ODEL JIANGSU — old
MEDIUM SIZE TRACTOR

OPERATION AND MAINTENANCE MANUAL

China First Tractors Qingjing Tractor Co., Ltd

MODEL JIANGSU MEDIUM－SIZE TRACTOR

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China First Tractor Qingjiang Tractor Co. , Ltd

Model Jiangsu Medium－size Tractor
Operation and Maintenance Manual

Compiled by China First Tractor Qingjiang Tractor Co. , Ltd

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PREFACE

Jiangsu－500 tractor, as a multi－purpose medium－size tractor for dry and paddy field operations and mainly for field works and providing power for transportation, with its characteristics of compact in construction, convenience control, nimble steering and facilitated maintenance, can be attached with appropriate implements for plowing, harrowing sowing, harvesting and transporting. It can also provide power for stationary operations.

Jiangsu－50H high ground clearance tractor, a new version of model Jiangsu－500, is a kind of specialized type which is suitabe for field management and plant protection operations of cotton, maize and sugarcane, etc.

Jiangsu－504 4WD tractor, another version of Model Jiangsu－500, equipped with advanced static hydrawlic steering system and fully sealed front drive axle, has its characteristics of easy control, well adhensive performance, relatively high traction ability and a large numbers of suitable working conditions despite the advantages of Model Jiangsu－500 and is especially suitable for paddy field operations and for cultivating in sandy loam and heavy clay soil land. It's reputable as "the king of paddy field" by our users. This model has won the championship of international the "day of the field" held in Australia 1984 and of the traction Championship held in the United States, the UK, Japan, Italy etc. for the same versions of tractors, and has made itself to be the first tractor which has won the international championship in our country.

Developing on the basis of Jiangsu－500 and Jiangsu－504 tractors, Jiangsu series tractor has expanded its family to a geat deal of new versions, such as Jiangsu－550, 650, 554, 654, 704 etc. Despite the advantages of their basic models, these new versions have significantly improved their traction and lifting ability due to the improvement in construction design and the increasing in the power of the engine equipped to have better field performance in paddy field and heavy clay soil operations than their basic madels. They can do paddy field works without high lug tire to generating improved productivity and benefits for our users.

This manual takes Jiangsu medium－size tractor equipped with Model 495T diesel engine as an example to show the structure, working principle and operating & maintenance of them, and it provides the drivers with systematic analysis of common troubles and remedies.

This manual is the essential reading for tractor users and maintenance personnel and the teaching material for training drivers. It also can be used by repair workers, technical and administrative personnel for reference. Since the structure of the tractor is being improved rapidly, the contents in this manual may be inconsistent with the products. Please refer to the prodution manual of this product while reading this manual.

Written by Engineer Liao Hanping and proofread by Senior Engineers Wu Rongsheng and Li Chunlin.

The whole book is examined and approved by Deputy General Manager Chang Xiaoling. Senior Engineers Wei Wenlin and Sun Huakun also participated in the examination.

We sincerely hope that our users give us the experience and suggestions about operating and functional requirements on the tractor, so as to fully meet the demand of our users.

China First Tractor Qingjiang Tractor Co., Ltd

May, 1999

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Chapter Ⅰ Main Technical Specifications of Jiangsu Medium－size Tractors

1. Tractor Parameters

Model		JS－500/550/550E	JS－50H	JS－504/554	JS－650	JS－654	JS－704
Type		General－purpose wheeled tractor for both dry and paddy field jobs	High－crop tractor	4WD tractor for both dry and paddy field jobs	General－purpose wheeled tractor for both dry and paddy field jobs	4WD tractor for both dry and paddy field jobs	
Power output at PTO (kW)		33/38.5			45.4		48.9
Traction (kN) with adhensive coefficient at 0.84 and slip at 15%		18/18.6/18.6	8 (rated value)	22.5/23.5	19.5	25.5	27
Draft power (kW) (Stipulated by factory)		27/30.5	27	27/30.5	36	36	40
Overall dimensions (mm)	Length	3350(to rear end of lower link)		3590	3415	3655	3800
	Width (normal)	1660/1830 (without ballast)			1830 (without ballast)		
	Height (to top of steering wheel)	1650	1880	1780	1650	1780	
	Height (to top of exhaust pipe)	2170	2400	2290	2615	2735	
Wheel base (mm)		1950	1900	2050	2015	2115	
Wheel tread (mm)	Front	1300 (normal), 1400, 1500, 1600	1470 (normal), 1570	1420 (normal), 1520	1300 (normal), 1400, 1500, 1600	1420 (normal), 1520	
	Rear	1250, 1350(normal), 1450(55 normal), 1550, 1650			1350, 1450(normal), 1550, 1650		
Ground clearance (mm)	Farming operation	510 (to main sleeve of front axle)	740 (as left)	415 (to both sides of front axle casing)	510	415	
	Road	370 (to front spherical joint of lower link)	600 (as left)	360 (to middle of front axle casing)	385	360	400
Structure mass (kg)		1920/1960/1980	1930	2280/2310	2050	2414	2500
Min. operating mass (kg)		2100/2160/2180	2110	2470/2510	2230	2614	2700
Min. operating mass distribution	Front axle (kg)	850/860/880	850	1150	910	1248	1269
	Rear axle (kg)	1250/1300/1300	1260	1298/1360	1320	1366	1431
Front axle ballast (kg)		54	54	150	90	150	

(Continued)

Model		JS-500/550/550E	JS-50H	JS-504/554	JS-650	JS-654	JS-704
Rear axle ballast (kg)		450/530/530	450	450/530	550		
Turning radius (m)	Without one-side braking	3.5	3.7	4.3	3.7	4.3	
	With one-side braking	3.0	3.2	4.0	3.2	4.0	
Travel speed (km/h)	Ⅰ	2.12			2.33		2.30
	Ⅱ	3.19			3.51		3.46
	Ⅲ	5.21			5.73		5.65
	Ⅳ	7.03			7.73		7.63
	Ⅴ	8.48			9.31		9.20
	Ⅵ	12.76			14.04		14.04
	Ⅶ	20.84			22.92		22.59
	Ⅷ	28.12			30.93		30.49
	Rev. Ⅰ	2.79			3.07		3.03
	Rev. Ⅱ	11.16			12.28		12.12

2. Diesel Engine*

Tractor model	JS-50 series		JS-55 series	JS-65 series	JS-704
Engine model	495T (Yangzhou)	495A (Shanghai)	YZ4100T (Yangzhou)	LR4105T$_7$ (Luoyang)	LR4105T$_{14}$ (Luoyang)
Type	Vertical, in-line, water-cooled, four-stroke, swirl chamber	Vertical, in-line, water-cooled, four-stroke, spherical chamber	Vertical, in-line, water-cooled, four-stroke, direct injection chamber		
Compression ratio	20:1	16.5:1	17.2:1	17:1	
Cylinder number	4				
Cylinder bore (mm)	95		100	105	
Piston stroke (mm)	115		122	125	
Piston displacement (L)	3.26		3.83	4.33	
Firing order	1-3-4-2				
Rated speed (r/min)	2000			2200	2300
Idling speed (r/min)	≤550			≤600	
Rated horsepower (for 12h)(kW)	35.3		40.5	47.8	52
Specific fuel consumption (at rated conditions)(g/kW·h)	≤251.7	≤246.2	≤242.0		

* Observe the specifications and maintenance instruction of the relative model of diesel engine.

(Continued)

Tractor model	JS－50 series		JS－55 series	JS－65 series	JS－704
Specific oil consumption (at rated conditions) (g/kW·h)	≤1.84	≤1.47	≤1.80		
Max. torque (N·m)	≥196.1	≥193.8	≥227	≥243.0	
Engine speed at Max. torque (r/min)	1400		1500	1550～1650	
Steady speed governing ratio at rated conditions (%)	≤8				
Crankshaft turning direction (to facing wards flying wheel end)	Counter clockwise				
Lubricating method	Forced circulation and splash lubrication combined				
Cooling method	Closed and forced circulation water－cooled			Closed and forced circulation water－cooled with oil radiator	
Starting method	Electric motor				
Engine net mass (kg)	330	340		410	
Overall dimensions (L × W × H) (mm)	837×630×810	977×595×785	830×660×810	844×619×828	
Valve timing					
Intake valve opens(before T.D.C)	17°	8°±2°	20°	12°	
Intake valve closes(after B.D.C)	43°	48°±2°	46°	38°	
Exhaust valve opens(before B.D.C)	43°	48°±2°	48°	55°	
Exhaust valve closes(after T.D.C)	17°	8°±2°	18°	12°	
Valve clearance (cold)(mm) Intake valve	0.30	0.25～0.30	0.35	0.3～0.4	
Valve clearance (cold)(mm) Exhaust valve	0.35	0.30～0.35	0.35	0.4～0.5	
Injection advance (before T.D.C)	16°±2°	23°±3°	20°±2°	18°～21°	
Injection pressure (MPa)	12～12.5	17.5±0.5	19.6～20.6		
Oil pressure (kPa)	300～500 (≥50 at idling speed)			300～500 (≥100 at idling speed)	
Oil temperature in sump	≤95℃	≤100℃	≤95℃	100℃	
Outleted cooling water temperature	75～90℃	≤98℃	75～90℃	≤98℃	
Exhaust temperature at rated conditions	≤470℃	≤600℃	≤550℃	≤620	

3. Transmission

Clutch	Dry, single－plate, constant engaged, double acting
Gearbox	Straight gear, two shafts, compound
Main drive	Spiral bevel gear
Differential	Simple, with two straight planetary bevel gears
Differential lock	Involute splined coupling

(Continued)

Final drive	Spur gear
Front main drive	Spiral bevel gear (for 4WD tractor)
Front differential	Simple, with two straight planetary bevel gears(for 4WD tractor)
Front final drive	Spiral bevel gears and straight bevel gears combined(for 4WD tractor)
Transfer case	Midship spar gear reduction box with engage/disengage device(for 4WD tractor)

4. Running gears, steering gears and braking system

Tractor model		JS-500/550	JS-50H	JS-504/554	JS-650/550E	JS-654	JS-704
Frame type		Frameless					
Front axle type		Steps, telescopic sleeve adjusting		Full closed, gear drive front drive axle	as JS-500	as JS-504	
Front tire size		6.00-16		9.5-24(paddy field) 9.5-24(high lugs)	6.50-16/ 6.00-16	9.5-24	11.2-24
Rear tire size		11-32/14.9-28 dryland, 11-32 paddy field (high lugs)			14.9-30/ 14.9-28	14.9-30	
Inflation pressure (kPa)	Front	200~300		80~120	200~300	80~120	
	Rear	80~120 (180 for High lugs tire)			80~120	80~120	
Front wheel adjustment	Toe-in	3~15 mm					
	Camber	3°		1°40′	3°	1°40′	
	Knuckle pin inclination	8°		7°30′	8°	7°30′	
	Caster	0°					
Front axle pivot angle		±10°					
Steering method		Mechanical steering linkage front wheel		Remotely full hydraulic steering front wheel	Hydraulic steering linkage front wheel	as JS-504	
Steering gear type		Recirculating ball-and-nut		BZZ1-100 full hydraulic steering unit	as JS-504	as JS-504	
Power steering cylinder				SGD50×160L double-acting	double-acting	as JS-504	
Power steering pump				CBN-E310 gear pump, right-hand	as JS-504	as JS-504	
Safety valve response pressure				7±0.5MPa	7±0.5MPa	7±0.5MPa	
Brake type		Dry, double disks, mechanical					
Parking brake		Locked pedal					
Trailer braking		Optional pneumatic braking system					

5. Working equipment

Tractor model		JS-500/550/550E	JS-50H	JS-504	JS-650	JS-654/704
Hydraulic lift and hitch	Type	Semi-remotely mounted				
	Plowing depth control	Draft, position and height controls				
	Pump type	CBN-E312, gear pump, right-hand			CBN-E314, gear pump, right-hand	
	Cylinder (bore×stroke)	Single-acting, 95×100 mm			Single-acting, 110×120 mm	
	Hydraulic outlet	One threaded hole M20×1.5 (under seat); optional: quick joint or multi-outlet valve				
	Response pressure of safety valve (MPa)	$17^{+0.5}_{0}$				
	Rated lifting force (N)	9000			12000	
	Rated lifting time	⩽3 sec.				
	Linkage type	Rear-mounted, category Ⅱ, three-point hitch (spherical joint)				
	Hitching triangle (mm)	754×510 (diameter×width)				
	Size of connecting hole of upper link (mm)	25.7×51 (diameter×width)				
	Size of connecting hole of lower link (mm)	28.7×45 (diameter×width)				
PTO shaft	Type	rear, semi-independent				
	Speed (r/min)	540 or 1000				
	Rotation direction	Clockwise (seen towards the head of tractor)				
	Spline dimension	6-35×30×8.69 (outer diameter×bottom diameter×teeth width), 8-38×32×6 (option)				
	Height to ground (mm)	560	790	690	560	690
Belt pulley	Size (mm)	235×180 (diameter×width)				
	Speed increase ratio	0.75				
Towing hook	Type	Stationary type or swing type as an option				
	Pin diameter of towing hook (mm)	ϕ34				
	Height (center to ground) (mm)	560	790	690	560	690

6. Electrical systems

Tractor model	JS-50 series, JS-55 series	JS-650, JS-654, JS-704
Electrical system	12V, negative grounded, single-wire system	
Generator	2JF200, 14V, 200W	JFZ1514Y, 14V, 500W

(Continued)

Tractor model	JS－50 series, JS－55 series	JS－650, JS－654, JS－704
Regulator	FT111, 14V, ≯500W	JFT1401, 14V
Battery	3－NQ－150, 6V, 150Ah, (two in series)	
Starting motor	2Q2C, 12V, 1.84kW	QD154C, 12V, 3.7kW
Front headlight	ND140×90T－1, 12V, 50/35W (two in series)	
Rear headlight	WD134－1, 12V, 45/20W (one)	
Front turning signal light	J－120, 12V, 20/8W, (two) 110, 12V, 20/8W, (two)	
Tail light	XH8－5, 12V, 20/8W, 20W, (one) or XH8－4, 12V, 20/8W, (two)	
Panel light	NZ2－2A(2B), 12V, 2W (two)	
Horn	DL 41DS/12, 12V	
Ammeter	307－A, 12V, ±30A	
Oil pressure gauge	308－A, 12V, 0～0.5MPa	
Water temperature gauge	302－A, 12V, 40～100℃	
Fuel gauge	304－A, 12V, 0～1/2～1	
Air pressure gauge	YTQ－60, 0～1.2MPa	
Speedometer and sensor	GS145, 12V, sensor M16×1.5 (495T、YZ4100T diesel engine), M18×1.5 (495A, LR4105T diesel engine)	

7. **Filling capacity (L)**

Tractor model		JS－500/550	JS－50H	JS－504/554	JS－650	JS－654, JS－704
Fuel tank		53				
Engine sump	495T、YZ4100T	17			/	
	495A	9			/	
	LR4105T	/			18	
Gearbox－rear axle		17		20	17	20
Final drive (each side)		6.5	7	6.5	6.5	
Steering gear housing		0.9		/	/	/
Lift housing and power steering canister		10				
Front main drive housing		/	/	8	/	8
Front final drive housing (each side)		/	/	6.5	/	6.5

Chapter Ⅱ Operating Instruction of the Tractor

Section 1 Controls and Instruments

Controls and instruments of the tractor (see Fig. 2 – 1).

1. Oil pressure gauge(No. 30)

It is used to indicate the oil pressure in the main passages of the engine. The normal pressure is

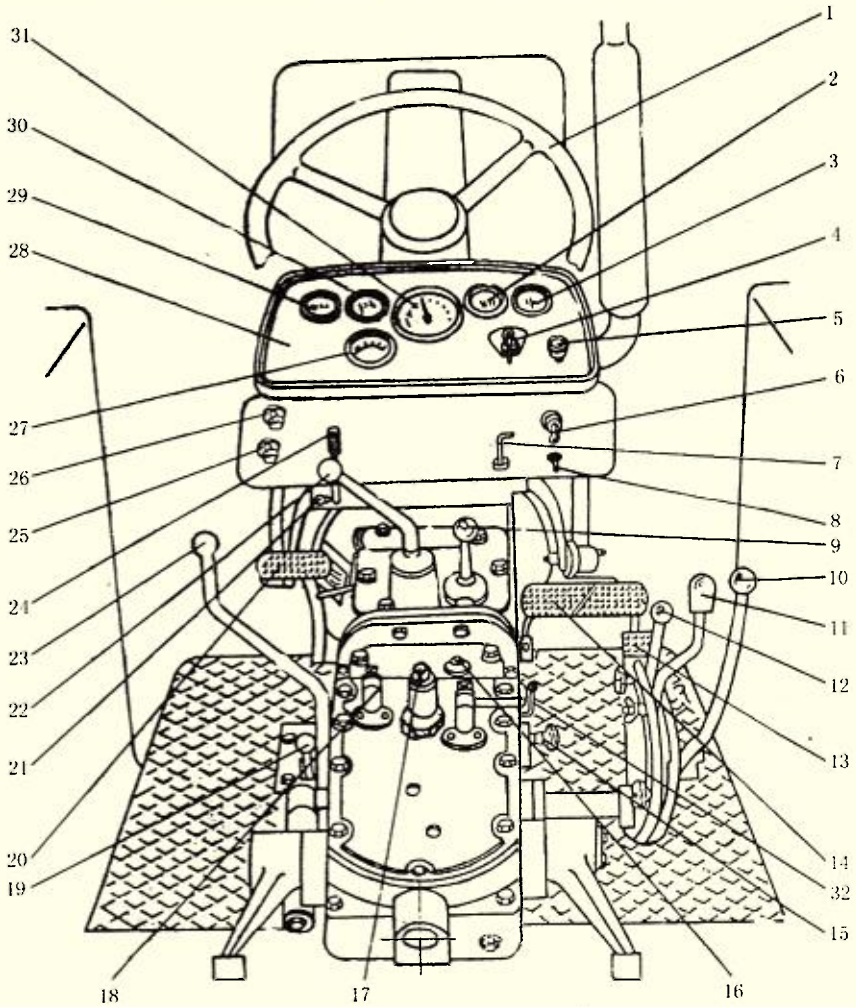


Fig. 2 – 1 Controls and insttuments

1. Steering wheel 2. Water temperature gauge 3. Ammeter 4. Light switch 5. Horn botton 6. Preheating and starting switch 7. Hand throttle lever 8. Turning signal switch 9. Auxiliary shift lever 10. Differential lock control lever 11. Draft control lever 12. Position control lever 13. Foot throttle pedal 14. Brake pedal 15. Handwheel for implement drop speed adjustment 16. Transmission – rear axle oil dipstick 17. Lifter oil filler 18. Hydraulic outlet point 19. Control lever for hydraulic oil pump 20. Clutch pedal 21. Fuel cutoff lever 22. Main shift lever 23. PTO control lever 24. Decompressing lever 25. 2nd shift switch 26. 1st shift switch 27. Air pressure gauge 28. Instrument panel 29. Fuel gauge 30. Oil pressure gauge 31. Speedometer 32. Transfer case control lever

between 200～400kPa.

2. Instrument light

It is used to light up the instrument at night .

3. Preheating and starting switch (No. 6)

Insert the key at "0"position and it could be turned left or right; counter clockwise:"Q"starting; clockwise:"D"connecting power,"Y"preheating,"Q"starting.

4. 1st shift switch(No. 26)

Pull the switch out, front and rear width indicators and instrument light are turned on.

5. Hand throttle lever(No. 7)

It is used to control the speed of the engine by hand, the hand throttle lever could be positioned in any place. It is used to adjust the quantity of the fuel supply.

6. Ammeter(No. 3)

It is used to indicate the operation and charging state of the storage battery. It is meant by the pointer being partial to "+" that the battery is in charging state, and it is meant by the pointer being partial to "－" that the battery is discharging. When the engine is working normally, the pointer should be partial to "+" slightly; if it is partial to "－", it means there is something wrong in the electrical system.

7. Water temperature gauge(No.2)

It is used to indicate the temperature of the diesel engine cooling water, the normal temperature is between 70～90℃.

8. Light switch(No. 4)(turning clockwise)

The first position: high beams of headlight on.

The second position: lower beams of headlight on.

The third position: lower beams of headlight, dim beam of rear light on.

9. 2nd shift switch(No. 25)

Roof light of cab on or wiper.

10. Turning signal switch(No. 8)

The turning signal switch is a double－direction switch, it could be passed to the right or to the left, which direction it is passed, the high beams of that signal on that side is on.

11. Decompressing lever(No.24)

Actuate the decompressing lever to make the intake valves in open condition, then the spinning resistance of the engine is decreased. It is used in driving the diesel engine, starting it and making adjustment and maintenance, it also could be used to stop the engine from working. Jiangsu－50 tractors are equipped with decompressing unit.

12. Foot throttle pedal(No. 13)

It is used to control the fuel supply by foot via the engine speed control rod, the fuel supply is increased when depressing it, otherwise the fuel supply is decreased and the engine operates at its idle speed automatically with the foot throttle pedal free.

13. Main shift lever(No.22)

It is used to choose the desired gear, and the main shift lever has six gear positions: neutral gear,

1st gear, 2nd gear, 3rd gear, 4th gear and reverse gear, if it is coordinated with the auxiliary shift lever, there will be eight advance gears and two reverse gears.

14. Auxiliary shift lever(No. 9)

The auxiliary shift lever has 3 gear positions: neutral gear, high gear, low gear. It is coordinated with the main shift lever, either one of the 2 shift levers is positioned at the neutral gear position, the tractor will stop running.

15. Fuel cutoff lever(No. 21)

It is used to stop the engine.

16. Brake pedal(No. 14)

There are two pieces of brake pedals, when depressing the left piece, the left rear wheel is braked; when depressing the right piece, the right rear wheel is braked. If the 2 pieces are connected togather by the brake pedal inter locking plate and depressing them simultaneously, the two rear wheels will be braked at the same time.

17. PTO control lever(No. 23)

The middle position for the PTO control lever is neutral position, the forward position is the high speed PTO position and the backward position is the low speed PTO position. If the PTO shaft only has one speed , the lever will only have 2 positions(the forward position is neutral, the backward position is working position). Whenever the lever is positioned at the neutral position, the power of the PTO shaft will be cut off and stop running.

18. Differential lock control lever(No. 10)

When one of the rear wheels is slipping, depress the clutch pedal and push forward the differential lock control lever to avoid one - wheel slipping, when the tractor is driven away from the slipping place, the lever should be released immediately so that the differential lock control lever could come back to the initial place automatically. The tractor is unable to turn a corner when the differential lock control lever is being pushed forward,otherwise the tractor parts will be easily damaged.

19. Control lever for hydraulic pump(No. 19)

Before using the hydraulic suspension system, push the hydraulic pump lever to the "engaging" position, then the hydraulic pump begins working; after using the hydraulic pump, pull the lever backward to the "disengaging" position.

20. Draft control lever(No. 11)

When the soil surface is rough or there exists variation of soil resistance during plowing, the draft control lever could be used to lift or drop the implement, at this time the position control lever is limited at the "lifting" area of the segment.

21. Position control lever(No. 12)

When operating rotatory tillage, reaping or when the soil surface is smooth and there is little variation of soil resistance during plowing, the position control lever could be used , at this time the draft control lever is limited at the "lifting" area of segment.

22. Handwheel for implement drop speed adjustment(No. 15)

The lowing speed of the implement is decreased when turning the hand wheel clockwise, and it is increased when turning counter clockwise. Turning the hand wheel to its stop, the implement is locked

at lifting position.

23. Speedometer(No. 31)

It is used to indicate the engine speed and the accumulative working hour of the engine.

24. Front drive axle transfer case control lever (No. 32)

Section 2 Points for Attention for Tractor Users

Check the technical condition of the tractor carefully before using:

1. Outward appearance checkup. Observe the place where the tractor is stopped , see if there is any oil or water mark, if there is, it means somewhere of the tractor leaks; Check the mouth of the exhaust pipe, see if there is any oil dirt or smokeblack, if there is oil dirt, it means the tractor injects oil, if there is smokeblack, it means that the fuel in the cylinder burned incompletely; Check the outward casing, see if there is any deformation.

2. Drive the engine, listen and observe if there is anything or any sound abnormal, sense whether the compression force is powerful or not.

3. Start the engine, it should be easy; the sound should be clear and even; When changing the throttle, the sound of the engine should still be normal.

4. Put into each gear, and check the operation mechanism and the working state of the chassis. The operation system should be reliable and easy to handle; there should be no unusual sound from the transmission mechanism; the working mechanism such as the hydraulic pump and the PTO shaft should be working well; there should be no high temperature of the bearing. Stop the tractor and check the radiator, find out if there is any oil in the radiator or any water in the oil sump. If there is any, it means there is leakage in the body of the engine.

Chapter Ⅲ The Diesel Engine

Section 1 Elementary Knowledge of the Diesel Engine

Ⅰ. Basic concept

A diesel engine depends on the principle that diesel is injected into the combustion chamber, fully mixes with fresh air under certain temperature and pressure, draws fire burning spontaneously and then turns the chemical energy of diesel into mechanical energy and do work outward.

A diesel engine is mainly composed of cylinder block assembly, cylinder head, piston and its connecting rod assembly, crankshaft flywheel assembly, valve mechanism, fuel and air supply system, lubricating system, cooling system and starting gear. These basic mechanisms and systems ensure constant and normal operation of the diesel engine.

The structure of a single－cylinder four－stroke diesel engine is showed in Fig. 3－1. Diesel burns into explosion in the air-tight cylinder, pushes the piston to move back and forth and brings the crankshaft into rotation through connecting rod.

In the process of operation of the diesel engine, when the piston moves downward, the intake valve opens and fresh air is drawn into the cylinder. When the piston moves upward, the intake valve closes and the air in the cylinder is compressed by the piston, with air pressure increasing and temperature rising, the injector injects the high－pressure diesel, which mixes with high－pressure air and burns spontaneously. The tremendous pressure created by expansion of gas pushes the piston to move downward, makes the crankshaft rotate through connecting rod and drives the working mechanism. Then the piston moves upward , at the same time the exhaust valve opens, ejects the exhaust out of the cylinder. Thus the diesel engine has finished one working cycle, which repeats constantly and makes the diesel engine constantly run.

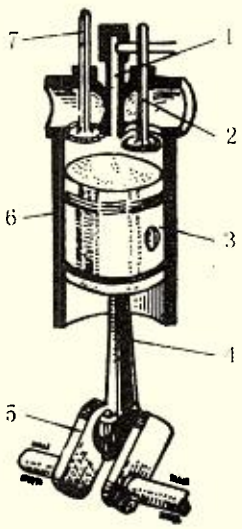


Fig. 3－1 Schematic diagram of the structure of a diesel engine

1. Injector 2. Exhaust valve 3. Piston 4. Connecting rod 5. Crankshaft 6. Cylinder 7. Intake valve

Ⅱ. Term explanation

1. Top dead center, bottom dead center

The piston moves back and forth in the cylinder along the direction of the center line, when it moves to the position farthest away from the center of the crankshaft(see Fig. 3－2), the position of the top of the piston is called "top dead center", and when the piston moves closest to the center of the crankshaft, the position of the top is called "bottom dead center".

2. Piston travel

Piston travel is also called stroke, the distance between top dead center(T. D. C) and bottom dead

center(B. D. C)(see S in Fig 3－2). When the crankshaft rotates 180°, the piston finishes one travel.

3. Working capacity of cylinder

The capacity of the cylinder between T. D. C. and B. D. C. is referred to as working capacity of the cylinder. And the sum of each working capacity is called the total displacement of the engine.

4. Capacity of combustion chamber

When the piston is at T. D. C. the space volume between the top of the piston and the cylinder head is called capacity of combustion chamber.

5. Total capacity of cylinder

When the piston is at B. D. C. the capacity of the cylinder beyond the top of the piston is called total capacity of cylinder, i. e. the sum of capacity of combustion chamber and working capacity.

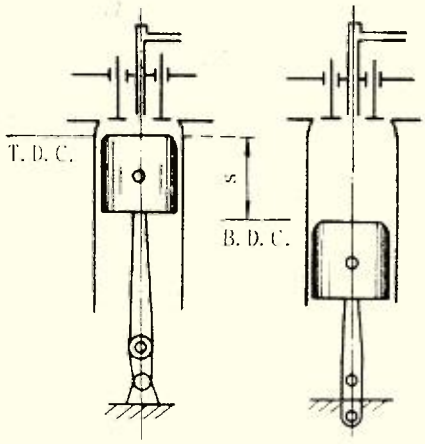


Fig. 3－2 Sketch of a single－cylinder four－stroke diesel engine

6. Compression ratio

Compression ratio refers to the ratio of the total capacity of cylinder and the capacity of the combustion chamber, which means the compression degree of air in the cylinder at the end of the compression travel. The general compression ratio of a diesel engine is 16∶1～20∶1.

7. Effective horsepower

Effective horsepower is just the rated horsepower of a diesel engine. Our country sets four types of rated horsepower: 15min. horsepower, 1hr horsepower, 12hr horsepower and sustained horsepower. The rated horsepower of the diesel engine of the tractor is 12hr. horsepower.

Section 2 Basic Working Principles of the Diesel Engine

The operation process of the diesel engine goes through 4 steps: intake, compression, work and exhaust. When each step finishes, the piston moves one travel and the crankshaft rotates half a circle (180°)Finishing intake, compression, work and exhaust 4 steps, is called one working circulation, the crankshaft rotating 720°(two circles), the piston moving 4 travels. This kind of diesel engine is four－stroke diesel engine. The operation process of single－cylinder four－stroke diesel engine is showed, as in Fig. 3－3.

Ⅰ. Intake stroke

The piston moves downward from T. D. C. , the capacity in the cylinder increasing , pressure falling, creates vacuum attraction. At this time , the intake valve opens, the exhaust valve closes and fresh air is drawn into the cylinder. When the piston moves to the B. D. C. , the intake stroke finishes and the intake valve closes, and the crankshaft rotates half a circle(0°～180°). When the intake is over , the pressure in the cylinder is 85～95 kPa, temperature is 50～70℃.

Ⅱ. Compression stroke

Intake over, the crankshaft continues to rotate, the piston moves upward from B. D. C. and both

intake and exhaust valves closes, air in the cylinder being compressed, temperature and pressure rising quickly. When the piston gets to the T. D. C., the compression stroke finishes. At this time, the crankshaft has rotated the second semi－circle(180°～360°). And at the end of the compression stroke, the pressure in the cylinder is 3500～4500 kPa, temperature is 500～700℃. As diesel can burn spontaneously at 360℃, at the end of the compression stroke, the diesel injected into the cylinder can burn spontaneously.

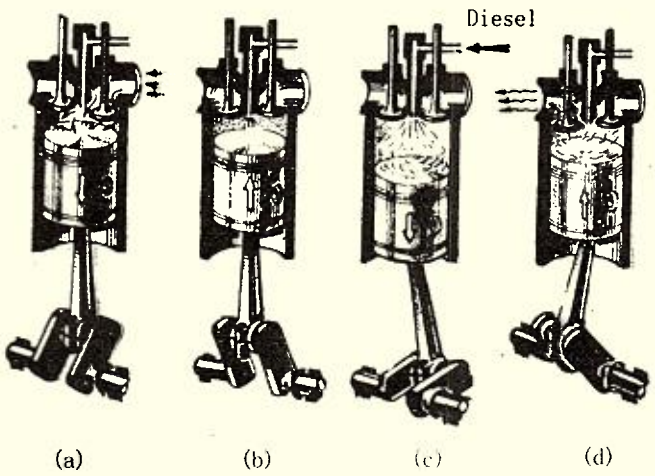


Fig. 3－3 Working principle of single－cylinder four－stroke diesel engine

(a) Intake (b) Compression (c)Work (d) Exhaust

Ⅲ. Work stroke

When the compression stroke finishes, the highest pressure in the cylinder after combustion of diesel can reach 5000～8000kPa, the temperature can reach 1600～2000℃. The high－temperature and high－pressure air expands quickly, with huge force pushing the piston to move downward (the force acting on the piston top of Model 495 engine can amount to 35000N). When the piston moves to the B. D. C., the air pressure and temperature of the cylinder quickly falls and the working stroke finishes. At this time, the crankshaft has rotated the third semi－circle (360°～540°).

Ⅳ. Exhaust stroke

When the work stroke finishes, the exhaust valve opens, the piston moves from B. D. C. to T. D. C. and the waste gas is quickly displaced to the air via the exhaust valve. When the piston gets to T. D. C., the exhaust valve closes and the exhaust is over. At this time the crankshaft has rotated the fourth semi－circle(540°～720°) and the exhaust stroke finishes, the pressure in the cylinder is 105～125kPa, and the temperature is 300～500℃.

