TRACTORS

Ford

EQUIPMENT

1965 - 1975 FORD TRACTOR Service Manual

Tractor Series 2000, 3000, 4000, 5000, 7000 3400, 3500, 3550, 4400, 4500, 5500, and 5550

This three-volume manual provides information for the proper servicing of the Ford 2000, 3000, 4000, 5000, and 7000 agricultural tractors Keep this manual readily available for reference at all times.

FOREWORD

This three-volume manual provides information for the proper servicing of the Ford 2000, 3000, 4000, 5000, and 7000 agricultural tractors Keep this manual readily available for reference at all times.

The manual is grouped into 17 parts. Each part contains chapter divisions. The chapters contain such information as general operating principles, detailed inspection and repair procedures, and full specifics regarding troubleshooting, specifications, and special tools. Whenever possible, the special tools are illustrated performing their specific operations.

The page and figure numbers are consecutively numbered throughout each part of the manual and each page bears the date of issue. Specifications listed on some pages may differ from those in the text. In these cases, the specifications listed on the pages bearing the latest issue date should be used. Any reference made in the manual to right, left, front, rear, top, or bottom, is as viewed facing the direction of forward travel from the driver's seat.

The tractor and engine serial numbers, and the production code numbers for the transmission, hydraulic pump, rear axle and hydraulic power lift, are located on the individual components. An explanation covering the usage and location of these numbers is detailed on the following page. The serial numbers and production codes should be used on all correspondence relative to these Ford tractors.

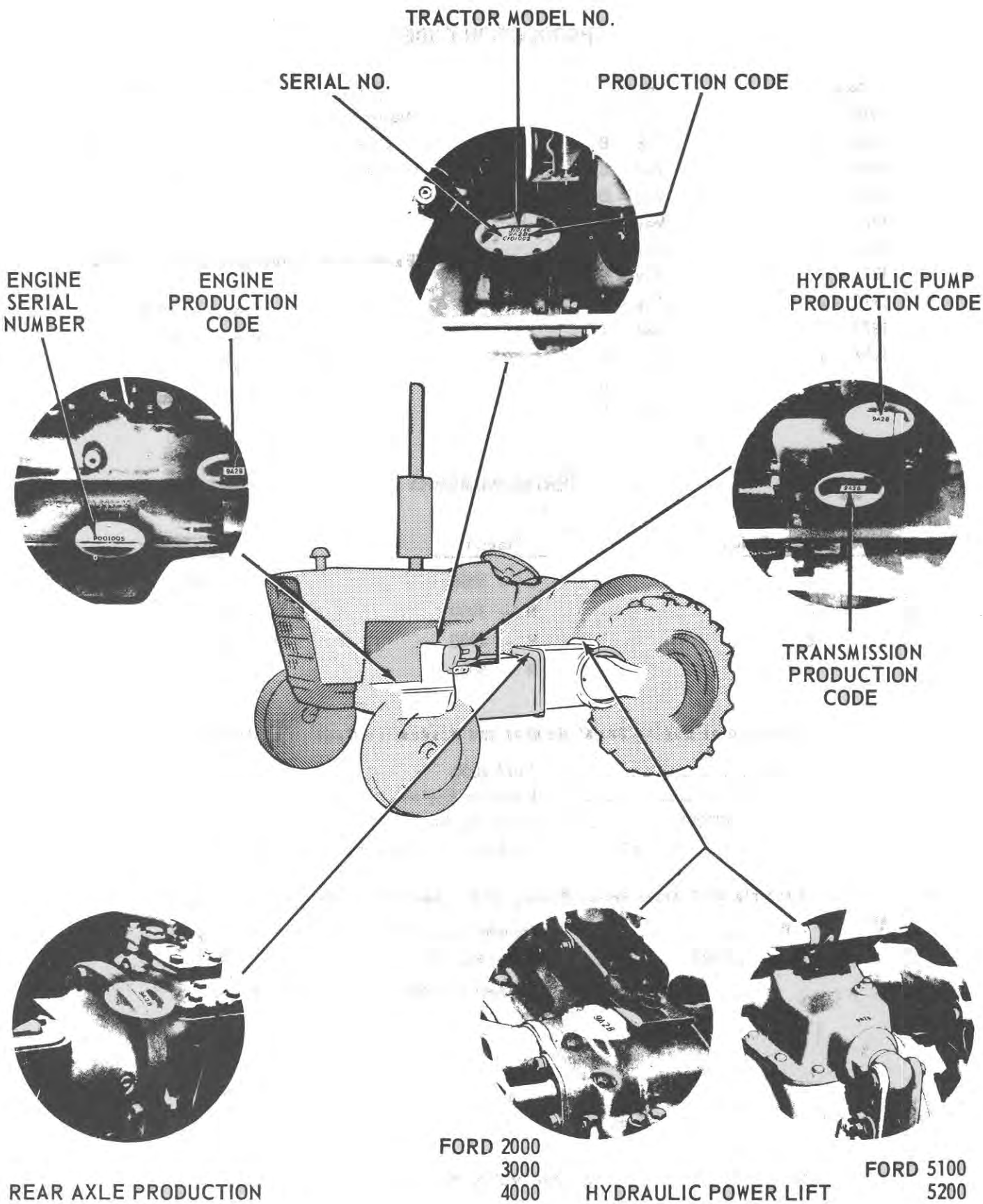
The material contained in this manual was correct at the time the manual was approved for printing. Ford policy is one of continuous improvement and the Ford Motor Company reserves the right to discontinue models at any time or change specifications or design without notice and without incurring obligation.

SAFETY PRECAUTIONS

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all tractors, as well as the personal safety of the individual doing the work. This manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help ensure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing tractors, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this manual must first establish that he compromises neither his personal safety nor the machine integrity by his choice of methods, tools, or parts.

PRODUCTION CODES AND SERIAL NUMBERS



PRODUCTION CODES

Year	Month	Day	Shift
1965 – 5	Jan – A	Numerical	Midnight – A
1966 – 6	Feb – B	Date	Day – B
1967 – 7	Mar – C	1 through 31	Afternoon – C
1968 – 8	Apr – D		
1969 – 9	May – E		
1970 – 0	June – F		
1971 – 1	July – G		
1972 – 2	Aug – H		
1973 – 3	Sept – J		
1974 – 4	Oct – K		
	Nov – L		
	Dec – M		

Example of Production Code: 5A2B

5 _ _ _	Year – 1965
A _ _	Month – Jan
2 _	Day – 2nd
B	Shift – Day

SERIAL NUMBERS

Manufacturing Codes	Tractor	Fuel Type
A	L – 2000	D – Diesel
B	N – 3000	G – Gasoline
C	P – 4000	P – Liquid Petroleum
	R – 5000	

Example of Engine Serial Number and Production Code: LG001005A5

L _ _ _ _ _ _ _ _ _ _	Ford 2000
G _ _ _ _ _ _ _ _ _	Gasoline Engine
001005 _ _ _ _	Serial Number
A5 _ _	Production Code – Built January, 1965

Example of Tractor Serial Number and Production Code: C1010025A2

C _ _ _ _ _ _ _ _ _	Manufacturing Code
101002 _ _ _	Serial Number
5A2 _ _	Production Code – Built 1965 January 2nd

NEW MODELS

FOREWORD

This Supplement covers the major differences between new and previous type Ford 2000, 3000, 4000 and 5000 Agricultural tractors. The mechanical changes detailed also apply to Ford 3400, 3500, 4400, 4500 and 5500 Industrial models. Changes to styling have little effect on service procedures, therefore where changes are merely ones of appearance, reference to the Parts Catalog should be made when replacing such items as radiator grilles, hoods and exhaust mufflers.

SERIAL NUMBERING AND DATE CODING

The following Serial Numbering and Coding information should be noted:

Model Code

The model code is stamped on the right-hand implement mounting pad of the transmission and is also shown on the identification decal located under the right-hand hood panel.

The first numerical digit which identified previous models has been changed to a letter for the new models. The chart below details the new code.

Model Identification		Chassis Type	Fuel Type	P.T.O. Type	Trans Type
Previous Model	*New Model*				
2 —— 2000 —— B		10–Agricultural All Purpose	1–Diesel	1–No P.T.O.	A–4-Speed
3 —— 3000 —— C			2–Gas	2–Trans 540	
4 —— 4000 —— D		11–L.C.G.	3–L.P.	3–Live 540	C–8-Speed
5 —— 5000 —— E		12–Highway		4–Independent 540	
		13–Rice			E–Select-O-Speed
		20–Row Crop		5–Independent 540-1000	F–4/4 T-C Power Reversing
		30–Vineyard			
		31–Narrow		6–Independent 540/1000 GD	K–6/4 Manual Reversing
		40–Utility			
		50–Industrial			
Example	E	10	1	4	C

Thus a model E1014C indicates a new model Ford 5000 All Purpose Tractor equipped with a diesel engine, Independent (540 r.p.m.) P.T.O. and an 8-speed transmission.

Tractor Serial Numbers

These will carry on in the same sequence as with previous models. The following chart shows the approximate Serial Number of each new model.

Assembly Plant	Ford 2000	Ford 3000	Ford 4000	Ford 5000
Highland Park	C204631	C204849	C204998	C204852

NOTE: *For an interim period previous model and new model tractors were being produced simultaneously; however, there were no previous model tractors produced with a date code after 8G19B.*

Engine Serial Numbers

With the new models, Engine Serial Numbers begin again at 000001, while the "power class" prefixes have been changed as indicated below.

NOTE: *A few of the first production new model Ford 2000 and 3000 engines were stamped with the previous Engine Number sequence.*

Model	Engine Serial Number Prefix	
	Previous	New Model
Ford 2000	L	B
Ford 3000	N	C
Ford 4000	P	D
Ford 5000	R	E

Part 1

ENGINE SYSTEMS

FORD 4000 DIESEL ENGINE

To provide increased power, a new cylinder head with modified porting has been introduced together with a new high lift camshaft, fuel injection pump and injectors, and a new air cleaner.

Cylinder Head

The inlet ports of the new cylinder head are larger than those of the previous cylinder head to provide improved breathing. All valve seats are located 0.020 in. (0.52 mm) deeper.

This head may be used in service on previous Ford 4000 tractors.

When milling a new type head for service, the distance between the top of the valve seat and the head to cylinder block jointing face must not be less than 0.137 in. (3.48 mm) after milling.

Cylinder Head Gasket

An improved cylinder head gasket with wider beading on the underside of the gasket is used on the new models. This gasket may be used on previous Ford 4000 diesel engines. See Figure 1.

Camshaft

A new camshaft with higher cam lift and wider timing is used with the new model diesel engine.

Connecting Rod

Heavier I-section connecting rods are used on all new model Ford 4000 and 5000 engines. While these may be installed when servicing a previous type engine, they must not be mixed with the previous type connecting rods.

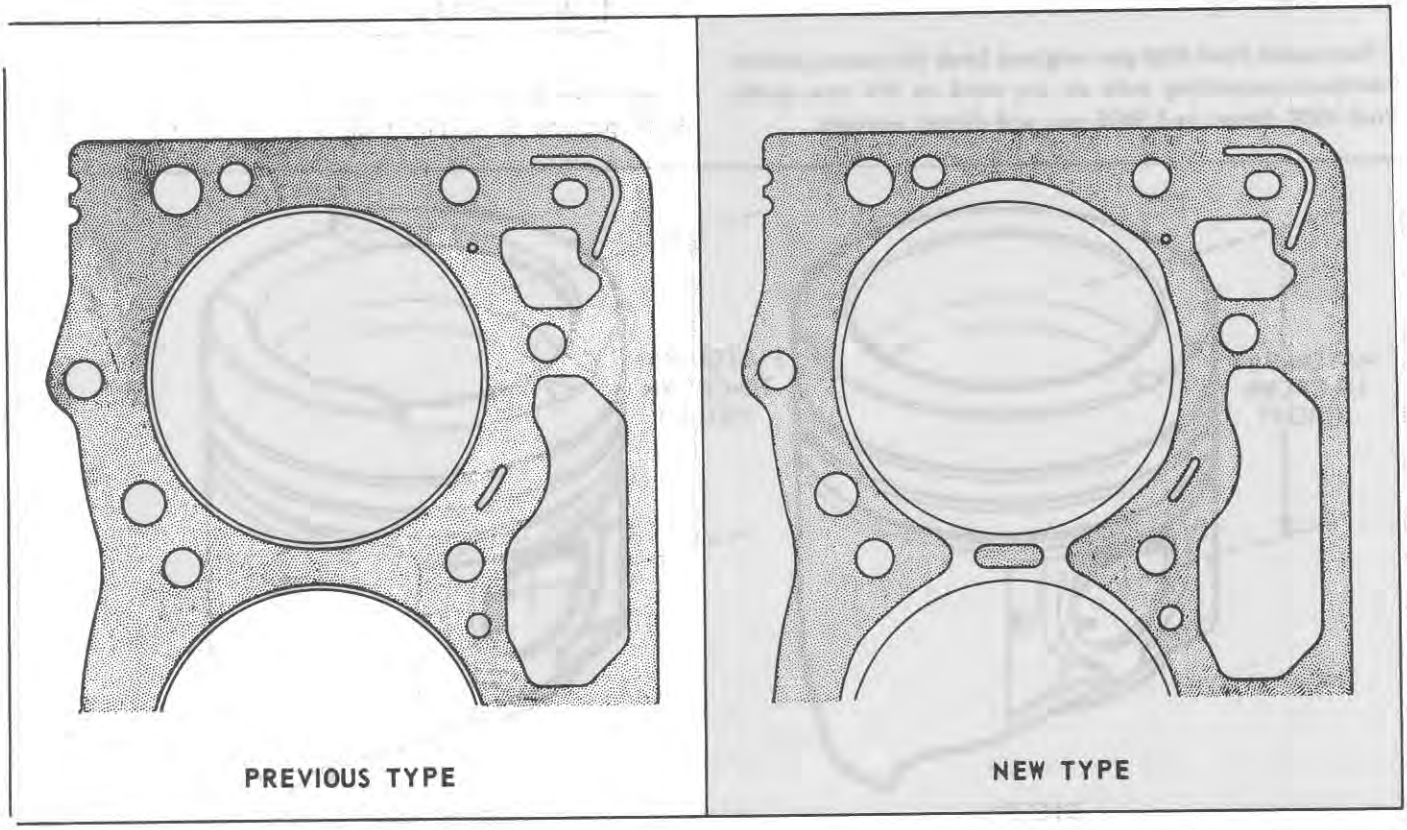


Figure 1
Cylinder Head Gasket

FORD 4000 GAS ENGINE

Increased power has been obtained by increasing the stroke from 4.2 in. (106.68 mm) to 4.4 in. (111.76 mm).

Cylinder Head and Gasket

A new cylinder head has been introduced which differs from that used on previous Ford 4000 gas engines in that the valve seats are located 0.020 in. (0.52 mm) deeper. There is no change to the cylinder head gasket.

Crankshaft

The crankshaft used in the new model Ford 4000 gas engine is common with the Ford 4000 diesel crankshaft and provides a stroke of 4.4 in. (111.76 mm).

Pistons

New pistons are used which have a piston pin-to-piston crown height of 2.523/2.525 in. (64.08/64.14 mm). Previous Ford 4000 gas pistons had a piston pin to crown height of 2.741/2.743 in. (69.62/69.67 mm). See Figure 2.

Connecting Rods

New model Ford 4000 gas engines have the same heavier I-section connecting rods as are used on the new model Ford 4000 diesel and 5000 gas and diesel engines.

FORD 5000 DIESEL ENGINE

Increased power for the new model Ford 5000 diesel engine has been achieved by increasing the cylinder bore diameter, introducing a new cylinder head with modified porting, a new camshaft and pistons, and a new injection pump and injectors.

Cylinder Block

The new model Ford 5000 cylinder block has piston bores which are 4.4 in. (111.76 mm) diameter, whereas the previous Ford 5000 bores were 4.2 in. (106.88 mm) diameter.

Pistons

While the pistons have been increased to the same diameter as those of the Ford 4000, they are not identical with the Ford 4000 pistons in that the Ford 5000 piston pin-to-piston crown height is greater. See Figure 2.

Piston Pin to Crown Height – Diesel	
Ford 4000	Ford 5000
2.661/2.663 in. (67.59/67.64 mm)	2.761/2.763 in. (70.13/70.18 mm)

Specified piston-to-bore clearance with these new Ford 5000 pistons is 0.0080/0.0090 in. (0.2032/0.2286 mm).

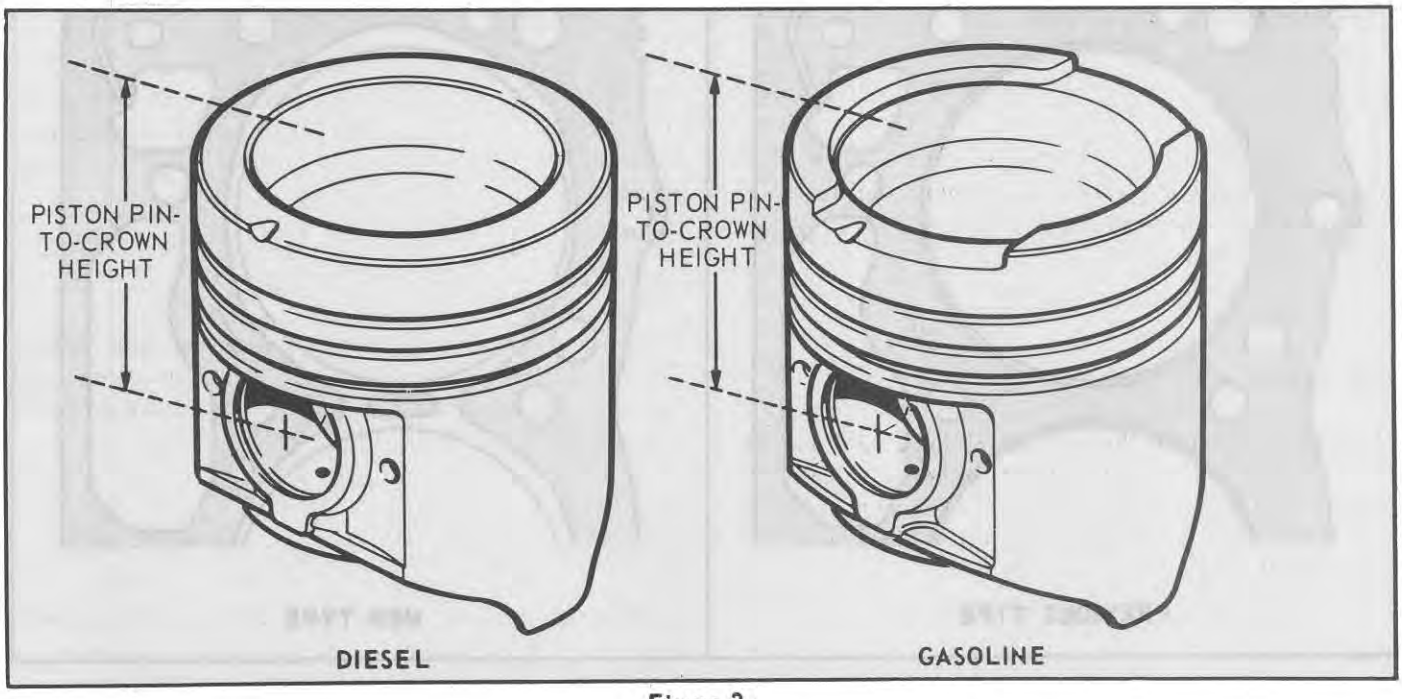


Figure 2
Piston Pin-to-Crown Height

Connecting Rods

Heavier I-section connecting rods, identical with those used on the new model Ford 5000 gas and Ford 4000 diesel and gas engines, are used on the new model Ford 5000 diesel engine.

Cylinder Head

A new cylinder head with increased diameter inlet ports to provide improved breathing, and valve seats located 0.020 in. (0.52 mm) deeper, is used on the new model Ford 5000 diesel engine.

The new head may be used on previous Ford 5000 engines but, as with the new model Ford 4000 diesel engine cylinder head, if it ever requires milling, the distance between the valve seat and the head face must not be less than 0.137 in. (3.48 mm) after milling.

Cylinder Head Gasket

New type with wide beading interconnecting the bores on the underside of the gasket. Because of the larger bores in the new model Ford 5000 diesel engine, this gasket is not suitable for use on any previous engine.

