SERVICE MANUAL

L210

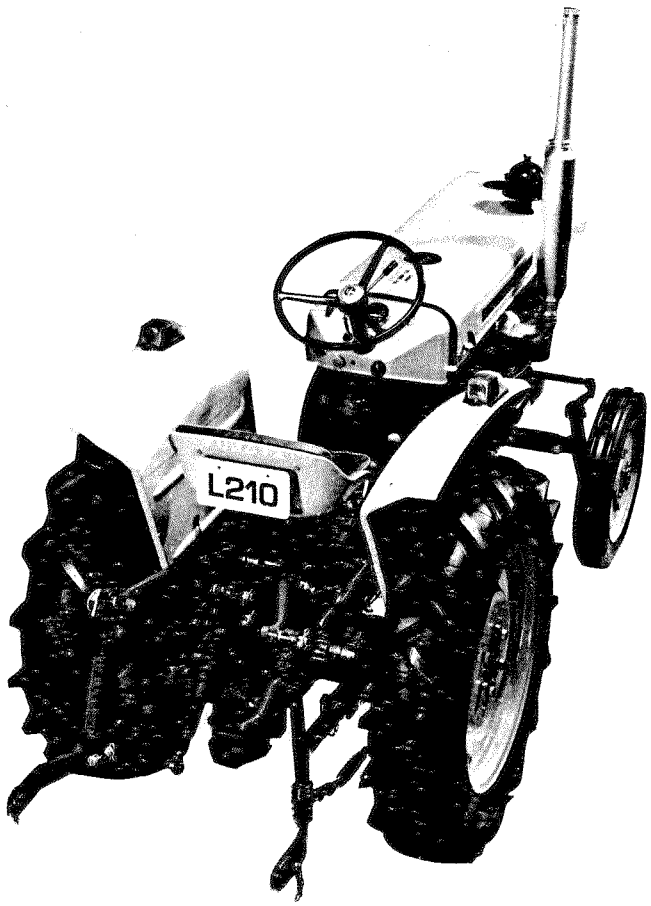
Kubota®

FOREWORD

This Service Manual has been specially prepared so that the explanation is very simple. It has been prepared so that if this Manual is thoroughly read, even comparatively new personnel can give satisfactory after services to the customers as well as disassemble and maintain the KUBOTA L 210 Tractor.

It would be very fortunate if this service manual can be utilized for the technical services of the tractor.

If there should be places which are not sufficiently explained or if there are places which are not understandable, please enquire of the Agricultural Machinery Technical Research Institute.



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I. MAIN SPECIFICATIONS

1. SPECIFICATIONS OF KUBOTA Z 1100—A ENGINE

Type	Vertical, water-cooled, 4 cycle Diesel engine
Number of cylinders	Two
Bore and stroke	3.46 x 3.46 in (88 x 88 mm)
Stroke displacement	32.65 cu. in. (535 cc)
Total displacement	65.3 cu in. (1070 cc)
Bare engine horse power/speed (without fan, muffler, air cleaner, radiator and dynamo)	21 HP / 2700 rpm
Net flywheel horse power/speed (includes fan, muffler, air cleaner, radiator and dynamo)	20 HP / 2700 rpm
Max. torques/speed	44.5 lb-ft/1600 rpm (6.15 kg-m /1600 rpm)
Direction of revolution	Left when seen from flywheel side
Compression ratio	20
Engine dimension	Length 26.8 in. (682.5 mm) Width 24.7 in. (628.4 mm) Height 44.5 in. (1127.8 mm) (From finished bottom of crankcase to tip of muffler)
Engine weight, dry (without water and lube oil)	492 lb. (223 kg.)
Combustion chamber	Swirl combustion chamber
Fuel injection pump	ND - PFR 2 K 70 / 2/ 8 - 3a
Fuel injection nozzle	N - 12 SD 12
Injection pressure	1990 p.s.i. (140 kg/cm^2)
Injection timing	24^o before top dead center
Fuel	No.2-D Diesel Fuel

Specific fuel consumption	7.6 oz/HP-hr (215 g/HP-hr)
Cooling system	Pressurized radiator 11.4 p.s.i. (0.8 kg/cm^2) (Natural circulation)
Lubricating system	Forced lubrication by gear pump
Lubricating oil	Service API classification DM DS oil If temperature is: Below 32°F (0°C) use 10W or 10W-30 Between 32°F and 77°F (0°C and 25°C) use #20 Above 77°F (25°C) use #30
Starting system	Battery (cell starter) cell starter with engagement controlled by electro-magnet type (with glow plug)
Starting motor	12 V 0.9 Kw (nominal power)
Charging dynamo	12 v 120 W (D. C.)
Battery capacity	12 V 80 AH capacity (20-hour dischange rate. Type N 70 Z)
Lube oil capcity	Approximately 1.32 US. gal. (5 liters)
Cooling water capacity	Approximately 1.98 US. gal. (7.5 liters)
Fuel tank capacity	Approximately 6.34 US. gal. (24 liters)

Remarks: The output is in standard atmospheric condition

(that is, Hg, 29.92 in.(760 mm), 68°F (20°C)
temperature and humidity 60%)

2. SPECIFICATIONS OF TRACTOR

Model	Kubota L 210
Dimensions	
Overall length	95½ in (2430 mm)(From front bumper to PTO guard).
Overall width	56½ in (1340 mm) (At standard tread)
Total height	74 in (1880 mm) (To top of muffler)

Min. ground clearance	13½ in (340 mm) (At bottom of gearcase)
Wheel Base	59.0 in (1500 mm)
Tread, front	36.2" (920mm) 39.4" (1000mm) 42.5" (1080mm) 45.7" (1160mm) 48.8" (1240mm) 52.0" (1320mm) (Standard) (Tractor is shipped with tread 36.2"(920mm))
Tread, rear	35.8 (910) 37.6 (1000) 40.0 (1015) 41.4 (1050) 43.7 (1110) 45.5 (1155) 49 (1250) (Standard) (Tractor is shipped with tread 35.8"(910))
Vehicle weight	2010 lb.(910 kg) (with front and front wheel weights)
Total weight	2160 lb.(980 kg) (Vehicle weight & operator -- 122 lb.(55kg))
Speeds	
No. of speeds	6 speed forward, 2 reverse (Selecting with lever)
Forward 1st	0.97 Mile/hr (1.20 km/hr) w 9.5/9-24
Forward 2nd	1.39 Mile/hr
Forward 3rd	1.91 Mile/hr
Forward 4th	2.74 Mile/hr
Forward 5th	5.39 Mile/hr
Forward 6th	11.25 Mile/hr
Reverse 1st	1.39 Mile/hr
Reverse 2nd	2.75 Mile/hr
Front wheel alignment	
Type	Center pivot rumoan type
Kingpin angle	9°
Toe in	0.2 in. (5 mm) (0.08 to 0.32 in) (2 to 8 mm)

Camber	2°
Caster	2°
Trail	1.1 in (28 mm)
Steering system	
Type	Ball screw type
Gear ratio	19.79 : 1
Rear wheel axle	
Type	Fixed type
Drive axle	Semi floating type
Tire	
Front tire	4.00 - 15 - 4 PR (Standard air pressure 42.7 psi (3.0 kg/cm^2)
Rear tire	9.5/9 -24 - 4 PR (Standard air pressure 17.1 psi (1.6 kg/cm^2)
Clutch	Dry single plate, foot activating type
Differential	Gleason straight bevel gear (With differential lock)
Brakes	
Type	Expansion type, with pedal interlock
Lining	Diameter 5.5 in (140mm) x width 1.5 in(38mm)
Parking latch	Interlocking with main brakes
Turning radius	75 in (1.9 m)
PTO Shaft	
Position	Center of rear end of transmission case
Specification	SAE, DIN 1 3/8"
Speeds	650 and 990 rpm (with engine speed 2700 rpm)

Implement lifting device	
Type	Hydraulic
Hydraulic pump	GP 1/25 (11.4 qt.(10.8 liters/1350 rpm))
Set pressure	1420 lb/in^2 (100 kg/cm^2)
Cylinder	Bore 2.6" (65ø) x Stroke 3.9 in.(100 mm)
Max. lifting power	1885 lb (855 kg) (At tip of lower link)

II. FEATURES

1. FEATURES OF KUBOTA Z 1100—A ENGINE

1) Newly designed and highly efficient engine

This diesel engine is an diesel engine which was newly designed for the highly efficient KUBOTA L210 Tractor, incorporating the results of researches during a long period of time and the past experiences of the various other engines. It is a powerful efficient and lightweight engine with a Bare maximum output of 21 horsepower, maximum torque of 44.5 ft lb. (6.15 kg - m) and total engine weight of 492 lb. (223 kg.)

2) Ample output

The engine has been designed with sufficient allowance for horsepower and is of water-cooled (pressurized radiator) type so the engine can be used with considerable overload. The torque performance is the same as that used for KUBOTA L200 and L 260 Tractor, being the unique automatic fuel control device of Kubota. Moreover, the total displacement is large and is 65.3 cu. in. (1070 cc.) Therefore, the engine is very tough at very slow speed and as an tractor engine shows very efficient performance.

As the tractor is mounted with such a strong powerful engine, the engine will not stall or stop even when the working field condition is very bad. You will be able to get very good results from the tractor.

3) Outstanding economical performance

Kubota's unique swirl chamber combustion system has been adopted for the combustion chamber so the engine shows excellent starting performance, amount of fuel consumption and output. In addition the engine has very superior torque performance. Therefore, working efficiency is very high. The engine is economical from all points.

4) Very satisfactory durability

KUBOTA Z 1100-A Engine has been designed especially with consideration being given to durability in spite of field and soil condition. That is, to give concrete examples,

a) The crankshaft is of chromium molybdenum steel and heat-treated.

The crankpin has been treated by high-frequency heat treatment.

The parts are both wear-resistant.

b) Taper-roller bearings have been adopted for the crank bearing and has been designed to withstand a maxiumum load. They can be used semi-permanently.

c) For crank pin metal, tri-metal bearings which have a very good reputation in the automobile industry is used.

d) Special steel has been used for cylinder liners. Moreover, they have been finished by honing so they will maintain the initial performance for a long period of time.

e) Piston is of alumimum alloy which has a very small coefficient of thermal expansion. Moreover the pressure rings and oil rings have been planted with hard chromium. Therefore, the output of the engine is eternal.

f) The air cleaner is a large oil bath type cleaner. Moreover, a cyclone is used together with the oil bath. The cleaning efficiency does not drop and the dust in the air sucked in is perfectly filtered. This makes the engine that much more durable.

g) The fuel filter is of ample size and the best filter paper is used for the filter element. Furthermore, the dust is further removed perfectly by the edge filter which is assembled in the nozzle holder. Therefore, the world's leading Bosch type fuel injection pump works without any anxiety about troubles.

h) The lubrication system has been designed so that the iron powder and large foreign matters by removed by the oil filter with a magnetic filter which is in the crankcase. It is further filtered by the full flow type filter paper

type oil filter which houses the oil pressure regulating valve. Therefore the oil is sent to the various parts after being filtered perfectly clean. Therefore, there is hardly any wear in the moving parts.

i) The overload output restriction device (fuel restriction device) which is on the gear case and which works automatically during operation of the tractor, together with the superior structure, and special materials, produces the great durability of the engine.

5) Starts easily on snowy day

KUBOTA Z1100-A and Z 1100 engine for the L210 and L200 Tractor is equipped with an automatic fuel control device which automatically increases the amount of fuel injection automatically at the time of starting. The glow plug is adopted to help starting. These together with the unique Kubota swirl combustion chamber makes starting very easy even on very cold days such as 5° F (-15°C) below freezing.

6) Operation is very easy

KUBOTA Z 1100-A and Z 1100 engine for the L 210 and L 200 Tractor is completely enclosed and is of completely automatic lubrication system

Therefore, lubrication and regulation of oil pressure which is very troublesome is automatically done by the engine. Moreover the automatic fuel control device automatically regulates the amount of fuel injection at the time of overload so that there would be no black smoke emitting at all times. Exclusive of the one oil pipe which leads to the cylinder head, oil is passed through the oil passage which is bored in the crankcase to the various places which require oiling. Therefore infilteration of dirt into the oil passage is completely prevented.

Consequently, if clean fuel oil and high grade engine oil (Service API classification DM or DS) is used, the cooling water is checked and refilled, and the air cleaner checked; and otherwise handled as related in the operator's manual, the engine would be tough and reliable for a long time.

7) Comfortable to operate

In order to keep fatigue to a minimum and make work as comfortable as possible, the mutual balance of the two cylinders have been made perfect so that there would be a minimum of vibration. Detailed places have also been taken into consideration at the time of design so as to prevent vibration. Therefore, we believe that you will be greatly satisfied at the time of use.
Furthermore, in order to prevent obnoxious noise, Kubota's unique swirl combusion chamber system, highly efficient muffler nylon fan, and various other superior and excellent parts structure have been adopted. These make operation with a silent comfortable running noise, which makes very efficient and comfortable work possible.

2. FEATURES OF TRACTOR

1) Smart design
A new smart design which is the image of dynamic series. The color is a steady orange and blue. The style of the tractor is one of a very good worker.

2) Operating does not cause fatigue
Operating the KUBOTA L 210 Tractor does not cause fatigue. Light operating large handle, soft clutch pedal, easy to shift gears, flipping seat to keep seat from getting wet during rain and furthermore, a wide seat which can be adjusted three stages (utility patent). These are some of the features which have been taken into consideration keeping in mind the operator's point of views.
In addition to these, obnoxious noise and vibration is lower when compared to the other manufacturer's machine. Operation for a long period of time is of no matter anymore.

3) Front and rear balance considered for all work
Rotary work in dry and wet fields, plow work in dry fields, trailer pulling, all types of work has been considered in setting the suitable balance of 4:6 when without implements and 3:7 with implements. Extension

of tread makes the tractor even more stable.

4) Strength shown in muddy places --- differential lock.
If one of the wheels should slip in muddy places, or if going into or out of fields, the differential lock prevents slippage of one wheel and makes moving very easy.

5) Powerful hydraulic system to make work easy
The hydraulic pump directly connected to the engine has ample strength. It is a highly efficient Dowty pump of aluminum alloy. The control valve has been considerably improved.
Besides the lowering adjusting device and the hydraulic oil automatic return device, drop preventing device and a hydraulic PTO tap hole has been added and the tractor is perfect. Moreover the lift of the hydraulic system is a maximum of 1885 lb. (855 kg.) (at the tip of the lower link) which is the greatest in this class of tractor.

6) Convenient two accelerator system (Utility pantent)
Plowing and tilling work by the throttle close at hand and a foot accelerator when pulling trailers, etc. The system is a very convenient and a safe system. Moreover, there is an engine lever which makes idling operation very easy.

7) Front wheel and powerful brakes make turning radius small
The brakes adopted for the tractor is the same as that for the KUBOTA L 20 which had a very good reputation for being easy to adjust. This enclosed brake, wheel nut type steering make the operation of the handle very light. The turning radius is 75 in. (1.9 meter)
So it is possible to work very efficiently even in small fields.

8) The 3 point linkage is DIN category 1. The RPM's are 650 rpm and 990 rpm, or two stages, and the PTO shaft is 1 3/8", so it is possible to use a wider range of implements.

9) Decomp close at hand to assist starting in cold weather. The easy starting of the series sister machine KUBOTA L 200 which is equipped with the high combustion efficiency swirl combustion chamber and the glow plug was very good. These were adopted. Furthermore, a larger battery (equivalent to 80 Ah) was adopted to give ample capacity. A decomp device close at hand was also adopted. These make starting in cold weather an outstanding feature of the tractor.

10) Hours of use, speed of PTO shaft, engine speed, indication of winker, and charge and discharge of the battery can all be seen at a glance in the "Tractormeter".

11) The minimum clearance is high when compared to the same class tractors of the competitors, so it is possible to work very efficiently in wet paddy fields or do inter-row cultivation.

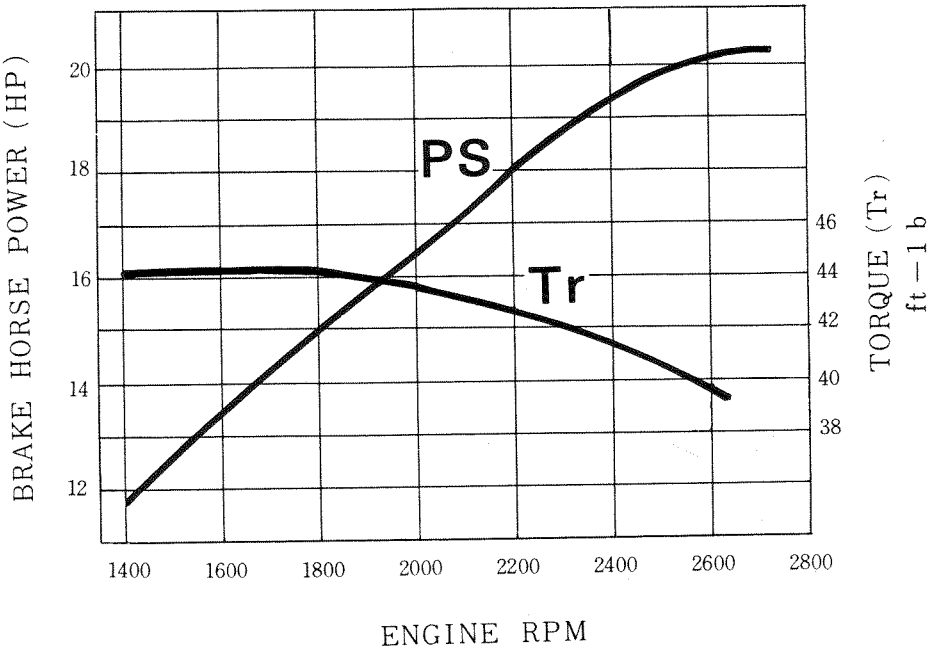
12) Axle, brake, electrical equipment, etc. which are important items are all totally enclosed. Therefore, it is possible to use the tractor for a long period of time even in the rain.

III. ENGINE

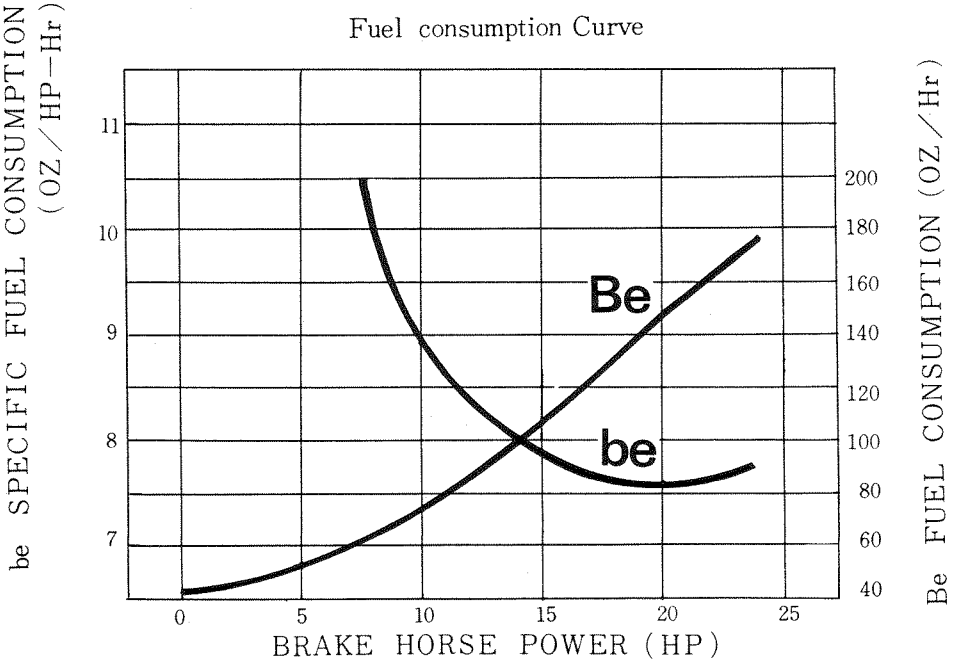
1. CHARACTERISTICS OF KUBOTA Z 1100-A ENGINE

Performance curve

(With fan, muffler, air cleauer, radiator and dynamo)



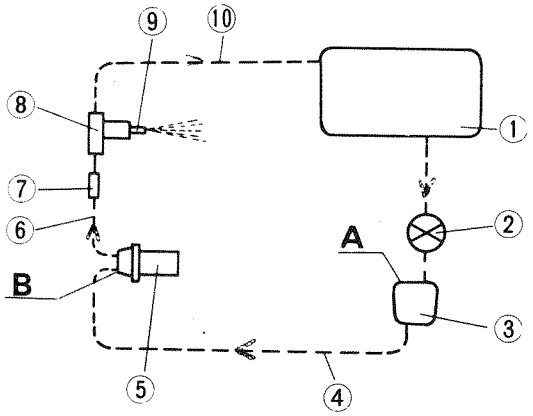
Fuel consumption Curve



2. DETAILS OF ENGINE STRUCTURE AND PRECAUTIONS IN HANDLING

(1) Fuel system

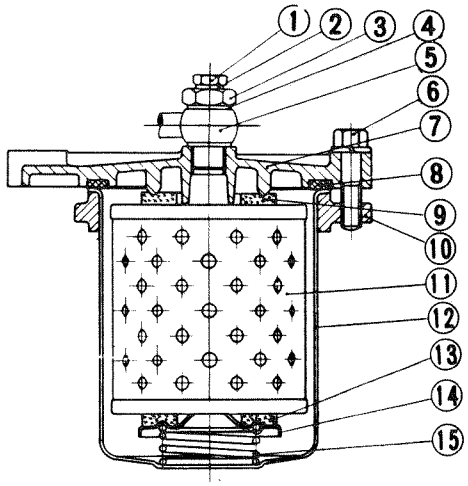
① The fuel system is shown in Fig. 1. When the engine is running, the fuel flows in the direction of the arrow. The air vent is on the top of the fuel filter (A) and on the top of the fuel injection pump (B), two places, and it is possible to vent the air completely.



1: Fuel tank
2: Fuel cock
3: Fuel filter
4: Fuel pipe
5: Fuel injection pump
6: Fuel injection piping
7: Edgefilter
8: Nozzle holder
9: Nozzle
10: Fuel overflow pipe

Fig. 1 Fuel system

② The structure of the fuel filter is as shown in Fig. 2. Disassemble after every 100 hours of operation and clean out the water or dirty matters which may have collected inside. The inside of the filter and the element should be washed after every 300 hours of operation.



1: Air vent screw
2: Packing
3: Coupling bolt
4: Packing
5: Fuel pipe
6: Clamp bolt
7: Cover
8: Cover packing
9: Packing
10: Case clamp
11: Element
12: Case
13: Packing
14: Spring retainer
15: Spring

Fig. 2 Structure of Fuel Filter

③ The fuel injection timing can be adjusted by increasing or decreasing the number of shims for the fuel injection pump.

(See Fig. 3)

That is, if one shim is increased, the crank angle is delayed about 1.5°, and if one shim is decreased the angle is quickened.

The injection timing is as indicated in Fig. 4. If the basic point on the window on the side of the clutch housing is aligned to marks 1 FI, 2 FI respectively on the side of the flywheel, the alignment is correct.

④ The fuel injection pump is contructed as shown in Fig. 5.

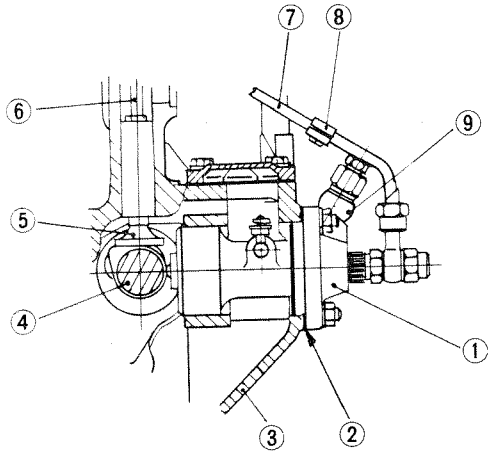


Fig. 3 Installation of Fuel Injection Pump

1: Fuel injection pump
2: Adjusting shim
3: Crankcase
4: Cam shaft
5: Tappet
6: Push rod
7: Fuel injection pipe
8: Stopper
9: Fuel pipe

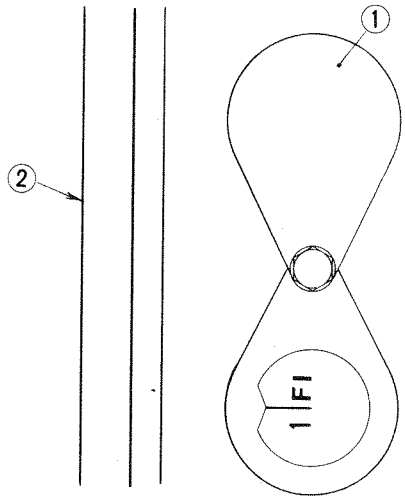


Fig. 4 Check of Injection timing

1: Housing cover (2)
2: Clutch housing installation side

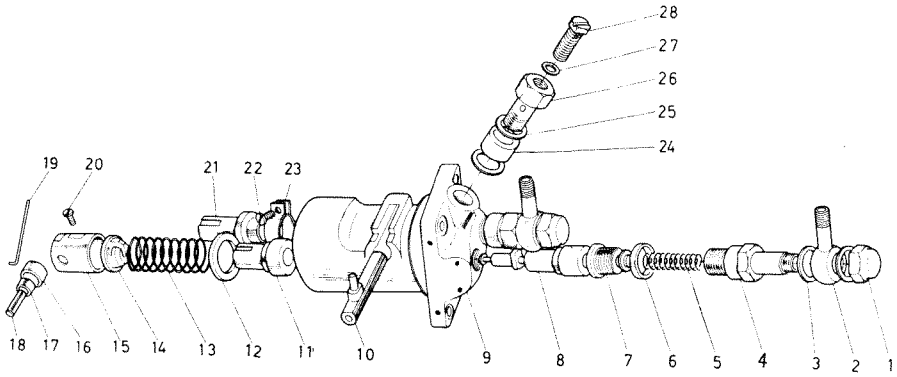


Fig. 5 Structure of Fuel Injection Pump

1: Delivery nipple nut	2: Delivery nipple	3: Nipple washer
4: Delivery valve holder	5: Delivery valve spring	6: Delivery valve gasket
7: Delivery valve comp.	8: Pump element comp.	9: Pump housing comp.
10: Control rack comp.	11: Control sleeve	12: Upper spring seat
13: Plunger spring	14: Lower spring seat	15: Tappet
16: Roller	17: Roller bushing	18: Roller pin
19: Cranp pin	20: Tappet guide pin	21: Control sleeve
22: Pin-on clamp screw	23: Control pinion	24: Fuel pipe
25: Nipple washer	26: Hollow screw	27: Washer
28: Air bleeder screw		

ⓐ Structure and Operation

This fuel injection pump is called Model PFR for two cylinder engines and is manufactured in Japan through a technical license agreement with Robert Bosch Co. of West Germany. It is the most suitable pump for the Kubota Diesel Engine. The fuel injection pump is a very precise pump and moreover, has an intimate relationship with the engine. Therefore, great care should be excercised in the handling of the pump.

The pump housing is of cast iron and maintains the various parts of the pump. It also acts as a protection for the parts.