When the exhaust is over, the crankshaft continues to rotate because of the inertial effect, the piston and the valves work according to the operation cycle order. The operation cycle repeats and the engine constantly provides power.

Model 495T (a product of Yangzhou Diesel Engine Works, called in short as Model 495 in this manual) diesel engine has four cylinders and four strokes, and every cylinder works according to the above－mentioned working process. In order to ensure an even speed, the work stroke of each cylinder should evenly distribute within the 720° angle of rotation of the crankshaft, which means every time the crankshaft rotates 180° there is just one cylinder doing work. Meanwhile the force acted on the crankshaft by the work stroke of each cylinder has to alternately happen on the crankshaft, i. e. the work strokes of four cylinders have a certain order, namely working order of engine (also called firing order). The firing order of the cylinders of Model 495 diesel engine is 1－3－4－2, see Table 2－1.

Table 2 – 1 Firing order of cylinders of Model 495 diesel engine

Angle of rotation of the crankshaft	Working order and process of each cylinder			
	1st cylinder	2nd cylinder	3rd cylinder	4th cylinder
1st semi – circle(0°~180°)	Work	Exhaust	Compression	Intake
2nd semi – circle(180°~360°)	Exhaust	Intake	Work	Compression
3rd semi – circle(360°~540°)	Intake	Compression	Exhaust	Work
4th semi – circle(540°~720°)	Compression	Work	Intake	Exhaust

Chapter Ⅳ Cylinder Block Assy.

Section 1 Structure of Cylinder Block Assy.

Cylinder assy. includes cylinder block, cylinder sleeve, main bearing of crankshaft, timing gear chamber cover, etc. It is showed in Fig. 4 – 1.

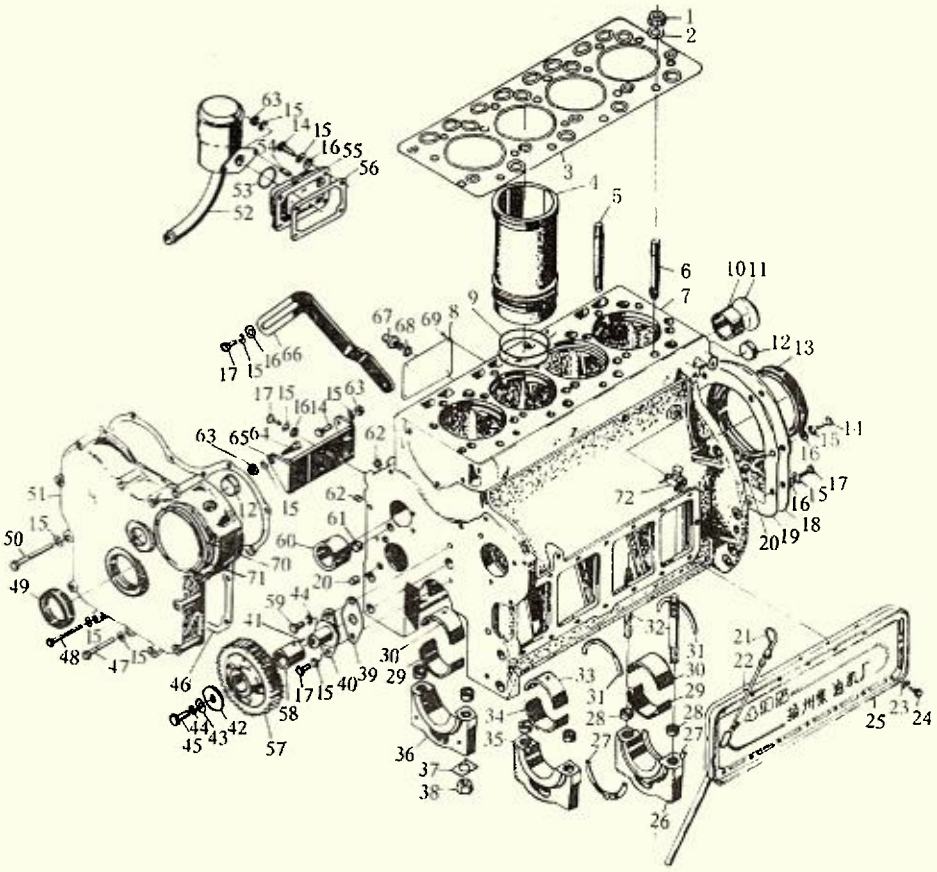


Fig. 4 – 1 Diesel engine cylinder block of Model 495

1. Cylinder head nut 2. Nut lock washer 3. Cylinder head gasket 4. Cylinder sleeve 5. Cylinder head long bolt 6. Cylinder head stud 7. Cylinder block 8. Engine nameplate 9. Expansion plug 10. Camshaft bushing Ⅱ, Ⅲ 11. Blocking piece 12. Plug 13,49. Reinforced seal 14,17,24,45,47,48,50,59. Bolt 15,16,23,43,44. Washer 18. Rear oil seal cap of crankshaft 19. Washer of rear oil seal cap 20. Positioning sleeve 21. Oil dipstick assy 22. Side plate washer 25. Side plate 26. 5th main bearing cap 27. Thrust ring (lower) 28. Positioning sleeve for main bearing cap 29. 1st and 5th lower main brass 30. 1st and 5th upper main brass 31. Thrust ring (upper) 32. Main bearing bolt 33. 2nd, 3rd and 4th upper main brass 34. 2nd, 3rd and 4th lower main brass 35. 2nd, 3rd and 4th main bearing cap 36. 1st main bearing cap 37. Locking piece for main bearing cap 38. Main bearing nut 39. Idle gear shaft washer 40. Idle gear shaft 41. Pin 42. Idle gear shaft retainer 46. Camshaft cover gasket 51. Camshaft cover 52. Breather 53. O – ring 54. Bolt 55. Seat for breather 56. Gasket for breather seat 57. Idle gear 58. Idle gear bushing 60. Camshaft bushing Ⅰ 61. Plug for main oil passage 62. Plug 63. Nut 64. Bolt for generator bracket 65. Generator bracket 66. Adjusting bracket for generator 67. Tube union for oil pressure gauge 68. Copper gasket 69. Rivet for engine nameplate 70. Washer 71. Cover bar 72. Drain cock

The cylinder block is the framework of the diesel engine, crank and connecting rod mechanism, valve timing mechanism and other parts are installed in the block. Sufficient strength and hardness are required . The block made of gray cast iron has a complex structure, including the cooling－water cavity, the lubricating oil passage, the cylinder sleeve seat holes and all kinds of screw holes. Four main seat holes on the top of the block are designed for four cylider sleeves and two finish－worked inner－conical－surface positioning cylinder sleeves are installed in each seat hole.

Five main bearing seats for main bearing bushing are cast on the separating plate in the block and main bearings and main bearing cap are all marked with aligning numbers. In assembling, the numbers should be toward the side cap window. They are not interchangeable. The tightening is completed in two to three times, starting from the middle bolt, gradually and symmetrically extending to the two sides. The final tighten torque is 160～180N·m.

There are thrust bushings on the two sides of the 5th main bearing seat and the main bearing cap, ensuring that the axial clearance of the crankshaft should be 0.07～0.34mm. Their faces with oil grooves must be toward the crankshaft. Notice that the place of the square tenon of the thrust bushing should be in the positioning bulge which is on the two sides of the 5th main bearing cap.

In the front of the cylinder block, there are idle gear, camshaft casing cover, coolant(water) pump. The positioning bolt hole for sensor of speedometer is on the camshaft casing cover.

The drain cock, side plate, air pump, injection pump, diesel fuel filter are all installed on the left of the block. After removing the side plate, the main bearings can be checked, the piston connecting－rods can be assembled and disassembled through the window of the block.

The generator, the starting motor, oil filter and the breather are distributed on the right side of the block. And the hole blocked with sealing plugs on its two sides on the inner wall is the main lubricating oil passa ge, under it is the lubricating oil inlet line. The main oil passage, the oil pump, the oil filter, the oil passage for camshaft, the oil passage for the main bearings of the crankshaft are all connected.

The bottom of the block is the fixing surface for the oil sump. There are stiffener, separating plate, boss on the inner wall.

Three camshaft bearing seats and eight tappet holes leading to the top surface are on the upper right side of the block. Each camshaft bearing has a bushing, special attention should be paid that the 1st camshaft bushing has two oil holes and the other two have one hole each.

The oil seal cap for crankshaft is installed in the rear of the block.

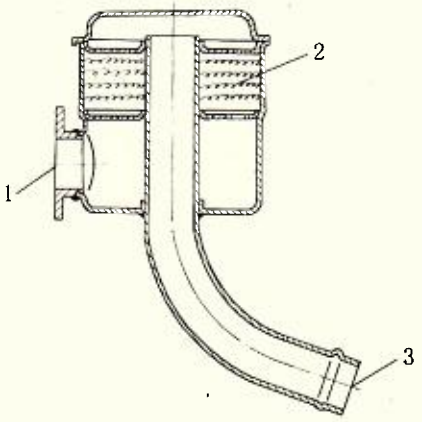


Fig. 4－2 Breather

1. Connecting hole with crankcase
2. Filter element 3. Connecting hole with open air

The cylinder sleeve is made of wear－resisting alloy cast iron. There are two finish－worked outer conical surfaces for locating. As it reaches the cooling water directly, the sleeve is of wet type.

Two grooves are made to prevent the sleeve from axial rolling and waterproof sealing rings in the

grooves to prevent water from entering into the combustion chamber or the crankcase.

The breather is fixed on the right side of the block. It is shown in Fig. 4－2. The filter elements keep the oil spray out of the crankcase in air exhausting and prevent the dirt from entering in aspirating.

Section 2 Maintenance of Cylinder Block Assy.

Ⅰ. Maintenance of cylinder block

1. Checking for cylinder block and cleaning

Before checking, the oil dirt should be cleaned. Remove the oil sealing plugs of the lubricating oil passage, clean the whole oil passage, then blow it up with compression air.

Checking ways include: check the block to see whether it is cracked, check the contact surface of the cylinder and its head to see whether there is any burr and scratch and check the flatness of the block top surface.

2. Causes for cracks

Accidental damage, such as strike or hit with hammer. In winter, after the tractor stopping for a long time without draining off water, the block will be frozen to crack. As lack of water will cause the running engine overheated, if cool water is used suddenly, the block will crack. The cracked cylinder should be sent to the repair shop and repaired by experienced workers through adhesional or welding methods. After repairing ,the water－pressure test should be conducted.

3. Causes and remedies for flexure of block top surface

Causes include: deformation of the block caused by overheating; in tightening the cylinder head bolts, the tighten torque is not uniform or tightening order is not correct.

The engine trouble shootings caused by flexure include air leakage, oil leakage, air flee and cylinder gaskets' damage.

The flexure of the block top surface can be checked with straight edge or feeler gauge, its maximum impact allowance deflection should be less than 0.05mm within total length..

The flexure can be repaired by hand shiving and scraping way can be used for the part with serious scratches. The simplest way is grinding the cylinder head against the cylinder block, scraping the protruding metal near the bolt holes, smearing grinding paste on any point of the top surface, holding down the cylinder head, pushing the head by two men in the trace shape of "8" to grind the head and the block, and several hours are needed if flexure is slightly serious. For the serious kind,it should be sent to the shop to repair with face grinder or turning miller. Special attention should be paid that the metal that would be grinded off should be as little as possible.

Ⅱ. Maintenance of cylinder sleeve

In working , cylinder sleeve should stand the side pressure and the high speed friction of the piston under the alternative acting of low－temperature gas and high－temperature high－pressure combustible gas . All of these cause serious and uneven wear on the sleeve inner wall. However,on the part of the sleeve upper port not touching the piston ring, there will be no wear in the main.

When the amount of wear, taper and roundness reach specific value, the sleeve needs repairing, otherwise, the diesel engine will have trouble symptoms such as starting difficulty , oil consumption

increase or lack of power. In disassembling, the tools as shown in Fig. 4－3 should be used. Do not hit with hammer. If lacking special tools, pieces of wood should be put under the edge of the sleeve. Before reassembling, the inner and outer sides of the sleeve must be cleaned. Pay attention to wiping the water sealing ring grooves and the boss cleaning. Lubricating oil is forbidden. In assembling, the sleeve should be pushing forward slightly by hands. Do not strike single flange. And all waterproof sealing rings should be replaced.

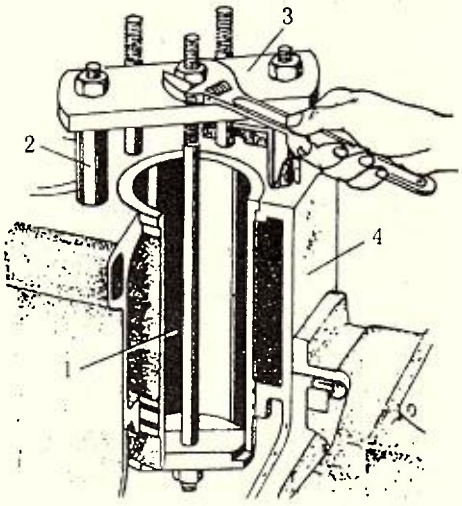


Fig. 4－3 Special tools for disassembling cylinder sleeves and ways

1. Cylinder sleeve 2. Steel pipe
3. Special tools 4. Cylinder block

Fit clearance between sleeve and piston skirt is called cylinder clearance. When checking, the piston without rings would be placed upside down into the sleeve and measured by a feeler gauge. It is shown in Fig. 4－4. If the clearance exceeds 0.38mm, do a repair or replacement.

After placing the sleeve into the cylinder hole, the flange surface should be 0.06～0.16mm higher than the top surface, as shown in Fig. 4－5. The protuberance difference of the four sleeves should not exceed 0.05mm. If the protuberance is beyond the specific value, the notch of the block hole should be processed or change the sleeve. If it is not enough, some copper gaskets with proper thickness may be placed between the bottom of the sleeve flange and the notch face to satisfy the assembling requirements.

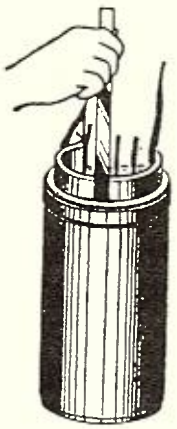


Fig. 4－4 Checking the clearance

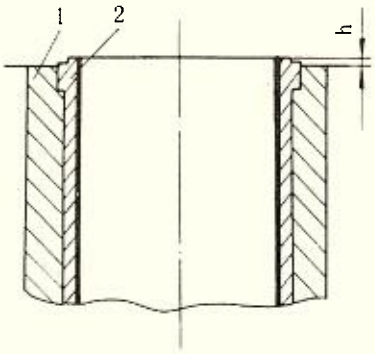


Fig. 4－5 Height difference between the cylinder sleeve top surface and the block surface

1. Cylinder block 2. Cylinder sleeve h＝0.06～0.16mm

Ⅲ. Replacing cylinder head gasket

The cylinder head gasket, made of the asbestos pieces covered with copper, is of elastic seal type to ensure the sealability. In removing and installing, special attention should be paid that the gasket surface should be smooth, its filler should be even, no damage , no corrosion, otherwise, replace it.

In assembling, the smooth surface should be placed toward the block, otherwise, it is difficult for gasket to stand high temperature and high pressure caused by combustible gas.

Chapter Ⅴ Cylinder Head

Section 1 Structure of Cylinder Head

The function of cylinder head is to seal the cylinder and make it into the combustion chamber. On the head there are injector and some parts of valve timing mechanism, etc. High design requirement for the structure and the shape of the head is required. Watercourse and oil passage are distributed in it to avoid air leakage, water leakage and oil leakage. The head is made of high－strength grey cast iron and has processed hole passages and surfaces.

Four inlets and four outlets are distributed on each side of the cylinder head and on its top there are four electrocaloric plug holes and four injector ports. The injector is installed with bolts and compressers, one end of it sticking into the swirl chamber. The inserted pieces of the swirl chamber are put on the chamber port. The oblate cylinder hole is the main port and the cylinder hole is the starting one. In maintenance, check the inserted pieces of the swirl chamber to see whether they are loose, which should not extend to the bottom of the head , and check the staring port to see whether it is blocked.

Valve set and driving set of the valve timing mechanism and the cylinder head cover are distributed on the head. The decompression mechanism is installed in the cylinder head cover.

Water jacket of the head is covered by cap on the front and back sides of the head. The thermostat and the transducer of water temperature gauge are installed on the front end of the outlet.

Section 2 Maintenance of Cylinder Head

Ⅰ. Disassembling cylinder head

Hit is forbidden in disassembling. First, remove the fuel pipe of the injector and the head cover, then unscrew the valve clearance adjusting screw, remove the fixed nuts of the support of rocker arm, take off rocker arm set, take out 8 pieces of push rods, remove bolts and nuts of the head, then disassemble the head and remove the cylinder head gasket. The parts such as valve collet, valve spring, valve, etc., should be disassembled by special tools. Do not make the valve collet spring out to injure people in disassembling without special tools.

Ⅱ. Maintenance of cylinder head

1. Checking cylinder head and cleaning

Firstly, remove the carbon deposit. Pay attention not to hit and damage the fixing surface. After cleaning, blow the valve guide holes and watercourse up with compression air.

Check the bottom of the cylinder and other faces to see whether they are cracked, check the valve seats to see whether they are excessively worn or cracked, check valve seat insert to see whether they are loose, check the collecting surface of the head and the block to see their flatness. Ways of checking

for the head are the same as that for the surface of the block.

2. Maintenance of cylinder head

Causes and remedies for crack and flexure of the bottom are the same as for the block.

3. Assembling cylinder head

In assembling, the bolts and the nuts should be tightened with a torque spanner. The tightening is completed gradually in 3 times and the final torque is 140 ~ 160N · m. Each time the nuts should be tightened from the middle one, in cross and diagonal trace, as shown in Fig. 5 - 1.

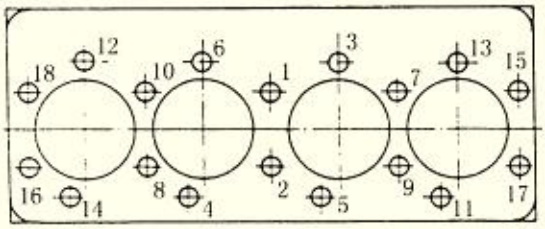


Fig. 5 - 1 Tightening order of nuts

Chapter Ⅵ Piston Connecting－rod Assy.

Section 1 Structure of Piston Connecting－rod Assy.

The piston connecting－rod assembly consists of piston, piston pin, piston ring, connecting－rod, connecting－rod small end bushing, connecting－rod bushing, connecting－rod bolt, etc. (see Fig. 6－1)

Ⅰ. Piston

The piston can be divided into four parts: top part, ring groove part, pin base part and skirt.

The top of the piston seems like a shovelled pit, its function is to guide the flow of air, promote the forming up of mixed gas, and improve the combustible ability. While installing it, the sharp angle of the sunken pit should point to the main spray nozzle of the swirl chamber and be partial to the open side of the connecting－rod big end.

The ring groove part has three compression ring grooves and one oil ring groove, when installed with the piston rings, it could keep good sealing, help lubricating, scratch oil and radiate heat. There are several radial holes on the inner side of the oil ring groove and oil scratched from the wall of the cylinder sleeve flows back to the oil sump through these holes.

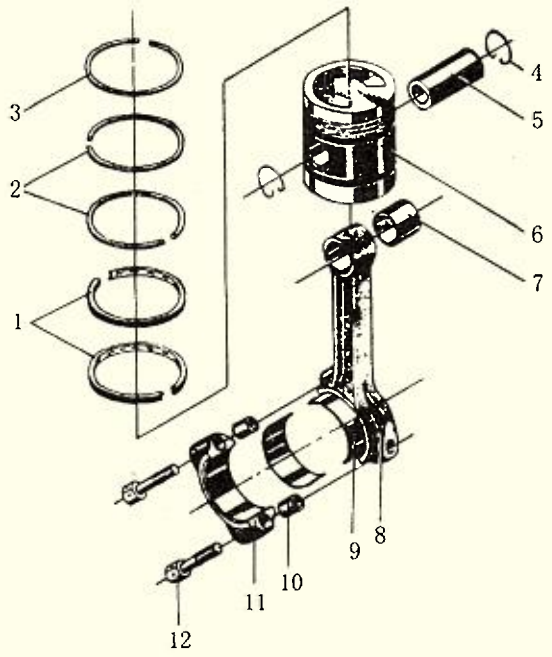


Fig. 6－1 Piston connecting－rod assy.

1. Oil ring 2. The 2nd and 3rd piston rings 3. The 1st piston ring 4. Piston pin lock ring 5. Piston pin 6. Piston 7. Connecting－rod small end bushing 8. Connecting－rod 9. Connecting－rod bushing 10. Connecting－rod positioning sleeve 11. Connecting－rod cap 12. Connecting－rod bolt

The pin base part is used to install piston pin and transmit the thrust force of the combustible gas to the connecting－rod.

The skirt acts as a guide of the reciprocating motion of the piston and it also endures the side pressure. The cross section of the skirt is an ellipse, its major axis is perpendicular to the axis of the pin hole in the pin base, ensuring perfect fitting of the cylinder sleeve when the pison expands under high－temperature.

In order to prevent the piston from being clutched by the cylinder sleeve after its expansion and on the other side, to help lubricating, there should be a certain clearance between the piston and the cylinder sleeve. Because the top part of the piston expands more than the skirt, the piston is made into a tapered object, its top being smaller than the skirt, to ensure the clearance between the cylinder sleeve and the piston is even. The clearance between the cylinder sleeve and the major axis direction of the

piston skirt is called cylinder clearance and the cylinder clearance of Model 495 diesel engine is 0.19～0.255mm.

Ⅱ. Piston ring

There are three compression rings and one spiral sustaining spring oil ring for Model 495 diesel engine. The piston should be wear－resisting, heat－resisting and corrosion－resisting, and it should also possess a certain degree of tenacity, heat－conducting ability and flexibility. The piston ring is made of copper chromium molybdenum cast alloy iron. Because of the requirement of its function, the first compression ring is porous chrome plated.

The first compression ring is level with the surface of the piston. The second and third compression rings are tapered rings, the outer fringe of the cross－section is a 45° chamfer so as not to scratch the oil but to smear oil evenly on the cylinder inside surface while the piston moves from B.D.C. to T.D.C.. On installation, the marks of the 2nd and 3rd compression rings should be placed upward, otherwise, the engine will be combusting oil.

When the piston rings are installed into the cylinder, there should be a clearance at the opening of the rings to ensure that the ring would not be blocked while heated on working, this opening clearance is calld end gap. The clearance between the groove and the surface of the piston ring is called side clearance.

Ⅲ. Piston pin

The installation of piston pin, piston and connecting－rod small end bushing is full floating, that is, there is clearance between the piston and the connecting－rod small end bushing, and there is certain installation tightness between the piston pin and the pin base. When being heated, the piston expands more than the piston pin, thus there will be a clearance between the piston pin and the pin base, ensuring that the pin is movable in the pin hole. In order to prevent the pin from scurrying axially, the two ends of the pin hole are installed with elastic lock rings.

During the installation, heat the piston to 100～120℃ in oil or water, and then push the pin into the pin hole and the bushing of the connecting－rod small end.

Ⅳ. Connecting－rod and connectiong－rod bolt

The connecting－rod small end is provided with a copper bushing. There is an oil hole in the bushing aligning with the one of the connecting－rod small end, ensuring lubrication.

The connecting－rod big end adopts 45°oblique section, so as to assemble and disassemble easily, and it also improves the force endurance condition of the connecting－rod bolt. The connecting－rod big end and the inner hole of its cap are processed in pairs, and there are paired marks on them, which must not be changed casually. There are upper and lower bushings, all steel－backed, and on the inner surface sinters a 0.5～0.8mm tin and aluminium antifriction alloy layer. There is a positioning bulge on the bushing. It should be set into the positioning groove of the connecting－rod and its cap to prevent the bushing from scurrying away. Tighten the connecting－rod bolt with a torque spanner in sequence in 3～5 times and the final tighten torque is 100～120N·m.

In order to ensure the smooth running of the diesel engine, the mass difference of the piston connecting－rod assemblies of an engine should not be more than 10g.

Section 2 Maintenance of Piston Connecting－rod Assy.

Ⅰ. Maintenance of piston connecting－rod assy.

1. Clearance of piston and cylinder sleeve(details in the 2nd part of section 2 in Chapter Ⅳ).

In maintenance, check the physical condition of the piston first, for example, see if there is any crack, bruise, scratch mark, burr, etc. If there is any crack, it is no longer usable; if there is any bruise, scratch or burr, it should be repaired.

2. Clearance of piston ring

There are two kinds of piston ring clearances: open end gap and side clearance.

(1) Open end gap of piston ring.

This gap refers to the gap at the openning of the piston ring, which is measured by inserting a feeler gauge while piston ring is inserted against the upper worn part of the cylinder sleeve. The gap of the first compression ring is 0.30～0.50mm, the others are 0.25～0.40mm. If the open end gap exceeds 2.5mm, it should be replaced(see Fig. 6－2). After a long time operation, because of the wear of the piston rings and cylinder sleeve, the open end gap will become larger, and the output characteristic and economic performance will go worse, and the engine will be more difficult to start. While installing the new piston ring or cylinder sleeve, if the open end gap is too small, there will be no enough room for its expansion and it will scrape the cylinder sleeve; if the gap is too large, the sealability will be reduced, causing oil combustion. If the open end gap is smaller than the standard size, repair it with a flat mill file. Be careful to file it slightly and measure again, if it is still narrow, file it slightly once more and do not file it too much. While filing, pay attention to making sure that there is no burr to scratch the cylinder sleeve.

(2) Side clearance of piston ring

It refers to the axial clearance between the piston ring and the ring groove, measure it with feeler gauge(see Fig. 6－3). The side clearance of the 1st compression ring is 0.05～0.87mm, the other clearances should be 0.03～0.062mm. If the side clearance is too small, the piston ring will be seized after it is heated in working; if the clearance is too big, there will be oil fleeing and carbon accumulating. When the side clearance is too small, grind the plane on a flat board with grinding paste or No. 0 abrasive paper(see Fig. 6－4).

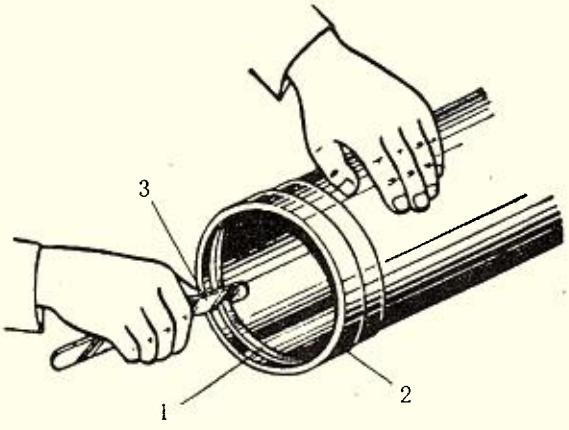


Fig. 6－2 Measuring the open end gap of the piston ring

1. Piston ring 2. Cylinder sleeve 3. Feeler gauge

In addition, the light leakage should also be checked up. Put the piston rings into the cylinder sleeve, their outer working surfaces should coincide closely with the wall of the cylinder, and each light leakage radian should be no more than 25°. The light leakage of the same ring should not exceed 45°,

and there should be no light leakage in the 30°radian of each side of the opening.

Check the rings carefully for cracks, tiny holes or pits. If there is any, it will be unusable. If there is any burr, it should be repaired.

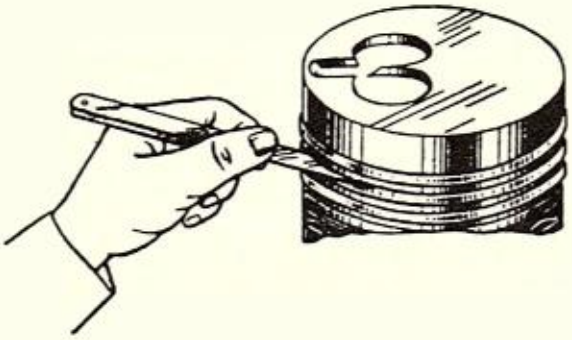


Fig. 6－3 Measuring the side clearance of the piston ring

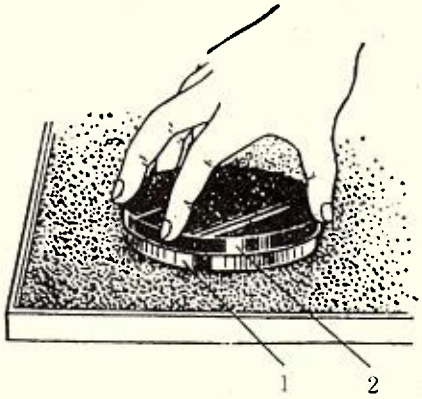


Fig. 6－4 Repairing the side clearance of the piston ring

1. Piston ring 2. Repair tool

3. Fitting of piston pin, pin hole and connecting－rod.

There should not be cracks, pits, abrasion marks, corrosion, etc. on the outer surface of the piston pin. The mass difference of the pins in the same diesel engine should be no more than 5g.

There should be a certain surplusage in the fitting of the pin and the pin hole, and a certain installation tightness when the machine is cold,. otherwise, when the engine is running, the piston thermostatically expands more than the pin, then there will be more clearance between them, which would result in knocking and accelerating wearing.

There should be a certain clearance between the pin and the connecting－rod small end bushing, which is 0.02～0.052mm. Under normal temperature, coat the pin with oil, then it could be smoothly pushed into the bushing, and if there is no apparent rocking, that is suitable. If the clearance is big, there will be knocking, and the bushing may be damaged easily, and the connecting－rod may be deformed; if the clearance is too small, the two will catch up or can not rotate smoothly, resulting in scraping the cylinder sleeve.

4. Fitting of connecting－rod bushing and connecting－rod journal

There should not be peeling off and pits on the alloy layer; the fringe, hole, and oil groove should be smooth, no rolling and burr; strike the bushing, the sound should be clear and crisp. There are a few ringlike tracks on the surface of the bushing, but the accumulative width of these tracks should not be more than 10% of the width of the bushing. The clearance of the rod bushing and the journal is 0.05～0.118mm, its wear limit is 0.25mm. If the clearance is too big, there will be oil leakage, oil pressure will decrease and the lubrication will become worse; if the clearance is too small, there will be no sufficient oil between the bushing and the journal, causing the bushing burnt. When the clearance exceeds 0.25mm, the bushing should be renewed, and nowhere is allowed to place gaskets.

5. While examing and repairing the diesel engine, check the rod if there is any bend or twisting.

If cylinder wall or shaft is overworn and the output power decreases, send it to workshop and examine the distortion of the connecting－rod with special tool, and correct it with a press or other tools.

6. Connecting－rod bolt

The connecting－rod bolt is one of the important parts of the diesel engine, if the bolt is broken, serious accident may occur, for example, the crankshaft may be broken and distroy the engine body. The bolt is made of alloy steel, and can not be replaced by normal bolt. Before installation, check the bolt, the thread should be perfect, no pressed damage, thread－sliding, injury, crack, etc. The hexagon of the bolt should be complete, the end faces should be smooth, and there must not be rolling edge and burr.

Ⅱ. Installation of piston connecting－rod assy.

Clean the parts before installing, all parts must be accord with the provided technical specifications. The assembling sequence and requirements are:

1. While assembling the connecting－rod small end bushing, align the oil hole and the hole in the small end. If there is no oil hole in the bushing, drill a hole according to the one of the small end, and remove the burrs.

2. Ream the inside wall of the small end bushing according to the size of the piston pin, ensuring that the clearance between the hole of the bushing and the pin is 0.020～0.056mm.

3. Remove the corrosion－inhibitive oil from the connecting－rod bushings and put them into the hole of the connecting－rod big end.

4. Heat the piston to 100℃ in oil or water, take it out after 5 minutes, put the small end between the two pin holes of the piston, and push the pin into the pin holes of the piston and the hole of the small end, then install the lock ring. The lock ring should be firm, otherwise, it will cause serious accident.

5. When assembling the piston rings, use special tools or the two iron rings used in disassembling. Arrange the openings of the three rings with offset of 120° each other. The opening of the first ring should not point to the axis of the piston pin. Pay attention while assembling: the first compression ring is chrome－plated, the 2nd and 3rd rings are tapered and not chrome－plated, and their marks should be upward.

Points for attention:

(1) The 4 pistons, 4 connecting－rods, 4 piston pins of the same diesel engine are divided into 4 separate mass sections. The mass difference of the 4 connecting－rod selections should not exceed 10g.

