Service Manual

INTERNATIONAL HARVESTER

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2½ TON G.S. 4 x 4
AUST. No 1 MK 3
WITH WINCH
INTERNATIONAL

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OF AUSTRALIA PTY. LTD.
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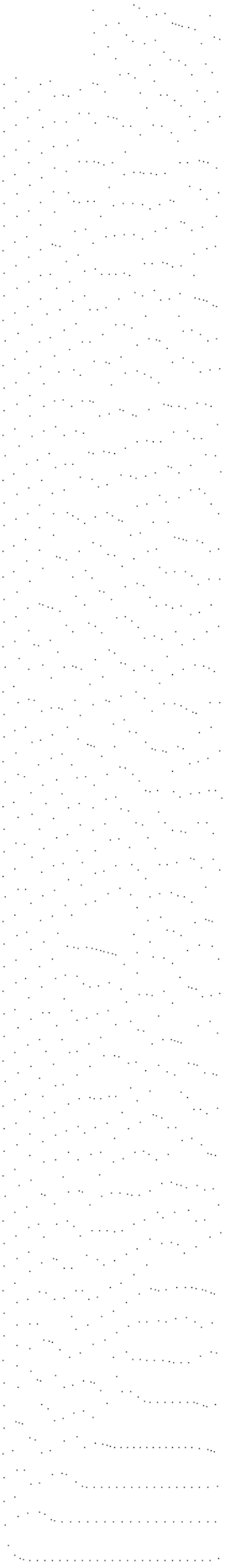



IMPORTANT

REVISION No. 2

to

SERVICE MANUAL No. 1405 172 R2

for

2-1/2 TON G.S. 4x4 - INTERNATIONAL

Following is a list of revised and new pages for Service Manual No. 1405 172 R2. Remove and destroy the old pages with corresponding page numbers and insert new pages sent herewith

Introduction Page

Section D1 - Page 1

Section D2 - Page 4

Section M - Page 4

Section P - Page 2 and Pages 24 to 31

IMPORTANT

REVISION No. 1

to

SERVICE MANUAL No. 1405 172 R2

for

2-1/2 TON G.S. 4x4 - INTERNATIONAL

Following is a list of revised and new pages for Service Manual No. 1405 172 R2. Remove and destroy the old pages with corresponding page numbers and insert new pages sent herewith.

Section D1 - Pages 1 and 2
Section E - Pages 5 and 6
Section O - Pages 5 and 6
Section P - Pages 5 and 6

Service Manual

2½-TON G.S. 4 x 4
AUST. No.1 MK3
WITH WINCH
INTERNATIONAL

INTRODUCTION

This publication contains complete descriptive information and maintenance data covering the International Harvester 2-1/2 Ton 4 x 4 G.S. Vehicle designed and built to meet the requirements of Specification Army (Aust.) 87.

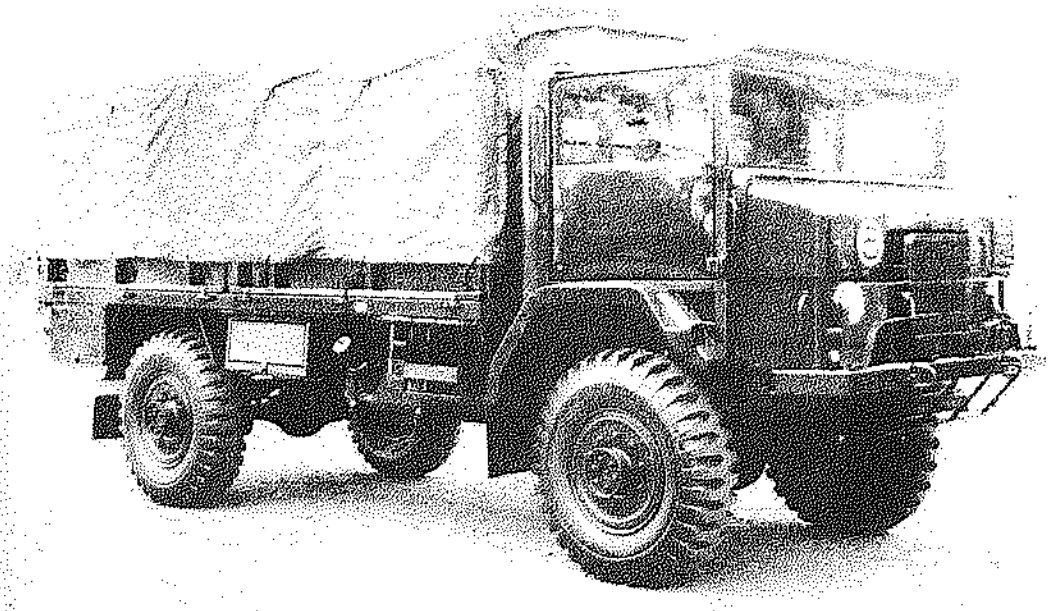
It's object is to provide all technical information required to ensure proper maintenance, lubrication, repair and overhaul, the emphasis being placed on the needs of workshop personnel, rather than on operational instructions.

For speedy reference, it has been sectionised into the various groups, prominently featuring a list of contents and a list of specifications and technical data for each section.

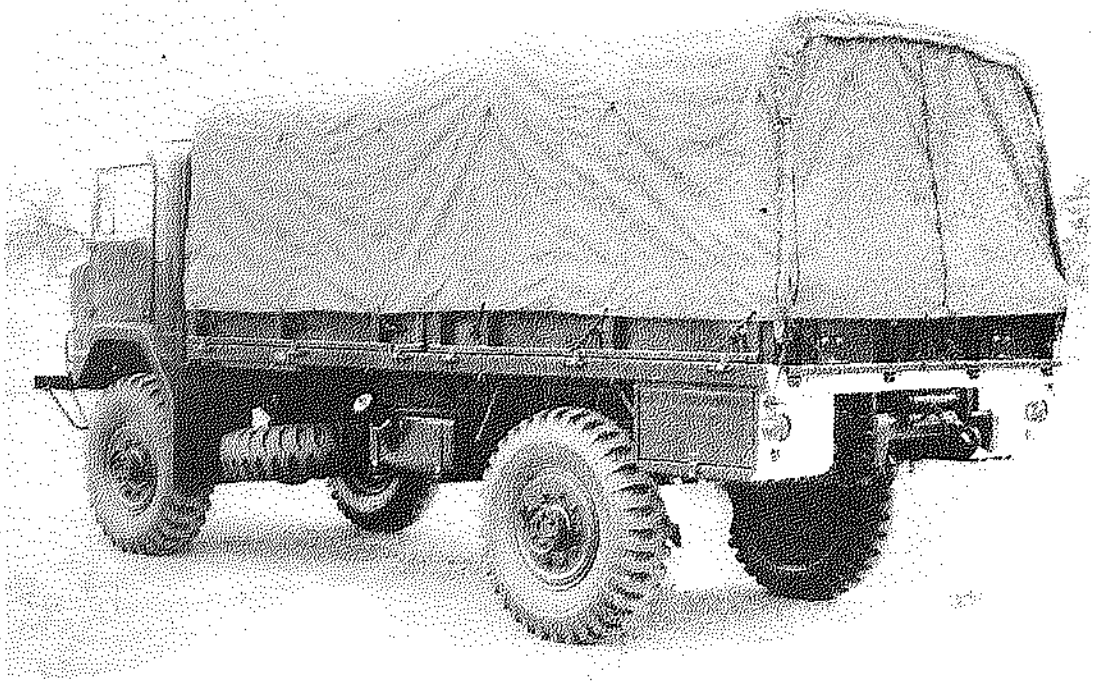
Where reference is made to the left or right hand side of the vehicle, the view is taken from rear to front in all cases, unless otherwise stated.

Revision No. 2

SECTION INDEX



Truck, Cargo, 2-1/2 Ton, Aust., No. 1, Mk 3
(International)



Truck, Cargo, 2-1/2 Ton, Aust., No. 1, Mk 3
(International)

TORQUE WRENCH LOADING - ENGINE

SIZE AND THREAD	NAME OF ASSEMBLY	RECOMMENDED WRENCH TORQUE LOAD. FT.-LB.
5/16-18	Generator strap to generator	14-16
5/16-18	Water outlet	8-10
5/16-18	Coil bracket to cylinder head	14-16
5/16-18	Fuel pump to crankcase	8-10
5/16-18	Oil pan to crankcase	14-16
5/16-18	Distributor Adaptor to Crankcase	14-16
5/16-18	Oil pump cover to body	14-16
5/16-18	Vibration damper to pulley	16-18
5/16-18	Oil pump body to crankcase	14-16
5/16-18	Cylinder head cover	14-16
5/16-24	Generator mounting	8-10
3/8-16	Clutch to flywheel	20-25
3/8-16	Manifold to cylinder head	25-30
3/8-16	Engine support bracket to crankcase	25-30
3/8-16	Generator bracket to crankcase	25-30
3/8-16	Intake to exhaust manifold	25-30
3/8-16	Water pump to crankcase	25-30
3/8-16	Gear case cover to crankcase	25-30
3/8-16	Camshaft thrust flange	25-30
3/8-16	Front plate to crankcase	25-30
3/8-16	Oil filter to crankcase	22-26
3/8-24	Connecting rod bolt	45-55
3/8-24	Carburettor to manifold	23-28
3/8-24	Intake to exhaust manifold	23-28
5/16-24	Gear case cover to plate	9-11
7/16-14	Flywheel housing	45-50
7/16-14	Oil pressure relief valve	30-40
7/16-20	Flywheel to crankshaft	70-80
1/2-20	Stud cylinder head	5
1/2-20	Nut cylinder head stud	85-95
1/2-13	Starting motor to flywheel housing	75-85
1/2-13	Cylinder head capscrew	85-95
1/2-13	Crankshaft bearing bolt	75-85
1/2-13	Engine rear mounting	70-80
1-14	Starting crank nut	90-100
1-20	Camshaft lock nut	110-120
14 MM	Spark plug (in cast iron)	15-18

TORQUE WRENCH LOADINGS - CHASSIS

	RECOMMENDED WRENCH TORQUE LOAD. FT.-LB.
Springs, front	
Nut, shackle pin	50-60
Nut, U-bolt	180-200
Springs, rear	
Nut, shackle pin	50-60
Nut, U-bolt	180-200
Wheels, front and rear	
Nut, wheel to hub	300-320
Steering	
Gearbox to bracket	85-95
Pitman arm to sector shaft	145-155
Tie rod end clamp bolts	50-70
Ball stud to arm double	95-105
Tie rod ball stud to arm	80-90
Axle, rear	
Companion flange to pinion shaft	280-300
Axle shaft to hub flange	150-160
Axle, front	
Companion flange to pinion shaft	280-300
Axle shaft outer to flange	150-160
Stub axle flange bolts	25-35
King pin cap nuts	85-95
Flange bolts tracta bell housing	70-80

OPERATION

Break-in

Your International engine must be properly broken in before maximum performance is demanded of it. A new engine, given an opportunity to wear-fit its parts by following the proper break-in procedure, will give smoother and quieter operation with greater economy and longer life.

For the first 500 miles, hold the vehicle speed below 40 m.p.h. Do not over-speed the engine to high r.p.m., and avoid lugging the engine at any time.

Consistent low speed driving (10 to 25 m.p.h.) during the first 500 miles of operation is not recommended nor is it the proper way to break-in a new engine. Although prolonged speeds in excess of 40 m.p.h. should be avoided for the first 500 miles, occasional acceleration up to 40 m.p.h. will materially assist engine break-in.

After the vehicle has been driven 500 miles occasional acceleration up to the governed or legal limit is permissible and desired. However your International must not be operated at top speed or full throttle for prolonged periods until it has been driven at least 1,000 miles.

Your new truck engine is filled at the factory with SAE-30 viscosity engine oil. This break-in oil and Oil Filter Cartridge must be changed at the 500 mile (or 30 day) inspection period. Refill the engine with oil of the proper viscosity as OUTLINED UNDER LUBRICATION INSTRUCTIONS IN THIS MANUAL.

SPECIAL TOOLS SUPPLIED BY THE MANUFACTURER ARE AS FOLLOWS

WRENCH, wheel nut

HANDLE, wheel nut wrench

WRENCH, (box), wheel bearing nut

HANDLE, wrench, wheel bearing nut

DIPSTICK, fuel

CRANK, starting, assembly

HOSE, inflating tyre assembly

The lubrication diagram Fig. 1, Page 4, shows the location of all main points of lubrication by means of ringed numerals, which correspond with the numerals shown in the following paragraphs.

1. Engine Oil Level: Check crankcase oil level daily to see that the level is maintained between the "full" and "low" marks on the dipstick.

2. Oil Changing: The correct quantity of oil to fill a dry engine is 17 pints (imp.) This will give a reading above the "full" mark until the engine has been run and oil is trapped in the oil cooler and the full flow filter.

When normal periodical oil changes are carried out, it is necessary to drain the oil cooler also, but do not drain the full flow filter. An oil change on this basis will require 14-1/2 pints, as the filter will retain 2-1/2 pints as it does not drain with the crankcase.

Engine oil should first be changed after 500 miles, and thereafter periodical changes will depend largely upon the kind of operation the engine is subjected to. Based on normal highway operation the crankcase and oil cooler should be drained and refilled every 2,000 miles maximum. For field work in 4 wheel drive or winching operations, changes should be based either on hours run or quantity of fuel consumed. For instance on winching operation 60 hours running would be approximately equal to 2,000 miles of highway running and for mixed operations including 4 wheel drive, winching and highway, a consumption of 250 gallons of fuel would be similarly equivalent. Actually oil changes cannot be firmly laid down for definite periods, the only true indication being the state of the oil itself as regards contamination, dilution, sludge formation, etc. In cold weather conditions, changes should be more frequent due to condensation of moisture. The recommended mileages quoted in this chapter therefore are to be used as a guide rather than a rule.

2. Full Flow Filter: The filter element should be renewed every 10,000 miles maximum highway operation. When installing a new element be sure to discard all gaskets and seals and fit all new gaskets as supplied with the new element kit. At this time, thoroughly clean the filter canister.

3. Crankcase Ventilator Air Cleaner: At the time of crankcase oil change, remove and wash the air cleaner element in solvent, drain off and refit, do not oil.

IMPORTANT: Do not operate this vehicle when the oil level is outside the working range shown on the dipstick. For trucks in multi-stop, or other services where sustained high engine speeds are not encountered select oil grade as follows:-

Engine Oil must conform to Spec. MS or MIL-L-2014A

Temperatures	Oil Grade	Temperatures	Oil Grade
90 deg. F and up	SAE-40	10 deg. F to 32 deg. F	SAE-20W
32 deg. F to 90 deg. F	SAE-30 (OMD-110)	-10 deg. F to 10 deg. F	SAE-10W (OMD-40 or 60)

Change oil every 2,000 miles.

Hot Climate - High Speed: For trucks operating on highway, or other service demanding sustained high engine speeds, use engine oil having a viscosity as near SAE-40 as possible and as starting ability will permit. NOTE: High viscosity oils are available which also have very good cold pour characteristics.

4. Battery: Check water level. If necessary, add pure distilled water to 3/8" above plates. Do not overfill. Coat terminals with petroleum jelly or cup grease.

5. Clutch and Brake Master Cylinder Fluid Reservoirs: The clutch control fluid reservoir is located in the right hand front compartment. The brake fluid reservoir is incorporated in the master cylinder of the air/hydraulic actuator mounted on the R.H. chassis rail. Check fluid levels. Do not allow dirt to enter. Fill to 3/4 inch from top of filler orifices with brake fluid which conforms to SAE-70-R3 specification (OX 9 Aust.)

6. Engine Air Cleaner: Remove filter element. Wash in kerosene. Clean out oil sump and refill to indicated level with clean engine oil, same grade as used in crankcase. Reassemble. 2,000 maximum mileage.

7. Air Receiver: Drain. In extreme conditions once daily may be necessary.

8. Clutch Release Fork Shaft: Do not over lubricate. Too much oil on clutch shaft can cause failure of clutch lining. Use XG-279 oil. Every 1,000 miles.

9. Parking Brake and Linkage: Lubricate all linkage, clevis pins, pivot pins and sliding surfaces with engine oil. Every 1,000 miles.

10. Spring Pins, Drag Link and Tie Rod Ends:
Winch and Pulleys:
Transfer Case Control Lever Mounting:
Power Take-Off Relay Tube:
Tow Hook:
Hand Brake Relay Levers:
Transmission Control Linkage:
Force a XG-279 lubricant into fittings until old lubricant, dirt and water are expelled. Every 1,000 to 2,000 miles.

Brake Bellcrank:
Brake Compensator:
Brake bellcrank is located on underside of cab. Compensator located on rear axle differential housing.

Auxiliary Spring Pads: Apply a coating of XG-279 lubricant, every 1,000 to 2,000 miles.

Transmission Control Lever Mounting: Remove screw cap and apply XG-279 lubricant to ball joint, every 2,000 miles.

11. Generator: Inject small quantity of engine oil into oiling hole in commutator end bracket bearing housing, every 6000 miles or 6 months whichever comes first.

12. Carburettor Linkage:
Door Hinges:
Door Latch:
Transfer Case Control Linkage:
Power Take-Off Linkage:
Lubricate linkage, clevis pins, pivot pins and sliding surfaces with engine oil. Put a suitable lubricant on door latches, every 500 to 1,000 miles.

13. Differential Rear. Transmission. Steering Gear: Inspect oil level every 1,000 miles and keep up to filler plug, using recommended oil.

Drain and flush twice yearly or every 10,000 miles preferably in the spring and autumn.

Use SAE-90 or OM-270 straight mineral oil in transmission and SCL oil SAE-90 or OEP-600 in differential and steering gear at temperatures above 32 deg. F.

14. Front Axle, Tracta Joints Differential: Keep filled to level plug with SCL oil SAE-90 or OEP-600. Drain and refill differential as for rear axle.

15. Propellor Shaft Sliding Joints: Use a XG-279 lubricant. Force a small amount into joint. NOTE: Too much pressure will damage oil seal and retainer. Every 1,000 to 2,000 miles.

16. Distributor: Take great care to prevent oil or grease from getting on or near contacts. Smear the cam and pivot on which the contact breaker works with vaseline. Remove rotor arm and apply a few drops of thin machine oil to the spindle to lubricate cam bearings, every 3,000 miles. Fill the oil cup mounted on the side of the distributor with similar oil at the same time.

17. **Front Wheel Bearings: Rear Wheel Bearings:** Remove wheels, clean and inspect bearings, races and wheel hubs. Repack bearings, using XG-279 grease. Replace wheels and adjust bearings, every 10,000 miles.

18. **Window Regulator:** Remove door panel and lubricate regulator slide. Use a XG-279 lubricant, every 15,000 to 20,000 miles.

19. **Propellor Shaft Universal Joint:** Use XG-279 grease. Use low pressure or hand grease gun to prevent damage to seals. Every 3,000 to 5,000 miles.

20. **Speedometer Cable:** Apply a thin coat of graphite impregnated non-hardening grease over the cable core, every 15,000 to 20,000 miles, as described in section P2, Page 5, instruments flexible drives.

21. **Clutch Release Sleeve and Fork:** With low pressure gun, completely fill the sleeve cavity with short fibre wheel bearing grease. At the same time lubricate the release fork contact pads, every 15,000 to 20,000 miles.

22. **Transfer Case:** Drain and refill every 2,000 miles, with OM-270 oil. NOTE: Inspect oil level every 1,000 miles and top up with same oil as already in the case. If same oil is not available, drain and refill.

23. **Winch:** Drain and refill every 5,000 miles, with OM-270 oil in temperatures above 20 deg. F.

Lubricant Capacities

	Imp. Pints	Lubricant Grades
Engine Dry	17	OMD-110 oil normal service
Drain and Refill	14-1/2	SAE-40 heavy service
NOTE: Engine oil filter does not drain into crankcase and holds 2-1/2 pints.		
Transmission	10	OM-270 oil
Transfer Case	13-1/2	OM-270 oil
Rear Axle Differential	7.9	SCL oil SAE-90 EP or OEP-600 above 32 deg. F.
Front Axle Differential	7.9	
Tracta Joints	3/4	OEP-600 above 32 deg. F.
Steering Box	2.9	SCL oil SAE-90 EP or OEP-600 above 32 deg. F.

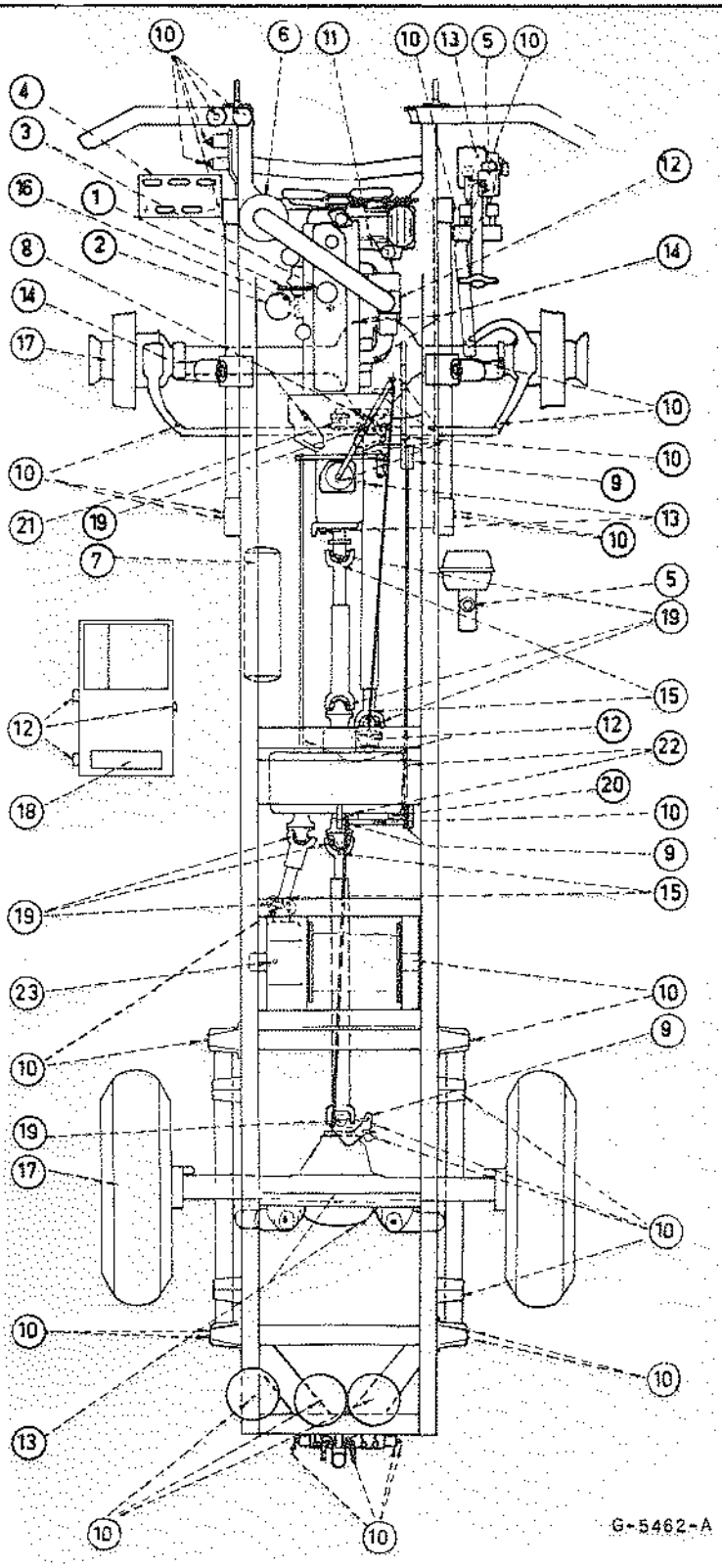


Fig. 1 - Chassis Lubrication Diagram

C

2-1/2 TON 4x4 G.S. - INTERNATIONAL

WHEELS

Type ..... Disc 10 stud

Rim Size ..... B 8.00 x 20 in. dia.

Rim Type ..... 3 piece flat base with detachable side rim and locking ring

Stud Diameter ..... 1 inch

Thread ..... 7/8 - 14 U.N.F. (rolled)

TYRES

Size ..... 12.00 x 20 - 12 ply (non-directional)

Valve TR-175-G13

INFLATION PRESSURE		Highway	Cross Country	Sand
Pounds/sq. in.	FRONT	52	34	24
	REAR	66	44	34

WHEELS

The wheels are of the pressed steel disc type having flat base rims with detachable side non split rim which is secured by a split locking ring. The wheels are attached to the hubs by 10 studs and nuts, the nuts being of the tapered face type. Both right and left sides have right hand threads.

INSPECTION

Mounting faces of the hub, wheel and nuts must be free from dirt or excess paint. Mounting faces which have been damaged from wear or abuse must be repaired or replaced.

When fitting wheels, the nuts should be tightened up alternatively to ensure that the wheels are drawn up to the driving flanges squarely.

Check for wheel run out at the rim flanges for lateral run out and at the tyre seats for radial run out. Run out in excess of 1/8 inch must be rectified by repair or replacement.

On new vehicles or when a wheel has been removed, check the tightness of the wheel nuts daily for the first 500 miles. The recommended torque wrench loading of the wheel nuts is 300-320 ft. lbs.

TYRES

The 12.00 x 20 - 12 ply tyres are of the non-directional type.

Inflation:

For normal road operation with a vehicle loaded to capacity, the recommended tyre inflation pressure is Front 52 and Rear 66.

Pressures should be checked regularly to maintain correct pressures. Normally, weekly checks are sufficient.

Warning:

Do not reduce tyre pressures which have increased in operation due to heat, but always check and adjust pressures when tyres are at normal atmospheric temperatures. Always see that tyre valves are equipped with valve caps which not only exclude dust etc. from the valve core, but provide a positive air tight seal.

Tyre Removal:

Deflate the tyre fully by removing the valve core. Prise the split locking ring out of the rim groove and remove the detachable side rim. The tyre and tube assembly can then be removed.

For rim removal use the tool provided, which has a specially shaped end for insertion under the end of the rim locking ring.

WHEEL BEARINGS

Wheel bearings should be inspected at least every 5,000 miles. To disassemble the rear hub bearings, jack the wheel clear of the ground, remove the axle shaft driving flange nuts, take off the sling ring and by means of two draw bolts (1/2 - 13 NC thread) withdraw the shaft. Referring to Fig. 1, unlock the locking tab securing the outer nut and seal assembly 1, and by means of the special box spanner provided remove the nut. The tab washer 2, can now be removed. With the box spanner remove the inner nut 3, and note that the raised shoulder is assembled outwards away from the bearing. It is important to reassemble this nut in the same way, because its inner face is machined square with the threads to ensure a square seating against the bearing cone.

WHEEL BEARINGS Continued;

By rocking the wheel or hub the outer bearing cone will be loosened for removal. It is preferable to have the wheel removed from the hub but not essential, provided care is taken in removing the hub, not to damage the oil seal located in the inner end of the hub. If removing wheel and hub together it is a good idea to place a slipping board under the tyre and let the jack down sufficiently to take some of the weight on the board then slide the hub off the axle.

Thoroughly clean parts and examine the bearings for score marks, roughness pitting, etc., and replace if any fault is revealed.

Reassembly:

Press the bearing cups into the hub until they abut against the shoulders in the hub and place the inner bearing cone in position with a smear of grease. Next, install the oil seal 9, preferably using a special spigoted driver to avoid damage to the seal. The lip of the seal must be toward the bearing.

Now pack with grease the space between the bearings and carefully slide the hub onto the axle, again taking care not to damage the oil seal. Smear the outer cone with grease and slide into place.

Assemble the inner bearing adjusting nut *FLAT SIDE INWARDS AGAINST BEARING* and tighten it up with the special box spanner, at the same time revolving the hub until a slight resistance is felt in the bearings, then slack the nut off about 1/6 of a turn. Assemble the locking washer if in good condition and screw on the outer nut to jam the washer in place and tighten securely. Before locking the outer nut recheck the bearing adjustment which should spin freely but have only the slightest perceptible rock. Readjust if necessary and lock the outer nut by bending over one of the unused tabs.

Assemble the sling ring and axle shaft and tighten up the nuts to the torque reading shown in the list in Section "A".

Refer to lubrication Section "B".

For instructions on front wheel bearings refer to front axle Section "E".

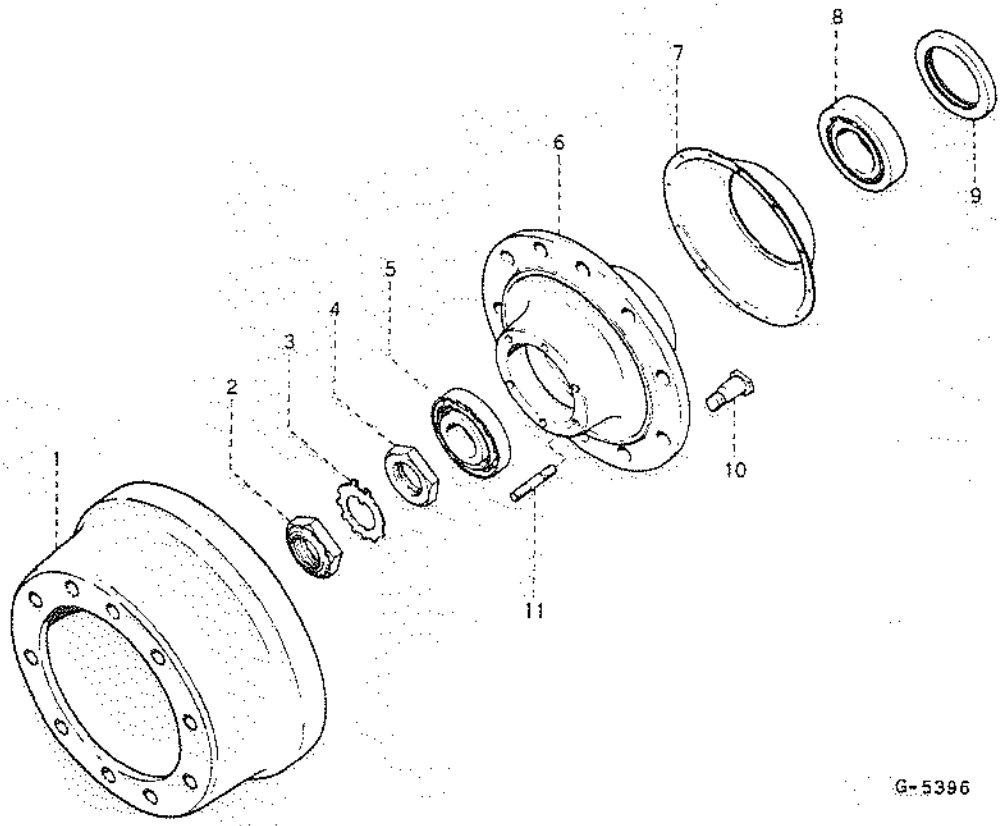


Fig. 1 - Rear Wheel Bearing Assembly

LEGEND - FIG. 1

1. DRUM, brake
2. NUT and SEAL, wheel bearing adjusting
3. LOCK, wheel bearing inner nut
4. NUT, inner, wheel bearing
5. BEARING, outer
6. HUB
7. TRAP, grease
8. BEARING, inner
9. SEAL, oil
10. STUD, wheel
11. STUD, driving flange

D

1. The vehicle is equipped with Girling 15-1/4 diameter x 4-1/4 brakes, of the two leading shoe type, hydraulically actuated on both front and rear wheels.

2. By means of air pressure controlled by the brake valve, the brakes are applied hydraulically by means of air/hydraulic actuator unit mounted on the right hand side of the chassis frame.

3. The front wheel brake cylinders are of the pusher type, and the rear cylinders of the puller type, with over-riding mechanical hand brake linkage.

4. The vehicle is fitted with compressed air equipment for the operation of trailer brakes, and for applying the hydraulic brakes of the vehicle itself, as shown in paragraph 2.

5. When the hydraulic brakes are applied on the vehicle a special hydraulically operated air valve automatically applies the trailer brakes. In addition the trailer brakes can be applied independently by a hand control valve mounted on the steering column.

6. This section is sub-divided as follows:-

D-1 POWER BRAKE UNIT - AIR/HYDRAULIC ACTUATOR

D-2 HYDRAULIC BRAKE SYSTEM

D-3 AIR COMPRESSOR

D-4 AIR BRAKE SYSTEM

D-5 HAND BRAKE LINKAGE

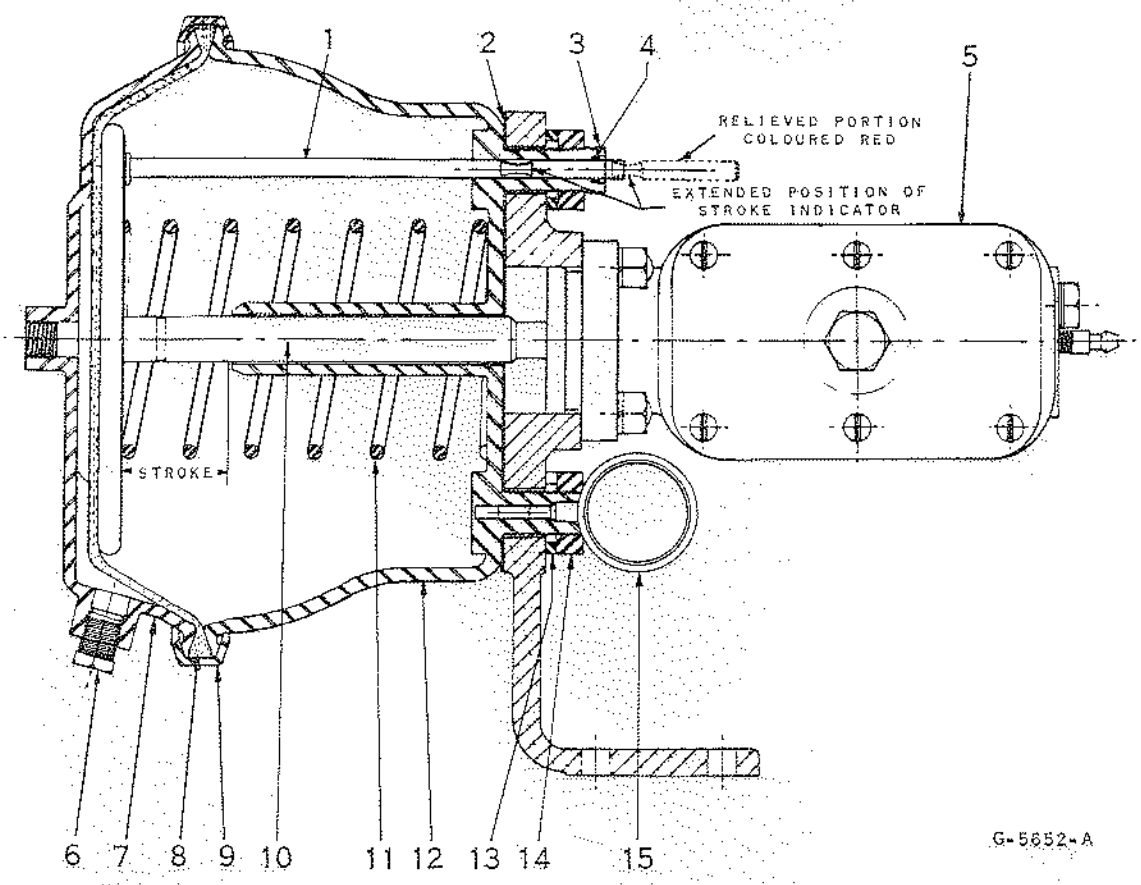


Fig. 1 - Actuator and Master Cylinder Unit

1. Stroke Indicator
2. Shims
3. Bolt
4. "O" Ring
5. Master Cylinder
6. Plug
7. Pressure Plate
8. Diaphragm
9. Clamp
10. Push Rod and Plate Asm.
11. Diaphragm Spring
12. Non Pressure Plate
13. Lock Washer
14. Nut
15. Breather

AIR HYDRAULIC ACTUATORS

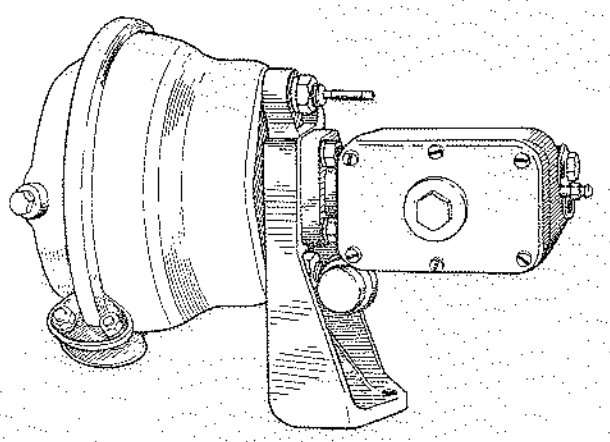
DESCRIPTION

Air-Hydraulic Actuators are a special form of brake chamber for actuating a hydraulic master cylinder. The brake chamber is mounted by means of bolts (3) (integral with the brake chamber non pressure plate) (12) and nuts to a cast aluminium mounting bracket. Steel shims (2) are located between the brake chamber and mounting bracket to allow clearance between the end of the push rod (10) and the master cylinder (5).

The master cylinder is secured to the common bracket by means of studs and nuts.

To prevent entry of dirt and water to the non pressure side of the brake chamber and to the piston of the master cylinder, one brake chamber mounting stud is tapped and a breather (15) fitted. All other openings to the non pressure side are sealed. A stroke indicator rod (1) is fitted through the other mounting stud, see figure 1 and 2.

The stroke indicator (1) (see figure 1) is not fixed in the brake chamber but is free to slide under pressure from the push rod push plate. An "O" Ring (4) is provided in the stud or bracket to keep out dirt and to provide friction to prevent the stroke indicator from moving under vibration.



G-6117

Fig. 2 - Air/Hydraulic Actuator Showing Stroke Indicator Fully Extended

OPERATION

Compressed air enters the chamber behind the diaphragm (6) and forces against the diaphragm which in turn moves the push rod forward, thus applying a thrust to the hydraulic master cylinder. The higher the air pressure admitted to the chamber, the greater the force applied to the hydraulic master cylinder. Conversely the lower the air pressure, the lesser the force applied to the hydraulic cylinder. When air pressure is released from the brake chamber the push rod return spring (11) in combination with the hydraulic master cylinder spring and brake shoe return springs returns the diaphragm and push rod assembly to their released positions releasing the brakes.

The stroke indicator (1) moves under pressure from the brake chamber push rod push plate and will project from the mounting stud, or bracket, according to the stroke of the brake chamber. It will stay in this position upon release of the brakes. As the brake linings and other wear takes place the stroke of the brake chamber increases and the stroke indicator will move further out from the stud or bracket. When the relieved portion of the stroke indicator (see figures 1 and 2) shows from the stud or bracket, it indicates that the brakes need adjustment, if the full relieved portion of the indicator shows, the brakes must be adjusted as the full brake chamber travel has been reached. If the brakes are not re-adjusted at this stage the brake chamber push plate will contact the stop built into the brake chamber and the brakes will NOT apply. This stop is provided to prevent the master cylinder reaching its full stroke. If this could occur considerable damage would be done to the master cylinder.

PREVENTIVE MAINTENANCE

1. Every month or after 2,000 miles depending on type of operation.

   (a) Check the mechanism actuated by the hydraulic master cylinder to ensure that all movement is kept to a minimum. Excessive travel will increase the stroke of the chamber push rod. Maximum travel should never be permitted, for in such cases all effective thrust to the master cylinder will be lost.

   (b) Check the stroke indicator rod. With no air in the brake chamber push the stroke indicator right in by hand. Apply the brakes and observe the travel of the indicator rod. If the relieved section on the indicator rod (the relieved section is also painted red) shows, the brakes must be adjusted.

2. Every year or after each 50,000 miles again depending on the type of operation.

   (a) Disassemble brake chamber and clean all parts.

   (b) Install new diaphragm or any other rubber parts, if they are worn or deteriorated. Install new spring if necessary.

LEAKAGE

With a full pressure application, check the brake chamber for leakage. No leakage is permissable. If leakage is detected around the flange, or clamping ring, the bolts should be tightened evenly, but only enough to stop the leakage, otherwise, the diaphragm, flange sealing surface or clamping ring could be distorted.

REMOVING

Release all air pressure from the system.

Disconnect the air line to the brake chamber.

Disconnect hydraulic lines to the master cylinder.

Unscrew the nuts holding the bracket to the chassis.

To remove brake chamber from bracket firstly remove breather. Unscrew two nuts (14) from the chamber mounting studs, remove the chamber and shims between the chamber and bracket, taking care to retain them for re-assembly.

To remove master cylinder remove three nuts from the studs in the mounting bracket.

DISASSEMBLY

After cleaning the exterior of the brake chamber, mark it in such a way that it can be assembled in the same way. IMPORTANT. Never permit the diaphragm to come in contact with hydraulic fluid or cleaning solvents.

Pull out push rod far enough to clamp it at the non pressure plate end with a vice or vice grip pliers to relieve the tension of the spring on the diaphragm. Remove clamp ring bolts and nuts.

Spread clamp slightly, just enough to slip it off the plates. It is sometimes necessary to use a screw driver and gradually pry under the clamp ring to remove it. If the clamp ring is to be reused, caution should be taken against bending it out of shape.

Remove pressure plate and diaphragms.

Release grip on push rod.

Remove push rod assembly, spring and indicator rod.

ASSEMBLY

BRAKE CHAMBER

Slide stroke indicator rod through mounting stud.

Stand push rod assembly upright on a flat surface.

Position return spring and non-pressure plate on push rod.

Press the non-pressure plate down against the tension of the spring until the plate bottoms on the flat surface.

Now clamp the push rod at the non-pressure plate in a vice or with vice grip pliers whose grips have been taped or covered. With the push rod held in this manner, place the clamp ring over the clamping surface of the non-pressure plate.

Next, position diaphragm in pressure plate and join the two with the non-pressure plate by working the clamp ring over the clamping surface of the pressure plate with the use of vice grip pliers of like tool drawing the clamp lugs together.

Assemble bolt and nut in clamp. It is sometimes necessary to tap the clamping ring to centre it, and this should be done only with a soft faced mallet.

Release hold on push rod and install remaining clamp ring nut and bolt. Tighten the clamp ring nuts and bolts evenly and only sufficiently to eliminate leakage.

ACTUATOR UNIT

1. Fit master cylinder to bracket.

2. Using a depth gauge, measure the depth from the brake chamber side of the bracket to the bottom of the push rod hole in the master cylinder.

3. Leaving the depth gauge set, place it on the end of brake chamber push rod and note the distance between the end of the depth gauge and the mounting face of the brake chamber.

4. Calculate the number of shims required to make up this difference, adding one extra shim if necessary to maintain a minimum clearance of 1/32" between the end of the push rod and the bottom of the bore in the master cylinder piston.

   NOTE: Shims are .032" thick.

5. Place the shims over the brake chamber push rod and mounting studs.

6. Fit brake chamber to mounting bracket ensuring that mounting nuts are tight.

7. Fit elbow and breather.

INSTALLING

1. Fit actuator unit on chassis.

2. Connect air and hydraulic lines.

3. Remove the filler cap and top up to within half an inch below the bottom of the filler cap orifice with clean Lockheed Super Heavy Duty Fluid to Spec. SAE70R3. Replace the filler cap and the gasket, bleed the system and check for leakage by applying a firm pressure to the brake pedal and inspecting the "lines" and connections.

2-1/2 TON 4x4 G.S. - INTERNATIONAL

Air/Hydraulic Actuator	Westinghouse
Type	Air Over Hydraulic Combination
Cylinder Bore Size - Inches	1-1/2
Wheel Cylinders - Make	Girling
Type (Front)	Push
(Rear)	Pull

ESSENTIAL PRECAUTIONS

1. Use only brake fluid which conforms to SAE-70-R3 or OX9 Aust. specifications.

2. ALWAYS excercise extreme cleanliness when dealing with any parts of the hydraulic system.

3. NEVER allow mineral oil in any form to touch any hydraulic part. NEVER handle parts with greasy hands. NEVER clean any parts with petrol, kerosene, paraffin or trichlorethylene, ALWAYS use clean brake fluid or alcohol, for cleaning purposes.

4. When a brake system has become contaminated with mineral oil, master cylinders and slave cylinders MUST be stripped down, the metal parts thoroughly washed in clean fluid or alcohol and new seals and gaskets fitted. The pipe lines MUST be similarly flushed out, and rubber hoses replaced by new.

5. ALWAYS take care not to scratch the highly finished surfaces of the pistons or cylinder bores.

6. ALWAYS take the opportunity when overhauling hydraulic cylinders to replace seals and dust covers. Service kits are designed for this purpose.

7. ALWAYS smear the protective rubber boots with a suitable rubber grease obtainable in collapsible tubes.

8. NEVER put dirty fluid back into the fluid reservoir. ALWAYS use clean non-aerated fluid for purpose of bleeding the hydraulic system.

BRAKE SHOE OPERATION

The brake groups consist of a torque plate onto which is mounted an aluminium bronze expander unit and shoe adjuster unit. Being a full two leading shoe brake, each shoe which has twin ribs is provided with a steel pencil strut and a pair of bell cranks. The shoes are not fixed pivoted, but are allowed to slide on the radiused ends.

The aluminium bronze expander unit shown in Fig. 1 is spigoted to the torque plate. Internally the units consist of a hardened steel expander plunger, in which is located the expander insert, held in position by a pin.

On the rear units a draw link is attached to the expander plunger to provide a means of attachment to the hand brake linkage.

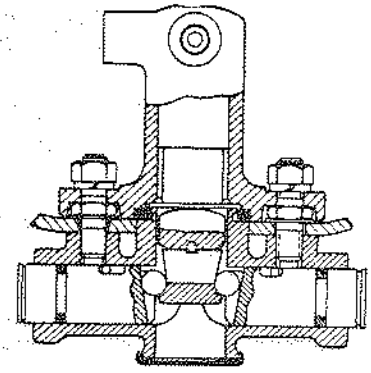
On the front units, being the push type and having no hand brake application the hydraulic plunger butts against the expander plunger.

Two inclined faced hardened steel shoe tappets are positioned at each end of the housing and between these tappets and the expander insert are hardened steel rollers, to reduce friction losses to a minimum. A metal dust cap is provided on the housing to exclude dust, etc. and two split pins located at the two ends of the housing to prevent the tappets from falling out when the brake shoes are removed. To ensure ease of operation, the expander unit should be packed with Girling Brake Grease.

The adjuster housing (Fig. 2), like the expander, is made from aluminium bronze and is spigoted and bolted firmly to the backplate, a hardened steel wedge is employed with a screwed adjuster stem being rotable within the wedge, which itself does not rotate, but moves at right angles to the two inclined faced tappets. These latter are again made from hardened steel and are inclined, to correspond to the angle of the wedge. The screwed adjuster stem is provided with a rolled steel dust cap, which protects the thread throughout the full movement of the stem. In order for a spanner to be used for adjustment purposes, the external end of the stem is machined with four flats. So that accurate adjustment for each brake assembly is possible a clicker spring is located between the screwed stem and the wedge. A further metal dust cover is rolled onto the boss end of the adjuster housing.

NOTE: If it should be found necessary to remove the adjuster wedge or clicker spring, the metal dust cover on the housing must be removed by prising off. The adjuster stem is then screwed inwards until the two locating pins of the wedge can be shaken out. With the two pins removed, the wedge and clicker spring can be detached. To replace, fit the clicker spring onto the two flats provided on the stem and reassemble the adjuster wedge. Refit the two pins, screw the stem anti-clockwise and replace the dust cover by peening over.

It is extremely unlikely that the screwed adjuster stem should have to be removed but, if this is desired, it will be necessary to remove the steel dust cover which in some cases, is held onto the stem by a circlip. Where this clip is not employed, the cover is rolled onto the stem and, in order to remove, the cover will have to be prised off. To fit new cover, first slip it into place over the flats of the adjuster stem and, with a suitable piece of tubing, flatten the concave top so that it clips into the undercut on the stem just below the flats.



G-6067

Fig. 1 - Front Expander Unit and Hydraulic Cylinder

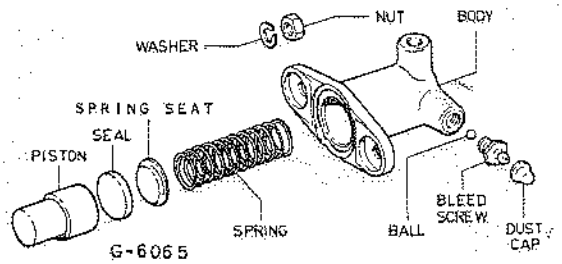


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Fig. 1A - Exploded view of Hydraulic Cylinder

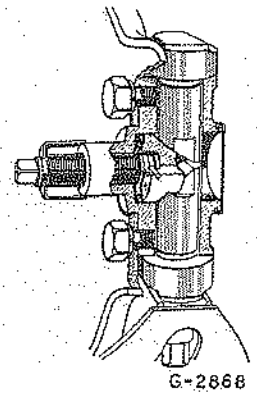

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Fig. 2 - Details of Girling Wedge Adjuster

FRONT WHEEL CYLINDER

Dismantling

To dismantle the front wheel cylinders disconnect the flexible hose, and remove the fixing nuts and washers, the cylinder can then be withdrawn from the studs. By shaking the cylinder or applying air pressure to the inlet, the piston can then be extracted together with seal, spring seat and spring. Examine the seal and replace if worn or damaged, clean the piston and housing with brake fluid.

Assembling

To reassemble, replace the seal retaining spring, and spring seat followed by the seal with the lips of seal inwards, be careful not to damage the seal when inserting. Replace the piston, large diameter first and fit the cylinder on to the studs and tighten securely. Refit the flexible hose to cylinder using a new copper washer. After this operation it will then be necessary to bleed the system.

REAR WHEEL CYLINDERS

Transverse Type

The transverse cylinders, Fig. 3, designed for rear brake operation, are bolted securely onto the reverse side of the torque plate. The body of the cylinder is made of cast iron, into which is assembled a piston, two rubber seals,

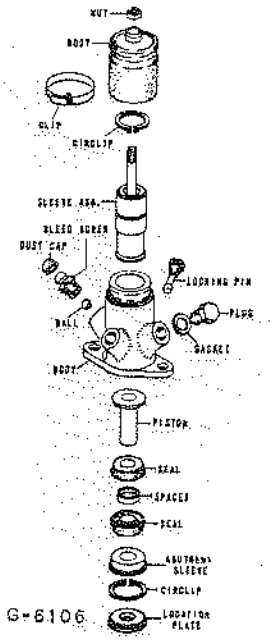


Fig. 3 - View showing component parts of Transverse Cylinder

separated by a distance piece, and a sleeve complete with slotted nut. A bleed valve is incorporated and a rubber boot is attached at the open end, being held in position by a metal clip. On one side of the cylinder body is a locating bolt, this, when in position, preventing the sleeve from turning and also acting as a stop.

Dismantling

Detach the hand brake rod from the rear compensator, unscrew the pipe union, remove the boot clip and boot, slacken the locating bolt and turn the sleeve assembly anti-clockwise until this can be removed. The cylinder body can then be detached from the torque plate when the two securing nuts and washers have been removed. Push out the piston from the flange end of the body, this will be removed complete with one seal. The distance piece and remaining seal is lifted out from the bore.

Check all parts for wear or distortion and replace if necessary. Clean all components with clean brake fluid. Under no circumstances must petrol, paraffin or trichlorethylene be used for this purpose.

Assembling

1. Before refitting the cylinder body to the torque plate, lock the shoes up in the drum by means of the adjuster.

2. With the draw link passing through the hole in the base of cylinder, refit the body to the torque plate, replace spring washers and nuts, securely tighten.

3. Assemble the piston with one seal, the back of which should be against the under side of the piston head, followed by the distance piece and then the remaining seal with lips facing piston head. Smear with clean brake fluid and insert into the bore, guiding the piston stem over the draw link and making sure the seals are not distorted in the process. When the piston assembly is correctly positioned, smear the sleeve assembly liberally with clean brake fluid and insert into the body.

By turning clockwise, screw the sleeve onto the draw link. When a resistance is felt and the sleeve can be turned no further, slack back so that the first flat of sleeve is opposite the locating bolt. Screw in the bolt. (NOTE: IT IS IMPORTANT THAT THE CORRECT SPRING WASHER IS USED UNDER THE HEAD OF THE LOCATING BOLT OR IF A LOCKING WIRE IS EMPLOYED A WASHER MUST NOT BE FITTED).

Pack the rubber boot with Wakefield Rubber Grease No. 3, fit and replace boot clip.

Reattach the transverse hand brake rod to the compensator and turn the shoe adjusters anti-clockwise until drums are again free.

BRAKE SHOE ASSEMBLIES (Fig. 4)

As the brakes are full two leading shoe, each twin ribbed shoe is provided with a solid steel strut and one pair of bell cranks, the latter being pivoted on bell crank pins, which are located at each end of the shoes. One arm of the bell cranks at the expander unit end of the shoes abut against the expander tappets, while the bell cranks at the opposite end of the shoes abut against the adjuster links. Between the inner arm of the bell cranks is located the steel strut through which is transferred the motion. On one arm of a bell crank on each shoe is carried an adjustable set screw which abuts against the head of the adjuster link or expander tappet.

Four shoe to shoe pull-off springs of equal tension are provided, these are hooked round the bell crank pins on the outside of the shoe ribs.

RUNNING ADJUSTMENTS

For normal rear brake adjustment, it is unnecessary to have the wheels clear of the ground, but, if a brake overhaul has been carried out this is advisable. By using a suitable spanner or key, turn the adjuster, (Fig. 2), stem in a clockwise direction until the shoes are locked in the drum, then turn the adjuster anti-clockwise two or three clicks, which are quite audible. The drum should then rotate freely. This procedure is again employed with the opposite wheel. It is advisable to apply the brakes hard two or three times in order to recentralise the shoes, then check again that each drum rotates without drag.

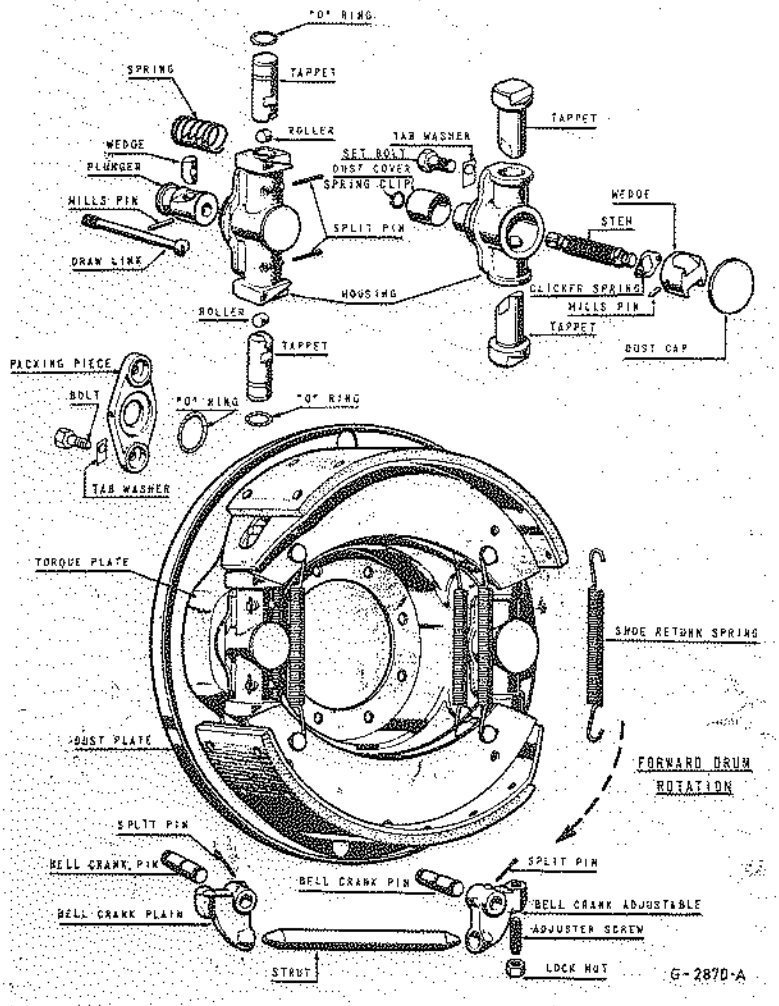


Fig. 4 - Exploded View of Heavy Duty Two Leading Shoe Brake (Expander Operated)

TO FIT REPLACEMENT SHOES, THE FOLLOWING INSTRUCTIONS SHOULD BE CAREFULLY FOLLOWED IN SEQUENCE OF OPERATION:-

1. Jack up the vehicle and remove road wheels.

2. Remove the brake drums.

3. Ease one shoe out of the registers of the adjuster link and expander tappet. Lift the shoe clear of the backplate when both shoes can be detached. Remove the four shoe return springs and push rods, together with bell cranks, from the shoes.

4. Clean down the backplate, check expander and adjuster units for easy working and turn the adjuster back (anti-clockwise) to the full "off" position. Lubricate with Girling Brake Grease.

5. Assemble each shoe with the pair of bell cranks and push rod, lubricating all moving parts. Fit new springs to the shoes and insert the two ends of one shoe into the expander tappet and adjuster link. Prise the other shoe onto its abutments.

The shoes must be fitted so that the hole for bell crank adjustment is at the leading end which is determined by the direction of normal rotation.

To reset the strut (Fig. 4), slacken off the adjuster screw lock nut and turn adjuster screw in the desired direction to ensure that there is no clearance between strut and bell cranks and yet no strain or pressure which might lift the shoe from the abutments.

It is always advisable, when fitting replacement shoes, that the hand brake transverse rods are disconnected from the rear compensator, this to ensure the expander plungers return to their full "off" position.

Refit the drums and road wheels. Lock the shoes up in the drum, reconnect the transverse rods and adjust as described in Section D-5.

MASTER CYLINDER (Refer Fig. 5 and Legend)

DESCRIPTION

The master cylinder consists of a body housing, a piston on the face of which a rubber cup is loaded by a spring, a piston washer is interposed between the cup and the piston to prevent the cup being drawn into the small holes around the piston head. At the end of the cylinder bore is a check valve which, when the brake pedal is depressed, opens to allow fluid to pass from the master cylinder to the brakes.

Upon relieving the brake pedal of its load, the spring returns the piston faster than the fluid (under the influence of the brake shoe pull off springs) is able to return from the brakes creating a vacuum which draws the edge of the main cup away from the piston head and allows fluid from the tank to flow through the small holes thus uncovered to make up the temporary deficiency. Fluid returning from the wheel cylinders lifts the check valve and re-enters the master cylinder.

When the piston reaches the end of its return stroke the by-pass port in the bore is uncovered and this allows the release of excess fluid to the fluid compartment (the by-pass port also allows full compensation for expansion or contraction of the fluid due to changes in temperature). If the excess fluid cannot be released, due either to the by-pass port being covered by the main cup as a result of incorrect pedal adjustment, or to the hole being choked by foreign matter, pressure will build up in the system and the brakes will drag.

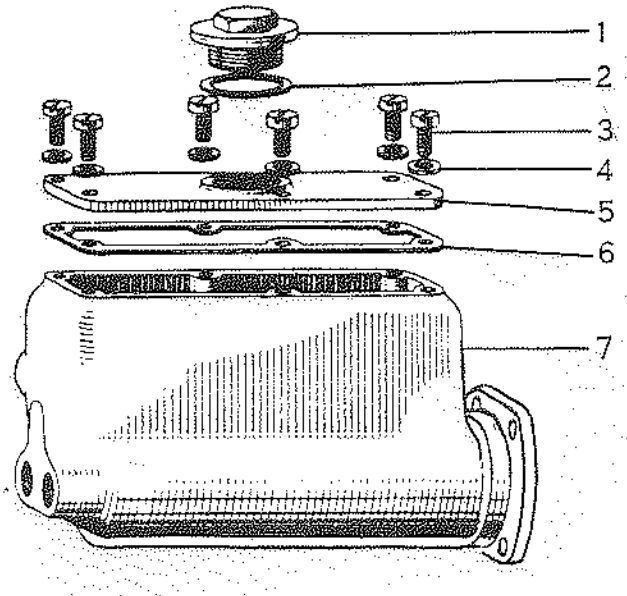
The purpose of the Check Valve is to prevent the return to the master cylinder of fluid pumped into the "line" during the "bleeding" operation; this ensures a fresh charge of fluid at each stroke at the pedal and a complete purge of air from the system.

DISMANTLING

1. Remove the tank cover and drain the fluid into a clean container.

2. Depress the piston to relieve the spring load. Remove the circlip, withdraw the piston and the rubber cup and shake out the loose internal parts.

3. Remove the secondary cup by stretching it over the head of the piston



1. FILLER, plug
2. GASKET
3. FIXING, screw
4. SPRING, washer
5. TANK, cover
6. GASKET
7. CYLINDER, barrel and tank
8. SPRING, circlip
9. STOP, washer
10. SECONDARY, cup
11. PISTON
12. PISTON, washer
13. MAIN, cup
14. SPRING, retainer
15. SPRING
16. VALVE, assembly

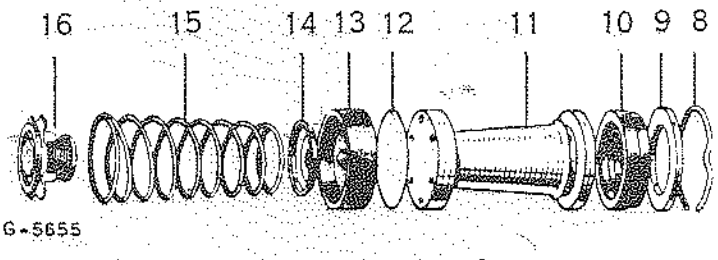


Fig. 5 - Master Cylinder

ASSEMBLING

The following procedure should be adopted to assemble the master cylinder, using new parts as required; it is usually advisable to renew all rubber parts.

1. Ease the secondary cup on the piston and into the groove, using the fingers only, so that the lip of the cup is towards the piston head, gently work the cup round the groove to ensure correct bedding.

2. Fit the check valve into one end of the return spring and the spring retainer on to the other end.

3. Insert the spring, valve innermost into the body and follow up with the main cup lip leading, ensuring that the lip is not turned back or buckled whilst the cup is entering the bore.

4. Insert the piston washer ensuring that its curved edge is towards the cup. Insert the piston, exercising caution to avoid turning back or damaging the lip of the secondary cup, push inwards to take the spring load and fit the piston stop and the circlip.

5. Fit the cover and a new gasket using the screws and the spring washers fill fluid compartment to within half an inch below the bottom of the filler cap orifice with clean Heavy Duty Brake Fluid to Spec. S.A.E. 70-R3 or OX-9. Fit the filler cap and the gasket.

Test the master cylinder by pushing the piston down the Bore. After one or two applications fluid should flow from the connections at the end of the bore.

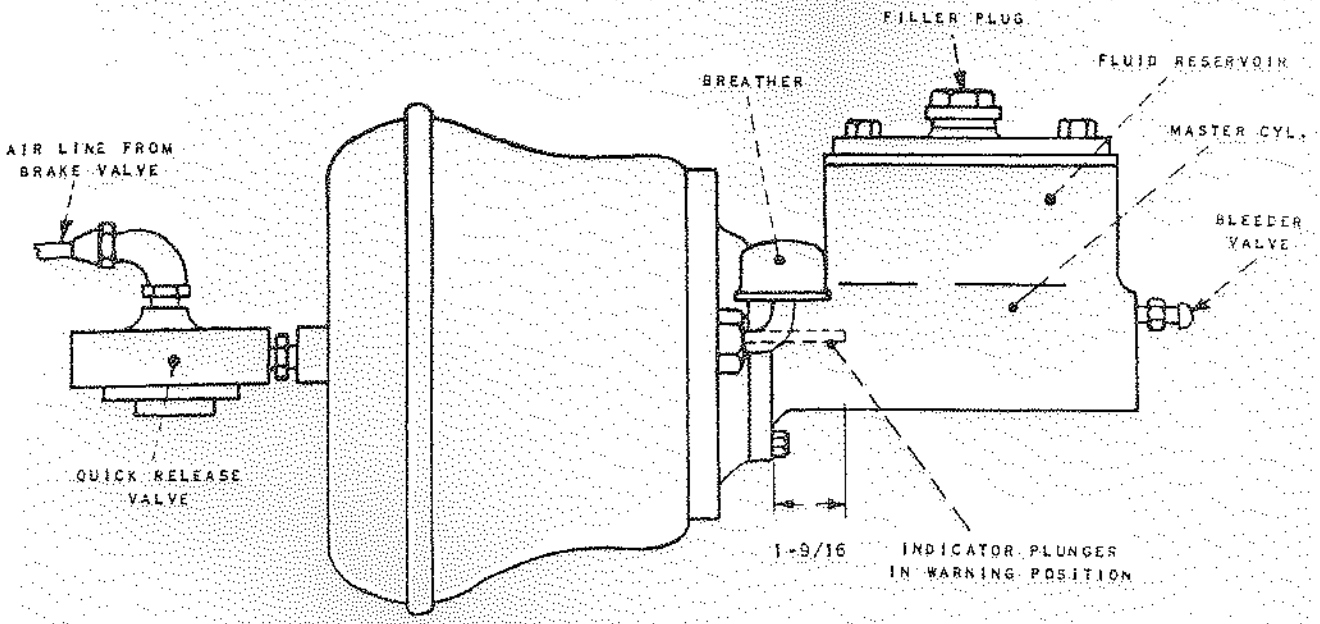


Fig. 6 - Air Hydraulic Actuator C-5569-A

BLEEDING THE HYDRAULIC SYSTEM (Refer Fig. 6)

Bleeding is necessary any time a portion of the hydraulic system has been disconnected, or if the level of the brake fluid has been allowed to fall so low that air has entered the master cylinder.

With all hydraulic connections secured and leak proof, remove the filler plug from the fluid reservoir and attach a pressure bleeding unit to the master cylinder.

Attach a bleeder tube to the master cylinder bleeder valve allowing the other end of the tube to hang into a glass container and submerged in clean brake fluid.

With the pressure in the bleeding equipment turned on, unscrew the bleeder valve about 3/4 of a turn and observe the fluid discharge from the tube. If bubbles appear in the flow, continue bleeding until these disappear then tighten the bleeder valve.

Now bleed each wheel cylinder in a similar manner preferably finishing with the wheel nearest to the master cylinder.

In the event no bleeding equipment is available have an assistant to apply the brake pedal just sufficient to actuate the master cylinder, and bleed the system as already outlined.

Always keep a careful check on the supply tank during this procedure, since it is most important that a full level is maintained. Should air reach the master cylinder from the reservoir, the whole of the bleeding operation will have to be recommenced.

After bleeding, top up the supply tank to its correct level of approximately three quarters full.

Never use fluid that has been bled from a brake system for topping up the supply tank, since this brake fluid may be to some extent aerated.

Great cleanliness is essential when dealing with any part of the hydraulic system and especially so where the brake fluid is concerned. Under no circumstances must dirty fluid be added to the system.

AIR COMPRESSOR (WESTINGHOUSE TU-FLO 400)

Number of cylinders	2
Bore (inches)	2-1/16
Stroke (inches)	1-1/2
Maximum speed for compressor	3000 r.p.m.
Piston to cylinder clearance	.002 - .004
Number of rings each piston	4
Ring gap in cylinder bore	.007 - .019
Ring fit in grooves:-	
Top	.0015 - .003
2nd	.0015 - .003
3rd	.0015 - .003
4th	.0015 - .003
Wrist pin to connecting rod bushing clearance	.0001 - .0006
Connecting rod bearing clearance	.0003 - .0021
Discharge valve travel	.036 - .058
Clearance between top of inlet valve seat and cylinder block	.101 - .113
Cooling	Air
Lubrication	Pressure Feed from Engine
Minimum Oil Pressure Required at Engine Idle Speed	5 p.s.i.
Minimum Oil Pressure at Maximum Governed Engine Speed	15 p.s.i.

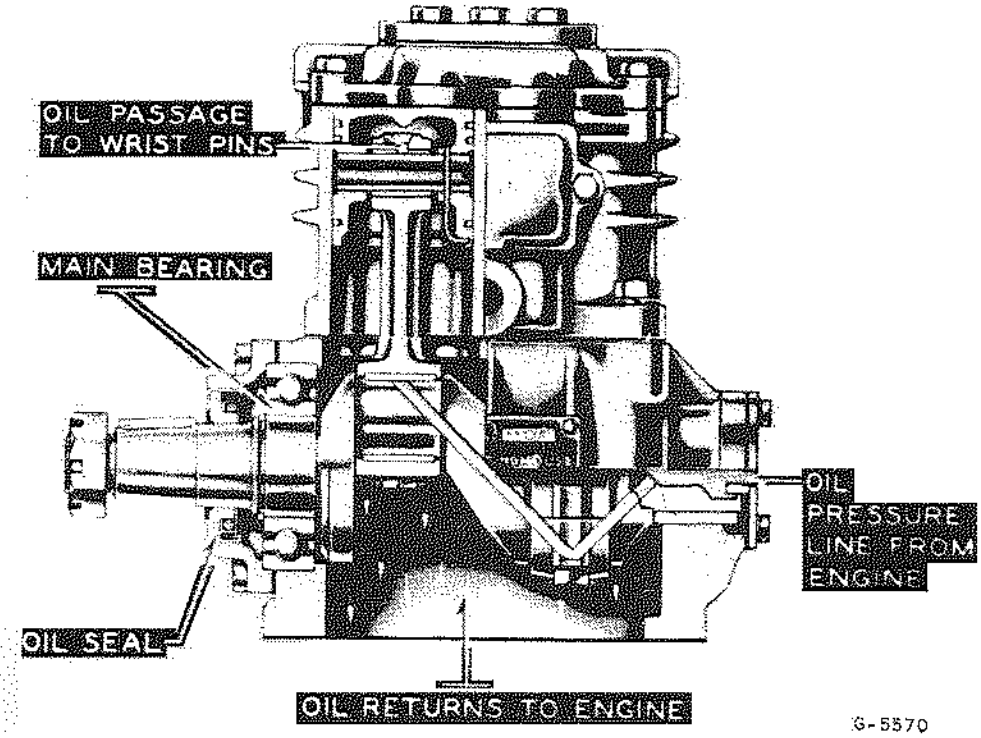


Fig. 1 - Sectional View of Compressor Oiling System

Description

The Tu-Flo 400 compressor is the single acting reciprocating type. The rated capacity of a compressor is based on the piston displacement in cubic feet per minute when operating at 1250 r.p.m. The capacity of the Tu-Flo 400 is 7-1/4 cubic feet per minute. This compressor has automatic inlet valves.

Lubrication

Engine lubricated compressors are dependent on the vehicle engine for oil and oil pressure, Fig. 1. In these compressors, oil from the vehicle engine enters the compressor through a passage in the compressor end cover, and is fed to the connecting rod bearings through drilled holes in the crankshaft. The wrist pins are lubricated through holes in the top of the connecting rod wrist pin bearing and bushing by means of oil dripping from a drip-boss on the piston. The main bearings are splash lubricated. Surplus oil returns to the engine crankcase through the open compressor base.

Operation

The compressors run continuously while the engine is running, but the actual compression of air is controlled by the governor, which, acting in conjunction with the unloading mechanism in the compressor cylinder block, starts or stops the compression of air by loading or unloading the compressor when the pressure in the air brake system reaches the desired minimum (80-85 p.s.i.) or maximum (100-105 p.s.i.)

COMPRESSING AIR (LOADED)

During the down stroke of each piston, a partial vacuum is created above the piston which unseats the inlet valve allowing air drawn through the intake elbow to enter the cylinder above the piston, Fig. 3. As the piston starts the upward stroke, the air pressure on top of the inlet valves, plus the inlet valve return spring force, closes the inlet valve. The air above the piston is further compressed until the pressure lifts the discharge valve and the compressed air is discharged through the discharge line into the reservoir, Fig. 4. As each piston starts its down stroke, the discharge valve above it returns to its seat, preventing the compressed air from returning to the cylinder, and the same cycle is repeated.

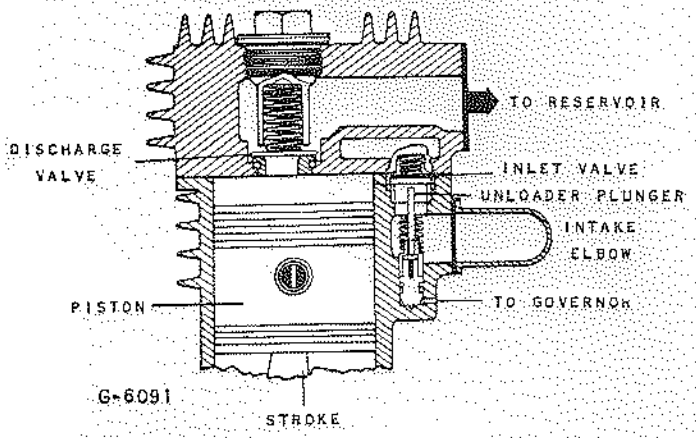


Fig. 3 - Intake of Air

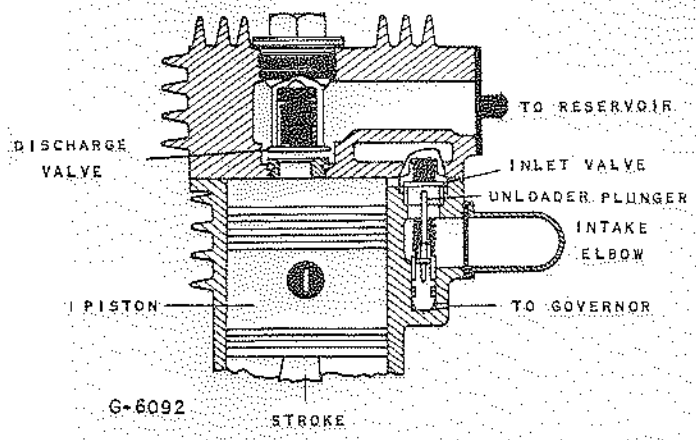


Fig. 4 - Compression of Air

NOT COMPRESSING AIR (UNLOADED)

When the air pressure in the reservoir reaches the maximum setting of the governor (100-105 p.s.i.) compressed air from the reservoir passes through the governor into the cavity below the unloading pistons in the compressor cylinder block. This air pressure lifts the unloading pistons which in turn lift the inlet valves off their seats. Fig. 5.

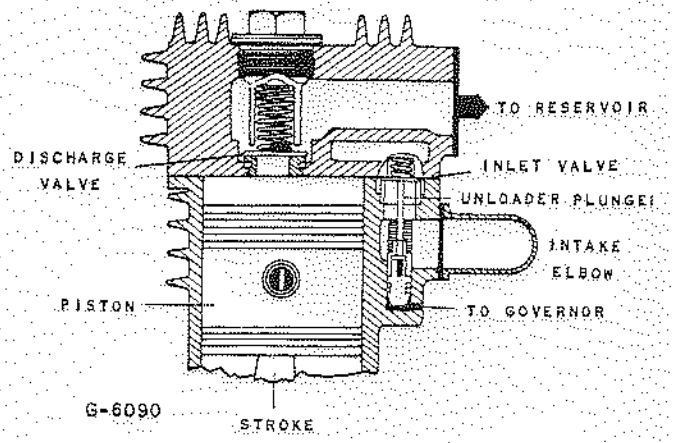


Fig. 5 - Compressor Unloading Mechanism

PASSAGE OF AIR DURING NON-COMPRESSION

With the inlet valves held off their seats, the air during each upstroke of the piston is forced through the air inlet cavity, and to the other cylinder where the piston is on the downstroke. When the air pressure in the reservoir is reduced to the minimum setting of the governor (80-85 p.s.i.), the governor releases the air pressure beneath the unloading pistons. The unloading piston return spring then forces the pistons down and the inlet valve springs return the inlet valves to their seats and compression is resumed.

Removal

1. Drain air brake system.
2. Disconnect all air and oil lines connected to compressor.
3. Remove compressor drive belt.
4. Remove compressor mounting bolts and remove compressor from engine.
5. Use a suitable puller to remove the pulley from the compressor crankshaft after removing the crankshaft nut.

Disassembly

Remove grease or dirt from the exterior of the compressor by scraping, if necessary, followed by the use of cleaning solvent and a brush.

Tu-Flo compressors should have the following items marked showing proper relationships prior to disassembly. Centre punch marks can be used if desired.

1. Position of cylinder block in relation to crankcase.

2. Position of end covers in relation to the crankcase.

3. Position of crankshaft in relation to crankcase.

REMOVING AND DISASSEMBLING CYLINDER HEAD

Remove capscrews or nuts from studs attaching cylinder head and lift off cylinder head. The cylinder may have to be tapped with a rawhide hammer to break gasket joint.

Remove cylinder head gasket and scrape off any gasket material that may remain on cylinder head and block.

Remove discharge valve cap nuts and lift out discharge valve springs and discharge valves.

REMOVING AND DISASSEMBLING PISTON AND CONNECTING ROD ASSEMBLIES

Remove cotter pins from slotted nuts on the bolts attaching connecting rod bearing caps and remove slotted nuts. Lift out the connecting rod bearing caps. Then push pistons with connecting rods attached, out the top of the cylinder block. Replace caps on each connecting rod to avoid damage to bearings. Connecting rod caps and connecting rods are already marked with centre punch marks to show the proper position of the caps on the rods.

Remove piston rings from each piston. If pistons are to be removed from connecting rods, remove wrist pin lock wires from wrist pins and press pins from pistons and connecting rods.

REMOVING CRANKSHAFT

Remove capscrews or nuts from studs securing end cover to crankcase at drive end of crankshaft.

Remove end cover with oil seal and gasket. If oil seal needs replacing, remove it from end cover.

Remove capscrews or nuts from studs holding opposite end cover to crankcase. Remove end cover and gasket.

Some crankcases are fitted with a shoulder to position the crankshaft in the crankcase. In such cases, the crankshaft may be removed only through one end of the crankcase. Press crankshaft and ball bearings out of crankcase.

REMOVING CYLINDER BLOCK

When cylinder head is removed from cylinder block, the inlet valve springs and inlet valves should be removed.

If compressor is fitted with an air strainer, remove screws and lockwashers securing air strainer in place and remove air strainer and air strainer gasket.

If compressor has a Type D governor mounted on cylinder block, remove governor and gasket.

Remove capscrews or nuts securing cylinder block to crankcase and remove cylinder block and cylinder block gasket.

Remove unloader spring and unloader spring seat.

Remove unloader spring saddle, unloader plunger, and unloader pistons. Remove unloader piston grommets. Remove inlet valve seat bushings only if seats are worn or damaged.

Cleaning of Parts

Clean all parts using cleaning solvent to remove all traces of dirt, oil and grease before inspection.

CYLINDER HEAD AND COMPONENTS

Put cylinder head body through a cleaning solution to remove all carbon from discharge valve cavities and to remove all rust and scale from water cavities. Use air pressure to blow dirt out of all cavities. Scrape carbon, dirt, and particles of old gaskets from all surfaces.

Clean discharge valves not damaged or worn excessively by lapping them on a piece of crocus cloth on a flat surface.

OIL PASSAGES

Clean thoroughly all oil passages through crankshaft, connecting rods, crankcase, and end covers. If necessary, prod oil passages with wire and flush with cleaning solvent.

CYLINDER BLOCK

Put cylinder block through a cleaning solution to remove all carbon and dirt from inlet passages and unloader passages.

Clean inlet valves that are not damaged or worn excessively by lapping them on a piece of crocus cloth on a flat surface.

Scrape particles of old gaskets from all surfaces.

BALL BEARINGS

All ball bearings must be cleaned thoroughly in cleaning solvent.

Inspection of Parts

CYLINDER HEAD BODY

Inspect cylinder head body for cracks or breaks. Replace if any defects are found.

DISCHARGE VALVE SPRINGS

Discard all used discharge valve springs and replace with new springs.

DISCHARGE VALVES AND SEATS

Inspect condition of discharge valves and discharge valve seats. If discharge valves are grooved deeper than .003" where they contact the seats, they should be replaced. If the discharge valve seats are worn excessively so there is no longer sufficient metal left to reclaim the seat by using a lapping stone, the seats should be replaced.

CRANKCASE AND END COVERS

Check crankcase and end covers for cracks and broken lugs. Replace if any damage is found.

END COVERS

If an oil seal ring is used in the end cover, check fit of ring in the ring groove and have .008" to .015" clearance at the gap when placed in the end bore of the crankshaft. Check oil seal ring for wear. If worn thin or damaged the oil seal ring must be replaced. Inspect oil ring groove in end cover. If ring wear has formed a step pattern in groove, replace end cover or machine groove for next oversize oil seal ring.

CRANKCASE BEARING BORES

Check fit of ball bearings in crankcase. Bearings must be a finger press fit. If crankcase bearing bores are worn or damaged, the crankcase should be replaced.

CYLINDER BLOCK

A cylinder block with broken lugs or with cracks of any kind must be replaced.

UNLOADING PISTONS AND PISTON GROMMETS

Check fit of unloading pistons and piston grommets in cylinder block for excessive wear. New grommets should be installed after which the unloading pistons should be a neat sliding fit in their bores. The bores must not be scratched or damaged in any way which might accelerate grommet wear. Check the unloading piston return spring for permanent set. If the spring does not have sufficient tension to return the unloader pistons to the loaded position, it should be replaced.

INLET VALVE AND SEATS

Inspect condition of inlet valves and seats If inlet valves are grooved deeper than .003" where they contact the seat, they should be replaced. If the inlet valve seats are worn or damaged so that they cannot be reclaimed by facing or lapping, seats should be replaced.

CYLINDER BORES

Check cylinder bores for evidence of excessive wear, out-of-round, or scoring. Cylinder bores which are scored or out-of-round more than .002", Fig. 6, or tapered more than .003" should be rebored or honed oversize. Cylinder bores should be finish honed while bolted to the crankcase if possible. Oversize pistons are available in .010", .020" or -030" oversize. Cylinder bores must be smooth, straight, and round. Refer to specifications for proper clearance between piston and cylinder bore.

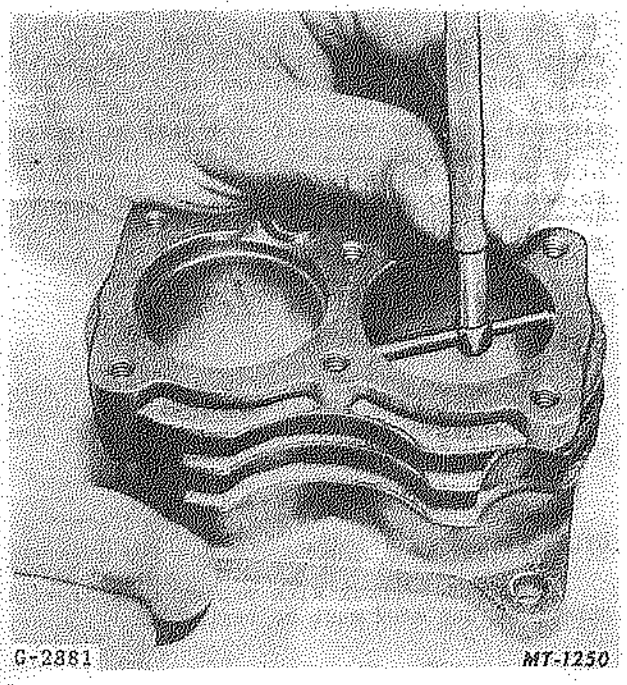


Fig. 6 - Measuring cylinder bore diameter

PISTONS

Inspect pistons for scores, cracks or damage. If scores or cracks are found, replace the piston. Check each piston with a micrometer, Fig. 7, in relation to the cylinder bore diameter to be sure the proper clearance is obtained as outlined in the specifications.

PISTON RINGS

Check fit of piston rings in the ring grooves. Also check ring gap with rings installed in cylinder bores, Fig. 8. Refer to specification for correct ring gap and groove clearance.

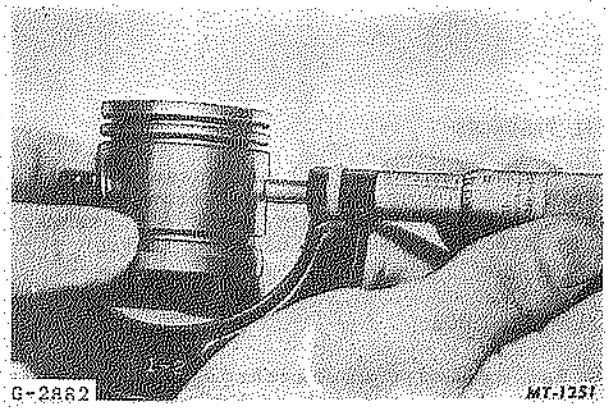


Fig. 7 - Measuring piston diameter

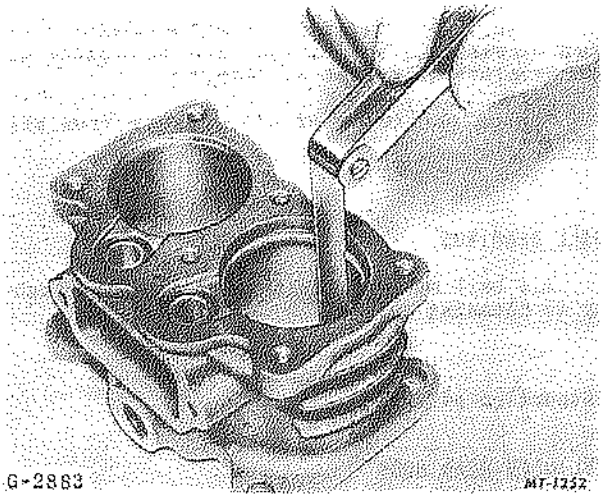


Fig. 8 - Measuring ring gap

WRIST PINS

Check fit of wrist pins in pistons and connecting rods. Wrist pins must be a light press fit in piston. If wrist pin is a loose fit in the piston, the wrist pin, piston, or both must be replaced. Check fit of wrist pin in connecting rod bushing by rocking the piston. Clearance of wrist pin to connecting rod bushing should not exceed .0015". If excessive clearance is apparent, replace wrist pin bushing in connecting rod. Wrist pin bushings should be reamed after being pressed in place. Discard all used wrist pin lock wires and replace with new.

CONNECTING ROD BEARINGS

Inspect connecting rod bearings for proper fit on crankshaft journals. Also check

connecting rod bearings for wear. If worn, cracked, or broken, the inserts must be replaced. Connecting rod caps are not interchangeable. Position the caps so that the two locking slots are both located adjacent to the same cap screw. Refer to specifications for proper connecting rod bearing clearance.

CRANKSHAFT

Crankshaft journals which are more than .001" out-of-round or scored must be reground. When regrinding, the fillets at the ends of the journals must be maintained. Connecting rod bearing inserts are available in .010", .020" and .030" undersize for reground cranksharts. Screw threads, keyways, tapered ends and all ground and machined surfaces of the crankshaft must not be mutilated or worn excessively. Main bearing journals must not be worn sufficiently to prevent the ball bearings being a press fit. The oil seal ring groove in crankshafts fitted with oil seal rings must not be worn sufficiently to prevent a good fit on the oil seal ring. Walls of the oil seal ring grooves must be square and have a good finish.

BALL BEARINGS

Check for wear of flat spots; if damaged, the bearings must be replaced.

REPAIRS

DISCHARGE VALVES AND SEATS

If discharge valve seats merely show signs of slight scratches, they can be reclaimed by using a lapping stone and grinding compound. If seats cannot be reclaimed, install new seats. After installing new discharge valves, discharge valve springs and discharge valve cap nuts, the discharge valve travel should be checked. This can be accomplished from the bottom side of cylinder head by measuring the movement of discharge valve from its seat. Refer to specifications for correct valve travel.

To test for leakage apply 100 p.s.i. air pressure through the discharge port of the cylinder head and apply soap suds to the discharge valve openings in the floor of the cylinder head. Leakage should not exceed a one inch soap bubble in not less than five seconds.

If excessive leakage is found, leave the air pressure applied and using a fibre or hardwood dowel and light hammer, tap the discharge valves off their seats several times to improve the seal between the valves and their seats. If the valves and valve seats have been reconditioned properly, this will reduce the leakage.

Leakage tests must also be made by applying soap suds around the discharge valve cap nuts, with air pressure applied as above. Leakage at cap nuts is not permissible.

INLET VALVES AND SEATS

If inlet valve seats show signs of slight scratches or wear they can be reclaimed by using a lapping stone and grinding compound. If the seats cannot be reclaimed in this manner, they should be replaced. Install new inlet valve seats by pressing them into cylinder block to dimensions shown in the specifications.

Inlet valves not worn excessively or damaged, can be reclaimed by lapping them on a piece of crocus cloth on a flat surface.

UNLOADER PISTONS

The grommet or "O" ring in the unloader piston should be replaced. Be careful in reinstalling the unloader piston in the bore so that the grommet is not damaged or cut. When reinstalled the piston should be a smooth sliding fit in its bore. It may be necessary to use air pressure, with caution, at the governor port of the cylinder block to remove the unloader piston for inspection, after removing the unloader plunger and associated parts.

After assembly unloader pistons should be tested by application of 100 p.s.i. air pressure through governor line port. When coating unloader pistons with soap suds, leakage should not exceed a 1/2" soap bubble in not less than five seconds.

Assembly

INSTALLING CYLINDER BLOCK

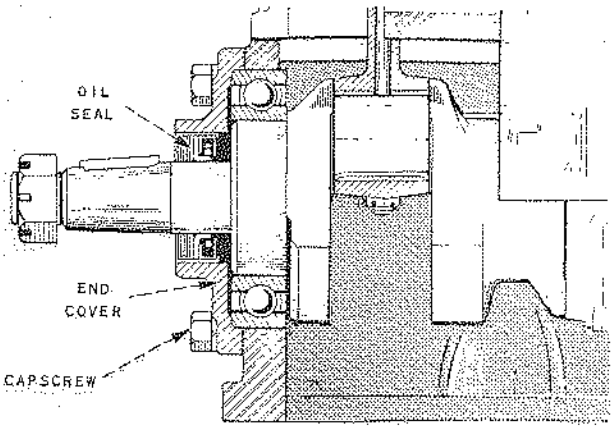
Place new cylinder block gasket in position on crankcase studs. Position cylinder block on crankcase in accordance with markings made before disassembly. Install nuts and lockwashers securing cylinder block to crankcase.

INSTALLING CRANKSHAFT

If the crankshaft is fitted with oil seal rings, install rings. Position ball bearings and crankshaft in crankcase being sure the drive end of the crankshaft is positioned as marked before disassembly. If one end of the crankcase is counterbored for holding bearing, be sure the crankshaft is installed through the correct end of the crankcase. Carefully press crankshaft and bearings into crankcase using arbor press.

Place a new rear end cover gasket in position over studs on rear end of crankcase being sure the oil hole in the gasket lines up with the oil hole in the crankcase. If end cover includes an oil seal ring, install oil ring. Position end cover over studs in crankcase being sure oil holes in end cover line up with oil holes in gasket and crankcase. Install capscrews or nuts securing end cover in place. Install pipe plugs in end cover oil openings which are not in use.

The opposite end cover includes an oil seal. If the seal has been removed, press a new seal in the end cover. Install a new end cover gasket. Carefully position the end cover to avoid damage to oil seal and install capscrews or nuts securing end cover in place, Fig. 9



G-6141

Fig. 9 - Sectional view of compressor crankshaft bearing and cover

ASSEMBLING PISTONS AND CONNECTING RODS

If wrist pin bushings have been removed from connecting rods, press new bushings into place making sure that the oil holes in the bushings line up with the oil hole in the connecting rods. Bushing must then be reamed, honed, or bored to provide the proper running clearance on the wrist pin as shown in the specifications. Position connecting rod in piston and press wrist pin into position with lock wire holes in pin aligned with lock wire hole in piston. Install new wrist pin lock wire in wrist pin so that the long end extends through piston and wrist pin and short end can be snapped into the lockwire hole near the bottom of the piston skirt, Fig. 10. Do not use pistons in which the wrist pin is loose.

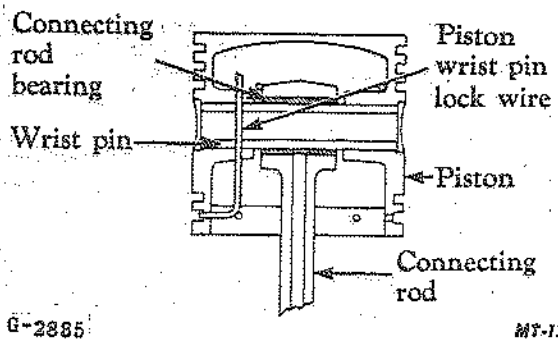


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Fig. 10 - Installing wrist pin lock wire

Install piston rings by hand, Fig. 11. Particular care must be taken when installing piston rings so that the pip mark on the ring is toward the top of the piston. Stagger the position of the ring gaps.

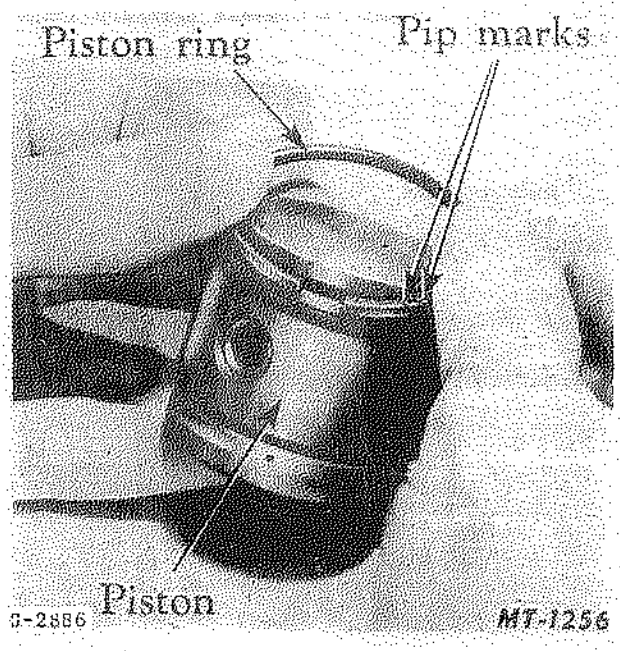


Fig. 11 - Installing piston rings

INSTALLING PISTONS AND CONNECTING RODS

Before installing pistons and connecting rods, thoroughly lubricate pistons, piston rings, wrist pin bearings, and connecting rod bearings with clean engine oil.

Turn crankshaft so as to position one crankshaft journal downward. Remove bearing cap from connecting rod.

Insert the connecting rod and piston through top of number one cylinder so that the connecting rod bearing makes contact with the crankshaft journal. Position and attach bearing cap to rod. The cap is in the correct position when the two locking slots in the bearing inserts and in the rod and cap are both located adjacent to the same connecting rod bolt. On the Tu-Flo 400 compressor install the two capscrews and slotted nuts. Then install cotter pins in the capscrews.

Turn crankshaft until other journal is downward and install second connecting rod and piston in same manner.

ASSEMBLING AND INSTALLING UNLOADER PISTONS

Lubricate the unloader piston cavity in the cylinder block and also the unloader piston and unloader piston grommet with clean engine oil. Install unloader piston grommet on unloader piston. Install unloader pistons and unloader plungers through the top of the cylinder block taking care to avoid cutting the unloader piston grommets on the block. Install unloader spring saddle on unloader plungers. Install spring seat in top of cylinder block strainer opening and place unloader spring between spring guide and spring saddle. Install inlet valve guides if they have been previously removed.

ASSEMBLING AND INSTALLING CYLINDER HEADS

Tu-Flo Model 400

Install discharge valve in the cylinder head. Install discharge valve spring and discharge valve cap nut.

Install inlet valves and inlet valve springs in cylinder block. Place new cylinder head gasket on block. Carefully align inlet valve springs with inlet valve guides in cylinder head and secure head to block by tightening cylinder head nuts evenly, Fig. 12.

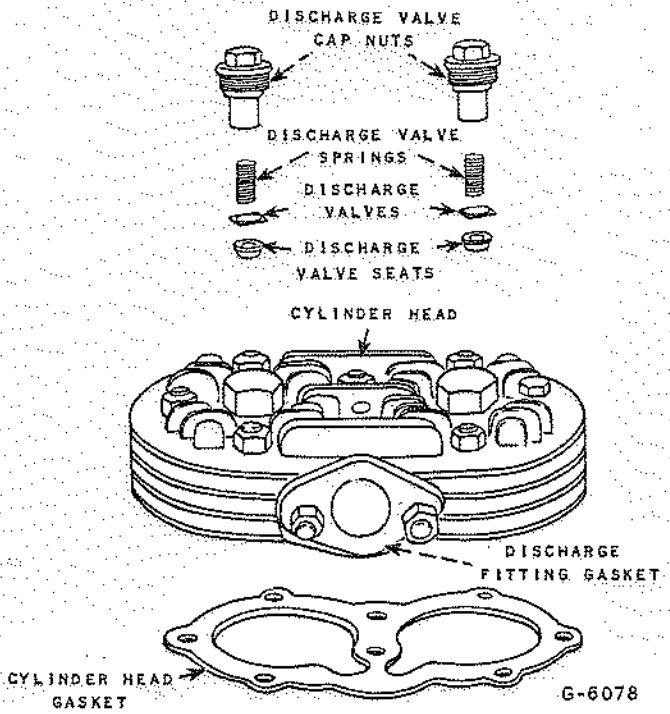


Fig. 12 - Exploded view of cylinder head

INSTALLATION

Clean oil supply line to compressor and, if possible, run engine a few seconds to be sure oil supply to compressor is flowing freely.

Clean oil return line or passage through compressor mounting bracket to be sure oil from compressor crankcase can return to engine crankcase.

Lubricate compressor cylinder walls and bearings with lubricating oil before placing compressor in position.

Always use a new mounting gasket and be sure oil hole in gasket and compressor is properly aligned with oil supply line.

Trouble Shooting

COMPRESSOR FAILS TO MAINTAIN ADEQUATE PRESSURE IN THE AIR BRAKE SYSTEM

1. Excessive carbon in compressor cylinder head or discharge line.
2. Discharge valves leaking.
3. Excessive wear.
4. Drive belt slipping.
5. Inlet valves stuck open.
6. Excessive leakage of inlet valves.

NOISY OPERATION

1. Loose drive pulley.
2. Excessive carbon in cylinder head or damaged line.
3. Worn or burned out bearing.
4. Excessive wear.

COMPRESSOR PASSES EXCESSIVE OIL

1. Excessive wear.
2. Excessive oil pressure.
3. Oil return line or passage to engine compressor crankcase flooded.
4. Oil seal ring in end cover excessively worn.
5. Back pressure from engine crankcase.
6. Piston rings improperly installed.

COMPRESSOR DOES NOT UNLOAD

1. Defective unloading piston grommet.
2. Unloading cavity plugged with carbon.
3. Unloading mechanism binding or stuck.

AIR COMPRESSOR GOVERNOR (TYPE D)

Description

The air compressor governor, Fig. 14, acting in conjunction with the compressor unloader mechanism, automatically limits system pressure to a predetermined range by opening unloading valves and stopping compression when system pressure has been built up to maximum pressure limit (100-105 p.s.i.), and by closing unloading valves and starting compression when system pressure has dropped to minimum pressure limit (80-85 p.s.i.).

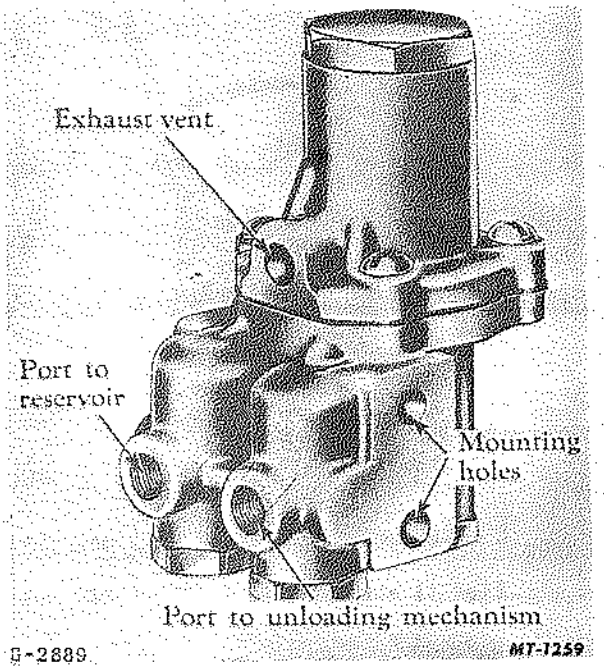


Fig. 14 - Type "D" Governor

The governor, Fig. 15, consists essentially of a diaphragm upon which air pressure acts, a spring to control the movement of the diaphragm assembly, and a valve mechanism controlled by the position of the diaphragm assembly which admits air to, or exhaust air from, the unloading mechanism in compressor cylinder heads.

Operation

Air pressure from the reservoir enters the governor, Fig. 16, at the port marked "RES", passes through the strainer and is always present above the inlet valve and on one side of the diaphragm. As the air pressure increases the diaphragm and stem assembly moves against the resistance of the pressure setting spring. When the reservoir pressure has reached the cut-out point of the governor (100-105 p.s.i.) the diaphragm assembly has moved enough to seat the exhaust valve and open the inlet valve. When the inlet valve is opened, reservoir air pressure flows to the compressor unloading mechanism, opening the unloading valves in the compressor cylinder head and stopping further compression of air. When the inlet valve is

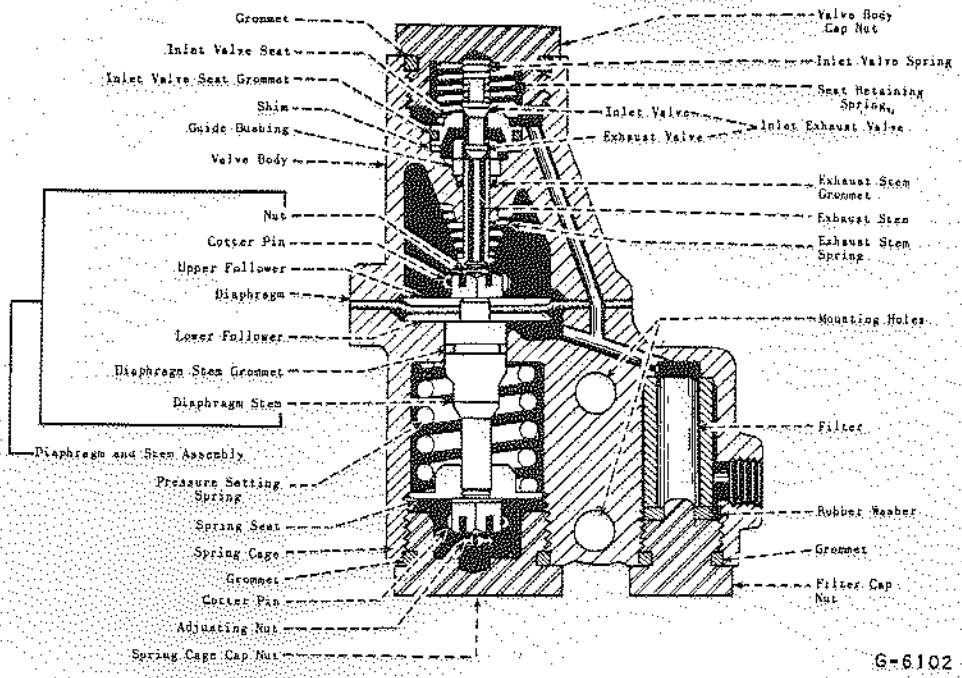


Fig. 15 - Sectional View of Type "D" Governor

opened, air also flows through the passages in the body to the cavity containing the pressure setting spring and, acting on the area of the stem, increases the effective force of the diaphragm, further compressing the pressure setting spring and fully opening the inlet valve.