Camshaft

New type with higher cam lift.

Oil Pan

A new oil pan has been introduced on new model Ford 5000 engines and the specified oil capacity of the engine, including filter, has been increased to 10 U.S.qts. (16.75 Imp. pints) (9.5 litres).

FORD 5000 GAS ENGINE

Increased power for the new model Ford 5000 gas engine has been achieved by increasing the cylinder bore diameter, introducing new pistons to suit, a new cylinder head with deeper valve seats, and a new air cleaner with increased oil capacity.

Cylinder Block

Piston bore diameter increased from 4.2 in. (106.68 mm) to 4.4 in. (111.76 mm).

Pistons

New type pistons are used on new model Ford 5000 gas engines. Although these are of the same diameter as the Ford 4000 gas engine piston, the new model Ford 5000 piston has a greater piston pin-to-piston crown height than the new Ford 4000 gas piston, and a lesser piston pin-to-crown height than the previous 4000 gas piston.

Piston Pin-to-Crown Height – Gas		
Previous Ford 4000	New Model Ford 4000	New Model Ford 5000
2.741/2.743 in. (69.62/69.67 mm)	2.523/2.525 in. (64.08/64.14 mm)	2.662/2.664 in. (67.62/67.67 mm)

Specified piston-to-bore clearance is 0.0032/0.0042 in. (0.8128/0.8627 mm) with these new pistons.

Cylinder Head and Gasket

The cylinder head is new in that the valve seats are located 0.020 in. (0.52 mm) deeper than on the previous Ford 5000 gas engine.

A new cylinder head gasket has been introduced to suit the larger bore size of the new model Ford 5000 gas engine.

Connecting Rods

Heavier I-section connecting rods, identical with those used on new model Ford 5000 diesel and Ford 4000 gas and diesel engines, are used on the new model Ford 5000 gas engine.

Oil Pan and Dipstick

The new oil pan described under Ford 5000 Diesel Engine is also used on the Ford 5000 Gas engine, and the oil capacity of the engine has been increased to 10 U.S. qts. (16.75 Imp. pints) (9.5 litres).

FORD 2000 AND 3000 GAS AND DIESEL ENGINES

The changes in new model Ford 2000 and 3000 engines are minor and are mainly introduced to take maximum advantage of machining and manufacturing techniques which have been changed to accommodate the new model Ford 4000 and 5000 engines.

Cylinder Head and Gasket

Although new cylinder head part numbers have been allocated, the only difference between the cylinder heads used previously and those used with the new model engines is that the latter have the valve seats located 0.020 in. (0.52 mm) deeper.

A new cylinder head gasket with wide beading interconnecting the bores on the underside of the gasket is used on new model Ford 2000 and 3000 diesel engines. This gasket may be used for service on previous Ford 2000 and 3000 diesel engines.

Camshaft – Diesel Engines only

A new camshaft with higher cam lift is used in new model Ford 2000 and 3000 diesel engines. This change is merely to commonize with the camshaft of the new model 4000 diesel engine.

The camshaft of the Ford 2000 gas engines, and also that of the Ford 3000 gas engines, are unchanged.

Crankshaft – Ford 3000 Diesel

Apart from a difference in material, the crankshaft in the Ford 3000 diesel engine is virtually identical with that of the previous type Ford 4000 gas engine. The current Ford 3000 diesel crankshaft will be discontinued when existing stock is exhausted. The crankshaft used in the previous Ford 4000 gas engine will then be used for production and service of all Ford 3000 diesel engines, as well as for service of the previous Ford 4000 gas engine.

COOLING SYSTEM

New radiators have been introduced with some of the new model Ford 4000 and 5000 Agricultural tractors and the 5200 Row Crop tractor. The difference is in the number of cooling fins per inch. There are no changes to the radiators in Ford 2000 and 3000 tractors.

Model	Engine	Trans.	Cooling Option	No. of Radiator Fins/inch	
				Previous	*New Model*
4000	Gas	8-Speed and Select-O-Speed	Standard	5	7
4000	Gas	Select-O-Speed	Tropical	7	9
4000	Diesel	8-Speed	Standard	5	7
4000	Diesel	8-Speed	Tropical	5	7
4000	Diesel	Select-O-Speed	Standard	No change	
5000	Gas	8-Speed and Select-O-Speed	Standard	7	9
5000	Diesel	8-Speed	Standard	5	9
5000	Diesel	Select-O-Speed	Standard	7	9
5000	Diesel	8-Speed and Select-O-Speed	Tropical	7	9
5200	Row Crop	All Models		7	9

Part 2

FUEL SYSTEMS–DIESEL

FORD 2000 and 3000

The fuel injection pumps and injectors of new model Ford 2000 and 3000 tractors are identical to those used on the previous model Ford 2000 and 3000 tractors.

FUEL INJECTORS

The fuel injectors used in new model Ford 4000 and 5000 engines differ from those used in previous Ford 4000 and 5000 engines. The outward appearance of the new injector is the same as those used on the previous tractors. The difference between current and previous injectors is in the size and angle of the nozzle holes which, without accurate gauges, cannot be readily recognized.

For this reason, when re-conditioning injectors in service, special attention should be given to the identification code numbers which are etched on the body of the nozzle. This number in conjunction with the following chart will enable each nozzle to be identified with the actor it was designed for.

Previous New Range Tractors	Nozzle Identification	Current New Model Tractors	Nozzle Identification
Ford 2000	BDLL150S6443	Ford 2000	BDLL150S6443
Ford 3000	NL 413	Ford 3000	NL 413
Ford 4000	BDLL150S6476	Ford 4000	BDLL140S6422
Ford 5000	NL 413	Ford 5000	BDLL140S6422

FORD 4000 DIESEL – AIR CLEANER

The air cleaner specified for use with the new Ford 4000 diesel engine is the same as that used on the previous and current Ford 5000 tractor. The diameter of this cleaner is 7 in. (178 mm) as compared to the 6.5 in. (165 mm) diameter cleaner previously used on the Ford 4000. The inlet and outlet ports are 2.25 in. (57.15 mm) diameter as compared to the 2 in. (50.8 mm) diameter ports in the previous cleaner. The air cleaner hoses have been changed accordingly.

Part 2

FUEL SYSTEMS–GAS

FORD 5000 (GAS) – AIR CLEANER

A new air cleaner is used with the new model Ford 5000 gas engine. This cleaner has a diameter of 7 in. (178 mm) compared to the 6.5 in. (165 mm) diameter cleaner used on the previous Ford 5000 gas tractor. It has an inlet port diameter of 2.25 in. (57.15 mm) as compared to the 2.0 in. (50.8 mm) diameter inlet port in the previous cleaner used on Ford 5000 gas tractors.

ALL GAS ENGINES – NO LOAD AND IDLE SPEEDS

The following no load and idle speeds are specified for new model gasoline engines.

Model	No Load Speed	Idle Speed
Ford 2000	2065–2165	600–700
Ford 3000	2285–2385	600–700
Ford 4000	2395–2495	600–700
Ford 5000	2285–2385	600–700

Part 3

ELECTRICAL SYSTEM

ALL MODELS – GENERATORS AND REGULATORS

All new model Ford 3000, 4000 and 5000 tractors have 22 amp. generators and regulators as standard equipment.

For a short period the 11 amp. generator and regulator may be installed on Ford 2000 tractors but eventually this model will also have the 22 amp. parts.

NOTE: ***It is not permissible to mix a 22 amp. generator with an 11 amp. regulator or vice versa. It is important, therefore, that care is taken to check which type is installed on a Ford 2000 before installing a service replacement.***

ALL TRACTORS WITH SELECT-O-SPEED – OIL PRESSURE WARNING LIGHT

It is no longer considered necessary to have an oil pressure warning light on Select-O-Speed transmissions and this item is, therefore, not incorporated on new model tractors.

Existing stocks of Select-O-Speed transmissions which incorporate a distributor plate assembly with a threaded hole for the warning light switch will continue to be used. As an interim measure, the switch will still be installed in the distributor plate assembly but its function will be merely that of a blanking plug to maintain pressure in the system.

Similarly, existing wiring harnesses will continue to be used but the wire connecting the warning light switch to the light (white/light green) is cut at a point 5 in. (12.7 cm) outside the rubber grommet in the cover, and at the wire clip inside the cover.

When existing stocks of wiring harnesses are exhausted, new wiring harnesses with only two wires will be introduced, and the warning light switch will be superseded by a pipe plug.

Part 4

CLUTCHES

FORD 5000 – 13" CLUTCH DISC

In December, 1967, the standard 12 in. (30.5 cm) diameter clutch disc was changed to the type which has a torsion spring damped hub and woven linings. A similar 13 in. (33 cm) disc has been introduced with the new model Ford 5000 for use in heavy duty applications where requested, Figure 3.

It should be noted that the spacers used between the new 13 in. clutch pressure plate cover and the flywheel have a different thickness from those used with the previous 13 in. clutch. It is important that the correct spacers are used in accordance with the disc being installed.

Previous type spacer thickness	0.184/0.200 in. (4.67/5.08 mm)
New type spacer thickness	0.090/0.100 in. (2.29/2.54 mm)

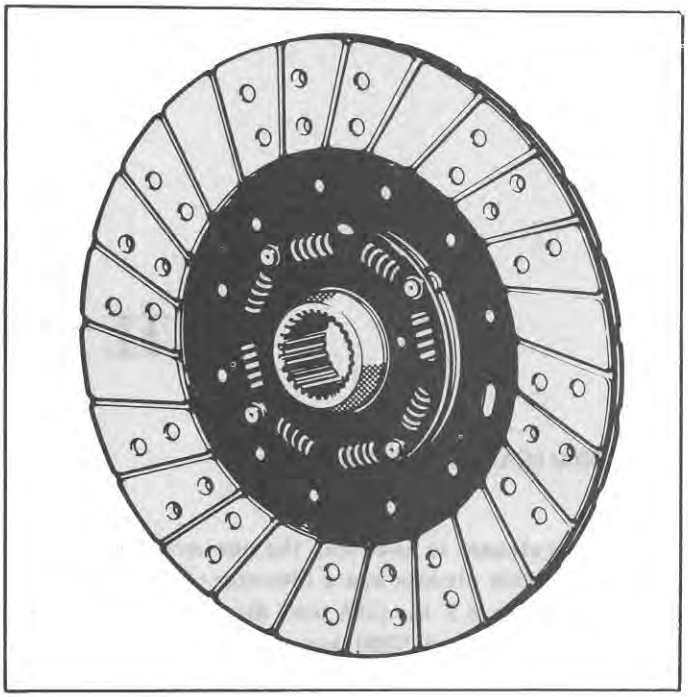


Figure 3
Ford 5000 – 13" Clutch Disc for Special Applications

FORD 2000/3000 WITH LIVE P.T.O. – DOUBLE CLUTCH ASSEMBLY

A new double clutch assembly has been released for use with the new model Ford 2000 and 3000 tractors with Live P.T.O.

The principal difference between the new assembly and that used previously is that the new assembly has a larger gap adjustment between the socket head (Allen) screws on the top of the P.T.O. pressure plate connecting links and the release lever struts, see Part 4, Chapter 2, of the Tractor Repair Manual.

This gap should be adjusted on new model double clutches to 0.070–0.074 in. (1.78–1.88 mm). The shank of a No. 50 drill may be used as a gauge when adjusting this gap, Figure 4.

The new double clutch assembly may be used in a previous tractor, but before installation, the gap mentioned bove should be adjusted to the previous specification of 0.050–0.054 in. (1.27–1.37 mm) using the shank of a No. 54 drill as a gauge.

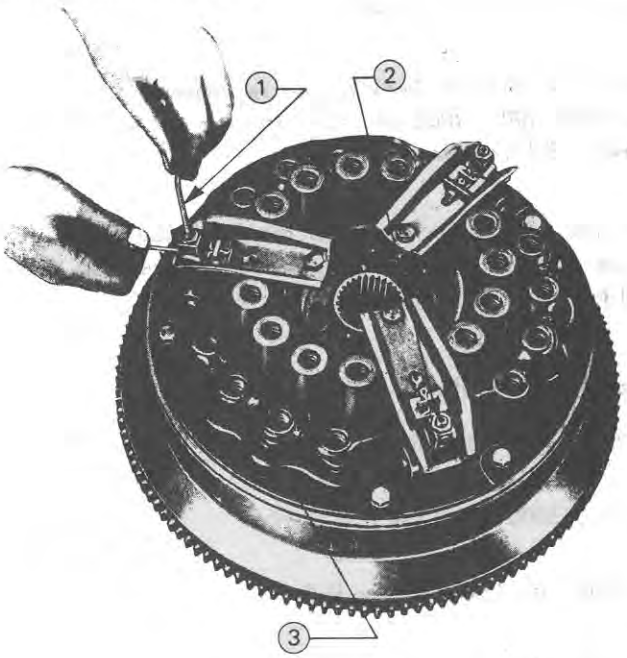


Figure 4
Setting P.T.O. Clutch Gap

(1) Socket Key
(2) Socket Head Adjusting Screw
(3) Drill Shank as Gauge

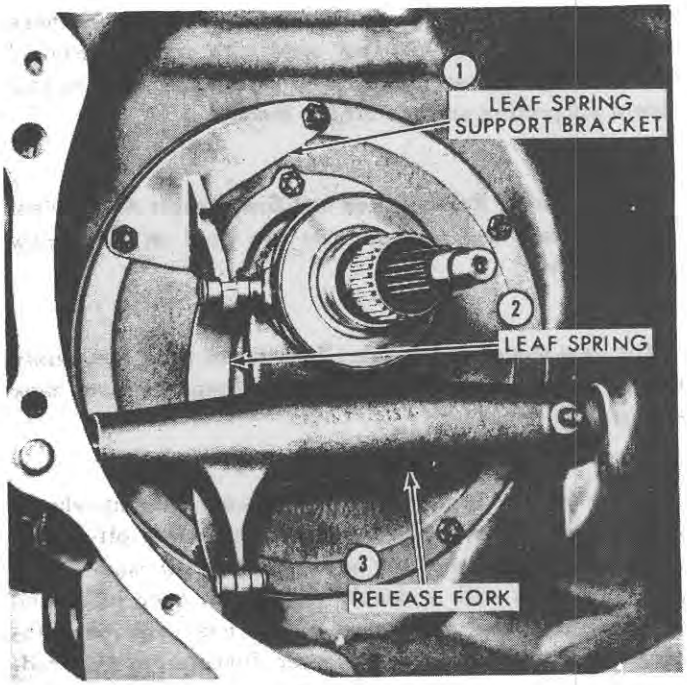


Figure 5
Clutch Release Bearing Spring and Fork

FORD 2000/3000 DOUBLE AND FORD 4000 SINGLE CLUTCH – RELEASE LINKAGE

Release Bearing Return Spring – A new leaf type clutch release bearing return spring has been introduced on Ford 2000 and 3000 tractors with a double clutch and on the Ford 4000 with a single clutch. See Figure 5.

Clutch Release Fork – New forks which extend fully across the transmission housing and completely enclose the cross-shaft are used in conjunction with the above-mentioned leaf spring. See Figure 5. The material from which the fork is manufactured has been changed, and the fork pads, which contact the release bearing hub, are specially hardened to reduce wear and provide minimal friction losses.

Release Bearing Hub – New release bearing hubs with specially hardened faces at the points of contact with the release fork have been introduced on these new models.

Release Bearing Hub Support Plate and Bracket – A bracket for each model has been introduced which acts as a falcrum point for the new leaf spring. This bracket is secured by two longer bolts which pass through the release bearing hub support plate. See Figure 5.

The release bearing hub support plate used on these new models differs from that used with previous models in that the plate casting is filled in and machined to provide a supporting surface for the bracket.

Clutch Pedal, Release Rod and Cross-shaft Arm – New design pedals and release rods are used on these new type models.

The new model pedals vary from those used previously in that the portion below the pivot is longer and set back at a greater angle.

The release rods for the new models are straight, whereas the previous rods had a portion which was off-set. In addition, the release rod used on the new model Ford 2000 and 3000 with a double clutch has been increased in diameter. The adjustable clevis has also been increased in size to suit the larger diameter release rod.

The cross-shaft arm of new model Ford 2000 and 3000 Live P.T.O. tractors is longer between centers than that used on previous models, and it has a different off-set to suit the new type release rod.

Together, these changes enable the clutches to be released with less effort than was required on previous models.

FORD 2000/3000/5000 SINGLE CLUTCH – RELEASE LINKAGE

Clutch Release Forks – New release forks have been introduced that differ only in the material. The fork contacts pads are specially hardened.

Release Bearing Hubs – New release bearing hubs with specially hardened faces at the points of contact with the release fork have been introduced.

Release Bearing Hub Support Plate – This has been changed for new model Ford 2000 and 3000 tractors with a single clutch to commonize with the support plate used on new model Ford 2000 and 3000 tractors with a double clutch. As the leaf spring type of release mechanism is not used on these models, there is no necessity for a spring fulcrum bracket; hence the change to the hub support plate is of no significance in service.

There is no change to the hub support plate on the Ford 5000.

Clutch Pedals, Release Rods and Cross-shaft Arms – New design pedals, release rods and cross-shaft arms are used on the new model Ford 2000 and 3000 tractors with a single clutch and on the new model Ford 5000.

Each of the new pedals is longer below the pivot point and the lower end is set back at a greater angle.

On the new model Ford 2000 and 3000 tractors with a single clutch, the clutch release rod is straight compared to the off-set design of the previous rod. It is also longer than the previous rod, as is the new release rod used on the Ford 5000.

The cross-shaft arm of the Ford 5000 is unchanged, but on the new model Ford 2000 and 3000 tractors with a single clutch, a new arm is used which has a different off-set to the previous arm.

CLUTCH PEDAL ADJUSTMENT

Regular checks on clutch pedal free play is very important. Recommendations are that this check be made at intervals of 50 hours of operation.

NOTE: ***This 50 hour check is now recommended for previous 2000, 3000, 4000 and 5000 tractors as well as on the new model tractors.***

Because of linkage changes, the free play specified for new models, see following table, differs from that specified for previous models.

Clutch Pedal Free Play – New Model Tractors

Ford 2000/3000 with Transmission P.T.O.	1.12–1.38 in. (28–35 mm)
Ford 2000/3000 with Live P.T.O.	1.38–1.63 in. (35–41 mm)
Ford 4000 with Transmission P.T.O.	1.25–1.50 in. (32–38 mm)
Ford 4000 with Independent P.T.O.	1.62–1.88 in. (41–48 mm)
Ford 5000	1.25–1.50 in. (32–38 mm)

Clutch Pedal Total Travel – Tractors with Live P.T.O.

On Ford 2000 and 3000 tractors with Live P.T.O. it may also be necessary to adjust the clutch pedal linkage in order to maintain correct **total** travel of the clutch pedal and so ensure that the P.T.O. clutch can be released when the pedal is fully depressed.

To adjust the pedal travel:

First adjust the length of the clutch release rod so that the clutch pedal is 8.50 in. (22 cm) above the foot platform with free play taken up, see Figure 6. This is the initial setting height for the pedal and some slight alteration may be required, as indicated below, to ensure that full release of the P.T.O. clutch is obtained.

Move the P.T.O. shift lever into the engaged position and start the engine, then fully depress the clutch pedal and check that the P.T.O. shaft stops revolving.

If the P.T.O. shaft does not stop revolving when the pedal strikes the stop on the foot platform, re-adjust the length of the release rod, and hence the pedal height, until satisfactory release of the P.T.O. clutch is obtained.