(2) Before assembling the piston, coat the inside surface of the connecting－rod small end bushing with clean oil to avoid dry friction when starting the engine.

(3) The opening of the connecting－rod big end should points to the direction of the window of the side cover. The sharp angle of the sunken pit on the top of the piston should points to the injector and the swirl chamber, and it should not be installed wrongly.

(4) Coat the piston rings, bushings, cylinder wall with clean oil.

Chapter Ⅶ Crankshaft Flywheel Assy.

Section 1 Structure of Crankshaft Flywheel Assy.

Crankshaft flywheel assy. (see Fig. 7－1) is made up of crankshaft, flywheel, crankshaft gear, crankshaft oil seal, V－belt pulley and crankshaft jaw, etc.

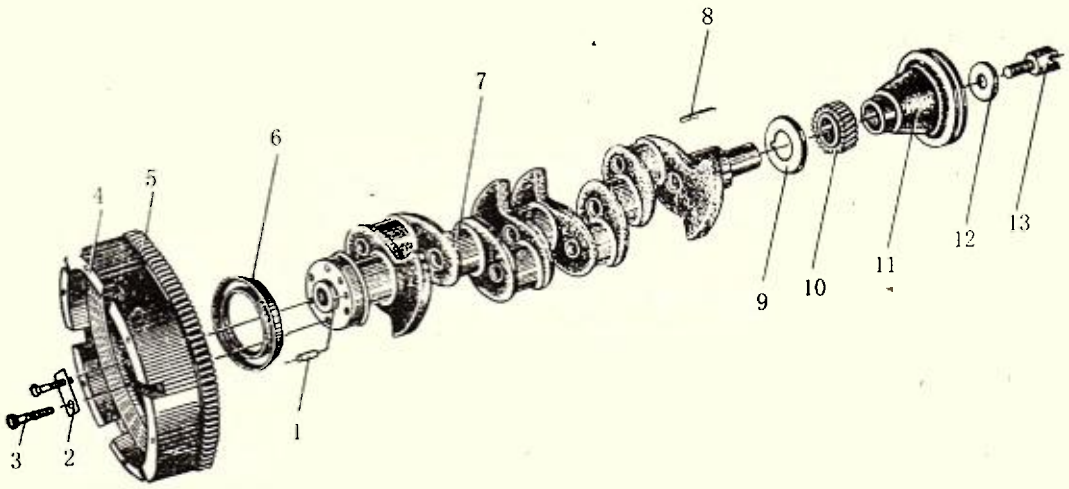


Fig. 7－1 Crankshaft flywheel assy.

1. Straight pin 2. Flywheel locking plate 3. Flywheel bolt 4. Flywheel 5. Ring gear
6. Rear oil seal 7. Crankshaft 8. Key 9. Front oil seal 10. Crankshaft gear
11. Crankshaft pulley 12. Crankshaft jaw washer 13. Crankshaft jaw

Ⅰ. Crankshaft

The crankshaft, with the help of the connecting－rod mechanism, turns the reciprocating rectilinear motion of the piston into the rotation of the crankshaft, thus turning the heat energy generated by diesel combustion into the mechanical energy which outputs power and brings the operating mechanism into running.

During the running process, the crankshaft has to stand constantly variable air pressure, all kinds of inertia forces and other additional pressures, so the crankshaft is possessed of certain functions of strength, wear resistance, anti－shock and vibration absorption.

The crankshaft of Model 495 diesel engine is made of rare－earth magnesium ductile iron, of hollow structure. Both the main journal and the connecting－rod journal have waist－drum shaped hollows.

The crankshaft has four connecting－rod journals and five main journals. Treated with quenching and well grinded, the journal has comparatively high surface hardness and processing quality, thus improving its wearlessness.

The crankshaft journal adopts pressure lubrication. The inner wall of the machine body has an oil

passage supplying oil for the crankshaft, and the adjacent main journal and connecting－rod journal are connected by the oil passage. Lubricating oil flows into the connecting－rod bearing through the main bearing and the journal oil hole.

In the front of the crankshaft installs crankshaft timing gear driving camshaft, oil pump and injection pump, and V－belt pulley driving water pump, fan and generator. At the back of the crankshaft gear, there is front oil seal used for throwing oil away.

The crankshaft is installed in the cylinder block with five successive main bearing seats, and the main bearing bushing is thin－walled, steel－backed and wear－resisting alloy bushing. The axial positioning of the crankshaft adopts the method of installing the wear－reducing thrust plate on both sides of the fifth main bearing. It not only ensures to limit the axial scurrying of the crankshaft, but also ensures that the crankshaft stretches out freely after thermostatic expansion. When the engine is cold, the clearance between thrust plate and crankshaft should be 0.07～0.34mm. At the back of the flywheel there are rear oil seal and flywheel.

Ⅱ. Flywheel

Flywheel is mainly used for storing energy, helping to finish auxiliary strokes, making the crank pitman mechanism smoothly cross T.D.C and B.D.C and keeping even rotation of the crankshaft.

Flywheel is a disc made of gray cast iron, on its outer fringe installed carbon steel starting ring gear by the hot－pressing method.

Flywheel is firmly fixed on the flange at the back of the crankshaft with one positioning pin and six bolts. The bolts, after temper treatment with alloy steel, cannot be superseded at will. Tighten the bolts according to the set moment of torque and lock them with locking plate after being tightened. The outer round surface of the flywheel is engraved with the signs of T.D.C of the 1st cylinder, advance angle of fuel and opening of intake valve.

Ⅲ. Main bushing and rod bushing

Both main bushing and rod bushing of the crankshaft are steel－backed, and both are made of rolled high－tin－aluminium－base antiwear alloy(at thickness of 0.5～0.8mm) and has good wear－in and load－bearing properties. During installation, take care of positioning and prevent from scurrying.

Section 2 Maintenance of Crankshaft Flywheel Assy.

Ⅰ. Disassembly of crankshaft flywheel assy.

First, disassemble piston connecting－rod assy. and fan pulley, so as to be able to disassemble crankshaft flywheel assy., the sequence is as following:

1. Disassemble crankshaft jaw and V－belt pulley.
2. Disassemble head of timing gear chamber, take off the front oil seal and pull out crankshaft gear.
3. Unbolt front main bearing seat bolt, remove front main bearing cap.
4. Twist off the bolts of the three main bearings in the middle.
5. Twist off fixed bolt of flywheel, remove the flywheel.

6. Remove rear oil seal and rear main bearing bolt.

7. Pull out crankshaft from the cylinder block at the back of the crankcase.

Ⅱ. Maintenance of crankshaft flywheel assy.

1. Maintenance of crankshaft

The working surfaces of main journals and connecting－rod journals of the crankshaft should not have bruise, hollow, pits, black dot, crack, burr, sharp edge and other defects.

Repairing of the crankshaft is to grind the journal; grind the main journal at 0.25mm each time, altogether 4 times; grind the connecting－rod journal at 0.50mm each time, twice. With the crankshaft ground, fit responding bushings to ensure of the bearing clearance.

The grinding of the crankshaft is done in repair factory, and the technical requirements of the crankshaft must be guaranteed.

2. Maintenance of main bushing and rod bushing

The alloy layer of the bushing is not permitted to have defects such as pit, peeling off. Strike it, the sound should be clear and crisp; fringe, hole and oil groove should be smooth, no burr and rolling edge. The contact area of the outer circle of the bushing should not be smaller than 85%. The old bushing is permitted to have a few ring－shaped groove marks, but the accumulating width should not be more than 10% of the total effective width.

The wearing of the bushing makes the bearing clearance increase, when the clearance increases to a certain limit and cannot satisfy the operation demand, the bushing should be replaced. It is well processed by the factory according to the technical demands and need not to scrape it. If it needs processing the inner face of the bushing, adopt the boring method, after boring, the alloy layer has to have certain thickness. Do not bore off all of the alloy layer. Manual scrape cannot guarantee the quality.

3. Flywheel should not have crack and damage, and the rubbed surface not have obvious frictional marks.

When replacing the flywheel, perform the dynamic balance check of the new flywheel and the crankshaft.

Ⅲ. Installation of crankshaft flywheel assy.

Before the assembly of the crankshaft flywheel assy., clean it carefully. Crankshaft with flywheel, main bearing, connecting－rod bearing are paired parts, and should not be installed wrongly.

Tighten the flywheel bolts with a torque spanner in 2～3 times, gradually tightening them in diagonal order, and the final tighten torque is 130～150N·m. Lock them with locking plate after tightening.

Chapter Ⅷ Valve Timing and Decompression Mechanism

Section 1 Structure of Valve Timing Mechanism

The function of valve timing mechanism is to open and close the intake and exhaust valves in the firing order to guarantee the normal operation of the diesel engine. It mainly has three parts: valve set, transmission set and driving set.

Ⅰ. Valve set

Valve set includes intake valve, exhaust valve, valve guide, valve spring, valve spring seat and other parts, all of which are installed on the cylinder head of the diesel engine, see Fig. 8－1.

Valves work under high－temperature condition and their lubrication is poor. Intake valve is made of ordinary alloy steel and exhaust valve is made of refractory alloy steel. The exhaust valve is smaller than the intake valve, but they have the same shape and the same stem diameter. As intake valve is big, air can abundantly enter the cylinder through it, which is favorable to combustion. The conical valve rim is 45° and contacts with the valve seat after careful processing when grinding, forming a tight circular belt at width of 1.2～1.6mm. On the top of the valves are engraved marks accoring to the seats they are assembled. At the bottom end there is a concave groove with taper used for installing valve collets.

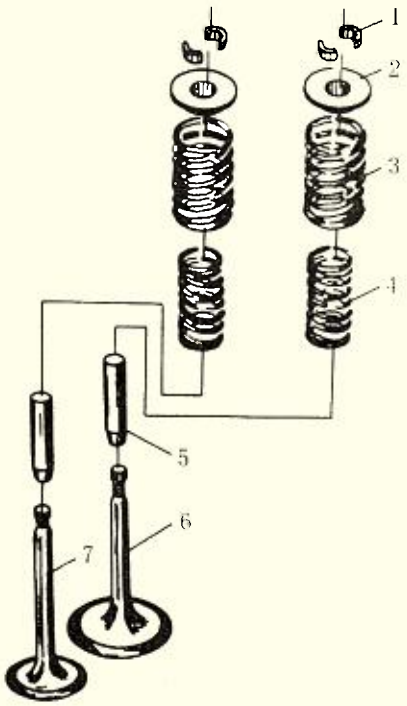


Fig. 8－1 Valve set

1. Collet 2. Spring seat 3. External spring 4. Internal spring 5. Valve guide 6. Intake valve 7. Exhaust valve

When moving up and down, valve guide performs the guiding function to make sure that valve and valve seat contact tightly. In addition, it can also transmit the heat energy of the valve, performing the cooling function . Valve guide is metallurgically pressed with iron－base powder. It is pressed into the cylinder head and its top end should be 17mm higher than the hole seat. The clearance between valve guide and valve stem is 0.04～0.77mm, if it is too big, it will cause oil absorption; if too small, it will increase resistance of the valve movement.

There are external and internal valve springs with opposite spiral directions, in this way, not only to guarantee elasticity, but also to reduce height and prevent resonance. If one spring is broken, the other one can still prevent the valve from falling into the cylinder.

The valve seat, an insert－ring model, is made of copper－molybdenum－chromium cast alloy iron. Press it into the open hole for the valve seat insert in the cylinder head, mill into the valve cone,

which is supplied for the paired grinding with the conical rim of valve.

Ⅱ. Transmission set

The parts of valve transmission set, as shown in Fig. 8－2, mainly include tappet, push rod, rocker arm, rocker arm shaft and adjusting screw.

The bottom surface of tappet is of mushroom type with its center near to one side of the cam. When the cam turns, the tappet moves up and down. It can also rotate for even wearing. The cylinder part of tappet is installed in the cylinder hole of the engine block.

The push rod is a long hollow rod with two round ends. One end stretches into the spherical concave groove of the tappet, the other one into the bowl－shaped concave groove of the adjusting screw.

The rocker arm is made of rare－earth magnesium ductile iron. In the rockerarm hole, there is bushing, and on the rocker arm and the bushing hole there are oil holes, where oil lubricates push rod, tappet, etc. On the longer arm side of the rocker arm is valve and on the shorter arm side is push rod. The longer and shorter arms are pairedly arranged to ensure the open degree of valve and shorten the moving distance of tappet and push rod, thus reducing shock and wearing.

The rocker arm shaft, made of steel tube, is fixed on four supports of rocker arm and supports eight arms. The supports are fixed on the cylinder head, the front one having an oil groove connected with oil passage. Oil flows into each rocker arm through the support and the arm shaft to lubricate the bushing, valve, push rod, tappet and other parts. The fixed bolts, installed on the foremost support of rocker arm, are used for the positioning and fixation of rocker arm shaft. There are springs between two rocker arms to prevent axial movement.

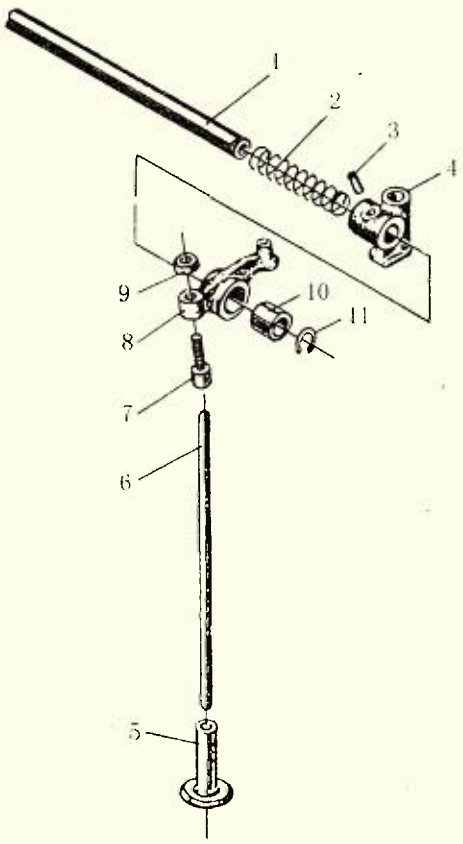


Fig. 8－2 Parts of valve transmission set

1. Rocker arm shaft 2. Spring 3. Holding screw 4. Support of rocker arm 5. Tappet 6. Push rod 7. Adjusting screw 8. Rocker arm 9. Locking nut 10. Bushing 11. Snap ring

Ⅲ. Driving set

The driving set of valve timing mechanism mainly includes camshaft, camshaft gear and thrust plate, as shown in Fig. 8－3.

The camshaft is made of rare－earth magnesium ductile iron and its surface is quenched to improve its hardness and wear－resistance. The shape of the camshaft is very important, if seriously worn, it will affect the opening time and opening height of valve, even performance of the diesel engine. The bearing of camshaft is iron－base－powdered metallurgical bushing, on which there are oil holes leading to the oil passage of main bearing. In order to prevent the camshaft from scurrying axial-

ly, on the front end of the engine block, there is a thrust plate, which is blocked between the camshaft gear and the 1st camshaft journal to limit the axial clearance. The replacement of thrust plates of different thickness can limit the axial clearance to 0.08~0.26mm.

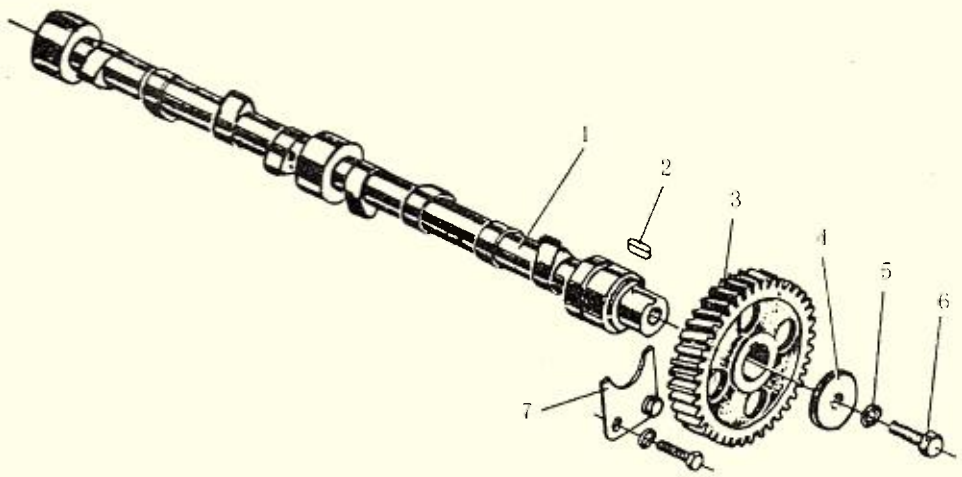


Fig. 8-3 Parts of driving set

1. Camshaft 2. Key 3. Camshaft gear 4. Washer 5. Spring washer 6. Bolt 7. Thrust plate

The camshaft gear is fixed in the front of camshaft with flat keys and tightened with bolts. It is used as valve timing gear, located in the front gear chamber and driven by crankshaft gear with the help of idle gear. The five gears in the gear chamber(crankshaft gear, idle gear, camshaft gear, oil pump gear and injection pump gear)are all helical gears. Except the oil pump gear, the other four all have marks. Align them according to the marks when assembling to ensure valve timing.

Section 2 Timing Phase and Valve Clearance

Ⅰ. Timing phase

The timing phase refers to the actual opening and closing moments and continuous time of intake and exhaust valves (usually indicated by the angle of rotation of crankshaft).

In order to enable the cylinder to take air in to the fullest and exhaust gas more completely, both intake and exhaust valves of the four-stroke diesel engine open and close before or after T.D.C. and B.D.C.

The intake valve opens before T.D.C, firstly, to prolong the intake time; secondly, to perform the full opening in a short time and decrease the intake resistance. It closes after B.D.C, because the pressure in the cylinder is lower than open air pressure and the airflow possesses certain inertia, air continues to enter. In a word, the intake valve opens in advance and retard close for fuller intake.

The exhaust valve opens before B.D.C, at that time the pressure of the waste gas exceeds 300kPa, so it can be quickly displaced. And the exhaust valve still opens for a while after T.D.C. Because of inertia effect of exhaust airflow and higher pressure in the cylinder, the waste gas can be more

completely displaced.

There is a period of time around T. D. C when the intake and exhaust valves both open, however, due to the shortness of overlapping opening time and huge inertia, the intake and exhaust airflow will not mix with each other.

For Model 495 diesel engine, the starting point of opening of the intake valve is 17° before T. D. C, the terminal point of closing is 43° after B. D. C, as to the exhaust valve, it is 43° before B. D. C and 17° after T. D. C. respectively.

Ⅱ. Valve clearance

As a result of thermostatic expansion, the valve, push rod and tappet of Model 495 diesel engine will stretch out to make the valve not close very tightly, therefore, a clearance is set between the head of rocker arm and the bottom end of valve stem, and it is named valve clearance.

At cold, the intake valve clearance is 0. 30mm, and the exhaust valve clearance is 0. 35mm. Because of higher temperature, the exhaust valve clearance is a little bigger than that of the intake valve.

If the valve clearance is not proper, it will lead to decrease of engine horsepower, increase of fuel consumption and worse running. The reason is that if the clearance is small, the valve will not close tightly; if it is big, the valve will open later, which results in insufficient intake and incomplete exhaust.

Section 3 Maintenance and Adjustment of Valve Timing Mechanism

Ⅰ. Maintenance of valve set

After the diesel engine runs for a period, because of erosion caused by high－temperature gas, friction of foreign substance and high－speed reciprocating motion of the valve, the conical rim of the valve and the valve seat will be worn, forming sunken holes and pits, causing untightness of the valve and leading to worse running condition of the diesel engine. Therefore, the tightness of the valve has to be checked regularly. If necessary, do a repair.

1. Checking the tightness of valve

Before checking, remove the cylinder head and clean grease dirt with kerosene or light diesel.

Pour kerosene from the intake and exhaust valves respectively, after 3～5 minutes, observe whether there is kerosene leakage between the valve and the valve seat, if there is, dismantle the valve and repair it.

2. Lapping valve and valve seat

When dismantling the valve, carefully press down the spring seat, head not facing the valve to avoid being hurt by the collet, then take out collet, spring seat, spring, valve, etc. Place them in set according to the cylinder order, and do not mix them up.

If there are small pits or dull black on the valve and the tight conical surface of the valve seat, lap the valve and the seat directly to remove them.

Clean the valve and the valve guide, evenly apply the conical surface with grinding paste (i. e. valve grinding powder) to perform manual lap.

When doing the manual lap, absorb the head of the valve with a rubber bowl with a handle, as

shown in Fig. 8－4. Turn the handle of the grinding tool with fingers to about 60°～90° to－and－fro, make the valve bump with the seat and lap while bumping. When the grinding paste becomes black, rub it off, change for some new and continue to lap. While lapping, use the coarse paste first until there are no clear speckles on the valve and the seat, then rub off the coarse paste, and change it to the fine one and continue to lap until on the tight conical surface appears a 2～3mm circular belt without luster, on which there are no breaks and hollows. Finally, rub off the grinding paste and lap them with oil for a period till it appears fine conical surface. Do not drop the grinding paste on the valve stem, lest the stem and the guide are grinded to widen the clearance.

The valve cone should be neither too wide nor too narrow. If too wide, it will affect the sealability; if too narrow, it will affect the durability.

After finishing the lap of valve and valve seat, thoroughly clean the cylinder head and the valve, assemble the valve set and check its tightness. Or draw some short lines of same distance with pencil on the conical surface, install the valve into the valve seat and slightly turn 1/4 turn. If every line is broken in its middle, it means the lapping is sucessful.

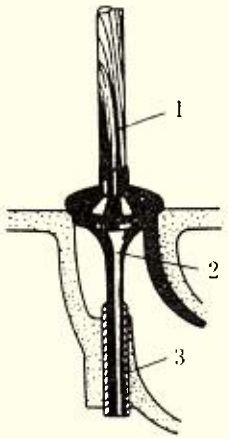


Fig. 8－4 Lapping valve and valve seat

1. Grinding tool 2. Valve 3. Valve guide

3. Milling valve seat

When the valve and the valve seat are excessively worn to create hollow, leaning, serious burning, etc., lap the valve and mill the valve seat, then perform the above－mentioned lapping process. The valve lap is done with the valve grinder. The lap and the mill should be in the minimum limit, to remove the defects is enough, or it will shorten the life span of the valve.

Milling of the valve seat can be done with the valve seat reamer. Before milling, check the clearance between the valve guide and the valve stem. Only if it fits the regulation, the valve seat can be milled , or the milling will affect the concentricity of the valve seat and the valve guide.

The valve reamers have three angles of 45°, 75° and 15°. The 45° one has thick blade and thin blade. Before milling, choose the proper guide rod and there should be no oscilation when it is inserted into the valve guide. Pay attention to milling evenly and straightly.

First mill the defects on the conical surface of the valve seat with 45°thick－bladed reamer, mill as little as possible to lengthen the working life. After milling, install the valve into the seat to have a try. First cover the conical surface with red lead oil, then install the valve into the seat and check if the circular belt is in the middle of the surface and its width is 2～2.5mm. If the belt is wide and to the bottom, mill it with a 75° reamer to move it upward and narrow the width; if the belt is narrow and to the top, mill it with a 15° reamer to move it downward and widen it. Finally, mill the conical surface carefully with the 45° thin－bladed reamer, or put fine abrasive cloth under the reamer to refacing.

4. Setting valve seat insert

If the valve seat has crackles or loosening, or the sunkening of the valve is beyond the limit, the insert should be replaced.

There should be an interference of about 0.1mm between the seat insert and the seat insert hole. Before setting the insert, put the cylinder into oil and heat it to around 100℃, then strike the seat insert into the hole. After finishing the set, flatten the surface of the insert which is higher than the cylinder head and mill the valve and the valve seat to reach the formulated demands. Ensure the sunkening depth of the valve to avoid it from touching the piston top. The distance from the intake valve to the cylinder head is 1.25mm, from the exhaust valve it is 1 mm.

Ⅱ. Replacing valve guide

Valve stem does high-speed reciprocating motion in the valve guide and stands in a state of semi-Coulomb friction or Coulomb friction. When the fit clearance exceeds 0.20mm, the valve guide should be replaced.

The normal fit clearance between the valve stem and the valve guide is 0.05~0.10mm. When measuring the clearance, fix the indicating gauge on the edge of the cylinder head, pull out the valve top to the maximum lift range, make the gauge probe tightly contact with the flange of the valve top and push the top from the left side to the right side. The difference of the two indications is just the measured clearance.

When disassembling the valve guide, use special tools. When assembling it, press it into the cylinder head hole, do not strike with hammer. Coat the outside of the guide with oil before pressing. The fit between the valve guide and the cylinder head hole is interference fit and the interference is 0.01~0.048mm. 6 mm of the guide should be left outside after being pressed into the hole.

There should be a proper fit clearance between the internal diameter of the valve guide and the external diameter of the valve stem, which can be checked with the following method: clean the tested part, coat the valve stem with oil, insert it into the guide and pull, then if the valve falls slowly due to its own weight, the fit is proved to be proper. If the fit is too tight, mill the internal diameter of the guide with a reamer.

Ⅲ. Maintaining driving set

The fit clearance between rocker arm bushing hole and rocker arm shaft is 0.016-0.052mm, if it exceeds 0.20mm due to its wearing, make a repair or a replacement.

If the end contacts with valve on the top of the rocker arm becomes sunken due to excessive wearing, change the rocker arm and do not continue to use after flattening the sunken part.

There should be no crack and deformation on the push rod. If peeling off appears on the end of tappet contact with cam, replace it with a new one.

Ⅳ. Maintaining camshaft

After a long period of operation, appearance and height of the camshaft will be worn, which affects the open height and opening period of the valves and output characteristic and economic performance of the diesel engine. The worn camshaft can be sent to factory for welding, then the size and the shape have to meet the demand of working.

The clearance between the camshaft journal and the camshaft bushing is 0.075~0.127 mm. If it exceeds 0.25mm, replace the bushing with a new one. Pay attention to aligning with the oil hole when pressing the new one in.

Ⅴ. Adjusting valve clearance

Adjustment of valve clearance should be performed at engine cold(see Fig. 8－5). When adjusting, remove the cylinder head cover, turn the crankshaft until the T.D.C. mark line of the first cylinder on the flywheel is at the same level with the line on the flywheel inspection window of the gearbox. When the piston of the first cylinder stands at T.D.C. in the compression stroke, both the intake and the exhaust valves of the first cylinder close. At this time, check the valve clearances of the intake and the exhaust valves of the first cylinder, the intake valve of the second cylinder and the exhaust valve of the third cylinder (i.e. the clearance of the 1st, 2nd, 3rd and 6th valves numbered from front) with a feeler gauge. The intake valve clearance is 0.3mm and the exhaust one is 0.35mm. If the clearance is not proper, loosen the locking nut with spanner and seize it, then screw the adjusting screw in or out with screwdriver to make the feeler gauge just be able to be inserted into the gap between the rocker arm head and the valve stem top. If taking out the feeler gauge, it should be neither too tight nor too loose, then tighten the locking nut and check the clearance until being up to standard.

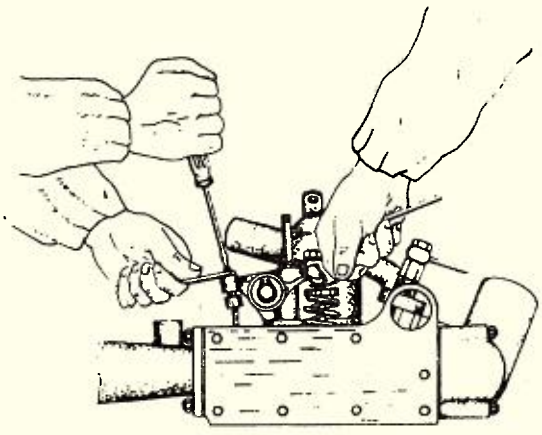


Fig. 8－5 Adjusting valve clearance

After having adjusted the four above－mentioned valve clearances, turn the crankshaft a full turn, at this time the piston of the fourth cylinder is right at T.D.C. of compression stroke. Then check the clearances of the intake and exhaust valves of the fourth cylinder, the intake valve of the third cylinder and the exhaust valve of the second cylinder, i.e. the clearances of the 4th, 5th, 7th and 8th valves numbered from front. Adjust the clearances with the same method. Do it twice in this way, complete the adjustment of all valve clearances and check one time more.

Section 4 Decompression Mechanism

Ⅰ. Structure of decompression mechanism

As the diesel engine possesses huge compression, the decompression gear is installed in the valve timing mechanism for the benefits of starting, crankshaft turning, adjustment and maintenance.

The decompression gear is installed in the cylinder head cover and made up of reducer seat, decompression shaft, decompression handle, shift fork, spring and screw (Fig. 8－6). While the decompression handle being controlled, it presses the decompression screws via through the shaft to make the four intake valves open, thus realizing cylinder decompression.

The handle has to be pulled back to the former place after decompression.

Decompression gear should smoothly transmit and when the handle being loosened, it can return to the former place. While finding the decompression screw or the locking nut loose, or after adjusting the valve clearance, check and adjust the decompression gear.

Ⅱ. Adjusting decompression gear

1. Screw tight the clamp nut of the support of rocker arm, turn the crankshaft and make the piston of the first cylinder at T.D.C. of compression stroke. At this time, the intake valves of both the first and second cylinders stand at the closing position.

2. Turn decompression shaft 1, decompression connecting – rod 2 being vertically downward and four screws 3 also vertically downward. Loosen the decompression locking nuts of the first and second cylinders and screw the decompression screws with screwdriver. When the screws contacts the rocker arm, continue to turn them downward for one and a half turns, that is to ensure the decompression screws open the intake valve for about 1mm. Then tighten the locking nut to lock the screws.

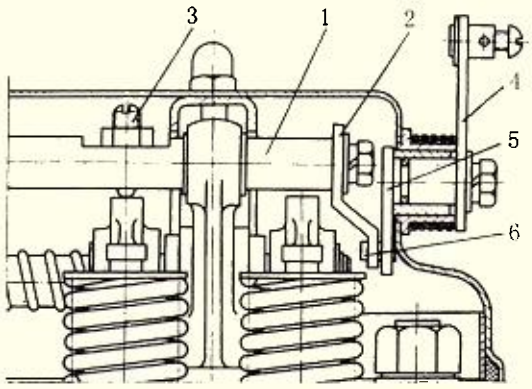


Fig. 8 – 6 Decompression gear

1. Decompression shaft 2. Decompression connecting – rod 3. Decompression screw 4. Decompression handle 5. Decompression shift fork 6. Straight pin

3. Turn the crankshaft for another turn (360°) to make the piston of the fourth cylinder stand at T.D.C of compression stroke. Adjust the decompression screws of the third and fourth cylinders with the above – mentioned method.

4. After finishing the adjustment of all of the 4 cylinders, if turn the crankshaft at non – decompression state, there should be compression force; and if turn it at decompression state, there should be no resistance, then the adjustment is proved to be proper.

In adjustment, be careful not to screw the screws in too much or too little. If screw them too much, the valve opens so wide as to strike the piston top; if too little, it cannot open so as to lose the decompression function.

Chapter Ⅸ Supply System

The function of the supply system is to inject a precise amount of diesel and clean air into the combustion chamber at proper time, and make it burn to provide power. The supply syetem of Model 495 engine consists of diesel supply system and air supply system. The diesel supply system is shown in Fig. 9 – 1. The diesel goes from fuel tank 1 to diesel sediment bowl 2, diesel filter 3 and fuel pump 5, the fuel pump presses it into injection pump 6, the injection pump sends the high – pressure diesel into the injector 8 through high – pressure pipeline 7 and the injector injects it into the combustion chamber. The air supply system consists of air cleaner and intake manifold. The fresh air is inhaled into air cleaner and enters cylinder through intake manifold.

Section 1 Air Cleaner

Ⅰ. Function of air cleaner

If dust and other impurity enter the cylinder, it will accelerate wear of valve, cylinder sleeve and piston. The function of air cleaner is to provide clean air for the diesel engine.

The air cleaner of Model 495 engine is of three – stage oil – bath type, see Fig. 9 – 2. Through the deflector grid, the airflow becomes a stream of swirling air and enters the air cleaner with the bigger grains of dust being thrown out to the periphery. Then the airflow goes vertically downward along the intake pipe, and part of the dust is sticked by oil. The air is filtrated once more by the filtering elements and finally enters the intake manifold.