As air pressure in the reservoir drops to the cut-in point of the governor (80-85 p.s.i.) the force exerted by the air pressure on the diaphragm and stem is reduced so that the pressure setting spring moves the diaphragm and stem assembly to a position where the inlet valve is closed and the exhaust valve is opened.

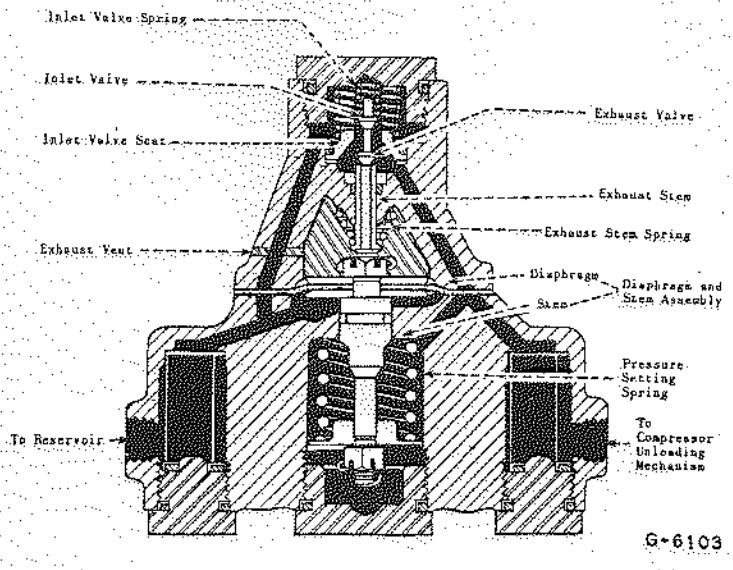


Fig. 16 - Cut-out Position (Compressor Not Operating)

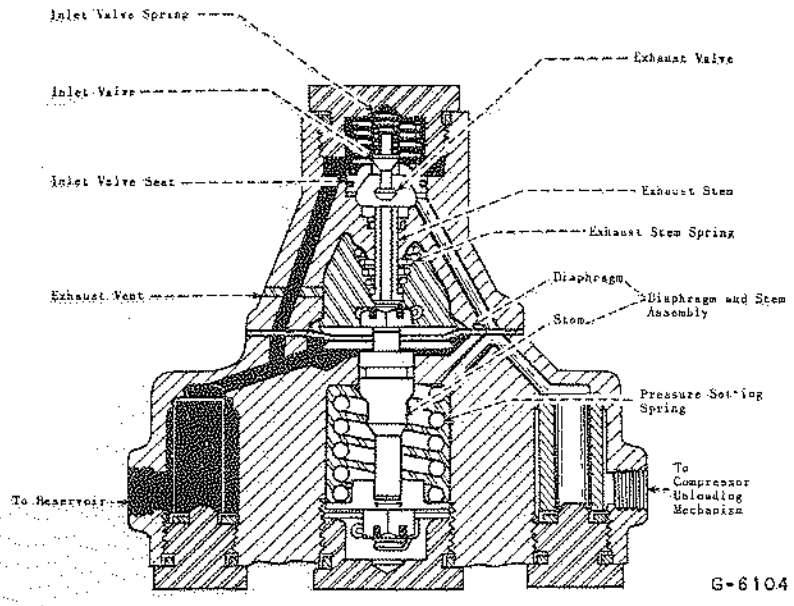


Fig. 17 - Cut-in Position (Compressor Operating)

Fig. 17. The opening of the exhaust valve allows air pressure in the unloading mechanism of the compressor to escape through the small exhaust vent in the governor body. This allows the unloading valves in the compressor cylinder head to close, and compression of air is resumed until reservoir pressure again rises to the cut-out setting of the governor. The opening of the exhaust valve also allows air to escape from the graduating spring cavity, thereby decreasing the effective force on the diaphragm and stem assembly so that a rapid complete opening of the exhaust valve is obtained.

Service Checks

OPERATING TESTS

With the engine running, build up air pressure in the air brake system and observe at what pressure registered by the dash gauge the governor cuts out, stopping further compression. The governor must cut out between 100 and 105 p.s.i.

With engine running, slowly reduce the air pressure in the air brake system by applying and releasing the brakes and observe at what pressure registered by the dash gauge the governor cuts in and compression is resumed. The governor must cut in between 80 and 85 p.s.i.

Before condemning or adjusting the pressure settings of the governor, be sure the dash gauge is registering accurately. This may be done by using an accurate test gauge to check the pressure registered by the dash gauge.

When necessary, the pressure settings (cut-in and cut-out pressures) may be adjusted by removing the cap nut on the spring cage. The pressure settings are raised by removing the cotter pin and turning adjusting nut clockwise. Pressure settings may be lowered by turning the adjusting nut counter-clockwise. The cotter pin must be replaced after any adjustment. The range between the cut-out pressure settings and the cut-in pressure setting is fixed at approximately 20 p.s.i. and cannot be adjusted.

LEAKAGE TESTS

With the governor in the cut-out position, test for leakage of the exhaust valve by applying soap suds to the exhaust vent in the body.

With the governor in the cut-in position, test for leakage of the inlet valve by applying soap suds to the exhaust vent in the body.

Leakage in excess of a one inch soap bubble in three seconds is not permissible in either of the above tests.

Coat the entire governor with soap suds to detect diaphragm, gasket and cap screw leakage. No leakage is permissible.

Removing and Installing

If it is necessary to remove or install a governor, the following procedure will apply.

REMOVING

1. Drain air brake system.

2. Disconnect air lines at governor.

3. Remove governor mounting bolts and remove governor.

INSTALLING

1. Clean or replace both air lines connected to the governor.

2. Mount governor in place with exhaust port pointing toward the ground.

3. Connect air lines to governor.

4. Test governor as outlined under "Service Check".

Disassembly

Before disassembly remove all dirt or grease from exterior of governor using cleaning solvent and a brush.

Inspect body for breakage or other damage. All broken or damaged parts must be replaced.

1. Unscrew both filter cap nuts from body and remove grommets, felt washers and strainers from body.

2. Unscrew body cap nut and remove inlet valve spring, seat retaining spring, and inlet exhaust valve. Remove inlet valve seat, being careful not to damage actual seating surface. Lift out shims found under valve seat.

3. Unscrew spring cage cap nut and remove adjusting nut from stem. Remove spring seat and pressure setting spring.

4. Remove four screws and separate body from spring cage. Remove diaphragm and stem assembly from spring cage. Remove nut and remove diaphragm and followers from stem.

5. Remove exhaust stem and conical spring from body.

6. Remove grommets from cap nuts, inlet valve seat, and diaphragm stem. With a small hooked wire, remove grommet from exhaust stem bore in upper body.

Cleaning and Inspection of Parts

Clean all parts in cleaning solvent and be particularly careful that all passages through the body and exhaust stem are not obstructed in any way. The strainers may be reused if they can be washed thoroughly clean in cleaning solvent.

Inspect both seats on the inlet-exhaust valve for grooves or damage. If either seat is grooved or damaged, the valve must be replaced.

Inspect inlet valve seat for wear or damage. If seat is worn or damaged it must be replaced.

Inspect seat on exhaust plunger for wear or damage. If seat is worn or damaged it must be replaced.

Check fit of exhaust stem in body. It should be a smooth sliding fit.

Assembly, Adjustment and Test

Carefully install new greased grommet in groove in exhaust stem bore in body. Install conical spring and exhaust stem and check to be sure the stem is a smooth sliding fit in its bore.

Assemble diaphragm and stem assembly using new diaphragm and grommet, making sure that beveled side of both followers is toward diaphragm. Tighten nut (10-15 inch pounds torque) and install cotter pin, bending both legs of the cotter pin toward the diaphragm. Check to be sure diaphragm stem is a smooth sliding fit in its bore. Assemble spring cage to body.

Install filters making sure felt washers are on bottom.

Measure total valve travel, Fig. 18, by pulling diaphragm assembly stem out as far as possible and setting dial indicator at zero when contacting exhaust valve stem. Push diaphragm stem completely in and read total valve travel. Total valve travel should be .060"-.098".

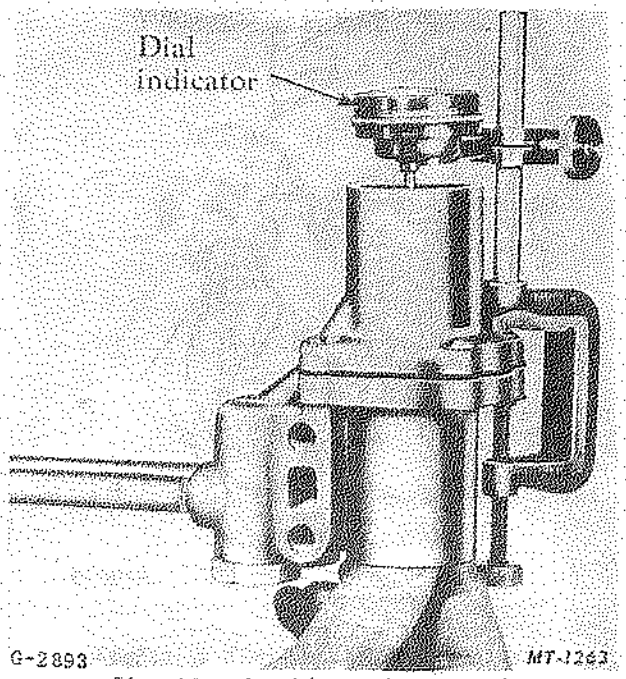


Fig. 18 - Checking valve travel

Install inlet valve seat and inlet valve and repeat above procedure with dial indicator zeroed on end of inlet valve. Add or remove shims under inlet seat until inlet valve travel is .030" - .040".

Install inlet valve spring and seat retaining spring. Install valve body cap nut with new grommet greased before assembly.

Position pressure setting spring and spring seat and install nut on stem. Mount governor on vehicle and with spring cage cap nut off, build up reservoir pressure from zero and note pressure at which air starts to escape from spring cage. If pressure is below 100 p.s.i. turn adjusting nut clockwise and if pressure is above 105 p.s.i. turn adjusting nut counterclockwise. After final adjustment leakage should start at 100-105 p.s.i. After final adjustment insert cotter pin and tighten cap nut.

The range between the cut-in and cut-out pressure is a function of the design of the governor and cannot be adjusted.

Maintenance

MONTHLY SERVICE

1. Check compressor mounting and drive for alignment, belt tension, etc. Adjust if necessary.

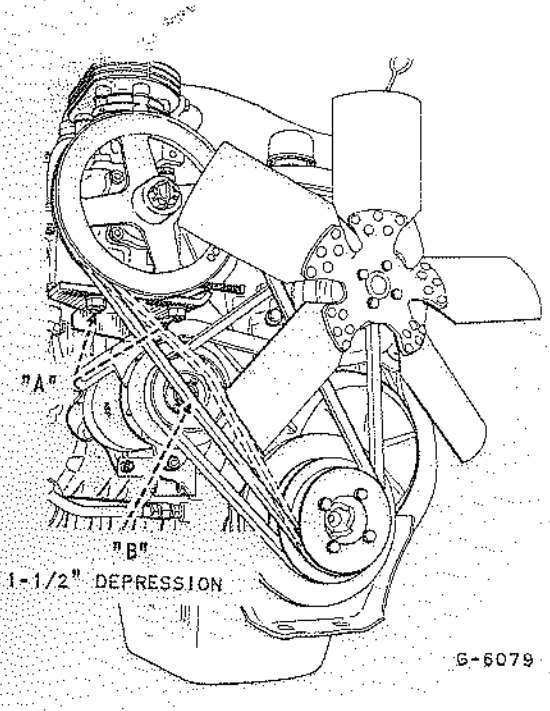


Fig. 19 - Compressor belt adjustment

2. To adjust the belt refer to Figs. 19 and 20. Loosen four nuts "A" which secure the compressor to its bracket, and the locknut of the adjuster "C" Fig. 20. Turn the adjuster as necessary to obtain the recommended depression of 1-1/2 inches at point "B" in Fig. 19. Check to ensure that the pulleys are in alignment and retighten all nuts.

EVERY SIX MONTHS

1. Clean oil supply line to compressor. Also clean oil return line to engine crankcase.

2. Remove compressor discharge valve cap nuts and check for presence of excessive carbon. If excessive carbon is found, clean the compressor cylinder head, also check compressor discharge line for carbon and clean or replace the discharge line if necessary.

3. Remove the governor air strainer and wash all parts thoroughly in cleaning solvent. Replace if necessary.

EVERY YEAR

1. Disassemble governor and clean all parts

2. Clean or replace both tubing lines connected to the governor.

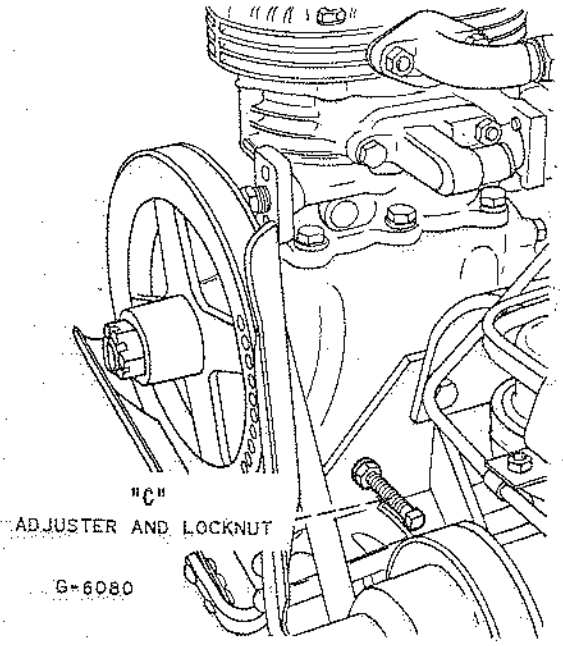


Fig. 20 - Compressor belt adjuster

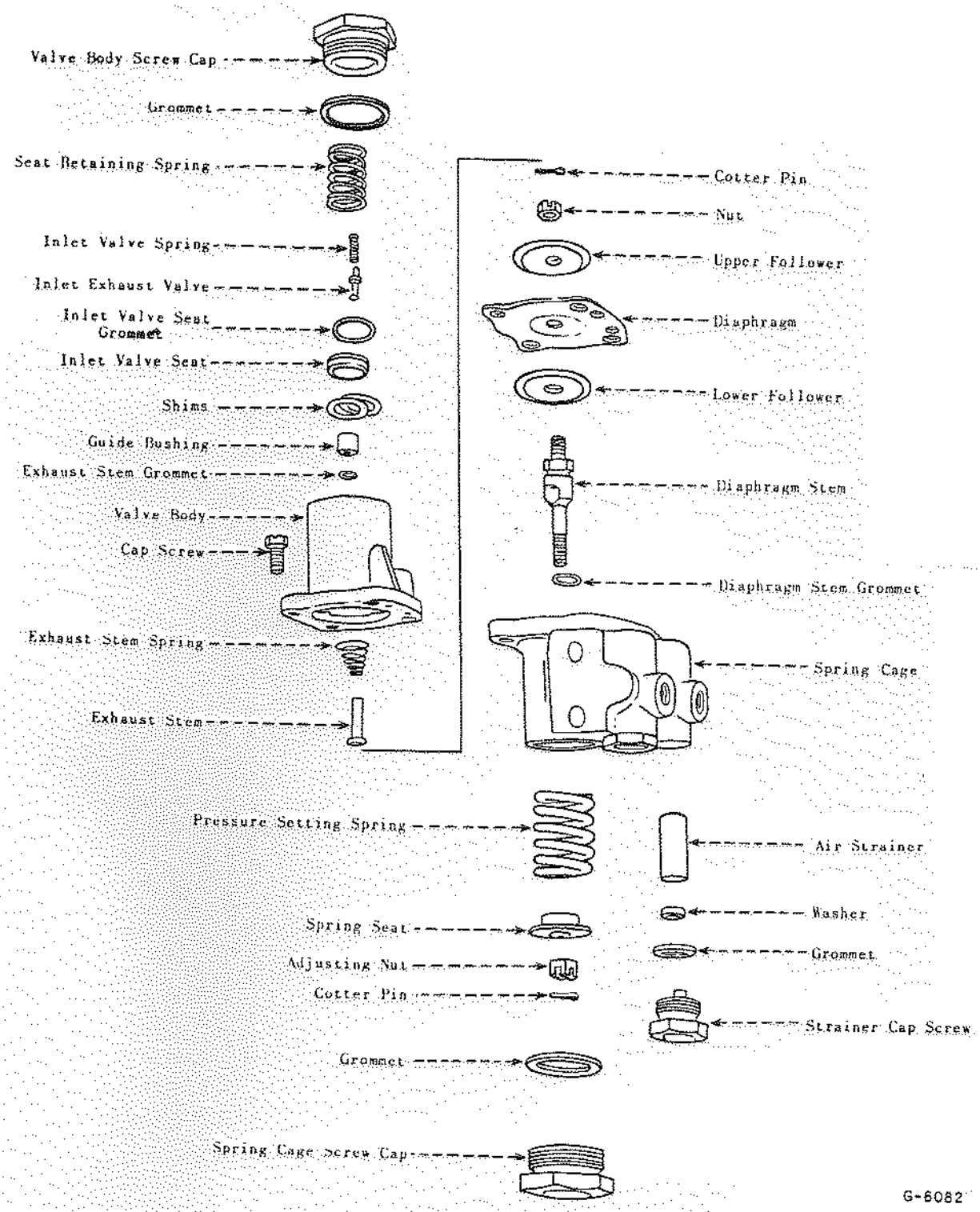


Fig. 21 - Exploded View of Governor

AIR BRAKE EQUIPMENT

Air brake equipment on the I.H. 2-1/2 Ton 4x4 G.S. Vehicle provides a means of controlling the brakes through the medium of compressed air. The air brake equipment consists of a group of devices as follows, and is illustrated diagrammatically in Fig. 1.

Compressor

The compressor supplies the compressed air to operate the brakes.

Governor

The governor controls the compression of air by the compressor. Although the compressor runs continuously when the engine is running, the governor, acting in conjunction with the unloading mechanism in the compressor cylinder head, stops and starts the compression of air by the compressor when the desired maximum and minimum air pressures are present in the air brake system.

Brake Valves

The brake valve controls the air pressure being delivered to the air/hydraulic actuator and in this way controls the operation of the brakes on the vehicle, and the trailer service coupling. The hand valve controls the air pressure to the trailer brakes.

Cocks

Cut-out cocks are used in the trailer connection lines to permit these lines to be closed when they are not being used. A reservoir drain cock is used also, mounted at the bottom of the reservoir. The drain cock permits draining the oil and water which collects in the reservoir.

Hose, Hose Fittings, Hose Couplings and Dummy Couplings

Flexible hose lines and hose fittings are used where it is necessary to have an air line between two points of the vehicle which change their position in relation to one another. Hose lines also make connections between two vehicles, and in such cases they are provided with hose couplings to permit the connections to be easily connected or disconnected.

Safety Valve

The safety valve protects the air brake system against excessive air pressure.

Reservoirs

Reservoirs store the compressed air until it is needed for brake operation and provide sufficient air pressure to make several brake applications even after the engine has stopped.

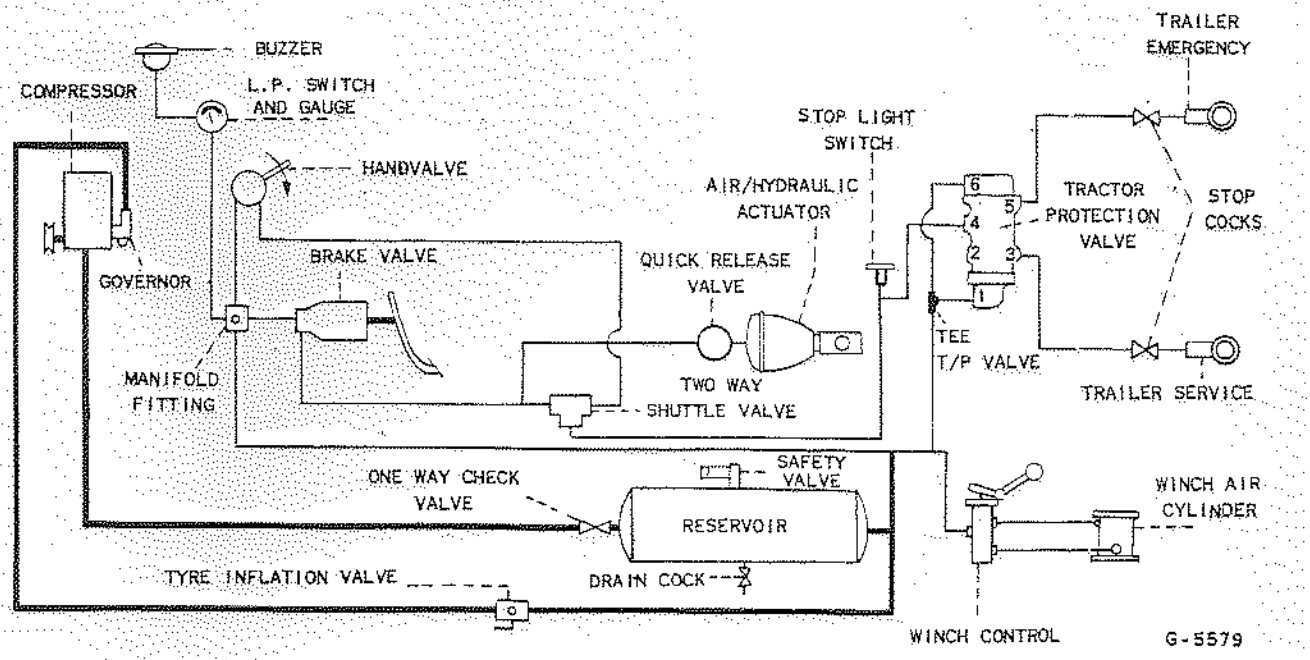


Fig. 1 - Schematic Diagram - Air Lines

Air Gauge

The air gauge mounted on the instrument panel of the vehicle registers the pressure in the air brake system, and incorporates a low pressure indicator.

Air Supply Valve

A tyre inflation valve is included to provide an easy means of obtaining compressed air from the air brake system for such purposes as tyre inflation.

PREVENTIVE MAINTENANCE AND TROUBLE SHOOTING

Daily Service

Drain the air reservoir if the vehicle is being used in conditions of high humidity.

Every Month or after each 2,000 Miles

Check compressor mounting and drive for alignment, belt tension, etc. Adjust if necessary.

Drain air reservoir as necessary. In humid atmosphere once daily may be advisable. In dry atmosphere once a month may be sufficient.

Every Six Months or After Each 10,000 miles

Remove compressor discharge valve cap nuts and check for presence of excessive carbon. If excessive carbon is found, clean the compressor cylinder head; also check compressor discharge line for carbon and clean or replace the discharge line if necessary.

Inspection

1. With compressor running, check for noisy operation and oil leaks.
2. Check unloader valve clearance.
3. Check compressor drive for alignment, belt tension etc.
4. Check to be sure compressor mounting bolts are secure.

Operating Tests

Failure of the compressor to maintain normal air pressure in the air brake system of a vehicle usually denotes loss in efficiency due to wear provided leakage in the remainder of the system is not excessive. Another sign of wear is excessive oil passing. If either of these conditions develop and inspection shows the remainder of the air brake equipment to be in good condition, the compressor must be repaired or replaced.

Air Leakage Tests

Excessive leakage past the discharge valves or the unloader pistons can be detected by charging the air brake system until governor cuts out and stopping the engine. Then carefully listen at the compressor inlet port for the sound of escaping air. If leakage is excessive, observe for leakage at the unloader pistons by squirting a few drops of oil around the unloader stems. If no leakage is noticeable at the unloader pistons, the discharge valves may be leaking. Remove the head and apply air pressure at the discharge port to check for excessive leakage at discharge valves. If excessive leakage is noted, repairs should be made as outlined in "Section D3" of this manual, or a factory reconditioned unit should be installed.

TROUBLE SHOOTING

Compressor fails to maintain adequate pressure in the air brake system

1. Restricted air intake.
2. Excessive carbon in compressor cylinder head or discharge line.
3. Discharge valve leaking.
4. Excessive wear.
5. Drive belt slipping.
6. No clearance at compressor unloading valves.
7. Unloading valves stuck open.
8. Excessive leakage of unloading valves.

Compressor passes excessive oil

1. Excessive wear.
2. Restricted air intake.
3. Excessive oil pressure.
4. Compressor crankcase flooded.
5. Oil rings improperly installed.

Noisy Operation

1. Loose drive pulley.
2. Excessive carbon in cylinder head or discharge line.
3. Worn or burnt out bearings.
4. Excessive wear.

Compressor does not unload

1. Defective unloading piston grommet.
2. Excessive clearance at unloading valves.
3. Unloading cavity plugged with carbon.
4. Unloading mechanism binding or stuck.

TRANSFER VALVE (Fig. 1A)

Description

A transfer valve is used on the tractor truck at the frame right hand side rail. It is connected into the air lines from the control valves to the trailer lines. The purpose of the transfer valve is to control the brakes on the trailer or towed load. If the transfer valve were not used when one of the brake valves was moved to its applied position, air pressure from the reservoir would escape through the exhaust port of the other brake valve, whose exhaust valve would be open. When the transfer valve is used and one of the brake valves is moved to the applied position, the transfer valve blocks off the line leading to the other brake valve, in this manner preventing any loss of air pressure through the open exhaust valve of the brake valve not being operated.

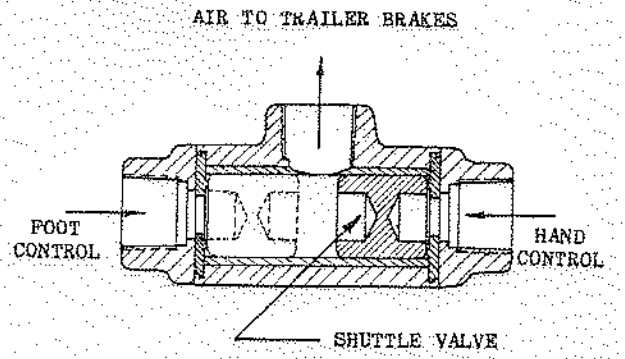


Fig. 1A - Transfer Valve

Testing

With the brake system fully charged and both brake valves in released position, move one of the brake valves to applied position, and check with soap suds for leakage at the exhaust port of the brake valve not being operated. Repeat test with the other brake valve. Leakage in excess of a three inch soap bubble in three seconds is not permissible. If excessive leakage is found, the defective transfer valve must be replaced.

SAFETY VALVE

Description

1. The purpose of the safety valve is to protect the air brake system against excessive air pressure. Should the air pressure in the air brake system rise above the setting of the safety valve at 150 pounds, the valve opens and permits pressure above 150 pounds to be exhausted. It is located on one of the reservoirs.

2. The safety valve consists of a spring loaded ball check valve which is set to "blow-off" at 150 pounds air pressure (Fig. 2).

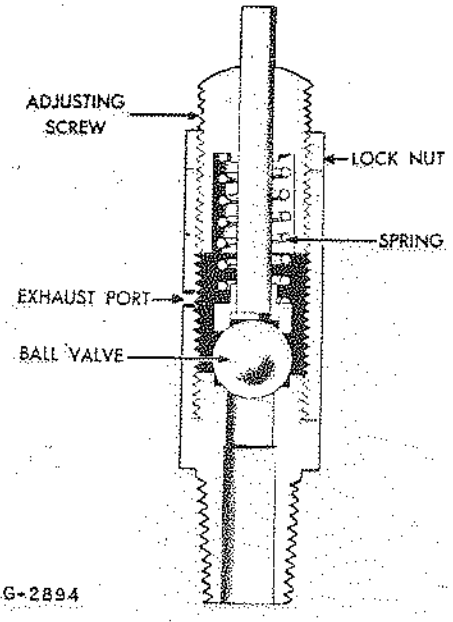


Fig. 2 - Sectional View of Safety Valve

TESTING

Pressure setting tests

1. Connect a test gauge known to be accurate into the air brake system so as to register reservoir pressure. A simple way to do this is to connect the air gauge to the emergency line at the rear of the tractor truck and open the emergency line cut-out cock. With the motor running, temporarily stop governor operation by turning the air supply valve on the left hand side rail near the reservoir supply position, and permit the air pressure in the air brake system to rise until the test gauge reaches 150 pounds. When the test gauge reaches 150 pounds, the safety valve must release or "blow-off". If the safety valve does not release, stop the engine immediately, and adjust the pressure setting of the safety valve. Do not permit air pressure in the air brake system to build up higher than 150 pounds, otherwise the compressor may become damaged.

2. To adjust the pressure setting of the safety valve, loosen the lock nut and turn the adjusting screw. Turning the adjusting screw counter-clockwise lowers the pressure setting. Turning the screw clockwise raises the pressure setting. Turn the adjusting screw as required until the safety valve releases at 150 pounds pressure registered by the test gauge. Then tighten the lock nut to hold the adjusting screw at the proper setting. Reduce air pressure in the air brake system to normal of approximately 100 pounds by applying and releasing the brakes.

Leakage Tests

With the air brake system fully charged to approximately 100 pounds, coat the safety valve all over with soap suds to check for leakage. Leakage in excess of a one inch soap bubble in 5 seconds is not permissible. Slight leakage may sometimes be corrected by lightly tapping the end of the release pin. If this fails to correct the leakage, replace the safety valve.

LOW PRESSURE WARNING

When the air pressure in the system falls below 60 p.s.i. two separate warnings occur, a buzzer and a red flasher light in the dial of the pressure gauge.

When the pressure in the system is above 60 p.s.i. an electrical circuit incorporated in the pressure gauge is "open", but when the pressure drops below 60 p.s.i., the circuit is automatically "closed" and current then flows to the indicator light and to the buzzer, which then operate until the pressure is restored or the ignition is switched off.

Access to the bulb is obtained by pulling the bulb holder out of its socket in the back of the gauge. The bulb is a miniature bayonet cap 12V. 2 CP Flasher type.

Testing

1. Drain air brake system, turn on ignition key and start engine. The low pressure indicator buzzer must sound until the air pressure in the air brake system reaches a point between 54 and 66 pounds when the buzzer must stop sounding, and the warning light goes off.

2. Continue to build up air pressure in the air brake system until the pressure reaches at least 75 pounds, stop engine, and reduce the air pressure in the air brake system by making brake applications. Check to see at what pressure the buzzer again sounds. The buzzer must sound when the pressure in the air brake system reaches a point between 66 and 54 pounds.

Leakage Test

With the air brake system fully charged apply the soap sud test to all pipe joints including the (manifold fitting) to the gauge. No leakage is permissible. Should leaks occur in the gauge itself, the gauge must be replaced.

AIR PRESSURE GAUGE

Description

1. The purpose of the air pressure gauge is to register the amount of air pressure in the air brake system. While air pressure gauges of this type are commercially accurate, they must never be confused with, or substituted for, test air gauges which are intended primarily for accurately checking air pressure in the air brake system.

2. Only test gauges known to be accurate are to be used for checking brake valve delivery pressures, governor pressure settings, and other tests. Test gauges differ from ordinary dash gauges in respect to material and workmanship much as an expensive watch differs from a cheaper one, and due to these differences they are more accurate over their entire range, and maintain their accuracy over longer periods.

Testing

1. Check the air gauge for accuracy. The simplest way to do this is to compare the pressures registered by the gauge over its normal pressure range with the pressures registered by a test gauge known to be accurate.

2. A gauge which loses its accuracy must be replaced. The continued use of a gauge showing an error of more than 5 pounds is not recommended.

RESERVOIRS

1. Reservoirs are tested against a 200 pound pressure.

2. The purpose of reservoirs is to provide a place to store compressed air so that there will be an ample supply available for immediate use in brake operation. They also provide storage for sufficient compressed air to permit several brake applications after the engine has stopped. Another function of a reservoir is to provide a place where the air, heated during compression, may cool and cause the oil and water vapours to condense.

Testing

1. LEAKAGE TESTS: With the air brake system charged, coat the outside of the reservoir with soap suds to check for leakage. If any leakage is found, replace the reservoir.

2. INSPECTION: Inspect inside and outside surfaces for damage or corrosion. A small flashlight is helpful when inspecting the interior. If damage or corrosion is found that would weaken the reservoir, replace the reservoir.

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

DRAIN COCKS

Description

1. Drain cocks have a brass body fitted with a tapered brass key. The drain cock is opened when the handle is parallel to the body and closed when the handle is at right angles to the body. Drain cocks are installed in the bottom of each reservoir in the air brake system to provide a convenient means of draining the condensation which normally collects in the reservoirs.

2. Always open a drain cock by hand. Never strike the handle with a hammer or any other instrument, as the cock would be damaged and leakage would develop.

Testing

1. With the air brake system charged, test with soap suds for leakage past the key. Also check for leakage through the body by coating the outside of the drain cock with soap suds. Leakage in excess of a 3 inch soap bubble in 3 seconds is not permissible.

2. Leakage is caused by a dirty or scored key or body. Leakage due to dirt is corrected by cleaning parts and applying a thin coating of cup grease on the key. Leakage due to a scored key or body cannot be repaired, and the drain cock must be replaced.

HOSE COUPLINGS

Description

1. Hose couplings provide an easy and convenient method of connecting and disconnecting air lines between vehicles by hand. The design of the hose couplings is such that when two of them are coupled together pressure is put on two rubber gaskets, making an air-tight seal.

Testing

1. With the hose couplings connected and brakes applied, coat the hose couplings all over with soap suds to check for leakage. There must be no leakage.

2. Leakage is usually caused by worn, damaged, or improperly installed gaskets. To correct leakage, install new gaskets.

3. Remove old gasket by prying out with a screwdriver. Before attempting to install a new gasket, be sure the groove in the coupling in which the gasket fits is thoroughly cleaned. Otherwise it will be impossible to install a new gasket properly.

4. To install a new gasket, partially collapse it with the fingers (Fig. 5) and enter one side of the gasket flange in the groove in the coupling.

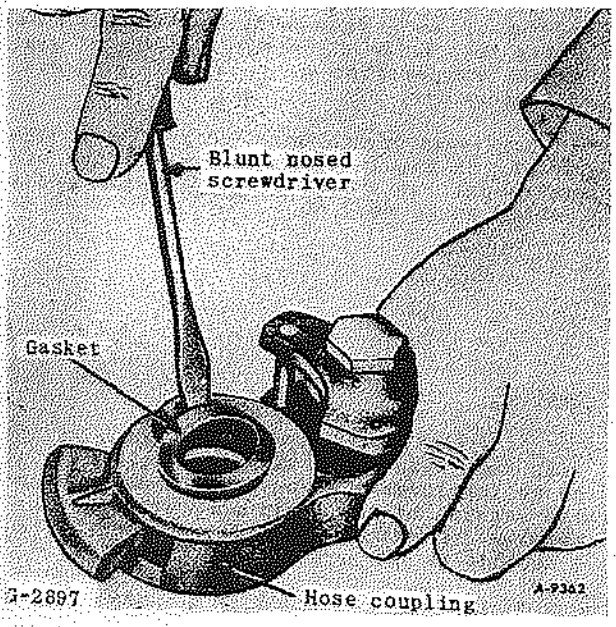


Fig. 4 - Trailer Brake Coupling

5. Then use a blunt nosed screwdriver or similar instrument to push the gasket into place (Fig. 4). When properly installed, the exposed face of the gasket will be flat, not twisted or bulged at any point.

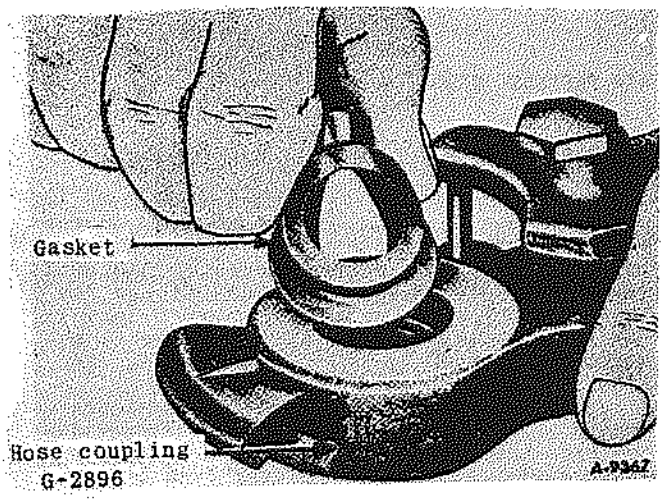


Fig. 5 - Trailer Brake Coupling

TUBING

Operating Tests

If any evidence is found that a tubing line is restricted, remove and blow air through it in both directions to be sure the passage through the tubing is not obstructed in any way, Inspect tubing for partial restrictions such as may be caused by dents or kinks. Damaged tubing must be replaced.

Leakage Tests

With the air brake system fully charged, the governor cut out, and brakes applied, coat all tubing lines and fittings with soap suds to check for leakage. No leakage is permissible. Leakage at a tubing fitting is sometimes corrected by tightening the tube fitting nut. If this fails to correct the leakage, replace the tubing fitting, the tubing, or both.

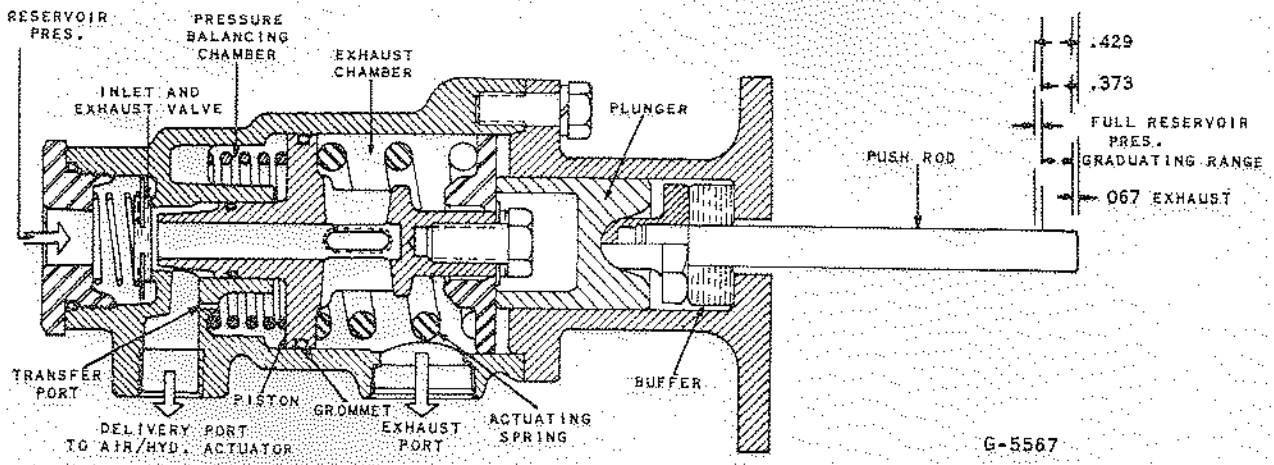


Fig. 6 - Brake Valve

BRAKE VALVE

The Bendix Westinghouse Brake Valve (push type E), is used in conjunction with an air/hydraulic actuator. The function of the brake valve is to control the pressure of air applied to the actuator, and thus the pressure the actuator in turn applies to the hydraulic brakes.

The brake valve is mounted in the front end compartment, access to it being through the compartment cover. It is coupled to the brake pedal by means of a push rod and yoke, to the brake control lever which is keyed to the brake pedal cross shaft, the brake pedal is also keyed to this shaft.

Operation (Refer to Fig. 6)

When the brake pedal is depressed the push rod moves forward and pushes the plunger and spring seat against the actuating spring. As this spring is compressed by further movement of the brake pedal the spring in the pressure balancing chamber is compressed, allowing the piston to move forward until its projection pushes the control valve off its seat.

Air from the reservoir then passes the valve and enters the delivery chamber and out through the delivery port to the air/hydraulic actuator. A small flow of air also passes through the transfer port into the pressure balancing chamber. This builds up pressure in the chamber against the piston and assists the balancing spring to move the piston back until a balance is achieved and a given pressure maintained at the delivery port.

In this way braking pressure is raised or lowered by the pressure applied to the actuating spring, since the further the foot pedal is applied the greater will be the opening of the control valve.

When the brake pedal is released the balancing spring, assisted by the air pressure in the balance chamber, moves the piston backwards, thus allowing the valve to shut off the air from the reservoir. Further backward movement of the piston then allows air in the delivery chamber to pass through the piston into the exhaust chamber and out through the breather to the atmosphere.

Adjustment (Refer to Fig. 7)

Correct adjustment of the brake pedal and push rod is obtained by means of the adjustable pedal stop, and the threaded yoke on the push rod.

Pedal Adjustment is as follows (Refer to Fig. 7)

1. First ensure that the clutch pedal is adjusted as shown in Section L, Page 7.

2. With the brake valve securely mounted in place, and the push rod (Fig. 6) held back against the buffer (Fig. 6) adjust the push rod yoke (Fig. 7) until the brake pedal pad is level with the clutch pedal pad.

3. Tighten up the yoke lock nut and check to ensure that the clevis pin is secured with a split pin.

Hold the push rod with a pair of grips and tighten up the lock nut. It is important that the push rod does not turn with the lock nut, since this will upset the pedal adjustment.

Brake Valve Leakage Tests

With the air reservoir at full pressure and brakes released, coat the exhaust port with soap suds and check the condition of the inlet valve. Leakage at this valve will escape through the exhaust port. Leakage in excess of a one inch soap bubble is one second is not permissible.

Brake Valve Pressure Test

Remove the pipe plug from the secondary delivery port and screw in securely a reliable pressure guage. With the reservoir full, press the brake pedal to its full travel and observe the reading on the test gauge. This should show maximum pressure approximately equal to that shown on the instrument gauge on the vehicle.

If a low pressure is indicated check for restriction in air lines from reservoir to brake valve such as damaged pipes, foreign matter, or air leaks.

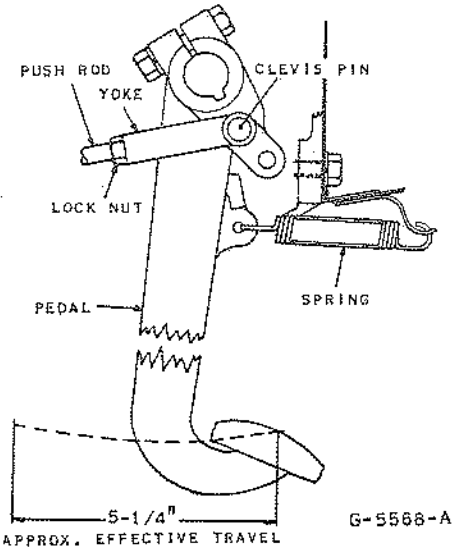


Fig. 7 - Brake Pedal Adjustment

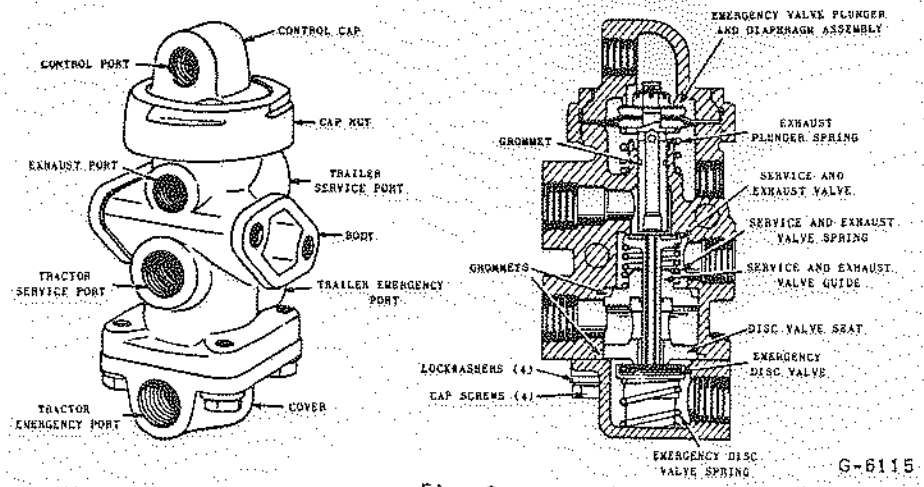


Fig. 8
Exterior and Sectional Views of Tractor Protection Valve

TRACTOR PROTECTION VALVES

DESCRIPTION

Basically, the Bendix-Westinghouse Tractor Protection System functions as a set of remotely controlled cut-out cocks. The trailer service and emergency lines pass through the valve.

OPERATION

Should a condition resulting in air loss from the tractor or trailer system occur which is not detected by the operator, the tractor protection valve will automatically close the air lines leading to the trailer and apply the trailer brakes by actuating the relay emergency valve on the trailer. This action will normally occur only after the operator has been forwarned by low pressure indication.

PREVENTIVE MAINTENANCE

Once a year the tractor protection valve should be disassembled and cleaned. Rubber parts and parts subject to wear should be replaced if worn or damaged.

OPERATING AND LEAKAGE CHECKS

Check dash air gauge against a test gauge known to be accurate prior to performing these tests. Install the test gauge in a "glad hand" hose coupling for use in these tests.

A. Block and hold vehicle by a means other than air brakes during these tests.

B. The following procedure should be carried out to be sure that the truck-tractor protection valve operates properly.

With the tractor reservoir at atmospheric pressure, the emergency and service line cut-out cocks open, and the emergency and service line couplings disconnected, connect the assembled coupling and test gauge in the tractor service coupling and start the engine to build up air pressure in the air brake system. When the reservoir pressure reaches about 30-40 psi, make a foot or hand brake valve application and note that pressure is indicated on gauge in the service coupling. Release the application. There should be no noticeable leakage at the emergency coupling until the reservoir pressure on the tractor reaches about 45-55 psi, and then observe the air passes through the emergency coupling. Close the emergency stop cock.

C. Continue to build up air pressure in the truck-tractor air brake system, until fully charged. Stop the engine.

D. Close the trailer service line stop cock and remove the hose coupling and test gauge assembly.

E. Observe that there is no leakage at the tractor emergency line coupling. Make and hold a foot or hand valve service brake application. Observe that there is no leakage at the tractor service line coupling. Release the application.

F. Connect the coupling and test gauge to emergency line coupling and open the stop cock. Note that tractor reservoir pressure is indicated on test gauge. Turn on ignition key, open drain cock on tractor and bleed down, observing that low pressure indication occurs at prescribed air pressure, normally about 60 psi. Observe that tractor protection valve vents the emergency line at about 30-40 psi test gauge reading which action will automatically apply the trailer brakes by actuating the relay emergency valve when a trailer is connected.

G. Disconnect emergency coupling and test gauge and with both cocks open, make and hold a service brake application on the tractor. There should be no noticeable leakage at either the emergency or service couplings on the tractor below 25 psi tractor reservoir pressure.

REMOVING AND INSTALLING

REMOVING

Drain air brake system.

Remove five (5) air lines from tractor protection valve.

Remove valve from vehicle.

INSTALLING

When installing the valve, use reverse procedure to removing (5) air lines, along with the following instructions.

1. Control port and cap. - Connect line from tractor protection control valve tee.

2. Exhaust port. - Must be open to permit venting the trailer emergency line.

3. Trailer service port. - Connect trailer service line.

4. Tractor service port. - Connect tractor service line from double check valve (two way shuttle valve).

5. Trailer emergency port. - Connect trailer emergency line.

6. Tractor emergency in cover. - Connect tractor emergency line from tractor protection valve tee.

DISASSEMBLY (Refer to Fig. 8)

IMPORTANT:

Three (3) springs in valve should be carefully marked as to their proper location in valve as valve is disassembled.

1. Remove four (4) cap screws, lock washers, and cover from valve.

2. Remove emergency disc valve and emergency disc valve spring from cover.

3. Remove emergency disc valve seat, service and exhaust valve guide, "O" rings, service and exhaust valve, and service and exhaust valve spring from body.

4. Remove cap nut and control cap.

5. Remove exhaust valve plunger and diaphragm assembly from body.

6. Remove exhaust plunger spring from body.

7. Inspect bores in valve body to be sure they are not damaged or out of round. Clean body, control cap and cover.

CLEANING AND INSPECTION OF PARTS

Wash all metal parts in cleaning solvent and dry them thoroughly.

Inspect all moving parts for wear or damage and bores for out of round condition.

Inspect diaphragm and bonded rubber valves for wear or deterioration.

Inspect springs for breaks or deterioration.

Inspect valve seats for nicks or burrs.

Replace any parts which are no longer serviceable by these inspections.

ASSEMBLY

1. Prior to assembly, note that the "O" ring is in position in its groove in the stem of the exhaust valve plunger and diaphragm assembly.

2. Lubricate lightly the following surfaces with Liqui-Moly or Moly-Kote or equivalent:-

   (a) Stem and "O" ring of exhaust valve plunger and diaphragm assembly.

   (b) All bores in valve body.

   (c) Stem of service and exhaust valve.

   (d) Three "O" rings.

   (e) Bores and outside surfaces of service and exhaust valve guide and disc valve seat.

3. Position valve body in a vice. Install exhaust plunger spring (dischromated-yellow-gold color) in valve body and install exhaust plunger and diaphragm assembly, being careful not to cut "O" ring on plunger stem. Plunger should be a neat sliding fit in bore. Position control cap and cap nut. Position control cap to desired port angle and holding it firmly on diaphragm to avoid distorting or damaging diaphragm, tighten cap nut.

4. Reposition valve body in the vice and install medium "O" ring in valve body.

5. Preassemble the following parts before installing them in valve. Place service and exhaust valve spring (cadmium plated-silver colored) on service and exhaust valve guide. Install service and exhaust valve in its guide. Place small "O" ring on stem of service and exhaust valve in contact with service and exhaust valve guide. Slide disc valve seat on stem of service and exhaust valve until it contacts service and exhaust valve guide.

6. Carefully install preassembled parts in body and hold in place, making sure that preassembled parts are properly centered in body.

7. Position large "O" ring in its groove in the valve body.

8. Position emergency disc valve spring (black color) and emergency disc valve in cover so that metal side of valve is in contact with spring. Install cover in desired port position and note that "O" ring and emergency disc valve are in position. Hold cover in position and install four (4) lockwashers and cap screws.

TESTING REBUILT TRACTOR PROTECTION VALVE

Apply air pressure to all ports of tractor protection valve except exhaust port and coat ports and valve with soap suds to check for leakage.

Perform operating and Leakage Check as outlined in previous section.

TYPE TC BRAKE VALVE

DESCRIPTION

The TC type brake valve is used to operate the trailer brakes independently of the tractor brakes. The TC brake valve provides the operator with a finely graduated and easily operated means of applying and releasing the brakes. It is mounted on the steering column within easy reach of the operator. The handle is moved in a clockwise direction on application and returned on release. The distance the handle is moved determines the amount of air pressure delivered by the valve.

THE VALVE SHOULD NEVER BE USED TO HOLD THE BRAKES APPLIED WHEN THE VEHICLE IS BEING PARKED UNATTENDED. The phrase *NOT FOR PARKING* is cast on top of the control handle to warrant against its misuse.

OPERATION (Refer to Fig. 9)

APPLYING

When the handle is moved in a clockwise direction from the released position, force is exerted on top of the pressure regulating spring through the action of the cam and cam follower. The force on top of the spring causes the piston to move down. The piston stem, which is the exhaust seat, contacts the exhaust valve and closes the exhaust passage in the valve. At the same time the exhaust closes, the continued downward movement of piston moves the inlet valve off its seat. Air pressure from the reservoir then flows by the open inlet and out the delivery port, through the service line and applies the brakes.

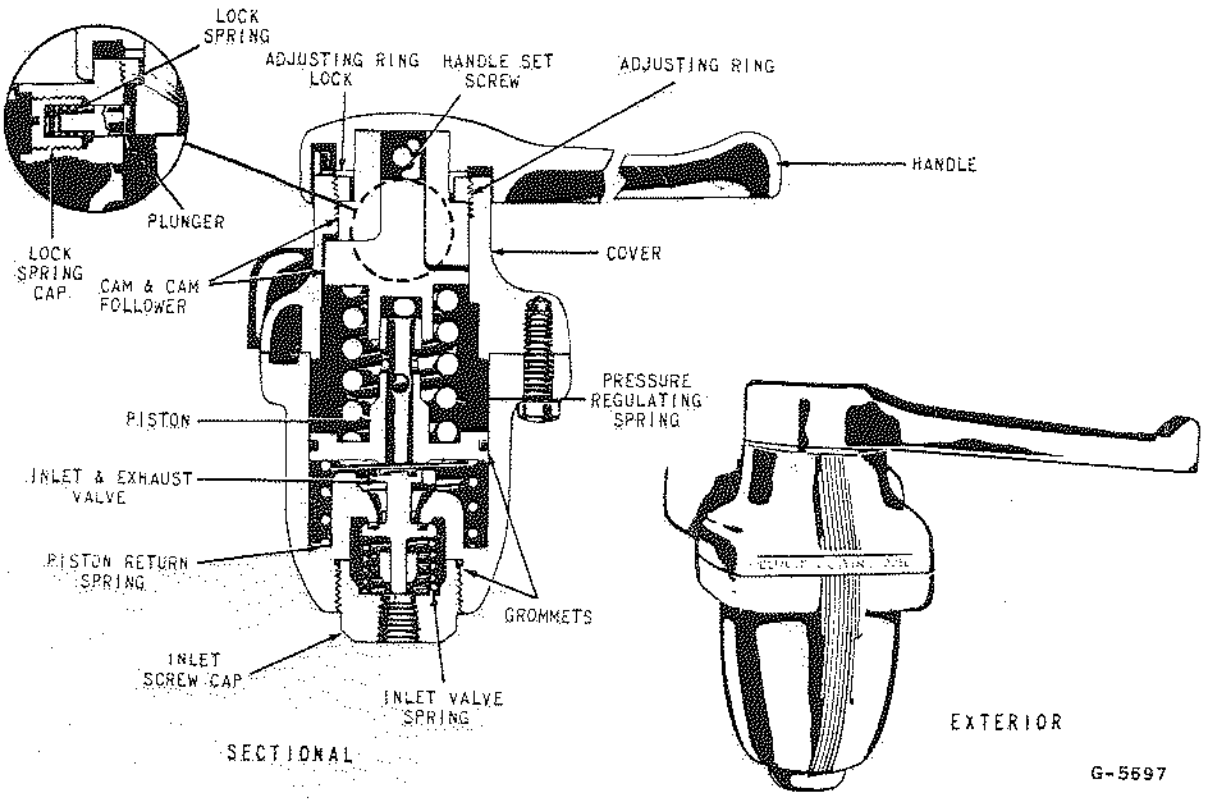


Fig. 9 - Type TC Brake Valve

BALANCED

As the force of the air pressure beneath the piston balances the force of the depressed graduating spring above, the piston lifts and the inlet valve returns to its seat. The exhaust valve remains seated so the flow of air through the valve is stopped and the air pressure in the service line is held.

RELEASING

From the balanced position, when the handle is moved in a counter clockwise direction, the force above the piston is decreased. Now the air pressure beneath the piston, because it is greater, will lift the piston and open the exhaust. This allows the air pressure in the service line to exhaust back through the valve and out the exhaust port.

PREVENTIVE MAINTENANCE

Every 500 Operating Hours or After Each 50,000 Miles.

It is recommended that the inlet and exhaust valve and the rubber grommets be lubricated and replaced if they show signs of deterioration or wear.

Every 3,000 Operating Hours or After 100,000 Miles.

Disassemble TC brake valve. Clean and inspect all parts. New parts should be installed where they are found on inspection to be worn or damaged.

SERVICE CHECKS

OPERATION

Check the delivered pressure of the valve with a test gauge known to be accurate. Move the control handle to the fully applied position; it should deliver a maximum of 85 PSI. Some special TC valves are preset to deliver higher or lower pressures, but the standard valve used on tractor-trailer combinations is set at 80 PSI.

Move the handle between the released and fully applied positions and note that the air pressure registered on the test gauge varies accordingly.

LEAKAGE

With the valve handle in the released position, check the exhaust port for inlet valve leakage.

With the handle in the fully applied position, check the exhaust port for exhaust valve or piston grommet leakage.

In either of the above checks, excessive leakage is not permitted.

If the brake valve does not function as described or leakage is excessive, it is recommended that it be returned to the nearest Bendix-Westinghouse authorized distributor for a factory rebuilt valve under the repair exchange plan. If this is not possible, the valve can be repaired with genuine Bendix-Westinghouse parts, in which case the following should be helpful.

REMOVING AND INSTALLING

REMOVING

Block or hold vehicle by means other than air brakes.

Drain air brake system.

Disconnect air lines at bottom of the valve, including the exhaust carry-off line if installed. Remove mounting bolts, clamp, and then valve.

INSTALLING

Check and clean air lines to valve. Mount valve with clamp and bolts. Tighten bolts evenly so mounting clamp does not bend or break.

DISASSEMBLY

Remove set screw from handle and lift off.

Lift out adjusting ring lock.

Remove adjusting ring nut with a suitable Spanner wrench.

Remove plunger lock spring cap, spring, and then plunger.

Remove four screws that hold the body to cover and separate cover from body.

Remove pressure regulating spring, cam, and cam follower.

Pull piston assembly from body and lift out the piston return spring.

Remove piston grommet.

Remove inlet screw cap.

Remove inlet valve spring, then inlet and exhaust valve.

CLEANING AND INSPECTION

Wash all metal parts in good cleaning solvent and dry.

All rubber parts should be wiped clean and dried.

Inspect all parts for excessive wear or deterioration.

Check springs for cracks, corrosion or distortion.

Inspect valve seats and piston bore for nicks and burrs.

Replace all parts not considered serviceable during these inspections.

ASSEMBLY

Before assembling the valve lubricate the piston, grommet, piston and valve bores with Bendix-Westinghouse recommended lubricant, piece number 239378. Place inlet and exhaust valve in body, follow with inlet valve spring and screw cap grommet. Install inlet screw cap into body making sure the inlet and exhaust valve guide stem fits into the guide hole of the screw cap. Tighten inlet screw cap just enough to compress its grommet to prevent leakage.

Place piston return spring in body.

Install piston grommet and place piston into body.

Place pressure regulating spring over piston.

Install cam in bottom of the cover.

Install cover with cam on body. Make sure the piston stem fits into the cam counterbore. Connect body and cover together with the four cap screws and tighten.

Place cam follower in cover over top of the cam so the indent groove aligns with the lock plunger hole.

Install lock plunger, spring and spring cap; tighten the lock spring cap and prick punch to prevent it from working loose. Install adjusting ring, screw it down until the top of the ring is flush with cover.

Install adjusting ring, lock with its lock prong positioned in the cover slot. Place handle over cam follower and align the hole in the handle with the one in the follower.

Install handle set screw and tighten securely.

TESTING REBUILT TC BRAKE VALVE

Perform "Operation and Leakage Checks" as outlined in "Service Checks" section.

QUICK RELEASE VALVES

DESCRIPTION

The quick release valve speeds up the release of air pressure from the brake chambers. When a brake valve application is released, the exhaust of the quick release valve opens and the air pressure accummulated in the brake chambers is exhausted through the quick release valve, rather than exhausting back through the brake valve. In an air brake system where a quick release valve is used, the release of all brake chambers is naturally more expedient.

The quick release valve is mounted on the air/hydraulic actuator. The valve should be mounted with its exhaust port pointing down. A line from a delivery port of the brake valve is connected to the top port of the quick release valve. The two side ports are for brake chamber connections and the bottom port is its exhaust. Only one of the side ports is used on the I.H. Mark 3 vehicles, the other side port being sealed by a plug.

OPERATION

When a brake valve application is made, air pressure enters the top port of the quick release valve, moves the diaphragm down, closing the exhaust port. At the same time this air pressure forces the edges of the diaphragm down and flows by into the brake chambers.

As soon as the brake chamber pressure beneath the diaphragm equals the air pressure being delivered by the brake valve, the diaphragm spring forces the outer edges of the diaphragm against the body seat. The exhaust port is still sealed by the centre portion of the diaphragm. When the brake valve is released air pressure above the diaphragm is exhausted. Now, the pressure under the diaphragm raises it and the exhaust port opens allowing brake chamber pressure to release.

PREVENTIVE MAINTENANCE

Every year or after 50,000 miles remove the quick release valve, dismantle it and clean all parts.

The diaphragm should be replaced if worn or deteriorated.

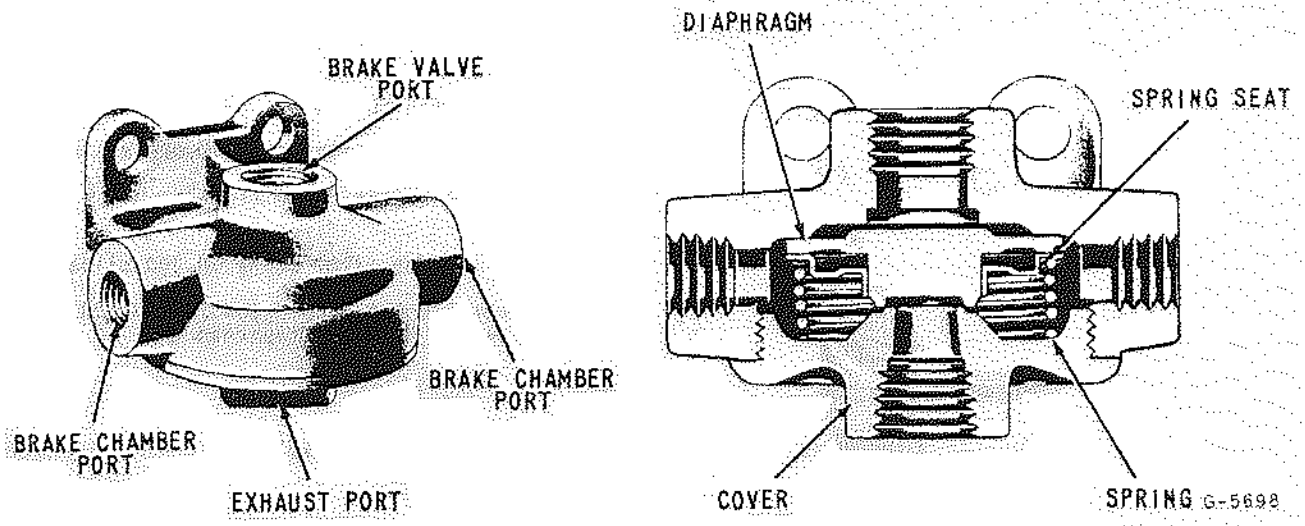


FIG. 10 - QUICK RELEASE VALVE

OPERATING TEST

Push the stroke indicator plunger on the air/hydraulic actuator to the released position, make a brake application and observe the indicator to see that the actuator chamber operates.

Release the application and observe that the air pressure is quickly exhausted through the exhaust of the quick release valve.

LEAKAGE TEST

Make and hold a brake valve application and check the exhaust port of the quick release valve for leakage. If the quick release valve does not function properly or leaks excessively, we recommend that it be returned to the nearest Bendix-Westinghouse authorized distributor for a factory reconditioned valve on our repair exchange plan, or it should be repaired with genuine Bendix-Westinghouse parts in which case the following information should prove helpful.

REMOVING AND INSTALLING

REMOVING

Drain air brake system.

Disconnect air line from quick release valve and unscrew the Q.R. valve from the actuator fitting.

INSTALLING

Screw the quick release valve with it's fitting into the actuator pressure chamber finally tightening it with the exhaust port downwards.

Connect the air line from the two way shuttle valve into the top port. Check to see that the exhaust port is not restricted.

DISASSEMBLY

Remove cover using wrench on square portion of exhaust port.

Remove spring, spring seat and diaphragm.

CLEANING AND INSPECTION

Clean all parts in good cleaning solvent.

Inspect diaphragm, especially the lower part that contacts the exhaust seat for wear or deterioration.

Check the cover exhaust seat for pitting or nicks. This seat should be smooth and sharp. If not, use a fine piece of emery cloth to dress the seat.

Check the spring and spring seat for wear or corrosion. Clean or replace as necessary.

ASSEMBLY

Position the spring seat over the diaphragm and then both into the body.

Position spring in place.

Install cover and tighten securely.

TEST OF THE REBUILT QUICK RELEASE VALVE

Perform the Operating and Leakage tests under Service Checks section.

STOPLIGHT SWITCH

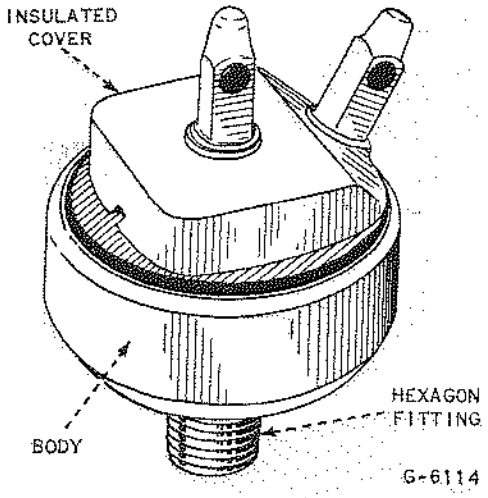


Fig. 11 - Stoplight Switch

DESCRIPTION

The Stop Light Switch, an electro-pneumatic switch, operates in conjunction with the Brake Valve and stop light by completing the stop light electrical circuit when a brake application is made.

It consists of a die cast body, a rubber diaphragm and an insulated cover on which are mounted the electrical connections. Inside the Switch above the Diaphragm a Contact Plunger Plate fitted with a contact point makes contact with the upper contact when air pressure enters the Switch below the Diaphragm. The coil spring is in the electrical circuit and connects the Contact Plunger with one of the electrical terminals.

OPERATION

When air pressure from the Brake Valve enters the cavity on one side of the Diaphragm, the Diaphragm changes its position, overcoming the force of the Spring and moving the Contact Plunger until the electrical contacts close. This closes the Stop Light circuit. It is designed to close as soon as 5 pounds of air pressure is delivered to it. This means the Stop Light circuit closes immediately as brake application is made.

When the air pressure acting on the Diaphragm is exhausted by the Brake Valve, the Spring forces the Diaphragm and the Contact Plunger back to their normal position and the Stop Light circuit is open.

PREVENTIVE MAINTENANCE

A. Every month or after each 10,000 miles

1. Check electrical connections.

B. Every year or after every 50,000 miles

1. Disassemble the Stop Light Switch and clean all parts. Replace Diaphragm.

TESTING FOR SERVICEABILITY

A. Operating Test

1. Apply the brake valve and note that with the first downward movement of the brake valve pedal, the Stop Light immediately lights.

2. Release the brake valve and note that the Stop Light goes "off".

B. Leakage Test

1. With the brakes applied, no leakage is permitted at the Stop Light Switch.

REMOVING

To remove the Stop Light Switch.

1. Disconnect electrical connections at the Stop Light Switch.

2. Screw the switch completely out of the T fitting in the air line to the tractor protection valve.

DISASSEMBLY

Unscrew the cover from the body and lift out the spring contact plunger, diaphragm ring, and diaphragm.

CLEANING AND INSPECTION

Clean all metal parts in cleaning solvent.

Examine diaphragm. If diaphragm is cracked, worn or damaged, replace with new diaphragm. Inspect the contact points for signs of pitting or wear. If pitting is not too severe, the contacts may be reconditioned by filing them

with a fine file such as is used for distributor points. If they cannot be reconditioned, they should be replaced.

Check the spring for tension. If it has lost its tension, it should be replaced.

If the body or cover are cracked or damaged, they should be replaced.

ASSEMBLY

Place the diaphragm on the body, followed by the diaphragm ring.

Position contact plunger on the diaphragm.

Attach the cover to the body.

TEST OF REBUILT STOP LIGHT SWITCH

Both operating and leakage tests, as indicated under section headed "Testing for Serviceability", must be made after rebuilding or repairing the Stop Light Switch. The Switch must meet the following specifications;

1. No leakage is permissible at the Stop Light Switch with the Brakes applied.
2. The Stop Light Swtich contacts should close with not more than 5 pounds of air pressure.

SINGLE CHECK VALVE

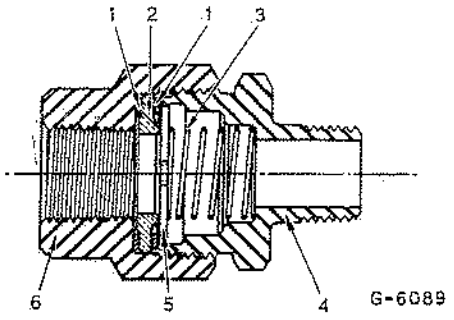


Fig. 12 - Single Check Valve

LEGEND

1. COPPER GASKET
2. VALVE SEAT
3. VALVE SPRING
4. SCREW CAP
5. DISC VALVE
6. BODY

DESCRIPTION

The single check valve is a small device placed in the air line to the reservoir to allow air passage in one direction only and prevent passage in the reverse direction.

OPERATION

The check valve is a disc type (Fig. 1) which contains a spring loaded disc which seats against air inlet in one end of an inner chamber. Air flow from the compressor moves the check valve from its seat and the flow is unobstructed. Flow in the reverse direction is prevented by the seating of the disc, which is caused by the action of the spring and assisted by the air pressure.

LEAKAGE TEST

Supply air pressure to the check valve. Coat the open end of the check valve with soap suds. Leakage should not exceed a one inch soap bubble in one second.

PREVENTIVE MAINTENANCE

Every year of after 50,000 miles. The check valve should be dismantled and thoroughly cleaned.

SERVICE CHECK

Every six months the check valve should be given an operating test and leakage test.

REMOVING

Disconnect air lines at single check valve and remove.

INSTALLING

The Single check valve is mounted horizontally. An arrow is stamped on the body indicating the direction of normal air flow, into the reservoir.

DISASSEMBLY

Unscrew cap nut from body and remove internal components.

CLEANING AND INSPECTION OF PARTS AND REPAIRS

Clean all parts in cleaning solvent. Inspect disc valve and seat for pitting or corrosion. Inspect body and cap nut for cracks or damage. Replace damaged parts. It is advisable to replace the two copper sealing gaskets (reference 1, Fig. 1) one on either side of the check valve seat.

ASSEMBLY

Lightly lap valve seat and disc valve.

Assemble internal components ensuring that there is a copper sealing gasket on each side of the valve seat.

Screw body into cap nut and tighten just enough to ensure an airtight seal. If the assembly is tightened too much the copper seals will distort resulting in leakage.

TEST OF REBUILT SINGLE CHECK VALVE

Both operating and leakage tests as previously described under "Service Check" must be made after rebuilding or repairing a single check valve.

Adjustment

To obtain the maximum efficiency from the hand brake the linkage must be correctly adjusted.

The following sequence of making the various adjustments is recommended.

1. With the hand brake lever in the fully off position apply the foot brake hard two or three times to centralize the shoes in the drums.

2. Disconnect the right and left hand transverse rods at the compensator end (Fig. 1).

3. By means of the brake shoe wedge adjusters, the square ends of which project from the backing plates at the rear of the axle, expand the shoes hard against the drums, and leave them thus until all linkage has been adjusted. This ensures that the bisectors at the opposite ends of the shoes are held in the "off" position.

4. Now adjust the yoke ends of the transverse rods to obtain dimension "A" and adjust the short rod (Fig. 1) to obtain dimension "B".

These settings must be checked with both transverse clevis pins in place.

5. The next step is illustrated in Fig. 2. Disconnect both adjustable yokes from the relay lever. Adjust the rear yoke until dimension "C" is obtained.

6. Now adjust the front yoke Fig. 2 to obtain dimension "D", Fig. 3.

7. Disconnect the adjustable yoke from the hand brake lever rod. Check to see that the hand brake lever is in the fully off position, and adjust the yoke until the clevis pin just goes in.

8. Tighten up all adjustable yoke lock nuts and secure all clevis pins with new split cotter pins.

9. Back off the brake shoe adjusters (mentioned in paragraph 3) until the drums turn without rubbing on the shoes.

10. With the rear wheels jacked clear of the ground apply the hand brake until the brakes are rubbing hard and check by turning the wheels to see that braking is equal. If not, let off the tighter of the two by means of the shoe adjuster until equality is obtained, and road test for final correction.

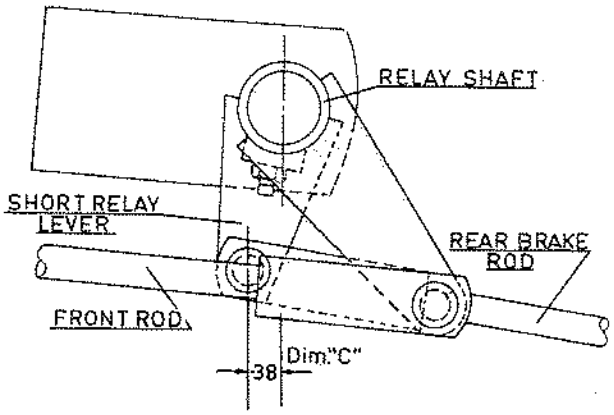


FIG.2 HANDBRAKE RELAY G-6062

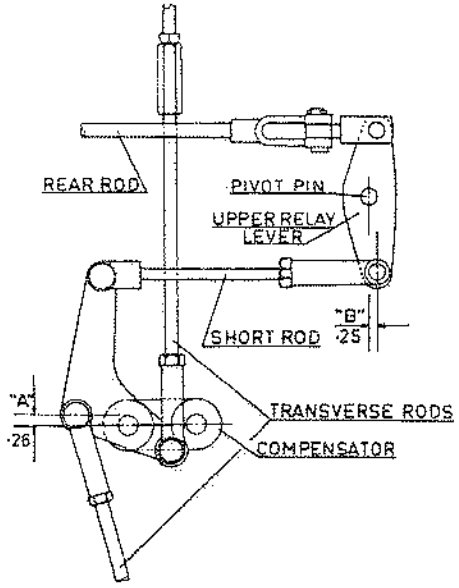


FIG.1 COMPENSATOR ADJUSTMENT G-6061

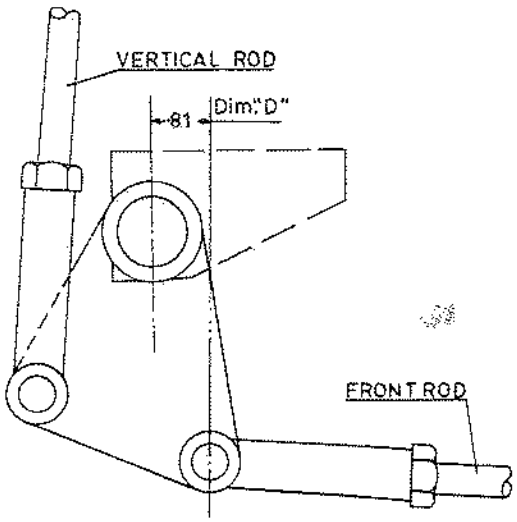


FIG.3 BELLCRANK G-6063

2-1/2 TON 4x4 G.S. - INTERNATIONAL

Type	Full floating
I.H. Model	RA-30 (Modified)
Pinion mounting	Straddled
Drive	Hotchkiss
Gears	Hypoid
Pinion adjustment press	10 Tons
Axle ratio	7.166 : 1
No. of teeth pinion	6
No. of teeth ring gear	43
Torque capacity	10544 ft/lbs.
Cage rotating torque (Scale Reading)	10-25 lbs.
Differential bearing preload	.005" - .007"
Lubricant capacity (Imp. pints)	7.9
King pin inclination	6 deg. 40
Wheel camber angle	1 deg. positive
King pin bearing preload	6-10 lbs. (See Text)
Front wheel toe-in	1/16 - 3/16 measured at side of wheel rims
Steering angle (Neutral to lock stop on inner wheel)	33 deg.

For torque wrench loadings refer to Section "G" rear axle except:-

Bell housing (tracta) flange bolts	70 to 80 ft/lbs.
King pin cap slotted nuts (top and bottom)	90 ft/lbs.
Stub axle flange bolts	30 to 35 ft/lbs.
Nuts - hub driving flange	120 ft/lbs.

LEGEND

1. Rim
2. Inner wheel bearing
3. Oil seal
4. Bolt
5. Spring washer
6. Brake drum
7. Dust shield brake drum
8. Brake torque plate
9. Gasket
10. Tracta joint housing outer
11. Steering arm stud
12. Steering arm R.H.
13. Steering arm L.H.
14. Shim stack
15. Capscrew
16. Spring washer
17. Top king pin bearing
18. Tracta joint
19. Shock absorber bracket
20. Tie rod socket
21. Split pin
22. Axle flange, shock absorber mounting bolt
23. Spring washer
24. Nut (See also 34, 35, 36)
25. Ball bolt
26. Nut
27. Split pin
28. Tie rod
29. Front axle housing
30. Driving axle, front, inner
31. Bolt
32. Washer (spring)
33. Nut
34. Bell housing flange bolt
35. Bell housing flange spring washer
36. Bell housing flange nut
37. Lubricator
38. Locating collar, inner axle
39. Bush, inner axle
40. Gasket
41. Bottom king pin bearing
42. Bell housing, tracta joint
43. Serrated oil retainer (2 halves)
44. Retainer, serrated, oil seal (rubber)
45. Ring seal (assembly)
46. Spacer, seal
47. Retainer, inner seal
48. Stud, bottom king pin bearing (3)
49. Cap, bottom, king pin
50. Spring washer
51. Slotted nut
52. Wire
53. Bolt
54. Spring washer
55. Brake shoes
56. Tube, grease trap
57. Grease trap
58. Screw
59. Spring washer
60. Outer wheel bearing
61. Nut, inner, wheel bearing adjusting
62. Lockwasher
63. Nut, outer, hub bearing
64. Hub front
65. Gasket
66. Driving flange
67. Centre cap screw
68. Spring washer
69. "O" ring seal
70. Retainer "O" ring
71. Sling ring lock nut
72. Sling ring
73. Stud, drive
74. Stud, wheel, R.H.
75. Stud, wheel, L.H.
76. Wheel nut
77. Snap ring, driving axle, outer
78. Driving axle, front, outer
79. Stub axle
80. Bush, axle, outer
81. Wheel stop
82. Filler plug
83. Brake return springs
84. Brake hose
85. Steering arm extractor holes
86. Driving flange extractor holes
87. Cork Seal

To Dismantle the Front Hub, "Tracta" Joint and Drive Shafts

1. Remove wheel. Both right and left wheel studs have right hand threads.

2. Remove the six slotted lock nuts located in the sling ring from the driving studs which will allow the sling ring to come free (See Fig. 1).

3. The centre cap screw (Fig. 2) can be removed from the end face of the driving flange (Fig. 1) to come free with 'O' ring, retainer and cork seal, located in the centre of the flange. The driving flange, however, may still be quite firm in position, in which case the centre cap screw can be used as a puller in the extractor holes (Fig. 2) tapped through the driving flange for that purpose.

4. The wheel bearing outer adjusting nut is now exposed. The locking tab on one side of the hexagon must be bent away from the flat and the nut can be unscrewed using the special wheel bearing tube spanner supplied. The nut locking washer is now removed, following which the inner adjusting nut can be unscrewed and the outer wheel bearing cone removed (Fig. 2).

5. The hub will then slide off the stub axle, exposing the brake shoe assembly (Fig. 3)

6. The brake shoes are removed and the brake hose disconnected from the wheel cylinder on the inner face of the brake torque plate (Fig. 3).

7. The ten cap screws securing the torque plate and stub axle are removed. A container should be available to catch the oil from the "Tracta" joint housing when the stub axle together with driving axle outer is removed (Fig. 3).

8. To remove the inner driving axle the bell housing flange bolts are removed which will allow the bell housing and outer tracta housing assembly, together with inner driving axle, to slide out. The driving axle is tapped out through the bell housing during which the locating collar is driven off the shaft and this allows it to slide free (Fig. 2).

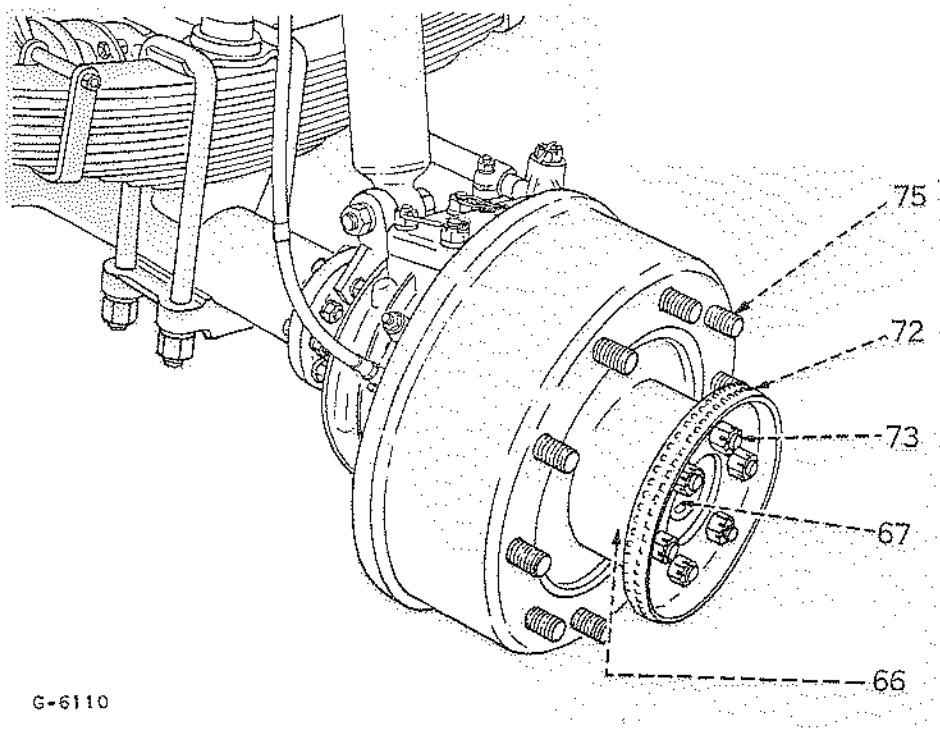


Fig. 1 - Left hand front wheel

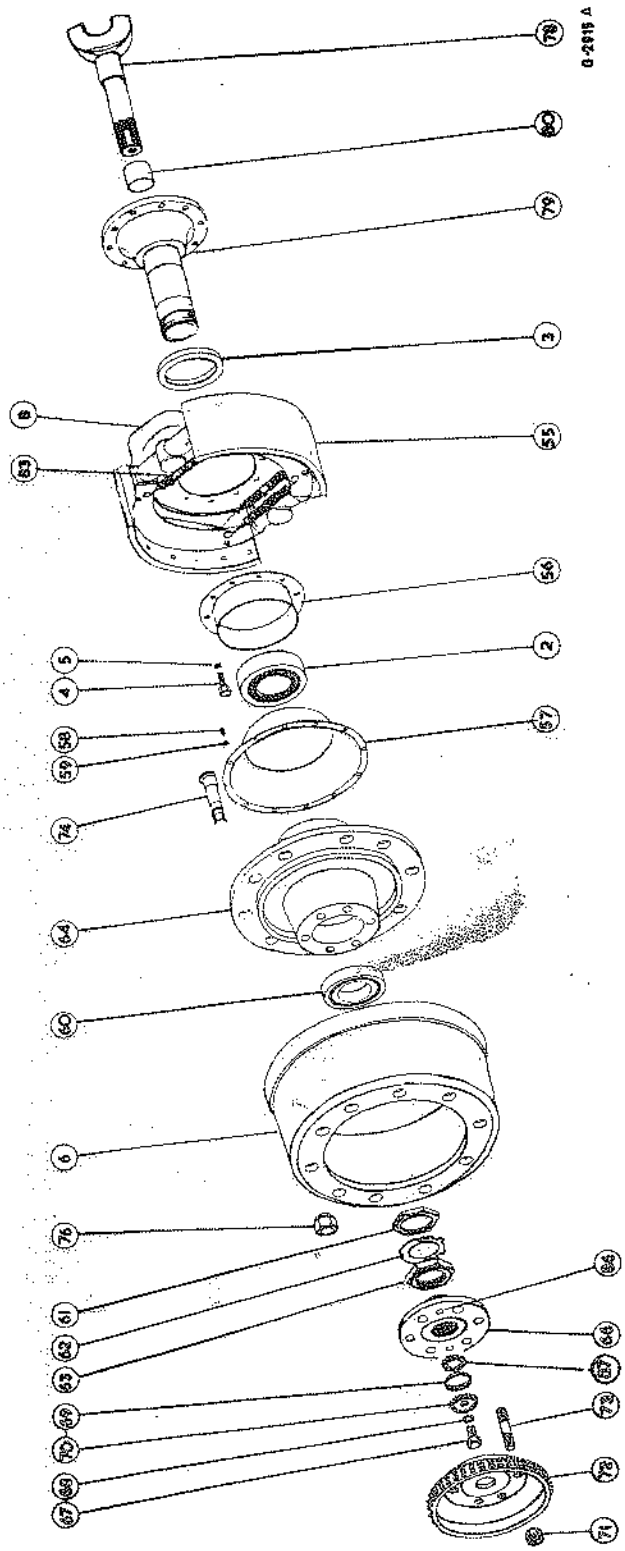


FIG. 2 OUTER RIGHT AXLE

To Dismantle the King Pin Bearings

1. This is done following the above sequence, but it is not essential to remove the inner driving axle and bell housing from the axle housing as in the preceeding paragraph. If desired, these can be left in place.

2. Remove the eleven cap screws from the inner face of the tracta housing outer which allows the rubber sealing ring and metal spacer rings to come free (Fig. 5).

3. Remove the locking wires from the slotted nuts to the top and bottom of the tracta housing outer (Fig. 6).

4. Remove the four slotted nuts securing the steering arm. The steering arm is then removed, using two set screws (3/8 UNC x 2" long) in the extractor holes provided (Fig. 6).

5. The outer tracta housing complete with bottom king pin bearing cone and cap should now come clear of the bell housing.

6. Remove the three slotted nuts holding the bottom king pin bearing cap and extract the cap using the aforementioned set screws.

Removal of Front Differential Assembly

1. Disconnect front propellor shaft.

2. Remove both front wheels. All wheel studs have right hand threads.

3. Remove each wheel hub and constant velocity joint housing assembly complete by removing the twelve bolts through the bell housing flange. The complete assembly with drive shafts will then slide out.

4. The twelve cap screws securing the differenterial carrier assembly can be removed, following which the assembly will come free.

5. Adjustment of the front axle differential assembly is identical with that of the rear axle. NOTE: The front differential assembly is the same as the rear except that the oil scoop attached to the side of the differential is of the opposite hand to the rear, (to allow for the opposite direction of rotation. Serious damage can occur if the correct oil scoop is not used).

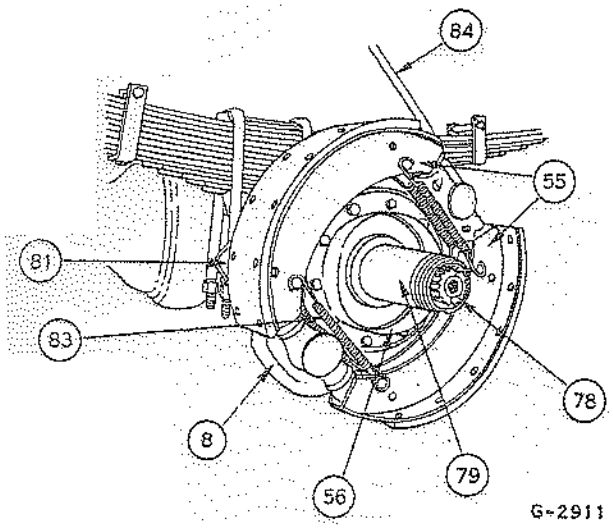
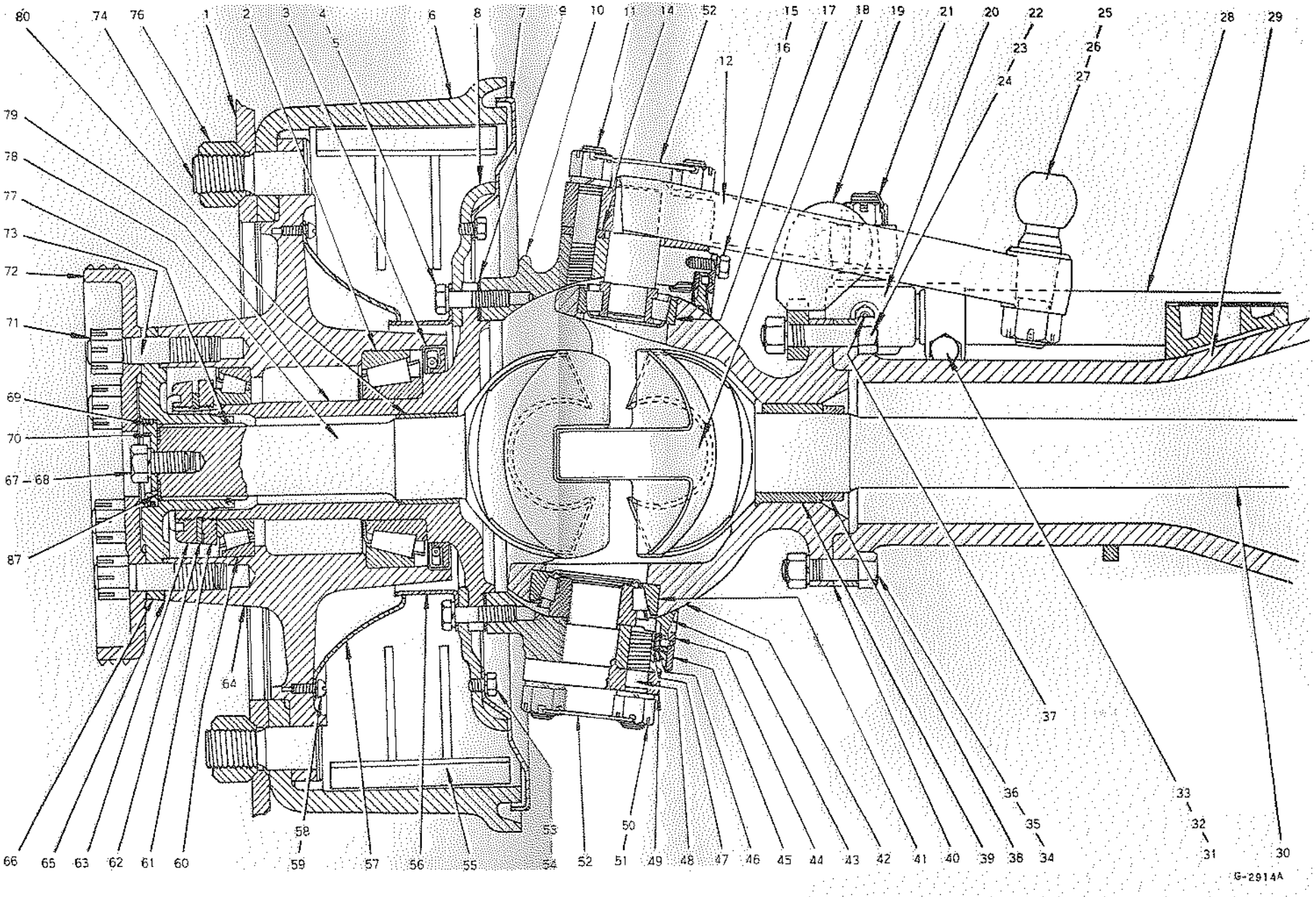


Fig. 3 - Right hand front wheel


80 74 76 1 2 3 4 5 6 8 7 9 10 11 14 52 15 17 18 19 21 20 22 25 28 29
16 12 23 26 24 27
79 78 77 73 72 71 69 70 67 – 68 87
64 37 36 33 35 32 31 30
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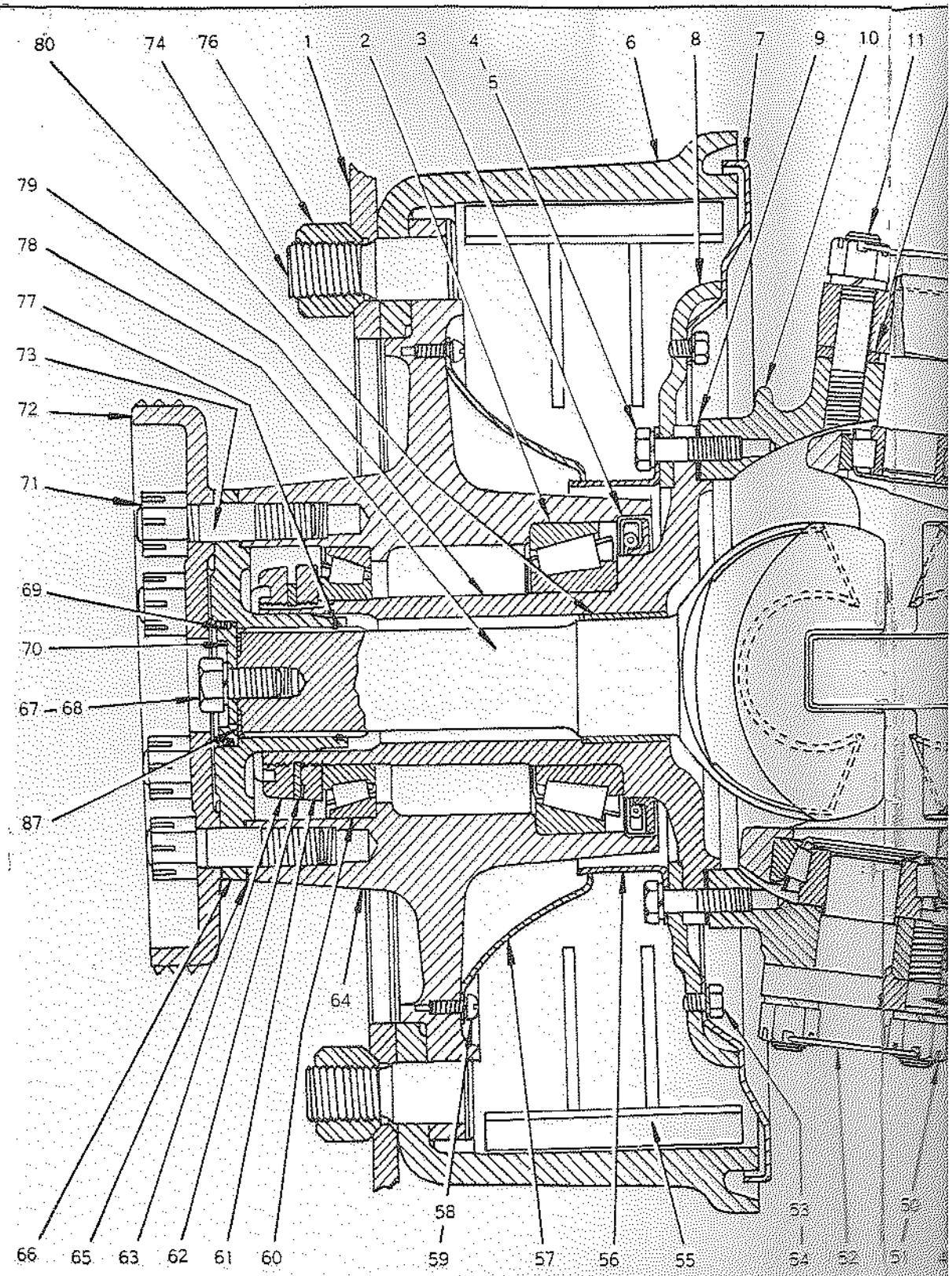
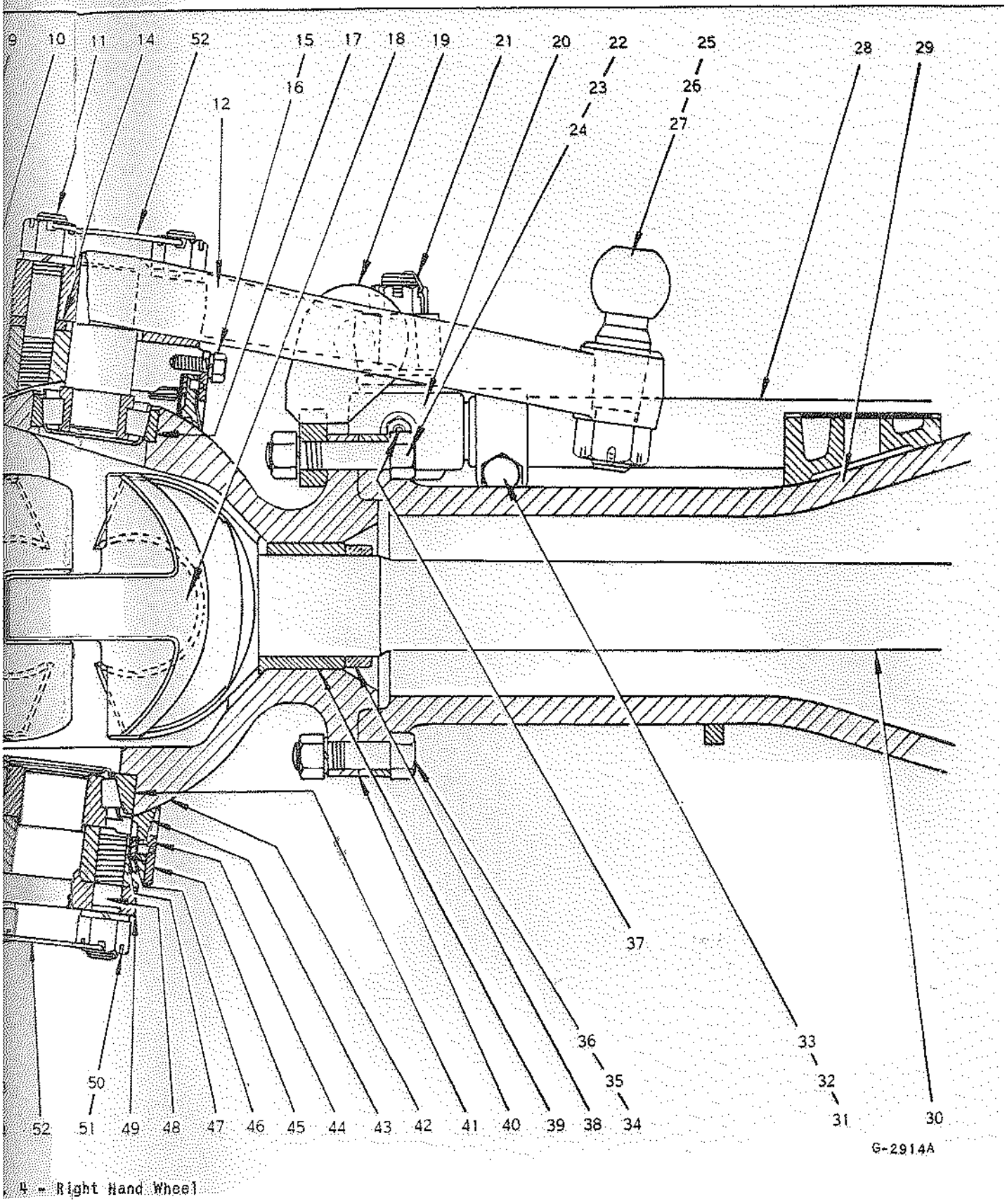


Fig. 4 - Right Rear



4 - Right Hand Wheel

ASSEMBLY OF FRONT AXLE

1. The differential carrier is assembled in the axle housing similarly to the rear axle. The differential carrier assembly is identical with that in the rear axle except that the oil scoop attached to the side of the differential is of the opposite hand (due to the opposite direction of rotation). To avoid serious damage to the differential, check that the oil scoop fitted will feed oil to the differential planetory gears during forward rotation of the wheels.

2. Pass the rubber oil seal and three retaining rings over the axle housing in the following order; large ring with locating dowels; rubber ring; thick plain ring; thin plain ring. Ensure that the rubber seal is facing with the knife edge towards the differential and that the locating dowels on the large ring face the rubber seal (See Fig. 4).

3. Upper and lower king pin bearing cups are pressed into the position in the bell housing. The inner bronze bush is pressed into the bore of the bell housing from inside the cavity, being careful that the oil feed groove in the bush is facing towards the smaller diameter king pin bearing (See Fig. 4).

4. The inner driving axle is assembled in the bell housing and bush and the locating collar is slipped over the splined end of the shaft, driven up to the bush to give an end float of .010" - .015" (Fig. 4).

5. The bell housing flange is mated with the axle housing with gasket, in between, and can be held in place by one of the flange bolts. The rubber sealing ring and locating rings must now be moved over the flange to hang on the bell housing. All of the twelve high tensile flange bolts can be fitted, the three longer ones also securing the shock absorber bracket in position at the top of the flange (facing as shown in Fig. 5). These bolts are tightened to a tension of 75 ft. lbs.

6. The top king pin bearing cone is placed in position and the bottom king pin bearing cone held in place. The tracta housing outer is slipped over into its approximate position and the bottom king pin cap isplaced over the studs and tapped home. The three slotted nuts can be screwed finger tight (Fig. 4).

7. The shim stack is placed over the top four studs on the tracta housing outer. This consists of one .111" shim and an average number of seven shims .005" thick below it. The steering arm is then placed in position, tapped home, and the four slotted nuts screwed down finger tight.

(Continued on next page)

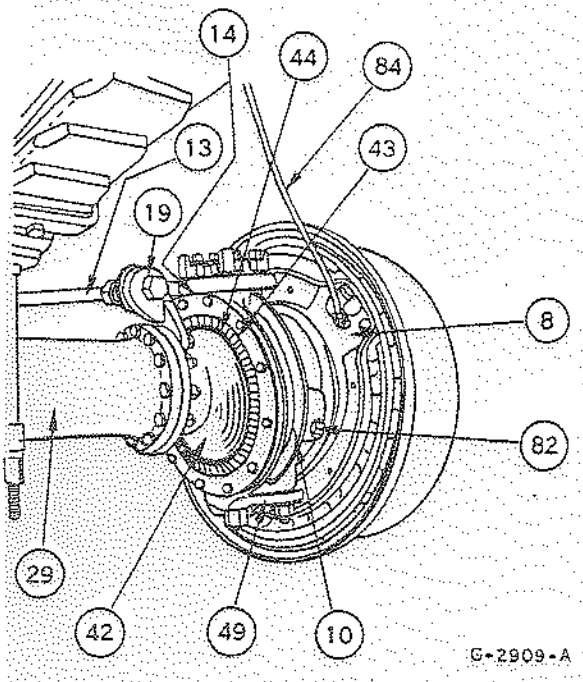


Fig. 5 - Left hand front wheel

ASSEMBLY OF FRONT AXLE, Continued

8. The bottom three slotted nuts are tightened to 90 ft. lbs. torque and the three lock-wired together (Fig. 6).

9. The top four slotted nuts are tightened in stages of 90 ft. lbs. torque, checking at each increment, that the king pin bearings have not excessive preload. The correct preload is obtained using a spring balance on the steering arm. A force of 6-10 lbs. is required on the end of the track rod arm to turn the outer tracta housing. This is adjusted by adding or removing .005" shims from the stack. Note that the torque measurements with the spring balance are done WITHOUT the rubber oil seal and retaining rings assembled. After the preload is set correctly, the four slotted nuts are tightened to 90 ft. lbs. tension and lock-wired in pairs (Fig. 6).

NOTE: When bearings are found fit for further service, they should be assembled with half the original preload torque loading specified.