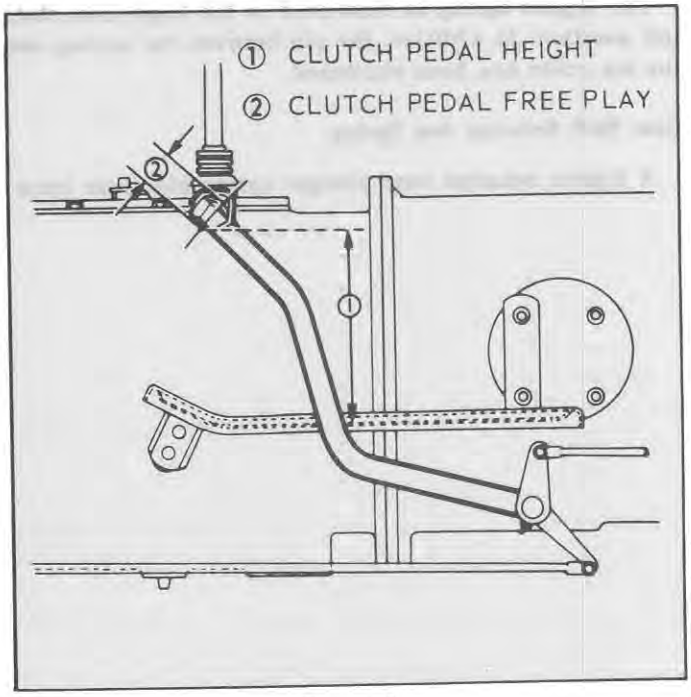


Figure 6
Clutch Pedal Height and Free Play

Part 7

SEVEN-AND EIGHT-SPEED TRANSMISSIONS

FORD 5000 – OIL CAPACITY

The quantity of oil specified in 7-speed and 8-speed transmissions of new model Ford 5000 tractors has been reduced to 10.5 U.S. qts. (18.5 Imp. pints) (10.2 litres). No oil level plug is used on these transmissions. A new combined filler plug and dipstick has been introduced.

A new 7/8 speed transmission housing has been introduced on new model Ford 5000 tractors. The new housing has an oil groove for feeding oil to the reverse idler gear.

Should it be necessary to install a service replacement housing, it is essential that only the correct new type be used in conjunction with the oil level dipstick and lower oil level of a new model Ford 5000.

GEAR SHIFT EFFORT

To reduce the physical effort required to shift gears on the 7-speed and 8-speed transmissions, the following changes have been made effective with new model tractors.

Gear Shift Levers and Lever Spring

The main gear shift lever and the High/Low gear shift lever of new model Ford 5000 tractors are 3 in. (76.2 mm) and 2.5 in. (63.5 mm) longer respectively than their counterparts.

Similarly, the main gear shift lever and the High/Low gear shift lever used on new model Ford 2000, 3000 and 4000 tractors are 2.38 in. (60.5 mm) and 2.72 in. (69.0 mm) longer respectively than their counterparts.

The gear shift lever ball retainer spring, common to all the levers, has been changed to one which applies a lighter load.

Gear Shift Rail Detent Springs and Pins

Lighter springs have been introduced between the main gear shift rail detent balls and the gear shift cover of 7-speed and 8-speed transmissions.

The lighter spring is also used in the High/Low shift rail position. In addition, the pin between the spring and the top cover has been shortened.

Gear Shift Selector Arm Spring

A lighter selector stop plunger spring has been introduced for the 4th/8th selector fork of the 7-speed and 8-speed transmissions of the new model Ford 5000.

This spring is also used on the 4th/8th selector arm of the 7-speed and 8-speed transmissions of the new model Ford 2000, 3000 and 4000 tractors.

Part 9

POWER TAKE-OFF

FORD 5000 INDEPENDENT P.T.O.

Independent P.T.O. Clutch Valve Operating Pressure

The increase in power of the new model Ford 5000 engine gives a corresponding increase in power available at the P.T.O. Because of the increased P.T.O. power, the operating pressure of the drive clutch regulating valve has been increased by introducing a new pressure regulating valve spring.

When checking the pressure of the P.T.O. system at the hydraulic pump of a new model Ford 5000, a reading of 150/225 psi (10.5/15.8 kg/cm^2) should be obtained when the oil is at operating temperature.

P.T.O. Clutch Dowel Locating Pin

To improve the efficiency of the independent P.T.O. clutch brake, new model Ford 5000 tractors have an adjustable pin locating the P.T.O. clutch valve assembly in the rear axle center housing. This new pin allows for better contact between the brake arm pad and the P.T.O. clutch housing than was possible with the previous non-adjustable locating pin.

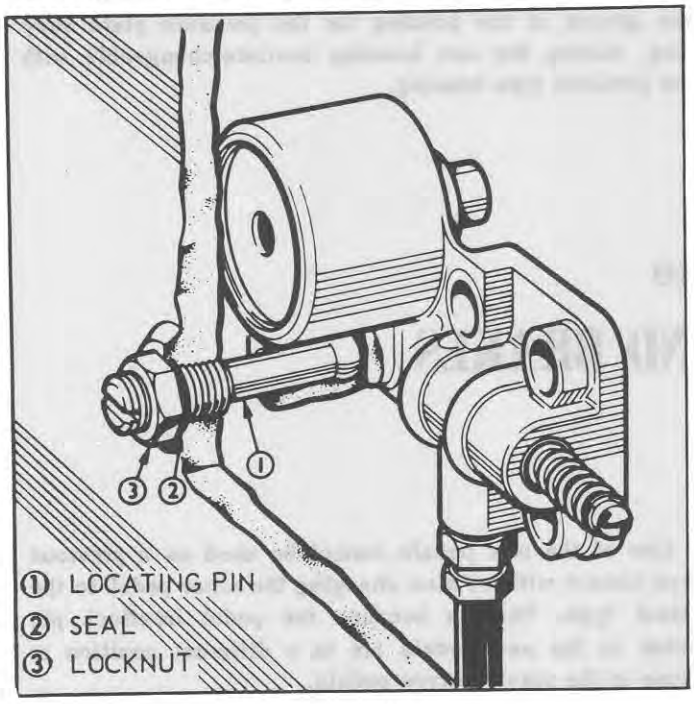


Figure 15
P.T.O. Valve Locating Pin

The new locating pin, Figure 15, incorporates an O-ring seal to prevent oil leakage. A nut is used to retain the pin.

The following adjustment procedure applies to the new type pin.

1. Loosen the locating pin nut, then back off the locating pin.
2. Screw in the locating pin until the P.T.O. brake piston spring just starts to compress.
3. Hold the locating pin with a screwdriver and tighten the nut to a torque of 15–20 lbs. ft. (2.07–2.77 kgm).

Where cases of inadequate P.T.O. braking are encountered on previous Ford 5000 tractors, and the evidence shows uneven contact between the brake arm pad and the clutch housing, the new type parts may be installed to overcome the condition.

P.T.O. Drive Clutch Operating Handle

A new operating handle has been introduced which extends rearward at a greater angle to provide better clearance for the operator's legs, Figure 16.

FORD 4000 P.T.O.

P.T.O. Rear Cover and Rear Axle Center Housing

On new model Ford 4000 Tractors, the P.T.O. rear plate and P.T.O. cover have been superseded by an integral cover and plate component.

The rear axle center housing has been modified and now has two additional tapped holes at the rear cover location, i.e., it now has 4 large and 4 small tapped holes at this location.

The new rear cover is secured by four bolts at the smaller tapped holes. The four large holes are used for retaining two new anchor brackets which have been introduced for attachment of hydraulic linkage check chains.

NOTE: *When installing a belt pulley on a new model Ford 4000 with internal check chains, the check chain anchor brackets should be located between the pulley and the*

rear axle center housing. Four longer bolts are supplied with the belt pulley kit to retain the pulley and the brackets to the center housing. If the tractor has external check chains, four spacers, which are supplied with the belt pulley kit, should be installed between the pulley and the rear axle center housing.

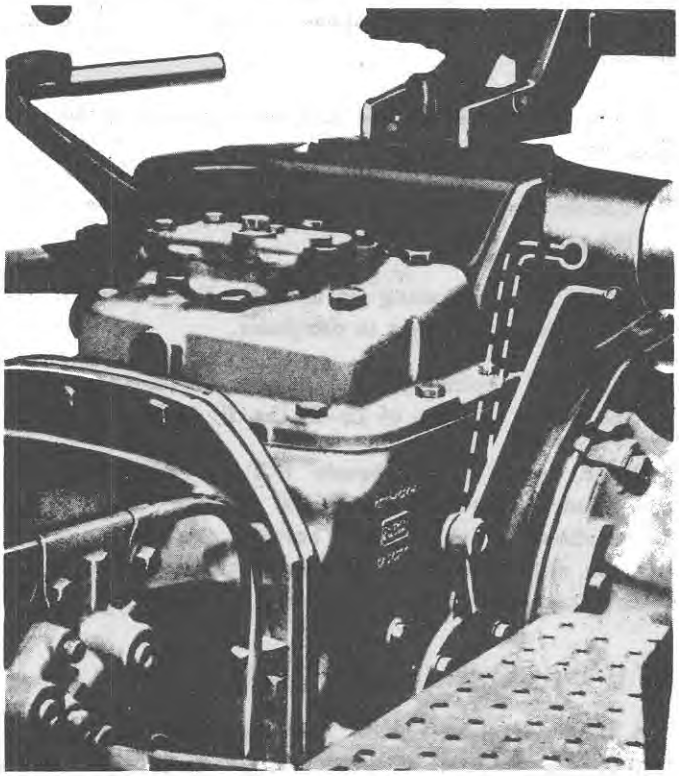


Figure 16
P.T.O. Operating Handle

P.T.O. Clutch Plates

The P.T.O. clutch plates and the P.T.O. clutch housing of the new model Ford 4000 tractor differ from those used on previous models.

Six externally splined steel plates and six internally splined phosphor bronze plates are now used instead of six internally splined steel plates and seven externally splined phosphor bronze plates.

The externally splined steel plates are identical with those already in use at various locations in Select-O-Speed transmissions. The internally splined phosphor bronze plates are also dimensionally the same as those used in P.T.O. clutches of Select-O-Speed transmissions but they have radial grooves on both sides and are, therefore, not interchangeable with the Select-O-Speed parts.

An externally splined steel plate is installed adjacent to the P.T.O. drive clutch piston in the new type P.T.O. clutch pack, thereafter the phosphor bronze and steel plates alternate so that the sixth phosphor bronze plate is adjacent to the P.T.O. clutch pressure plate.

The new steel plates are flat, whereas in previous type tractors they were dished. This, together with the reduced total number of plates in the pack, means that the pressure plate takes up a different position in the P.T.O. clutch housing. This in turn necessitates relocation of the groove in the housing for the pressure plate snap ring, making the new housing non-interchangeable with the previous type housing.

Part 10

REAR AXLE AND BRAKES

BRAKE PEDALS

New brake pedals have been introduced on all models except the Ford 4000 and 5000 Row Crop and the Ford 5500. The new pedals have parallel width throughout their length, whereas the previous pedals tapered in towards the pad end.

One of the new pedals cannot be used on a previous type tractor without also changing the other pedal to the latest type. This is because the pedal interlock pin holes in the new pedals are in a different position to those in the previous type pedals.

Part 11

HYDRAULIC SYSTEMS

ALL MODELS – HYDRAULIC PRESSURE RELIEF VALVE

A new type of pressure relief valve assembly, Figure 17, has been introduced in the hydraulic pumps of new model Ford 4000 and 5000 tractors with Independent P.T.O. This valve will also be introduced shortly as a running change in the rear axle center housing of all models with the engine mounted hydraulic pump. It may also be installed when servicing previous type tractors if so desired.

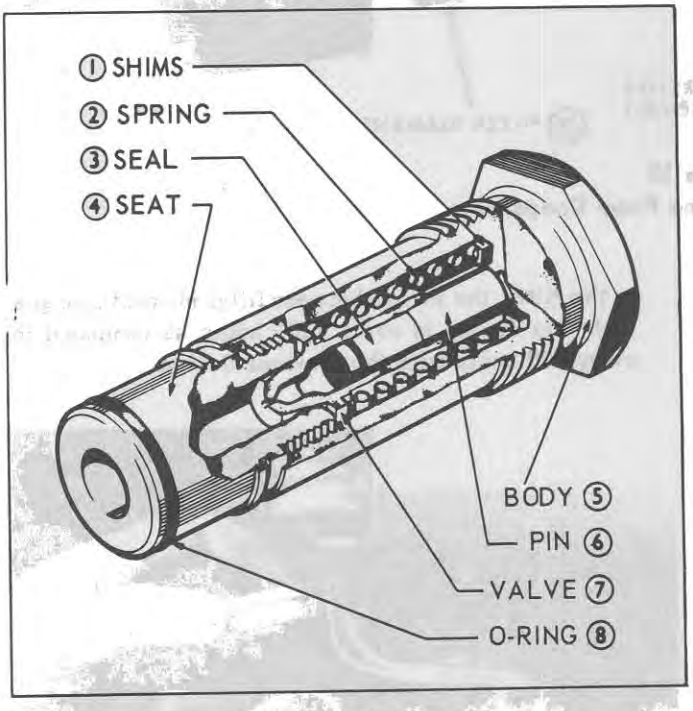


Figure 17
Hydraulic Pressure Relief Valve

With the previous type valve assembly, a sudden heavy lifting load, in excess of the designed lifting capacity of the hydraulics, caused the valve to open. It was then necessary for the pressure in the system to be reduced considerably by relieving the load before the valve would reseat and allow lifting to be resumed.

The new valve re-seats at a higher pressure, enabling maximum lifting power to be sustained in the hydraulic system.

The following is a comparison of the operating pressure characteristics of the previous and new valve assemblies.

Pressure	Previous Type	New Type
Initial Opening (Minimum Crack-Off)	2100 psi (147.5 kg/cm^2)	2150–2450 psi (151–172 kg/cm^2)
Full Opening (Maximum By-Pass)	2550–2650 psi (179–186 kg/cm^2)	2400–2600 psi (169–183 kg/cm^2)
Re-seat (Minimum)	1600 psi (112.5 kg/cm^2)	1950 psi (137 kg/cm^2)

Relief Valve Adjustment

If, on checking the pressure of the hydraulic system, the maximum pressure is found to be above or below that specified, 2400–2600 psi (169–183 kg/cm^2), no attempt should be made to adjust the valve without first establishing that it is in fact the valve which is at fault.

The easiest way to check this is to install another valve assembly known to have the correct setting. If this corrects the fault then the original valve should be dismantled for examination. Where necessary, the valve may be adjusted by adding or subtracting shims (1), Figure 17, from behind the spring.

To gain access to the shims, grip the assembly lightly in a soft jaw vice, unscrew the body and remove the valve and spring.

Two thicknesses of shims are available. One has a thickness of 0.010 in. (0.25 mm) and provides a pressure difference of 63–70 psi (4.4–4.9 kg/cm^2). The other has a thickness of 0.015 in. (0.38 mm) and provides a pressure difference of 95–106 psi (6.8–7.4 kg/cm^2).

Part 12

STEERING SYSTEMS

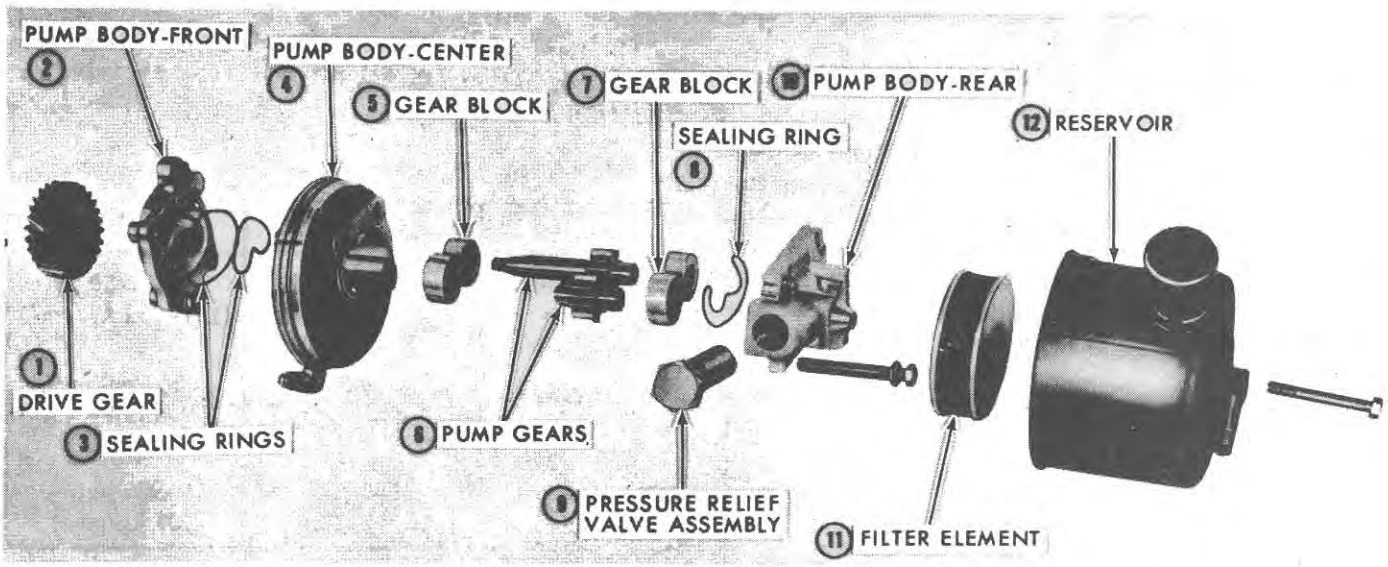


Figure 18
Power Assisted Steering Pump Components

POWER ASSISTED STEERING – ALL MODELS
(where fitted)

While there will be no significant change in the steering systems of early production new model tractors, a change is being made to agricultural tractors with power assisted steering. Three new pump assemblies, each with integral reservoir and filter will be introduced. These three pumps will be identical except for the pressure relief valve setting.

Figure 18 shows the pump and reservoir components. The new reservoir will completely enclose the rear of the pump. See Figures 18 and 19. The following should be noted when servicing the unit.

1. Every 300 operating hours the oil level in the reservoir should be checked with the oil at operating temperature and the wheels in the straight ahead position. If necessary, add fresh oil of the correct grade to bring the level up to the bottom of the filler neck. Then, with the engine running, turn the steering from lock-to-lock to purge air from the system. Add oil as necessary to maintain the level.

2. Oil must be Ford Oil Part No. M2C41.

3. While it will be necessary to remove the complete pump and reservoir assembly in order to gain access to the filter, the period between filter element changes with this design is every 1200 hours as compared to every 600 hours with the previous design.

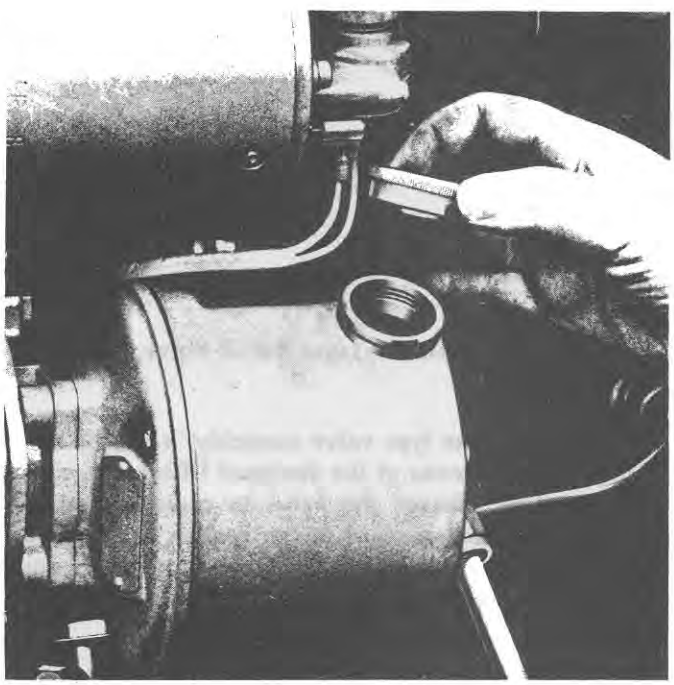


Figure 19
Power Assisted Steering Reservoir Filler Cap

To remove the filter element, disconnect the oil tubes from the pump, remove the pump and reservoir assembly (two bolts) from the engine, drain the oil from the reservoir then remove the reservoir and filter element from the pump.

Clean the inside of the reservoir, install a new filter element and re-install the reservoir. The flat detent in the reservoir should be placed between the two locators on the pump (2), Figure 20.

Re-install the pump and reservoir assembly on the engine. Connect the oil tubes and refill the reservoir with clean oil of the correct grade. Purge the system of air by running the engine and turning the steering wheel from lock to lock several times. Add oil as necessary to maintain the level at the bottom of the filler neck.

Power Steering Pump Pressure Relief Valve

While the new type pump is similar in principle to that used previously, detail changes have been made to the components, including the introduction of a new type pressure relief valve. The new valve, which is incorporated in the rear body of the pump, is similar in design to the pressure relief valve used in the hydraulics of the new models, see Hydraulic Section of this Supplement, but it has a different spring, a lower pressure setting and a thinner head. It has a larger capacity than the previous type relief valve, therefore the flow control spool valve, which was used in previous pumps, has been discontinued for use in the new pump.