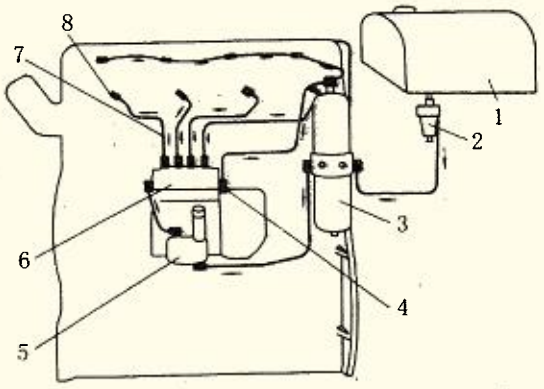


Fig. 9 – 1 Diagram of diesel supply system

1. Fuel tank 2. Diesel sediment bowl 3. Diesel filter
4. Return screw 5. Fuel pump 6. Injection pump
7. High pressure pipeline 8. Injector

Ⅱ. Maintenance of air cleaner

The air cleaner should be frequently maintained. Clear off dust and waste first, then take out the filtering elements and clean them. Change the oil and keep the oil surface at a certain level.

Section 2 Combustion Chamber

The combustion chamber of Model 495 engine is swirl chamber type, and it consists of two parts (see Fig. 9 – 3): main combustion chamber and auxiliary combustion chamber (also called swirl chamber). The space between the piston top and the bottom surface of the cylinder head is the main com-

bustion chamber; and the part, which is cast on the cylinder head and added with an inserted piece, is the auxiliary combustion chamber. The main and auxiliary combustion chambers are jointed by the main injection orifice which has a smaller tapered injection orifice for starting in front of it. In order to make the combustion gas combust completely, the top of the piston takes the shape of a sunken pit.

Before the piston reaches T. D. C, the diesel is injected into the combustion chamber. Because of the compression temperature, part of the diesel in the auxiliary combustion chamber first begins to burn, then the pressure in the chamber increases, the combusting mixed gas enters the main combustion chamber, the air and diesel mix further and burn completely.

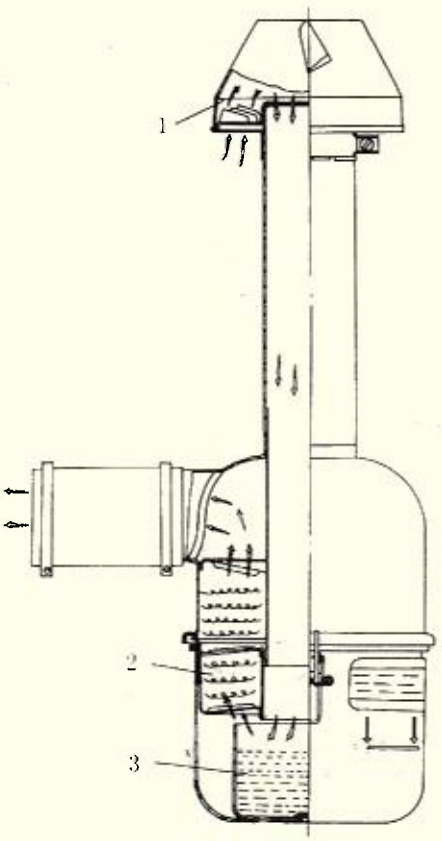


Fig. 9－2 Oil－bath three－stage air cleaner

1. Primary cleaner 2. Filtering element 3. Oil bath

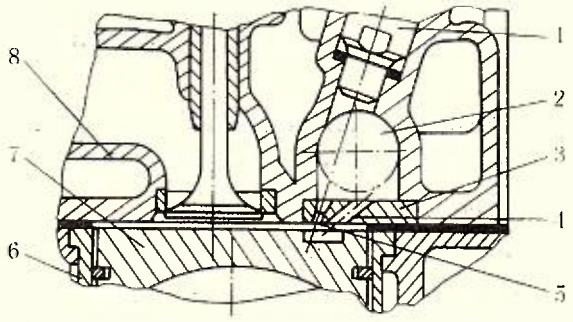


Fig. 9－3 Swirl chamber

1. Injector 2. Swirl chamber 3. Inserted piece of swirl chamber 4. Main injection orifice 5. Starting orifice 6. Cylinder sleeve 7. Piston 8. Cylinder head

While starting the engine, the injector points to the starting orifice, thus part of the diesel enters the main combustion chamber directly, helping to start.

If the inserted piece is burnt, change it in time. While installing a new one, pay attention to the positioning and its reliability, and it is required that the inserted piece should not be higher than the face of the cylinder head, otherwise, it would be scraped or grinded.

Section 3 Diesel Filter

Ⅰ. Structure of diesel filter

There are two stages of diesel filters in Model 495 engine: primary and secondary, and both are C0708 paper element filters (see Fig. 9－4).

The compound filter (see Fig. 9－5) combines the two stages into one. The upper part is the secondary filter, the lower part is the primary filter, and they are linked up by interior passages. The

parts of the compound filter are interchangeable with those of the C0708 filter except for the filter seat.

Ⅱ. Maintenance of diesel engine filter

Clean the cover and the inner and outer faces of the casing together with the elements. Before cleaning, block the hole on the two ends of the element with a rubber or cork plug to prevent the filth from entering the element, then put it into clean diesel or kerosene, and clean the fold with a brush and lastly wash it with clean diesel. The filth can also be blown out by compressed air or an air pump. If there is any damage in the element or too much filth deposit, replace it. Before installing the filter element, check the sealing washer and see if there is any damage or deformation, and it should be placed on the correct point. Align the casing and the filter seat while screwing the pull rod nut.

After installation, bleed the interior air. Loosen the air vent screw till there is no bubbles in the outflowing diesel, then tighten the screw.

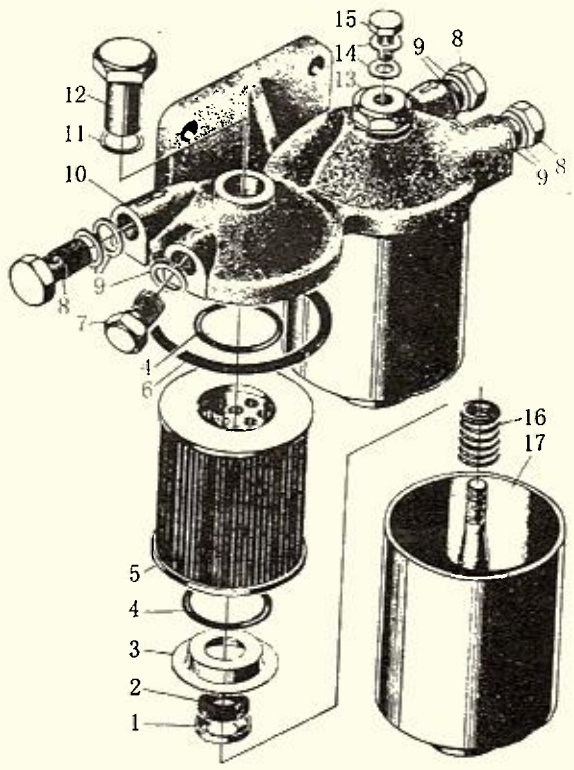


Fig. 9－4 C0708 filter

1. Filter plate 2. Seal filler 3. Filter element seat 4. O－ring 5. Secondary filter element part 6. Seal ring 7. Plug 8. Oil pipe bolt 9. Oil pipe bolt washer 10. Casing 11. Sealing washer 12. 1st stage pull－rod nut 13. Pull rod nut 14. Joint screw washer 15. Joint screw 16. Spring 17. Casing set

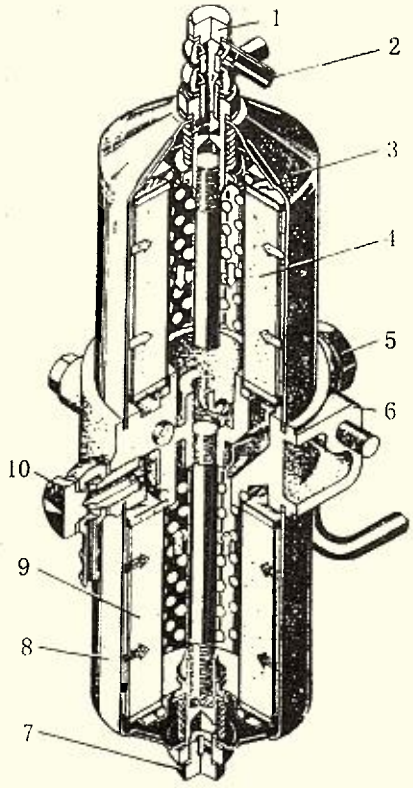


Fig. 9－5 Compound diesel filter

1. Air bleed screw 2. Return pipe joint 3. Secondary filter casing 4. Secondary filter element 5. Outlet joint 6. Filter seat 7. Water drain screw 8. Primary filter casing 9. Primary filter element 10. Inlet joint

Section 4 Fuel Pump

Ⅰ. Function and working principle of fuel pump

While the diesel is being transfered from the fuel tank to the injection pump, the fuel pump can surmount the resistance from the fuel pipe and the filter, ensuring the quantity and stable pressure of the diesel.

The fuel pump of Model 495 engine is of single acting piston type, and it is installed on the injection pump, its structure is shown in Fig. 9－6, while its working principle is shown in Fig. 9－7.

Get rid of the air in the fuel pipeline system, ensuring that the pipeline is filled with diesel before starting. A hand pump is attached to the fuel pump. When it is idle, screw the upper nut tight to prevent air or oil leakage.

Ⅱ. Maintenance of fuel pump

When the fuel pump has been used for some time, take out the fuel strainer and clean it. If the strainer is damaged, replace it. Wear of piston and deformation or snap of the spring will both cause insufficient fuel supply, so change them.

Section 5 Injection Pump

Ⅰ. Function and structure of injection pump

The injection pump is used to increase the diesel pressure, and supply a precise amount of pressurized fuel to each injector to inject to each cylinder in sequence according to the working cycle and the change in load.

Model 495 diesel engine adopts injectors of one－piece－plunger－type No. Ⅰ series. The diameter of the left－handed plunger is 8mm. The structure of the injection pump is shown in Fig. 9－8.

Ⅱ. Working process of injection pump

The working process of the injection pump is shown in Fig. 9－9.

Pumping oil process is shown in Fig. 9－9 a, both of the two holes in the sleeve open and the diesel from the fuel pump fills the plunger sleeve. When the bulging part of the camshaft lifts the roller wheel, the plunger moves upward and the holes in the sleeve are covered thus a tighten fuel cavity is formed at the top of plunger. As the plunger moves upward further, the fuel pressure increases rapidly, then the high pressure fuel pushes the outlet valve open, enters the high pressure pipeline and makes the needle valve of the injector open so that the injector can inject fuel into the combustion chamber. See Fig. 9－9 b.

The plunger continues to move upward until the chute is interlinked with the fuel hole in the plunger sleeve, and at this time, the high pressure and low pressure cavities are interlinked by the chute and the hole in the head of the plunger, and fuel pressure suddenly drops. Then the outlet valve closes due to the spring and the fuel supply is cut off (see Fig. 9－9 c). When the bulging part of the camshaft passes, the plunger moves downward caused by the plunger spring. Thus , as the rotation of the camshaft going on, the plunger and the outlet valve repeat the above－mentioned process and the

pump supplies high pressure diesel for each cylinder.

It could be known from the above description (see Fig. 9 – 9 d) that the amount of diesel supply depends on fuel supply travel "a", that is, the distance fron the plunger end to the edge of the chute. Consequently, the plunger rotation could change the fuel supply travel "a" and the amount of fuel supply. The plunger travel "1" (the distance between T. D. C. and B. D. C. of the plunger) is determined by the lift travel of the camshaft; the supply starting time is determined by the camshaft and has nothing to do with travel "1".

The fuel supply starting time is called advance angle of fuel supply and it is indicated by the rotation angle of the crankshaft before T. D. C. Because the high pressure diesel has to travel from the injection pump to the injector through high pressure pipeline, the diesel supply time is earlier than that of fuel injection time, so apparently, the advance angle of fuel supply is bigger than that of the fuel injection. The advance angle of fuel supply for Model 495 engine is 16° before T. D. C. with a tolerance of ±2°.

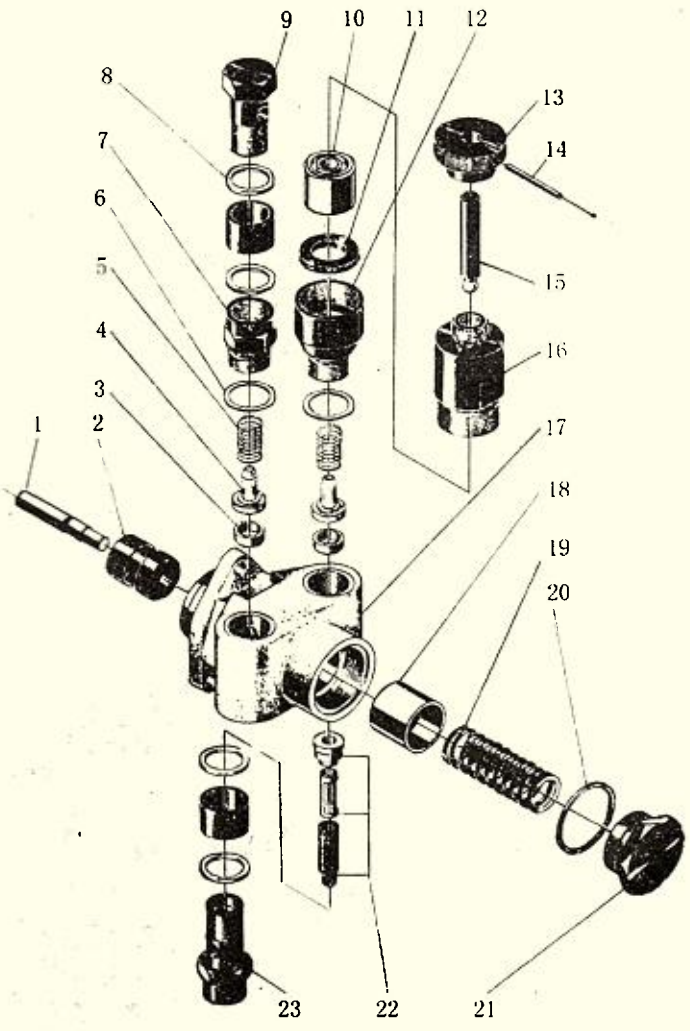


Fig. 9 – 6 Fuel pump parts

1. Tappet plunger 2. Tappet plunger sleeve 3. Check valve seat 4. Check valve 5. Check valve spring 6. Washer 7. Outlet joint 8. Washer 9. Fuel pipe line joint 10. Hand pump piston 11. Rubber cushion 12. Hand pump joint 13. Pulling button 14. Straight pin 15. Hand pump core 16. Hand pump block 17. Fuel pump block 18. Piston 19. Piston spring 20. Washer 21. Screw plug 22. Fuel strainer 23. Inlet joint

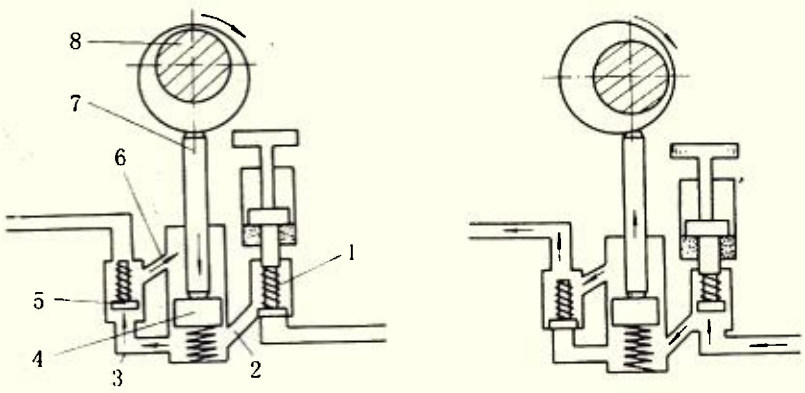
Ⅲ. Maintenance of injection pump

The injection pump is the "heart" of the diesel engine. Its working condition has a direct influence on the economic characteristic and output performance of the engine and its working reliability and life span have direct relation with the maintenance.

1. Use proper light diesel and select the diesel type according to the temperature.

2. The diesel should be precipitated for more than 48 hours and filtered by double – layered silk or woollen cloth before being filled into the fuel tank. The refuel tool should be kept clean and specialized.

3. Change the element of the diesel filter in time. Clean the fuel tank after 1000 working hours.



(a) Fuel pumping into upper cavity from lower cavity of the plunger

(b) Fuel pump out from upper cavity and fuel pumping into lower cavity

Fig. 9－7 Working principle of fuel pump

1. Inlet check valve 2. Inlet path 3. Lower outlet path 4. Piston 5. Outlet check valve 7. Tappet plunger 8. Camshaft

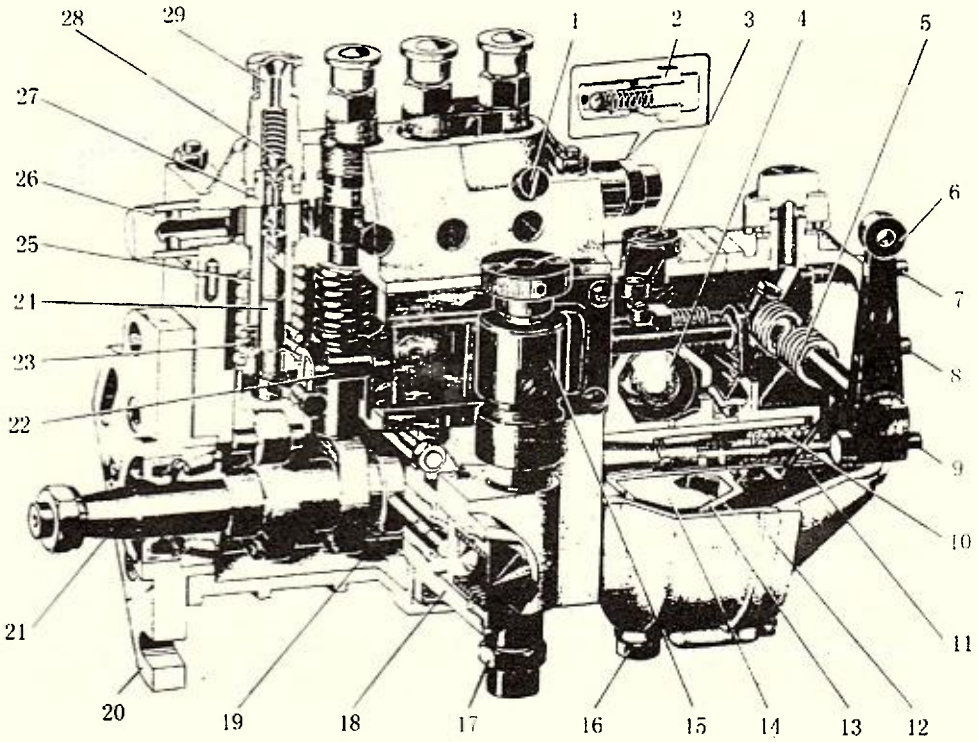


Fig. 9－8 No. 1 injection pump and governor

1. Air bleed screw 2. Fuel return valve 3. Shut－off handle 4. Steel ball 5. Governor spring 6. Governor control handle 7. High－speed screw 8. Idle－speed screw 9. Fuel check screw 10. Check spring 11. Sliding sleeve 12. Governor casing 13. Sliding plate 14. Drive plate 15. Hand pump 16. Drain screw plug 17. Inlet screw 18. Fuel pump 19. Eccentric cam of fuel pump 20. Fixing joint flange 21. Camshaft 22. Pull rod 23. Plunger spring 24. Plunger 25. Plunger sleeve 26. Inlet screw 27. Outlet valve seat 28. Outlet valve 29. High－pressure pipeline joint

The diesel in the fuel tank should not be used up in order to prevent the air or filth from being drawn in. Outlet the water and filth in the fuel tank regularly.

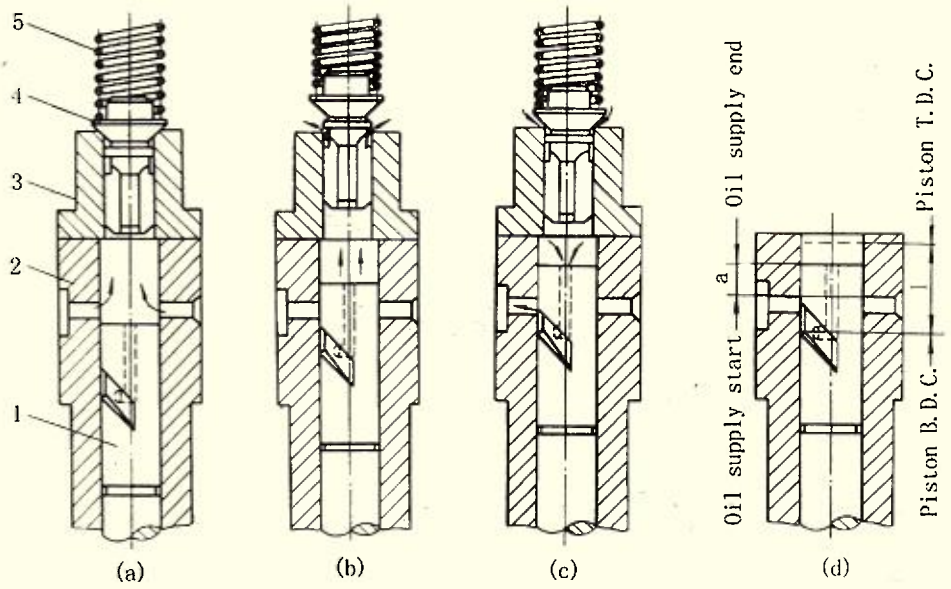


Fig. 9－9 Working process of injection pump

a) Inletting b) Supplying c)Stopping supply d)Fuel supply travel "a" plunger travel "l"

1. Plunger 2. Plunger sleeve 3. Outlet valve seat 4. Outlet valve 5. Outlet valve spring

4. Check the oil level in the pump and the governor block, if necessary, open the aeration hood and add clean oil to the required level which is between the upper and lower mark on its dipstick. If the level is too low, the lubrication will be bad; if it is too high, the sensitivity of the governor will decrease, even lead to running－away of diesel engine.

5. When it is necessary to get rid of the air in the fuel path of the injection pump, loosen the air bleed screw, pull the hand pump handle until there is no air bubles in the outflowing diesel.

6. Check the tightness of the installation bolts of the injection pump and screw them tight on time.

Section 6 Governor

Ⅰ. Function and structure of governor

The function of the governor is to automatically adjust the fuel supply under varing loads and ensure the even running of the diesel engine in a certain speed. While the diesel engine is working , its load is variable. For example, when the tractor is doing field operation, the dryness and hardness of soil, uneven terrain, always changing soil resistance and variable resistance of the road in transportation will all cause the variation in load. If the fuel supply does not change in each cycle, the speed of the engine will change distinctly according to its loads, even engine running－away could occur. Such an engine cannot work at all, and the governor is just used to handle all these problems.

The governor of Model 495 diesel engine is fixed on the rear part of the injection pump. It is a mechanical all－speed governor and could maintain any selected engine speed between its maximum and minimum.

The parts of the governor is shown in Fig. 9－10. The driver plate 11 presses tightly against the driving bearing sleeve 10 and becomes integral. The driving bearing sleeve is fixed on the end of the camshaft by woodruff key, spring washer and locking nut and used to drive the governor.

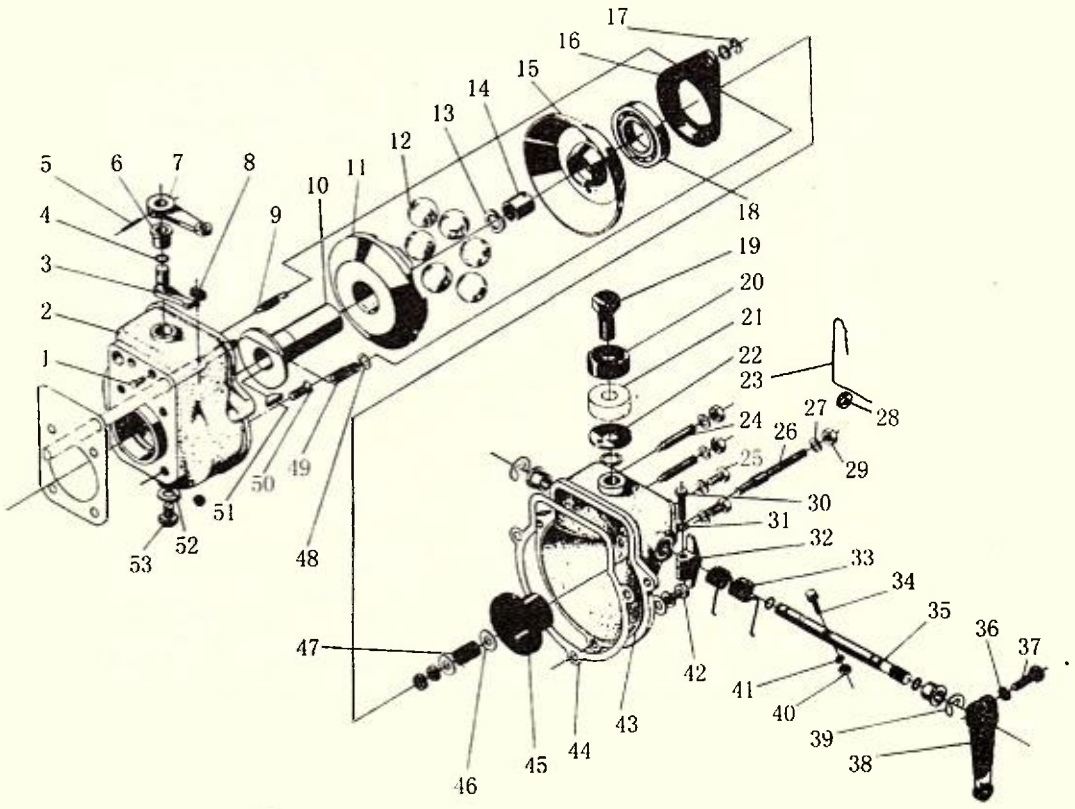


Fig. 9－10 Parts of Model 495 engine governor

1. Straight pin 2. Governor seat 3. Shut－off arm 4. Sealing ring 5. Straight pin 6. Bush 7. Shut－off handle 8. Shut－off stopper pin 9. Starting spring 10. Driving bearing sleeve 11. Driver plate 12. Ball 13. Spring washer 14. Nut 15. Sliding plate 16. Driving plate of pull－rod 17. Split retaining ring 18. Bearing 19. Joint screw 20. Aeration hood 21. Element 22. Inlet plate 23. Iron wire 24. High－speed screw 25. Bolt 26. Fuel control screw 27. Copper gasket 28. Leaden seal 29. Nut 30. Bolt 31. Spring washer 32. Governor stopper 33. Governor spring 34. Position bolt 35. Governor shaft 36. Spring washer 37. Bolt 38. Governor handle 39. Split retaining ring 40. Nut 41. Spring washer 42. Screw 43. Governor casing 44. Governor shim 45. Sliding sleeve 46. Washer 47. Check spring 48. Washer 49. Shut－off spring 50. Sunk screw 51. Woodruff key 52. Copper gasket 53. Drain screw plug

The upper screw in the governor is high－speed screw and used to limit the highest no－load speed of the engine; the middle one is idle speed screw, used to adjust the lowest steady speed of the engine; the lower one is the fuel amount adjusting screw, adjusting the normal fuel amount and the

corrected amount. The adjusting screws and positioning screws have been adjusted and leaden－sealed in the factory, basically their positions should not be changed.

Ⅱ. Working process of governor

When the diesel engine is running at a certain speed, the centrifugal force of the flying balls is balanced with the reactive force of the governor spring so that the speed is kept unvariable. When the load decreases, the running speed increases and the centrifugal force increases, which makes the pull rod moves rightward, as a result the fuel supply decreases and the running speed of the engine also decreases; on the contrary, if the load increases, the running speed and the centrifugal force decrease, which makes the pull rod moves to the left, then both the fuel supply and the running speed increase. See Fig. 9－11.

1. Adjusting process

When the governor handle is at a certain point, the engine is running steadily at a certain speed, however, once its load increases, the amount of fuel supply will no longer coordinate with the load and the engine speed decreases. As a result, the axial component of the centrifugal force becomes weaker than the elastic force of the check spring, so the force pushes the sliding plate and makes the pull－rod move toward the direction of increasing fuel supply. The fuel supply is increased till it can meet the demand; then the engine speed will no longer decrease. At this time, the axial component of the centrifugal force is balanced with the elastic force of the spring again, which makes the engine run steadily.

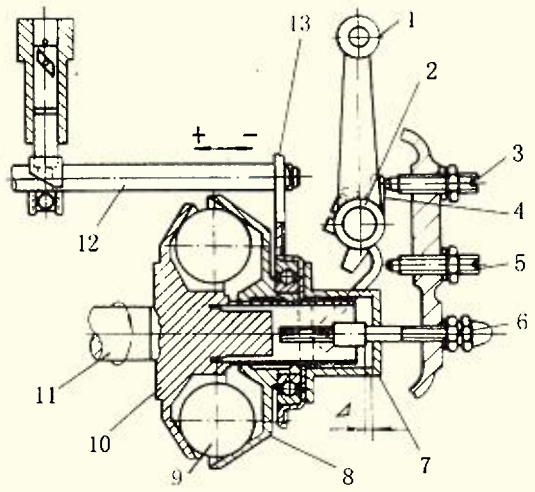


Fig. 9－11 Diagram of governor working process

1. Governor handle 2. Check spring 3. High speed screw 4. Governor stopper 5. Idle speed screw 6. Fuel control screw 7. Sliding sleeve 8. Sliding plate 9. Ball 10. Driver plate 11. Camshaft 12. Pull－rod 13. Driving plate of pull－rod

Conversely, when its load decreases, the fuel supply increases and the engine speed also increases, consequently, the centrifugal force increases, its axial component becoming stronger than the elastic force of the spring. And then together with the sliding plate, the pull－rod moves toward the fuel supply decreasing direction to make the amount of fuel supply coordinate with the load, and the axial component of the centrifugal force is balanced with the elastic force under new condition, ensuring the diesel engine runs steadily.

The destroying and building of the balance is caused by the load of the engine and the adjustment is handled by the governor automatically.

2. Shut－off

The governor is installed with shut－off mechanism. While shutting off, loosen the governor handle to make the engine in idle running for some time, then make the pull－rod to the shut－off position by pulling the fuel shut－off lever (Fig. 2－1 No. 21), the engine will stop. Push the shut－off lever, to let the shut－off handle return to its position automatically.

Under emergency situation, pull the shut－off handle directly (not necessary to loosen the governor handle) to make the pull－rod move to the shut－off position quickly from any place and make the engine stop. After it is stopped, make sure to loosen the governor handle.

Ⅲ. Maintenance of the governor

There are inlet screws and oil drain screws on the top and bottom of the governor casing. The oil level should be checked regularly, if necessary, add oil to it or change oil in time.

Section 7 Injector

Ⅰ. Function of injector

Injector is used to inject high－pressure fuel from the injection pump into the combustion chamber. In order to be advantageous to the formation of mixed combustible gas and the complete combustion, the diesel injected by the injector should be with good atomization, certain oil－beam shape and injection direction. The injection should be quick and without drip.

Ⅱ. Structure and operation of injector

Model 495 diesel engine adopts needle injector, as shown in Fig. 9－12.

When the injection pump supplies fuel, the high－pressure fuel goes into the collar fuel groove on the top of the needle valve body and into the fuel cavity at the bottom of the valve body through the angled holes. Then fuel pushed the needle valve upward and after overcoming the spring pressure, the valve lifts and opens the spit hole, thus fuel being injected into the combustion chamber. When the injection pump stops supplying fuel, the needle valve quickly closes the spit hole under spring pressure.

In injector operation, little amount of remaining fuel flows back from the middle of the needle valve and the valve body, and out of the fuel return pipe through the tappet plunger passage.