The delivery valve is assembled in between the delivery chamber and the high pressure pipe, and is closed by the delivery valve spring. If the pressure in the delivery chamber becomes high, this valve opens but it does not allow the return flow of the fuel. Another funtion that this valve has is return suction to lower the remaining

pressure within the injection (high pressure) valve and thereby prevents the "dripping" of the nozzle.
The pump element is comprised of the cylinder and the plunger. The cylinder has the feed-hole and the plunger has the control groove. The fit of the cylinder and the plunger is very precise so handle the two parts as if one. They cannot be considered to be separate parts.
The control rack is engaged to the pinion, and the pinion and the plunger revolves together. Therefore, when the rack is moved, the plunger also moves and thereby regulates the amount of injection. It is connected to the governor housed inside of the engine and injects fuel in accordance to the load and the speed of the engine.
The tappet changes the rotating movement of the fuel cam housed inside of the engine to the reciprocating movement of the plunger. (The fuel camshaft is integral with the intake and exhaust cam).
The plunger spring always pushes down the plunger through the lower spring seat.

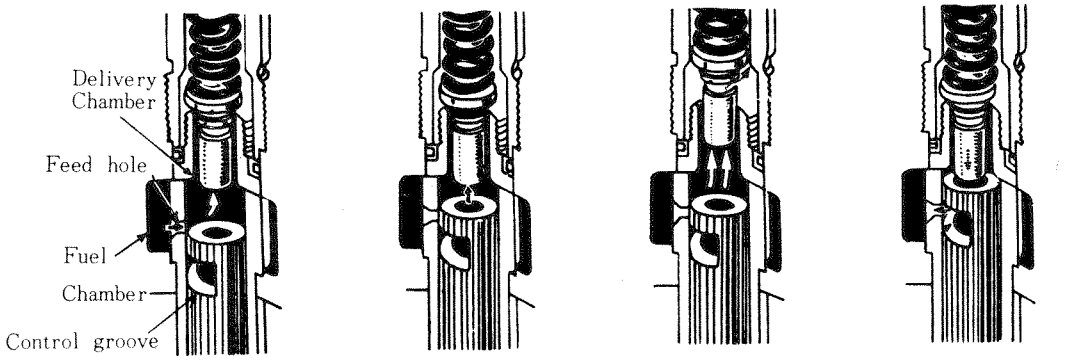
(b) Fuel conveying
The fuel from the fuel tank is filtered by the fuel filter and brought to the fuel injection pump from where it is sent under pressure by the reciprocating movement of the plunger in the following way.

(a) When the plunger is at the bottom dead center, the fuel flows into the pump cylinder from the fuel chamber through the feed hole as shown in Fig. 6 (1).

(b) The fuel cam revolves and the plunger is raised, and when the upper surface of the plunger is aligned with the top of the feed hole, it is the start of the fuel being sent under pressure (Fig. 6 (2)).
By further rising of the plunger, the fuel opens the delivery valve and is flown under pressure to the high pressure pipe and unto the nozzle. (Fig. 6 (3))

(c) The plunger is raised further. When the slanting control groove and the feed hole are aligned, as shown in Fig. 6 (4), the fuel under high pressure at the top of the plunger passes through the hole in the central part of the plunger to the control groove and is returned to the fuel chamber from the feed hole.

The pressure is reduced and completes the covering of fuel under pressure.



(1) Suction stroke

(2) Beginning of delivery

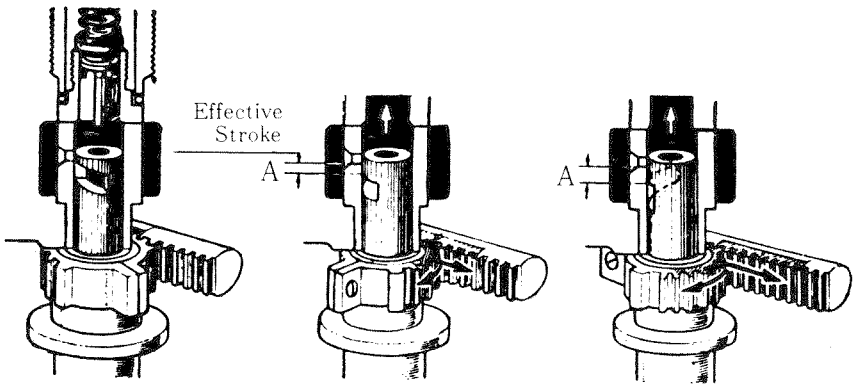
(3) Delivery stroke

(4) End of delivery

Fig. 6 Function of Plunger

ⓒ Adjustment of amount of injection

Fig. 7 shows the variation in the amount of injection at the various rotating position of the plunger.



(1) No injection (2) Medium injection (3) Maximum injection

Fig. 7 Adjustment of amount of injection

(a) Before the feed hole is closed by the upper surface of the plunger, it comes into alignment with the control groove so the fuel oil is not under pressure. The amount of injection becomes "0".

(b) Next, when the plunger is turned in the direction of the arrow, it is possible to attain an effective stroke of A before the feed hole and the control groove are aligned. This means that that much fuel would be injected.

(c) If the plunger is moved further to position (3), the amount of injection would be maximum. In other words the condition would be where the effective stroke would be maximum.

ⓓ Effective stroke

The effective stroke is the distance the plunger moves upwards from the time the upper surface of the plunger closes the feed hole and the control groove comes into alignment with the feed hole. Therefore, the effective stroke is varied by the rotation of the plunger. The result is that the amount of fuel injection is in proportion to the effective stroke.

The teeth of the control rack is engaged to the pinion, and the pinion is tightened to the control sleeve which can move freely around the outer circumference of the cylinder. The driving face at the bottom of the plunger is in the lower part of the control sleeve and by moving the control rack forwards or backwards, rotates the plunger, which would vary the amount of injection.

The above related adjustment of amount of fuel injection is all carried out automatically to suit the condition of load and speed of revolution by the connection of the governer mechanism housed in the engine and the control rack of the fuel injection pump.

5 The structure of the nozzle holder is as shown in Fig. 8

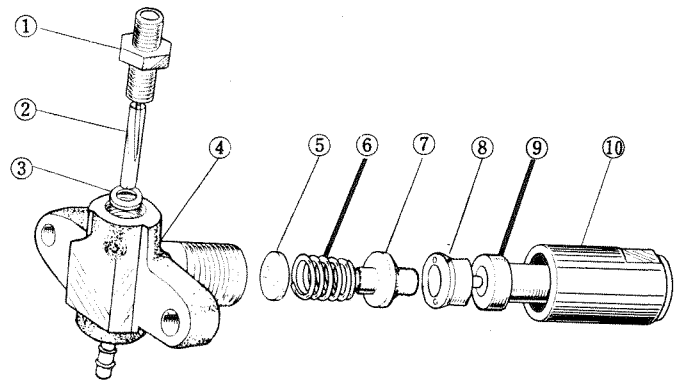


Fig. 8 Construction of Nozzle Holder

1: Connecting pipe
2: Bar filter
3: Packing
4: Nozzle holder body
5: Adjusting washer
6: Pressure spring
7: Pressure pin
8: Distance piece
9: Nozzle (N-DN 12 SD 12)
10: Retaining cap

A bar filter is assembled into the nozzle holder and removes small dirt so the protection of the fuel system is perfect. But, the nozzle piece is finished precisely as is the fuel injection pump so great care must be given to not get it dirty at the time of handling.

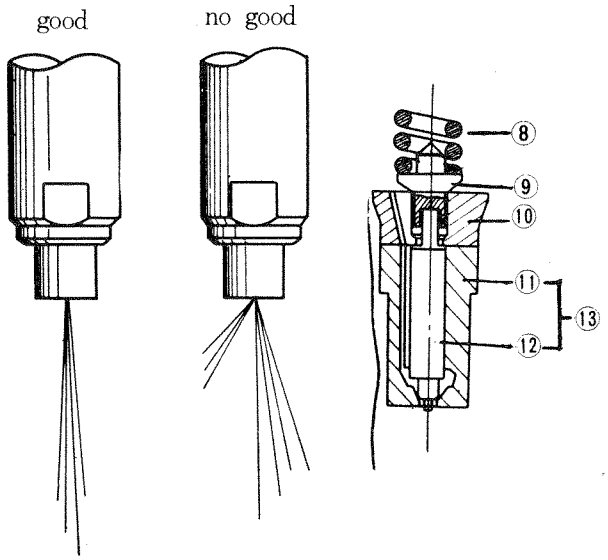
It is possible to adjust the injection pressure by the shim inside of the nozzle holder. There is hardly any need of adjusting the injection pressure but if there should be a neceesity, insert shim between 4 and 5 in Fig. 8.

A shim with a thickness of 0.00394 in. (0.1 mm) would raise the pressure approximately 142.2 p.s.i. (10 kg/cm^2)

⑥ The injection pressure is 1990.8 p.s.i. (140 kg/cm^2).

Check the injection pressure and the state of atomization with the nozzle tester.

This is shown in Fig. 9. At the time of checking the condition of atomization by attaching the nozzle holder to the



8 Pressure spring
9 Pressure pin
10 Distance piece
11 Nozzle body
12 Needle valve
13 Nozzle piece

Fig. 9 Check of nozzle

Notes: At time of assembling pressure pin 9 do not mistake the top for the bottom.

tip of the injection pipe and injecting into the air, loosen the cap out of the injection pipe of the other cylinder and remove the nozzle holder. (This prevents the engine from starting.) Then set the accelerator lever to the position of maximum revolution.
When fuel is injected, if the needle valve is working correctly, it would develop a high shrill sound.
If this high shrill sound cannot be heard and the fuel is not atomized but flows out or even if atomized, the atomization is not perfect, refer to section on "injection nozzle" in Maintenance Reference Chart in IV 11 (1).

Notes:

ⓐ Disassembly and assembly of nozzle piece should be done very carefully in clean fuel oil.

ⓑ At the time of replacing nozzle piece, do not separate and replace nozzle body and needle valve as units but always replace as complete units.

ⓒ If the atom injected from the nozzle should penetrate into the fingers or the hand, it would damage the structure. If it should inter into the blood stream, there is the fears of blood poisoning. Be careful not to come into contact with the injection.

ⓓ Always tighten the retaining nut with a tightening torque of 43.4 to 57.8 ft-lb (6 to 8 m-kg). If the nut should be tightened more than this, the operation of the needle valve would become heavy, and the injection performance would be bad.

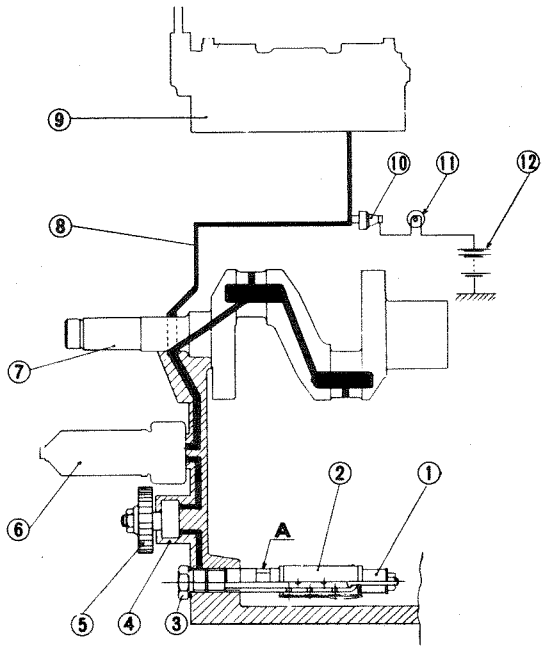
(2) Lubrication system

1 The lubrication system is as shown in Fig. 10.

a A magnetic filter is equipped to the top of the oil filter and removes iron particles, etc. This prevents wear of the various parts.
At the time of exchanging oil, clean the inside of the crankcase and be sure to remove the oil filter (1).

Clean the filter together with the magnetic filter. After removing all the used oil inside of the crankcase, wipe out all the oil that may be remaining. Then fill with new engine oil up to the specified oil level.

* The oil filter (1) can be removed by using #19 wrench on the hexagon part. At the time of assembly, screw in to the end of the thread.



1: Magnetic filter
2: Oil filter (1)
3: Plug
4: Oil pump
5: Oil pump drive gear
6: Oil filter (2)
7: Crankshaft
8: Oil pipe
9: Cylinder head
10: Oil switch
11: Pilot lamp
12: Battery

Fig. 10 Lubrication system

(b) The oil which has passed through oil filter (1) is pumped up by the gear pump and sent to oil filter (2). Here it passes through a high quality paper filter and is filtered still further. The oil is regulated to a pressure of 64 p.s.i. (4.5 kg/cm^2) by the regulating valve inside of the oil filter (2), and a part is sent through the crankshaft to lubricate the crankpin metal. Another part is sent to the rocker arm shaft by oil pipes to lubricate parts related to the rocker arm. On the other hand, splashing of oil by the crankshaft rotation lubricates various moving parts such as the crank bearing, cam bearing, cylinder liner, etc.

ⓒ The oil switch is equipped to the oil pipe on the head side coupling and watches the oil pressure. That is, if the oil pressure should drop lower than 21.3 p.s.i. (1.5 kg/cm^2), the pilot lamp of the dash board lights up and informs of the danger.
If the pilot lamp should not go out when the engine is at normal working speed, be sure to check for the cause and make necessary repairs for the low oil pressure.

Causes of Oil pressure decrease

(a) The various bearings in the lubrication system has a clearance over the limits for the bearing.

(b) Check to see if the rocker arm bracket has been attached firmly. Oil may be leaking from the connections and may be causing a lowering of the oil preasure.

(c) Check to see if the function of the pressure regulating valve, complete, is correct. The operating pressure may be too low.
If the function of the valve should be poor, operate the valve in light oil and check to see if it works lightly. Then equip the valve exactly as it should be.
The working pressure is adjusted by increasing or decreasing the number of packings 15 shown in Fig. 11.
When making this adjustment, be sure to use an oil pressure gauge and adjust to the specified pressure.

② Structure of oil filter (2) is as shown in Fig. 11

ⓐ Replace element with new element every other time the engine oil is replaced. (that is, after every 150 hours of operation.)

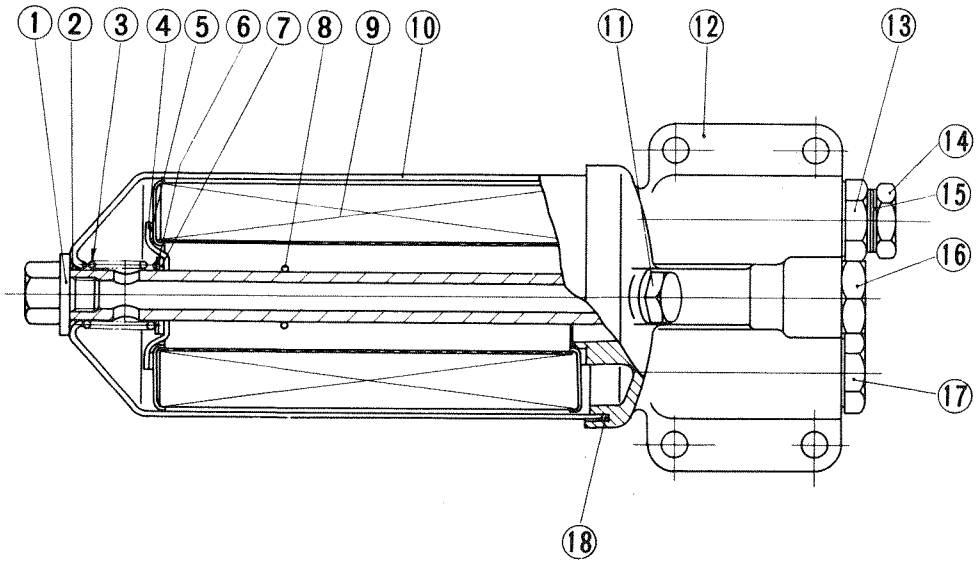
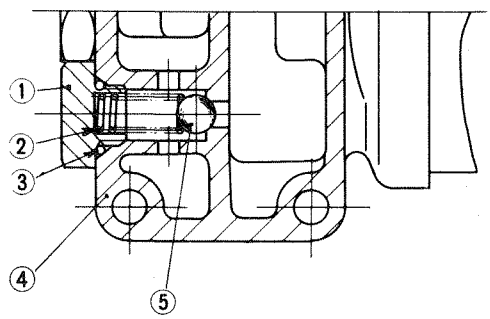


Fig. 11 Structure of Oil Filter (2)

1: Center pipe
2: "O" ring A
3: Spring
4: Washer, large
5: Packing
6: Washer, small
7: Felt packing
8: Circlip
9: Element
10: Body
11: Plug, small (M10, P 1.5)
12: Cover
13: Pressure regulating valve, comp.
14: Pressure regulating valve bolt
15: Packing
16: Plug, large
17: Relief valve, comp.
18: "O" ring

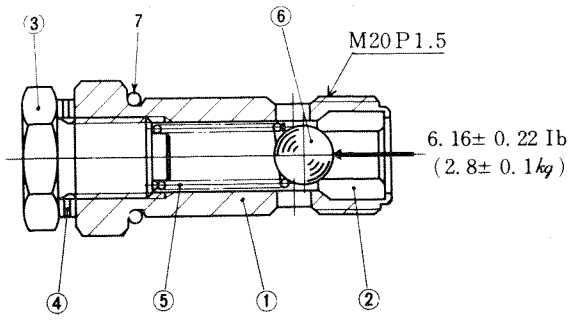
ⓑ Disassembly and assembly should be according to Fig. 11 and should be done accurately.

ⓒ There is no necessity of disassembling into detailed parts but if it should become specially dirty, remove the relief valve complete and the pressure regulating valve complete, being very careful not to damage it. After washing completely, replace as before. (See Fig. 12 and Fig. 13)



1: Relief valve body
2: Relief valve spring
3: "O" ring
4: Oil filter (2) cover
5: Relief valve

Fig. 12 Relief valve, complete



1: Pressure regulating valve body
2: Valve seat
3: Bolt
4: Packing
5: Valve spring
6: Steel ball
7: O Ring

Fig. 13 Pressure Regulating Valve

ⓓ When the oil filter (2) has been removed and assembled to the engine, and the engine were to be started, the oil level in the engine would drop. Therefore, run the engine for a little while so as to see if the various parts are normal and the oil pressure is of the specified pressure. Then stop the engine and fill oil up to the upper mark before starting work.
(The amount of oil equivalent to that which would enter into oil filter (2) would be the amount the oil level would drop.)

③ The engine oil should be replaced with new engine oil after the first 35 hours of operation and thereafter after every 75 hours of operation. Be sure not to overlook this precaution.

How to exchange engine oil:

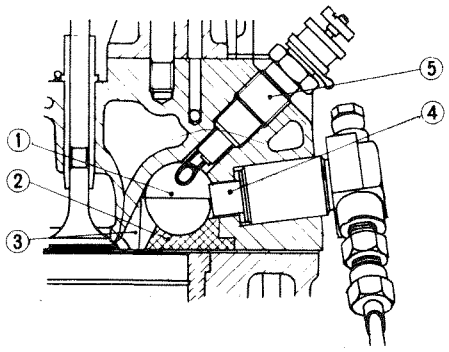
ⓐ Drain out the engine oil while the engine is still warm. (Then it would be possible to drain out all the oil.)

ⓑ After draining the engine oil, be sure to clean the inside of the crankcase and the oil filter (1).

4) When changing the brand of oil, drain out the used oil even if the time for exchanging oil has not arrived. Also be sure to clean the oil filter and the interior of the crankcase before changing to a different brand. (Do not mix two different brands of oil.)

(3) Combustion system

① The combustion chamber adopted for this engine is the unique Kubota swirl combustion chamber (Fig. 14) which has an improved performance over the conventional ones. The mixture of the fuel and the air is performed effectively and the use of the air after ignition is very high, so the ratio of fuel consumption is very low. Moreover, it is provided with the best injection condition of fuel and a glow plug has been incorporated, This makes starting features excellent. The engine is capable of starting even in 5° F temperature.



1: Swirl combustion chamber
2: Combusion chamber
3: Injection hole
4: Fuel injection nozzle
5: Glow plug

Fig. 14 Structure of Combustion Chamber

② The part which has the role of sending in the necessary air for combustion of fuel at the right time are the valve timing and air cleaner.

ⓐ The valves must be assembled in correct manner to the cylinder head as shown in Fig. 15. The standard dimensions of the valve and valve guide are as of the figures in Fig. 16. At the time of exchange of the valve guide, the inner dimensions must always be reamer finished to $0.3543 \, {}^{+0.00059}_{0}$ in. (9ϕ H7 $^{+0.015}_{0}$) 58.5 as shown in Fig. 16.

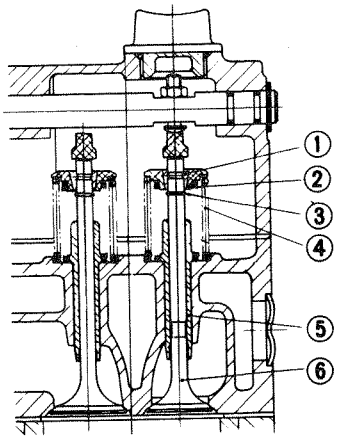


Fig. 15 Longitudinal crosssection of valve

1: Valve stopper
2: Valve spring retainer
3: Circlip
4: Valve spring
5: Valve guide
6: Valve

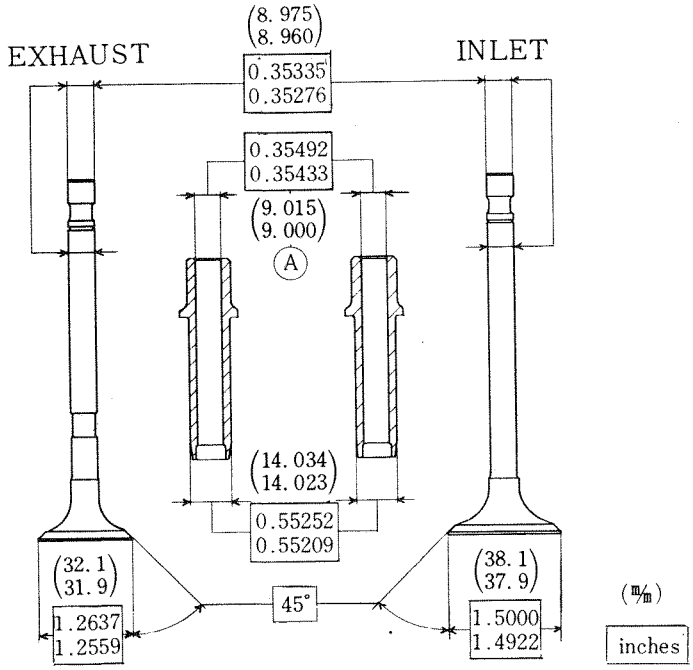
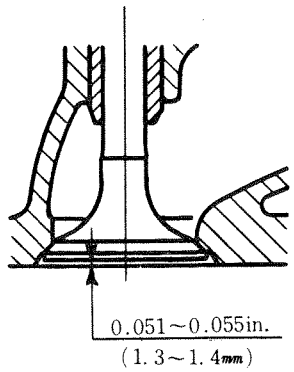


Fig. 16 Standard dimensions of valve and Valve Guide

A: designates dimensions after insertion into cylinder head



The sinking of the valve from the surface of the head should be 0.051 to 0.055 in. (1.3-1.4mm) as shown in Fig. 17. Check the dimension. If the dimension should be smaller than the specified dimensions, the valve would hit the top of the piston and may cause great damages.

Fig. 17 Sinking of valve

ⓑ If the valve timing is adjusted to 0.008 to 0.010 in. (0.2 to 0.25 mm) when the engine is cold, as shown in Fig. 18, the figures would be as shown in the following chart.

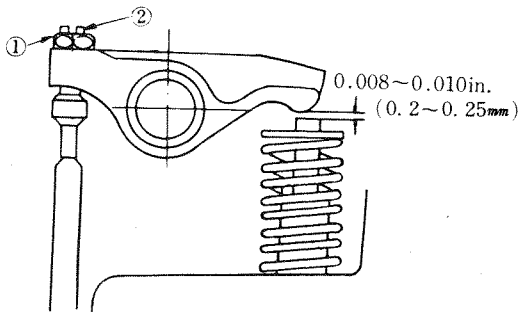


Fig. 18 Valve Clearance

Item	Designed Figure
Inlet valve open	TC - 20°
Inlet valve close	BC + 45°
Exhaust valve open	BC - 50°
Exhaust valve close	TC + 15°

Adjust valve clearance to 0.008 to 0.010in. (0.2 to 0.25mm when engine is in cold state.

Loosen adjusting nut 1 and adjust to 0.008 + 0.010 in. (0.2 to 0.25 mm) at top of adjusting bolt 2 . After making adjustment, tighten nut 1 securely.

(Way to adjust)

Adjust by the thickness gauge with the respective cam in the compression top position when they are not functioning.

ⓒ The rocker arms should be assembled in the correct way as shown in Fig. 19.

ⓓ The decomp system should be assembled in the cor rect way as shown in Fig. 20. The illustration shows the position of "Operation". If the knob 1 was to be moved to the position of decomp, then the lever, decomp lever 6 , would come to the position of decom-pression. Check to see if the device is working properly and that it comes to the position of decompression.

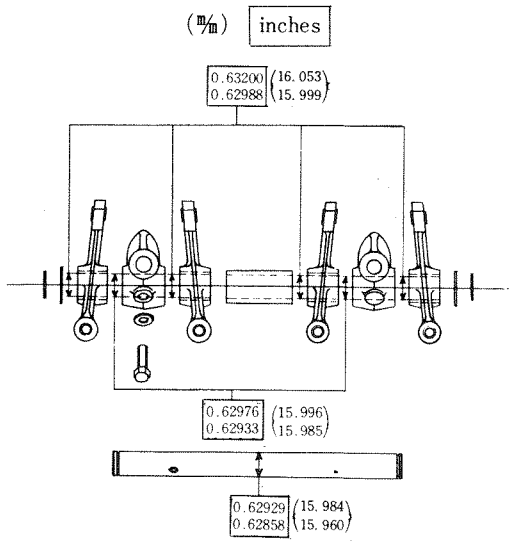


Fig. 19 Standard Rocker Arm Dimensions

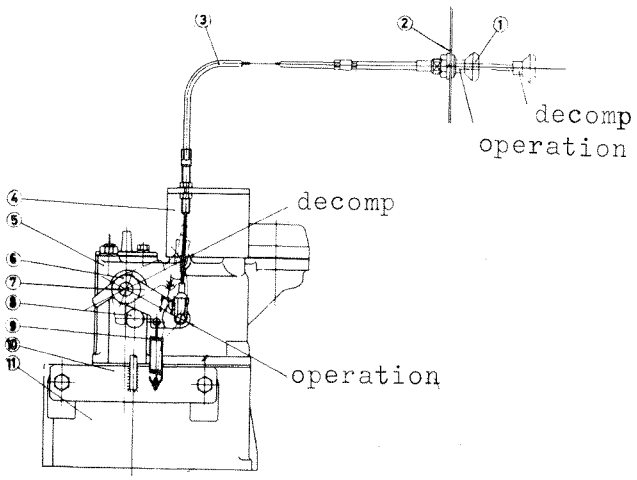


Fig. 20 Decomp Device

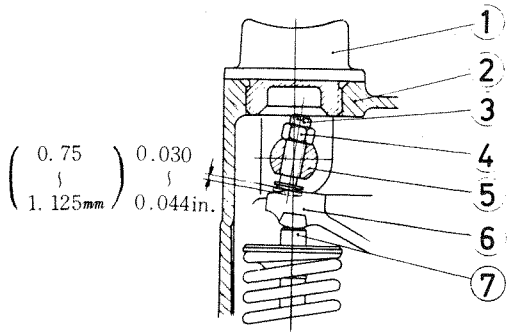
1: Knob
2: Panel
3: Decomp wire
4: Decomp wire stay
5: Cylinder head cover
6: Decomp lever
7: Decomp shaft
8: Stopper
9: Return spring
10: Radiator stay

Precautions:

Do not operate the decomp when the engine is running at high speed. If it should be necessary to operate the decomp, be sure to set the engine to "idling".