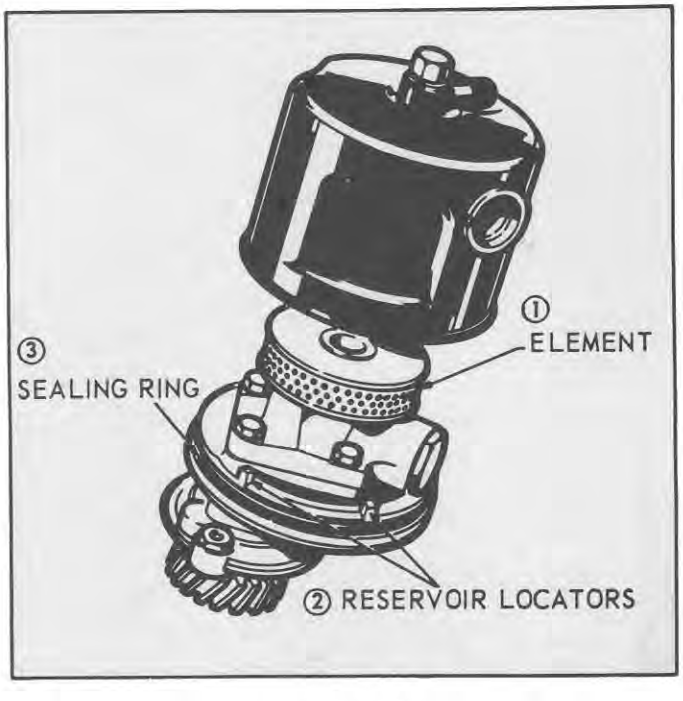


Figure 20
Power Assisted Steering Pump, Filter, and Reservoir

Pressure Testing and Adjustment

The relief valve operating pressure and the procedure for pressure testing the system will be the same for the new pumps as with the previous types.

If pressure testing the system shows that the operating pressure of the new type pump pressure relief valve needs to be adjusted, the following procedure applies:

1. Disconnect the two tubes from the pump and remove the two bolts retaining the pump assembly to the engine.
2. Remove the pump assembly from the engine. Drain the oil from the reservoir.
3. Remove the reservoir and filter element from the pump.
4. Remove the pressure relief valve from the rear body of the pump, grip it lightly in a soft jawed vice and unscrew the head from the body. Extract the valve and spring.
5. The pressure adjusting shims are now accessible. Shims are available in thicknesses of 0.010 in., 0.015 in. and 0.060 in. (0.25 mm, 0.38 mm and 1.52 mm). The addition or subtraction of one of these shims will vary the opening pressure of the relief valve by the following amount.

   0.010 in. (0.25 mm) – 66–74 psi (4.6–5.2 kg/cm^2)
   0.015 in. (0.38 mm) – 99–110 psi (7.0–7.7 kg/cm^2)
   0.060 in. (1.52 mm) – 396–440 psi (27.8–30.9 kg/cm^2)

6. On re-assembly, care should be taken to be sure the head of the valve is not overtightened. The specified tightening torque is 6–10 lbs. ft. (0.83–1.38 kgm).
7. Install the valve assembly in the pump, re-assemble the filter element and reservoir, and install the unit on the tractor.
8. Refill the reservoir with fresh oil of the correct grade. Run the engine and turn the steering from lock-to-lock to expel air from the system. Add oil as necessary to maintain the level.

7000 SUPPLEMENT

FOREWORD

This supplement provides information for the proper servicing of the Ford 7000 Tractor. Where service information for the Ford 5000 Tractor also applies to the Ford 7000, this supplement refers to the appropriate section of your Ford Tractor Repair Manual, SE 9205, for that information. This supplement can be kept in its entirety at the front of your repair manual, or it can be separated into its various parts and inserted behind the appropriate dividers of the repair manual.

The material contained in this supplement was correct at the time the supplement was approved for printing. Ford policy is one of continuous improvement and the Ford Motor Company reserves the right to discontinue models at any time or change specifications or design without notice and without incurring obligation.

FORD TRACTOR OPERATIONS

FORD MOTOR COMPANY

Part 1

ENGINE SYSTEM

The Ford 7000 diesel engine is similar to the Ford 5000 diesel engine and develops greater power through use of a turbocharger along with different pistons, valves, connecting rods, and air cleaner.

PISTONS

The Ford 7000 diesel engine has pistons of 4.3922-4.3947 inch (111.56-111.62 mm) diameter. Specified piston-to-bore clearance with the 7000 diesel piston is 0.0080/0.0090 inch (0.2032/0.2286 mm). The ring set for the 7000 diesel piston is comprised of 3 compression rings, 1 oil control ring, and 1 oil control ring expander (slotted).

PISTON RINGS

The Production Piston Ring Set consists of:

Top Compression Ring – bright chrome finish, keystone tapered.

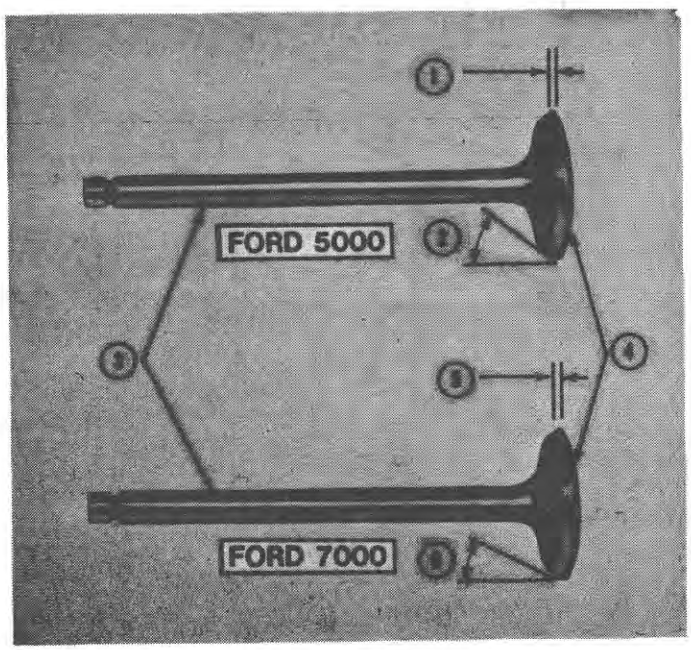


Figure 1
Critical Tolerances – Intake Valves

1. 1/32 Inch (0.7937 mm.) Minimum
2. 45° 30' – 45° 45'
3. Check for Bent Stem and Correct Diameter
4. Check Maximum Valve Face Runout
5. 1/16 (1.58 mm) Minimum
6. 29° 15' – 29° 30'

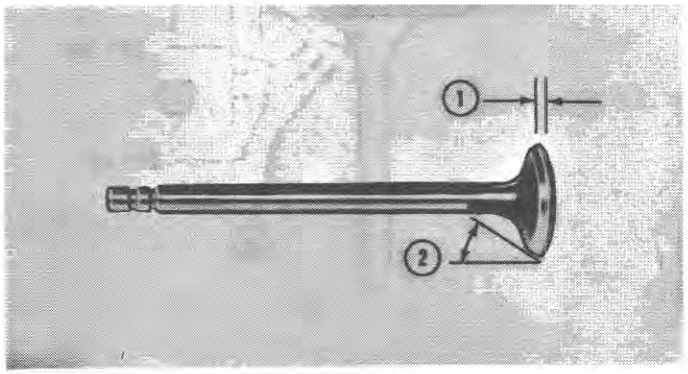


Figure 2
Critical Tolerances – Exhaust Valves
Ford 5000 and 7000

1. 1/32 Inch (0.79mm) Minimum
2. 45° 30' – 45° 45'

2nd Compression Ring – bright chrome finish, step on inside diameter, assemble with step facing upwards.

3rd Compression Ring – dull black finish, step on inside diameter, assemble with step facing upwards, no expander behind ring.

Oil Control Ring – install either face upwards with slotted expander behind ring.

The Service Piston Ring Set consists of:

Top Compression Ring – bright chrome finish, keystone tapered. Assemble with either taper facing upwards.

2nd Compression Ring – bright chrome finish, step on inside diameter. Assemble with step facing upwards.

3rd Compression Ring – dull black finish, step on outside diameter. Assemble with step facing downwards and non-slotted expander behind ring.

Oil Control Ring – install either ring upwards with slotted expander behind ring.

Piston installation and ring fitting is performed in the same manner as outlined in Part 1, Engine Systems, of this manual.

VALVES

The critical inspection points and tolerances of the valves are shown in Figure 1 for the intake valves, and Figure 2 for the exhaust valves. The intake valves do

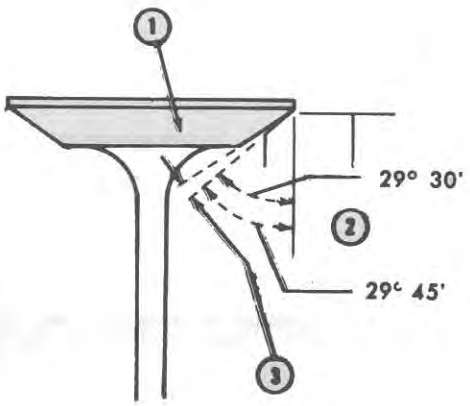


Figure 3
Interference Angle on Intake Valve Seat
1. Valve Face 29° 30'
2. Valve Seat 29°
3. Interference Angle 1°

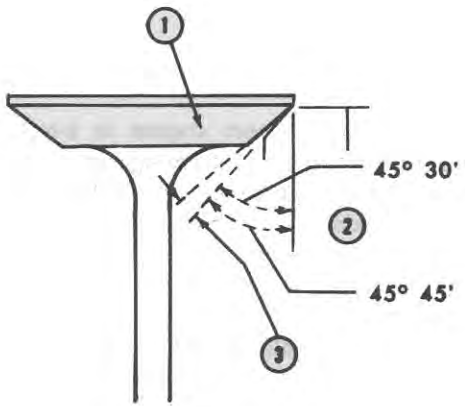


Figure 4
Interference Angle on Exhaust Valve Seat
1. Valve Face 45° 30'
2. Valve Seat 45°
3. Interference Angle 1°

not have umbrella seals. Inspection and refacing of valves is performed in the same manner as outlined in Part 1, Engine Systems, of this manual.

NOTE: *The valve refacing operation should be closely coordinated with the valve seat refacing operation so that the finished angle of the valve is 1° more than the valve seat to provide an interference angle for better seating. Adjust the refacing tool to obtain a face angle of 29° 30' for intake valves, Figure 3, and 45° 30' for exhaust valves, Figure 4.*

The valve seats are inspected and refaced as outlined in Part 1, Engine Systems, of this manual, except when adjusting the seat width of the intake valve. Use a 15° grinding wheel to remove stock from the top of the seat (lowers the seat), and use a 45° grinding wheel to remove stock from the bottom of the seat (raises the seat). Refer to Figure 5.

CONNECTING RODS

The connecting rods in the Ford 7000 engine contain a drilled passage for oil to aid in piston cooling and incorporate a different bearing. If new connecting rods or bearings are required, follow the installation procedures covered in Part 1, Engine Systems, of this manual.

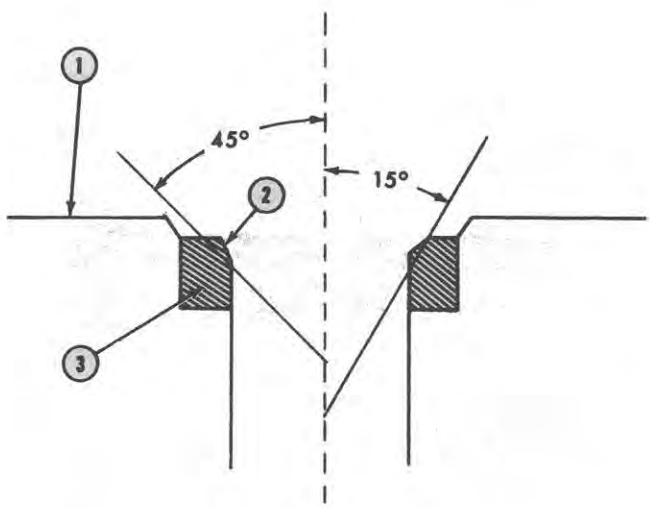


Figure 5
Intake Valve Seat Dimensions
1. Cylinder Head Surface
2. Valve Seat
3. Insert

COOLING SYSTEM

OIL COOLER

An engine oil cooler is located in the radiator bottom tank of all Ford 7000 diesel engine tractors.

Part 1

ENGINE SYSTEMS

Chapter 4

TURBOCHARGER – FORD 7000

1. DESCRIPTION AND OPERATION

The turbocharger is a small turbine mounted directly on the engine exhaust manifold. A sectional view of the turbocharger is shown in Figure 1. The turbine wheel and the compressor wheel are mounted on a common shaft, supported by bearings in the bearing housing. Exhaust gasses from the engine flow into the turbine housing and drive the turbine wheel and shaft assembly and the compressor wheel at speeds in excess of 80,000 rpm. The compressor wheel forces clean air drawn from the air cleaner into the engine at an increased rate. This increased air supply helps the engine develop more power and better fuel economy.

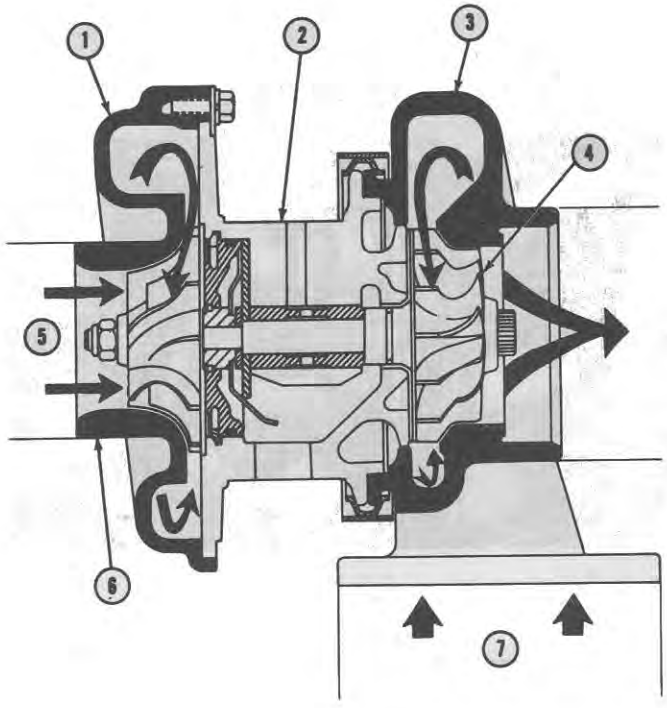


Figure 1
Turbocharger Air Flow

1. Compressor Cover
2. Bearing Housing
3. Turbine Housing
4. Turbine Wheel
5. From Air Cleaner
6. Compressor Wheel
7. From Exhaust Manifold

The turbocharger consists of turbine, bearing, and compressor housings. The turbine housing is flange mounted on the exhaust manifold and ducted to the exhaust stack. It contains the turbine wheel and shaft assembly. The turbine wheel is made of cobalt steel to withstand the high temperatures of the exhaust gasses.

The compressor housing consists of the compressor wheel and cover. The cover is ducted to the air intake manifold. The compressor wheel is made from aluminum since it operates in relatively cool air.

The bearing housing contains the bearings, seals, and retainers. The housing also contains a passage for oil used for cooling and lubrication. Figure 2 illustrates the oil flow through the bearing housing. Oil directed from the engine oil pump enters the passage at the top of the housing and flows under pressure to the bearing area. The oil completely surrounds the bearing by flowing in both directions between the bearing O.D. and the bearing housing, and between the bearing I.D. and the turbine shaft. Sealing rings at each end of the bearing housing, with air or gas pressure behind them, prevent oil from leaking into the compressor and turbine housings.

The oil moves to the lower portion of the bearing housing and drains to sump by gravity.

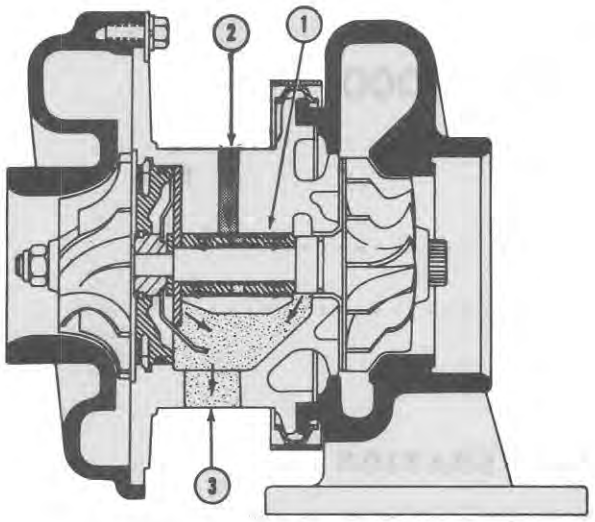


Figure 2
Turbocharger Lubrication
1. Bearing
2. From Pump
3. To Sump

The oil acts as a heat barrier between the hot turbi and the compressor, lubricates the bearings, and aids i. the removal of excess heat.

The high speed at which the turbine wheel and compressor wheel revolve, and the high temperature of the exhaust gasses, require the turbocharger to receive an adequate supply of clean quality oil, adequate clean air, and the full pressure of the exhaust gasses.

CAUTION: ***To avoid personal injury and prevent flange warp, allow the exhaust manifold to cool sufficiently after the tractor engine has been run before attempting to service the turbocharger.***

2. TURBOCHARGER OVERHAUL

A. Removal

1. Remove both hood side panels and the exhaust extension (muffler) from the tractor.

2. Remove the exhaust pipe by removing the four bolts from the exhaust flange, Figure 3.

3. Remove the three bolts that secure the exhaust flange to the manifold and remove the flange and seal ring.

4. Disconnect the air cleaner-to-turbocharger tube and the turbocharger-to-intake manifold tube, Figure 3, from the compressor side of the turbocharger by loosening the clamps securing the tubes to the turbocharger.

5. Remove the oil supply tube and disconnect the oil return tube from the cylinder block. Cap the ends of the tubes and the openings to prevent foreign material from entering the system.