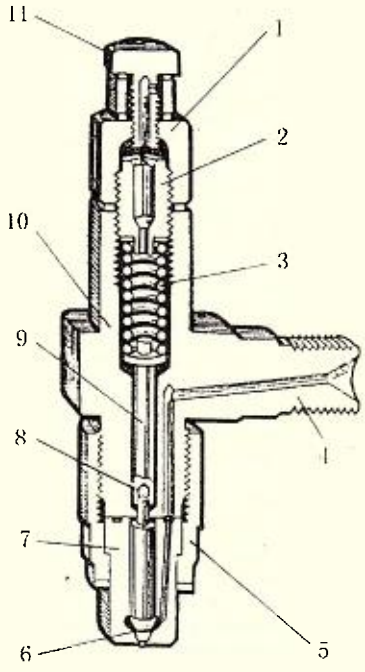


Fig. 9－12 Needle injector

1. Nut 2. Adjusting screw 3. Pressure spring 4. High－pressure line joint 5. Cap 6. Needle valve 7. Needle valve body 8. Steel ball 9. Tappet plunger 10. Injector body 11. Fuel return pipe joint

Ⅲ. Maintenance of injector

In cleaning and assembly, the needle valve pair cannot be changed with each other. When cleaning, get rid of carbon deposit with wood chip or bronze blade and poke the needle hole with copper wire. After finishing cleaning with clean diesel, lap the needle valve and the valve body with clean oil. Be careful not to damage the tight surface of the needle valve.

Section 8 Check and Adjustment of Fuel System

Ⅰ. Check and adjustment of advanced angle of fuel supply

After disassembly, assembly and overhaul of the diesel engine, the advanced angle of fuel supply has to be checked and adjusted to ensure comparatively low fuel consumption and good operating property.

1. Remove the high pressure line of the first cylinder and replace it with one with a thin glass tube. Put the governor handle of the injection pump at its maximum, and press the hand pump to bleed air in supply system. Turn the crankshaft until there is diesel fuel without air bubbling out in the glass tube.

2. Turn the crankshaft slowly and observe the change of the fuel level in glass tube. When the fuel level just rises, which proves that the first cylinder starts to supply fuel, stop turning at once. Observe if the line of the advanced angle of fuel supply on the flywheel is at the same level with the line on the flywheel inspection window of the gearbox.

3. If the lines are not at the same level, loosen the three holding screws on the triangle flange of the injection pump. Turning the injection pump body toward the diesel engine body, the advanced angle of fuel supply increases; otherwise, it reduces.

4. If the advanced angle of fuel supply of each cylinder relatively exceeds that of the first cylinder $\pm 1^{\circ}$, the adjusting spacer on the tappet plunger of the injection pump should be replaced. If the spacer is made thinner, the angle reduces, otherwise, it increases.

5. When the injection pump is out of the factory, the advanced angle of every cylinder has been adjusted well, if it is not necessary, do not disassemble and adjust at will.

Ⅱ. Check and adjustment of injector

Injection pressure of the injector and fuel atomization are very important for normal running of the diesel engine. The injected fuel should be with certain spraying pattern, the shut off being clear-out, no drip and leakage after injection, and the normal injection sound being clear and crisp.

Check and adjustment of the injector should be performed on the testing stand and it mainly includes the three following items:

1. Check and adjustment of injection pressure

Continuously press the hand pump of the testing stand, and the injection pressure should be 12~12.5MPa. If it does not reach the requirement, loosen the top nut, screw the pressure-adjusting screw with screwdriver. If screw in, the pretension of the pressure spring rises and the injection pressure also rises; if screw out, the pressure falls. Then tighten the nut and check the pressure once more.

2. Injector sealability test

Press the hand pump and evenly increase the pressure to 10MPa at the step of 0.2~0.3MPa/sec, keep the pressure for more than 15 seconds, and no fuel should be leaked from the nozzle. Then gradually increase the pressure to 11.5MPa and keep the pressure instantaneously, drip is not allowed, but a little moisture is acceptable, otherwise, the conical surface of the needle valve has no good sealability and should be cleaned, repaired or replaced.

3. Spraying condition check

Press the hand pump at the speed of 120 times per minute and check the spraying condition. The spraying should be even and has no deformation, otherwise, make a cleaning, repair or replacement.

Ⅲ. Check and adjustment of injection pump and governor on testing stand

Before injection pump test, clean it, add lubricating oil and completely bleed air.

1. Appearance check

Every part of the injection pump should be nimble and without fuel leakage, and the governor handle should be at a certain position and without loosening.

2. Adjustment of fuel amount for starting

The rotation speed of the camshaft should be 100 ~ 150 rounds per minute. Set a cylinder as a standard one and adjust it to the set starting fuel amount, i.e. 17ml per 200 cycles. Tighten the screw on the top of the gear fork and successively adjust other cylinders.

3. Adjustment of rated fuel amount and fixation of check screw

(1) Adjustment of rated amount

When the camshaft rotates at the rated speed, adjust the amount of the standard cylinder to the rated amount, i.e. 12ml per 200 cycles, the error not exceeding ±0.2ml. Then adjust the fuel supply amount of other cylinders to the requirement and tighten the screw on the gear fork.

(2) Fixation of high speed screw

At the rated working state (at the speed of 1000 r/min. and the amount of 12ml/200cycles), screw the high speed screw until it contacts with the governor stopper, and tighten the high speed screw.

(3) Fixation of fuel control screw

At the rated working state, screw the fuel control screw until its plain washer contacts with the sliding sleeve, and tighten the fuel control screw.

(4) Check of corrected amount

The camshaft speed should be the corrected speed (700 r/min.), the governor handle at the high - speed check position and the fuel supply amount of each cylinder in the specified limit, that is 14.5 ±0.5ml/200cycles.

4. Check of governor property

The governor handle being at the high - speed position, check the following items.

(1) Rated working state and its stability

The camshaft speed should be the rated speed and the fuel supply amount of each cylinder should be the rated amount. After changing the engine speed and returning to the rated one, the fuel amount of each cylinder should restore to the rated limit.

(2) Governor speed

When the camshaft rotates at the rated speed, increase the speed according to the specified value, and the fuel supply amount should decrease correspondingly.

(3) Shutoff speed

Increase the camshaft speed till shutoff, and at this time, it should not exceed 1100 r/min.

5. Adjustment of idle - speed fuel amount

Loosen the governor handle to the free position, and the camshaft speed decreases to 275 r/min. Adjust the governor handle and make the fuel supply amount of each cylinder in the idle – speed amount limit, then screw the idle – speed screw in until it contacts with the stopper and tighten it.

After the adjustment of the injection pump and the governor, high – speed, low – speed and fuel contol screws should be sealed with lead.

Chapter Ⅹ Lubricating System

The functions of the lubricating system include lubricating, cleaning, cooling and sealing. As the diesel engine is working, enough clean oil is supplied to lubricate the friction surfaces. The grindings on the friction surfaces are washed in time, and the heat produced by friction is lowered. The function of the lubricating oil is sealing and rust prevention for some other parts such as the fitting surface of the cylinder sleeve and the piston. Lubricating system is important for the diesel engine to ensure its reliability and durability.

In Model 459 diesel engine, the lubricating oil is transported to the main motion pairs such as crankshaft bearing, connecting rod bearing, camshaft bearing, driven gear bearing, rocker arm bearing, etc., by means of pressure lubrication and to other motion pairs such as cylinder sleeve and piston, piston pin and its bushing, valve and valve guide, gear, etc., by means of splash lubrication. The anti-friction bearing, pump bearing and motor bearing, should be filled with grease regularly.

Section 1 Oil Passage of Lubricating System

The lubricating system of the Model 495 diesel engine is shown in Fig. 10-1.

In order to prevent the main oil passage from lack of oil caused by the element block, safety by-pass valves are parallel connected in the oil filter. The pressure limiting valve of the oil pump is paralleled with the oil passage of the lubricating system to control the oil pump pressure.

Section 2 Main Parts of Lubricating System

Ⅰ. Oil pump

1. Structure and working principle of oil pump

The oil pump of Model 495 diesel engine is of inner-and-outer-rotor type, as shown in Fig. 10-2. It consists of oil pump housing, inner and outer rotors and oil pump shaft. The working principle is shown in Fig. 10-3.

2. Maintenance of oil pump

In assembling, special attention should be paid to check the connecting part of the oil suction pipe to see whether it is sealed and has no air leakage. After the oil pump has been used for some time, the rotor facing clearance should be adjusted with a paper washer. The specific value should be 0.04~0.08mm, as shown in Fig. 10-4. And the clearance between the inner and outer rotors should be less than 0.25mm, same as the clearance between the outer rotor and the pump housing. If it exceeds the specific value, make a replacement.

Ⅱ. Oil filter

1. Structure and working principle of oil filter

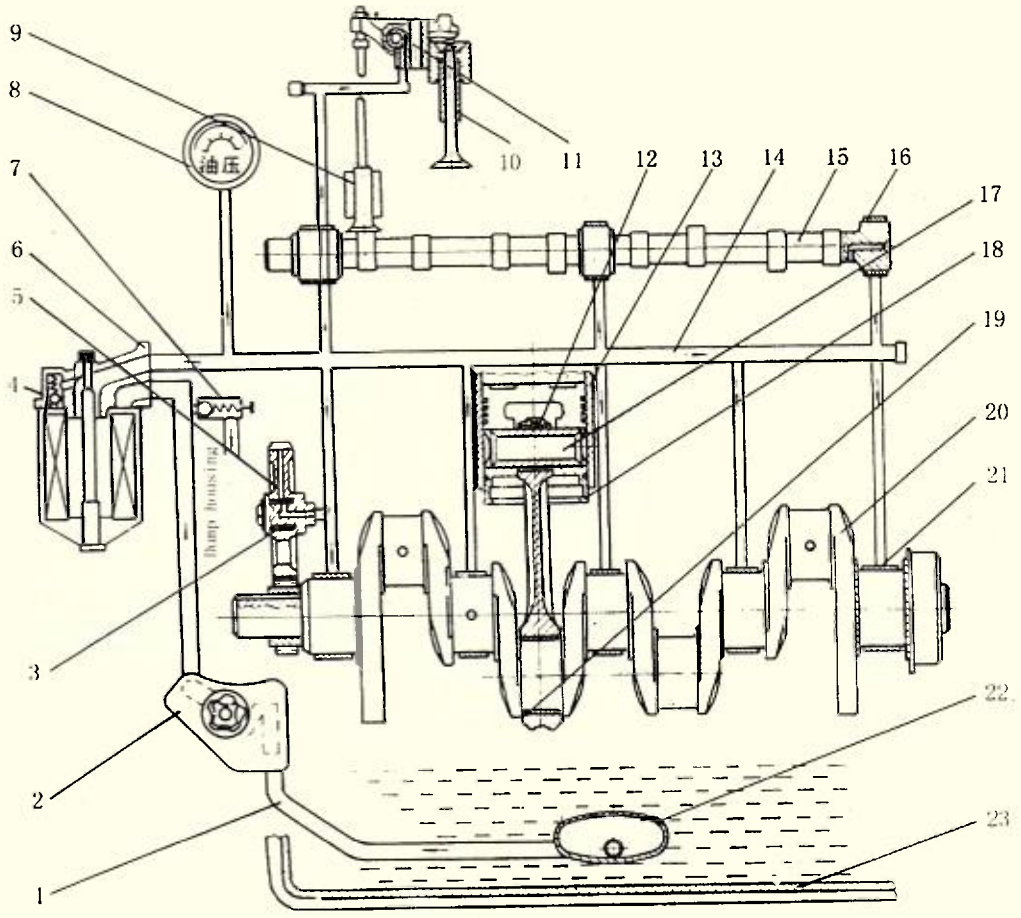


Fig. 10－1 Lubricating system

1. Oil suction pipe 2. Oil pump 3. Idle gear bushing 4. Safety by pass valve 5. Idle gear 6. Oil filter 7. Pressure adjusting valve 8. Oil pressure gauge 9. Tappet 10. Valve and valve guide 11. Rocker arm bearing 12. Connecting rod small end bushing 13. Cylinder sleeve 14. Main oil passage 15. Camshaft 16. Camshaft bearing 17. Piston pin 18. Piston 19. Connecting rod bearing 20. Crankshaft 21. Main bearing 22. Screen 23. Oil sump

Structure and working principle of the oil filter is shown in Fig. 10－5.

The pressure－adjusting valve 5 and by－pass valve 4 are installed on the filter to ensure the normal oil pressure in the main oil passage. If the pressure is greater than the specific value, the pressure－adjusting valve opens, and superfluous oil returns to the oil sump. If the oil filter element is blocked, the by－pass valve opens, oil directly enters the main oil passage through it so as to keep parts get lubricated.

2. Maintenance of oil filter

The troubles of the oil filter mainly include: filter element being blocked or damaged; oil leakage via washer and sealing ring; pressure adjusting valve and by－pass valve being out of order, etc.

After a new diesel engine runs for the first 125 hours, the filter elements should be replaced. Later

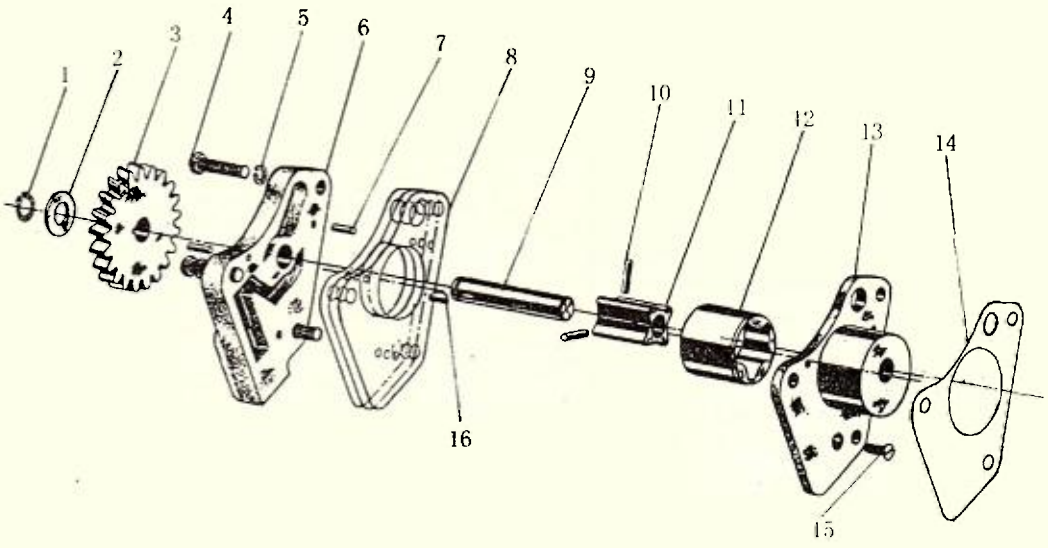
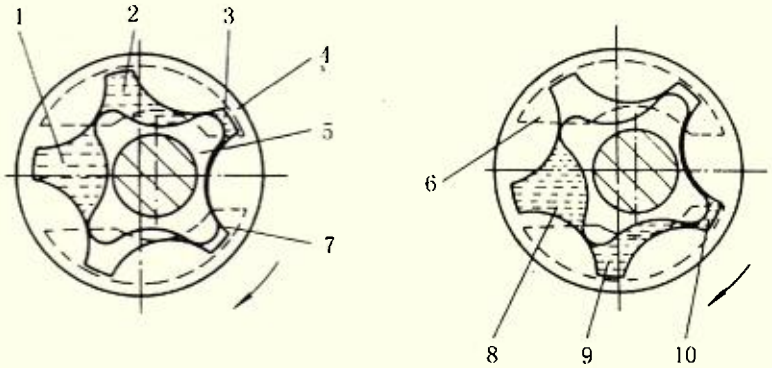


Fig. 10－2 Elements of oil pump

1. Shaft retaining ring 2. Washer 3. Oil pump gear 4. Bolt 5. Spring washer 6. Oil pump top cover 7. Straight pin 8. Adjusting gasket 9. Oil pump shaft 10. Straight pin 11. Inner rotor 12. Outer rotor 13. Oil pump housing 14. Oil pump gasket 15. Sunk screw 16. Woodruff key



(a) Sketch of oil pumping (b) Sketch of oil sucking in

Fig. 10－3 Working principle of oil pump

1. Start pumping oil 2. Pumping oil 3. Complete pumping oil 4. Outer rotor 5. Inner rotor 6. Oil outlet passage 7. Oil inlet passage 8. Complete inletting oil 9. Inletting oil 10. Start inletting oil

filter elements should be checked regularly, if worn seriously, replace them in time. In checking, the following steps should be followed: remove external dirt, remove the oil filter base and housing, take off the filter elements, drain off the waste oil, wash it with clean diesel. Cotton yarn is not allowed and it is strictly forbidden to scrape with a metal brush or a scraper.

Caution: do not damage or miss the seal ring and felt washer.

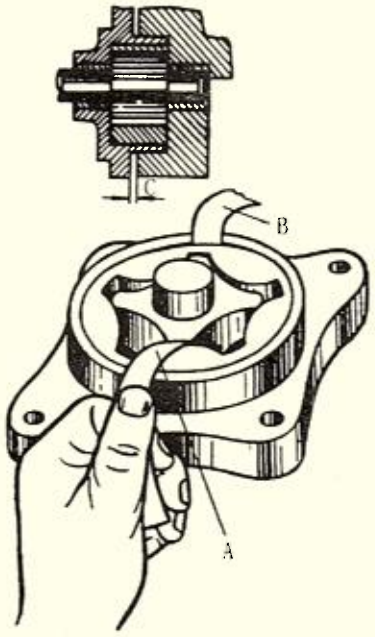


Fig. 10－4 Checking the clearances of the pump with feeler gauge

A—Clearance at this place should be less than 0.25 mm. B—Clearance at this place should be less than 0.25mm C—Checking the clearance with a feeler gauge. In adjusting, the washer should be 0.01－0.05 mm thicker than the measured clearance.

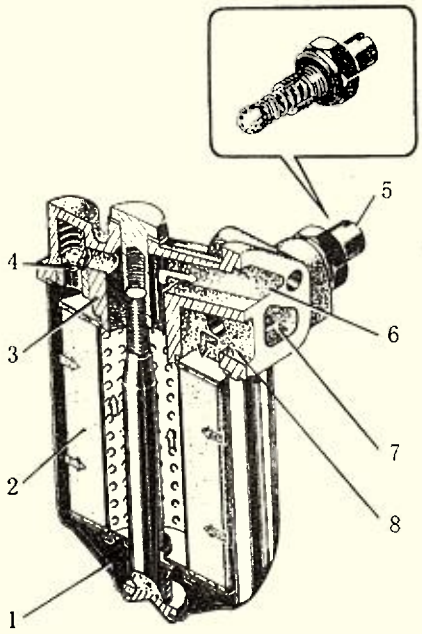


Fig. 10－5 Oil filter

1. Oil filter housing 2. Filter elements 3. Oil filter base 4. By－pass valve 5. Pressure adjusting valve 6. Oil outlet 7. Oil return port 8. Oil inlet

Section 3 Use and Adjustment of Lubricating System

Ⅰ. Use and maintenance of lubricating system

1. Check the oil level of the oil sump and it should be between two mark lines on the oil dipstick. If the level is too high, the piston ring will be cemented or the oil consumption will increase; if the level is too low, the oil pressure will decrease and the parts cannot be kept lubricated. The oil level should be checked when the engine stops running for some time and the tractor is on flat ground.

2. Use the high－speed diesel engine oil, in winter, use No. CA－20 or CA－30; in summer use CA－40.

3. Following steps for checking and replacing oil should be observed. First, watch and compare two oil drops on a white filter paper, one from the new oil and the other from the used oil. If there are a lot of granula carbon and bituminous remains left on the central black point of the oil drop, it means there is trouble with the oil filter, but it does not show the oil is deteriorated; if the central black point is too big, reflects black－brown color and has no granula carbon, it means the oil is deteriorated, then it should be replaced. If the point is smaller and the color of the oil mark around the central point is similar with the color of the new oil, it shows the oil could be used continuously.

Ways of replacing oil:

(1)Under the normal working temperature of the diesel engine, remove the oil drain plug of the oil sump, drain off the oil, clear the iron grindings on the magnet of the drain plug, then assemble it to the original place.

(2) Fill the cleaning diesel (1/5 clean oil can be added into it) into the crankcase till the specific level is reached, start the diesel engine, run it at idling speed for 3～5 minutes, then drain the cleaning diesel out.

(3) Add new oil according to the specific requirement. The engine cannot be started until the indication of the oil pressure gauge apprears.

Ⅱ. Adjustment of lubricating system

In operating, the normal oil pressure should be 0.2～0.4 MPa. If it cannot satisfy the specific value, the pressure adjusting valve on the oil filter can be adjusted to reach the rated oil pressure. Steps include: as the oil temperature is 70～90℃, first loosen the locking nut, screw the adjusting screw with a screwdriver. Screw it in, the pressure adjusting spring is compressed, the oil return amount decreases and the oil pressure increases; conversely, oil pressure decreases. When the specific level is reached, tighten the locking nut.

If the by－pass valve is blocked or difficult to tighten, the adjustment of the oil pressure will be performed. Clean the by－pass valve with diesel, put the oil filter base into clean diesel, move the steel ball aside with iron wire or wooden stick for several times, then wash it. If the dirt is cleaned and it is easy to open and close, the by－pass valve can be used continuously. If the by－pass valve is damaged, it should be disassembled and the pretension of the spring should be checked again to ensure the specified opening pressure.

Chapter XI Cooling System

Section 1 Introduction to Cooling System

The function of the cooling system is to make the diesel engine work at an appropriate temperature range so as to ensure its good power characteristics and high efficiency. In working, such parts of the diesel engine as piston, cylinder and valve directly contacting the combustible gas will stand the high-temperature, so it is necessary to cool them to prevent the parts from their strength, hardness or deformation due to the over-heating, for which will change the fitting clearance or cause the oil deterioration. If the temperature is too low to guarantee enough heat, the lubricating oil will not flow smoothly and the wear of the parts will be accelerated. The cooling system of Model 495 diesel engine is of forced circulation type and called the pressured cooling system. The cooling water is forced by a centrifugal cooling pump to circulate. This way is adopted to speed up the water cycle and guarantee the high cooling efficiency and make the upper part of the cylinder close to the lower part.

The cooling system includes cylinder block, water jacket of the cylinder head, water pump, thermostat, fan, radiator and water temperature gauge, as shown in Fig. 11-1. Modle LR4105 diesel engine is equipped with oil radiator.

Section 2 Main Elements of Cooling System

Ⅰ. Water pump

The cooling water in the cooling system is forced by water pump to circulate. The water pump of Model 495 diesel engine is of the centrifugal one. It consists of pump base, pump body, impeller, pump shaft, pulley and water seal.

The pump pulley is driven by the crankshaft pulley through the V-belt. The water from the radiator enters into the water pump and is splashed to the edge of the impeller with strong centrifugal force under the action of the pump impeller, then enters into the water distributing chamber through the outlet. If the pump stops running due to accidental causes, gravity circulation should be kept in the cooling system. There is a grease nipple on the pump body to fill lime grease into the bearings regularly for the purpose of preventing water from entering them, and the rubber self-tight oil seal, water splasher and washer are installed on the pump body. A water hole on the body can be used to leak the water deposit and check the sealability of the water seal. Within the 3 minutes after the pump has stopped running, the water being leaked out should be less than 6 drops, otherwise, the water seal should be replaced.

Ⅱ. Fan and pulley

The function of the fan is to increase the velocity of airflow and make the airflow pass the radiator to decrease the temperature of the cooling water and radiate the heat produced by the cylinder block.

The fan of Model 495 diesel engine is of suction, axial type. It is driven by the pulley and for the

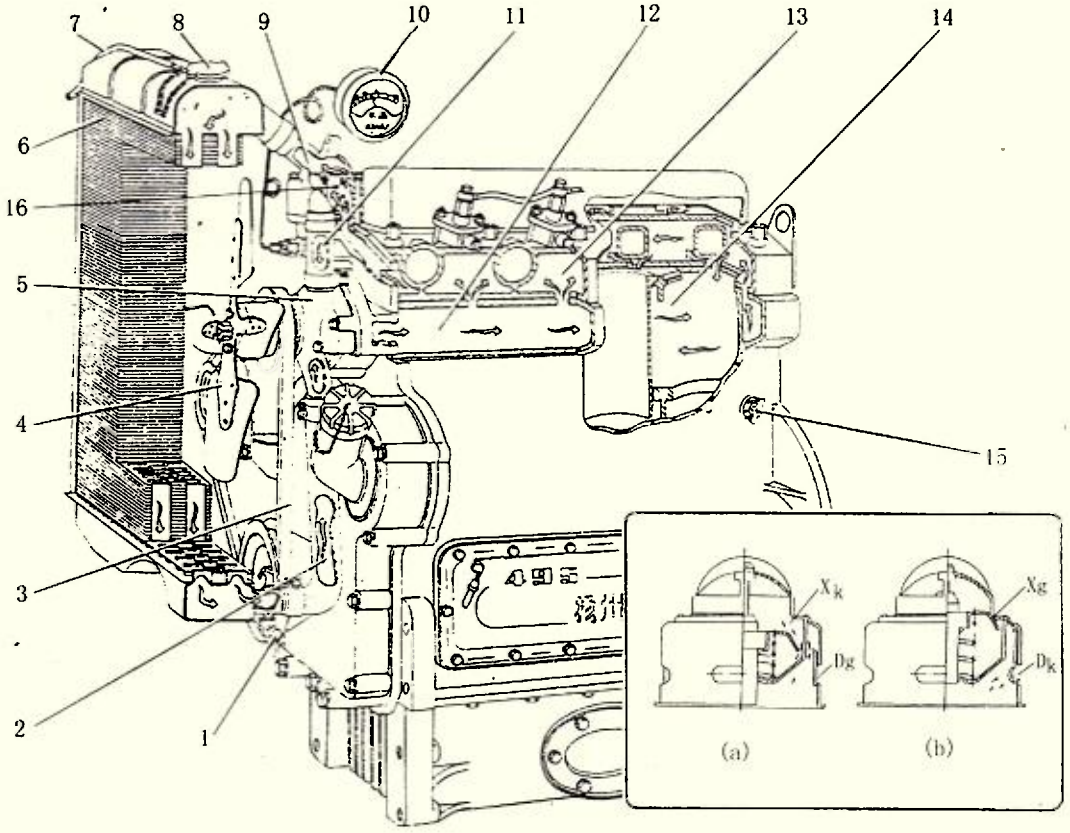


Fig. 11－1 Cooling system

1. Water drain valve 2. Water inlet pipe 3. V－belt 4. Fan 5. Water pump 6. Radiator 7. Air vent 8. Radiator cap 9. Water outlet pipe 10. Water temperature gauge 11. Water return pipe 12. Water distributing chamber 13. Water－jacket of the cylinder head 14. Water－jacket of the cylinder block 15. Water drain valve 16. Thermostat

(a) Minor cycle in thermostat (as temperature is lower than 70℃): D_g——Major cycle port closes; X_k—— Minor cycle port opens

(b) Major cycle in thermostat (as temperature is higher than 70℃): D_k——Major cycle port opens; X_g——Minor cycle port closes

purpose of improving the efficiency of the fan, the deflector is installed at the back of the radiator.

The rotation speed has a direct influence on the wind amount of the fan and the flow rate of the pump, so the tension of the belt should be regulated. The too loose belt will decrease the rotation speed of the fan and the water pump, while the too tight belt will shorten the service life of the pump bearing and the belt. Hence, the tension of the belt should be checked regularly. Press down the fan belt with 30～40N force at the middle, if the distance which the belt moves from its original position is 10～15mm, the tension is qualified, otherwise, it needs adjusting. Unbolt the tightening bolts and move the generator to adjust the belt tension. In the adjusting process, the oil dirt on the fan belt and the rust on the pulley V－groove should be cleaned.

Ⅲ. Thermostat

For the purpose of keeping a specific temperature of the cooling water and shortening its warming time after the diesel engine starts, the thermostat is installed in the base hole on the front cap of the cylinder head (see 16 in Fig. 11－1).

The thermostat of Model 495 diesel engine is of duplex－type. An expansion tube is filled with low boiling point wax. As the water temperature is lower than 70℃, pressure in the tube is low, the tube contracts, the valve leading to the radiator closes, and the water flows into the engine to circulate through the by－pass hole. As the temperature is higher than 70℃, the wax in the expansion tube makes the tube extend longer, the by－pass hole is closed, the valve leading to the radiator opens. As the temperature rises to 85℃, the tube reaches to its max. length, the valve opens completely, the by－pass hole is closed completely, and the cooling water flows past the radiator, then the water enters the engine body to circulate through the water pump. The former is called minor cycle and the latter is major cycle.

In winter, for the purpose of preventing the thermostat from closing as the normal water temperature is not reached to cause the water in the radiator to be frozen, a small hole is opened on the thermostat valve to make a little amount of hot water enter into the radiator to avoid the radiator from freezing to crack. While filling water into the radiator, air in the cylinder block and the water jacket of the cylinder head can flee out of the hole to make the water entering the water jacket smoothly.

The thermostat has a direct influence on the performance of the diesel engine, so its good condition should be guaranteed. At cold, if there is water flowing out of the upper water chamber through the outlet, it means the thermostat valve cannot close; as the temperature of the cooling water reaches 70℃ and above, there is no water flowing out of the upper water chamber, it means that the thermostat valve cannot open, then it should be disassembled to check. If the technical requirements are not satisfied, replace it.

Ⅳ. Radiator and rediator cap

Radiator is used to cool the hot water from the water jacket and made of copper band. It consists of upper water chamber, lower water chamber and radiator fin. The temperature of the cooling water can fall 10～15℃ after passing the radiator. The radiator cap is of sealed type, a steam and air valve is installed in it. The valve is combined by a one－way steam valve and a one－way air valve. As the pressure of the steam in the radiator is 20～30 kPa higher than the atmospheric pressure, the steam valve is pushed to open, and the steam is exhausted. This way is adopted to ensure the weld of the radiator cannot be cracked by expansion, although the pressure in the cooling system is slightly higher than the atmospheric pressure. While the pressure increases, the boiling point rises (about 110 ℃), and the water consumption by its boiling and evaporation falls. As the pressure in the radiator is 1～4 kPa lower than the atmospheric pressure, the air valve is pushed to open and the air enters the radiator to prevent the radiator fin from damaging.

Section 3 Operation of Cooling System

For the purpose of keeping cooling system in working state, pay attention to the following points:

1. Check the cooling system before starting the engine to see whether the cooling water is enough and the water leakage place must be repaired in time, top up if necessary.

2. For the purpose of preventing water scale crust from blocking the water－jacket space, soft water like rain water or boiled well and spring water must be used. Commonly, well water, spring water and river water are of hard water and the water scale crust will be accumulated to block the radiator fin and the water－jacket space.

3. Only when the water temperature goes up to 70～90℃, can the load be added. If the cooling water is found insufficient when the engine is working under high temperature, add water after the engine temperature falls. And sudden filling of cooling water is strictly forbidden, otherwise, the cylinder head and block will be cracked because of cold impact. When the cooling water temperature goes up to the boiling point, in order to avoid being injured, it is not allowed to open the radiator cap by hand.

4. Check the cooling system to see whether there is any leakage in it, such as check the elasticity of the dip on the rubber tube, and the connecting bolt should be tightened in time. Special attention should be paid to clear off the oil dirt on the face of the radiator.

5. When the engine is running, the radiator cap must be tightened to seal the radiator.

6. When the engine stops at an ambient temperature below 5℃, the cooling water in the radiator and the engine body should be drained off, then the engine should be shaken for several turns to ensure it has been drained off completely. The cooling water should be drained off after the engine has stopped for some time and the water temperature has fallen. In cold winter, it is not suitable to fill the hot water into the cold engine.

7. In overhaul, the cooling system should be cleaned by rinsing liquid (add 0.06 kg soda per litre water). Following steps should be observed: first, drain off the cooling water, fill rinsing liquid, start the diesel engine, when the water temperature goes up to 70～90℃, stop the engine for 1～2 hours and drain off the rinsing water, then add clean water and start the diesel engine, till the outflowing water becomes clean, close the water drain valve and fill water.

8. The efficiency of the cooling system depends on the working state of its elements. The improper operation will cause unexpected high water temperature.

Chapter Ⅻ Transmission

Transmission is part of the chassis (all the parts except for the engine and the electrical system are generally called chassis).

All the assembly that transmits force from the crankshaft of the engine to the driving wheel is called transmission. Its function is to transmit the torque of the engine and change its amount and direction , so that the tractor could acquire different speeds of forward gear and reverse gear and provide different traction force. Transmission also transmits part of the engine power to the PTO shaft and the hydraulic pump to lift or drop the implement or drive other farm machinery.

The transmission of Jiangsu－500 tractor consists of clutch, gearbox, main drive and final drive.

The transmission order of the Jiangsu－500 transmission is (see Fig. 12－1): crankshaft→clutch 1→gearbox 2→main drive 3→differential 4→final drive 5→driving wheel 6.

