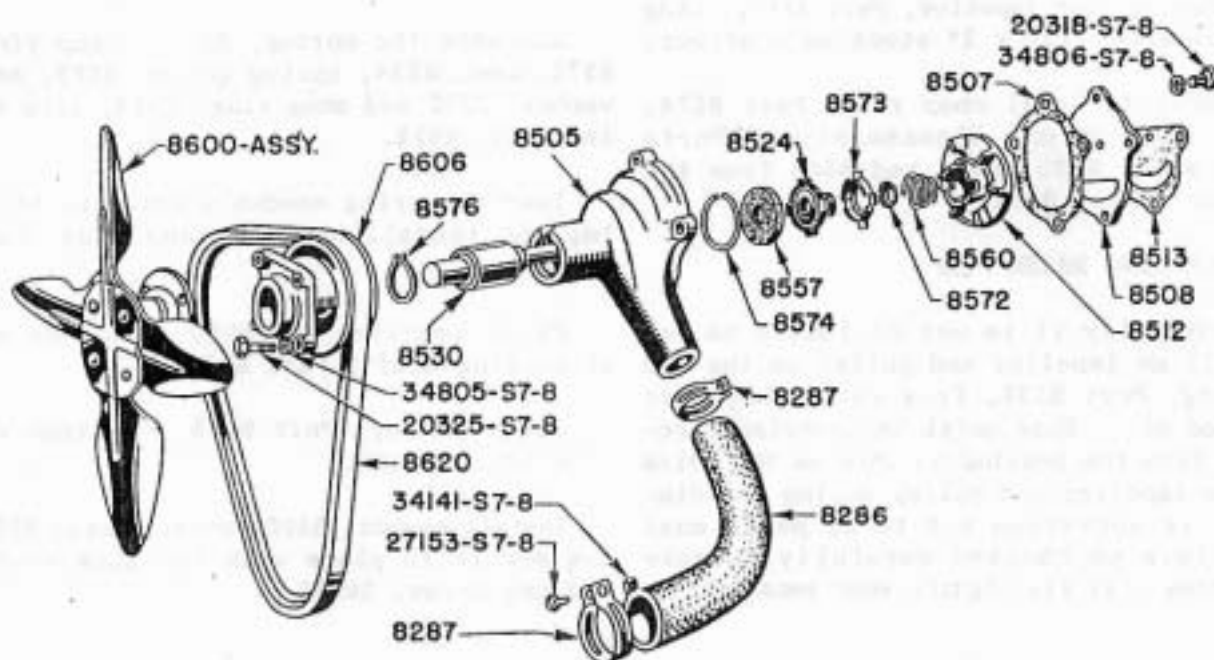


Fan Belt Adjustment
Fig. 112

FAN AND FAN BELT:

A four-blade fan is bolted directly to the pulley which also drives the water pump. It is held in place on the pulley by four cap screws.

Tension of the fan belt is controlled by the position of the generator on the right side of the engine which is also driven by the fan belt. As shown in Figure 112, there should be 1" free play when the belt is pushed alternately inward and outward at a point midway between the generator pulley and the crankshaft pulley. To adjust this, loosen the generator support nut, shown in Figure 112, and move the generator outward until the proper tension is secured. Make sure the generator support nut is tightened securely after the belt has been properly adjusted.



Exploded View of Water Pump Assy-
Fig. 113

8286 Hose
8287 Hose clamp
8505 Housing
8507 Gasket
8508 Cover
8512 Impeller

8513 Gasket
8524 Seal
8530 Bearing Assy
8557 Washer
8560 Spring
8572 Clamp Ring

8573 Spring guide
8574 Seal Snap Ring
8576 Housing Snap Ring
8600 Fan Assy
8606 Pulley
8620 Belt

WATER PUMP

The water pump is a pre-lubricated, impeller type having a capacity of 25 gallons per minute at engine speed of 2000 R.P.M. All parts of the pump, in correct position for assembly, are illustrated in Figure 113.

To remove the pump from the engine, loosen the generator bracket pivot bolt illustrated in Figure 112 and push the generator toward the cylinder block so the fan belt can be slipped off the pump pulley.

Loosen the upper hose clamp on hose 8286 and disconnect hose from pump housing.

Remove the three cap screws which hold housing to front of cylinder block after which the pump and fan assembly can be removed.

DISASSEMBLING WATER PUMP

The procedure outlined below should be followed to disassemble the water pump.

Disassemble the fan (8600) from the pulley, 8606, by removing the four cap screws, 20325-S8.

Remove the cap screw 20318-S which holds the cover, 8508 and gasket 8507 to the housing.

Press the pulley, Part 8606, off the bearing, Part 8530, in an arbor press. A special fixture which will hold the pulley in the belt grooves should be used for this operation. It is also advisable to use a piece of hard stock 1/2" x 2" as a driver for pushing the bearing out of the pulley.

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Remove the housing snapping, Part 8576.

Press off the Impeller, Part 8512, using the piece of 1/2" x 2" stock as a driver.

Remove the seal snap ring, Part 8574, which will permit disassembly of Parts 8557, 8524, 8573, 8572 and 8560 from the impeller, Part 8512.

REASSEMBLING WATER PUMP

Ordinarily it is not advisable to re-install an impeller and pulley on the old bearing, Part 8530, from which they were pressed off. Some metal is invariably removed from the bearing as well as the holes in the impeller and pulley during the disassembly operation and these parts must therefore be checked carefully to make sure they will fit tightly when reassembled.

If there is the slightest question, it is advisable to use new parts.

Assemble the spring, 8560, clamp ring, 8572, seal, 8524, spring guide, 8573, seal washer, 8557 and snap ring, 8574, into the impeller, 8512.

Insert bearing assembly into the housing and install housing snap ring, Part 8576.

Press impeller assembly onto rear end of bearing shaft, Part 8530.

Press pulley, Part 8606, on front end of bearing shaft.

Install gasket, 8507, cover plate, 8508, and secure in place with the lock washer and cap screw, 20318-S.

CARE OF COOLING SYSTEM:

Precautionary measures against the forming of rust or scale in the cooling system in order to avoid troubles resulting from overheating should be taken. This can be controlled to a great extent, by making sure that the water used in the cooling system is as nearly neutral and free from chloride salt as possible. In other words, it should have the minimum tendency to rust or corrode the metal with which it comes in contact.

In localities where alkaline, acid or saline waters are the only kind available, the addition of a rust inhibitor in the cooling system will tend to minimize the corrosive action of such water.

As an additional precaution against the formation of rust or scale in the cooling system, it is recommended that the system be flushed out twice a year. This should be done in the fall before installing an Anti-Freeze solution and again in the spring when the Anti-Freeze solution is drained from the

system. At the same time all hose connections should be checked carefully and tightened, if necessary. Any hose which shows an indication of deterioration should be replaced immediately.

ANTI-FREEZE:

The Ford Motor Company does not recommend the use of any inorganic substances such as calcium chloride, honey, glucose, sugar, kerosene or other oils as an anti-freeze. Due to the fact it is inexpensive and more readily available, alcohol is most commonly used as an anti-freeze solution. Other satisfactory fluids are Ethylene-Glycol or radiator glycerin. These last mentioned materials are not subject to evaporation to such a great extent as alcohol but are considerably more expensive.

Any one of the three materials mentioned above are available and in most cases when supplied as a radiator anti-freeze they contain a suitable inhibitor to control rust and corrosion.

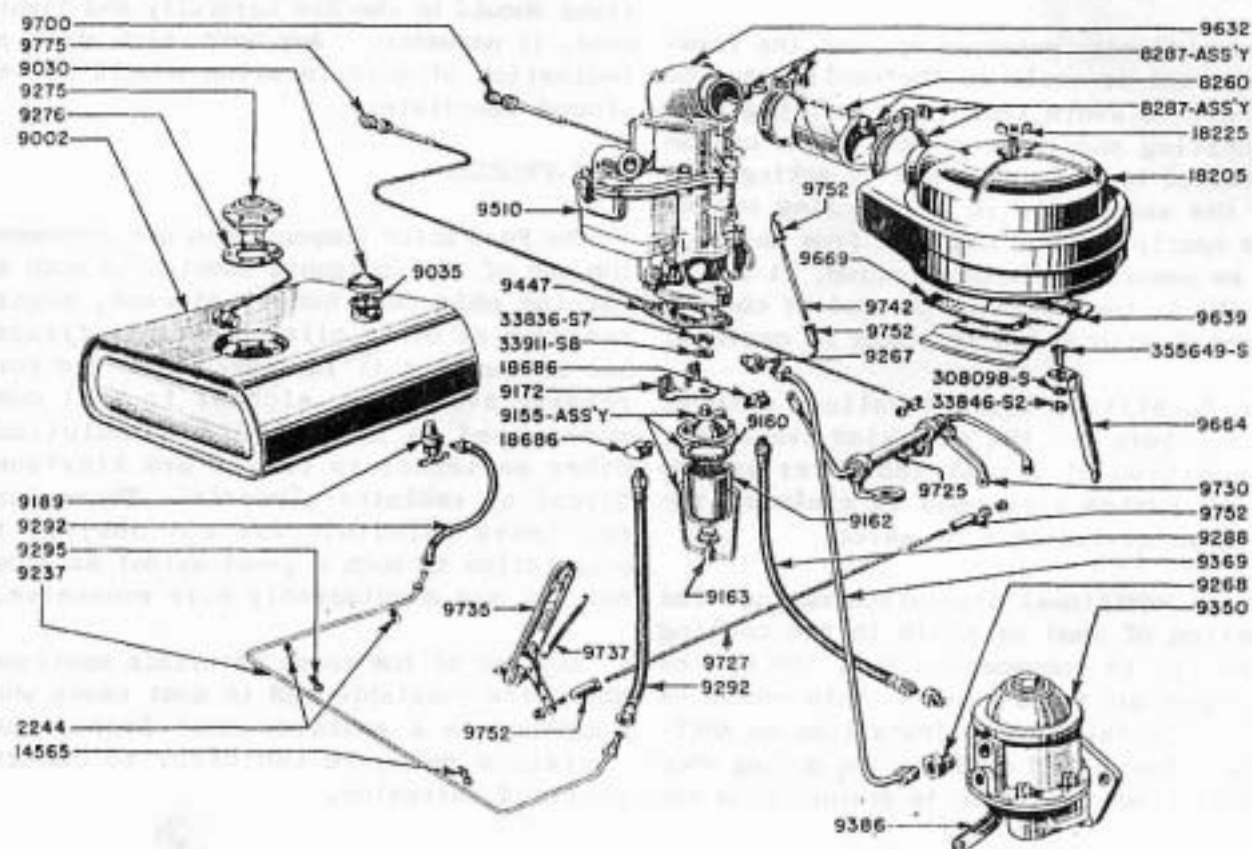
ANTI-FREEZE CHART

Capacity Cooling System--10 Quarts

| | Alcohol* | Radiator Glycerine** | Ethylene Glycol |
|-------|----------|----------------------|-----------------|
| + 20° | 4 pts. | 7 pts. | 3 pts. |
| + 10° | 6 pts. | 10 pts. | 5 pts. |
| 0 | 8 pts. | 13 pts. | 6 pts. |
| - 10° | 9 pts. | 15 pts. | 8 pts. |
| - 20° | 11 pts. | 17 pts. | 9 pts. |
| - 30° | 12 pts. | 19 pts. | 12 pts. |

* Denatured (90%--180 proof)

** 60% Concentration.



Fuel System - Fig. 114

FUEL SYSTEM:

All parts of the fuel system are illustrated in the exploded view, Figure 114. The fuel tank which has a capacity of ten gallons, is located underneath the driver's seat. The filler cap is in the top of the tank and is exposed by merely raising the seat cushion.

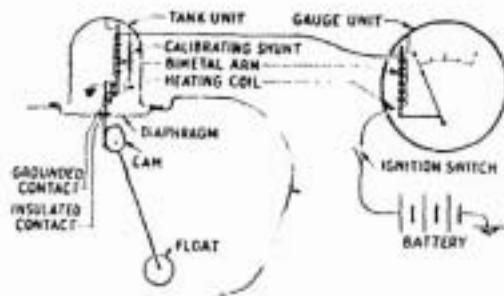
As shown in the illustration of the fuel system, Figure 114, there is a gasoline shut-off valve in the bottom connection from which the flexible tubing leads to the fuel line on the frame. There is also

a flexible connection from the other end of the fuel line leading to the fuel filter on the dash.

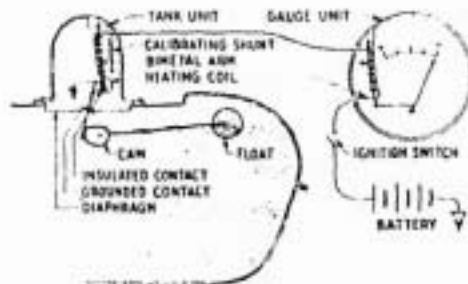
The fuel filter bowl, Part No. 9162, should be removed and cleaned periodically. This is done by loosening the thumb nut and removing bale, Part No. 9163.

FUEL GAUGE

The fuel gauge is an electric type which operates only when the ignition switch is turned on. The illustration of the fuel system, Figure 114, shows the tank unit,



Fuel Gauge Diagram - Tank Empty
Fig. 114



Fuel Gauge Diagram - Tank Filled
Fig. 115

Part 9275, which is connected to the gauge unit on the dash by a wire running through the wiring harness.

The tank unit is an electrical instrument consisting of a pair of contact points, one of which is fixed to a bimetal arm and the other to a more or less flexible diaphragm. The cam on the end of the float illustrated in Figure 115 causes the point fixed to the diaphragm to change its position with relation to the point on the end of the bimetal. When the ignition switch is turned on, current flows through the wire around the bimetal with the result that this point alternately makes and breaks contact with the point on the diaphragm. Since the tank unit is connected directly to the gauge unit, this alternate making and breaking of the circuit is registered on the gauge unit on the instrument panel.

The illustrations in Figures 115 and 116 are diagrams showing the electrical connections in both the tank unit and the gauge unit. When the tank is empty as in Figure 115, the two contacts in the tank unit are barely touching. When the tank

is filled as shown in Figure 116, the action of the float and cam pushes the grounded contact against the insulated bimetal contact and bends the bimetal in the tank unit. Due to the bimetal being under a strain, a greater amount of current is required to bend the bimetal sufficiently to break contact with the contact point on the diaphragm. This causes more current to flow through the bimetal in the gauge unit on the dash and movement of the needle to the "Full" position on the gauge occurs.

CHECKING TANK UNIT:

Disconnect the wire at the tank unit and connect it to a new tank unit. Ground the new tank unit to the car frame and turn on the ignition switch. Move the float of the new tank unit from empty to full position and watch the action of the gauge unit on the dash while doing this (allow ten to fifteen seconds for gauge to read full scale).

If the gauge unit now registers correctly, the original tank unit is damaged or defective and must be replaced or it is improperly grounded due to paint or grease.

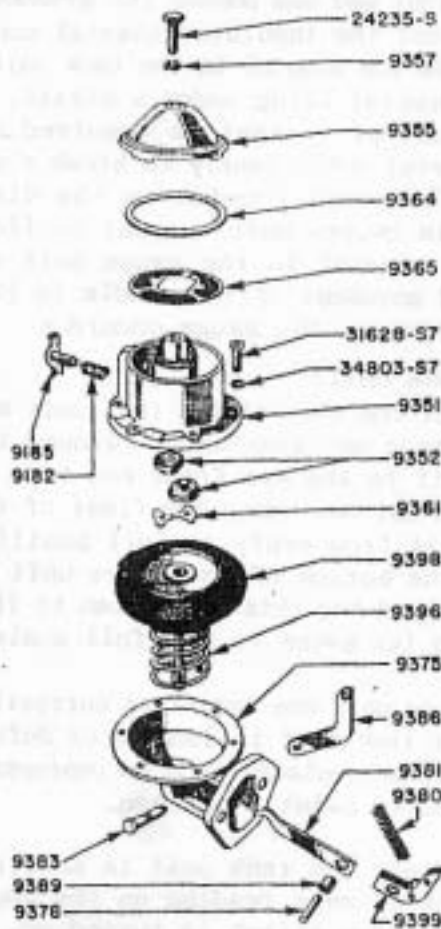
In the event the tank unit is shorted, it will show an over reading on the gauge whenever ignition switch is turned on.

If the new tank unit performs in the same manner as the old tank unit, the trouble is in the wiring which should be checked carefully. If the wiring connecting the tank unit to the gauge unit is broken or grounded, it should be repaired or replaced. In the event both wiring and tank units check o.k., the trouble is located in the gauge unit. This can be checked by merely removing the old gauge unit and connecting a new one into the circuit.

FUEL PUMP:

The fuel pump is the mechanical type which is operated by an eccentric on the camshaft.