ⓔ How to adjust decomp clearance

As shown in Fig. 21, set the exhaust valve in the completely closed condition and set the decomp adjusting bolt ③ to the valve clearance 0 position shown in the figure by thick lines. When the decomp adjusting bolt ③ is screwed



1: Oil supply port cover
2: Cylinder head cover
3: Decomp adjusting nut
4: Locknut
5: Decomp pinion
6: Rocker arm
7: Valve stem

Fig. 21 Adjustment of Decomp Clearance

in 1 to 1.5 times, the decomp clearance would be 0.030 to 0.044 in. (0.75 to 1.125 mm) as shown by the dotted lines.

After making the adjustament of the decomp clearance, be sure to tighten the locknut (4) securely.

This adjustment is made for the first and second cylinder through the oil supply port cover (1) and the decomp adjusting access door oover respectively.

* It should be added that after completion of adjustment above mentioned, turn the crankshaft by hand to check to see if the valve and the piston are not hitting each other because the decomp clearance is too great at the position of decomp.

3) The top clearance should be 0.035 to 0.043 in. (0.9 to 1.1 mm. Use cylinder gasket shim (thickness 0.008 in (0.2mm)) and make the adjustment. To check the measurement of the top clearance, tighten the cylinder head securely in the order shown in next section.

The measurement should be taken by a fuse.

The cylinder gasket shim should be inserted on the head side. The protrusion allowance of the top surface of the liner above the cylinder frame is 0.008 to 0.011 in. (0.20 to 0.27 mm)as shown in Fig. 22. If the liner should be in excess of this figure, it may become the cause of troubles.

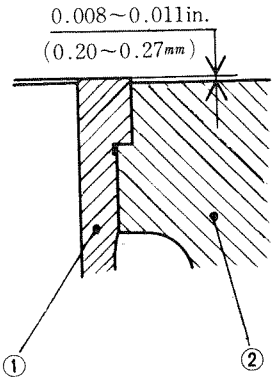


Fig. 22 Protrusion of Cylinder Liner

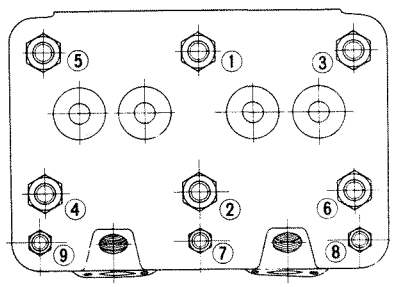


Fig. 23 Order of tightening Cyliner Head

1: Cylinder liner	1 -	Head nut (2)
2: Crankcase	2 - 6	Head nut (1)
	7 - 9	Head nut (3)

④ Tightening of cylinder head

ⓐ The tightening torque of the cylinder head nut are as follows:

Nut (1) and (2)	148 - 155 ft-lb. (20.5 - 21.5 m-kg.)
Nut (3)	36 - 43.5 ft-lb. (5 - 6 m-kg.)

Do not forget to use a washer for nut (3).

ⓑ At the time of tightening the cylinder head nuts, be sure to tighten the nuts unformily. To do this, tighten the nuts in the order of 1 2 3 .... 6 a little at a time very carefully. At the end tighten nuts 7 8 9 securely. (Refer to Fig. 23)

ⓒ It is necessary to retighten if the tractor is to be used for a long period of time. After retightening the bolts, be sure to adjust the valves to the correct clearance as related in previous section.

ⓓ If the sylinder gasket has been exchanged for new gaskets, check the top clearance as related above. After working for one or two hours, be sure to retighten. Make correct adjustments of the valve clearance as related above.

⑤ The structure of the air cleaner is an shown in Fig. 24 The air cleaner has the important role of sending clean air into the engine. This air cleaner is a combination cyclone and oil bath type of air cleaner. The air velocity sucked into the engine is increased without increasing the intake resistance and makes the cleaning efficiency excellent. It has furthermore been designed so that the cleaning efficiency would be excellent not

only for high speed but also for slow speed.

As illustrated in Fig. 24, large dust and dirt in the air is first filtered in the cyclone (2) which is in the upper part and then again filtered by the oil pan (5) which is in the lower part by shaking. Furthermore, small dust and dirt are filtered by the filter netting assembly (4). Oil should be filled until it reaches the lower line of the "oil level line".

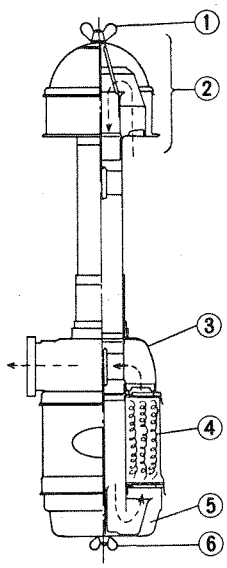


Fig. 24 Structure of Air Cleaner

1: Center bolt (1)
2: Cyclone
3: Air cleaner cover
4: Filter netting
5: Oil pan
6: Center bolt (2)

Be careful not to fill above the shoulders of the line.

At the time of filling oil, wait until the oil stuck to the element (inside of the filter netting assembly (4)) has returned back to the oil pan (which takes about 15 minutes after stopping the engine), and then check the oil level. If it should be short, refill.

The oil in the oil pan should be checked ordinarily after every 20 hours of operation, and exchanged after every 50 hours of use. At such times clean the filter netting assembly (4) and the oil pan.

* Do not use gasoline for washing.
* After washing, shake well to dry off the gasoline and then assemble.

In especially dirty places, check every day and clean a

little earlier than usual.
Another precaution is to check the packing on the flange of the filter netting assembly, etc. to see whether they have been damaged. If they should be torn or peeled, there will be a hole through which unfiltered air would pass into the engine. Therefore check these packings carefully.

(4) **Governor** system

ⓐ The governor is a ball governor which is equipped to the inside of the cam gear on the end of the chamshaft and is of the same structure to which you are accustomed to from long ago. (See Fig. 25.)

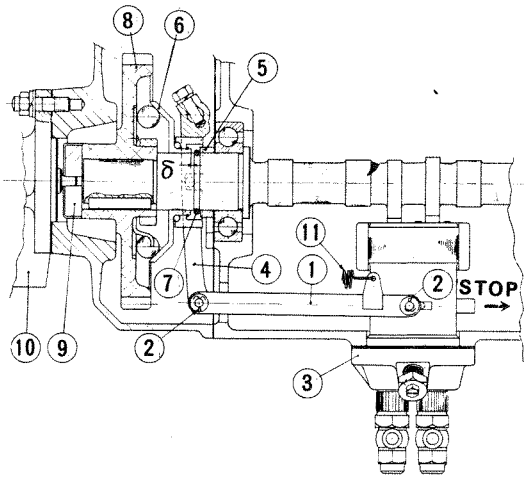


Fig. 25 Structure of governor

1: Governor link
2: Cotter pin
3: Fuel injection pump
4: Fork lever
5: Camshaft bushing
6: Governor sleeve
7: Camshaft stopper ring
8: Cam gear
9: Oldham coupling
10: Hydraulic pump
11: Governor spring

ⓑ The adjustment of the fuel pump rack and the governor link should be performed in the following manner.
In Fig. 25, move the fork lever in the direction of the "O" position of the fuel pump rack (in the direction

of the arrow mark) until it would not move anymore. Then select the governor link so that the clearance δ (see Fig. 25) between the governor sleeve and the camshaft stopper ring would be 0.020 to 0.039 in. (0.5 to 1 mm.)

Code No.	Name of Part	Total Length
15103-56361	Governor link 1	5.28 in. (134 mm.)
15103-56351	Governor link 2	5.355 in. (136 mm.)
15103-56551	Governor link 3	5.43 in. (138 mm.)

© The automatic fuel control device is equipped to the gear housing. (Fig. 26)

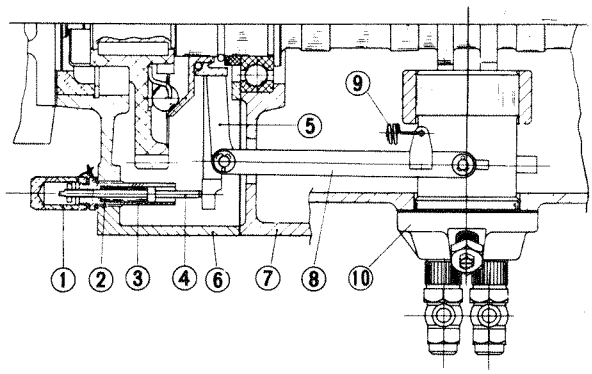


Fig. 26 Automatic fuel control device

1: Fuel control cap nut
2: Fuel control spring
3: Fuel control device body
4: Fuel control device pushrod
5: Fork lever
6: Gear housing
7: Crankcase
8: Governor link
9: Governor spring
10: Fuel injection pump

This device is of the same structure as that used for KUBOTA E 650 B Engine on KUBOTA L 13 Tractor, KUBOTA UL Engine on KUBOTA L 15 Tractor and KUBOTA Z 1000 Engine on KUBOTA L 20 Tractor.

This device has the role of properly controlling the amount of fuel injection.

That is, at the time of starting the engine, the amount of fuel injection is increased and supplies the necessary amount of fuel for starting. Moreover, during operation and running of the tractor, it prevents the black exhaust at the time of overload and restricts the output.
The outline of this function is illustrated in Fig. 27.

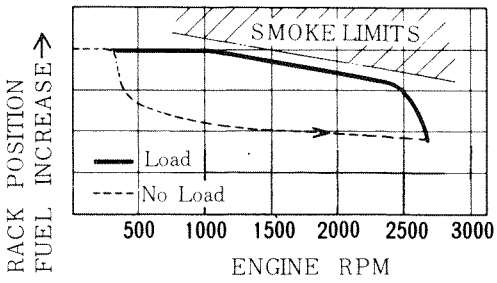


Fig. 27 Function of Automatic Fuel Control Device

(Explanation of function)
At the time when the engine speed is "0", that is at the time the engine is started, the position of the rack is near maximum amount of injection. As soon as the engine starts, the speed of the engine is increased. For instance, if the throttle or the speed accelerator lever has been set so that the revolution would rise to 2700 rpm. Then the position of the rack would drop from the initial position to the place where it would stabilise at 2700 rpm without load.
When the controlled maximum load is added to the various speed, the position of the rack would pass through the thick lines shown in Fig. 27. It has been designed so that the position of the rack would not fall on the limits of exhaust smoke. As a result, even at the time of of maximum load, working with black smoke can be avoided. In other words, it means that the overload on the engine can be avoided.
Again, on the other hand, if there should be a very heavy overload and the speed of the engine should drop gradually, the amount of fuel injection would

be increased by the automatic fuel control device and increase the torque. This prevents the engine from stopping of stalling. In such a case like this there may be a little black smoke emitted but as the speed of revolution is increased, the engine will return to the former condition.

(5) Main moving parts

① The piston and the piston ring is arranged as shown in Fig. 28.

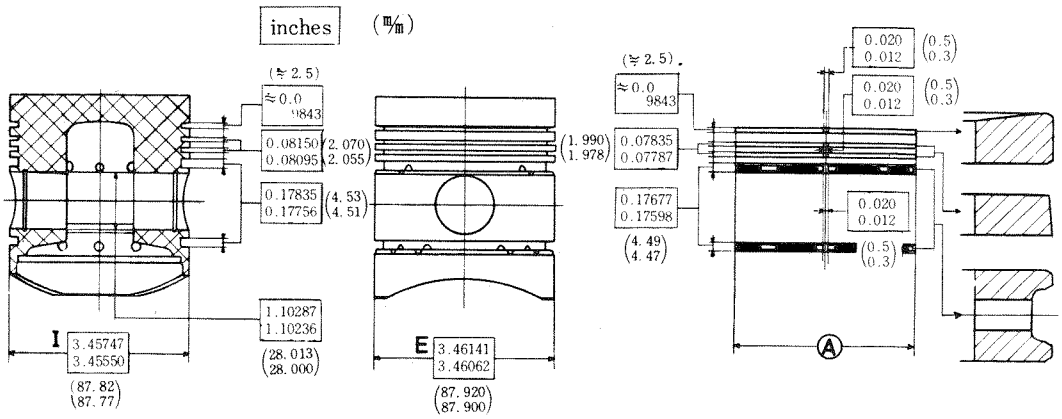


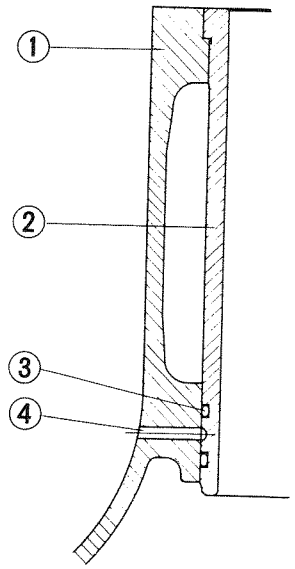
Fig. 28 Standard dimensions of piston and piston ring

A: The ring gap when ring is inserted into standard liner.
E: Piston skirt dimension when at right angles to pision pin.
I: Piston skirt dimensions in direction of piston pin.

Considering thermal expansion and other things, the most suitable aluminum alloy casting, Low-Ex material, has been used for the piston. The sides have been cam taper finished, so that the piston would be perfectly round because of combustion heat during operation. Therefore the fit between the piston and the piston liner is very good.

The piston ring is air-tight, has better wear-resistance and has been made to become accustomed by the keystone type chromium plated ring and the taper faced ring. The other respective rings have ferox coating.

② The cylinder liner is of boron iron casting which excells in being wear-resistant than the ordinary iron alloy casting which is used for the liners. Moreover, the finishing for the inside of the liner is by honing so it will show its features from the beginning and the performance would not deteriorate during use.
As shown in Fig. 29, the liner ② is inserted into crankcase ① , and prevents the leakage or mixture of cooling water and oil by the two "O" rings ③ which are at the bottom.
If there should be a necessity to exchange the liner because of troubles, be sure to exchange the "O" ring ③.
If there should be a scratch or defects, the "O" ring would not be able to perform its purpose.
Then, water or oil will come out from the escape hole ④ which is on the side of the crankcase. In other words, if water or oil should appear from the escape hole ④ , it means that the "O" ring ③ is damaged and is the cause.



F.g 29 Cylinder liner

1: Crankcase
2: Cylinder liner
3: "O" ring
4: Escape hole

Therefore, there is a necessity to replace the "O" ring with new ones.
It should be added that if the cylinder liner is replaced great attention should be paid to the protrusion of the cylinder liner shown in Fig. 22.

③ The piston pin has been heat-treated by cementation and the inside as well as the outside has been super-finished so the durability is absolutely superior.

④ The crankshaft is of special alloy steel and is precisely forged. It has been heat-treated by tempering and the crankpin part has been treated by high frequency heat-treatment. Therefore it is wear-resistant.

Fig. 30 shows the standard dimensions of the crankshaft and the arrangement of the bearings. Since high quality taper roller bearings are used for the crankshaft bearing, they are nearly semi-permanent.

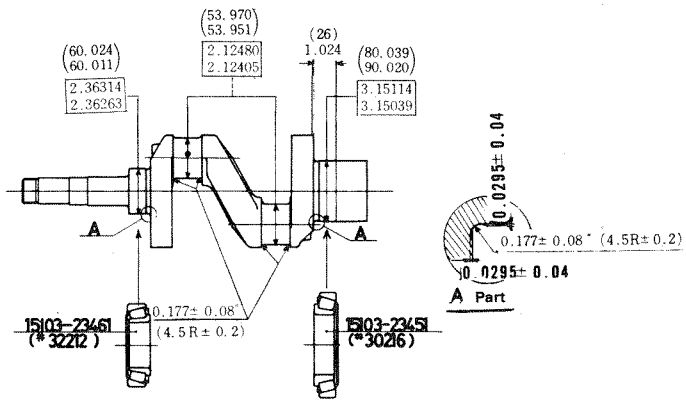


Fig. 30 Crankshaft

Standard dimensions and bearing arrangement

Make adjustments with the main bearing cover adjusting shim on the flywheel side so that the side clearance of the crankshaft is 0.0039 in. to 0.0079 in. (0.1 to 0.2 mm.)

There are three kinds of shims with thickness of 0.0039 in. 0.0079 in. (0.1, 0.2) and 0.0197 in. (0.5 mm.) so select the most suitable one and adjust to the correct clearance.

⑤ Tri-metal which are very reliable in performance and durability have been used for the crankpin metal.

Fig. 31 shows the standard dimensions of the metal on the large and small end of the rod. The piston pin and the bushing are interchangeable with that of the KUBOTA D 1500 Engine of KUBOTA L 27 Tractor and the rod and the crankpin metal are interchangeable with that of KUBOTA Z 1000 Engine of the KUBOTA L 20 Tractor.

That is, the divided surface of the large and of the rod is the same as that of KUBOTA Z1000 Engine of KUBOTA L 20 Tractor and is a serration joint.

This has been machined in a precise manner as in high

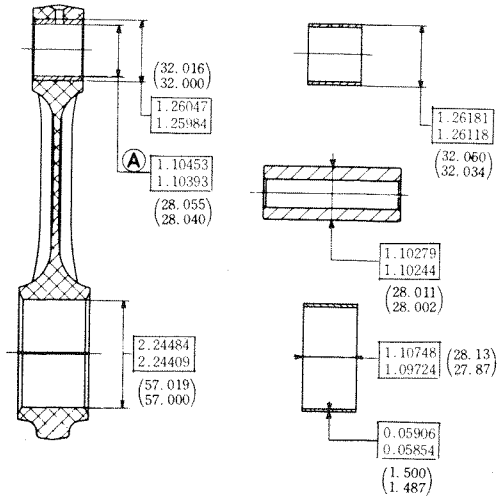


Fig. 31
Standard dimension of large and small end metal of rod

A: Finished dimension after inserting into small end

class automobile so at the time of assembly of the large end of the rod, the following precautions should be observed.

ⓐ Clean the serrated part well so that there would be no dirt or dust stuck to it.

ⓑ Lubricate the whole rod bolt with engine oil, tighten uniformily with a tightening torque of 43.5 to 47 ft-lb. (6 to 6.5 m-kg.), and be sure to bend the lock washer well. It should be added that at the time of assembly care should be paid so that the assembly mark of the large end stem and the cap would be in the same direction and the respective sides must be correctly in the same plane.

⑥ If the engine is used for a long period of time the crankpin should become so worn that it is not possible to use the standard metal, use the undersize metal.
When using the undersized metal, be sure to observe the following precautions.
(This precaution also applies in the case of other models.)

ⓐ Machine the corner R of the crankpin correctly to 0.177 ± 0.08 in (4.5 ± 0.2).

(Refer to Fig. 32) After machining, correct the dimensions of the grindstone so that there would not be any steps and then grind. If this grinding is done carelessly, it may cause serious troubles.

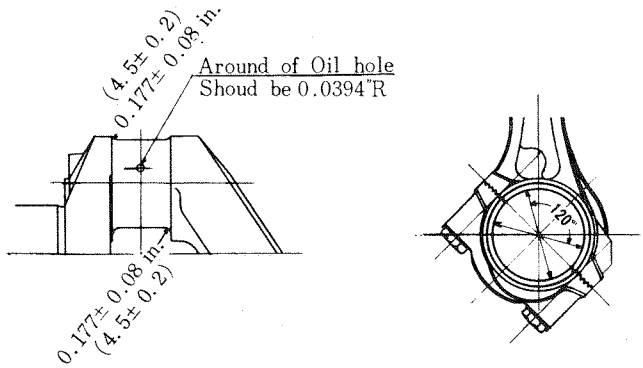
ⓑ After grinding the crankpin, be sure to round off the circumference of the oil hole with an oilstone so that it would be 0.0394 in (1 R). (Refere to Fig. 32) If this machining is neglected, an oil film would not form on this part and the metal would become overheated.

ⓒ The finish of the surfaces of the crankpin parts should always be a super-finish of $\overset{0.8\text{-}S}{\nabla\nabla\nabla}$

ⓓ The combination of the undersized metal and the crankpin

Size in. (mm)	Code No.	Name of Parts	Crankpin Dia D in. (mm)	Metal Mark	Oil Clearance
0.00984 (0.25)	15103-22541	Crankpin metal 025 Minus	$2.11614^{-0.00118}_{-0.00193}$ ($53.75\phi ft^{-0.030}_{-0.049}$)	025 US	0.00118 to 0.00370
0.01969 (0.50)	15103-22551	Crankpin metal 050 Minus	$2.10630^{-0.00118}_{-0.00193}$ ($53.5\phi ft^{-0.030}_{-0.049}$)	050 US	(0.03 to 0.094)

ⓔ When measuring the oil clearance, lubricate the whole rod bolt with engine oil, tighten to the specified torque of



Crankpin for undersized metal

Fig. 32 Measurement of crankpin and crankpin metal inner diameter

43.5 to 47 ft-lb (6 to 6.5 m-kg.) and as illustrated in Fig. 32, measure the inner diameter of the crankpin metal between the angle of 120°. Find the difference between it and the crankpin diameter. Be careful because it is impossible to find the correct oil clearance near the cut surface of the crankpin metal.

(6) Main integral parts

① Be sure to align the assembly marks of the various gears correctly as illustrated in Fig. 33.

② The crank gear and the cam gear should be heated to about 176°F (80°C) and inserted into the crankshaft and the camshaft. In this case if the shrinkage should be much and there are fears that the shaft would be damaged, lower the temperature much more and make soft before inserting.

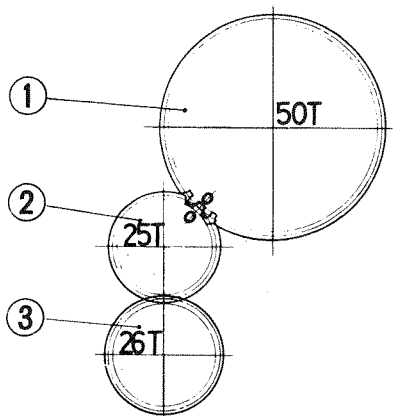


Fig. 33 Assembly mark of gears

1: Cam gear
2: Crank gear
3: Oil pump drive gear

Item	Fit
Fit of crank gear and crank shaft	Clearance 0.0009lin (0.023) Allowance 0.0007lin(0.018)
Fit of cam gear and cam shaft	Allowance 0.00087in (0.022) - 0.00189in (0.048)

③ The structure of the camshaft part is as shown in Fig. 34. As illustrated in the figure, the governor mechanism and the various bearings should be assembled correctly and precisely and then assembled in the crankcase. When doing this, be sure to insert both the intake and exhaust tappet beforehand.

When the camshaft is assembled be sure to tighten the bearing retainer, bend the lock washer and thereby prevent the loosening of the bolt.

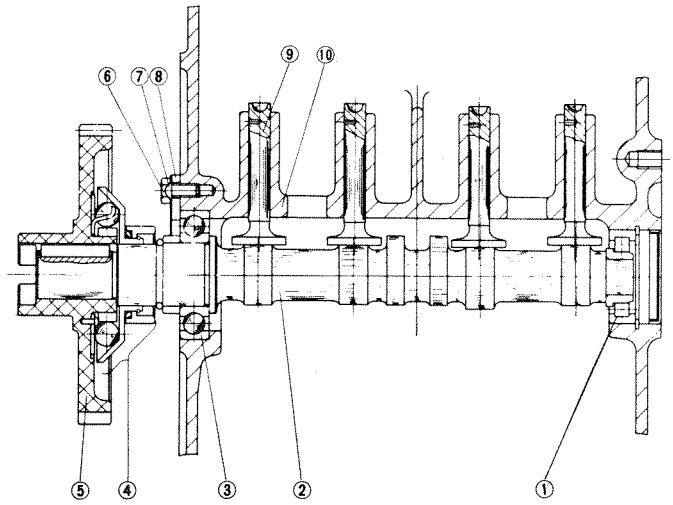
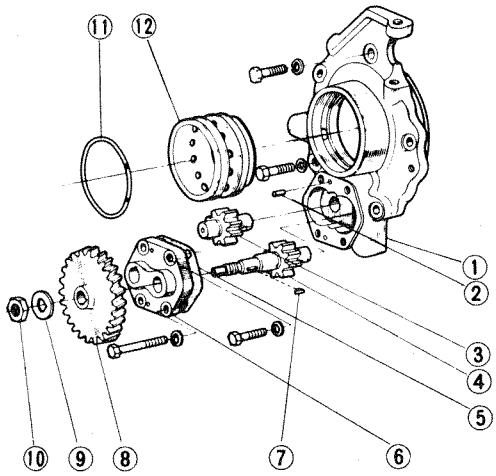


Fig. 34 Structure of camshaft

1: Camshaft bearing wheel side (NT 304)
2: Camshaft
3: Camshaft bearing gear side (#6207 C 3)
4: Governor mechanism
5: Cam gear
6: Bolt
7: Lock washer
8: Bearing retainer
9: Tappet
10: Crankcase



1: Crankcase bearing housing (1) complete
2: Knock pin
3: Oil pump gear (2)
4: Oil pump gear (1)
5: Oil pump cover packing
6: Oil pump cover
7: Pump drive gear key
8: Oil pump drive gear
9: Pump drive gear washer
10: Pump drive gear nut
11: Oil ring "O" ring
12: Oil ring

④ Crankcase bearing housing (1) (gear side), as illustrated in Fig. 35, is integral with the oil pump proper. Therefore when assembling the main bearing housing to the crankcase, use the specified packing in a correct manner, assemble the whole in even manner so that the tightening would be even all around.

⑤ As illustrated in Fig. 36, the oil ring is assembled into the crankcase bearing housing (1) (gear side). This has a very important role of sending oil from the fixed bearing housing to the crankshaft which is rotating a high speed so there is a necessity of paying good attention to this important part.
The clearance between the oil ring and the oil receiving sump is 0.012 to 0.021 in. (0.3 to 0.53 mm) so after inserting the oil ring it should be possible to feel the movement of the oil ring in the direction of the diameter by the fingers.

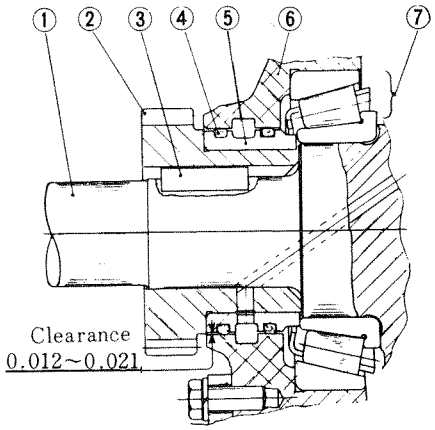


Fig. 36 Structure of oil ring

1: Crankshaft
2: Crank gear
3: Key
4: "O" ring
5: Oil ring
6: Crank bearing housing (1)
7: Crank bearing gear side

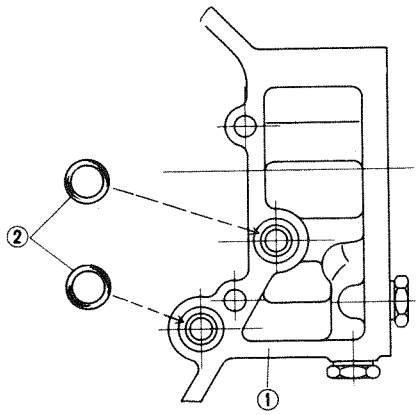


Fig. 37 "O" ring in oil passageway joints

1: Gear case
2: Oil orifice ring

Note: This figure shows the inside of the gear case (oil passageway joints)

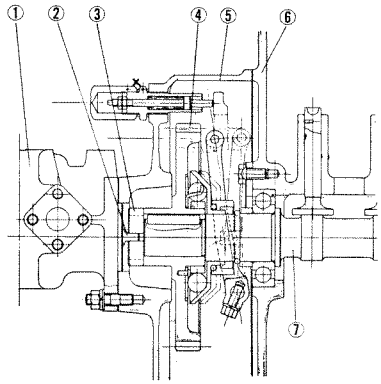
⑥ Insert an "O" ring in the oil passageway joints of the gear case and the crankcase, and tighten securely. If this "O" ring is forgotten, oil will leak out from

the joints, which would mean that oil is not properly being conveyed. This would be the cause of serious troubles.