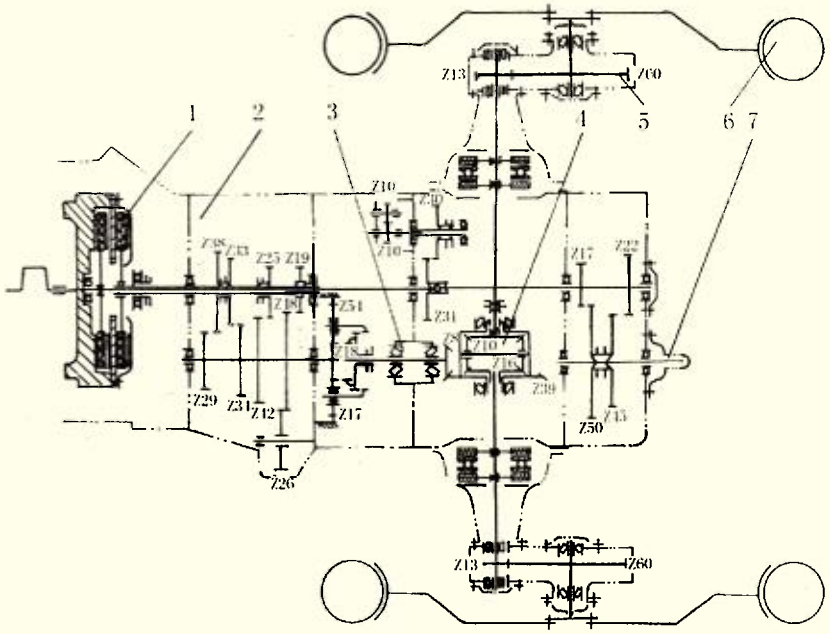


Fig. 12－1 Power transmission of Jiangsu－500 tractor

1. Clutch 2. Gearbox 3. Main drive 4. Differential 5. Final drive 6. Driving wheel 7. PTO shaft

Section 1 Clutch

The clutch is between the engine and the gearbox. The Jiangsu－500 tractor is equipped with a single plate, dry, and constant engaged double－acting clutch which actually combines two clutches. The main clutch engages or separates the power to the driving wheel, and the auxiliary clutch engages or separates power to the hydraulic pump and the PTO shaft. The power of the engine could be trans-

ferred simultaneously by the 2 clutches separately and it also could be transmitted by either main or auxiliary clutch singly(see Fig. 12－2).

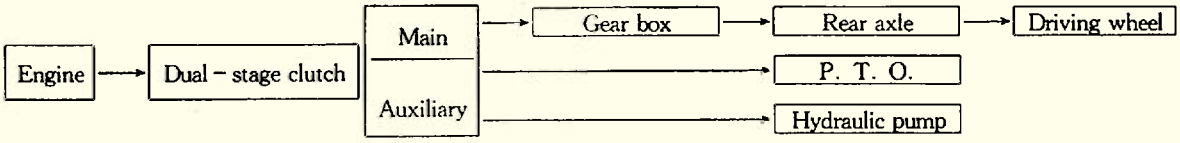


Fig. 12－2 Power transmission of main and auxiliary clutches

Ⅰ. Function of the clutch

1. It could disengage the crankshaft and the transmission quickly and completely, ensuring that no impact effect occurs among the gears in the gearbox when shifting gears. Disengagement of the clutch could also make the tractor stop temporarily.

2. When shifting gears, it could make the crankshaft and the transmission engage gently to prevent the parts from shocking.

3. When the transmission system is overloaded, the relative slipping between the driving part and the driven part of the clutch could prevent the transmission assy. from being damaged.

Ⅱ. Structure of clutch

The clutch consists of driving part, driven part, pressure part, release part and control part. See Fig. 12－3.

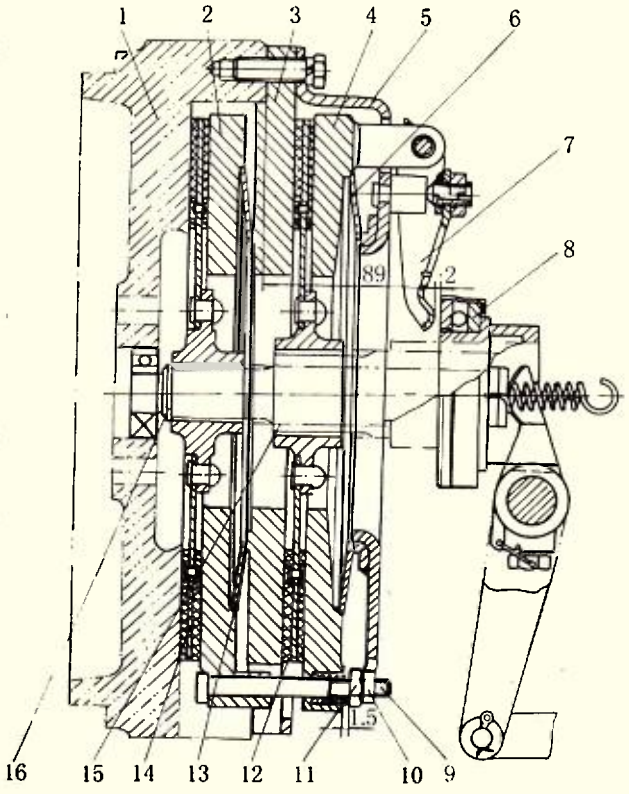


Fig. 12－3 Structure of clutch

1. Flywheel 2. Auxiliary clutch pressure plate 3. Intermediate pressure plate 4. Main clutch pressure plate 5. Clutch cover 6. Main disk spring 7. Release lever 8. Release bearing 9. Release drag rod 10. Locking nut 11. Adjusting nut 12. Main clutch driven disk assy. 13. Auxiliary disk spring 14. Auxiliary clutch driven disk assy. 15. Drive shaft of the gearbox 16. PTO shaft

1. Driving part

The driving part, rotating together with the crankshaft of the engine, consists of flywheel 1, auxiliary clutch pressure plate 2, interme diate pressure plate 3, main clutch pressure plate 4, clutch cover 5, etc.

The intermediate pressure plate and the clutch cover are fixed on the flywheel by screws, the auxiliary and main clutch pressure plates are embedded into the groove of the intermediate pressure plate and the clutch cover by their lugs, so they can not only rotate with the flywheel but also make axial motion.

2. Driven part

It consists of main clutch driven plate assy. 12, 1st shaft of gearbox 15, auxiliary clutch driven plate assy. 14 and PTO shaft 16. The driven plate assy. 12 and 14, are engaged with shafts 15 and 16

by their splines on plate hub and could also make axial motion.

There are two pieces of copper wire asbestos clutch facings riveted on the two faces of the driven plate, see Fig. 12－4. There are 6 radial cuts on the plate to prevent it from bending caused by the heat when there is serious sliding. As the clutch facing may become thinner due to its wear, while riveting new ones, the rivets head should be sunken into the clutch facing for no less than 1mm to prevent the pressure plate facing from scratching.

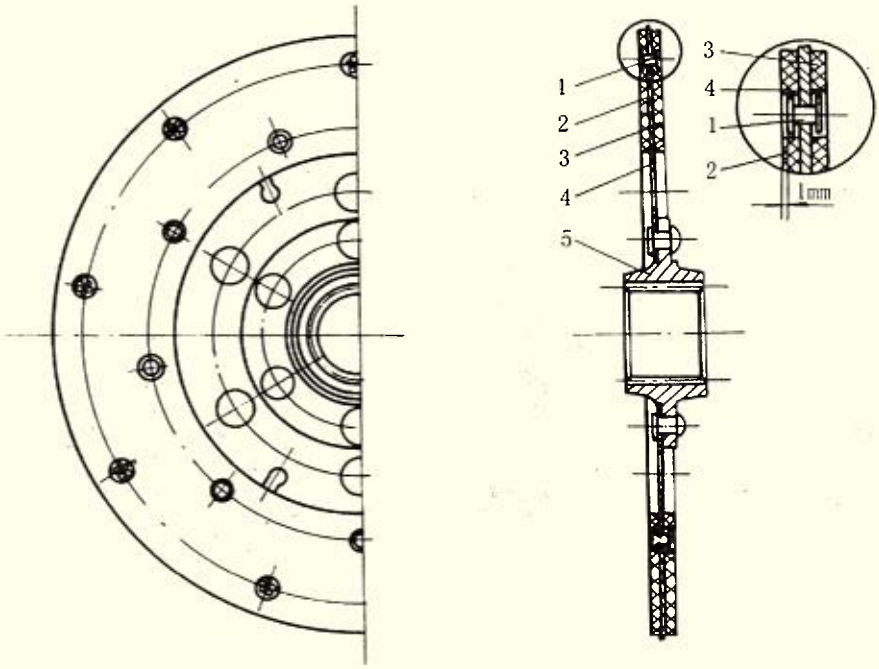


Fig. 12－4 Clutch driven plate assy.

1. Rivet 2. Clutch facing 3. Clutch facing 4. Steel plate 5. Hub

3. Pressure mechanism

It adopts disk spring as pressure element. There are compressed disk springs between the auxiliary clutch pressure plate and the intermediate pressure plate, the main clutch pressure plate and the clutch cover, which press tightly on the auxiliary and main clutch facings between the flywheel and the auxiliary clutch pressure plate, the intermediate pressure plate and the main clutch pressure plate. Because of the friction of the clutch facings, the power of the engine is transmitted to the drive shaft of transmission and the PTO shaft. (see Fig. 12－3).

4. Release control mechanism

It includes interlock shaft and arm 1, pedal 2, drag rod 3, release fork shaft and arm 4, release fork 5, and release bearing 7. The release forks 5 are fixed with the release fork shaft and arm 4 by screws and the two ends of the drag rod 3 are joined with the release fork shaft and arm 4 and the pedal 2. See Fig. 12－5.

Ⅲ. Check and adjustment of the clutch

In order to make the engagement and disengagement of the clutch smooth and reliable, adjust it

correctly in time.

1. Check and adjustment for the free travel of the pedal

The free travel refers to the distance moved by the pedal from the position of a free state to the position at where the clutch begins to release. The free travel should be 20～27mm (measuring as in Fig. 12－6). Adjust it if it is not in that range.

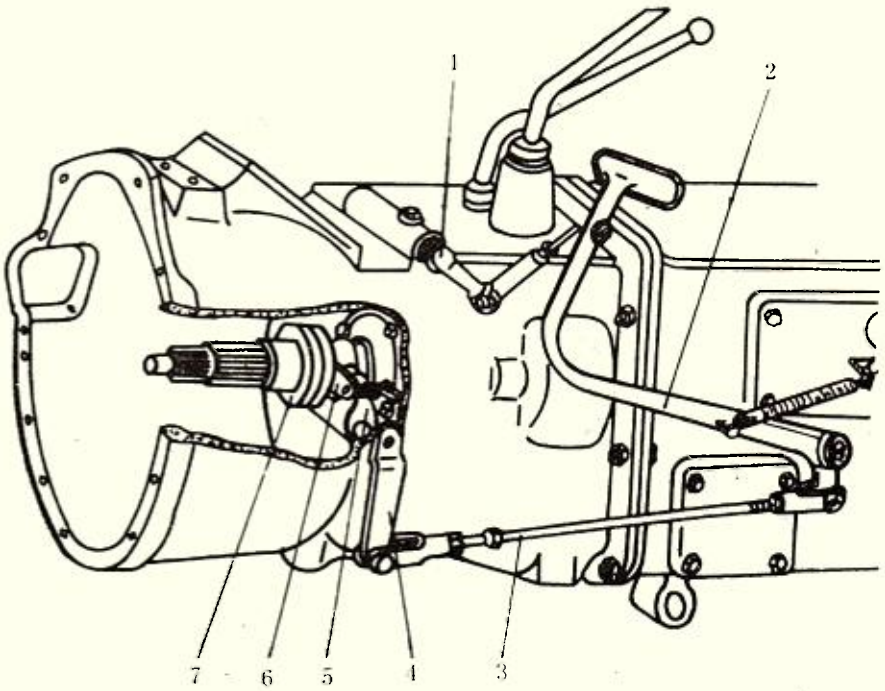


Fig. 12－5 Clutch control mechanism

1. Interlock shaft and arm 2. Pedal 3. Deag rod 4. Release fork and arm 5. Release fork 6. Bearing seat 7. Release bearing

When beginning adjusting, first loosen the locking nut 3 on the drag rod, then turn the drag rod 2 to change its effective length, thereby varing the free travel, finally tighten the locking nut 3. Remove the inspection window cover to check whether the adjustment is correct, measure the clearance between the release bearing and the end of the release lever with a 2mm－thick special feeler gauge. A 2mm clearance should be maintained between the release bearing and the release lever, while the 3 release levers must maitain equal clearances with the release bearing (the max. permissible mutual deviation is 0.2mm). If the deviation is exceeding this value, it means that they are not at the same level. Then they must be checked one by one and adjusted individually. It is necessary to turn the socket head screw on the release lever only to vary the clearance between the release lever and the release bearing. Check if the release bearing follows when the engine is started and made to run at the max. idle speed. If it follows, increase the free travel. Repeat the adjustment until it stops following. If the free travel has increased a great deal but the release bearing still follows, it means that the torsion spring has low elasticity and should be renewed.

2. Adjustment of disengagement travel of main clutch

From the time the main clutch disengages to the time the auxiliary clutch begins to release, there should be a suitable pedal travel. If this travel is too short , the auxiliary clutch will disengage too early: if it is too long, the auxiliary clutch will disengage incompletely. The correct disengagement travel is decided by the clearance (1.5 ± 0.05mm) between the inside ends of the 3 adjusting nuts and the pressure plate of the main clutch 2. See Fig. 12－7. During operation, this clearance reduces gradually due to wearing of the auxiliary clutch facings, so regular check and adjustment is necessary. When beginning adjusting, remove the inspection window first, loosen the locking nut 4, turn the adjusting nut 3 and check the clearance 1.5 ± 0.05 mm with a feeler. After adjustment, tighten the adjusting nut 4.

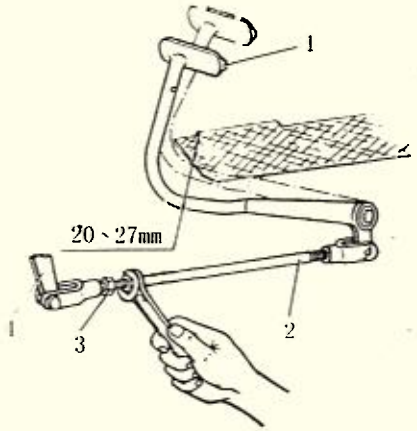


Fig. 12－6 Check and adjustment of free travel

1. Clutch pedal 2. Drag－rod 3. Locking nut 4. Release arm

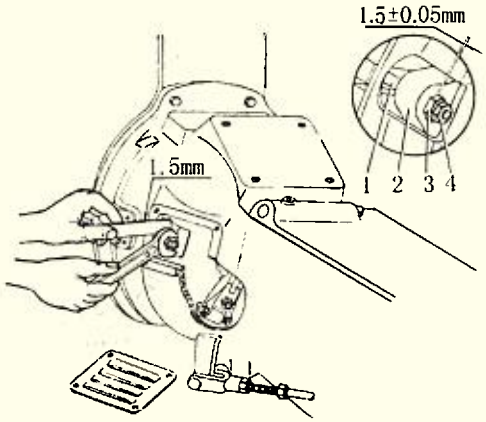


Fig. 12－7 Adjusting the disengagement travel of the main clutch

1. Release drag rod 2. Main clutch pressure plate 3. Adjusting nut 4. Locking nut

3. Adjustment of the position of the release levers

When assembling the clutch, it is necessary to ensure that the distance between the surface of the head of the release lever and the rear of the engine is $h = 189^{+1}$ mm(i.e. the distance between the outer end of the flywheel and the upper end of the release lever is 89^{+1} mm) , and the value "h"of the three release levers should not be more than 0.2 mm (Fig. 12－8). When adjusting, first fasten the movable rod 8 on the side of the fixing rod 9 with the fastening screw 10 of a special tool. Insert the threaded part of the fixing rod into the hole on the engine for mounting the starting motor and fasten it with a nut. Then rotate the flywheel, and check the fitting dimension. If not satisfactory, adjust it with the adjusting screw 6.

Adjust the position carefully. If this dimension is too small, the release lever may touch the clutch cover in disengagement, causing incomplete disengagement of auxiliary clutch; if it is too big, possibly the free travel of the clutch cannot be adjusted when the driven plate facing is worn; if the difference of the clearances of the three release levers is too evident, it may cause partial friction and incomplete disengagement.

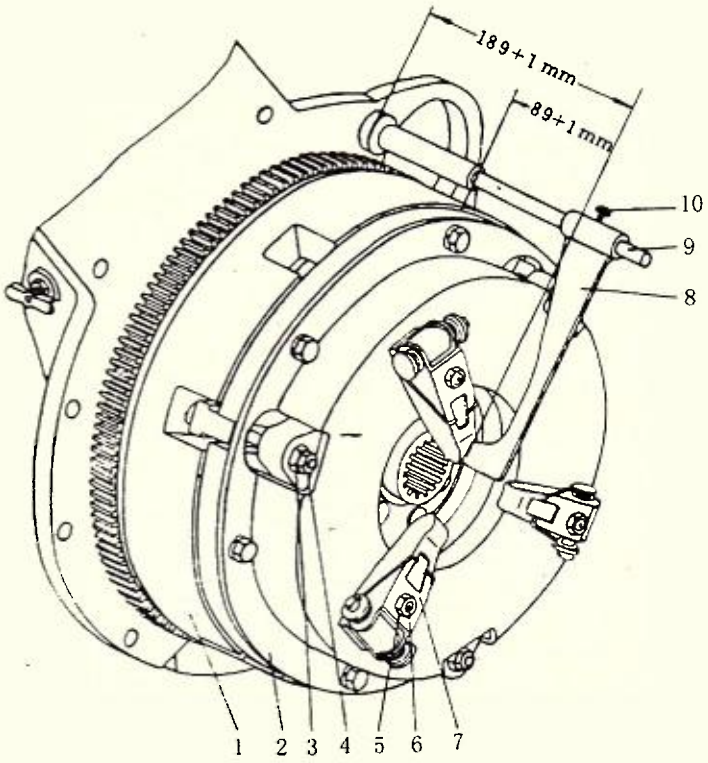


Fig. 12－8 Adjusting the position of clutch release lever

1. Flywheel 2. Clutch cover 3. Adjusting nut 4. Locking nut 5. Locking nut of release lever 6. Adjusting screw 7. Release lever 8. Movable rod 9. Fixed rod 10. Fixing screw

Section 2 Gearbox

Ⅰ. Function of gearbox

1. Increasing torque and reducing speed: the torque transmitted from the engine to the transmission increases, the speed is reduced, to meet the requirement of the driving wheel for high torque and low speed.

2. Varying torque and varying speed: shift gears to change the gear ratio of the transmission system and make the tractor have required travel speed and traction force.

3. Realizing neutral gear, which makes the tractor stop for a long time without shutdown the engine and makes it easy to start the engine.

4. Realizing reverse gears, which can make the tractor move backward.

Ⅱ. Structure of gearbox

Jiangsu Medium－size tractor adopts combined gearbox (see Fig. 12－9). It combines the two－shaft gearbox (main gearbox), which has four forward gears and one reverse gear; and the planetary gear mechanism (auxiliary gearbox), which has high and low gears, so eight forward gears and two reverse gears can be obtained.

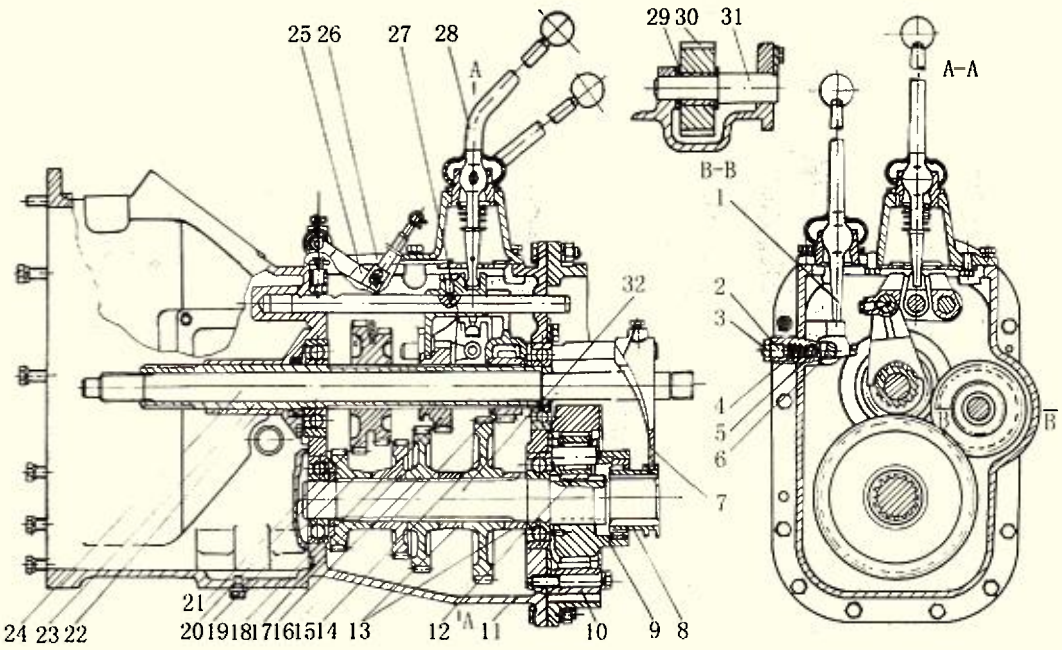


Fig. 12－9 Structure of gearbox

1. Auxiliary gear shift lever 2. Adjusting screw 3. Locking nut 4. Spring 5. Lock pin 6. Hi－Lo gear shift fork shaft 7. Hi－Lo gear shift fork 8. Hi－Lo gear shifter collar 9. Planetary gear carrier 10. Annular gear 11. Gearbox block 12. Planetary gear 13. Spacer sleeve 14. 1st gear stationary gear 15. 1st gear sliding gear 16. 2nd gear stationary gear 17. 3rd gear stationary gear 18. 2nd and reverse gear sliding gear 19. 4th gear stationary gear 20. Thrust ring 21. 4th and 3rd gear sliding gear 22. Separate bearing support 23. Drive shaft 24. PTO drive shaft 25. Interlock shaft 26. Gearbox cover 27. Hi－Lo gear shift fork head 28. Main gear shift lever 29. Spacer ring 30. Reverse gear 31. Reverse gear shaft 32. Main shaft

1. Main gearbox

The drive shaft of the main gearbox (i.e. main clutch shaft)is a hollow shaft, which is supporting in the seat hole of the gearbox block 11 with two bearings, and its front end is joined with the plate hub of the main clutch by splines. The main shaft is also supporting in the seat hole of the gearbox block 11 with two bearings which has a gear(i.e. the central gear of the auxiliary gearbox planetary gearing) at its rear end, reverse gear shaft 31 is installed in the seat hole on the left rear end of the gearbox block 11, and the reverse gear 30 and the 1st gear stationary gear 14 are constant－meshing gears. Consequently, when moving the 3rd and 4th, 2nd and reverse and 1st gear sliding gears on the drive shaft 23 with the shift fork to mesh the corresponding 4th, 3rd, 2nd and 1st gear stationary gears on the main shaft 32, the power of the engine can be imported from the drive shaft and transmitted to the main shaft 32 by any pair of meshing gears in above, thus four forward gears can be obtained. When the 2nd and reverse gear 18 moves backward to mesh the reverse gear 30, the reverse gear can be obtained.

2. Auxiliary gearbox

The auxiliary gearbox is a single－stage planetary gearing, which is fixed on the back wall of the main gearbox housing. It mainly consists of central gear 3 (i.e. the end gear on the rear end of the

main shaft), three planetary gears 14, annular ring gear 6, annular gear 2 and Hi－Lo gear shifter collar. See Fig. 12－10.

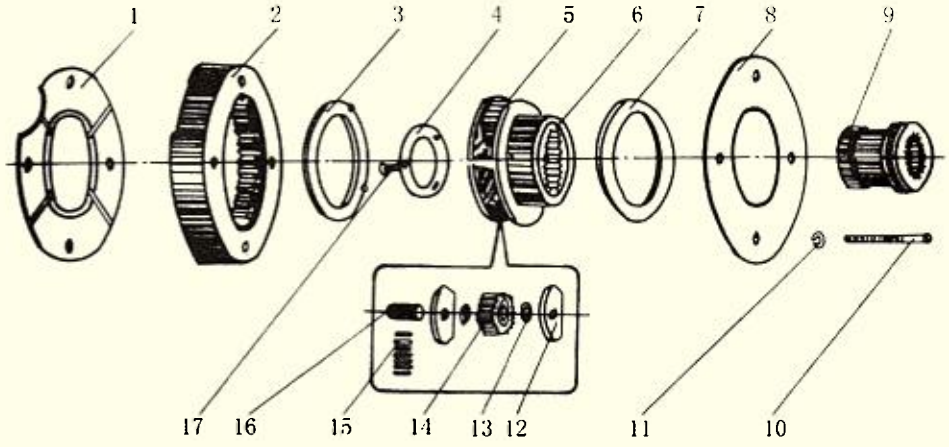
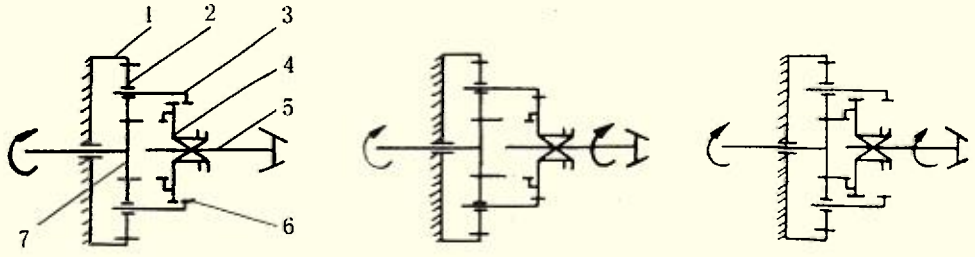


Fig. 12－10 Planetary gear mechanism of auxiliary gearbox

1. Annular gear positioned plate 2. Annular gear 3. Planetary carrier thrust plate 4. Press plate 5. Planetary gear carrier 6. Annular ring gear 7. Planetary carrier thrust plate 8. Annular gear cover plate 9. Hi－Lo gear shifter collar 10. Bolt 11. Washer 12. Thrust plate 13. Roller pin spacer 14. Planetary gear 15. Roller 16. Planetary gear shaft 17. Sunk screw

Fig. 12－11a shows the neutral gear condition. When the Hi－Lo gear shift fork moves the shifter collar 4 forward, the shifter collar contacts with the central gear 7 and the conical drive gear shaft 5 and the power is transmitted from the main shaft to the conical drive gear shaft, then the tractor obtains high speed gear, as shown in Fig. 12－11c. When the shifter collar 4 moves backward to mesh with the annular ring gear 6 on the planetary gear carrier 3, the power is transmitted to the conical drive gear after a speed reduction by the planetary gear, then the tractor obtains low speed gear, as shown in Fig. 12－11b.



(a) Neutral gear (b) Low gear (c) High gear

Fig. 12－11 Diagram of working process of planetary gearing

1. Annular gear 2. Planetary gear 3. Planetary gear carrier 4. Hi－Lo gear shifter collar 5. Conical drive gear shaft 6. Annular ring gear 7. Central gear

Ⅲ. Travel track of each gear and speed

The meshing transmission of each gear is shown in Fig. 12－12.

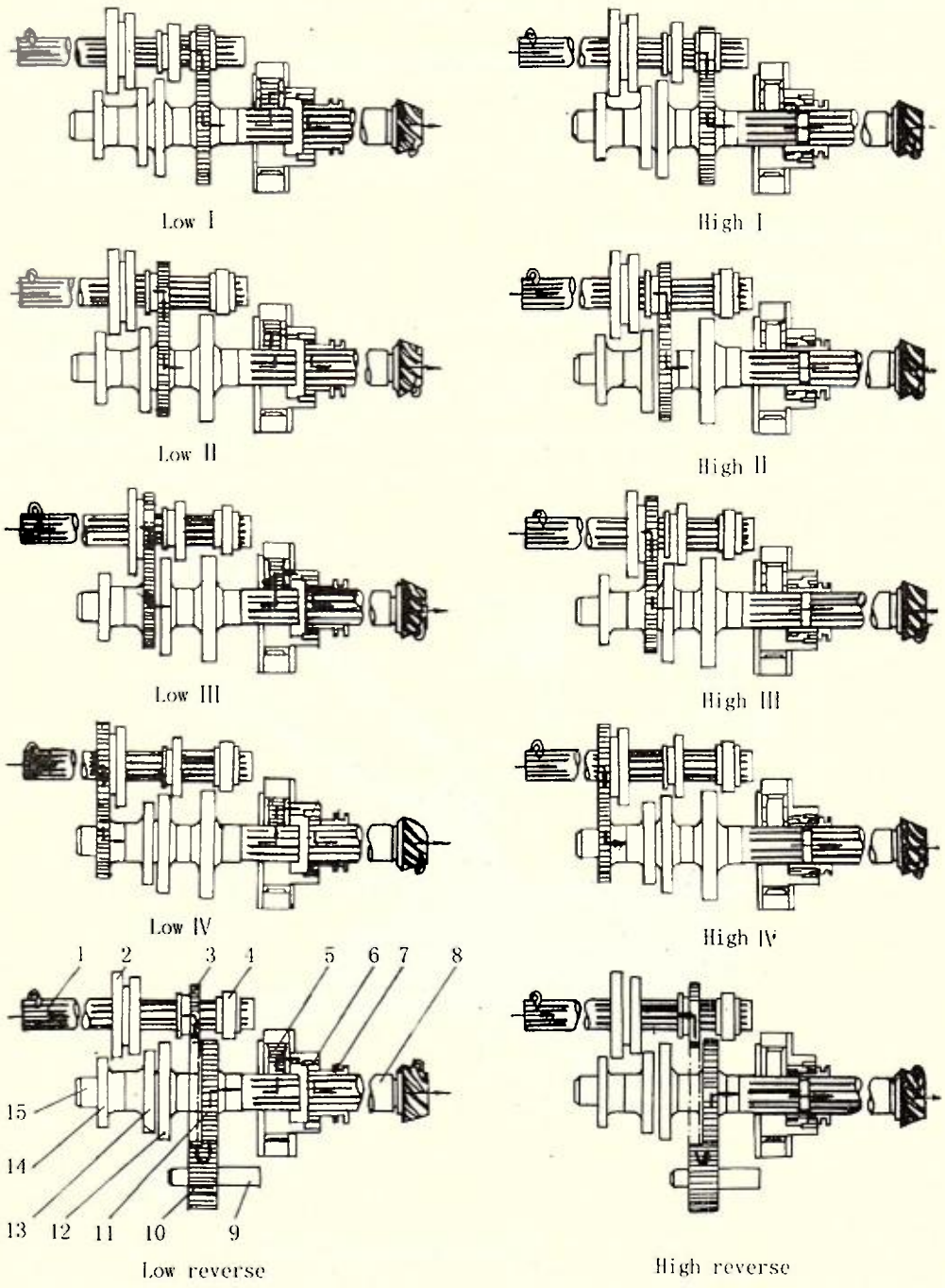


Fig. 12 - 12 Diagram of meshing transmission of each gear

1. Drive shaft 2. 3rd and 4th gear sliding gear 3. 2nd and reverse gear sliding gear 4. 1st gear sliding gear 5. Planetary gear 6. Annular ringgear 7. Hi - Lo gear shifter collar 8. Conical drive gear and shaft 9. Reverse gear shaft 10. Reverse gear 11. 1st gear stationary gear 12. 2nd gear stationary gear 13. 3rd gear stationary gear 14. 4th gear stationary gear 15. main shaft

The theoretical speed of each gear of Jiangsu－500 tractor is shown in Table 12－1.