Where the original preload is specified in terms of decimals, by means of shims old bearings must be reassembled with the original thickness of shims.

Where preload is specified by housing deflection as in differential bearings, old bearings should be reassembled with no deflection i.e. Free running without clearance.

10. The rubber oil sealing ring and retaining rings can now be fitted in position in the tracta housing outer. Two serrated bronze half rings are located between the rubber ring and large locating ring to reinforce the knife edge of the rubber sealing ring. The seal assembly is then tightened in place by eleven cap screws (Fig. 4).

11. The bronze bush outer is pressed into the stub axle with oil groove breaking through to the end of the bush on the flanged end of the axle, and the groove located circumferentially closest to another groove through the threads on the stub axle. The circlip is fitted into a groove in the splines on the outer driving axle, and the two centre floating components of the tracta joint are placed in the bell housing to mate with the driving axle inner (Fig. 4).

12. The driving axle outer is placed in the stub axle and bush and the stub axle flange is mated to the outer face of the tracta housing outer, with a gasket between the two. At the same time, the driving axle outer must mate with the centre floating components of the tracta joint. The stub axle is then located with the groove through the threads uppermost (Fig. 7). The stub axle is tightened up together with the brake torque plate, and dust cover (bolt tension 30 ft. lbs.)

13. The brake shoes are now fitted, ensuring that the four return springs are correctly placed with the overhang of the coils towards the brake shoe webs (Fig. 3). The compression struts must be correctly located between the twin shoe webs in the socket of both equalizing arms. For adjustment of these rods see Section D - Brakes.

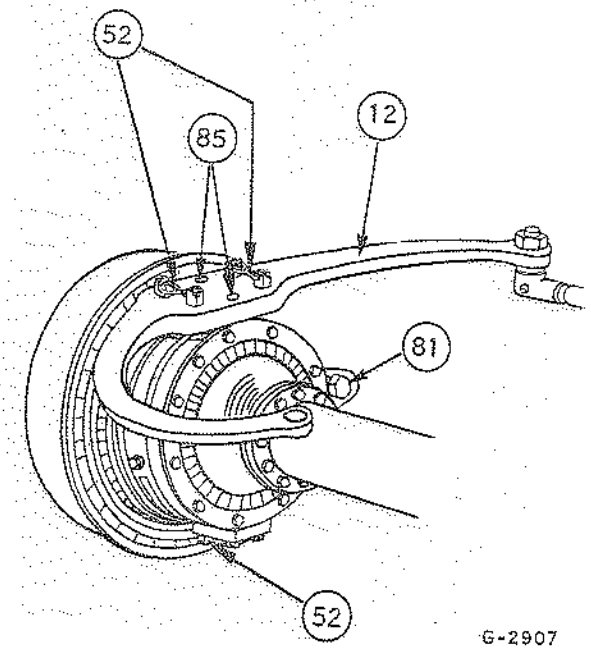


Fig. 6 - Right hand front wheel

ASSEMBLY OF FRONT AXLE, Continued

14. The grease trap is screwed with twelve slotted round head screws onto the inner face of the hub and the wheel bearing cups pressed in from both ends of the hub. The inner bearing cone is assembled in the cup and the oil seal is pressed over it, taking care to have the lip of the seal facing in towards the bearing. The wheel hub is assembled on the stub axle and the bearings and cavity between them approximately 2/3 filled with wheel bearing grease. The outer wheel bearing cone is assembled and the wheel bearing inner adjusting nut screwed on (shoulder outwards). Using the special tube spanner provided, the nut is tightened so that the end float is eliminated but the hub must still turn freely (Fig. 4).

15. Assemble the nut locking washer and tighten up the second wheel bearing nut. Check that the hub still turns freely.

16. The driving flange is now assembled on the outer face of the hub with a gasket underneath. The hub should be turned until the line visible on the end of the drive shaft outer is horizontal (line shown in Figs. 3 and 7). The "O" ring oil seal and retainer are assembled in position with the centre cap screw finger tight, using a new cork seal.

17. The sling ring is assembled over the driving studs and the slotted lock nuts screwed up firmly on them (Fig. 4).

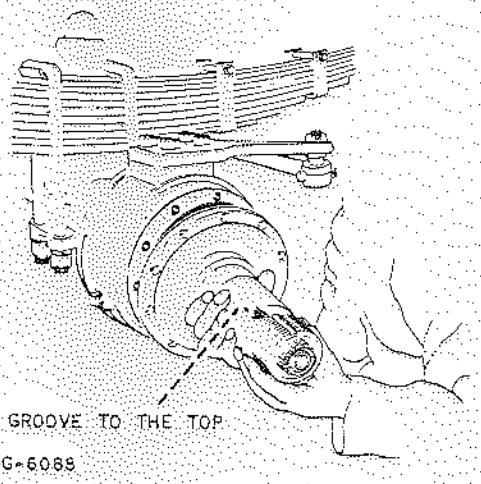


Fig. 7 - Assembly of stub axle on Tracta Housing. Note line marked on end of Driving Axle Outer

18. The running clearance on the tracta joint components should now be checked. The hub must be located with the line on the drive shaft horizontal and the hub turned to the maximum lock position. The centre cap screw is slackened off approximately 1/2 inch and the end float on the driving axle outer measured by pushing this screw in and out. The end float should be between 1/8 and 11/32 inch. This adjustment should never vary outside these limits, if it so appears, a check should be made on all measurements and adjustments, before altering anything. If this clearance becomes less than 1/8" a shim may be inserted between the driving flange and the hub outer face, but care must be taken that this does not seize the driving axle outer hard up against the bronze bush. The slotted lock nuts can now be tightened on the driving studs to 150-160 ft. lbs. tension and the centre cap screw should be tightened firmly.

19. The brake hose should be connected and brake bled and adjusted.

20. The tracta housing outer and differential are both filled with oil. (See Section "B" Lubrication).

21. The wheel is placed on the hub, track rod and drag link connected and toe-in adjusted by rotating the track rod. The toe-in is to be 1/16 - 3/16" measured on the side of the wheel rims.

22. Each hub must turn from neutral through an angle of 33 degrees before striking the stop on the outer "tracta" housing. The camber angle of each wheel is 1 degree positive. An axle is unacceptable if the camber angle of one wheel varies more than 1/2 degree from the other.

REMOVAL AND REPLACEMENT OF RUBBER SEALING RING

1. Remove wheel.

2. Remove wheel hub and constant velocity joint housing assembly complete by removing bell housing flange bolts (as above)

3. Remove oil seal and replace with new one.

4. Reassemble.

2-1/2 TON 4x4 G.S. - INTERNATIONAL

Model	S35
Make	Ross
Ratio	24 : 1
Lever shaft diameter	1.5
Pitman travel available	92 degrees
Steering tube diameter	1"
Steering jacket diameter	1.75"
Oil capacity (Imp. Pints)	2.9

STEERING GEAR

In this vehicle Ross Steering Gear S35 has been used and detailed instructions are given in the following pages.

Construction (See Figs. 1, 2, 3)

The truck is equipped with (Ross) semi-reversible cam and twin lever steering gears.

The twin lever construction is shown in Fig. 1, Item (7).

Type of twin lever gear used:-

TWIN-LEVER WITH ROLLING STUDS - the studs are mounted in the lever with tapered roller bearings so that the studs have a rolling contact on the cam (Fig. 1). Item (21).

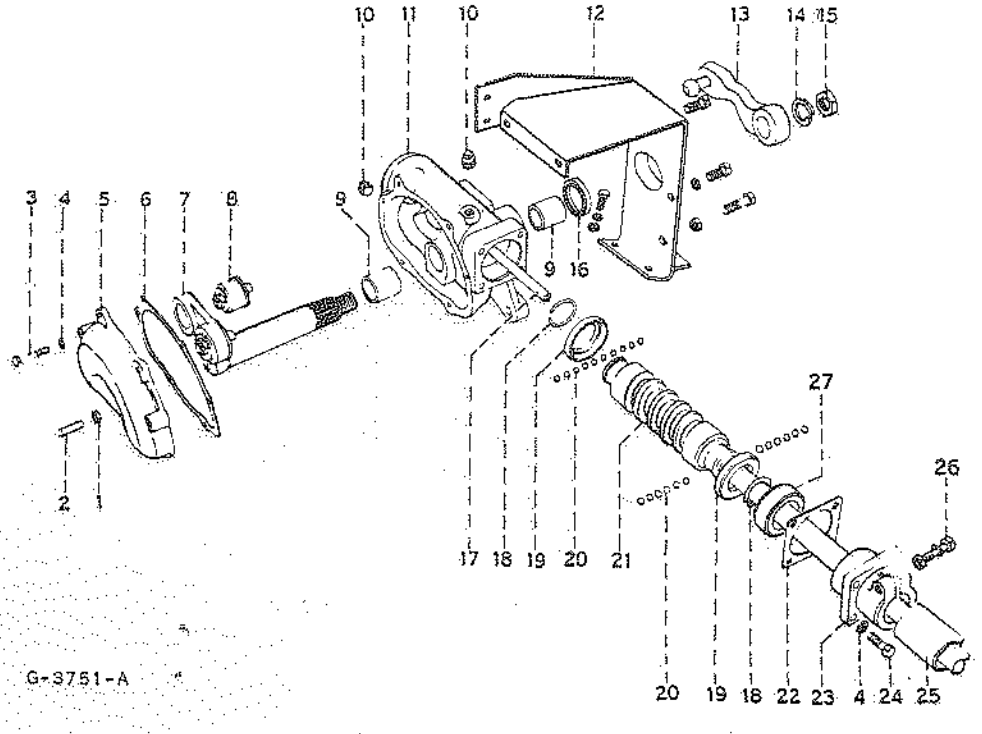
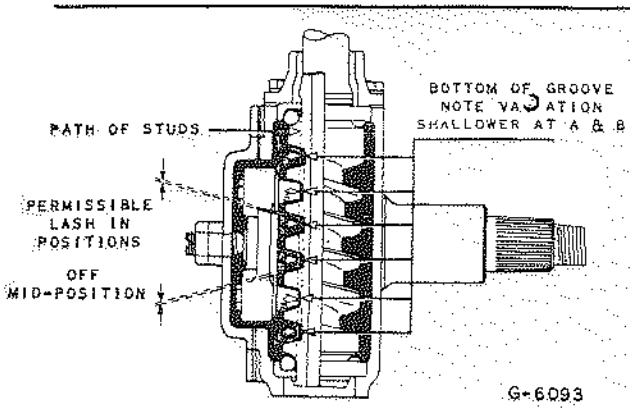


Fig. 1 - Model S35 Steering Gear

LEGEND

1. NUT, side cover, adjusting screw
2. SCREW, adjusting, side cover
3. BOLT, hex-hd.
4. WASHER, lock
5. COVER, gear housing, with adjust. screw and nut.
6. GASKET, side cover
7. LEVER SHAFT, w/studs, nut and lock washer
8. STUD, set, w/BEARINGS assy. (matched set)
9. BUSHING, housing
10. PLUG, pipe sq-hd.
11. HOUSING, w/bushing, seal and end cover, assy.
12. BRACKET, mounting, steering gear
13. ARM, steering, w/BALL
14. WASHER, lock
15. NUT, lever shaft
16. SEAL, oil
17. COVER, housing end, w/tube assy.
18. RING, snap
19. BEARING, cup
20. BALL, steel
21. CAM, with tube, assy. w/cup bearing, ball and snap ring
22. SHIM, housing cover upper
23. COVER, gear housing, upper, w/bolt, nut and lock washer
24. BOLT, hex-hd.
25. COLUMN, steering assy.
26. BOLT, hex-hd.
27. SPACER



GEAR (STUDS A & B) SHOWN AT MID-POSITION OF TRAVEL.
A-SHOWS VARIOUS POSITIONS OF STUD A ON TURN.
B-SHOWS VARIOUS POSITIONS OF STUD B ON TURN.
IMPORTANT-ADJUST THE MID-POSITION.

Fig. 2

Adjustments

When making adjustments, free the steering gear of all load, by disconnecting the drag link from the steering arm, and loosen instrument panel bracket clamp on steering gear jacket tube.

If the ball thrust bearings on the cam must be adjusted, make adjustment (1) before making side adjustment to lever shaft studs in cam groove (2). As follows:-

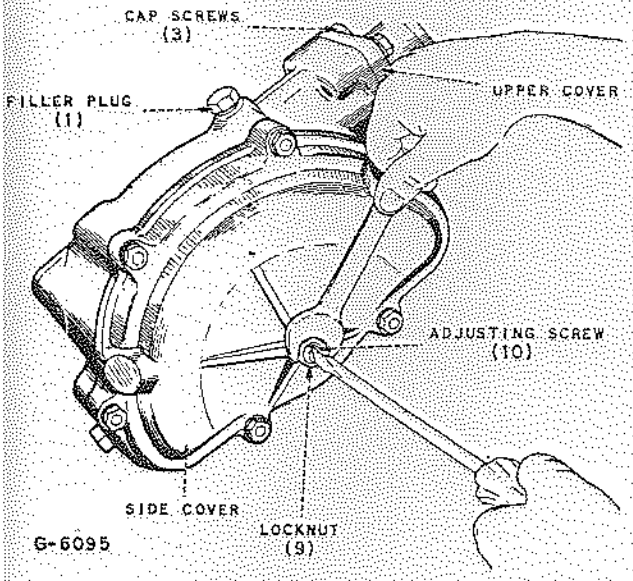


Fig. 3 - Illustrates location of Adjusting Screw and Locknut

ADJUSTMENT 1

ADJUSTMENT OF BALL THRUST BEARING ON CAM

(a) Before making this adjustment loosen the housing side cover adjusting screw (9, 10) to free the studs in the cam groove (Fig. 3).

(b) Adjustment should be made so there is a very slight drag but not so much that the steering wheel cannot be turned from extreme to extreme by lightly gripping steering wheel rim with thumb and forefinger.

(c) Unscrew the four screws (3) and raise the housing upper cover to permit removal of shims. (Shims are of .002", .003" and .010" thicknesses). (Fig. 4).

(d) Clip and remove a thin shim or more as required, and draw cover down tight against shims.

(e) Test as outlined in paragraph (b) and if necessary remove or replace shims until adjustment is correct.

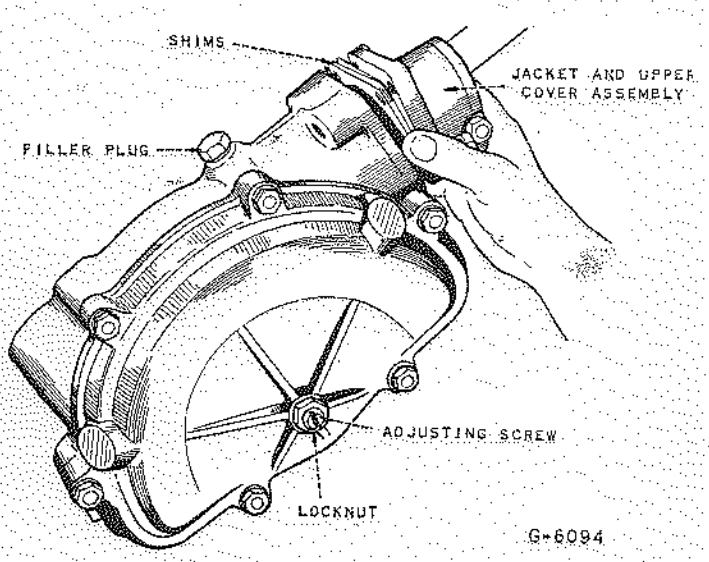


Fig. 4 - Showing location of Shims under Upper Housing Cover used to adjust end play on Cam

ADJUSTMENT 2

ADJUST LEVER SHAFT STUDS IN CAM GROOVE FOR BACKLASH

(a) Backlash at this point shows up as end play of lever shaft, also as backlash at steering wheel and at steering arm.

(b) The groove is purposely cut deeper in ends of cam than in mid-position. This produces a high range through mid-position and makes grooves narrower through this range. This permits take up of backlash in mid-position after normal wear of groove, without causing a bind in ends (Fig. 2).

(c) Adjust to this mid-position high range. Do not adjust in end positions. Play in end position is not objectionable.

(d) Tighten side cover adjusting screw (10), Fig. 3, until a very light drag is felt through the mid-position high range when turning steering wheel slowly from extreme to extreme position. if this slight drag cannot be obtained by adjustments 1 and 2 the cam is probably worn.

(e) IMPORTANT: Steering gear must not bind in any position. Only a very slight drag should be felt. A closer adjustment will not correct steering looseness caused by wear in other steering gear members, but will damage parts and impair operation.

(f) When proper adjustment has been made tighten lock nut (9) and then give gear a final test.

(g) Make sure steering gear arm is tight on splined lever shaft and that lockwashers and nut are tight also.

(h) After these adjustments have been made, connect up and adjust the drag link ball joint and check to see that the mid position of the steering gear (point of slight drag mentioned in para. (d) coincides with the straight ahead position of the front wheels. If not, check to see that the pitman arm assembly mark coincides with the assembly mark on the end of the lever shaft. Relocate the pitman arm if necessary, otherwise the steering gear will be off the mid position when driving the vehicle straight ahead. See Fig. 5A.

STEERING COLUMN ALIGNMENT

(a) After adjustments have been made and lock nut tightened, turn steering wheel to see if any stiffness exists. If so, steering gear has been adjusted too tight or steering column is out of alignment. Misalignment of the column places a bend in the column Consequently, the wheel tubes must undergo reverse bending stresses during each revolution. This is a serious condition and must be avoided. THE STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION TO OBTAIN INSTALLATION.

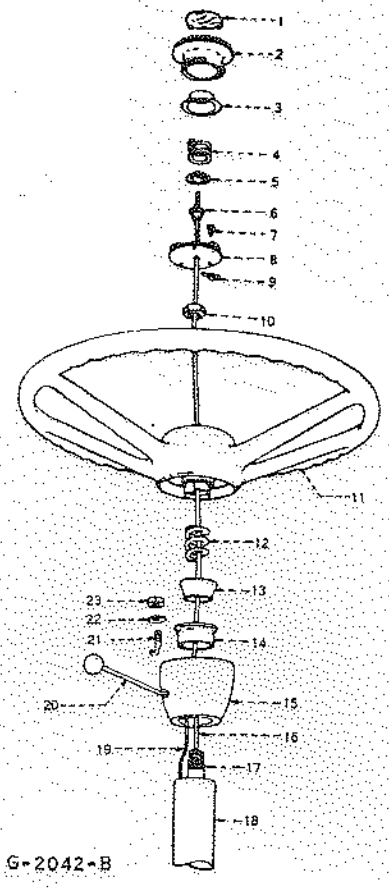


Fig. 5 - Steering Wheel Mounting

LEGEND

1. INSERT, horn button
2. BUTTON horn assy.
3. CUP, contact
4. SPRING horn button, contact
5. CAP, horn cable contact
6. FERRULE horn cable, insulating
7. SCREW rd-hd., slotted
8. PLATE base, horn button
9. CONTACT, horn button
10. NUT, wheel
11. WHEEL, steering
12. SPRING, bearing spacer
13. RETAINER spring
14. BEARING jacket tube, upper
15. FLANGE with bearing assy.
16. CABLE horn assy.
17. CAM, with tube and wheel nut assy.
18. TUBE, jacket, assy.
19. CABLE, turn signal switch and wiring
20. LEVER, turn signal
21. BOLT, clamp
22. WASHER, plain
23. NUT lock

STEERING GEAR CONNECTION WITH FRONT WHEELS

(a) Assemble pitman arm to sector shaft so that alignment marks coincide (see Fig. 5A) and tighten nuts to 145-155 lbs. ft.

Check steering knuckle stop on axle to ensure correct steering angle refer Section E, Page 1.

See that steering gear housing is filled with lubricant as recommended in lubrication section.

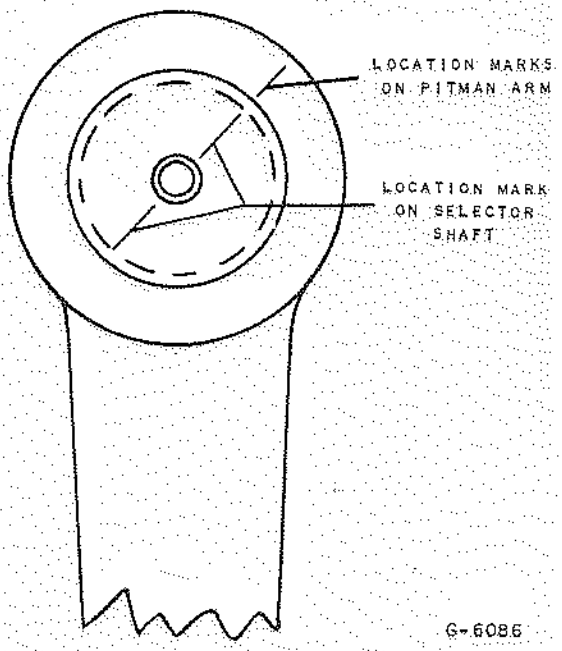


Fig. 5A - Pitman to Sector Shaft Assembly

TO REMOVE STEERING WHEEL (Fig. 5)

(a) Disconnect horn wire at bottom of steering gear.

(b) Remove horn button (2) by pressing down and turning to right or left with palm of hand or vacuum cup, holding steering wheel stationary.

(c) Remove contact cup (3) spring (4) and cap (5).

(d) Remove the three screws (7) holding the horn button retainer base plate (8) and remove this plate and horn wire (16).

(e) Remove steering wheel nut (10) and take off steering wheel using suitable puller.

TO INSTALL STEERING WHEEL

(a) The wheel should be installed on the steering tube in such a position that when steering straight ahead the spokes will occupy positions of 9 and 10 o'clock, and 2 and 3 o'clock as viewed from the driver's seat.

(b) Install steering wheel nut (10) and tighten securely.

(c) Insert horn wire and thread through hole in cover plate at bottom of steering gear housing. Attach horn button retainer base plate (8) with three screws, with the spring contact (9) below the plate on one of the screws. The contact point of the spring (9) to be downwards.

(d) Install contact cap (5), spring (4) and horn button (2). Horn button should be pressed down and turned until it locks in the rubber retainers on retainer base plate using vacuum cups or palm of hand.

(e) Connect horn wire at bottom of steering gear.

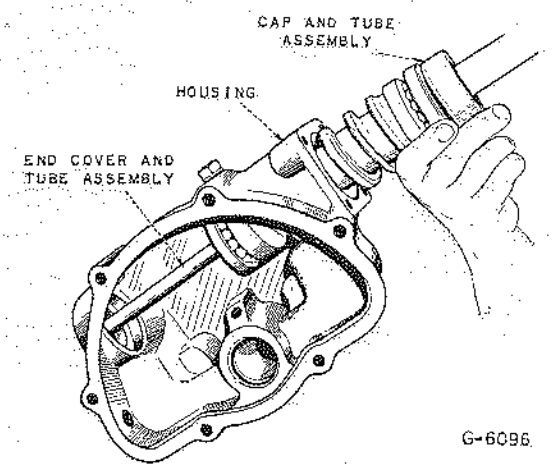


Fig. 7 - Removing Cam and Tube Assembly with Bearings

DISASSEMBLING STEERING GEAR

(a) Remove horn button, cable and steering wheel as previously described.

(b) Remove housing side gear cover and pull out lever shaft (Fig. 6).

(c) Loosen clamp collar and remove jacket tube and housing upper cover (Fig. 4).

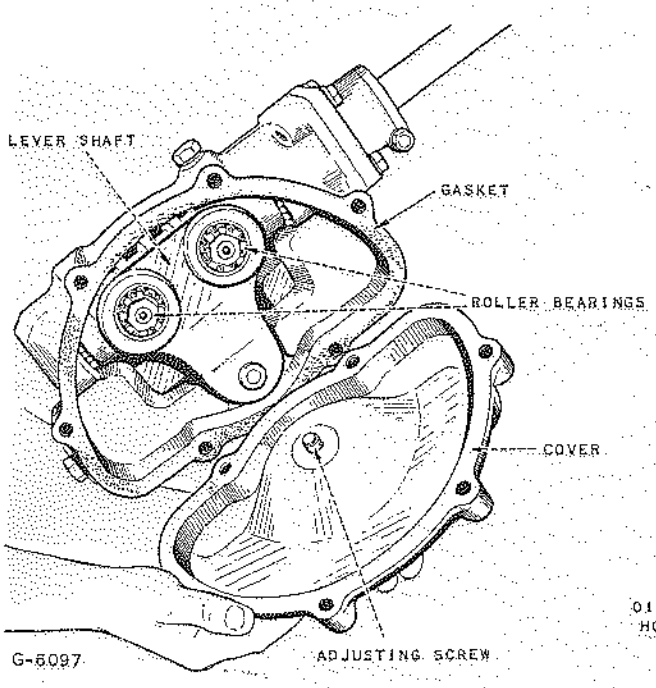


Fig. 6 - Removal of Housing Side Gear Cover revealing Lever Shaft

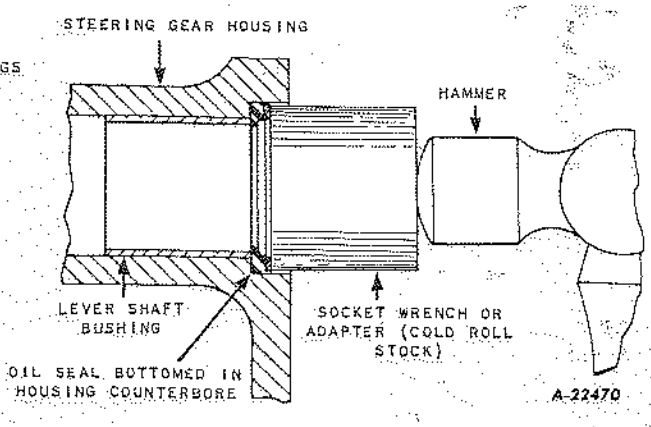


Fig. 8 - Location and Installation of Lever Shaft Oil Seal

(d) Remove cam and tube assembly, complete with bearings, from the housing (Fig. 7).

(e) Remove lever shaft oil seal and clean the counterbore in the gear housing.

REASSEMBLING STEERING GEAR

(a) Install new lever shaft oil seal (Fig. 8). Position oil seal in housing with side stamped "Fluid Side" toward bottom of counterbore. Using a hammer, tap lightly on the end of a socket wrench or adapter (cold rolled stock) having a slightly smaller outside diameter than the oil seal. It is important that the seal bottoms in the counterbore of housing.

(b) Place cam and tube assembly with bearings in the housing (Fig. 7).

(c) Assemble housing upper cover with shims and make proper bearing adjustments.

(d) Install lever shaft in housing and assemble housing side cover, first loosening the adjusting screw (Fig. 6). Draw side cover screws tight.

(e) Adjust lever shaft stud in cam groove for backlash and lock adjustment with lock nut.

(f) Assemble jacket tube with clamp collar and tighten clamp.

(g) Install steering wheel, horn cable and button.

Drag Link (Figs. 9 and 10)

This type of drag link requires very little care other than periodical lubrication and occasional inspection to make sure that it is properly adjusted.

Adjustment is made by removing cotter pin and turning adjusting plug in the desired direction. To adjust for wear, turn adjusting plug in until it is tight, then back off to first cotter pin hole. Insert a new cotter pin of the correct size and bend ends over securely. Drag link should not be adjusted too tight, otherwise steering will be affected.

WARNING: Adjustment for wear on the ball MUST be made with the steering on full lock.

Steering Jacket Tube Bearing

A ball-type steering jacket bearing is used, improving steering gear performance and ease of handling. Fig. 11 illustrates this construction.

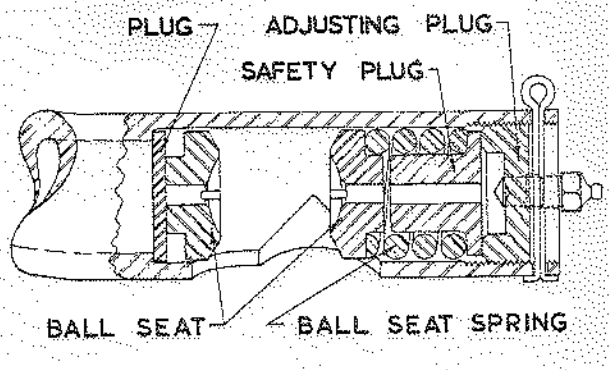


Fig. 9 - Drag Link rear end assembly

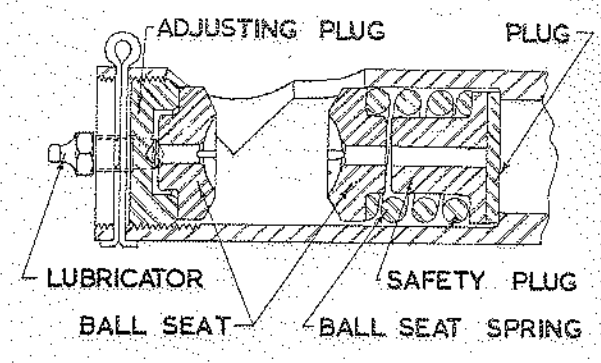


Fig. 10 - Drag Link front end assembly

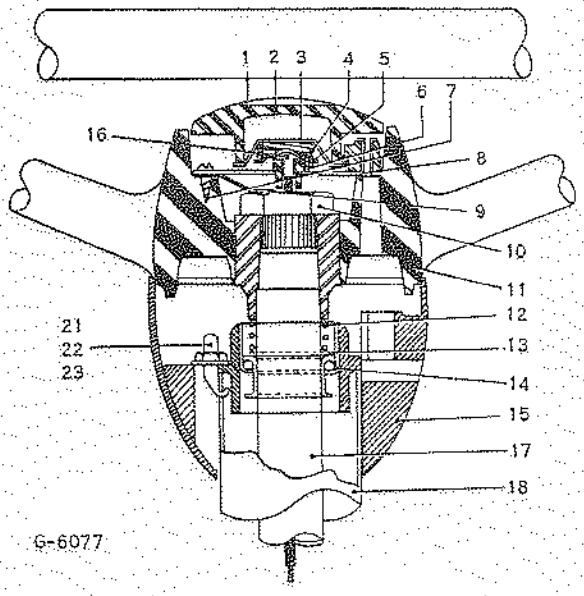


Fig. 11 - Steering wheel to column assembly (Refer to legend for Fig. 5)

2-1/2 TON 4x4 G.S. - INTERNATIONAL

Type	Full Floating
I.H. Model	RA-30 (Modified)
Pinion Mounting	Straddled
Drive	Hotchkiss
Gears	Hypoid
Pinion Adjustment Press	10 Tons
Axle Ratio	7.166 : 1
No. of teeth pinion	6
No. of teeth ring gear	43
Torque Capacity	10544 Ft/Lbs.
Cage Rotating Torque (Scale Reading)	10 - 25 Lbs.
Differential Bearing Preload	.005" - .007"
Lubricant Capacity (Imp. Pints)	7.9

TORQUE WRENCH LOADINGS	FT/LBS.
Pinion End Nut	280 - 300
Pinion Cage To Carrier	100 - 120
Carrier to Housing	50 - 70
Differential Case	80 - 90
Bearing Cap to Carrier	150 - 160
Drive Flange to Wheel Hub	150 - 160
Ring Gear Rivet Pressure	40 - 50 Tons

SINGLE-REDUCTION HYPOID AXLE

RA-30

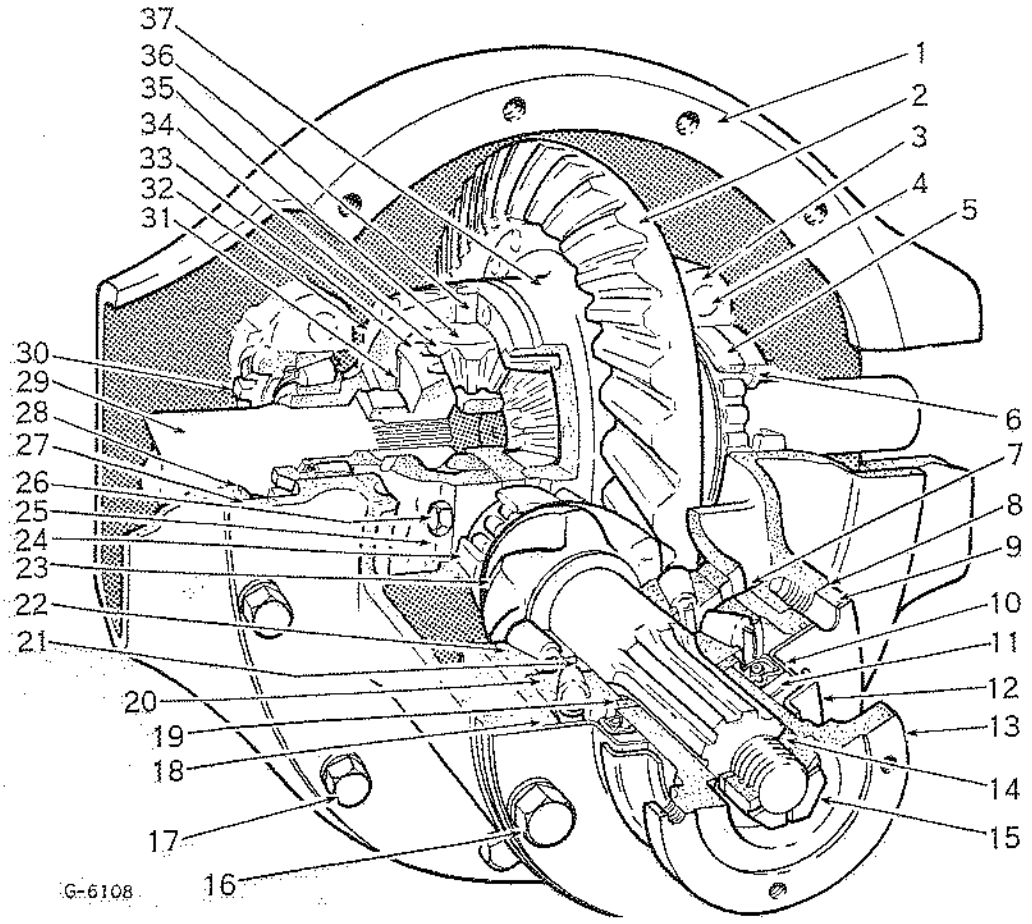


Fig. 24—Sectional View of Hypoid Rear Axle.

1. Axle housing.
2. Hypoid ring gear.
3. Differential bearing cap.
4. Differential bearing cap mounting stud.
5. Differential bearing.
6. Differential bearing adjuster.
7. Oil passage to pinion bearings.
8. Pinion bearing cage shims.
9. Pinion bearing cage.
10. Pinion oil seal retainer
11. Pinion oil seal.
12. Slinger.
13. Companion flange.
14. Thrust washer.
15. Propeller shaft companion flange nut.
16. Pinion cage mounting capscrew.
17. Differential carrier mounting capscrew.
18. Pinion bearing cage cork seal.
19. Thrust washers.
20. Pinion bearing, outer.
21. Pinion bearing spacer.
22. Pinion bearing, inner.
23. Hypoid pinion (straddle mounting).
24. Pinion bearing.
25. Differential case bolt lockwire.
26. Differential case bolt.
27. Differential carrier.
28. Differential carrier mounting gasket.
29. Axle shaft.
30. Differential bearing adjuster lock.
31. Differential side gear thrust washer.
32. Differential case, plain half.
33. Differential side gear.
34. Differential spider pinion.
35. Differential spider pinion thrust washer.
36. Differential spider.
37. Differential case, flanged half.

AXLES - REAR

GENERAL INSTRUCTIONS FOR ALL HYPOID AXLES

HYPOID REAR AXLES

All rear axles have a hypoid ring gear and pinion, whether single reduction, double-reduction, double-reduction (single and two-speed final drive) and two-speed differential. Hypoid gears have a greater inherent torque capacity, due largely to the fact that the hypoid pinion is much larger in diameter and the pinion teeth are correspondingly larger than those found in a spiral bevel pinion for the same number of teeth and the same diameter ring gear.

The hypoid pinion has a longer face because of its offset location. It also has larger tooth surface areas and usually has more teeth in instant contact with the gear. It is these design characteristics which contribute to greater strength and quieter final drive operation. Because of this greater tooth contact, it is more difficult to secure correct pinion setting at time of overhaul or when replacing differential bearings and every effort must be made to be sure the final setting results in best possible tooth contact.

Note that the pinion centre line (E, F) is offset from the ring gear centre line (C, D).

NOTE: When adding to or replacing lubricant in a rear axle having hypoid gears, use only hypoid lubricants.

REAR AXLE HYPOID GEAR REPLACEMENT AND ADJUSTMENT

Hypoid Gear Tooth Contact

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

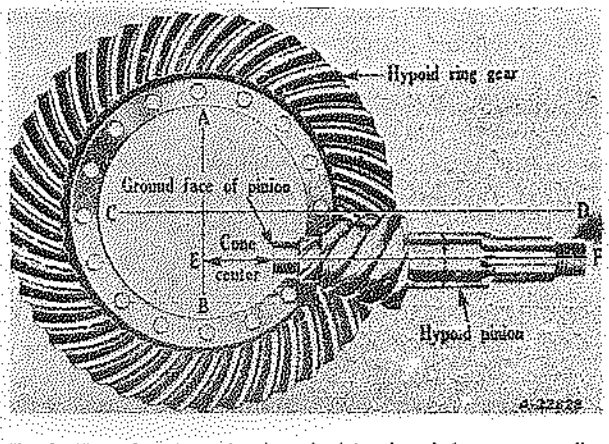


Fig. 1—Illustration shows location of pinion in relation to centre line of ring gear. Centre line of pinion is below centre line of ring gear.

There are two distinct considerations in obtaining the proper tooth contact, cone centre and backlash.

Hypoid as well as bevel and spur gears are cut with a predetermined amount of backlash. The backlash usually varies from .003″ to .005″ on small gears and increases on large gears. Generally, the gears are machined to run flush with each other at the outer end (heel or large end) of the tooth, and gears should be set according to their theoretical cone centre (Figs. 2, 3, and 4).

Cone Centre Specifications

Matched and mated hypoid ring gears and hypoid pinion gears are furnished both for service and for production.

Mated gears are marked with figures showing the amount of variation from their theoretical cone centre.

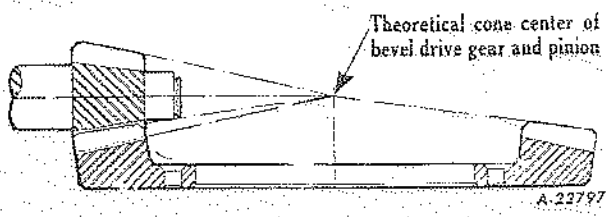


Fig. 2

Fig. 2 illustrates a hypoid ring gear and pinion adjusted to theoretical cone centre, wherein the cone centres of both gears coincide. The specifications in this case would be the distance from the line (A, B) (Fig. 1) drawn through the centre of the hypoid ring gear to the ground face of the hypoid pinion on centre line (E, F).

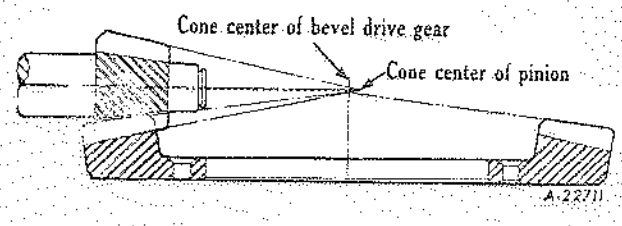


Fig. 3

Fig. 3 illustrates a setting wherein the mating of the gears has necessitated the pinion cone centre being farther than the ring gear centre. The pinion marking in this case will be minus (—) because the distance from the ring gear centre is less.

Fig. 4 illustrates a condition where the mating of the gears required the pinion cone centre to be farther OUT. The pinion marking will be plus (+) because the distance is greater.

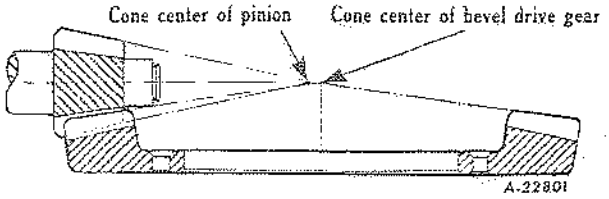


Fig. 4

SE-1065 Pinion Setting Gauge

The SE-1065 pinion setting gauge is a precision gauge designed for use in adjusting differentials to the proper cone setting of the ring gear and pinion. It is used only in adjustment of matched sets of gears. A step plate and bracket have been added to the set so that the gauge may be used on all hypoid differentials with satisfacory results. NOTE: Be sure to allow for thickness of the step plate .400" when making calculations (Fig. 5).

The use of SE-1065 gauge makes possible the exact duplication of the setting etched on the pinion. This results in the best possible setting with a minimum loss of time. It is advisable to check all pinion settings with a paint impression before considering the work complete. By so doing, visible proof of the pinion gauge setting accuracy is obtained, also long and quiet gear performance is assured.

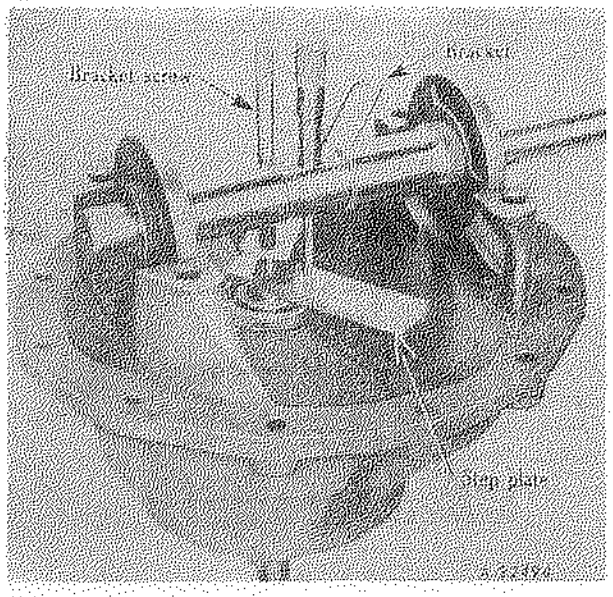


Fig. 5

Fig. 5 shows SE-1065 tool equipment in position on hypoid differential case. Make certain that the bearing bores are clean and free of nicks or burrs. The step plate must be placed on the pinion end so that the lugs in the step plate straddle the bearing staking indentations on the smaller axles.

Adjustment of differentials is a simple matter with the SE-1065 gauge. Briefly, it is only necessary to.

1. Install pinion and bearing assembly in differential carrier.
2. Install step plate and bracket as shown in Fig. 5. CAUTION: Be sure lugs on step plate straddle the bearing staking indentations.
3. Mount assembled SE-1065 gauge in bearing bores of carrier.
4. Take micrometer reading to check point of pinion. Add .400" (thickness of step plate) to reading. Write down reading.
5. Locate specified cone centre specification for particular model on chart. Write down specified figures.
6. Locate on pinion the etched marking which indicates variation from zero cone centre. If a minus figure, subtract from specified cone centre, and if a plus figure, add to specified cone centre. Results of calculation give corrected cone centre.
7. Comparison of corrected cone centre (6) with measurement (4) indicates amount of change necessary for pinion position.
8. Install ring gear and carrier in position.
9. Adjust backlash according to marking on ring gear.

Example of mathematics involved:

(a) Micrometer reading (add .400" for step plate)	3.4400"
(b) Specified cone centre on chart	3.400"
(c) Pinion marked (-5)	.005"
(d) Subtraction (b-c) gives corrected cone centre	3.395"
(e) Subtract corrected cone centre (d) from actual measurement (a)	.045"
(f) It is necessary to move pinion IN	.045"

(g) Remember—It is essential to arrive at a measurement as nearly equal the corrected cone centre as possible.

(h) DO NOT FAIL TO VERIFY ACCURACY OF THE ADJUSTMENT SECURED WITH THE SE-1065 gauge by checking the gear tooth contact using the paint impression method as set forth under General Rear Axle Hypoid Pinion and Ring Gear Adjustment, which follows.

GENERAL REAR AXLE HYPOID PINION AND RING GEAR ADJUSTMENTS

(PAINT IMPRESSION METHOD)

The following general instructions and suggestions are for the benefit of those service stations not equipped with an SE-1065 pinion setting gauge. Bear in mind that the accuracy of the adjustment obtained with the following procedure is dependent upon the skill of the operator.

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

Checking tooth contact is accomplished by means of oiled red lead applied lightly to the bevel gear teeth (Fig. 6). When the pinion is rotated, the red lead is squeezed away by the contact, of the teeth, leaving bare areas the exact size, shape, and location of the contacts.

Sharper impressions may be obtained by applying a small amount of resistance to the gear with a flat steel bar and using a wrench to rotate the pinion. When making adjustments, check the drive side of the bevel gear teeth. Coast side contact should be automatically corrected when drive side contact is correct. As a rule, coating about twelve teeth is sufficient for checking purposes.

With adjustments properly made, the correct tooth contact shown in Fig. 7 will be secured. The area of contact starts near the toe of the gear and extends about 80 per cent of the tooth length. This adjustment results in a quiet running gear and pinion set which, because the load is distributed over the teeth within the proper area, will deliver all the long service built into it.

Figs. 8 to 11 illustrate method of adjustment in securing the proper gear tooth contact.

Gear Adjustment for Lash

Generally if original gears are being reinstalled, red leading of teeth will not indicate the same contact as new gears and can be misleading. Gears that have been in service for long periods form running contacts due to wear of teeth; therefore, the original shim pack should be maintained to check gear lash. Gear lash, when using original gears, can be reduced only to a point of smooth rotation of gears.

If the gear lash is in excess of maximum tolerance as stated under Gear Adjustment, the lash may be reduced only in the amount that will avoid overlap of the worn tooth section (Fig. 12). Rotate the gears and check for smooth or rough operation. If a slight overlap, as illustrated (Fig 12), takes place at the worn tooth section, rotation will be rough.

Fig. 12 illustrates worn condition of gear teeth and overlapping condition.

When installing new gears, check gear lash with dial indicator (Fig. 13) and adjust to obtain amount of backlash marked on ring gear as follows:

1. Set pinion according to procedure outlined under SE-1065 Pinion Setting Gauge.
2. To move ring gear, tighten or loosen differential bearing adjusting nuts as required.
3. After correct gear lash is secured, check and adjust as necessary to obtain the correct tooth contact. (See Gear Adjustment for correct tooth contact.)

Adjust Differential Bearing Pre-Load

Using dial indicators at side of each bearing cap (Fig. 14), adjust to obtain bearing pre-load as follows:

1. Loosen adjusting nuts only enough to notice end play on indicators.
2. Tighten adjusting nuts only enough to obtain .000" end play reading on indicators.
   Note: While gear is held in .000" end play and before loading bearings, check gear for runout. If runout exceeds .008", remove differential and check for cause.

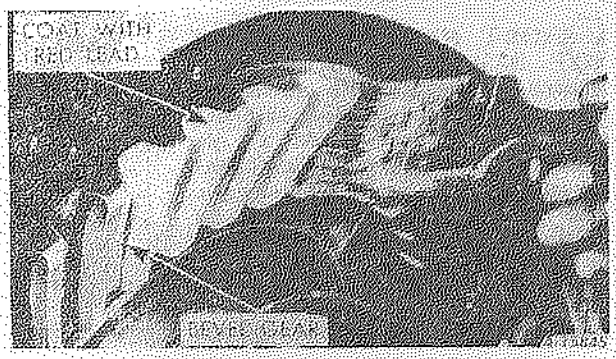


Fig. 6

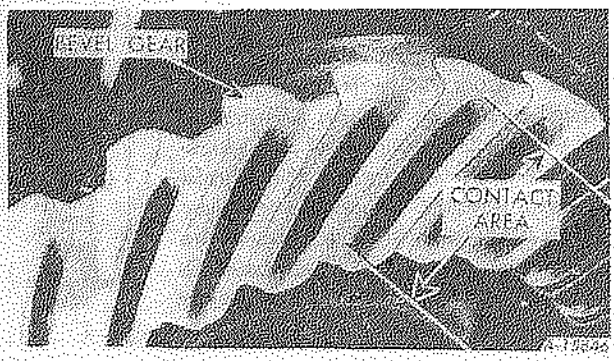


Fig. 7

A HIGH NARROW CONTACT IS NOT DESIRABLE. If gears are allowed to operate with an adjustment of this kind, noise, galling and rolling over of the top edges of the teeth will result. To obtain correct contact move pinion toward bevel gear to lower contact area to proper location. This adjustment will decrease backlash between pinion and bevel gear teeth, which may be corrected by moving bevel gear away from pinion. Backlash of .006" to .012" is correct.

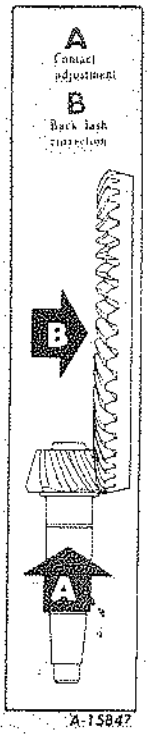
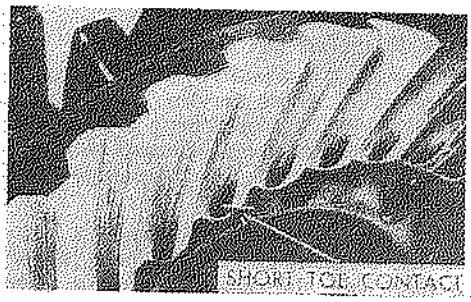


Fig. 8



A SHORT TOE CONTACT IS NOT DESIRABLE. If gears are allowed to operate with an adjustment of this kind, chipping at tooth edges and excessive wear due to small contact area will result. To obtain correct contact, move bevel gear away from pinion. This will increase the lengthwise contact and move contact toward heel of tooth. Correct back lash of .006" to .012" can be obtained by moving pinion toward bevel gear.

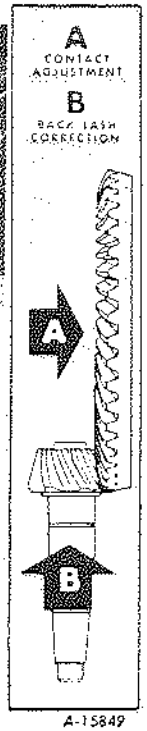


Fig. 10

A LOW NARROW CONTACT IS NOT DESIRABLE: If gears are allowed to operate with an adjustment of this kind, galling, noise and grooving of teeth will result. To obtain correct contact, move pinion away from bevel gear to raise contact area to proper location. Correct backlash of .006" to .012" may be obtained by moving bevel gear toward pinion.

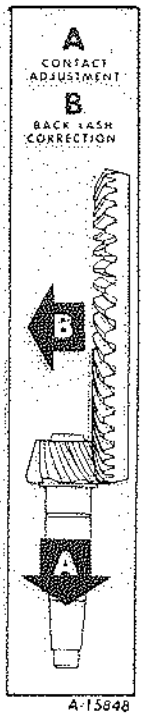
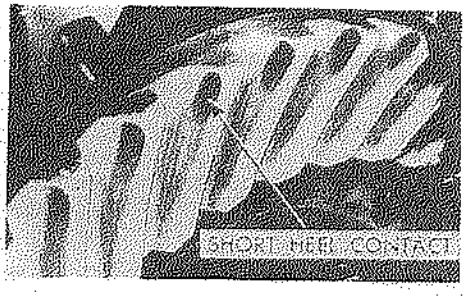


Fig. 9



A SHORT HEEL CONTACT IS NOT DESIRABLE. If gears are allowed to operate with an adjustment of this kind, chipping excessive wear and noise will result. To obtain correct contact, move bevel gear toward pinion to increase the lengthwise contact and move contact toward toe. Correct backlash of .006" to .012" can be obtained by moving pinion away from bevel gear.

Several adjustments of both pinion and gear may be necessary before correct contact and backlash are secured.

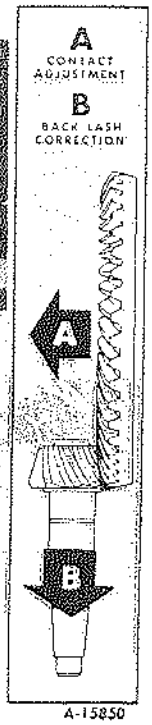


Fig. 11

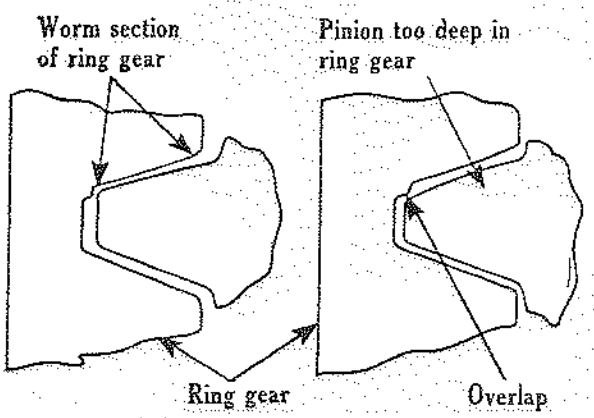


Fig. 12

3. Tighten BOTH adjusting nuts from .000" end play to pre-load differential bearings. Adjust pre-load to secure equal pre-load reading at indicators. (See specifications for pre-load data on the various axles.)
4. Tighten bearing cap stud nuts to specified torque.
5. Install adjusting nut locks.

Pinion Bearing Adjustment for Correct Pre-Load (Torque Method)

After the pinion, the pinion bearings and spacers have been assembled in the pinion bearing cage, place the assembly in a press being sure to use a sleeve adapter as shown in Fig. 15. Press the bearing down firmly and rotate the pinion cage to align the bearings and assure normal bearing contact. Set press at correct pressure and attach a spring scale to pinion cage as indicated in Fig. 15. Read scale only while pinion cage is turning. If preload reading is incorrect, the bearing load may be increased by installing a thinner spacer or decreased by using a thicker spacer.

The correct press ram pressure and scale reading for the various axles may be found in the Rear Axle Specifications.

Fig. 15 shows method of checking pinion bearing preload using scales to measure torque.

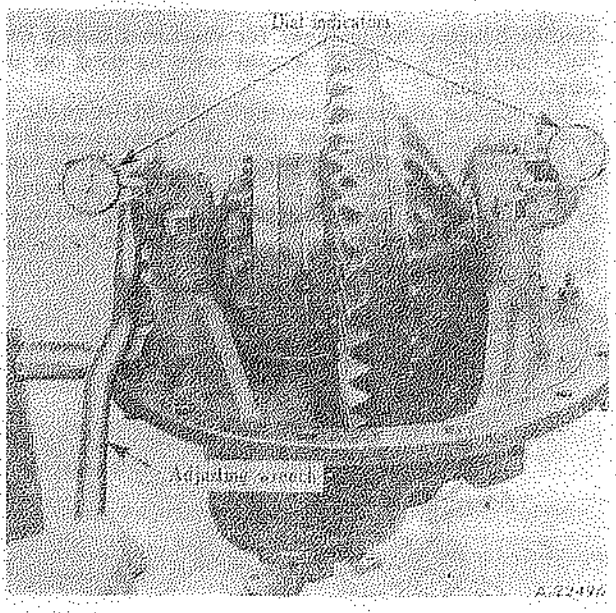


Fig. 14—Adjusting differential bearing pre-load.

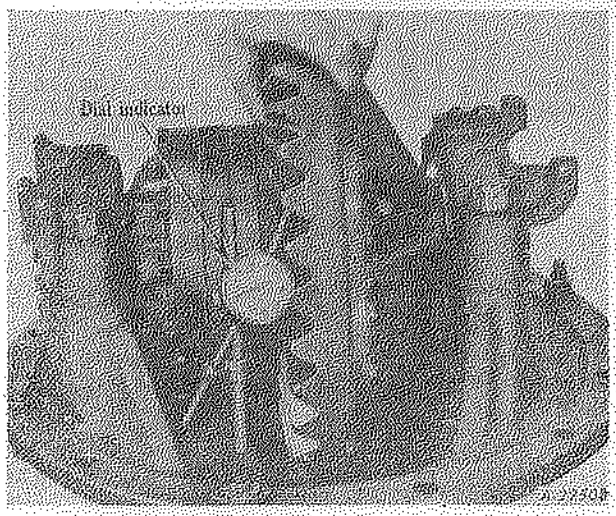


Fig. 13—Checking gear lash.

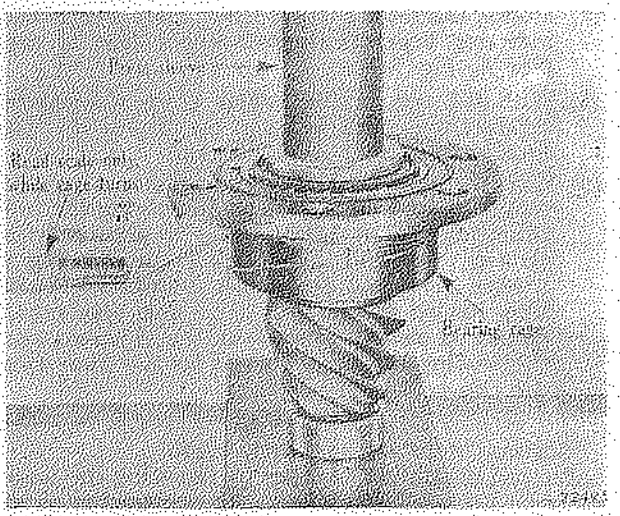


Fig. 15

Pinion Bearing Adjustment for Pre-Load Using Dial Indicator (This method should only be used on the smaller axles).

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

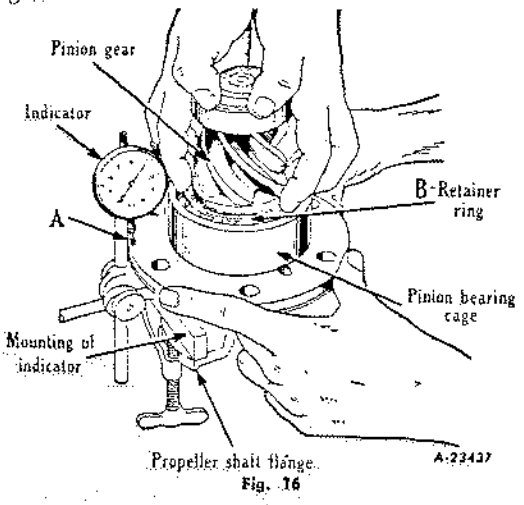


Fig. 16

Fig. 16 shows method of attaching dial indicator when adjusting bearing pre-load. This method can be used when press equipment is not available.

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

(1) Place assembly in vice in position shown.

(2) Mount indicator on propeller shaft flange with indicator finger resting on upper face of cage. (See A, Fig. 16.)

(3) With the tips of the fingers grasp the bearing retainer and work bearings up against the back face of pinion. (See B, Fig. 16.)

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

CAUTION

Bearings must be absolutely clean!

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

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

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

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

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

(4) The ideal condition is to secure a firm drag when turning the pinion cage by hand.

After proper bearing fit has been obtained, place pinion bearing cage shims approximately .020 in thickness over end of cage and place cage and pinion assembly in carrier, it being necessary to match flange holes in cage, since one hole is out of equal spacing to assure proper position of cage. Next assemble two cage bolts only until gear setting is completed. Assemble differential and bevel gear assembly and place bearing cap and adjuster in position. Tighten bearing cap bolts and back off slightly to provide sufficient looseness to allow turning the adjuster for a temporary backlash adjustment of approximately .010". After this adjustment has been made tighten each bearing adjuster snug then give them a final tightening operation, drawing them up to secure the .005" to .007" total bearing pre-load. This is important in order to make certain that the bearings are seating properly.

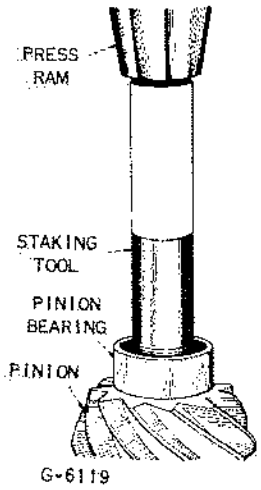


Fig. 17—Using the pinion staking tool.

Note: When bearings are found fit for further service, they should be assembled with half the original preload torque loading specified.

Where the original preload is specified in terms of decimals, by means of shims old bearings must be reassembled with the original thickness of shims.

Where preload is specified by housing deflection as in differential bearings, old bearings should be reassembled with no deflection i.e. Free running without clearance.

IMPORTANT: Hypoid drive pinion oil seals must be soft and pliable before being installed. If the seals have become dried out and hard while in stock, use kerosene and work it in thoroughly. When seal has become soft and pliable, dip it in hot oil and work this oil in thoroughly.

Pinion Bearing (Straddle bearing)

The straddle pinion bearing is held in place on the pinion by a staking operation.

The staking operation is accomplished through the use of a hydraulic or screw press applying 18 to 20 tons pressure on the special staking tool as illustrated in Fig. 17. The result will be uniformly spaced ball indentations that securely lock the pinion bearing to the shaft.

Differential Ring Gear Rivet Removal

If necessary to remove hypoid ring gear or herringbone gear rivets, drill the rivet heads from the gear side, using a drill slightly larger than the rivet itself. Use a punch for the removal of the remaining portion of the rivet (see Fig. 18).

Knocking off or "busting" rivets is a dangerous practice both from the standpoint of personal safety and because such practice may cause distortion to the gear carriers or gears and will elongate the rivet holes.

Rivet Pressures

Proper installation of differential ring gear rivets demands that sufficient pressure be applied to the rivets to expand them and cause them to completely fill the holes in which they are installed. Riveting should be done with COLD rivets. Hot rivets will shrink when cool, leaving a space and inviting shearing upon the application of torque.

Riveting Jig SE-1575 is available and is designed for use with hydraulic or mechanical press equipment.

The following pressures are recommended for differential ring gear rivet installation:

Rivet Size (inch)	Pressure Per Rivet (tons)
5/16	12 to 15
3/8	17 to 20
7/16	30 to 35
1/2	45 to 50
9/16	60 to 70
5/8	60 to 70

Axle Housing Breather Valve

When the rear axle becomes warm, after a short period of operation, a pressure is built inside the axle housing. To prevent this pressure from forcing lubricant past the rear wheel oil seals and damaging the brake linings, a breather valve hase been provided. The valve is so constructed that warm air may pass out of the axle to relieve built up pressure, yet dirt and moisture are prevented from entering. The location of the breather valve is shown in Fig. 19, inset shows detail of valve.

The breather valve should be kept open and clean. When the vehicle is operated on unimproved highways or in ice and snow it is possible that dirt will be forced under the valve cap, thus rendering the valve ineffective. Remove valve occasionally and clean thoroughly in a cleaning solution.

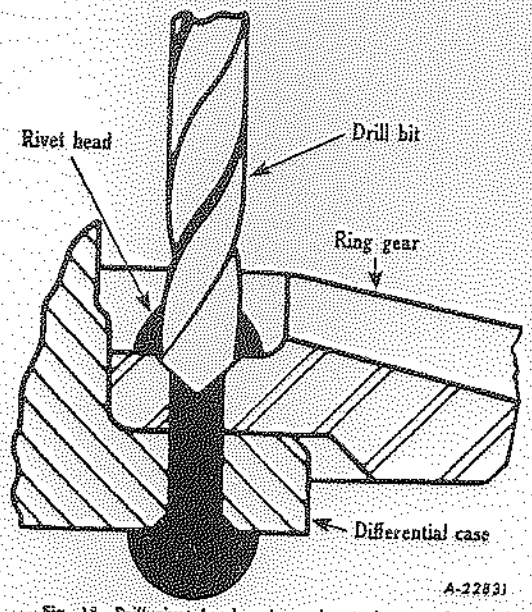


Fig. 18—Drill rivet head and punch-out rivet as shown.

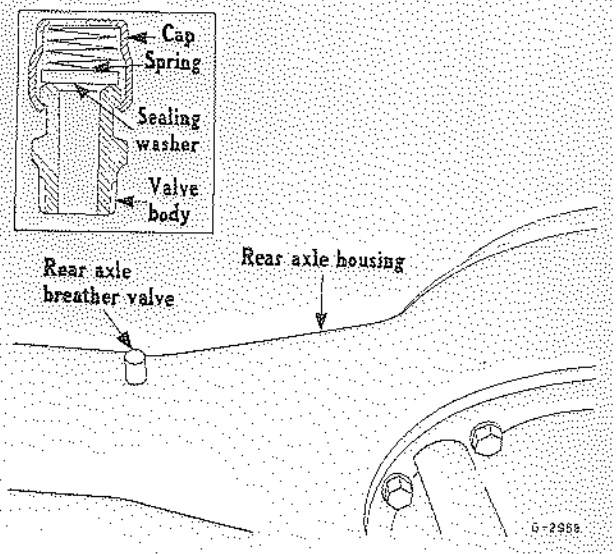


Fig. 19—Keep breather valves clean and free of obstruction. Breathers are usually located in housing as illustrated.

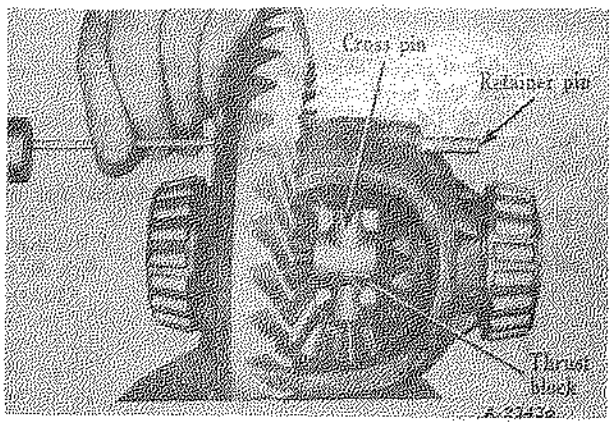


Fig. 20—Driving retainer pin from differential case using a hammer and punch.

IMPORTANT

Lubrication of Hypoid Axles

The lubricant used in hypoid axles is an important factor in obtaining long gear life and satisfactory drive unit service. Past experience proves that a large portion of service problems can be traced to using incorrect, or lubricant of poor quality.

In the selection of **Hypoid Lubricants,** it is advisable to consider using products of unquestionable quality.

Because of the higher unit pressures and sliding tooth characteristics of hypoid gearing, the lubricant must have properties which enable it to withstand these actions.

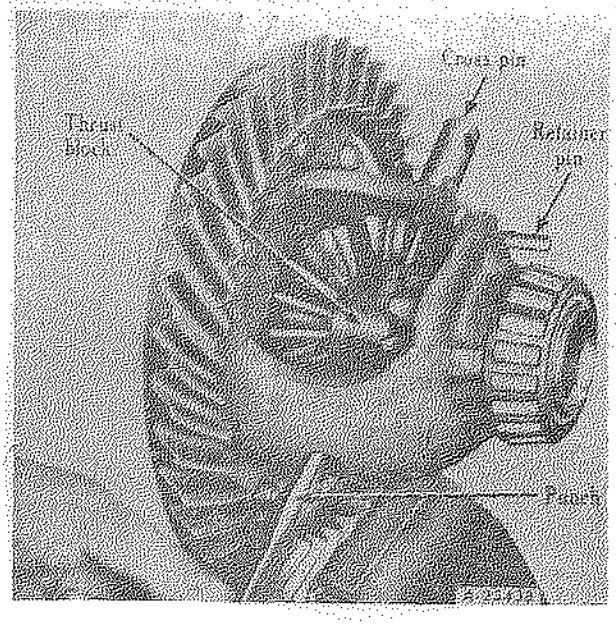


Fig. 21

It is important that the axle hypoid gearing receives initial lubrication after overhaul, or when a vehicle has been standing in storage, and BEFORE THE AXLE IS SUBJECTED TO HEAVY LOADS. Good practice is to check the lubricant level in the axle housing then, JACK UP BOTH rear wheels and operate the vehicle in high transmission gear at approximately 25 miles per hour for five minutes. This will assure thorough lubrication of the gearing before the unit is placed into service. (Do not allow one wheel to race faster than the opposite wheel.)

Where the axle pinion cage is provided with a plug at the pinion cage, insert one pint of lubricant to provide initial lubrication for the pinion bearing.

Specified Lubricant for Hypoid Axles

For hypoid axles use SCL, EP gear oil or a multipurpose gear lubricant suitable for hypoid axles and supplied by a reputable refinery. SAE-90 for cold climate and SAE-140 for warm climate.

NOTE: When reassembling the differential gears, thrust washers, cross shaft spur gears and bearings, lubricate the wearing surfaces with a light coat of the specified axle lubricant.

2-1/2 TON 4x4 G.S. - INTERNATIONAL

Main Springs

Front and rear

Rate of deflection

Clamped	1184 lbs/inch
Unclamped	1000 lbs/inch
Number of leaves	14
Width	3"
Free opening	5-13/16"
Load to bump	4-3/4
Length under load flat	54" eye centres
Centre bolt position	Central
Centre bolt diameter	7/16

Auxiliary Springs

Rate of deflection	1130 lbs/in (1075-1185)
Number of leaves	6
Width	3"
Free opening	(Approx. at contact centres) 2-5/8"
Load to bump	4"
Centre bolt position	Central
Centre bolt diameter	3/8

Shock Absorbers

Type	Hydraulic Telescopic (Non-Serviceable)

Shock absorbers fitted to this vehicle are of telescopic type and are interchangeable front and rear.

Springs are identical all round with the exception that a helper spring is incorporated with the rear spring as shown in the illustration Fig. 1. Main springs are 54" span when flat and the height of a FREE spring is 9" from spring mounting pad face to centreline of eyes. Main spring rate is 1040 lbs/inch.

The camber in the main leaf of the auxiliary spring is 4-9/16 at two points on a 36" span. Spring rate is 1130 lbs/inch.

FRONT SPRING MOUNTING

Front springs are mounted at the front with brackets and at the rear by shackles.

REAR SPRING MOUNTING

Rear springs are mounted at the front with brackets and at the rear with shackles.

AUXILIARY SPRING MOUNTING

Auxiliary springs are mounted on top of the main rear spring and under load the auxiliary spring ends will contact the brackets attached to the side rails.

SPRING MAINTENANCE

Spring failures at the centre section, or near the centre bolt hole, are generally caused by loose U-bolts. These bolts must be kept tight and checked frequently. The best results will be obtained by having the vehicle fully loaded at the time of tightening the U-bolts, since this assures the spring leaves being compressed.

Spring pins on this truck are clamped in position as shown in Fig. 1.

DISASSEMBLY OF SPRINGS

The disassembly of front or rear springs is identical in procedure. Disassemble springs as follows:-

1. Place spring in vice, clamping assembly near centre of spring.
2. Remove nuts from four spring clip bolts, and remove bolts from clips.
3. Remove nut from spring centre bolt.
4. Release vice to permit leaves to separate. Remove spring from vice. Separate and remove leaves from centre bolt.

AUXILIARY SPRINGS

Disassembly of the auxiliary springs differs only slightly from that of the front or rear springs.

1. Place auxiliary spring in vice, and clamp leaves together.
2. Straighten tabs of two spring clips, being careful not to break them off. Heating clips with a torch will help avoid breakage.
3. Remove nut from centre bolt, and release vice to permit leaves to separate. Remove spring from vice.
4. Remove spring leaves from centre bolt.

CLEANING AND INSPECTION OF SPRINGS

Wash or scrub all parts in cleaning solvent or clean all parts with steam cleaning equipment. Brushing of spring leaves with a wire brush will facilitate scale removal.

1. Inspect all spring leaves for breakage and cracks. Replace defective leaves. Inspect all leaves for arch by comparison with new leaves. If leaves are flattened, either re-arch or replace.
2. Examine spring pins for wear. If wear is apparent, or if pins are corroded or cracked replace with new pins.

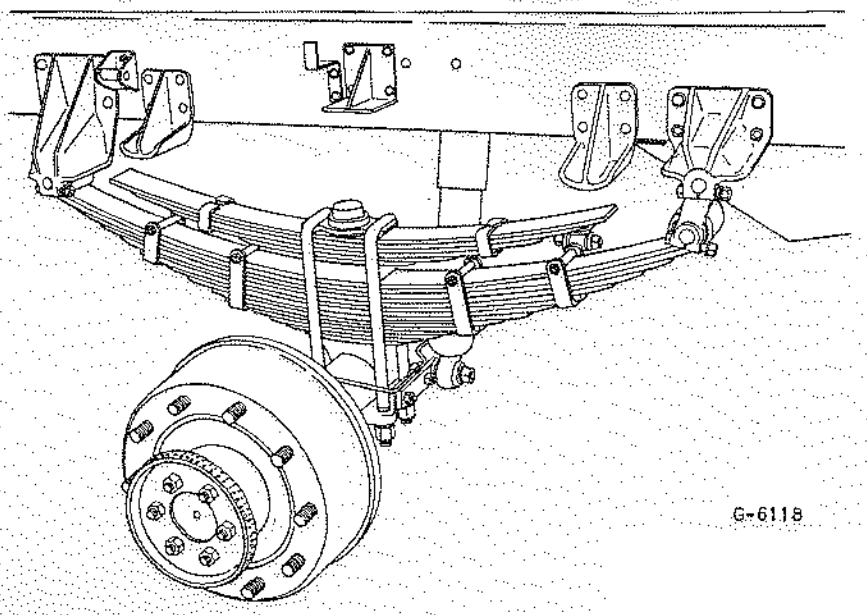


Fig. 1 - Rear Spring and Shock Absorbers

3. Inspect spring eye bushing, and rear spring shackle bushings for wear, and replace if defective.

4. Inspect spring bracket for breakage and for wear in mounting bolt, or rivet holes and replace if worn or broken.

5. Replace centre bolts at each overhaul.

ASSEMBLY OF FRONT AND REAR SPRINGS

1. Lightly coat spring leaves with graphite grease. Replace spring leaves in proper order, lining up the centre bolt holes.

2. Partially compress spring leaves, and insert centre bolt and nut.

3. Place spring assembly in vice, and compress spring leaves fully.

4. Install four spring clip bolts in spring clips, and install nuts on bolts. Tighten centre bolt nut.

5. Run over end of clip bolts and centre bolt enough to prevent loosening of nut.

AUXILIARY SPRING ASSEMBLY

1. Coat spring leaves lightly with graphite grease. Place leaves one on top of another in accordance with length.

2. Compress spring leaves and install centre bolt and nut.

3. Place spring in vice and compress leaves fully. Tighten centre bolt nut. Bend down ends of spring clips, being careful not to break them. Heating of the clips with a torch will facilitate the operation.

SHOCK ABSORBERS

The shock absorbers with which the vehicle is equipped have a capacity far in excess of actual requirement, and will therefore function efficiently under any conditions likely to be encountered in service.

The units are not serviceable and should be replaced with new if their performance becomes unsatisfactory, or they develop an oil leak.

Testing the shock absorbers for efficiency can only be done with special and expensive equipment, but the following points should be a useful guide to operators and workshop personnel.

1. Worn oil seals will allow oil to leak from the shock absorber at the point where the piston rod enters the assembly.

2. A bent piston rod will tend to impair free movement.

3. Incorrectly assembled rubber mounting bushes will rapidly wear out, and should be examined at least every 2,000 miles.

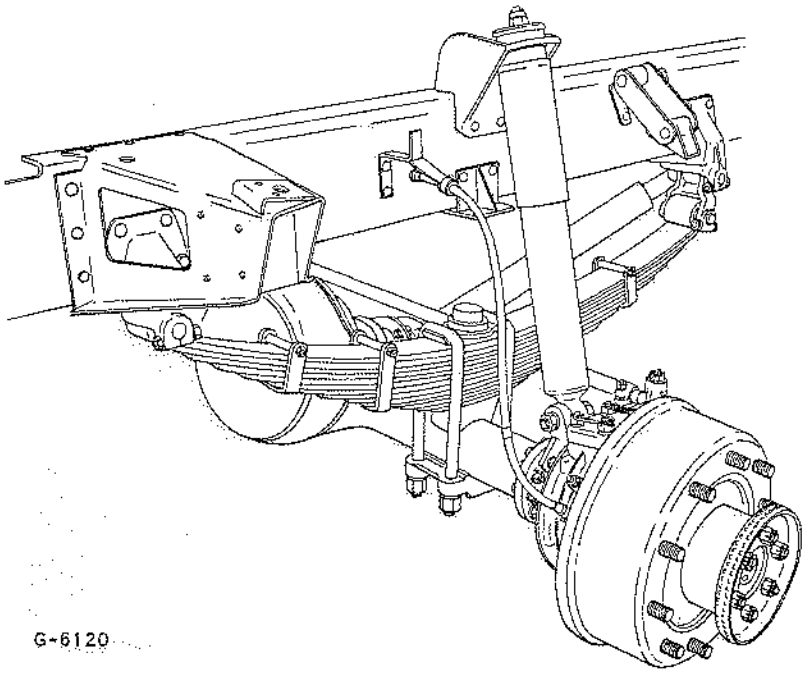


Fig. 2 - Front Springs and Shock Absorbers

Frame Construction

Construction of the frame is shown in Fig. 2.

Frame Alignment

Any vehicle that has been in an accident which might result in a bent or sprung frame should have the frame and axle alignment carefully checked.

Checking Frame Alignment (Fig. 1)

A satisfactory method of checking the frame and axle alignment, particularly when a body and cab is on a chassis, is to mark on a level floor all points at which measurements are to be taken. Tack or cement pieces of paper to the floor directly under each point of measurement on the chassis and indicated by the letter "M" in the figure. The points of measurement must be accurately marked in relation to the frame in order to obtain a satisfactory alignment check.

After each measurement point has been carefully marked on the floor, proceed as follows:

1. Locate centre line of chassis by measuring front and rear end widths, using marks on floor. If frame widths check, draw centre line on floor, full length of chassis. If frame widths do not check, lay out centre line as follows:

2. Centre line can be drawn through the intersection of any one pair of equal diagonals (A-A, B-B, C-C, D-D, E-E) and centre point of one end of frame or through points of intersection of any two pairs of equal diagonals.

3. Measure distance from centre line to opposite points marked over entire length of frame. Measurements should not vary more than 1/8" at any part.

4. Measuring diagonals, A-A, B-B, C-C, D-D, E-E will indicate point where misalignment occurs. If diagonals in each pair check within 1/8", that part of frame included between points of measurement may be considered in satisfactory alignment. These diagonals should intersect wighin 1/8" of centre line.

Axle Alignment with Frame

After determining the frame is properly aligned, the axle alignment with the frame should be checked by comparing diagonals.

Dimensions for side elevation of frame should be checked at the points indicated and should not vary more than 1/8".

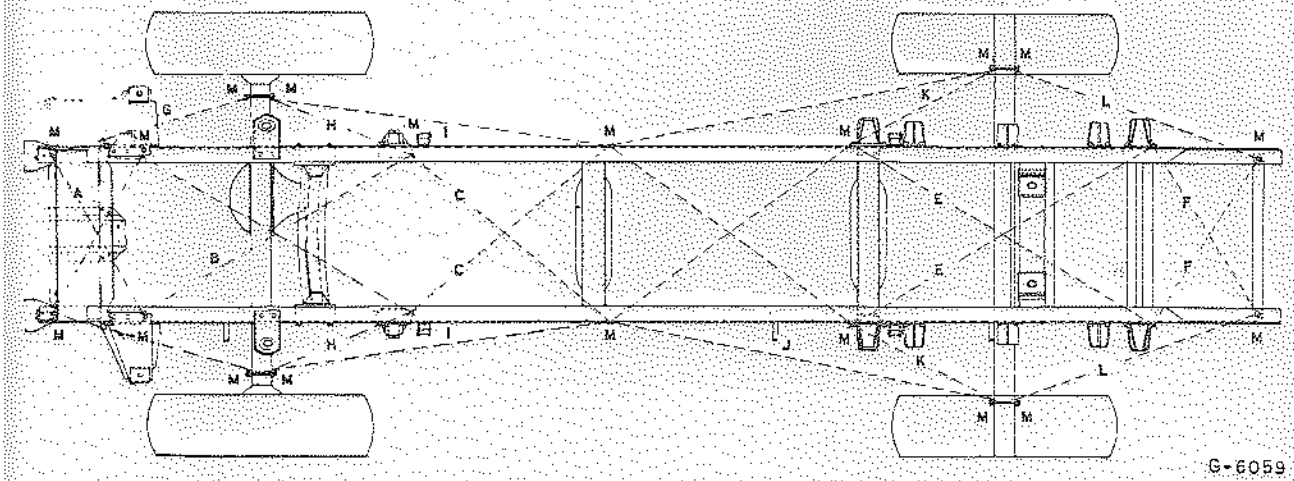
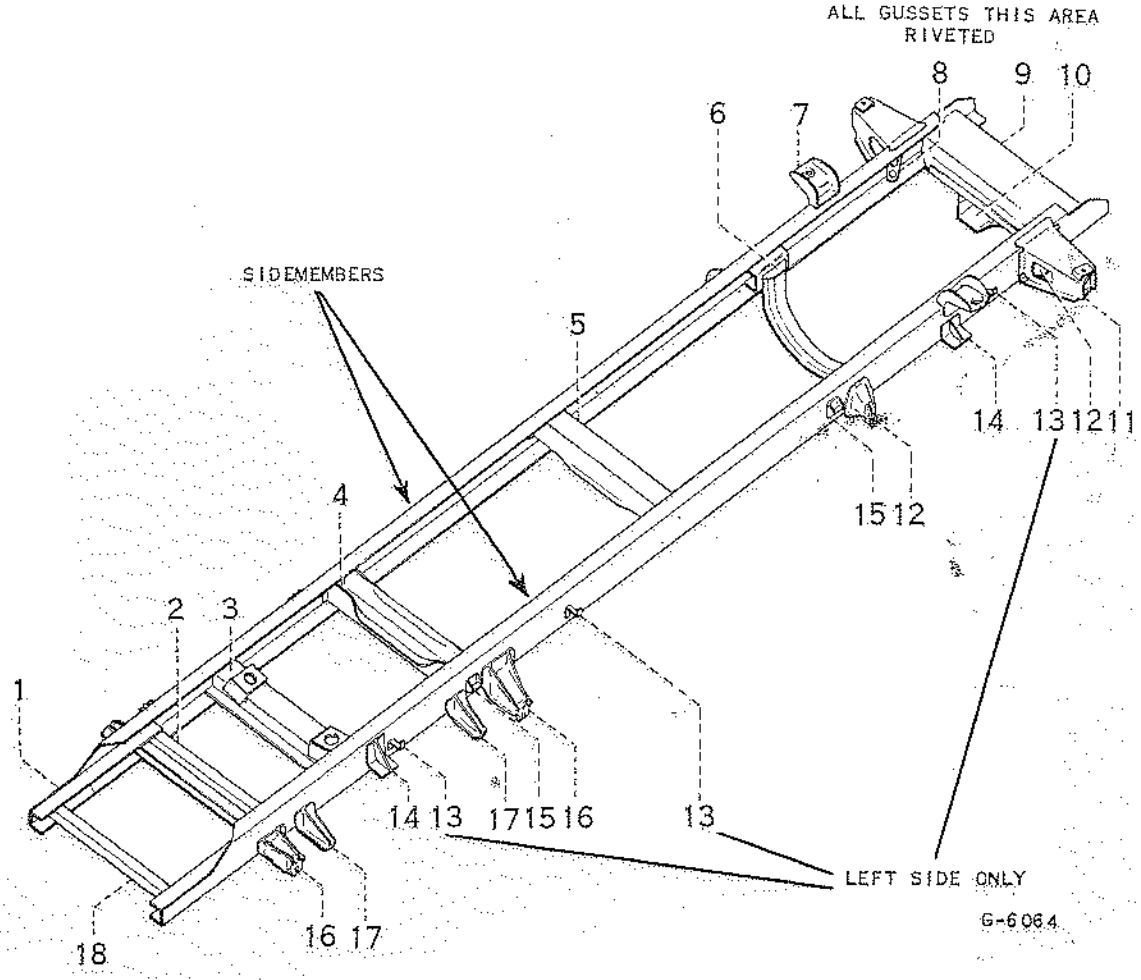


Fig. 1 - Frame and Axle alignment checking diagram

Frame Straightening

Use of heat is not recommended when straightening frames. Heat weakens structural characteristics of frame members and all straightening should be done cold. Frame members which are bent or buckled sufficiently to show cracks or weakness after straightening, should be replaced.



ITEM	DESCRIPTION	R-RIVET B-BOLT	ITEM	DESCRIPTION	R-RIVET B-BOLT
1	EXTENSION CHASSIS	B & R	10	ENGINE FRONT MTG.	B
2	CROSSMEMBERS	B & R	11	CAB MTG. BRACKET	R
3	CROSSMEMBER SHOCK ABSORBER	R	12	SHACKLE BRACKET FRONT	R
4	CROSSMEMBER	B & R	13	BRACKET ROPE SUPPORT	R
5	CROSSMEMBER	R	14	BUMP STOP BRACKET	R
6	CROSSMEMBER AND GUSSET	B & R	15	LASHING LOOP	B
7	SHOCK ABSORBER BRACKET	R	16	SHACKLE BRACKET REAR	R
8	OIL HOSE BRACKET	R	17	AUXILIARY SPRING BRACKET	R
9	FRONT CROSSMEMBER	B & R	18	CROSSMEMBER	B

2-1/2 TON 4x4 G.S. - INTERNATIONAL

Number of cylinders	6
Bore	3-13/16
Stroke	4-1/8
Displacement (cu. ins.)	282.5
Rated H.P. (A.M.A.)	34.9
Brake H.P. maximum	148
At r.p.m.	3800
Brake H.P. (Net)	123
At r.p.m.	3300
Torque Maximum (LBS. FT.)	243.5
At r.p.m.	1800
Torque (Net)	235.5
At r.p.m.	1400
Maximum recommended speed r.p.m.	3400
Recommended low idle r.p.m.	450 - 500
Compression ratio	7 : 1
Firing order	153 624
Crankcase dry capacity (Imp. Pints)	11
Plus filter (full flow)	2-1/2
Plus oil cooler	3-1/2
Weight (bare) Lbs.	599
Weight with standard accessories Lbs.	667

K

Crankshaft

Main journal diameter	2.748 - 2.749
Number of main bearings	4
Crankpin diameter	2.373 - 2.374
Bearing clearance (main journals)	.0012 - .0042
Bearing O.D. and spread	2.942 + .025
Crankshaft end play	.005 - .010
Thrust taken by	Number 3
Hardening method	Through
Bearing Tunnel	2.941" - 2.942"

Camshaft

Camshaft journal diameter

Front	2.109 - 2.110
Second	2.089 - 2.090
Third	2.069 - 2.070
Fourth	1.4995 - 1.5005

Camshaft Bearing Clearance	.0010 - .0035
Camshaft End Play	.012 - .004
Thrust taken by	Thrust flange
Timing Gear Backlash	.004" - .007"

Connecting Rods

Bearing end clearance	.009 - .015
Running clearance	.0032 - .0011
Bearing O.D. and spread	2.500 + .025
Weight variation in set of six	1/4 ounce

Pistons

Material	Aluminium Alloy

Recommended piston clearance

Top of skirt	.0025
Bottom of skirt	.0015

Feeler Gauge Ribbon Checking

Width of ribbon	1/2"
Thickness	.003
Tension on scales (lbs.)	6 - 18
Desired tension (lbs.)	12
At 70 degrees F. ambient temperature	*NOTE: Desired tension will decrease Approx 3-1/2 lbs for every 10 degree drop in temperature below 70 and increase approx. 5 lbs. for every 10 degree increase above 70*

Piston Pins

Length	2.9505"
Diameter	.8748" - .8749"
Pin fit (room temperature 70 degrees F.)	
Recommended clearance in rod	.0007" - .0002"
Recommended clearance in piston	
Loose end	.00035" - .00010"

Piston Rings

Compression rings on each piston	2
Size	(1) 3/32 (1) 1/8
Oil rings on each piston	1
Size	3/16
Diameter	3-13/16

Ring Gap

Compression Rings	.015" - .031"
Oil Ring - Side Rail	.015" - .055"
Spacer	.020" - .030"
Spring Expander (assembled on piston on cylinder)	1/8" min.

Fit in Groove

Top (Comp.)	.0025 - .0040
Second (Comp.)	.0015 - .0030
Third oil	.0037 - .0075

Inlet Valves

Stem diameter	.3715 - .3725
Angle of face	60 degrees
Tappet clearance (hot)	.024 - .026
Stem clearance in guide	.0015 - .0040

Valve Seats

Angle of face	30 degrees
Width of seat (inlet)	.048 - .074
Width of seat (exhaust)	.083 - .109

Exhaust Valves

Stem diameter	.4020 - .4015
Angle of face	60 degrees
Tappet clearance (hot)	.024 - .026
Stem clearance in guide	.0020 - .0045

Valve Guides

Distance above head measured from valve spring seat face

Exhaust	27/32
Inlet	1-1/16

Valve Tappet

Clearance in block	.0023 - .003

Valve Springs

Free length	2-1/4
Load at 1.477"	142-157 lbs.

Valve rocker arms

Clearance on shaft	.0015 - .004

Valve Timing

Inlet opens (before T.D.C.)	12 degrees
Inlet closes (after B.D.C.)	38 degrees
Exhaust opens (before B.D.C.)	55 degrees
Exhaust closes (after T.D.C.)	15 degrees
Inlet and exhaust timing checking clearance	.033

Oil Pump

Gear end clearance	.0055 - .0025
Running clearance - gear to body	.0108 - .0068
Clearance - drive shaft to body	.003 - .0015
Clearance - idler gear to shaft	.0035 - .0015

Oil Pump (Continued)

Back lash - body gears	.006 - .003
Back lash - drive gears	.008 - .002
Oil pressure at 400 r.p.m.	6-12 lbs.
Oil pressure at 1500 r.p.m.	35-45 lbs.
Pump shaft diameter	.4885" - .4890"
Flow Capacity at 3400 Engine r.p.m.	7-8 Gals. per min.

Flywheel Housing

Permissible run out (T.I.R.)	.000 - .010
Rear face square with centre line of C-shaft	Within .0005 per inch from centre line

Ignition Timing

Initial Setting - premium fuel	6 degrees B.T.D.C.
standard fuel	3 degrees B.T.D.C.
Optimum Setting	By road test
Distributor contact points	
Adjustment - Bosch gap	.012" - .016
dwell	36 deg. - 40 deg.

All Settings to be checked after Engine Run-In for 500 Miles.

RECONDITIONING LIMITS

Crankshaft Regrinding :

Main bearing journals	Undersize .060 max.
Connecting rod journals	Undersize .060 max.

Undersize bearings available .002, .010, .020, .030, .040 and .060

Crankcase Cylinder Bores ..... Oversize .030 max.

Oversize pistons and rings available .005, .010, .020 and .030

Oversize pistons pins available .005 and .008

Cylinder Head

Insert exh. valve seat ..... Oversize .030 max.

Oversize inserts available .015 and .030

Insert int. valve seat .... one size only available

Joint face resurfacing Metal to be removed ..... .010 max.

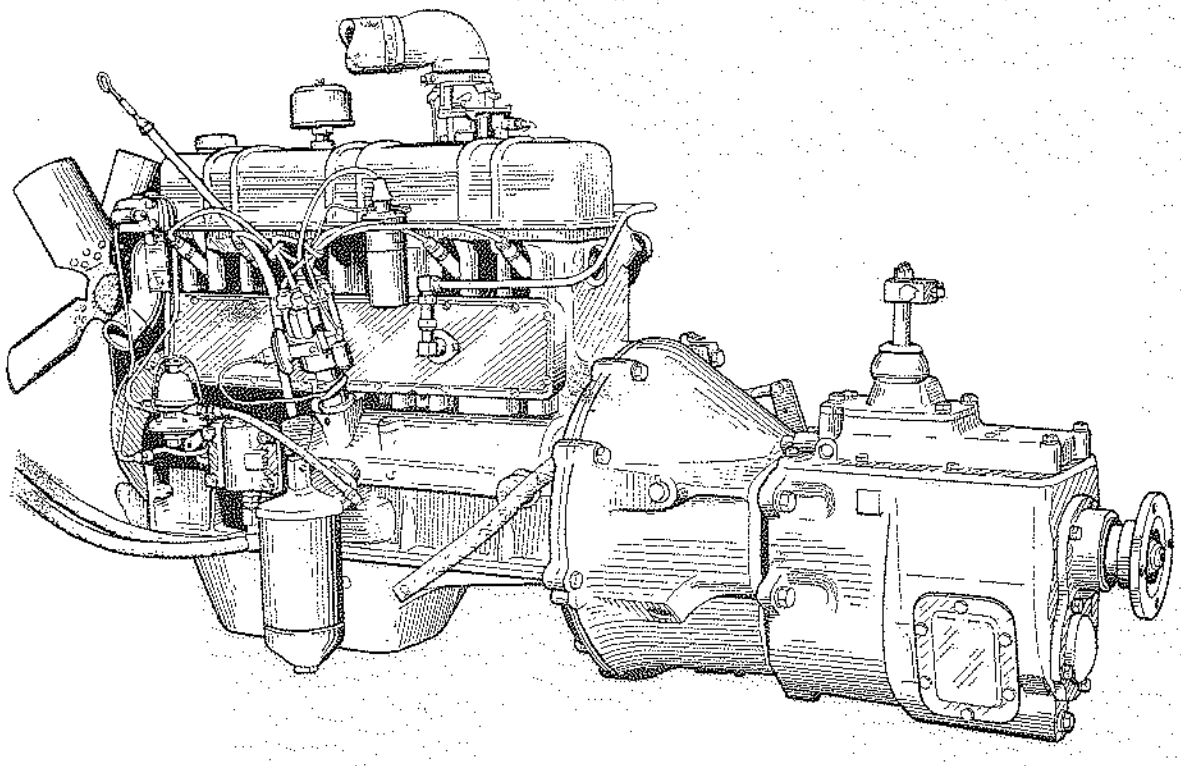


Fig. 1 - Left hand view of engine

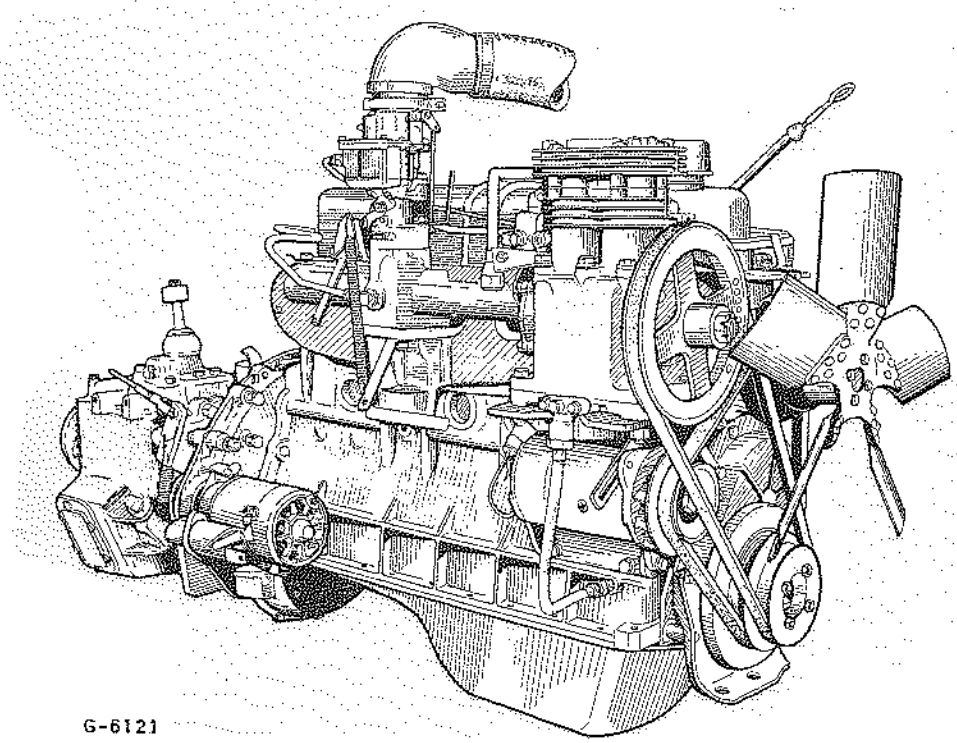


Fig. 2 - Right hand view of engine

DESCRIPTION

General Features of Engine

The International Model AGD-282 Engine is a 4 cycle, 6 cylinder in line petrol engine similar to that illustrated in Figs. 1 and 2.

The cylinders are numbered from the front for the purpose of firing order, valve timing and piston numbering.

Crankshaft rotation is clockwise viewed from the front.

The oil filler cap is located at the front end of the valve rocker cover.

The oil level dipstick is located on the right looking from the front and is accessible through the front compartment.

Engine Number

This is stamped on the top edge of the oil pressure relief valve pad located on the left hand side viewed from the rear.

NOTE: Unless otherwise stated, references to left or right hand side are to be taken as viewed from the rear of the vehicle.

Construction

1. The generator, fan and water pump are driven by a V-type belt from a driven pulley mounted on the front end of crankshaft. The distributor, mounted on the left side of engine is driven by the camshaft through the oil pump gear and shaft.

2. The exhaust and intake manifolds are bolted to each other and to the right side of the engine head. The intake manifold and the exhaust manifold are each cast in one piece.

3. A vibration damper is provided at the front end of the crankshaft.

4. The cylinder block and crankcase are cast in one piece, and carry the crankshaft main bearings. Water circulation passages completely surround the cylinders in the crankcase, and also provide coolant to the cylinder head.

5. Oil is supplied under pressure by the oil pump to the engine lubrication system. Oil spray from the revolving crankshaft is distributed to the cylinder walls, piston and other moving parts inside the engine.

6. Exhaust valve seats are of alloy, and are pressed into place (Fig. 13). These valve seats lengthen the period between valve reconditioning operations. Valves and valve seats are cooled by continuous circulation of water through the cylinder head.

7. The detachable cylinder head is bolted to the crankcase, and a gas tight and water tight seal is maintained by means of a gasket.

8. The crankshaft is a drop forging of heat-treated steel. It is counter-weighted, balanced both statically and dynamically, and ground to close limits. The shaft is mounted in four precision-type replaceable shell bearings, the number three bearing taking up the thrust.

9. The pistons are made of an aluminium alloy, are cam ground, and are fitted with two compression rings and one oil control ring. The full-floating type piston pins are held in place in the pistons, at the ends of the pins, by snap rings.

10. The camshaft is machined from a solid drop forging and mounted in four special replaceable bearings.

11. The flywheel is bolted and dowelled to the crankshaft flange. The timing mark is located on the flywheel by means of a steel ball let into the front face, and is visible through an aperture in the front left hand side of the flywheel housing (viewed from the rear).

ENGINE DISASSEMBLY

Install the engine in a suitable engine rotating overhaul stand. NOTE: Many of the disassembly operations can be performed with the engine in the chassis. However, the following disassembly outline is performed with the engine removed from the chassis to clearly illustrate each of the units. Except where indicated, no attempt has been made to prescribe a particular sequence for removing the various units, since some can be readily removed with the engine in the chassis. The extent of the service required on a particular unit will govern the necessity for its removal.

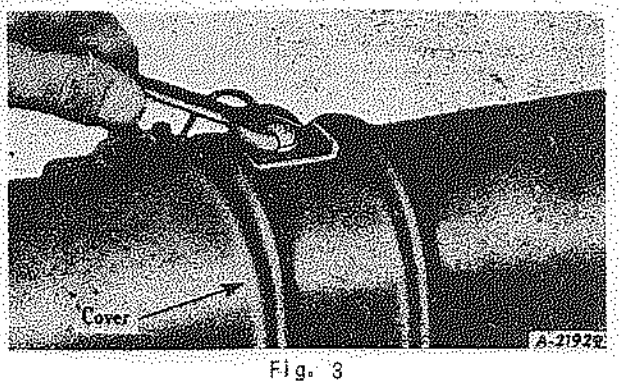


Fig. 3

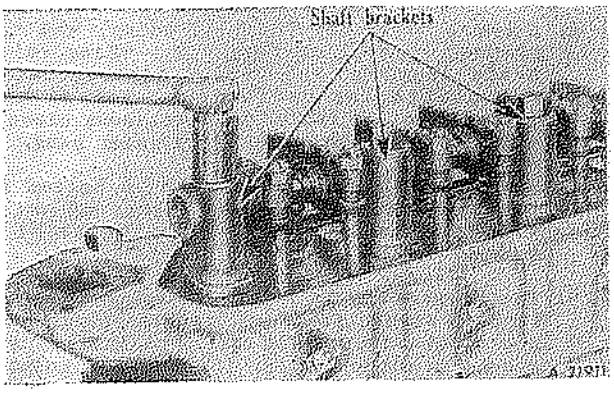


Fig. 4

Removing Rocker Arms

The following steps are to be followed when removing the rocker arm cover and rocker arm assembly. (Carburettor and air cleaner previously removed):

1. Remove three capscrews from rocker arm cover and remove cover (Fig. 3).
2. Remove capscrews from shaft brackets (Fig. 4).
3. Remove rocker arm assembly as a unit (Fig. 6).

Rocker Arm and Valve Mechanism Disassembly

1. The rocker arm assembly is composed of front and rear shafts joined at the centre, on which are mounted twelve rocker arms and six tension springs (Fig. 6). The shafts are mounted in seven brackets, and are prevented from turning at the two end brackets by means of 5/16 dia. roll pins, Fig. 5. These are inserted downwards into each end bracket and engaged with the small slots in the rocker shafts. This ensures correct location of the oil holes in relation to the rockers. The split in the roll pin should be away from the shaft as shown in Fig. 5.
2. Number two, four and six rocker arm brackets have sleeve dowels which keep the rocker arm assembly aligned.
3. These sleeve dowels measure approx. 5/8" in diameter, 1" long, and 1/32" wall.

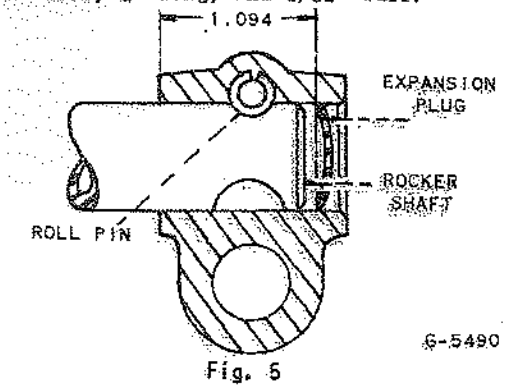


Fig. 5
Installation of Rocker Shaft

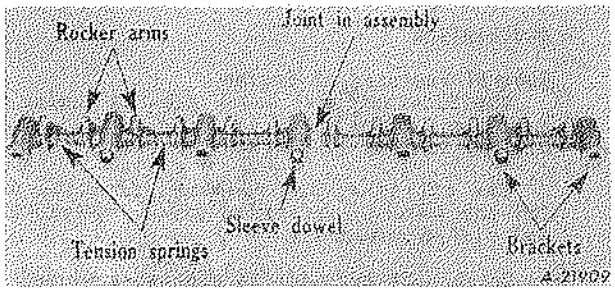


Fig. 6

4. The three hold-down brackets are reamed, from the bottom side (Fig. 7) so that the sleeve dowels will fit .0005"-.0035" tight in brackets. About one-half inch of dowel is in the bracket. The remaining half of dowel is fitted .0025"-.0055" loose in the head. When removing rocker arm assembly the dowels will remain in hold-down brackets.
5. Separate the shafts and slide rocker arms, springs and brackets from shafts.
6. Clean all parts in a solvent cleaning fluid, being careful to clean all accumulated sludge and carbon deposits from oil holes and slots.