⑦ The hydraulic pump for the oil pressure required to do the various work of the tractor is equipped to the gear case and is driven by the camshaft as shown in Fig. 38 through an oldham coupling.

Fig. 38 Drive of hydraulic pump

1: Hydraulic pump
2: Hydraulic pump drive shaft
3: Oldham coupling
4: Cam gear
5: Gear case
6: Crank case
7: Camshaft

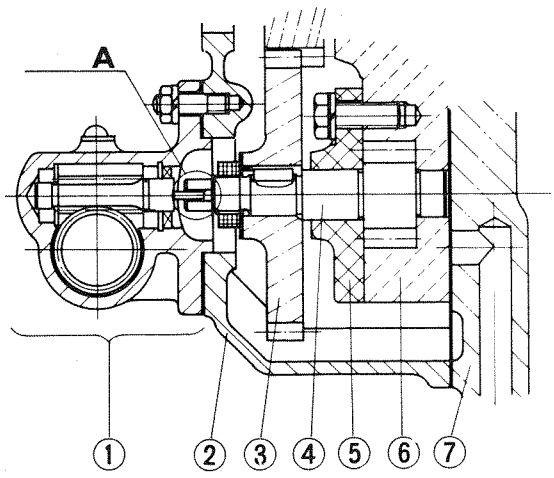


⑧ The hourmeter unit is equipped to the gear case and as illustrated in Fig. 39, the drive is taken from the oil pump drive shaft, connected to the combination meter by cable, and indicates the revolution (speed) and the hours of operation, etc. to the operator.

Fig. 39 Drive mechanism of the hourmeter unit

1: Hourmeter unit assembly
2: Gear case
3: Oil pump drive gear
4: Oil pump driving gear shaft
5: Oil pump cover
6: Gear side crank bearing housing
7: Cylinder frame

A: Fit



⑨ At the time of attaching the flywheel to the crankshaft, clean the fitting surface carefully, lubricate the sliding

surface with a thin film of oil, remove all traces of oil from the fitting surface (wash with gasoline and dry well), and then tighten with flywheel set bolts carefully to the specified tightening torque of 79.5 to 86.7 ft-lb (11to 12 m-kg). Then bend the lock washer so as to prevent loosening.

(10) To set the tension of the cooling fan belt, as illustrated in Fig. 40, depress the central part between the cooling fan pulley and the dynamo pulley with the fingers. The amount of slackness = 0.276 to 0.354 in (7 to 9 mm.) Move the dynamo so as to obtain the correct slackness.

If the tension of the belt should be too weak, the revolution of the cooling fan would drop, and the cooling efficiency as well as the charging efficiency would drop. Again on the other hand, if the belt should become hot because the belt slip, the life of the belt would be shortened considerably. Therefore, it would be better to make the belt a little taut. Also, there is the necessity to make the belt tension to the proper tension by the dynamo pulley.

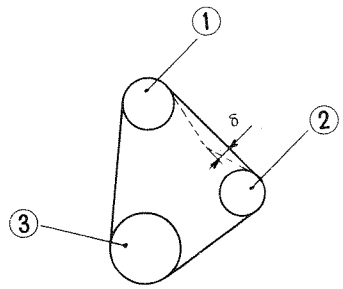


Fig. 40 Tension of fan belt

1: Cooling fan pulley
2: Dynamo pulley
3: Fan drive pulley

(11) In relation to the radiator system, please be careful of the following points.

(a) Fur inhibitor, cleaning agent, and anti-freeze should be used in strict accordance with the instructions in the Instruction Manual.

(b) Be sure at all times to remove the insects, mud, dust, dirt, etc. which may be stuck to the grill, fin and tubes, so as not to reduce the cooling effect of the radiator.

ⓒ If the machine should be used for a long period of time, the shock absorbing rubber of the radiator would become worn. Check after 300 hours of use and if it should be faulty, replace with a new one.

ⓓ In the same manner check the set bolts for the shock absorbing rubber of the radiator.

(7) About engine oil

Use Kubota genuine engine oil "Kubota Tractor Engine Oil SS" "Kubota Tractor Engine Oil SS" has been developed by research conducted by Kubota and three oil companies, Kyodo Oil Company, Nippon Oil Company and Maruzen Oil Company. It is the highest quality engine oil which is indispensible to the tractor engine which requires special lubricating conditions. It belongs to a category which is superior to the Service DM of the American Petroleum Institute.

When this Kubota Tractor Engine Oil SS is used, it prevents sticking of the piston ring, overheating of the piston, abnormal wear and other engine troubles. Stable engine performance can be guaranteed with the use of this oil.

In other words, selection and maintenance of oil is very important to make the high speed and high output engine work in good condition for a long period of time.

Especially when the engines become high performance engines as of the present time, the engine is very sensitive to engine oil. For instance, if low quality engine oil should be used, the engine would develop engine troubles such as sticking of the piston ring, overheating of the piston, abnormal wear, etc. In other words, good or poor quality engine oil greatly effects the performance of the engine.

Based upon the necessity of supplying the customers with such an important oil with high performance, and yet of stable quality and with easiness, Kubota conducted a research with the oil manufacturers. As a result, Kubota Tractor Engine Oil SS for tractor engines were developed and put on sale from April first 1968.

With this new engine oil, the number of engine oils on sale was increased and the engine oil series was completed.

In other words, they are Service MS Kubota Engine Oil, Service DG Kubota Engine Oil S, and this engine oil of higher quality than Service DM, Kubota Engine Oil SS.

A trio of engine oil was newly established.

Engine Oil SS

At the time of use of the Kubota Tractor Engine Oil SS, be care of the following points so that the oil which has the above-mentioned superior properties would be able to amply show its features.

ⓐ Check the oil level and refill if necessary every day. Shortage of oil would cause poor lubrication and surplus oil would seep up into the combustion chamber, and thereby cause trouble.

ⓑ Exchange oil at routine intervals.
Exchange engine oil after the first 35 hours of operation when the tractor is newly purchased. Thereafter, exchange oil after every 75 hours of operation.
It should be added that drainage of used oil at the time of exchange of engine oil should be performed when the engine is still warm. Then all of the engine oil can be drained out completely.

ⓒ At the time of exchange of the engine oil, if the inside of the crankcase should be washed and oil filter 1 should be cleaned, wipe off the light oil inside of the crankcase completely. If light oil should be left inside, it would dilute the engine oil which is not good for the engine.

ⓓ Exchange of the element of oil filter 2 should be performed after 150 hours of operation.
In other words, the element should be exchanged once every two times the engine oil is exchanged.

ⓔ When engine oil is stored away, be very careful so that water or dust positively would not enter into it.

ⓕ High quality engine oil should not be mixed with engine oil of other manufacturers or with oil of different viscosity. If engine oil must be changed to that of another manufacturer or of a different viscosity number, drain out the engine oil, clean the inside of the crankcase and wipe off the light oil completely. Then fill with new engine oil up to the specified level (upper mark on the oil level gauge). This should be performed even if exchange of engine oil is to be performed before the specified time.

(g) If engine oil which has only a little cleaning agent added to it is used, much sludge would be stuck to the inside of the engine and so even if Kubota Tractor Engine oil SS which has much cleaning agent in it is used to replace the former oil, the cleaning agent would be only sufficient to dissolve and disperse the sludge which has collected. It would not be able to dispose of the carbon, etc. which may develop newly, and so would not be able to show its function to the best. In other words, in this case the engine oil would become dirtier much more than in ordinary cases, so operation must be carried out being careful to check the clogging of the oil filter at all times. Furtheremore, the engine oil must be exchanged after the first 35 hours of operation, and thereafter the engine oil should be exchanged after every 75 hours of operation as explained above.

(h) Engine Oil should be used as follows according to the temperature.

Above 77°F (25°C)	SAE #30 (API classification)
32°F (0°C) to 77°F (25°C)	SAE #20
Below 32° (0°C)	SAE #10W or 10W-30

Ⅳ. TRACTOR

1. FRONT AXLE

(1) Inner structure and name of parts

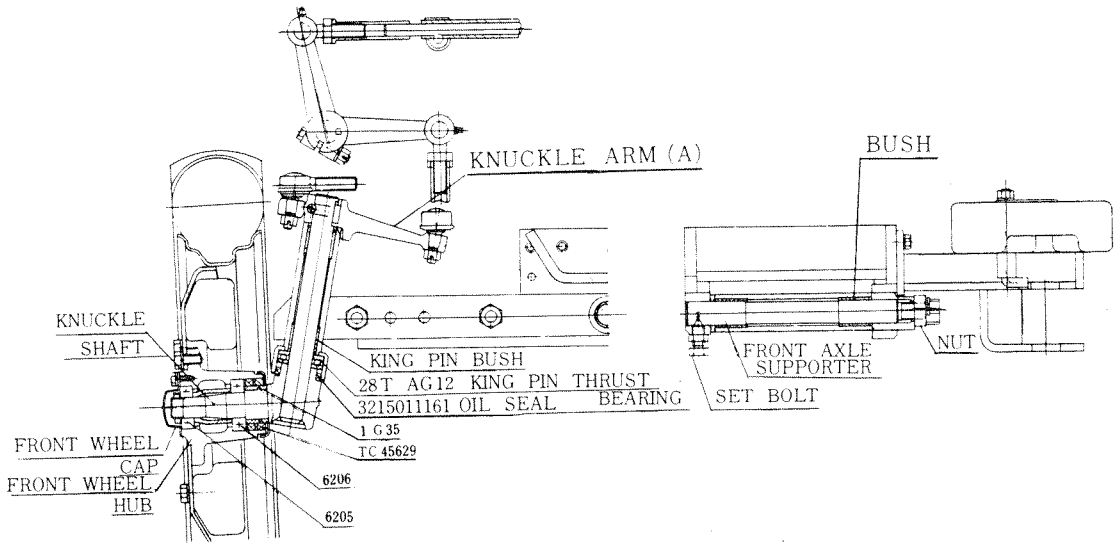


Fig. 41

The front wheel hub is bearing supported and two oil seals have been used in the rotating parts, which makes it a completely water-proof structure. The knuckle shaft is supported by the thrust bearing and king pin bushing, and is completely water-proof by the special oil seal on the lower part and the "O" ring in the upper part. The front axle supporting lever is supported by the supporting lever bushing (also acts as the king-pin bushing). The front and back clearance can be easily adjusted by the supporting lever nut.

(2) Disassembly and assembly

2-1 Front wheel hub

1 Remove the front wheel tire, and remove the crown nut inside of the front wheel cap with a hook wrench or special tools. (Refrain from using chisels or screw drivers.)

2 Tap out the hub with a hammer (mallet, copper, or resin hammer) to the outer side.

3 At the time of assembly, apply ample bearing grease (refer to grease sold on the market given in the table elsewhere in this manual) to the bearing, oil seal and the space inside of the hub.

Note: Do not use grease with foreign matter such as dirt in it. Also be specially careful to keep mud, dirt, sand, etc. from entering into the hub.

2-2 Knuckle shaft

1 Remove the knuckle arm and take out the key and "O" ring.

2 Next, lift up the front axle to a height so that it would be possible to remove the knuckle shaft downwards.

3 At the time of assembly, apply ample chassis grease (refer to grease sold on the market give in the table elsewhere in this manual) to the thrust bearing and oil seal.

Note: Be careful not to damage the "O" ring.

2-3 Front Wheel Shaft Supporter

1 Remove the bumper and using a 1.26 in.(32mm) wrench, loosen the supporting lever nut to remove the adjusting collar.

2 Lift up the front axle, remove the supporter set screw and tap out from back side using a small bar (copper, brass).

3 Adjust the frontward and backward clearance of the front axle to 0.004 to 0.020 in. (0.1 to 0.5 mm) and assemble.

(3) Checks and maintenance

Item	Important things	Cause and repairs
Air pressure of front tires	Standard pressure 32.0 psi ($2.25\ kg/cm^2$)	Too high or too low pressure is not good for the tire and tube.
Loosening of front tire and front axle set bolts		Tighten to specified torque.
Loosening of knuckle arm set bolt. Check if cotter pin is used.		Tighten to specified torque.
Loosening of set screw for front axle supporting lever.		Tighten locknut securely.

Clearance of front wheel hub.	Less than 0.12 in. (3 mm) around tire circumference.	Lift up front tire and move forwards and backwards. If clearance is too large, exchange bearing (6206, 6205).
Front axle supporting lever is worn and loose. 1 Front and backward direction. 2 Left and right, and up and down direction.	Standard 0.004-0.020 in. (0.1 - 0.5 mm) Limit of use for Kingpin bushing Inner diameter 1.109-1.110 in. (28.23-28.25 mm) (Limit of wear 0.009 in.(0.25mm)	Screw in the nut at the front of the supporting lever and make the clearance small. Exchange supporting lever bushing.
Clearance of knuckle shaft	Standard clearance 0.004-0.006 in. (0.1 - 0.15 mm) Limit of use 0.009 in.(0.25 mm) Limits of wear of knuckle shaft Outer dia 0.004 in. (0.1 mm) Limits of use of kingpin bushing Inner dia. 1.109-1.110 in. (28.23-28.25 mm) (Limit of wear 0.009 in.(0.25 mm)	Lift up the front wheel and move forwards and backwards. If amount of movement is large, exchange kingpin bushing.
Check oil seal of Front wheel hub Knuckle shaft		If the tip of the lips should be worn or damaged and mud, water, etc. should enter through oil seal, exchange.
Check front wheel hub oil seal collar	Limits of wear 0.008 in.(0.2 mm)	Exchange if there is a groove of over 0.008 in.(0.2 mm) on the oil seal contact surface or

		severe rust has developed. (Exchange of "O" ring inside is preferable.)
Worn and loose knuckle shaft in the up and down	Within 0.04 in. (1 mm)	Judge by movement when front wheel is lifted or lowered. If excessive, disassemble and exchange thrust bearing (28TAG12).
Lubrication of grease 1 Knuckle shaft 2 Front axle supporting lever 3 Front wheel hub	 Every 50 hours Every 50 hours Every 300 hours	 Chassis grease Bearing grease

(4) Front wheel alignment

Specification

Camber	2°
Caster	2° 30'
Kingpin angle	10°
Toe-in	0.08 to 0.32 in. (2 to 8 mm)

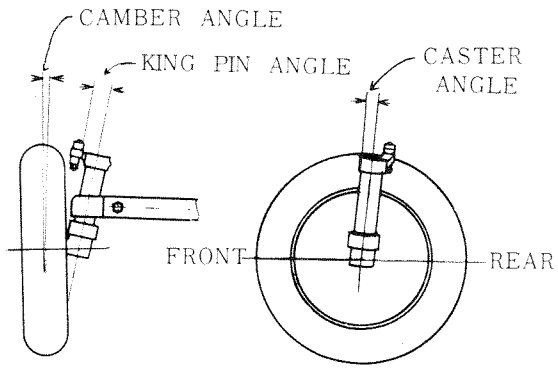
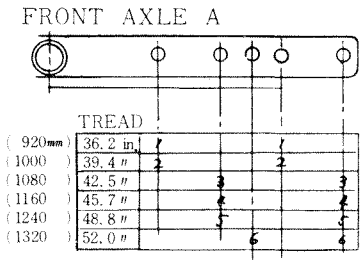
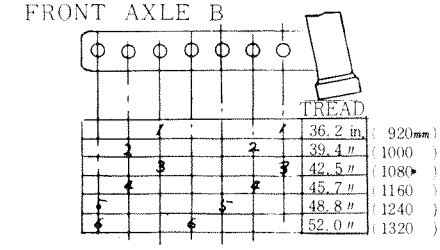


Fig. 42

Adjustment

Camber, caster and kingpin angle are all constant and as long as checks and maintenances are performed accurately, they would not need adjustments. But there is a necessity to check toe-in at times. Especially when the tread is changed, adjustment must always be made.





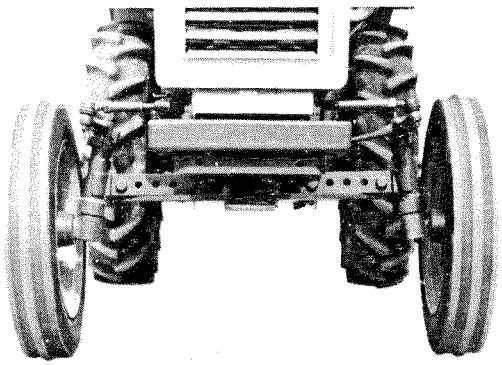


Fig. 43

Fig. 44

To take measurements, it would be best to use the wheel alignment tester or a toe-in gauge, but if they are not available, measure with a precise tape measure.

(5) Adjustment of tread

The tread of the tractor at the time of shipment from the factry is standardized at 36.2 in.(920 mm). As illustrated in Fig. 44, it is possible to change the tread by changing the position of the holes, and obtain 6 tread width.

2. STEERING SYSTEM

(1) Inner structure and name of parts

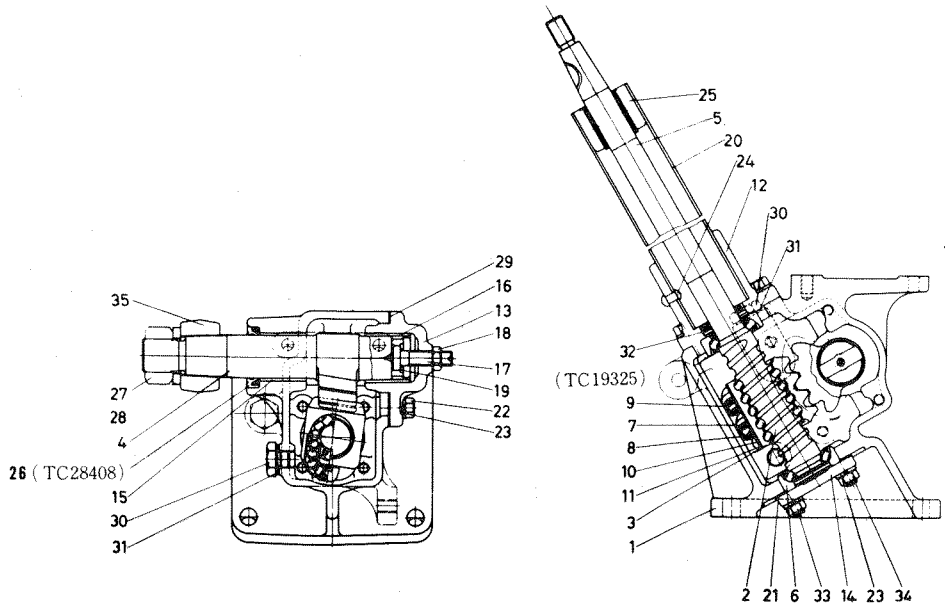


Fig. 45

The structure of the steering system is of "The Ball screw type" The transmission of the revolution is performed by the contact of the rolling of the ball so it is smooth and can withstand heavy loads. Therefore it is superior in durability when compared to the conventional sector worm type.

(2) Disassembly and assembly

2-1 Disassembly and assembly of the gear box

As related above, the system is very durable and so there is hardly any necessity of disassembly but if there should happen to be a necessity, disassemble in the following manner.

1 Remove the pitman arm (35) with the gear puller, and the handle (steering wheel) with the steering wheel puller. (There is an assembly mark on the pitman arm and the sector shaft.

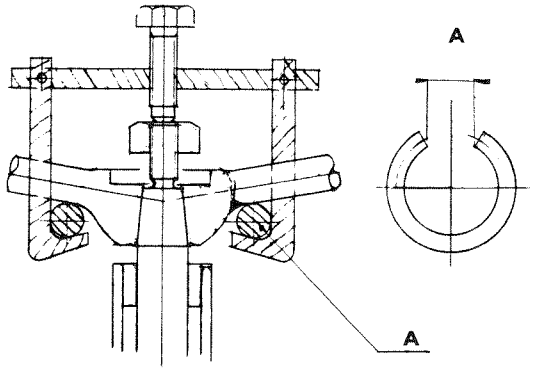


Fig. 46 Removal of Handle

2 Remove battery, battery stand and instrument panel so that only the gear box is left.

3 Remove side cover (13) and take out the sector shaft (4).

4 Remove front cover (12), and take out the handle column and steering shaft (5). (Be careful of the front cover shim.)

Note: The ball and screw are precisely machined and assembled so do not disassemble.

5 At the time of assembly, wash carefully and assemble in the reverse order to disassembly.

6 After assembling the rear cover, check to see if the steering shaft turns lightly and without loosening by use of the front cover shim. After confirming, insert the sector shaft.

7 After fixing the handle, measure the amount of "play" of the handle. Adjust by the adjusting screw (17) so that the "play" of the circumference of the handle would be 0.8 to 2.0 in.(20 to 50 mm).

2-2 Removal of the tie-rod end

1 The end is fixed to the knuckle arm and the pitman arm with a taper. Therefore, loosen the nut a little, and tap with a mallet or a resin hammer. It should come out very easily.

2 The exchange of the tie-rod should be performed as a complete unit. At the time of assembly, be sure to insert a cotter pin in the nut and split the pin.

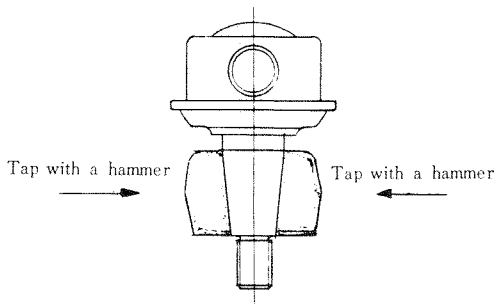


Fig. 47

(3) Checks and maintenance

Item	Important things	Cause and repair
Play of outer circumference of handle	Standard play is 0.8 - 2.0 in. (20 - 50 mm)	If play is too large, screw in the adjusting screw (17)on the left side cover. If too little, loosen. Set after adjustment with locknut.
Abnormal noise when the handle turns		Lack of oil in gear box or sticking of column bushing; wear and damage of bearings; are causes. Disassemble and check.
Handle is heavy		No play in handle. Causes are column bushing (25) is stuck or lack of lubrication. Repair in way described above.
Handle is loose in forward and backward direction	Up to 0.04 in. (1 mm)	Cause is wear of column bushing (25) or wear of bearing (6). Exchange with new ones.
Handle is loose in up and down direction	Up to 0.008 in. (0.2 mm)	Remove front cover (12), remove shim and make adjustments.
Sector shaft is loose	Limit of wear of	Cause is wear of bushing

	bushing is 0.012 in.(0.3 mm)	(15) of sector shaft so exchange.
Oil leakage from sector shaft		Damage to sector shaft oil seal (TG 28408) so exchange.
Loose tie-rod end	Up to 0.02 in. (0.5 mm)	Exchange as an unit.
Sufficient oil 1 Gear box	First 100 hrs Thereafter every 300 hours	#90 gear oil
2 Steering link (Tie-rod end)	Every 50 hours	Chassis grease

3. CLUTCH AND PROPELLER SHAFT

(1) Innerstructure and name of parts

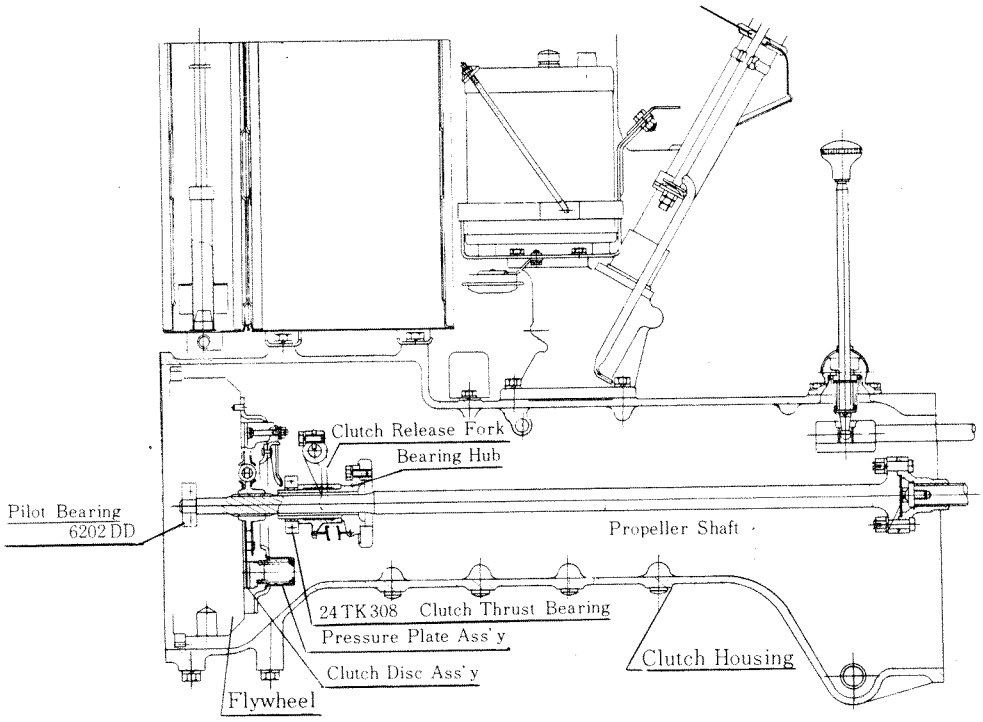


Fig. 48

The pressure plate is the same one as it used for KUBOTA L 200 tractor. A higher quality material has been used for the facing of the clutch disk. The performance has been greatly improved. Furthermore, the release hub does not require lubrication so maintenance is very easy.

(2) Disassembly and assembly

2-1 Removal of the clutch

To disassemble the clutch, it is first necessary to separate the engine from the clutch housing. But here, the details will be omitted and only the necessary precautions will be treated At the time of disassembly.

1 The wiring of the dynamo and starter should be performed only after removal of the ⊖ wire of the battery from the battery.

2 Before removing the hydraulic pressure pipe, drain out the hydraulic oil from the hydraulic oil tank through the drain plug. (This prevents the entrance of foreign matters.)

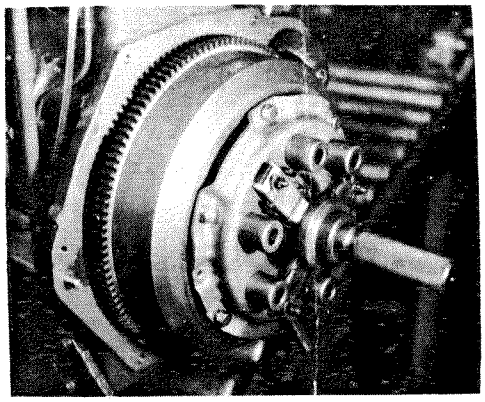
3 As an "O" ring is used on the tip of the hydraulic pressure pipe, be careful not to lose or damage it.

4 At the time the engine is dismantled, there are fears that the engine might fall or tip over, so be very careful. Supporting only by a jack is insufficient so be sure to use a hoist or chain block.

5 It would be preferable to suspend the clutch housing with a hoist or chain block. If the rotary device is left attached, the rear part would be heavy; and if the rotary device is detached, or is in the lowered position, the front would be heavy.

At the time of assembly

1 At the time of attaching the clutch to the flywheel, if the alighnment of the flywheel centerline and the clutch centerline is not made, the propulsion would not be smooth so be sure to align them perfectly.