Rotation of the camshaft eccentric actuates the rocker arms, Part No. 9399, Figure 116, which in turn pulls the link and diaphragm assembly, Part No. 9398, downward against the pressure spring. As shown in the sectional view of the fuel

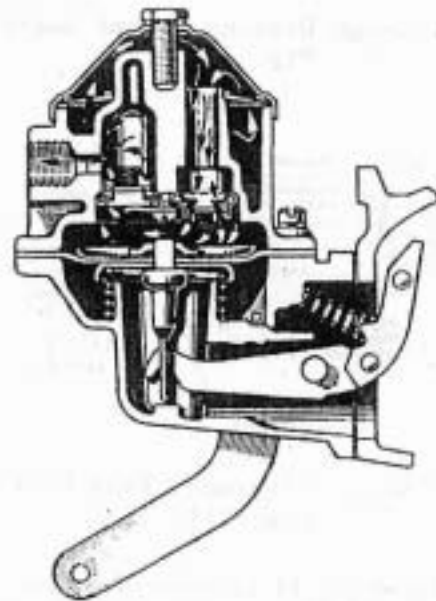


Exploded View of Fuel Pump
Fig. 117

Fuel Pump

- 9182 Drain Plug Spring
- 9185 Drain Plug
- 9351 Upper Body
- 9352 Valve
- 9355 Cover
- 9357 Cover Screw Washer
- 9361 Valve Plate
- 9364 Cover Gasket
- 9365 Screen
- 9375 Lower Body
- 9378 Rocker Pin
- 9380 Return Spring
- 9381 Link
- 9383 Primer Eccentric
- 9386 Primer Lever
- 9389 Rocker Arm Bushing
- 9396 Diaphragm Spring
- 9398 Diaphragm and Pull Rod
- 9399 Rocker Arm

pump, Figure 118 the downward movement of the diaphragm causes a suction which draws fuel through the pump inlet into the sediment chamber and then passes through the strainer and inlet valve into the pump chamber. On the return stroke the pressure spring pushes the diaphragm upward, forcing fuel from the pump chamber through the outlet valve and outlet line to the carburetor.



Sectional View of Fuel Pump
Fig. 118

When the carburetor bowl is filled, the float in the carburetor will shut off the needle valve, thus creating a pressure in the pump chamber. This pressure will hold the diaphragm in the downward position until the carburetor requires additional fuel and the needle valve opens.

The suction stroke of the fuel pump is positive and the discharge stroke of the pump is spring-operated. Consequently, the stroke of the diaphragm is proportionate to the amount of fuel required by the carburetor.

CHECKING FUEL PUMP:

A simple check of the suction and pressure may be made by holding the fingers over the inlet and outlet of the pump while manipulating the rocker arm. A more positive test can be made by assembling a piece of gasoline line about 3 feet long to the inlet connection of the pump. Then place the lower end of this fuel line in a tank

of fuel and manipulate the rocker arm. If the pump is in satisfactory condition, it will force fuel from the outlet opening with a maximum of 40 strokes, raising the fuel at least 30 inches.

If fuel does not appear at the outlet opening with this number of strokes, the pump should be disassembled to determine the cause.

DISASSEMBLING FUEL PUMP:

A complete set of fuel pump reconditioning tools and fixtures can be secured from K. R. Wilson, Buffalo, New York. The following instructions are written under the assumption that the tools and fixtures of this kind will be available at any point where such repairs are likely to be made.

Place the fuel pump in holding fixture and use a "Yankee" type screw driver to remove the six (6) upper body to lower body screws, Part No. 31628S7, after removing the following parts in the sequence listed:

- 24235S Pump cover screw
- 9357 Washer
- 9355 Pump cover
- 9364 Gasket
- 9365 Screen
- 9185 &
- 9182 Drain plug and spring and (6) upper body to lower body screws, Part No. 31628S7

Next, remove the following parts from the lower body assembly.

- Rocker arm return spring Part No. 9380
- Diaphragm and pull rod assembly Part No. 9398
- Fuel pump diaphragm spring Part No. 9396

The diaphragm and pull rod assembly can be removed very easily by pressing down on the rocker arm, Part No. 9399, while slipping the pull rod, Part No. 9398, off the end of the link.

Drive out the fuel pump rocker arm pin, Part 40-9378. This will result in disassembly of the following parts: fuel pump rocker arm, part 9378; rocker arm bushing, Part 9389; Link 9381.

Place the upper body, Part 9351, in the holding fixture and remove the 2 screws, Part 9373, which hold the valve plate, Part 9361, to the upper body. This will permit disassembly of the two valves, Part 9352.

Clean all parts thoroughly, making sure that all corrosion is removed from the sediment chamber in the upper body.

In reassembling fuel pump make a visual inspection of all parts for indications of rough handling or abuse and discard any parts that appear damaged.

Clean out broken thread and dirt from the pump inlet and outlet holes, using tap No. 9354-A which is included in the tool kit supplied by K. R. Wilson. Inspect the drain screw, Part 9185, and scrap if any ring wear is apparent on the seating end of the screw. Inspect contacting surfaces at each end of link, Part 9381 and also hole for bushing, Part 9389, and discard the link if there is any indication of wear. This can best be determined by comparing it with a new part.

Inspect contacting surface at each end of rocker arm, Part 9399, as well as the bushing hole and discard the part if it is worn at any of these points. All new gaskets must be used when reassembling.

Place the upper body, Part 9351, in the fixture and install the paper gasket for the valve seat. Then install the valves, Part 9352, making sure that the intake valve is installed with the spring visible and the outlet valve is in the reverse position, so that the spring is not visible. Then install the valve plate, Part 9361, and the 2 screws which hold it in place.

Place the lower body in the fixture and assemble the rocker arm, Part 9399; link, Part 9381; bushing Part 9389, and pin, Part 9378. Make sure that graphite grease is applied to the bushing before assembly.

The fuel pump diaphragm spring Part 9396, and diaphragm 9398, should next be installed. This is done by holding the end of the link down while the slotted end of the diaphragm pull rod is slipped over the end of the link. Dip the lower end of the diaphragm pull rod in graphite grease before as-

assembly. Apply graphite grease to contact surfaces between rocker arm and link and then install the rocker arm return spring. Place the upper body on the lower body assembly and start the screws, No. 31628-S7 which hold the upper body to the lower body. This operation should be done on the K. R. Wilson fixture 9350, so as to place the proper tension on the fuel pump diaphragm. In using this fixture, the lever should be in the upper position so the diaphragm will be straightened out when the screws, are started. After starting the screws, put the fixture lever in the down position so the rocker arm drops to its lower position. This will permit the large diaphragm spring to push the diaphragm to its extreme upper position, at which point the screws should be securely tightened. If this operation is not performed properly, there is a possibility that the diaphragm will be stretched too tightly and its life will be shortened.

After assembling the upper body to the lower body, install the following parts. Be sure the screen is installed with the reinforcement side up. 9182 and 9185 drain plug spring and screw; 9365 fuel pump screen; 9364 fuel pump cover gasket; 9355 fuel pump cover; 9357 fuel pump cover screw washer and 24235-S fuel pump cover screw.

After assembling, the fuel pump should be checked on a test fixture. If properly repaired, the pump will prime itself within 18 seconds which is approximately 36 strokes on the rocker arm. The pump should also develop from 1-1/2 to 2-3/4 lbs. pressure.

CARBURETOR

The Ford Carburetor is a single down draft, of the balanced type. In this type all the main channels are carried in a removable nozzle bar.

See insert Figure 119, which carries the idle tube and an aspirating nozzle. The central portion of the nozzle bar forms the discharge nozzle. This construction makes it possible to locate the discharge nozzle in the center of the air stream without having attaching bracket or bosses which interfere with the flow of air into the venturi.

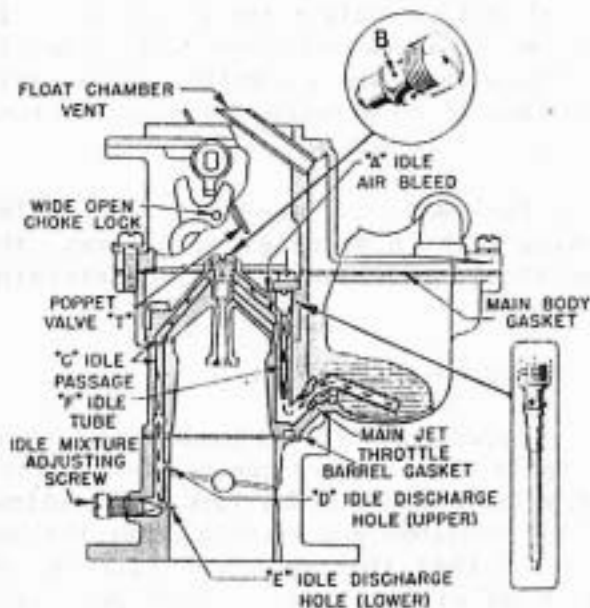


Fig. 119

The discharge nozzle proper is located in the smallest part of the venturi, See Figure 119. It is circular and of such diameter as to create a high suction at the end of the nozzle. This suction, in addition to the atomizing holes in the nozzle, help to completely vaporize the fuel.

CHOKE

The choke valve is mounted on a shaft located off-center in the air passage, as shown in Figure 119. A torsion spring, tends to close the choke valve when the choke lever is moved to the checked position. There is a certain amount of free movement in the mechanism at the partly choked position, so that if the choke is partially closed to operate at a relatively low speed, the inrushing air at a higher speed will force the valve open and compensate for the increased speed.

This does not mean, however, that the car can or should be continuously operated with the choke control in part choke position. With full choke, the valve is held in a locked position by the control lever. If the choke is held in fully closed position after the engine starts, a poppet valve will open. This supplies enough air to keep the engine running and eliminate choke sensitivity.

The rush of air through this poppet valve makes considerable noise and is a signal to the operator that the choke button is pulled out. The poppet valve will continue to make this noise until the choke button is pushed into a part choked position.

In full choke position, all the orifices below the choke valve are subjected to intake manifold vacuum and most of the fuel is supplied through the main discharge nozzle.

IDLE FUEL SUPPLY

The fuel from the carburetor bowl passes through the main metering jet into the idle tube "F" as indicated by the arrows in Figure 119. Air is introduced into the fuel stream by the idle air bleed "A" and a small additional amount of air is bled in by the small hole "B" in the aspirating nozzle (See insert Figure 119). The idle mixture goes around the aspirating nozzle by means of an undercut around its outside diameter as shown. The mixture then travels down the idle passages "C" to the idle discharge holes "D" and "E".

When the engine is running at a speed of approximately 350 RPM, the mixture is discharged out of the lower hole "E" only. As the throttle blade opens and the speed is increased, the upper hole "D" starts discharging. The lower hole only discharges from idle to about 450 RPM. The upper hole very gradually starts discharging, in addition to the lower hole, from about 450 RPM to 1250 RPM. The action and timing are such that the upper discharge hole gradually starts to feed, reaches a maximum about 750 RPM and then gradually becomes less effective as the main nozzle starts to discharge.

The idle mixture adjusting screw, Figure 119, controls the output of the lower discharge hole. Turning the needle out gives a richer mixture and in, a leaner mixture. For best results, the idle adjustment should be set by using a tachometer or vacuum gauge so as to secure the highest and steadiest reading. The idle adjustment screw should not be screwed in hard against the seat as this may cause a groove in the needle point. If this occurs, it would be necessary to replace the idle adjusting screw in order to obtain a satisfactory idle adjustment.

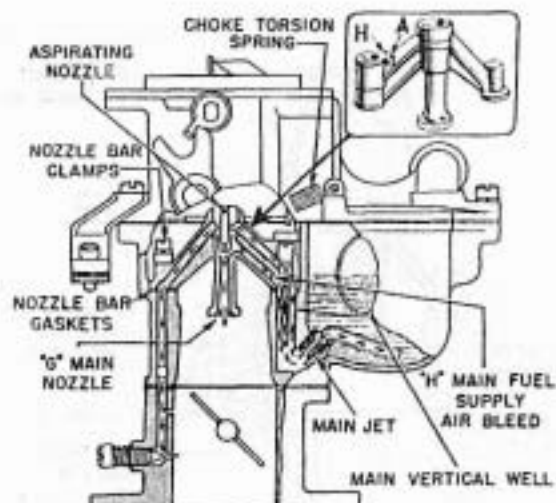


Fig. 120

MAIN FUEL SUPPLY

At approximately 900 RPM, the idle fuel system becomes less effective and the main nozzle "G" starts to deliver fuel. Between 900 RPM and 1250 RPM there is a definite blend of the idle system and the main metering system. In this range, all the fuel passes through the main jet, as shown in Figure 120, up through the main vertical well, then up and around the idle tube. The main fuel is emulsified by air entering at the main fuel supply air bleed "H" which lightens the fuel and makes the mixture more responsive to throttle changes. The mixture is again aspirated by the aspirating nozzle as it starts down the main nozzle "G".

The power valve "J" shown in Figure 121, is operated by the vacuum below the throttle plates through passage "L" and the power valve springs "K". The power valve remains closed up to approximately 3400 RPM except when the engine is under a load which causes manifold vacuum to drop. With high vacuum, the piston is held in the up position and the power jet springs hold the valve closed. With low vacuum the spring on the piston rod pushes the end of the rod against the power jet valve and causes it to open. The vacuum is highest when the engine is idling and decreases as the load on the engine increases.

The power jet valve remains on its seat until the vacuum drops to from 7-1/2 to 8" of mercury at which point it is not high enough to resist the action of the spring. This point at level road running at a con-

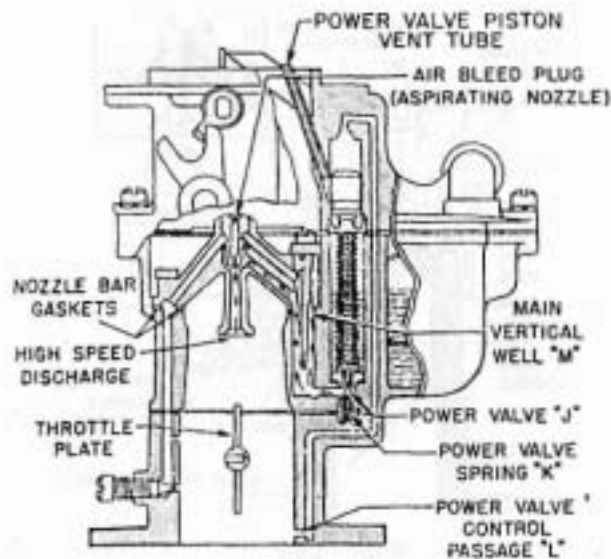


Fig. 121

stant speed is approximately 3400 RPM. When the engine is under a load as in climbing hills or through mud, the manifold vacuum drops as it becomes necessary to open the throttle wider in order to maintain speed. When the vacuum drops to about 7-1/2 to 8" of mercury, the power valve is opened by the spring, the same as when the engine speed exceeds 3400 RPM on a level road. The fuel then flows into the power valve and channels and up through the high speed gas restriction into the center or main vertical well "M" as shown by the arrows in Figure 121. This gives the additional fuel required for high speed and for heavy loads at full throttle.

Due to the necessity for sealing the carburetor against water, etc., the air vent tube for the float bowl is placed in the air horn. The smaller tube in the air horn is the air vent for the vacuum power valve piston.

ACCELERATING PUMP

The accelerating pump is directly connected to the throttle and its purpose is to slightly enrich the mixture for rapid acceleration. As indicated in Figure 122, fuel is drawn into the pump chamber through the pump inlet check valve "N" on the up stroke of the pump piston (when the throttle is closed). When the throttle is open, the piston "O" moves down closing the pump inlet check valve and overcoming the weight of the pump discharge valve needle. This

additional fuel then goes around the pump discharge valve "P" and out of the pump discharge nozzle. Free movement against a spring load is provided in the pump piston stem and the pump operating rod so as to give a prolonged discharge when the throttle is opened suddenly.

The pump link is adjustable to compensate for weather conditions. For extremely hot weather the link should be set in hole No. 1, for average summer weather in hole No. 2 and for extremely cold weather in hole No. 3.