ROCKER ARM INSPECTION

Carefully inspect all parts for defects and wear:

1. Inspect rocker arm shaft expansion plugs. Check on a surface plate for signs of bending, check for wear from rocker arms. If a shaft is bent or shows perceptible wear, it must be replaced.
2. Inspect rocker arm adjusting screws for wear at contact surface and for thread wear. Replace worn screws. Check rocker arm bushings for wear. If clearance of shaft exceeds .004", replace arms. Inspect valve stem contact pad surface of rocker arms, and resurface if wear is perceptible, but do not reduce material thickness by more than .010.
3. Inspect tension springs for breakage or loss of tension. Replace defective springs. Remove valve lifter rods.

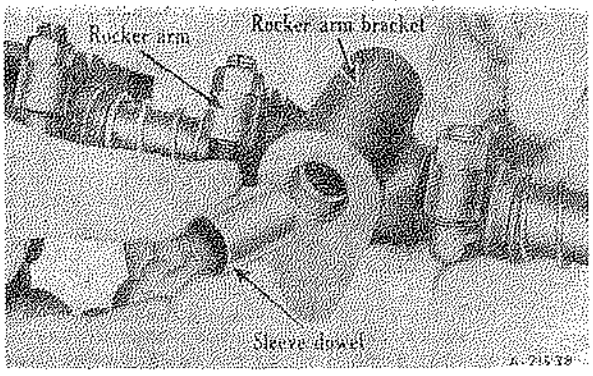


Fig. 7 - Details of sleeve dowel located in bracket

Valves

The AGD-282 International Engine is equipped with sodium cooled exhaust valves and silchrome inlet valves.

Both exhaust and inlet valves are of the rotating type, this rotation being achieved by the use of a rotocoil assembly located under each valve spring (6) Fig. 13.

As shown at (8) Fig. 13. The exhaust valve seat is an insert, whereas the inlet valve seats directly onto the cylinder head.

Cylinder Head and Valves

The following instructions are to be followed when reconditioning cylinder head and gasket. Remove push rods, remove cylinder head bolts and lift off cylinder head and gasket.

1. Compress valve spring with a valve compressor and remove valve spring retainer locks (Fig. 13). Remove retainer. Remove valve springs and damper and separate valve spring damper from valve spring. Note that valve springs can be installed with either end toward the cylinder head. Remove all valve springs as outlined, and remove valve spring damper from each spring (Fig. 10).
2. Invert cylinder head. Remove all valves from their valve guides and from the head.
3. Scrape all carbon from cylinder head combustion chamber, and clean any gasket material from surface of head. Clean the head using steam cleaning or other suitable cleaning equipment.

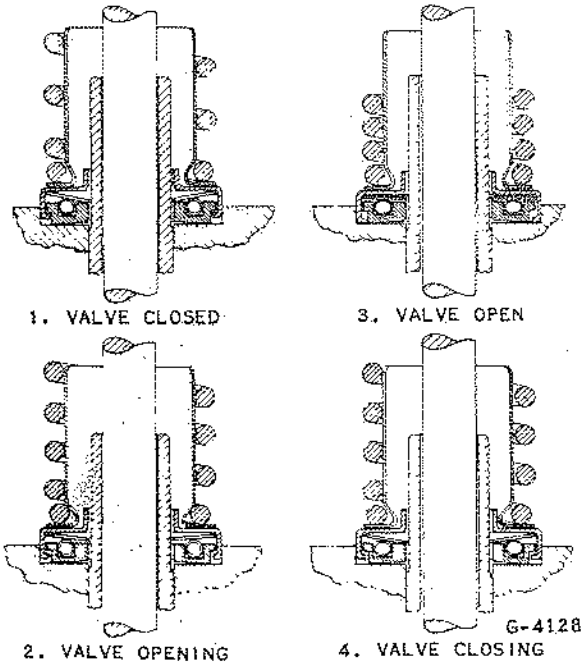


Fig. 9 - Rotocoil cycle

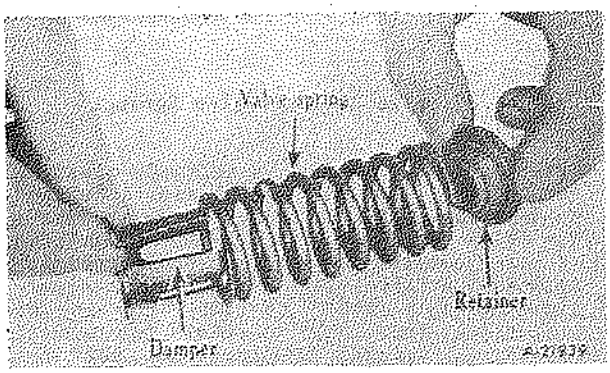


Fig. 10 - Dampers are used on all valves. Assemble damper, spring and retainer as shown

4. Clean all carbon deposits from valve heads and valve stems with a wire brush. Wash all valve springs and retainers in cleaning solvent. Do not scratch valves, particularly in the area under the head. Such scratches can cause valve failure.

Inspection of Cylinder Head

1. Inspect cylinder head visually for signs of cracks or sand holes. If found defective, weld or replace head.
2. Inspect exhaust valve seat rings for looseness and inspect for excessive width of valve seat surface. If rings are loose replace. If a seat has been previously ground to such an extent that it cannot be narrowed from top to bring to proper position near centre of valve face, the ring must be replaced.

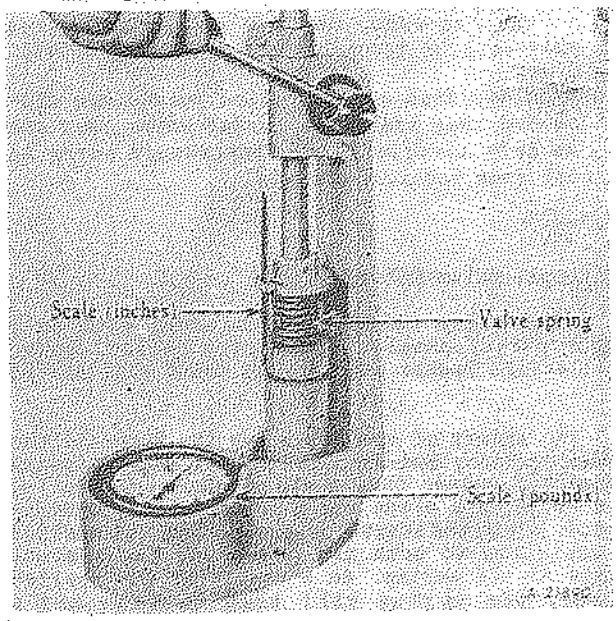


Fig. 11 - Use a valve spring testing tool or similar tool to check spring tension

Inspection of Valve Guides, Valve Springs and Valves

1. Clean valve guides with a suitable cleaning tool. Check each valve guide with a "Go and No-Go" gauge, if available, otherwise, use a new valve to check fit. If "No-Go" portion of gauge enters, the guide must be replaced. Recommended valve stem to valve guide clearance is from .0015" to .004" for intake valves, and from .002" to .0045" for exhaust valves. Clearances in excess of .006" for intake valves or .008" for exhaust valves, require guide replacement. Minimum inside diameter of guides after assembly into cylinder head to be, Inlet .3737 and Exhaust .4042.

2. Test valve springs with damper in position. Test tension of each valve spring and valve open length with a valve-spring tester (Fig. 11). Check valve springs at 1.477" length, and replace if pressure is less than 142 pounds. If a spring testing machine is not available place a new spring end to end on the old spring and compress one against the other in a vice or press. This will reveal a weak spring.

3. Inspect each valve for warpage, for severely burned condition, and for excessive grinding on the valve head. Inspect valve stem for scuff marks or perceptible wear. Inspect valve stem end for wear at contact surface with valve rocker arm. If valve is warped, excessively burned, or has been previously ground to extent that valve head in thin at edge, replace valve; otherwise valve can be reconditioned and reinstalled.

WARNING: When sodium cooled valves are discarded they should be buried where they can be left indefinitely. They should never be cut open indiscriminately.

Rotocoil Valve Rotator

This valve rotator is designed with only four parts, namely, the spring collar, body, Belleville washer and a close wound coil spring.

The theory of operation for the Rotocoil can best be described with the aid of the following example. Assume that a close wound coil spring is lying on a plane and a force, evenly distributed along the length of the spring, is applied vertically to both the plane and the central axis of the spring. As a result of the applied load, the spring will tend to lean and a portion of the load will be shifted in the direction of the coil winding.

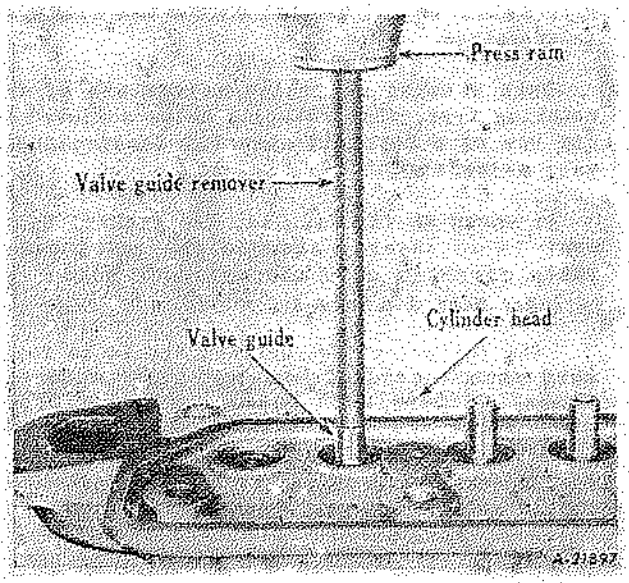


Fig. 12
Use a valve stem guide tool

Fig. 9 illustrates the application of this idea:

1. Orientation of component parts for the valve closed position.

2. As the valve begins to open the Belleville spring is raised from its seat (point A) on the retainer body which transfers the valve train load to the coil spring.

3. This deflects the coil spring in the direction of its winding and induces rotation of the valve through the retainer cap and collets (not shown in illustrations).

4. When the valve begins to seat the Belleville washer and coil spring recover simultaneously without inducing rotational torque to the valve, since the washer maintains contact with the seating collar throughout the recovery cycle.

Advantages of the Rotocoil assembly are:

1. Prevents Valve Stem Tip wear.
2. Keeps valve stems free from deposit built up.
3. Keeps valve seats clean.
4. Prevents local hot spots from forming and minimises the tendency of valve seat guttering and burning.
5. More uniform valve face to valve seat contact.

Checking Rotary Action

To check a roto-coil assembly to ensure it is fit for further service, make a pencil or similar mark across the edges of the two outer parts. Lay the rotocoil on a hard flat surface and with a light hammer, sharply rap the assembly about 20 times. Examine the pencil marks which should indicate that the two parts have moved round in relation to each other. If this rotary movement has occurred and the assembly is otherwise in good condition it can be used again. Otherwise replace it.

Repair of Cylinder Head

1. If cylinder head has to be resurfaced, remove only enough material to true-up surface, maximum .010. It is safer to use a new head to avoid upsetting the normal compression ratio of the engine.

2. If any valve guide shows excess clearance of out-of-round condition, press guide from cylinder head with a special removing tool (Fig. 12). Install new guide, and press into cylinder head until approximately 1-1/16 for intake and 27/32 for exhaust remains above top surface of cylinder head (Fig. 13).

3. If an inspection has indicated the necessity replace the valve seat.

4. Grind the valve seats in cylinder head to 30 degrees on exhaust and 30 degrees on intake.

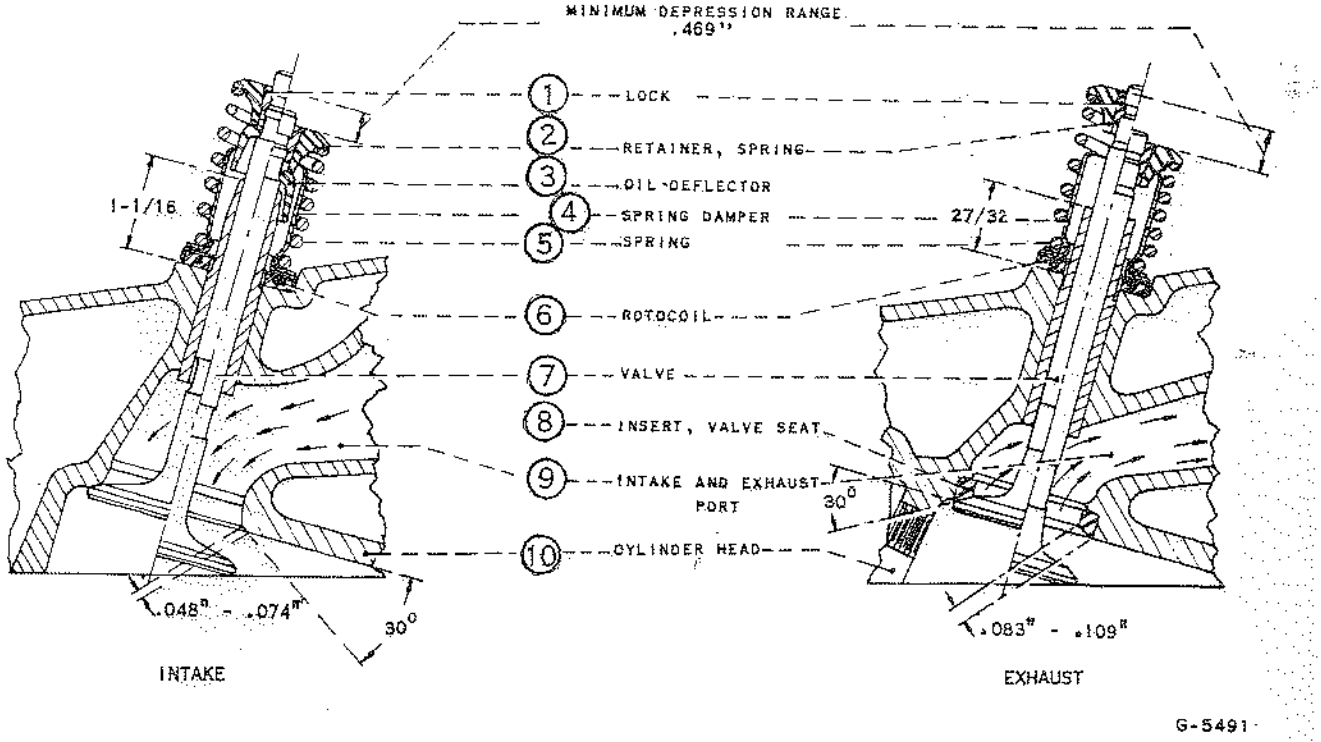


Fig. 13
Valve Installation

Reconditioning Valves and Seats

One of the principal difficulties experienced in reconditioning valves is obtaining nearly identical angles on the valve seat and valve face. The importance of these angles in the grinding operation cannot be overemphasized because it is impossible to produce a flat or square seat by lapping.

The grinding stones on both the valve refacing machine and valve seat grinder should be dressed before starting a reconditioning job. You will be unable to determine how closely the angle of the seat will match the valve face until the valve and seat have been ground and a check made with a very light tint of Prussian blue. If a full seat width contact around the entire circle of seated valve is not shown the angles do not match. It will then be necessary to redress the valve seat grinding stones, changing the angle sufficiently to correct the error. The correction should be made on the valve seat, and not on the valve. No more material should be removed from the valve face than is necessary to true it up and remove the burned or pitted portion. New valves should not be refaced, but should be checked for trueness. When a satisfactory match of valve seat and valve face angles has been obtained, the adjustment of both the valve refacer and the seat grinder should be locked in position, in order to eliminate this trial-by-error method on additional valves having the same angle.

Valve Seats

The primary purpose of a valve seat is to seal the combustion chamber against pressure losses and to provide a path to dissipate the heat accumulated in the valve head so as to prevent burning of the seat and warping of the valve head.

The location of the valve seat on the valve face, and its width, controls the amount of valve head that protrudes into the combustion chamber. It is obvious that the greater the exposure within the combustion chamber, the higher the valve temperature; or in other words the more heat it will collect. High valve temperatures and poor heat dissipation also produce excessive valve stem temperatures and hasten the accumulation of carbon on the stems, causing them to stick in the guides.

Valve Seat Widths

In general the width of exhaust seat should range between the average and maximum specifications and the intake seats between the minimum and average specifications. The intake seats may be narrower than the exhaust because they are usually larger in diameter, thus providing a total seat area approximately equal to smaller exhaust valve with the wider seat. Also the less severe heat conditions do not require as large a seat area for heat dissipation purposes.

There are also objections to an excessively wide seat, a few of which are as follows:

1. In city or light delivery service a wide seat collects carbon and particles of dirt that will produce variations or loss of compression, resulting in poor idle and possibly a loss of general performance and economy.

2. A wide seat in severe service operating in the presence of dirt or an excess of carbon will produce a badly pitted seat which may be just as detrimental to valve life as a too narrow seat. Under these conditions a seat width to the minimum limit would possibly be better, however, the source of trouble (which is the dirt and excessive carbon) should be eliminated, making it possible to retain the wider seat.

3. Specified valve seat widths are shown in Fig. 13.

Valve Seat Inserts

Necessity for replacing valve seat inserts should be very rare; however, if a replacement is made it is important that new inserts be peened securely in place, using either insert peening tool or a dull pointed chisel, 1/4" wide, to peen cylinder head metal over outer edge of valve seat insert.

Valve seat insert installing tools are available.

Valve seat inserts supplied for service are standard size only for inlet and .015 and .030 oversizes in addition to standard size for exhaust.

Repair of Valves

1. True-up the ends of inlet valve stem against face of grinder. Remove only enough material to true the surface.

2. Reface exhaust valves to 60 degrees. The valve face and valve seat angle must be identical.

3. Reface intake valves to 60 degrees with valve seat being the same.

4. Place valves in cylinder head. Place a thin coat of Prussian blue on each valve face and tap valve lightly to its seat. NOTE: This is merely for test and proof of results of refacing and reseating operations. A poor grinding job cannot be corrected by valve lapping.

5. Inspect each valve coated with blue for seat position. The seat should be at approximate centre of valve face. (Fig. 13).

Valve Assembly (all valves)

1. Wipe valve faces and valve seats with a cleaning solvent to remove all dirt or foreign material. Coat valve stems and valve faces with oil, and install valves in same seats to which they were checked.

Exhaust Valves

2. Install valve springs with dampers and rotocoils. Compress valve springs with a valve spring compressor and install valve spring retainers and retainer locks. Be sure that retainers and locks are correctly seated.

Inlet Valves

3. Referring to Fig. 13, place a rotocoil assembly (6) over the guide (flange upwards). Insert the valve and hold it on it's seat. Push the oil deflector (3) over the valve and guide as shown as far as it will go. Place a valve spring (5) and damper (4) with a retainer (2) over the stem and guide. Compress the spring with a suitable compressor until the locks (1) can be assembled onto the valve stem end groove, and release the spring. Finally push the valve open until the oil deflector locates itself into the lower groove in the stem.

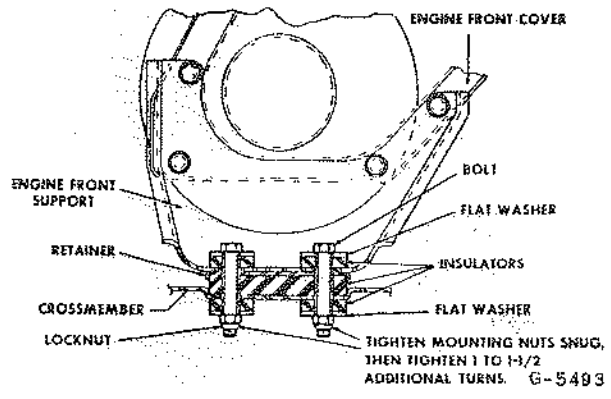


Fig. 18
Engine Front Mounting

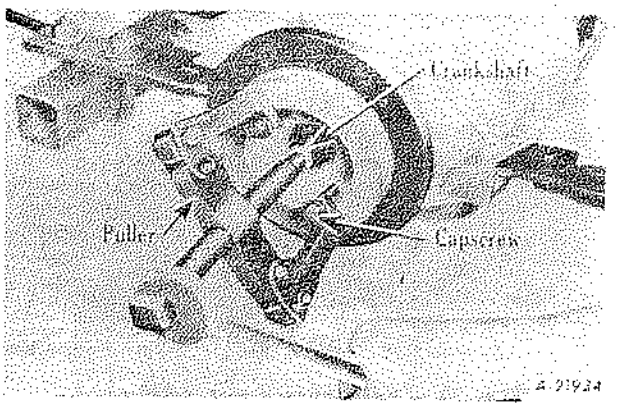


Fig. 19

When overhauling engine with head and pan removed, the following procedures are recommended:

1. Remove front motor to frame bracket by removing two nuts (Fig. 18). Remove fan drive pulley nut and washer from end of crankshaft. Install puller and remove crankshaft fan drive pulley from crankshaft (Fig. 19). Remove 4 capscrews holding motor mounting bracket to block (Fig. 18).

2. Remove nuts and capscrews from engine gear case cover, remove gear case cover and gasket. Remove crankshaft oil slinger from end of shaft (Fig. 21).

3. Remove two self-locking capscrews from camshaft retainer thrust flange plate, working through two holes in camshaft gear (Fig. 22). Pull camshaft and gear assembly from cylinder block. Remove two capscrews holding the gear case cover to block;

(Continued on next page)

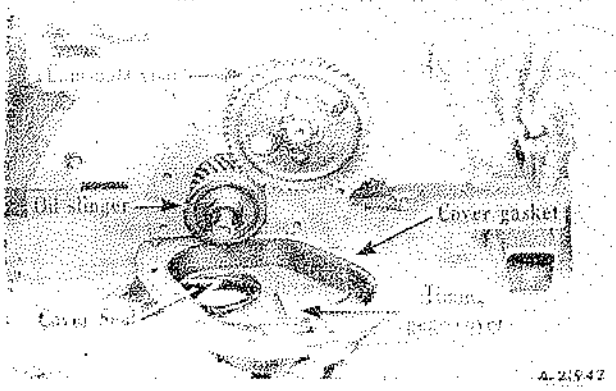


Fig. 21 - Gear case cover removed showing timing gear details

remove plate and gasket (Fig. 23). Remove crankshaft timing gear, using a special gear puller (Fig. 24). NOTE: Lubricate puller screw to prevent damage to screw threads.

Turn engine in the overhaul stand and proceed with disassembly as follows:

4. Each connecting rod is numbered as to its position in the engine and these numbers are located on the camshaft side of the engine. Remove self-locking capscrews from connecting rod cap and remove cap. Push connecting rod and piston assembly toward top of block, but first remove ridge from top of cylinder wall, if any. Lift piston and connecting rod assembly from top of cylinder block. Replace cap on connecting rod. Remove the remaining pistons, following the same procedure.

5. The crankshaft bearing caps are numbered to identify their position and they must be reinstalled in their respective positions. Remove self-locking capscrews from each bearing cap. Remove all crankshaft main bearing caps. NOTE: To remove the rear, or

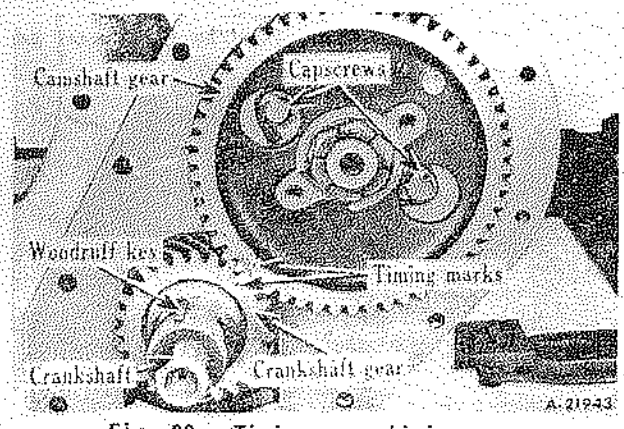


Fig. 22 - Timing gear timing marks and camshaft thrust plate details

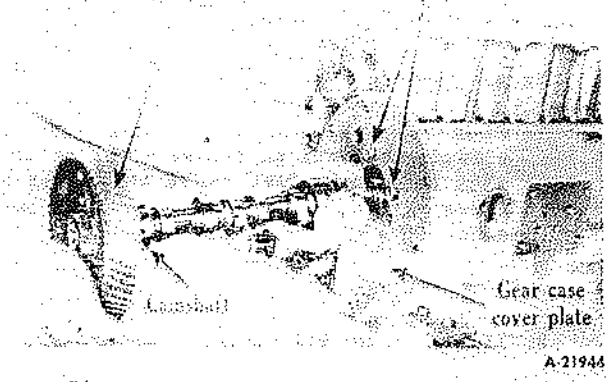


Fig. 23 - Camshaft and cover plate removal

No. 4 main bearing cap, a puller is required (Fig. 25). After all caps have been removed lift crankshaft straight up and out of cylinder block, and place in a vice equipped with soft jaws.

6. With crankshaft securely clamped in vice, remove the six self-locking capscrews holding flywheel to crankshaft (Fig. 26). Tap flywheel with a soft hammer to loosen it from crankshaft; remove flywheel with ring gear assembly.

7. Remove six capscrews and lockwashers from engine flywheel housing. Drive out the two engine block dowels, remove flywheel housing

8. Remove fuel pump, starter, oil pressure regulator valve assembly, distributor, generator, oil gauge, coil, and all "freeze plugs" in block. NOTE: Removal of the "freeze plugs" or core hole plugs is only necessary when it is determined that the condition of the water passages in the block warrant a thorough cleaning, or the plugs appear to be leaking). Clean inside and outside of block with a solvent cleaner or steam. Install core plugs using a suitable adaptor.

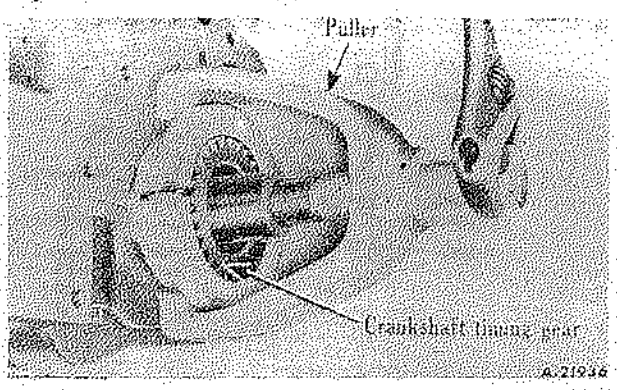


Fig. 24 - A crankshaft gear puller is installed with puller plates in position shown. Lubricate puller screw thoroughly

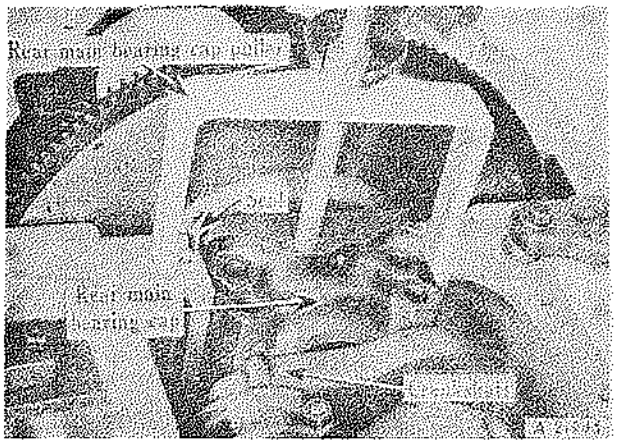


Fig. 25 - Use a bearing cap puller to remove rear main bearing cap

Water Pump Removal and Overhaul

The water pump is of the centrifugal packless type (Fig. 27). It is bolted to the front end of the engine and is driven by the fan pulley. It requires no external adjustment. The bearing is of the sealed lubricated type and does not require added lubrication at any time. The water pump is driven by a V-belt on the fan pulley. The pump, by means of centrifugal force developed by the impeller rotation, draws water up from the lower part of the radiator into the water passages in the cylinder block and cylinder head. The water circulates through the cylinder block and then out through the thermostat housing into the radiator upper tank.

Water Pump Disassembly

1. Remove four capscrews and lockwashers holding fan to hub. Remove fan blade assembly and spacer from hub.

2. Remove four mounting capscrews from water pump (Fig. 28). Remove water pump from front end of cylinder head.

3. Remove three screws from back cover plate. Remove plate and gasket from pump body.

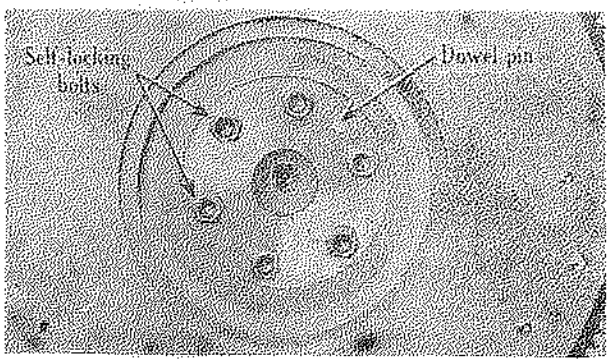


Fig. 26 - Remove self-locking capscrews to remove flywheel

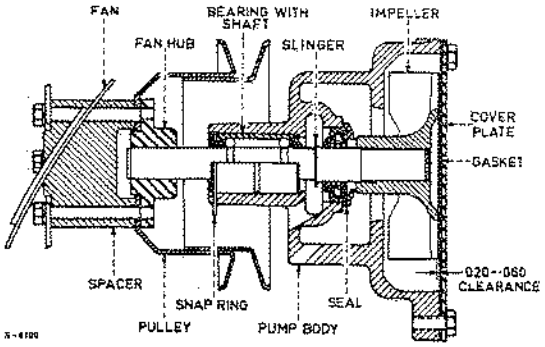


Fig. 27 - Sectional view of water pump

4. Remove snap ring from front of water pump shaft bearing. Support the water pump on an arbor press and push shaft and bearing out, as one assembly. (Fig. 29).

5. Place shaft assembly in press and press fan hub from shaft. Do not attempt to remove bearing or slinger, as they are factory installed on the shaft in the proper location.

6. Remove seal from housing through back side of pump. Use a drift, and carefully drive seal from the pump body.

Water Pump Cleaning and Inspection

Before reassembling water pump, the following should be checked:

1. Clean all parts by steam or cleaning solvents.

2. Examine seal for wear or damage and replace parts as necessary. Use special tool when installing seal. Use a new seal when rebuilding the pump since the oil seal may have been damaged upon removal.

3. Examine pump impeller seat seal surface, if face or surface is scored, it must be resurfaced, or replaced to prevent leakage.

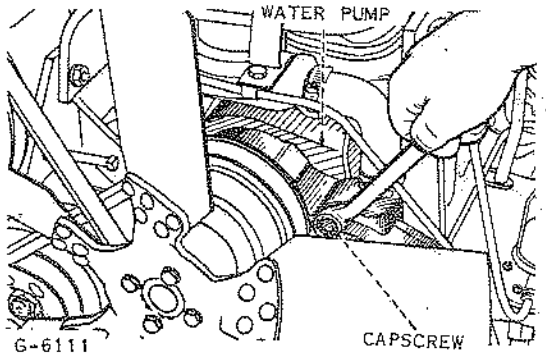


Fig. 28

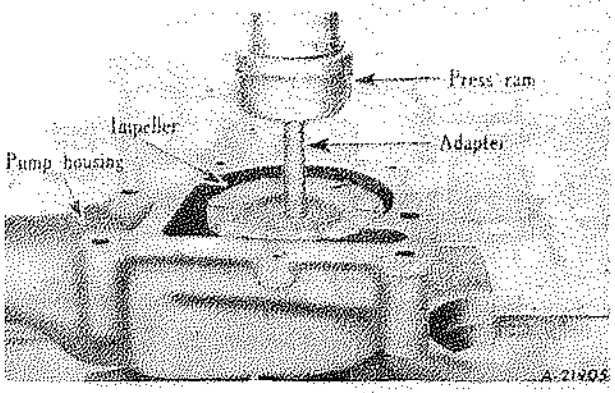


Fig. 29

4. Inspect pump shaft bearing for wear. If worn replace shaft and bearing assembly.

5. Examine shaft and if worn replace shaft and bearing assembly.

Water Pump Assembly

1. Press fan hub on shaft with the smaller diameter of the hub to the front (Fig. 30).

2. Install shaft in housing from front end by pressing shaft, bearing, slinger, and fan hub in as one unit (Fig. 31).

3. Install snap ring in place behind fan hub.

4. Mount assembly in press. Press impeller on rear end of shaft. Place a straight edge across the back of the water pump housing and check the clearance between the straight edge and impeller. There should be about .025" clearance (Fig. 32).

5. Install cover plate with new gasket, and mount fan blades.

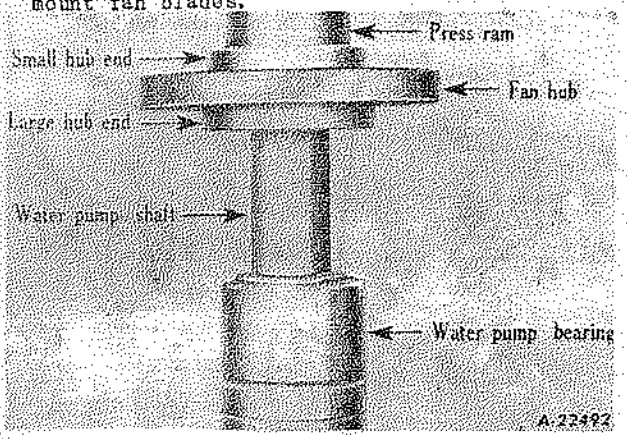


Fig. 30

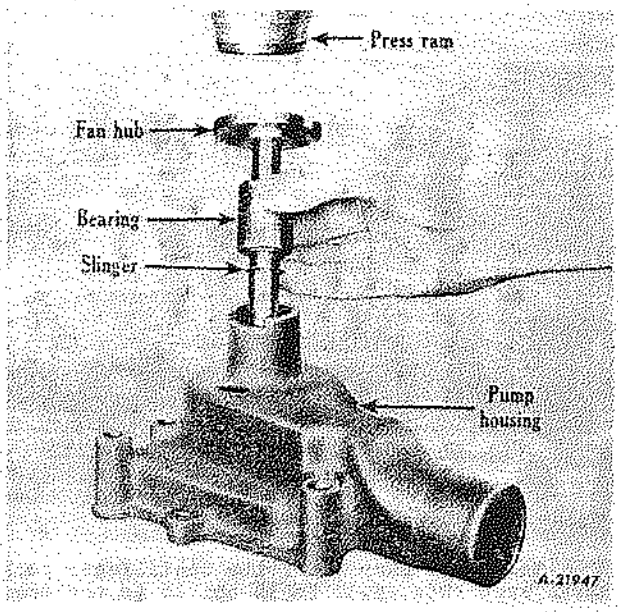


Fig. 31

Fan Belt

Fan belt adjustment is obtained by loosening the generator mounting cap screws and the generator brace cap screw, and moving the generator towards or away from the engine until it is possible with the fingers to press the belt inwards about 1 inch. Recheck this after the cap screws have been retightened. Measurement to be taken half way between fan and generator pulleys.

Intake and Exhaust Manifolds

When disassembling and assembling the manifolds, the following procedures are used:

1. After removing the eight capscrews from head and three bolts from exhaust flange, remove both intake and exhaust manifolds as a unit. NOTE: Let manifolds cool before starting above operations.

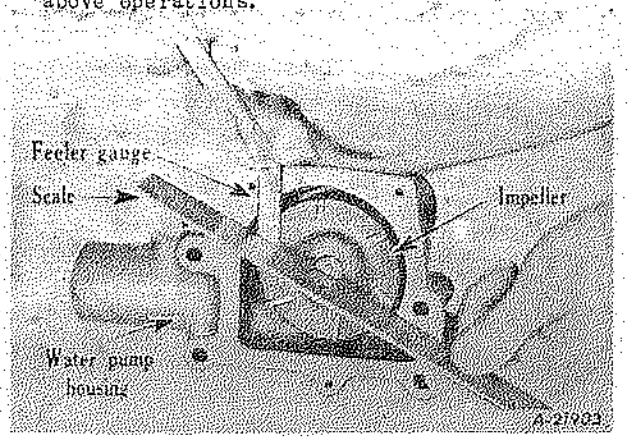


Fig. 32

2. To separate the two manifolds, remove the four nuts from the centre of manifolds.

3. The intake and exhaust manifolds are each of one piece construction, requiring no disassembly after separation.

Intake Manifolds

1. The intake manifold consists of three outlets, each supplying fuel to two cylinders. Four studs are located on the top for carburettor mounting.

2. If vacuum is needed to operate any unit with in the truck, a threaded inlet is provided in the manifold for such purposes.

Exhaust Manifold

The exhaust manifold consists of four outlets. The two end outlets remove burned gases from the No. 1 and No. 6 cylinders, while the two centre outlets remove burned gases from No's. 2, 3, 4 and 5 cylinders.

Manifold Inspection

Inspect intake and exhaust manifolds visually for cracks or breakage. Place manifolds on surface plate and check for warpage. If cracked or broken, replace or weld. If slightly warped, true-up on surface grinder but replace if warpage is extreme.

Manifold Assembly

Place new gasket between the intake and exhaust manifolds and install four nuts. Mount manifolds together loosely before installing on engine. This will assure proper alignment of the units with each other and with the engine cylinder head.

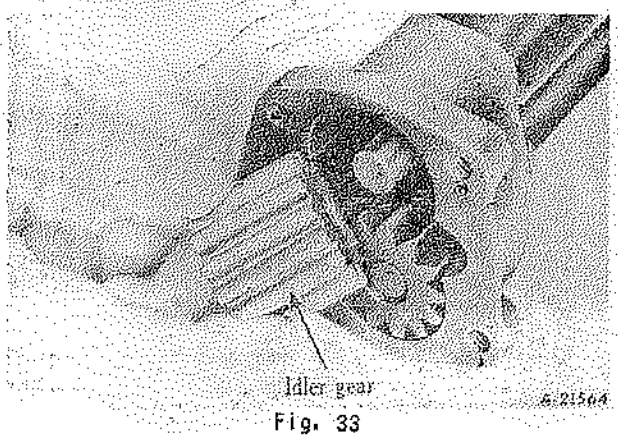


Fig. 33

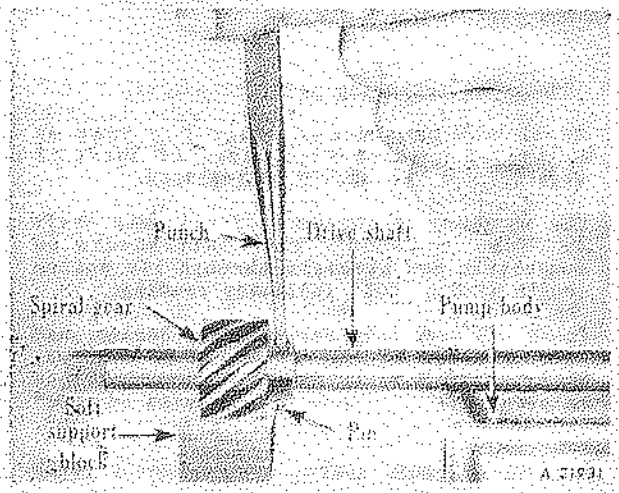
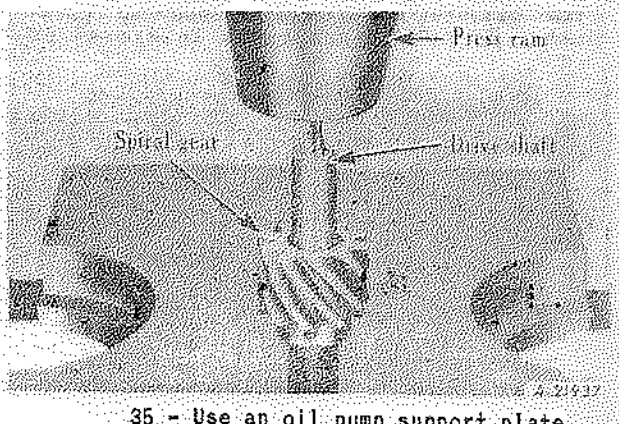


Fig. 34

Oil Pump Removal and Overhaul

After oil pump has been removed, the following steps are to be used for disassembly:

1. Remove cotter pin holding float to oil pump. Remove float from pump. Remove two capscrews holding pump in block. Remove oil pump.
2. Remove four capscrews and lockwashers from oil pump cover plate. Then lift cover and gasket from oil pump body. Remove "O" ring seal.
3. Lift out oil pump idler gear from idler gear shaft (Fig. 33).
4. Support oil pump shaft to prevent bending shaft, and using a small punch, drive out spiral gear pin from oil pump spiral gear. (Fig. 34).
5. Place two support plates under spiral gear in press, and press oil pump drive shaft out of pump spiral gear (Fig. 35). Remove Woodruff key.
6. Remove body gear and drive shaft from oil pump body (Fig. 36).
7. Press pump body gear from shaft and remove Woodruff key.
8. Wash all parts in a cleaning solvent.



35 - Use an oil pump support plate when pressing shaft from gear

Oil Pump Inspection

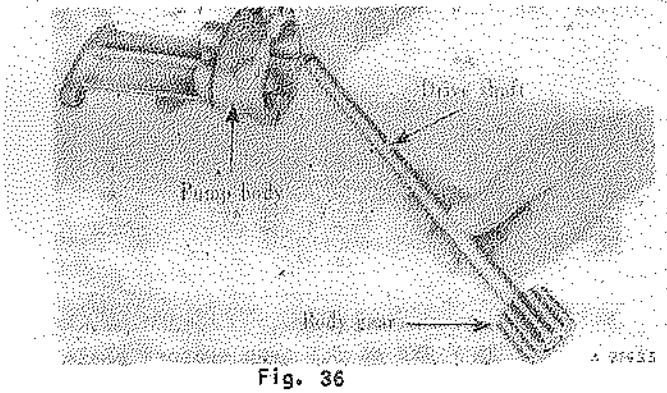
Check the following parts carefully.

1. Check oil pump drive shaft for wear at points of contact with body. If shaft is worn or bent, it should be replaced.
2. The standard measurement of oil pump shaft is .4885" - .4890". The shaft should be concentric and straight through its entire length within .004" indicator reading.
3. Check oil pump body for warpage, damage, and wear. Replace if body is warped or cracked, or if shaft bore is worn so that clearance between shaft and bore is in excess of .005" The oil pump body shaft bore measures .490".
4. Inspect oil pump gears, and replace if wear is perceptible.

Oil Pump Assembly

The following instructions are to be followed for reassembly:

1. Install new Woodruff key on body end of drive shaft.
2. Place in press and press body gear on drive shaft. The end of the shaft can be from flush to .030" below the level of gear face.
3. Insert oil pump drive shaft and body gear into oil pump body.
4. Install new Woodruff key in spiral gear end of drive shaft and press on spiral drive gear. Make sure that spiral gear hub is down. Install new spiral gear pin in place.
5. Install idler gear on idler gear shaft. Install gaskets, oil pump body cover, four capscrews, and lockwashers.
6. Check oil pump body gear end clearance by using a dial indicator (Fig. 37). If end clearance is less than .0025" add one gasket that measures not more than .003" in thickness. If end clearance is in excess of .0055" remove one gasket of not more than .003" in thickness. Body gear end clearance should measure between .0025" and .0055".
7. Install new "O" ring seal into the inlet opening and insert the float screen tube. Line-up the cotter pin hole with the groove in the float tube and secure with a new cotter pin.



A-21455

Fig. 36

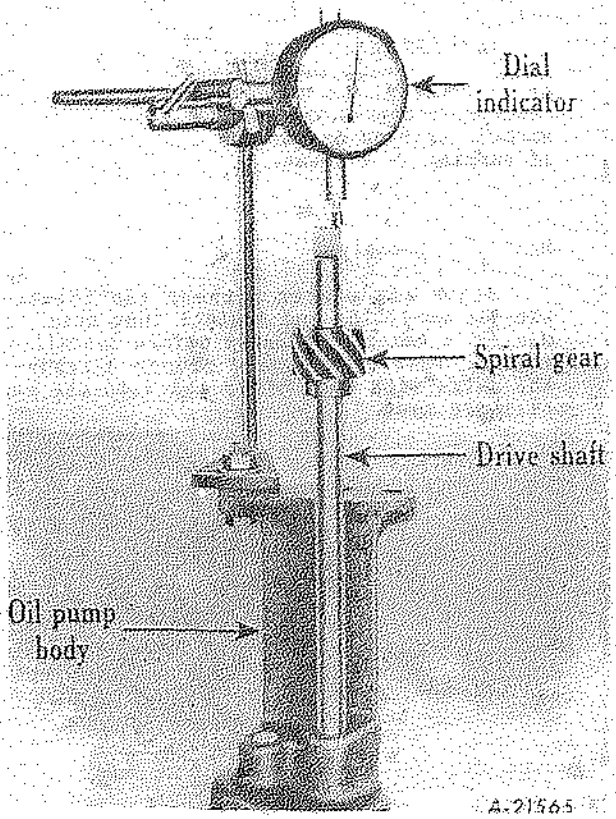
DISASSEMBLY, CLEANING, INSPECTION, REPAIR AND ASSEMBLY OF SUBASSEMBLIES

Cleaning the Cylinder Block

1. Remove all old gasket material from block. Clean both inside and outside of block with steam or cleaning solvent. Remove all dirty oil, sludge, scale, and carbon from cylinder block. Check core plugs for indication of leakage. Remove and replace plugs that show signs of leaking, or rusting through. Use installing tool for core plug replacement.

Cylinder Block Inspection

1. Inspect cylinder walls for cracks. Weld the cracks or replace block if necessary.
2. Check top surface for trueness with a straight edge. Test by attempting to insert a .012" feeler gauge ribbon between the straight edge and the cylinder block. If this is possible, either machine the top surface or replace the cylinder block.



A-21565

Fig. 37 - Checking and clearance of pump shaft and body gear

3. Inspect camshaft bearings for damaged or scored condition, and inspect for wear. Replace if damaged or if worn beyond clearance limit of .006".

4. Measure cylinder walls with an inside reading micrometer to determine taper, out-of-round, or worn condition. The measurements must be made not only at top of the cylinder bore, just below ring groove, but at several places around the inside circumference of the bore. Bore should be checked at the bottom, below ring wear surface, to determine the amount of taper. Rebore if worn beyond .008" clearance.

Replacing Camshaft Bushings

1. If camshaft bearing replacement is necessary remove and install new bushings with special camshaft bearing installation tool (Fig. 38) No reaming is required.

Connecting Rod and Piston

1. Remove piston pin retainers from each piston and remove piston rings from piston ring grooves.

2. Heat piston in boiling water or piston heater. Place piston in piston vise, and using pin-driving tool, drive piston pin from piston and connecting rod. After piston pin is removed, lift piston from connecting rod.

3. Wash all parts in a cleaning solvent. CAUTION: Do not use a caustic solution for aluminium pistons. Clean the carbon from piston ring grooves with a broken ring or ring groove cleaner.

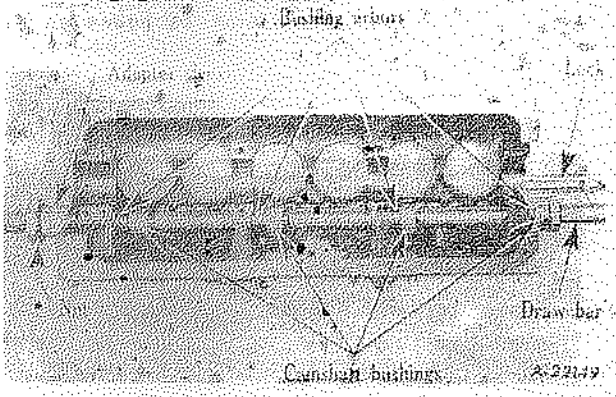


Fig. 38 - Camshaft bushing installation. Showing special tool in position

4. Inspect connecting rods, caps, and bearing shells. All connecting rod bearings and piston pin bushings should be replaced at every major overhaul. Test rods for alignment. Rods only slightly misaligned can be straightened with proper equipment. Badly twisted or bent connecting rods must be replaced.

5. Inspect pistons for cracks, breakage or scored. Check piston ring grooves and ring lands for wear, using a new piston ring and feeler gauge. If clearance between ring and ring land exceeds .005" (total clearance) replace piston (see specifications for data covering piston fit in cylinder block).

6. Inspect piston pins for wear, and if wear is perceptible, replace pins. Replace piston pins which show signs of corrosion or etching.

7. With properly fitting adapter, press old piston pin bushing from connecting rod. Place new piston pin bushing in position, align oil hole in bushing with oil hole in connecting rod, install bushing with a .0055" to .0035" press fit. Burnish bushing in place in the connecting rod (Fig. 39).

8. With reamer, ream piston pin bosses in piston to provide a tight fit of from .0000" to .0002" with piston pin. NOTE: When fitting piston pins, the pins should be at room temperature (70 degrees F.) and the pistons should be heated to approximately 200 degrees F. in boiling water or piston heater. The pin should be a "palm-push" fit under these conditions.

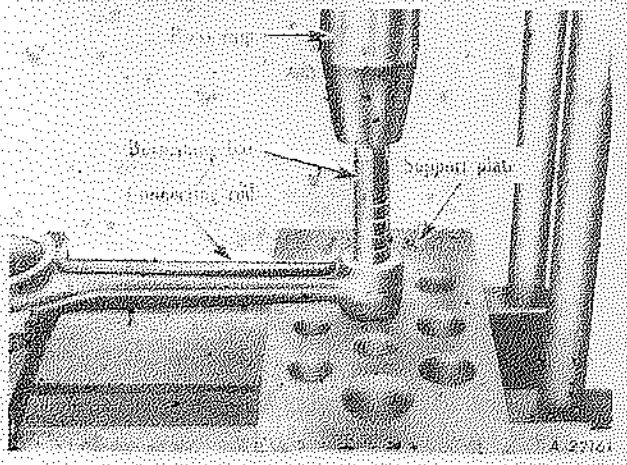


Fig. 39 - Use a burnishing tool

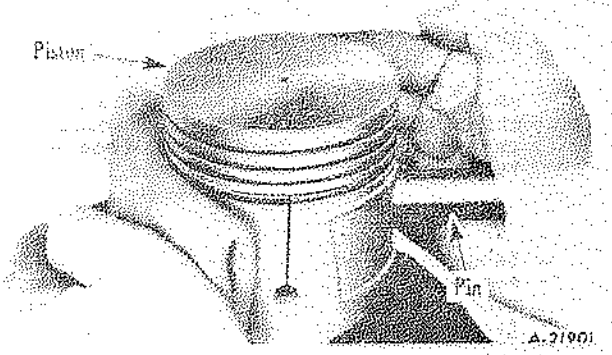


Fig. 40

Connecting Rod and Piston Assembly

1. With piston heated to approximately 200 degrees F., support connecting rod in vise, push piston pin into piston bosses while piston is hot (Fig. 40). When assembling piston on rod the slot in the piston skirt must be toward the side of the engine, which is camshaft numbered side of the connecting rod. Install piston pin retainer in piston at each end of pin, making sure that retainers seat fully and with tension in grooves. Test connecting rod and piston assembly on a connecting rod aligner and correct any misalignment.

2. Place piston and connecting rod in vise. Test each piston ring for proper gap by placing in cylinder and measuring gap with feeler gauge. Gap should be .015" to .031" (Fig. 41).

3. When installing piston rings in piston grooves, be careful not to distort rings. If possible use a suitable piston ring expander tool (Fig. 42). Also check new piston rings in piston ring grooves for clearance between ring and ring lands. The correct ring clearance is shown in specifications.

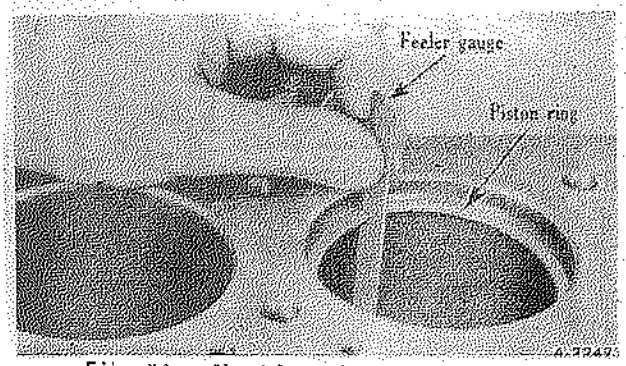


Fig. 41 - Checking ring gap

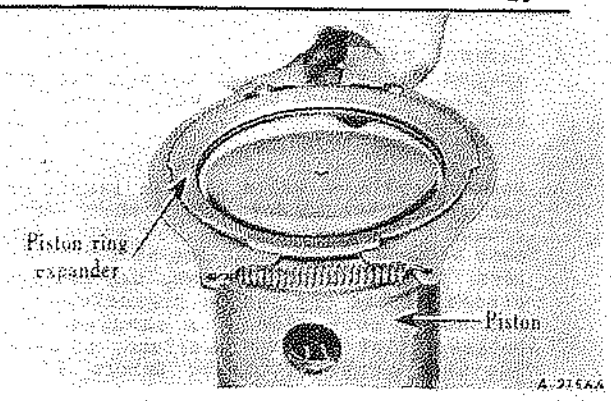


Fig. 42 - Installing piston ring using a piston ring installing tool

Crankshaft Cleaning and Inspection

1. Wash and clean crankshaft with cleaning solvent or steam.

2. Inspect main bearing and connecting rod journals for wear. If journals show wear, or out-of-round in excess of .003", the shaft should be either reground and undersize bearings installed, or replaced. Use micrometers for checking.

3. Check crankshaft and flywheel dowel for damage and fit, and replace if worn or damaged.

4. Examine crankshaft timing gear teeth, and replace gear if teeth are worn or damaged.

5. Install Woodruff key in groove in crankshaft Heat crankshaft gear in boiling water or piston heater. This will expand the gear enough to let it be tapped on the crankshaft without the danger of damaging the gear. Use gear driver to ensure alignment when starting gear (Fig. 43).

Flywheel and Ring Gear Inspection

1. Clean flywheel and ring gear with a cleaning solvent, remove all traces of oil and grease.
2. Inspect the flywheel ring gear. If any teeth are damaged, or if ring gear is loose on flywheel, the ring gear must be replaced.

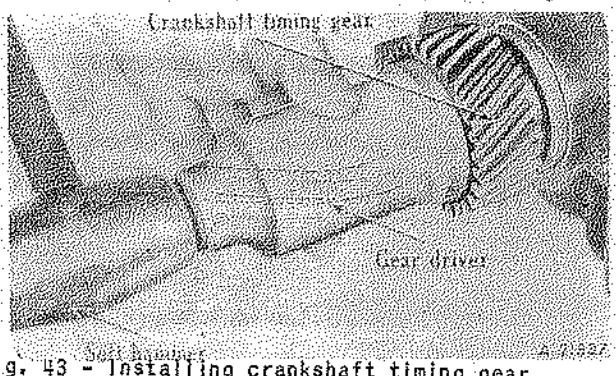


Fig. 43 - Installing crankshaft timing gear using an installing tool

3. Check the flywheel dowel hole and mounting bolt holes for wear, also check for flywheel having been loose.

4. To replace flywheel ring gear, heat gear with torch, and remove from flywheel with a hammer and drift. Heat new ring gear with torch, heating evenly all the way around. While the ring gear is hot, install gear on flywheel and allow it to cool.

5. Check pilot bearing in flywheel for wear or damage and replace if needed.

6. Install flywheel on crankshaft. Install six self-locking capscrews, drive dowel pin through flywheel to crankshaft.

Camshaft Cleaning and Inspection

1. Remove nut from front of camshaft gear. Attach gear puller, and remove camshaft gear from camshaft, and remove camshaft thrust flange. Remove Woodruff key.

2. Wash parts in cleaning solvent, brushing to facilitate removal of all sludge or carbon deposits.

3. Inspect camshaft journals for signs of wear or out-of-round.

4. Inspect oil pump drive gear in centre of shaft. If teeth are worn or damaged, the camshaft must be replaced, as the gear is integral with shaft.

5. Inspect camshaft lobes. If worn, chipped, or scored, replace the camshaft.

6. Inspect camshaft gear, and replace if wear is evident or gear teeth are nicked or otherwise damaged.

7. To reassemble, install thrust flange over end of camshaft. Install Woodruff key in slot in shaft. Place camshaft gear in boiling water or piston heater, and install over Woodruff key. Install camshaft nut and tighten to approximately 120 foot-pounds torque.

Cleaning and Inspecting Miscellaneous Parts

1. Cleaning miscellaneous engine parts includes brackets, oil pan, engine case cover, flywheel housing and other parts that were removed during disassembly of engine and were not covered by procedure. Wash in cleaning solvent or steam clean preliminary to inspection.

2. Check all twelve valve lifter or push rods for straightness by rolling them on a flat surface. Replace any that are bent or have loose ends.

3. Inspect oil pan for cranks or deep bends, and straighten or weld.

4. Inspect oil pan drain plug and drain plug boss for fit and thread wear. If plug is loose or threads are damaged, replace plug. If threads in oil pan boss are worn or damaged, repair threads or replace oil pan.

5. Inspect crankshaft vibration damper for evidence of rubber coming loose from steel plates and inspect for wear. Replace damper

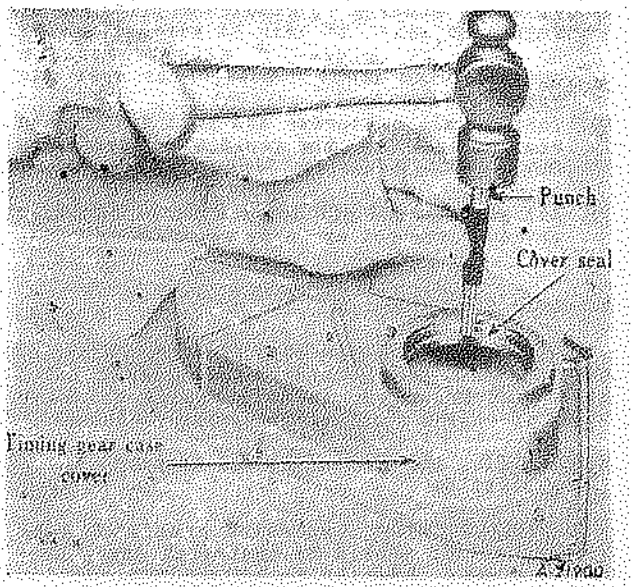


Fig. 44

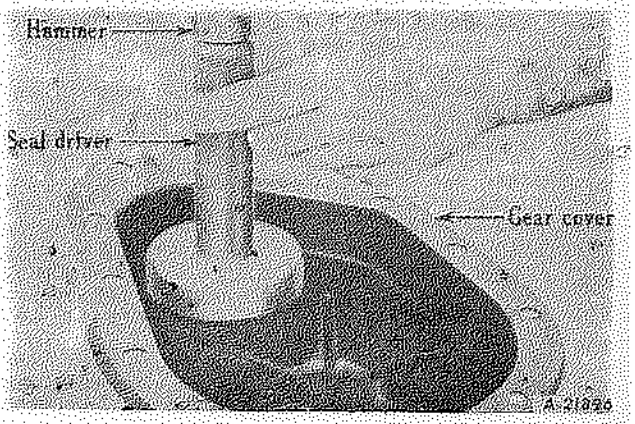


Fig. 45 - Use a seal installing tool

if either condition is encountered. Do not submerge vibration damper assembly in hot cleaning solvents.

6. Inspect crankshaft fan drive pulley for wear in hub bore. If inner diameter of bore is worn, scored, or Woodruff keyway damaged replace pulley.
7. Inspect engine gear case cover, and replace if cracked or broken. Remove old cover seal (Fig. 44) and with special driver install new seal (Fig. 45).
8. Check each of 12 engine valve tappets for irregular wear, chipping, cracking, or scores. Replace defective tappets.
9. Inspect engine flywheel housing for cracks or breakage and replace if damaged. Inspect flywheel housing to crankcase pilot dowel holes for wear. If wear is evident, drill or ream the holes and install oversize dowels. Also inspect dowels for wear and replace if wear is evident.
10. Inspect all capscrews and nuts for thread wear or breakage, and replace as necessary. Use new lockwashers when reassembling engine.
11. All gaskets and oil seals must be replaced at each overhaul or major repair.

Assembly of Engine

When all parts have been cleaned, inspected and repaired, and necessary replacement parts have been procured, install engine cylinder block in engine overhaul stand for reassembly.

Main Bearing and Connecting Rod Bearing Installation

BEARING CRUSH. Undersize precision type bearing shells should be installed when, because of wear, bearing to crankshaft running clearances are to be reduced. Bearing caps must not be filed, lapped, or in any other manner reworked.

Premature bearing failure will result from attempts to reduce journal to bearing running clearance by reworking of either bearing caps, bearings or both, because such reworking will alter the engineered fit of the bearing shells in their bores and destroy the specifically desired "crush".

When installing precision type connecting rod or main bearings, it is important that the bearing shells fit tightly in the rod or case bore. To accomplish this, the bearing manufacturer makes the diameter at right angles to the parting line slightly larger than the actual diameter of the bore into which they are assembled. When the assembly is drawn up tight, the bearing is compressed, assuring a good contact between the bearing back and the bore. The increased diameter is referred to as bearing "crush" (Fig. 46).

To obtain proper bearing assembly with the correct "crush" care must be taken when tightening the clamping bolts to make sure they are drawn down alternately and evenly, using a tension wrench and tightening as specified.

As a result of excessive bearing crush due

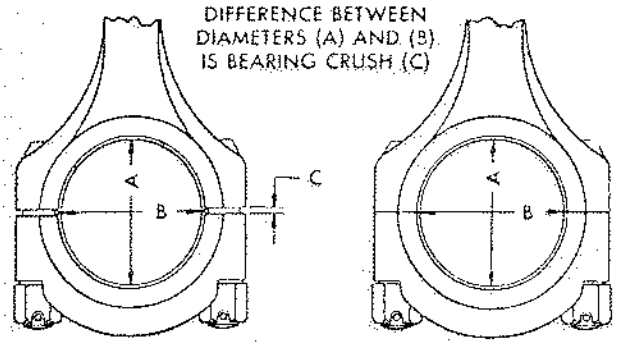


Fig. 46

to reworking the caps, the rod or main bearing bore will possibly become distorted, because more force is required to draw the cap and housing together.

Rods, caps, or blocks must not be filed, lapped, or in any other manner reworked in order to reduce clearance. While such practice will make a tighter fit at top and bottom, it will result in an out-of-round bore and bearing shell distortion. New bearing shells will have to be installed eventually and that is when additional trouble starts.

In general, a visual inspection of the parting faces of the rod or caps under a magnifying glass will provide sufficient proof of any attempt at reworking. Under the glass, the parting line surface of standard parts will show the manufacturing cutter tool marks and will not have a polished or extremely smooth appearance. On the other hand, reworked parts will have a polished surface and, if a file was used, will show the even pattern of the file teeth. Seriousness of this condition is in direct proportion to the amount of reworking.

BEARING SPREAD. Main and connecting rod bearings are designed with the "spread" (width across the open ends) slightly greater than the diameter of the crankcase bore or connecting rod bore into which they are assembled (Fig. 47). For example the width across the open ends of the connecting rod bearing, not in place, is approximately .025" more than when the bearing is in position in the rod. This condition causes the bearing to fit snugly in the rod bore and the bearing must be "snapped" or lightly forced into its seat.

Rough handling in shipment, storage, or normal results of use in an engine, may cause

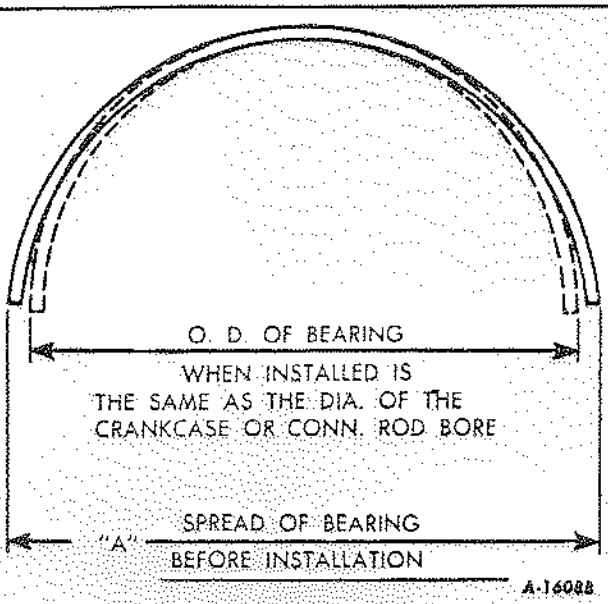


Fig. 47

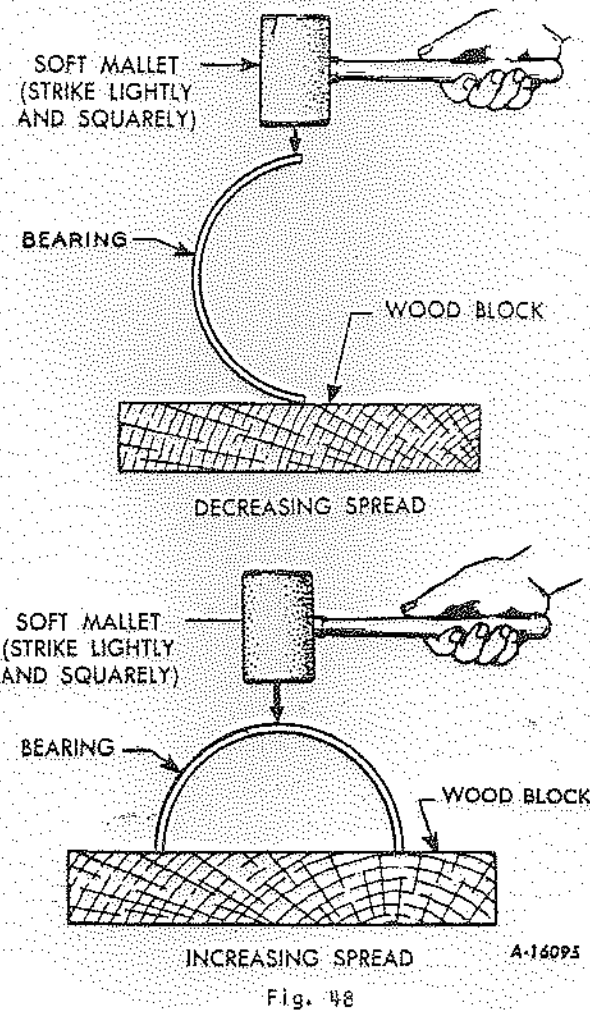


Fig. 48

the bearing spread to be increased or decreased from the specified width. Bearing spread should therefore, be carefully measured and corrected as necessary before installation in an engine.

Bearing spread can be safely adjusted as follows, although care and judgement should be exercised in the process;

1. EXCESSIVE SPREAD. If measurement of spread (Fig. 47) indicates that distance "A" is excessive (see chart for specifications) place bearing on a wood block (Fig. 48) and strike the side lightly and squarely with a soft mallet. Recheck measurement and, if necessary, continue until correct width (measurement "A" in chart) is obtained.

2. INSUFFICIENT SPREAD. If measurement of spread indicates insufficient spread place bearing on wood block (Fig. 48) and strike the back of the bearing lightly and squarely with a soft mallet. Recheck measurement and, if necessary, continue until correct width (measurement "A" in chart) is obtained.

Chart of Bearing Spread Dimensions (Minimum)		
"A"	Connecting Rod Bearing	2.500" + .025"
	Main Bearing	2.942" + .025"

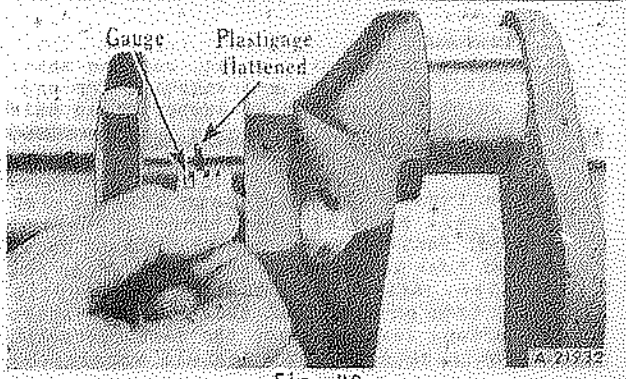


Fig. 49

1. INSTALL CRANKSHAFT AND BEARINGS. Clean all surfaces of crankshaft bearing journals and wipe clean the bearing bores in the cylinder block. Remove bearing cap self-locking capscrews and bearing cap. Wipe backs of cylinder block half of bearings, making sure that dirt and oil are removed. Place bearing shell halves in position in bore in cylinder block, making sure that bearing shells are fully seated, that oil holes in bearing shells line up with oil holes in cylinder block, and that locking tangs on bearings fit into recess. Follow same procedure, place bearing shell cap halves in bearing caps. Place a film of engine oil on shell bearing surfaces. Lubricate the crankshaft journals and carefully lower the shaft into place. Lubricate the bearing surfaces of the cap half of the bearings. Place the bearing caps with shells over crankshaft journals.

Be sure bearing caps are properly installed with numbers to camshaft.

2. In order that an accurate measurement can be made to check all bearing clearances, "plastigage" can be used.
3. Use the following instructions when using "plastigage":

   (a) Remove oil from bearing cap insert and exposed half of crankshaft journal.

   (b) Place a piece of "plastigage" the full width of the bearing insert.

   (c) Reinstall the bearing cap. Tighten the self-locking capscrews to approximately 80 foot-pounds.

   (d) Remove the bearing cap. The flattened plastic material will be found adhering to either the bearing shell or the crankshaft.

   (e) To determine the bearing clearance, compare the width of the flattened plastigage at its widest point with the graduations on the envelope (Fig. 49). The number within the graduation on the envelope indicates the clearance in thousandths of an inch. NOTE: Do not turn crankshaft during the above procedure.
4. If clearance is not within .001" to .004", either use undersize bearing, regrind shaft or replace shaft. Check crankshaft for end-play which is taken up by number three main bearing. End clearance should be from .005" to .010".

5. Before installing rear main bearing cap (after all bearing clearances have been checked) install upper seal in block. Use a special tool to press or roll seal (Fig. 50) in place. After seal has been seated in block, trim ends of seal that projects above cap surface level. Repeat the same operation with main bearing cap. Install wicking on each side of rear main bearing cap (Fig. 51) Tighten all main bearing cap bolts to 80 foot-pounds.

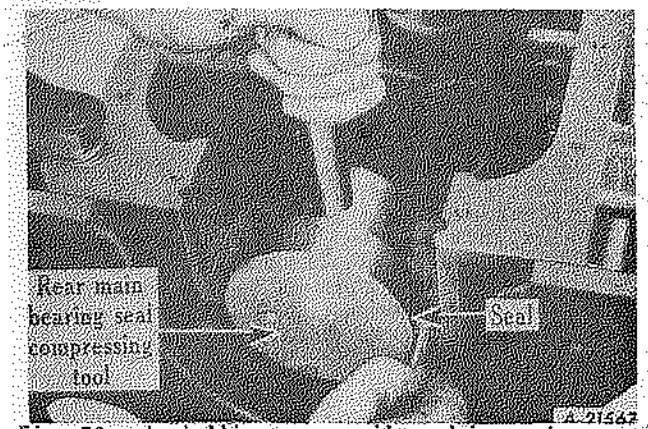


Fig. 50 - Installing upper oil seal in crankcase using a Rear Main Bearing Oil Seal Compressor

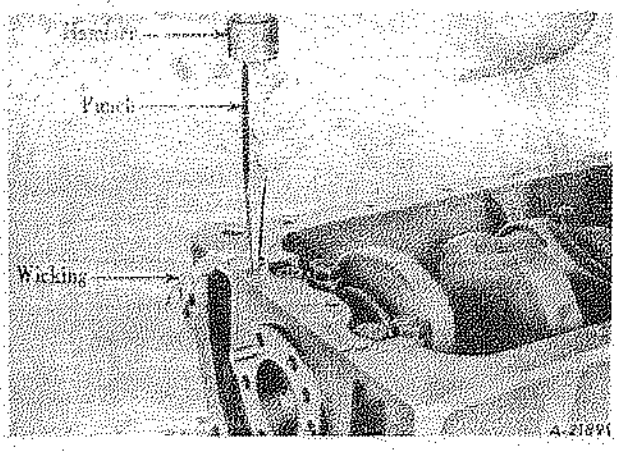


Fig. 51

6. Place the flywheel housing adaptor (Fig. 53) in position over the locating dowels in the crankcase. Install the attaching capscrews and tighten up evenly to torque loadings according to size of bolt (Sect. "A" Page 1)

Assemble flywheel as shown in Paragraph 7. Install clutch as shown in Paragraph 7 Page 27.

Install flywheel housing with clutch release fork and shaft.

In the event a new crankcase, flywheel housing, or adaptor is to be fitted it will be necessary to check the alignment as shown in Fig. 53, as follows.

With the clutch mechanism removed, assemble the adaptor to the flywheel housing with the sleeve dowels in place and tighten the capscrews.

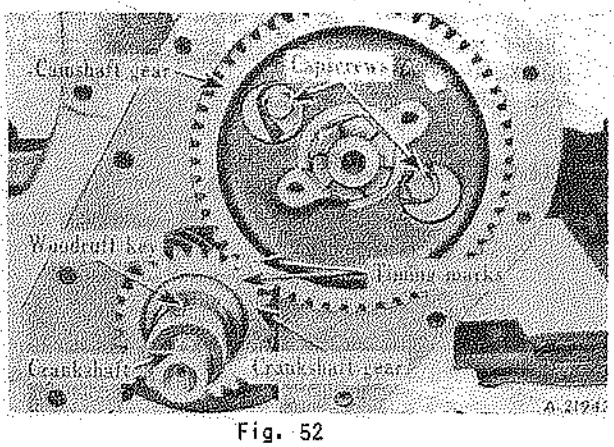


Fig. 52

Remove the dowels from the crankcase and bolt the adaptor and housing assembly to the crankcase with the capscrews which assemble from the front.

Install the dial indicator as in Fig. 52 securely to the crankshaft, and check the alignment by slowly revolving the crankshaft and observing the dial. Total indicator reading must not exceed .010".

If the alignment is outside this limit, slightly loosen the adaptor on the crankcase and with a soft mallet or wood block, tap the adaptor in the direction necessary to achieve alignment and re-tighten the capscrews, repeat this trial and error procedure until proper alignment is indicated.

NOTE: When checking the alignment by this method with the engine level, it is preferable to finalize the alignment with the permissible "plus" reading of the indicator to the bottom or 6 o'clock position.

When final alignment has been achieved check the dowel holes and if not perfectly lined up, it will be necessary to ream the holes oversize and use new dowels to suit. These are available in .030 oversize.

Finally check the rear face of the housing by the same method with the dial indicator mounted to register a full circle on the rear face. Permissible total indicator reading on a circle 6 inches in diameter is .003" or .0005 per inch of diameter.

Should this tolerance be exceeded look for burrs or foreign matter between the mating surfaces.

7. INSTALL ENGINE FLYWHEEL. Place engine flywheel and ring gear into position on dowel in crankshaft flange. Install six self-locking cap screws in flywheel and crankshaft flange, and tighten to a torque of approximately 75 foot pounds, using a tension wrench.

8. INSTALL GEAR CASE COVER PLATE. Place plate and gasket at front end of engine cylinder block. Install two capscrews and lockwashers.

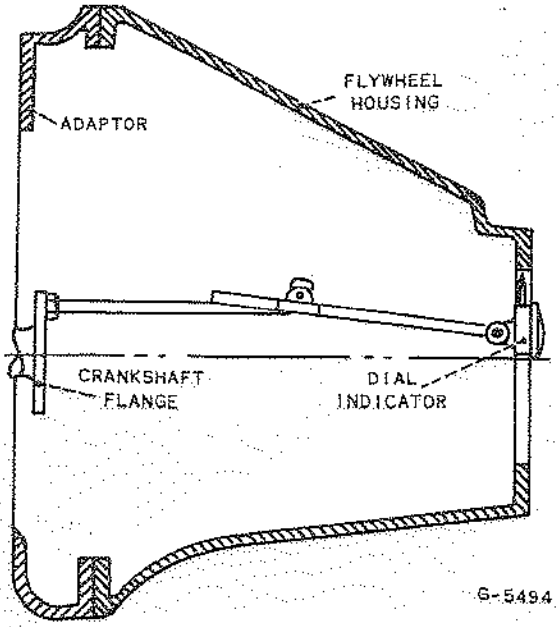


Fig. 53 - Checking flywheel housing alignment

INSTALL CAMSHAFT AND GEAR. Coat camshaft with engine oil. Insert camshaft into front end of engine block, being careful not to damage camshaft bearings. Before completely entering camshaft, rotate shaft until marked teeth on crankshaft gear and camshaft gear index (Fig. 52). Install two capscrews and lockwashers in camshaft thrust flange, working through large holes in camshaft gear. Rotate crankshaft and camshaft to establish that the gears do not bind or interfere. Backlash must be from .004" to .007".

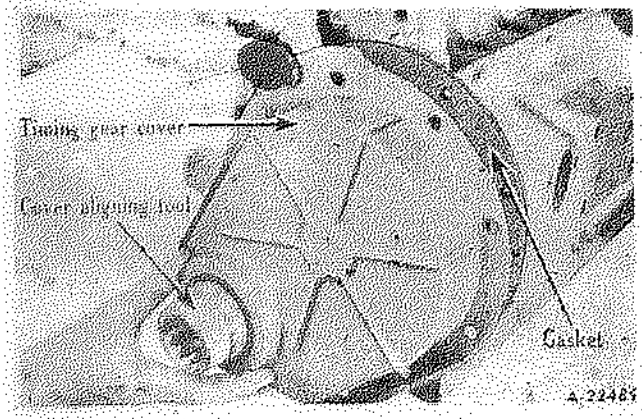


Fig. 54 - Aligning timing gear cover using an aligning tool

10. INSTALL GEAR COVER CASE. Place gasket in position on case cover. Place crankshaft oil slinger over end of crankshaft and install Woodruff key for fan drive pulley in crankshaft. Place gear case cover in position and install gear case cover aligning tool (Fig. 54). Install capscrews, new lockwashers and nuts. Remove aligning tool.

11. INSTALL FAN DRIVE PULLEY AND VIBRATION DAMPER. Heat crankshaft fan drive pulley and vibration damper assembly in boiling water. When heated, quickly install assembly on crankshaft and install washer and fan drive pulley nut. Tighten nut to 90-100 lbs/ft. torque.

INSTALLING CONNECTING RODS AND PISTONS

1. Install one connecting rod and piston assembly down through top of cylinder block having slot in piston towards camshaft side of engine. Pistons are also marked with an arrow indicating front of engine. Use a piston ring compressor sleeve to compress piston rings and thus avoid possible ring damage.

2. Wipe base of connecting rod free of oil and dirt. Place bearing shell upper half in connecting rod base, being sure that locking tangs of bearing shell fit into recess. Clean connecting rod cap bearing bore and clean back of bearing. Place bearing shell lower half in connecting rod cap, making sure that tang of bearing fits into recess in cap (NOTE: See instructions under "Main Bearing and Connecting Rod Bearing Installation").

3. Coat bearing surfaces with oil. Pull connecting rod unto position on crankshaft journal and install connecting rod cap and bearing. NOTE: Bearing cap can only be installed on connecting rod one way, because of the construction of rod and cap. Install two self locking capscrews and tighten to 50 foot pounds, using tension wrench.

4. To check connecting rod bearing to crankshaft clearance, follow procedure given for "plastigage" test. Specified connecting rod bearing to crankshaft clearance is from .001" to .0035". Do not attempt to file connecting rod or bearing caps.

5. Follow the foregoing procedure for installing remaining connecting rods and pistons.

6. INSTALL OIL PUMP. Place crankshaft and piston in position for firing on No. 1 piston. Insert oil pump assembly into opening in cylinder block, rotate pump drive shaft so that tang in top of shaft is parallel to engine block. This position will assure the oil pump drive shaft being in proper position for distributor installation. Install and tighten two capscrews. Place one piece oil pan gasket in place and install 25 capscrews around oil pan flange.

7. INSTALL CLUTCH. Install clutch driven disc against flywheel so that the long portion of the hub is toward the rear. Place clutch in position on flywheel overclutch driven disc. Correct clutch to flywheel location is ensured by the two dowels in the flywheel being of different diameters. Install two or three mounting cap screws and lockwashers loosely. Insert a clutch aligning arbor, if available, or a transmission main drive gear shaft, through clutch driven disc hub spline and into clutch pilot bearings. Hold clutch driven disc in position while completing installation of six mounting capscrews and lockwashers in flange of clutch backing plate or cover. Tighten all six capscrews securely. Remove three retaining clips which were installed to hold clutch compressed.
NOTE: Clutch will not operate properly unless these retaining clips are removed.

8. INSTALL VALVE TAPPETS. Coat each of 12 valve tappets with heavy engine oil and drop each, flat side down, through recess in side of cylinder block into sockets in block.

9. INSTALL VALVE LIFTER ROD COVER. Install new gasket over opening at left hand side of engine block. Install valve lifter rod covers and slotted screws.

INSTALL CYLINDER HEAD

1. INSTALL HEAD. Place gasket on cylinder block and align bolt holes. Place cylinder head on crankcase, being careful not to damage or shift gasket position. Loosely install all cylinder head bolts and flat washers, omitting bolts in holes for rocker arm assembly.
WARNING: The gasket is stamped with the words "This side out" and must be installed with these words upwards against the cylinder head.

2. INSTALL VALVE ROCKER ARM ASSEMBLY. Insert 12 valve lifter rods in cylinder head, make sure they enter the valve tappet. Lift the valve rocker arm assembly into position on cylinder head with the drilled oil bracket placed third from front. Make sure number 2, 4 and 6 bracket sleeve dowels are in place (Fig. 7). Install the remainder of cylinder head bolts and tighten alternately and evenly in sequence to 90 foot pounds (Fig. 55).

3. ADJUSTING VALVES. To adjust valve stem to valve rocker arm clearance correctly, each cylinder must be on top-dead-centre on its compression stroke at the time of adjustment of valves for that cylinder. To determine the correct position, turn the engine crankshaft until No. 1 piston is at top-dead-centre on compression stroke and the ignition timing dot on the flywheel is in line with the pointer on the flywheel housing (Fig. 56). Adjust clearance on each valve of No. 1 cylinder to .024 to .026 by using a feeler gauge between valve stem and valve rocker arm and turn rocker arm adjusting screw out of rocker arm until clearance is obtained. Tighten adjusting screw lock nut and recheck

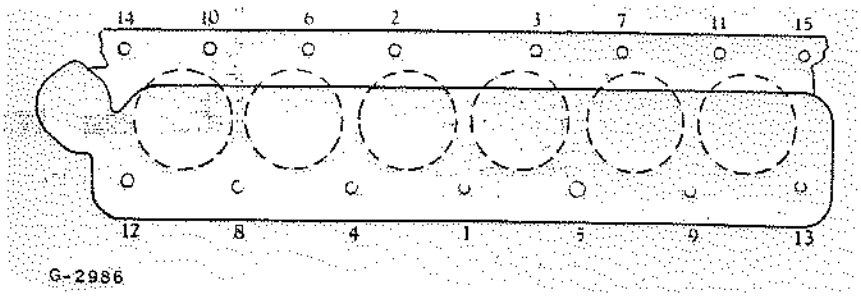


Fig. 55 - Cylinder head mounting bolt tightening sequence

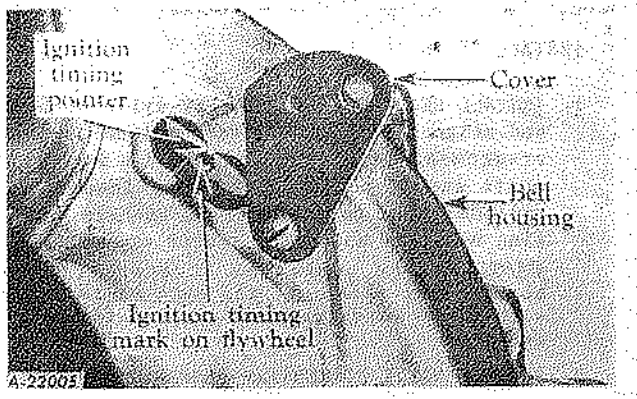


Fig. 56

clearance. (NOTE: Valve clearance should be rechecked with engine at normal operating temperature preferably with engine running at low idle speed, using a .025 hardened feeler strip).

4. Turn crankshaft one third revolution and adjust clearance on No. 5 valves. Working in firing order sequence, continue to set valve of each of the remaining cylinders, turning crankshaft one third turn after each valve adjustment.

5. INSTALL INTAKE AND EXHAUST MANIFOLDS. To facilitate installing the manifolds, after manifold gaskets and pilot rings are installed, start capscrews at each end of intake manifold. This will permit the manifold to slide straight up between the engine head and capscrews and flat washers. When manifold is lined up with pilot rings and gasket tilt bottom of manifold toward engine block. This will force manifold out at top enough to bind against the two capscrews and hold manifold in position until the front and rear capscrews can be installed.

6. INSTALL WATER PUMP. Place water pump gasket in position, at water pump opening in front of cylinder head. Install water pump and fan and install four capscrews and lockwashers in pump and cylinder block.

7. INSTALL OIL FILTER. Place oil filter and new gasket in place on cylinder block. Install two capscrews and lockwashers in mounting bracket. (NOTE: Be sure filter assembly is thoroughly cleaned and a new cartridge is installed before replacement on engine). Tighten centre tube nut (Fig. 57).

8. INSTALL ACCESSORIES. Install carburettor, generator, distributor and connecting wires, starter, fuel pump, ignition coil, oil gauge and thermostat.

9. FILL ENGINE WITH OIL. After making certain that oil drain plug is securely installed, fill crankcase with oil. After engine has been installed and placed in operation, again recheck oil level and if necessary add sufficient oil to bring level up to full mark on gauge.

10. INSTALL CYLINDER HEAD COVER. If engine is not to be installed at this time, install new cylinder head cover gasket and install cylinder head cover. Install three flat washers and three capscrews on cover, ensuring that the three grommets are in place in the cover bolt holes.

11. Engine oil circulation is shown systematically in Fig. 58.

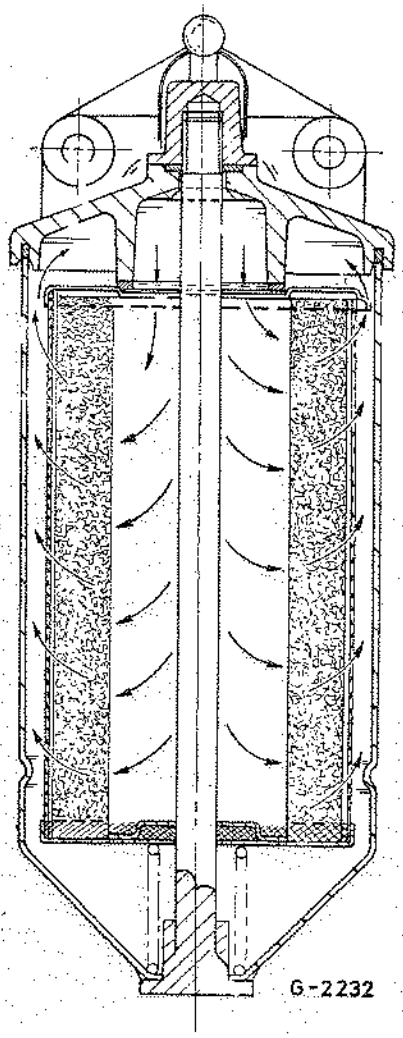


Fig. 57
Full Flow Oil Filter

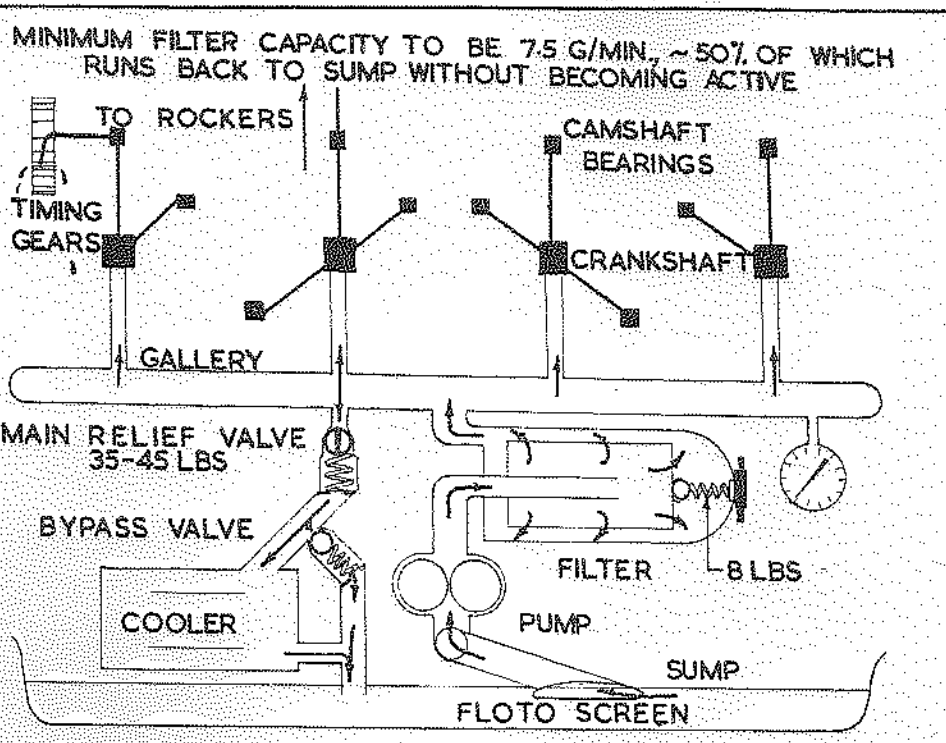


Fig. 58 - Schematic diagram of engine lubrication

VENTILATION SYSTEM

Positive crankcase breathing is designed into the engine. Inlet manifold vacuum is utilized to draw off fumes and contaminating vapors from the crankcase and cylinder head, and exhausts them through the combustion chambers and exhaust system (Fig. 60). Clean air is admitted to the crankcase, through a dry type air cleaner mounted on the valve rocker cover. The amount of air drawn through the ventilating system is controlled by the metering valve (Fig. 59) which is mounted on the push rod chamber cover, just rear of the ignition distributor. The metering valve is connected by a pipe to the elbow in the induction manifold.

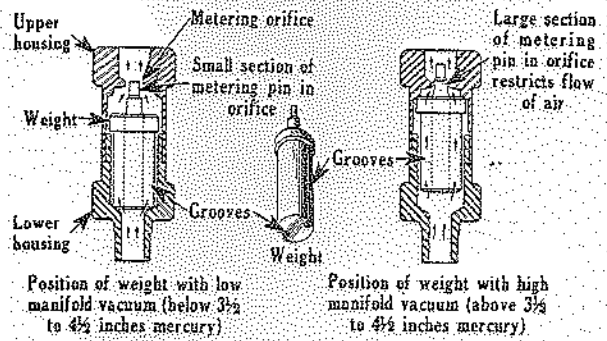


Fig. 59

For crankcase ventilation to remain efficient, the metering valve should be serviced every 10,000 miles. To service this unit, disconnect the manifold vacuum line and remove the valve. Separate the two halves of the valve and remove the weight. Clean all parts. Always remove and clean the 1/4 inch street elbow which connects the valve to the push rod cover. Install metering valve with arrow (stamped on side) pointing up. Connect manifold vacuum line.

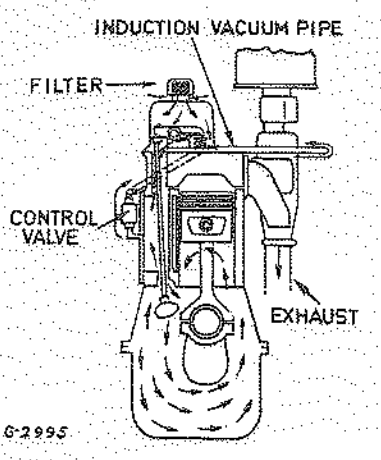


Fig. 60 - Crankcase ventilation

TROUBLE SHOOTING

Satisfactory performance of the engine, depends on the most efficient operation of all the three basic systems - Electrical, Carburetion and Mechanical. Generally speaking most engine troubles occur in that order.

For example, when an engine develops some kind of trouble, the first system to suspect and check is the electrical. If the trouble is not located there, go to the fuel system, and finally to the mechanical.

By reference to the following chart, a systematic approach to trouble shooting can be adopted. The chart lists the most common engine complaints and the probable causes to look for.

HARD STARTING - Engine Cold

A. Electrical

1. Starter cranking voltage too low
2. Spark plug voltage too low
3. Distributor
   a. Point gap incorrect (dwell)
   b. Timing not set correctly
4. Worn or fouled spark plugs

B. Fuel

1. Carburettor
   a. Loose choke linkage
   b. Fuel leakage
   c. Incorrect idle r.p.m.
   d. Improper idle mixture
2. Fuel Pump
   a. Not pumping
   b. Incorrect pump pressure

C. Mechanical

1. Test engine compression
   a. Head gaskets
   b. Valves
   c. Rings

HARD STARTING - Engine Hot

A. Electrical

1. Starter cranking voltage too low
2. Spark plug voltage too low
3. Distributor
   a. Point gap incorrect (dwell)
   b. Timing not set correctly
4. Worn or fouled spark plugs

B. Fuel

1. Carburettor
   a. Choke plates stuck in closed position
   b. Percolation
   c. Fuel bowl float set too high
   d. Leaking needle and seat
   e. Dirty air cleaner
   f. Air cleaner oil level too high
   g. Idle mixture too rich
2. Fuel pump
   a. Not pumping
   b. Incorrect pump pressure

C. Mechanical (not usually at fault in this complaint)

STALLING - Engine Cold

A. Electrical (not usually at fault in this complaint)

B. Fuel

1. Carburettor
   a. Sticking choke plates
   b. Improper float level
   c. Idle mixture too lean
2. Out of gasoline

C. Mechanical

1. Improper or defective thermostat causing long warm-up
2. Leaking exhaust crossover tube

STALLING - Engine Hot

B. Fuel

1. Carburettor
   a. Choke plates sticking
   b. Idle r.p.m. too low
   c. Improper idle mixture
   d. Incorrect float setting
   e. Pump stroke improperly set
   f. Leaking needle and seat
2. Improper grade fuel

C. Mechanical

1. Vacuum loss because of leaks at intake manifold
2. Vacuum leaks between carburettor and manifold

MISSING - At Low Engine Speed

A. Electrical

1. Distributor
   a. Point gap incorrect or varying (dwell)
   b. Automatic spark advance not working
2. Low voltage to spark plugs
3. Fouled spark plugs

B. Fuel

1. Improper fuel mixture at idle and intermediate speeds
2. Incorrect float setting
3. Inoperative pump
4. Partially closed choke plates
5. Small particles of dirt around main jet

C. Mechanical

1. Leaks at intake manifold
2. Test engine compression
   a. Head gaskets
   b. Valves
   c. Rings
3. Air cleaner improperly installed
4. Incorrect valve to rocker arm clearance

MISSING OR CUTTING OUT - At High Engine Speed

A. Electrical

1. Distributor
   a. Point gap incorrect (dwell)
   b. Automatic spark advance not working
2. Low voltage to spark plugs
3. Fouled spark plugs

B. Fuel

1. Carburettor
   a. Float level set too low
   b. Inoperative pump
   c. Dirt in main jet
   d. Partially closed choke plates
   e. Restriction in filter
2. Fuel Pump
   a. Low pressure
   b. Low volume
   c. Restriction in filter

C. Mechanical

1. Test engine compression
   a. Head gaskets
   b. Valves
   c. Rings
2. Incorrect valve to rocker arm clearance

EXCESSIVE PINGING - Detonation

A. Electrical

1. Distributor
   a. Point gap incorrect (dwell)
   b. Spark advanced too far
2. Fouled spark plugs

B. Fuel

1. Carburettor
   a. Main metering system too lean
   b. Float level set too low
2. Low octane fuel

C. Mechanical

1. Improper or stuck closed thermostat causing overheating
2. Combustion chamber full of carbon
3. Cylinder head not bolted down tight

NO POWER

A. Electrical

1. Distributor
   a. Point gap incorrect (dwell)
   b. Out of timing
   c. Automatic spark advance inoperative
2. Low voltage to spark plugs
3. Fouled spark plugs

B. Fuel

1. Carburettor
   a. Float level set too low
   b. Accelerating pump not working
   c. Power or economizer valve inoperative
   d. Choke plates partially closed
   e. Restricted throttle linkage
2. Fuel pump
   a. Insufficient pressure
   b. Insufficient volume

C. Mechanical

1. Air cleaner improperly installed
2. Incorrect valve to rocker arm clearance
3. Late valve timing
4. Loss of engine compression

USES TOO MUCH FUEL

A. Electrical

1. Distributor
   a. Point gap incorrect (dwell)
   b. Ignition timing
   c. Spark advance inoperative
2. Low voltage to spark plugs
3. Worn or fouled spark plugs

B. Fuel

1. Carburettor
   a. Float level set too high
   b. Power or economizer valve stuck open
   c. Leaking needle or seat
   d. Choke plates not fully open
2. Fuel pump pressure too high

C. Mechanical

1. Air cleaner improperly installed
   a. Restriction in air cleaner
   b. Air cleaner oil level too high
2. Valves
   a. Insufficient clearance
   b. Valves not seating
3. Worn piston rings

ROUGH IDLE

A. Electrical

1. Distributor
   a. Point gap incorrect (dwell)
   b. Ignition timing
2. Voltage to spark plugs not constant
3. Worn or fouled spark plugs

B. Fuel

1. Carburettor
   a. Incorrect idle mixture - idle tubes not seated
   b. Leaking needle or seat
   c. Leaking accelerator pump
   d. Over-choking
2. Fuel pump has too much pressure

C. Mechanical

1. Intake manifold leaking
2. Air cleaner improperly installed
3. Valves
   a. Insufficient clearance
   b. Valves not seating

LOW TOP SPEED

A. Electrical

1. Distributor
   a. Point gap incorrect (dwell)
   b. Ignition timing
2. Low voltage to spark plugs
3. Worn or fouled spark plugs

B. Fuel

1. Carburettor
   a. Partially closed choke plates
   b. Float level set too low
   c. Power system not working
   d. Main metering and power enrichment jets specified for different altitude
   e. Restricted throttle linkage
   f. Dirt in air bleeds or vents
2. Fuel pump
   a. Insufficient pump pressure
   b. Insufficient volume
   c. Restricted filter

C. Mechanical

1. Compression test
   a. Head gaskets
   b. Valves
   c. Rings
2. Air cleaner improperly installed
   a. Restriction in air cleaner
   b. Oil level too high
3. Restricted tail pipe

OVERHEATING

A. Electrical

1. Distributor
   a. Timed incorrectly
   b. Retarded spark advance

OVERHEATING - Continued

B. Fuel

1. Carburettor set too lean

2. Intake manifold leaking

3. Leaking in vacuum operated accessories

C. Mechanical

1. Radiator
   a. Obstruction inside radiator
   b. Air flow through radiator restricted
   c. Loose radiator fins

2. Thermostat defective

3. Collapsed hose

4. Loose belts

5. Leaking head gaskets

6. Plugged water passages in cylinder head or crankcase

BREAK-IN

A new or rebuilt engine must be properly broken-in before maximum performance is demanded of it. When given an opportunity to wear fit its parts by following the proper break-in procedure, the engine will give smoother and quieter operation with greater economy and longer life.

For the first 500 miles hold the vehicle speed below 40 miles per hour. Do not over speed the engine to high r.p.m. and AVOID LUGGING THE ENGINE ANY TIME.

Consistent low speed driving (10 to 25 m.p.h.) during the first 500 miles of operation is not recommended nor is it the proper way to break-in a new or rebuilt engine. Although prolonged speeds in excess of 40 m.p.h. should be avoided for the first 500 miles, occasional acceleration up to 40 m.p.h. will materially assist engine in break-in.

After the vehicle has been driven 500 miles, occasional acceleration up to the governed or legal limit is permissible and desired. However, the truck must not be operated at top speed or full throttle for prolonged periods until it has been driven at least 1,000 miles.

2-1/2 TON 4x4 G.S. - INTERNATIONAL

Clutch Model	12 A.S.
Type	Single plate dry disc
Vibration Damper	Coil spring

Pressure Springs

Type	Coil
Colour Code	Yellow
Number Used	16
Free Length	2.678
Spring Pressure (Lbs.)	135 - 145
At spring length	1.688

Note: Springs to be compressed to solid height before testing

Number of Release Levers	4
Number of Facings	2
Thickness (Inches) Each Lining	.140 - .150
Outside Diameter (Inches)	11.85 - 11.91
Inside Diameter (Inches)	7.500 - 7.510
Adjustment	External
Flywheel Face to Levers	2-1/4 inches
Release Bearing Lubrication	Manual gun

MAINTENANCE

Description

The clutch is of the single dry plate type of Borg and Beck design having 16 pressure springs and 4 release levers.

The levers are adjustable, but being accurately set by the manufacturer, should require no adjustment during the life of the driven member facings. As these wear however, it is important to maintain the recommended clearance between the release lever plate and the release bearing. Such adjustment is made at the hydraulic slave cylinder rod yoke ONLY.

Failure to maintain clearance between the release lever plate and release bearing will result in damage to the bearing, and could cause the clutch to slip. Refer to Illusts.

Whenever it is necessary to do any service work on the clutch, advantage should be taken of the opportunity to thoroughly recondition it. This is a comparitively short job and will assure satisfactory operation over a long period of time, whereas failure to do this may necessitate another tear-down within a short time.

NOTE: Illustrations used in this section are intended to show methods of servicing procedure, and do not necessarily represent the actual clutch details.

Removal

When removing the transmission for the purpose of gaining access to the clutch or for any other reason, extreme care should be taken to support the weight of the transmission until it is completely removed so that the main shaft splines will clear the driven member. There is a possibility of distorting the driven member which will not permit a free release of the clutch.

New clutch assemblies are supplied in a compressed state, by the use of four dispatching staples, one inserted between each release lever and the backing plate. These are for dispatch and storage purposes only and will not remain in place when the clutch is assembled to the flywheel. Care must therefore be taken to see that they do not fall into the clutch, when the clutch attaching screws are tightened.

When removing the clutch from the flywheel, four spare staples should be on hand and inserted one to each release lever, as the eight attaching screws are loosened off. Correct locationof the staples is illustrated in Fig. 4.

All capscrews should be backed out gradually to avoid damage to the back plate.

Driven Member Assembly

The clutch driven member assembly should be carefully inspected. Facings showing considerable wear of facings that are rough or oil soaked should be replaced.

When installing new facings of the continuous ring type, and in cases where two different thicknesses are used on each plate, the thick facing is installed on the pressure plate side. The thin facing is installed on the flywheel side. The clutch in the International Mark 3 has two linings of equal thickness.

Installation of clutch facings on the cushion type driven member is shown in Fig. 2.