There is a tool to align the center of the clutch. Pass the propeller shaft through the clutch disk until it is in to the pilot bearing in the central part of the clywheel. Screw in the pressure plate set bolts and when nearly tightened pull out the tool.

Fig. 49

2 Move the engine and the clutch housing in an horizontal direction to align. If there is a difference in height, the propeller shaft would not fit, and therefore it would not be possible to assemble. Not only would it be impossible to assemble, the shaft might be bent so please be very careful.

2-2 Disassembly and assembly of pressure plate assembly

Type G 77

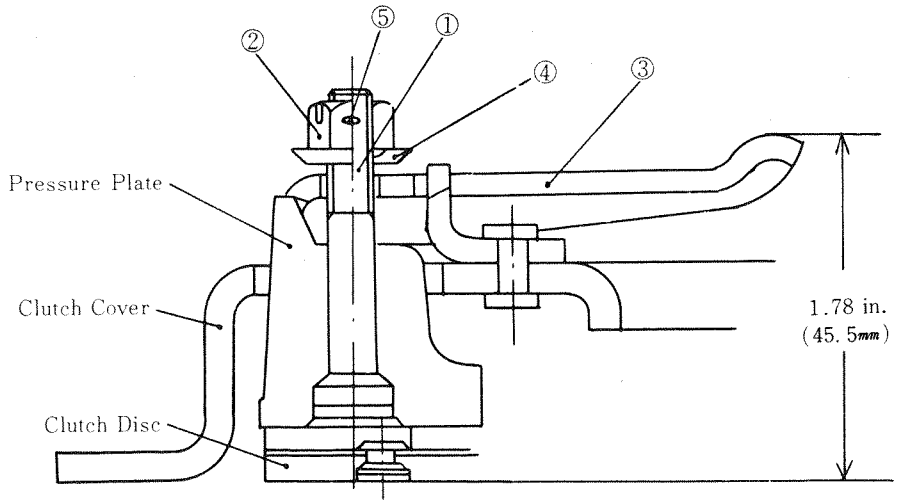


Fig. 50

No	Name of Parts	Code No.	Manufacturer's No.
1	Lever bolt	32130-1457-1	G 204-21110
2	Lever nut	32130-1458-1	G 70-20111
3	Release lever	32130-1454-1	G 204-21103-2
4	Release yoke washer	32130-1465-1	G 70-20116
5	Cotter pin	32130-1456-1	G 24-22130

At time of disassembly

1 Before removing the pressure plate from the face of the fly-wheel, remove the cotter pin of the lever nut and loosen the nut.

2 After removing the lever nut, loosen the clutch cover set bolt from the flywheel and remove. Then it would be possible to disassemble the pressure plate completely.

At the time of assembly

*Tools to be prepared beforehand------

plate ring equivalent to the flywheel

1 In a plate ring with an outside diameter of 9.85" inner diameter of 4.92" and a thickness of about 0.4 in.(10 mm) as shown in the figure at the left, drill three holes at the place where it would tighten on the clutch cover, with a 9/32" (7 mm) drill and cut threads with a M 8 (8 mm) tap.

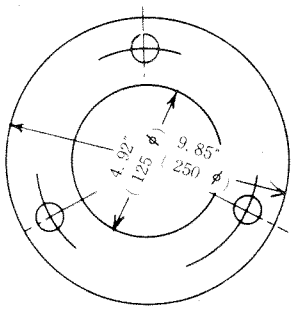


Fig. 51

2 Set the clutch disk on the tool just made. Set the pressure plate on top of it.

3 Put a lever bolt in the pressure plate, set the pressure spring on top of it, set the clutch cover on the pressure plate square boss part and cover. Insert bolts in the tightening hole of the clutch cover and tighten uniformily to tool.

4 When perfectly tightened to the tool, set the release lever on it and gradually tighten the lever nut. Set the height of the lever and then insert the cotter pin. (Refer to section on adjustment of height of lever.)

Notes:

1 The pressure plate assembly has been perfectly balanced. Therefore at the time of disassembly be careful to note the place of the parts so that they would be assembled into the former places. (If it is not properly balanced, it may become the cause of troubles.)

2 At the time of assembly as well as disassembly be careful not to let the clutch disk and the pressure plate assembly become oily or greasy. (It would be the cause of poor

clutch disengagement or slipping clutch.)

(3) Adjustment of clutch

3-1 Adjustment of height of release lever

1 Remove the cotter pin of the lever nut with the pressure plate assembly and the clutch disk attached to the flywheel or the tool.

2 Using a $^{0}.4$ in. (10 mm) wrench, turn the release nut and adjust so that the height of the release lever is 1.78 in.(45.5 mm) from the surface of the flywheel as shown in the figure. Then insert the cotter pin.

3 If there should be a necessity to adjust the release lever from the outside (that is like when the adjusting bolt of the clutch pedal is screwed in completely and yet is unable to disengage completely), make the adjustment in the same manner as related above through the adjusting access window of the clutch housing.

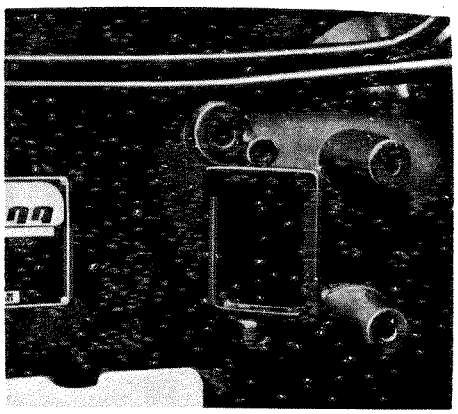


Fig. 52

To make the height of the release lever uniform, insert a thickness gauge between it and the release bearing and it would be very easy. If the clutch still does not work properly although the adjustment has been made, there is a necessity to disassemble and make detailed checks. (Refer to section on bad clutches and repairs.)

Note: The difference in the height of the three release levers should be less than 0.012 in. (0.3 mm).

3-2 Adjustment of clutch pedal

The adjustment for the amount to be stepped (depression) on the clutch pedal is performed by the adjusting bolt and the clutch lever connecting rod.

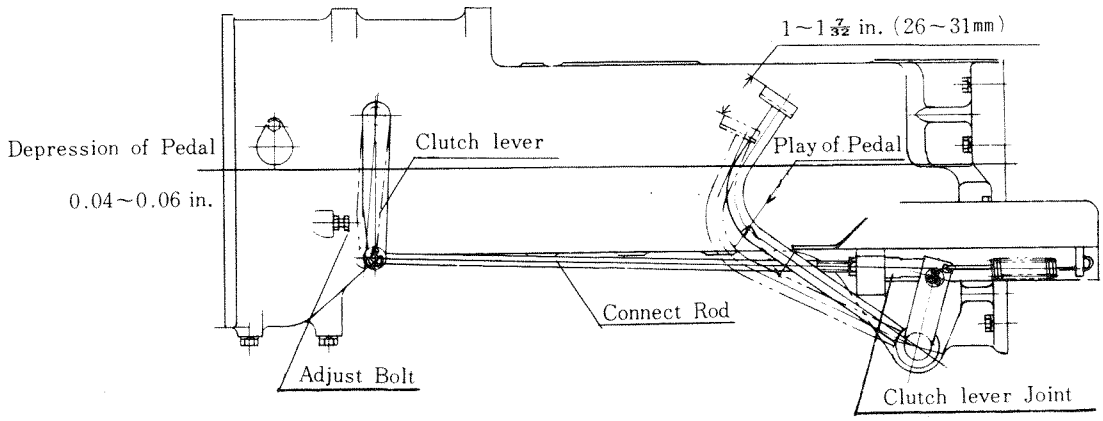


Fig. 53

When the disengagement of the clutch is poor, screw in the adjusting bolt until in a position where the clutch would be disengaged. (Do not remove the nut and screw in.) When the condition becomes good, set the dimensions between the pedal and the footboard to the following by the connecting rod clutch lever coupling.

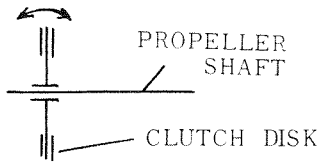
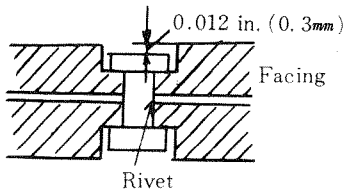
**Play of pedal (Pedal depressed lightly) 1 to 1 7/32 in. (26 to 31 mm)

**Depression of pedal (from play until clutch is disengaged) 2 33/64 to 2 29/32 in. (64 to 74 mm)

(4) Checks and maintenance

4-1 Clutch disk

Item	Important things	Cause and repair
Facing oily or greasy		In case a little oily, clean off lightly with sandpaper. In case greatly oily, clean with solvent or gasoline. Remove trace of oil.
Wear of spline	Sway of facing tip to side is 0.06 in.(1.5 mm)	If wear is severs and when inserted into propeller shaft, if tilt of facing tip is in excess of 0.06 in. (1.5 mm), exchange.

		
Evenness of surface of facing	Within 0.016 in. (0.4 mm)	If more than 0.016 in.(0.4 mm) difference at the outer circumference, exchange.
Facing worn	To 0.012 in. (0.3 mm) from top of rivet.	Measure from surface of facing to top of rivet and decide. If less than 0.02 in.(0.5 mm) at time of disassembly, it would to betterto replace. 
Facing blackened by heat		Improper use of clutch (for instance using for long time with clutch half engaged, etc.) cause facing to become heated. The facing would turn blackish ash color. Clutch performance would deteriorate if blackened. Wear would be quick, so exchange.

4-2 Pressure plate assembly

Item	Important things	Cause and repair
Correct height of lever	1.78 in.(45.5 mm) from flywheel surface.	For details refer to adjustment of clutch.
Wear of lever tip		If severely worn, disassemble and exchange release lever. Follow directions given in section on disassembly and assembly.

Worn clutch spring	Free length is 1.87 in.(47.4 mm)	If free length (length of spring in as is condition) is excessively worn, exchange as a pressure plate assembly unit.
Pressure plate scarred Oily or greasy		If scratch is slight, repair with sandpaper. If severe, exchange. Clean the surface of the plate with solvent or gasoline. Wipe other parts clean.

4-3 Propeller shaft and release hub

Item	Important things	Cause and repair
Propeller shaft pilot bearing worn	Up to 0.004 in. (0.1 mm) in diameter	Wear of shaft is apt to occur when pilot bearing is faulty. Check bearing and if necessary exchange.
Worn propeller shaft	Within 0.06 in. (1.5 mm) at tip of clutch disk	Engage clutch disk and if more than 0.06 in.(1.5 mm) sway at tip of facing, exchange.
Loose between clutch release fork and fork shaft		Tighten bolt securely so there would be no loosening.
Lack of grease in bearing hub	Every 500 hours	Fill bearing grease.
Worn clutch thrust bearing causing loosening	24 T K 308	Replace bearing which has severe worn surface or which emit abnormal noise.

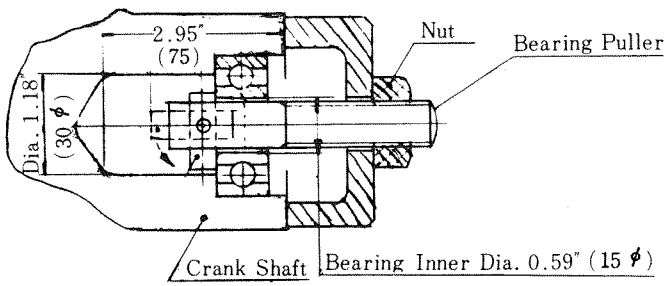


Fig. 54 Pulling out of propeller shaft bearing
(Similar for pulling out bushing)

(5) Causes of clutch troubles and repairs

5-1 Clutch slips

Phenomenon	Cause	Repair
No acceleration	Poor contact of facing	Use sandpaper to make repairs.
Engine not affected by overload	Oily or greasy facing	Clean with solvent or gasoline.
Speed is remarkably decreased when load is put on rotary	Worn or heated facing	Exchange clutch disk.
Smoke is emitted from clutch or smells	Clutch spring weakened	Exchange pressure plate assembly

5-2 Clutch does not disengage

Phenomenon	Cause	Repair
Noise from gear when changing speed	Poor contact of facing	
Tractor moves or rotary turns even when clutch pedal is depressed.	Poor clutch pedal adjustment	Refer to adjustment of pedal.
	Release fork and shaft worn	Refer to checks and maintenance.
	Height of clutch release lever uneven or height is too low	Refer to adjustment of height of release lever.
	Sway of facing great	Exchange
	Spline of clutch disk severely worn	Exchange
	Pilot bearing part of propeller shaft severely worn, or pilot bearing worn and loose.	Exchange

5-3 Noise develops from clutch

Phenomenon	Cause	Repair
Noise develops from clutch	Release bearing severely worn,	Exchange

	Pilot bearing severely worn	Exchange

5-4 Precautions in operating clutch

The clutch must transmit power without loss and moreover must engage or disengage without fail. For this reason operation and maintenance must be performed very carefully.

The clutch pedal should be depressed to disengage quickly and released to engage gradually. Do not leave the foot on the pedal while operating or travel with the clutch half-engaged. Also, this precaution should be observed at the time of working. The tractor should not be used with a jerk by overload more than the specified capacity, nor should it be used for a long periods with overload. These things shorten the life of the clutch, and are the major causes for clutch troubles. It should be added that if the tractor is to be stored away for a long period of time, insert a piece of wood into the clutch pedal so that the clutch would be in the disengaged position.

These are the things which the servicemen should instruct the operators.

4. TRANSMISSION (INCLUDING PTO GEAR SYSTEM)

(1) Inner structure and name of parts

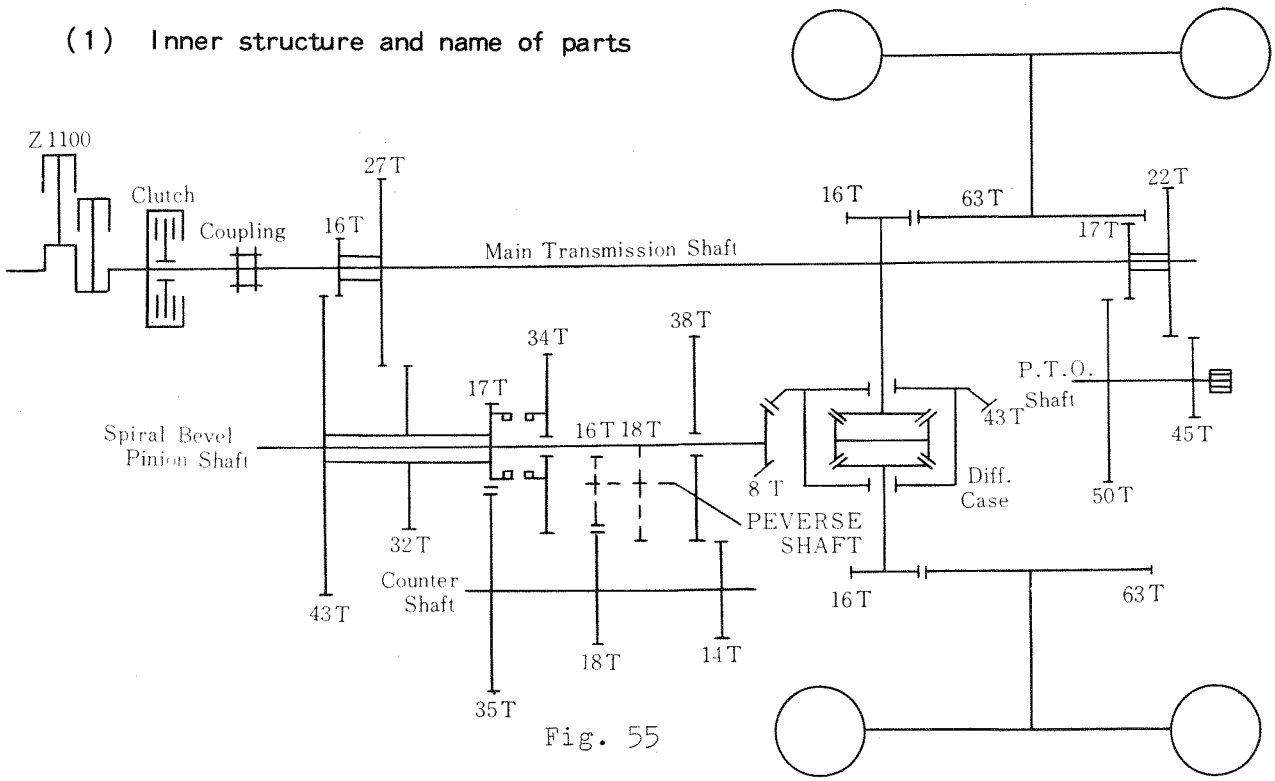


Fig. 55

(2) Disassembly and assembly

2-1 Disassembly

The transmission is usually not disassembled. But if there happens to be a need to disassemble, disassemble very carefully in the following order.

1 Separate the engine from the clutch housing and remove the fender, seat, and hydraulic cylinder so that only the transmission case is left. (The details are omitted.)

2 Remove the propeller shaft and the coupling. (The bolt on the inside of the coupling is a left-handed thread bolt.)

3 Set the gear shifter to neutral and knock out the shift bar to the outside. (Be careful of the interlock ball which is in front of the transmission part and the position setting ball.)

4 Remove the right and left rear axle housing, and take out the differential. (The differential gear can also be taken out when only the left rear axle housing is removed.) When doing this, be sure that the work-table is very firm, otherwise the case may tilt and fall over. Be very careful of this.

5 Remove the oil seal (S C 35529) and the snap ring on the front part of the transmission shaft (at the coupling joint). Remove the snap ring of the central bearing 6205 and then pull out the main transmission shaft to the front.

6 Loosen the four bolts of the pinion shaft bearing case and remove the crown nut of the pinion shaft. Then tap the pinion shaft out backwards.
(There are shims in the bearing retainer so at the time of disassembly confirm how many shims are used. Also be very careful not to damage the hi-lo interconnecting gear needle bearing and thrust bearing at the time of taking out the pinion shaft.

7 The countershaft can be removed to the back by removing the center bolt and tapping backwards.

8 Remove the bolts for the bearing retainer of the PTO shaft and allow the case to rise. Then tap out the upper shaft (transmission shaft) from the inside. After this, remove the stopper of the PTO shaft and tap out from the inside.

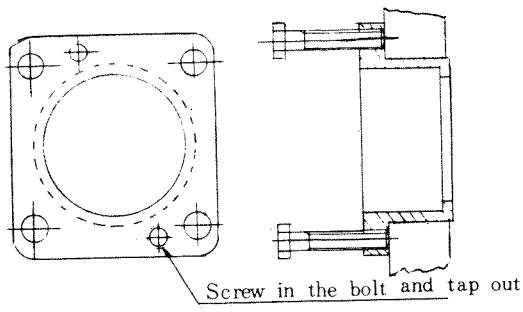


Fig. 56 Removal of bearing case

9 Remove the shift bar and the shift fork of the PTO shaft.

2-2 Assembly

1 Wash the transmission case and parts in clean oil. (Do not use gasoline.

2 Next, check well to see if there are any damaged or abnormal parts. Slight defects can be repaired but severely damaged parts should be replaced with genuine spare parts. Be specially careful to check the rolling condition of the bearings, the gnawing in moving parts, wear and sliding parts of oil seals.

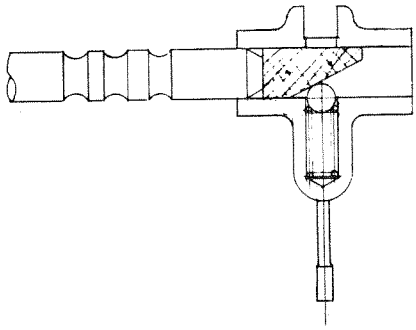


Fig. 57 Insertion of shift bar

3 When inserting the thrust bearing into the spiral bevel pinion shaft, put the pinion shaft to the back tap in with a support so that it would not move. To fix the thrust bearing, tighten securely with a crown nut and bend the washer.

4 The order of assembly is in the reverse order to disassembly. so it is omitted here.

(3) Checks and maintenance

3-1 Checks from the outside

Items	Important things	Cause and repairs
Oil leakage	Gear housing oil is 13.2 qt(12 ℓ)of gear oil	* Check to see if amount of oil is proper amount of 13.2 qt. (12 ℓ) * Check if oil seal, "O" rings and packings are damaged. * Check for loose bolts.
Gear shifting difficult		* Clutch not completely disengaged. * Insufficient lubrication of gear shifting lever.
Loose bolts and nuts		* Retighten to the tightening torque given in the chart.

3-2 At time of disassembly

Items	Important things	Cause and repairs
Correct width of gear engagement (Especially speed change of PTO)		Small engaging surface of the teeth is due to faulty gear shifting position. Change gears position and make repairs.
Loose right and left hi-lo interconnecting gear	Within 0.04 in. (1 mm)	If more than 0.04 in. (1 mm) change collar on both sides.
Clearance between back gear and shaft	Limits of use of bushing should be within 0.008 in. (0.2 mm) at diameter	Check bushings and exchange if necessary.
Wear of ball bearing		Turn the ball bearing and if it catches and does not turn smoothly or sounds unnatural, exchange
Wear of needle bearing	Limits of use of roller should not be over 0.02 in. (0.5 mm) at diameter	At time of disassembly, there are cases when rollers fall out of gages. If the wear of the roller is slight, it is possible to use but there is the

		necessity of returning the roller to the former position.
Gnawing of teeth		This chipping of the teeth is caused by improper shifting of the gears. Slight damages can be repaired by oilstone. Severely damaged gears should be exchanged
Backlash and engagement of spiral bevel pinion and bevel gear of differential	Standard backlash 0.006" - 0.008" (0.15 - 0.20 mm) Teeth engagement of over 80% of width is necessary	For details refer to section on differential gear
Clearance between gear and spline	Limit of use 0.008 in.(0.2 mm)	If too large, exchange
Backlash of gear	Standard backlash 0.006 - 0.008 in. (0.15 - 0.2 mm) Limit of use 0.02 in.(0.5 mm)	If too large, exchange.
Clearance of shiftfork	Standard 0.004 - 0.008 in. (0.1 - 0.2 mm) Limit of use 0.016 in.(0.4 mm)	If too large, exchange.

5. DIFFERENTIAL GEAR AND REAR AXLE

(1) Inner structure and name of parts

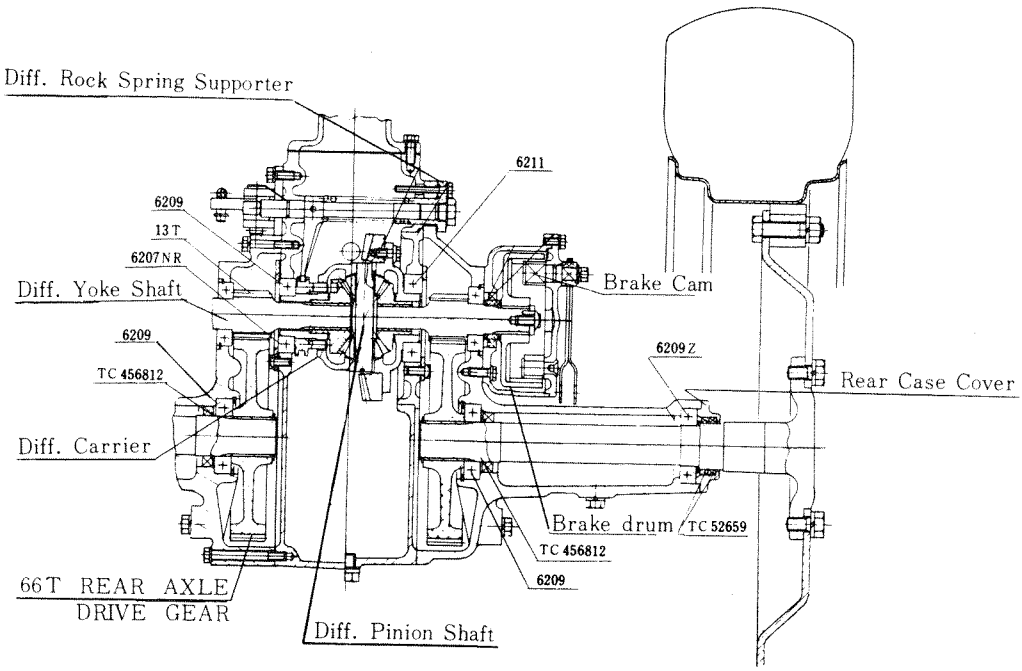


Fig. 58

The revolution is transmitted from the spiral bevel pinion shaft to the differential gear. There are two differential pinion gears and two differential side gears assembled into this gear, and there-by transmit the revolution to the rear axle to fit the load on the tires.

Now, if the differential lock pedal should be depressed, the differential side gear and the differential case will be fixed. Then the differential would not be able to do the work it is meant for, and so the two wheels turn together.

(2) Disassembly and assembly

2-1 Disassembly and assembly of differential

1 Remove the left side rear axle housing and take out the differential together with the differential bearing case. If the hydraulic cylinder is removed and the differential tapped out from the inside, it would be much easier.

2 Remove the differential bearing case, straighten the lock-washer of the set bolts for the spiral bevel gear, loosen the bolt and take out the gear. Then tap out the differenti pinion shaft from the opposit side of the key.

3 Next, move the pinion gear and take out the pinion gear from the differential case access hole. Take out the differential side gear in the same way.

4 Assembly is in the reverse order to disassembly.

Note: The set bolt for the spiral bevel gear is of special material so tighten the bolt according to the tightening torque chart.

2-2 Disassembly and assembly of differential lock mechanism

1 Loosen the two set bolts of the differential spring on top of the left side rear axle, remove the differential lock spring, pull out the roll pin which sets the fork and remove the fork.

2 Assembly should be performed as of the following figure.

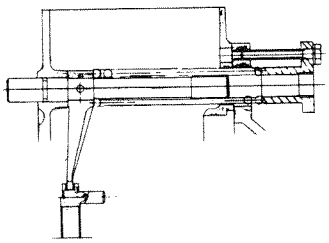


Fig. 59 Fixing differential lock spring

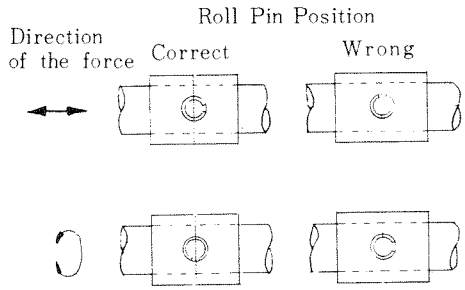


Fig. 60 Insertion of roll pin

2-3 Disassembly and assembly of rear axle

1 When the rear axle housing is removed, remove the brake case (refer to section on disassembly of brake), and take out differential yoke shaft.

2 Remove the snap ring of the rear wheel drive gear and remove gear.

3 Remove rear axle housing cover and tap out the rear axle from the inside.

Note: When tapping out the rear axle, be careful not to damage the oil seal.

(3) Adjustment of spiral bevel pinion and gear

(The bevel gear of the rotary is adjusted in the same manner.)

The adjustment of the spiral bevel pinion and the gear is by

the adjusting shim on the differential bearing side and the shim of the pinion shaft bearing case in front of the transmission case.

At the time of disassembly, carefully note the position of the shim and be careful not to lose. At the time of assembly, the shim is inserted into the former position. Then check the engagement of the teeth and the backlash. If they are correct, proceed with the assembly.

However, if it should not be correct, make the correct adjustments. A simple way of measuring is to put solder between the teeth in case of backlash, and then to measure the thickness by a micrometer. In the case of engagement of teeth, paint a little lead paint onto several teeth and turn. Check the condition it sticks on the bevel gear and judge whether good or faulty.