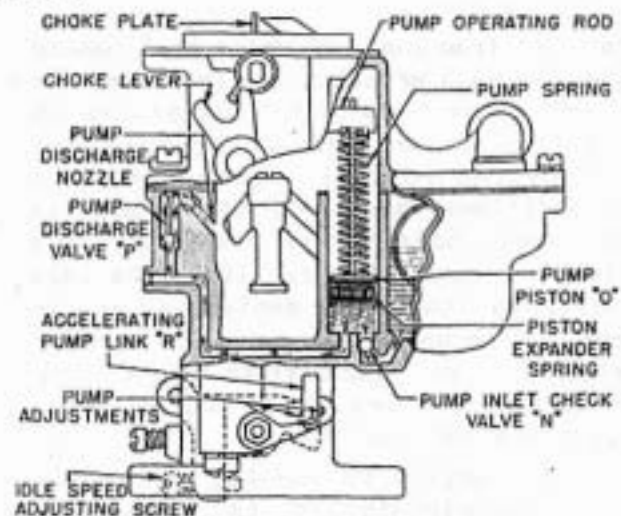


Fig. 122

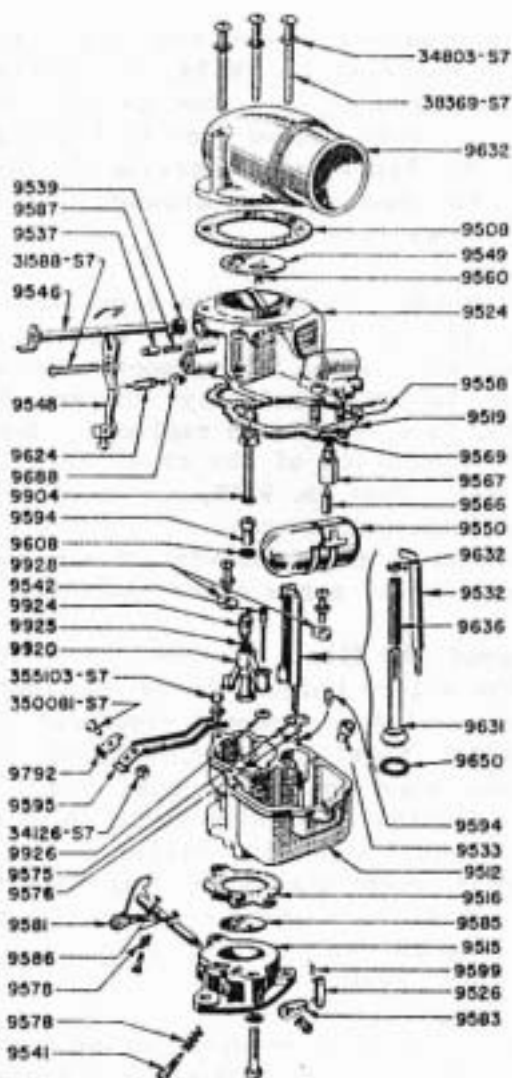
DISASSEMBLING CARBURETOR

To identify the parts as they are mentioned in the following paragraphs, refer to Figure 123.

Remove the three screws, Part No. 3480387, holding the carburetor air horn cover, Part No. 9632. Remove gasket, Part No. 9508. Remove the choke lever screw, Part No. 315888 which permits removal of the choke lever, Part No. 9458. Part No. 9537 and spring Part No. 9587, as well as the spring Part No. 9624.

Remove the five screws holding the float bowl cover, Part No. 9524, to the float bowl, Part No. 9512. Removal of these screws also permits disassembly of the choke wire bracket, Part 9595, spring, 9624 and clip, 9628.

Remove accelerating pump link, Part No. 9526. Remove accelerator pump, Part Nos. 9632, 9532, 9636, 9631, 9650 as a complete assembly. Remove the main metering jet extension tube, illustrated but not marked in Figure 120, by merely pressing down on



Exploded View of Carburetor-- Fig. 123

- 9508 Gasket
- 9512 Main Body
- 9515 Throttle Body
- 9516 Throttle Gasket
- 9519 Main Body Gasket
- 9524 Air Horn
- 9526 Pump Link
- 9532 Operating Rod
- 9533 Main Jet
- 9537 Choke Lever Plunger

- 9539 Choke Shaft Spring
- 9541 Adjusting Needle
- 9542 Idle Tube
- 9546 Shaft and Lever Assy.
- 9548 Choke Lever
- 9549 Choke Plate
- 9550 Float and Lever Assy.
- 9558 Float Lever Shaft
- 9560 Spring
- 9566 Fuel Valve
- 9567 Fuel Valve Seat
- 9569 Gasket
- 9575 Check Valve Retainer
- 9576 Pump Check Valve
- 9578 Spring
- 9581 Throttle Lever and Shaft
- 9583 Pump Operating Lever
- 9585 Throttle Plate
- 9586 Screw
- 9587 Spring
- 9594 Power Jet
- 9595 Choke Wire Bracket
- 9599 Pump Link Retainer
- 9608 Power Jet Gasket
- 9624 Return Spring
- 9631 Pump Piston
- 9632 Elbow
- 9363 Pump Spring
- 9650 Expander Spring
- 9688 Spring Clip
- 9792 Ball Joint
- 9904 Economizer Piston
- 9920 Nozzle Bar
- 9924 Air Bleed
- 9925 Gasket
- 9926 Gasket
- 9928 Clamp

the clamp spring and lifting out the tube. The main jet can then be screwed out of the float bowl.

Remove the nozzle bar clamps, Part No. 9928, by taking out the two screws which hold them in place. Remove from nozzle bar the idle tube, Part No. 9542, and the brass air bleed, Part No. 9924. The nozzle bar gasket, Part No. 9926, should also be removed. Next remove the check valve retainer, Part No. 9575. A tool for this operation can be made by grinding the end of a small diameter rod down to a point which can be hooked under the end of the retainer. This will complete disassembly of the float bowl.

The two screws holding the carburetor throttle body, Part No. 9515, to the float bowl, Part No. 9512, should next be removed. Aside from removing the accelerator pump lever, Part No. 9583, and the idle adjusting screw and spring, Part No. 9578, no further disassembling of the throttle body should be done. The position of the throttle plate with respect to the idle holes in the throttle body must be carefully fixed and it is unlikely that this position would be maintained if the throttle plate and shaft were disassembled. The same is true of the choke valve and shaft in the air horn.

Disassemble the float bowl cover Part No. 9524, by first removing the float hinge pin, Part No. 9558, and the steadying springs on the float brackets. Then disassemble the fuel inlet needle and seat, including the gasket. The fuel inlet needle and seat, Part No. 9564, should be kept intact as an assembly as a needle from one seat will not always work properly in another seat.

Inspect the needle and discard the complete assembly if there is any indication of wear on the seating portion of the needle. If suitable for further use, polish the end of the needle that contacts float with the No. 320 wet or dry paper.

Clean all parts thoroughly being particularly sure that all corrosion is removed from the float bowl of the carburetor.

RE-ASSEMBLING CARBURETOR

Make a visual inspection of the float bowl cover, Part No. 9524, to determine fit of the choke plate when in the closed position. This can be done by holding up toward the light and observing amount of light that can be seen around the edges of the choke plate.

Check the poppet valve stem in choke plate. If loose or if poppet valve spring is weak or broken so that poppet valve will not stay in position firmly, the assembly, Part No. 9549, should be replaced. Make a visual inspection of the choke shaft and choke lever, Part No. 9548, and other points which are subject to wear. If there are any indications of excessive wear, it is advisable to install a new cover assembly.

Inspect the float, Part No. 9515, to be sure the solder holding lever to float is in good condition. Inspect float for leaks by holding float under surface of water that has been heated to just about the boiling point. Bubbles will appear if float leaks. A badly leaking float can frequently be detected by shaking vigorously to see if it is loaded with liquid. Discard float if there is the slightest indication of a leak.

Polish the fuel needle contact surface of float arm using No. 320 wet or dry paper.

THROTTLE BODY

Make a visual inspection of the fit of throttle plate in the closed position. Hold the throttle body up toward the light with the throttle plate closed and observe the amount of light that can be seen around the edges of the throttle plate. A very snug fit is necessary for proper idling and low speed operation. The complete assembly should be discarded if wear and looseness is encountered around the edges of the throttle plate, or if throttle shaft is worn loose so air will leak into the throttle.

Clean out the idle feed holes in the throttle body above the throttle plate. Use a .037" drill for the lower hole and

a .0395" drill for the upper hole (hole farthest from the throttle plate).

Clean out the idle adjustment screw holes in throat, using a .046" drill.

Inspect the idle mixture jet tube, Part No. 9542, and discard same if plugged, bent or damaged in any way or if screw driver slot is noticeably mutilated. Wire should not be used to clean out any jets or passages.

To reassemble the carburetor, it is suggested the following procedure be adhered to:

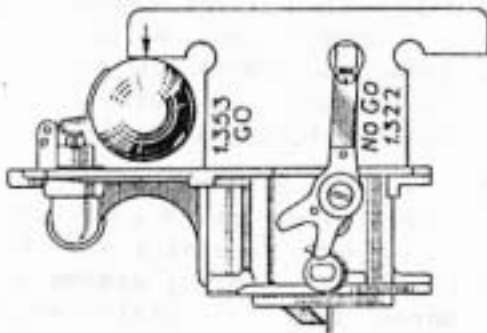
Assemble idle adjustment needle, Part No. 9541, with the spring, Part No. 9578. The screw should be run in until it just barely touches the seat, then backed out 5/8 to 3/4 of a turn. Next assemble the following parts to the float cover, Part No. 9524, making sure that the fuel inlet needle and seat is a matched fit and that the stop on the float will permit it to drop to the bottom of the float chamber.

Nos. 9566 and 9567 Fuel inlet needle and seat.

No. 9550 Float Assembly

No. 9558 Float Hinge Pin

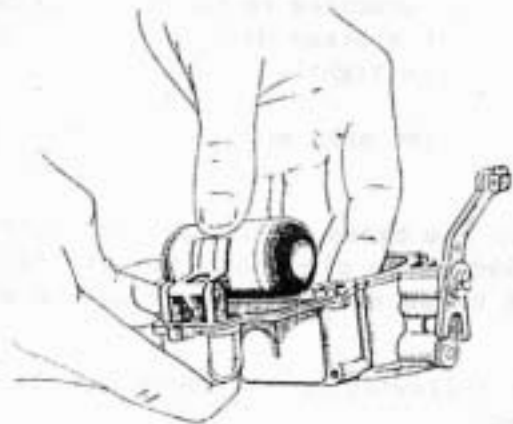
Also assemble the small spring into the two holes in the float bracket directly above the float hinge pin.



Checking Position of Float - Fig. 124

After assembling the float to the float bowl cover, check the float position. A gauge is available from K. R. Wilson under the No. 9550-A for making this check. As indicated in Figure 124, the position of the float is established by the distance from the bottom side of the float cover to the

bottom of the float. The correct setting is from 1.322 minimum to 1.353 maximum.



Raising Float Level - Fig. 125

If the float position is not correct, it can be changed as shown in Figure 125 and 126. The float arm bending tool is available from K. R. Wilson under the No. 9550-C. The bending tool is used as shown in Figure 125, if the no-go end of the float position gauge does not touch the float. This operation will lower the float level. Press down on the float as shown in Figure 124 if the "go" end of the float position gauge does not clear the float. This operation will raise the fuel level in the float bowl.



Float Arm Bending Tool - Fig. 126

Assemble the main body, Part No. 9512, to the throttle body, Part No. 9515, making sure that the throttle body gasket, Part No. 9516, is assembled in place. In the event the accelerator pump lever, Part No. 9583, has been previously removed for any reason, make sure it is in place and the nuts securely tightened on the end of the throttle shaft.

Assemble the pump check ball, Part No. 9576 and retainer, Part No. 9575, using a

piece of 5/8" diameter wood or fiber dowel stock to push the retainer down into place. It is a good practice to tap the steel ball lightly with a brass drift rod to be sure that it seats tightly.

Install the main metering jet, Part No. 9533.

Drop the brass discharge needle, Part No. 9594, into place and tap it lightly with a brass drift rod to insure a good seat.

The following parts should next be assembled:

Nozzle bar gasket, Part No. 9926.

Nozzle bar, Part No. 9920.

Then install the nozzle bar clamp, Part No. 9928, and screw, to hold the nozzle bar in place while installing Part No. 9542, idle tube, Part No. 9925, air bleed plug gasket and Part No. 9924, air bleed. The other nozzle bar clamp, Part No. 9928, screw and lock washer, should then be installed.

At this point it is advisable to blow out the assembly with compressed air and inspect it for any burrs or foreign matter which may have been caused by the previous operations.

Install the accelerator pump assembly consisting of the Part Nos. 9650, 9631, 9636, 9532 and 9632.

Install the accelerator pump connecting link, Part No. 9526, placing it in No. 1 hole for summer operation, No. 2 hole for winter operation or No. 3 hole for extremely cold weather operation.

Install the float cover assembly, Part No. 9524, on the lower body after putting in place the gasket, Part No. 9519. Install and tighten the four screws and lock washers which hold these two assemblies together. Make sure that the choke wire bracket, Part No. 9595, as well as the clamp, Part No.

9792, are assembled to the carburetor, using the hex head screw, Part No. 355103S7, which is slightly longer than the other four round head screws which are used for fastening the float bowl cover to the body of the carburetor. The choke lever return spring clip, Part No. 9688, should be installed on the screw directly in front of the choke lever and the choke lever return spring, Part No. 9624, should be connected to the clip and choke lever after the screws have all been tightened down.

Installation of the gasket, Part No. 9508, and air horn cover, Part No. 9632, completes reassembly of the carburetor.

ELECTRICAL SYSTEM

In addition to the conventional type wiring diagrams shown on following pages, an actual layout of the various electrical units and wiring harnesses, super imposed on an outline of the vehicle, is shown in Figure 127. While the conventional wiring diagram is easily understood by experienced electrical men, many automobile mechanics are frequently at a loss when called upon to trace out electrical troubles quickly. This tendency can be reduced by carefully studying the detailed drawings in Figure 127 which clearly show all connections to each of the various electrical units in the vehicle. For the purpose of simplifying the wiring of the automobile, as well as protecting the wires from becoming chafed, all wires are enclosed in a conduit or woven loom wherever possible. These wiring assemblies are then clamped securely at various points on the frame and chassis and every precaution taken to prevent insulation becoming worn, thus causing a short circuit.

It is of utmost importance that electrical connections make a good contact in order to prevent excessive resistance in the circuit. Corrosion, grease or paint on a contact sets up a resistance to the free flow of current. All such contact points should, therefore, be cleaned before making the connections and terminal nuts should be securely tightened.

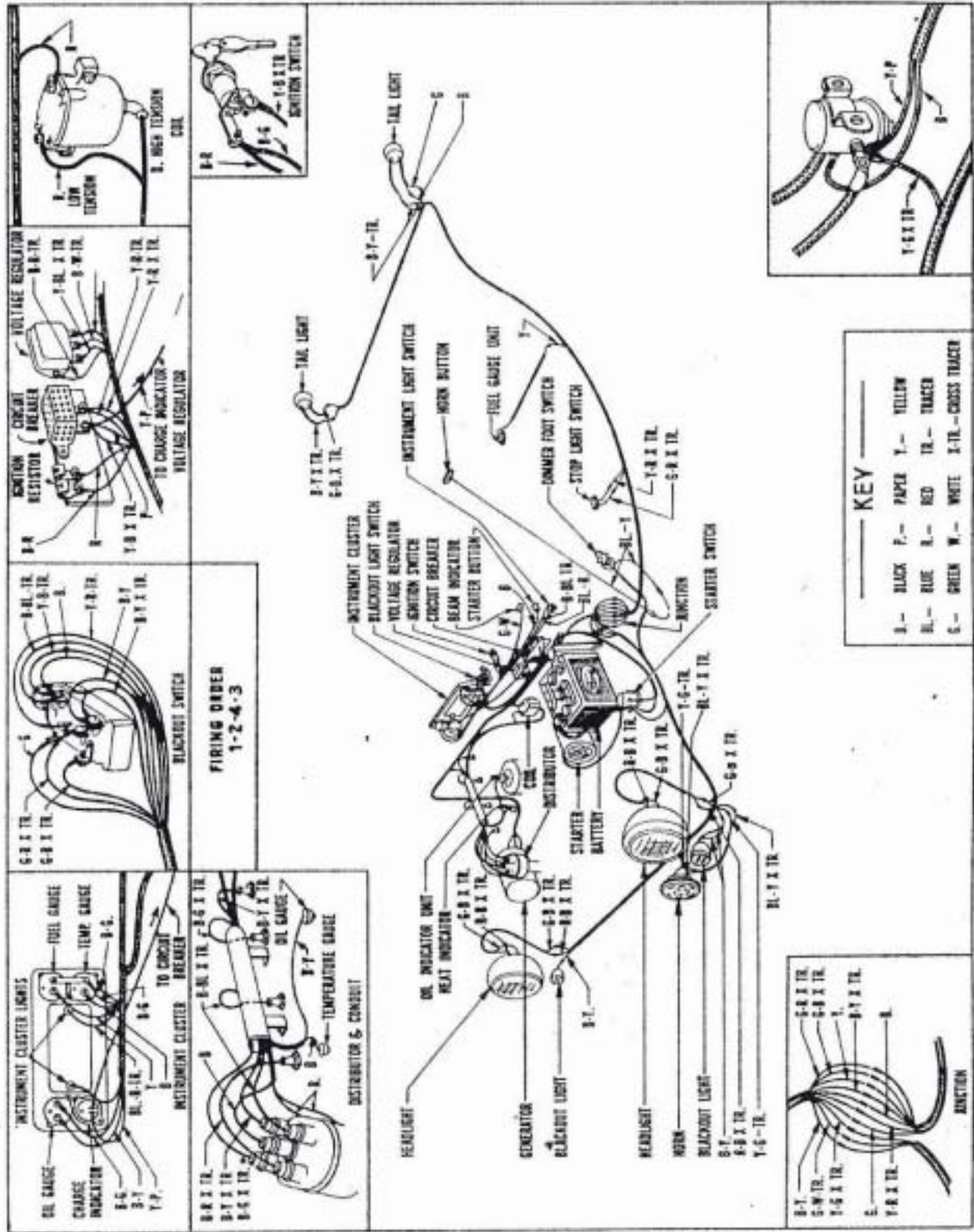


Diagram of Electrical System Fig. 127

GENERATOR

The generator is a 6 volt, air cooled, unit of the two-brush type. In these generators, the field is grounded to the generator and the other end of the field windings are connected to the armature through a combination voltage and current control unit mounted on the dash. The output of this type of generator is completely controlled by the voltage regulator which is covered in more detail in another section of this book. Due to the fact the voltage regulator is actually a part of the generator circuit, the output of the generator depends upon the state of charge and temperature of the battery. How this is accomplished is thoroughly explained in the section devoted to the voltage regulator, and the following paragraphs merely cover actual maintenance and repair operations on the generator.