IMPORTANT: ***Dirt or other foreign material that may enter the lubrication system will seriously damage the turbocharger and/or engine components. Take care to prevent dirt entry into the system.***

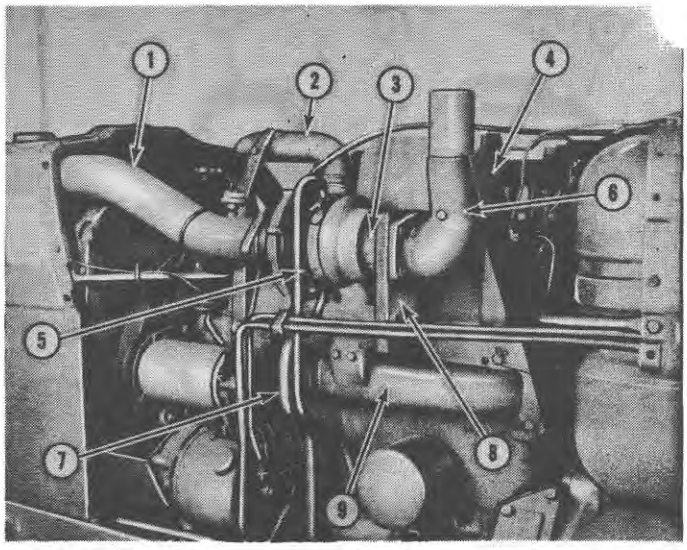


Figure 3
Component Identification – Left Side

1. Air Cleaner-to-Turbocharger Tube
2. Turbocharger-to-Intake Manifold Tube
3. Seal Ring
4. Heat Shield
5. Oil Supply Tube
6. Exhaust Pipe
7. Oil Return Tube
8. Exhaust Flange
9. Exhaust Manifold

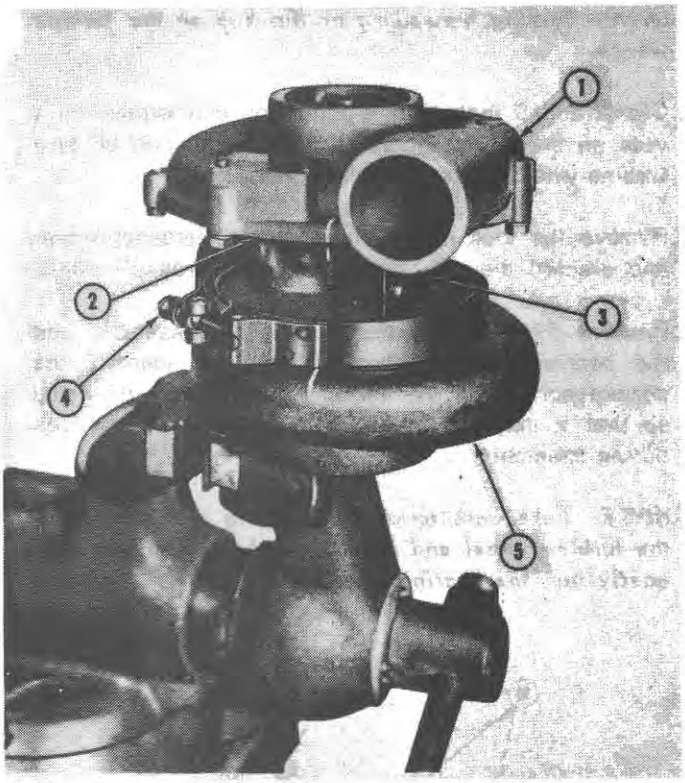


Figure 4
Turbocharger Disassembly

1. Compressor Cover
2. Clamp Plate
3. Bearing Housing
4. Clamp Band
5. Turbine Housing

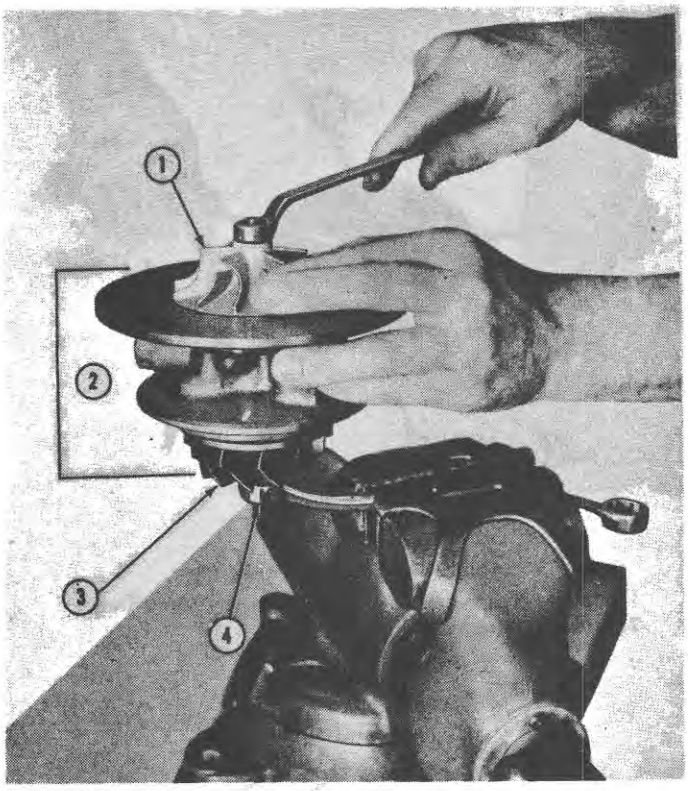


Figure 5
Compressor Wheel Removal

1. Compressor Wheel
2. Core Assembly
3. Turbine Wheel and Shaft Assembly
4. 5/8" 12-Point Socket

6. Remove the heat shield and manifold attaching bolts.

7. Remove the four nuts and lock washers securing the turbocharger to the manifold and remove the turbocharger. Remove the gasket between the turbocharger mounting flange and the manifold. Cover the exhaust opening in the manifold with a clean cloth to prevent foreign material from entering the exhaust manifold.

   IMPORTANT: *Because of the high rpm at which the turbocharger operates, dirt or other foreign material which may enter the exhaust manifold will seriously damage the turbine wheel blades. Take care to prevent foreign material from entering the exhaust system.*

8. Remove the oil return tube and gasket.

B. Disassembly

1. Mark the relative positions of the compressor cover, the bearing housing, and the turbine housing, Figure 4, before disassembling the turbocharger to aid in reassembling the unit.

2. Remove the eight bolts, lockwashers, and four clamp plates from the compressor cover. Remove the cover.

   NOTE: *The bolts are of a special design. Do not replace the bolts with a different type since no substitute will be satisfactory.*

3. Remove the nut from the clamp band screw. Remove the clamp band and the core assembly, Figure 5, from the turbine housing.

   NOTE: *If the core assembly is frozen in the turbine housing, hold the core assembly and drive the housing down and away from the core. DO NOT hammer*

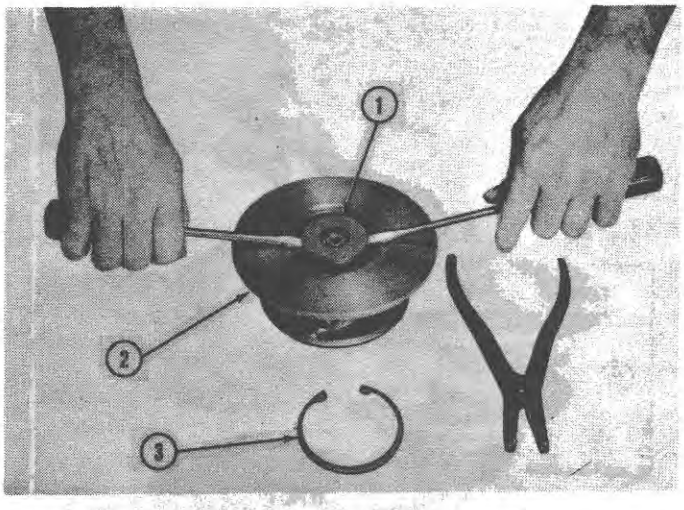


Figure 6
Compressor Insert Removal

1. Compressor Insert
2. Bearing Housing
3. Insert Snap Ring

on the bearing housing or the hub of the turbine wheel.

4. Clamp a 5/8 inch twelve-point box end wrench in a vise as shown in Figure 5. Place the hub of the turbine wheel in the wrench socket.

5. Remove the lock nut retaining the compressor wheel and discard the nut. Remove the compressor wheel.

6. Remove the turbine wheel and shaft assembly and the bearing from the bearing housing. Identify the compressor end of the bearing with a piece of string so that it may be installed in the same position during assembly.

NOTE: *Take care to avoid dropping the bearing or the turbine wheel and shaft assembly. Both will slip easily from the bearing housing.*

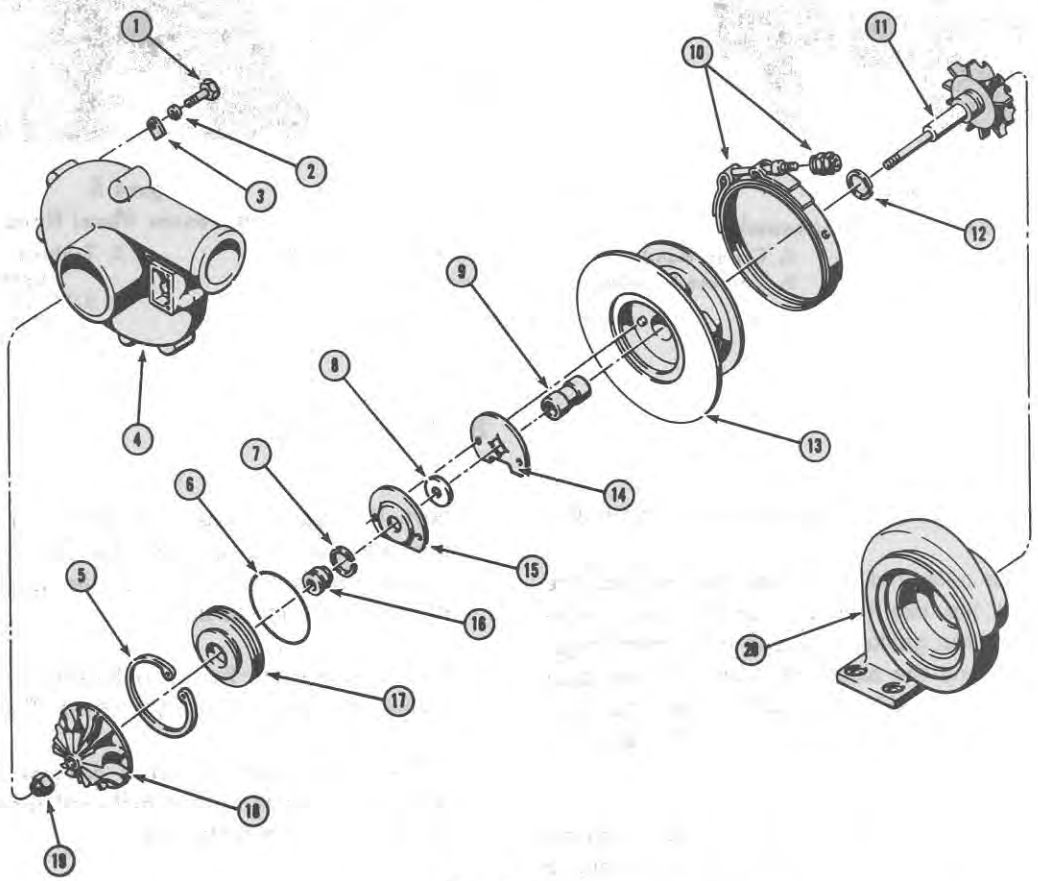


Figure 7
Turbocharger – Exploded View

1. Bolt
2. Lock Washer
3. Clamp Tab
4. Compressor Cover
5. Snap Ring
6. "O" Ring
7. Sealing Ring
8. Thrust Ring
9. Bearing
10. Clamp and Nut Assy.
11. Turbine Wheel & Shaft Assy.
12. Sealing Ring
13. Bearing Housing Assy.
14. Thrust Bearing
15. Deflector-Oil
16. Flinger Sleeve
17. Insert
18. Compressor Wheel
19. Locknut
20. Turbine Housing

Place the housing on a clean flat surface with the compressor side up as shown in Figure 6. Remove the snap ring retaining the compressor insert. Place a hand over the snap ring while removing it to prevent either loss of the ring or personal injury.

8. Using two screwdrivers, gently lift the insert from the bearing housing as shown in Figure 6. Remove and discard the O-ring from the insert.

9. Remove the flinger sleeve, the oil deflector, the thrust ring, and the thrust bearing. Refer to Figure 7. Do not remove the two dowel pins from the bearing housing.

10. Remove the sealing ring from the flinger sleeve and the copper-coated sealing ring from the turbine wheel and shaft assembly.

NOTE: ***The sealing rings have different diameters and must not be interchanged. Identify each ring with a tag so that they will be properly installed at assembly.***

Refer to the exploded view illustration, Figure 7, and to the following Turbocharger Diagnosis Guide during the inspection and repair of the turbocharger parts.

TURBOCHARGER DIAGNOSIS GUIDE

PROBLEM	POSSIBLE CAUSE	CORRECTION
DAMAGED COMPRESSOR BLADES	Foreign object	Determine source and correct.
DAMAGED TURBINE BLADES	Foreign object	Determine source and correct.
DAMAGED TURBINE AND COMPRESSOR BLADES	Turbine shaft and/or bearing worn (possibly due to cold start)	Install necessary new parts.
CARBONIZED CRUST ON BEARING	Excessive heat (due to hot shut-down)	Install necessary new parts.
BEARING DISCOLORED TO BLUE (OR BLACK)	Excessive exhaust temperatures	Determine cause and correct.
BEARING WEAR ON ENDS OF OUTER SURFACES	Damage due to dirty oil	Install necessary new parts, change oil and filter.
BEARING BRONZE WIPED ONTO SHAFT	Due to cold start (oil lag)	Possibly require new bearing and shaft.
END OF BEARING WORN	Excessive end play	Install new wear parts.
DIRT BUILD-UP COMPRESSOR WHEEL AND/OR COVER	Air leak between air cleaner and compressor	Locate and repair leak.
	Operating without air cleaner	Install clean air filter.

TURBOCHARGER DIAGNOSIS GUIDE (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
EXCESSIVE WEAR ON BACK OF TURBINE WHEEL	Oil lag or starvation	Determine cause and correct. Install necessary new parts.
BURNT OR WORN OIL SEAL RINGS	Oil lag or starvation	Determine cause and correct. Install necessary new parts.
HEAT DISCOLORATION OR EXCESSIVE WEAR OF THRUST BEARINGS AND WASHER	Oil starvation	Determine cause and correct. Install necessary new parts.

C. Inspection and Repair

1. Soak all parts in a commercially approved cleaner that is safe for aluminum. Allow the parts to soak until all deposits are loose.

   IMPORTANT: *A caustic solution will damage aluminum parts and should not be used.*

2. Clean all aluminum parts with a bristle-type brush or a plastic scraper. Use a fine abrasive cloth to clean the turbine housing.

3. Clean all drilled passages with compressed air.

4. Make certain that surfaces adjacent to the turbine wheel and the compressor wheel are clean and smooth.

5. Inspect the turbine wheel shaft for excessive scoring or wear on the bearing surfaces. Check the wall of the sealing ring groove for scoring.

6. Inspect the turbine wheel and the compressor wheel for cracked, bent, or damaged blades. A very slight bend of 20° or less on any one blade of the wheel is tolerable.

   IMPORTANT: ***DO NOT attempt to straighten the wheel blades. If more than one blade is bent, replace the wheel.***

7. Check the I.D. and O.D. of the bearing for heavy scratches or grooves. Light scratches on the bearing surface are tolerable. Slight discoloration of the bearing due to heat will not affect its performance.

8. Inspect the bearing housing externally for cracks or other damage. Inspect the housing internally for excessive scratch marks or wear in the bearing bore or in the sealing ring recess.

9. Inspect the sealing ring groove on the flinger slee for wear or damage. Replace the flinger sleeve if is damaged, worn, or scored.

10. Inspect the thrust ring and the thrust bearing for excessive or uneven wear on the thrust faces. Polished areas on the face of the thrust ring and bearing will not impair operation.

11. Inspect the oil supply and return tube seals. Replace the seals if they are damaged.

D. Assembly

Refer to Figure 7 for parts identification during assembly.

1. Install the copper-coated sealing ring in the groove of the turbine wheel shaft.

2. Lubricate the sealing ring with engine oil and install the turbine wheel and shaft assembly in the bearing housing as shown in Figure 8. Be caref when seating the sealing ring in the bearing housi to prevent damage to the ring or the bore.

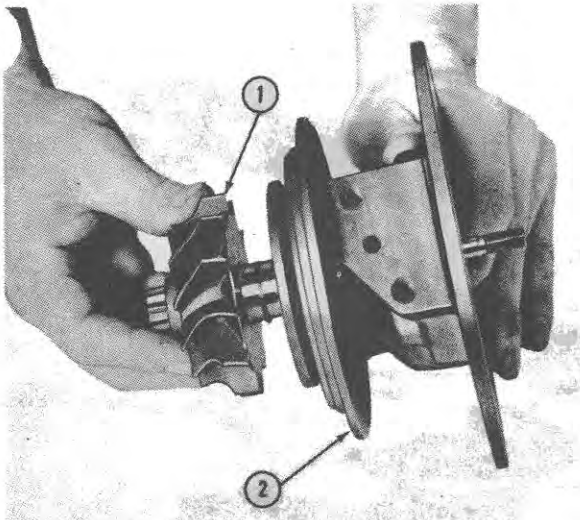


Figure 8
Turbine Wheel and Shaft Installation
1. Turbine Shaft and Wheel Assembly
2. Bearing Housing

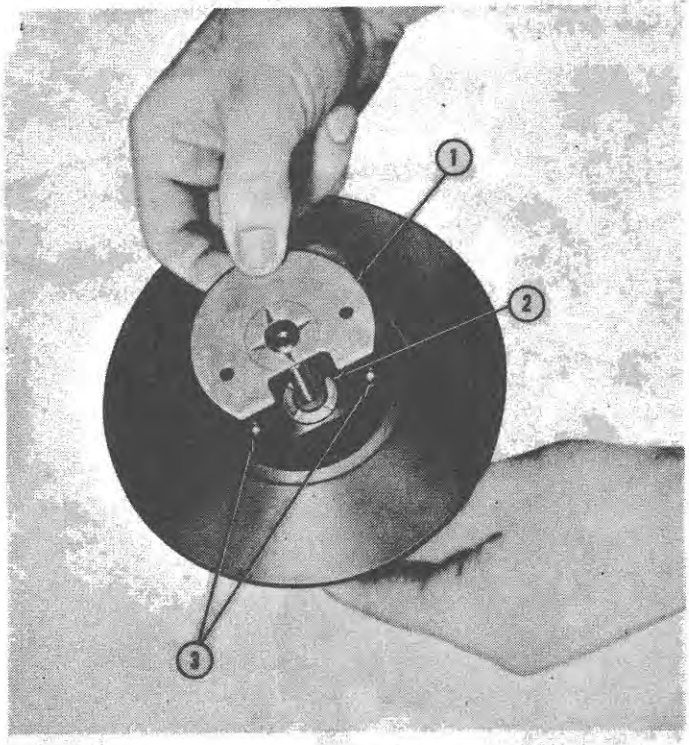


Figure 9
Thrust Bearing Installation
1. Thrust Bearing
2. Bearing
3. Dowel Pins

3. Lubricate the bearing thoroughly. Slide the bearing onto the shaft and into the bearing housing bore, Figure 9.

NOTE: ***If the original bearing is being reinstalled, make sure the end previously identified as the compressor end of the bearing is installed toward the compressor side of the housing.***

4. Lubricate the thrust bearing thoroughly and install it, bronze face up, over the shaft, aligning the holes in the bearing with the two dowel pins in the bearing housing. See Figure 9.

5. Install the thrust ring over the shaft and against the thrust bearing.

6. Place the oil deflector, with the lip down, over the shaft, aligning the holes in the deflector with the two dowel pins in the bearing housing.

NOTE: ***The oil deflector will go on the pins only one way. Make sure the deflector is correctly positioned on the dowel pins.***

7. Install the sealing ring in the groove of the flinger sleeve and lubricate thoroughly. Press the flinger sleeve into the compressor insert so that the flat side of the flinger sleeve is flush with the flat side of the compressor insert.

8. Lightly lubricate the new O-ring and place it in the groove in the compressor insert.

9. Slide the compressor insert, flat side out, over the turbine shaft. Press the insert firmly into the bearing housing counterbore until it clears the snap ring groove in the housing. See Figure 10. Keep the flinger sleeve in place and be careful not to damage the O-ring seal while installing the insert.

10. Install the snap ring, beveled side out, in the snap ring groove to secure the compressor insert. Make sure that the snap ring is completely seated in the snap ring groove by lightly tapping the ends of the ring with a flat end punch or other appropriate tool.