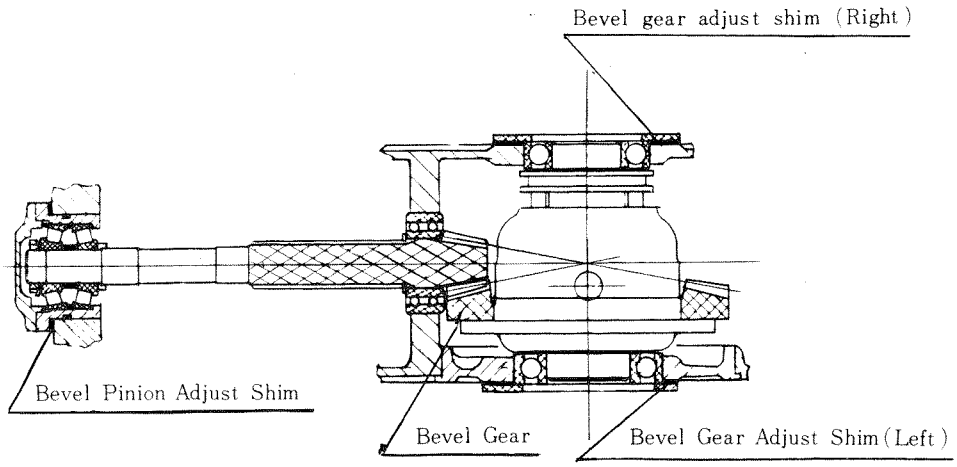
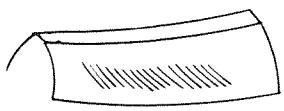
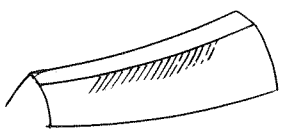
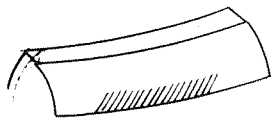
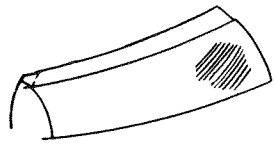


Fig. 61

Correct	Backlash	0.006 - 0.008 in. (0.15 - 0.2 mm)
	Teeth engagement	
Tip engaged		Teeth engage shallow so only tips are engaged. Remove shim from the left side of differential case and insert same thickness shim on right side.

Base engaged		Teeth engage deep so only bases are engaged. Remove shim from right side of differential case and insert same thickness shim on left side.
Toe engaged		Engagement of pinion gear shallow and only Toe part engaged. Remove shim of pinion shaft bearing and move pinion gear to differential side.
Heel engaged		Engagement of pinion gear deep and only Heel part engaged. Loosen the pinion shaft bearing case and insert shim so that pinion gear would become farther from differential.

The above engagements are only examples of general cases. Actually there are cases when two may be intermixed, and one adjustment may not correct the fault. Moreover, the adjustment must be made so that the backlash would be within the figures given above. Therefore, be very careful when making adjustments.

(4) Precautions in handling differential lock

If the differential lock is used in the proper manner, it is very advantageous, but if used in a wrong way, it may be dangerous. It may even become the cause of accidents so it is necessary that proper instruction be given in the handling of the differential lock at the time of delivery of the machine to the customer.

1 The differential lock pedal must not be depressed at random. It should be used only in the following cases. When both wheels are turning at the same revolution, the differential lock would not work even if the pedal is depressed.

At the time of entering or leaving a field and the ground condition is so bad that one wheel slips and tractor cannot proceed.

A part of the field is soft and one of the wheels slip in the soft ground and tractor cannot travel.

In case of plowing, the hillside wheel is in soft soil and slips.

2 The use of the differential lock is for temporary measures and should not be used for long period of time.

3 If there is a load on the wheel, once the differential is locked, there are cases when the differential cannot be unlocked even if the pedal is released. Therefore, at the same time as releasing the pedal, depress either the right or left brake when traveling straight, or depress the brake opposite to the side the tractor is moving to when turning. (When the brake is depressed, the load on that side becomes lighter, and differential lock engagement is released by the strength of the spring.)
If the differential lock cannot be disengaged, it is impossible to turn, so it is very dangerous.
Be especially careful of this.

4 Positively do not turn with the differential locked. (The differential would be forced, and may become the cause of troubles.)

(5) Checks and maintenance

5-1 Check and maintenance of differential (inclusive of lock)

Item	Important things	Cause and repair
Backlash of differential pinion gear and differential side gear	Standard backlash 0.006 - 0.008 in. (0.15 - 0.2 mm) Limit of use 0.016 in.(0.4 mm)	If the backlash is large, exchange the global washer of the differential pinion gear and the differential side gear.
Clearance of pinion gear and pinion shaft		If the clearance is large, exchange shaft and gear.
Clearance of side gear and differential case		If the clearance is large, exchange.
Height of differential lock pedal	1.77 - 2.0 in. (45 - 50 mm) from Step	Refer to section on adjustment of brake pedal
Wear of differential lock shifter pin		If the wear of the pins are excessive, exchange.

(8 pins)		If the tip is dull, repair with oilstone.
Fatigue in differential	Standard free	If fatigue is severe, exchange.
Lock spring Loose bolts	length 5.71 in. (145 mm)	 Tighten to tightening torque given in chart.

5-2 Checks and maintenance of rear axle system

Item	Important things	Cause and repair
Air pressure in rear tire	Standard pressure 22.8 lb/in^2 (1.6 kg/cm^2)	Make routine checks.
Backlash of rear wheel drive gear	Standard backlash 0.006 - 0.008 in. (0.15 - 0.2 mm) Limit of use 0.016 in.(0.4 mm)	If backlash is large, exchange (Check bearings, too.)
Lubrication of rear axle case cover 6209 Z bearing and oil seal	Every 500 hours	Make routine checks. Fill bearing grease.
Loose bolts		Tighten to tightening torque given in chart.

Note: The wear of the shaft, gear and bearing is greatly governed by the amount and quality of the oil. Therefore be sure to instruct the customers to make routine checks and to exchange oil for good quality oil.

(6) Adjustment of rear wheel tread

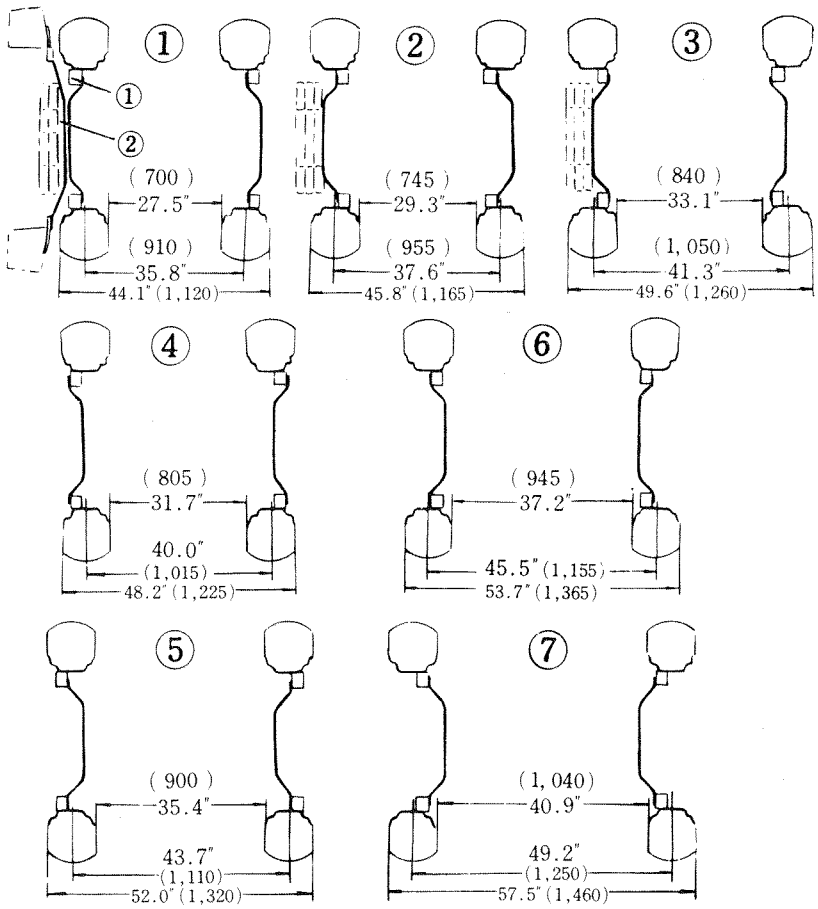


Fig. 62

1 Raise both of the rear wheels with a jack. Loosen nut 1 or 2, and by reversing the tire or the rim, it is possible to select the tread most suitable for the work.

2 By loosening nut 1 , it is possible to reverse the tires; and by loosening nut 2 , it is possible to reverse the rims.

Note: Whichever the case, set the tires so that the arrow mark on the tires point in the direction the tractor goes. In this case, the tire-marks form a "V".

6. BRAKE SYSTEM

(1) Inner structure and name of parts

Refer to Fig. 58.

The enclosed internal expansion type of brake system which was adopted for the KUBOTA L 20 Tractor and which was well-received by the users have been adopted for this tractor. The position of the installation is high, is very water-proof and has a simple structure which is easy to check and maintain.

(2) Disassembly and assembly

1 Remove brake connecting rod and the brake case cover. Then the brake cam and shoe can be removed attached to the case cover. (The brake shoe can be checked or maintained in this condition just by removing the spring.)

2 Remove the center bolt of the brake drum and pull out the drum.

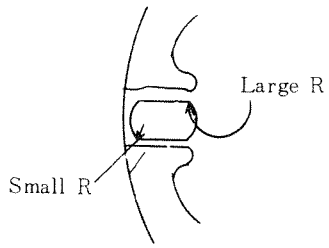
3 Loosen the four bolts and remove the brake box. (Knockpin have been used, so it may be difficult at times.)
In case it is necessary to dismantle brake case, drain out the oil in the transmission case beforehand.

4 At the time of assembly, the damaged packing should be exchanged for new one. The genuine parts used for the KUBOTA L 200 is a three sheet packing so do not use liquid packing such as three bond, etc.

(3) Checks and maintenance

The brake plays an important role at the time of work as well as for safety. Make routine checks of the brakes so that the brakes would always be in the best working condition.

Items	Important things	Cause and repairs
Correct amount of depression for brake pedal	0.59 - 0.79 in. (15 - 20 mm)	Refer to section on adjustment of brake pedal
Firm brake connecting rod connections		Check the cotter pin and spring of front part of brake connect-rod for damages and if necessary exchange.

Correct fit of brake cam. Also wear of cam.		
Wear of brake shoe cam part	Limit of use Up to 0.02 in. (0.5 mm)	When excessively worn, replace.
Wear of brake lining	Limit of use 0.012 in. (0.3 mm) from top of rivet	In the tractor, the frequency of use of the brake is very great so the wear of the lining is very fast. Therefore, conduct routine checks and change before excessively worn. If the brake is used with the limits over that of limits of wear, the lining may damage and peel, which is very dangerous.
Wear of brake drum	Standard inner dia 5.508-5.516 in. (139.9-140.1 mm) Limit of use 5.528-5.535 in. (140.4-140.6 mm)	Exchange those over limit of use. Damaged sliding surfaces should be lightly shaved or repaired with sandpaper.
Leakage inside of brake case (Leakage with brake in assembled condition)		When leakage occurs after disassembly of brake drum, the cause is because the "O" ring of the collar and oil seal is inserted poorly. Check "O" ring and oil seal.

(4) Adjustment of brake pedal

The position for depressing the brake pedal is always changing

because of the wear of the brake lining. In this structure the adjustment is made by adjusting the length of the brake connecting rod. The method is very simple when compared with the conventional method. It is by the brake lever adjusting nut.

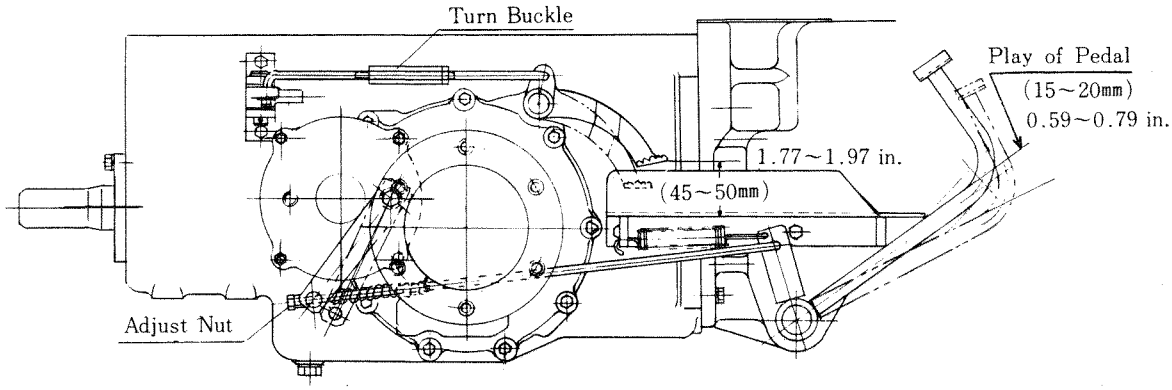


Fig. 63

1 The adjustment of the play is by the adjusting nut. When the play is great turn the nut to the right and when small turn to the left. (Be sure to adjust the pedals so that the heights of both would be the same.)

2 The height of the differential lock pedal is adjusted by the turnbuckle. When the height is high, turn the turnbuckle to the left, and when low, turn to the right.

7. HYDRAULIC SYSTEM

(1) Appearance and name of parts

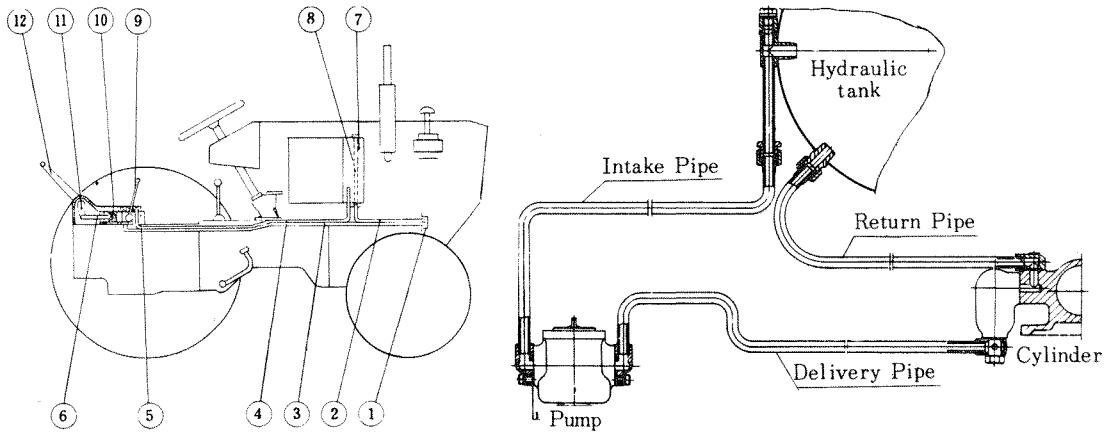


Fig. 64 Hydraulic piping system

1. Hydraulic pump	2. Intake pipe	3. Delivery pipe
4. Return pipe	5. Control valve	6. Hydraulic rod
7. Hydraulic oil tank	8. Oil filter	9. Control lever
10. Hydraulic piston	11. Hydraulic arm	12. Lifting lever

The hydraulic system in the tractor plays a very important role. Therefore, it need not be said that daily routine checks and maintenance must be performed carefully. The hydraulic pump and the control valve have been precisely machined and specially made so great care must be taken in the maintenance and checks of the pump and valve.

(2) General precautions concerning hydraulic system

1 Use specified oil. If poor grade oil, oil of unsuitable viscosity, acidic or alkaline oil, oil with kerosine high octane value, or vegetable oil should be used, the efficiency would decrease and be the cause of troubles. Be sure to use specified oil.

2 Be careful to use clean oil and to maintain at specified amount.

Time to exchange	1st time after 100 hours Thereafter every 300 hours	To line on filter 7.7 qt (7 liters)

3 Check the oil filter at all times and clean if necessary. It should be especially stressed that the metallic screen should not be torn so that foreign matters would infilterate into the oil. Also, if hydraulic system is used for front loaders, dump trailer, etc. by taking out from the hydraulic take-off tap of the control valve, the oil is apt to become dirty which would dirty the filter. Be careful to check well.

Check and clean every 100 hours

4 When the hydraulic piping has been removed or the oil has been drained, be sure to assemble perfectly, increase the revolution of the engine gradually in "lowering" or "neutral" position, and when the oil has circulated to all the parts, start to do the desired work. This is especially necessary in cold weather.

5 When air enters the piping system, it would develop a noise and vibration. It would necessitate attention to the coupling packing and "O" ring.

(3) Hydraulic pump

The various inner parts of the hydraulic pump have been machined precisely and are of very high quality. The respective parts are engaged and work at very high speed and move or slide at high speed. Therefore even a little "scratch" on the parts would greatly affect the performance. Parts with damages should be exchanged for new replacement parts.

3-1 Inner structure and name of parts

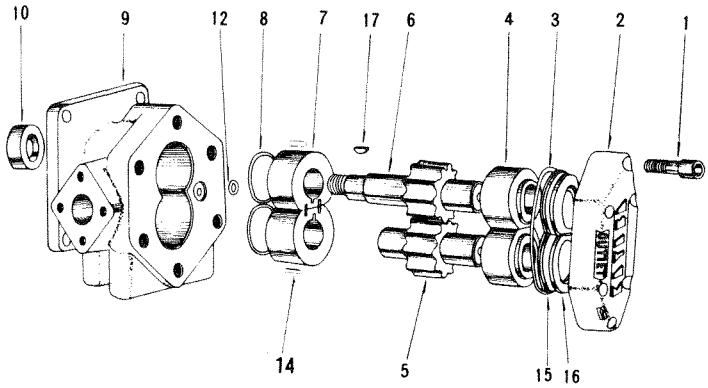


Fig. 65 Exploded view of gear pump (clockwise rotation)

1: Drilled bolt
2: Cover
3: "O" ring
4: A bushing (1 pair)
5: Gear
6: Drive shaft (1 pair)
7: C bushing (1 pair)
8: "O" ring
9: Body
10: Oil seal
12: "O" ring
14: Spring pin
15: Sealing ring
16: Support ring
17: Key

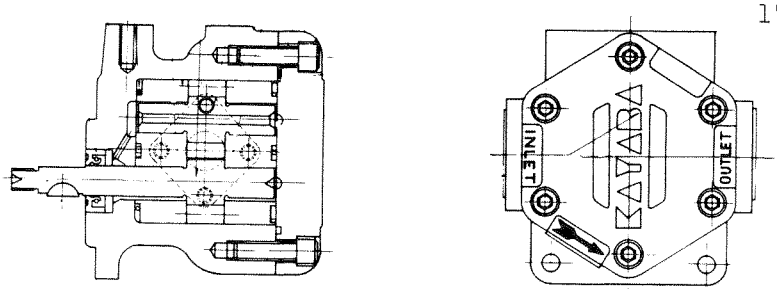


Fig. 66 Gear pump assembly

3-1 Disassembly and assembly

If anything abnormal develops in the hydraulic system, stop the system and check the whole system carefully. After confirming that the cause of the trouble is the pump, disassemble the pump.

Disassembly

1 Loosen drilled bolt (1).

2 Remove end cover (2) and "O" ring (3)

3 Remove the seal element which is composed of two sealing ring and support ring (15, 16).

Note: The sealing ring (15) and the support ring (16) can be removed as a unit.

4 Next, push the drive shaft (6) into the body. Then it would be possible to lift up the bushing (4) with the fingers.

After removing the bushing, take out the drive shaft and gear (6), gear (5), and the second bushing (7) to which "O" ring (8) is attached.

(Note) Do not use hammer or mallet to remove the bushing. If it should be difficult to remove the bushing, tap the body of the pump with something soft like wood very lightly. Then it would be possible to remove easily.

Precautions

1 At the time of disassembly, arrange the disassembled parts in the order of disassembly. Especially, care should be given to arrange the shaft and the bushing in their relative position so that there would be no mistakes.

Be careful not to mistake the idler side bushing for the drive shaft side bushing and assemble.

2 If oil seal (10) is not damaged, refrain from removing.

3 When removing the seal from inside of the casing, be careful not to damage the inner bore surface of the housing.

Item	Important things	Cause and repairs
Wear of gear tip and body Damage to gear, shaft and bushing	Clearance between gear tip and body should be within 0.002 in.(0.05 mm)	Worn or damaged body and gear would also mean greatly worn bushing and shaft so it is much more economical to change whole pump rather than parts.
Damaged "O" ring		At the time of re-assembly, replace "O" rings with new ones.
Worn shaft	Limits of wear of shaft at dia 0.4960 in. (12.598 mm)	When diameter is smaller than figure at left, replace with new one.
Worn bushing	Limits of wear lengthwise 0.7350 in. (18.669 mm)	When smaller than figure at left, replace with new one.
Clearance between shaft and bushing hole	Limits of clearance 0.0070 in. (0.177 mm)	When larger than the figure at left, (since the gear and the bushing are a pair with a width of 0.0002 in. (0.005 mm) respectively) exchange.
Damaged oil seal		When oil leaks or seal is deteriorated because of hardening or cracking, replace.

Assembly is in the reverse order to disassembly. Special attention should be paid to the following at the time of assembly.

1 Wash all parts clean with a cleaning solvent, being careful so that dirt and dust would not be stuck on the parts.

2 Insert bushing so that escape groove on bushing surface would not be slanted.

3 When parts are to be re-used, be sure to assemble in the same position it was at the time of disassembly.

4 After finishing assembly, check to see that it has been assembled properly. The pump should turn smoothly with something which is 3.94 in.(100 mm) radius. If it should be hard to turn, there is necessity of checking for the cause.

5 If the gear, bushing and body is exchanged, turn the pump at 500 rpm, zero atmospheric pressure for thirty minutes, then, gradually raise the revolution and the pressure. During this procedure, touch the pump with the hands and if the temperature has risen, check for the cause.

6 Even at the time of troubles with the pump, uncarefullness at the time of disassembly and re-assembly causing pump to become unusable would not warrant claims so positively do not disassemble the pump unless absolutely necessary.

(4) Hydraulic control valve

4-1 Inner structure and name of parts

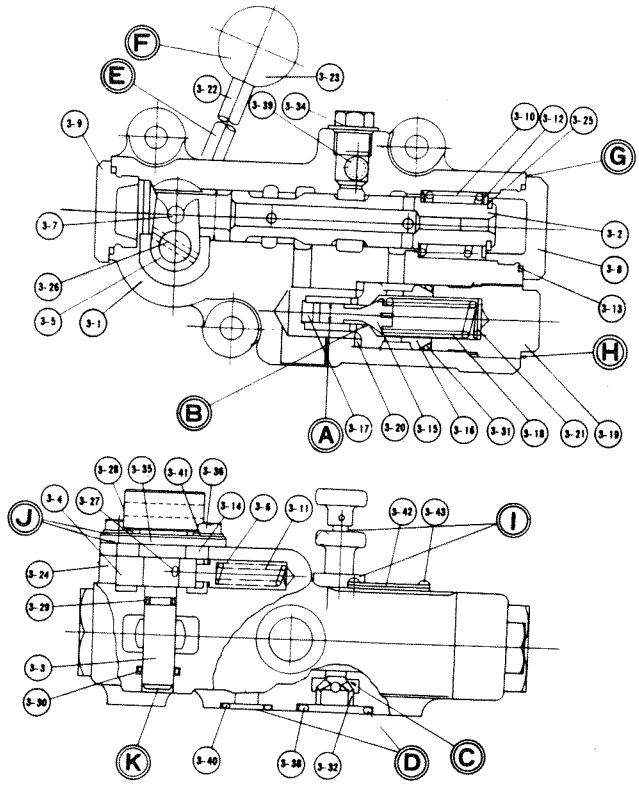


Fig. 67

As illustrated in Fig. 67, the inside of the valve is very complicated. Moreover, the various parts are very precisely machined. Therefore, be very careful in handling and disassembly.

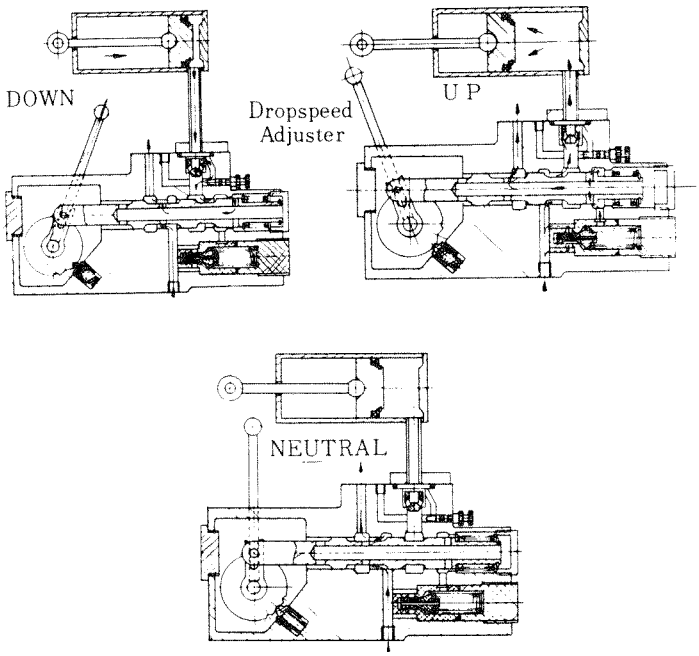


Fig. 68 Structure and function of hydraulic control valve

4-2 Disassembly and assembly

1 In the relief valve, loosen relief holder (3-19) and remove "O" ring (3-31). Then it would be very easy to remove the relief holder (3-16) and the relief valve.

2 To remove the spool (3-2), loosen cap (3-9) and pull out roll pin (3-26). Then it would be possible to disassemble camshaft (3-3). Push spool in fully and (3-7) will come off, and it would be possible to remove spool.

Assembly is in the reverse order to disassembly but be careful of the following.

1 Positively do not damage the sliding parts.

2 As "O" rings have been used for the shaft, refer carefully to the drawing at time of disassembly and assembly and be careful not to damage. If there should be

scratches or damages, exchange.

3 Be careful so that particles of iron or dirty water would not get into the parts and assemble after washing.

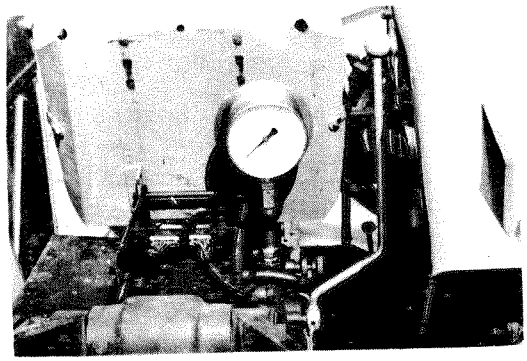
4-3 Checks and maintenance

Please refer to Fig. 67 for marks

Mark	Phenomena	Important things	Repairs and replacement parts
A	When worn, oil leakage from relief valve and drop in pressure	Limits of use of clearance (dia) 0.006 in.(0.15 mm)	Replace as complete units (3-15) - (3-18)
B	Faulty seating and drop in pressure One sided, or spring fatigue	Depth of scar on surface over 0.008 in. (0.2 mm) Also scar on seat (3-16)	Replace as complete unit (3-15), (3-16) (3-15) - (3-18) sold as complete unit .
C	Adjustment of lowering speed of implement does not work, or when there are scars	Check whether (3-32) moves lightly	Exchange (3-32) Slight repairs can be made by grinding. Desireable that control valve complete be exchanged in severe cases.
D	Oil leakage because of damaged "O" ring or because of loosened set bolts.	Check "O" ring	(3-38) P24 change "O" ring (3-40) P18 change "O" ring Tighten set bolts.
E	Dropping from neutral because of wear, or because of damage by scar	Limits of use clearance (dia) within 0.00079 in.(0.020 mm) Check inside and outside for scar Also check oil, oil filter	(3-1), (3-2) are selective fits so exchange together.
F	Lever does not stay fixed at "UP" or "DOWN"	Remove (3-28), (3-36) and check (3-4) cam and (3-11) notch spring	Replace (3-4), (3-6) and (3-11).