Table 12－1 Theoretical speed of each gear (km/h)

gear	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ	Ⅵ	Ⅶ	Ⅷ	rev. Ⅰ	rev. Ⅱ
speed	2.21	3.19	5.21	7.03	8.48	12.76	20.84	28.12	2.79	11.16

Ⅳ. Control mechanism of gearbox

1. Shift mechanism

The shift mechanism of the gearbox is used to pluck the sliding gears and shifter collar to engage or shift gear . It consists of the main, auxiliary gear shift levers and shift fork head, shift fork shaft, etc. See Fig. 12－13. The fork heads and forks of the 1st gear and the 2nd gear and reverse gear are integral and they are fixed on their corresponding shift fork shafts by screws. The shift forks and fork heads of the 3rd and 4th gear and Hi－Lo gear are two parts, which are also fixed on the corresponding

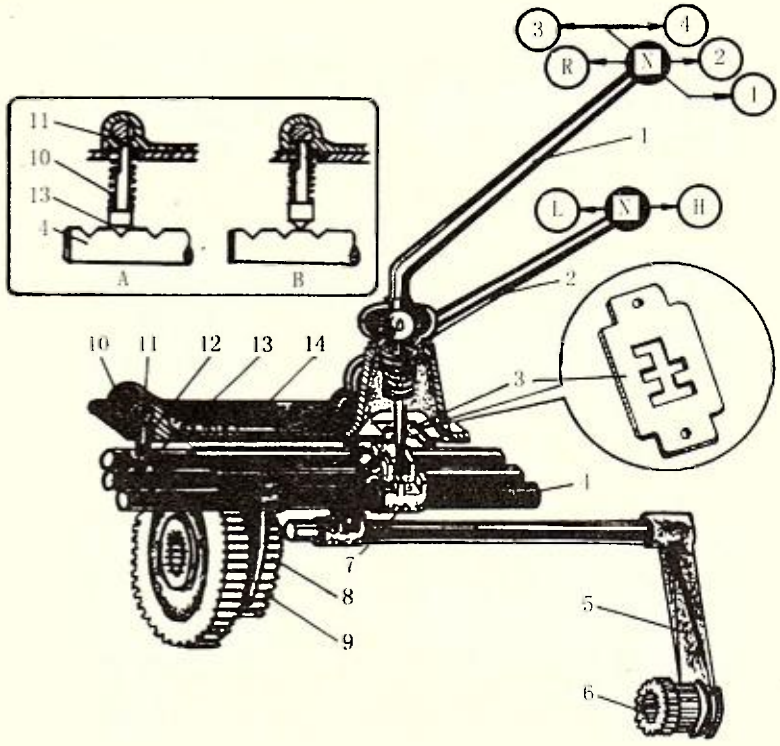


Fig. 12－13 Control mechanism of gearbox

1. Main gear shift lever 2. Auxiliary gear shift lever 3. Gear lever lock 4. Shift fork shaft 5. Hi－Lo gear shift fork 6. Hi－Lo gear shifter collar 7. 3rd and 4th gear shift fork head 8. 3rd and 4th gear sliding gear 9. 3rd and 4th gear shift fork 10. Spring 11. Interlock shaft 12. Locking plate 13. Shift fork shaft detent plug 14. Gearbox cover

positions. The feet of the shift forks are embedded into the groove of the sliding gears or the shifter collar. The ball－shaped part of the main lever is installed in the lever seat, acting as a fulcrum, so the lever can be pendulated to the front, back , left or right. The lower end of the main lever is set in-

to the groove of the shift fork head. When the grooves of the 3 shift forks are in juxtaposition, it is the neutral gear position for the main lever. When turning the main lever left or right, its end enters one of the grooves of the forks ; then turn it forward or backward, the shift fork shaft moves together with the fork head and lastly the shift fork plucks the sliding gears to engage or disengage the corresponding gear. Turn the auxiliary gear shift lever in the same way, and the tractor can obtain eight forward gears and two reverse gears.

2. Interlocking mechanism of gearbox

The gearbox adopts detent plug interlocking mechanism, see Fig. 12 – 13A. There is a "V" groove on the shift fork shaft 4, and when the clutch pedal is at a free position, the detent plug 13 is set into the "V" groove by the spring 10. At this time, the round surface of the interlock shaft is right above the lock pin so that the pin cannot be lifted and the shift fork shaft is at the lock position. Thus, it ensures the working gear pair to mesh in full range and the non – working gear pair to disengage completely; and it also prevents automatic disengagement in working. When engaging gears or shifting gears, depress the clutch pedal first, then the interlock shaft 11 is turned by the interlock drag rod which is connected with the pedal. When the milled face of the interlock shaft 11 is right above the detent plug 13, the detent plug can be lifted and the shift fork shaft is movable to perform shifting gear or gear engagement. See Fig. 12 – 13B.

3. Gear lever lock mechanism

The gearbox also adopts gear lever lock mechanism, see Fig. 12 – 13. Each guide groove of the gear lever lock 3 is corresponding with a shift fork shaft so that the lower end of the main gear shift lever can only move in one of the grooves , avoiding engaging two gears at the same time.

V . Adjustment of gearbox

1. Adjusting the spring tension of the detent plug of Hi – Lo gear shift fork shaft

The spring pressure of the detent plug is adjusted with the fastening conehead set screw (Fig. 12 – 9). If the pressure of the spring 4 is too weak, automatic disengagement of Hi – Lo gear may occur; if it is too strong, the gear shifting will not be smooth and it may accelerate the wearing of the detent plug 5 and the milled groove of Hi – Lo gear shift fork shaft 6. It is preferable to choose a spring tension which will produce a shifting force of 130 N on the Hi – Lo gear shift lever in speed shifting. This value may be measured on the ball knob hand with a spring balance. The adjustment method is shown in Fig. 12 – 14, loosen the locking nut 1 first, and then turn the adjusting

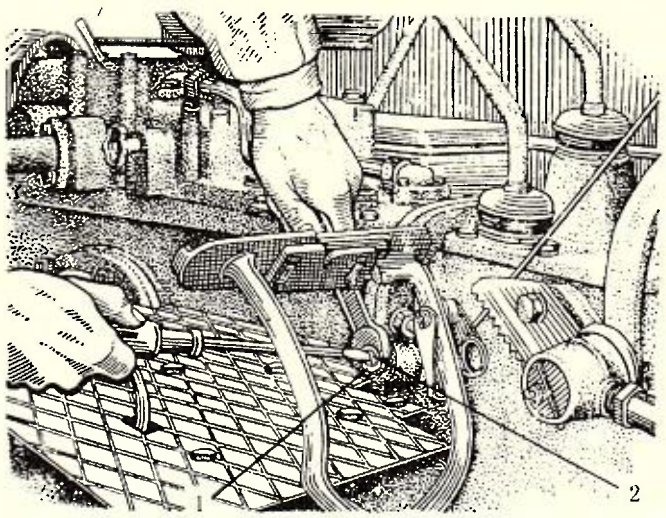


Fig. 12 – 14 Adjusting the spring tension of the detent plug of Hi – Lo gear shift fork shaft

1. Locking nut 2. Adjusting screw

screw 2 with a screwdriver. After adjusting, lock it with nut 1.

2. Side shift of gears in using

In operation, damage or peeling off of teeth often affect the normal working of the gearbox. In order to extend its workable life span, change the installing position as following (see Fig. 12－9):

(1) When there is peeling off of teeth ends on the 1st and 2nd gear stationary gear 14, 16, 1st gear sliding gear 15 and reverse gear 30, turn each gear 180°and install again to get new teeth ends and meshing zone.

(2) When there is peeling off of teeth ends on the 3rd and 4th gear sliding gear, 3rd and 4th gear stationary gear 19,17, the above method could also be adopted, but their gear positions for the main shift lever are exchanged, pay special attention while driving.

(3) The planetary gear 12 can also be turned 180°and installed again.

Section 3 Rear Axle

Rear axle refers to all of the transmission mechanism between the gearbox and the driving wheel and their cases. It consists of main drive, differential, differential lock and final drive, as shown in Fig. 12－15.

Ⅰ. Main drive

1. Function and structure of main drive

Main drive refers to the transmission mechanism behind gearbox and ahead of differential. Its function is increasing transmission ratio, decreasing speed and increasing and changing the torque direction to reach the requirement of rotary direction of the driving wheel. The main drive is made up of a pair of spiral bevel gears. The small spiral bevel gear (i.e. driving spiral bevel gear) 18 is installed in the bearing seat via two opposite conical bearings 19 and 20. Its shaft end spline connects via Hi－Lo gear shifter collar with the main shaft of the main gearbox or the annular gear of the auxiliary gearbox. The big spiral bevel gear 13 (i.e. driven spiral bevel gear) is fixed on the left differential casing with bolts and the tighten torque is 80～90 N·m, as shown in Fig. 12－15.

2. Check and adjustment of main drive

In order to ensure its normal operation and prolong its operating life, the main drive gear pair has been adjusted to the proper meshing position when the tractor is out of factory.

(1) Check and adjustment of installation tightness of main drive conical bearing

As the main drive stands comparatively huge axial force, it adopts conical roller bearing as support. The factory has in advance adjusted the installation tightness of the conical bearing before the bevel gear installation (that is to install the bearing with certain pre－tension to ensure its support stiffness), however, during the operational process, the axial position of the spiral bevel gears will change due to the bearing wearing and make the driving and driven spiral bevel gears depart the former meshing positions. Thus, adjustment of the main drive is aimed at getting rid of the axial clearance increased by the wearing and restoring the spiral bevel gears to the proper meshing positions.

1) Check and adjustment of driving spiral bevel gear bearing clearance

In the factory installation, the two conical bearings supporting the driving spiral bevel gear possess

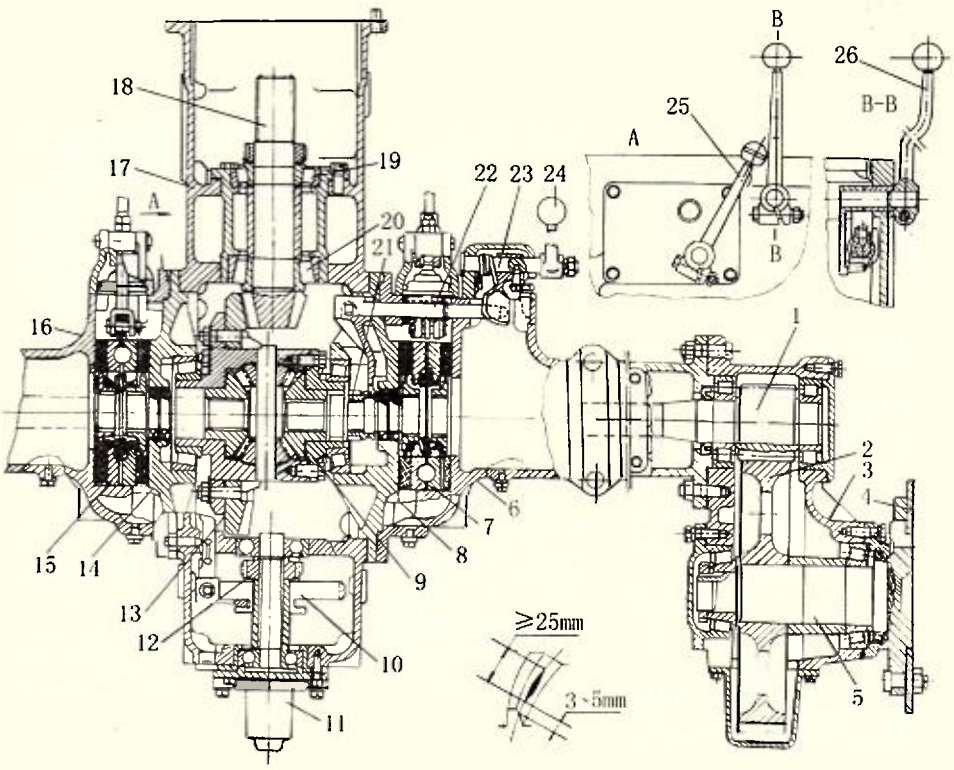


Fig. 12－15 Schematic drawing of rear axle structure

1. Final drive driving gear 2. Final drive driven gear 3. Final drive casing 4. Driving wheel disk 5. Drive shaft assy. 6. Right half shaft housing 7. Right brake 8. Right bearing seat 9. Differential cover 10. Sliding gear(Z50) 11. PTO shaft bushing 12. PTO shaft driving gear(Z17) 13. Driven spiral bevel gear 14. Left bearing seat 15. Left brake 16. Left half shaft housing 17. Rear axle housing 18. Driving spiral bevel gear shaft 19. Conical bearing 20. Conical bearing 21. Splined coupling 22. Shift fork and shaft 23. Rocker arm and shaft 24. Differential lock control lever 25. Hydraulic oil pump control lever 26. PTO control lever

certain pre－tension, but when its wearing makes the axial clearance of the driving spiral bevel gear beyond 0.10mm (measured with micrometer), the clearance should be adjusted. In adjustment, remove the driving spiral bevel gear assy. (including gear, bearing and bearing seat)from the seat hole of the rear axle housing, then, as shown in Fig. 12－16, grip the gear end with bench clamp, loosen the lock shim 3, take out a certain amount of adjusting shims 4(Fig. 12－17)and tighten the adjusting nut (2 in Fig. 12－16) with a special tool or a hook spanner to make the friction drag torque turning the driving gear amount to 1.5～2.5N·m. If the torque cannot be measured, screw the adjusting nut 2 , meanwhile, turn the bearing seat with hand till it can be turned just by force not by inertial force. Strike the driving spiral bevel gear shaft with wooden hammer to make the outer and inner rings of the bearing closely connected, then check the bearing pre －tension and tighten the nut with lock plate.

2)Check and adjustment of driven spiral bevel gear bearing clearance

The driven spiral bevel gear is fixed on the differential casing with bolts, and both ends of the casing are supported by two conical bearings in the seat hole of the rear axle housing. Although the two

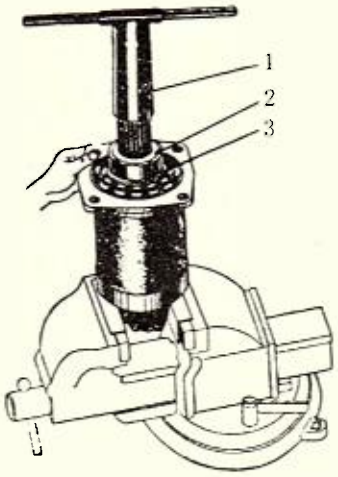


Fig. 12 - 16 Adjustment of driving spiral bevel gear bearing

1. Specialized tool 2. Adjusting nut 3. Locking shim

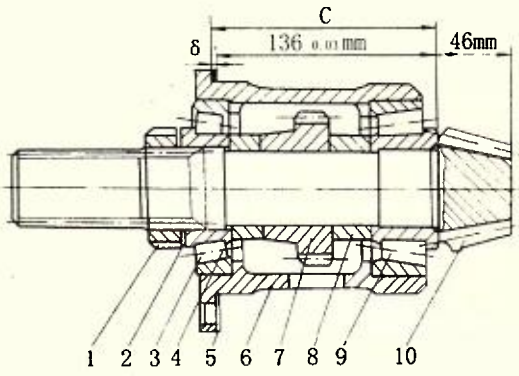


Fig. 12 - 17 Installation dimension of driving spiral bevel gear

1. Adjusting nut 2. Locking shim 3. Bearing 4. Adjusting shim 5. Adjusting shim 6. Bearing seat 7. Drive gear of transfer case 8. Spacer 9. Bearing 10. Driving spiral bevel gear

bearings also possess certain installation tightness, when the bearing wear makes the differential axial play exceed 0.15mm (measured with micrometer), the play should be adjusted. See Fig. 12 - 15, first remove right half shaft housing 6 and right bearing seat 8, then take out the outer steel ring of the right bearing from the seat and increase the thickness of the shim set R (see Fig. 12 - 18) finally install them in order till the resistance torque reaches 2～3N·m while turning the differential assy.

(2) Check and adjustment of meshing position of main drive gear pair

In order to ensure that the main drive gear pair are at the proper meshing positions, at the time of overhaul for abnormal operation and change of new bearing or new gear pair, the gear meshing positions should be checked and adjusted to obtain proper meshing imprint and gear backlash.

1) Adjustment of meshing position

Meshing position is ensured by the installation dimension of driving spiral bevel gear assy. and differential assy.

The installation dimension of the driving spiral bevel gear assy. should be obtained by adjustment after its bearing pre - tightening has been done well. The adjusting method is as shown in Fig. 12 - 17, first measure the distance C between the big face of spiral bevel gear and the internal face of bearing seat connecting plate, then adjust the thickness of the shim set 5 $\delta = C - 136_{-0.03}^{0}$ mm.

The installation dimension of the differential assy. is ensured by the combination dimension of the left bearing and the shim set. The adjusting method is shown in Fig. 12 - 18, exert 80～90 N force on the outer steel ring of left bearing 4 to make the outer and inner rings lean closely against the roller, then measure its height A and choose the shim set D thickness $\delta = 35.6_{-0.03}^{0} - A$ mm, ensuring the combination dimension of shim set D and bearing 4 is $35.6_{-0.03}^{0}$ mm. Finally choose the thickness of shim set R to adjust the pre - tightness of the driven spiral bevel gear bearing.

2) Check of meshing imprint and gear backlash

The correctness of the main drive meshing position is determined by meshing imprint and gear backlash. Therefore, after the adjustment of the meshing position, the meshing imprint and the gear backlash should be checked.

(a) Check of meshing imprint

The proper meshing imprint should be at length of no less than 25mm, width of no less than 6mm, and at the middle part of the gear face with leaning toward the small end a little, at a distance of 3～5mm.

Imprint checking method

Evenly paint red lead oil on the face of the driving spiral bevel gear (or driven spiral bevel gear), then turn the driving gear (meanwhile exert certain resistance on the driven gear), the meshing imprint will be shown on the driven gear face. At forward gear, the concave surface of the driving spiral bevel gear and the convex surface of the driven spiral bevel gear are working surfaces; at reverse gear, just the opposite.

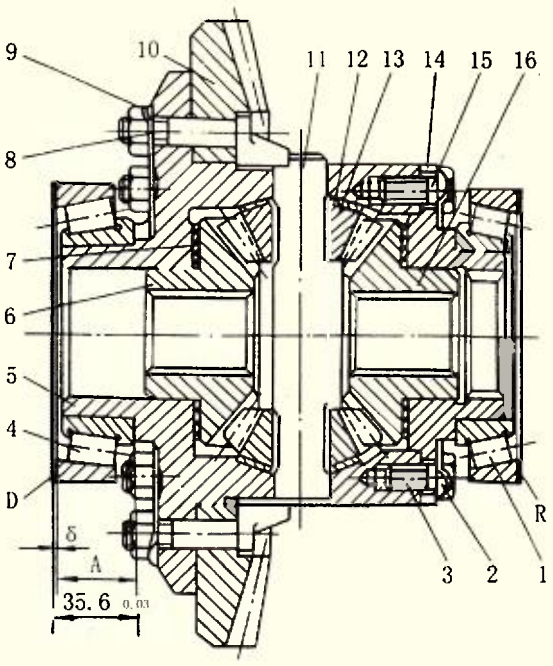


Fig. 12－18 Differential assy.

1. Bearing (R. H.) 2. Lock shim 3. Bolt 4. Bearing (L. H.) 5. Differential casing 6. Half shaft gear 7. Half shaft gear shim 8. Driven spiral bevel gear fixing bolt 9. Lock shim 10. Driven spiral bevel gear 11. Planetary gear shaft 12. Planetary gear shim 13. Planetary gear 14. Differential cover 15. Bolt 16. Half shaft gear

If the meshing imprin does not meet the above－mentioned requirements, it should be adjusted. In adjustment, according to the requirements, change the axial position of the small or the big spiral bevel gear to obtain the proper meshing imprint. The adjusting method is shown in Table 12－2.

If the smalll gear scurries forward along the shaft, the contact imprint on the convex surface of the big bevel gear will move to the big end near the gear top, in this way, the gears are inclined to be damaged. Therefore, pay attention to restoring the pre－tension of the small gear bearing in time.

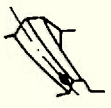
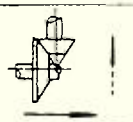
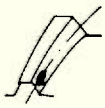
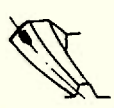
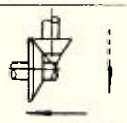
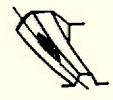
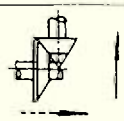
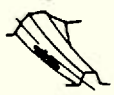
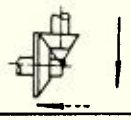
(b) Check of gear backlash

The gear backlash of new gear pair should be 0.25～0.35mm. In operation, the wearing of the gear surface leads to increase of gear backlash, but this kind of adjustment is not necessary, on the contrary , it will affect the meshing imprint and damage the meshing position. When the wearing makes the gear backlash amount to 2 mm, replace them in pairs with new gears.

There are two methods to measure the gear backlash. The first one is to use a special bridge to make the micrometer probe be vertical with the middle part of the driven spiral bevel gear surface, brake the driving spiral bevel gear, then turn the driven one slightly and reciprocatingly and read out the gear backlash value from the micrometer. The second one is to put a piece of lead plate of 0.5～1.0 mm thick, 5 mm wide and 50 mm long (or some thicker fuses) between the non－working surfaces of

the gear pair, turn the gear pair, then take out the lead plate, the thickness of the thinnest place is just the gear backlash value . Whatever method is adopted, evenly measure out more than three points on the whole gear circle.

Table 12－2 Adjusting method of contact imprint of main drivebevel gears of Jiangsu Medium－size tractor

	forward gear	reverse gear	adjusting methods	
normal contact imprints				
abnormal contact imprints			move the big bevel gear near	
			move the big bevel gear afar	
			move the small gear faraway from the big bevel gear axis	
			move the small gear near to the bevel gear axis	

Note: The real－line arrows refer to adjusting contact imprint and the dotted－line arrows refer to adjusting gear backlash.

After check and meaure, if the gear backlash does not fit the above －mentioned requirements, it should be adjusted. In adjustment, mainly need to change the axial position of the big bevel gear correspondingly , but do not change the total thickness of the shims between left and right differential bearings and their seats in order to keep the bearing pre－tightness. If needing to decrease the gear backlash, take out the right shims R and add them to between the left bearing and its seat, if needing to increase the gear backlash, take out the left and add them to the right.

Ⅱ. Differential and differential lock

1. Differential

(1) Function

Differential is an important transmission mechanism of rear axle. It not only evenly transmits the power from the main drive to the left and right half shafts, but also makes the two driving wheels drive at different speeds (i. e. differential speed) to realize smooth steering of the tractor. In fact, even if the tractor does straight－line running, the differential also plays a role. For example, on an uneven road surface, when the two driving wheels cover different distances and the two tyres have dif-

ferent pressure during a same period of time, their actual rolling radius are also not same. All of these require the differential to cause differential speed and make the wheels only roll, not slide, to reduce the tyre wearing.

(2) Differential construction

Jiangsu Medium－size tractor adopts closed spiral bevel－gear differential, as shown in Fig. 12－18. The differential assy., using differential casing 5 and cover 14 as support, is supported on the left and right bearing seats between the half shaft housing and the rear axle housing via bearing 4 and bearing 1. The casing and the cover are fixed together with bolts 3 and 15, the bolt torque is 60～70 N·m. The two half shaft gears 6 and 16 are slidding fitted in the borings of differential casing 5 and differential cover 14 and connected with the left and right half shafts via internal splines. Two planetary gears 13 are slidding fitted on the planetary gear shaft 11 and the shaft 11 is installed in the hole of the casing 5. The axial force of half shaft gear and planetary gear are correspondingly stood by friction－reducing shim 7 and 12.

2. Function and construction of differential lock

(1) Function

Differential is characterized by differential speed, not by differential torque. It is favorable to the tractor steering, but in some cases, it brings bad effects on the driving. For example, due to the differential effect, the driving wheel on the one side cannot create more driving power than the slippery side. The reason is that under the poor adhesive condition, the driving power of the driving wheel is limited by the maximum adhesive force and becomes very small and the corresponding driving torque is also small, which leads to the small torque acted on this half shaft gear. As the differential does not have the function of differential torque, the torque acted on the other half shaft gear is also limited and the driving power on this side wheel is only equal to the applied force on the driving wheel of the slippery side, so that the driving power of the whole tractor greatly falls, which cannot overcome the driving resistance, and the tractor is unable to drive out of the slippery ground. In this case, if suddenly press the throttle, the sliding driving wheel will further scatter the soil and sink deeper and deeper,, while the driving wheel on the other side still cannot turn. In order to get rid of the above－mentioned phenomenon and improve the passing ability of the tractor, a special gear is installed on the differential. It connects the two half shafts together and temporarily eliminate the differential speed so as to make use of the driving effect of the driving wheel on the side with good adhesive condition, and make the tractor smoothly drive out of the slippery ground. This gear is called differential lock.

(2) Construction

On the differential of Jiangsu Medium－size tractor is installed involute splined coupling differential lock, whose construction is shown in Fig. 12－19. It consists of control lever 5, rocker arm 4, rocker arm shaft 7, shift fork 1 and splined coupling 8.

When using the differential lock, first make the driving wheel stop turning, then pull the control lever 5 backward, push the shift fork shaft 3 to the left via the rocker arm shaft 7 and the rocker arm 4, then the splined coupling moving to the left with it and the external splines meshing with the internal splines of the differential cover, hence the splined coupling 8 connects the right half shaft and the cover. In this way, the two half shafts are connected together via the differential casing, the left and

right driving wheels can turn at the same speed and the tractor can be driven out of the slippery ground. After the tractor is out of the slippery ground, loosen the control lever 5, the rocker arm 4 is back to the former position under the effect of the torsion spring 6, the shift fork 1 moves to the right under the effect of spring 2 and brings the splined coupling 8 into moving right, then the sleeve comes off the differential cover and the function of the differential is restored. Rocker arm 4 and shift fork shaft 3 should keep contacting, for the clearance would lead to the free rock of the control lever. The adjusting method is shown in Fig. 12 – 20. Loosen the lock nut, tighten the adjusting screw, push the rocker arm to eliminate the clearance between it and the shift fork shaft. , then the control lever 5 cannot rock freely.

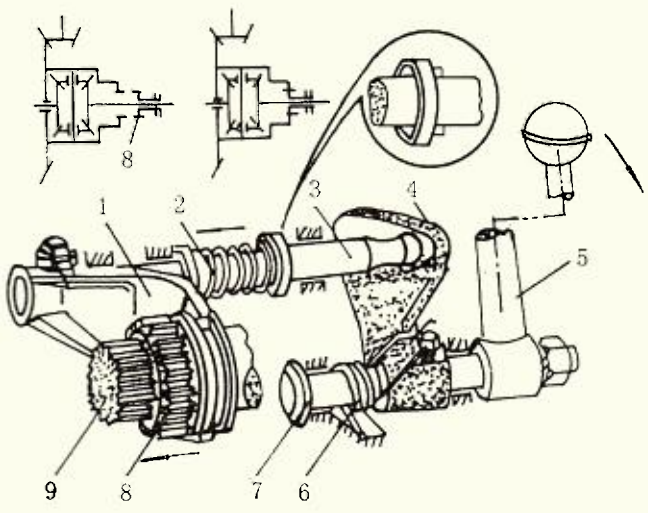


Fig. 12 – 19 Differential lock and its operating schematic diagram

1. Shift fork 2. Retracting spring and spring seat 3. Shift fork shaft 4. Rocker arm 5. Control lever 6. Torsion spring 7. Rocker arm shaft 8. Splined coupling 9. Right half shaft of differential

Ⅲ. Final drive

1. Function of final drive

The function of final drive is to further increase the torque and decrease the speed to meet the operational requirements of the tractor.

2. Structure of final drive

Jiangsu Medium – size tractor adopts externally – positioned final drive, as shown in Fig. 12 – 21. The final driving casing is connected with the half shaft housing by fitted bolts and average bolts. In order to prevent lubricating oil from getting into the half shaft housing to affect the operation of the brake, on the half shaft is installed a self – holding oil seal. The final drive has its separate oil inlet and outlet. This kind of structure enables the whole final drive to be put in the rim of the driving wheel to improve the ground clearance. In addition, if the final drive casing and the half shaft housing are comparatively turned an angle and then installed, the ground clearance and the wheel base are also changed, which is favourable to the design of the tractor to meet different operating requirements.

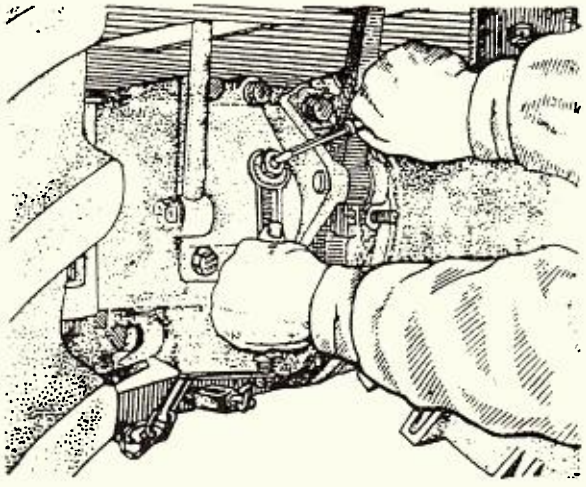


Fig. 12 – 20 Adjustment of control lever of differential lock

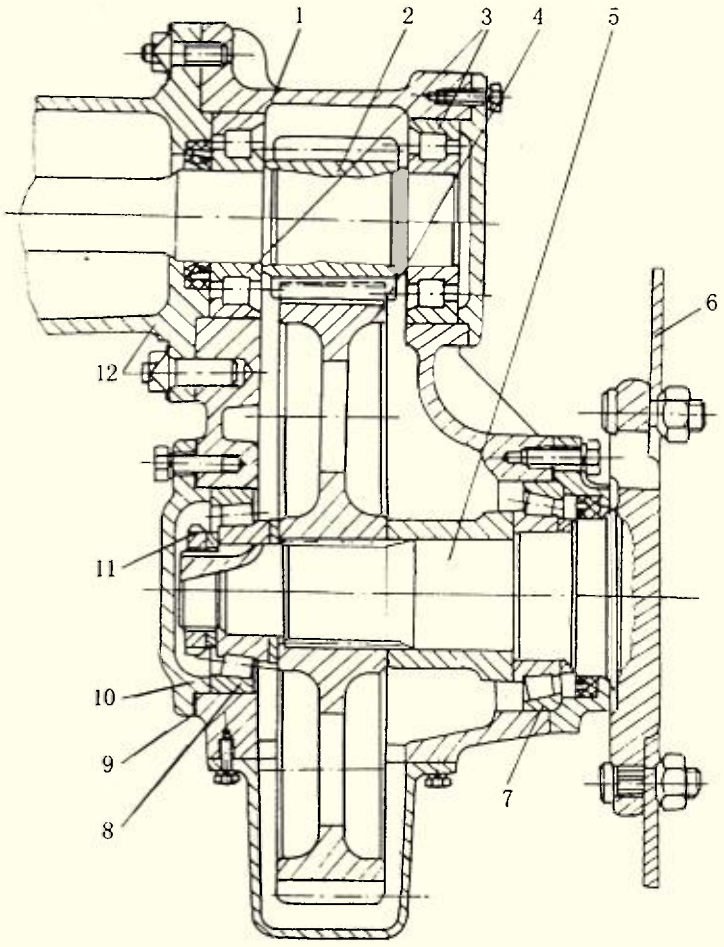


Fig. 12－21 Final drive

1. Final drive casing 2. Final drive small gear 3. Short parallel roller bearing 4. Final drive big gear 5. Drive shaft 6. Driving wheel disk 7. & 8. Conical roller bearing 9. Adjusting gasket 10. Bearing cover 11. Nut 12. Half shaft housing

3. Adjustment of final drive

(1) Check and adjustment of drive shaft bearing

During the operational process, when the wear of the conical bearings 7 and 8 influences the normal operation of the final drive gear pair, check and adjustment should be conducted in time. In check, support the rear wheel away from the ground, push the driving wheel reciprocatingly, observe the axial play of the drive shaft 5 and measure it with micrometer. When the axial play exceeds 0.15mm, it should be adjusted. In adjustment, remove the rear wheel and the bearing cover 10, take out all the gaskets of the adjusting gasket set 9, then place the bearing cover 10 to its former position and exert 80～90 N force along the axial direction to make the inner and outer steel rings of the bearings 7 and 8 closely against the conical roller. At the same time, measure the distance between the internal end face of the bearing cover and the final drive casing surface with feeler gauge. The value minus 0.05 mm is

just the thickness δ of the adjusting gasket set 9 to be added. Install the adjusting gasket set at thickness of δ, then tighten the bolts on the bearing cover with the torque of 20～30N·m. When turning the drive shaft with hand, it is proper to exist a little resistance but be able to turn.

(2) Exchangeable usage of final drive gear pair

When finding the driven gear surface peel off, turn it 180° and install it again; when the driving gear surface peels off, exchange the left and right half shaft gears and install them again. Thus, new meshing surface can be obtained to prolong their service life.