Before coming to the conclusion that a generator is faulty and must be disassembled, it is necessary to make a thorough check of the complete charging circuit consisting of the battery, voltage regulator and generator, as well as the various connections between these three units. Such tests necessitate the use of extremely accurate meters and the following instructions are written on the assumption that such testing will be done with meters having not more than 1/2 of 1% error.

If it is definitely determined that a condition exists within the generator which necessitates disassembling the unit, remove the generator support bolts which will permit taking the generator assembly off the engine. All parts of the generator are shown in their relative assembly position in Figure 128, and the part numbers mentioned in the following text can be identified by referring to the above mentioned illustration.

DISASSEMBLING GENERATOR:

Remove the two end bolts, Part No. 10120 which will also permit disassembly of the brush end bracket assembly, Part No. 10050. Pull the complete assembly consisting of the armature, Part No. 10005, front end plate, Part No. 10139, and pulley, Part No. 10130, out of the generator yoke. Remove the generator pulley from the armature by

taking out the wire retainer ring which rests in the groove in the armature shaft directly in front of the pulley, and then unscrew the pulley from the shaft.

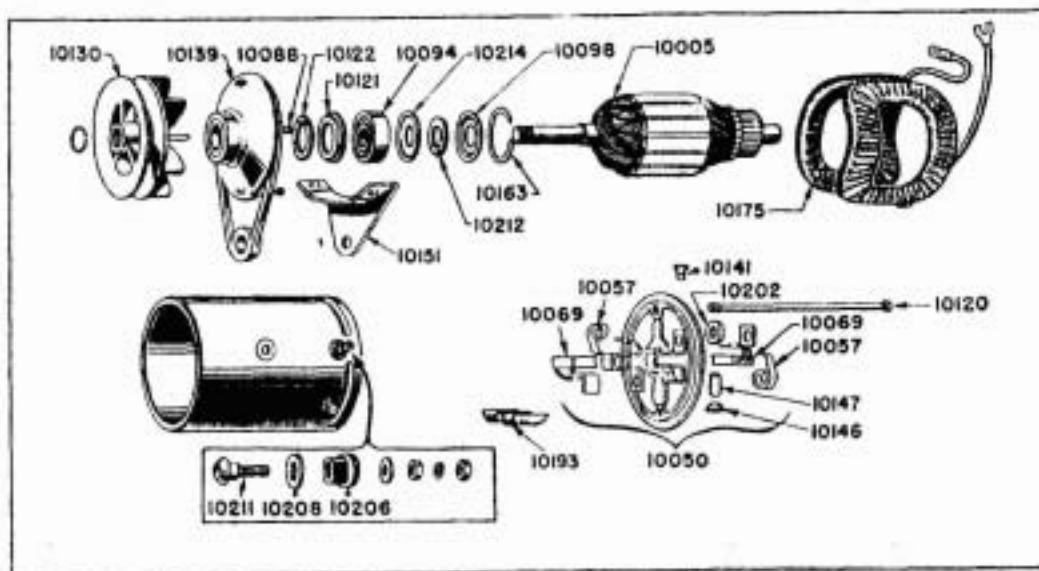
After the pulley has been removed the front end bracket, Part No. 10139, including the bearing, Part No. 10094, and oil seals, can be slipped off the shaft.

To remove the bearing from the front end bracket, use a screw driver to pry the retainer ring, Part No. 10163, out of the groove. The bearing, together with the washer, Part No. 10098, felt, Part No. 10212, washer Nos. 10214 and 10211, together with the felt, Part No. 10122, can then be lifted out of the end plate.

It is assumed, of course, that regular generator test and repair equipment will be available at any point where generators are likely to be disassembled. Instructions for making the necessary electrical tests of armatures and field coils ordinarily accompany such equipment and such instructions will apply in their entirety to checking the Ford generator armature. If such tests show that the armature is free of shorts or ground, the commutator should be carefully examined. If the commutator is rough or scored, it should be turned down in an armature lathe after which it should be sanded off with 00 sand paper. Undercut the Mica between the commutator segments and then re-check on the growler.

Before re-building the generator, a check should be made of the field coils to make sure they are in perfect condition. A visual examination will show whether or not the insulation has been damaged at any point. The field should then be checked for resistance. If total resistance of both coils is approximately 2.72 OHMS, the coils are okay. If the resistance is greater than 2.72 OHMS, check each coil individually to determine if one coil has more resistance than the other. Each coil should read approximately 1.36 OHMS. A shorted coil will, of course, show resistance much less than this amount while an open coil will show an indefinite amount of resistance.

To replace a field coil in the yoke, use a piece of square "Key" stock to remove the pole-piece screw. Disconnect the armature terminal, and the coil, together with the pole-piece, can be disassembled.



Exploded View of Generator - Fig. 128

- | | | |
|-----------------------|-------------------------|-----------------------------|
| 10005 Armature | 10122 Front Grease Seal | 10163 Stop Ring |
| 10050 End Plate | 10130 Pulley | 10175 Field Coil |
| 10057 Brush Spring | 10139 End Plate | 10193 Insulator |
| 10069 Brush Assembly | 10141 Oil Cup | 10202 Terminal Insulator |
| 10088 Dowel | 10146 Oil Plug | 10206 Outer Insulator |
| 10094 Bearing | 10147 Wick | 10208 Inner Insulator |
| 10098 Grease Retainer | 10151 Bracket | 10211 Terminal |
| 10120 Thru Bolt | | 10212 Grease Seal |
| 10121 Grease Retainer | | 10214 Inner Grease Retainer |

RE-ASSEMBLING GENERATOR

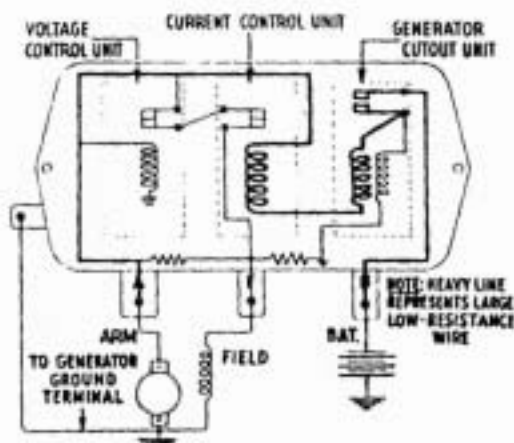
The front bushing in the generator front end plate, Part 10139, is a graphite impregnated bushing and replacement of this bushing is so rarely needed that the part is not supplied for service. If the bushing is damaged in some manner, the complete end plate should be replaced. Assemble the felt, Part No. 10122, and washer, Part No. 10121, in the plate and then put the bearing, Part No. 10094 in place. The washer, No. 10214, felt, No. 10212 and washer, No. 10098, should then be put in place and the retainer ring inserted in the groove. This assembly should then be slipped on to the front end of the armature shaft and the pulley, No. 10130, installed. Screw the pulley down as far as it will go and then install the wire retainer ring in the groove in the armature shaft.

Turn this assembly up on end so it is resting on the pulley with the commutator end of the armature up. Then put the generator yoke and field assembly in place, turning the front end bracket so the rivet

in the edge of the bracket lines up with the slight depression which is cut into the end of the generator yoke to properly locate these two parts. The rear end plate, including the brush holders and brushes should then be installed and the two end bolts, Part No. 10121, screwed into place.

To facilitate removal of the generator rear end plate and avoid chipping the brushes, the tension of the springs should be released from the brushes. This can be done quickly and easily by having a small hook screwdriver to lift the springs and at the same time pull the brushes partly out of the brackets and then letting the springs down so the tension rests upon the side of the brush rather than the top.

When re-installing the generator rear end plate, the operation will be facilitated by positioning the brushes and springs in that manner, making sure that the brushes are properly seated on the commutator and the springs properly placed on top of the brushes after the assembly has been completed.



Generator and Voltage Regulator Circuit
Fig. 129

VOLTAGE REGULATOR

It was pointed out in the generator section that the output of the generator is controlled by a voltage regulator mounted on the dash. As shown in the wiring diagram, Figure 129, the voltage regulator consists of three coils, one of which is merely an automatic switch or cut-out to break the circuit from the generator to the battery when the generator is not charging. When the generator voltage reaches between 6.00 and 6.3 volts (at between 60 and 80 degrees Fahrenheit), the shunt coil closes the cut-out points thus completing the circuit to the battery. The main output of the generator passes through these points and through a series coil in the cut-out. The points remain closed until the generator voltage drops below the voltage of the battery at which point, current from the battery reverses through the series coil and causes the points to open.

The voltage at which the cut-out points close is controlled by the spring tension on the cut-out points. The greater the tension, the higher the closing voltage. It is extremely important that the cut in voltage be carefully controlled due to the close limits which must be held between the point of voltage regulation and the cut-in voltage. This is due to the necessity for keeping the point of voltage regulation low enough to avoid over-charging the battery and still keep the battery fully charged. The cut-in voltage must be substantially below the regulating voltage or the cut-out will not close.

Low cut-in voltage requires low spring tension on the cut-out armature but if, on the other hand, the tension is too low the cut-out may fail to open. For the above reasons it is essential that the cut-in voltage be held within three-tenths of a volt range.

A very important factor in the performance of the cut-out is the temperature. A noticeable increase in temperature raises the resistance of a shunt coil in the cut-out. To compensate for this, a Bi-metal clip to which the armature tension spring is attached, lowers the spring tension when the cut-out is hot and thus maintains a constant cut-in voltage.

TESTING VOLTAGE REGULATOR

As explained in the section covering generators, it is imperative that extremely accurate meters be used for testing the voltage regulator. Such meters should be accurate within 1/2 of 1 percent error and should be checked frequently with Master Meters to make certain this degree of accuracy is maintained.

There are a number of different types of electrical testing equipment on the market and since it is impossible to determine what type of equipment will be available, the following instructions are written so the condition of the voltage regulator and other parts of the electrical system can be determined by merely using an accurate volt meter with a range of zero to ten and an ammeter, (center-zero) having a range fifty zero fifty. It is also necessary to have a 3/4 OHM resistor which will serve as a fixed load in place of the battery, the resistance of which will, of course, vary depending upon its condition.

It is preferable, of course, to use test equipment which is especially designed for this type of work as such equipment usually incorporates the necessary resistances and switches for making the essential tests more efficiently and accurately. Such equipment is also accompanied with detailed instructions for making complete tests of all the factors entering into the operation of the voltage regulator, generator and battery. Under the circumstances, the fol-

lowing instructions are confined to the most essential operations which can be performed by the use of a volt meter and ammeter:

In the event the following tests reveal the necessity for internal adjustment in the regulator, the complete unit should be replaced and returned to the base where suitable equipment for making internal repairs and adjustments are available.

Before making any tests to determine the condition of the voltage regulator it is imperative that the condition of the battery and connections in the circuit be determined. A battery should first be checked for voltage and specific gravity. If the battery shows an extremely high capacity reading and requires water frequently, the point of voltage regulation may be higher than necessary. If the battery tests low in capacity, the point of voltage regulation may be too low, there may be excessive resistance in the circuit or the generator or the regulator may be faulty.

After determining the condition of the battery, proceed as follows to check the resistance in the circuit:

1. Start engine and set the speed at approximately 1250 RPM (21 MPH) on the speedometer.
2. Turn on the headlight country beam.
3. Contact the positive battery post with the negative lead of the volt meter.
4. Contact the generator case with the positive lead.
5. The reading thus obtained should be less than one-tenth volt. If more than that amount, excessive resistance exists in the ground circuit.
6. Connect the negative volt meter lead to the armature terminal of the generator and contact the armature terminal of the regulator with the positive volt meter lead. Carefully observe the reading.
7. With the negative volt meter lead still on the armature terminal of the generator, contact the battery terminal of the regu-

lator with the positive volt meter lead and observe the reading. The reading thus obtained should not be more than six times the reading secured in the test outlined in the previous paragraph. If greater than this amount, excessive resistance exists in the cut-out points.

8. Next contact the negative post of the battery with the positive lead of the volt meter. This reading should not be more than six and one-half times the reading first obtained. If higher than that amount, excessive resistance exists elsewhere in the generator to battery circuit which must be corrected.

CHECKING CUT-IN VOLTAGE

Disconnect the battery ground strap to remove the wire from the battery terminal on the regulator. Install the 3/4 OHM resistor on the battery terminal of the regulator and clip the wire on the 3/4 OHM resistor to a good ground.

Connect the negative volt meter lead to the armature terminal of the generator and the positive lead to ground.

Reinstall the battery ground connection.

Start the engine. Slowly and steadily increase the engine speed and observe closely the point on the volt meter where the indicator hand suddenly drops back. The highest point reached by the indicator is the voltage at which the cut-out points close.

The last reading obtained just before the indicator drops back will be the cut-in voltage of the cut-out.

It may be found in some cases that the idle speed of the engine is above the speed at which the cut-out cuts in. In such cases it will be necessary to slow down the idling speed for the test.

After making the test, re-establish the correct idling speed of the engine.

Be sure the cut-out is grounded when making the above test as otherwise the circuit in the cut-out will not be completed and the points will not close.

Always increase the engine speed slowly

for this test, otherwise the inertia of the meter pointer will affect these readings. It is also important to get the readings the first time as the magnetism of the cut-out usually causes the cut-out to close approximately one-tenth volt lower on subsequent readings.

The cut-in voltage should be between 5.8 and 6.3 volts. The voltage regulator should be replaced if the cut-in voltage is not within these limits.

CHECKING VOLTAGE REGULATION

With the positive volt meter lead still grounded, connect the negative lead to the knurled screw on the 3/4 OHM resistor.

Regulating voltage should be tested at exactly 2300 RPM of the generator. (1510 RPM of the engine.)

This is very important and in the event a tachometer is not available, it is suggested that the rear wheels be jacked up and the transmission placed in gear so the reading can be taken from the speedometer. With the transmission in high gear, the reading on the speedometer at 2300 RPM of the generator will be 25-1/2 miles per hour.

The reading on the volt meter will be the point of voltage regulation. This should be 6.9 to 7.2 volts with the temperature of the regulator between 70 and 80 degrees Fahrenheit.

If the point of voltage regulation is not within the above limits, the regulator should be replaced.

CHECKING CURRENT CONTROL

The current control points are normally closed and the current is determined by the length of time the voltage control points remain closed in each cycle. If the current is excessive, the generator will be over-loaded. Therefore, the current control points are set to open if the flow of current becomes higher than a pre-determined

limit. With the points open, resistance is put in the field circuit and thus reduces the field current.

With the field current reduced, the generator voltage is reduced which in turn reduces the flow of current and the points again close. The voltage again rises until it reaches a point where the current control point again opens and the above cycle is repeated.

To check the current control, connect the positive ammeter lead to the battery wire which was removed from the regulator in the previous test. Connect the negative ammeter lead to the knurled screw of the 3/4 OHM resistor. Disconnect the ground connection of the 3/4 OHM resistor.

Have the engine running at the same speed 1510 RPM for the previous test.

Close the starter switch and observe amperage at which the generator is being limited while the starter is running idle and headlight country beam is on. The regulator should limit the amperage at from 30 to 33 amperes. If not within these limits the regulator should be replaced. Reduce the engine speed until amperage reading drops to approximately 5 amperes.

Reverse the ammeter lead so the positive lead is connected to the knurled screw of the 3/4 OHM resistor and the negative lead is connected to the battery wire.

As the engine speed is reduced further, a positive reading will be obtained at least momentarily until the cut-out points open. This positive reading is the reverse current and should not exceed 8 amperes.