A = .329-.331
B = 1.909-1.931
C = 2.24-2.26

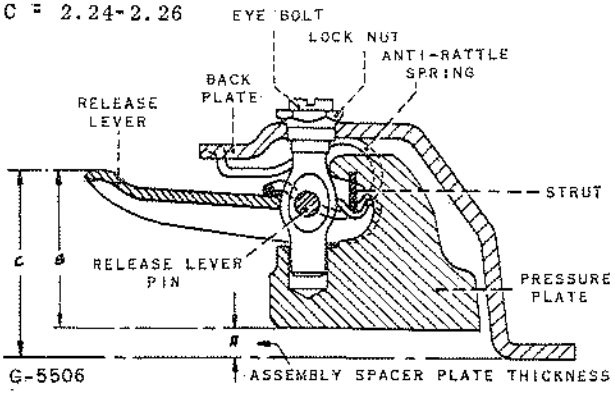


Fig. 1 - Sectional View of 12" A.S. Type Clutch

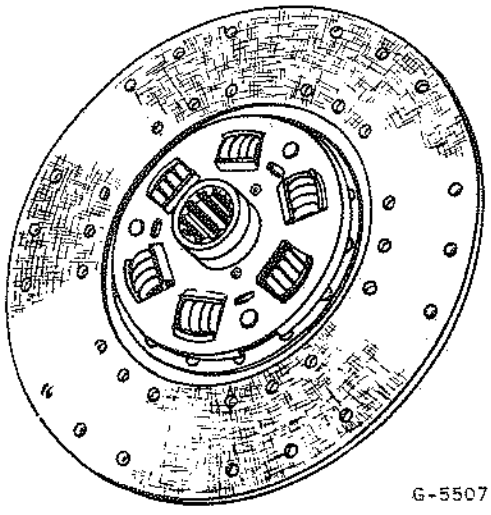


Fig. 2 - Driven member. Each facing independently rivetted to the disc

Clutch Overhaul

Most service stations are equipped with a clutch rebuilding fixture (SE-990 or equivalent). The following procedure illustrates rebuilding of a clutch assembly using SE-990 fixture, except for variations in retaining capscrews and retaining clips, and release lever mounting, this procedure applies to all series clutches. When an overhaul fixture is not available, the hydraulic press may be utilized as described at the rear of this section.

The back plate and pressure plate are dismantled by selecting the specified spacer plate Fig. 3 (dimension "A" see specifications) and Fig. 1, and centering it on the fixture base.

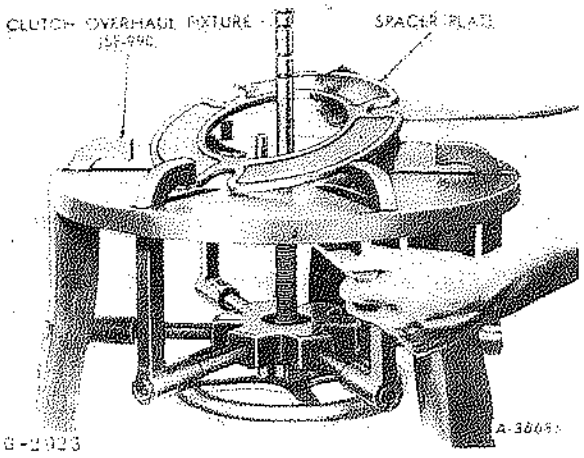


Fig. 3 - Selecting proper spacer plate

Position the clutch assembly on the fixture and directly over the spacer plate. Compress the assembly with a burnishing tool, (clutch release attachment) and remove the dispatch staples, Fig. 4.

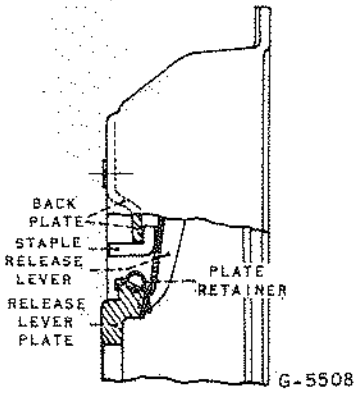


Fig. 4 - Dispatch Staple Location

Remove the burnishing tool and position the back plate spacers and fixture arms on the back plate mounting flanges Fig. 5. Compress the assembly until the back plate is firmly seated on the surface plate.

Remove four eyebolt nuts Fig. 6. Remove the four strap bolts and ferrules.

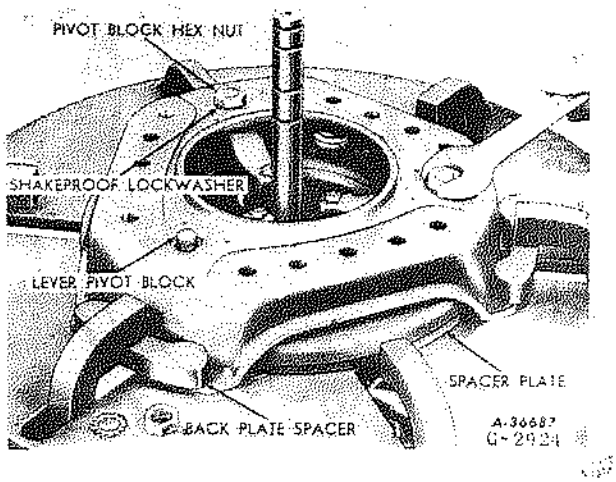


Fig. 5 - Securing clutch assembly in overhaul fixture (SE-990)

Release the fixture jaws and lift off the back plate, Fig. 6. Note the position of the pressure springs and remove the springs.

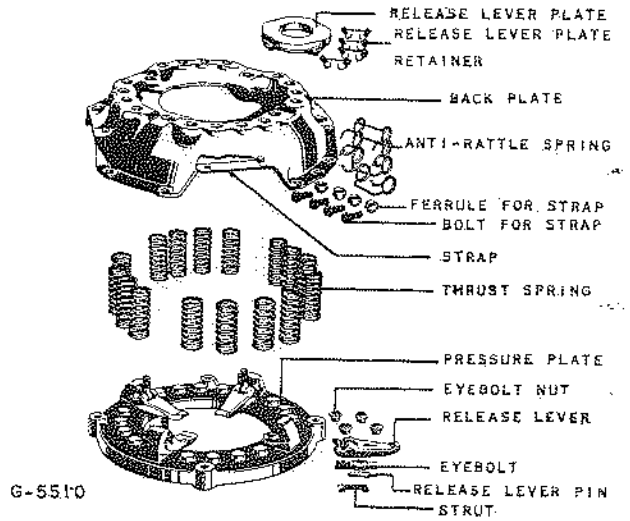
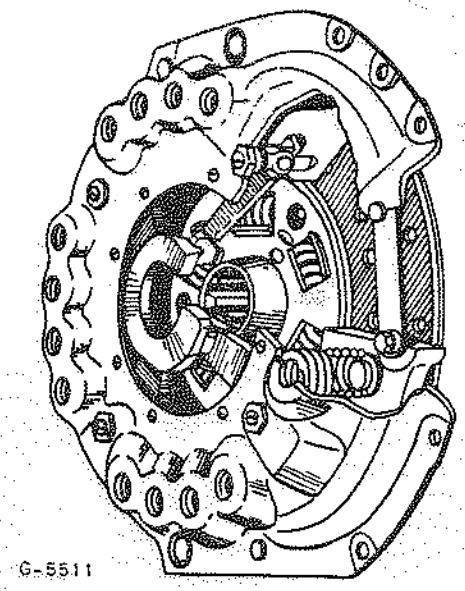


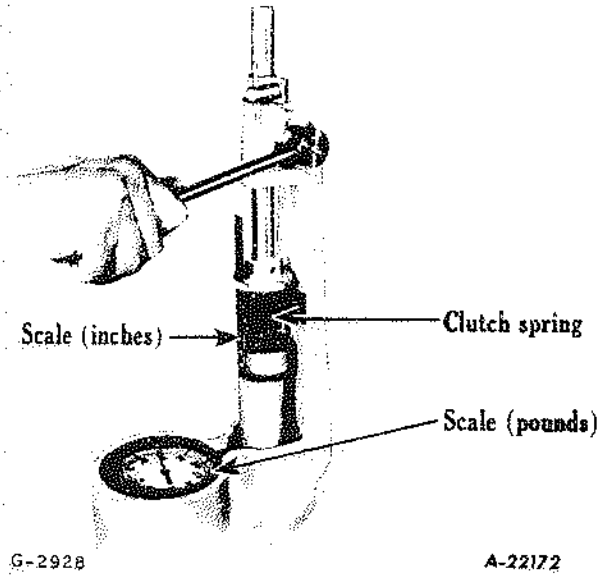
Fig. 6 - 12 A.S. Clutch Assembly

Remove the four release levers, pins, struts, eyebolts and anti-rattle springs, Fig. 6.



G-5511

Fig. 7 - Sectioned View of the 12" A.S. Clutch



G-2928 A-22172

Fig. 9 - Check springs on SE-1565 spring tester

Inspection

Check the clutch springs for proper tension (see specifications) using SE-1565 spring test, Fig. 9, or similar equipment. If a tester is not available, make a comparison test with new springs. Discard those not of the same length or discoloured due to heat.

Check all moving parts for wear and replace as necessary.

A pressure plate that is badly scored, checked or warped should be replaced as it will not perform satisfactorily and will damage the clutch driven member.

If the clutch surface on the flywheel is not smooth, the flywheel should be removed, mounted in a lathe and smoothed with emery cloth, using first a coarse cloth and finishing with a fine emery cloth. Where the surface is extremely rough, a light cut should be taken on the flywheel with a lathe tool and then polished with emery cloth.

TO ASSEMBLE THE CLUTCH

After cleaning inspecting and replacing worn or otherwise faulty parts, lubricate and assemble the clutch as follows.

Points of Lubrication

PART	AREA TO BE LUBRICATED
Eyebolts	Shank (Plain End)
Cover or back plate	Eyebolt nut seats
Release lever pins	Total length
Release lever plate	Points of contact with release levers
Struts	Contact edges
Anti rattle springs and plate retainers	Contact points

Lubricant

A light coating of lubriplate No. 220 or equivalent is recommended for the above points.

Assembly

Lay the pressure plate face downwards on a clean surface.

Place four eyebolts into their respective sockets. Insert four release lever pins through the eyebolts. Place a release lever over each eyebolt at the same time inserting a strut into position notched edge upwards as shown in Fig.6.

Place the sixteen thrust springs on their respective bosses.

Check the four straps which are rivetted to the back plate to ensure they are in good condition, and place the back plate into position over the eyebolts and thrust springs.

By means of a clutch fixture Fig. 5, or hydraulic press as in Fig. 12, compress the springs sufficiently to assembly the eyebolt nuts onto the eyebolts.

Assemble the four ferrules and strap bolts and tighten these until a torque of 15-25 lbs/ft. is required to unscrew them. Stake the ferrules against at least two flats of the bolt head.

With the spacer in place as shown in Figs. 3 and 5, or 11 and 12 the clutch can now be adjusted. This is done by means of the four eyebolt lock nuts Figs. 1 and 6 which are tightened or loosened progressively until the dimension "B" in Fig. 1 is obtained on all four levers, then lock the nuts to the eyebolts by staking the nut collar into the slot in the eyebolt. Staking to be secure and require a torque of 60 lbs/ins. minimum to unscrew the nuts.

Finally assemble the release lever plate on the four levers and secure with the four retainers as shown in Fig. 4, the centre portion of the retainer to be hooked over the projections on the plate, and the ends of the retainers to hooked over the levers.

Release Lever Adjustment

The release levers must be set to the specified dimensions as shown in the specifications and illustrated in Fig. 1. Dimensions A, B and C. The lever adjusting gauge, Fig. 10 can be used for accurate measurement of the lever heights. Set the gauge to the dimensions listed in specifications.

Release the fixture arms and with the clutch release attachment, press the levers down until the four despatch staples Fig. 4 can be inserted, to hold the assembly compressed for installation onto the flywheel.

Installing Clutch Assembly to Flywheel

Position the driven member and clutch pressure plate assembly on the flywheel, using a stub shaft to align the driven member. Install the clutch to flywheel retaining capscrews and tighten only to a point where the dispatch staples can be removed.

WARNING: Take care to ensure than none of the staples falls into the clutch, since they will drop out of place as soon as the clutch attachment capscrews are tightened. On completion of clutch installation there should be four staples in hand. These should be kept for future clutch overhauls.

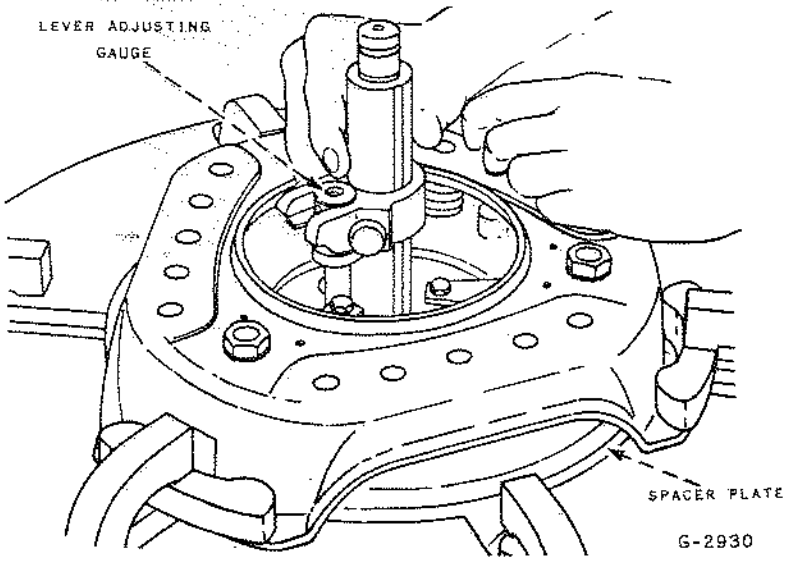


Fig. 10 - Release lever adjustment gauge

CLUTCH OVERHAUL (Where no special fixture is available)

12" A.S. CLUTCH

The back plate and pressure plate assembly is dismantled by placing the unit on a hydraulic press with the spacer plate under the pressure plate. NOTE: The spacer plate must not extend beyond the outside diameter of the pressure plate. Place a bar, Fig. 11, across the back plate and compress the assembly slightly to remove the retaining staples.

From this point, follow the same procedure as outlined with the special clutch fixture previously explained.

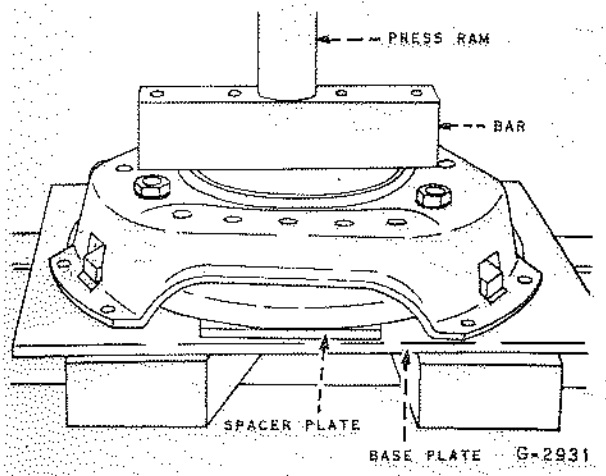


Fig. 11 - Disassembling the clutch with hydraulic press

RELEASE LEVER ADJUSTMENT WITHOUT SPECIAL FIXTURE

Position the clutch assembly in a hydraulic press on a flat surface plate, Fig. 12, with a correct thickness spacer plate (see specifications) under the pressure plate. Bridge the bar across the top of the back plate to provide access to the four eyebolt nuts.

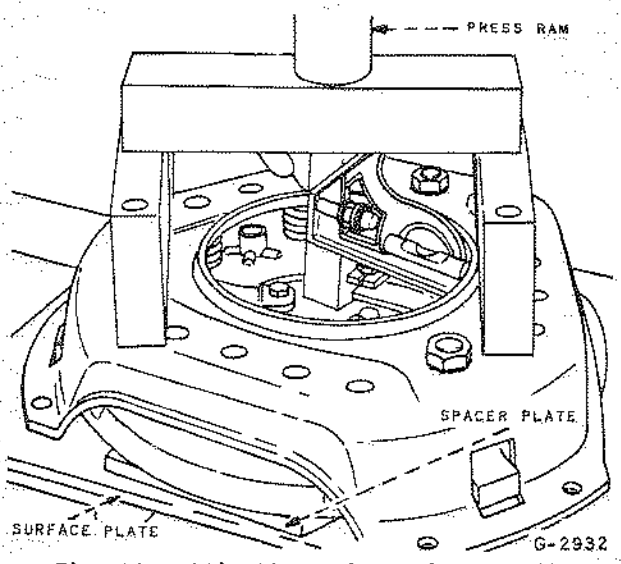


Fig. 12 - Adjusting release levers with hydraulic press

Compress the assembly until the back plate is firmly seated on the surface plate. Using the specified thickness spacer plate, Fig. 12, will provide the correct dimension from the pressure plate to the back plate mounting flange for the release lever adjustment. With a small square, adjust the levers to the specified dimension.

LUBRICATION

Easy clutch operation is dependent to a large degree on lubrication of the clutch release shaft and clutch control linkage, and the application of a thin coating of lubricant to the wearing surfaces of the clutch release sleeve. Inspect these points to assure that there is lubricant present. DO NOT OVERLUBRICATE. Use a suitable lubricant on the release sleeve.

CLUTCH RELEASE SLEEVE

Use a low pressure hand gun and lubricate every 15,000 to 20,000 miles under normal conditions. For unusual "Stop and Go" conditions, lubricate every 10,000 miles. DO NOT OVER LUBRICATE.

CLUTCH CONTROL

The hydraulic control of the clutch release mechanism consists of a pendant pedal and master cylinder group mounted on the windscreen belt rail, and a slave cylinder and push rod group mounted on the right hand side of the transmission case. A hydraulic line connects the master cylinder to the slave cylinder. When the clutch pedal is depressed the master cylinder push rod operates the M/C piston, forcing fluid from the M/C via the hydraulic pipe into the slave cylinder. The piston of the slave cylinder is thus moved forward. An adjustable push rod connected to the clutch release shaft lever has its rear end held in contact with the recess in the slave cylinder piston by a pull off spring. When the piston is hydraulically moved forward the push rod moves with it and actuates the clutch release lever and shaft, and through the clutch release sleeve and bearing and clutch pressure plate levers, releases the clutch.

BLEEDING THE SYSTEM

Fill the master cylinder reservoir with approved hydraulic brake fluid.

Connect a suitable rubber tube to the bleeder valve at the rear end of the slave cylinder. Open the bleeder valve abour half a turn and insert the other end of the rubber tube into a glass container. The clutch pedal must then be operated and the stream of fluid from the rubber tube observed until all air bubbles are expelled from the system. During the bleeding operation see that a good level of fluid is maintained in the master cylinder reservoir to prevent entry of air.

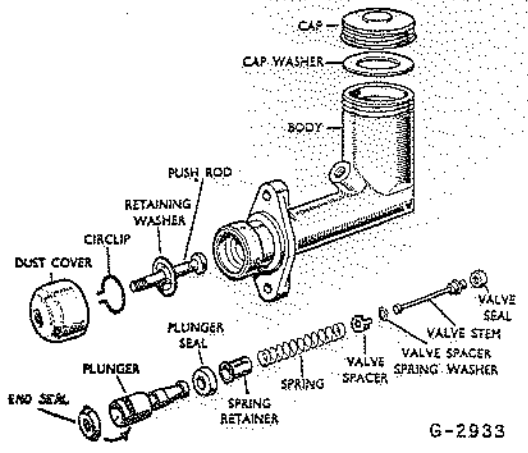


Fig. 13 - Master cylinder group

FLUID LEVEL

The fluid level in the master cylinder reservoir must be checked periodically. Do not overfill but maintain level approximately 1/2" from the top of the filler neck, shown in Fig. 13.

For the hydraulic clutch system always use low viscosity brake and clutch fluid.

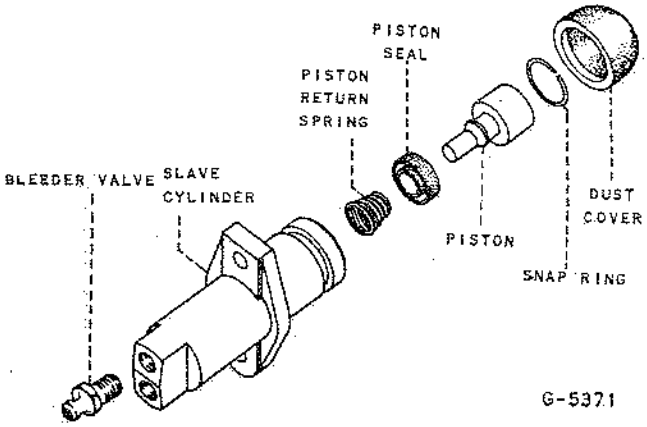


Fig. 14 - Slave cylinder group

ADJUSTMENT PROCEDURE (Refer to Fig. 15)

1. Ensure that master cylinder is filled with fluid and the system is bled.
2. Adjust the pedal stop until there is a minimum of 7.5 inches of effective movement available at the pedal foot pad.
3. Remove the clevis pin and adjust the push rod yoke until the hole in the yoke is 1/32" forward of the hole in the actuating lever, when the push rod is held forward against the master cylinder piston.
4. Replace the clevis pin, and secure with a split pin.

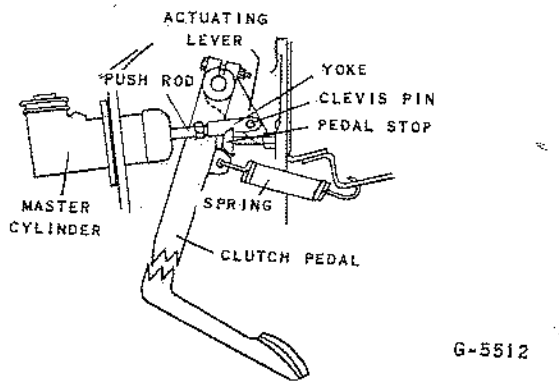


Fig. 15 - Master cylinder and clutch pedal

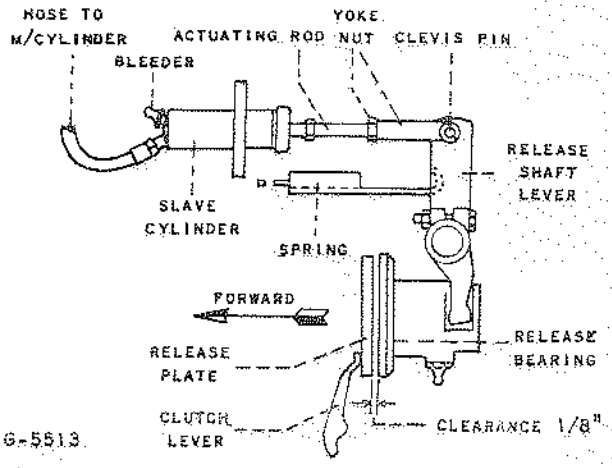


Fig. 16 - Slave Cylinder Adjustment

ADJUSTMENT PROCEDURE (Refer Fig. 16)

1. Unhook the spring.

2. Remove the clevis pin.

3. Hold the release shaft lever rearwards to ensure that the release bearing is resting against the clutch release plate.

4. Loosen the yoke nut, and adjust the yoke until the clevis pin hole in the yoke is 5/32 forward of the hole in the release shaft lever, when the actuating rod is pushed back into the slave cylinder as far as it will go.

5. Replace and pin up the clevis pin, tighten the yoke nut, and hook up the spring.

NOTE: These adjustments will ensure that the clearance between the release bearing and release plate is correct.
WARNING: Free pedal movement is no guide to correct clutch control adjustment.

DISMANTLING MASTER CYLINDER (Refer Fig. 13)

Disconnect the pressure pipe union from the cylinder and remove the securing bolts and clevis pin from jaw end. Remove the filler cap and drain out the fluid. Pull back the rubber dust cover and remove the circlip with a pair of long nosed pliers. The push rod and retaining washer can then be removed. When the push rod has been removed the plunger with seal attached will then be exposed. Remove the plunger assembly complete. The assembly can then be separated by lifting the spring retainer over the shouldered end of the plunger. The seals should be eased off the plunger. Depress the plunger return spring allowing the valve stem to slide through elongated hole of spring retainer thus releasing tension of spring. Remove Spring retainer, spring and valve complete. Detach the valve spacer taking care of the spacer spring washer which is located under the valve head. Remove the seal from the valve head.

Examine all parts especially the seals for wear or distortion and replace with new parts where necessary.

ASSEMBLING

Replace the valve seal so that the flat side is correctly seated on the valve head. The spring washer should then be located on the under side of valve head being held in position by the valve spacer the legs of which face towards the valve seal. Replace the plunger return spring centrally on the spacer, insert the spring retainer into the spring and depress until the valve stem engages through the elongated hole of spring retainer making sure the stem is correctly located in the centre of it. Check that the spring is still central on the spacer. Refit new plunger seal on to the plunger with flat of seal seated against the face of plunger. Insert the reduced end of plunger into the spring retainer until the retainer engages under the shoulder of the plunger. Press home the retainer. Place end seal in its groove on the plunger as in Fig. 13.

Smear the assembly well with brake fluid, and insert the assembly into the bore of cylinder valve end first, easing the plunger seal lips in the bore. Replace push rod with the dished side of washer under the spherical head into the cylinder followed by the circlip which engages into groove machined in cylinder body.

Replace the rubber dust cover and refit the cylinder to the chassis.

Dismantling and assembling the slave cylinder is identical to the master cylinder, provided that the order of assembly shown in Fig. 14 is followed.

MAINTENANCE

With an oil can apply two or three drops of oil to the clevis pins once monthly. Check fluid level weekly. If topping up is required more than once a month examine system for leaks.

TRANSMISSION

INDEX

M

I.H. Model	T-35
Type	Synchromesh Except 1st and reverse
Forward Speeds	5
Reverse Speeds	1
Reductions	
First	7.170 to 1
Second	3.960 to 1
Third	2.365 to 1
Fourth	1.410 to 1
Fifth	Direct
Reverse	7.020 to 1
Lubricant Capacity	10 pints (Imp.)

This vehicle is equipped with a Model T-35 Transmission - A 6 ratio type having 5 speeds forward and 1 reverse. Forward ratios 2nd, 3rd, 4th and 5th having synchromesh engagement.

A magnetic drain plug has been used in place of the conventional pipe plug, to collect foreign metallic particles which may be present in the lubricant.

1. HOUSING, SHIFT BAR
2. CUP, SHIFT BAR DUST
3. BALL, 1/2 SHIFT BAR POPPET
4. SPRING, POPPET BALL
5. BAR, SECOND AND THIRD SPEED SHIFT
6. BAR, FOURTH AND DRIVE SPEED SHIFT
7. CUP, SHIFT BAR DUST
8. BALL, 3/4, SHIFT BAR INTERLOCK
9. PIN, SHIFT BAR INTERLOCK PLUNGER
10. BAR, FIRST AND REVERSE SPEED SHIFT
11. BLOCK, FIRST AND REVERSE SHIFT
12. SCREW, SHIFT BLOCK AND SHIFT FORK SET
13. BEARING, MAINSHAFT PILOT, ASSY.
14. FORK, FOURTH AND DRIVE SPEED SHIFT
15. FORK, SECOND AND THIRD SPEED SHIFT
16. FORK, FIRST AND REVERSE SPEED SHIFT
17. MAINSHAFT
18. SLINGER, OIL, MAINSHAFT BEARING
19. SPACER/GEAR
20. WASHER, MAINSHAFT BEARING
21. BEARING, MAINSHAFT REAR
22. GEAR, MAINSHAFT, FIRST SPEED SLIDING
23. RING, SNAP, MAINSHAFT SECOND SPEED GEAR
24. WASHER, THRUST
25. GEAR, MAINSHAFT SECOND SPEED
26. RING, W/PINS, SYNCHRONIZER UNIT INNER REAR
27. SPRING, SLIDING CLUTCH
28. PIN, SPRING
29. CLUTCH, SLIDING, W/PINS AND SPRINGS
30. RING, W/PINS, SYNCHRONIZER UNIT INNER FORWARD
31. RING, SYNCHRONIZER UNIT OUTER STOP
32. GEAR, MAINSHAFT THIRD SPEED
33. WASHER, THRUST, THIRD SPEED GEAR
34. RING, SNAP, EXTERNAL
35. GEAR, MAINSHAFT FOURTH SPEED
36. RING, OUTER STOP
37. SYNCHRONIZER, FRONT ASSY.
38. GEAR, MAINSHAFT CLUTCH
39. RING, SNAP MAINSHAFT
40. BEARING, COUNTERSHAFT FRONT
41. WASHER, COUNTERSHAFT FRONT BEARING
42. RING, SNAP, COUNTERSHAFT GEAR
43. GEAR, COUNTERSHAFT DRIVE
44. SPACER, COUNTERSHAFT GEAR
45. GEAR, COUNTERSHAFT FOURTH SPEED
46. GEAR, COUNTERSHAFT THIRD SPEED
47. KEY, WOODRUFF
48. COUNTERSHAFT
49. BEARING, COUNTERSHAFT REAR
50. NUT, COUNTERSHAFT REAR BEARING
51. BEARING, REVERSE IDLER GEAR
52. GEAR, REVERSE IDLER
53. SPACER, REVERSE IDLER GEAR BEARING
54. LOCK, REVERSE IDLER GEAR SHAFT
55. SHAFT, REVERSE IDLER GEAR
56. GEAR, MAIN DRIVE
57. BEARING, MAIN DRIVE GEAR
58. NUT, MAIN DRIVE GEAR BEARING
59. SEAL, OIL BEARING RETAINER
60. GASKET, BEARING RETAINER
61. RETAINER, W/SEAL, MAIN GEAR BEARING
62. RING, SNAP, EXPANSION PLUG
63. PLUG, EXPANSION, COUNTERSHAFT FRONT BEARING
64. CASE, W/PLUG, TRANSMISSION
65. PLUG, FILTER
66. COVER, P.T.O. OPENING
67. GASKET, P.T.O. OPENING
68. PLUG, PIPE, DRAIN
69. COVER, W/SEAL AND BUSHING MAINSHAFT REAR BEARING
70. PLUG, SPEEDOMETER OPENING
71. SEAL, MAINSHAFT OIL, ASSY.
72. GASKET, MAINSHAFT REAR BEARING COVER
73. PLUG, PIPE SLOTTED
74. GASKET, SHIFT BAR HOUSING MOUNTING
75. NUT, COMPANION FLANGE
76. WASHER, COMPANION FLANGE NUT

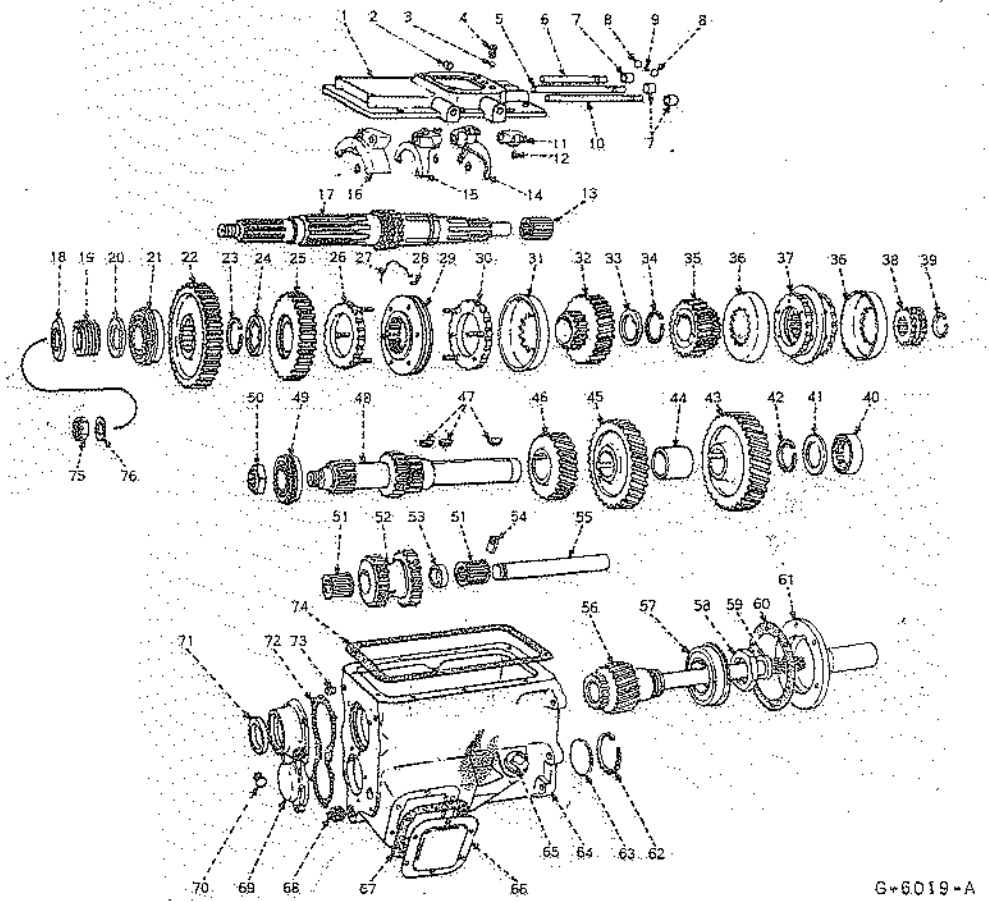


Fig. 1 - T-35 Transmission (Exploded View)

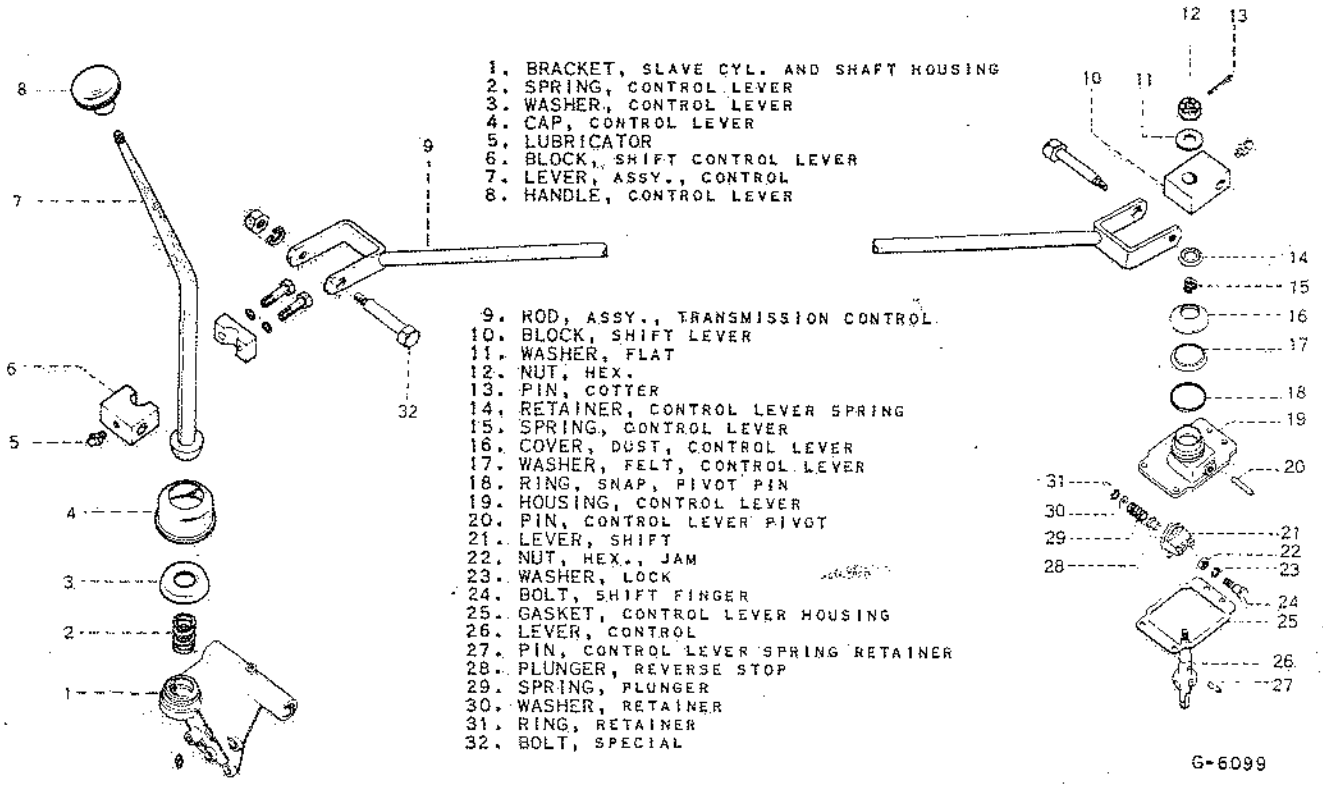


Fig. 2 - Control Lever, Shift Lever and Housing

DESCRIPTION

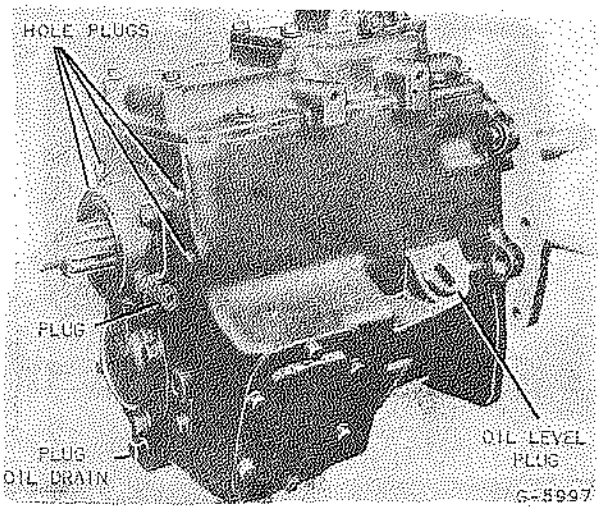


Fig. 3 - Transmission Assembly (External View)

The Model T-35 transmission has five speeds forward and one reverse. The fifth speed is direct. Fig. 4 illustrates the shift diagram.

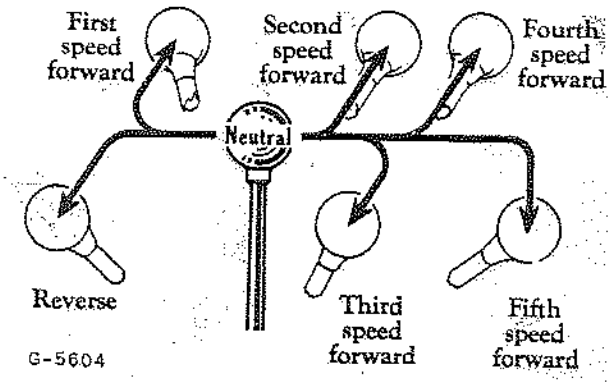


Fig. 4 - Shift Diagram

OPERATION

The T-35 transmissions incorporate synchronizers on the mainshaft to provide a smooth silent shift. The first and reverse gear (22, Fig. 1) is non-synchronized.

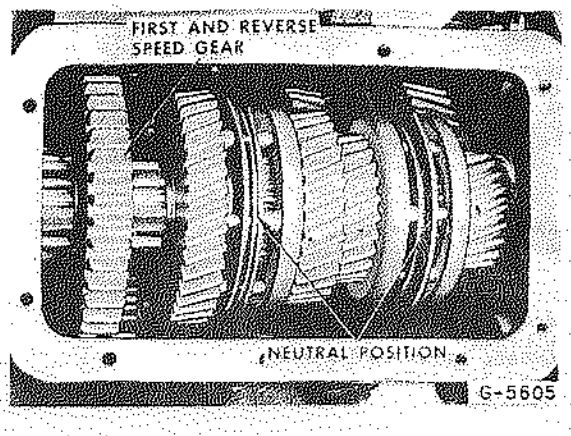


Fig. 5 - Synchronizer Positions with Transmission in Neutral

With the transmission control lever in neutral position, the sliding clutch of the front (4th and 5th speed) and rear (2nd and 3rd speed) synchronizers is as shown in Fig. 5. This allows the main drive gear (56 Fig. 1) to turn independently of the mainshaft (17).

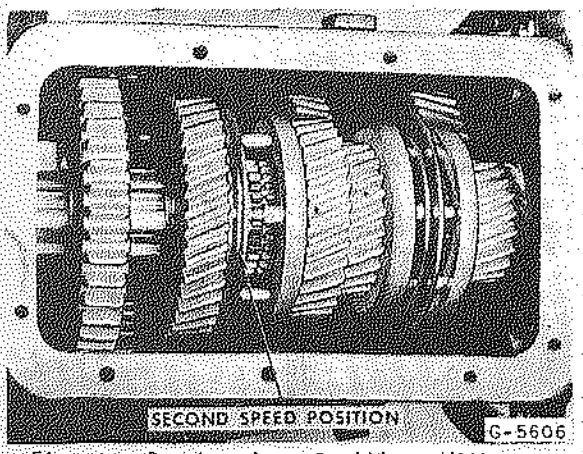


Fig. 6 - Synchronizer Positions With Transmission in Second Gear

When shifting from first to second gear, the driving torque from the main drive gear passes through the countershaft (48, Fig. 1) to the mainshaft second speed gear (25). However, slightly prior to the actual gear change, the pressure of the shift fork (16, Fig. 1) on the synchronizer sliding clutch (29), moves the clutch against the shoulders of the three pins extending from the inner stop ring (26). This pressure causes the inner stop ring to press against the second speed gear (25). The turning speed of the synchronizer assembly will become equalized with the second speed gear. As soon as both units are turning the same speed, the pressure of the shift fork will continue to completely engage the sliding clutch with the second speed gear (Fig. 6). The driving torque is thereby delivered through the synchronizer sliding clutch and on out the mainshaft.

The action involved in delivering the torque from the main drive gear to the mainshaft third speed gear is much like the action described previously for the second speed gear except that the sliding clutch (29, Fig. 1) is moved forward (Fig. 7) against the three pins extending from the inner stop ring (30). The inner stop ring is moved against the outer stop ring (31) which is constantly meshed with the third speed gear (32). As soon as the sliding clutch and the third speed gear are turning the same speed, the shift fork pressure completely engages the sliding clutch with the third speed gear.

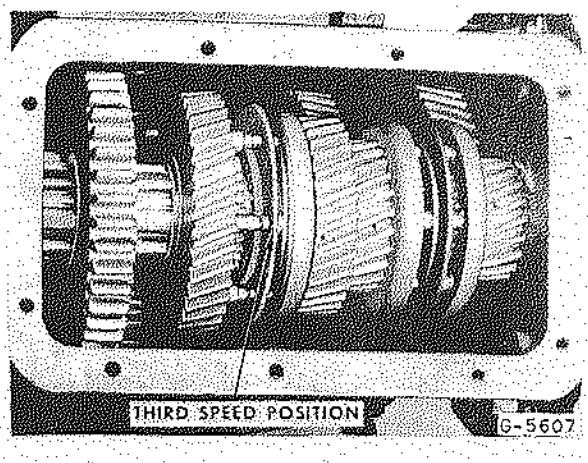


Fig. 7 - Synchronizer Positions With Transmission in Third Gear

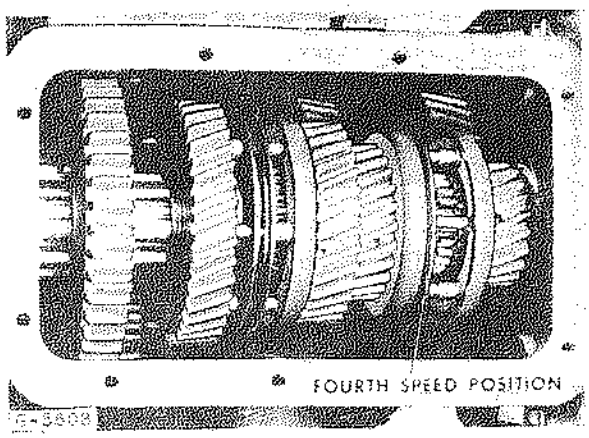


Fig. 8 - Synchronizer Positions With Transmission in Fourth Gear

Torque delivery in the fourth speed forward is similar to the second and third speed except that the rear synchronizer is in a neutral position while the sliding clutch (37) of the front (4th and 5th speed) synchronizer is moved toward the rear of the mainshaft (Fig. 8). The inner stop ring (37, Fig. 1) moved against the outer stop ring (36) which is constantly meshed with the fourth speed gear (35). The pressure of the inner stop ring against the outer stop ring corrects the speed of the fourth speed gear with the speed of the sliding clutch. The sliding clutch which is constantly meshed with the mainshaft through the clutch gear (38) is then engaged with the fourth speed gear by the shift fork (14). The torque is then delivered through the synchronizer and on out the mainshaft.

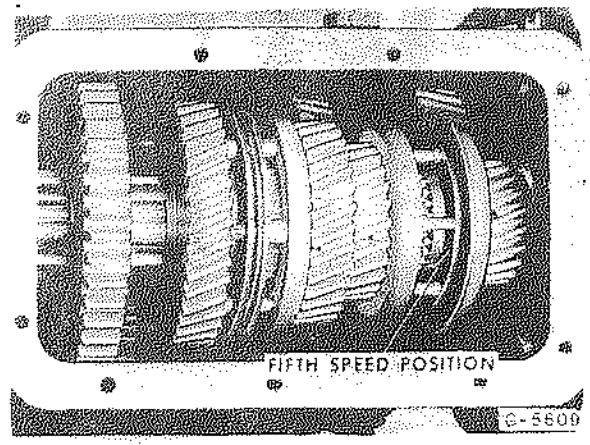


Fig. 9 - Synchronizer Positions With Transmission in Fifth Gear.

When the control lever is moved from fourth to fifth gear the shift fork (14, Fig. 1) moves the sliding clutch (37) forward and against the three pins of the inner stop ring (37). The inner stop ring then presses against the outer stop ring (36) and begins to equalize the speed of the main drive gear (56) with that of the sliding clutch. As soon as the speed is equalized the shift fork completes engagement of the sliding clutch with the main drive gear (Fig. 9). Since the sliding clutch is constantly meshed with the clutch gear (38), which is splined to the mainshaft, the torque is carried by the synchronizer to the mainshaft. The countershaft (48) has no function in delivering torque when the transmission is in fifth gear. It is carried through the transmission by the mainshaft itself; hence the fifth speed forward is direct.

DISASSEMBLY

CONTROL LEVER AND SHIFT BAR HOUSING

Place control lever in neutral position. Remove nine bolts and lockwashers from shift bar housing and lift housing and gasket from top of transmission case, (Fig. 10).

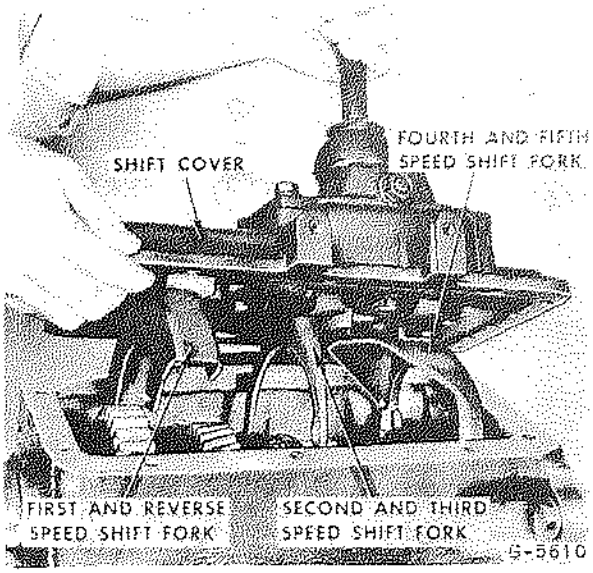


Fig. 10 - Removing Shift Bar Housing

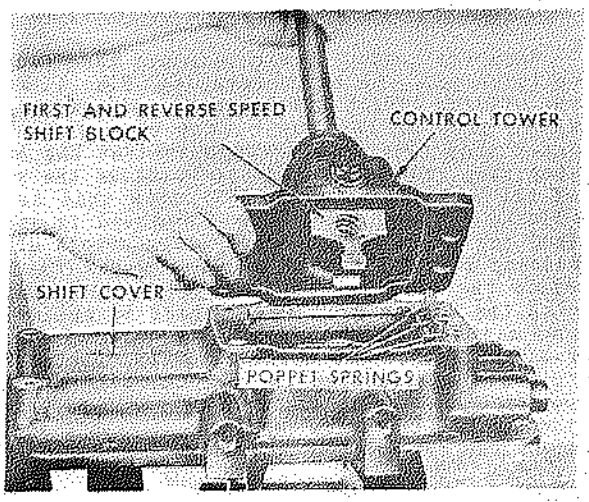


Fig. 11 - Removing Control Lever Housing

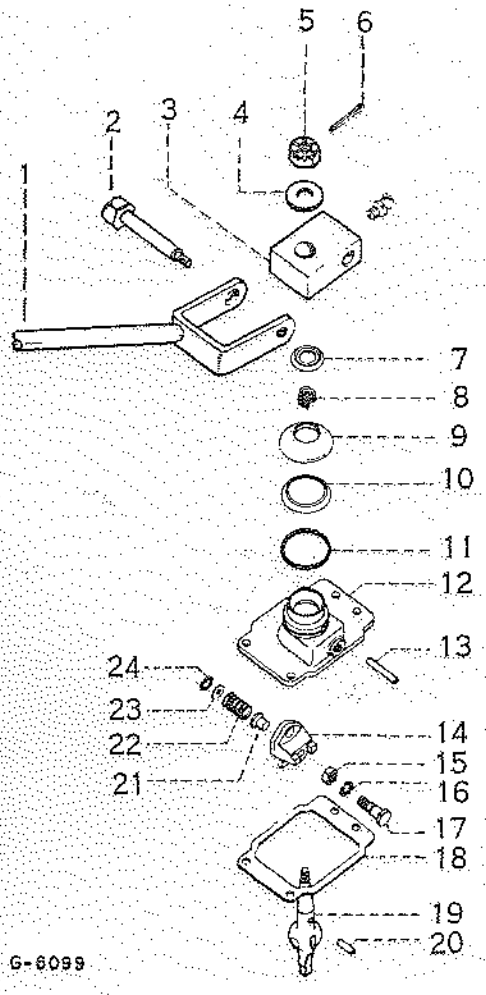


Fig. 12 - Control Lever Housing Assembly (Exploded View)

LEGEND (FIG. 12)

1. ROD, ASSY., TRANSMISSION CONTROL
2. BOLT, SPECIAL
3. BLOCK, SHIFT LEVER
4. WASHER, FLAT
5. NUT, HEX.
6. PIN, COTTER
7. RETAINER, CONTROL LEVER SPRING
8. SPRING, CONTROL LEVER
9. COVER, DUST, CONTROL LEVER
10. WASHER, FELT, CONTROL LEVER
11. RING, SNAP, PIVOT PIN
12. HOUSING, CONTROL LEVER
13. PIN, CONTROL LEVER PIVOT
14. LEVER, SHIFT
15. NUT, HEX. JAM.
16. WASHER, LOCK
17. BOLT, SHIFT FINGER
18. GASKET, CONTROL LEVER HOUSING
19. LEVER, CONTROL
20. PIN, CONTROL LEVER SPRING RETAINER
21. PLUNGER, REVERSE STOP
22. SPRING, PLUNGER
23. WASHER, RETAINER
24. RING, RETAINER

Remove transmission control rod assembly (1) from control lever (19).

Take out four bolts securing control lever housing to shift bar housing and lift off control lever housing (12).

Place control lever housing in vice and remove control lever retainer pin (20). Remove retainer (7) spring (8), dust cover (9), felt washer (10) and snap ring (11). Take out pivot pin (13) and control lever (20).

Remove shift finger bolt (17) from control lever housing. Take retainer ring (24), washer (23), spring (22) and plunger (21) out of shift lever (14).

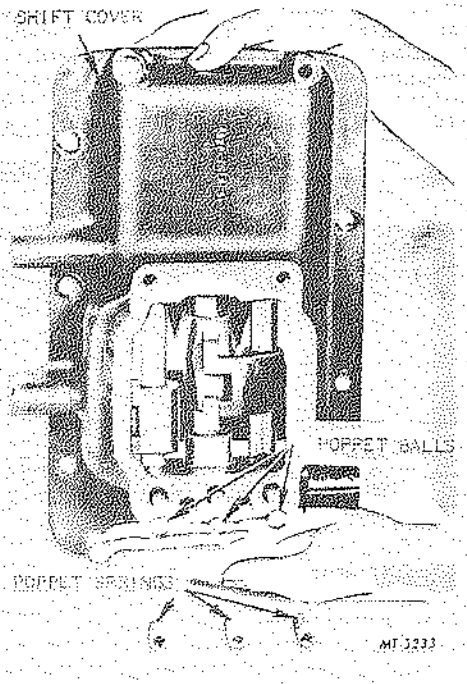


Fig. 13 - Removing Poppet Springs and Balls

Key numbers used from this point on refer to Fig. 1.

Remove poppet springs (4) and poppet balls (8) from shift bar housing (1). See Fig. 13. NOTE: The short poppet spring is for the first and reverse speed shift rail. Remove lock screws (12) from first and reverse speed shift block (11) and shift forks (14, 15 and 16). Drive fourth and fifth speed shift rail out toward the front of the shift bar housing, driving out shift rail thimble (7), and remove shift fork (14).

Remove interlock ball and cross pin retainer thimble (2) located on the left outside of the housing just below the poppet ball and spring housing, releasing interlock ball (8) and pin (9). Remove first and reverse speed and second and third speed shift forks (15 and 16) and shift rails (5 and 10). CAUTION: In reassembling controls, be certain to replace all parts in their respective positions.

MAIN DRIVE GEAR AND MAINSHAFT REMOVAL

Lock the transmission by placing it in two gears and remove flange nut, washer and flange. Remove parking brake drum and band.

Remove six bolts and lockwashers from mainshaft rear bearing retainer (69). Lift retainer and gasket (72) from case (64). Slide mainshaft slinger (18), spacer/gear (19) and washer (20) from mainshaft (17). See Fig. 14. NOTE: Remove countershaft rear bearing nut (50) while transmission is locked.

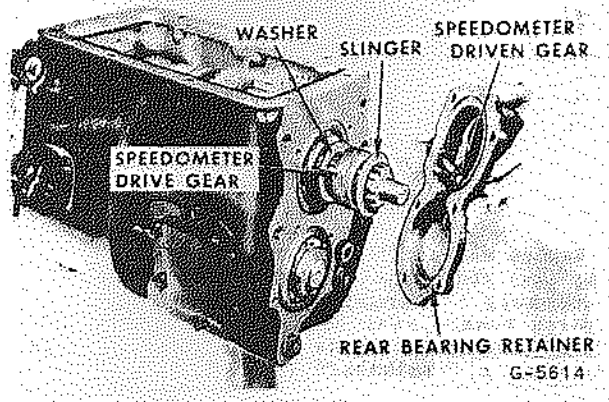


Fig. 14 - Removing Mainshaft Rear Bearing Retainer

Drive mainshaft assembly toward rear of case sufficiently to expose mainshaft rear bearing (21) and snap ring. Install a suitable bearing puller and pull bearing (21) from mainshaft (17) as shown in Fig. 15.

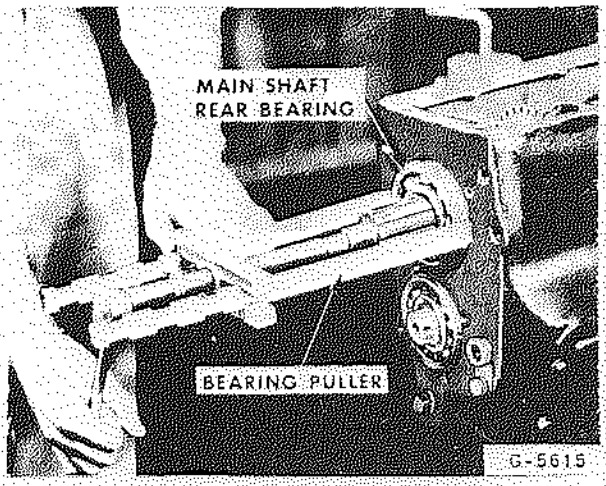


Fig. 15 - Removing Mainshaft Rear Bearing

Remove six bolts from main drive gear bearing retainer (61) and remove retainer and gasket (60) as shown in Fig. 16.

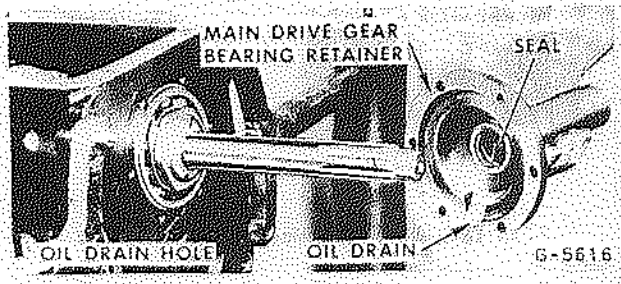


Fig. 16 - Removing Main Drive Gear Bearing Retainer

Lift main drive gear (56) and bearing (57) also mainshaft pilot bearing (13) out through front of case (Fig. 17).

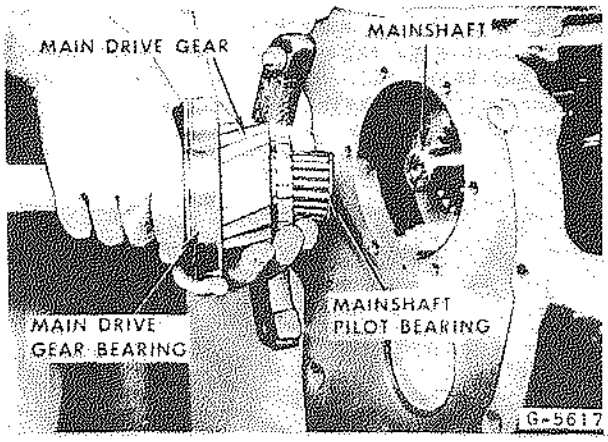


Fig. 17 - Removing Main Drive Gear

Lift mainshaft (17) and gears out through top of case (64), tilting the front end upward and leaving the first and reverse speed gear (22) in the case (Fig. 18).

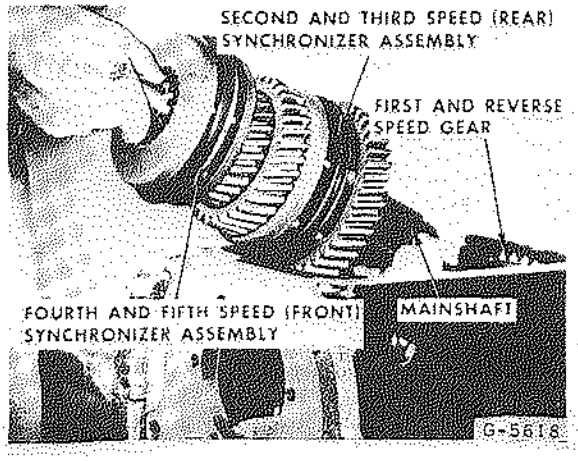


Fig. 18 - Removing Mainshaft Assembly

With the mainshaft assembly removed, lift the first and reverse speed gear out of the case. NOTE: During reassembly, "R" stamped on gear should face rear of case.

Slide front (4th and 5th speed) synchronizer assembly off mainshaft (17) as shown in Fig.19.

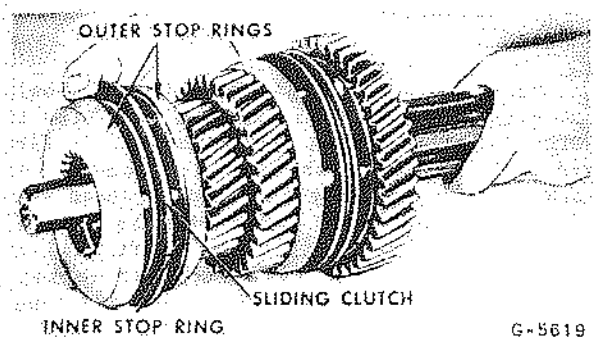


Fig. 19 - Removing Front Synchronizer Assembly

Remove retainer ring (39) and mainshaft clutch gear (38). NOTE: When reassembling mainshaft clutch gear (38), place oil grooves toward rear of mainshaft, or next fourth speed gear (35). Slide fourth speed gear off mainshaft (Fig. 20).

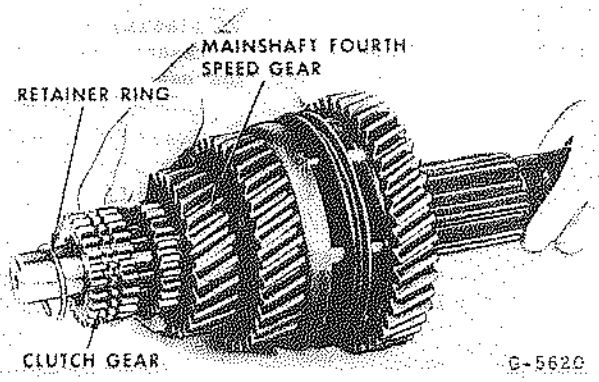


Fig. 20 - Removing Mainshaft Fourth Speed Gear

Remove mainshaft third speed gear retainer ring (34) and thrust washer (33). NOTE: During reassembly of thrust washer (33), place oil grooves toward rear of mainshaft, or next to third speed gear. Slide mainshaft third speed gear (32) off mainshaft (Fig. 21)

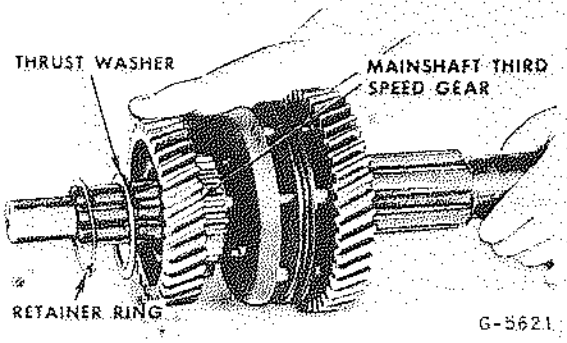


Fig. 21 - Removing Mainshaft Third Speed Gear

Remove rear (2nd and 3rd speed) synchronizer assembly (Fig. 22).

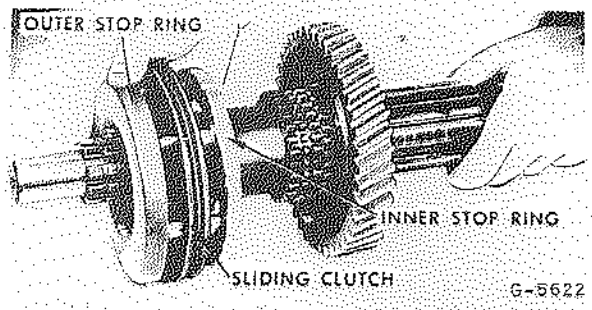


Fig. 22 - Removing Rear Synchronizer Assembly

Remove mainshaft second speed retainer ring (23) and thrust washer (24) by sliding them off the rear of the mainshaft. NOTE: When reassembling thrust washer (24), place oil grooves next to second speed gear (25). Slide mainshaft second speed gear (25) off rear of mainshaft (Fig. 23).

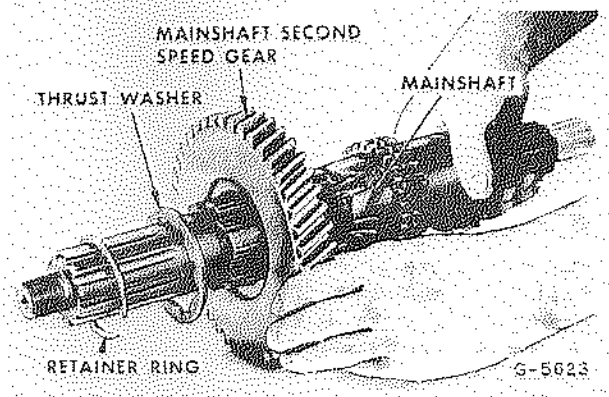


Fig. 23 - Removing Mainshaft Second Speed Gear

COUNTERSHAFT AND REVERSE IDLER GEAR REMOVAL

Remove the bolt and lockwasher from the reverse idler shaft lock plate (54) and remove lock plate from slot in reverse idler shaft (55). Pull reverse idler shaft out of case using SE-1879 Puller Set (Fig. 24).

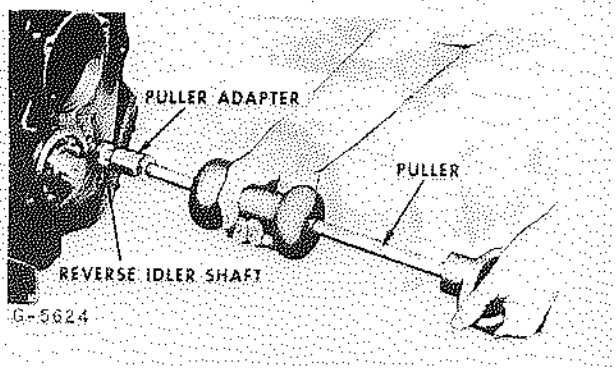


Fig. 24 - Removing Reverse Idler Shaft

Lift out reverse idler gear (52), bearings (51) and thrust washers (not shown in Fig. 1). See Fig. 25.

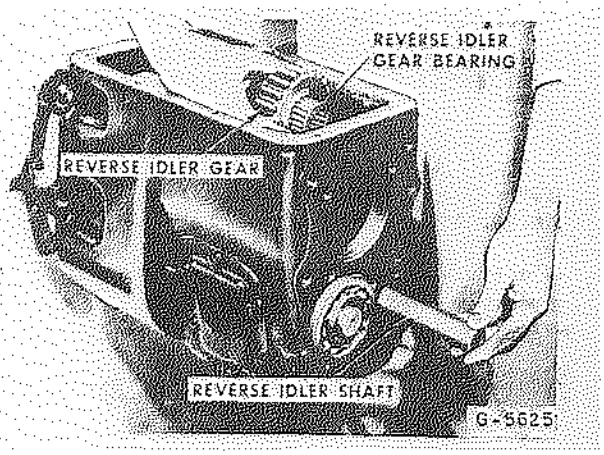


Fig. 25 - Lifting Out Reverse Idler Gear and Bearings

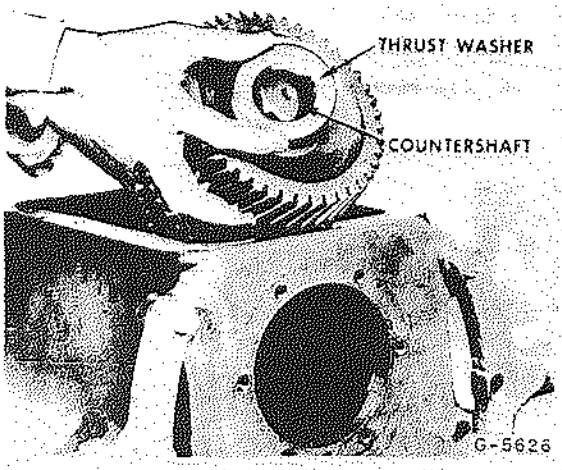


Fig. 26 - Removing Countershaft and Thrust Washer

Drive countershaft assembly toward rear of case (64) sufficiently to expose rear bearing snap ring. Attach a suitable puller and remove rear bearing (49) from countershaft (48). Lift countershaft assembly out through top of case, lifting front end upward and tilting the assembly. Also remove front bearing thrust washer (41). See Fig. 26.

The countershaft front roller bearing (40) is disassembled by removing the countershaft expansion plug snap ring (62) and driving the expansion plug (63) from the case.

Drive countershaft front roller bearing (40) from case (64) with a brass drift.

COUNTERSHAFT DISASSEMBLY

Remove snap ring (42) from countershaft (48). Using adapter plates, press countershaft drive gear (43), spacer (44), fourth speed gear (45) and third speed gear (46) from countershaft (48). Remove Woodruff keys (47) from countershaft. NOTE: In reassembling, new snap rings should be used throughout the unit.

CLEANING, INSPECTION AND REPAIR

After disassembly, clean all parts thoroughly with a cleaning solvent. The transmission case should be washed before reassembly. Replace all oil seals and gaskets.

Bearings should be washed in a pressure bearing washer. Be certain that all ball bearings are a press fit on the shafts and that the outer races of these bearings fit tightly in their bores. Check all bearings for defects and replace if necessary. Examine teeth on all gears carefully. Cracked or chipped teeth, or spots where case hardening is worn through renders gears unfit for further use. Inspect splines on mainshaft and main drive gear for evidence of wear. Check first and reverse gear to see that it slides smoothly on the mainshaft. Inspect mainshaft thrust washers and if worn to permit excessive end play, replace them. Check reverse idler shaft and roller bearings; replace if worn.

REASSEMBLY

Reassembly is essentially the reverse of DISASSEMBLY.

NOTE: "The four hole plugs indicated in Fig. 3 are for plugging purposes only. If removed they should be coated with a suitable sealer and screwed in flush, then secured by staking".

LUBRICATION

All roller bearings should be dipped in transmission lubricant before reassembling.

For initial filling, fill transmission with proper lubricant until it runs out filler hole then replace plug. Refer to Section B for correct Lubricant viscosity and type.

At each chassis lubrication or 1,000 mile interval, inspect transmission for oil level. Fill as necessary. Drain and flush every 10,000 miles or twice each year, preferably in the spring and autumn.

Lubricant capacity is to 10 imp. pints.

TORQUE CHART (ft. lbs.) *

I.H. MODEL	T-35
Drive Gear Bearing Retainer to Case	3/8-16 30-40
Control Lever Housing To Shift Cover	7/16-14 50-70
Cover to Case	3/8-16 30-40
Mainshaft Rear Bearing Retainer to Case	3/8-16 30-40
Countershaft Lock Bolt to Case	3/8-16 30-40
P.T.O. or P.T.O. Cover to Case	3/8-16 30-40
Companion Flange to Mainshaft	7/8-16 190-210

* For determining the correct torque, be certain that screw threads are cleaned and lubricated before taking torque wrench readings.

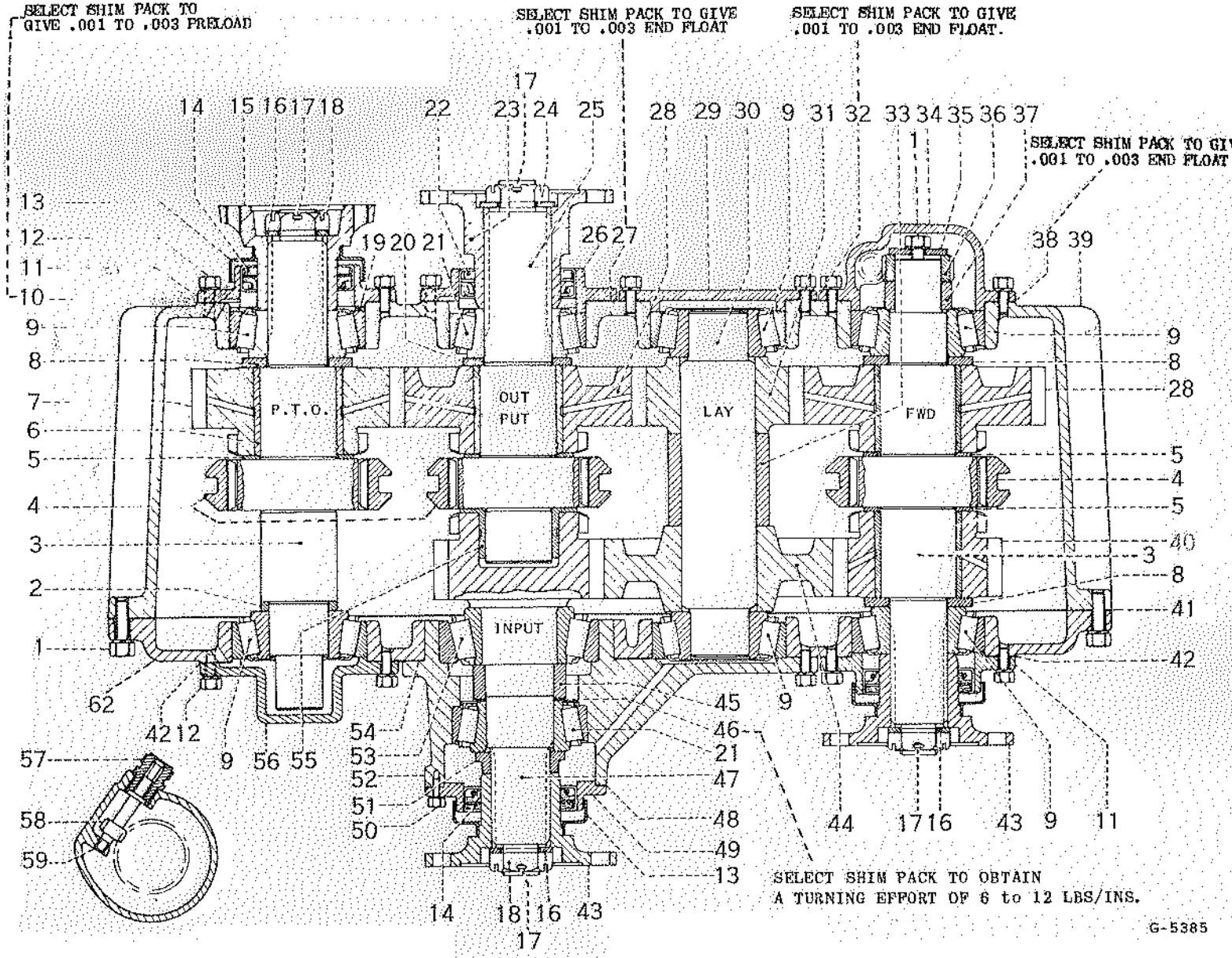


Fig. 1 - Transfer Case Assembly

LEGEND TO FIG. 1

TRANSFER CASE

1 BOLT, hex-hd., 3/8 UNF x 1-1/4
WASHER, lock, 3/8 med.

2 SPACER
3 SHAFT, F.W.D. and P.T.O.
4 SLEEVE, sliding
5 WASHER
6 BUSH, gear
7 GEAR, P.T.O. shaft, w/BUSH
8 SPACER

9 CONE, bearing, asm. (TIMKEN 527)
CUP, bearing (TIMKEN 522)

10 SHIM, set, P.T.O. shaft
11 COVER, P.T.O. and F.W.D. shaft

12 BOLT, hex-hd., 5/16 UNF x 1
WASHER, lock, 5/16 med.

13. SLINGER, mud
14 SEAL, oil, 2-3/8 x 3-3/8 x 3/4 (FLASEAL)
15 FLANGE, coupling, 1-3/4" shaft
16 WASHER, retaining
17 PIN, cotter, 1/8 x 1-3/4
18 NUT, hex., slotted
19 RING, spacing, P.T.O. shaft
20 SPACER

21 CONE, bearing, asm. (TIMKEN 529X)
CUP, bearing (TIMKEN 522)

22 SEAL, oil, 2-9/16 x 3-1/2 x 3/4 (FLASEAL)
23 FLANGE, coupling, 2" SHAFT
24 WASHER, retaining
25 SHAFT, output
26 COVER, output shaft
27 SHIM, set, output shaft
28 GEAR, output and F.W.D. asm.
29 COVER, lay shaft
30 LAY SHAFT
31 GEAR, layshaft
32 SHIM, set, lay shaft
33 SPACER, lay shaft
34 HOUSING, speedo gear
35 WASHER, retaining
36 GEAR, speedo drive
37 SPACER, F.W.D. shaft
38 SHIM, set, F.W.D. shaft
39 CASE, transfer, machining, asm.
40 GEAR, F.W.D. shaft, asm.
41 GASKET, cover to transfer case
42 GASKET, cover, P.T.O. and F.W.D. shaft
43 FLANGE, coupling, 1-3/4" shaft
44 GEAR, layshaft
45 SPACER, bearing
46 SHIM, set, input shaft
47 SHAFT, input
48 GASKET, cover, input shaft
49 COVER, input shaft

50 BOLT, hex-hd., 1/4 UNF x 3/4
WASHER, lock, 1/4

51 SPACER, companion flange
52 HOUSING, bearing input shaft

53 CONE, bearing, asm. (TIMKEN 623)
CUP, bearing (TIMKEN 612)

54 GASKET, input shaft bearing housing
55 BUSH, spigot bearing

56 COVER, P.T.O. shaft

57 SLEEVE, pinion, speedometer

58 GEAR, driven, speedometer, asm.
59 BUSHING, speedo driven gear

.. BREATHER
... PLUG, sq-hd., 3/4 dry seal
62 MAIN COVER

TRANSFER CASE

The transfer case has been designed to provide driving power to the front and rear axles at suitable ratios to cope with a great variation of operating conditions, from high speed road transport to cross country treking through sand, mud, boulders, river fords and steep gradients.

Ratios are as follows:-

Rear Wheel Drive (RWD) (or four wheel drive)	High Ratio	1.0 : 1
Power Take-Off (PTO)		2.0 : 1
Four Wheel Drive	Low Ratio	2.5 : 1

In conjunction with the normal transmission therefore it is possible to operate in a ratio as low as 128.5 : 1 in forward four wheel drive and down to 125.7 : 1 in reverse drive.

Alternative drives are provided as follows:

High Ratio	Rear Wheel Drive
High Ratio	Four Wheel Drive
Low Ratio	Four Wheel Drive
Power Take-Off	

SPEEDOMETER DRIVE

The speedometer drive gear is attached to the rear end of the front wheel drive shaft which turns at the same speed as the RWD shaft and through the layshaft, is in constant mesh with it.

ASSEMBLY

Step by step assembly of the transfer case is clearly outlined in this chapter, from which the sequence of disassembly can be readily determined.

NOTE: When bearings are found fit for further service, they should be assembled with half the original preload torque loading specified.

Where the original preload is specified in terms of decimals, by means of shims old bearings must be reassembled with the original thickness of shims.

Where preload is specified by housing deflection as in differential bearings, old bearings should be reassembled with no deflection i.e. Free running without clearance.

A - Input Shaft and Housing (Bench Work) (Refer to Fig. 1)

1. Press the bearing cups into housing (52) hard up to the shoulders of the housing.
2. Press the inner bearing cone onto the shaft (47).
3. Assemble the bearing spacer (45) and suitable shim stack (46) over the shaft, and press on the outer bearing cone (21).
4. Assemble the spacer (51) and companion flange (43), washer (16) and nut (18) and tighten this nut to the recommended torque loading of 200-250 lbs. ft.
5. Hold the housing (52) in a vice and check the preload on the bearings as shown in fig. 2 on page 4. (This check must be carried out with seals omitted).

   The correct preload should give a reading of 2-1/2 to 4-3/4 lbs. on the scale, which is equivalent to a turning torque of 6 to 12" ins/lbs.

   If the reading on the scale is not within these limits, add or remove shims from the stack (46) until the correct loading is obtained.
6. Press the combination seal assembly (14) into the input cover (49), until it is flush with the outer edge.

NOTE: Leather seals should be soaked in engine oil for a minimum of 12 hours prior to use.

7. Assemble the cover on the housing with gasket (48).
8. Assemble the companion flange (43) washer (16) and nut (18) and tighten the nut to the recommended torque loading of 200-250 ft. lbs., finally securing the nut with a cotter pin (17).

B - Front Wheel Drive (FWD) Shaft (Bench Work)

1. Place one of the two thin spacer washers (5) over the splined end of the shaft (3) followed by the smaller of the two gear wheels (40) engagement dogs first, nearest to washer. The washer can be used either way round.
2. Assemble one of the thick thrust washers (8) (either way round).
3. Press on the bearing cone (9).
4. Assemble the clutch ring (4) on the shaft (either way round).

5. Repeat 1, 2, 3, on the plain end of the shaft using the larger of the two gear wheels (28) the engagement dogs toward the clutch ring.

6. Assemble the speedometer driving gear spacer (37) and press on the gear (36) locking it to the shaft with the larger washer (35), screw (1) and spring washer.

C - P.T.O. Shaft (Bench Work)

1. Assemble the smallest diameter spacer (2) of the plain end of the shaft (3) and press on the bearing cone (9).

2. Place the thin thrust washer (5) over the splined end of the shaft followed by the gear wheel and bush assembly (7) with the engagement dogs toward the mating dog teeth on the shaft.

3. Assemble the thick thrust washer (3) and press on the bearing cone (9).

D - Layshaft (Bench Work)

1. Press the bearing cone (9), onto one end of the layshaft (30).

2. Assemble the small gear wheel (31), spacer (33), and large gear wheel (44) on the shaft (the gears can be placed either way round on the shaft) and when they are in place, the shaft and gear assembly will not assemble the wrong way round.

3. Press on the other bearing cone (9).

4. Ensure that the spacer has no end float between the gears.

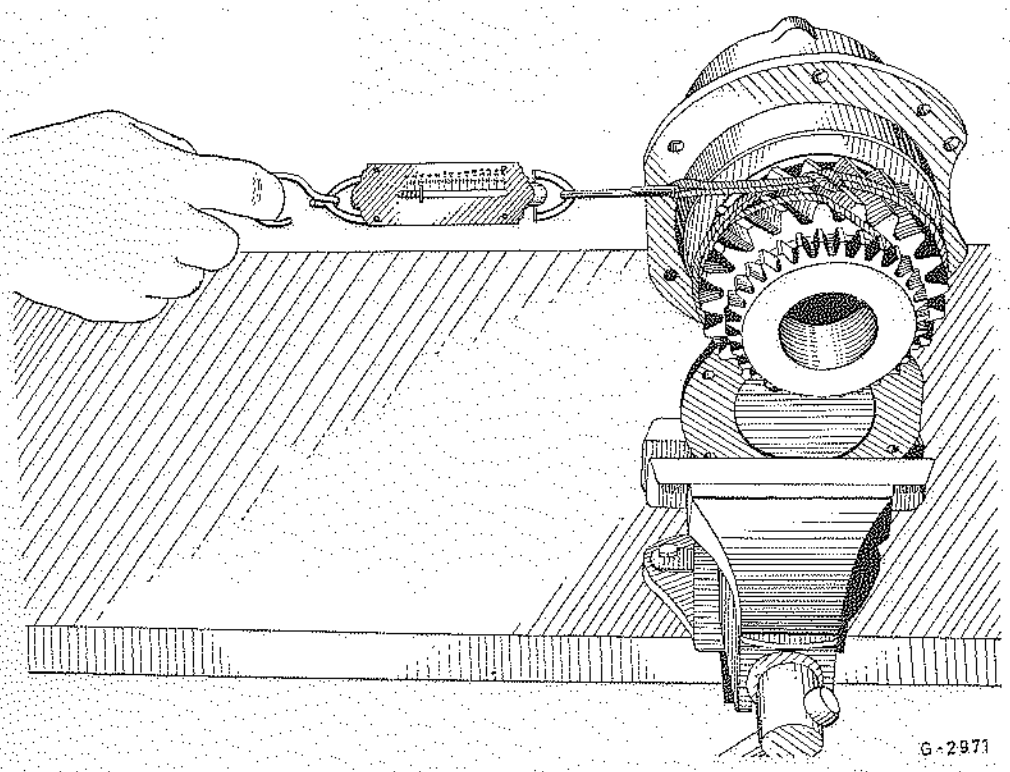


Fig. 2 - Checking input shaft adjustment

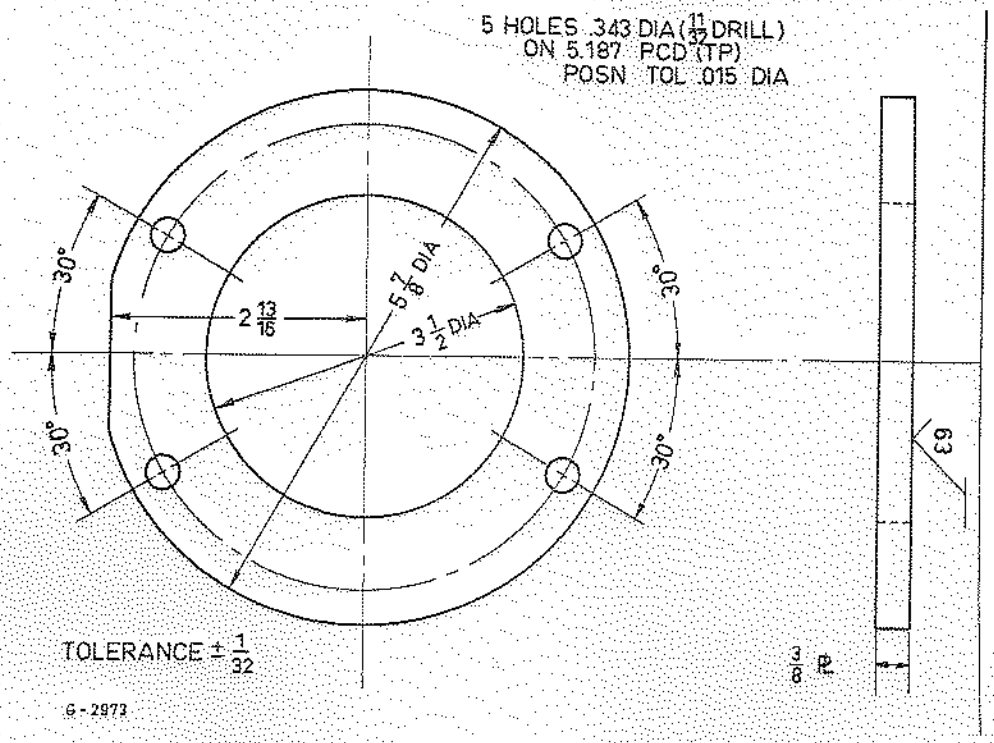


Fig. 4 - Special plate layshaft assembly

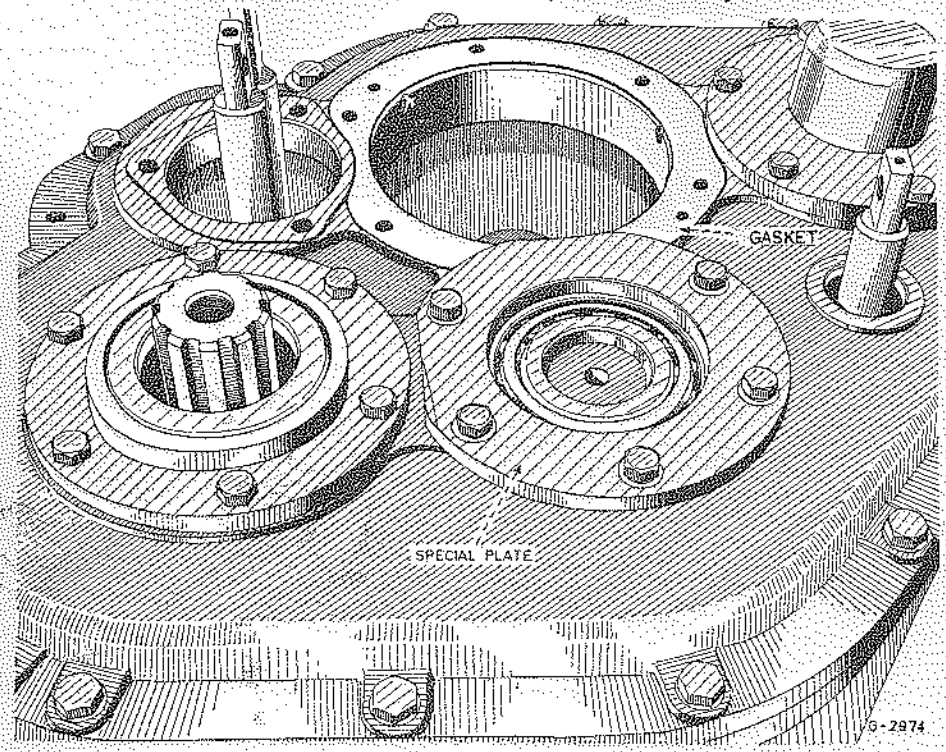


Fig. 5 - Special plate in place over layshaft

E - Output Shaft (Bench Work)

1. Assemble the thin thrust washer (5) on the splined end of the shaft (25).

2. Assemble the large gear (28) and bush assembly with the dog teeth toward the mating dog teeth on the shaft.

3. Assemble the thick thrust washer (20) and press on the bearing cone (21).

F - Assembly and Adjustment of Shafts

1. Bolt the P.T.O. and F.W.D. covers 56 and 11 on the main cover (62), using gaskets 41 and 42 respectively.

2. Bolt the special plate (Figs. 4 and 5) over the layshaft opening at the front of the main case (39). With gasket in position as shown in Fig. 5, page 5.

3. Press the bearing cups into the main cover from the inside ensuring that they seat hard against the shoulders.

4. Press the bearing cups into the main case until they are approximately 1/8 inch below the machined face.

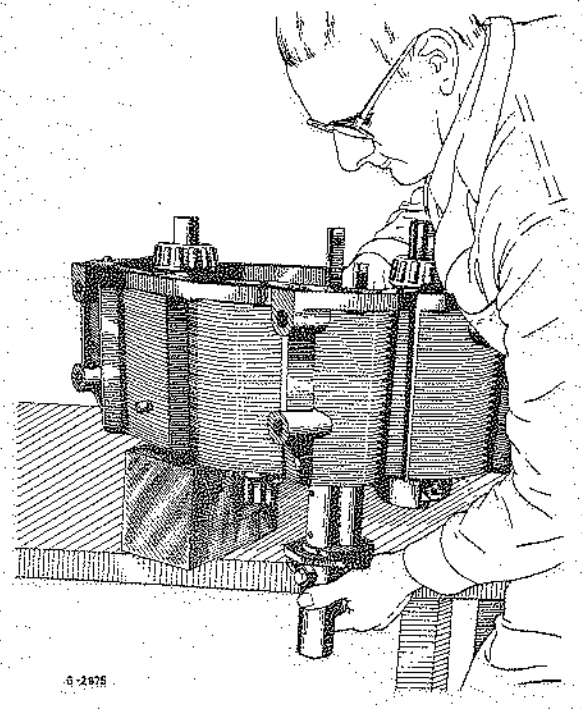


Fig. 6 - Assembling shift rod assembly into case

G - Adjustment of the Layshaft

To adjust the layshaft it is necessary to install the shaft in the case and bolt the cover on. No other shafts should be installed at this stage.

1. Have the case mounted in a suitable fixture with the rear downwards as in Fig. 6.

2. Place the layshaft assembly in the case with the larger gear uppermost.

3. Bolt on the cover with gasket using 8 or 9 bolts spaced around the layshaft, being sure that the cover dowels are in place ("A" Fig. 7). These are pressed into the case and are a clearance fit in the cover.

4. Place the rear layshaft cover (29) in position and draw up the bolts evenly until the gear drags slightly when turned by hand. Now measure the gap between the cover face and the case.

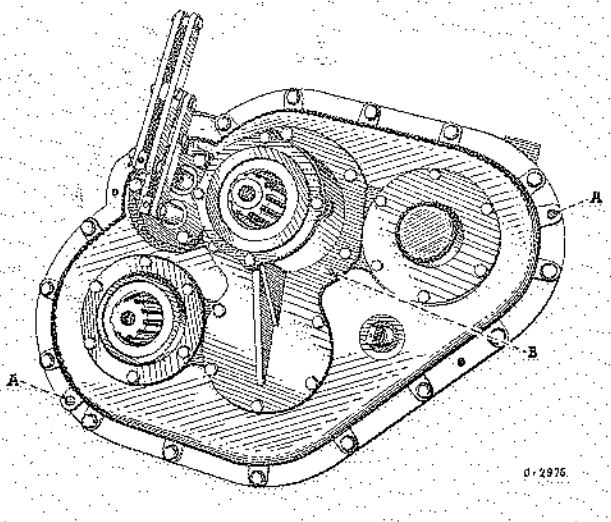


Fig. 7 - View from input side of transfer case

5. Remove the cover and replace it with sufficient shims to take up the gap measured in paragraph 4 and tighten the bolts (Fig. 14).

6. Rap the front end of the shaft to seat the cup. The gear should still drag slightly, if not, readjust.

7. When rapping the shaft, ensure that the sleeve has no end float otherwise a false reading will be obtained.

8. Add .001 to .003 of shims and replace the shims and cover and again seat the cup by rapping.

H - Adjusting the F.W.D. Shaft

Use the same method as in "G".

J - Adjusting the P.T.O. Shaft

Use the same method as in "G" except that a puller should be used on the splined end to seat the bearing instead of tapping the shaft and instead of adding .001 to .003 shim thickness, this amount should be removed to obtain a preload on the bearings.

K - Adjusting the Output Shaft

Use the same method as "J" except that .001 to .003 should be added to the shim stack (10), to provide end float.

The special plate should be removed from the housing and the input housing assembly bolted to the cover. (When removing the input housing use the two extractor holes one of which is visible at "B" in Fig. 7.)
NOTE: Before carrying out this adjustment ensure that the spigot bush (55) is in place.

L - To Assemble the Selector Mechanism (Bench Work) (Refer to Fig. 8)

1. Hold the shift rod housing (1) in a vice and slide in the F.W.D. shift rod (2) until the central locating groove can be seen through the side of the housing.

2. Drop in the three interlock plungers (3) through the holes in the housing (4) using the special tool (Figs. 9 and 10).

3. Insert the R.W.D. shift rod (5) until the locating groove closest to the centre can be seen through the housing.

4. Screw in the stop screw (6). Check to ensure that the rods are free and operating correctly in the housing. When assembly is correct the following conditions will exist:

A. With the R.W.D. shift rod in the central position the F.W.D. shift rod will be locked.

B. The R.W.D. shift rod will slide freely to the right (Fig. 8) and this movement will release the F.W.D. rod, which will then slide freely to the right and lock the R.W.D.

C. Starting from the neutral position again, movements to the left will be similar to the right hand movements.

If the movement of the shift rods is not free examine moving parts for burrs or foreign matter. Burrs should be removed with a fine stone. The travel of the rods is approximately 3/4 inch each way from the central position. The purpose of the interlocks is to ensure that:

A. Low ratio F.W.D. cannot be engaged with high ratio R.W.D. and vice versa.

B. F.W.D. cannot be engaged without first engaging R.W.D.

The large spring (7) at the end of the R.W.D. rod prevents low ratio R.W.D. being engaged without F.W.D. since it tends to neutralise the R.W.D. until the low F.W.D. is engaged (which would of course lock the R.W.D.).

The spring and plunger assembly ("B" Fig. 13) controlled by the Bowden cable, prevents high ratio F.W.D. being accidently engaged. Engagement can only occur when the plunger is lifted clear of the slot in the F.W.D. shift rod.

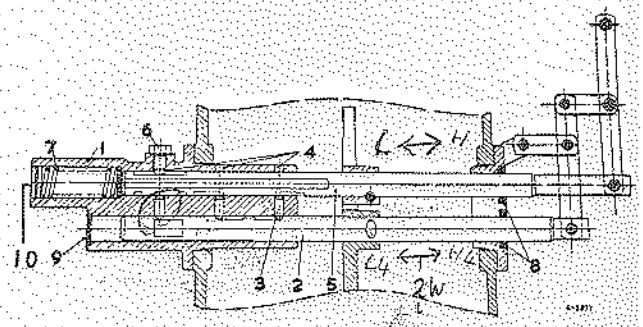


Fig. 8 - Shift rod housing assembly

LEGEND

1. Shift rod housing
2. Shift rod front wheel drive
3. Plunger interlocking
4. Assembly holes
5. Shift rod rear wheel drive
6. Stop screw
7. Spring and shift rod
8. Seals and guide
9. Welch plug
10. Welch plug

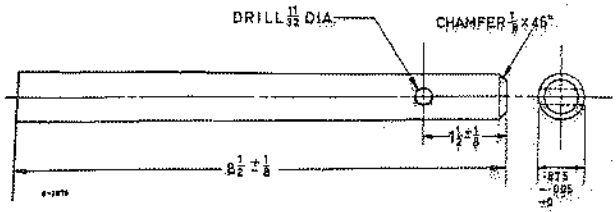


Fig. 9 - Tool special interlock plunger assembly

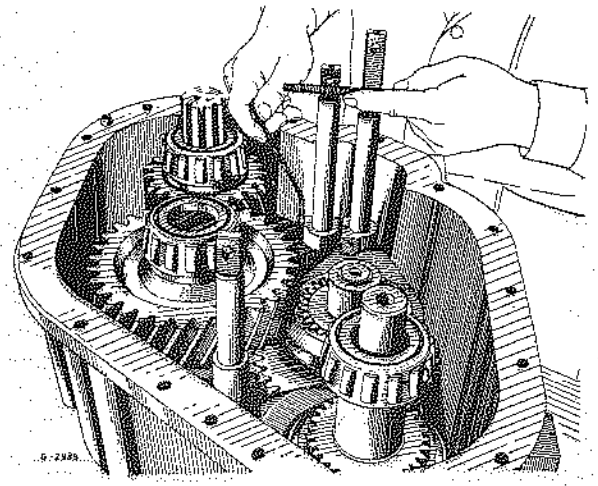


Fig. 11 - Checking shift rod with a straightedge and locking the shift fork

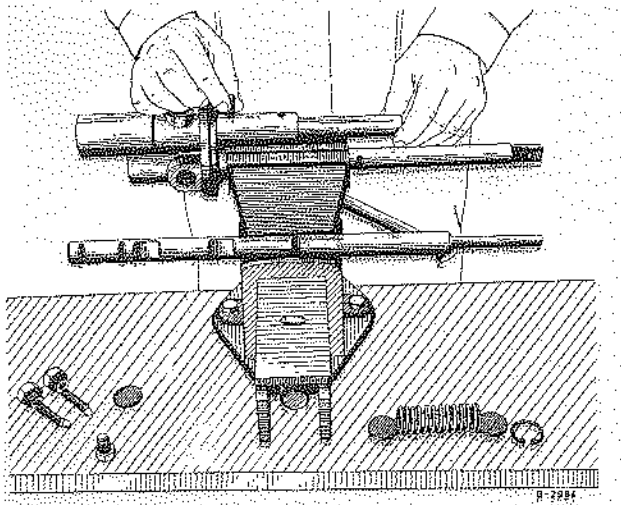


Fig. 10 - Assembling interlock plungers using special tool

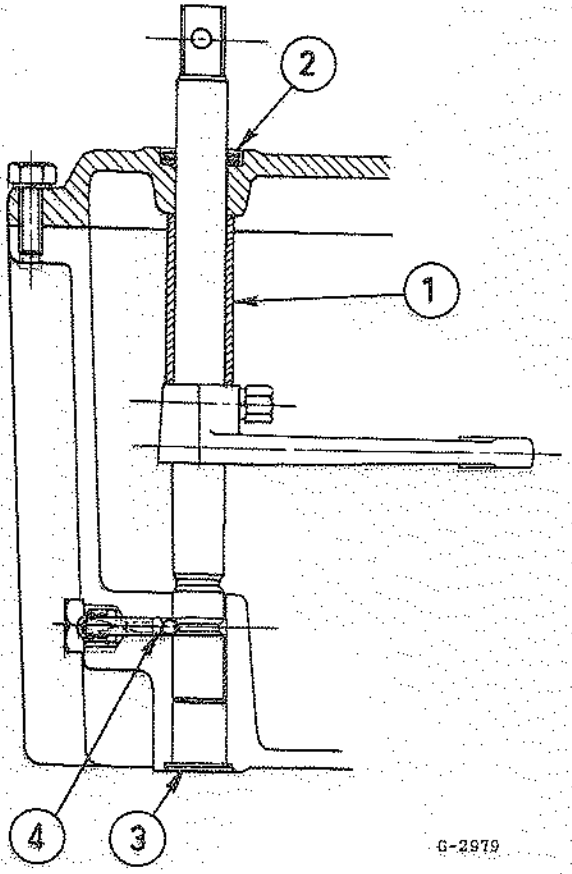


Fig. 12 - Power take-off shift rod assembly

M - To Assemble the Case

1. Assemble the F.W.D. and P.T.O. in the case.

2. Assemble the shift fork on the F.W.D. shaft clutch ring, with the boss towards the small gear. The three shift forks are interchangeable.

3. With the case held with the front end uppermost insert the assembled shift rod housing from the bottom (Fig. 6) inserting the F.W.D. shift rod through the F.W.D. shift fork and bolt to the case with gasket

4. Assemble the output shaft in the case.

5. Assemble the output shaft clutch ring to the shift fork and assemble in the case (boss away from the large gear) by inserting the shift fork over the R.W.D. shift rod and mating the clutch ring to the input gear clutch.

6. With both shift rods moved as far as possible down, insert the shift fork locking bolts and spring washers. Using a straight edge ensure the flats on the shift rods at the top end are in line, and then tighten the shift rod locking bolts (Fig. 11).

7. Assemble the P.T.O. shift rod and fork (boss towards the flats on the rod). Insert the locking bolt and washer and tighten. Assemble the clutch ring to the shift fork and assemble in the case by inserting the shift rod in the case bore and mating the clutch ring with the shaft. Assemble the spacer over the shift rod (1) Fig. 12.

8. Assemble the layshaft in the case.

9. Press the small seals into the case cover and the shift rod guide (8) Fig. 8, and (2) Fig. 12 if replacement is necessary.

10. Assemble the cover and gasket on the case and bolt down

11. Assemble the shift rod guide and gasket over the shift rods and bolt down. Ensure that the shift rods now move freely. If binding is evident, loosen the bolts on both the housing and guide and retighten.

12. Assemble the locating balls, springs, plungers and retaining screws in the case and shift rod housing (4) Fig. 12 in the case, and 2 others in the shift rod housing.

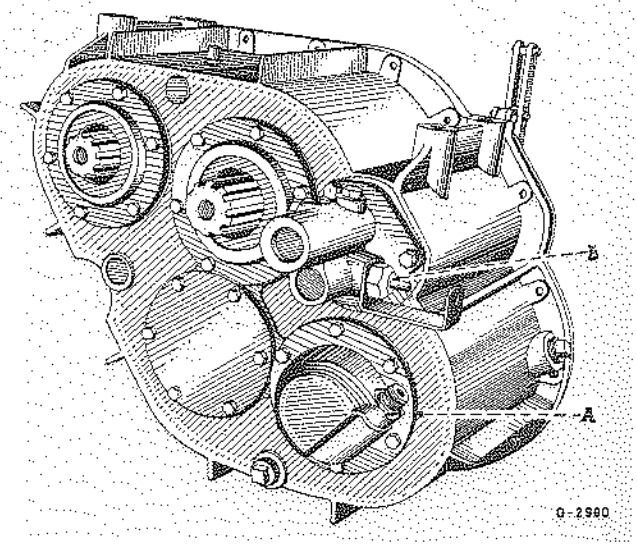


Fig. 13 - Transfer case output side

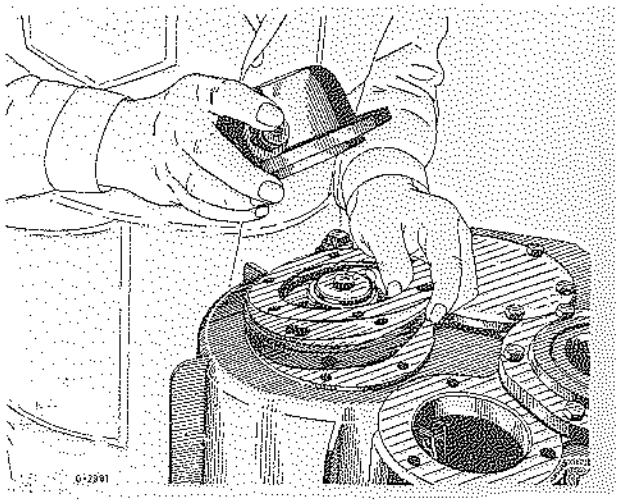


Fig. 14 - Shim stack
front wheel drive shaft

13. Replacement of Oil Seals

There is one combination felt and leather seal assembly to each shaft.

The leather seal retains the oil in the case, and the felt excludes foreign matter.

The seal assemblies must be assembled in their locations with the felt towards the outside.

Press the seals into the covers until they are flush with the outer faces of the covers.