11. Slide the compressor wheel over the turbine shaft until it bottoms against the flinger sleeve.

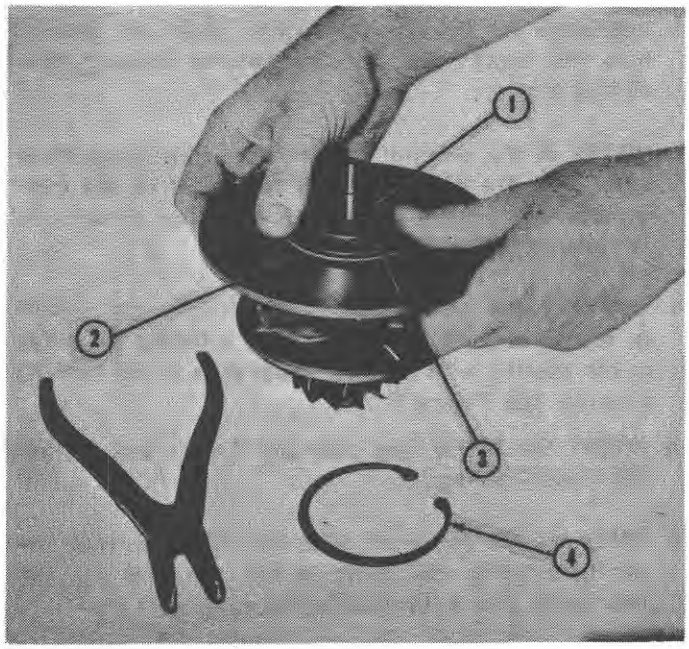


Figure 10
Compressor Insert Installation

1. Flinger Sleeve
2. "O" Ring
3. Compressor Insert
4. Snap Ring

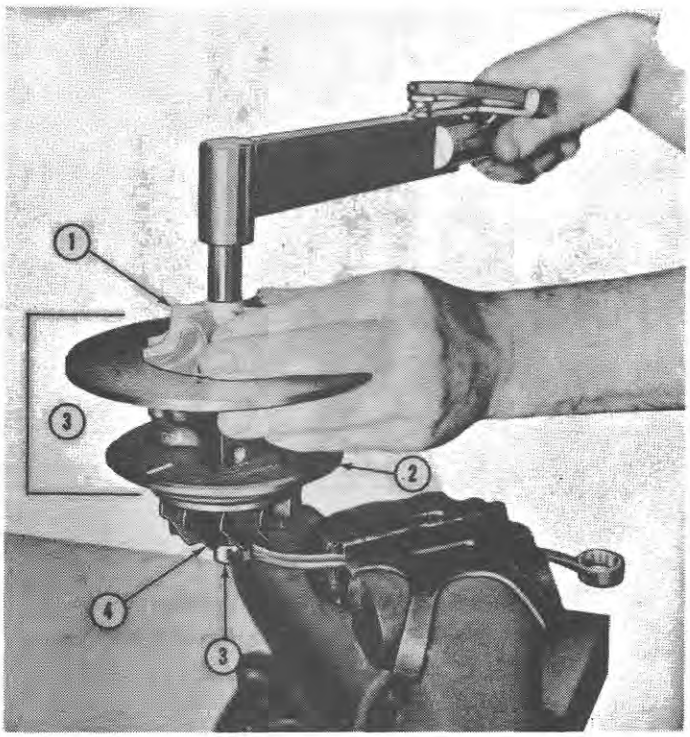


Figure 11
Compressor Wheel Installation

1. Compressor Wheel
2. Bearing Housing
3. Core Assembly
4. Turbine Wheel
5. 5/8" 12-Point Socket

12. Clamp a 5/8 inch twelve-point box end wrench in a vice, as shown in Figure 11, and position the hub of the turbine wheel in the wrench socket.

    IMPORTANT: ***Use care when positioning the turbine wheel hub in the wrench socket since the assembly is free to slide out of the bearing housing.***

13. Coat the threads and the flat shoulder of a new lock nut with graphite grease. Install the lock nut to secure the compressor wheel, as shown in Figure 11, using a 1/2 inch socket and a lbs. in. torque wrench. Tighten the nut to a torque of 156 lbs. in. (1.794 kgm).

14. Spin the compressor wheel. The rotating parts of the assembly must spin freely with no binding or rubbing. If binding or rubbing exists, disassemble, correct the problem, and reassemble.

    NOTE: ***A slight amount of end play will exist in the turbine shaft when the components are assembled in the bearing housing.***

15. Clamp the turbine housing in a vise as shown in Figure 12.

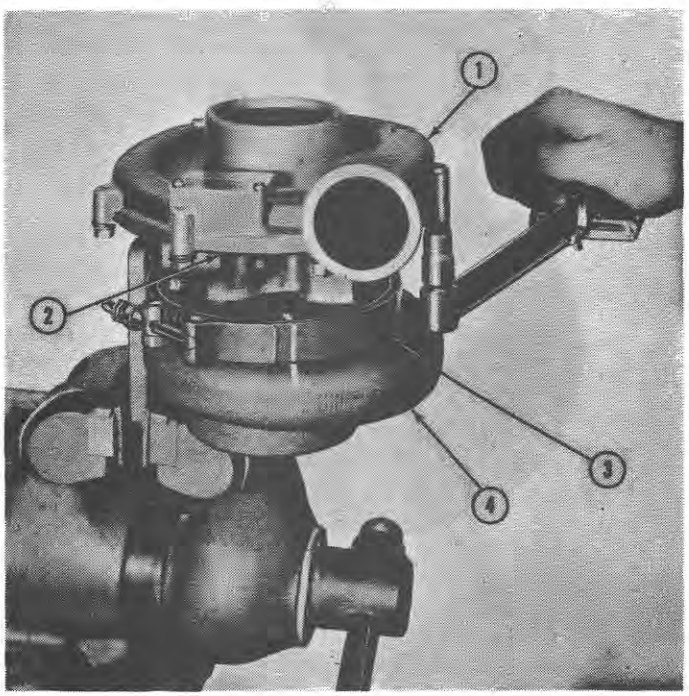


Figure 12
Compressor Cover Installation

1. Compressor Cover
2. Clamp Plate
3. Clamp Band
4. Turbine Housing

6. Place the clamp band over the flange on the turbine housing. Position the core assembly in the turbine housing aligning all reference marks.

IMPORTANT: ***Make sure the mating surfaces are clean and free of burrs to prevent possible misalignment and damaged blades.***

17. Coat the threads of the clamp band bolt and the flat face of the clamp band nut with graphite grease. Make sure the band is properly positioned to catch the flanges of both housings. Install the nut and tighten it to a torque of 120 lbs. in. (1.380 kgm).

18. Apply graphite grease lightly around the machined flange of the compressor cover to ease positioning the cover when the turbocharger is completely assembled.

IMPORTANT: ***Make sure the mating surfaces are free of burrs to prevent possible blade damage.***

19. Position the compressor cover on the bearing housing aligning the reference marks as shown in Figure 12.

20. Secure the compressor cover to the bearing housing with the eight bolts, lock washers, and the four clamp plates. Tighten the bolts diagonally to a torque of 60 lbs. in. (.990 kgm).

21. Spin the turbine wheel. The compressor wheel and the turbine wheel should rotate freely. If a drag is felt, remove the compressor cover and the turbine housing to determine the problem area. If necessary, completely disassemble the unit and inspect all parts again. Reassemble and recheck.

E. Installation

Before installing the turbocharger on the tractor, the following checks must be made and corrected if necessary:

- Check the exhaust and air intake systems for leaks, and remove any loose, foreign, or deteriorating material.

- Clean the air cleaner element.

Foreign material can quickly damage the turbocharger blades and destroy the precise balance of the rotating components. Exhaust and air intake leaks or restrictions will cause a reduction in the air supply to the engine and result in high exhaust temperatures.

1. Install the oil return tube and gasket on the turbocharger.

2. Position a new gasket and the turbocharger on the manifold, Figure 13, at the same time locating the oil return tube on the cylinder block adapter. Secure the turbocharger with the four nuts and lock washers and tighten the nuts to a torque of 30-35 lbs. ft. (4.15–4.84 kgm).

3. Add an ample supply of clean engine oil to the turbocharger through the oil intake port to thoroughly lubricate the turbocharger.

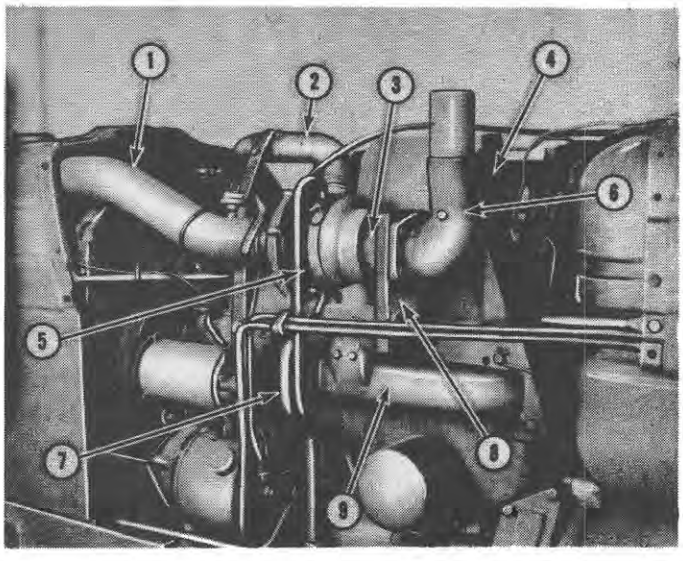


Figure 13
Component Identification

1. Air-Cleaner-to-Turbocharger Tube
2. Turbocharger-to-Intake Manifold Tube
3. Seal Ring
4. Heat Shield
5. Oil Supply Tube
6. Exhaust Pipe
7. Oil Return Tube
8. Exhaust Flange
9. Exhaust Manifold

4. Install a new gasket and connect the oil supply tube to the cylinder block adapter. Tighten the oil supply and oil return tube connections.

5. Install the heat shield and secure it with the manifold bolts and new locking tabs.

6. Position the exhaust seal ring into the recess of the turbine hub. Install the exhaust flange and secure it to the manifold with the three bolts and lock washers. Tighten the bolts securely.

   IMPORTANT: ***Make certain that the intake manifold tube is not producing a strain on the compressor cover. If necessary, loosen the clamp plate bolts and realign the cover with the intake manifold tube. Be sure that the mating flanges of the compressor cover are properly seated and the clamp plate bolts are properly tightened to a torque of 60 lbs. in. (.990 kgm).***

7. Connect the turbocharger-to-intake manifold tube as shown in Figure 13, and secure it with the clamps. Tighten each clamp bolt to a torque of 15-20 lbs. (.172—.230 kgm).

8. Connect the air cleaner-to-turbocharger tube as shown, and secure it with the clamps. Tighten each clamp to a torque of 15-20 lbs. in. (.172—.230 kgm).

9. Install the exhaust pipe on the exhaust flange and a new gasket. Secure the pipe by installing the four bolts in the exhaust flange. Tighten the bolts to a torque of 20-26 lbs. ft. (2.77—3.59 kgm).

10. Crank the engine for approximately 15 seconds with the diesel engine stop control out. This will provide initial lubrication to the turbocharger.

11. Install both hood side panels and the exhaust extension.

12. Check the engine oil level and add oil as required.

13. After several hours of operation, retighten all bolts.

Part 2

FUEL SYSTEM

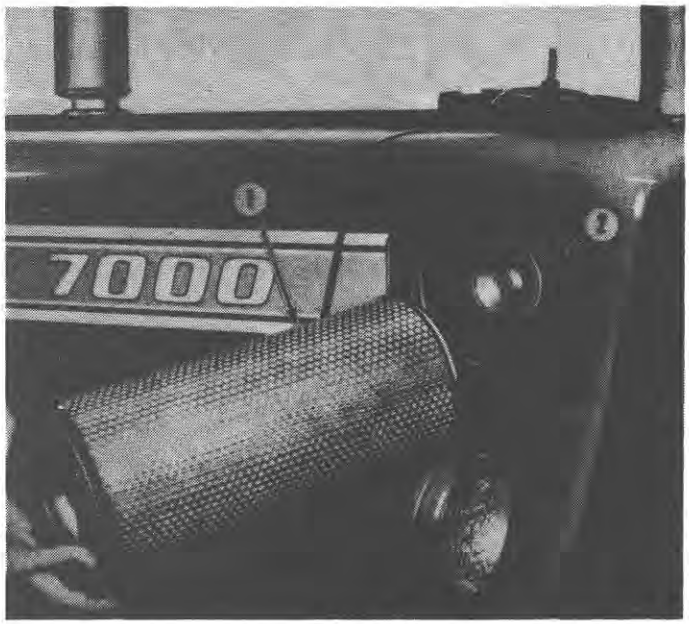


Figure 1
Air Cleaner

1. Air Cleaner Primary Element
2. Air Cleaner Secondary (Safety) Element

AIR CLEANER

The air cleaner, Figure 1, on the Ford 7000 Tractor is located in front of the radiator and is of the dry element type. It consists of a primary element and a secondary (safety) element.

The primary element should be cleaned whenever the air cleaner restriction warning light glows red. To clean the primary element:

1. Remove the filter element, Figure 1.

2. Check the rubber seal on the end of the element for adhesion. If the seal is loose, install a new element. A loose, damaged, or missing seal will allow dust to enter the engine and cause severe engine wear.

3. Clean the element by tapping it against the palm of your hand. DO NOT beat the element against the tire or a hard surface as damage to the element will result.

   NOTE: *Compressed air, not to exceed 100 psi, may be used for cleaning. Blow dust from the inside to the outside by inserting the nozzle inside the element. Blow loose particles from the outside by holding the nozzle at least 6 inches from the element.*

4. Inspect the element for signs of damage. If any damage exists, install a new filter element.

5. Clean the inside of the cannister with a damp, lint free cloth, then reinstall the element.

6. Check and tighten all air induction connections before resuming operation.

   The primary air cleaner element should be changed every 600 hours, (or whenever the 300 hour inspection shows the element to be damaged), or after ten cleanings, or whenever damage to the element is observed.

The secondary filter element is a safety element. It will protect the engine from damage in the event dust passes through a damaged primary element. The secondary (safety) element should be replaced when a new primary filter fails to extinguish the air cleaner restriction warning light, provided that the glowing light is not due to a malfunction in the electrical circuit. To install a new secondary (safety) element:

1. Remove the retaining nut and seal, Figure 1.

2. Remove the secondary (safety) element.

3. Install the new secondary element making certain that it seats properly to avoid admitting dust or dirt into the air intake tubes.

4. Install the retaining nut and seal. Tighten the retaining nut to a torque of 20 to 40 in. lbs. (.23 to .46 kgm).

5. Install a new primary filter element or the cleaned element as necessary. Tighten the wing nut securely.

6. Install the air cleaner cover.

   IMPORTANT: *The secondary (safety) filter element is not serviceable and must be replaced with a new one when required.*

FUEL INJECTION PUMP

Calibration

Test bench specifications and calibrating procedures for the Ford 7000 Injection pump are identical to those of the Ford 5000 with the 256 cu. in. engine with the following exception:

Maximum fuel delivery from each element is specified as 16.8 cc ± 0.2 cc for 200 shots at 900 rpm.

Part 3

ELECTRICAL SYSTEM

ELECTRICAL SYSTEM

The electrical system of the Ford 7000 Tractor uses a 128 ampere hour battery, with either a 55 ampere alternator and regulator or a 22 ampere generator and regulator, depending upon market area. All tractors with "A" or "B" prefixed serial numbers are equipped with a generator and all tractors with "C" prefixed serial numbers are equipped with an alternator. The respective voltage regulators for either the alternator or generator is located to the left side and in front of the fuel tank. The alternator regulator is an all-electronic transistorized unit that uses no mechanical contacts or relays. The generator regulator is electro-mechanical. Both units are sealed and cannot be adjusted.

Figure 1 illustrates a circuit schematic for tractors with a "C" prefixed serial number. Exercise care to avoid damage when removing electrical harnesses or wires. When installing the harnesses or wires, be sure that all clips are installed properly and that the wiring is not damaged by sharp corners or hot surfaces. For tractors with "A" or "B" prefixed serial numbers, refer to Part 3, Electrical System, of this manual.

IMPORTANT: ***Never connect or disconnect the battery leads while the tractor engine is running. Avoid reversed polarity when connecting booster cables to the battery. Do not run the tractor engine without a battery in the circuit.***

AIR CLEANER RESTRICTION WARNING LIGHT

The Ford 7000 Tractor incorporates an air cleaner restriction warning light. When the light glows red, it is an indication that sufficient air is not reaching the engine and the air cleaner must be serviced. Refer to Part 2, "Fuel System", of this supplement for procedures on servicing the primary and secondary air cleaner elements.

NOTE: ***The air cleaner restriction warning light will glow red for approximately 15 seconds after the key starter switch is turned to the on position. If the warning light glows red for more than 15 seconds after the engine starts, stop the engine immediately and investigate the possible cause.***

KEY TO WIRING CODES FOR FIGURE 1
(Circuit Descriptions – Tractors with "C" prefixed serial numbers).

Wire No.	Wire Description	Wire Code
1	Alternator to Starter Relay	Brown
2	Voltage Regulator F to Alternator	Brown/Green
3	Voltage Regulator I to Key Starter Switch	Brown/White
4	Starting Motor Relay to Key Starter Switch	Brown
5	Alternator to Key Starter Switch	Red
6	Voltage Regulator A to Key Starter Switch	Brown/Yellow
7	Starting Motor Relay to Starter Safety Switch	White/Red
8	Key Starter Switch to Starter Safety Switch	White/Yellow
9	Thermostart Connection to Key Starter Switch	Brown/Red
10	Key Starter Switch to Fuse	White
11	Key Starter Switch to Light Switch	Brown
12	Fuse to Voltage Stabilizer and Warning Lights	White
13	Light Switch to Rear Lamps and Head Lamps (Row Crop only)	Red
14	Light Switch to Head Lamps	Blue/Red
15	Temperature Gauge to Temperature Sending Unit	Green/Blue
16	Light Switch to Panel Light Connection	Red/White
17	Oil Pressure Switch to Oil Pressure Warning Light	Blue
18	Air Cleaner Restriction Vacuum Switch to Key Starter Switch	Red/Yellow
19	Voltage Regulator G to Alternator Warning Light	Black

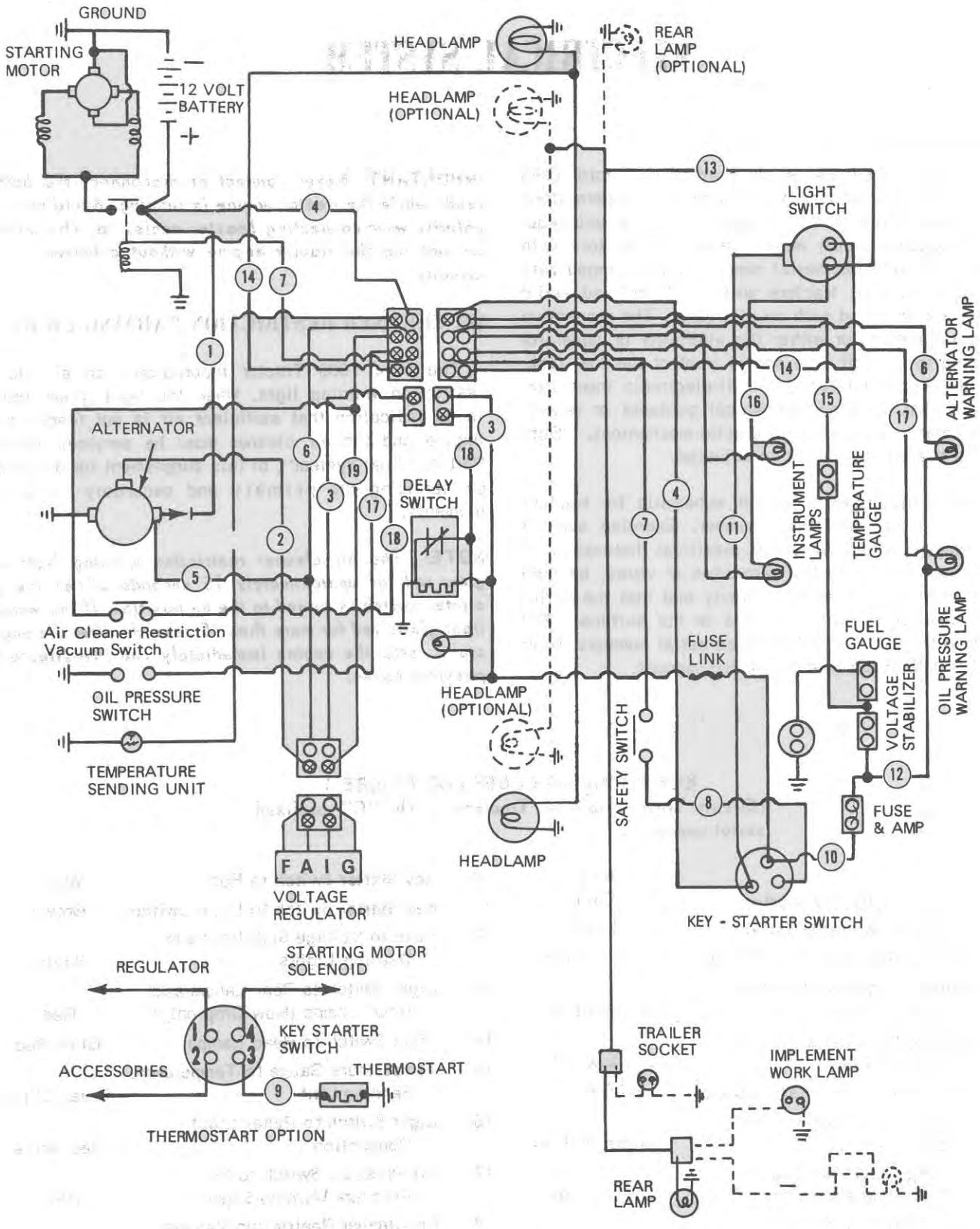


Figure 1
Electrical System Schematic

Part 3

ELECTRICAL SYSTEM

Chapter 7

ALTERNATOR AND REGULATOR – FORD 7000

1. INTRODUCTION

ALTERNATOR

The alternator system consists of an alternator and solid state voltage regulator, Figure 1. Figure 2 shows the terminal arrangement at the rear of the alternator. Figure 3 shows the side view.