Remove the 3/4 OHM resistor and connect the battery wire to the battery terminal of the regulator.

Turn off headlights.

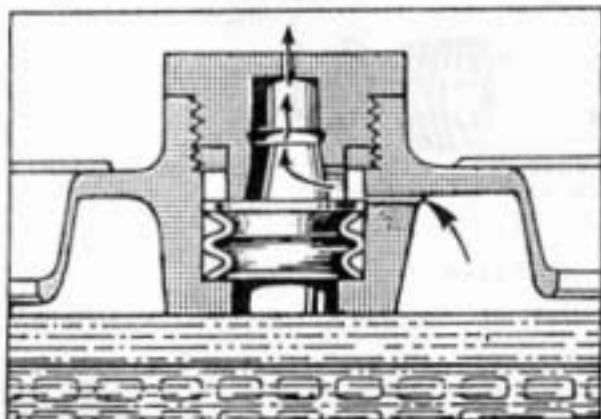
Readjust idle speed.

BATTERY

The battery is a six-volt high plate type with thirteen (13) plates and has a capacity of 82 ampere hour at 20-hour rate. This means that the battery will maintain slightly more than a 4 ampere rate for 20 hours.

The battery is located under the hood on the left side of the engine and is readily accessible for inspection and refilling with distilled water.

It is advisable to check the battery at least once a week with a hydrometer and refill each cell with distilled water. Water should be added until it is level with the top of the filler hole, inasmuch as the battery is fitted with a valve which automatically establishes the correct level for the electrolyte. This valve is incorporated in the battery cell cover and consists of a rubber billows which expands when the cap is removed and closes the air vent hole in the filler opening. When sufficient water is added to bring the level of the fluid up to the bottom of the filler hole, the air in the cell above the bottom of the filler neck is trapped and any additional water added comes up in the filler hole. When the cap is installed, it collapses the billows so the air vent hole is open and the water in the cell immediately drops to the correct level. This is illustrated in Figure 130.



Non-Overflow Battery Filler Cap
Fig. 130

Care should be exercised when adding water to the battery to avoid holding down on the rubber billows. This would defeat the purpose of the cell and permit the battery to be over filled.

While the battery is being recharged out of the car, the caps must be in place in order to permit the gases to escape through the vent hole.

TESTING BATTERY

The specific gravity of the electrolyte in each cell is a direct indication of the state of charge of the cell being tested.

The temperature of the electrolyte at the time of making the test is a most important factor as the specific gravity rises approximately 1 point with each 3 degree drop in temperature. It is, therefore, essential to use a hydrometer which will permit computing all gravity readings for temperature variation.

Do not attempt to take a gravity reading from a cell which has had water added to it until after the car has been driven on the road for at least 30 minutes.

If readings of 1225 or less are obtained, the battery is only half charged and should either be recharged or replaced. Unless the battery has been discharged by leaving the lights or ignition switch turned on, such a low reading is an indication that a faulty condition exists in the charging circuit or battery. It is, therefore, essential that a through check be made at once to determine the cause.

If readings above 1250 are obtained, the battery is fully charged and it will merely be necessary to add distilled water.

When changing a battery, make sure that the battery to body ground strap is connected to the positive terminal of the battery.

THE STARTING SYSTEM

When the operator presses the starter button, the contacts in the starter switch close the circuit so that current flows to the magnetic starter switch mounted on the dash. This magnetic starter switch then closes the circuit from the battery to the starter motor. The current thus applied to the starter motor causes the armature to revolve and thus engage the pinion on the end of the armature shaft with the ring gear on the flywheel.

FORD TRUCK 1/4-TON 4 x 4

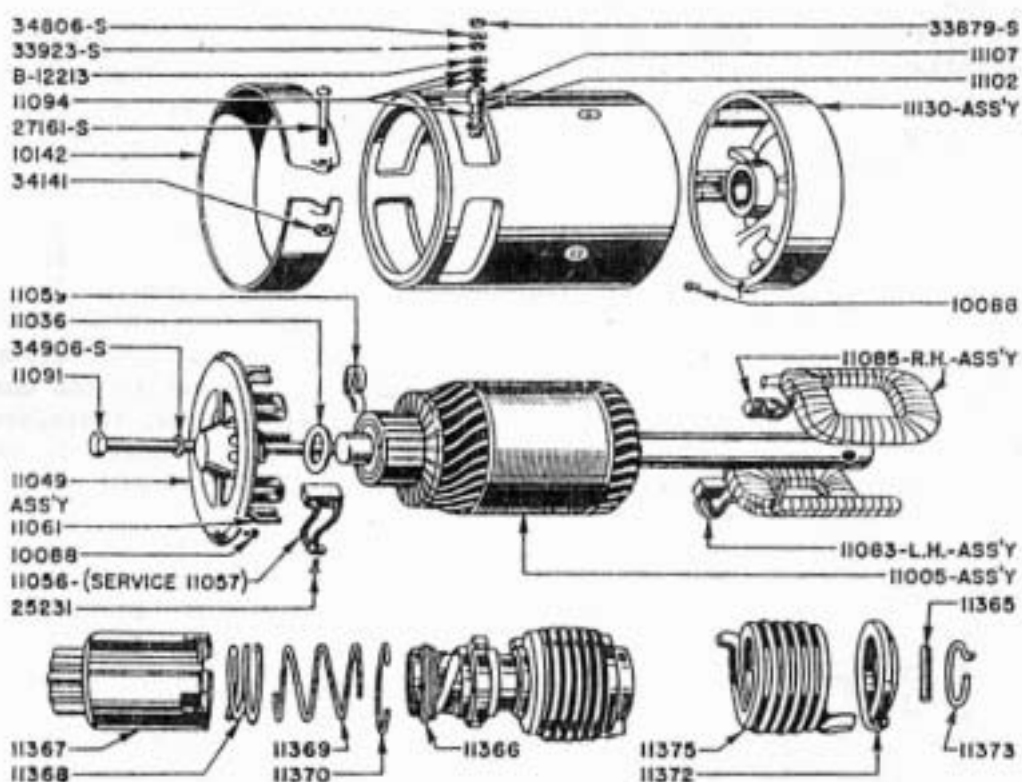
A wiring diagram of the starter circuit is shown in Figure 132.

THE STARTING MOTOR

The starting motor is bolted to the upper left side of the flywheel housing and can be disassembled from the engine by removing the two through bolts, Part No. 11091. After removing these two bolts, pull the starter motor forward and at the same time tilting it in toward the engine slightly so the starter drive will clear the flywheel. The starting motor and starting drive are removed as a complete assembly.

DISASSEMBLING STARTER MOTOR

The various parts of the starting motor, as well as the starter drive assembly are shown in their relative assembly position in Figure 131. To disassemble the starting motor, the starter drive must first be removed from the armature shaft. This is accomplished by pressing down on the Part No. 11372, anchor plate, against the compression of the spring, Part No. 11375, while removing the retainer ring, Part No. 11373. Continue to press down on Part No. 11372 and remove the pin, Part No. 11365, which goes completely through the body of



Starter Motor and Starter Drive Fig. 131

10088 Dowel
10142 Cover Band

11005 Armature

11036 Thrust Washer

11049 Brush End Plate

11057 Brush (Set)

11059 Brush Spring

11061 Brush Holder

11083 Field Coil - L.

11085 Field Coil - R.

11091 Thru Bolt

11094 Terminal Washer

11102 Field Terminal

11107 Terminal Bushing

11130 Rear End Plate

STARTER DRIVE

11366 Screw Shaft

11367 Pinion and Barrel Assembly

11368 Meshing Spring

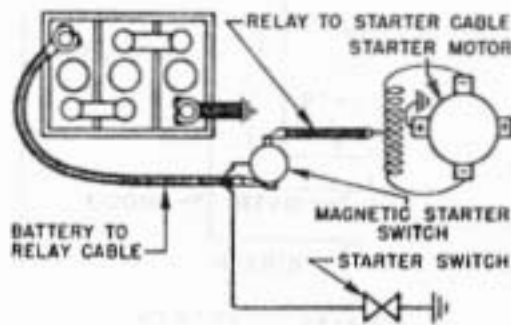
11369 Anti-drift Spring

11370 Retaining Ring

11372 Anchor Plate

11373 Lock Ring

11375 Spring



Starter Circuit Wiring Diagram
Fig. 132

the starter drive and the armature shaft and may therefore, be pushed out of the hole from either end.

Removal of this pin will release the anchor plate, Part No. 11372, and spring, Part No. 11375. The balance of the starter drive assembly can then be slipped off the armature shaft.

In the event it is necessary to replace either of the internal springs, Part No. 11368, or No. 11369, merely remove the retainer ring, Part No. 11370, which seats in the groove in the end of the pinion and barrel assembly, Part No. 11367.

No further disassembling of the starter drive can be done and in the event the screw shaft assembly, Part No. 11366, is damaged in any way, the entire assembly must be replaced. Surplus oil, special grease or any dust on the triple thread retards normal meshing action, particularly in cold weather. To clean triple thread, rotate the pinion barrel to full meshing position, compressing the drive springs and wipe exposed thread with a cloth wet with kerosene. If the dirt is thick and gummy, apply kerosene to the thread with a small brush; then work pinion back and forth several times and re-wipe the thread.

To disassemble the starter motor, first remove the brush and cover band, Part No. 10142, and lift the brush tension spring so the spring tension is released from the

brushes. This can be done by partially lifting the brushes out of the bracket and then placing the spring against the side of the brush rather than on the top.

Then remove the two through bolts, Part No. 11091 and push the armature shaft out of the starter motor yoke. The brush end bracket can then be lifted off the armature.

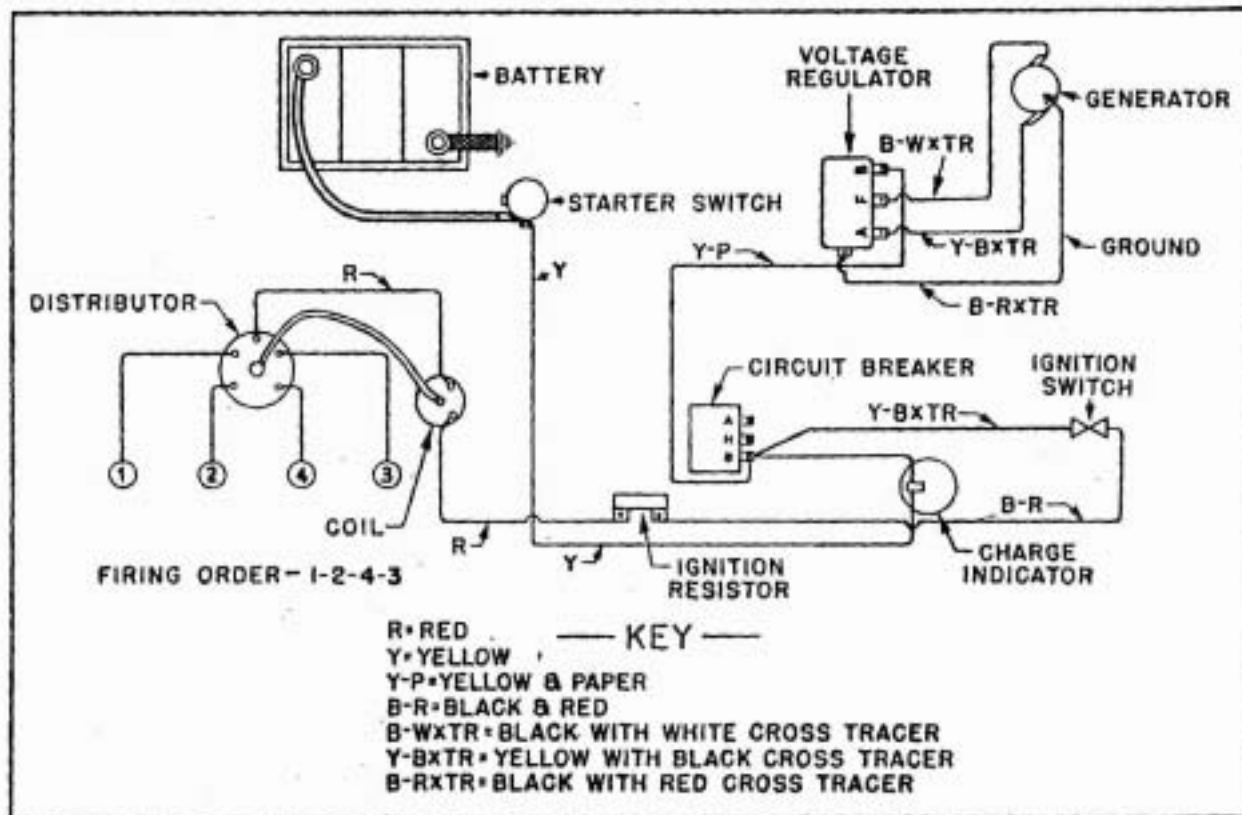
The starter rear end plate assembly, Part No. 11130, can be removed by tapping it slightly from the inside with a hammer handle.

It is assumed that starter motors will only be disassembled at bases where complete electrical test equipment is available. With such equipment, the usual procedure can be followed to determine whether the field coils are shorted or open, leads properly soldered and whether the armature is suitable for further use. The bushings in the end brackets should also be examined and if badly worn, the complete end bracket should be replaced.

The armature commutator should also be examined and if rough or burned, it should be turned down in a lathe after which it should be sanded carefully with No. 00 sandpaper so the surface is smooth.

The two brushes on the field coils should be examined carefully and if worn, new brushes should be soldered to the field coil wires. The two armature brushes should also be replaced which can be done by removing the screws which hold the brush terminals to the brackets.

To reassemble the starter motor, merely reverse the procedure outlined in the foregoing paragraph. It will be observed that the end plates both have a hole in the edge into which is inserted a small dowel. Part No. 10088. The purpose of this dowel is to properly locate the end plate on the starter motor frame and when assembling the two plates, make sure this dowel fits into the depression in the frame.



Ignition Wiring Diagram
 Fig. 133

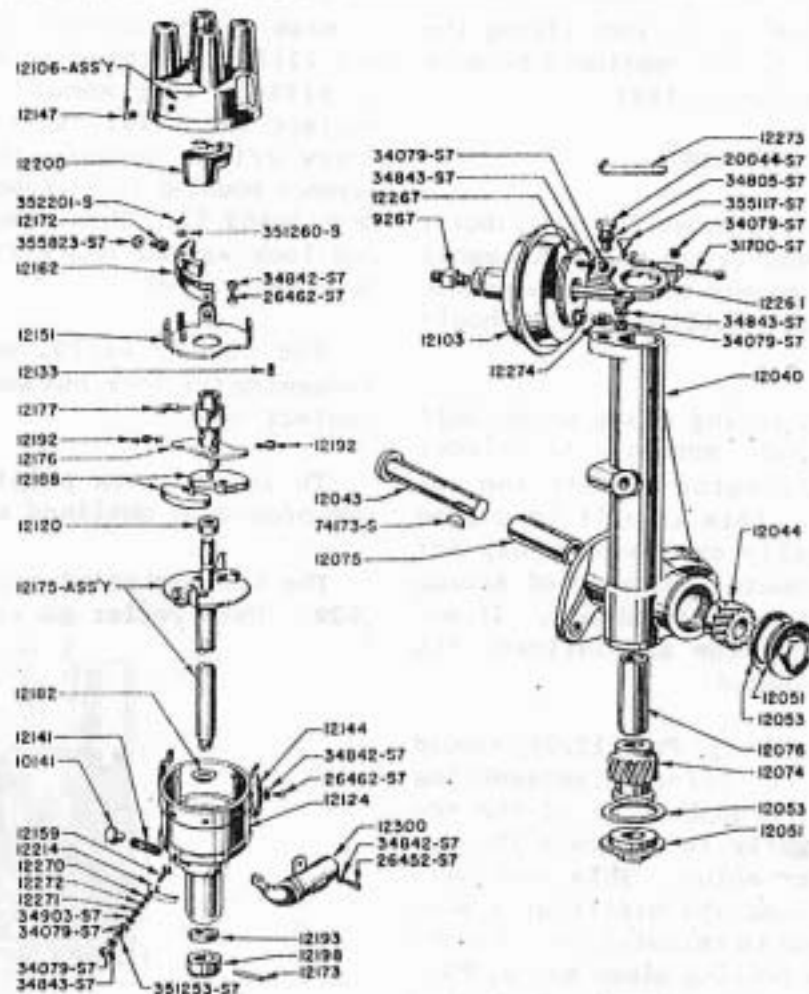
IGNITION

The complete ignition system consists of the coil, distributor, spark plugs and necessary wiring for connecting these units. In order to cause a spark inside the cylinders of the engine, it is necessary to change the low tension current from the battery to high tension which will have sufficient voltage to jump the spark plug gap under the high compression encountered in the engine. This is accomplished by the ignition coil which consists of a primary and secondary winding insulated from each other and wound around a soft iron core. When current from the battery passes through the primary circuit, this iron core becomes magnetized. Interruptions of the flow of current through the primary circuit by the opening of the breaker points, causes the

magnetic field to collapse, which in turn induces an electromotive force in both the primary and the secondary windings. The emf from the secondary discharges across the spark plug gap, which ignites the fuel air mixture in the cylinders.