To avoid damage to the seals use a driving tool which will apply pressure to the outer edge of the seal casing.

NOTE: *Seals should be soaked in oil as shown in note on Page 2.*

14. Replace the covers and gaskets and tighten.

15. Assemble the companion flanges (43, 23 and 15) complete with mud slingers (13) onto the shafts. Assemble the washer and nut, and tighten to the recommended torque of 200-250 lbs. ft. secure nuts with cotter pins.

16. Assemble the speedometer driven gear and union (A) Fig. 13. If a new bush is required, it should be pushed in until level with the machined face.

17. Assemble the R.W.D. shift rod spring (7) Fig. 8, in the housing with one of the discs at each end of the spring, compress the spring and assemble the circlip in the groove.

18. Assemble the locking plunger assembly and replace the rivet and cable yoke. Screw the plunger assembly and cable anchor bracket into the shift rod housing (B) Fig. 13. To replace the seal (2), dismantle the assembly by removing the rivet (1) in Fig. 16.

19. Assemble the links and pins on the shift rods (Figs. 7 and 8).

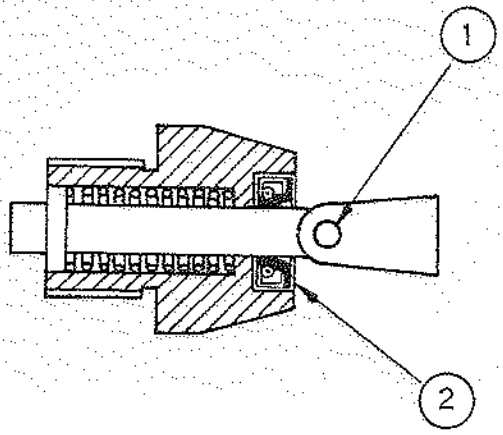
20. If the welch plugs have been removed, press new plugs into place as shown at (9) and (10) in Fig. 8 and at (3) in Fig. 12.

LUBRICATION

Fill case to level plug situated on the right hand side of the case with the assembly in its operating position. The plug is shown in Fig. 13. Use OM-270. Oil capacity is 13-1/2 Imp. Pints. Drain and refill every 5,000 miles. Check oil level every 1,000 miles.

RECOMMENDED TORQUE WRENCH LOADS (FOOT POUNDS)

All 3/8 bolts	24
All 5/16 bolts	16
All 1/4 bolts	8 to 10
Companion Flange Nuts	200-250



G-5480

Fig. 16 Plunger, Locking Assembly

The vehicle is equipped with a special cooling system designed to meet severe operational requirements and incorporates both water and oil cooling.

WATER COOLING

This employes a centrifical pump mounted at the front of the engine block and belt driven from the crankshaft (see section K). Water is drawn from the bottom radiator tank and pumped through the cylinder block and cylinder head, thence via a thermostat to the top radiator tank. The thermostat is situated in the water outlet and is designed to open at 148 degrees F to 153 degrees F. It is fully open at 173 degrees F., thus ensuring a suitable engine operating temperature at all times. A fan mounted on the pump spindle, draws air through the radiator core thus cooling the water and oil.

The water capacity of the system is 36 pints approximately, and a drain cock is provided at the bottom radiator tank and a drain plug in the right hand side of the engine block.

After the filler cap has been removed for filling or topping up the system, it should be replaced securely to ensure a pressure tight seal.

An overflow tube carries away any overflow due to expansion or overfilling, but this must first pass the relief valve incorporated in the filler cap. The relief valve is designed to open at 6-1/4 to 7-1/2 p.s.i. pressure. This causes a pressure to be built up in the system which raises the temperature at which the coolant will boil, and thus enable the engine to operate at high temperatures, before evaporation takes place.

For operation where ambient temperatures may go below 32 degrees F. the use of an anti-freeze solution is essential.

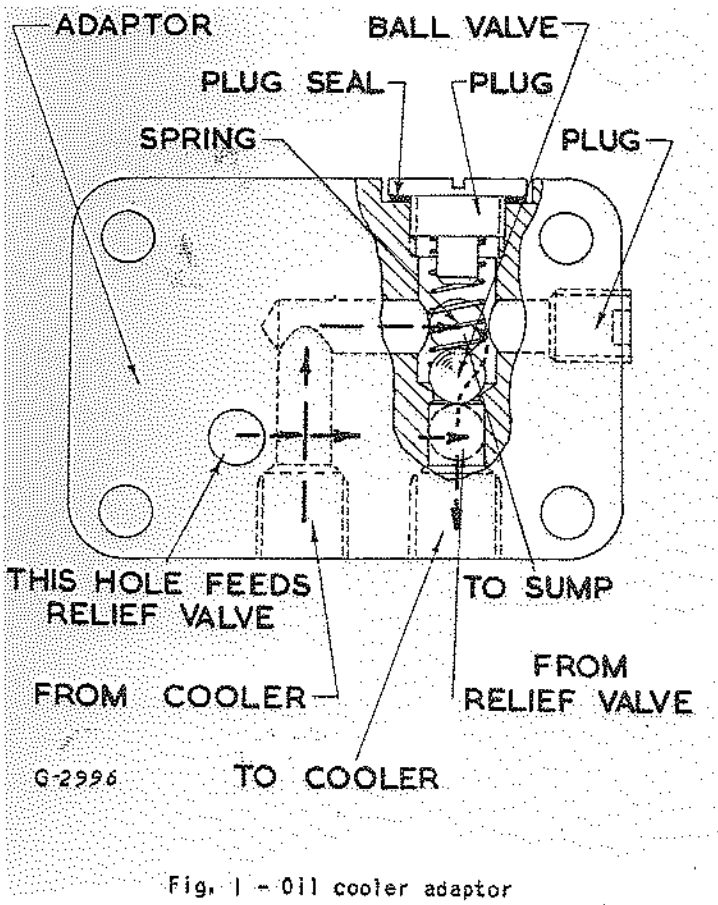


Fig. 1 - Oil cooler adaptor

N

OIL COOLING

An oil cooler is provided to maintain suitable temperatures under the very severe engine conditions that may be encountered in service. This consists of an air-cooled core mounted in the same frame as the water cooling core. To provide a large enough oil flow, a large capacity lubricating oil pump has been installed.

The oil that passes through the cooler comprises all the oil that passes through the relief valve mounted on the outside of the cooler adaptor on the left hand side of the engine. This flow normally passes straight to the sump but on this vehicle the adaptor shown in Fig. 1 is installed between the relief valve and the crankcase. This adaptor collects the flow for transmission to the cooler. The cooler outlet is connected back to the adaptor for return to the crankcase sump.

If the adaptor is removed for any reason, care must be taken to see that it is refitted with the connections downwards and with the word FRONT (stamped on one end) towards the front of the vehicle. Failure to do this will render the relief valve and cooler inoperative.

Incorporated in the adaptor is a spring loaded ball valve leading from the cooler inlet to the sump. The valve opens at 10 p.s.i. and this protects the cooler from any higher pressure should any obstruction develop in the cooler or return pipe. With cold oil the valve opens and by-passes the cooler.

FAN

A five blade fan mounted on the water pump spindle provides sufficient cooling capacity in still air. The fan is driven from a pulley on the engine crankshaft by a V-belt, which also drives the generator. Fan belt adjustment is described in Section K.

REMOVAL OF RADIATOR

Referring to Fig. 2, 2A and 2B proceed as follows:-

(1) Drain the radiator through the drain cock provided in the bottom tank of the radiator core.

(2) Disconnect the radiator hoses and oil cooler pipes. Oil will drain from lower pipe fittings.

(3) Remove the self-locking nut from the underside of the chassis cross member with the washer, insulator and retainer.

(4) Remove four bolts attaching the stabilizer brackets to the cab and swing the brackets inwards.

(5) Lift the radiator, oil cooler and support frame vertically through the top of the compartment, taking care to retain the rubber insulator and retainer.

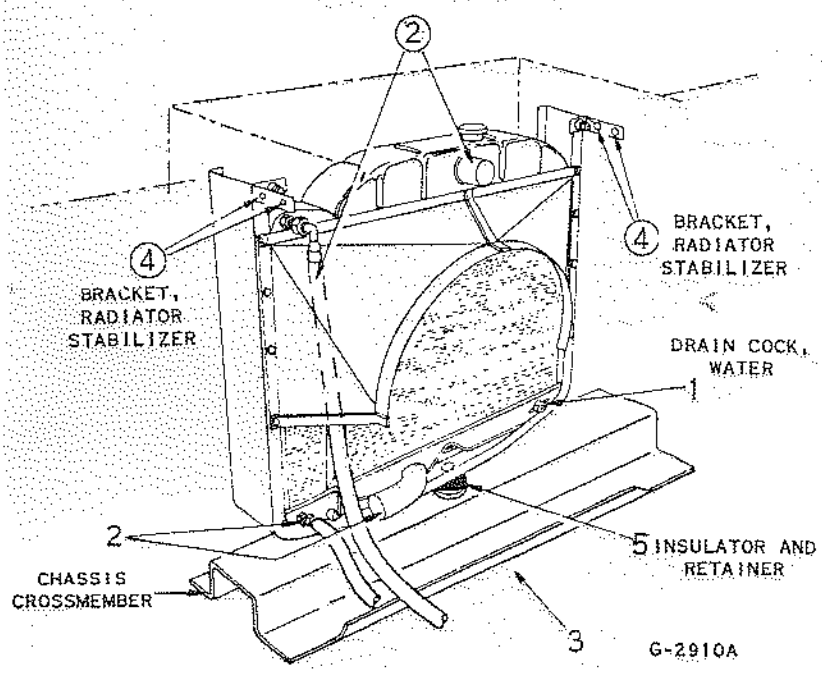


Fig. 2 - Radiator Installation

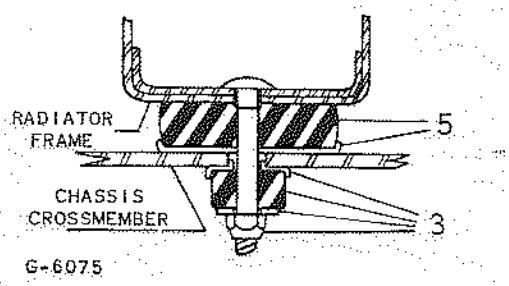


Fig. 2A - Radiator Mounting - Lower

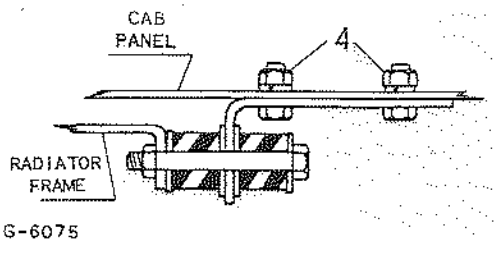


Fig. 2B - Radiator Stabilizer

2-1/2 TON 4x4 G.S. - INTERNATIONAL

FUEL TANKS

Number	2
Capacity, each tank	22 Imp. Gals.
Total range minimum	250 miles

FUEL PUMP

Make	AC (Series FG)
Operating pressure up to 3,500 r.p.m. engine speed (Static at pump level no delivery)	2-3/4 to 4-1/4 p.s.i.

CARBURETTOR

Make	Bendix
Carburettor model	BX
Main venturi	1-9/32"
Main metering jet	.071"
Main discharge nozzle	.1405"-.1065"
High speed bleed	.031"
Power Jet	.067"
Accelerator pump jet	.028"
Accelerator pump by-pass jet	2 X .0465"
Idle discharge holes	.042", .055"
Idle air bleed	.0635"
Idle tube	.035"
Fuel inlet seat	.092"
Vacuum spark holes	3 X .040"
Fuel level	19/32" - 5/8"
Power jet starts to open	4" Hg
Power jet closed at	6" Hg

AIR CLEANER

Type	Oil bath
Oil capacity (Imp. Pints)	1.8

The fuel system incorporated in the 2-1/2 ton 4x4 G.S. International Truck comprises two fuel tanks, each with a minimum capacity of 22 Imperial gallons providing a total driving range in excess of 250 miles.

Fuel is transferred from the tanks to the carburettor by an AC Fuel Pump which also filters the fuel through a filter element.

The engine is equipped with a Downdraft Model BX Bendix Carburettor, and an oil bath type air cleaner.

FUEL SYSTEM - GENERAL

What is vapour lock

When a section of the fuel system becomes filled with petrol vapour causing either partial or total disruption of fuel service to the carburettor, it is said to be vapour-locked.

Principal sources of heat - vapour lock

The fuel pump is generally the part of the fuel system where the greatest rise in fuel temperature occurs because of heat derived from the following sources:

(a) Heat conducted from crankcase and camshaft.

(b) Heat received from hot oil splashed into pump body for lubricating purposes.

(c) Radiated heat from exhaust manifold.

(d) Heat received from under hood air.

The fuel line from the fuel tank to the regular mechanical pump is under a depression, or more commonly known as suction, which lowers the vapourizing or boiling point of a liquid. This makes it particularly bad to have it located close to the exhaust system.

When and Why of vapour lock

Vapour lock occurs in hot weather with a hot engine when the fuel requirements are at a minimum, such as idling after a hard run. When the maximum amount of fuel is again required, the fuel pump must first expel the vapour during which time the following cycle is being established.

(a) Reduced engine speed because of lack of fuel.
(b) Reduced fuel pump speed with proportional loss of pumping ability.
(c) Increased fuel temperatures and resultant increase in vapour formation resulting in reduced fuel delivery and further reduction of engine speed.

How to diagnose vapour lock

A vapour lock in the system permits the fuel level in the float bowl to become low or even dry, causing a weak mixture, which is evidenced by the following operating characteristics:

(a) Lack of power on full throttle or softness and flat spots on part throttle operation.
(b) Stalling on idle when engine is hot.
(c) Inability to start a hot engine.

Truck Storage - Preparation of Fuel System

When placing trucks in storage remove all fuel from the fuel system. If fuel is not entirely removed, a gum-like substance will be deposited on all parts contacted by the fuel, and will seriously affect operation of the carburettor and fuel pump.

All standard grades of petrol have a small gum content, which is not sufficient to cause any trouble under ordinary conditions. However, when allowed to stand for a period of two or more weeks, the gum will increase to a point where a deposit is formed on the surfaces which it contacts. This deposit, when dry, has a hard, varnishlike appearance.

Gum deposits may completely alter calibration of the carburettor for it will partially or completely plug the jets or cause the power jet valve and the accelerating pump to stick. Gum deposits in the fuel pump will cause the fuel filter to become clogged or the check valves to stick.

IMPORTANT: IT IS WELL TO EMPHASIZE THE POSSIBILITIES THAT CAN DEVELOP BECAUSE OF GUM FILM IN CARBURETTOR JETS. A thin film of gum (assume .002" thick) is transparent and would escape casual inspection; but this thickness of film represents a .004" reduction in orifice size, and should one or all jets be affected there would be a weak mixture that would be detrimental to the engine as well as performance - for it would contribute to sticking and burning of valves because of gum accumulation on the stems. The condition would also be a contributing cause of premature spark plug failures. Gum is not soluble in petrol, therefore any reduction in the capacity of the jets will be perpetuated almost indefinitely.

THE BEST KNOWN MEANS OF PREVENTING GUM FORMATION IN TRUCKS THAT ARE TO BE PLACED IN STORAGE ARE ALLOWED TO STAND IDLE FOR A PERIOD OF TWO OR MORE WEEKS IS TO THOROUGHLY CONDITION THE FUEL SYSTEM AS FOLLOWS:

1. Completely drain the fuel tank.
2. Run engine until all fuel is consumed.
3. Remove plug from carburettor under main jet assembly to complete draining.
4. Empty sediment bowl at fuel pump.

The possible affected parts in the fuel pump are the check valves and the strainer. To determine the condition of the check valves, remove the caps from over the valves and test for freedom of action.

The filtering screen, if in a gummed condition, should be replaced and the sediment bowl cleaned.

If there is doubt as to the condition of the carburettor, it is suggested that a one quart mixture of 50-50 CP acetone and petrol be burned through the carburettor at fast idle from a closed container attached direct to the carburettor - not through the fuel pump because of the detrimental affect of acetone on fuel pump diaphragms. This will serve to remove a large amount of the gum providing that it has not become hard and varnish-like. If the results are not satisfactory the carburettor must be removed and all jets and valves replaced.

FUEL PUMP (Refer Fig. 1)

Description

The fuel pump is installed on the engine between the fuel tank and the carburettor. The suction side of the pump is connected to the fuel tank and the discharge side to the carburettor by tubing designed to carry the fuel. The purpose of the pump is to suck fuel from the supply tank and push it into the carburettor float bowl as it is required by the engine.

Incorporated in the pump is a fuel bowl (2), containing a strainer (4), through which all fuel pumped from the fuel tank passes.

Operation

The pumping operation is accomplished through a rocker arm on the pump (15) contacting an eccentric on the engine camshaft.

The link (19) is hinged to the rocker arm so that it can be moved down, but cannot be raised by the rocker arm. The only function of the rocker arm spring (14), is to make the rocker arm follow the cam. The link and diaphragm (10) are moved by the diaphragm spring (11). The pump therefore, delivers fuel to the carburettor only when the fuel pressure in the outlet line is less than the pressure maintained by the diaphragm spring. This condition arises when the float needle valve is not seated and the passage from the pump into the carburettor float chamber is open. When the needle valve in the carburettor float chamber is closed, and held in place by the pressure of the fuel on the float, the pump builds up pressure until it overcomes the diaphragm spring. This pressure results in almost a complete stoppage of diaphragm movement until further fuel is needed.

How to Diagnose Fuel Pump Trouble

Fuel pump trouble is of only two kinds. Either the pump is supplying too little fuel or in rare cases too much.

If the pump is supplying too little, the engine either will not run at all, or will cough and falter.

If the pump is supplying too much, you will be able to see petrol dripping from the carburettor, or the engine will not run smoothly when idling. Engines are hard to start when getting too much petrol.

Locating Fuel Pump Trouble

ALWAYS CHECK WHILE THE PUMP IS INSTALLED ON THE ENGINE. DO NOT TAKE IT OFF TO CHECK IT.

Engine Not Getting Enough Fuel

If the engine is getting too little fuel, the trouble may be in the pump, the fuel line or the fuel tank.

First, be sure that there is fuel in the tank.

Disconnect the outlet line from the pump or the carburettor, whichever is easier to reach. Then, turn the engine over a few times, using the starting motor. It is best to turn off the ignition switch.

If fuel spurts from the pump or the outlet line, the pump, fuel line, and tank are O.K.

If no fuel flows at all, or if only a little flows, do the following:

1. Look for a leaky bowl gasket (3). Install a new gasket if you are not sure.
2. Remove and clean the strainer which is inside the pump bowl.
3. Look for loose line connections. Check all the way back to the tank. Tighten all connections.
4. Look for a clogged fuel line. Blow out with compressed air.
5. Make sure that all cover screws (23) on the pump are tight.
6. Inspect the flexible fuel line for breaks or porous conditions.

IF CORRECTION OF THE ABOVE SIX ITEMS DOES NOT PLACE THE PUMP IN OPERATING CONDITION. IT SHOULD BE REMOVED FOR REPLACEMENT OR OVERHAUL.

Engine Getting Too Much Fuel

More often than not, an over supply of fuel is caused by trouble somewhere else - not in the pump. So first check the following:-

1. Excessive use of hand choke.
2. Punctured carburettor float.
3. Defective carburettor needle valve.
4. Loosely connected fuel line, or loose carburettor assembly screws.
5. Improper carburettor adjustment.

NOTE: IF NONE OF THESE IS THE CAUSE OF FLOODING OR POOR MILEAGE. THEN THE PUMP NEEDS OVERHAULING.

Final Check

After overhauling, a simple check of the suction and pressure should be made before installing the pump on the engine. This can be done by holding the fingers over the inlet and outlet openings of the pump and manipulating the rocker arm by hand. The pump may then be reinstalled on the engine and tested. (See installation instructions below. It should prime itself, that is, fill the filter bowl, in about 30 seconds with the starter button depressed. If it fails to provide sufficient pressure, the diaphragm has been incorrectly installed, preventing the full stroke of the push rod, or the springs do not have sufficient tension; and it will be necessary to disassemble the pump to reinstall the diaphragm correctly or to replace the linkage springs if this has not been done.

If the bowl can be filled by using the priming lever but not by cranking the engine check for bent rocker arm or other mechanical defect in the linkage.

Installation of Fuel Pump

Using gasket (18) between the adaptor (17) and the crankcase and gasket (16) between the adaptor and pump, assemble the pump to the crankcase with two bolts and lock washers (21) tighten up the bolts evenly to 8-10 ft. lbs. torque.

Connect fuel lines, first making sure that there is no dirt on the fittings which might be drawn into the system.

Fill the carburettor by means of the fuel priming lever on the pump base (20).

If there is an air leak between filter bowl and gasket, the pump cannot draw fuel into the bowl. To remedy this, install a new gasket and see that bowl seats squarely. Tighten clamp screw securely with the fingers only.

If fuel pump bowl still does not fill, the trouble may be due to an air-bound condition, In this case the bowl should be loosened slightly so that air can escape and, by blowing in the tank filler neck, fuel will be forced into the pump. Then tighten bowl securely and start engine.

DISASSEMBLY AND SERVICE

Referring to Fig. 1 and its legend, disassemble the pump as follows:-

Loosen the notched screw on the filter bowl retainer and remove the retainer, filter bowl, gasket and strainer (4).

Remove a snap ring from one end of the pin (12), tap out the pin and take out the rocker arm (15), spring (14), and link (19).

Match-mark the edges of the valve housing assembly (6) and pump base assembly (20) to assure correct alignment at reassembly.

Remove the screws (23) holding housing to base and separate the valve housing from the pump base.

Turn the diaphragm and spring assembly in the pump base and disengage.

Remove the two valve retainer screws and the retainer (9) and carefully tip out the valves. Wash all parts in a suitable solvent preparatory to inspection.

INSPECTION

Whenever the fuel pump is serviced, there are some parts which should always be replaced whether the old parts appear serviceable or not.

The parts are the diaphragm assembly, bowl gasket, and the pump to crankcase gasket. Fuel pump repair kits containing all these parts are available. All other parts should be inspected as follows:- Inspect the pump base, valve housing, for cracks or breakage in castings. Check the mating surfaces of castings for warpage.

Inspect the base and housing for stripped screw threads.

Check the rocker arm for wear at the camshaft contact point and at the pivot point.

If the inlet and outlet valves are defective, the valve housing assembly must be replaced as a complete unit, since the valves are factory installed only and are not serviced separately.

When the valves are seating correctly it should not be possible to suck through the inlet fitting, nor blow through the outlet fitting with the mouth.

TO ASSEMBLE THE FUEL PUMP

Referring to Fig. 1, place the housing (6) on a clean bench flange upwards, with the inlet connector to the left, place the gasket (7) into the recess in the casting. Place a valve assembly (8) into the valve port nearest to the inlet fitting, with the valve spring to the top. Place the other valve into the outlet port, with the spring downwards. The pump will not function if they are not assembled in that way. Now place the valve retainer (9) (arched upwards) with one fork end over each valve, and secure with the screws.

Now assemble the link (19), rocker arm (15) washers (13) and spring (14) into the body (20). The spring ends must be located over the projection in the base casting, and over the projection on the rocker arm. Line up the pin holes of the link and rocker arm with the pin holes in the base and insert the pin, (12) finally securing it with a snap ring at each end. The washers (13) must be located one at each side of the link. See that the rubber grommet in the centre of the housing is in good condition, then place the spring (11) into the base, locating it over the central boss of the base casting. Place the diaphragm (stem downwards) onto the spring. Turn the diaphragm until its flat ends are lined up with the slotted end of the link already assembled. Press down on the diaphragm until the stem passes through the link then turn the diaphragm a half turn to engage the stem notches with the link, when proper engagement has been achieved it will be impossible to pull the stem out and when the rocker arm is pressed upwards the diaphragm will be pulled downwards.

Line up the holes in the diaphragm with the nearest holes in the base, and assemble the housing (6) onto the base with the six screws and lockwashers (23).

Place the strainer (4) in position on the housing boss as far as it will go. Place a new bowl gasket (3) in its groove and assemble the bowl (2), finally securing it with the bowl retainer (1). Before finally tightening the retainer turn the bowl on the gasket, at the same time as the retainer is finally tightened. Finally, loosen the six screws (23) press up the rocker arm to its fullest extent and hold it in this position whilst the six screws are evenly tightened securely.

The pump is now ready for testing.

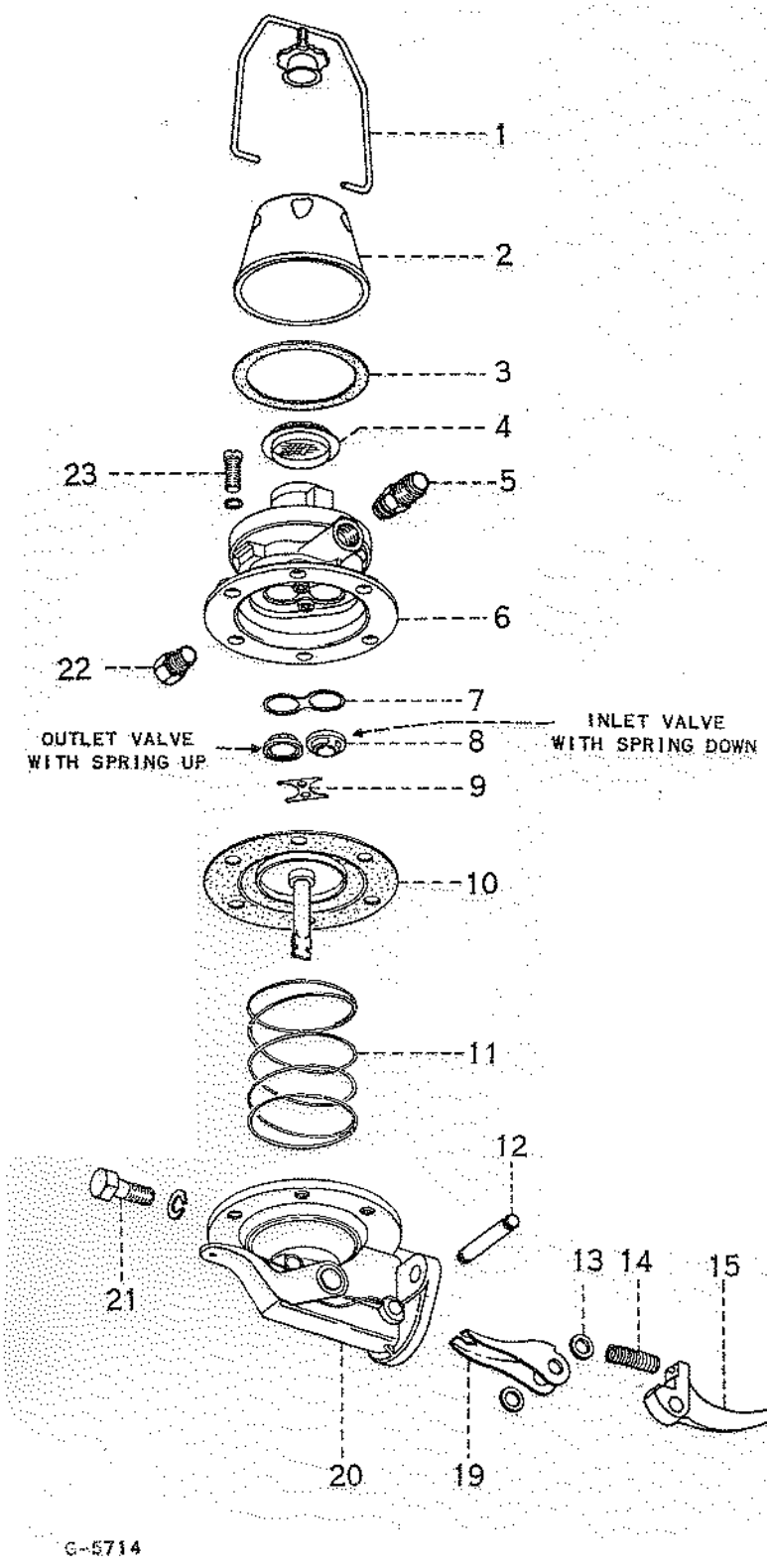
TESTING

Where no testing equipment is available, connect a flexible pipe tightly into the "in" fitting and submerge the pipe into clean fuel. Operate the rocker arm or primer lever, a few strokes of which should fill the bowl and discharge from the outlet fitting with a full stream.

To test the pressure of the pump install it either in a fuel pump testing fixture or on the engine itself.

As shown in the specifications at the beginning of this section pressure readings must be taken at pump level.

Attach a reliable pressure gauge (capable of accurately reading 0-10 p.s.i.) to the outlet of the pump and run the engine up to 3500 rpm and read the pump pressure at this speed. A reading between 2-3/4 and 4-1/4 p.s.i. is satisfactory.



1. RETAINER, BOWL, ASSY.
2. BOWL
3. GASKET, BOWL
4. STRAINER
5. CONNECTOR, INLET
6. HOUSING, VALVE
7. GASKET, VALVES
8. VALVE
9. RETAINER, VALVES
10. DIAPHRAGM, ASSY.
11. SPRING, DIAPHRAGM
12. PIN, PIVOT, W/SNAP RING, ASSY.
13. WASHER
14. SPRING
15. LEVER, CAM
16. GASKET, PUMP/SPACER
17. SPACER
18. GASKET, SPACER/ENGINE
19. LINK
20. BASE, PUMP, ASSY.
21. BOLT, HEX-HD.,
22. CONNECTOR, OUTLET
23. SCREWS, BODY

Fig. 1 - Fuel Pump (Exploded View)

AIR CLEANER

The construction of the oil bath type air cleaner (Fig. 2) is such that uncleaned air is drawn into the upper portion of the unit and then downwards at high velocity. Just above the oil bath in the bottom bowl the direction of air travel is suddenly reversed which causes the larger particles of dirt in the air to fall into the oil. The remainder of the dirt in the air is carried upward through an oil moistened filtering element where it adheres to the oily surface of the element. Thus clean air passes to the carburettor.

SERVICE

The necessity for cleaning and replenishing oil bath aircleaners cannot be over-emphasized. The frequency of servicing depends entirely upon the condition of dust in which the engine is operating. Under normal conditions the cleaner should be removed and serviced every 2,000 miles, but in severe dust conditions at much more frequent intervals, even daily, especially trucks in convoy over dusty roads where dust is thrown up by leading vehicles. To service the air cleaner remove the oil bowl or reservoir and clean out old oil and dirt. Wash the filtering mesh or element in a solvent such as kerosene, then dip in clean engine oil and allow the excess oil to drain off. Use the same grade of oil as used in the engine. When the air cleaner is reinstalled ensure that all joints are air tight, otherwise uncleaned air will be drawn into the engine.

The oil level in the bowl is clearly shown on the reservoir, the capacity being approximately 1-3/4 Imperial pints or 2.2 U.S.A. pints.

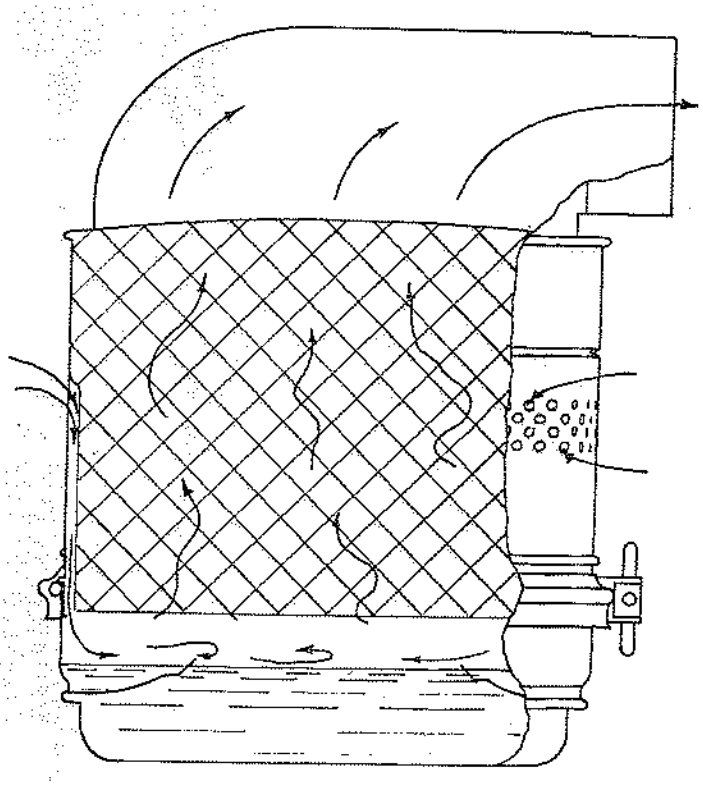


Fig. 2 - Air Cleaner

CARBURETTOR (BENDIX BX SERIES)

General Description

The series BX Carburettor (See Figs. 4 and 5) is a single barrel downdraft type which incorporates six systems namely: The Float System, the Idle System, the Main Metering System, the Power System, the Accelerating System and the Choke System.

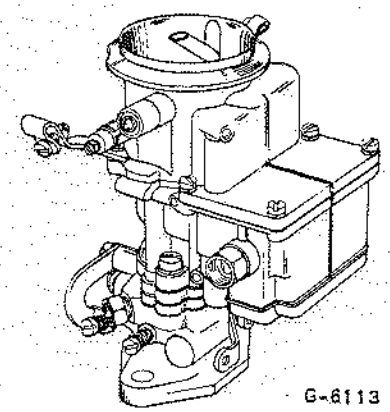


Fig. 4 - Series BX Caruburettor

Operation

The float system - The function of the float system is to maintain a constant level of fuel in the float chamber at all times and under all conditions of operation. Fuel enters the carburettor at the fuel inlet, flowing through the float needle valve and seat into the float chamber (see Fig. 6). When the fuel reaches a given level, the float shuts off the fuel supply at the needle valve.

Float chamber is vented internally by a vent tube which connects the float chamber with the air horn.

Idle System -With the throttle valve closed and the engine running at slow idle speed, fuel from the float chamber is metered into the idle tube through an orifice at the base of the idle tube (See Figs. 6 and 7). The air taken in through the idle air bleed hole mixes with the fuel at the top of the idle tube. This mixture of air and fuel then flows down the idle channel where it is mixed with additional air entering through the upper idle discharge hole. The mixture is then discharged at the lower idle discharge hole. The quantity of fuel discharged is controlled by an adjustable idle needle valve.

As the throttle valve is opened slightly the air-fuel mixture is also discharged from the upper idle discharge hole to supply the additional fuel required for increased engine speed.

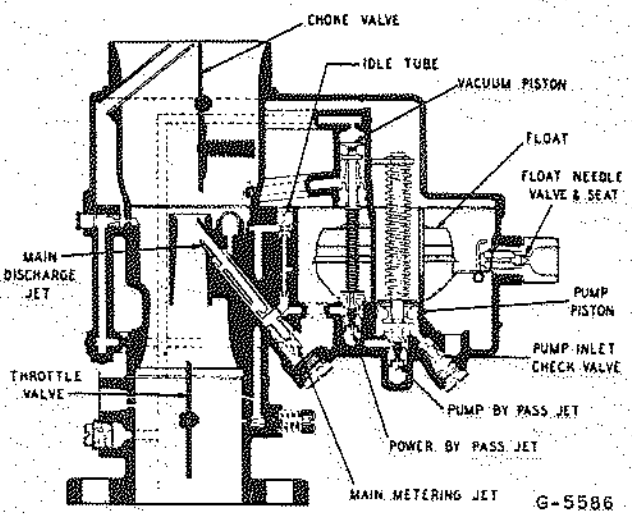


Fig. 5 - Exploded View of BX Carburettor

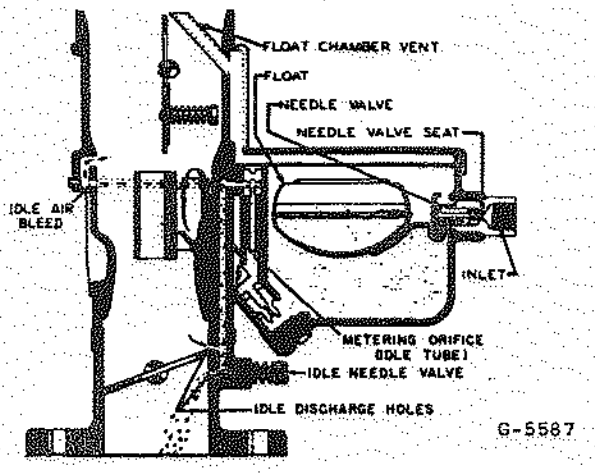


Fig. 6 - The Float System

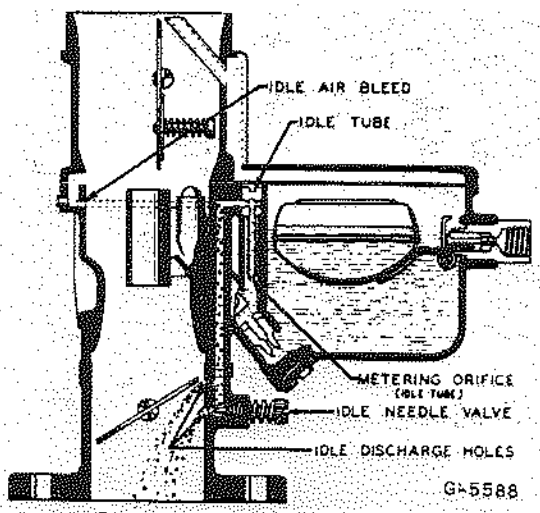


Fig. 7 - The Idle System

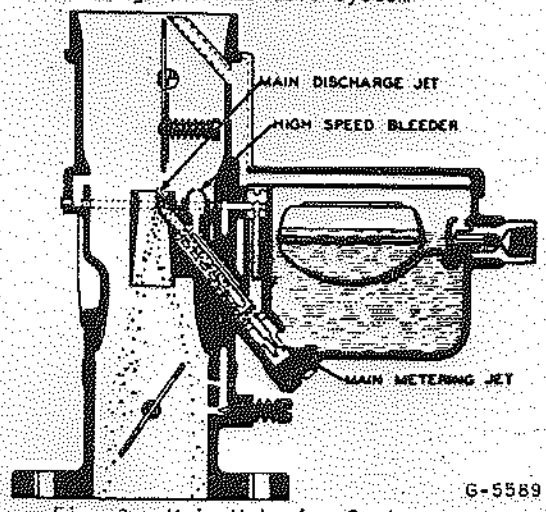


Fig. 8 - Main Metering System

Main metering system - The main metering system controls the flow of fuel during the intermediate or part throttle range of operation. With the throttle valve in a partially open position, fuel flows from the float chamber through the main metering jet and enters the main discharge jet where it is mixed with air taken in through the high speed air bleeder (See Fig. 8). This mixture of air and fuel is then discharged into the air stream through the auxiliary venturi tube. The main body and main discharge jet are so designed that should vapor bubbles form in the fuel in the main discharge system, due to high temperatures, the vapor bubbles will collect in the outside channel surrounding the main discharge jet, rise and vaporise in the dome of the high speed air bleeder, thus preventing percolation.

Power system - The power system is incorporated into the carburettor to provide a richer mixture of fuel for maximum power and high speed operation. The extra fuel for power is supplied by a vacuum controlled power piston which automatically operates the power by-pass jet in accordance with throttle opening. Intake manifold vacuum is maintained above the vacuum piston through a vacuum channel which leads to the manifold flange of the carburettor (see Fig. 10).

During partial throttle operation, the vacuum above the vacuum piston is sufficient to overrule the compression spring and hold the piston in the up position.

When the throttle valve is opened to the point where the manifold vacuum drops to approximately 4" to 5" Hg, the compression spring then moves the piston down to open the power by-pass valve and meter additional fuel into the main metering system.

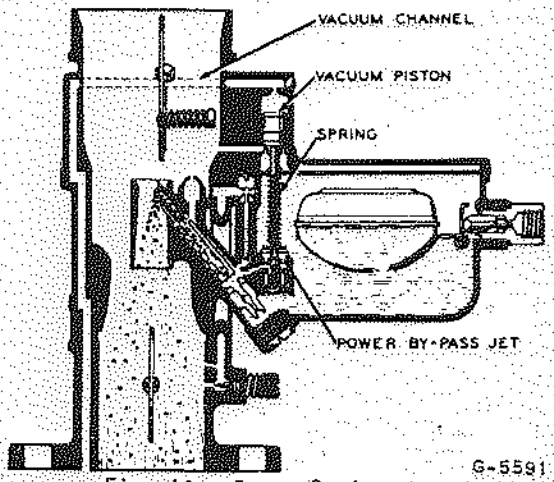


Fig. 10 - Power System

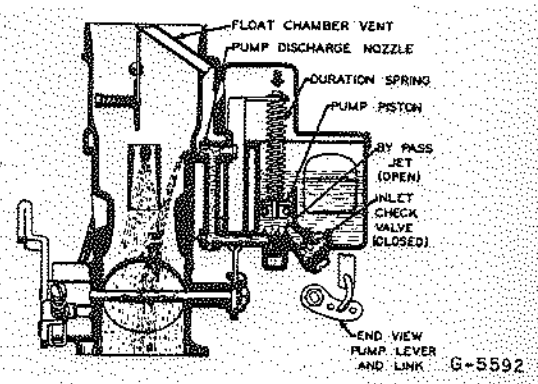


Fig. 11 - Accelerating System

LEGEND

1. LEVER, FAST IDLE
2. WASHER, LOCK, FAST IDLE LEVER NUT
3. NUT, FAST IDLE LEVER
4. SCREW AND LOCKWASHER, ASM. AIR HORN ATTACHING
5. HORN, AIR, ASM.
6. GASKET, AIR HORN
7. ROD, FAST IDLE
8. PIN, COTTER, PUMP STEM
9. ROD, PUMP
10. SPRING, PUMP PISTON
11. PISTON, PUMP, ASM. AND STEM
12. JET, PUMP BY-PASS
13. CLIP, PUMP SCREEN
14. SCREEN, PUMP
15. SPRING, FLOAT, FULCRUM PIN
16. FLOAT AND LEVER, ASM.
17. PIN, COTTER, FAST IDLE ROD AND CAM PIN
18. PIN, FLOAT LEVER FULCRUM
19. BODY, MAIN ASM.
20. VALVE, CHECK, PUMP INLET
21. GASKET, CHECK VALVE PLUG
22. PLUG, CHECK VALVE
23. JET, MAIN DISCHARGE
24. JET, MAIN METERING
25. GASKET, METERING JET PLUG
26. PLUG, MAIN METERING JET
27. LINK, PUMP
28. CLIP, PUMP LINK
29. BODY, THROTTLE, ASM.
30. NUT, THROTTLE SHAFT
31. WASHER, LOCK, THROTTLE SHAFT
32. THROTTLE AND PUMP LEVER
33. VALVE, THROTTLE
34. SPRING, IDLE NEEDLE VALVE
35. PIN, FAST IDLE CAM
36. VALVE, IDLE NEEDLE
37. LEVER, FAST IDLE CAM
38. CAM, FAST IDLE
39. SPRING, SLOW IDLE ADJUSTING SCREW
40. SCREW, SLOW IDLE ADJUSTING
41. LEVER, SLOW IDLE ADJUSTMENT
42. SHAFT, THROTTLE
43. SCREW, THROTTLE VALVE
44. GASKET, MAIN BODY AND INSULATING SPACER
45. SPACER, MAIN BODY AND INSULATING
46. VALVE, FLOAT NEEDLE AND SEAT
47. SCREW, AND LOCKWASHER, ASM. MAIN BODY
48. PLUG, DRIVE
49. GASKET, POWER BY-PASS JET
50. BLEEDER, HIGH SPEED
51. JET, POWER BY-PASS
52. GASKET, PUMP BY-PASS JET
53. TUBE, IDLE
54. PISTON ASM. VACUUM POWER
55. BALL, LEAD
56. LEVER, ASM. MANUAL CHOKE
57. SCREW, WIRE CLAMP
58. SPRING, MANUAL CHOKE LEVER
59. LEVER AND SHAFT, CHOKE
60. SCREW, CHOKE VALVE
61. SCREW, CHOKE TUBE CLAMP
62. HOLDER, CHOKE TUBE
63. WASHER, LOCK CHOKE TUBE CLAMP SCREW
64. NUT, CHOKE TUBE CLAMP SCREW
65. SCREW, AND LOCKWASHER, ASM., CHOKE HOLDER ATTACHING
66. CHOKE, VALVE, ASM.
67. TUBE, VENT

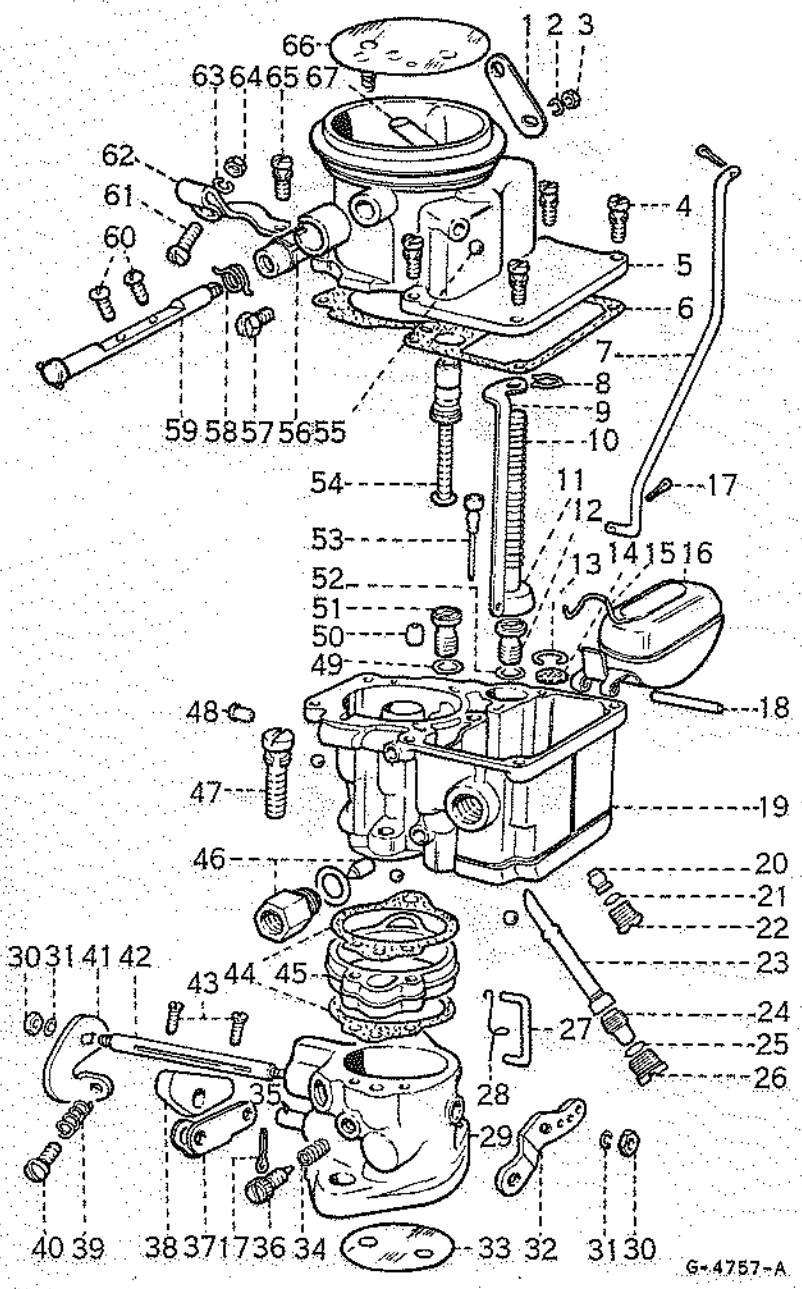


Fig. 9 - Series BX Carburettor (Exploded View)

Accelerating system - To ensure a smooth uninterupted flow of power for acceleration, additional fuel must be metered into the engine. This is accomplished through the use of an accelerating pump which is operated from the throttle linkage. As the throttle valve is opened, the accelerating pump moves the pump piston down to close the inlet ball check valve and force a metered quantity of extra fuel through the pump by-pass jet and pump discharge nozzle into the air stream (see Fig. 11).

As the pump lever moves down, the pump duration spring compresses to distribute the supply of extra fuel over a metered period of time. A spring loaded relief valve is incorporated in the accelerating pump piston on some models which opens at a given pressure to prevent excessive pressure build up in the system when the throttle is snapped fully open.

With the release of the accelerator pedal and the return of the accelerating pump to the release position, the pump by-pass jet closes while the inlet ball check valve reopens, thus permitting fuel from the float chamber to enter and refill the accelerating pump cylinder (see Fig. 12).

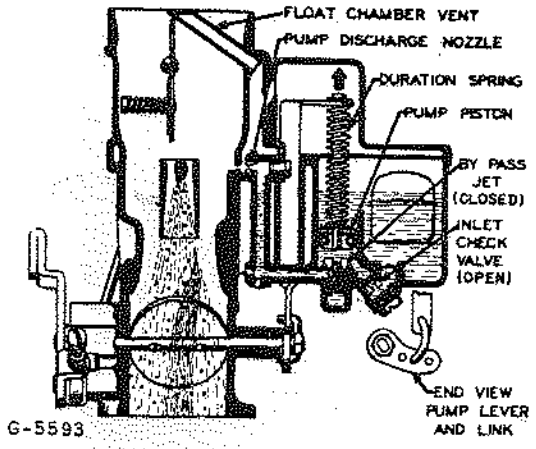


Fig. 12 - Accelerating System

To Disassemble the Carburettor

Disassembly consists of separating the carburettor into its three basic groups, namely: the Air Horn, the Main Body and the Throttle Body, and then disassembling each group.

1. Remove fast idle rod and dashpot rod.
2. Remove accelerating pump link and clip.
3. Remove air horn attaching screws and lift off air horn.
4. Remove throttle body attaching screws and lift off main body, main body gaskets and spacer.

To Disassemble Air Horn

1. Compress vacuum power piston spring and remove piston.
2. Scribe choke valve along side of choke shaft, remove screws, choke valve and choke shaft.

To Disassemble Main Body

1. Remove cotter pin, accelerating pump rod, spring, pump piston and air horn gasket.
2. Remove float clip, float, fulcrum pin, needle valve, dashpot piston and spring.
3. Remove needle valve seat add gasket.
4. Remove idle tube, dashpot inlet check valve, power by-pass jet and pump by-pass jet and gasket.
5. Remove main metering jet and pump inlet check valve plugs. Then remove pump inlet check valve, main metering jet and main discharge jet.
6. Remove pump inlet strainer and retainer clip and then remove lead ball plugs.

To Disassemble Throttle Body

1. Remove throttle stop adjusting screw and spring.
2. Remove idle needle valve and spring.
3. Remove pump lever nut, spring, washer, pump lever and dashpot lever (pry lever off).
4. Scribe throttle valve along edges of throttle shaft.
5. Remove screws and throttle valve.
6. Remove throttle lever and shaft and fast idle cam.

To Clean and Inspect Carburettor

Thoroughly clean all metal parts. Blow out tubes and passages with air pressure. Inspect housings for damage, excessive wear, burrs or warpage.

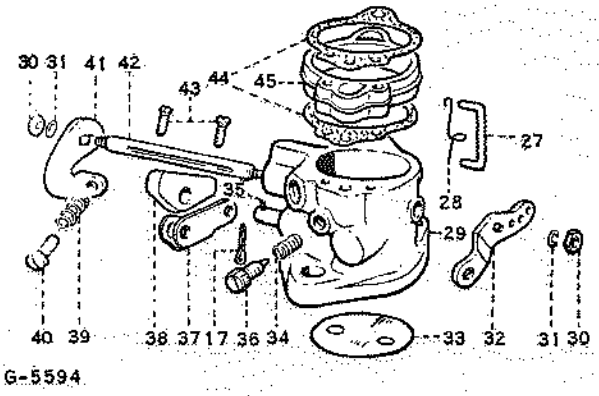


Fig. 13 - THROTTLE Body
(See Fig. 9 for key)

To Assemble Throttle Body

1. Assemble fast idle cam (38) and lever (37) and throttle lever and shaft (42) (see Figs. 9 and 13).
2. Assemble throttle valve (33) leaving attaching screws (43) loose. Align valve to scribe marks and then check valve for best closing against a light. Tighten screws.
3. Assemble lever (32) lockwasher and nut. Securely tighten nut.
4. Assemble throttle stop screw (40) and spring
5. Replace idle needle valve (36) and spring.
6. Turn needle in just to the point of contact with seat, then back out one full turn.

To Assemble Main Body

1. Replace drive and lead ball plugs. Assemble main discharge jet (23) in main body (see Figs. 9 and 14).
   NOTE: Be sure bevelled side of jet is parallel to sides of venturi.
2. Assemble new main jet (24) in main body, and then replace main metering jet plug (26) and gasket.
3. Replace pump inlet check valve (20), gasket and plug (22).
4. Assemble idle tube (53) in main body.
5. Place gasket on accelerating pump by-pass jet (12), assemble jet at bottom of pump cylinder.
   NOTE: Pump by-pass jet stem does not project above top of jet.
6. Place gasket on power by-pass jet (51) and assemble jet in main body.
7. Replace pump inlet strainer (14) and clip.
8. Assemble new float needle valve (46), seat and gasket. Securely tighten.
9. Place dashpot piston (54) in cylinder at bottom of float chamber.
10. Assemble float fulcrum pin (18) in float and place float in position with pin in recess of body. Replace U shaped spring clip (440) with ends resting on fulcrum pin and loop under projection at side of main body.
11. Check float level. Float level is gauged from top of main body (without gasket) to top centre of float when needle valve is held firmly on its seat (Refer to specifications). Bend float hanger arm if necessary.
12. Assemble accelerating pump piston (11) in pump cylinder of main body (use care to avoid damage to leather).
13. Place upper pump spring (10) over piston rod; then place gasket (6) on main body and assemble pump rod (9) and hairpin cotter (8).

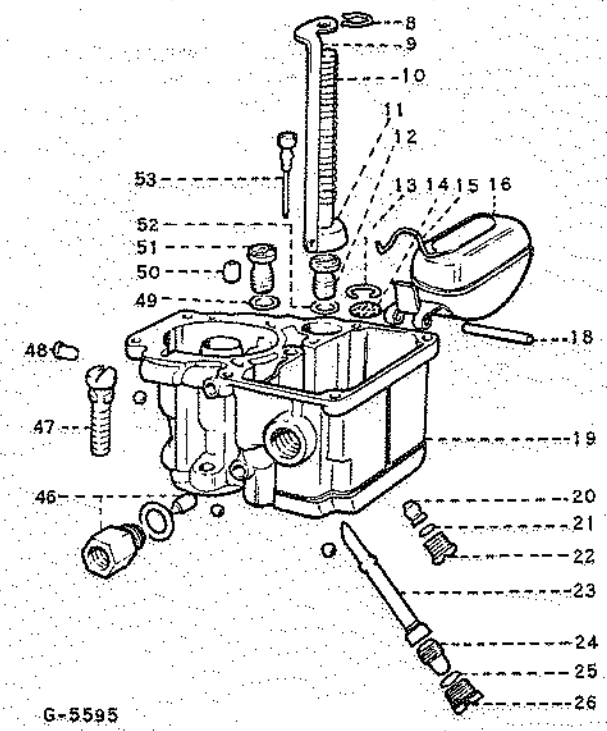


Fig. 14 - Main Body
(See Fig. 9 for key)

To Assemble Air Horn.

1. Replace lead ball plugs (See Figs. 9 and 15).
2. Assemble choke shaft (59), choke valve (66) and attaching screws. Close choke and align valve for best closing before tightening SCREWS. Choke shaft should not bind in any position of operation. Assemble vacuum piston (54) in air horn.
   NOTE: Do not use any form of lubricant on piston.

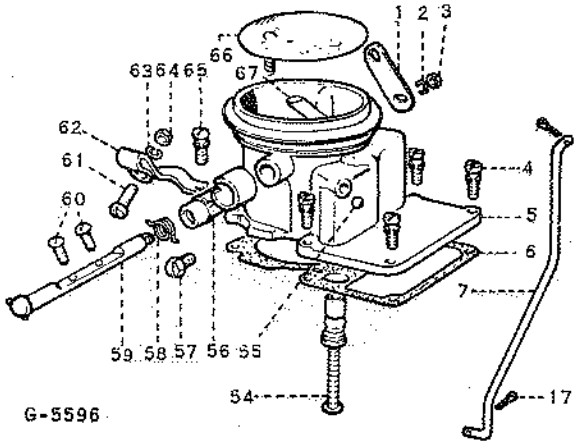


Fig. 15 - Air Horn
(See Fig. 9 for Key)

To Assemble Three Basic Groups

1. Place gaskets (44) and spacer (45) on throttle body (See Figs. 9 and 16).

   NOTE: Vacuum passages in spacer and gaskets must line up with holes in throttle body.

2. Attach main body to throttle body with screw and lock washers (47) and tighten securely. Set fuel level before assembling air horn.

3. Assemble air horn on main body, using screw and lock washers (4). Tighten screws uniformly.

4. Attach short end of fast idle rod (7) to choke lever, then attach lower end of rod to fast idle cam lever using cotter pin. (17).

To Adjust Fuel Level

The fuel level is reasonably critical and should be established with the engine idling. This can be achieved by removing the air horn from the carburettor and blanking off the air passage to the power valve (See Fig. 17).

The level is adjusted to the gauge shown by bending the float tongue with a suitable tool (See Fig. 18).

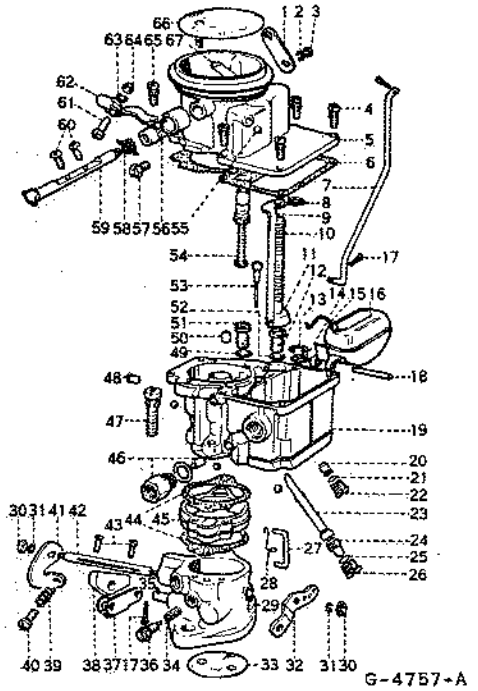


Fig. 16 - Three Basic Groups
(See Fig. 9 for Key)

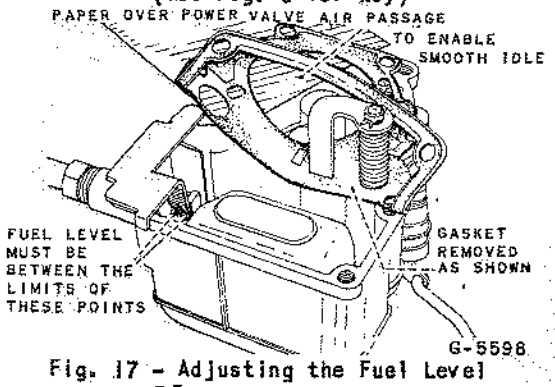


Fig. 17 - Adjusting the Fuel Level

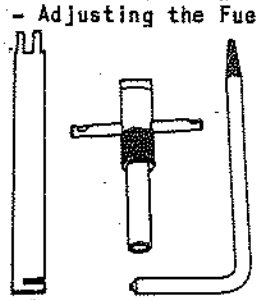


Fig. 18 - Tool Kit Including Adjusting Fuel Level Float Tang

TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTION
(1) Hard starting	(a) Incorrect idle adjustments	(a) Perform all idle adjustments
	(b) Binding linkage, choke plate, or choke piston	(b) Repair or replace defective parts
	(c) Air leaks into vacuum and hot air passage	(c) Replace defective gaskets
	(d) Improper fuel level	(d) Adjust fuel level
(2) Stalling when accelerator is released suddenly	(a) Improper idle adjustment	(a) Perform all idle adjustments
	(b) Clogged air bleeds or idle passages	(b) Clean with solvent and compressed air
	(c) Leakage intake manifold and carburettor gaskets	(c) Replace leaking gaskets
(3) Rough idle and stalling	(a) Improper idle adjustments	(a) Perform all idle adjustments
	(b) Damaged tip on idle mixture screws	(b) Replace screws
	(c) Clogged air bleeds or idle passages	(c) Clean with solvent and compressed air
	(d) Leaking intake manifold and carburettor gaskets	(d) Replace leaking gaskets
	(e) Improper throttle stop adjustment	(e) Adjust throttle stop screw
	(f) Improper fuel level	(f) Adjust fuel level
	(g) Improper fast idle cam adjustment	(g) Perform all idle adjustments
	(h) Loose or damaged idle tube	(h) Remove and inspect idle tubes
(4) Poor low-speed operation	(a) Idle adjusting screws unequally adjusted	(a) Perform all idle adjustments
	(b) Clogged idle transfer holes	(b) Remove and clean carburettor with solvent and blow out holes with compressed air
	(c) Restricted idle air bleeds and passages	(c) Remove and clean carburettor with solvent. Blow out passages with compressed air

TROUBLE	PROBABLE CAUSE	CORRECTION
(5) Faulty acceleration	(a) Improper pump strokes	(a) Adjust pump stroke
	(b) Inoperative pump discharge check ball	(b) Clean or replace
	(c) Worn or damaged pump piston	(c) Replace pump piston
	(d) Leaking throttle body gasket	(d) Replace gasket
(6) Surging (cruising speeds to top speeds)	(a) Clogged main jets	(a) Clean main jets with solvent and blow out jets with compressed air
	(b) Undersize main jets	(b) Replace main jets
	(c) Low fuel level	(c) Adjust fuel level
	(d) Low fuel pump pressure or volume	(d) Test fuel pump
	(e) Blocked air bleeds	(e) Clean with solvent and blow out bleeds with compressed air
	(f) Clogged filter screen	(f) Clean with solvent and compressed air
(7) Reduce top speed	(a) Low fuel pump volume	(a) Test fuel pump
	(b) Clogged vacuum passage	(b) Clean with solvent and blow out passage with compressed air
	(c) Economizer valve stuck	(c) Clean or replace
	(d) Improper size, or obstructed main jets	(d) Clean or replace
	(e) Faulty choke operation	(e) Check choke operation

2-1/2 TON 4x4 G.S. - INTERNATIONAL

Battery	12 volt, 9 plate
Capacity	61 amps at 20 hour rate
Specific gravity (fully charged)	1.280 - 1.290 at 80 deg. F

Overall Dimensions

Length	12-1/2 inches
Width	6-3/4 inches
Height	8-23/32 inches

Distributor

Make	Bosch
Model	U-VJUR 6BL 62T

Contact breaker

Open Period	24° - 20°
Closed Period	36° - 40°
Gap setting (new)	.014" - .016"
Gap setting (run in)	.012 to .016
Spring tension at contacts	14 - 17-1/2 ozs.

Condensor Capacity	0.22 microfarad

Generator

Make	Lucas C45PV-5
Service Number	(Y) 67215B
Volts	12
Output control	Compensated voltage
Maximum output	30 amperes
Drive	V-belt (adjustable)
Direction	Clockwise

P

Starter Motor

Make	Lucas M45G (Short Core)
Service Number	(Y) 629 250 17A
Volts	12
Lock torque	13.5 ft/lbs. with 430 amps. at 6 volts
Torque at 1,000 rpm	6.5 ft/lbs. with 270 amps. at 8 volts
Light running current	80 amps. at 8,000 - 9,000 rpm
Brush spring tension	30-40 ozs.

Solenoid Starter Switch

Make	Lucas
Model	10S

Generator Control Box

Make	Lucas
Model	RB-310
Volts	12
Capacity (at 4,000 rpm generator speed)	30 amps.

Headlamps

Make	Lucas
Model	F-700
Main Bulb	12 volt 50/40 watt

Horn

Make	R.V.B.
Volts (rated)	12
Amperage draw (at rated volts)	5
Frequency cyc/sec	290-320

Instrument Cluster

Bulb, minature Bayonet Cap	12 Volt 1 C.P.

Air Pressure Gauge

L/P Warning Lamp Minature Bayonet Cap	12 Volt C.P. Flasher

2-1/2 TON 4x4 G.S. - INTERNATIONAL

SUPPRESSION, RADIO INTERFERENCE

Ignition, High Tension	Suppressed Type Distributor Rotor.
Spark Plugs	6 Supressors. (5,000 OHMS) One on each spark plug
Low Tension	1 Capacitor .5 m.f.d. Mounted on ignition coil holding bolt and connected to switch terminal of coil.
GENERATOR	1 Capacitor .5 m.f.d. Mounted on commutator end plate and connected to "D" terminal.
CONTROL BOX	1 Supressor. (Choke Type) Eye terminal to D of control box. Fork terminal to F of control box. Earth strap to control box mounting. Generator "F" cable to "F" terminal of suppressor. Generator "D" cable remains on "D" terminal of control box.
WINDSCREEN WIPERS	1 Capacitor .5 m.f.d. Mounted on motor cover and connected to switch cable terminal.
INSTRUMENT CLUSTER	1 Capacitor .5 m.f.d. Mounted on cluster mounting screw and connected to the instrument terminal of the instrument voltage regulator.

GENERAL

The vehicle is equipped with a 12 volt, positive to earth system.

The wiring is illustrated in Figs. 1 to 4 as follows:-

Fig. 1 - Circuit Diagram

2 - Wiring Diagram (Plan View)

3 - Wiring Diagram (Cab Front View)

4 - Wiring Diagram (Cab Side View)

Fig. 1 should be used where tracing through any circuit whilst Figs. 2, 3 and 4 show the installation of cables, harness and the electrical components in outline.

Circuit breakers are connected in various circuits to protect the wiring against accidental overload, short circuit, etc. See Fig. 1.

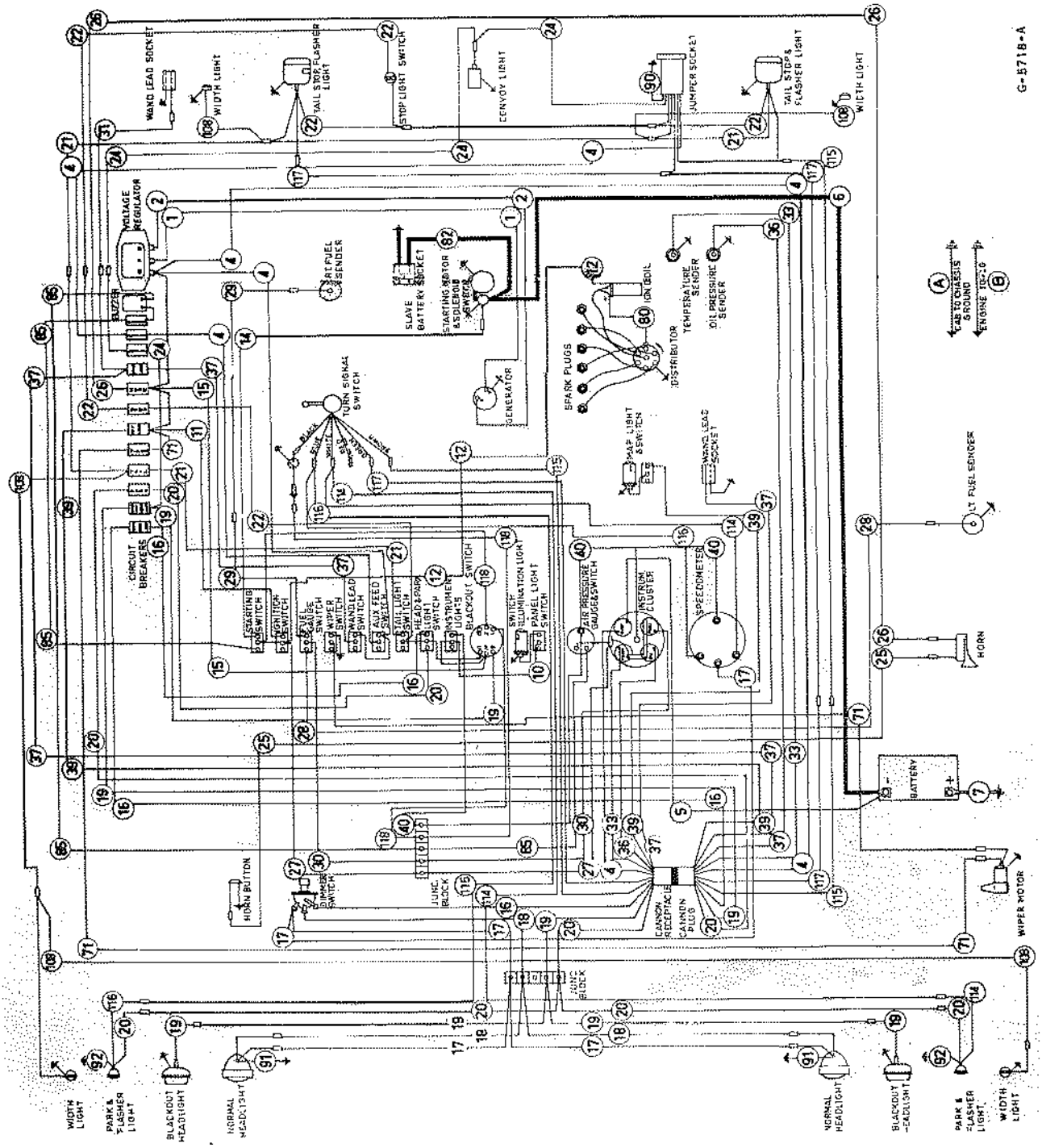
To facilitate disassembly and reassembly all cables bear a circuit number at the terminal ends, which correspond with the circuit numbers in Fig. 1.

The major electrical components are of Lucas manufacture, the servicing of which is fully described in this section.

The ignition distributor and coil is of Bosch manufacture and is described separately in this section.

A feature of special note is the Slave Battery Socket which enables a vehicle with a run down battery to be connected to another vehicle battery for starting purposes, battery charging etc. The socket is conveniently mounted under the drivers seat as shown in Figs. 2, 3 and 4.

The wiring is so designed that it can readily be disconnected for removal of the cab front section, as described in Section "Q".


G-5718-A
WAND LEAD SOCKET
WIDTH LIGHT
TAIL STOP FLASHER LIGHT
STOP LIGHT SWITCH
CONVOY LIGHT
JUMPER SOCKET
VOLTAGE REGULATOR
BUZZER
FUEL SENDER
SLAVE BATTERY SOCKET
STARTING MOTOR & SOLENOID
GENERATOR
ION BOIL
TEMPERATURE SENDER
OIL PRESSURE SENDER
DISTRIBUTOR
SPARK PLUGS
TURN SIGNAL SWITCH
MAP LIGHT ASSEMBLY
CIRCUIT BREAKERS
STARTING SWITCH
IGNITION SWITCH
GAUGE SWITCH
WIPER SWITCH
HANDLEAD SWITCH
AUX FEED SWITCH
TAIL LIGHT SWITCH
HEATER SWITCH
INSTRUMENT LIGHTS
BLACKOUT SWITCH
SWITCH ILLUMINATION LIGHT
PANEL LIGHT SWITCH
AIR PRESSURE GAUGE & SWITCH
INSTRUM. CLUSTER
SPEEDOMETER
HORN
BATTERY
HORN BUTTON
DIMMER SWITCH
JUNC. BLOCK
CANNON RECEPTACLE
CANNON PLUG
WIPER MOTOR
WIDTH LIGHT
PARK & FLASHER LIGHT
BLACKOUT HEADLIGHT
NORMAL HEADLIGHT

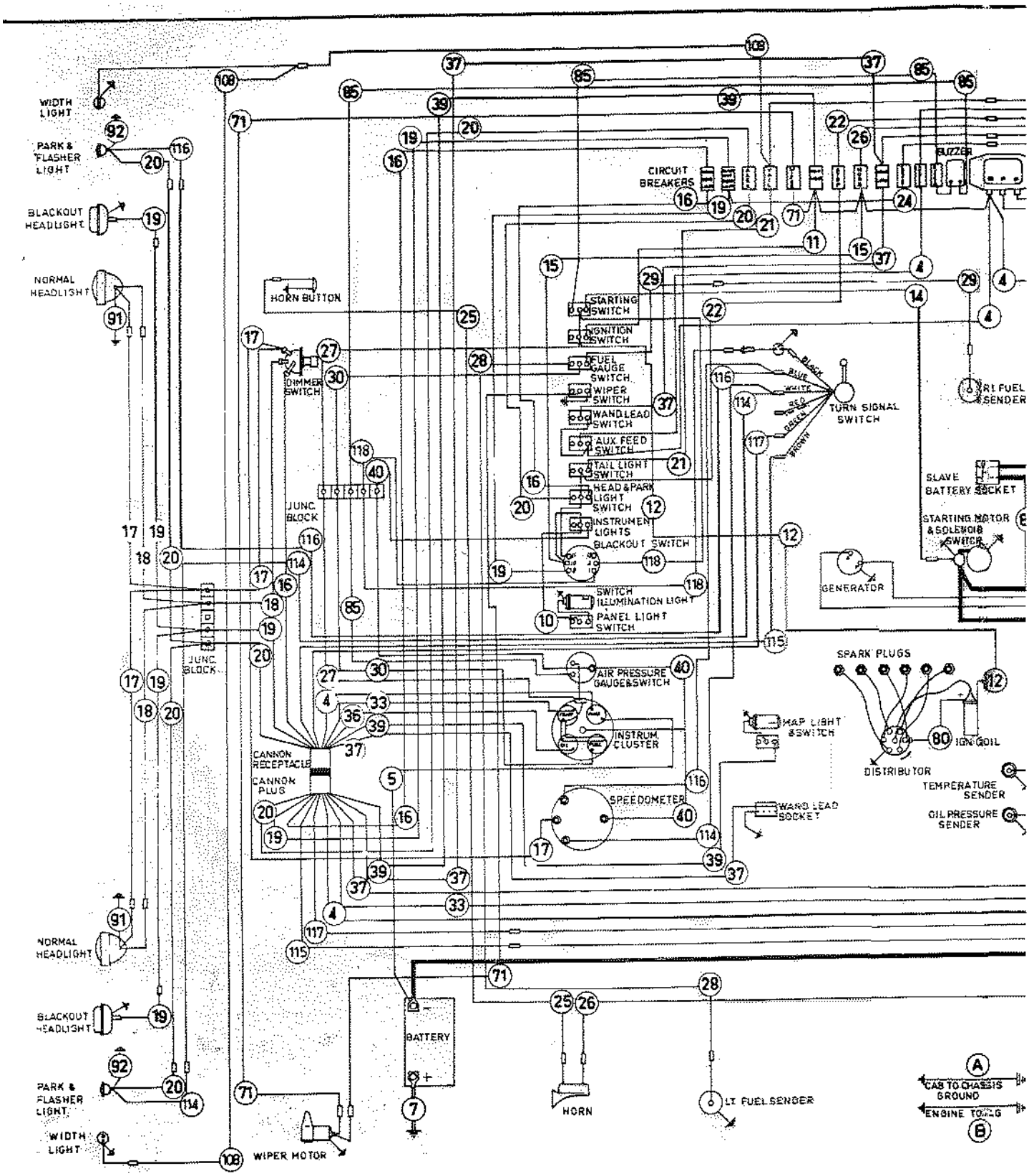
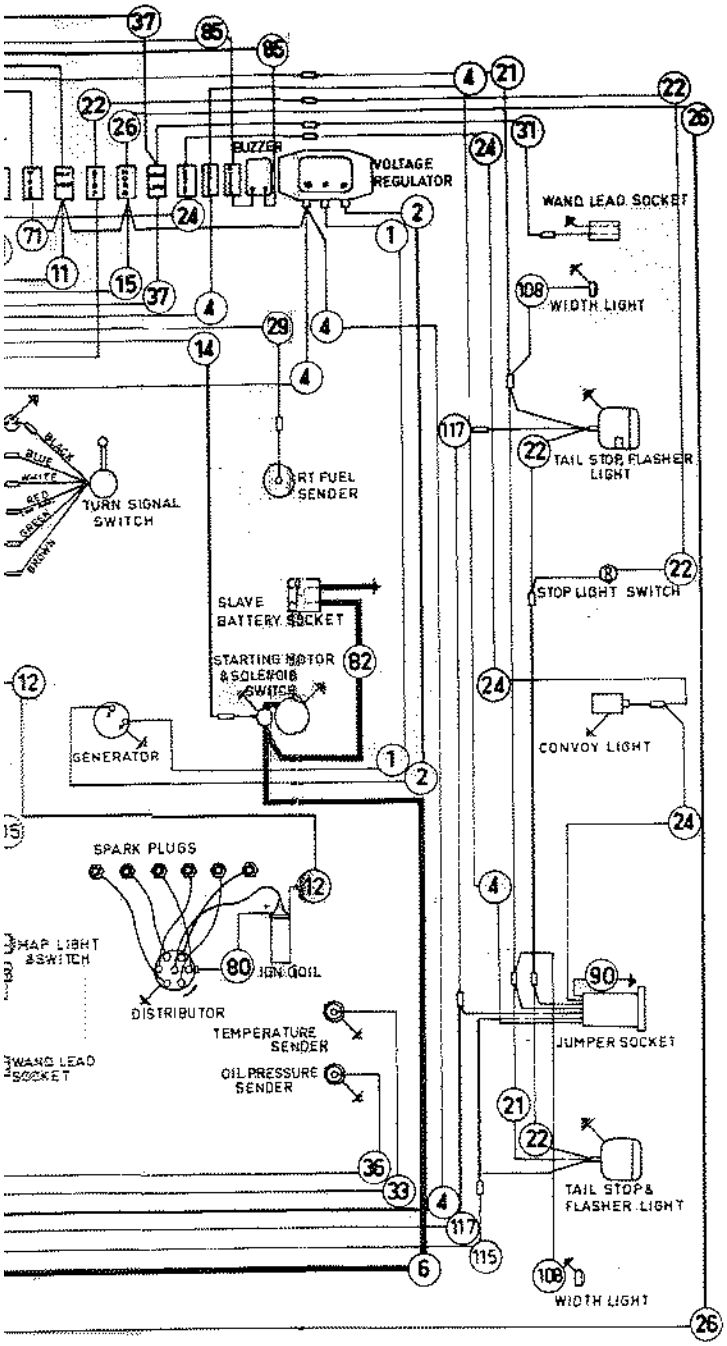
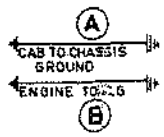


Fig. 1 - Circuit Diagram





G-5718-A

LEGEND

1. GENERATOR FIELD
2. GENERATOR ARMATURE
4. REGULATOR TO AMMETER
4. TRAILER AUXILIARY FEED
5. BATTERY TO AMMETER
6. BATTERY TO STARTER MOTOR
7. BATTERY GROUND
10. PANEL LIGHTS FEED
11. IGNITION SWITCH FEED
12. IGNITION SWITCH TO COIL
14. STARTING SWITCH TO STARTING SOLENOID
15. LIGHT SWITCH AND BLACKOUT SWITCH FEED
16. DIPPER SWITCH FEED
17. HIGH BEAM FEED
17. HIGH BEAM INDICATOR
18. LOW BEAM FEED
19. BLACKOUT HEADLIGHT FEED
20. PARKING LIGHT FEED
21. TAIL LIGHT FEED
22. STOP LIGHT FEED
24. CONVOY LIGHT FEED
25. HORN BUTTON TO HORN
26. HORN FEED
27. INSTRUMENT FEED
28. FUEL SENDER TO SWITCH - LEFT
29. FUEL SENDER TO SWITCH - RIGHT
30. SWITCH TO FUEL GAUGE
33. TEMPERATURE SENDER TO RECEIVER
36. OIL PRESSURE SENDER TO RECEIVER
37. WANDERING LEAD LIGHT FEED - FRONT & REAR
39. MAP LIGHT FEED
40. INSTRUMENT LIGHTS FEED
71. WIPER SWITCH FEED
80. IGNITION COIL TO DISTRIBUTOR
82. STARTER MOTOR TO SLAVE SOCKET
85. LOW PRESSURE BUZZER CIRCUIT
90. JUMPER SOCKET GROUND
91. HEADLIGHT GROUND - NORMAL
92. PARK & FLASHER LIGHT GROUND
108. WIDTH LIGHTS - FRONT & REAR
114. TURN SIGNAL SWITCH TO LEFT FRONT FLASHING LIGHT
114. TURN SIGNAL SWITCH TO LEFT TURN INDICATOR
115. TURN SIGNAL SWITCH TO LEFT REAR FLASHING LIGHT
116. TURN SIGNAL SWITCH TO RIGHT FRONT FLASHING LIGHT
116. TURN SIGNAL SWITCH TO RIGHT TURN INDICATOR
117. TURN SIGNAL SWITCH TO RIGHT REAR FLASHING LIGHT
118. TURN SIGNAL SWITCH IGNITION SWITCH

A. CAB TO CHASSIS GROUND
B. ENGINE TO CHASSIS GROUND

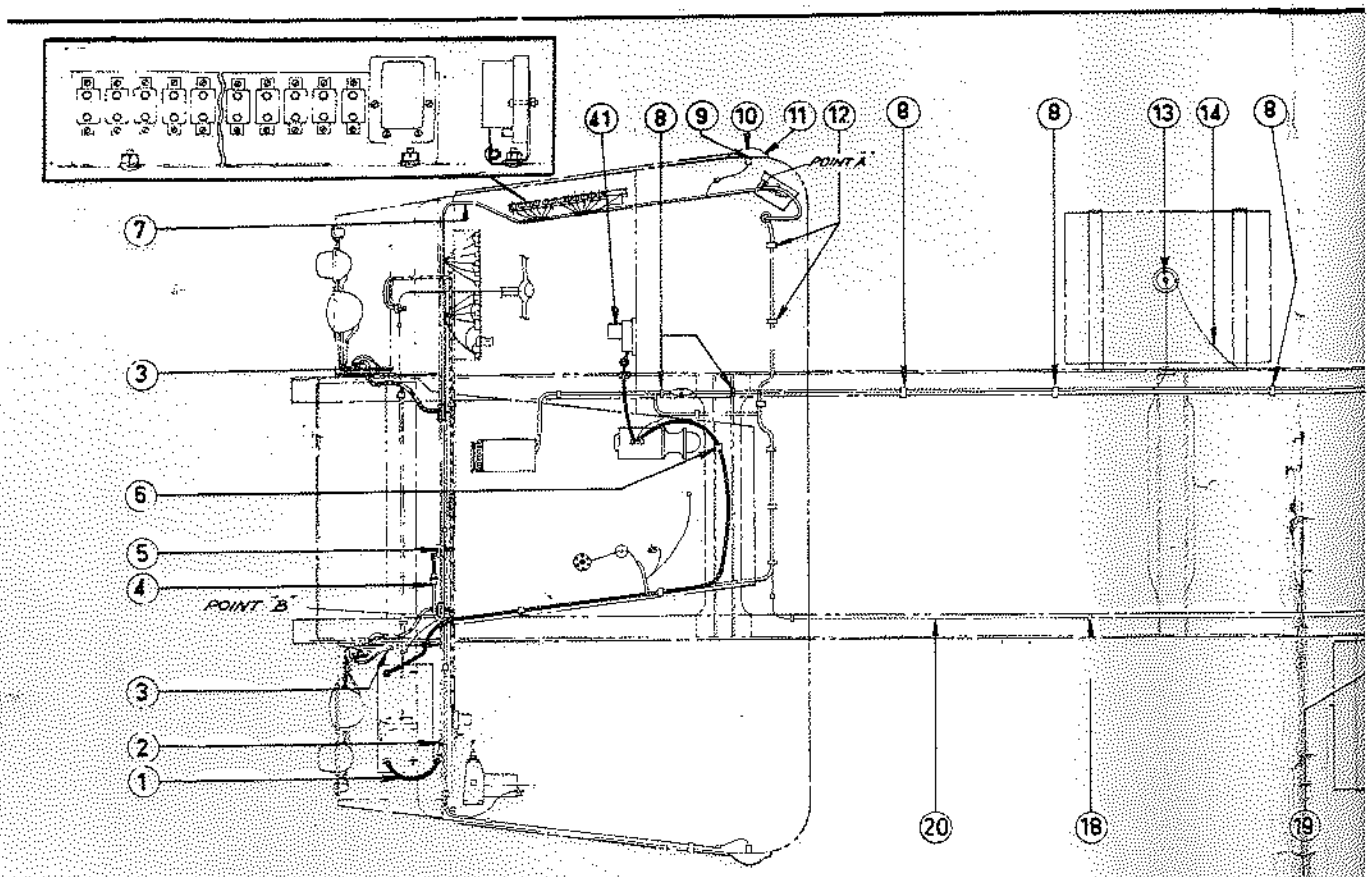


Fig. 2 - Wiring Diagram (Plan View)

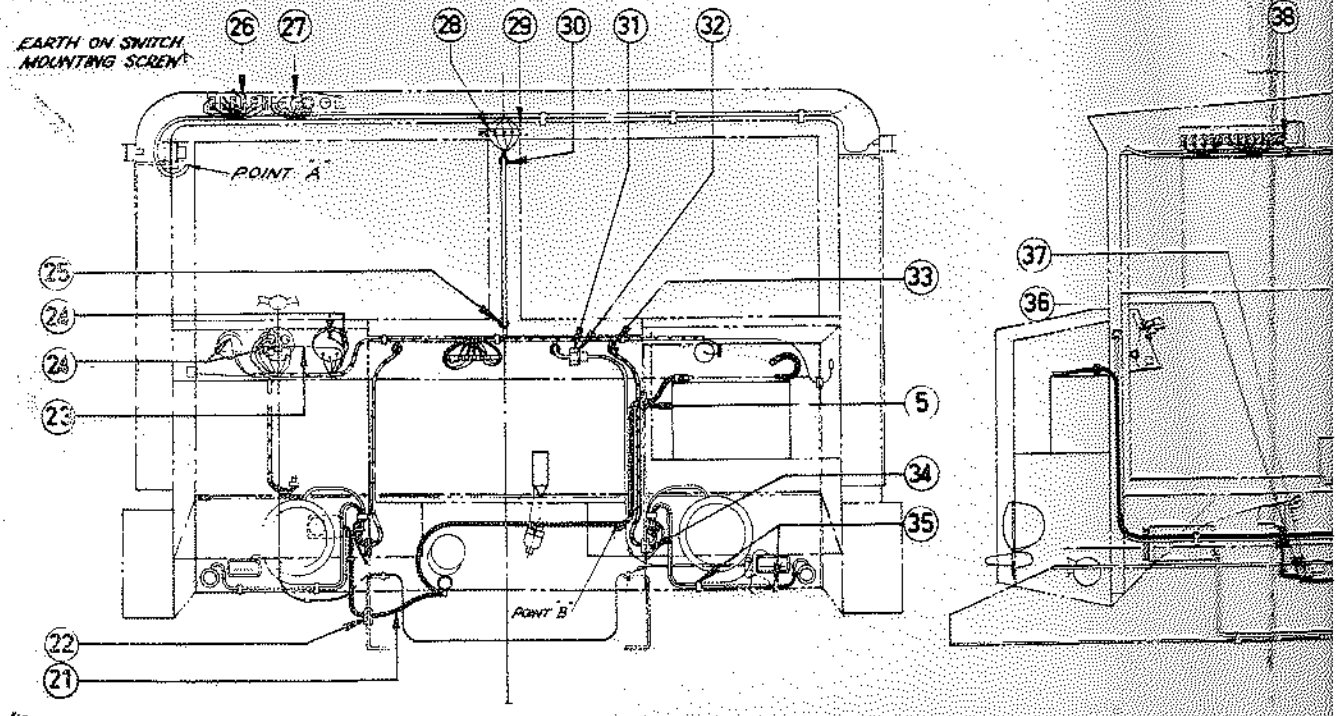
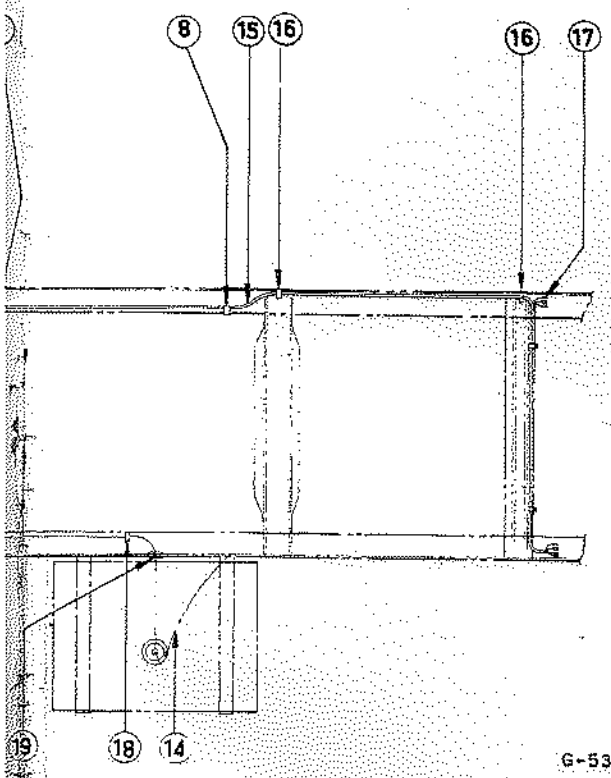


Fig. 3 - Wiring Diagram (Cab Front View)

Fig. 4 - Wiring Diag



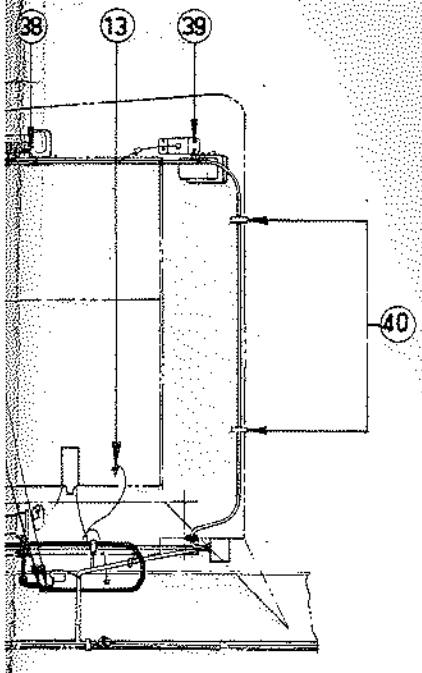


Diagram (Cab Side View)

LEGEND TO FIGS. 2, 3 AND 4

1. CABLE ASSY., GROUND
2. WASHER, LOCK
3. WASHER, LOCK
4. SCREW
5. GROMMET
6. CLIP, CABLE
7. CANNON PLUG AND HARNESS, ASSY
8. CLIP
9. LAMP
10. LIGHT, ASSY. - FRONT WIDTH
11. SEAL - WIDTH LIGHT
12. CLIP
13. NUT
14. CABLE, ASSY. - FUEL TANK GROUND
15. HARNESS, REAR END
16. CLIP, CLOSED
17. CONNECTOR, DOUBLE
18. CLIP
19. GROMMET
20. CABLE, ASSY. CONNECTOR TO LEFT HAND TANK
21. CABLE, ASSY. STARTER TO SLAVE SOCKET
22. GROMMET
23. CABLE, ASSY, WITH SOCKET
24. LAMP
25. GROMMET
26. CABLE, ASSY. - WIPER SWITCH EARTH
27. CABLE, ASSY. - BLACKOUT SWITCH TO HEADLIGHT SWITCH
28. BLOCK, JUNCTION
29. SCREW
30. GROMMET
31. BOLT
32. BRACKET, CANNON RECEPTACLE MOUNTING
33. GROMMET
34. GROMMET
35. CLIP
36. BUS BAR, STARTER MOTOR
37. BOLT
38. CABLE, ASSY. - CIRCUIT BREAKER TO BUZZER
39. SCREW
40. SCREW
41. SOCKET, BATTERY SLAVE

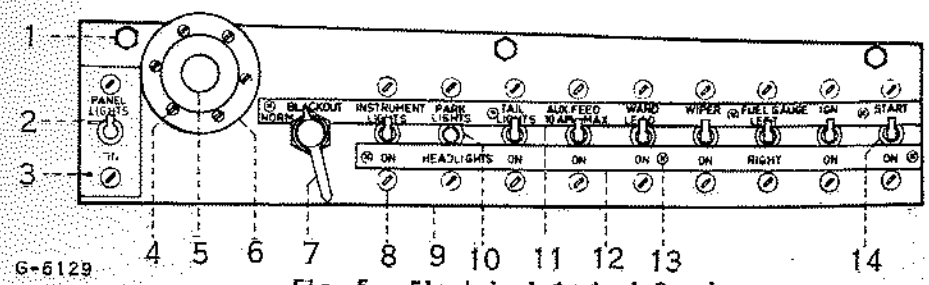


Fig. 5 - Electrical Control Panel

LEGEND TO FIG. 5

1. BOLT, HEX.
2. SWITCH, ASSY. TOGGLE - TWO POSITION
3. PLATE, PANEL LIGHTS SWITCH
4. SCREW
5. LAMP, 12 VOLT
6. LAMP, ASSY.
7. SWITCH, ASSY. BLACKOUT
8. SCREW
9. PLATE, SWITCH MOUNTING
10. SWITCH, ASSY. TOGGLE - THREE POSITION
11. PLATE, DESIGNATION
12. PLATE, DESIGNATION
13. SCREW, RD-HD.
14. SWITCH, ASSY. TOGGLE - TWO POSITION NON LOCK

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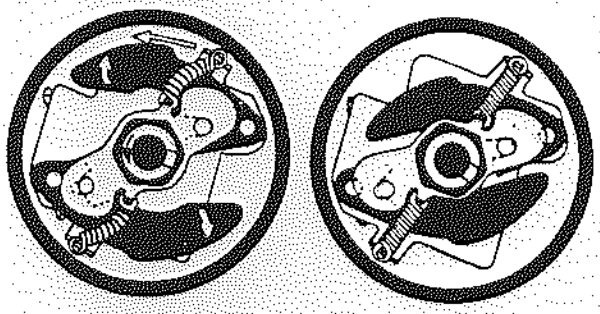
DISTRIBUTOR (Bosch U-Vjur 6BL 62T)

The cup-shaped housing of the distributor contains the automatic timing device, the contact breaker assembly and the distributor proper, which also forms the cover. A vacuum control advance unit whose diaphragm is mechanically connected to the moveable section of the contact breaker assembly is mounted on the outside of the housing. An extension of the distributor housing carries the bearing bushes for the drive shaft; this part fits into the engine block and the drive is taken from the engine oil pump shaft. The distributor incorporates a radio supressed rotor.

OPERATION (Refer to Figs. 1 and 2)

Rotation of the Distributor shaft by the engine drives the distributor cam through the driving plate and centrifugal weights. The cam can rotate through a pre-determined number of degrees in the direction of rotation. This operation is transmitted by the outward movement of the weights and controlled by the springs. (Fig. 1). The cam lobes contact the rubbing block of the contact breaker lever and open the points breaking the primary circuit. The spark which is produced by the coil is directed to the centre tower of the distributor cap, which is made of high quality insulating material, from where it is distributed by the turning rotor, which is made of the same material as the distributor cap, to the cap segments and then to the spark plugs.

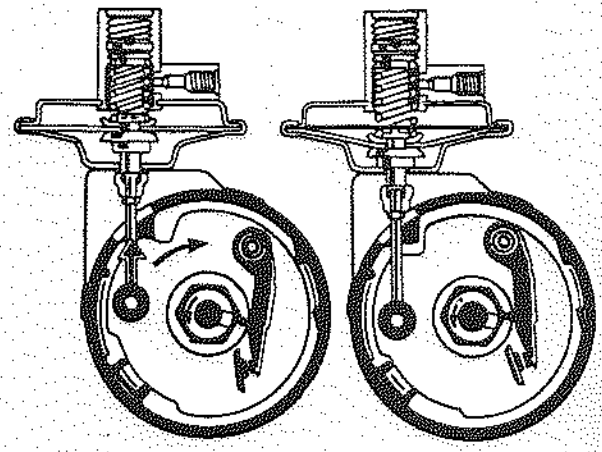
The vacuum control unit provides an additional timing device operating in accordance with engine load. A link from the diaphragm turns the contact breaker plate against the direction of rotation. (Fig. 2). The relationship between degrees of advance and applied vacuum is controlled by spring tension opposing advanced diaphragm movement.



TIMING ADVANCED TIMING RETARDED

G-5629

Fig. 1 - Centrifugal Advance Mechanism



G-5628 TIMING ADVANCED TIMING RETARDED

Fig. 2 - Vacuum Advance Mechanism

DISASSEMBLY (Refer to Fig. 3)

1. Unfasten spring clips (16) holding distributor cap (1) in place and remove cap.
2. Carefully lift the rotor (2) from the cam spindle, and remove dust protection cap (22).
3. Remove primary terminal (17) by unscrewing the outer nut and condensor (14) by removing two screws (13).
4. Remove screw (6) and link (7) which connects the diaphragm actuating link to the contact breaker plate.
5. Remove two screws (18) and detach the vacuum control unit (19) from the distributor housing.
6. Remove two screws (15) holding the spring clips to the housing and threaded into the contact breaker plate (8) and withdraw plate from housing.
7. Press out driving pin (20) securing drive sleeve and remove sleeve (21).
8. Push shaft (12) from housing by applying light pressure at the drive end.
9. Unhook advance control springs (11) from brackets and remove cam (10) and weights (9).
10. Remove spring clip (3), screw (4) and contact set (5).

LEGEND

1. DISTRIBUTOR CAP
2. ROTOR
3. SPRING CLUP
4. SCREW
5. CONTACT BREAKER SET
6. SCREW
7. HOLDING BRACKET
8. CONTACT BREAKER PLATE
9. CENTRIFUGAL WEIGHTS
10. CAM
11. CENTRIFUGAL WEIGHTS SPRING
12. DRIVE SHAFT
13. SCREW
14. CONDENSOR
15. SCREW
16. CAP HOLDING SPRING
17. INSULATING WASHER
18. SCREW
19. VACUUM TIMING CONTROL UNIT
20. GROOVE PIN
21. DRIVING SHAFT BUSHING
22. CONTACT BREAKER DUST GUARD COVER

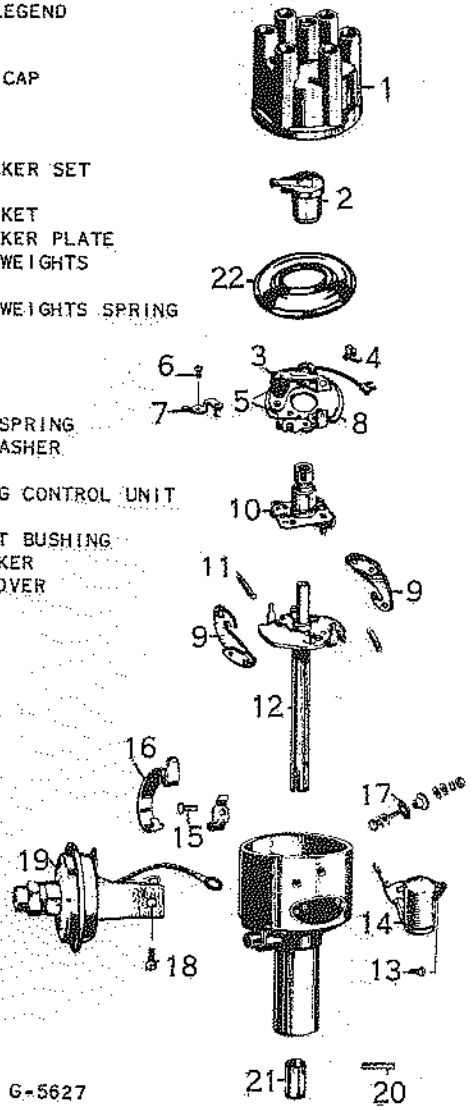


Fig. 3 - Distributor

CHECKING DISMANTLED DISTRIBUTOR COMPONENTS

Check bearing surfaces for wear and replace worn parts. New sintered bushings should be soaked in oil for an hour before installation and a correct fitting mandrel used for pressing out and replacing them. Extreme caution must be exercised not to distort the housing as distortion will necessitate complete housing replacement. Test condenser by means of a suitable tester (Bosch Tester EFAW 105). The body of the condenser must make good contact with the distributor housing, and the connecting wire must be properly connected to the terminal together with the contact breaker lead.

Contact points must not be loose or misaligned in relation to each other. Displaced or distorted contact points should be aligned by means of a suitable setting tool (Bosch Tool EFAW 57). The rubbing block of the contact breaker lever should not be worn. Burnt contact surfaces can be redressed if the pitting and piling is not excessive. Contact spring tension must be tested with a spring balance and should be within 14-17 1/2 ozs.

Failure to comply with any one of the above requirements makes it necessary to replace the contact set with a geniune replacement part.

Distorted or stretched advance springs must be replaced with the correct springs as the springs determine the advance curve which is important to optimum engine performance. The vacuum control unit must be tested for leaks and in the event of a leak being found the complete unit must be replaced.

RE-ASSEMBLY

To assemble distributor reverse disassembly procedure.

IMPORTANT: Cleanliness is essential, oil and grease must be kept away from the electrical contact surface and insulating parts.

The earth lead connected to the inside of the control unit must have its terminal placed under the screw (6).

Ensure gasket is fitted between housing and vacuum unit.

LUBRICATION (Refer to Sect. B)

NOTE: For extremely dusty conditions the inner groove on the top of the dust protection cap can be filled with Bosch grease Ft 1 v 8 or equivalent.

SHAFT END PLAY

Shaft end play must be adjusted at the drive end to .004" - .008" by placing or removing shims from between the drive sleeve and housing.

CONTACT POINT OPENING (DWELL)

Adjust contact point opening by loosening the fixed contact plate securing screw and turning the small eccentric screw at the opposite end of the contact plate, in the required direction to increase or decrease the gap. Point gap should be .012" - .016" or, if checked with a dwell angle meter, 36 - 40°. The contact closing period is determined by the shape of the cam and the contact point opening, and each opening should be equal.

TESTING ADVANCE CURVE

Check advance curve as per values specified below on an approved distributor test bench. Rotate distributor and adjust scale so that at low speed (without centrifugal advance) one of the contact closing points appears at 0°. Increase speed slowly and check automatic advance at the prescribed speeds. Adjustment is made by increasing or decreasing the spring tension as required. The vacuum advance curve can be tested by applying a depression to the vacuum unit and reading the degrees of advance on the scale.

Centrifugal Advance

Deg.	Begin.	5°	10°	15°	End.
Adv.	RPM	RPM	RPM	RPM	RPM
14-16	350-450	590-660	800-960	-	1180-1350

Vacuum Advance

Deg.	Begin.	End.
Adv.	ins.	ins.
9-11	4-3/4 - 6	15

TESTING FIRING INTERVAL

The firing interval for a 6-cyl. engine is obtained at:-

$$\frac{360^{\circ}}{\text{number of cylinders}} = 60^{\circ}$$

On the degree scale, the contact opening (firing angle) must appear at these intervals, admissible tolerance is $\pm 1^{\circ}$.