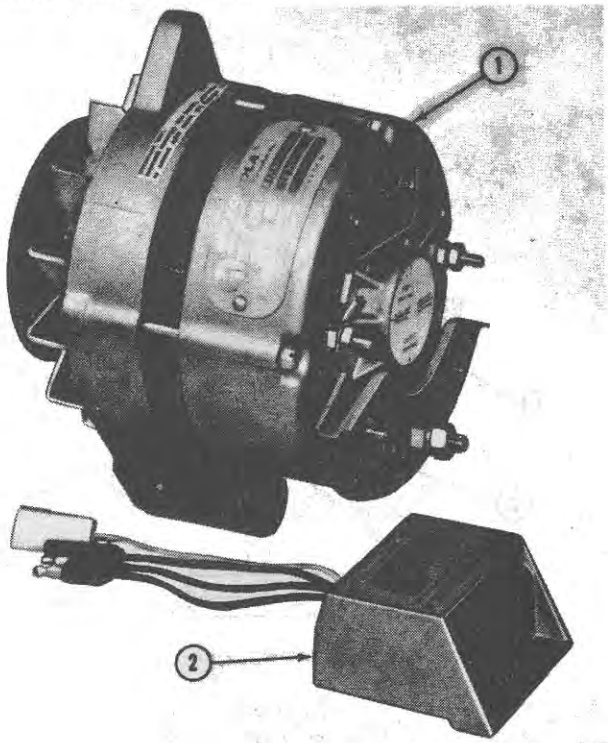


Figure 1
Alternator and Regulator

1. Alternator
2. Voltage Regulator

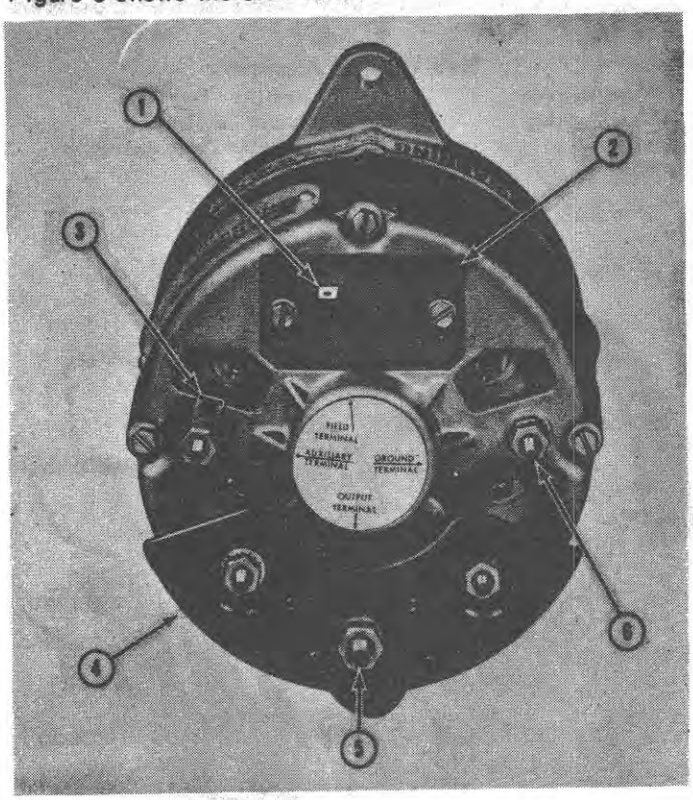


Figure 2
Alternator Terminal Identification

1. Brush (Field) Terminal
2. Dust Shield
3. Auxiliary Terminal
4. Isolation Diode Assembly
5. Output Terminal (Positive)
6. Ground Terminal (Negative)

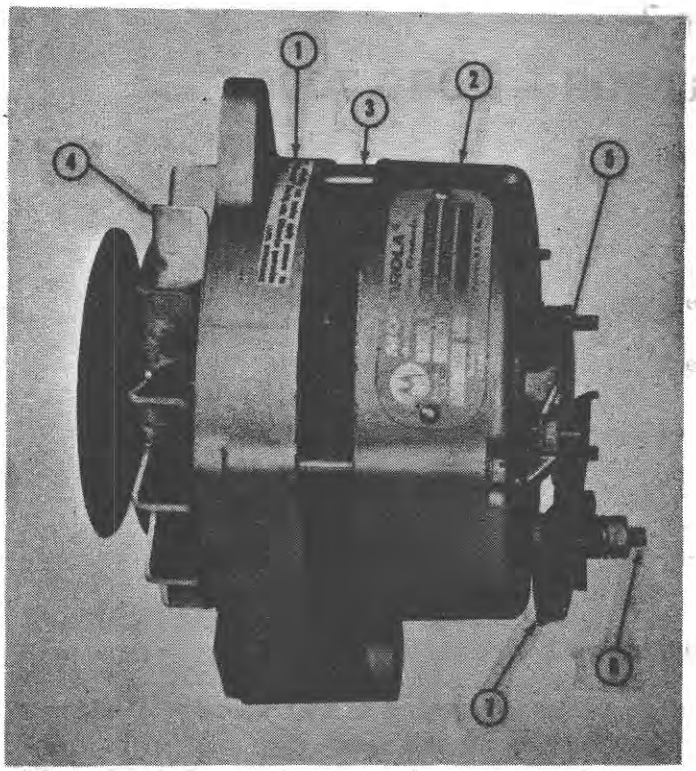


Figure 3
Side View of Alternator

1. Front Housing
2. Rear Housing
3. Stator
4. Fan
5. Auxiliary Terminal
6. Output Terminal
7. Isolation Diode Assembly

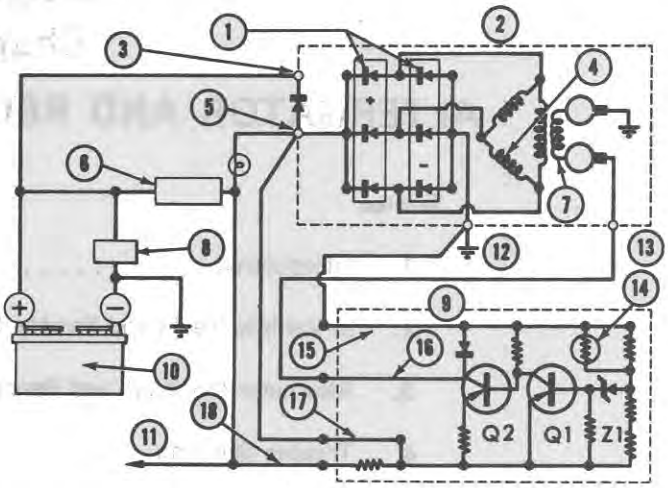


Figure 5
Alternator System Schematic

1. Rectifying Diodes (Six)
2. Alternator
3. Output
4. Stator
5. Auxiliary
6. Key-Switch
7. Rotor
8. Load
9. Regulator
10. Battery
11. To Distributor (If Applicable)
12. GND
13. Field
14. Right
15. Black
16. Green
17. Red
18. Yellow

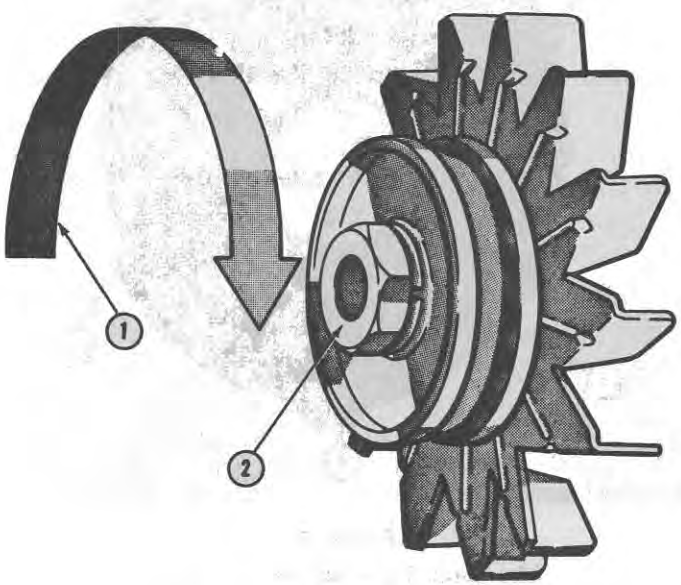


Figure 4
Front Mounted Cooling Fan

1. (Standard) CW Rotation
2. Tighten to 35–50 Lbs. Ft.

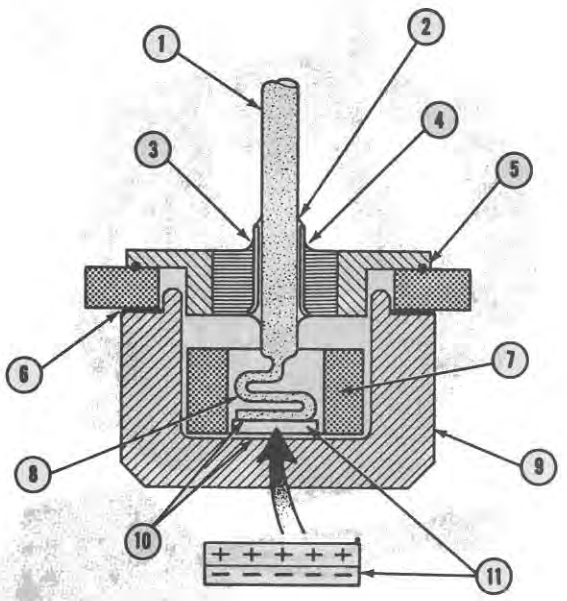


Figure 6
Diode Construction

1. Copper Lead
2. Solder
3. Glass Insulator
4. Tube
5. Weld
6. Solder
7. Getter Material
8. Flattened Wire
9. Brass Case
10. Solder
11. Silicon Crystal Wafer

The alternator is cooled by a front mounted fan, Figure 4, that draws air into the rear housing. The air stream is directed across the rectifying diodes, stator and rotor, and expelled out the openings in the front housing. The rotor assembly is mounted on ball bearings.

The alternator converts magnetic and mechanical energy to alternating current by rotating an electromagnet (the rotor) inside the stator assembly. The alternating current and voltage is changed to direct current (D.C.) by a three-phase, full wave rectifier system, employing six silicon rectifying diodes. See Figure 5.

DIODES

A diode, simply stated, is an electrical "check valve" that allows current to flow in one direction only, from positive (+) to negative (–). Figure 6 shows the construction of a diode. The silicon crystal wafer is the "heart", or rectifying element; it determines the direction of current flow through the diode. The silicon crystal wafer consists of two substances. The silicon crystal has a natural positive charge. It is coated on one side with a substance that has a negative charge. Current passes through the wafer in one direction only – FROM THE POSITIVE SIDE TO THE NEGATIVE SIDE – due to the chemical composition of the electrically opposite sides. The side to which the flattened wire is soldered determines the direction of current flow in relation to the construction of the diode, and consequently, establishes the diode as being positive or negative. When the copper lead is soldered to the positive side of the wafer, the diode is positive. When the copper lead is soldered to the negative side of the wafer, the diode is negative. Diodes with part numbers printed in **red** are POSITIVE. Diodes with part numbers printed in **black** are NEGATIVE.

Since diodes pass direct current in only one direction, their arrangement in the alternator eliminates the need for a cut-out or a relay to connect or disconnect the alternator from the battery. The diodes are assembled into two heat-dissipating plates. These plates or heat sinks are placed in the alternator with mounting studs that also serve as system terminal connections. See Figure 7.

The isolation diode, shown in Figure 8, is directly connected to the auxiliary terminal stud that is a part of the positive rectifier diode assembly. This places the isolation diode in series with the rectifier diodes and the positive output terminal of the alternator. The auxiliary terminal is considered to be the voltage regulator connecting terminal.

The isolation diode consists of a pair of negative diodes, connected in parallel and mounted in a heat sink. The heat sink is coated with a special corrosion resistant red paint to prevent electrolysis. The red color indicates that the electrical potential at this point is **positive,** therefore, the alternator is a **"negative ground machine".**

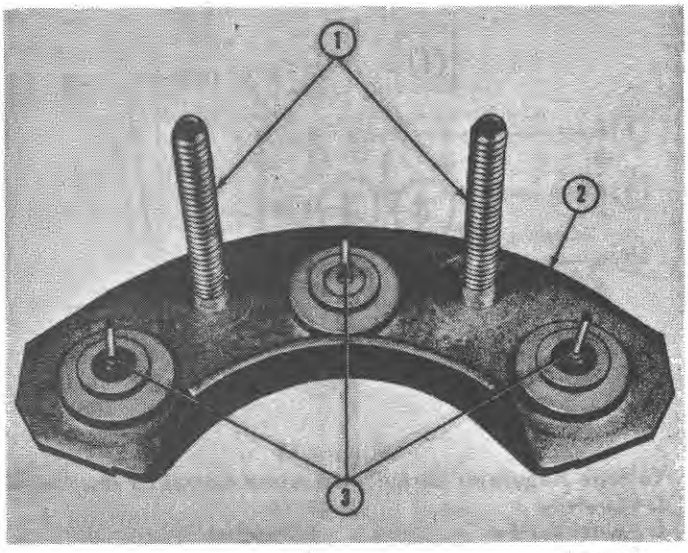


Figure 7
Rectifying Diode Assembly
1. Terminal Studs 2. Heat Sink 3. Diodes

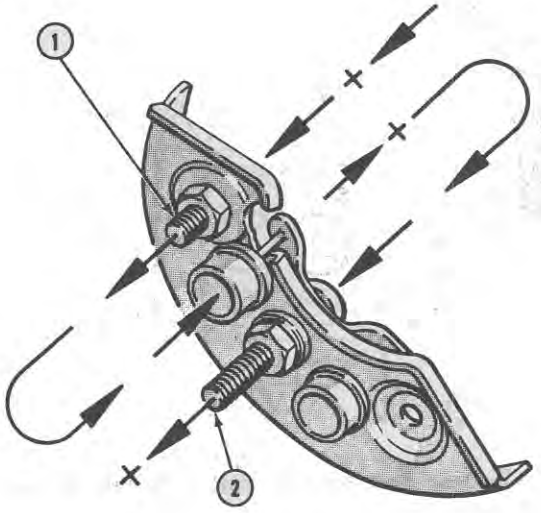


Figure 8
Current Flow Through Isolation Diode
1. Auxiliary Terminal (Part of Rear Housing Assembly) 2. Output

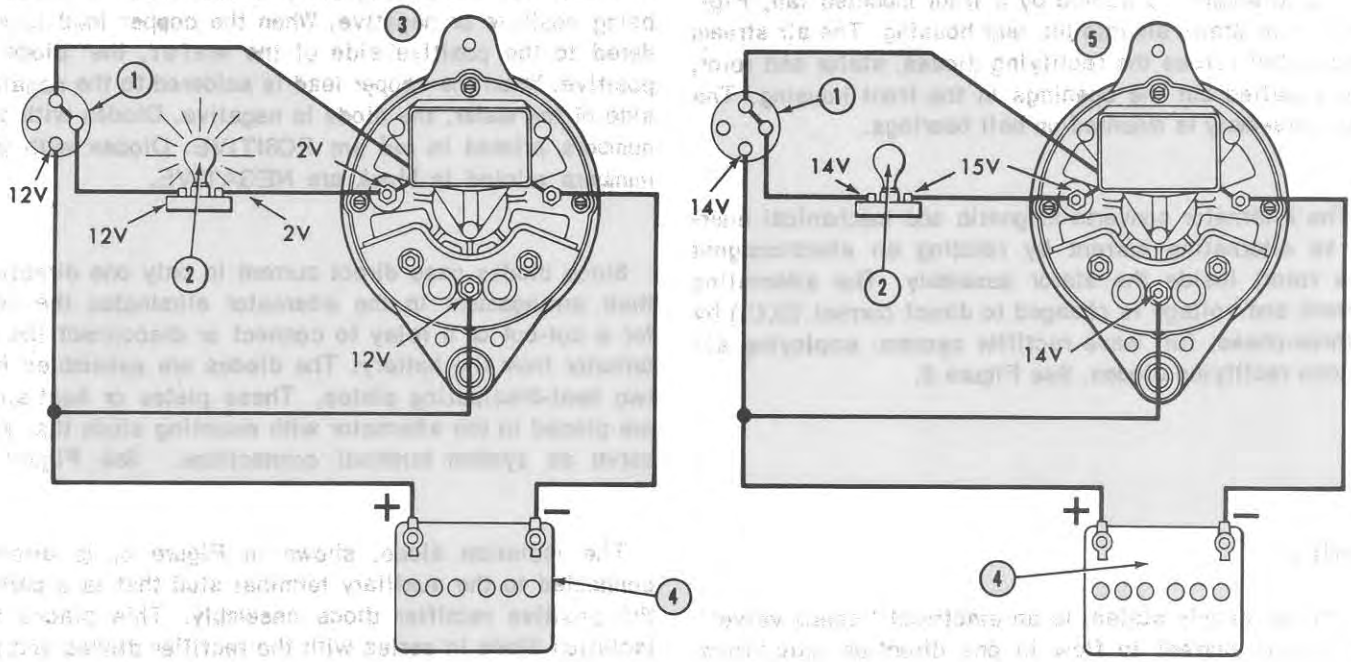


Figure 9
Charge Indicator Light Circuit

1. Key-Switch
2. Charge Indicator Light
3. Key on Engine Not Running Voltage Across Light 10 Volts (Light Will Come On)
4. Battery
5. Key on Engine Running Voltage Across Light 1.0 Volt (Light Will Not Come On)

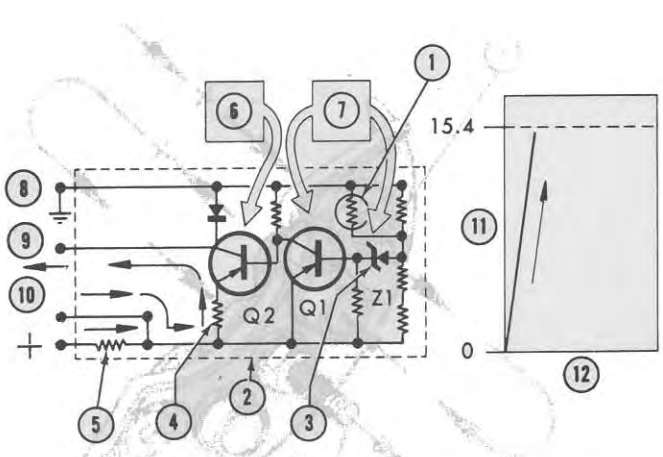


Figure 10
Voltage Regulator Circuit – Battery Current Flow

1. Thermistor
2. Emitter Resistor
3. Zener Diode
4. Regulator
5. Excitation Resistor
6. On
7. Off
8. Negative
9. Field
10. Auxiliary
11. Volts
12. Time

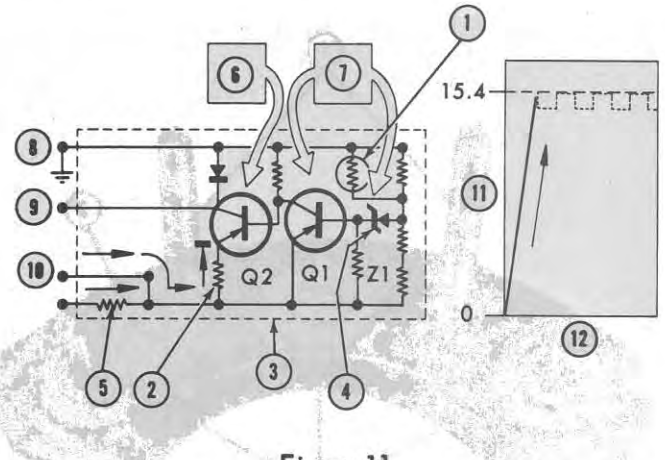


Figure 11
Voltage Regulator Circuit – Battery Current Flow Cut-Off

1. Thermistor
2. Emitter Resistor
3. Regulator
4. Zener Diode
5. Excitation Resistor
6. Off
7. On
8. Negative
9. Field
10. Auxiliary
11. Volts
12. Time

The isolation diode provides a means of operating the charge indicator light without using a special relay. Electrically, the charge indicator light is connected in parallel with the isolation diode. When the alternator is producing a normal charge, the voltage differential across the isolation diode is so small that the light will not come on, indicating that the alternator is charging. See Figure 9.