The spark must occur at the proper time in relation to piston travel and opening of the valves in order to secure the utmost efficiency from the engine. This is controlled by the opening and closing of the breaker points. The breaker points are actuated by a cam on the end of the distributor shaft, which is in turn driven by gears connected to the end of the camshaft.

An exploded view of the distributor showing all the parts in their relative assembly position is illustrated in Figure 134. This



Exploded View of Distributor Assembly - Fig. 134

Distributor

- | | |
|--------------------------------|---------------------------------|
| 9267 Fuel Line Connector | 12172 Contact Screw |
| 10141 Oil Cup | 12173 Retainer Pin |
| 12040 Adapter Housing | 12175 Shaft |
| 12043 Adapter Shaft | 12176 Cam and Plate Assembly |
| 12044 Drive Gear | 12177 Cam Retainer |
| 12051 Adapter Cover | 12182 Thrust Washer - Upper |
| 12053 Adapter Cover Gasket | 12188 Weight Assembly |
| 12074 Driven Gear | 12192 Governor Spring |
| 12075 Adapter Shaft Bushing | 12193 Thrust Washer - Lower |
| 12076 Shaft Bushing | 12198 Shaft Retainer |
| 12103 Vacuum Control Diaphragm | 12200 Rotor |
| 12106 Cap | 12214 Insulator |
| 12120 Thrust Collar | 12261 Clamp |
| 12124 Housing | 12267 Vacuum Control Bracket |
| 12133 Cam Felt | 12270 Insulating Washer - Inner |
| 12141 Oiler Felt | 12271 Insulating Washer - Outer |
| 12144 Cap Spring | 12272 Insulating Bushing |
| 12147 Vent Plug | 12273 Control Rod Stop |
| 12162 Breaker Arm and Spring | 12274 Control Bracket Spacer |
| | 12300 Condenser |

illustration will assist in identifying the various parts as they are mentioned by part numbers on the following text.

DISASSEMBLING DISTRIBUTOR

It is advisable to remove the distributor advance housing and drive shaft assembly from the engine when any repairs are necessary. The procedure outlined below should be followed.

Unsnap the two spring clips which hold the distributor cap assembly in place, and lift the distributor cap off the advance housing. At this time it is a good practice to visually examine the cap for cracks, carbon runners, evidence of arcing or corroded high tension terminals. If any of the above conditions are noticed, the cap should be replaced.

The distributor rotor, Part 12200, should next be removed, but before disassembling this part, mark the upper edge of the advance housing lightly to indicate the position of the rotor point. This mark will facilitate retiming the distributor when the advance housing is reinstalled. Loosen the spark advance housing clamp screw, Part 31700-F7 and lift the assembly including the distributor drive shaft from the distributor mounting, Part 12040.

Before proceeding further it is advisable to examine the rotor, Part 12200, carefully for cracks or excessive burning at the end of the metal strip. If burning is found on top of the strip, it indicates the rotor is too short and should be replaced. Ordinarily when this condition is found in the rotor the distributor cap points will also be burned on their horizontal face, and the cap should also be replaced.

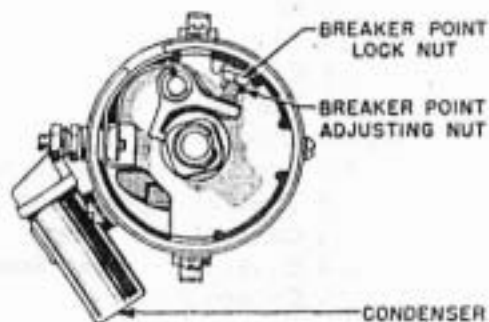


Fig. 135

Examine the contact points, Part 12162 and 12172, if they are noticeably burned or pitted, they should be replaced. To replace the 12162, merely insert a small screw driver between the spring and the advance housing to release it from the dowel, Part 26462-S7. Then remove the cotter pin and lock washer and lift the assembly up off the bracket.

The point, 12172, can be removed by loosening the lock nut and screwing out the contact point.

To install new points merely reverse the procedure outlined above.

The breaker point gap should be .018 to .020. Use a feeler gauge to adjust the gap

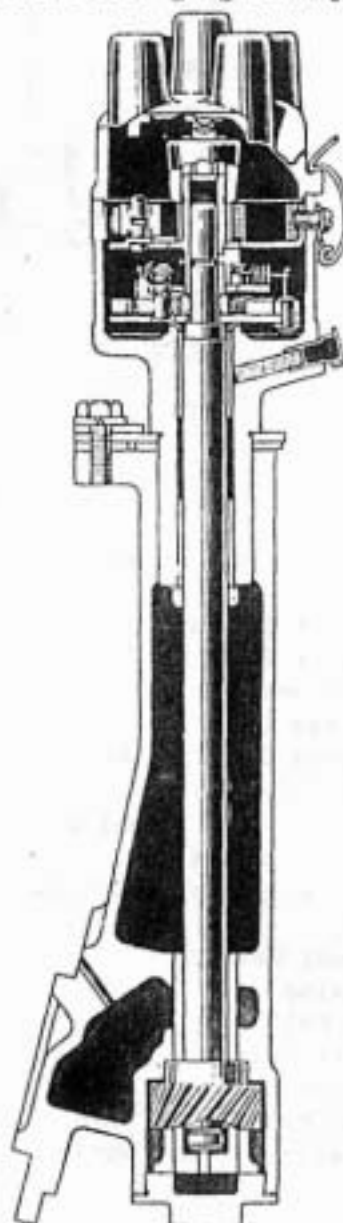


Fig. 136

and after this has been properly set, re-tighten the breaker point lock nut. Always recheck the gap after tightening the lock nut.

The breaker points should be aligned so as to make contact near the center of the contact surfaces. Bend the stationary contact bracket to secure proper alignment, and then recheck the gap, as outlined above.

The breaker point spring tension should be 20 to 24 ounces. This can be checked with a suitable spring scale hooked on the breaker arm at the contact. The pressure being exerted on a line perpendicular to the breaker arm. A reading should be taken just as the points separate.

If a suitable tester is available check the capacity of the condenser, Part 12300. This should be 29 to 32 micro farad.

Inspect the condenser contact and clean and tighten the connection to the terminal post. Make certain the condenser is firmly mounted to the base.

It is not advisable to attempt repairs to the distributor governor mechanism unless suitable test equipment is available on which the governor advance can be checked. This fixture should show the spark advance in degrees corresponding to the various distributor speeds.

The spark advance curve is adjusted by bending the outer spring lugs on the governor advance mechanism, Part 12175. The tension of the governor weight spring, Part 12192, of course, has considerable bearing on this operation, and for this reason it is not recommended that any repairs be attempted to the governor mechanism unless suitable equipment for checking the governor advance is employed.

The correct governor advance in distributor degrees and distributor RPM is as follows:

| | |
|-----------|-------------|
| 2 deg. | at 200 RPM |
| 3.2 deg. | at 400 RPM |
| 4.7 deg. | at 600 RPM |
| 6 deg. | at 800 RPM |
| 7.4 deg. | at 1000 RPM |
| 8.7 deg. | at 1200 RPM |
| 10.1 deg. | at 1400 RPM |
| 11.5 deg. | at 1600 RPM |

When reassembling the distributor, place only one drop of light oil on the breaker arm hinge pin. Saturate the felt in the top of the breaker cam with light oil. Place a thin film of high melting point lubricant on the cam and apply two drops of light oil on the governor mechanism.

REASSEMBLING DISTRIBUTOR ON ENGINE

Install the rotor, Part 12200.

Assemble the distributor in the distributor mounting, Part 12040, and turn the distributor rotor so the metal strip points to the light mark which was made on top of the advance housing before the rotor was disassembled. Then push the distributor completely down in the mounting, so the end of the drive shaft engages the driving slot. The driving slot in the gear is slightly off center so as to eliminate the possibility of incorrect engagement.

At this point it will be necessary to reset the timing.

RETIMING DISTRIBUTOR

The timing of the distributor must be set to occur 2 degrees (crankshaft) before top dead center. The initial setting is made by turning the crankshaft until #1 cylinder is at top dead center on the compression stroke. There is a mark on the top of the cylinder front cover, Part 6019, as well as a similar groove in the edge of the crankshaft pulley. When these two marks are in line on the compression stroke, #1 cylinder is at top dead center.

To determine whether or not the cylinder is on the compression stroke, remove the spark plug from that cylinder, and if both intake and exhaust valves are closed as the piston is coming up, the cylinder is on the compression stroke.

Next, move the distributor body and observe the action of the breaker points. The ignition timing is correctly set when the breaker points just start to open and the advance housing should be clamped in that position by tightening the clamp screw, Part 31700-S7.

Make sure the primary leads as well as

the high tension wires to the spark plugs are firmly seated in the distributor cap with the rubber shields securely in place. Then install the distributor cap on the advance housing and snap the spring retainers into position.

DISTRIBUTOR MOUNTING BRACKET

The distributor mounting bracket is bolted to the engine by 3 cap screws. It should seldom be necessary to remove this assembly, but in the event any internal repairs become necessary, the procedure outlined below should be followed.

DISASSEMBLING DISTRIBUTOR MOUNTING BRACKET

To disassemble the distributor mounting bracket, remove the distributor adapter cover, Part 12051, which will also release the gasket, Part 12053, and Gear, 12074.

In the event it is necessary to replace the bushing, 12076 a special driver must be obtained, by means of which the bushing can be pressed out of housing in arbor press. The gear, 12044, is a tight pressed fit on the 12043 shaft and is held in position by the Woodruff key, Part 74173-S. If it becomes necessary to replace this gear, a special driver and anvil, which will properly support the distributor housing should be used. This also applies to replacement of the bushing, 12075.

When reinstalling the 12074 gear, it must be correctly meshed with the gear, Part 12044. There is one tooth on the 12074 gear which has a bevel ground on the end. This tooth must be placed between the 2 teeth on the 12044 gear, which are marked with the letter "O".

DISTRIBUTOR VACUUM CONTROL

In order to secure peak efficiency from an engine, it is desirable that the ignition timing be advanced as far as is possible without causing detonation (spark knock). As the engine speed increases, the governor weights in the distributor automatically advance the timing, but when the engine is pulling a heavy load at low engine speed, it is necessary to retard the timing. The distributor vacuum control, Part 12103,

automatically accomplishes this purpose.

The control consists of a diaphragm to which is attached a pull rod. Behind the diaphragm is a spring which exerts tension towards pushing the pull rod outward. A line running from the intake manifold subjects the diaphragm to manifold vacuum, which causes the diaphragm and pull rod to move inward against the tension of the spring. When the engine is subjected to a heavy pull, the throttle is open so widely that intake manifold vacuum drops to a low point and the spring tension in the diaphragm is then strong enough to force the pull rod outward, thus turning the distributor advance housing and retarding the spark.

The distributor vacuum control, Part 12103, is manufactured as a unit and no repairs should be attempted to this assembly.

LIGHTING SYSTEM

The wiring diaphragm of the lighting system is shown in Figure 138.

The headlights are the sealed beam type and are mounted on a hinged bracket which can be swung upwards so the beam of light can be directed backwards on to the motor compartment and other parts of the vehicle when desired. As shown in Figure 137, this bracket is held in place by a wing nut and it is merely necessary to loosen this wing nut in order to release the bracket.

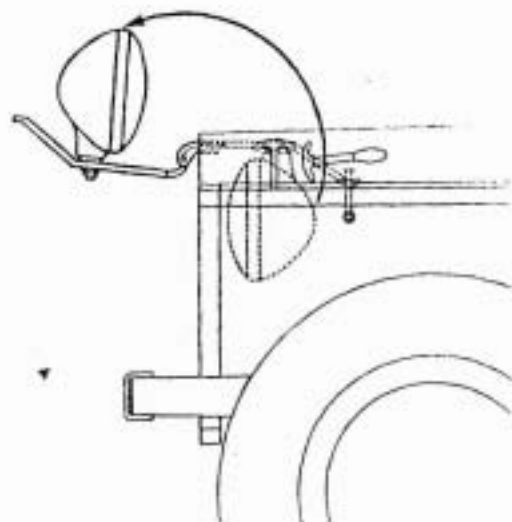
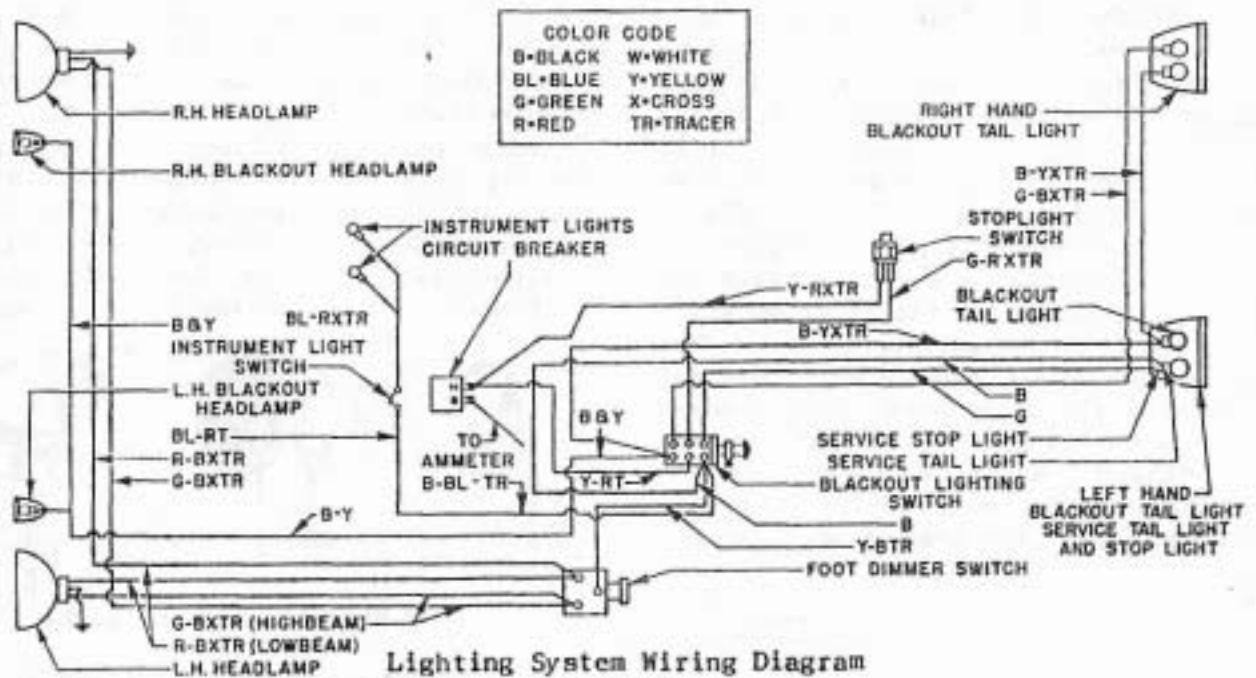


Fig. 137



This feature also facilitates the operation of replacing the headlight bulb assembly in the event this becomes necessary. The sealed beam headlight is manufactured with the lens reflector and bulb as a complete unit. This unit, Part 13007, must be replaced in the event the bulb should be burned out.

To replace the bulb, remove the screw, Part 36920-S2, Figure 139 and pull outward on the bottom of the rim, Part 13045. The upper part of the rim is held in place by a spring catch at the top, and after the rim has been released from the bottom it should be lifted up to release it from the catch at the top.

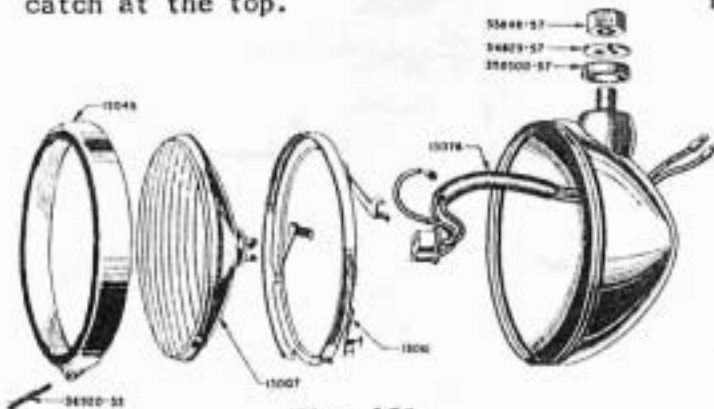


Fig. 139

The headlight bulb assembly is clamped in the rim, 13045, by the retainer ring, Part 13061. As shown in the illustration, there are three clamps riveted to the retainer ring, which hook into the flange on

the inner side of the rim, Part 13045. To release the bulb from the rim, press down on each clamp and turn it inward to release it from the flange.