Where the prescribed test values are not attained, this may be due to the following defects:-

Defect	Remedy
Contact points soiled or contact opening excessive.	Clean and adjust, replace contact set.
Contact pressure too weak.	Replace contact set.
Cam lobes, bearing bushes or shaft worn.	Replace worn parts.
Centrifugal advance incorrect.	Check mechanical operation if this is smooth. Replace springs.
Vacuum advance incorrect.	First check for air leaks in the vacuum unit and replace unit if necessary, then adjust diaphragm spring tension to above specifications.
Battery terminal voltage lower than prescribed.	Check for circuit resistance or low supply voltage.
Electrodes of distributor spark gap burnt.	If burning is excessive replace cap or rotor.
Excessive contact sparking. (To facilitate observation of the contact sparking, remove distributor cap and connect high tension cable from the ignition coil to a test gap.)	Defective condenser or poor condenser connection. Replace condenser or repair connection and replace contact set if pitting is excessive.
Ignition coil winding or series resistance defective (Check coil separately with an ignition coil tester - Bosch tester EFMZ 1A.)	Replace Ignition coil.

SPECIAL TOOLS

The following tools are especially suitable for repairing and testing Distributor U-VJUR 6BL 62T.

Z4/ZDA 0749
Ignition C.R. Aust. No. 1

6625-66-017-3723
Capacitor, Automatic Ignition "Autolab", Model 215

4910-66-017-3657
Ignition Coil, 240V, "Autolab", Model 205

4910-66-017-3646
Ignition Distributor "Vane", Model 410

GENERATOR

(Model C45PV-5)

1. GENERAL

The generator is a shunt-wound two-pole two-brush machine, arranged to work in conjunction with a regulator and cut-out unit. The output of the generator is controlled by the regulator and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When fitting a new control box, it is important to use only an authorised replacement. An incorrect replacement can result in damage to the generator.

With generators having the letter V in their model number, a fan, usually integral with the driving pulley, draws cooling air through the generator, inlet and outlet holes being provided in the end brackets of the unit.

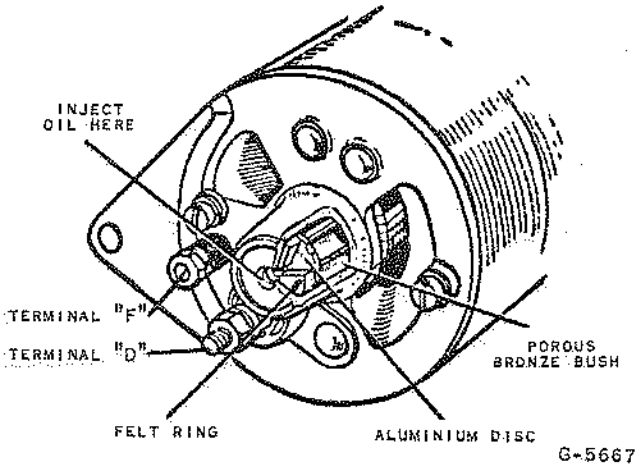


Fig. 1
Details of Lubricator in Commutator End Bracket

2. ROUTINE MAINTENANCE

(a) Lubrication

Every 12,000 miles, inject a few drops of any high quality medium viscosity (S.A.E. 30) engine oil into the hole marked "OIL" at the end of the bearing housing.

(b) Inspection of Brushgear and Commutator

At the same time, remove the metal band cover to inspect the brushgear and commutator. Check that the brushes move freely in their holders by holding back the brush springs and pulling gently on the flexible connectors. If a brush is inclined to stick, remove it from its holder and clean its sides with a clean lint free cloth. Be careful to refit brushes in their original positions in order to retain the bedding. Brushes which are badly worn must be replaced. (See also paragraph 4 (a) (7)

The commutator should be clean, free from oil or dirt and should have a polished appearance. If it is dirty, clean it by pressing a clean dry fluffless cloth against it while the engine is slowly turned over by hand.

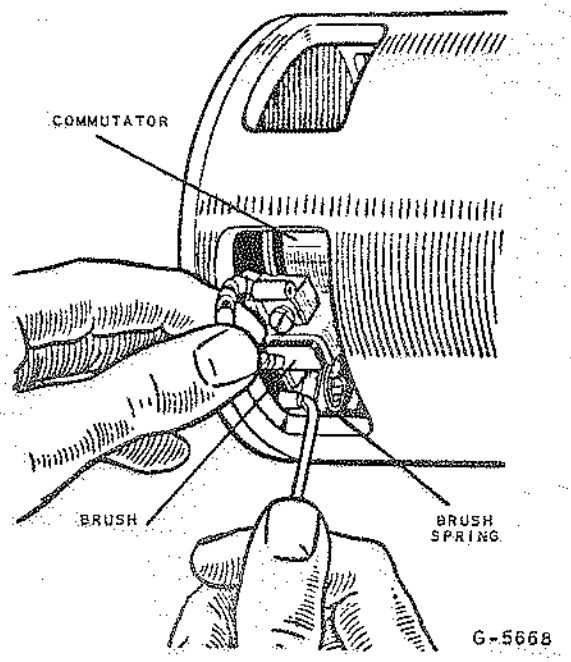


Fig. 2 - Checking Brush Gear

(c) Belt Adjustment

Occasionally inspect the generator driving belt and adjust, if necessary, to take up any undue slackness by turning the generator on its mounting. Care should be taken to avoid over-tightening the belt, the tension needed being just enough to drive without slipping. See that the machine is properly aligned, otherwise undue strain will be thrown on the generator bearings. Approximately 1 inch depression as shown in Fig. 3 is correct.

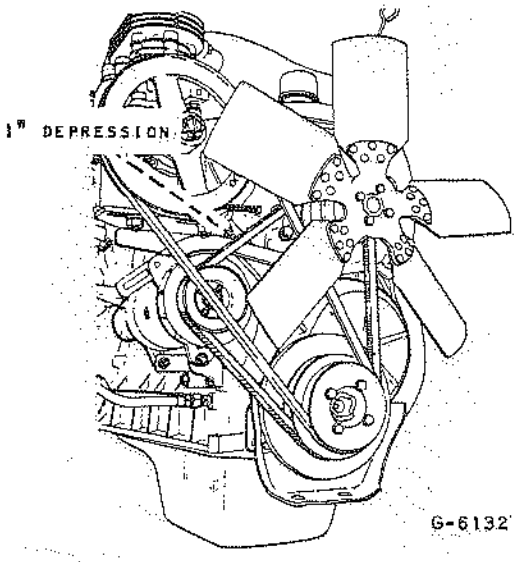


Fig. 3 - Tension Adjustment of Driving Belt

3. PERFORMANCE DATA

Cutting-in speed 1480-1540 rpm at 13 generator volts.

Cold maximum output 30 amps at 1850-2000 rpm at 13.5 generator volts.

Field resistance 6 OHMS, on resistance load 0.61 OHMS.

4. SERVICING

(a) Testing in Position to Locate Fault in Charging Circuit

In the event of a fault in the charging circuit, adopt the following procedure to locate the cause of trouble.

(1) Inspect the driving belt and adjust if necessary (See Para. 2c).

(2) Check that the generator and control box are connected correctly. The larger generator terminal must be connected to control box terminal "D" and the smaller generator terminal to control box terminal "F". With compensated voltage control units, check the earth connection to control box terminal "E".

(3) Switch off all lights and accessories, disconnect the cables from the terminals of the generator and connect the two terminals with a short length of wire.

(4) Start the engine and set to run at normal idling speed.

(5) With "positive-earth" machines, clip the negative lead of a moving coil type voltmeter, calibrated 0-20 volts, to one generator terminal and the other lead to a good earthing point on the yoke.

(6) Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts and do not race the engine in an attempt to increase the voltage. It is sufficient to run the generator up to a speed of 1000 r.p.m.

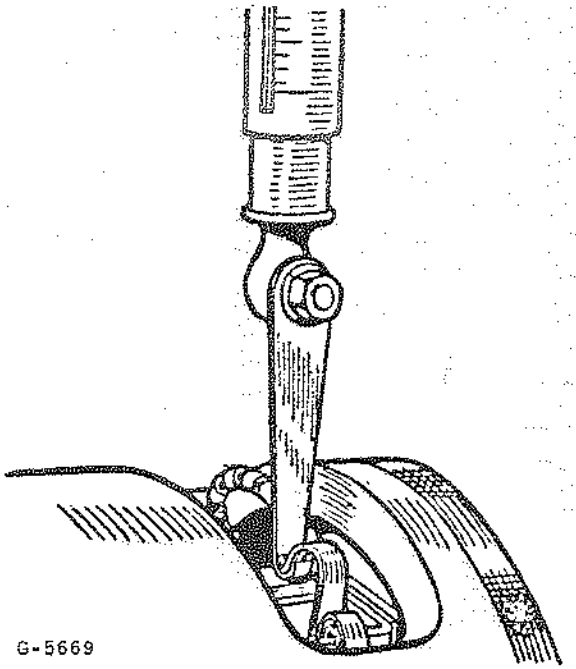


Fig. 4 - Checking Brush Spring Tension

If there is no reading, check the brushgear as described in (7) below. If there is a low reading of approximately 1/2-1 volt, the field winding may be at fault (see Paragraph 4e). If there is a reading of approximately half the nominal voltage, the armature winding may be at fault (see para. (4d).

NOTE: Excessive sparking at the commutator in the above test indicates a defective armature which should be replaced.

(7) Remove the cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always refit brushes in their original positions. If the brushes are badly worn, new brushes must be fitted and bedded to the commutator. The minimum permissible length of brush is 7/16". Test the brush spring tension with a spring scale. The tension of the springs when new is 36-44 oz. In service, it is permissible for these values to fall to 30 oz. before performance may be affected. Fit new springs if the tension is low. If the commutator is blackened or dirty, clean it by holding a clean lint free cloth against it while the engine is turned slowly by hand-cranking.

Refit the cover band and re-test the generator as in para. 4(a) (6).

If there is still no reading on the voltmeter, there is an internal fault and the complete unit, if a spare is available, should be replaced. Otherwise the unit must be dismantled (see Para. 4b) for internal examination.

NOTE: If a capacitor is fitted between the output terminal (or insulated brushbox) and earth, disconnect this capacitor and re-test the machine before dismantling. If a reading is now given on the voltmeter, the capacitor is defective and must be replaced.

(8) Slacken the driving belt and check the generator bearings for free-running by spinning the pulley by hand. If the armature fails to spin freely, with the brushes raised from the commutator, the generator should be dismantled and the bearings examined.

(9) If the generator is in good order, remove the link from between the terminals and restore the original connections, taking care to connect the larger generator terminal to control box terminal "D" and the smaller generator terminal to control box terminal "F". Proceed to test the regulator unit as described under Current and Voltage Regulator.

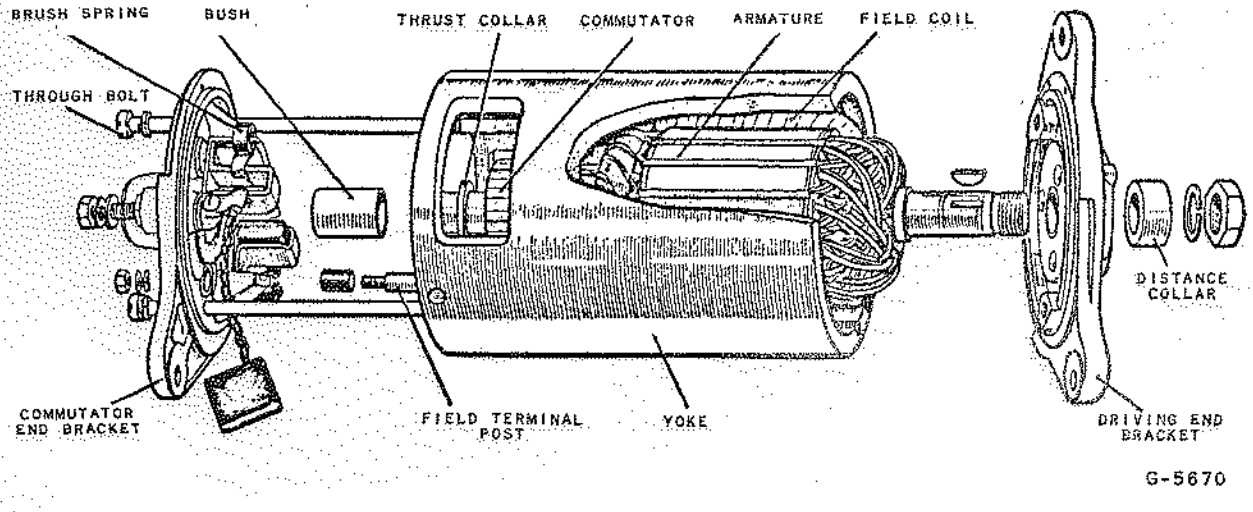


Fig. 5 - Dismantled View of Typical Generator With Yoke Cut Away to Show Interior

(b) To Dismantle (After Removal from Engine)

(1) Take off the driving pulley.

(2) Remove the cover band, hold back the brush springs and remove the brushes from their holders.

(3) Unscrew and withdraw the two through bolts, it will be necessary first to remove the nut, spring washer and flat washer from the smaller terminal (i.e. the Field terminal) on the commutator end bracket.

(4) The commutator end bracket can now be withdrawn from the generator yoke.

(5) The driving end bracket together with the armature can now be lifted out of the yoke. Take care not to lose the fibre thrust washer or collar.

(6) The driving end bracket, which on removal from the yoke has withdrawn with it the armature and armature shaft ball-bearing, need not be separated from the shaft unless the bearing is suspected and requires examination, or the armature is to be replaced; in this event the armature should be removed from the end bracket by means of a hand press.

(c) Commutator

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a clean lint free cloth. If this is ineffective, carefully polish with a strip of fine glass paper while rotating the armature. To remedy a badly worn commutator, mount the armature, with or without the drive end bracket, in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass paper. Emery cloth must not be used on the commutator. Undercut the insulators between the segments to a depth of 1/32" with a hack saw blade ground to the thickness of the insulator. See Fig. 6.

(d) Armature

Indication of an open-circuited armature winding will be given by burnt commutator segments. If armature testing facilities are not available, an armature can be checked by substitution.

To remove the armature shaft from the drive end bracket and bearing, support the bearing retaining plate firmly and press the shaft out of the drive end bracket. When fitting the new armature, support the inner journal of the ball bearing, using a mild steel tube of suitable diameter, whilst pressing the armature shaft firmly home (see also Para. 4g).

No attempt should be made to machine the armature core or to true a distorted armature shaft.

(e) Field Coils

Measure the resistance of the field coils, without removing them from the generator yoke, by means of an ohm meter connected between the field terminal and the yoke.

Field resistance values are tabulated in paragraph 3.

If an ohm meter is not available, connect a 12-volt d.c. supply between the field terminal and generator yoke with an ammeter in series. The ammeter reading in each case should be approximately 2 amperes. Zero reading on the ammeter or an "Infinity" ohm meter reading indicates an open circuit in the field winding.

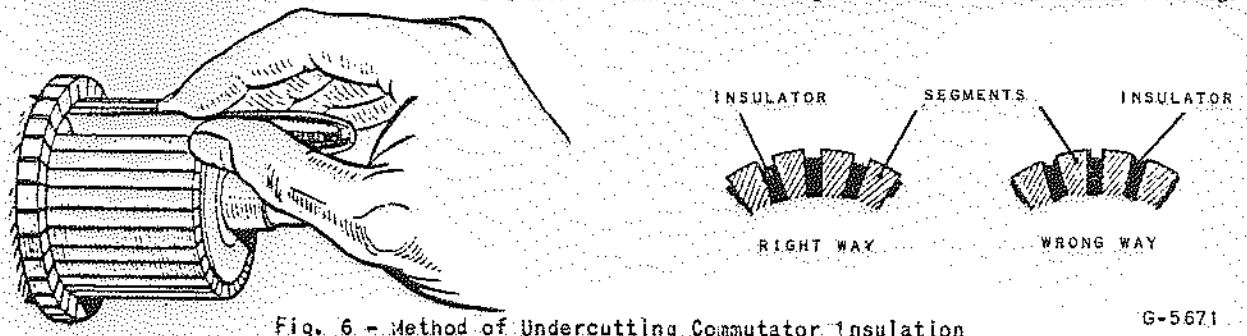


Fig. 6 - Method of Undercutting Commutator Insulation

G-5671

If the current reading is much more than 2 amperes, or the ohm reading much below 6 ohms, it is an indication that the insulation of one of the field coils has broken down.

In either event, unless a substitute generator is available the field coils must be replaced. To do this, carry out the procedure outlined below:-

(1) Drill out the rivet securing the field coil terminal assembly to the yoke, and unsolder the field coil connections.

(2) Remove the insulation piece which is provided to prevent the junction of the field coils from contacting with the yoke.

(3) Mark the yoke and pole shoes so that the latter can be refitted in their original positions.

(4) Unscrew the two pole shoe retaining screws by means of a wheel-operated screw-driver.

(5) Draw the pole shoes and coils out of the yoke and lift off the coils.

(6) Fit the new field coils over the pole shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

(7) Locate the pole shoes and field coils by lightly tightening the fixing screws.

(8) Fully tighten the screws by means of the wheel operated screwdriver and lock them by caulking.

(9) Replace the insulation piece between the field coil connections and the yoke.

(10) Re-solder the field coil connections to the field coil terminal tags and re-rivet the terminal assembly to the yoke.

(f) Bearings

Bearings which are worn to such an extent that they will allow side movement of the armature shaft must be replaced.

To replace the bearing bush in a commutator end bracket, proceed as follows:-

(1) Remove the old bearing bush from the end bracket. The bearing can be withdrawn with a suitable extractor or by screwing an 11/16" tap into the bush for a few turns and pulling out the bush with the tap. Screw the tap squarely into the bush to avoid damage to the bracket.

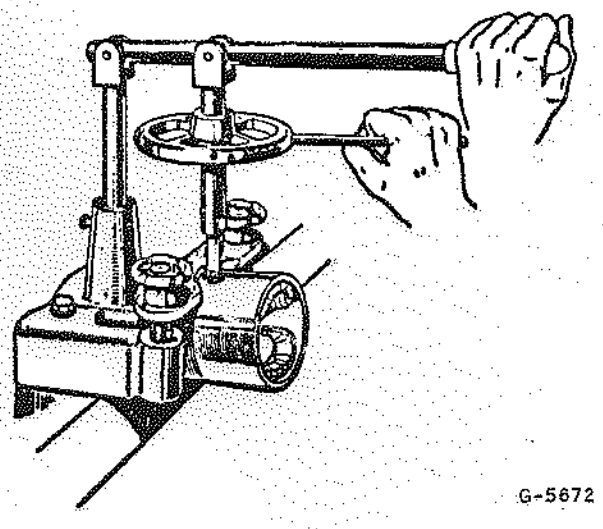


Fig. 7 - Tightening Pole Shoe Retaining Screws

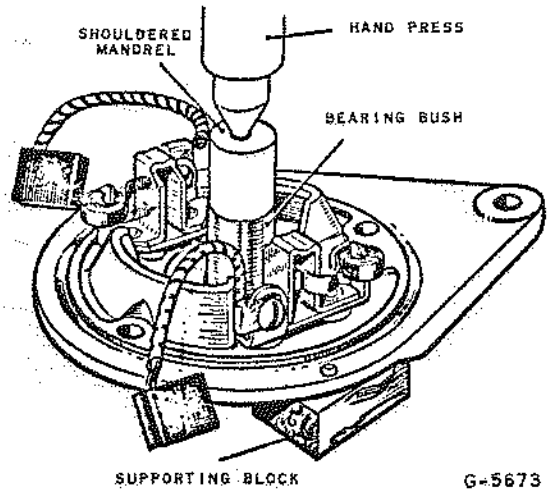


Fig. 8 - Method of Fitting Porous Bronze Bearing Bush

(2) Insert the felt ring and aluminium disc in the bearing housing, then press the new bearing bush into the end bracket, using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing, until the visible end of the bearing is flush with the inner face of the bracket.

Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.

NOTE: Before fitting the new bearing bush it should be allowed to stand for 24 hours completely immersed in a good grade thin engine oil; this will allow the pores of the bush to be filled with lubricant.

The ball bearing at the driving end is replaced as follows:-

(1) Drill out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

(2) Press the bearing out of the end bracket and, remove the corrugated washer, felt washer and oil retaining washer. See Fig. 9.

(3) Before fitting the replacement bearing see that it is clean and pack it with lithium base multi-purpose lubricant.

(4) Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.

(5) Locate the bearing in the housing and press it home.

(6) Fit the bearing retaining plate. Insert the new rivets, from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

(g) Reassembly

In the main the reassembly of the generator is a reversal of the operations described in Para. 4(b).

The dimensions of the drive end bearing housing on Model C45 generator has been modified to give a light push fit for the bearing outer journal instead of a tight press fit.

When fitting any drive end bracket to an armature shaft, the inner journal of the bearing must be supported by a suitable tube. Mild steel tubes approximately 4 in. long and 1/8 inch thick can be used, the internal diameter being 11/16 inch.

Do not use the drive end bracket as a support for the bearing whilst fitting an armature.

After reassembly lubricate the commutator end bearing, referring to Para. 2(a) for the correct procedure.

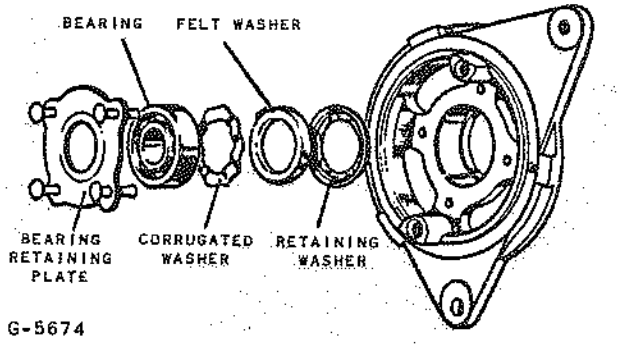


Fig. 9 - Exploded View of Typical Drive End Bearing

CONTROL BOX

1. GENERAL

The model RB310 is a current voltage control box containing a cut-out relay and two regulators, one to control the voltage of the charging system and the other the current.

All electrical and mechanical settings are accurately adjusted during manufacture and it should seldom be necessary to remove a control box cover in service.

(a) Cut-Out Relay

The cut-out relay (usually referred to as "The Cut-Out") is an electro-magnetic switch having its contacts connected between the generator and battery. Two coils, one having a high resistance winding and the other a low resistance winding, are carried on the cut-out bobbin. The high resistance coil is connected in shunt with the generator. When the generator is accelerated from rest, this coil is energised and causes the contacts to close then the generator voltage is high enough to charge the battery. The second coil, connected in series with the generator, carries the charging current and its magnetic effect on the cut-out armature assists that of the shunt coil in keeping the contacts closed. When the generator voltage falls below that of the battery, e.g. when the engine is slowing down or is stationary, the neutralising effect of the resulting discharge or reverse current flowing through the generator windings and the cut-out series coil reduces the magnetic pull on the cut-out armature, so that the contacts open and isolate the generator from the battery.

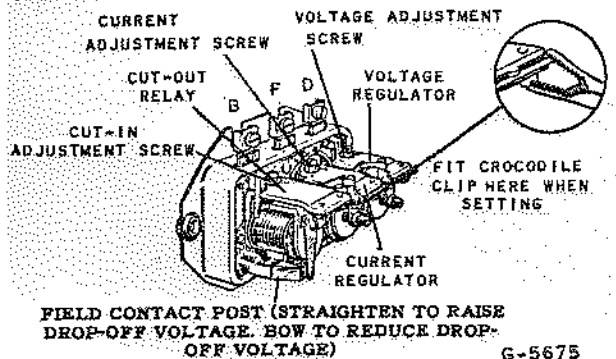


Fig. 1 - Control Box Model RB310 with Cover Removed

(b) Voltage Regulator

The voltage regulator has two coils, one being a high resistance main coil and the other a low resistance frequency (or "bucking") coil. The main coil is connected in shunt with the generator and so makes this regulator responsive only to changes in the system voltage.

The operating frequency of the regulator is largely determined by the inductance of the generator field system and also of the regulator itself. The purpose of the frequency coil is to increase the rate of vibration of the regulator armature (see also below, under "OPERATION"). The coil carries the generator field current and, magnetically, assists the main coil to attract the voltage regulator armature to the bobbin core when both the voltage regulator and current regulator contacts are closed. Immediately either pair of contacts opens, the frequency coil is de-energised and its contribution to the magnetic pull on the armature removed. In this way, the vibration frequency of the armature is increased, resulting in a steadier charging current.

(c) Current Regulator

The current regulator has a single low resistance coil which carries the generator output. This unit is therefore responsive only to changes in the charging current.

(d) Operation

The generator (which must be a shunt wound machine) has its field coils energised via the regulator contacts, these being normally closed and connected in series with the frequency coil.

An alternative circuit is formed by a field current resistor (referred to as the "contacts resistor") connected in parallel with the contacts and frequency coil.

As the generator speed is increased from rest, the field coils are energised and the open circuit voltage rises. When a predetermined voltage is reached, the cut-out relay contacts close and connect the generator to the battery.

Further increase of speed causes the generator voltage to continue rising until, under conditions of light load and a well charged battery, the operating setting of the voltage regulator is reached. At this point, the magnetic attraction of the voltage regulator armature towards the bobbin core causes the contacts to open. The contacts resistor, now in circuit, reduces the field current and causes the generator voltage to fall. This results in a reduced magnetic pull on the regulator armature so that the contacts reclose and the field strength again increases. This cycle is repeated many times per second and the generator voltage is thus limited to the preset value.

However, if the generator voltage fails to reach the operating setting of the voltage regulator, due to a discharged battery or a large electrical loading, an auxiliary means of limiting the generator output to a safe value is necessary and this is the purpose of the current regulator. When the current output of the generator reaches its maximum rated value, the electro-magnetic effect of this current, flowing through the current regulator coil, causes its armature to be attracted to the bobbin core and its contacts to open and the resistor to be inserted in the field circuit. Consequently, the current regulator armature is now set into vibration and a safe limit is imposed on the generator output.

On beginning to charge a flat battery, the voltage of the system is too low for the voltage regulator to operate. Consequently, the current regulator permits the full rated output of the generator to pass to the battery. This continues until the battery approaches a charged condition, when the voltage of the system rises sufficiently to initiate operation of the voltage regulator, the current falls and the current regulator becomes inoperative. In practice, a changeover period often exists when both regulators are in action.

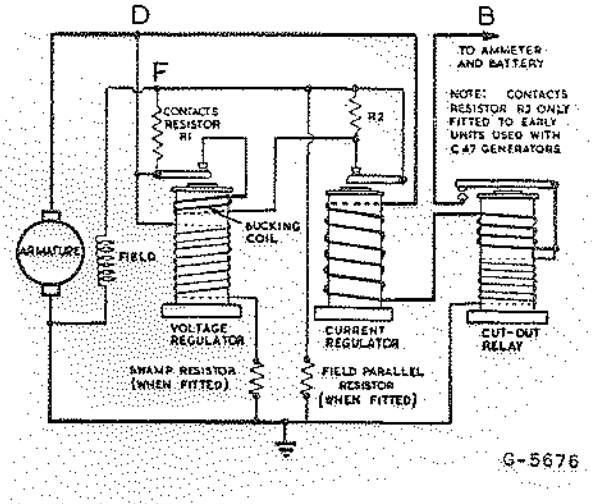


Fig. 2 - Control Box Generator Internal Connections

(e) Temperature Compensation

The main coils of the cut-out and voltage regulator consists of many turns of fine copper wire and, consequently, the ohmic resistance of these coils rises and falls as the temperature rises and falls due in part to ambient working conditions and in part to the normal passage of current. In turn, this causes the operating current and therefore the magnetic pull on the armature to vary inversely with changes in temperature. Thus, to maintain the necessarily close operating limits expected of these units, some form of compensation is required.

The method adopted with the cut-out and voltage regulator is to utilise a bi-metal strip either to supplement or to take the place of the armature tension spring - the hinge spring being of steel, copper coated in cut-outs and blue in voltage regulators. The effect of the bi-metal is to cause the spring force on the armature to reduce with rises in temperature and to increase with falls in temperature. This method also compensates for variations in battery voltage with temperature a higher operating voltage being provided in cold weather.

Current regulators are not compensated, the resistance of the operating coil being too low to vary significantly with changes in temperature.

(f) "Hot Setting"

During manufacture, the control box is heat-soaked at 70°C. before electrical settings of the voltage regulator are made. Then, while at this temperature, the regulator is set on open circuit to very close limits (14.1±0.2 volt). This method known as "hot-setting", ensures that accurate, stable settings obtain at normal working temperatures.

On cooling to 20°C., the temperature compensation device causes units to regulate at higher voltages and between slightly wider limits (15.2 ± 0.6 volt, with "hot-set" units.)

As specified in para. 2 (a) (1), closer limits are necessary when service settings are made at the lower temperature in order to ensure correct regulation at the higher.

2. DESIGN DATA

(a) Electrical Setting of Voltage Regulator

(1) Open Circuit Voltages

14.9-15.5

(2) Conditions for Voltage Measurement

When checking or making settings to the above limits, the following conditions should obtain:

The control box should be connected to its usual generator or to another having the same Service Number.

The generator should be driven at 3,000 r.p.m.

The control box should be mounted so that the plane of its contacts is vertical and the terminals point upwards. (See also page 20 "Current Regulator On-Load Setting, on the Bench").

Checking and setting should be completed as rapidly as possible to avoid heating errors.

The ambient temperature and that of the control box windings should be at approximately 20°C. (68°F.). If not, a temperature correction factor must be applied to the above limits:

(3) Temperature Correction Factor

Correction to be made to the above voltage limit when checking or making settings at temperatures other than 20°C. is as follows:-

For every 10°C. (18°F.) above 20°C., subtract 0.2-volt.

Conversely, the same corrections must be added for every 10°C. below 20°C.

(b) Electrical Setting of Current Regulator

The current regulator must be set to operate at a current value equal to the maximum rated output of the generator it controls. The relevant value is given in this manual, under Generator Performance Data.

(c) Electrical Setting of Cut-Out Relay

Cut-in Voltage	*Drop-off Voltage*
12.7 - 13.3	9.5 - 11.0

NOTE: By means of the bi-metal compensation device, cut-out settings remain substantially constant over a wide range of temperatures. Any small variations in setting due to changes in temperature result merely in proportionately small increases or decreases in the generator cutting-in speed. No temperature correction factors need therefore be applied to the above setting.

(d) Resistor Values

(1) Contacts Resistor - 63 $\pm \frac{12}{3}$ *ohms*

(2) Field Parallel Resistor - 38 $\pm \frac{7}{2}$ *ohms*

(e) Resistance of Shunt Windings at 20°C.

Voltage Regulator	*Cut-out Relay*
103-115 ohms	58-65 ohms

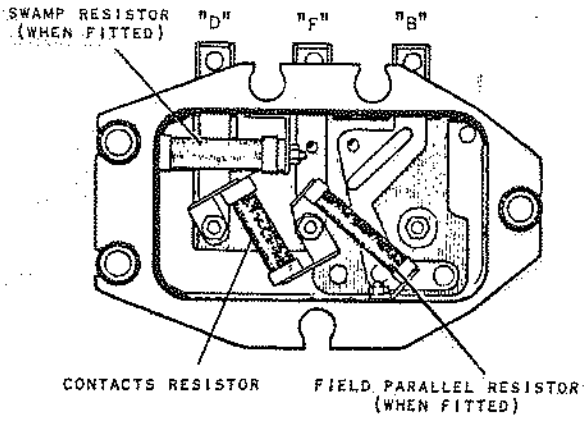


Fig. 3
Underside View of Control Box
Showing Positions of Resistors

3. SERVICING

(a) Fault Diagnosis

Symptom	*Probable Causes*
No output from generator.	Generator driving belt broken. Loose connection or broken cable in charging circuit. Defective generator, control box or ammeter.
Intermittent or low output.	Generator driving belt slipping. Loose connection in charging circuit. Defective generator, control box or ammeter.
Normal output but battery under-charged.	Low mileage Defective battery.
High initial output quickly falling to a low value.	Loose or corroded earth connection. Electrical or mechanical settings of control box incorrect. Sulphated battery plates.
High output and battery over-charged.	Electrical or mechanical settings of control box incorrect.

NOTE: The circuit resistance between the regulator and battery should be 0.02 ohm.

(B) Adjustment of Electrical Settings

(1) Preliminary Checking of Charging Circuit

Before disturbing any electrical settings, ensure that the fault does not lie outside the control box, as follows:

Check the battery by substitution or with an hydrometer and a heavy discharge tester.

Inspect the generator driving belt.

Check the generator by substitution or by linking terminals "D" and "F" and connecting a voltmeter between this link and earth and running the generator up to about 1,000 r.p.m., when a rising voltage should be shown.

Inspect the wiring of the charging circuit and carry out continuity tests between the generator, control box, and ammeter.

Check earth connections, particularly of the control box.

If the generator is run at a fixed speed but the ammeter pointer swings more than the permitted amount to each side of the mean maximum value, the contacts of the voltage regulator or current regulator may need cleaning, or a piece of ferrous swarf or other foreign matter may be affecting the operation, or, if a mechanical setting has been disturbed, the air gap measurement may be incorrect.

(2) Voltage Regulator Open Circuit Setting

Disconnect control box terminal "B".

Connect a first-grade moving coil voltmeter between terminal "D" and earth, using a 0-20 instrument.

Start the engine and run the generator at 3,000 r.p.m., when the open circuit voltage reading should lie between the appropriate limits given in para. 2(a).

If the reading occurs outside the appropriate limits (and a correction for temperature has, when applicable, been made) it will be necessary to stop the engine and make an adjustment.

Access to the adjustment screw is gained by removing the cover of the control box.

Restart the engine and again run the generator at 3,000 r.p.m.

Slacken the locknut of the voltage adjustment screw, turn the screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained, and retighten the locknut. Check the setting by switching off and then raising the speed again to 3,000 r.p.m.

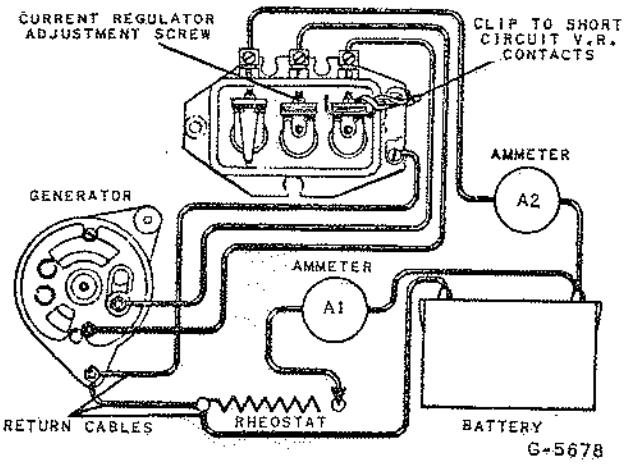


Fig. 4 - Connections for Bench Testing of Current Regulator

(3) Current Regulator On-Load Setting

On the vehicle:

When setting the current regulator on the vehicle, the generator must be made to develop its maximum rated output, whatever the state of charge of the battery might be at the time of setting. The voltage regulator must therefore be rendered inoperative. To do this, the voltage regulator contacts should be short-circuited with a clip large enough to bridge the outer armature assembly securing screw and the insulated fixed contact bracket, as shown in Figs. 1 and 4.

Disconnect the cable from control box terminal "B" and connect a first-grade moving coil 0-40 ammeter between this cable and terminal "B". Switch on all lamps and accessories. This will prevent the voltage of the system rising when the engine is started.

With the generator running at approximately 4,000 r.p.m., the ammeter needle should be steady and indicate a current equal to the maximum rated output of the generator. If it does not, the unit must be adjusted in a manner similar to that described for the voltage regulator.

Remake the original connections.

On the bench:

When setting the current regulator away from the vehicle, a test generator and an artificial load is needed. The load circuit should comprise a 51 ampere-hour battery, a 0-40 ammeter and rheostat capable of carrying up to 35 amperes. The connections are shown in Fig. 4. The control box, it will be noted, is shown with its terminals pointing vertically upwards. This is the position in which electrical settings are made during production and is the mounting position recommended to vehicle manufacturers. However, since settings can be affected by change of position, bench settings should be made with the control box mounted as on the vehicle. Adjust the rheostat until ammeter A1 (Fig. 4) indicates a current slightly in excess of the maximum rated output of the generator normally controlled by the regulator. Run the test generator at approximately 4,000 r.p.m. and adjust the current regulator until the required setting is indicated by ammeter A2.

The permissible tolerances on the current regulator setting is 1-1/2 amperes.

(4) Cut-out Relay Electrical Settings

Cut-in voltage:

Connect a first-grade moving coil voltmeter between control box terminal "D" and earth. Switch on an electrical load, such as the headlamps, and slowly increase the engine speed from zero. Closure of the contacts, indicated by a slight drop in the voltmeter reading, should occur between the limits given in para. 2 (c). If it does not, the unit must be adjusted in a manner similar to that described for the voltage regulator.

NOTE: When setting the cut-in voltage at a test bench, a suitable load resistor capable of passing about 6 amperes without overheating should be connected between control box terminal "B" and earth. This will cause the voltmeter needle to flick, at the instant of contact closure.

Drop-off voltage:
Disconnect the cable from control box terminal "B". Connect a first grade moving coil voltmeter between this terminal and earth. Run the engine up to speed and then slowly decelerate, noting the instant when the voltmeter reading drops to zero. This should occur between the limits given in para. 2(c). If it does not, the spring force exerted by the moving contact blade must be adjusted by altering the height of the fixed contact. To do this, carefully straighten the legs of the fixed contact post to raise the drop-off voltage or bow them to reduce it. Repeat the test and, if necessary, re-adjust until the armature releases at the voltage specified.

As with voltage regulators, the electrical settings of cut-outs should be completed as quickly as possible to avoid errors due to heating.

(c) Cleaning Contacts

When cleaning the voltage or current regulator contacts, use fine carborundum stone or silicone carbide paper, followed by methylated spirits (denatured alcohol).

When cleaning the cut-out contacts, use a strip of fine glass paper-never carborundum stone or emery cloth.

(d) Checking Internal Continuity of Control Box

Single overall continuity checks of the internal connections, windings and resistors can be made by measuring the resistance between certain terminals of the control box. The resistance values quoted below apply for an ambient temperature of 20°C., with all external terminal connections removed.

However, it should be noted that, except for the first of the terminals "D" to "F" checks, these measurements involve parallel circuits having branches of differing resistance values. An overall ohmic reading which falls within the correct limits does not therefore necessarily indicate a good unit. On the other hand, a reading which falls outside the appropriate limits can be assumed to indicate some defect of continuity or resistance, such as open or short circuits and high resistance joints or contacts.

(1) Units with one contacts resistor

Terminal "D" to base:	36-42 ohms
Terminal "D" to terminal "F" with VR or CR contacts open:	60-75 ohms (nominally 63 ohms)

(2) Units with contacts resistor and field parallel resistor

Terminal "D" to base with VR or CR contacts open:	26-31 ohms

(e) Adjustment of Air Gap Settings

(1) Gauge Thickness

Air gap settings are accurately adjusted during assembly and should require no further attention. If, however, an armature is removed for any reason, care must be taken to obtain the correct setting on re-assembly. When setting an armature-to-bobbin core air gap, the correct size of gauge required is determined by the thickness of the non-magnetic separation used in the gap and also, in the case of voltage regulators, on the thickness of the bimetal spring located behind the tensioning spring of the armature.

The above variable features are easy to identify and are as follows:

0.015" separation is by means of a disc of copper.

0.009" separation is by means of a square of copper.

0.012" bi-metal springs are bright and unplated.

0.010" bi-metal springs are copper plated.

A flat steel gauge of 0.015", 0.018" or 0.021" is used as follows:

VOLTAGE REGULATORS:

Use a 0.015" gauge for units fitted with a 0.015" disc of copper and a bi-metal spring of either 0.010" or 0.012" thickness.

Use a 0.018" gauge for units fitted with a 0.009" square of copper and a bi-metal spring of 0.012" thickness.

Use a 0.021" gauge for units fitted with a 0.009" square of copper and a bi-metal spring of 0.010" thickness.

CURRENT REGULATORS:

Use a 0.015" gauge for units fitted with a 0.015" disc of copper.
Use a 0.018" gauge for units fitted with a 0.009" square of copper.

(2) Voltage and Current Regulator Mechanical Settings

Slacken the two armature assembly securing screws so that the armature is loosely attached to the regulator frame.

Slacken the fixed contact locking nut and unscrew the fixed contact adjustment screw until it is well clear of the armature moving contact.

Slacken the voltage (or current) adjustment screw locking nut and unscrew the adjustment screw until it is well clear of the armature tension spring.

Using a flat steel gauge of appropriate thickness (see para. 4(e) (1)) and wide enough to cover the bobbin core, insert the gauge between the underside of the armature and the copper disc or square. Take care not to turn up or damage the edge of the disc or square.

Press the armature down squarely against the gauge and retighten the two armature assembly securing screws.

With the gauge still in position, screw in the fixed contact adjustment screw until it just touches the armature moving contact. Retighten the locking nut.
Carry out the electrical settings as given in para. 3(b) (2) and (3).

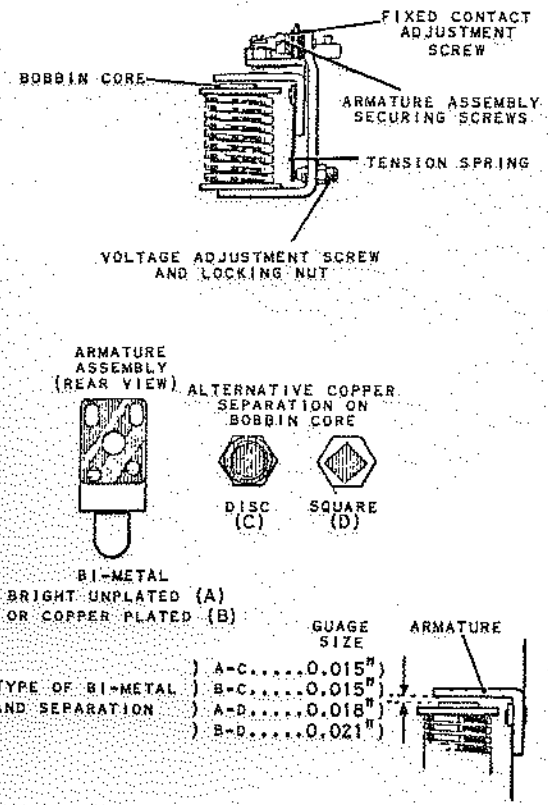


Fig. 5

Mechanical Setting of Voltage Regulator

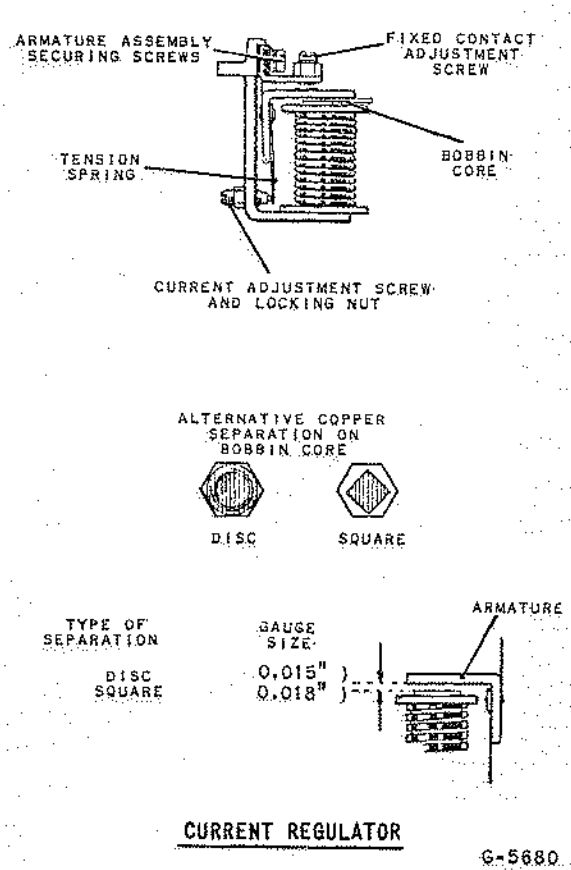


Fig. 6

Mechanical Setting of Current Regulator

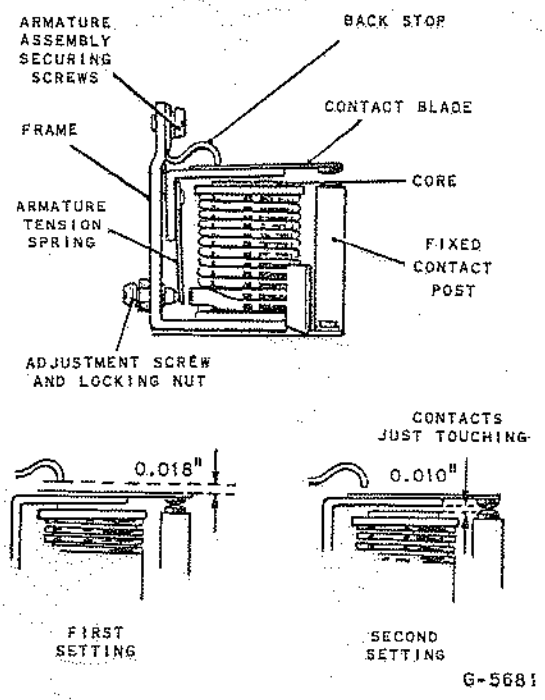


Fig. 7
Mechanical Settings of Cut-Out Relay

(3) Cut-out Relay Mechanical Settings

Slacken the two armature assembly securing screws so that the armature is loosely attached to the cut-out frame. Slacken the adjustment screw locking nut and unscrew the adjustment screw until it is well clear of the armature tension spring.

Press the armature down squarely against the core face fitted with a square of copper and retighten the two armature assembly securing screws. No gauge is necessary.

Press the armature down against the core face and adjust the armature back stop so that a 0.018" gap is obtained between the tip of the back stop and the contact blade.

Insert a 0.010" thick flat steel gauge between the underside of the armature and the copper separation. The gauge should be inserted from the side of the core nearest the fixed contact post. The leading edge of the gauge should not be inserted beyond the centre line of the core face. Press the armature down against the gauge and check the cut-out contacts. These should be just touching.

If necessary, adjust the height of the fixed contact by carefully straightening or bowing the legs of the fixed contact post.

Carry out the electrical setting as given in para. 3(b) (4).

4. RADIO INTERFERENCE SUPPRESSION

Interference with vehicle radio originating at the control box can be recognized by periods of continous crackling and is caused by normal regulator action. This interference can only be eliminated or reduced by electrical filtering and no attempt should ever be made to remedy it by the indiscriminate fitting of capacitors or by tampering with the regulator contacts. The remedy to be adopted depends on the type of radio equipment carried by the vehicle.

Interference with normal vehicle radio can be cured by fitting a supressor unit, model WS14. This unit incorporates a filter circuit comprising a choke and two capacitors and is designed for direct attachment to terminals "D" and "F" of control box.

WARNING: Under no circumstances should capacitors be connected to control box terminal "F", or to the generator field terminal, or in parallel with the regulator contacts. Attempts to correct regulator interference in this way can affect the proper functioning of the charging system and may cause damage to the regulators.

If replacement of an existing suppressor unit becomes necessary, it is important to use only authorised spares. The electrical values of filter components are critical, both with respect to regulator performance and to the frequency ranges over which suppression is required.

STARTING MOTOR

SECTION 1 - GENERAL DESCRIPTION

The starting motor is a fourpole four-brush earth-return machine with series-parallel connected field coils.

A solenoid-operated pre-engaged drive assembly is carried on an extension of the armature shaft. The main features of this type of drive are:-

(1) Positive pinion engagement, which prevents the pinion being thrown out of mesh whilst starting.

(2) A roller clutch incorporated in the assembly which provides over-speed protection for the armature.

(3) A pre-engaging pinion to ensure smooth engagement of the pinion and flywheel teeth, before the starter transmits torque to the engine flywheel gear.

(4) An armature brake to ensure rapid return to rest when the starter switch is released.

SECTION 2 - OPERATION

(1) When the starter switch is depressed to "ON", a solenoid unit mounted on the starting motor yoke is energised, and actuates a forked lever (14) Figs. 1 and 2, to engage the drive pinion with the engine flywheel gear.

(2) On occasions of tooth to tooth abutment axial movement of the drive pinion is momentarily arrested, but the engagement lever continues to move the operating bush (36) Fig. 2, and also the operating sleeve (37), thus compressing the engagement spring (38), until the starter switch in the solenoid is closed, and the armature starts to rotate. The pinion then turns, and snaps into engagement with the flywheel, under the spring pressure.

(3) The helical splines on the armature shaft also provide a slight time lag between pinion speed and armature speed, to permit full tooth engagement with the flywheel gear, before the starter driving torque is transmitted to the flywheel.

(4) The helical splines also assist axial movement of the pinion into mesh.

(5) When the engine fires, and the starter switch is released, the solenoid unit is de-energised and the spring loaded plunger (34) Fig. 1 and 2, withdraws the drive pinion to its out of mesh position.

(6) The armature is then brought rapidly to rest by the centrifugal action of the spring loaded brake shoes (6) Fig. 1 and 2, bearing against the brake drum situated in the commutator end bracket (30) Fig. 1 and 2.

(7) Provision is made to ensure that in the case of the pinion jamming in mesh (this may occur with an engine which fails to start), there is sufficient slack in the engagement lever-to-solenoid plunger linkage to permit the solenoid switch contacts to open.

LEGEND TO FIG'S 1 AND 2.

1. SPIRAL TENSION SPRING
2. ELECTRICAL CONTACT BRUSH
3. COMMUTATOR END BRACKET BUSH
4. FIBRE WASHER
5. THRUST WASHER
6. ARMATURE SHAFT, BRAKE SHOE
7. ARMATURE SHAFT BRAKE SHOE SPRING
8. BRUSH ACCESS COVER BAND
9. COVER BAND CORK SEAL
10. CONNECTOR STRAP (SOLENOID TO STARTER)
11. FIELD COIL
12. POLE SHOE
13. ARMATURE
14. PINION ENGAGING SHIFTER FORK
15. TERMINAL NUT
16. TERMINAL WASHER
17. RELAY SOLENOID
18. END BELL
19. DRIVE END BRACKET BUSH
20. SHIFTER FORK PIVOT ECCENTRIC SCREW
21. THRUST WASHER
22. RETAINING RING
23. THRUST COLLAR
24. DRIVE ASSEMBLY
25. INTERMEDIATE BRACKET BUSH
26. INTERMEDIATE BRACKET
27. FIELD TERMINAL
28. BRAKE RING
29. THROUGH FIXING SCREW
30. COMMUTATOR END BRACKET
31. COMMUTATOR
32. YOKE
33. RETURN SPRING
34. PLUNGER
35. CLEVIS PIN
36. OPERATING BUSH
37. OPERATING SLEEVE
38. ENGAGEMENT SPRING
39. ROLLER CLUTCH
40. ARMATURE SHAFT EXTENSION

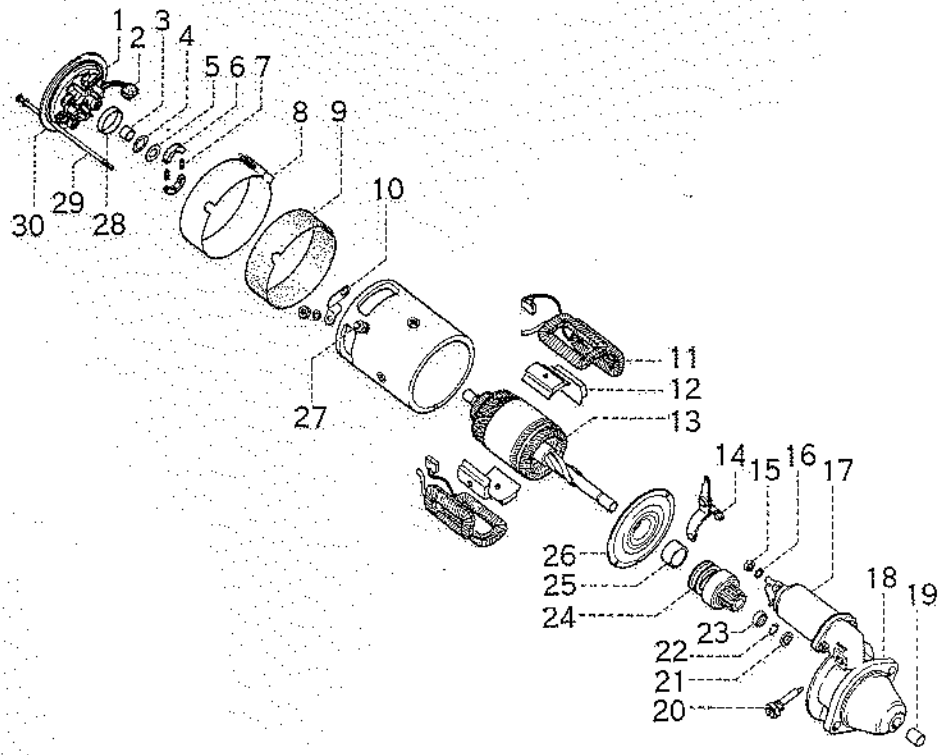


Fig. 1 - Exploded View of Starting Motor

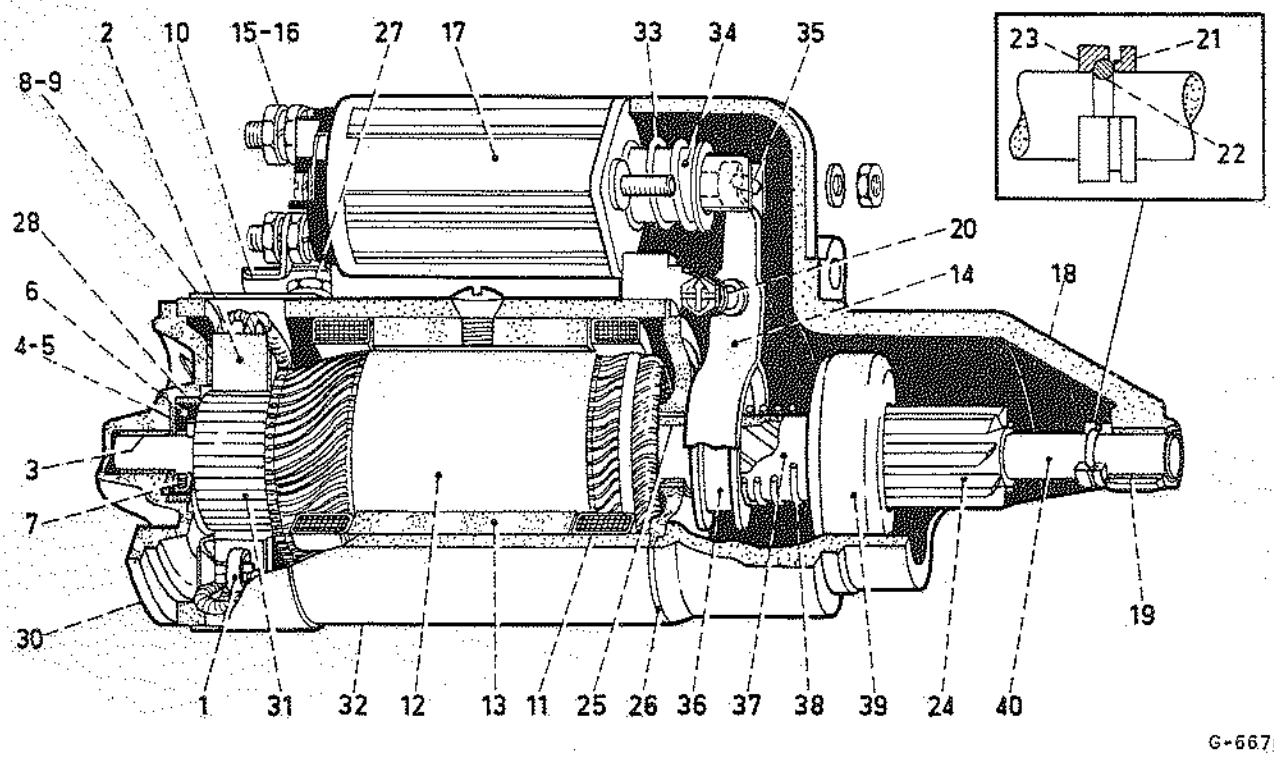


Fig. 2 - Sectional View of Starting Motor

(8) In the event of the drive remaining in mesh with the flywheel after the engine has run up to speed, the starting motor armature is protected from over-speeding by the roller clutch assembly (Fig. 3). This clutch allows torque to be transmitted from the starting motor to the engine but not in the reverse direction which is free-running.

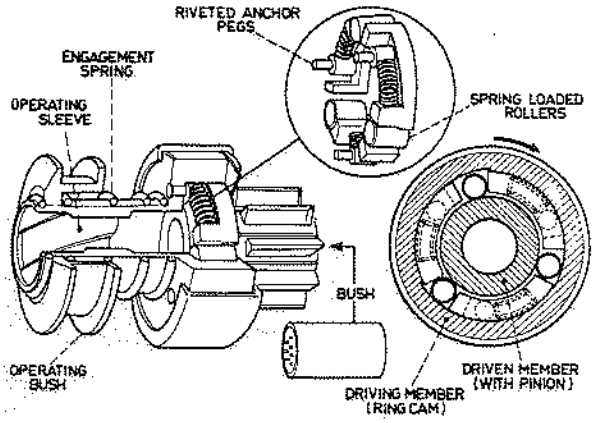


Fig. 3 - Starter Drive Assembly

SECTION 3 - MAINTENANCE

(1) The starting motor requires no routine maintenance beyond the occasional inspection of the electrical connections which must be clean and tight.

Two Yearly Examination

(1) After the starting motor has been in service for two years, remove the starting motor from the engine and submit it to a thorough bench inspection, as detailed in Section 8.

(2) Check pinion movement and adjust as detailed in Section 9.

(3) Clean and lubricate the indented bearing inside the pinion sleeve using a bentonite based grease, such as Ragosine "Bentone", for this purpose. This should also be done any time when the drive becomes sluggish in operation.

SECTION 4 - PERFORMANCE DATA

(a) Starting Motor

(1) Light running current:- 80 amp. at 8500 R.P.M.

(2) Lock torque: 13.5 lb with 430 amp. at 6 terminal volts.

(3) Torque at 1000 R.P.M. : 6.5 ft.lb. with 270 amp. at 8 terminal volts.

These figures are based on the use of a fully charged 12 volt battery having a capacity of 115 amp. hr. at the 10 hour rate.

(b) Solenoid

(1) Operating coil resistance: 0.36 - 0.42 ohm.

(2) Holding coil resistance: 1.49 - 1.71 ohm.

(3) Spring pressure to close contacts: 4.5 - 8 lbs. (with plunger return spring removed).

(4) Spring pressure to push plunger home 13 - 18 lbs.

(5) Plunger movement to close contacts: 0.092" - 0.171".

(6) Total plunger movement: 0.203 - 0.221".

SECTION 5 - TESTING AND SERVICING

(a) Testing in Position

Switch on the headlamps, operate the starter switch and watch for the following symptoms:

(1) THE LAMPS DIM AND THE MOTOR DOES NOT CRANK THE ENGINE.

Check by hand-cranking that the engine is not abnormally stiff.

Check the battery by substitution.

(2) THE LAMPS DO NOT DIM AND THE MOTOR DOES NOT CRANK THE ENGINE.

Check the starter circuit for continuity.

Check the solenoid unit.

If the armature rotates, check for a defective drive mechanism.

(b) Bench Testing

(1) Disconnect the battery. Disconnect and remove the starting motor from the engine.

(2) MEASURING THE LIGHT RUNNING CURRENT. With the starting motor securely clamped in a vice and using a 12-volt battery, check the light running current as in Figure 4, and compare with the values given in Section 4. If there appears to be excessive sparking at the commutator, check that the brushes are clean and free to move in their boxes, and that the spring pressure is correct. See symptoms 7 and 8 in Section 6.

(3) MEASURING LOCK TORQUE AND LOCK CURRENT. Carry out a torque test as in Fig. 5 and compare with the values given in "Section 4".

If a constant voltage supply is used it is important to adjust this to 6 volts measured at the starter terminal.

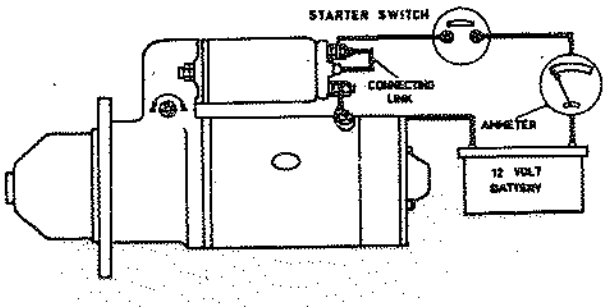


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Fig. 4 - Measuring Light Running Current

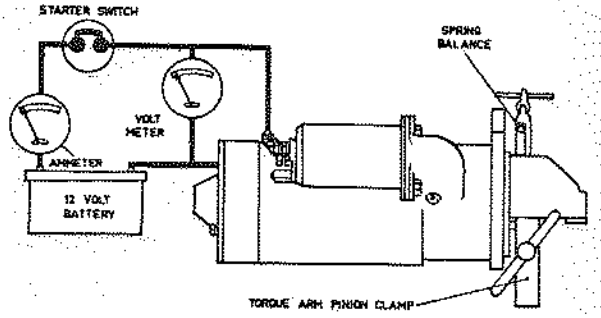

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Fig. 5 - Measuring Lock Torque and Lock Current

A suitable apparatus for measuring lock torque and lock current is shown in Fig. 6.

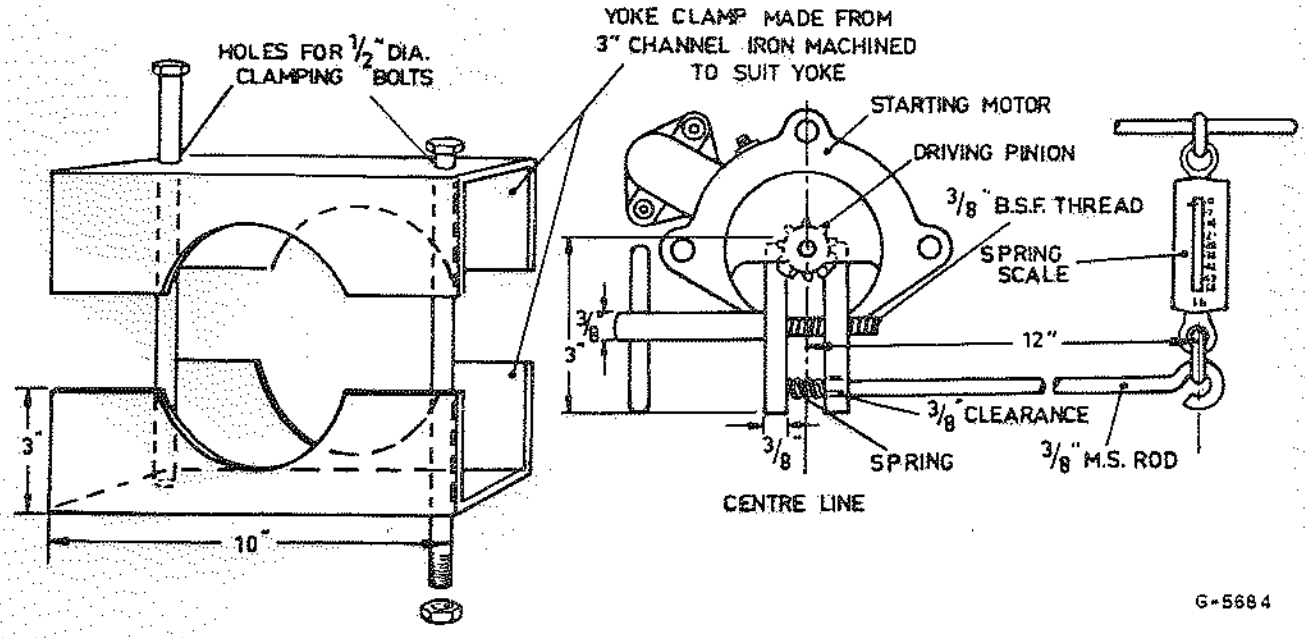

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Fig. 6 - Apparatus for Measuring Lock Torque

SECTION 6 - FAULT DIAGNOSIS

An indication of the nature of the fault, or faults may be deduced from the results of the no-load and lock torque tests.

	SYMPTOM	PROBABLE FAULT
1.	Speed, torque and current consumption correct.	*Assume motor to be in normal operating condition.*
2.	Speed, torque and current consumption low.	*High resistance in brush gear, e.g. faulty connections, dirty or burned commutator causing poor brush contact.*
3.	Speed and torque low. current consumption high.	*Tight or worn bearings, bent shaft, insufficient end play, armature fouling a pole shoe, or cracked spigot on drive end bracket. Short-circuited armature, earthed armature or field coils.*
4.	Speed and current consumption high, torque low.	*Short-circuited windings in field coils.*
5.	Armature does not rotate, no current consumption.	*Open-circuited armature, field coils, or solenoid unit. If the commutator is badly burned there may be poor contact between brushes and commutator.*
6.	Armature does not rotate, high current consumption.	*Earthed field winding or short-circuited solenoid unit. Armature physically prevented from rotating.*
7.	Excessive brush movement causing arcing at commutator.	*Low brush spring tension, worn or out-of-round commutator, "Thrown" or high segment on commutator.*
8.	Excessive arcing at the commutator.	*Defective armature windings, sticking brushes or dirty commutator.*

SECTION 7 - DISASSEMBLY

(1) Disconnect the copper link between the lower solenoid terminal and the starting motor yoke.

(2) Remove the solenoid unit securing nuts. Withdraw the solenoid from the drive end bracket casting, carefully disengaging the solenoid plunger from the starter drive engagement lever.

(3) Remove the cover band and lift the brushes from their holders.

(4) Unscrew and withdraw the two through bolts from the commutator end bracket. The commutator end bracket and yoke can now be removed from the drive end bracket.

(5) Loosen the nut securing the eccentric pin (20) Fig's 1 and 2, on which the starter drive engagement lever pivots, and remove the pin, which is threaded into the D/E bracket.

(6) Separate the drive end bracket from the armature and intermediate bracket assembly.

(7) Remove the thrust washer from the armature shaft, tap the thrust collar away from the snap ring and remove the snap ring. Slide the drive assembly and engagement lever off the shaft.

(8) Slide the intermediate bracket (26) Figs. 1 and 2, off the shaft.

(9) Thoroughly clean all parts with a suitable solvent, and dry them off with a dry air blast.

SECTION 8 - BENCH INSPECTION

After dismantling the starter motor, thoroughly clean all parts with a suitable solvent, and examine individual components as follows:-

1. Solenoid

The solenoid unit contains two coils; a closing coil which is by-passed when the plunger is drawn fully home, and a hold-on coil to retain the plunger in the fully home position. To check the individual coils, remove the existing connections and using a constant voltage 4-volt D.C. supply with cables of adequate size, proceed as follows:-

CLOSING COIL:

Connect the supply between the solenoid terminal marked "STA" and the solenoid cable terminal. This should actuate the plunger and cause a current of 14.8-17.4 amperes to pass.

HOLD-ON COIL:

(1) Connect the supply between the solenoid body and the small centre terminal. This should actuate the plunger and cause a current of 4.5-5.6 amperes to pass.
N.B. Do not carry out these tests while the solenoid unit is hot.

(2) Check to ensure that the inner terminal nuts are tight. If these are loose the switch contacts inside the bakelite can move out of position and cause faulty operation.

(3) If a constant voltage supply is not available check the coil resistances, using an accurate method of measuring low resistance values, such as the Wheatstone Bridge. Connect the measuring instrument as for measuring the current and compare the resistances with those given in "Section 4". Also check the spring pressure and plunger travel with the figures given in "Section 4". If, after testing, the solenoid is found to be faulty, it should be replaced by a serviceable unit. DO NOT ATTEMPT TO REPAIR A FAULTY SOLENOID.

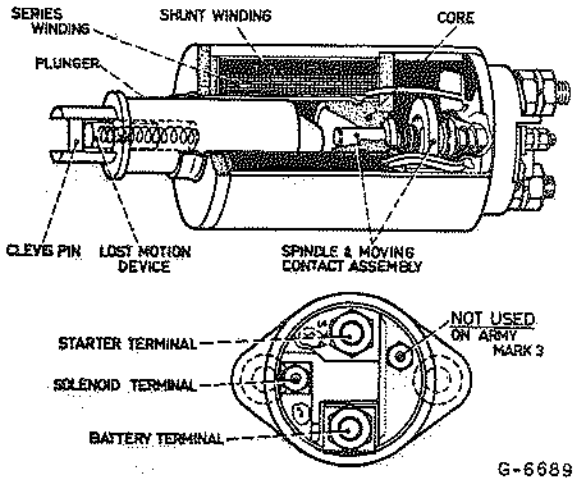


Fig. 7 - Solenoid Unit

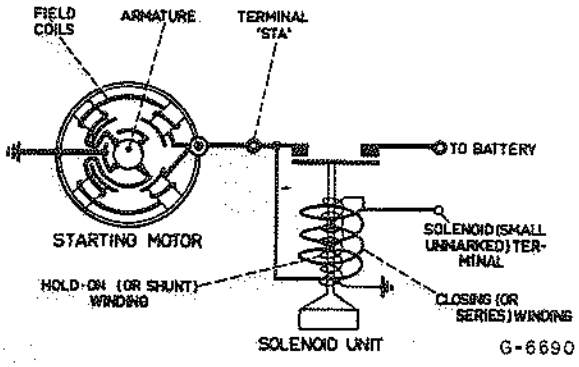


Fig. 8 - Starter and Solenoid Circuit

2. Brushes

Brushes should be checked and renewed if the length is down to or approaching close to 5/16 inch.

3. Replacement of Brushes

(1) The flexible connectors are soldered to terminal tags; two are connected to brush boxes, and two are connected to free ends of the field coils. Unsolder these flexible connectors and solder the connectors of the new brush set in their place.

(2) The brushes are pre-formed so that "bedding" to the commutator is unnecessary.

(3) Check that the new brushes can move freely in their boxes.

BRUSH SPRING TENSION:

Correct tension is 30-40 oz. Renew springs if tension has dropped below 25 oz.

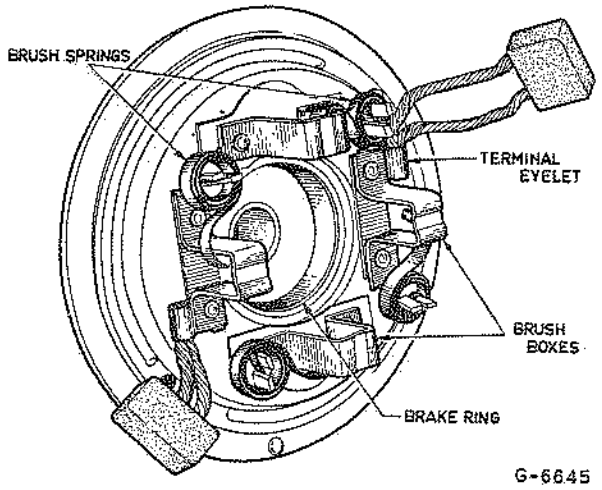


Fig. 9 - Commutator End Bracket

4. Field Coils

CONTINUITY TEST:

Connect a 12-volt test lamp and battery between the insulated terminal on the yoke and each individual brush (with the armature removed from the yoke). Ensure that both brushes and their flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated. Replace the defective coils.

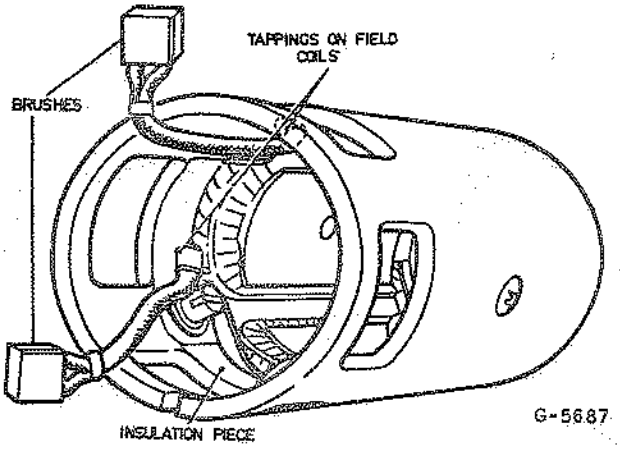


Fig. 10 - Brush Connections to Field Coils

INSULATION TEST:

(1) Connect a 110-volt A.C. test lamp between the terminal post and clean part of the yoke. The test lamp lighting, indicates that the field coils are earthed to the yoke and must be replaced.

(2) When carrying out this test, check also the insulated pair of brush boxes on the commutator end bracket. Clean off all traces of brush deposit before testing. Connect the 110-volt test lamp between each insulated brush box and the bracket. If the lamp lights this indicates faulty insulation and the end bracket must be replaced.

REPLACING THE FIELD COILS:

(1) Unscrew the four pole-shoe retaining screws using a wheel-operated screw-driver. Remove the insulation piece which is fitted to prevent the inter-coil connectors from contacting with the yoke.

(2) Draw the pole shoes and coils out of the yoke and lift off the coils.

(3) Fit the new field coils over the pole shoes and place them in position inside the yoke. Ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

(4) Locate the pole shoes and field coils by lightly tightening the retaining screws.

(5) Replace the insulation piece between the field coil connections and the yoke. Finally, tighten the screws by means of the wheel-operated screwdriver while the pole pieces are held in position by a pole shoe expander, (see Fig. 11), or a mandrel of suitable size.

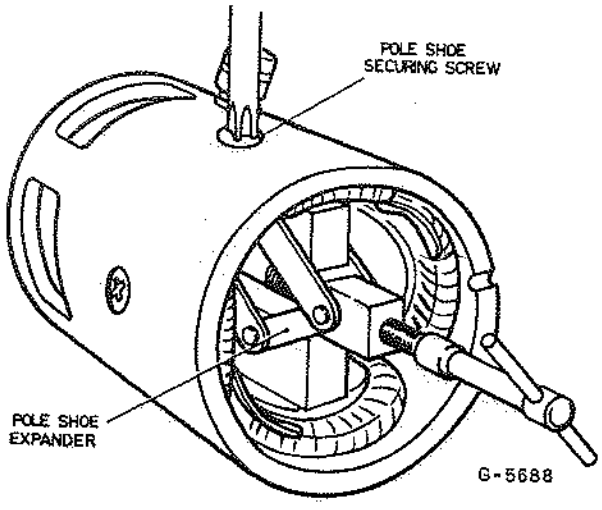


Fig. 11 - Tightening Pole Shoe Retaining Screws Using Pole Shoe Expander

5. Armature

LIFTED CONDUCTORS:

If the armature conductors are found to be lifted from the commutator risers, over-speeding is indicated. In this event, check that the drive assembly is disengaging correctly when the engine fires.

INSULATION TEST:

(1) To check armature insulation, use a 110 volt A.C. test lamp. The test lamp must not light when connected between any one commutator segment and the armature shaft.

(2) If a short circuit is suspected check the armature on a "growler". Overheating can cause blobs of solder to short circuit the commutator segments.

(3) If the cause of an armature fault cannot be located or remedied, fit a replacement armature.

(4) Fouling of armature core against the pole faces indicates worn bearings or a distorted shaft. A damaged armature must in all cases be replaced and no attempt should be made to machine the armature core or to true a distorted armature shaft.

6. Bearings and Bearing Replacement

(1) The commutator and drive end brackets are each fitted with a porous bronze bush and the intermediate bracket is fitted with an indented bronze bearing.

(2) Replace bearings which are worn to such an extent that they will allow excessive side play of the armature shaft.

(3) The bushes in the intermediate and drive end brackets can be pressed out, whilst that in the commutator end bracket is best removed by inserting a 11/16" tap squarely into the bearing and withdrawing the bush with the tap.

(4) Before fitting a new porous bronze bearing bush hold it on end on one thumb, fill it with clean engine oil, then pressurize the oil with the other thumb until the oil can be seen seeping from the outer surface of the bush.

(5) Fit new bushes by using a shouldered, highly polished mandrel approximately 0.0005" greater in diameter than the shaft which is to fit in the bearing. Porous bronze bushes must not be reamered out after fitting, as the porosity of the bush will be impaired.

(6) After fitting a new intermediate bearing bush, lubricate the bearing surface with Ragosine Molybdenised Non-creep oil.

COMMUTATOR

A commutator in good condition will be burnished and free from pits or burned spots. Clean the commutator with a fluffless cloth. Should this be ineffective spin the armature and polish the commutator with fine glass paper; remove all abrasive dust with a dry air blast. If the commutator is badly worn, mount the armature between centres in a lathe, rotate at high speed and make a light cut with a very sharp tool. Do not remove more metal than is necessary. Finally polish with very fine glass paper. The INSULATORS between the commutator segments MUST NOT BE UNDERCUT.

7. The Roller Clutch Drive

A roller clutch drive assembly in good condition will:-

(1) Provide instantaneous take-up of the drive in the one direction.

(2) Rotate easily and smoothly in the other.

(3) Be free to move round or along the shaft splines without roughness or tendency to bind.

(4) The operating bush must be free to slide smoothly along the driving sleeve when the engagement spring is compressed. See Fig. 3.

(5) The roller clutch is not repairable and should be replaced complete if found to be faulty.

SECTION 9 - ASSEMBLY

After cleaning all parts, re-assembly of the starting motor is a reversal of the dismantling procedure given in Section 7, but the following special points should be noted.

(1) To facilitate fitting the solenoid unit to the drive end bracket, ease the drive assembly forward along the armature shaft.

(2) Set the pinion movement before tightening the eccentric pivot pin securing nut. See Fig. 12.

(3) Before assembling the commutator end bracket, check to see that the brake ring insert is in good condition, then insert the fibre and brass thrust washers (fibre first) and install the two spring loaded brake shoes. See that the shoes sit squarely in the ring, and that the driving slots (one in each shoe) are aligned to engage with the driving peg in the armature shaft, when the end bracket is assembled to the yoke.

(4) When the starting motor pinion is in the fully retracted non-operative position, the distance between the engaging edge of the pinion and the flywheel ring gear is determined by the sum of all the endwise manufacturing tolerances of the starting motor and engine components.

The nominal dimension for this pinion out-of-mesh clearance is 1/8" $\pm$ 1/32" (3.17 mm. $\pm$ 0.8 mm.).

Setting Pinion Movement

(1) After complete assembly of the starting motor, connect the small centre terminal on the solenoid unit by way of a switch to a 6-volt supply. Connect the other side of the battery to one of the solenoid fixing studs.

(2) Close the switch (this throws the drive assembly forward into the engaged position) and measure the distance between the pinion and the washer on the armature shaft extension. Make this measurement with the pinion pressed lightly towards the armature to take up any slack in the engagement linkage. For correct setting this distance should be 0.020" - 0.030".

(3) To adjust the setting, slacken the eccentric pivot pin securing nut and turn the pin until the correct setting is obtained. Note that the arc of the adjustment is 180° and the head of the arrow marked on the pivot pin should be set only between the arrows on the arc described on the drive end bracket casting.

(4) After setting, tighten the securing nut to retain the pin in position.

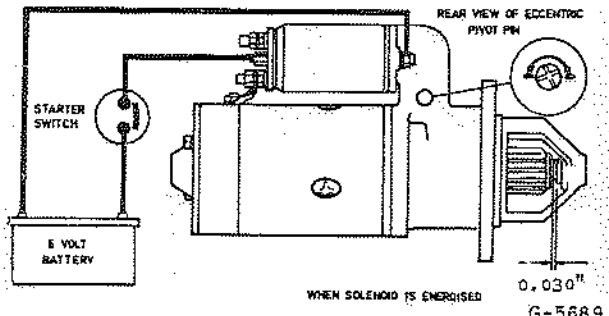


Fig. 12 - Setting Pinion Movement

NOTE: In the event of a replacement motor or drive end bracket being fitted, check the out-of-mesh clearance when assembling the starting motor to the engine. This should be 1/8" between the leading edge of the pinion and the engine flywheel with a tolerance each way of 3/32".

WINDSCREEN WIPER
MODEL DR2

1. GENERAL

The DR2 windscreen wiper installation consists of a shunt wound electric motor and gearbox unit connected by a cable rack type transmission to a pair of wheelboxes near the edge of the windscreen. In each wheelbox is a gear or sprocket wheel having a splined spindle to which an arm carrying one of the wiper blades is attached. The motor is mounted on three pillars cast integral with the gearbox casing and is located in the cab. The cable rack consists of a flexible core of steel wire wound with a wire helix for meshing with the gear in each wheelbox. Rotation of the motor armature is converted to a reciprocating motion in the cable rack by means of a single stage worm and nylon gear reduction drive, the motor end of the cable rack being coupled to a connecting rod and crosshead in the gearbox. The cable rack passes through protective outer tubing to the wheelboxes and thus imparts an oscillating motion to the wiper arm spindles.

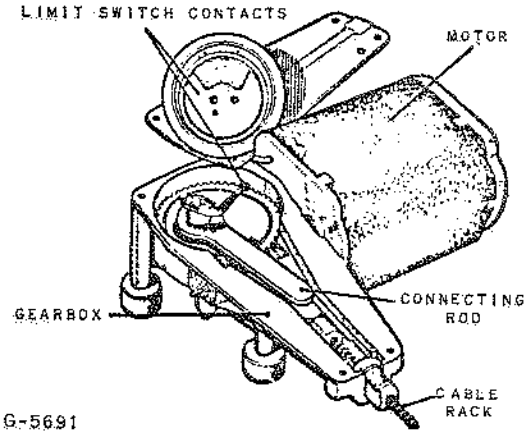


Fig. 1
Windscreen Wiper Motor with Gearbox Cover Removed to Show Limit Switch

(a) Self-Switching

The arms and blades return automatically to the edge of the windscreen before stopping, irrespective of their positions at the instant of switching off. This is effected by means of a limit switch located in the gearbox, its action being controlled by the crank pin. For the greater part of each wiping cycle the switch contacts are closed and provide an earth return path for the motor operating current, alternative to and in parallel with the earth return path provided by the wiper control switch. Each time the blades reach the edge of the windscreen, however, the limit switch contacts open. Thus, when a control switch is turned to "OFF", the motor continues to run until the blades reach their parked position. The limit switch can be adjusted for setting the instant of cut-off.

2. MAINTENANCE

The gearbox, cable rack and wheelboxes are greased during manufacture and need no periodic lubrication. Efficient wiping is dependent upon having a clean windscreen and wiper blades in good condition. Windscreens can be cleaned with methylated spirits (denatured alcohol) or with good quality silver plate polish in order to remove oil, tar spots and other forms of contamination. Silicone or wax based polishes must not be used. Worn or perished wiper blades are readily removed for replacement.

3. TEST DATA

(1) Current consumption of motor 60 seconds after switching on (with rack disconnected)*.	2.7 - 3.4 amp.
(2) Stall torque (applied 60 seconds after switching on):	975 oz.-in. (0.702 kg.-m.)
(3) Revolutions per minute of final gear 60 seconds after switching on (with rack disconnected):	44 - 50 r.p.m.
(4) Minimum voltage at which motor should run with rack disconnected.	3 volts
(5) Resistance in ohms at 60°F. (15.5°C.) of armature winding, measured between adjacent commutator segments. Gauge of wire given to assist identification.	0.29 - 0.35 (25 S.W.G.)
(6) Resistance in ohms at 60°F. (15.5°C.) of field winding. Gauge of wire given to assist identification:	8.0 - 9.5 (25 S.W.G.)
(7) Pressure of brushes against commutator:	125 - 140g. (4.4 - 4.93 oz.)
(8) Armature end play:	Adjusting screw in gearbox set and locked to give 0.008" - 0.012" (0.2 - 0.3 mm.) endwise movement of armature.
(9) Wheelbox end play:	0.003" (0.076 mm.) max. Adjustable, by bending tongue in gear cover plate.
(10) Maximum permissible force required to move cable rack in protective outer tubing (Blades away from windscreen and rack disconnected at gearbox):	6 lb. (2.7 kg.)

*Due to differences, between one vehicle and another, of blade friction and windscreen surfaces and to the difficulty of accurately measuring widely fluctuating currents, practical data cannot be given for current consumptions of complete working installations. However, if arms and blades are first removed the current consumption of a cold motor driving only cable and wheelboxes will be found to vary little from the bench values given above for the motor only-being between 2.8 and 3.5 amperes for a unit of present production if the motor and transmission is satisfactory.

4. SERVICING

Before disconnecting a defective motor, make notes of the existing wiring, etc. Inaccessibility of the gearbox or crosshead covers may necessitate the removal of arms and blades and withdrawal of the motor and rack from the tubing. In other cases, the complete installation (tubing and wheelboxes) may have to be removed from the vehicle.

(a) Fault Diagnosis

(1) Possible Causes of Poor Performance

Poor performance can be electrical or mechanical in origin and not necessarily due to a faulty motor. For example:-

Low voltage at the motor due to poor connections or to a discharged battery.
Cable rack binding in protective outer tubing.
Excessive loading on the wiper blades.
Wheelboxes loose, out of alignment or spindles binding in the bearing housing.

(2) Wiring

Motor terminal "1" to one terminal of panel switch (normally, a black-with-green cable).
Motor terminal "2" to supply point (normally, a green cable to ignition auxiliaries fuse or circuit breaker, when fitted).
Motor terminal "E" and other terminal of panel switch to earth (normally, black cables). N.B., when no limit switch is fitted, terminal "E" is disused and the panel switch is normally connected on the supply side of the motor.

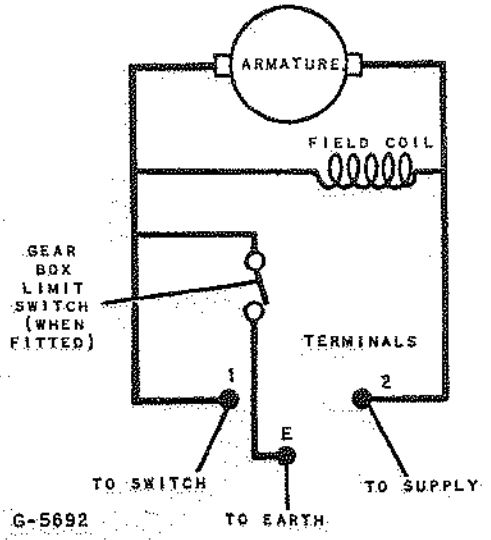


Fig. 2
Schematic Circuit Diagram Showing Internal Connections of Wiper Motor

(3) Testing:

Unless the origin of the fault is apparent, proceed as follows to determine the cause of failure:-

MEASURING SUPPLY VOLTAGE:

Switch on the motor.

Using a first grade moving coil voltmeter, measure the voltage between the motor supply terminal "2" and a good earthing point. If the reading is low, check the battery, cabling, connections and (by substitution) the panel switch.

Check the external circuit breaker. If the fault is outside the motor, locate and rectify.

MEASURING LIGHT RUNNING CURRENT:

If the correct operating voltage is obtained at terminal "2", disconnect the cable rack and measure the light running current with a first grade moving coil ammeter connected in the supply cable.

As disconnecting the cable rack involves removing the gearbox or crosshead cover, the opportunity can be taken to observe the speed of operation by counting the cycles per minute of the crosshead and comparing it with the figure given under "Test Data".

If, due to a defective motor, the light running current speed is outside the appropriate limits, replace the motor or dismantle for examination.

Possible causes of low current consumption include worn brushes, weakened brush spring brush levers not free to move on their pivots and dirty commutator while excessive light running current may be due to reduced armature end play or to worn bearings or to internal short circuits either of the field or armature or of adjacent commutator segments by pieces of carbon. Clean the commutator and brushes with a petrol-moistened cloth and check resistances of field and armature with an ohm meter. Excessive current consumption during normal operation may be due to a sticking wiper blade or to a fault in the transmission.

(4) Checking Cable Rack and Tubing:

The maximum permissible force to move the cable rack in its protective tubing is 6 pounds with the wiper arms, blades and motor disconnected. The measurement can be made by hooking a spring balance in the hole in the crosshead (into which a pin on the connecting rod is normally located) and withdrawing the rack with the balance.
Binding of the rack can be due to kinked or flattened tubing or to faulty installation. Minor faults can be cleared with a suitable test mandrel sold specifically for checking wiper installations. Badly kinked or flattened tubing must be renewed. Any bends of less than "9" radius must be reformed.

At the wheelboxes the flared ends of the pro-tective outer tubing should be located in the outer narrow slots of the clamp plates. The inner wider slots are provided for use in the event of fixing hole inaccuracies precluding the employment of the more positive tube anchorages afforded by the outer narrow slots. The cable rack should be well lubricated with Ragosine Listate or Duckhams H.B.B. greases.

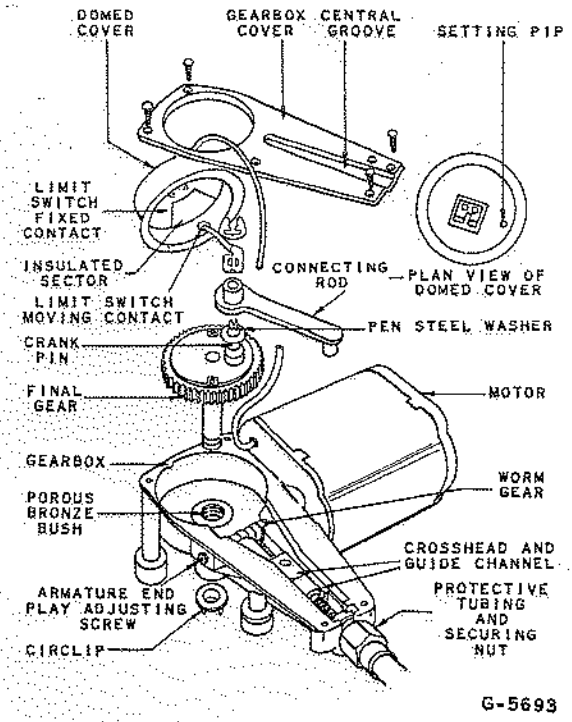


Fig. 3
Windscreen Wiper Motor with Gearbox Dismantled

(5) Checking Wheelboxes:

Check the wheelboxes for misalignment or looseness and rectify as required. The correct wheelbox end play is given under "Test Data".
Renew siezed wheelboxes.

(b) Dismantling (Refer Fig. 3).

(1) Removal of Motor from Vehicle:

Isolate battery.

Note the terminal connections before disconnecting the motor, to assist subsequent refitting. Note, similarly, the angular position of the domed limit switch cover relative to the flat gearbox cover before dismantling.

Withdraw the four gearbox cover securing screws. As these are self-tapping, each screw should be returned to its original hole when reassembling.

Remove the switch and gearbox covers.

Unscrew the hexagon nut securing the protective tubing to the gearbox.
Remove the three nuts securing the motor.
Remove the circlip from the shaft of the final gear on underside of gearbox.
Remove any burr from around the circlip groove with a fine file. This will obviate scoring of the bearing bore during shaft withdrawal.
Partially withdraw the final gear assembly and disengage the cable rack and tubing from the connecting rod and gearbox.
The motor can now be removed from the vehicle.

FINAL GEAR AND LIMIT SWITCH:

Lift out the final gear, connecting rod and limit switch blade assembly from the gearbox.
Examine the gear teeth and, if worn or damaged, renew the assembly.
Withdraw the circlip from the crank pin, noting particularly that the prongs of the circlip pass on either side of a small turned up tag on the slotted portion of the switch blade. The circlip must be positioned in like manner when refitted.
Lift off the switch blade from the crank pin.
Lift off the pen steel washer, taking care not to lose this item which must be refitted in the same position on reassembly.

(2) Removing Armature

Withdraw the Lucar cable connectors and through bolts, taking care not to lose the Lucar earthing blade from beneath the head of the right hand through bolt.
Withdraw the commutator end cover.
Withdraw the brush arm retainer from below the terminal assembly. The sole function of this comb-shaped fibre plate is to prevent the brush arms leaving their pivots in the event of rough handling of the unit while in transit to the vehicle assembly line. Its omission in service would not affect performance.

Note carefully the side and position occupied by each brush to ensure refitting exactly the same way round and then withdraw the brushgear, taking care not to over-stretch the tension spring. If a limit switch is fitted, unsolder the switch wire at the terminal tag.
Withdraw the yoke from the armature.
Unscrew the two self-tapping screws which secure the field coil assembly to the yoke and withdraw the assembly out of the yoke, noting carefully the hole occupied by each screw for subsequent reassembly.

Withdraw the armature and worm assembly from the gearbox.

(c) Reassembly

In the main, reassembly is the reversal of the dismantling procedure previously described. A number of precautions have been given therein and these should be observed.

(1) Lubrication:

The following parts should be lubricated, taking great care to keep the commutator and brush-gear free from oil and grease.

LIMIT SWITCH:

The brass sector inside the cover should be smeared with petroleum jelly.

BEARING AND GEARS:

Three oil impregnated porous bronze bearings are fitted - one for the final gear shaft and two for the armature shaft, the bearings for the latter being self-aligning. Oiline B.B.B. should be applied sparingly before assembly to these bearings, the felt backing washers and the armature shaft. It is important that the felt washers are not over-loaded with oil.

NOTE: A lubricating groove is machined round the final gear shaft and the shaft runs in a plain brass bearing (Part No. 743044). When servicing the groove should be filled with Ragosine Listate grease and the complete shaft smeared with Rocol Molypad oil.

While a groove continues to be machined in all final gear shafts provided for service replacement purposes, it is important that this is not filled with grease when a shaft is to run in an oil impregnated porous bronze bearing (Part.No. 743964).

In production, Oiline B.B.B. is applied sparingly to the final gear shaft, Rocol Molypad Molybdenised Disulphide oil to the crank pin, and Ragosine Listate grease to the crosshead, guide channel and driving pin. Between 25 and 35 cubic centimetres of Ragosine Listate grease is applied to the worm and gear. This latter grease is also applied to the cable rack.

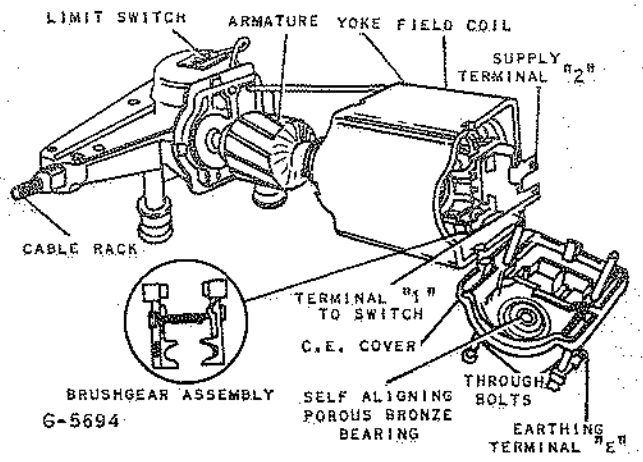


Fig. 4
Windscreen Wiper Motor with Commutator End Cover and Yoke Withdrawn from Armature

(2) Armature End Play:
The adjusting screw in the side of the gearbox should be set and firmly locked to give 0.008" to 0.012" end play of the armature.

(3) Brushgear:
After assembling the spring, the brush arms must clip on to and be able to move quite freely about the pivots, care being taken not to over-stretch the tension spring whilst refitting. Care must be taken to see that no part of the brushgear or brushes can foul the commutator tags or connections and that the brushes ride wholly on the copper segments.
The pressure exerted by the brushes on the commutator should be 125 to 140 grammes.

(4) Fitting Arms and Blades:
First ensure that the wheelbox spindles are in the correct parking position by switching on the motor and then switching off and waiting for them to come to rest at the end of a cycle.
Fit the arms and blades to the splined driving drums on the wheelbox spindles at the correct parking angle, pressing the headpieces on until the retaining clip is heard to snap over the end of the drum.
Switch on and note the wiped areas. If necessary, the position of the arms can be adjusted by removing and re-engaging them in the appropriate position, the pitch of the driving drum splines being 5°.

NOTE: Do not attempt to turn the arms on the spindles but press back the retaining clip in the headpieces and withdraw the arms from the driving drums and refit in the desired position.

(d) Limit Switch Adjustments

Slacken the four gearbox cover securing screws. Rotate the domed cover until the setting pip on the top of the cover is in line with the central groove in the gearbox cover. The pip must be on the side of the cover nearest the cable rack to obtain parking with the crosshead away from the worm gear, or turned through 180° to obtain parking with the crosshead toward the worm gear.
Retighten the gearbox cover securing screws.

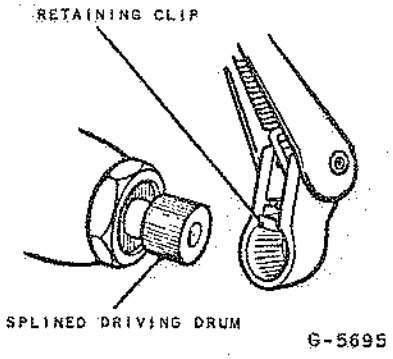


Fig. 5
Wiper arm-to-wheelbox attachment

(e) Setting the Wiper Arms and Blades

Withdraw the wiper arms from the splined driving spindles.

Switch on the supply (ignition switch) and operate the panel switch.

Switch off the wiper motor and wait for the spindles to come to rest at the end of a cycle.

Refit the arms and blades to the spindles. The angular pitch of the splines on the driving drums is 5° to enable an appropriate arm position to be engaged.

(f) Wiper Blade Replacement

The wipers are normally fitted with "Rainbow" wiper blades of Standard, pattern in which the rubber wiping element and "backbone" is a replaceable part. Before fitting a replacement, however, the blade carrier and wiper arm must be carefully examined for signs of wear. If these are found to be worn or distorted they should be replaced in addition to the wiper element and "backbone". No responsibility can be accepted for subsequent poor wiping performance or DAMAGE TO THE WINDSCREEN if a replacement element and "backbone" is fitted to existing worn parts.

New elements should be handled with care It is important to keep the rubber clean and free from oil or petrol and to avoid distortion of the metal "backbone".

HEADLAMP

MODEL F-700

Bulb Replacement

To remove the Light Unit, press in against the tension of the three spring loaded adjusting screws and turn it in anti-clockwise direction until the heads of the screws can be disengaged through the slotted holes in the Light Unit rim. Do not disturb the screws as this will affect the lamp setting.

Twist the bulb adapter in an anti-clockwise direction and withdraw it. The bulb can then be removed. Identical double filament bulbs are fitted in each lamp. In the dipped position, both headlamp beams are deflected downwards and to the left.

Replacement Bulb

12 volt 50/40 watt.

Renewal of Light Unit

Remove the Light Unit assembly and bulb. Withdraw the three screws from the unit rim and remove the seating rim and unit rim from the Light Unit.

Position the replacement Light Unit on the seating rim taking care to see that the diecast projection at the edge of the Light Unit fits into the slot in the seating rim. Ensure that the unit rim is correctly positioned and finally secured by the three fixing screws.

Replace the bulbholder, etc.

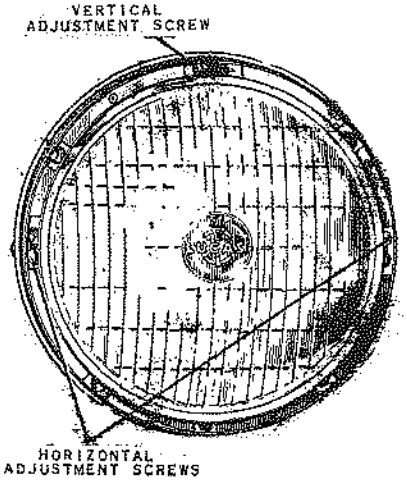


Fig. 1 - Headlamp REC-311

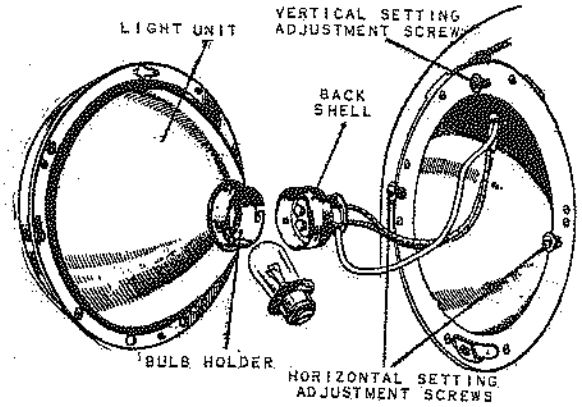


Fig. 2 - Headlamp Bulb Replacement

SETTING THE LAMPS

Set each lamp to the correct position in the vertical plane by means of the screw at the top of the light unit. Turn the screw clockwise to raise the beam and vice versa. Horizontal adjustment is affected by turning the two screws at the side of the Light Unit.

The lamp should be set so that the main beams are straight ahead and parallel to each other and to the road, with the vehicle normally loaded. If a focus board or stand is not available, setting can best be carried out by placing the vehicle in front of a blank wall at a distance of at least 25 feet. See that the surface on which the vehicle is standing is level and not sloping relative to the wall. It will be found advantageous to cover one lamp whilst setting the other.

PARK/FLASHER LIGHTS

The park/flasher lights mounted in the front panel are of rubber construction with a metal locking rim which holds the moulded rubber lamp rim around the lens.

To replace the park/flasher light bulb, prise the metal locking ring out of the rubber flange. The rubber flange can then be spread allowing the lens to be removed.

The bulb will then be accessible for removal, The bulb is a 12 volt, 21/6 watt D.C. bayonet cap.

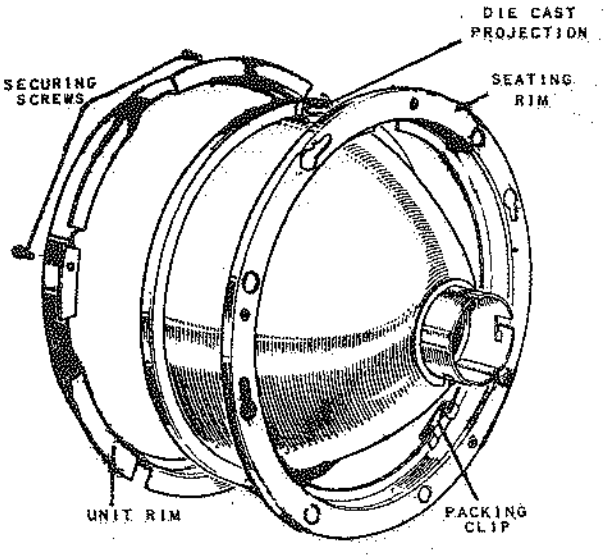


Fig. 3 - Light Unit Replacement

STOP/TAIL/FLASHER LIGHT

Combination stop/tail/flasher lamps are mounted one each side of the rear of the vehicle. The lamps are divided into two compartments, one of which has an amber lens for flasher compartment and the other a red lens for the stop/tail compartment. This compartment also has a clear lens at the side, for illumination of the licence plate.

The bulbs used are as follows:-

STOP/TAIL LIGHT	12 VOLT 18/6 WATT D.C.
FLASHER LIGHT	12 VOLT 21 WATT S.C.

Access to the bulbs is gained by removing the lenses attached to the lamp by four screws.

CONVOY LAMP

The convoy lamp mounted on the rear shock absorber crossmember is equipped with a 12 volt 4 candle power, S.C. bulb, access to the bulb being obtained by removal of the tubular cover which is secured to the lamp body by 3 bayonet slots.

LOW AIR PRESSURE FLASHER

The bulb is a miniature bayonet cap, 12V, 2 C.P. and is accessible by pulling the bulb holder out of its socket, in the back of the air pressure gauge.