REGULATOR

The voltage regulator, Figure 1, is an electronic switching device. It senses voltage appearing at the alternator auxiliary terminal, and supplies the necessary current to the rotor winding (field) for maintaining system voltage at the alternator output terminal.

The components of the voltage regulator are sealed in epoxy resin for protection against damage from vibration, dust, and moisture.

A zener diode (Z1), Figure 10, and a thermistor are incorporated in the voltage regulator circuit, along with calibrating resistors and two switching transistors (Q1 and Q2). The zener diode is the voltage sensitive component, while the thermistor serves to adjust the zener diode action to suit regulator operating temperatures.

Note that the output transistor (Q2) is in series with the regulator input lead and with the regulator output lead to the rotor (field) winding. This transistor is turned "on" and "off" by the action of the regulating zener diode, and the driver transistor (Q1).

Initial alternator excitation, creating a light magnetic field around the rotor assembly, is accomplished by passing battery energy through the excitation resistor, emitter resistor, output transistor (Q2) to the rotor (field) winding.

During initial excitation, and any other time the alternator system voltage is below the regulating level of the zener diode, the zener diode and driver transistor are turned "off". The only switching component in the regulator that is turned "on" at this time, is the output transistor (Q2), allowing battery energy to pass through the regulator circuit to the rotor (field) winding.

Rotating the magnetized rotor in the alternator induces current flow in the stator windings as alternating current and voltage. This energy is converted to direct current by the rectifying diodes and appears at the auxiliary terminal as direct current and voltage. The system voltage then starts to rise, as shown in the graph, Figure 10.

When alternator D.C. voltage reaches the regulating level of the zener diode, the zener diode conducts, turning the driver transistor "on". The output transistor is turned "off", cutting off the flow of current to the rotor (field) winding, as shown in Figure 11.

The magnetic field of the rotor winding begins to collapse, reducing alternator voltage, as shown in the graph, Figure 11. The instant that the voltage drops below the zener diode conducting or "regulating" level, the zener diode becomes an open circuit and the driver transistor switches "off", allowing the output transistor (Q2) to switch "on" again. The dotted trace in the graph shows the slight drop in voltage and the rapid rise, caused by the "on/off" action of the semi-conductors.

The thermistor exerts its influence on the regulated voltage level by changing its resistance with changes in temperature. The resistance variations have a direct effect on the function of the zener diode, providing higher charging rates in cold weather and lower charge rates in warm weather.

A typical temperature-resistance characteristic curve is shown in Figure 12. Also refer to the voltage vs. ambient air temperature chart on page 12.

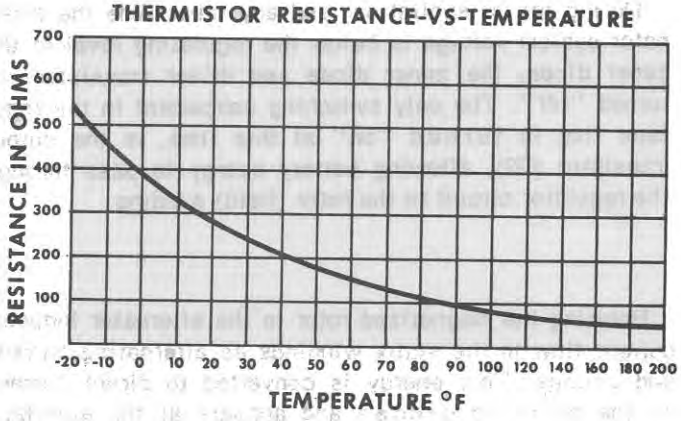


Figure 12
Typical Temperature – Resistance Characteristics of Thermistor

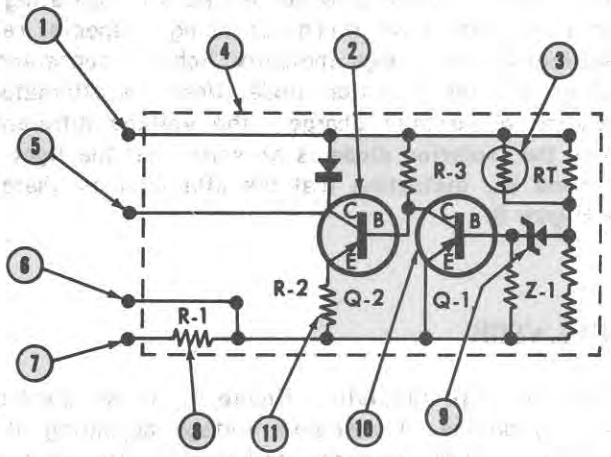


Figure 13
Voltage Regulator Circuit

1. Black Lead Ground
2. Output Transistor
3. Thermistor
4. Regulator
5. Green Lead Field (Rotor)
6. Red Lead Auxiliary (Stator)
7. Yellow Lead Excitation
8. Excitation Resistor
9. Zener Diode
10. Driver Transistor
11. Emitter Resistor

A series of short connecting cables are soldered to the regulator circuit board, with the opposite ends terminating in a polarized connector plug. The regulator circuit is insulated from the metal housing, therefore the regulator requires no external ground. The regulator will function as long as it is connected, even if it is merely hanging by the connector.

Generally, red leads connect to the voltage sensing auxiliary terminal of the alternator, the positive source. Black leads connect to the negative or ground terminal of the alternator. Green leads connect to the brush, (field) terminal. The fourth lead, the external lead from the excitation resistor (R1), Figure 13, connects to the key-starter switch. The fifth lead, the output from the alternator to the battery, is a heavier brown lead.

2. IN-VEHICLE TESTS AND SERVICE PROCEDURES

IN-VEHICLE TESTS

Preliminary Checks

Prior to electrical testing, a thorough inspection of the charging and electrical system is required to eliminate associated conditions that may be interpreted as a defective alternator or regulator.

1. Check all electrical leads and connections, repair or replace necessary parts. Check the condition of the alternator drive belt and pulleys. Severe operating conditions will accelerate belt and pulley wear. Tighten the belt to avoid slippage during testing. Belt adjustment is covered on page 14.
2. Check the alternator brushes for wear. Replace if worn more than half their original length. Brush removal and installation is covered on page 14. Brushes worn too short tend to lose contact with the slip rings. While the brush cavity is exposed, check the slip rings for cleanliness. If cleaning is required, use a fine grade of crocus cloth for this purpose. Inspect radio capacitors (filter), if installed, for open or shorted conditions, replace defective units.

Check the battery. The battery used in electrical testing must be of correct voltage and must be in good condition and fully charged. If a slave or jumper battery is used for testing, the connecting cables must be securely fastened to the system.

IMPORTANT: *Observe proper battery and system polarity when installing the battery in the tractor. The alternator nameplate indicates the system polarity. See Figure 14. Incorrect battery polarity will destroy the rectifier diodes in the alternator.*

As a precautionary measure, always disconnect the battery ground cable from the battery when charging the battery with any battery charger. This is mandatory with fast chargers that may have defective rectifying systems, as the rectifier diodes in the alternator could be destroyed.

DO NOT, under any circumstances, short the alternator field terminal to ground, as permanent damage to the regulator may result.

DO NOT disconnect the voltage regulator connector plug from the tractor wiring harness while the alternator is operating. A large voltage transient could develop and may damage the alternator.

DO NOT disconnect the alternator output lead from the alternator while the alternator is operating. This same precaution applies to the battery cables, they must not be switched "off" or disconnected from the battery while the alternator is operating. The loss of battery resistance would cause system voltage to rise to an extreme value, damaging the alternator, regulator, and possibly other accessories.

ALWAYS disconnect the battery ground cable from the battery when removing or installing the alternator.

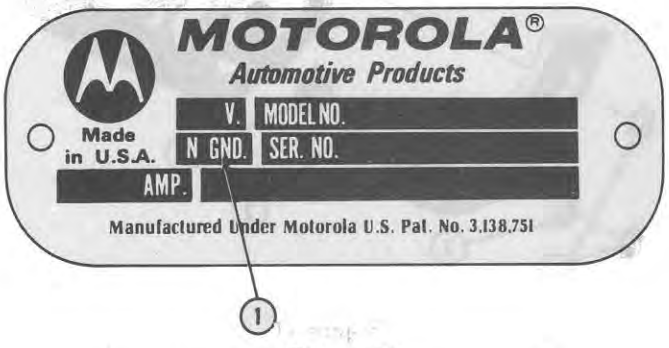


Figure 14
Alternator Nameplate
1. Ground Information

4. Check the key-starter switch. One of its functions is to supply initial excitation current for the alternator rotor (field) windings. The switch must be in good condition to perform the following tests. Switch removal and installation is covered in Chapter 1.

Test Equipment Required

The alternator and regulator tests require electrical test equipment that will measure voltage, current, and resistance. Individual meters are used in the following in-vehicle tests, however, most commercial testing equipment incorporate several testing devices in a single assembly. Use your equipment according to the manufacturers instructions. Equipment should provide:

- Voltmeter, with 0 to 20 volt scale
- Ammeter, with 0 to 60 ampere and 0 to 6 ampere scales
- Field Rheostat, wire-wound, 0 to 50 ohms, 100 watt rating, with alligator clips on connecting leads
- Series Resistor, 1/4 ohm, with connecting clip or leads
- Carbon Pile (Sun BST-11 or equal)
- Volt-Ohm-Milliammeter (Simpson 260 or equal)
- 12 volt test lamp, and 115–120 volt A.C. Test Lamp
- Diode Tester, any commercial type (optional)
- Assortment of jumper cables with alligator clips

The ammeter will be connected into the system when the field current is tested, and for the total output test, page 12. If the ammeter has provisions for reversing meter circuit, and for switching from one scale to another, the test will advise this action. If necessary, meter leads would be reversed to accomplish this action.

NOTE: *Ammeter leads must be secure and should not separate during testing. If alligator clips on the ammeter leads are questionable, replace them.*

Reference to "ground" indicates that a good ground is necessary. The alternator ground stud would be the best grounding point.

Battery Voltage and Shorted Isolation Diode Test

Conditions: Key Starter Switch OFF, Engine NOT Running

1. This test will determine if the tractor battery is properly installed and if the isolation diode is functioning properly by keeping battery voltage off of the alternator auxiliary terminal, Figure 15. A shorted isolation diode will allow the battery to discharge through the voltage regulator. The charge indicator light will "burn" when the key is off if the isolation diode is shorted.

2. Connect the voltmeter negative lead to ground and the positive lead to the output terminal at the isolation diode heat sink, Figure 15. The voltmeter should indicate battery voltage.

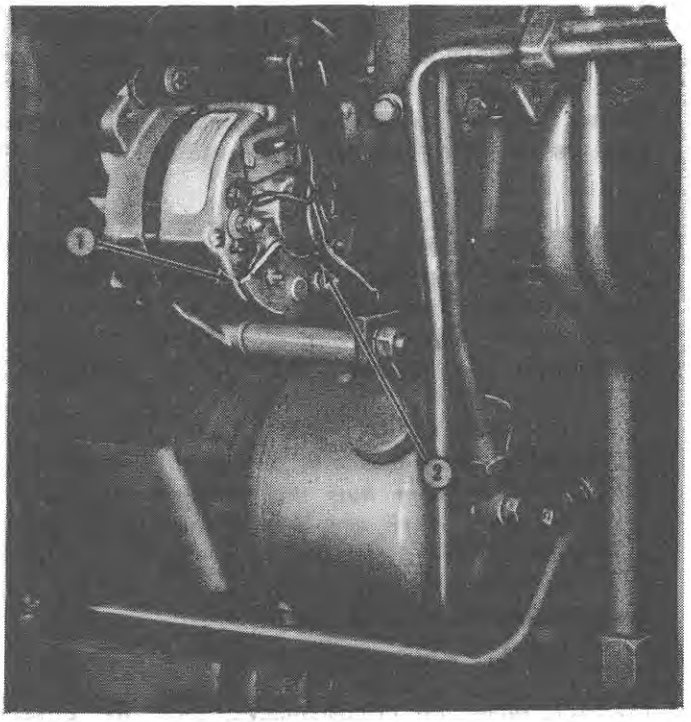


Figure 16
Output Lead Position

1. Heat Sink
2. Do Not Allow Output Lead To Touch Heat Sink

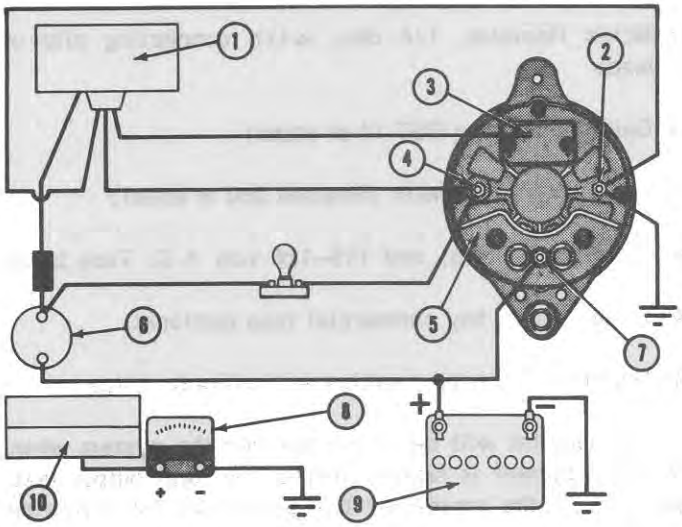


Figure 15
Battery Voltage and Shorted Isolation Diode Test

1. Regulator
2. Ground
3. Field
4. Auxiliary
5. Isolation Diode Heat Sink
6. Key-Switch
7. Output
8. Test Voltmeter
9. Battery
10. Auxiliary Output

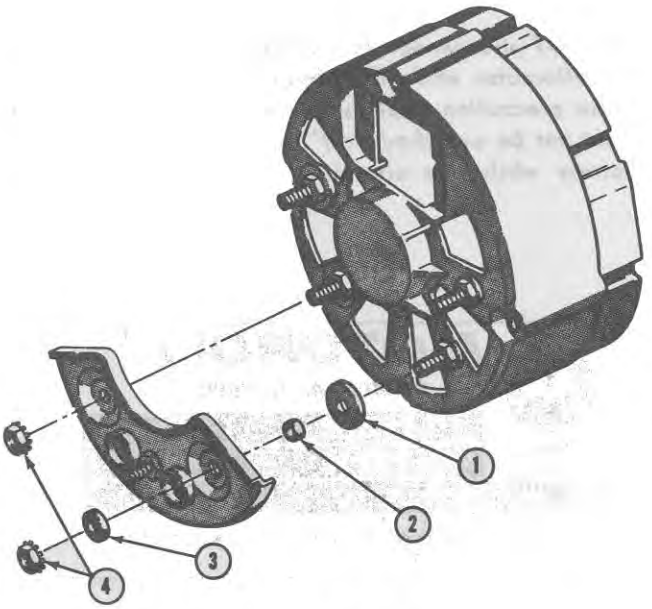


Figure 17
Insulators for Isolation Diode Assembly

1. 3/4" O.D. Washer
2. Nylon Sleeve
3. 1/2" O.D. Fiber Washer
4. Lock Nuts

3. Move the positive voltmeter lead to the auxiliary terminal, Figure 15. The voltmeter should read zero volts. If the voltmeter continues to indicate battery voltage, either the isolation diode is shorted, or the output lead is contacting the isolation diode heat sink, Figure 16, allowing battery current to bypass the isolation diode. Loosen the nut and reposition the output lead if necessary.

4. The isolation diode may be replaced without removing the alternator. Remove the battery ground cable (negative) during replacement.

NOTE: ***Reinstall the heat sink insulators in their original positions, Figure 17.***

Excitation Voltage Test

Conditions: Key Starter Switch ON, After Connecting Voltmeter Leads, Engine NOT Running

1. The results of this test will indicate if battery voltage and current, controlled by the key-starter switch.

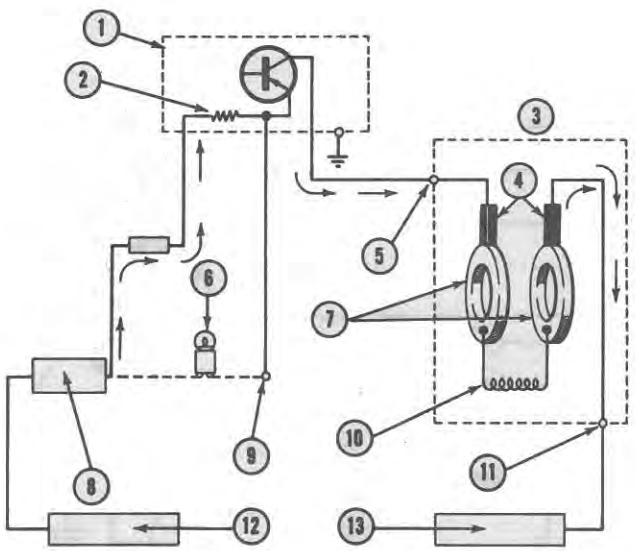


Figure 18
Alternator Field Circuit

1. Regulator
2. Excitation Resistor
3. Alternator
4. Brush Set
5. Field Terminal (Alt)
6. Ind. Lamp
7. Slip Rings
8. Key-Switch
9. Auxiliary Terminal (Alt)
10. Rotor Winding
11. Negative Output
12. Battery Positive
13. Battery Negative

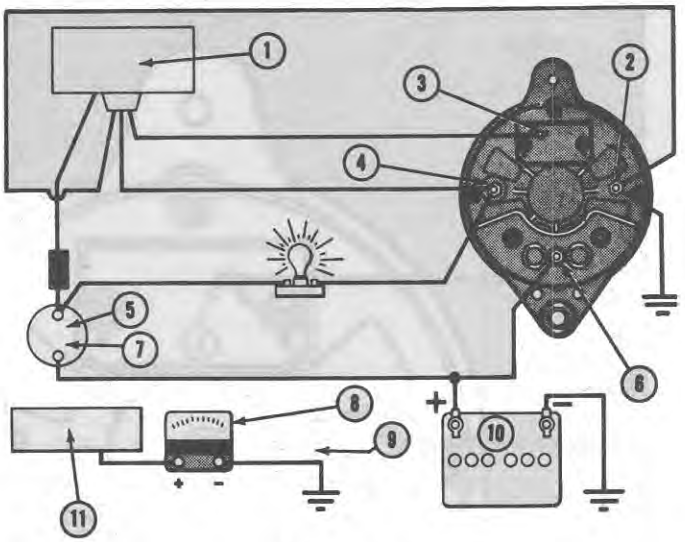


Figure 19
Excitation Voltage Test

1. Regulator
2. Ground
3. Field
4. Auxiliary
5. Key-Switch
6. Output
7. On
8. Test Voltmeter
9. 1.5 to 2.5 Volts
10. Battery
11. Auxiliary

is passing through the voltage regulator and into the rotor (field) winding to provide initial excitation of the alternator. Figure 18 shows the circuit involved.

2. Connect the voltmeter negative lead to ground and the positive lead to the auxiliary terminal, Figure 19. Turn the key-starter switch on. The voltmeter reading should be approximately 2.5 volts. If the voltmeter reads approximately 2.5 volts, remove the fuse from the instrument panel. The charge indicator light should go out and the voltmeter should drop to 1.5 volts

3. If the voltmeter indicates zero volts, recheck all connections between the key-starter switch and the excitation lead of the regulator. Repair as needed and continue the test.

4. If the voltmeter reads more than 2.5 volts or 1.5 volts with the instrument fuse removed, it indicates a fault in the regulator or in the alternator rotor (field) winding. Bypass the regulator input-output circuit with a jumper cable in order to isolate the fault. See Figure 20.

Thank you very much for your reading.

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