After removing the outer rim with the bulb and retainer ring from the headlight case, merely pull the 3-pronged socket off the headlight bulb assembly.

A cross sectional view of the headlight assembly is shown in Figure 140.

ALIGNING THE HEADLIGHTS

The focusing of the light beam is a permanently built-in feature of the sealed

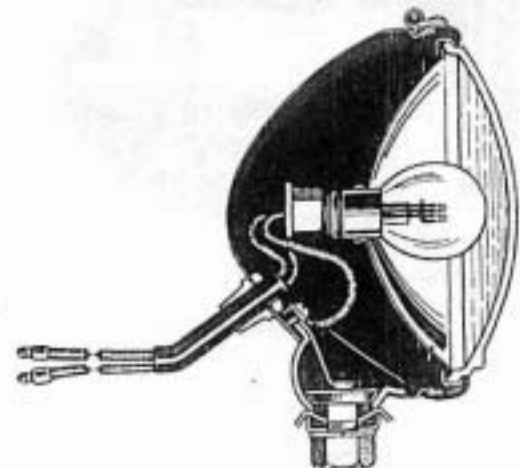
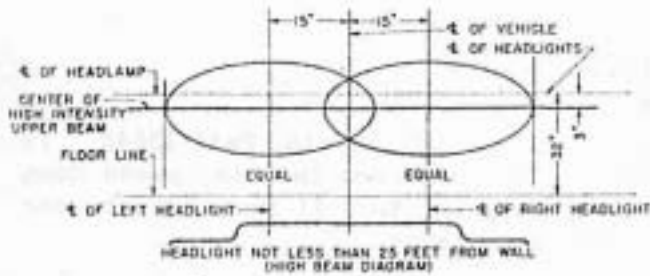


Fig. 140

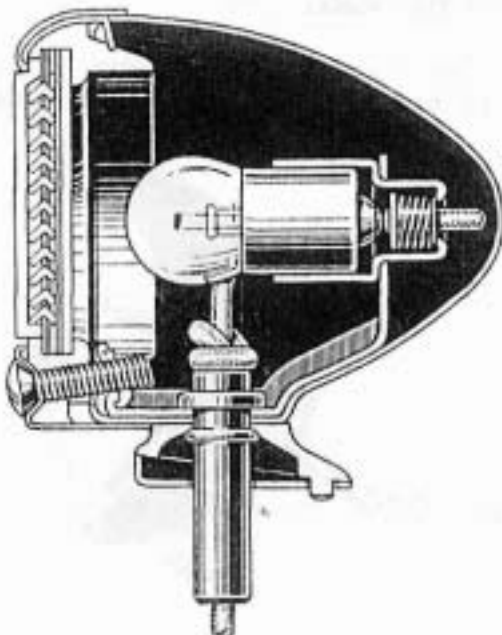
beam headlight. For this reason the only adjustment necessary is properly aiming the headlight, so the high beam is directed straight ahead and the correct distance above the ground. This should be done by using a screen or wall on which has been marked the aiming diagram shown in Figure 141. Place the truck 25 feet back from the screen or wall, making sure the tires are correctly inflated and the floor on which the vehicle stands is perfectly level. Turn on the headlights and make sure they are switched to the high beam. Then loosen the nut which holds the headlight assembly to the hinged bracket and move the headlight assembly as required to center the high intensity of the beam as shown in the diagram.



Headlight Alignment Diagram - Fig. 141

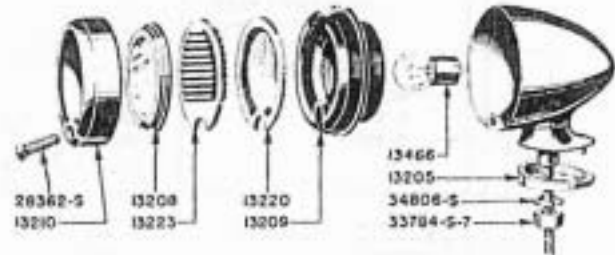
BLACKOUT LIGHTS

In addition to the sectional view of the blackout lights shown in Figure 142, an exploded view showing all the parts in



Sectional View of Blackout Light
Fig. 142

their relative assembly position, is shown in Figure 143. A sectional view as well as an exploded view of the combination tail and stop light is shown in Figure 143. The left hand tail light differs from the right hand light in that the former has a stop light bulb in the lower socket, and does not have blackout lenses over the stop light. The right hand tail light serves exclusively as a blackout light, and has the same candle

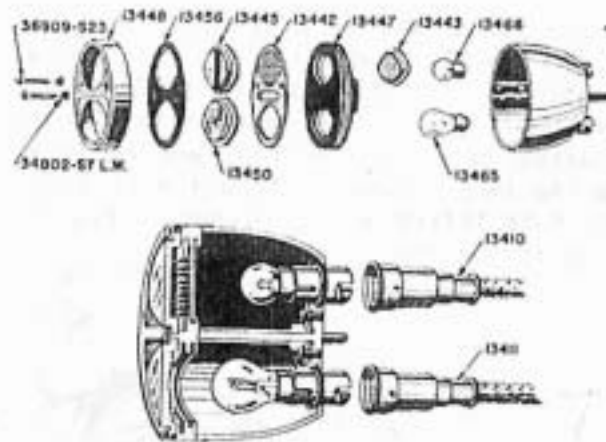


Exploded View of Blackout Light

Fig. 143

power bulb in both the upper and lower socket.

As shown in the above mentioned illustration, it is merely necessary to remove the screw holding the rim to the light shell in order to disassemble the various pieces comprising the blackout lens as well as to replace a bulb.



Exploded View of Tail and Stop Light

Fig. 144

SHOCK ABSORBER

Effective control of the spring action is highly important in a vehicle of this type in order to prevent excessive spring breakage and facilitate maneuvering the truck over difficult roads. This problem is efficiently handled in the Ford truck by the use of hydraulic double acting shock absorbers. In this type shock absorber, a special shock absorber fluid is forced from one chamber to another by movement of the lever arm, which in turn is connected by linkage to the spring. Inasmuch as the size of the orifice through which the fluid must pass to get from one chamber to another, is controlled by an adjustable valve, any amount of resistance desired can be established. A sectional view of the Ford shock absorber which clearly shows the construction of the instrument is illustrated in Figure 145.

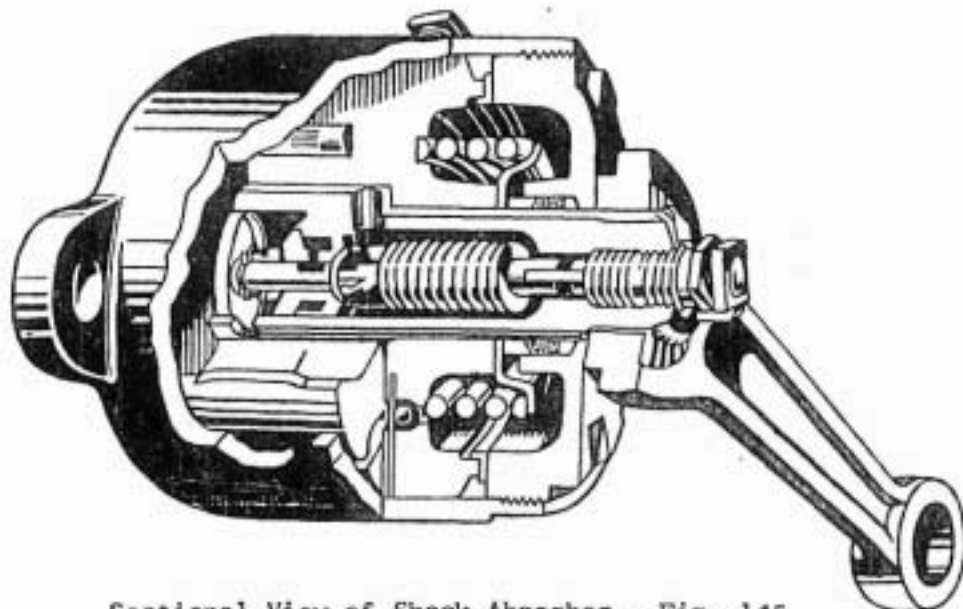
Normally, the only care required by this type shock absorber is the replenishment of the shock absorber fluid. A filler plug in the reservoir should be removed each spring and fall or at intervals of 5000 miles, and the reservoir refilled to the bottom of the filler plug hole. Use only an approved shock absorber fluid as substitute fluid, grease or oil may cause the shock absorber to become inoperative.

It is imperative that the shock absorber body be cleaned thoroughly around the fil-

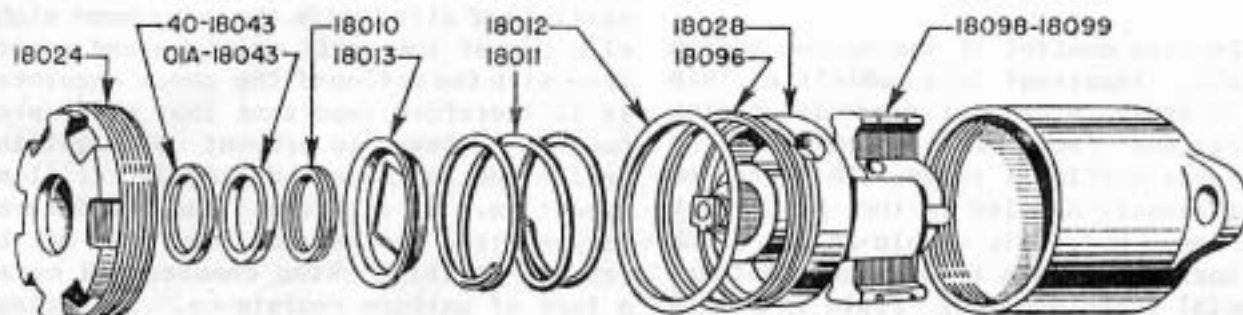
ler plug before removing the plug. A small particle of dirt inside the instrument might clog one of the small orifices and interfere with the action of the shock absorber. It is therefore important that every precaution be taken to prevent dirt getting inside the instrument during the refilling operation. In the event the fluid level is permitted to get too low, air may be trapped in the working chamber and cause a lack of uniform resistance. To correct this, disconnect the link and pump the lever several times through its full range of travel. This will draw the fluid from the auxiliary reservoir into the working chamber. Add more fluid and repeat pumping. When working chamber is properly filled, there will be no evidence of lost motion in the shock absorber.

CAUTION: Do not fill the shock absorber above the level of the filler plug, as there must be an air space between this point and the top of the reservoir in order to permit expansion of fluid.

An exploded view of the shock absorber showing all the parts in their relative assembly positions is shown in Figure 146. The parts illustrated can be easily replaced if suitable holding fixtures and wrenches are secured. Such tools are available from the Houde Engineering Company, Buffalo, New York, and it is not recommended that any attempt to disassemble the shock absorbers be made without these special tools.



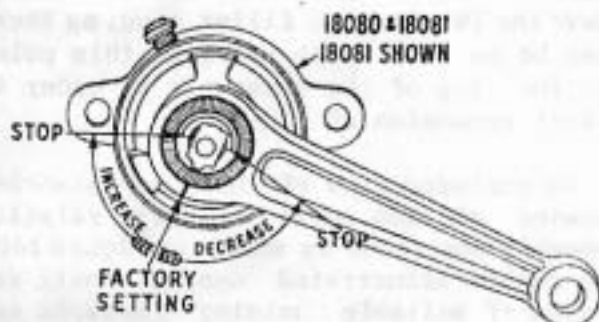
Sectional View of Shock Absorber - Fig. 145



Exploded View of Shock Absorber - Fig. 146

ADJUSTING SHOCK ABSORBERS

As shown in Figure 147, resistance of the shock absorber can be increased or decreased by turning the needle valve in the



Shock Absorber Adjustment - Fig. 147

end of the wing shaft. A factory setting mark inscribed on the lever arm indicates the correct adjustment for average operating conditions, and normal temperatures. If stiffer resistance is desired due to high atmospheric temperatures, turn the pointer clockwise from the factory setting mark. If less resistance is desired due to temperatures below freezing, decrease the resistance by turning the pointer counterclockwise from the factory setting mark. The adjustment is very sensitive, and for this reason the pointer should not be moved more than one or two serrations at a time, if possible, riding the car between each adjustment.

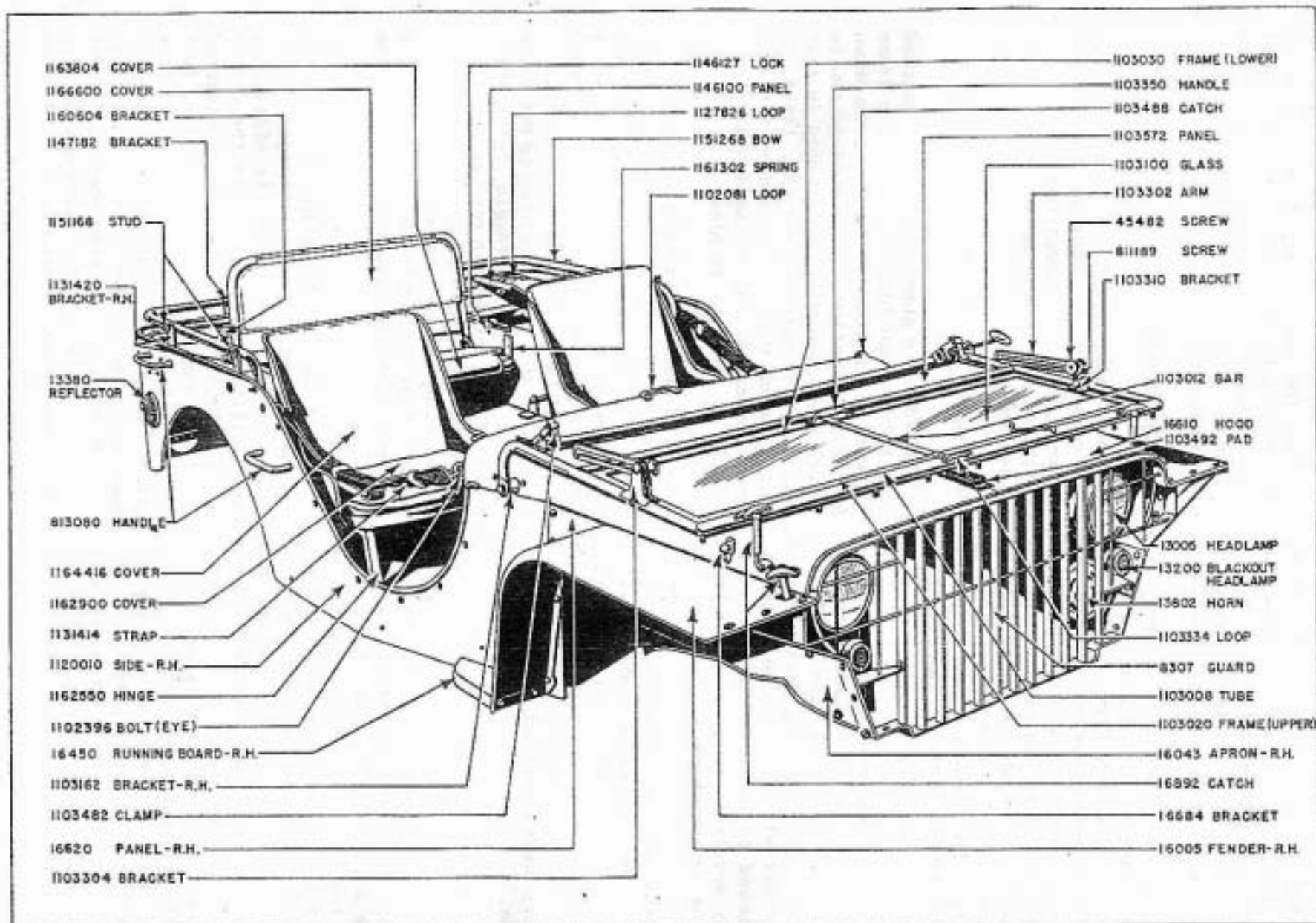


Fig. 148

The complete body unit is illustrated in Figure 148. This illustration shows the part number and name of each of the various assemblies mentioned so as to obtain a clear understanding of the body construction:

The panels and supports of the body are all welded together into a sturdy compact unit. The brush guard, Part No. 8307, is of solid bar construction with ends of the vertical bars doweled and welded to the outer frame. This unit constitutes the front end frame support and is mounted to the chassis frame on springs so as to permit greater flexibility. The balance of the body unit is fastened to the frame by ten (10) body bolts.

All seat cushions and backs are easily removed for washing or replacement. The rear seat is of the steel tube design and is so constructed that the seat and seat back, together with the cushion, fold in to the closed position in unison. This is done by merely lifting up on the front edge of the seat cushion.