BLACKOUT LAMPS

The vehicle is wired in such a way, that when the blackout switch is in the normal position all other lights can be used, but when the switch is turned to blackout position only the blackout headlights, convoy light, and dash panel lights can be used.

The blackout headlamps are equipped with 12V 18 W.S.C. bulbs which are accessible by removing the two screws which secure the lamp rim.

TURN SIGNALS

The turn signals comprise the following main components.

1. Two front lamps incorporated in the front parking lights.
2. Two rear lamps incorporated in the tail lamps.
3. A two way switch located in the steering column flange cup.
4. A flasher unit.
5. Two lamps incorporated in the speedometer instrument.

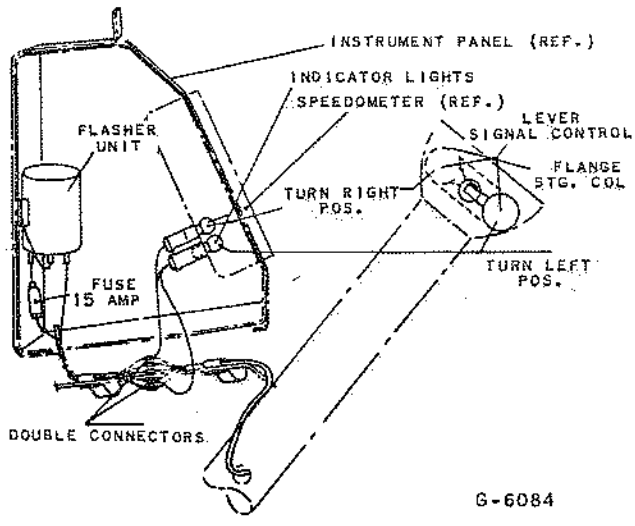


Fig. 1 - Turn Signal Control

OPERATION

1. The flasher unit (Fig. 1) is connected via the ignition switch, blackout switch, and ammeter to the battery. From the flasher unit a cable runs to the centre or live contact in the two way switch.

2. When the switch is operated to right turn or left the "live" contact is connected to the appropriate "right" or "left" contact in the switch, to which are connected cables to the front and rear signal lamps.

3. Tapped into these latter cables by means of double connectors (Fig. 1) are cables to the indicator lights in the speedometer instrument.

4. These lights flash in conjunction with the signal lights, through green arrow shaped slots in the speedometer dial, thus indicating to the driver that the control lever is in a signalling position.

THE FLASHER UNIT

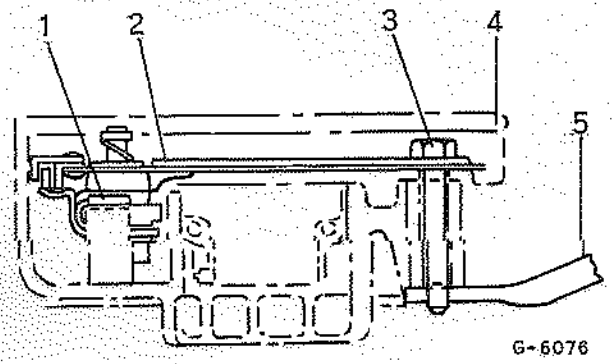
1. This is located on the dash panel as shown in Fig. 1.

2. It requires no maintenance and is not repairable.

LAMPS

1. The indicator lamps in the speedometer instruments are 12V 1 C.P. S.C. and are accessible by pulling out the lamp sockets.

2. The vehicle signal lamps are described in previous chapters.



1. SCREW
2. SWITCH ASSY.
3. SCREW HEX.
4. FLANGE STG. COL.
5. LEVER, CONTROL

Fig. 2 - Turn Signal Switch Installation

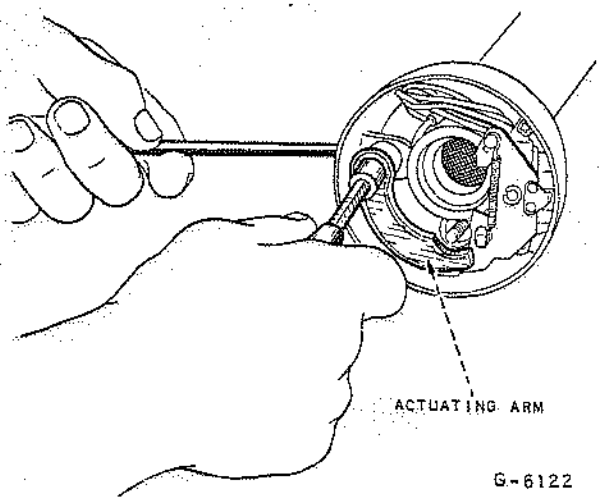


Fig. 3 - Turn Signal Switch Installation

TURN SIGNAL SWITCH

1. Access to the turn signal switch is obtained by removing the steering wheel as shown in Section F.

2. This will expose the switch as shown in Fig. 3.

TO REMOVE THE SWITCH

1. Disconnect the battery.

2. After removal of the steering wheel refer to Fig. 2 and 3, and screw out the hexagon screw which secures the control lever to the switch actuating arm (Fig. 3.) The control lever can then be withdrawn.

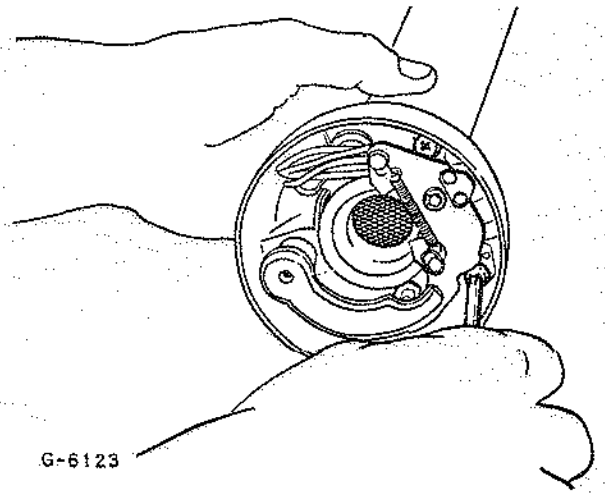


Fig. 4 - Switch Attaching Screws

3. Remove two cross recess screws which secure the switch to the flange cup (Fig. 4).

4. Disconnect the five cables at the connectors located below the instrument panel to the right of the steering column.

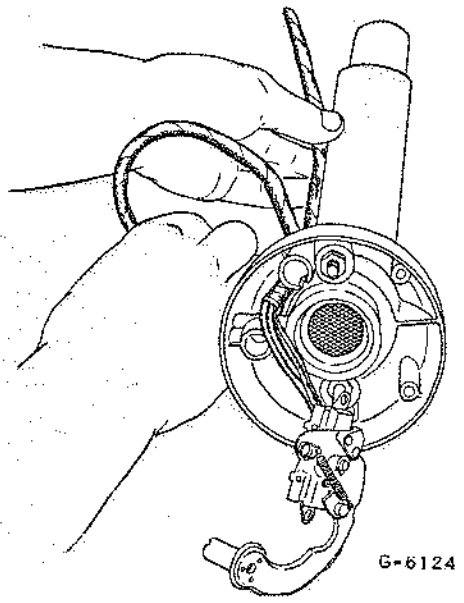


Fig. 5 - Removal or Assembly of Cables

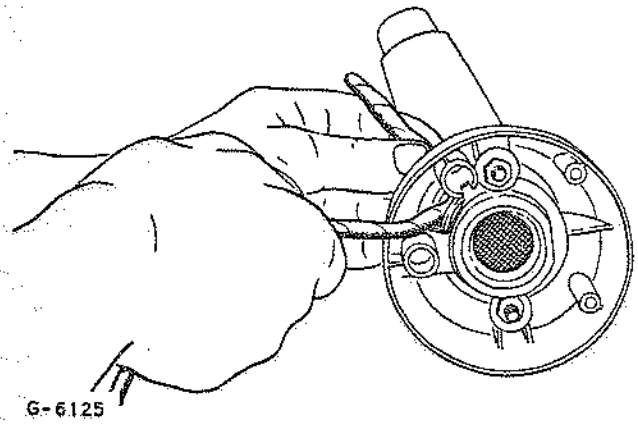


Fig. 6 - Removal or Assembly of Cables

5. Untape the sixth cable (coloured red) and tape the six ends together as shown in Figs. 5 and 6.

6. Withdraw the switch assembly with cable as shown in Figs. 5 and 6.

7. The switch is not repairable and is supplied complete with cables as shown in Fig. 7.

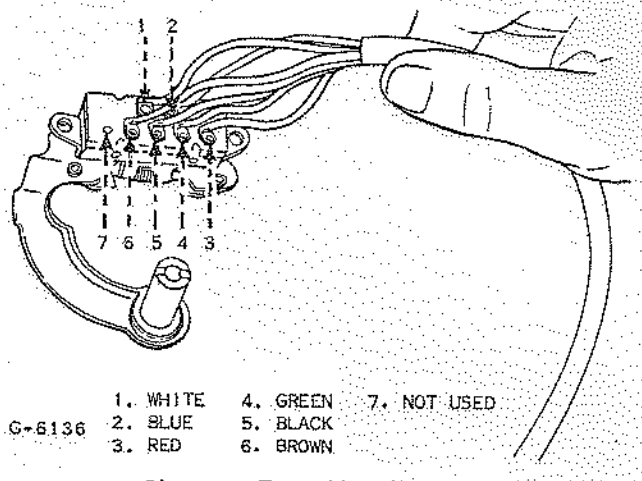


Fig. 7 - Turn Signal Switch

REASSEMBLY

Follow the reverse sequence of disassembly, not forgetting to insulate the red cable.

WIDTH LIGHTS

1. The width lamps mounted one each side of the cab roof panel, incorporate a 12V 3 CP S.B.C. bulb, access to which is gained by removing two round head screws which secure the red/amber lens to the lamp base plate.

2. The lamp base is secured to the cab with four screws and nuts which can be removed after the lens has been taken off.

3. In refitting the lens, ensure that the cork seal is in good condition and correctly located between the lens and the base, to exclude dust and water. Fit the lens with the amber towards the front.

4. To facilitate removal of the lamp base, a cable connector is located a few inches from the lamp inside the cab.

JUMPER SOCKET

Mounted at the rear of the vehicle as shown in Fig. 8, is a jumper socket to permit a trailer to be connected electrically to the vehicle. A sprung lid covers the socket when not in use.

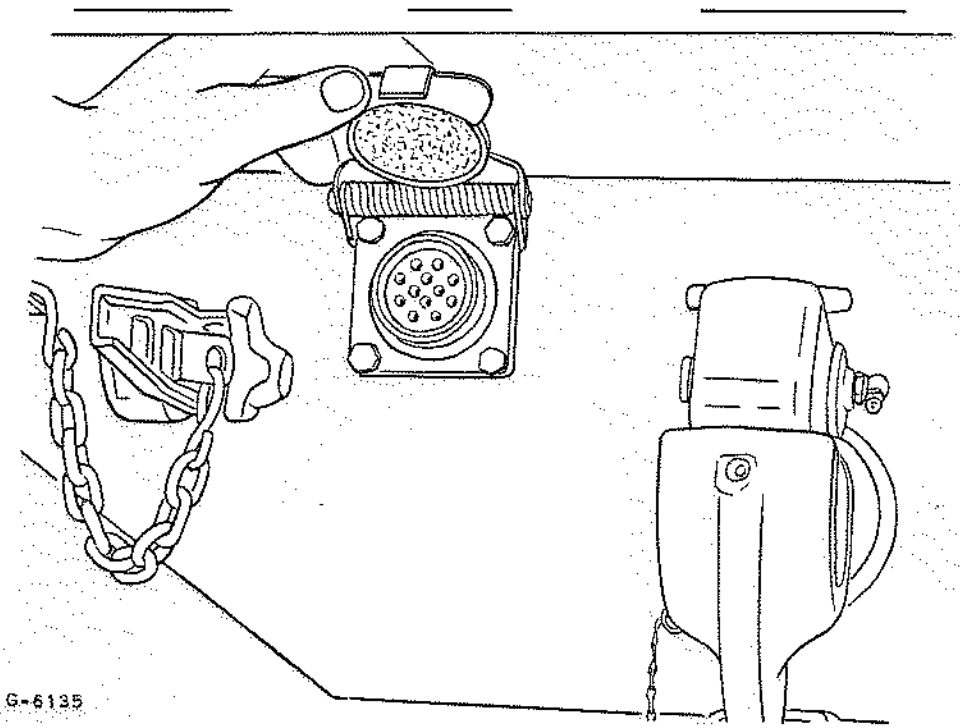


Fig. 8 - Jumper Socket

The cables are soldered into the socket pins at one end, and soldered to terminals at the other.

Each cable is numbered for circuit identification and connected into the jumper socket as in the chart shown in Fig. 9.

Viewed from the rear the socket pins are lettered as shown in Fig. 10.

CIRCUIT DESCRIPTION	CIRCUIT No.	SOCKET PIN
AUX. FEED	4	K
TAIL LIGHT FEED	21	E
STOP LIGHT	22	B & J
BLACKOUT & CONVOY	24	A, C & H
SOCKET GROUND	90	D & L
LEFT INDICATING	115	M
RIGHT INDICATING	117	N

Fig. 9 - Circuit Tabulation
(Jumper Socket)

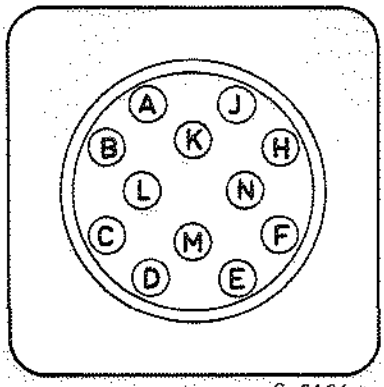


Fig. 10 - Socket Pin Arrangement
(Viewed from the rear)

CIRCUIT BREAKERS

As shown in Fig. 1, (refer Page 5) various circuits are protected by circuit breakers. When an overload occurs in any particular circuit the circuit breaker contacts open thus preventing current flow. The circuit breakers are mounted in a group inside the cab above the driver's door. The circuit breaker affected by

over-load will remain open a few seconds and then close again, thus opening and closing the circuit and causing the ammeter to fluctuate, between a normal reading and a high discharge reading. Such a condition must be investigated immediately by checking through the circuit for broken insulations allowing current to "earth" etc.

To test a circuit breaker to determine its efficiency, apply by means of a 6 volt battery, a rheostat, and an ammeter, a load of 30 amps. Under this test a circuit breaker should break in 11 to 19 seconds. Replace faulty breakers.

HORN

The horn is mounted on the left hand front cab support bracket, and is a vibration type with a frequency of 290/320 cycles per second.

All adjustments are set by the manufacturer and should not require readjustment in service.

Conditions affecting horn performance:-

LOW HORN VOLTAGE

If the horn produces a weak signal, the voltage at the horn should be checked. Connect a voltmeter from the horn terminal to ground. The reading should not be less than 11 volts. A low reading would indicate a low battery or a high resistance in the horn circuit. Take readings at all points in the circuit until the fault is located, including the horn button contacts. See that all connections are clean and tight.

NOTE: Horn button assembly is illustrated in Section F, pages 5 and 7.

DESCRIPTION

The ammeter, oil pressure gauge, fuel gauge, temperature indicator, are incorporated in one instrument cluster, mounted in the instrument panel

Fig. 1 illustrates location of instruments in the cluster. The cluster is attached to the panel with two screws, as shown in Fig. 6, Section Q.

Each instrument can be replaced individually but are not repairable. Access to the instruments is gained by removing the six instrument panel screws and disconnecting the air pipe at the gauge, and speedometer cable at the speedometer head.

Screw off the vent control knob. The panel can then be moved away sufficiently to provide access to the rear of the instruments.

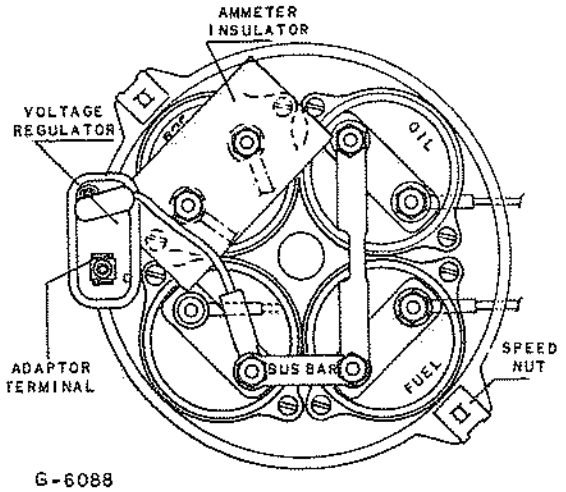


Fig. 1 Instrument Cluster, (Rear View)

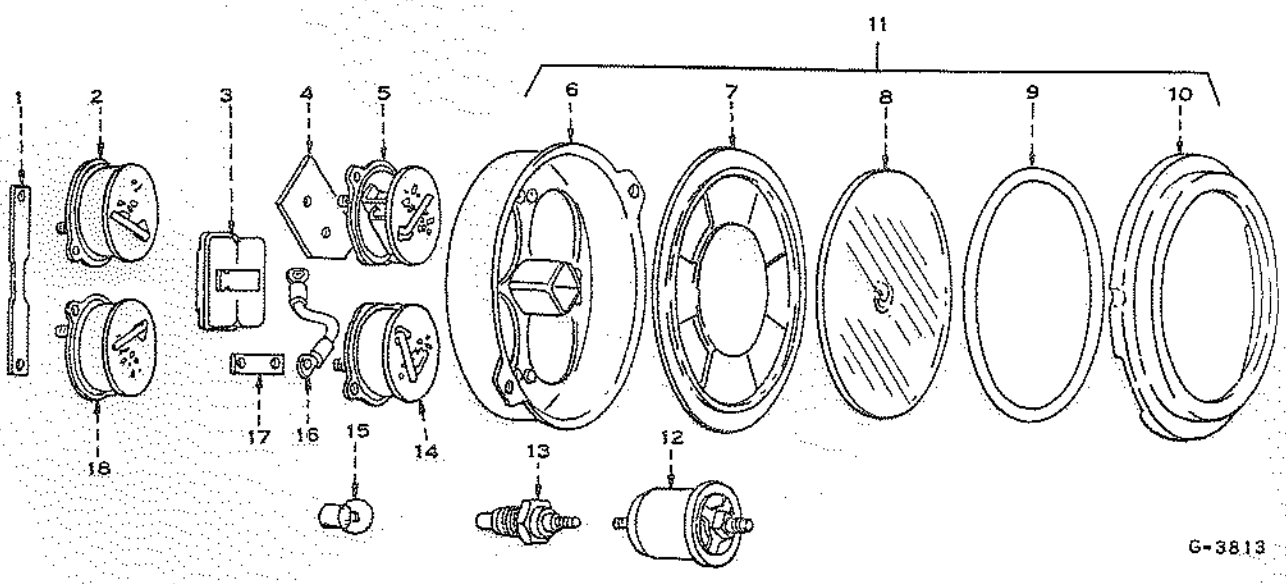


Fig. 2 - Instrument Cluster and Senders

LEGEND

1. BAR, BUS
2. GAUGE, OIL PRESSURE RECEIVER
3. REGULATOR, VOLTAGE
4. INSULATOR, AMMETER
5. AMMETER, ASSY.
6. BODY
7. MASK
8. GLASS, DIAL
9. GASKET
10. BEZEL
11. CASE, INSTRUMENT, ASSY.
12. SENDER, OIL PRESSURE GAUGE
13. SENDER, WATER TEMPERATURE GAUGE
14. GAUGE, WATER TEMPERATURE RECEIVER
15. LAMP
16. CABLE, ASSY.
17. BAR, BUS
18. GAUGE, FUEL RECEIVER UNIT, ASSY.

As shown in Fig. 1 each instrument is attached to the body by two screws.

Fig. 2 shows an exploded view of the instrument cluster, each component being serviceable except item 6, Body.

No attempt should be made to repair a faulty instrument.

OPERATION

The "C.V." (constant voltage) Telegage is an electric metering system for the remote indication of fuel level, oil pressure or water temperature. It is a simple, single wire system between the panel indicator and the tank sender units.

Each system (that is, fuel level, oil pressure or water temperature) consists of three components.

1. The panel instrument.
2. The level unit, pressure unit and temperature unit (sender unit).
3. The output voltage regulator.

The voltage regulator, Figs. 1, 2, and 3, is common to all the systems, that is, one regulator is used to operate the three gauge systems.

Fig. 3 shows the instrument circuit diagram

VOLTAGE REGULATOR

Its function is to regulate the variable (input) voltage available from the vehicle storage battery, or the charging system, to produce a constant 5.0 volt output to the gauges. This regulator is a simple device, operating with a heater bimetal in conjunction with a pair of contacts. It is temperature compensated to produce correct constant voltage for the gauge systems at all expected ambient temperatures. It is mounted near the panel indicators at approximately their same ambient temperature. The voltage regulator does not produce a steady DC voltage output, but rather a pulsating voltage at an effective constant average value of 5.0 volts. Input voltage lower than 5.0 volts will result in proportionately low gauge indication, input voltages in excess of 16.0 volts will overload the regulator contacts and may result in premature wear.

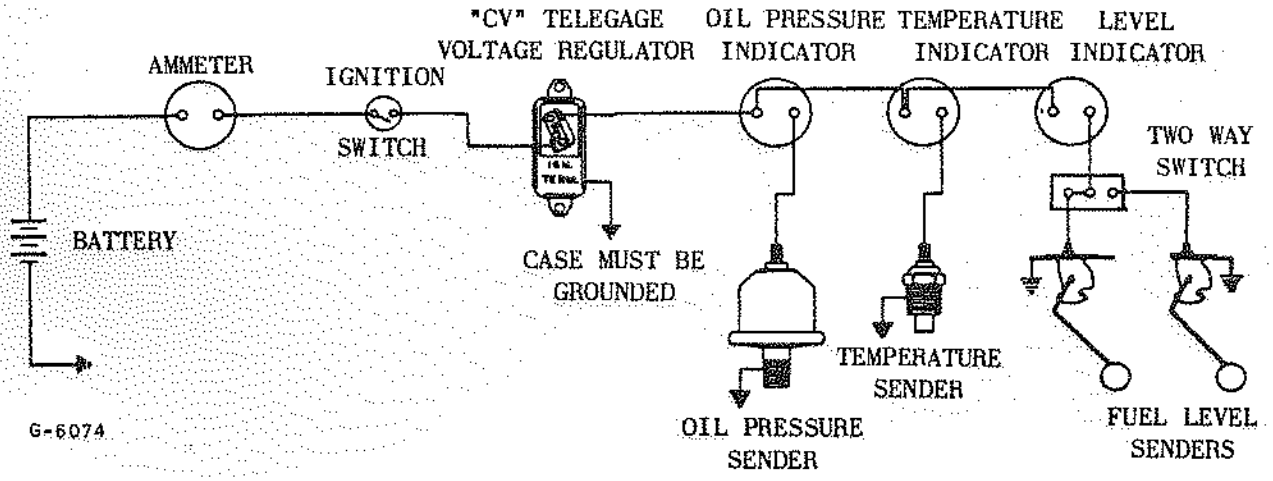


Fig. 3 - Circuit Diagram Instruments

FUEL LEVEL GAUGE

With the tank empty, the float, Fig. 4, holds the slide rheostat (variable resistance) at maximum resistance causing the gauge to read zero, with ignition switch on. With the tank full, Fig. 5, the slide rheostat is moved to the minimum resistance point causing the gauge to read full, with the ignition switch on. The use of a bimetal in the fuel indicator provides stability of reading and eliminates pointer fluctuation incidental to surging in the tank and the float bobbing on the surface of the fuel.

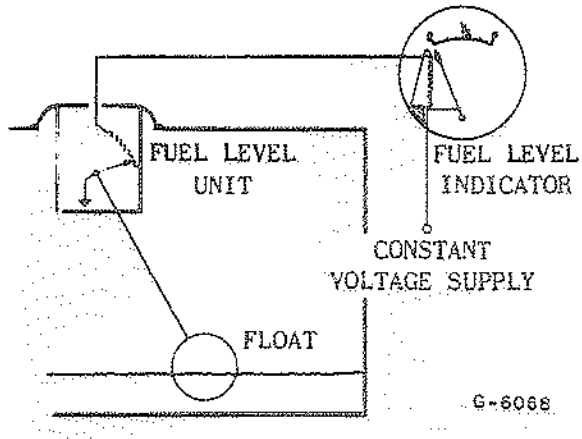


Fig. 4 - Operation with fuel tank empty

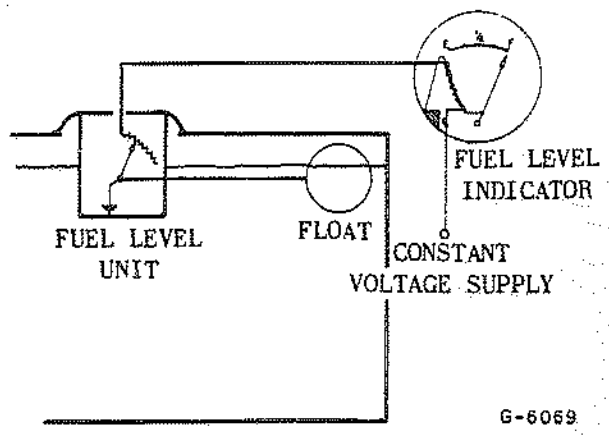


Fig. 5 - Operation with fuel tank full

TEMPERATURE GAUGE SENDER UNIT

This instrument operates on an entirely different principle, without any moving parts in the sender unit. The heart of the unit is a "sintered" material, which has a characteristic of having low resistance when hot and high resistance when cold.

It is enclosed in a sealed bulb which is screwed into the cylinder head so that the resistor located in the extreme end of the bulb will faithfully follow the coolant temperature to be measured. The high resistance in the unit when surrounded by cold coolant, causes the temperature indicator to read the cold end of the dial, Fig. 6, with the ignition switch on. The low resistance in the unit, when surrounded by hot coolant, Fig. 7, causes the temperature indicator to read the hot end of the scale, with the ignition switch on.

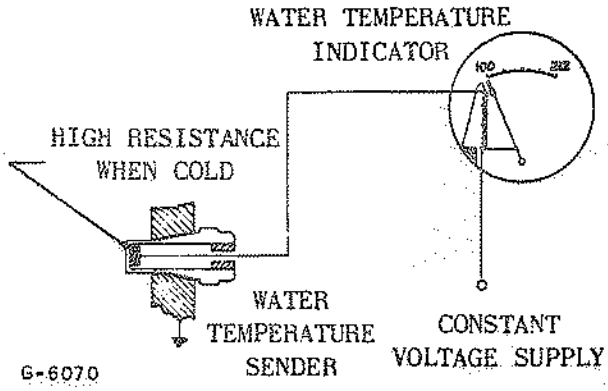


Fig. 6 - Operation with low temperature

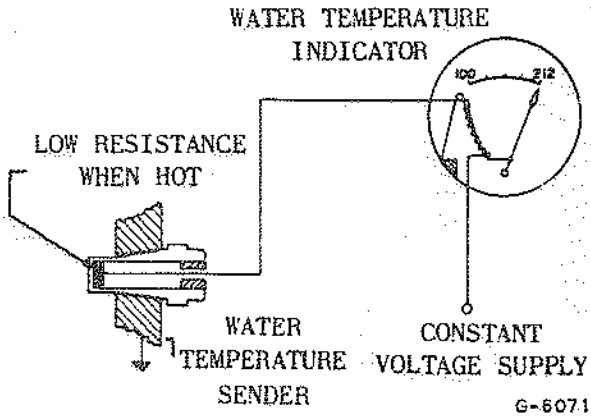


Fig. 7 - Operation with high temperature

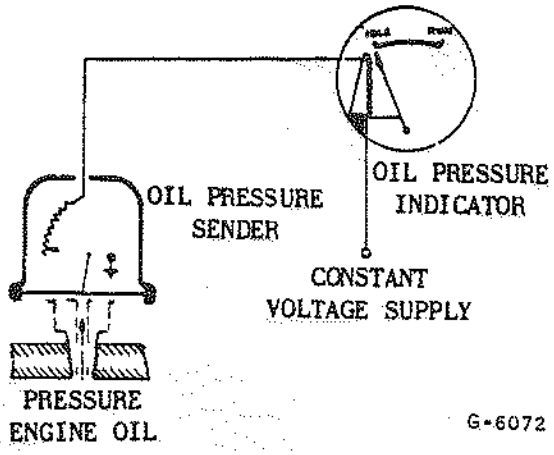


Fig. 8 - Operation with low oil pressure

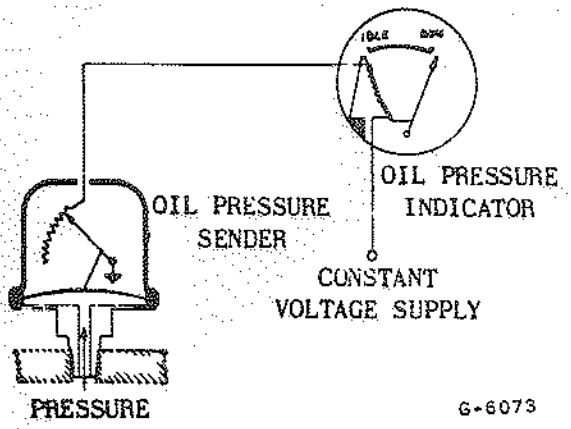


Fig. 9 - Operation with high oil pressure

OIL PRESSURE GAUGE SENDER UNIT

The construction of this instrument shown in Figs. 8 and 9 is similar to the fuel level gauge except that the slide rheostat movement is caused by diaphragm flexing incidental to varying oil pressure delivered by the engine oil pump. The sender unit is screwed into the engine oil gallery on the L.H. side rear.

SERVICE INSTRUCTIONS

No units should be removed from the vehicle until all checks are completed and it is determined which unit is defective.

EQUIPMENT NECESSARY FOR CHECKING

1. One new fuel level sender. If there is any question about the level unit being in good condition hook it up in series with a panel indicator and a "C.V." voltage regulator known to be in operating condition and a 6 or 12 volt battery, operate level sender by hand and see if panel indicator reads "empty" with level (tank) unit float in bottom position, and "full" with level unit in top position.

2. Three ten-foot lengths of insulated wire equipped with clip terminals at each end. These long lengths will, in practically all instances, permit individual making check to sit in seat of truck and observe gauge reading being checked.

3. For a detailed check of voltage regulators, one new panel indicator (any type fuel, oil, or water temperature).

METHOD OF CHECKING

A. Voltage Regulator - the "C.V." Telegage voltage regulator, Fig. 3, is common to all three systems, that is, one regulator is installed on each vehicle to operate three gauge systems. Check voltage regulator first.

1. If all three gauges simultaneously read considerably too high - for example, if the fuel gauge reads up scale with an empty tank, and the temperature gauge reads up scale with a cold engine and the oil pressure gauge reads too high with low pressure, the voltage regulator is not working properly and should be replaced.

NOTE: Check ground connections of voltage regulator. The grounding is essential to the proper functioning of the regulator.

2. If all three gauges simultaneously read too low, either the input voltage to the regulator is below 5.0 volts of the voltage regulator is inoperative and should be replaced. Check battery voltage output before replacing voltage regulator.

NOTE: A direct specific method for checking voltage regulator operation follows:-

a. Check battery voltage.

b. Connect lead wire from output terminal of voltage regulator to one terminal of new panel instrument. Connect lead wire from the other terminal of panel instrument to terminal of new level unit.

c. Ground level unit. Hold float in empty position.

d. Turn on ignition switch. Panel indicator should read empty (that is, bottom line on dial).

e. Start engine, run at faster than idle speed. Gauge reading should not change if "C.V." voltage regulator is functioning properly so as to control average output at 5.0 volts. Because the voltage regulator provides intermittent contacting, averaging the voltage to 5.0 volts, its voltage output cannot be checked with a conventional volt meter.

f. Move level unit float to full position. Panel instrument should read top end of dial scale.

B. PANEL INSTRUMENTS

1. Disconnect lead wire at level, pressure of temperature sender.

2. Hook in new level unit. Ground level unit. Place float in empty position. Turn on ignition switch. Place instrument being checked should read bottom end (that is empty, no pressure or lowest temperature) of dial scale.

3. Move float to full position. Panel instrument should read top end of scale. If checks show proper operation, both panel instrument and lead wire to unit are correct, otherwise, hook up new level unit to proper terminal of panel instrument, eliminating the lead wire from the panel instrument to the unit from the circuit. Repeat empty and full checks. If checking procedure shows a proper operation, check lead wire for broken insulation, short or broken wire. Correct or replace lead wire.

LEVEL, PRESSURE OR TEMPERATURE SENDER

If panel instrument and lead wire function properly with new good level unit substituted, but did not with original unit, replace original unit.

Be sure level (tanks) unit is properly grounded to tank and also that the tank is grounded to the frame.

Do not attempt to repair or calibrate any panel instrument, sender or voltage regulator in the field, as this is not practical. Replacement with a new unit is the only practical means of servicing these gauges.

AIR PRESSURE GAUGE

Should this instrument fail to operate or there is doubt about its accuracy, use a test gauge as a comparison and if necessary replace the instrument with a new one.

The flasher warning bulb can be replaced by pulling the bulb holder out of its socket in the rear of the air pressure instrument.

This is a miniature bayonet cap 12V 2 CP. Flasher type.

SPEEDOMETER

The speedometer unit is only serviced complete.

To remove the speedometer instrument, disconnect the speedometer drive cable by unscrewing the knurled nut at the back of the instrument.

Remove two attaching screws adjacent to the front of the instrument and withdraw it forward and down from the instrument panel.

LUBRICATING FLEXIBLE SHAFTS

Thoroughly clean the core and casing. Apply a thin coat of graphite impregnated non-hardening grease on the core only. Lubricate only 3/4 of the way up to core, (starting at the lower end) leaving the top 1/4 free of grease, to eliminate any possibility of grease getting into the instrument head. Hold the casing with one hand and feed the core with lubricant into casing.

CAUTION: Never fill or pack the casing with grease. Periodical lubrication of flexible shaft is recommended to avoid premature failure.

BUZZER

LOW AIR PRESSURE

The low pressure warning buzzer mounted in the cab above the R.H. door is a 12 Volt instrument controlled by an air pressure switch incorporated in the air pressure gauge mounted in the dash panel.

No maintenance is required and the buzzer unit should be replaced if found to be faulty.

In the event that the tone adjustment becomes faulty, this can be reset by removing the cover which is secured by a knurled nut at the rear side and adjusting the contact adjusting screw located opposite the cover screw. Loosen the lock nut and turn the adjusting screw in or out until the tone is restored, retighten the locknut.

Should the buzzer still be inoperative at low air pressure after tone adjustment has been checked, replace the unit complete.

The cab has been designed to enable the front end section to be removed in one piece to facilitate engine removal.

FRONT END REMOVAL (ELECTRICAL)

1. Disconnect the battery terminals and remove the battery. See Fig. 1. (Page 2)

2. Pull the negative cable through the grommet hole in the side of the battery compartment, bringing the grommet with it. The cable can then hang loose.

3. Disconnect the cannon plug by unscrewing the serrated ring nut (3) Fig. 1, and pulling out the elbow sleeve (2).

4. Disconnect the five lower pull/off terminals (2) Fig. 4, and disconnect the earth cable (3) Fig. 4, (Page 3)

5. Remove the two windscreen wiper arms and blades (method of attachment is shown in Fig. 5 section "P" electrical.

6. Detach the steering column at the instrument panel (2 bolts) one of which can be seen at (3) Fig. 6, (Page 4).

7. Unclip three clips which secure the horn to steering column cable to the front end crossmember (4) Fig. 2, (Page 2).

FRONT END REMOVAL (MECHANICAL)

1. Unscrew the two hand bolts (4) Fig. 1. and swing the brush guard forward and down on it's hinges. This then becomes a step up to the front compartments.

2. Remove the engine cover.

3. Remove two bolts from the top of each "A" frame, one of which is shown at (1) Fig. 3, (Page 3).

4. Disconnect the clutch hydraulic pipe at the union near the air compressor.

5. Remove 4 bolts (two from each side) attaching the radiator stabilizers to the side of the front compartments, and swing the brackets clear, (5), Fig. 1, (Page 2).

6. Disconnect the front speedometer drive cable from the rear cable, unclip it from the chassis and cab, and coil it up to the front end. It will then come away with the front end assembly.

7. Take out all floor mats.

8. Remove right hand toe board attaching screws, (but not the toe board itself).

9. Remove four screws attaching the left hand toe board to the floor panel.

10. Remove the small toe panel to which the accelerator cross shaft is attached.

11. Remove the air lines (2) Fig. 5, and (4) Fig. 6, from the air control valve and toe board fittings. Disconnect the air guage pipe (2) Fig. 6 (Page 4) at the manifold fitting on the toe board.

12. Remove eight capscrews from each side flange (1) Fig. 2, and ten capscrews from the top mounting flange (2) Fig. 2 (Page 2).

13. Remove the two brush guard attaching pillars (3) Fig. 2, and the front bumper bar.

14. The front end assembly can then be removed.

NOTE: During front end removal take particular note of the locations of all seals, to ensure correct installation at reassembly.

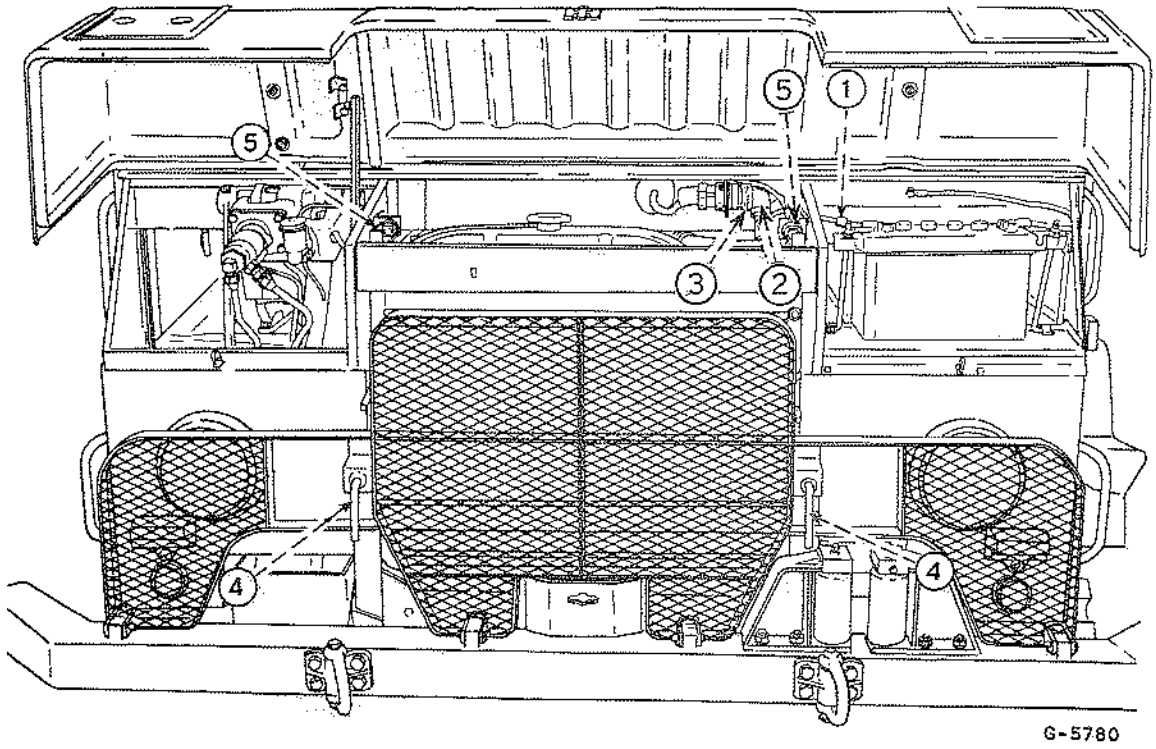


Fig. 1

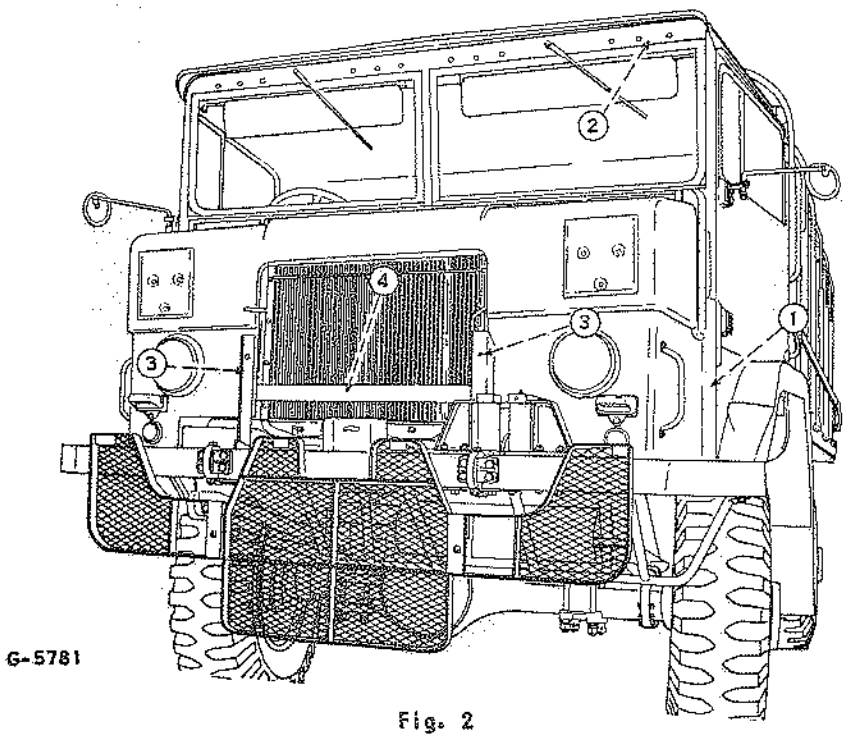


Fig. 2

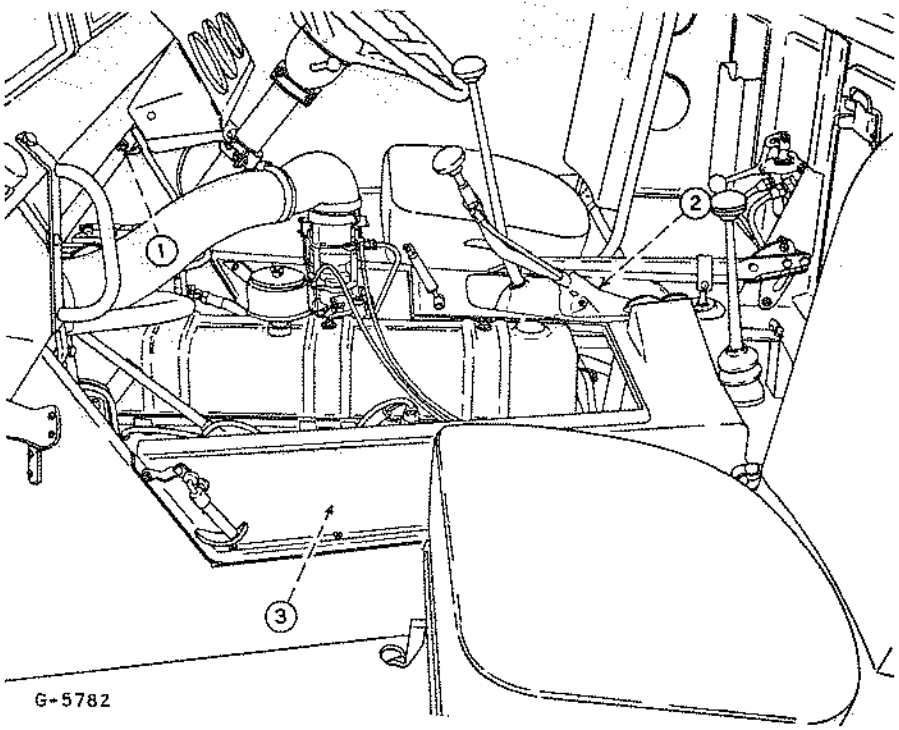


Fig. 3

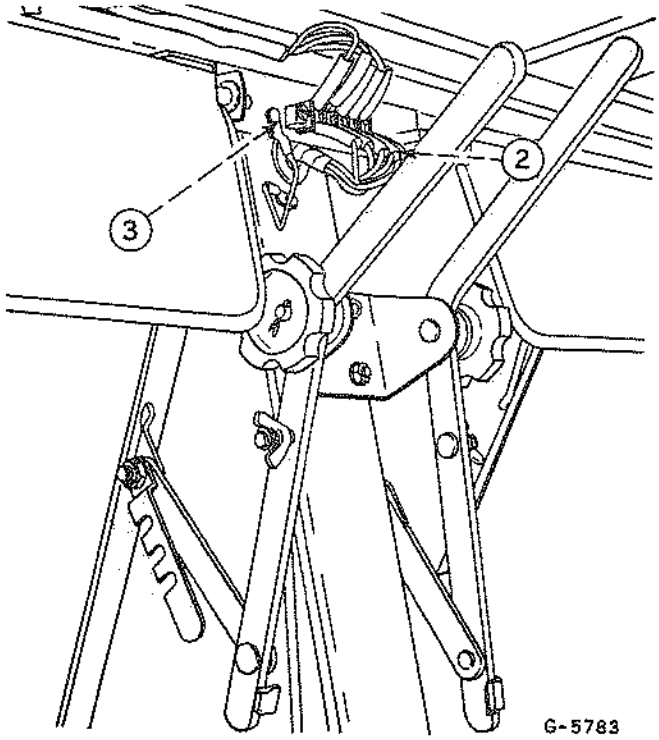


Fig. 4

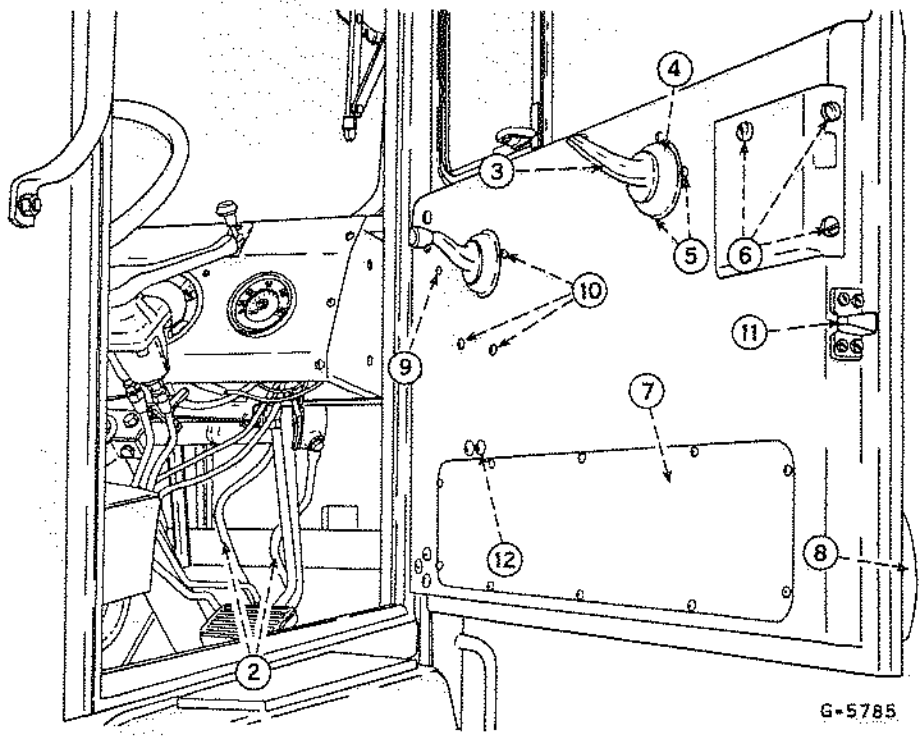


Fig. 5

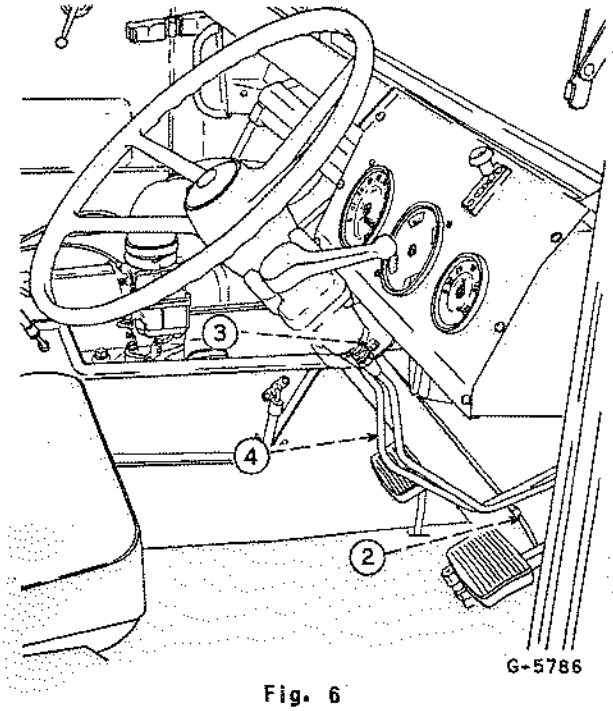


Fig. 6

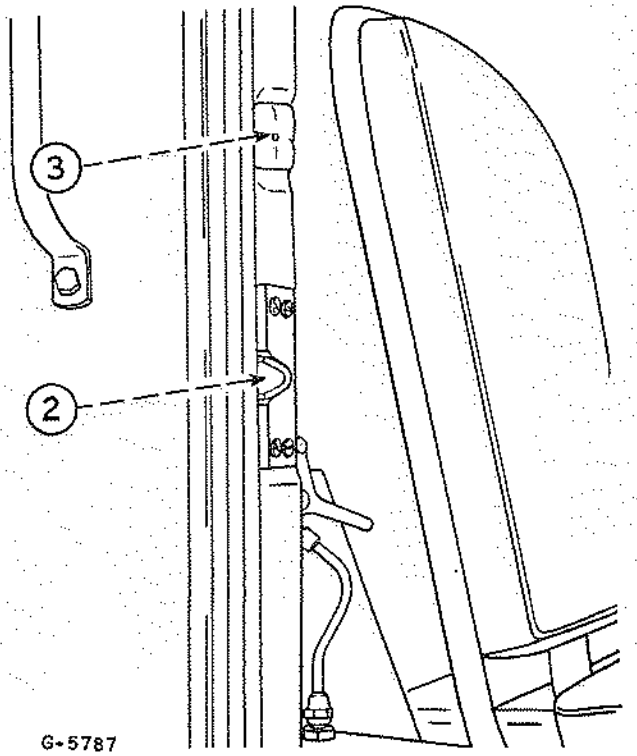


Fig. 7

REMOVAL OF CAB
FRONT MOUNTINGS (Fig. 8)

Note the correct order of assembly of the front mounting rubbers and remove the 1/2 x 3-1/2 hex. bolts.

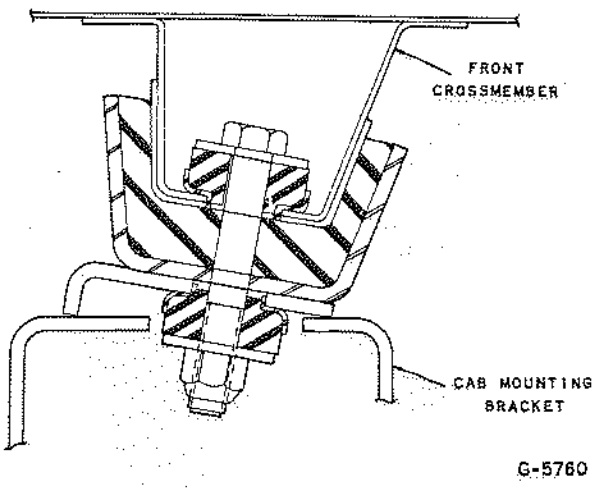


Fig. 8 - Cab Mounting Front

REAR MOUNTING (Fig. 9)

Place suitable blocks between the chassis side rails and the cab cross member rear, to support the cab. Remove four 3/8 x 1" hex. bolts which attach the rear mountings to the cab crossmember. Hand holes in the cab crossmember provide access to these bolt heads.

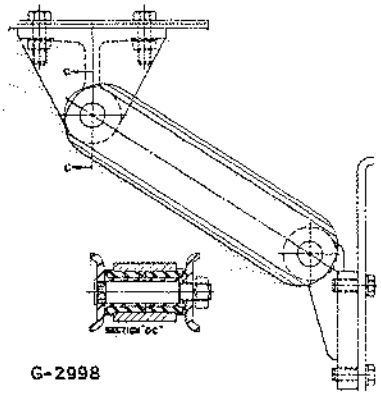


Fig. 9 - Cab Mounting Rear

CAB REMOVAL

Remove the engine cover by unhooking the spring catches.

Disconnect the throttle and choke cables from the carburettor.

Undo the press buttons of the control lever boot (2) Fig. 3 (Page 3).

Remove sixteen screws from the lower cover (3) Fig. 3 and lift off the cover.
Remove the rear clevis pin to disconnect the handbrake rod from the bellcrank. (Fig. 3, Section D5).

Disconnect earth strap at L.H. front cab mounting bracket.

Disconnect the horn wire at the cable connector located near the chassis rail beneath the engine air cleaner.
Disconnect the starter motor cable from the starter motor and pull clear.

Disconnect the flexible fuel pipe from the fuel pump.

Disconnect the oil pressure sender cable at the sender unit.

Disconnect the engine temperature sender cable at the sender.

Disconnect the low tension cable from the negative terminal of the ignition coil.
Disconnect the foot throttle to carburettor rod at the front end.

Disassemble the hydraulic clutch control pipe bracket from the engine tunnel R.H. side.

Disconnect the fuel sender cable connector situated under the rear L.H.corner of the engine tunnel.

Remove the clevis pin from the front yoke of the transfer case control rod.
Remove the swivel bolt from the rear end of the transmission control rod.

After identifying with tags to ensure correct reassembly, uncouple three winch control hoses beneath the cab.

Disconnect the fuel pipes from the two way cock under the cab floor.

Disconnect the front speedo cable from the rear speedo cable at the coupling situated inside the R.H. chassis rail just rear of the front spring rear hanger. (If the front end has been removed this will have been disconnected previously).

Unclip the cable and coil it up as described for front end removal.

After carefully identifying for correct reassembly, disconnect two air brake hoses below the R.H. toe panel. (If the front end has not been removed, access to these hoses can be obtained by taking out the R.H. headlamp).

Disconnect six cable connectors on the harness leading into the steering column. (These are coloured for identification on re-assembly).

Remove the horn button and steering wheel as described in section "F".

Lift the cab a few inches and check to ensure all cables, pipes and controls are free, then lift off the cab.

REMOVAL OF CAB DOORS

Tap out the two hinge pins - the doors are then free to lift off.

RENEWAL OF DOOR GLASS (Refer Fig. 5) (Page 4)

1. Remove ten tapping screws and take off the door access plate (7).
2. Open the vent window.
3. Wind the main window right down.
4. Remove two round head screws (12) securing the front glass run channel.
5. Remove one round head screw securing the same run channel. This screw is situated just below the vent window and access to it is gained by raising the lower seal of the vent window the screw head being upwards.
6. Remove one flat head countersunk screw and nut securing the top end of the glass run channel to the top of the door; access to this screw is downwards from above the door near the top corner of the vent glass.
7. The glass run channel can now be moved forward sufficiently to allow the main door window to be slid off the roller on the actuating arm of the regulator.
8. Pull the bottom of the window towards you and down through the door access opening.
9. Remove all broken glass and rubber insert from the glass channel.
10. Using raw rubber sheet, press the new glass centrally into the channel and trim off excess rubber. Allow the rubber to air cure for 24 hours before using the window again.

VENT WINDOW REMOVAL (Refer Fig. 5) (Page 4)

To remove the vent window take out two pan headed screws securing the top swivel bracket to the door, and two screws securing the bottom swivel bracket to the inside of the door inner panel. One of these screws is visible at (9) in Fig. 5.

The vent window can then be lifted out bringing the lower swivel bracket with it.

DOOR LOCK REMOVAL: (Refer to Fig. 5) (Page 4)

First remove the access cover (7). To remove the door locks wind the main door glass to the top. Remove the inside door lock handle (3) by pressing the escutcheon and removing the locking pin from the spindle. Take off the handle and escutcheon (4). Remove three round head screws and washers (5) securing the handle plate to the door panel. Push the spindle and plate through into the door and let it swing down on the actuating link to which it is attached. Remove three round head screws (6) securing the lock to the door, two located on the jam face and one on the inside panel. Through the access hole remove the circlip attaching the lever of the exterior door handle to the actuating link. Lower the lock plate with both actuating links down and out through the door access hole.

DOOR FITTING

Two adjustments are provided - the wedge plate dove tail (11) Fig. 5, on the door can be adjusted vertically by loosening the fixing screws and sliding the dove tail to the desired position. Similarly the door lock striker plate (3) Fig. 7 can be adjusted horizontally to obtain a firmly shut door.

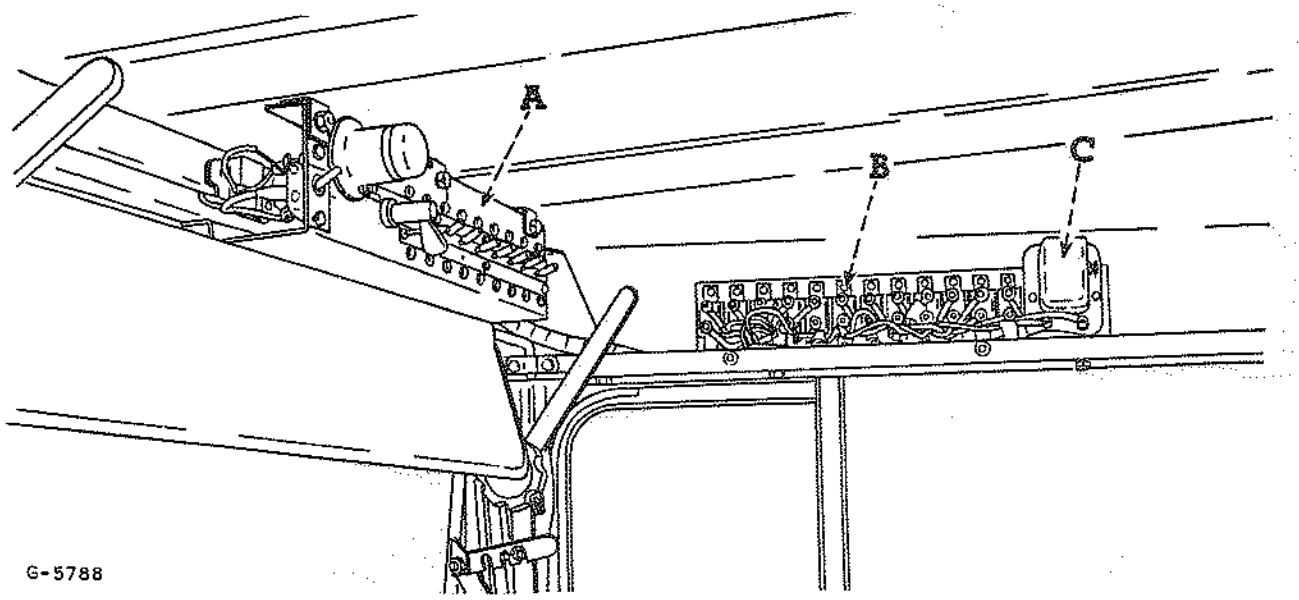


Fig. 10

Cab Interior showing location of
Control Switch Panel "A", Circuit Breakers "B"
and Low Pressure Buzzer "C"

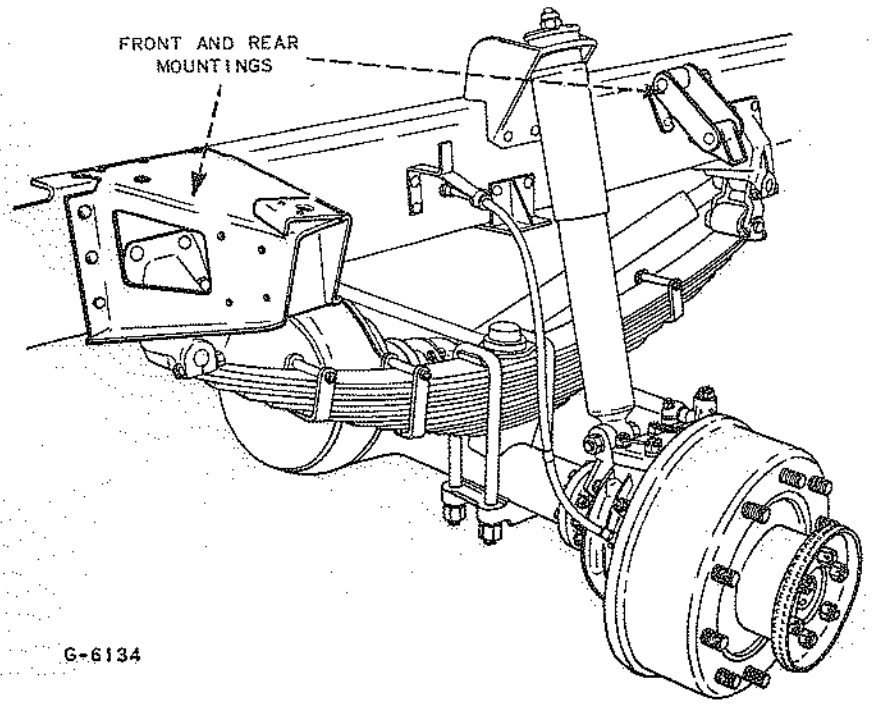


Fig. 11 - Cab Mounting Brackets

FIBREGLASS REPAIR

Several parts of the cab such as the hood, front fenders, engine covers etc., are made of fibre glass.

When these become damaged they must either be replaced or repaired according to the severity of the damage. If the damage is within economical repair a special fibreglass repair kit is required.

A step by step method of repair is as follows.

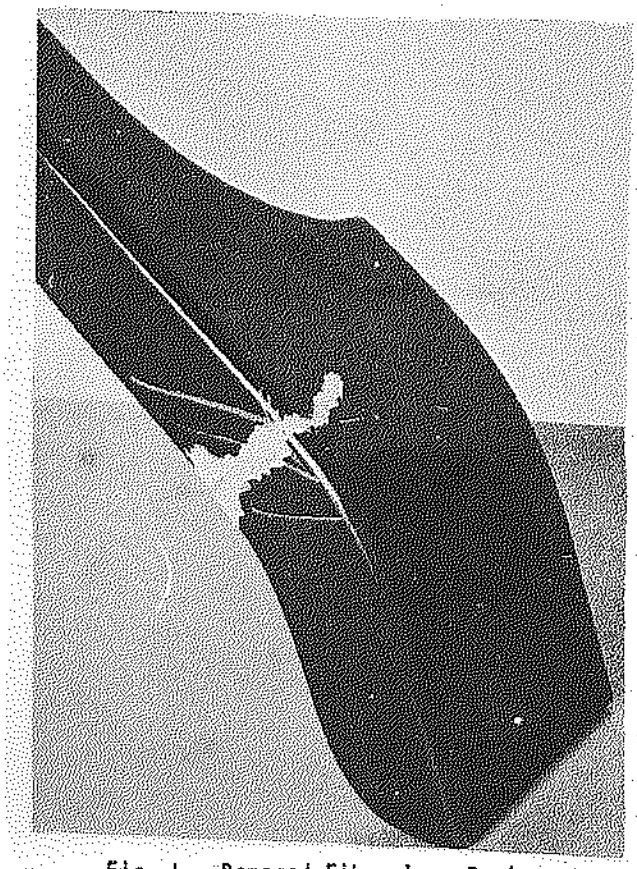


Fig. 1 - Damaged Fibreglass Part

METHOD OF REPAIR

1. Mark out damaged area with pencil approximately 2 inches from the fracture as shown in Fig. 2.
2. Sand thoroughly the area within the pencil lines leaving a feathered outer edge. As in Fig. 3.
3. From the repair kit, cut or tear suitable size pieces of mat for patches, Fig. 4.

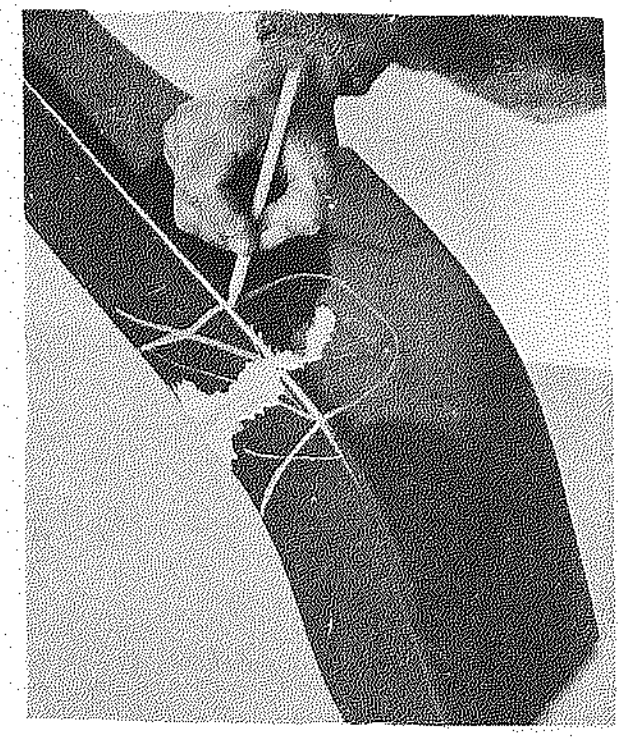


Fig. 2 - Marked Out Damaged Area

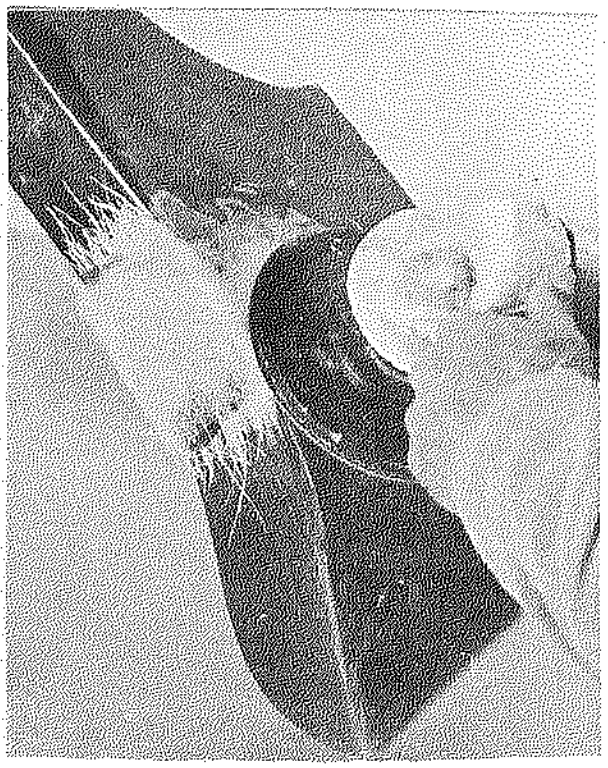


Fig. 3 - Sand Thoroughly

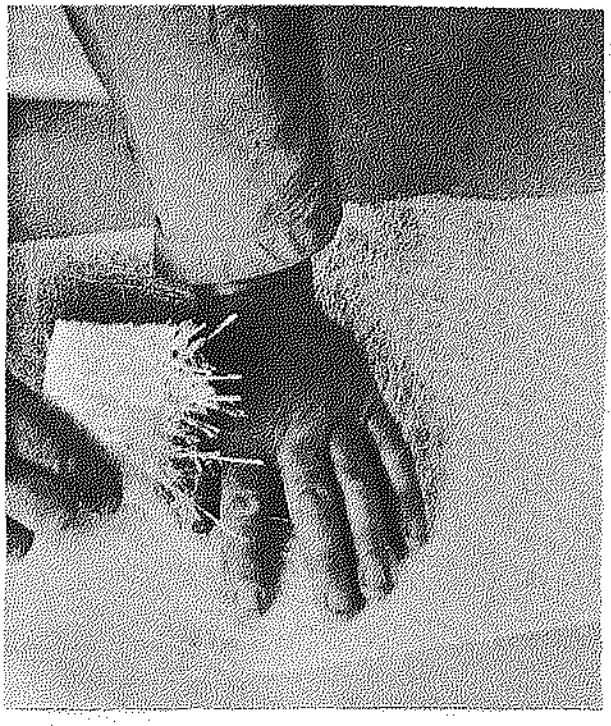


Fig. 4 - Tearing Piece of Mat for Patch

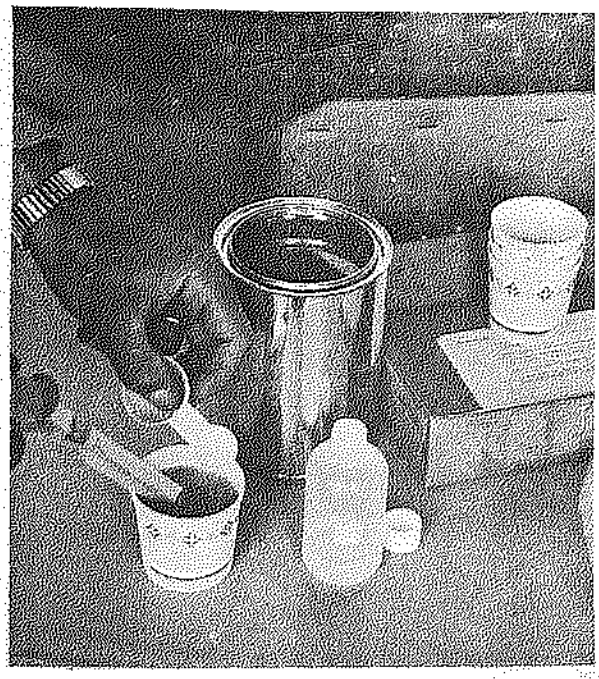


Fig. 5 - Mixing Resin

4. Measure out one small paper cup of resin, add one teaspoon of hardener and stir thoroughly with a clean piece of wood. These quantities can be increased or decreased according to size of repair.

   These proportions are suitable for temperatures around 60 to 70 degrees F. or below. Halve the quantity of hardener for higher temperatures.

5. Select a clean dry brush, and using a stippling motion impregnate the first glass patch. When this patch is completely wet out apply further patches in the same way to build up sufficient thickness. Allow to harden.

6. Clean brush in solvent acetone ensuring all traces of resin are removed. Any resin remaining will render a brush useless for further use. Acetone may also be used sparingly for cleaning resin off the hands.

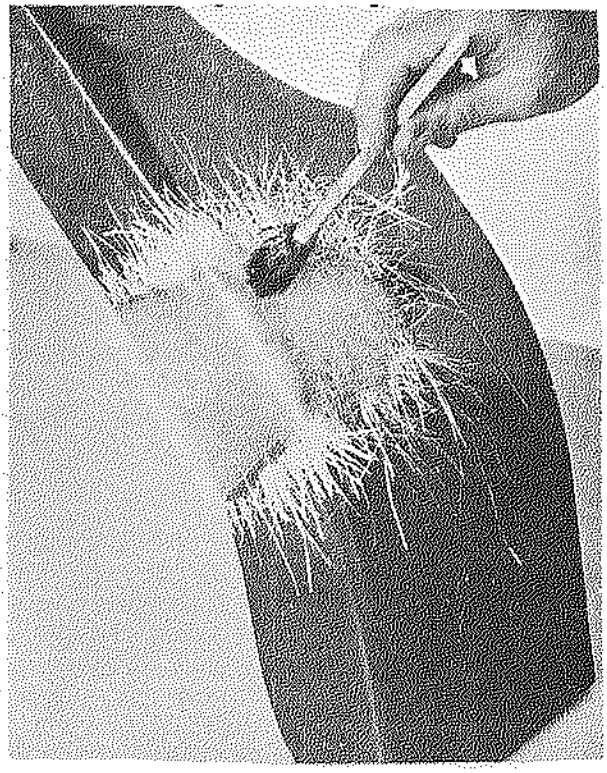


Fig. 6 - Applying Resin Mix To Resin in Position

7. Sand back to original shape using power sander files or garnet paper.

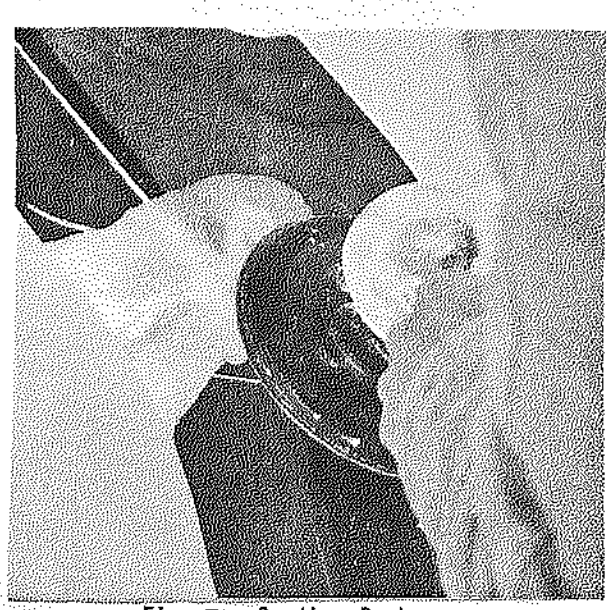


Fig. 7 - Sanding Back

8. Fill any imperfections using a patching putty made up as follows:-
   Take 1/2 cup of resin and stir in sufficient filler to make a smooth stiff putty.
   Add 1/2 teaspoon of hardener and stir thoroughly until pinkish tinge disappears.

9. Stop up imperfections with point of knife or putty knife or similar tool.
   When putty hardens rub down with fine garnet paper or dry wet and dry sandpaper.

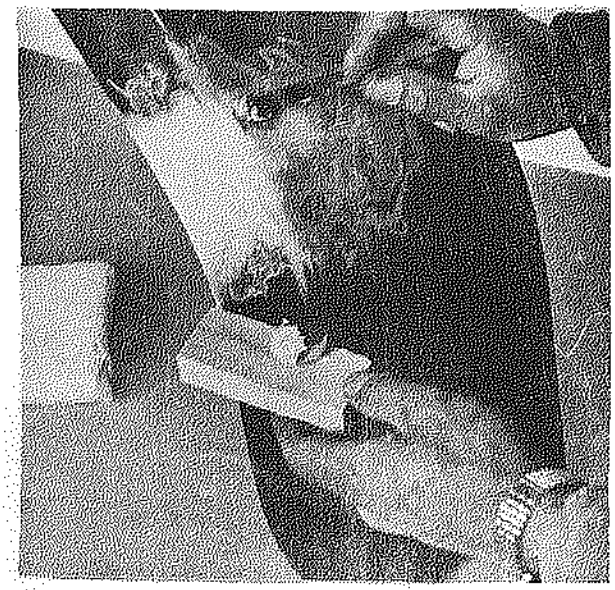


Fig. 8 - Stopping Up

10. Brush or spray primer coat and then finish coat of paint.

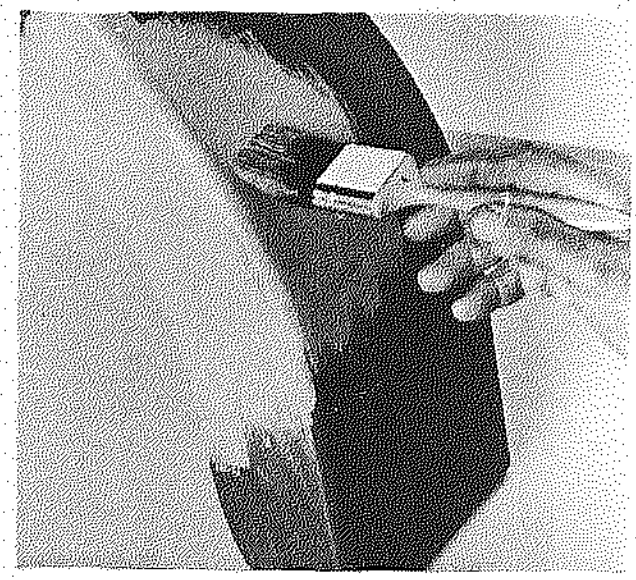


Fig. 9 - Prime Coating

11. If a fibre glass part has a piece completely knocked out, back up the hole with cardboard, aluminium sheet, or any other temporary material, and proceed with repairs as illustrated.

    Repairs can also be done on the reverse side.

NOTE: Keep resin and hardener in a cool dry area out of direct sunlight.

Avoid handling the resin unnecessarily.

Always wash the hands thoroughly after using the resin and hardener, using an abrasive soap.

Avoid inhaling the fumes as much as possible.

If acetone, resin or hardener gets into the eyes wash immediately with water.

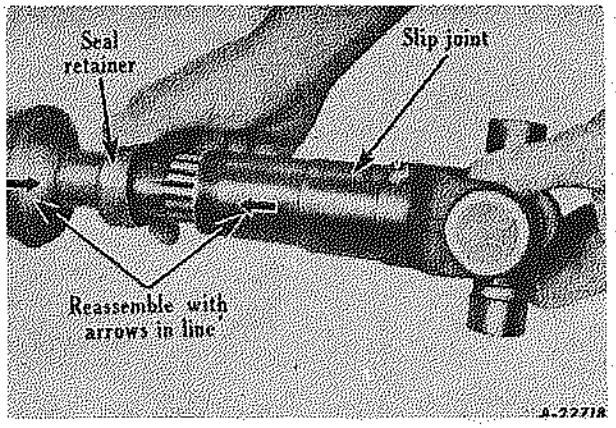


Fig. 1

PROPELLOR SHAFTS

Spicer 1510 type shafts are used throughout, for the drive lines, and Spicer 1410 for the winch drive.

To remove the shaft with joints, disassemble 4 bolts from the companion flanges.

Dismantling (Type 1510 Spicer) Joint

A. Remove oil seal retainer from end of slip joint and remove slip joint from shaft, after first marking the male and female splines to ensure correct reassembly Fig. 1.

B. Place joint assembly in vice using soft jaws to protect the joint threads.

C. Using a small punch, tap end of needle bearing assembly to loosen snap ring. Move needle bearing only enough to break bearing assembly away from snap ring (Fig. 3), which shows a universal joint after the flange yoke has been removed. Fig. 2 illustrates a typical needle bearing assembly.

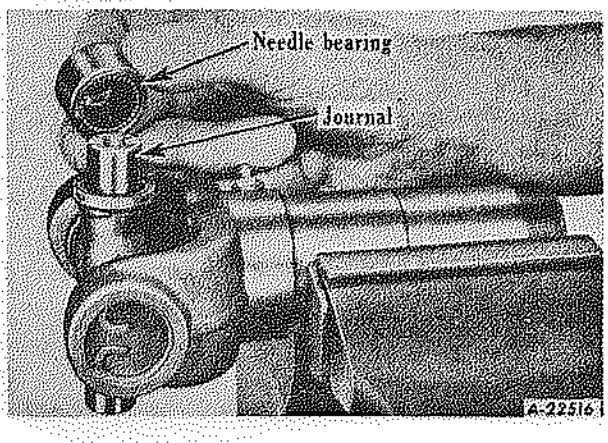


Fig. 2

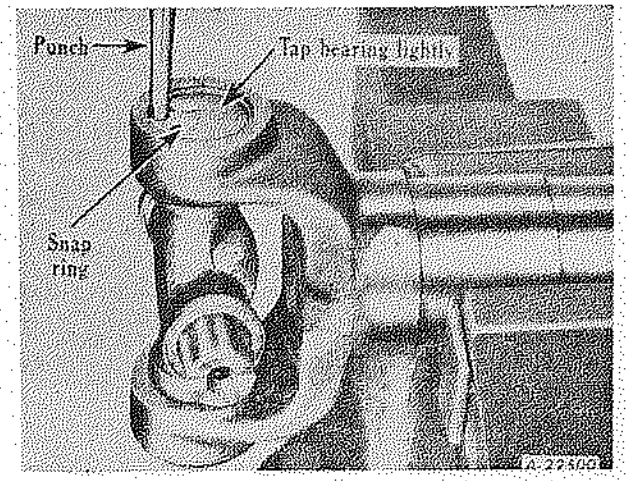


Fig. 3

D. Remove snap ring from slip joint yoke. Turn joint over and remove opposite snap ring (Fig. 4).

E. Tap needle bearing until opposite needle bearing is free of yoke; using a soft round drift (brass) with flat face about 1/32" smaller than the diameter of the hole in the yoke to prevent damage to the bearing (Fig. 5).

F. Turn yoke or joint over and tap on exposed end of journal or cross end to remove remaining needle bearing (Fig. 6).

G. Remove journal cross from yoke. Tip cross as shown in Fig. 7 and lift out of yoke.

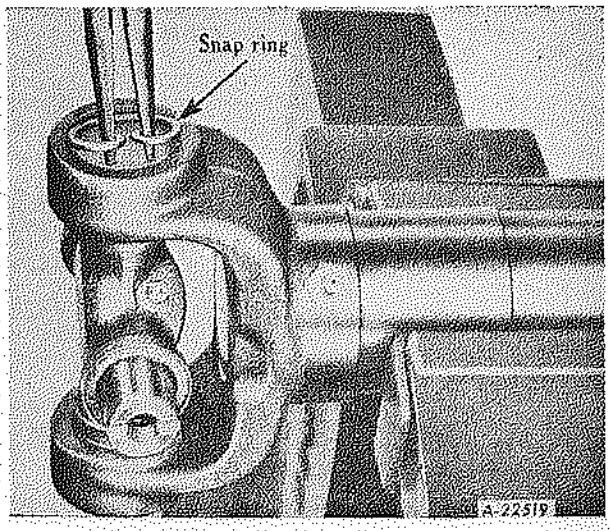


Fig. 4

R

Cleaning and Inspection

1. CLEAN ALL PARTS. Use a suitable cleaning fluid. Allow the parts to remain in the cleaner for some time to loosen up any particles of grease or foreign matter. Remove any burrs or rough spots from any machined surfaces.

2. NEEDLE BEARING. Do not dismantle. Clean with short stiff brush and blow out with compressed air. Work a small quantity of lubricant (140 SAE oil) into each needle bearing and turn the needle bearing on the trunnion to check wear. Replace if worn.

3. JOURNAL CROSS. Because worn needle bearings used with a new journal cross, or new needle bearings used with a worn journal cross, will wear more rapidly (making another replacement necessary in a short time) always replace the journal cross and four needle bearings as a unit.

4. JOURNAL AND BEARING KIT. To facilitate the replacement of journals and bearings, a journal and bearing kit is available. The use of the kit ensures having the correct individual parts when required, and saves valuable time.

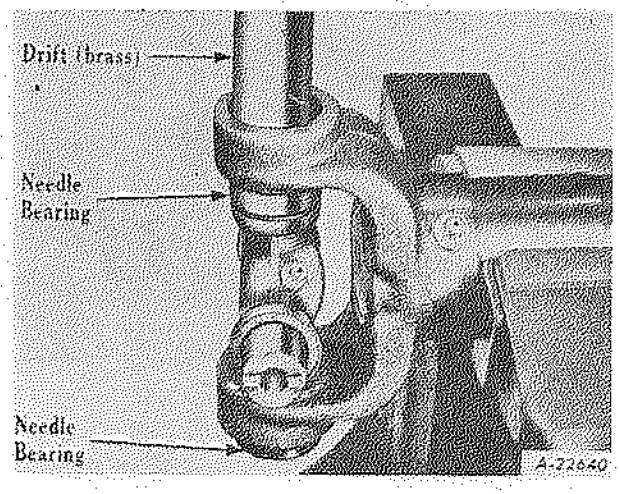


Fig. 5

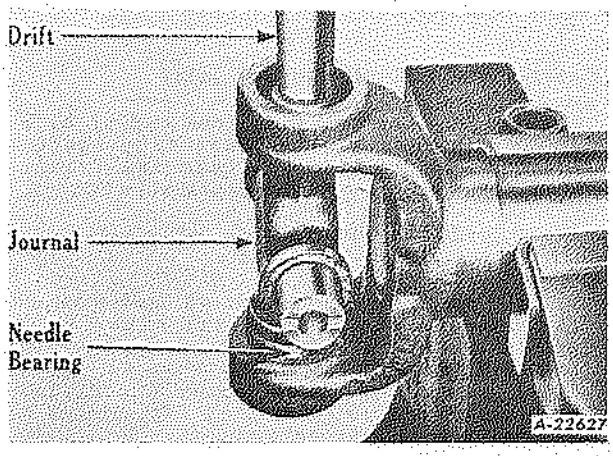


Fig. 6

Reassembling (Type 1510 Spicer) Joint

Reassembling is merely a reversal of the foregoing disassembling operations. On joints without a lubrication fitting, replace reservoirs in the journal cross ends with grease (XG-279). Make sure the reservoirs in each trunnion are filled. With the rollers in the race, fill the race about 1/3 full.

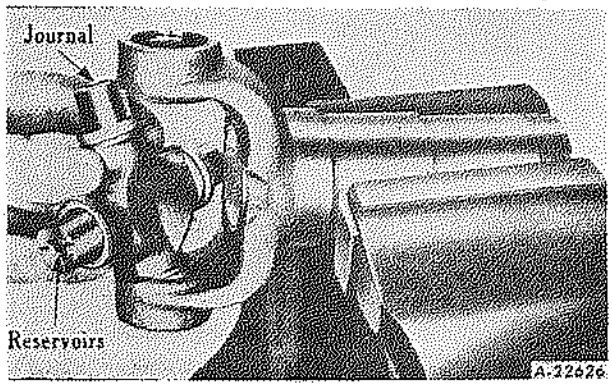


Fig. 7

Lubrication (Slip Yokes and Joints)

Propellor shaft slip yokes are to be lubricated every 1,000 to 2,000 miles. Use viscous chassis lubricant. Remove the pipe plug and inject lubricant. Replace the pipe plug.

The universal joints are lubricated every 3,000 to 5,000 miles using XG-279 grease.

PROPELLOR SHAFT (OR DRIVE LINE) VIBRATION

Where drive line vibration is experienced, it will be necessary to inspect the following units as outlined below, before any attempt is made to balance the propellor shafts as described under the heading "Step-by-Step Procedure for Checking Drive Line Vibration".

COMPANION FLANGES. The companion flange mounting nuts, and the bolts that attach the shaft to the flange, must be tight to assure drive line balance. The least degree of looseness in the flange mounting nuts, or the shaft attaching bolts, is enough to cause excessive (out of balance) vibration at high propellor shaft speeds. Where the flange also maintains the adjustment on the rear axle pinion bearings or propellor shaft centre bearings, this adjustment is destroyed because of lack of torque on the nut. When a companion flange is removed from a transmission, or rear axle, the flange and shaft should be marked so that the flange can be reinstalled in the same position on the shaft. Care should be exercised in the removal or replacement of companion flanges as rough handling such as hammering on the trunnion mounting may bend or distort flange.

CORRECT ALIGNMENT. Correct alignment of the universal joints is imperative for efficient torque transmission at high speeds. To assure parallel alignment of the joints mark the mating parts before disassembling as shown by arrow in Fig. 1.

LUBRICATION. When a propellor shaft has been removed from a chassis, proper lubrication is an important part in the reinstallation operation. Be sure to work a small quantity of lubricant (SAE140 gear oil) into the roller assemblies and make certain that the slip joint splines are also properly lubricated.

ENGINE MOUNTINGS. Tighten the engine mounting bolts. Should the engine mountings be oil soaked or deteriorated, they should be replaced. Loose mounting bolts, or oil soaked or deteriorated mountings, can cause excessive vibration.

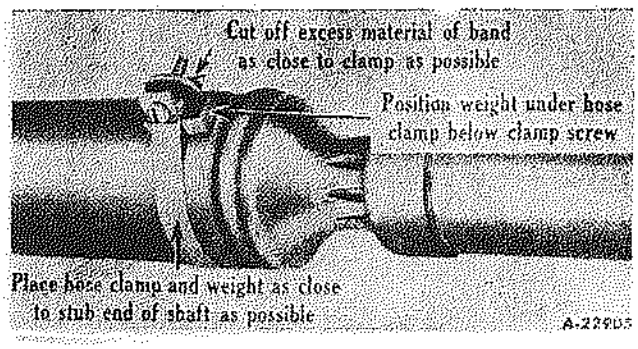


Fig. 8

Step-By-Step Procedure for Checking Drive Line Vibration

Start engine, and with clutch disengaged and transmission in gear to keep the clutch disc from spinning, bring engine speed up slowly to governed speed to determine if vibration in engine itself or due to an out of balance clutch pressure plate assembly. If only normal vibration is evident, disconnect the front propellor shaft at the transmission companion flange and with transmission in direct drive and clutch engaged, slowly bring engine speed to governed speed to determine if vibration is caused by an out of balance clutch disc or out of balance transmission gears.

If both the above checks show only normal vibration, connect the front propellor shaft and use the following step by step procedure in balancing the drive line assembly.

Drive line vibration can be checked by road testing truck, spinning the drive line with truck up on jacks or by pulling the rear axle shaft and spinning the drive line.

Before any balance weights are added to propellor shafts, disconnect the rear propellor shaft at centre bearing and rotate shaft 180 deg. in relation to companion flange (truck without centre bearing rotate shaft at transmission) reconnect shaft then road test truck or spin drive line and check for vibration.

If vibration is still present after above change use an adjustable hose clamp and a small metal weight (approximately 1/2 ounce). Clamp the weight to the rear shaft near the transmission and cut off excess material of band as close to clamp as possible (See Fig. 8). Then road test truck or spin drive line; then by moving the weight to various locations on the shaft, find the point of least vibration. Then increase or decrease the weight at this point to obtain as perfect balance as possible. Mark location of weight on shaft; remove hose clamp and weight. Weigh the weight and add 3/8 of an ounce for clamp screw and nut. Select a piece of steel of this total weight and tack-weld to propellor shaft at locating mark. Hold weld material to a minimum.

CAUTION: When attaching loose weights to propellor shaft with hose clamps (when checking for vibration) make sure that weights are clamped securely to shaft to avoid hazard of weights flying off.

WINCH AND DRIVE ASSEMBLY

AUTOMATIC BRAKE

This is a spring loaded brake operating on a drum keyed to the worm shaft. The spring tension loosens when raising or pulling a load, then tightens when the winch stops or is reversed.

The brake automatically holds a load when winch is stopped and prevents winch reversing when take-off is neutral. When properly adjusted, it will hold any load within the rated capacity of the winch.

ADJUSTING THE AUTOMATIC BRAKE:

If the brake fails to hold a load, remove cover (6) Fig. 1. and inspect brake mechanism to see no parts are damaged or broken. Increase brake tension by tightening adjusting bolt (7).

A properly adjusted brake band will smoke if winch is run for extended length of time without stopping. Continuous operation requires more frequent brake adjustment than when winch is used in intermittent operation.

Check brake adjustment by load testing and readjust spring if necessary.

DISMANTLING AND ASSEMBLY PROCEDURE 20L WINCH

1. Remove input drive flange, automatic brake case, automatic brake band and automatic brake disc from the worm shaft.

2. By use of a pointed tool driven into the oil seals remove both oil seals from each end.

3. Remove the circlip (24) from one end of the worm shaft.

4. Using a soft hammer, tap the worm shaft through the housing. It will be necessary to rotate the winch shaft slightly as this operation is being performed to allow the worm shaft to clear.

5. Remove end frame setscrews.

6. Remove end frame (39) complete with the end frame bush (36).

7. Remove spacer washers.

8. Slide off winch drum assembly from winch shaft. In carrying out this operation, care must be taken to see that thrust washer (31) is not lost.

9. Remove clutch operating lever and shaft (21) by removing the split pin and retaining washer.

10. Slide the dog clutch (47) outwards. This will allow the clutch operated yoke to fall and so enable it to be removed through the housing.

11. Remove the nut (17), washer (18) and adjust shims (16).

12. The winch shaft complete with worm wheel and spider may now be removed from the winch housing.

13. Remove winch support angle members.

NOTE: With all parts dismantled in the manner indicated, it is advisable to check all parts for wear and replace where necessary.

WINCH REASSEMBLY

Assembling the winch is the reverse of the procedure adopted for disassembly, however, certain precautions must be taken before proceeding with the work.

New circlips should always be fitted and under no circumstances should the circlips previously removed from the winch, be re-used. When fitting spacer shims between washer (18) the gear case housing (52), it is necessary to ensure that a running clearance of between .010" and .020" is maintained. THIS IS IMPORTANT.

The above running clearance must also be maintained when fitting spacer shims between the end frame (39) and winch drum assembly. THIS IS IMPORTANT.

When checking for this clearance it is necessary to loosen the base angle bolts and pull the end frame in a direction away from the gear case. This will take up all the clearance in the bolt holes and thus, by using the correct amount of shims, will automatically give the correct running clearance.

When fitting the winch drum assembly to the winch shaft, care must be taken to ensure that the thrust washer (31) is located in the retaining groove machined into the winch drum.

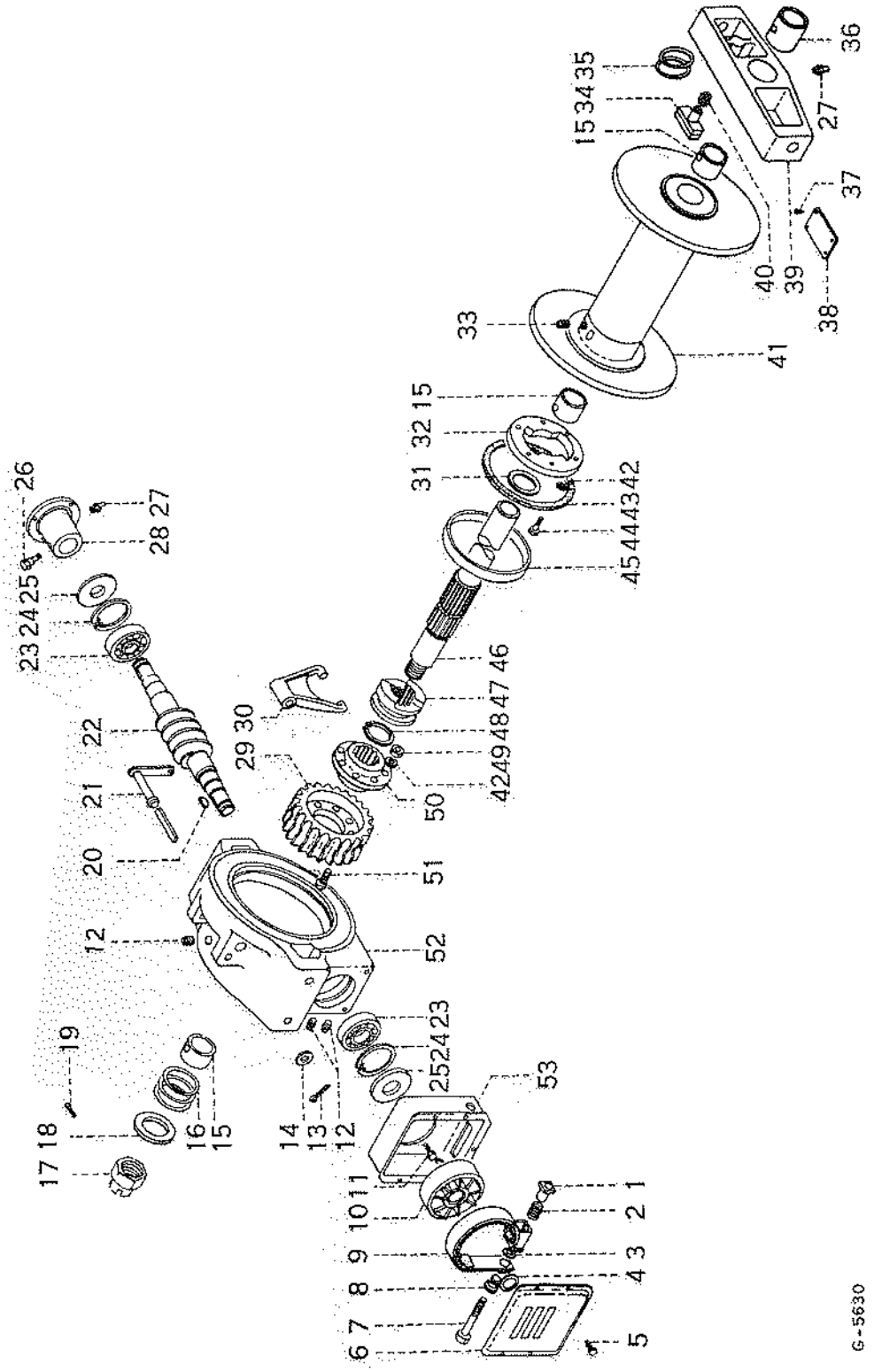


Fig. 1 - Winch (Exploded View)

WINCH OVERLOAD PROTECTION

The winch is designed to be protected from damage by the drive line shear pin (26). Should this pin fail, unscrew the head portion from the drive flange (28) and remove the broken section by using a fine punch inserted through the drift hole in the flange located diametrically opposite the tapped hole for the shear pin. Insert and securely wire a replacement shear pin.

ROUTINE LUBRICATION

WINCH ASSEMBLY

1. Keep gear case filled to oil level plug at the end of the case. This plug is located just above the drain plug. Inspect monthly and top up where necessary. Drain and refill case yearly using 4-1/2 pints of OM270 gear case oil for the Model 20L Winch.
2. Lubricate all grease fittings on the winch and winch drive parts with standard pressure gun grease. This should be done weekly or at least when the truck is greased.

CONTROLS

1. Monthly lubrication of the cylinder grease nipples with standard pressure gun grease.
2. Oil pivots and clevis pins of cylinder control concurrently with the above greasing.
3. Routine check of cylinder and valve seals for leakage is recommended whilst lubricating.

GUIDE ROLLERS AND FAIR LEADS LUBRICATION:

Grease all nipples and lubrication points weekly using standard pressure gun grease.

LEGEND FOR FIG. 1

1. *NUT, adjusting*
2. *SPRING*
3. *CIRCLIP*
4. *CIRCLIP*
5. *SCREW*
6. *COVER, auto brake*
7. *BOLT, brake adjusting*
8. *BUSHING*
9. *BAND, brake, w/LINING*
10. *DRUM, worm brake*
11. *BOLT, hex-hd., w/SHAKEPROOF WASHER*
12. *PLUG, pipe*
13. *PIN, split*
14. *WASHER*
15. *BUSH*
16. *SHIM*
17. *NUT, castellated*
18. *WASHER*
19. *PIN, split*
20. *KEY*
21. *LEVER, clutch operating*
22. *WORM*
23. *BEARING, ball*
24. *CIRCLIP*
25. *OIL SEAL*
26. *PIN, shear*
27. *NIPPLE, grease*
28. *FLANGE, winch drive*
29. *GEAR, worm*
30. *YOKE, shift*
31. *WASHER, thrust*
32. *RING, clutch*
33. *SETSCREW, socket*
34. *SHOE, asm., drag brake*
35. *SHIM, drumshaft*
36. *BUSH, frame*
37. *SCREW*
38. *NAMEPLATE*
39. *FRAME, end*
40. *SPRING, drag brake*
41. *DRUM, asm.*
42. *WASHER, spring*
43. *RING, oil retaining*
44. *BOLT, hex-hd.*
45. *BUSHING, drum*
46. *SHAFT, drum*
47. *CLUTCH, sliding*
48. *CIRCLIP*
49. *NUT, hex.*
50. *SPIDER*
51. *BOLT, hex-hd.*
52. *CASE, gear*
53. *CASE, auto brake*

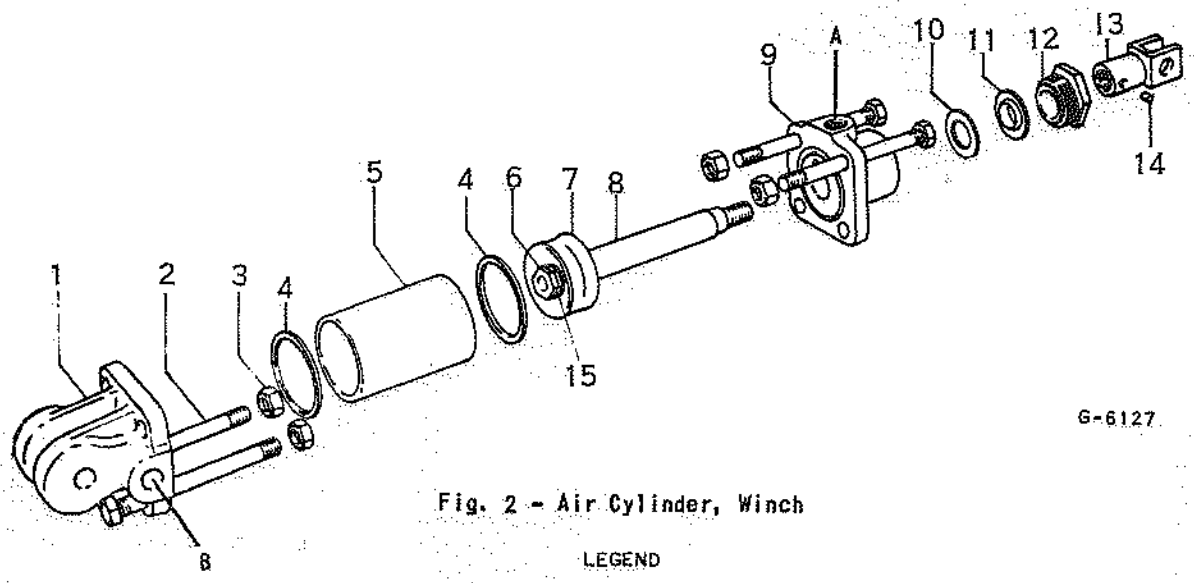


Fig. 2 - Air Cylinder, Winch

LEGEND

1. BLIND END
2. STRAP BOLT
3. NUT, STRAP BOLT
4. GASKET
5. BARREL
6. NUTS (TWO)
7. PISTON
8. ROD
9. SEAL END AND BUSH ASSEMBLY
10. TULIP SEAL
11. GLAND PACKINGS (TWO)
12. GLAND ADJUSTER
13. YOKE
14. GRUB SCREW
15. WASHER

AIR CYLINDER (Winch)

Except for lubrication of the two clevis pins, no maintenance is required.

Should air leaks develop the reservoir should be drained and the air cylinder removed and disassembled for examination as follows.

1. Loosen the grub screw (14) which secures the yoke (13) to the piston rod (8) and screw off the yoke.

2. Loosen the gland adjuster (12).

3. Remove a nut (3) from each of the four strap bolts (2).

4. Remove the seal end (9) with the piston (7) and rod (8) assembly.

5. Remove the piston rod from the seal end.

6. Remove the barrel (5) from the blind end (1).

7. Remove the gasket (4) from the annular groove in the seal end (9) and blind end (1).

8. Clean and examine all parts. The cylinder bore should be smooth and free from scuffs, burrs or damage.

9. Cylinder end faces must be clean and free from damage.

10. The annular grooves in the two ends, must be clean and free from burrs, nicks or other discrepancies.

11. The piston (7) should be examined for imperfections such as scratches or distortion, and replaced if at all imperfect.

12. To remove the piston from the piston rod, clamp the flats at the yoke end in a vice and remove the two nuts, (6) and flat washer (15) which secure the piston cup. Fit new piston and reassemble the washer and nuts, locking them together securely.

REASSEMBLY

1. Lightly smear all internal surfaces with Molybdenum Disulphide grease and reassemble in reverse order to disassembly.

2. In entering the piston into the cylinder bore every care must be taken to avoid damaging the piston.