G	Oil leakage	Damaged (3-13) gasket (3-8) faulty tightening	Replace (3-13) gasket.
H	Oil leakage	(3-31) "O" ring damaged or distorted	Replace (3-31) "O" ring. (This is special dimension so use genuine parts.)
I	Oil leakage	Adjusting handle (3-33) screwed in too much, or too loose "O" ring (3-39) damaged	Replace "O" ring (3-39) P5 "O" ring.
J	Oil leakage	(3-14) rubber bushing (3-29) "O" ring damaged or distorted	Replace (3-14), (3-29) P10A "O" ring.
K	Oil leakage	(3-30) "O" ring damaged or distorted	(3-30) P14 "O" ring should be exchanged.

4-3 Pressure test of relief valve set when the relief valve has been exchanged or if the lifting power of the hydraulic system has decreased, check the set pressure of the relief valve in the following manner, and set to the specified pressure.



1 Remove plug (3-34), attach a coupling and set a 0 - 2130 psi. (0 - 150 kg/cm^2) or 0 - 3560 psi. (0 - 250 kg/cm^2) pressure gauge.

2 Set the control lever to "UP" and allow the relief valve to work. (Remove the automatic return device.) In this condition, if the cracking pressure is 1420 psi. (100 kg/cm^2) and the set pressure is 160 psi. (115 kg/cm^2), (with the rated engine revolution at 2800 rpm),

the setting is correct. If not, make adjustments by increasing or decreasing shims (3-21). (When the thickness of the shim is 0.02 in.(0.5 mm), the pressure difference would be 71.1 psi. (5 kg/cm^2)

(5) Hydraulic cylinder

5-1 Inner structure and name of parts

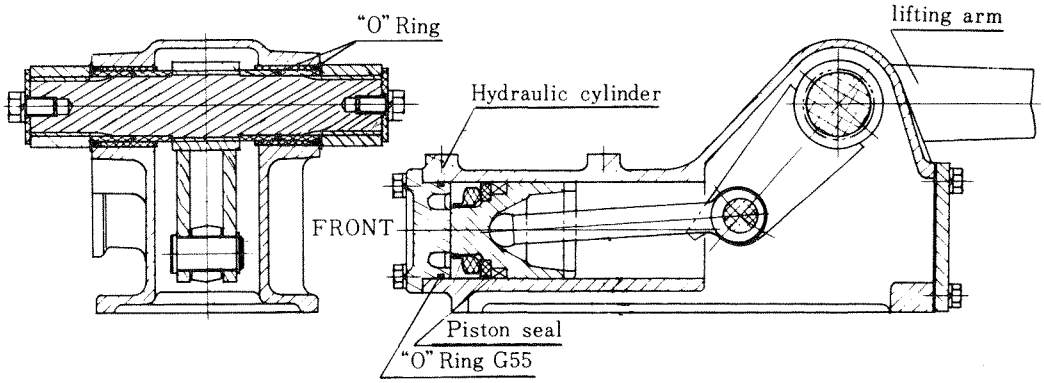


Fig. 69

5-2 Disassembly and assembly

The structure is very simple, so it is omitted here.

5-3 Checks and maintenance

Mark	Phenomena	Important things	Repairs and replacements
A	Insufficient hydraulic pressure for lifting because of scars	Limit of use dia. 2.56 in.(65.1 mm) Scars, axial direction depth under 0.002 in. (0.05 mm) width under 0.004 in.(0.1 mm) Roughness of surface under 234	Replace hydraulic cylinder
B	Poor lifting or hydraulic oil decreased because of damaged piston	Check piston seal. Damaged or those without elasticity are no good	Exchange piston seal

	seal		
C	Oil leakage	Damaged or distorted "O" ring of body cover Those without elasticity are no good	Exchange "O" ring G 55
D	Oil leakage from shaft part of lifting arm	Damaged "O" ring, or distorted Those without elasticity are no good	Exchange "O" ring

(6) Hydraulic oil tank

The hydraulic oil tank is together with the fuel tank and is on the engine side. When the cap of the oil tank is removed, there is the shaft of the oil filter. When the oil filter is removed, there is a notched line for the amount of oil in the central part. A metallic netting is at the tip of the filter.

Check of oil filter	Every 100 hours
Hydraulic oil	Hydraulic oil or turbine oil # 140

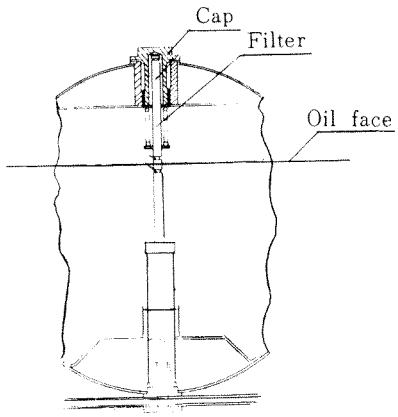
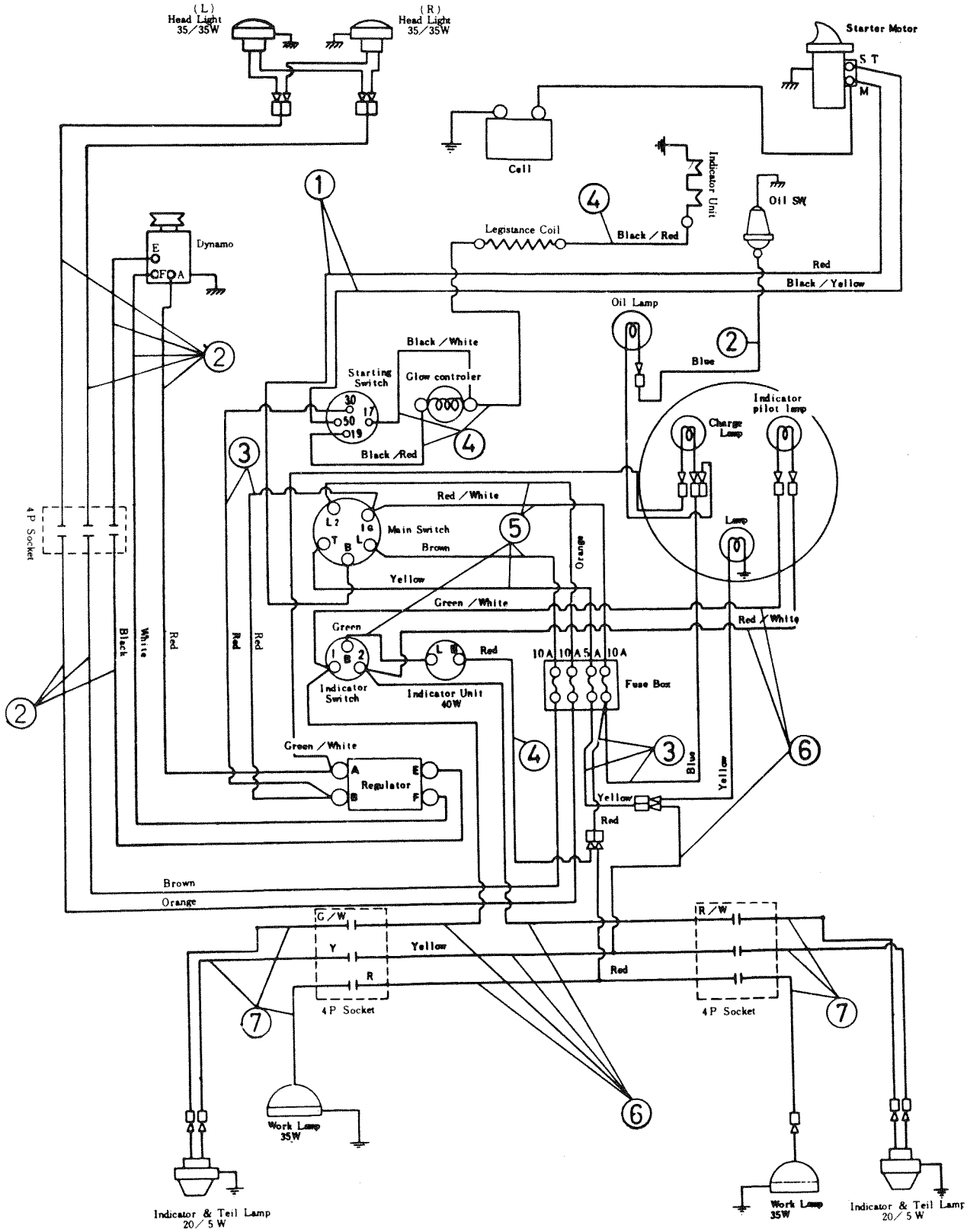


Fig. 70 Inside of hyraulic oil tank

8. ELECTRICAL EQUIPMENT

(1) Wiring diagram



(2) Dynamo

The dynamo used for this engine is a DC dynamo and the structure is as illustrated in Fig. 72. This DC dynamo uses the phenomenon of electro-magnetic induction. The alternating current developed in the copper wire is changed to direct current by the rectifier, taken out and is supplied as charging current to the battery. But it should be remembered that if the voltage developed in the dynamo is too great or the current is too large, it would be the cause of troubles. A regulator has been adopted to correct the voltage and current.

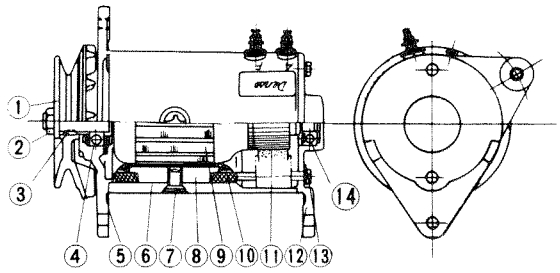


Fig. 72 Structure of dynamo

1: Pulley
2: Pulley locknut
3: Key
4: Ball bearing
5: Drive side end frame
6: Yoke complete
7: Pole core screw
8: Pole core
9: Armature complete
10: Field coil
11: Brush complete
12: Commutator side end frame
13: Through bolt
14: Ball bearing

1 Specification of dynamo

Code number	15211-64011 (Nippon Denso make)
Nominal voltage	12 V
Nominal output	10 A
Max. output revolution	Under 2100 rpm (at 68°F (20°C) 13 V)
Max. Continuous revolution	4500 rpm
Excitation system	Field coil inside earth
Direction of rotation	Clockwise (Seen from drive pulley side)
Regulator	26000-062-0

Ordinarily it is very easy to detect the trouble of insufficient charging of the battery because at the time of starting the engine, the revolution of the self starting motor becomes slow. In the case of over-charging, the battery electrolyte decreases very quickly and so should be easy to detect, but the trouble is very often apt to be overlooked.

The troubles can be categoried in the following way.

(a) Faulty battery itself

(b) Dynamo not generating properly

(c) Regulator not working properly

(d) Faulty wiring, such as poor contact or cut wires

At the time of detecting the trouble, first of all check which part of the above-mentioned is faulty and make necessary repairs.

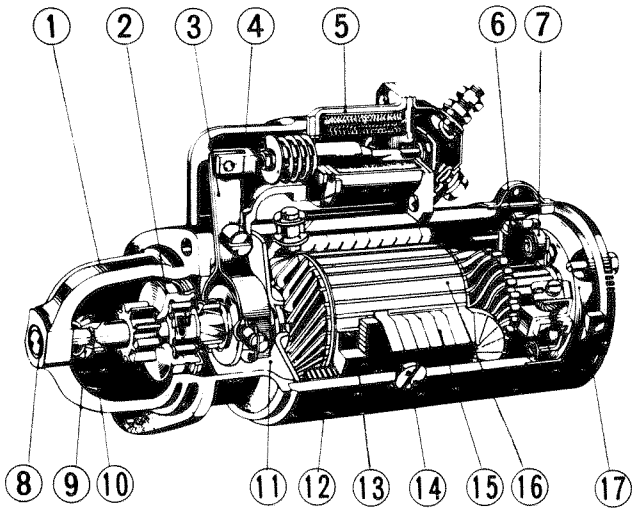
The reason why the battery is over-charging is due to the regulated voltage of the regulator being too high or the regulator is not capable of regulating the voltage. These are the only causes. In the case of insufficient charging, the above mentioned four causes are all causes.

Standard maintenance of dynamo

Item	Values	
Motoring test	Voltage	12 V
	Current	4 - 5 A
	Revolutions	1000 - 1400 rpm (Good..when smooth running)
Field coil	Resistance	About 15Ω (at 68° F)(20°C)
Brush	Length	24 mm (when new) Limit of use 16 mm
Brush spring	Pressure	800 - 1000 g (when new)
Pole core	Distance between poles 2.468 ± 0.0024 in.(62.7 ± 0.06 mm)	
Air gap		0.012 - 0.016 in.(0.3 - 0.4 mm)
Pulley lock nut	Tightening torque	21.7 - 36.2 ft-lb (3 - 5 m kg)

(3) Cell starter

The cell starter used in the tractor is a 2 coil type magnet switch, and does not require auxiliary relay. It can be worked directly by a starter switch. The structure is shown in Fig. 73.



1: Drive side housing complete
2: Overrunning clutch complete
3: Pinion drive lever
4: Drive lever set pin
5: Magnet switch assembly
6: Brush complete
7: Brush spring
8: Bearing bushing
9: Stop collar
10: Snap ring
11: Center bearing complete
12: Yoke complete
13: Pole core
14: Pole core screw
15: Feed coil complete
16: Armature complete
17: Commutator side frame

Fig. 73 Structure of cell-starter

This self starter is turned by the electricity from the battery It drives the engine through the ring gear. It has a very important function of starting the engine.

1 Specification of cell-starter

Code number	15021-63011 (Nippon Denso make)
Type	Magnetic switch type with over-running clutch
Nominal voltage Nominal output	12 V 0.9 KW
Type of motor	Series motor
Direction of rotation	Clockwise (when seen from pinion side)

When cell starter turns slowly or does not turn

In such cases, the cause may be faulty battery, faulty wiring

or the cell starter itself may be faulty. A simple way of detecting is to switch on the head-light. That is, with the engine stopped switch on the headlight.

If the lights are dim, the cause is battery not charged enough, or faulty wiring or faulty contacts of the terminal. Of course in this case, it is supposed that the headlight circuit is normal.

If the battery is not charged sufficiently because of faulty charging device, be sure to eliminate the cause before charging. Otherwise, the same trouble would be repeated.

With the battery in a completely charged condition

(a) If the lights should not light up

- - - Battery terminals are not connected correctly.

(b) If the lights become extremely dim at the time of starting, and the circuit should break or stop

- - - Engine side is faulty (resistance to turn great).
- - - Armature shaft bent
- - - Bearing bushing worn
- - - Pole core screw loose

} Cell starter does not turn.

- - - Field coil grand or layer short.
- - - Armature coil grand or layer short.

(c) If the lights should be bright and turning is slow

- - - Cell starter terminals not connected correctly.
- - - Contacts of magnet switch not connected correctly.
- - - Magnet switch does not work properly (broken wires, grand or layer short)
- - - Contacts of starter switch faulty.
- - - Brush contact pressure decreased.
- - - Commutator dirty and worn.

At the time of equipping the cell starter, if the tightening is insufficient and the brush is not in close contact, the contact of the pinion and the ring gear would be poor. This would damage the pinion and housing. In extreme cases, the self starter may not even turn.

When the switch is turned on and the engine is turning well but yet the engine does not start, check the fuel system, etc. and eliminate the causes of starting difficulties.
Even in the case of starting difficulties, absolutely refrain from using the cell starter continuously for over 30 seconds. The features of the cell starter is a short period rating for starting the engine so if the cell starter should be used for a long period of time, the solder of the armature would become damaged or the coil or lead wires may become burnt out. More-over the battery would be extremely consumed. These things would make starting much more difficult. Therefore, even in cases of starting difficulties, turn the cell starter for 10 seconds and rest for 10 seconds. Repeat this procedure to start.
In case the cell starter does not catch because the cell starter pinion gear and the flywheel ring gear is not well engaged, the tip of the pinion gear would wear excessively. In such cases, adjust the forward position of the pinion.
If the switch should be turned on while the engine is running, the pinion gear would come into contact with the ring gear which is turning. In such a case, a strength as of a hammer would be beating upon the pinion, and it would break the pinion gear, bend the shaft, break the housing, etc. Which are very serious troubles. Be very careful not to turn the switch on when the engine is running.

(4) Regulator

1 The regulator (26000-062-0) is a two element two contact point type regulator and is comprized of a voltage regulator with two pairs of point and cut-out relay. The structure of the various element is as of illustration in Fig. 74. The outstanding feature of this regulator is that it would stabilize and regulate the voltage even when there is an extremely wide range of dynamo speed fluctuation. Furthermore, the life of the point is very long.

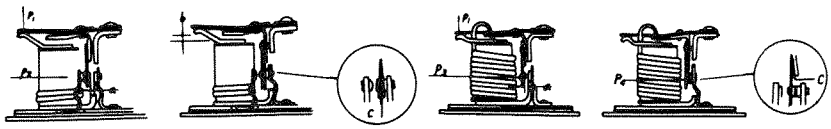
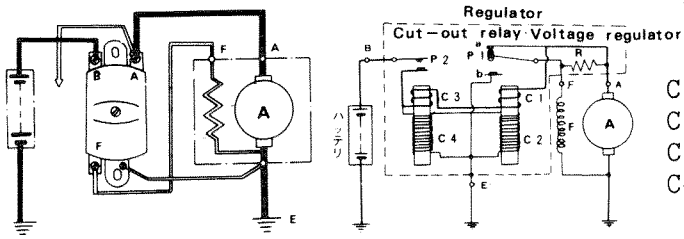


Fig. 74 Voltage regulator Cut-out relay

2 The wiring for charging is as illustrated in Fig. 75, and the various terminals of the regulator is connected as follows.

A----A terminal of dynamo F----F terminal of dynamo

B----B terminal of battery E----E terminal of dynamo



R: Control resistance
F: Field coil
A: Armature
C1: Current coil
C2: Voltage coil
C3: Current coil
C4: Voltage coil

Fig. 75 Wiring of charging system

Code number	17105-64601 (Nippon Denso make)
Type	2 element 2 contact point type
Regulated voltage	14.0 - 15.0 V (when load current is 0 A)
Regulated voltage	Over 13 V (when load current is 6 A)
Cut-in voltage	12.5 - 13.5 V
Counterflow	Under 8A

Wiring should be performed correctly and accurately according to Fig. 75. In this specified wiring condition, the various terminals should not be grounded or short-circuited. This regulator must not be assembled and used together with the dynamo for KUBOTA Z 1100 engine (Code number 15211-64011 Nippon Denso make).

It should be added that this regulator is interchangeable with those used for KUBOTA E 90 Engine (KUBOTA L12 Tractor), KUBOTA UL Engine (KUBOTA L15 Tractor), KUBOTA Z 1000 Engine (KUBOTA L 20 Tractor), KUBOTA Z 1200 Engine (KUBOTA ST 22

Tractor) KUBOTA D 1500 Engine (KUBOTA L27 Tractor), KUBOTA D 1900 Engine, (KUBOTA L 35 Tractor) and the general purpose diesel engines KUBOTA KND3, KUBOTA Z 105 and KUBOTA D 105 respectively.

The regulator has been sealed so that the inside of the regulator would not be touched. Refrain from touching unless absolutely necessary. If it must be opened, be very careful. Even if it should be absolutely necessary, the repair of the regulator should be limited to grinding of the point only. In case of troubles listed hereunder, exchange the unit as a complete unit.

(a) burnt or melted point

(b) cut or burnt out coil

(c) burnt out or damaged resistor

(d) other unrepairable troubles

The troubles with the regulator are greatly from outside influence so at the time of replacement with new ones or at the time of repair, be sure to check for the cause and eliminate it. Otherwise it would be a repetition of the same cause.

The resistance between the terminals of the regulator are given below for your reference. However, it should be remembered that the figures given are those when the regulator is normal.

Place	Resistance	Remarks
A-F	0 Ω	When there is resistance, contact of the points of the voltage regulator is faulty.
A-E	Ab. 50 Ω	When about 100Ω, either one of the voltage coil is cut. When less than 50Ω, either one or other of the voltage coil is earthed or layer short-circuited.
A-B F-B		When there is current the point of the cut-out relay is in contact.
E-B		When there is current between E-B, earthing of the coil may be the cause.
F-E	Ab. 50Ω	When larger than 50Ω, contact of voltage regulator point faulty.

		When 100Ω, either one or other of voltage coil is cut, When smaller than 50Ω, either one or the other of voltage coil is earthed or layer short-circuited. When 0Ω,unter rage point of voltage regulator (Fig. 76) has melted.

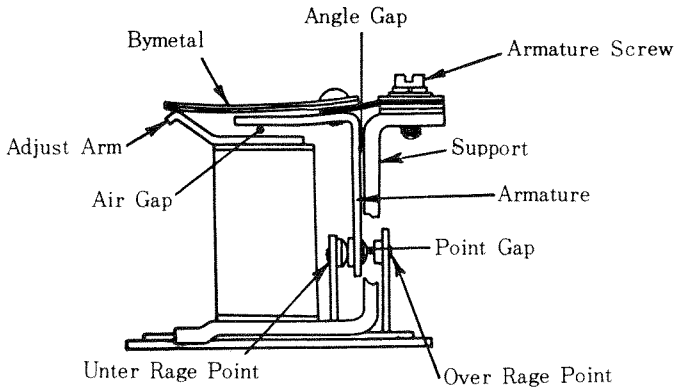


Fig. 76 Names of various parts of voltage regulator

(5) Glow plug

The glow plugs are of coil type and are equipped one to each cylinder

They are connected in series. The wiring is as of Fig. 77.

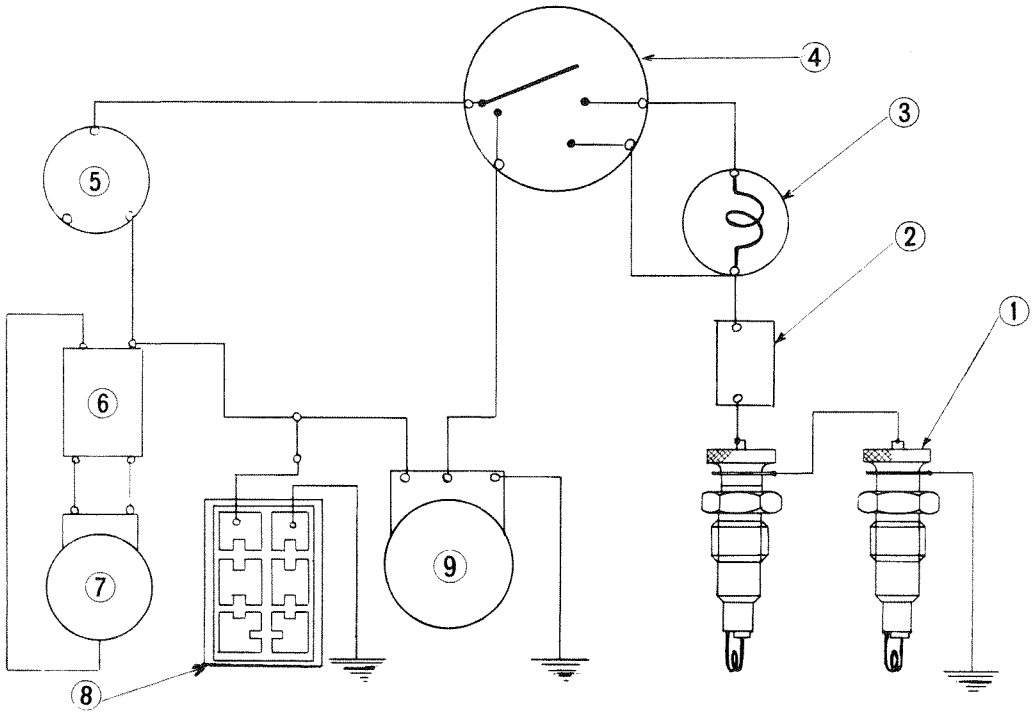


Fig. 77 Wiring of glow plug

1: Glow plug　　2: Glow plug resistor　　3: Glow plug controller
4: Starter switch　　5: Main switch　　6: Regulator
7: Dynamo　　8: Battery　　9: Starter

Code number	15101-65511 (Nippon Tokushu Togyo make)
Voltage Current	Direct current 1.5 V 40 A

Unless code number 32150-32701 (Nippon Denso make) glow plug controller is used as the controller and code number 32270-32901 (Nippon Denso make) resistor is used as the resistor, the time for the glow plug and controller to become red would vary. Then the start would be bad, and become the cause of troubles. It should be stated here that these parts are the same controller and resistor used in Model L 15 Tractor and Model L 20 Tractor.

Since the glow plug are in series, even if one of them should become faulty, the controller would not turn red. In such cases, check both of the plugs.

If the glow plug should become faulty, just changing the faulty glow plug cannot be said a complete repair. If the condition of the glow plug trouble should indicate defects in parts other than the glow plug, check for the defective part and eliminate. Some of the causes which may be considered are unsuitable or improper injection timing, faulty nozzle, poor quality fuel, mistaken wiring, leakage of gas, etc.

Concerning other maintenance, refer to the maintenance chart for the KUBOTA Z 1100 Engine and maintain the engine in the proper manner.

(6) Troubles of switch system

6-1 When engine does not start or is difficult to start

1 Turn the main switch to the right one stage, and test the continuity between terminals B and I G with a tester. If it should be normal, next, with the starter switch lever turned to the right one stage, measure

the continuity of terminals 30 and 17 and 50 with a tester.

Next, with the lever turned to the left, measure the continuity between terminals 30 and 19 with a tester.

With the above tests, if there should be nothing abnormal, the trouble is places other than the switch.

(Examples) Cut cords — Loosened terminal screws
Faulty cell-starter — Faulty glow, resistance
Faulty fuel system — Blown fuses

6-2 Headlights and taillights do not light up

Headlights blink.

Winker switch not turned on but tail light blinks.

1 Turn main switch key to the right two stages, and measure the continuity between terminals B - L_1 and B - T with a tester.

2 Turn main switch key to the right three stages and measure the continuity between terminals B - L_2 with a tester.

In the above tests, if there should be nothing abnormal, the trouble is places other than the switch.

(Examples) Cut cords — Loosened terminal wiring
Faulty bulb — Blown fuses
Faulty earthing

6-3 Winker circuit is not working properly (tail light, front winker)

1 If the blinking is extremely unusual, the cause is the flasher unit.

2 After confirming that the bulb is not faulty, turn the flasher switch to the right or the left and confirm the continuity of terminals B - 1, B - 2. If it does not work correctly, the cause is the flasher unit.

Otherwise, it is places other than the flasher unit.

(Examples) Cut cords — Loosened terminal screws
Blown fuses — Loose fuse
Faulty arm

(7) Correct handling of battery

7-1 Routine checks

The battery is always losing its capacity by self discharge. Therefore, even if the tractor is not to be used, the battery should be checked in a routine manner.

1 Check of charged condition

When the amount of electricity in the battery decreases, the starting of the engine would become difficult, and the lights would become dim. But even if this is noticed and the battery is charged, it is not possible to charge the battery fully.

Check the condition of the charge in the battery and try to charge the battery before it is discharged and always keep the battery charged at a constant amount.

Check electrolyte by the hydrometer.

Check by measuring the voltage.