The front passenger seat is hinged on the front legs and can be pushed forward to facilitate getting in or out of the rear compartment. Straps are provided on the bottom of the front passenger seat to hold the top and side curtains when they are not in use.

ASSEMBLING CANOPY TOP

The hand rail, Part No. 1151268, described as bow in the illustration, also serves as a top bow for the canopy top. When the top is desired on the unit, the first step is to raise the bow. This is done by releasing the two thumb screws, one on each side, which hold the front end of the bow in place. Lift the bow backward and insert the ends in the top bow sockets located near the tool compartment covers. Then tighten the top bow support thumb screws and swing the hand rail side support bracket, Part No. 1131420, upward over the stud on the top bow and tighten the wing nut. Then place the safety clip into the hole in the stud.

Place the narrow edge of the top to the fasteners on the top edge of the rear panel of the body, then pull the top over the bow and fasten it to the fasteners on the top of the windshield frame.

TOOL COMPARTMENT

Tool compartments are located at the rear corners of the body on each side of the rear seat. The compartment covers can be latched without the use of a key or lock if desired.

WINDSHIELD

The laminated glass windshield is mounted in a light-weight high carbon tubular frame for extra strength and flexibility. As shown in the illustration, the windshield can be folded down over the hood and when in that position, the catches, Part No. 16892, on each side of the hood should be fastened to the upper part of the windshield frame to hold it securely in place.

The windshield is held in the raised position by the clamps, Part No. 1:03482. These clamps are adjustable so that any looseness which may result from the rubber seal taking a set, can be eliminated. This is accomplished by loosening the screws which hold the toggle catches to the dash. The back part of the toggle catch which bears against the dash is ratcheted. After loosening the screws which hold the catch to the dash, move it downward a sufficient amount to take up any looseness which exists in the toggleclamps and then retighten the screws.

Some of the useful features incorporated in the body which may not be readily apparent but which increase its efficiency and facilitate maintenance are the center bar on the rear bumper which is inverted to provide support for the spare tire, foot rest provided at the gun mount base, ten-gallon fuel tank concealed under the driver's seat and protected from the rear by a shield, 17-inch diameter steering wheel and front fender aprons which are flared out to give the maximum amount of room for motor repairs or adjustment.

REMOVING BODY FROM CHASSIS

When major repairs are required which necessitate removal of the body from the chassis, it is advisable to remove the complete unit consisting of the body, hood, front fenders, brush guard and running board. The procedure outlined below should be followed to perform this operation:

1. Remove gun from gun mount.
2. Remove spare tire.
3. Remove battery and battery support.
4. Remove air cleaner.
5. Drain water from motor and remove radiator core and hose connections.
6. Remove steering wheel.
7. Remove steering column to instrument panel brace.
8. Remove fire extinguisher and bracket.
9. Remove knobs from gearshift levers.
10. Remove clutch and brake pedal pads.
11. Remove floor pan seals at steering column and pedal.
12. Remove transmission cover and seals.
13. Loosen steering column at frame.
14. Remove fuel line at tank and filter on dash.
15. Remove wire from generator.
16. Disconnect wires and junction under left headlamp.
17. Remove cable from starter.
18. Remove wires from ignition coil.
19. Remove wires from oil pressure plug and water temperature plug on motor.
20. Disconnect choke and throttle cables.
21. Remove speedometer drive cable from speedometer head and pull out of body.
22. Remove fuel gauge wire from tank.
23. Disconnect wires at tail and stop lights.
24. Remove ground wire at flywheel housing.
25. Remove brush guard to frame nuts, lock-washers, bolts and springs.
26. Remove 10 body to frame bolts.
27. Lift body assembly from frame.

To assemble the body on the frame, reverse the procedure outlined above. Cement new body to frame pads to the frame when reinstalling the body.

STEERING GEAR:

Steering Gear:

Make Gemmer
 Model #250
 Type Worm and roller
 Column end play Shims
 Cross - shaft end play .. Shims and adjusting screw in side cover
 Mesh adjustment Shims - .006 max.
 Ratio 17 to 1.0

Steering Geometry:

Toe-in 0 to 1/16"
 Camber 1° - 30 min.
 Caster 4°
 King pin or steering knuckle pivot inclination 7° - 30 min.

Steering Connecting Rod:

Make Own
 Type Spring loaded

Cramping Angle:

Right wheel 28°
 Left wheel 28°

REAR AXLES:

Rear Axle:

Make Spicer
 Model 23-2
 Type Full floating

Gear Ratio 4.875

Differential:

Type Hypoid (Spicer)
 Gear and Pinion Backlash .. .005 - .007
 Lubricant Capacity .. 2-1/2 pts. or lbs.

FRAMES:

Length Main Side Members 123.90"
 Depth Main Side Members 4.00"
 Width Main Side Members 1.62"
 Thickness Main Side Members120-.130

SPRINGS:

Front Main:

Dimensions:
 Center to Center (with load) . 32.00"
 Center to Center of Eyes
 (without load) 30.98"
 Eye to seat Centers 16.00"
 Width 1.75"

Leaves:

Quantity 6
 Thickness .222-.228" (#2 leaf 1.82-.188")

Rear Main:

Dimensions:

Center to Center (with load) . 38.00"
 Center to Center of Eyes
 (without load) 36.59"
 Eye to seat Centers 19.00"
 Width 1.75

Leaves:

Quantity 8
 Thickness222 - .228"

Shackles:

Make O and S Bearings
 Type Oilless Shackle Bolts

ENGINE:

Make Ford
 Model G.P.
 H.P. 45 at 3600 rpm
 SAE Rating 16.28
 Max. Torque 85 ft. lbs. at 1700 rpm
 Type "L-head"
 No. of Cylinder Four
 Bore 3-3/16
 Stroke 3-3/4
 Piston Displacement .. 119.5 cu. inches
 Compression Pressure at

Cranking Speed 110 lbs.

Cylinder Head:

Material Cast Iron
 Bolt Tension 50 lbs.

Maximum rebore (oversize) permissible to avoid weakening cylinder wall . .060"

Firing order 1-2-4-3

Compression Ratio 6.1 to 1.0

Fuels:

Engine will operate satisfactorily using gasoline of 68 octane (minimum) and 74 octane (maximum) ratings.

Head Gasket:

Material sheet steel and asbestos

Valves:

Intake:

Angle of Valve Seat 45°
 Clearance (hot) .012

Exhaust:

Angle of Valve Seat 45°
 Clearance (hot) .012

Distance Lifted307"

Valve Springs:

Exhaust and Intake:

Free length 2.41"
 Length under 63# 1.84"

ENGINE (Continued)

Pistons:

Available oversized pistons0025, .005", .015", .030", .045", and .060".
 Type Cam Ground - T-Slot Skirt
 Material Aluminum
 Diameter:
 At top 3.1585
 At skirt 3.184 - 3.1865
 Cam Grinding Used Yes
 Fitting 8 to 12 lb. pull on piston
 pull scale using .003 feeler

Piston Pins:

Diameter7501 to .7504
 Length 2.972 to 2.975
 Oversize available002
 Method of Fastening . in piston by wire
 retainer rings.
 Fit in piston ... selected .0005 - .0007

Piston Ring:

Compression 2 Oil 1
 Width:
 Top0940 to .0950
 Center0935 to .0945
 Oil1565 to .1575
 Type Solid Cast, Oilgroove
 Groove Clearance:
 Top002 - .0035
 Center0015 - .003
 Oil0015 - .003
 Gap Clearance:
 Compression010 - .015
 Oil007 - .015

Connecting Rod:

Type:
 Rod Forged "I" Beam
 Brg. - Steel bckd, Alloy lined, replaceable
 Diameter Size 2.2195 to 2.220
 Diameter Clearance:..... .0004 - .0025
 (Selected)0000 - .0025
 End Clearance004 - .008
 Length (Center to center) 4.687 to 4.688
 Rod and Piston Assy. removed from above.

Main Bearings:

Type.. Steel backed, lined, replaceable
 End Thrust taken on center bearing
 Bearing Adjustable for Wear No
 Normal Clearances000 - .0025

Crankshaft Gear:

No. of teeth 22

Camshaft Gear:

No. of teeth 44

Camshaft:

Type Cast alloy
 Bearing Clearance0015 - .0032
 End thrust Taken on Face of Front
 Bearing End.

Timing Gears:

Backlash003 - .004

CLUTCH:

Make Long - Model 9CF-CS
 Type Single plate, dry
 Facings:
 Quantity 2
 Type Woven
 Facing Size:
 Inside Diameter 5.76
 Outside Diameter 9.0"
 Thickness135-.138
 Fingers:
 Quantity 3
 Type Forged
 Release (Throw Out) Bearing .. Federal or
 FaFnr Ball Type
 Pilot Bearing: Federal or
 FaFnr Ball Type
 Pedal Clearance: 1" at toe board

TRANSMISSIONS AND TRANSFER CASE MECHANISM:

Transmission:

Make Own
 Model CP-7000
 Type Sliding Gear
 Mounting Integral with power plant

Bearings:

Clutch Shaft - in flywheel Ball
 Clutch Shaft in rear Ball
 Main Shaft - front Roller
 Main Shaft - rear Ball
 Countershaft - front Roller
 Countershaft - rear Roller
 Reverse Gear Bronze Bushing

Gear Ratios:

First Speed 3.1215 to 1
 Second Speed 1.8567 to 1
 Third Speed 1 to 1
 Reverse Speed 3.7458 to 1

Transfer Case Mechanism:

Make Spicer
 Model TC-18
 Type 2 Speed
 Mounting Amidship of frame
 Bearings ... 2 Tapered Roller .. 1 Ball
 Gear Ratios:
 High Speed 1.00 to 1
 Low Speed 1.97 to 1
 Controls ... Automatic so as to prevent
 low range operation when
 front axle is disengaged.

PROPELLER SHAFTS:

Type of Drive Hotchkiss
 Number of Shafts Used Two
 Universal Joints:
 Make Spicer
 Model GP (Front and Rear)
 Type Needle Bearing
 No. Used Four

COOLING SYSTEM:

Type Liquid (water) - forced circulation.
 Total capacity 10 qts.
 Thermostat opening temperature:
 Starts to open at 145° Fahrenheit and fully opens at 185°

Radiator:
 Shell:
 Make Own
 Core:
 Make Long
 Type Fin and tube

Hose:
 Upper:
 Inside Diameter - 1.5 .. Length - 2.5
 Lower:
 Inside Diameter - 1.5 .. Length - 2.5

Fan:
 Make Schwitzer-Cummins
 Model Ford
 Number of blades 4
 Diameter 15.8
Fan Belts:
 Type V-Smooth
 Size I.D. 46.12"
 Width 5/8"
 Adjustment (by moving generator):
 Fan belt deflection 1"

Water Pump:
 Type Impeller
 Drive .. Belt driven (see "Fan Belt" above)
 Lubrication Prelubricated

FUEL AND EXHAUST SYSTEM:

Fuel Pump:
 Make AC
 Pressure (at carburetor)
 1-1/2 to 2-3/4 lbs.
 Filter ... In fuel pump. Also separate filter on dash

Fuel Tanks:
 Number of Tanks 1
 Total Capacity 10 gal.

Gasoline Line:
 Fuel tank to pump:
 Length (3 Flexible connections and 1 tubing)
 Pump to carburetor:
 Length 14
 Size (inside diameter)225"

Air Cleaner:
 Make Industrial Wire Cloth
 Model A-8020
 Type Oil Bath
 Oil Capacity 1 pt.

Carburetor:

Make Holley
 Model Ford GP-9510
 Type Downdraft - single
 Idling adjustment:
 Number of turns to open 5/8

Main discharge jet:
 Lean 218CC/min.
 Rich 221CC/min.
 Standard 224CC/min.

Accelerator jet #68 Drill
 Power jet030

Gasoline Gage (Instrument Panel):
 Type Electric

Gasoline Gage (In fuel tank):
 Type Electric

Muffler:
 Make Noblitt Sparks
 Type Straight through
 Size--cylindrical 4.05" x 18.00"
 Opening:
 (Exhaust pipe) 1.60
 (Tail pipe) 1.50

ELECTRICAL

General:

Voltage 6 volts system

Battery:
 Make Ford
 Capacity 20 ampere hours at 85 ampere rate.
 Plates per cell 13
 Outer dimensions (to fit battery cradle)
 Length 9.156"
 Width 7.09"
 Height 8.69"
 Terminal Grounded Positive
 Recharge when hydrometer reads 1.225 specific gravity.
 Location Under hood

Battery Cables:
 Positive: Type Strap
 Length 6.0"
 Negative: Type Cable
 Length 15.0"

Ignition and Starting:
Starting Motor:
 Make Ford
 Model 52-11001
 Rotation (viewed at drive end) Clockwise
 Winding Series
 Poles 4
 Drive .. Bendix Spring Type 9 teeth
 End Play000 to .0035"
 Brush spring tension 26 ounces

ELECTRICAL CIRCUITS (Continued)**Distributor:**

Make Ford
 Model GP-12100
 Breaker Point Gap018 - .020"
 Firing Order 1-2-4-3
 Advance and retard mechanism .. Fully automatic vacuum type, 20 crankshaft degrees.
 Timing 2 degrees before top dead center.
 Breaker Spring Tension 20-24 oz.

Coil:

Make Ford
 Model IGA-12024
 Coil Amperage (Engine Idling) . 4 amp.
 Coil Amperage (Engine stopped-breaker points closed) 6 amp.

Spark Plugs:

Make..... Champion 14MM
 Type Comm H-9
 Gap029

Lighting and Generating:**Generator:**

Make Ford
 Maximum charging rate (when hot) 29 amperes at 1600 RPM (M.P.H.)
 Regulation Voltage Regulator
 Rotation (viewed from driven end) Clockwise

Generator Drive:

Belt driven (see "Fan Belt" in section "Cooling System").

Generator Adjustment Data:

Brush spring tension 22 ounces
 Field current at 6 volts 1.78 amperes

Generator Cut-Out Relay:

Make Ford
 Cut-Out:

To close 5.8 to 6.3 volts
 To open 8 amperes discharge

Voltage Regulator:

Make Ford

Lamps:**Head:**

Make General Electric Mazda
 Type Sealed Beam

Tail and Stop:

Type Bulb combination 3 candle power for tail lamp and 21 candle power for stop lamp. Double contact.

Instrument Panel:

Type Bulb Mazda #55 1.5 candle power, single contact.

Special:**Horn:**

Make Sparton
 Type Vibrator
 Current draw, .8 amp. through ammeter
 Adjustment for tone Screw

Protective Devices: Thermostatic Circuit Breaker Capacity (located on back of instrument panel). 30 amps. opens in 30 seconds under 60 amp. load.

BODY AND CAB:**Body:**

Make Ford
 Type ..All steel, box sill construction
 Mounting Rigid to frame

Windshield Wiper:

Make Trico
 Type Manual
 Number provided 1

Rear View Mirrors:

Location One outside
 Make American Automatic Devices

Windshield:

Type Movable Ainsworth

Upholstery:

Cushions Latex rubber covered with specially prepared army duck

LUBRICATION**Engine:**

Capacity 5 qts.
 Crankshaft Journals Full Force
 Connecting Rod Journals Full Force
 Pistons and Cylinder Walls Splash

Oil Pump:

Make Own
 Type Gear

Oil Filters:

Make Purolator
 Model PEAL/2-03
 Replacement cartridge. Complete element

Engine Oil (SAE Numbers):

| Temperature | Number |
|----------------------|---------------|
| Above 32° Fahrenheit | SAE 30 |
| Below 32° Fahrenheit | SAE 10 or 10W |

Oil Change .. Change crankcase oil every 2000 miles unless operating conditions make earlier change desirable.

LUBRICATION (Continued)

Gauge:

Make King Seeley
 Model #B-8805
 Type #11C-9273-A
 Oil Pressure 26 lbs. (@ 35 m.p.h.)

Wheel Bearings:

16 oz. ES-444 Type 1 Grade 2

Water Pump: Prelubricated; Lubricant
 Sealed in.

Generator, and Distributor: .01 oz. Ford
 #4601.

Front Axle:

Hypoid E P Gear Lubricant--
 Summer VVL-761 Class #2
 Hypoid E P Gear Lubricant--
 Winter VVL-761 Class #2

Rear Axle:

Hypoid E P Lubricant--
 Summer VVL-761 Class #2

Hypoid E P Lubricant--
 Winter VVL-761 Class #2

Steering, Gear Lubricant-VVL-761 Class #2

Transmission SAE 70 oil or
 VVL-761 Class #2

Transfer Case:..... SAE 70 oil

Universal Joints:.. ES-444 Type 1 Grade 1

Chassis:

Type Fittings 10 Fittings Stewart
 Warner Alemite Zerk

Lubricant ES-444 Type 1 Grade 1

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