Judge of charged condition

Check of specific gravity of electrolyte by hydrometer.

The relation between the specific gravity of electrolyte and the charged condition would be as follows.

Specific gravity and charge

The specific gravity at time of complete charge is considered 1.280 at a temperature of 68° F. (20° C.)

Specific gravity	Condition of charge		
1.280	100%	Charged condition	Useable
1.250	75%		
1.210	50%	Useable limit	Charge immediately
1.180	25%	Discharged condition	
1.150	10%		
1.120	0	Completely discharged	

Note:

When the temperature is high, the specific gravity of the electrolyte decreases, and when the temperature is low increases. Therefore, the specific gravity at time temperature is

68° F (20°C) is taken as the standard. To find the correct specific gravity, use the following equation and calculate the specific gravity at 68°F (20°C), and make the specific gravity of the electrolyte to the specified specific gravity.

$$S_{20} = S_t + 0.0007\left\{\frac{5}{9}(t-32) - 20\right\}$$

wherein t . . . temperature of electrolyte

S_t . . . specific gravity of electrolyte

S_{20} . . calculated specific gravity at 68°F (20°C)

For instance we have here a battery which had a specific gravity of 1.280 (completely charged) at 68°F (20°C), and which is now discharged and must be charged. If the temperature of the electrolyte is 77°F (25°C),

$$1.280 = S_t + 0.0007\left\{\frac{5}{9}(77-32) - 20\right\}$$

$$S_t = 1.280 - 0.0035 = 1.2765$$

When S_t = 1.2765, it would mean completely charged.

Check by measuring the voltage

Check by excel tester.

In the case of ordinary battery, it is possible to judge the charged condition by and , but with the tractor battery it is not possible to check the voltage of the respective cell because in the tractor battery it is possible to check only the positive and negative terminals.

Therefore, checks must be performed by the first method given above.

Check of the level of the electrolyte

While the battery is being used, the water in the electrolyte will evaporate or may decreased because of decomposition during charging. Therefore, while the tractor is being used, check once a week, and if the level of the electrolyte has fallen refill with distilled water. If adding water is neglected, the plates of the battery would be extremely damaged and it would become impossible to charge the battery or influence the performance and life of the battery. Be very

careful of this.

Charging the battery

Although the battery is not being used, it would self discharge at a rate of 0.5 - 1% daily. Therefore, if a battery which had been stored away for a long period of time is to be sold, it would not only be unsuitable for operation but also would be damaging the battery. Therefore, at the time of taking out of the storeroom, check the electrolyte of the battery and if it should be below 1.200 (68°F) (20°C), charge the battery.

Remove the battery and wash well with clean water. Then check the electrolyte level. If it should be low, add distilled water.

Connect to charger.

There are two types of charging, the constant current charger (charging for a long time at a low constant current) and the quick charger (charging for a short time at a relatively large current). Recently, the quick charger is greatly being used but it would be better to refrain from using the quick charger is very damaging to the batter.

Gas (hydrogen) develops during charging so remove the cap of the battery. Also be very careful of fire because it is explosive.

When the electrolyte becomes 113°F (45°C), drop the current to 1/2, and wait for the temperature to drop.

After finishing charging, polish the terminal of the cable and the terminal of the battery and then mount onto the tractor. Apply a little grease or vaseline to the terminal connections.

Precautions for long storage

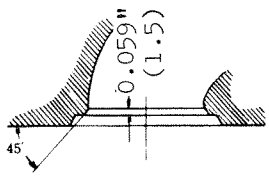
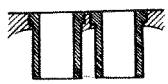
When the tractor is to be stored away for a long period of time, remove the battery from the tractor and charge the battery completely. After adjusting the level of the electrolyte, store away in a dry shady place.

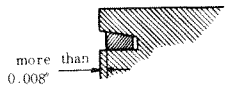
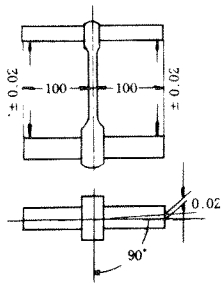
The battery will self-discharge during storage so it is necessary to charge the battery once a month for certain.

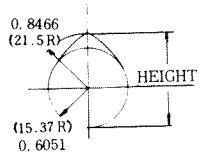
9. REFERENCE CHARTS

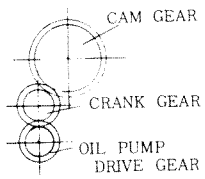
(1) Maintenance chart

1-1 Standards of maintenance for KUBOTA Z 1100 Engine

Group	Maintenance item \ Standards	Dimensions in. (mm)	Standard clearance (Assembly standards) in. (mm)	Limits of wear	Remarks in. (mm)
Cylinder head	Tightening of cylinder head (1)	M14 P 1.5	152±3.6ft-lb (21±0.5 m-kg)		
	" (2)	M10 P1.25	36-43.5ft-lb (5-6 m-kg)		
	Distorsion of cylinder head		Less than 0.00197" (0.05)		
	Seating dimensions of intake & exhaust valves	45° 0.059" (1.5)			Gasket thickness 0.071 0.004" (1.8 0.1 mm) (Adjust by using 0.008" (0.2 mm) adjusting shims.)
	Top clearance		0.035-0.043" (0.9-1.1)		
Cylinder liner	Standard inner dimensions	34.6" +0.00087 0 (88øH6 (+0.022 0))		0.008" (0.20)	 Two assembled together cylinder liner. Protrusion of liner from frame surface 0.008-0.011" (0.2-0.27)
	Piston clearance		0.00315-0.00480" (0.08-0.122) at skirts		
	Type		Two wet type assembled together		
Piston	Standard outer dimensions	34.6" (88ø)			
	Inner dimensions of piston pin boss	1.1024" +0.00051 0 (28ø H6 (+0.013 0))		0.002" (0.05)	
	Clearance between inner dimension of boss and pin		Tightening allowance 0.00043" (0.011) Clearance 0.00043" (0.011)		

Piston ring	Ring gap		0.012-0.020" (0.3 - 0.5)	0.059" (1-5)	
	Ring width (top)	Keystone type			
	Ring width (second, third)	$0.0787\ ^{-0.00039}_{-0.00087}$ $\left(2(^{-0.01}_{-0.022})\right)$	Clearance to ring groove 0.00256-0.00362" (0.065-0.092)		When top ring is fitted into groove ring should sink more than 0.008" (0.2 mm) from side surface of piston
	Oil ring	$0.17716\ ^{-0.00039}_{-0.00118}$ $\left(4.5(^{-0.01}_{-0.03})\right)$	0.00079-0.00236" (0.02-0.06)		
Piston pin	Outher diameter	$1.1024^{+0.000433}_{+0.000079}$ $\left(28\phi K5(^{+0.011}_{+0.002})\right)$		-0.00098 (-0.025)	
	Clearance between pin and bushing		0.00114-0.00209 (0.029-0.053)	0.008" (0.2)	
Connecting rod	Inner diameter of small end	$1.2598"\ ^{+0.00063}_{0}$ $\left(32\phi\ H6(^{+0.016}_{0})\right)$			
	Width of small end	1.0236" (26)			
	Inner diameter of large end	$2.2441"\ ^{+0.00075}_{0}$ $\left(57\phi\ H6(^{+0.019}_{0})\right)$			
	Width of large end	$1.4567"\ ^{-0.01181}_{-0.01575}$ $\left(37(^{-0.3}_{-0.4})\right)$			
	Clearance between Crank arm and sides		0.016-0.024" (0.4-0.6)		Lubricate whole bolt with engine oil at time of assembly.
	Distorsion of rod (See diagram)		0.0008" (0.02)	0.002" (0.05)	
	Tightening torque of connecting rod bolts	M10 P 1.0	43.5-47ft-lb (6-6.5 m-kg)		
Crankpin metal	Inner diameter	$2.126"\ ^{+0.00177}_{0}$ $\left(54\phi\ (^{+0.045}_{0})\right)$			Undersize 0.00984 0.01969" (0.25, 0.5) Thickness at central part $0.059"\ ^{0}_{-0.00051}$ $\left(1.5(^{0}_{-0.013})\right)$
	Width	1.1024±0.005" (28±0.13)			
	Outer diameter	$2.2441\ ^{+0.0039}_{+0.0008}$ $\left(57\phi\ (^{+0.1}_{+0.02})\right)$			
	Oil clearance		0.00118-0.00370" (0.03-0.094)	0.0098 (0.25)	

Crankshaft main bearing	Flywheel side Diameter of main	3.1496" $^{+0.00177}_{0}$ (80ø n6 ($^{+0.045}_{0}$))			
	Flywheel side Inner diameter of main bearing	3.1496" $^{+0.00016}_{-0.00075}$ (30ø ($^{+0.004}_{-0.019}$))			Taper roller bearing #30216
	Flywheel side Main bearing width	1.1024" $^{+0.01969}_{0}$ (28ø ($^{+0.5}_{0}$))			
	Flywheel side Outer diameter of main bearing	5.5118" $^{+0.00028}_{-0.00106}$ (140ø ($^{+0.007}_{-0.027}$))			
	Gear side Diameter of main bearing journal	2.3622" $^{+0.00094}_{+0.00043}$ (60ø m5 ($^{+0.024}_{+0.011}$))			Taper roller bearing #32212
	Gear side Inner diameter of main bearing	2.3622" $^{+0.00016}_{+0.00075}$ (60ø ($^{+0.004}_{-0.019}$))			
	Gear side Main bearing width	1.1614" $^{+0.01969}_{0}$ (29.5 ($^{+0.5}_{0}$))			
	Gear side Outer diameter of main bearing	4.3307" $^{+0.00024}_{-0.00083}$ (110ø ($^{+0.006}_{-0.021}$))			
	Diameter of crankpin journal	2.1260" $^{-0.00118}_{-0.00193}$ (54øf6($^{-0.030}_{-0.049}$))			
	Crankshaft side clearance		0.004-0.008 (0.1 - 0.2)		Adjust by bearing case packing
Camshaft	Flywheel side Inner diameter of bearing	0.7874" $^{+0.00012}_{-0.00051}$ (20ø ($^{+0.003}_{-0.013}$))			Roller bearing N J 304
	Gear side Inner diameter of bearing	1.3780" $^{0}_{-0.00047}$ (35ø ($^{0}_{-0.012}$))			Ball bearing 6207 C3
	Axial direction clearance				
	Intake & exhaust cam lift	0.2362" (6)			
	Intake & exhaust cam height	1.4516" (36.87)			
	Fuel cam lift	0.2756" (7)			
	Basic circle of fuel cam	1.2205" (31ø)			

Timing gear	Number of teeth crank gear	25 teeth			
	Number of teeth cam gear	50 teeth			
	Number of teeth oil pump drive gear	26 teeth			
	Backlash		0.0028-0.0059″ (0.07-0.15)		
Valve	Valve angle	45°			
	Valve diameter (Intake)	1.4961±0.0039″ (38ø± 0.1)			
	Valve diameter (Exhaust)	1.2598±0.0039″ (32ø ± 0.1)			
	Valve stem diameter	0.3543″ $^{-0.00098}_{-0.00157}$ ($9øe7(^{-0.025}_{-0.040})$)			
	Inner diameter of valve guide	0.3543″ $^{+0.00059}_{0}$ ($9øH7\ (^{+0.015}_{0})$)			
	Stem guide clearance		0.001-0.002″ (0.025-0.055)		
	Valve clearance		0.008-0.010″ (0.2-0.25)		Valve clearance dimensions when engine is cold.
Valve spring	Free length	1.87″ $^{0.0197}_{0}$ 47.5 ($^{+0.5}_{0}$)			
	Spring pressure		32.4 lb/1.5945″ (14.7kg/40.5)		Attached weight/ attached length.
	Straightness			3%	
	Decrease in spring pressure at time of attaching			1.5%	
Pushrod	Total length	7.9527±0.0059″ (202±0.15)			
	Diameter	0.2756± 0.00394″ (7ø ± 0.1)			

Valve timing	Intake valve opens		TC - 20°		TC-Top dead center
	Intake valve closes		BC - 45°		BC-Bottom dead "
	Exhaust valve opens		BC - 50°		- Before
	Exhaust valve closes		TC - 15°		+ Past
	Firing order		1 → 2		
	Injection timing		TC - 24°		Injection pump PFR 2K70/2/8-3a
Oil Pump	Width of gear tooth	0.6290" $^{-0.00126}_{-0.00197}$ ($16e7(^{-0.032}_{-0.050})$)			Oil to be used (Service DM . DS) Under 32°F (0°C) SAE 10W or 10W 30 32°F to 77°F (0°C to 25°C) SAE 20 Over 77°F (25°C) SAE 30
	Number of gear tooth	0.3543" (9)			
	Clearance between gear and body		0.00098-0.00295" (0.025-0.075)		
	Side clearance between gear and body		0.00181-0.00362" (0.046-0.092)		At oil temperature 176°F (80°C) after one running
	Oil pressure		71.1-78.3p.s.i. (5-5.5 kg/cm^2)		
	Oil pressure to light pilot lamp		21.35 p.s.i. (1.5 kg/cm^2)		
Fuel injection pump	Type	Bosch type PFR2K70/2/8-3a			
	Injection pressure		1990 p.s.i. (140 kg/cm^2)		
	Diameter of pump plunger	0.2756" (7ø)			
	Stroke of pump plunger	0.2756" (7)			
	Pump capacity		(152.6±12.2)x10^{-5}in^3/st (25±2mm^3/st) (per one cylinder)		Cam speed 1350 rpm rack position at knotched position
	Injection starting angle adjustment		4° (Cam angle)		See page 19 for details of adjustment.
Injection nozzle	Type	N-DN12SD12			
	Injection pressure	1990 p.s.i. (140 kg/cm^2)			See page 24 for details of adjustment

Radiator	Cooling system	Natural circulation			Without thermostat
	Type of radiator	Fin and tube type			
	Radiator cap pressure		11.4 p.s.i. (0.8 kg/cm^2)		
	Fan belt dimension	VA 48			
Battery	Type	12V 80AH equivalent			N 70 Z
	Discharged specific gravity	1.116			
	Charged specific gravity	1.280 68°F (20°C)			
	Overcharged specific gravity	1.300			
Dynamo	Voltage	12V			
	Current	10A			
	Check time	1000 hours			Insulation, resistance
	Positive spring pressure		31.7 OZ (900 gr)	±15%	
	Insulation resistance		Should be normal at 500V mega		
Voltage Regulator	Regulated voltage		14 - 15 V		
	Current		10 A		
	Cut-in voltage		12.5-13.5 V		
Starter	Number of pinion teeth	11 teeth			
	Number of ring gear teeth	122 teeth			
	Positive spring pressure		1.764-2.205 lb. (0.8-1.0 kg.)	1.389 lb. (0.63kg)	
	Insulation resistance		Should be normal at 500V mega		
	Check time	1000 hours			Insulation resistance
	Output	0.9 kw (nominal power)			

Tightening torque	Rod bolt	M10 P 1.0	43.5-47 ft-lb (6-6.5 m-kg)	
	Flywheel set bolt	M12 P 1.0	79.5-86.6ft-lb (11-12 m-kg)	
	Rocker arm bracket set stud	M10 P 1.25	36-43.5 ft-lb (5-6 m-kg)	
	Nozzle holder set stud	M8 P 1.25	13-15.2ft-lb (1.8-2.1 m-kg)	
	Cylinder head nut (1)	M14 P 1.5	148-155ft-lb (20.5-21.5m-kg)	
	Cylinder head nut (2)	M10 P 1.25	36-43.5ft-lb. (5-6 m-kg)	
	Fuel injection pump set stud	M8 P 1.25	17.3-20.2ft-lb (2.4-2.8 m-kg)	
	Ordinary parts set bolts or studs			
		When M 12	57.8-66.5ft-lb (8-9.2 m-kg)	(7) ⬡ ⊕ This is applicable when the bolt or the stud side has the figure 7 or punch-marks and are of S 45 C material.
		When M 10	36-41.2 ft-lb (5-5.7 m-kg)	
		When M 8	17.7-20.2ft-lb (2.4-2.8 m-kg)	
		When M 6	7.2-8.3 ft-lb (1-1.15 m-kg)	

1-2 Fuel injection pump and nozzle

Group	Maintenance items	Standard	Repair Limits	Remarks
Fuel injection pump	Plunger oil leakproofness:			Use pressure gage attaching pipe
	Time required to drop from a beginning pressure of 8640 p.s.i. to 7200 p.s.i. (600 kg/cm^2 to 500 kg/cm^2)	Over 8 seconds	4 seconds	
	Delivery valve oil leak-proofness			Use pressure gage attaching pipe and plunger must always be at bottom dead center.
	Time required to drop from a beginning pressure of 1420 p.s.i. to 72 p.s.i.(100 kg/cm^2 to 5 kg/cm^2)	Over 10 seconds	5 seconds	Oil pressure gage .....5000psi(350kg/cm^2) Pipe .....Inner dia. 0.0787" (2 ø) Lenght 3.937" (100 mm)

Fuel injection nozzle	Oil leakage from seat of needle valve	There should be no leakage		When drop pressure to 1850 p.s.i. (130 kg/cm^2)
	Needle valve shaft oil leak-proofness	Over 5 seconds	3 seconds	Apply a pressure of 4270 p.s.i. (300 kg/cm^2) at beginning to the nozzle and take the time required for pressure to drop to 2850-3560 p.s.i. (200-250 kg/cm^2. Provided however, the pump to be used in NP-EFRP60ANI.
	Atomization and injection	(1) There should be no large droplets when seen with the naked eye. (2) Droplets should not scatter sideways. (3) Initial injection should be intermittant injection.		

Remarks:

Check of pump element

Wash the plunger and cylinder is cleaning solvent or light oil. Then pull out the plunger and tip the cylinder at an angle of 60°.

Release the plunger. The plunger should sink slowly into the cylinder.

Test in this way, turning the plunger several times.

Check of delivery valve.

Check the delivery valve by checking the wear of the piston and the seating of the valve seat. An easy and simple way of testing the delivery valve is to pull up the piston and close the bottom part of the valve seat with thumb.

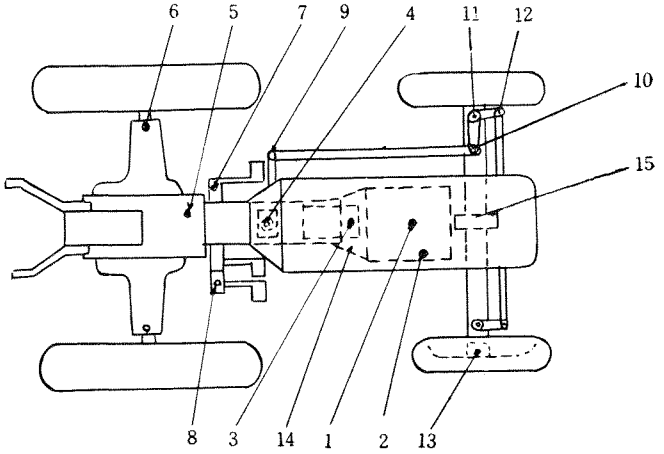
If the piston is extremely worn, the piston would drop quickly. But if it should be in good condition, it would hardly drop down. Then push the valve from above, and release the hands. The piston would the return to the former position. If the fit is not such, it would not function properly.

1-3 Standards of maintenance for Model L 200 tractor body

	Maintenance items	Dimensions in.(mm)	Standard clearance (Assembly standards) in.(mm)	Limits of Use	Remarks
Brake	Type				Internal expansion mechanical type
	Drum inner diameter	5.5" (140mm)	0.0079-0.024" (0.2 - 0.6mm)	5.6" (142 mm)	
	Lining thickness	0.2" (5)		0.12(3)	
	Brake pedal play		2.0"(50)		At tip of pedal
Clutch	Type				Dry single plate
	Disk outer diameter	7.2"(184.2)			Levelness of facing less than 0.015" (0.4 mm)
	Disk inner diameter	5.0"(127)			
	Assembled disk thickness	0.31-0.33" (7.8-8.3)			Vertical away of facing at circumference less than 0.04" (1.0mm)
	Clutch pedal play		0.79 - 0.90" (20 - 25)		
	Spline play		0.0005-0.0045 (0.013-0.114)	0.012 (0.3)	
Alignment	Toe-in	0.2"(5)	0 - 0.4" (0 - 10)		
	Camber	2°			
	Caster	2° 30'			
	King pin angle	10°			
	King pin outer dia	1.1"ø (28ø)			
	King pin bushing inner diameter	1.1"ø (28ø)	0.004-0.005" (0.10-0.141	0.009" (0.25)	Limit of clearance between king pin and bushing
	Front hub bearing	6205, 6206			
Steering	Type				Ball screw type
	Gear ratio		19.79 : 1		
	Steering wheel play		0.90 - 2.0" (25 - 50)		
	Minimum turing radius		6.2 ft. (1.9 (M))		

Transmission	Type				Gear selection sliding type Forward..... 6 Reverse..... 2
	Gear backlash		0.004-0.008″ (0.1 - 0.2)	0.020″ (0.5)	
	Spline clearance		0.0012-0.0030″ (0.030-0.078)	0.008″ (0.2)	
	Shift fork width	$0.28^{\prime\prime}\ ^{-0.005}_{-0.007}$			
	Shift gear groove width	$\left(7\ (^{-0.05}_{-0.10})\right)$	0.004-0.008″ (0.1 0-0.2)	0.016″ (0.4)	Clearance between fork and gear groove
	Shift gear groove width	$0.28\ ^{+0.002}_{-0.001}$ $\left(7\ (^{+0.10}_{+0.05})\right)$			
	Type				Gleason 35° spiral
	Backlash of drive bevel		0.0051-0.0071″ (0.13 - 0.18)		
	Assembly dimension A		3.9″ (99)		
	Assembly dimension B		1.5″ (38)		
	Differential pinion backlash		0.004-0.008 (0.1 - 0.2)	0.016 (0.4)	
	Thickness of bevel adjusting shim		0.008″ (0.2)		
	Type				Spur gear
	Number of teeth				13 T - 66 T
	Backlash		0.004-0.008″ (0.1 - 0.2)	0.020″ (0.5)	
	Rear tire		9.5/9 - 24		
	Rear wheel rim		DCW 7 x 24		
	Rear tire air pressure		17.1 psi. (1.2 kg/cm^2)		
	Front tire		4.00 - 15		
	Front wheel rim		DC3.00D x 12		
	Front tire air pressure		42.7 psi. (3.0 kg/cm^2)		
	Pump model	GP 1/25			Gear pump
	Pump pressure	1420 psi. (100 kg/cm^2)			
	Pump capacity	11.4 qt/min (10.8 L/min			
	Arm lifting speed	1.75 sec			
	Lifting capacity	1885 lb (855 kg)			At tip of lower link

(2) Checks and lubrication chart



No.	Name of part	Lubricant	Period for Exchange	Amount
1	Engine	Ambient temerature Under 32°F (0° C) SAE 10W or 10W-30 32°F to 77°F (0°C to 25°C) SAE 20 Over 77°F (25°C) SAE 30	Initially after 35 hours Thereafter every 75 hours	Approx. 5.3 qt. (5 liter)
2	Air cleaner	#30 engine oil	Initially after 20 hours Thereafter every 100 hours Refill every 50 hours	Up to designated line
3	Hydraulic oil tank	#140 turbine oil	Initially after 100 hours Thereafter every 300 hours	7.4 qt. (7 liter)
4	Steering gear box	#90 gear oil	Initially after 100 hrs. Thereafter every 300 hrs.	0.3 qt. (0.3 liter)
5	Mission case	#90 gear oil	"	13.2 qt. (12 liter)

6	Rear axle bearing (Right) (Left)	Bearing grease	Every 300 hrs	Little
7	Clutch pedal shaft	Chassis grease	Every 50 hrs	"
8	Brake pedal shaft	"	"	"
9	Draglink joint (Rear)	"	"	"
10	" " (Front)	"	"	"
11	Knuckle shaft (Right) (Left)	"	"	"
12	Tie-rod end ball joint (Right) (Left)	"	"	"
13	Front axle hub (Right) (Left)	Bearing grease	Every 300 hrs	"
14	Clutch release bearing hub	Chassis grease	Every 500 hrs	"
15	Front wheel supporting lever	"	Every 50 hrs	"

(3) List of brands of lubricants on market

	Engine oil	Hydraulic oil	Gear oil
Esso Standard Oil Co.	Standard Fleet Oil 9000 series Diesel Engine Oil	Standard THC Oil 52 Telesso Oil 52	Standard Gear Oil 90 Esso Gear Oil GP 90
Shell Oil Co.	Shell Rimla Oil Shell Rotela Oil	Shell Terace Oil 29 Shell Turbo Oil 33	Shell Ogla 72 Shell Spirax 90 EP
Mobile Oil Co.	Delpack 1100 series Delpack 1300 series	Mobile Hydraulic Oil 48 Mobile DTE Oil Heavy medium	Ragaesus Gear Oil 90 Mobilube GX 90

(Note)

Engine oil (called HD oil and belongs to Service DM, DS) should be used in the following manner.

Under 32°F (0°C) ---------- SAE #10W or 10W-30
Between 32°F (0°C) and 77°F (25°C) ------- SAE #20
Over 77°F (25°C) ---------- SAE #30

(4) Tightening torque of bolts

Unit: ft.lb. (kg-cm)

Material / Nominal diameter	Ordinary bolt	Special bolt	Special bolt
	SS 41, S20C	S45C, S50C treated	SCR3, SCM3 treated
M 6	5.8 - 6.8 (80 - 95)	7.2 - 8.3 (100-115)	9.0 -10.5 (125-145)
M 8	13 - 15 (180-210)	17 - 20 (240-280)	22-25 (300-350)
W 3/8	22 - 27 (300-370)	28 - 33 (390-460)	36 -42 (500-580)
M 10	29 - 33 (400-460)	35 - 41 (490-570)	45 - 53 (620-720)
M 12	46 - 53 (640-740)	57 - 66 (790-920)	76 - 87 (1050-1200)
W 1/2	54 - 61 (750-850)	63 - 72 (870-1000	82 - 94 (1140-1300)
M 14	80 - 92 (1100-1280)	92 - 108 (1260-1500)	120 - 140 (1700-2000)
W 5/8	110 - 130 (1550-1800)	130 - 150 (1800-2100)	170 - 200 (2400-2800)
M 16	120 - 140 (1700-1950)	140 - 160 (2000-2300)	190 - 220 (2650-3100)
M 18	180 - 210 (2500-2900)	200 - 230 (2800-3250)	250 - 300 (3500-4100)
W 3/4	220 - 250 (3000-3500)	250 - 280 (3400-3900)	300 - 350 (4200-4900)
M 20	250 - 290 (3400-4000)	270 - 320 (3750-4400)	360 - 420 (5000-5800)

Tightening torque for special material bolts (Tractor body)

(Note: for engine refer to standards given in maintenance chart)

Name of part	Tightening torque	Q'ty	Place
Coupling bolt	35-41 ft.lb. (490-570 kg-cm)	1	Bolts for tierod adjustment
Front axle bolt	108 - 130 " (1500-1800 ")	4	Set bolts for front axle (A) (B)
Knuckle arm bolt	35 - 41 " (490-570 ")	2	Set bolts for left and right knuckle arm
Thrust shaft coupling bolt	35 - 41 " (490-570 ")	4	Set bolts for thrust shaft and coupling
Bolt for thrust shaft coupling	35 - 41 " (490-570 ")	1	Left-handed thread Set bolt of coupling and drive shaft
Bevel gear bolt	35 - 41 " (490-570 ")	8	Set bolts for spiral bevel gear to differential
Wheel set bolts	108 - 130 " (1500-1800 ")	12	Set bolts for rea wheel
Hitch bolt	57 - 66 " (790-920 ")	4	Set bolts for rear pulling hitch

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