Section 4 Operation and Maintenance of Transmission

Ⅰ. Operation and maintenance of clutch

When engagement or disengagement is needed in starting to move or shifting gears, sliding and friction may occur for the unequal rotary speeds of the driving part and the driven plate of the clutch, which will generate heat and accelerate wear of the clutch facing. So in operation, the disengagement should be quick and complete and the engagement should be gentle and smooth. To meet this requirement, pay attention to the following points:

1. Precautions for clutch

(1) When releasing the clutch, the action should be quick and the pedal should be depressed to its stop to disengage completely.

(2) The disengaging time should not be too long, normally not more than 15～20 seconds. If a long stop time is needed, shift to neutral gear.

(3) While the tractor is running, semi－disengagement of the clutch should not be adopted to reduce the speed. The foot should be away from the pedal, otherwise, it will result in rapid wearing for the release bearing and the clutch facing.

(4) While engaging the clutch, release the pedal slowly to make the engagement gentle.

(5) Violent engagement should not be adopted to go through difficult areas.

(6) Only when the auxiliary clutch is disengaged completely, the PTO shaft and the hydraulic pump can be engaged or disengaged.

2. Maintenance of clutch

(1) Fill grease to the pedal shaft every 8～10 working hours.

(2) After working for some time, screw off the oil drain plug under the clutch to bleed the oil filth deposit.

(3) If there is oil on the clutch facings, which causes sliding, wash it clean with kerosene or gasoline. If not necessary to dismantle the clutch, inject kerosene or gasoline to the clutch facings with an injector and start the engine to make the clutch run for several minutes, then bleed the dirty oil. Carry this operation twice, on the first time clean off the dirt in the casing under the engaging condition, drain the dirty oil out; on the second time clean the dirt on the facings under the disengaging condition.

(4) Check and adjust the free travel of the pedal after 125 working hours.

3. When overhaul is needed, pay attention to the followings:

(1)Dismantle the gearbox block away from the engine first, disassemble the torsion spring before disassembling the clutch parts from the flywheel, in order not to twist it and destroy its elasticity.

(2) Need not to add grease to the release bearings at normal time, but if it needs grease at this time, make a check. If it does, disassemble it and put it into melting lime grease to let the grease seep in, then take it out and assemble it while it is cooled.

(3) In installation after repairing, insert the installing centering shaft, one of the tools with the tractor, into the hole of the flywheel bearing to make the splined hole of the main clutch and the auxiliary clutch driven plate concentric, facilitating the installation of the gearbox.

Ⅱ. Operation and maintenance of gearbox

Basically, the correct use of the gearbox is to prevent the shafts, gears and bearings from being impacted by heavy load. Therefore, pay attention to that:

(1) Do not engage the clutch violently. Even if the tractor is in an difficult area, such an action is not allowed to prevent gears from damaging while the load suddenly increases.

(2) Reduce the speed while surmounting obstacles.

(3) While running on uneven surface, select proper speed according to its load.

(4) While changing the forward or reverse direction, shift gears after the tractor is stopped completely to prevent the teeth of the gears from breaking.

(5) While shifting gears, release the clutch completely to prevent possible impact between gears. If shifting gears in transporting speed, adopt the following method to prevent the shocking between sliding gears and stationary gears: while shift to a higher gear, release the clutch, shift from lower gear to neutral and wait for a second under this condition and then put it into high gear. While shift to a lower gear, in order to avoid tooth－breakdown, adopt "2－step" shifting . The correct process is as following: firstly, release the clutch and shift to neutral gear, secondly, depress the throttle transitorily, thirdly, release the clutch and shift the lever to lower gear.

(6) In operation, pay attention to the temperature of the gearbox. If the temperature is higher than 70～80℃ (scalding to the touch), it means some parts in the gearbox are in bad performance, so stop the tractor for checking and repair it.

(7) Pay attention if there is any unusual sound in the gearbox or if there is oil leakage, gear－mixing, automatic disengagement. If there is anything abnormal, stop the tractor for a check. Find out the reason and get rid of the trouble before continuing to use, so as to prevent further damage. In maintenance, the user should focus on oil leakage and lubrication. Pay attention to the following points:

1) Check the joint tightness everyday after working, if there is any loosening, fix it.

2) After working for 125 hours, unscrew the inlet plug on the cover of the rear axle, check the oil level. While measuring the oil level, the tractor should be stopped at flat surface, and do not screw the plug in. If the oil is not sufficient, top up in time.

3) After a new tractor has worked for 500 hours, bleed the oil, clean the gearbox and fill oil to it. Change the oil after every 1000 working hours.

Ⅲ. Operation and maintenance of main drive

1. When newly installing or adjusting the main drive, tighten the locking nut of the driving spiral

bevel gear shaft and the screws to join the driven spiral bevel gear and the differential casing, and then lock them with corners folded lock plate.

2. In operation, if there is any sound abnormal in the rear axle, stop the tractor for a check and get rid of the trouble.

3. For a new tractor, after working for 500 hours, clean its rear axle housing, bleed the oil and fill it in after cleaning. Change the oil after every 1000 working hours. Check and adjust the pre-tightness of the main drive bearing and the meshing imprint of the spiral bevel gear pair, if the bearing is seriously worn, it should be renewed. Do not make do with it, so as to avoid serious accidents.

Ⅳ. Operation and maintenance of differential and differential lock

1. If the lubrication of the differential is good, the rotating of each gear should be smooth. If there is any iron filings or sand in the differential casing, which may cause the friction faces of the planetary gear and the planetary gear shaft to be scratched or seized and give abnormal sound, get rid of the trouble in time to prevent other parts from damage.

2. Only if one of the rear wheels is sliding, the differential lock could be used to make the two rear wheels run at same speed. After passing the slippery area, release the control lever, the differential lock will disengage automatically. In order to prevent the gear teeth damaging, the engagement should be conducted when the tractor is stopped or at low speed. When the tractor is turning a corner or travelling at high speed, the differential lock is forbidden to be used, otherwise, the half shaft will be twisted to lead to serious accidents.

3. As the differential lock is rarely used, the shift fork shaft is easy to get rusted and becomes difficult to resume its original position automatically. Therefore, coat the sliding face of the shift fork shaft with grease while newly installing or repairing and shift the control lever to make the shift fork shaft slide reciprocally to prevent it from being rusted.

Ⅴ. Operation and maintenance of final drive

1. Jiangsu Medium-size tractor adopts externally-positioned final drive. The joint place of its housing and the half shaft casing endures huge torque, check the tightness of the bolts after every 8~10 working hours, if any one is loose, tighten it in time. When assembling or disassembling, the positioning bolt should not be missed or wrongly assembled in order to prevent the casing from damaging.

2. Check the oil level of the final drive every 125 working hours, fill up if necessary. After a new tractor has worked for 500 working hours outlet the oil and fill it in after cleaning the housing. Clean the housing and renew the oil every 1000 working hours.

3. Check the axial scurrying of the driving shaft caused by the wear of the conical bearings after every 500 working hours, adjust it in time when the scurrying range exceeds 0.15mm.

4. For the frequent operating tractor, especially paddy-field tractor, the sealing system for the driving shaft should be checked regularly. If there is any oil leakage, which is often caused by wearing, ageing or damage of oil seal, repair it in time.

Chapter XIII Steering System

Section 1 Steering Control Mechanism

Jiangsu－500 tractor is equipped with mechanical steering system, and its steering control mechanism includes steering wheel, steering gear, steering linkage, etc, as shown in Fig. 13－1.

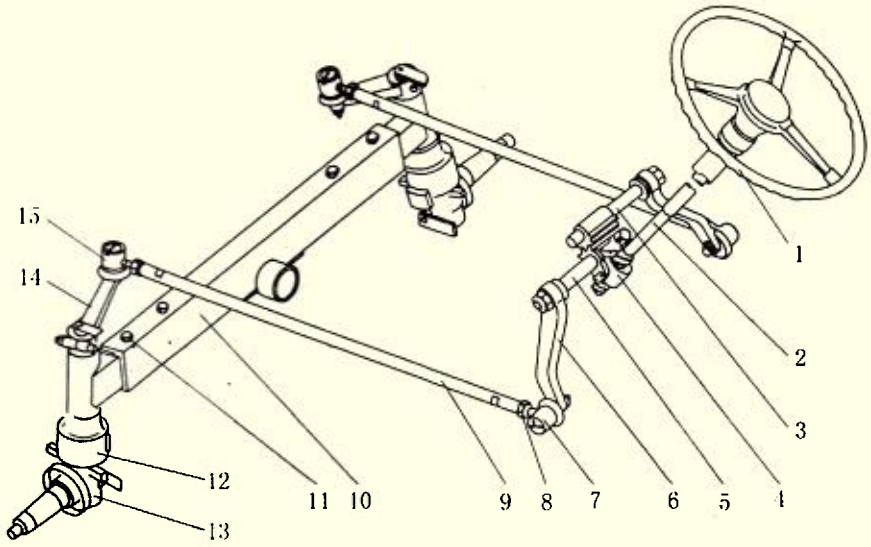


Fig. 13－1 Steering control mechanism

1. Steering wheel 2. Steering column 3. Right segment gear 4. Steering nut 5. Left segment gear 6. Pitman arm 7、15. Steering link joint 8. Lock nut 9. Steering drag link (left) 10. Main sleeve assy. 11. Bolt 12. Auxiliary sleeve assy. 13. Steering knuckle 14. Steering knuckle arm

Ⅰ. Steering gear

The steering gear transmits the controlling torque of the steering wheel to the pitman arm, then makes the guide wheel deflect via the steering linkage. It also plays the function of increasing torque, decreasing speed and changing torque direction.

Jiangsu－500 tractor adopts recirculating ball－and－nut steering gear, as shown in Fig. 13－2. The lower end of the steering column 12 is screwed into the steering nut 9. The nut spiral groove is filled with steel balls 10 and the ball sleeve 1 connects with both ends of the spiral groove of the steering nut 9 facilitating the circulative movement of the steel balls. The balls should not completely fill the groove, a clearance equal to a steel ball should be left to make the steering shaft easily turn. The steering nut is connected with with left steering segment gear by peg 5. The segment gears are connected with the pitman arm 11 by splines, and the steering wheel 24, which connects with steering column 12 by conical fit and is fastened with nut 25, is used to control the driving direction of the tractor.

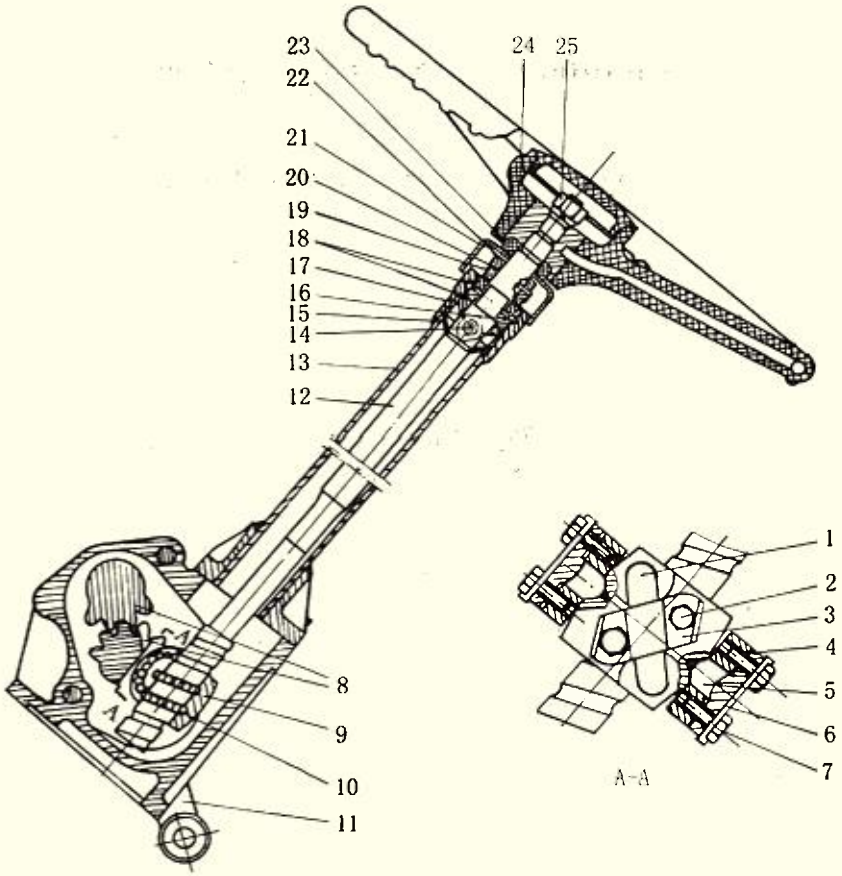


Fig. 13－2 Steering gear

1. Ball sleeve 2. Screw 3. Ball sleeve clip 4. Adjusting gasket 5. Peg 6. Lock plate 7. Screw 8. Steering segment gear 9. Steering nut 10. Steel ball 11. Pitman arm 12. Steering column 13. Steering column jacket 14. Oil cup 15. Grease retainer 16. Steel ball 17. Lower steel ball cup 18. Steel ball cup 19. Adjusting nut 20. Lockwasher 21. Dust cover 22. Lock nut 23. Felt washer 24. Steering wheel 25. Nut

Ⅱ. Steering linkage

The steering linkage changes the swing of the pitman arm into the turning through steering drag link, steering link joint and steering knuckle arm to make the guide wheel deflect.

1. Pitman arm

The top of the pitman arm 6 (Fig. 13－1) is connected with the segment gear shaft by the triangle splines. In order to fix the axial position of the pitman arm, the triangle splines is made into conical shape and fixed on the end face with nuts. Meanwhile, in order to ensure that both the left and right steering have the specified steering locking angle, there should be a proper fitting position between the pitman arm and the shaft. Therefore, a tooth is cut off from the splines, forming a blind key to avoid wrong installation. The bottom of the pitman arm and the steering drag link form steering ball joint through ball pin.

2. Steering drag link

Jiangsu－500 tractor adopts double drag link steering linkage. The drag link is a seamless steel tube (as shown inFig. 13－3) used to joint the pitman arm and the knuckle arm. Because it conducts space motion during the steering process, ball pins are installed on both ends.

3. Drag link ball joint

As shown in Fig. 13－3, the ball pin 9 is installed between the cover 5 and the seat 6 and is pressed by the counterpoise spring 4.

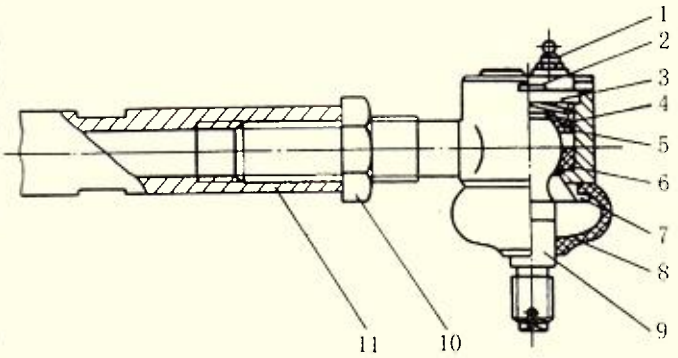


Fig. 13－3 Steering drag link joint

1. Oil cup 2. Cotter pin 3. Sealing cover 4. Spring 5. Cover of ball pin 6. Seat of ball pin 7. Drag link end 8. Oil seal cover 9. Ball pin 10. Lock nut 11. Drag link

Ⅲ. Adjustment of steering system

During the operational process, when the free travel of the steering wheel exceeds 30°due to wearing, it should be adjusted. Before the adjustment, check the clearance between the front wheel bearing, the steering king pin and the bushing first, if the clearance is too big, it should be cleared up. Check whether there is any deformation and loosening on the drag link, the pitman arm and the knuckle arm, if there is, it should be cleared up. Then make the following adjustment:

1. Adjusting fit of ball pin and pin seat

Move the drag link back and forth, if there is obvious rock, it means the fit clearance is too big and should be adjusted. In adjustment, first take out the cotter pin, screw the sealing cover to its stop, then turn back 1/4 ～ 1/2 turn and install the cotter pin (see Fig. 13－3). After adjusting, it is appropriate that the ball pin can be turned freely.

2. Adjusting thrust bearing of steering column

Too big clearance of the thrust bearing will cause the axial scurrying of the steering column. While checking, hold the steering wheel by hand then push and pull it along its axis. If the axial clearance is too big, remove the steering wheel 14, loosen the lock nut 9, turn the steering column 7 constantly with hand while tightening the adjusting nut 6, until the clearance is cleared up and there exists a little resistance. Finally, tighten the lock nut and install the steering wheel to its original place, as shown in Fig. 13－4.

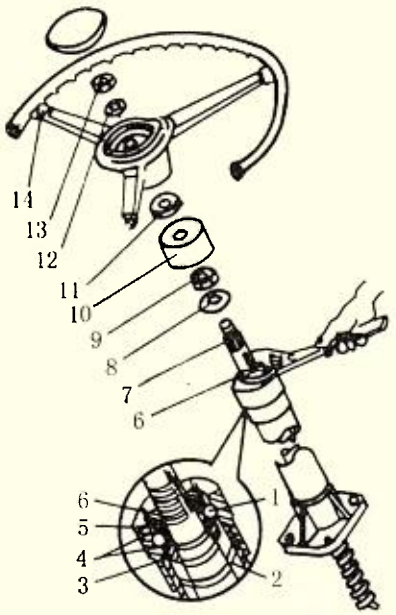


Fig. 13－4 Adjustment of thrust bearing of steering column

1. Steel ball 2. Oil seal cover 3. Lower steel ball cup 4. Steel ball cup 5. Steering column jacket 6. Adjusting nut 7. Steering column 8. Lock washer 9. Lock nut 10. Dust cover 11. Felt washer 12. Washer 13. Nut 14. Steering wheel

3. Adjusting the fit of peg and steering nut

If the free travel of the steering wheel is still on the large side after the two above－mentioned adjustment, remove the steering gear assy. and check the fit state of the steering nut between the left segment gear forked frame. As shown in Fig. 13－5, if the steering nut 5 rocks on the peg 7, reduce the thickness of the adjusting washer 6 to make the nut turn at a small torque without rocking.

Section 2 Operation and Maintenance of Steering System

As normal operation of the steering system plays a direct role in personal safety and machine safety, during the operational process, check constantly and maintain carefully to ensure its constantly good technical state. Do the following items for safe driving:

1. When driving the tractor, do not make a sharp turn at high speed or on a muddy or snow road to avoid overturn caused by side slip of the front wheels.

2. Constantly check the tightening of hitching elements, if there is anything loose, tighten them in time.

3. Fill every ball joint with grease on time and periodically check the oil level in the steering gear box to guarantee good lubrication.

4. Check and adjust related clearances in time to make the steering system in good technical condition.

5. In the case of making a small turn or running on soft ground or in paddy fields, the driver may depress the brake pedal corresponding to the steering direction while turning the steering wheel to help the turning when the side slip of the front wheels makes the steering out of nomal function (left and right brake pedals should be divided beforehand).

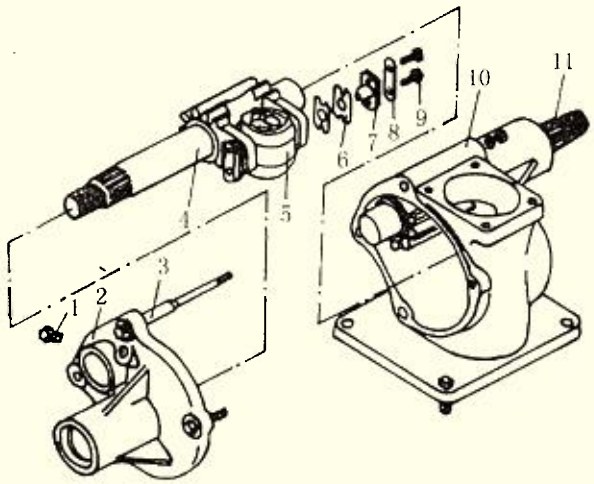


Fig. 13－5 Adjustment of fit of steering nut and peg

1. Plug 2. Side cover of steering gear box 3. Bolt 4. Segment gear L. H. 5. Steering nut 6. Adjusting washer 7. Peg 8. Lock plate 9. Fastening bolt 10. Steering gear box 11. Segment gear R. H.

Chapter XIV Braking System

The function of the braking system is to help the tractor to quickly reduce the running speed, to make an emergency brake application or a small turn and to stop on the slopes. The braking system of the wheeled tractor consists of brakes and brake control. Brakes are used to help the turning half shaft quickly reduce the speed or stop and the brake control is used to actuate the brakes.

Section 1 Structure of Brakes

I. Structure of brakes

The brake of Jiangsu Medium-size tractor is of a chute, double-disk type. Two disk brakes are installed in the half shaft housings (L.H & R.H.) symmetrically and two sets of brake control are respectively installed for two brakes (L.H & R.H) to ensure they can be operated separately on making a small turn.

The disk brakes are installed between the half shaft housing 7 and the bearing seat 9 (as shown in Fig. 14-1). The internal splines on the two brake disk 12 (on them are riveted friction lining) are

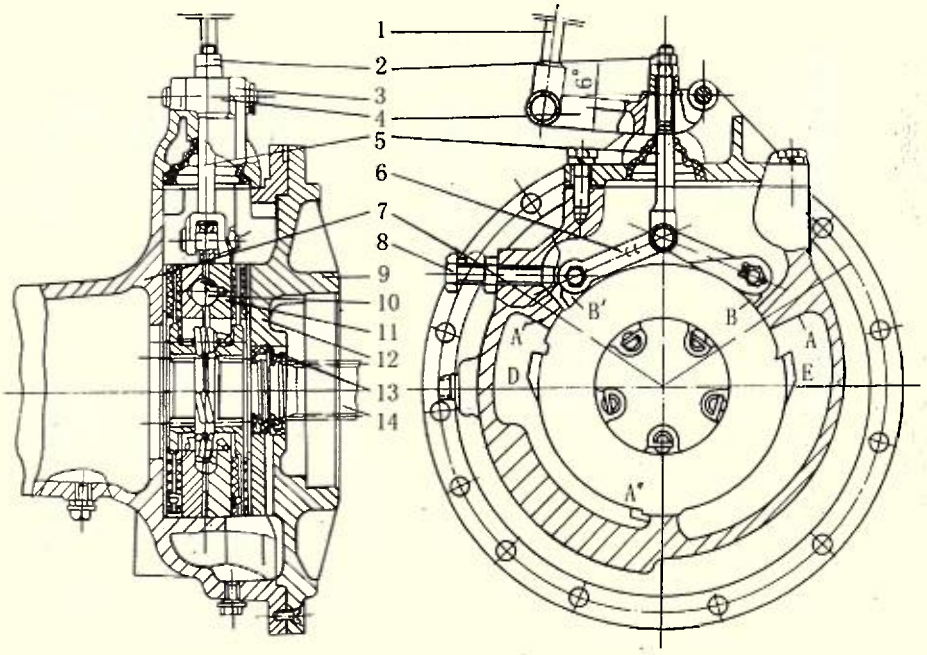


Fig. 14-1 Structure of brake (L.H.)

1. Brake rod 2. Locking nut 3. Rocker arm seat 4. Brake rod arm 5. Adjustable rod 6. Lift rod 7. Half shaft housing 8. Adjusting screw 9. Bearing seat 10. Steel ball 11. Brake press disk 12. Brake disk 13. Release spring 14. Half shaft

A, A', A"——Bosses in the half shaft housing B, B'——Lug latch on the brake disk

installed on the external splines of the half shaft, turning with the half shaft and being able to make axial sliding. This is the turning part of the brakes. There is a pair of round press disk 11 with lug latch between the two brake disks. They are made of nodular cast iron and supported on the A, A′, A″ bosses in the floating way to ensure that they are concentric with the half shaft and able to turn at a small radians till B touches A (or B′ touches A′). Five spherical chutes from shallow to deep are milled on the inner surface between two press disks 11, and five steel balls 10 are put in them. As the brake is not in the braking state, five release springs draw the two press disks together and steel balls are in the deepest place of the chutes, at this time, there is certain clearance between the brake disks 12 and the press disks 11 and clearance among the brake disks 12, the half shaft 7 and the bearing seat 9, the total clearance is 2 mm.

Ⅱ. Braking process

As the brake pedal is depressed, as shown in Fig. 14 − 2, the operating force is transmitted through the brake rod 1, the brake rod rocker arm 4, the adjustable rod 5 and the lift rod 6 and makes the brake press disks turn an angle, as shown in Fig. 14 − 2e, the steel balls in the chutes begin to roll from the deep part to the shallow part, the press disks are far aparted to the two sides, as shown in Fig. 14 − 2d, and the two brake disks are pressed between the brake press disk and the surface of the half shaft housing and between the press disk and the surface of the bearing seat. Then the brake frictional torque from the friction surfaces will make the half shaft stop turning and the tractor is braked.

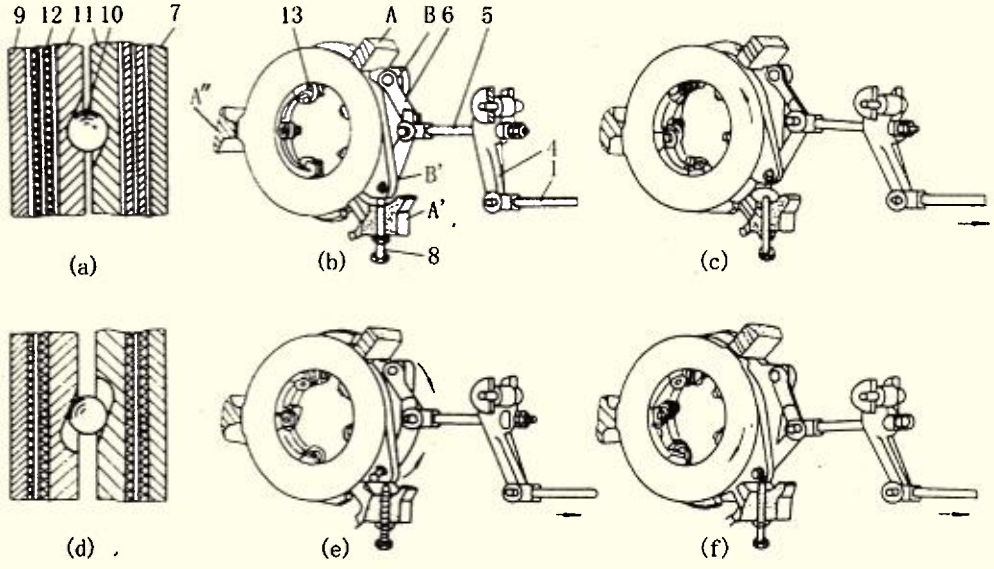


Fig. 14 − 2 Disk brake braking process

(a) In non − braking state, place of steel balls and press disks (b) Non − braking state (c) Braking power self − increasing at forward gear (d) In braking state, place of steel balls and press disks (e) Braking starting state (f) Braking power self − increasing at reverse gear

1. Brake rod 4. Brake rod arm 5. Adjustable rod 6. Lift rod 7. Half shaft housing 8. Adjusting screw 9. Bearing seat 10. Steel ball 11. Brake press disk 12. Brake disk 13. Release spring

If the brake pedal is released, it returns to its original place under the action of the release springs and the press disks ,under the action of the five release springs 13, make the steel balls slide into the deep part of the chutes, as shown in Fig. 14－2a. In this way, the clearance on the two sides of the two press disks is recovered, then the brakes are in the non－braking state.

The disk brake has a function of braking power self－increasing. When the two brake disks 11 are driven by the half shaft to turn counter－clockwise (it is at forward gear), as shown in Fig. 14－2c, the brake press disks 11 are also driven by the frictional torque from the friction surfaces to turn counter－clockwise. However, the lug latch B of the internal press disk is limited by the boss A on the half shaft housing and cannot turn continuously, while the external brake press disk is driven by the frictional torque to turn counter－clockwise relatively to the internal press disk, which helps the steel balls make the two press disks far apart to the both sides. This process performs the function of braking power self－increasing and saves the operating force.

When the brake disk 12 turns clockwise (at reverse gear), as shown in Fig. 14－2f, lug latch B′ of the external brake press disk is limited by the adjusting screw 8 on the boss A′, and its power self－increasing and braking process is similar to the above－mentioned. Therefore, either at forward gear or at reverse gear the disk brake can increase braking power.

Section 2　Brake Control

The braking control in the tractor is generally of mechanical type and its structure (as shown in Fig. 14－3) is similar to the structure of the clutch operating mechanism.

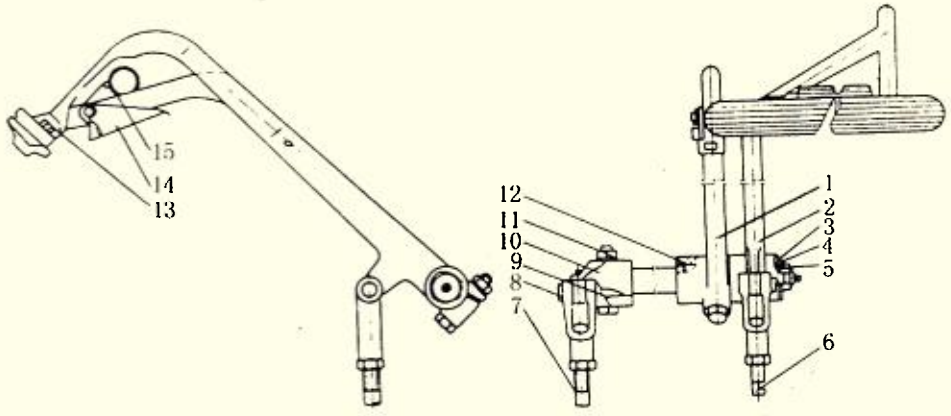


Fig. 14－3　Braking control

1. Brake pedal assy. (L. H.)　2. Brake pedal assy. (R. H.)　3. Bushing　4. Snap ring　5. Pedal shaft　6. Brake rod (R. H.)　7. Brake rod (L. H.)　8. Locking screw　9. Woodruff key　10. Pedal rocker arm (L. H.)　11. Lock bolt　12. Woodruff key　13. Interlock plate　14. Retaining pawl　15. Torsion spring

The pedal shaft 5 is supported in the seat hole of the gearbox casing and on its right protruding part is installed the pedal assy. (L. H. and R. H.), which are tightened with the shaft 5 by the

woodruff key 12 and the locking screw 8 ; the pedal assy, (R.H.) is installed on the shaft 5 and limited by the snap ring 4. Rocker arm 10 (L.H.) is fixed on the left end of the shaft 5 by the woodruff key 12 and the bolt 11, and the pedal rocker arm (R.H.) and the pedal assy. (R.H.) are made into one body. The forks on both ends of the brake rods 6,7 are connected via pins with their separate brake rod and rocker arm. One end of the brake rod arm 4 has a pivoting point on its seat 3 (see Fig. 14 - 1) and the adjustable rod 5 passes through the hole in its waist, the outer end being locked by the nut 2, while the inner end being hinged with the lift rod 6. The other end of the lift rod 6 is connected with the lug latch of the two press disks B and B'. In installing the brake, the following steps should be followed: screw in the adjusting screw 8, push the press disk B through the press disk B' and the lift rod to turn an angle till its lug latch touches the boss A, then tighten it with the nut 2 to avoid the impact sound on braking.

Section 3 Check and Adjustment of Braking System

In operation, because of the gradual wearing of the friction lining, the free travel of the pedal will increase correspondingly. Too long free travel will cause poor braking performance, even unsuccessful braking, while too short free travel will cause automatic braking or burn the friction lining. The difference of the pedal free travels (L.H. and R.H.) will lead to brake bias, therefore, in the operational process, the free travel of the pedals should be checked regularly and adjusted if necessary.

Ⅰ. Adjustment of pedal free travel

Free travel refers to the distance of the pedal's moving from the upmost point down to the place where the resistance increases obviously. The rated value of the free travel should be 60～80 mm, as shown in Fig. 14 - 4.

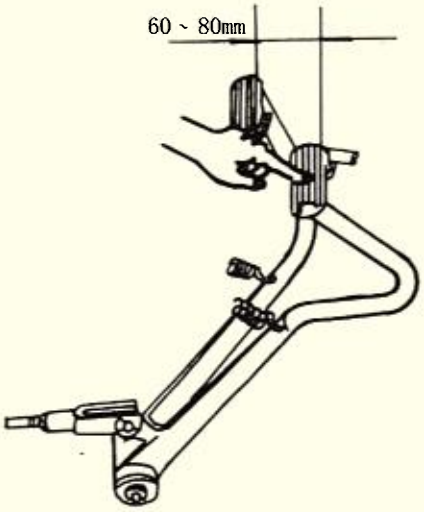


Fig. 14 - 4 Checking the free travel of the brake pedal

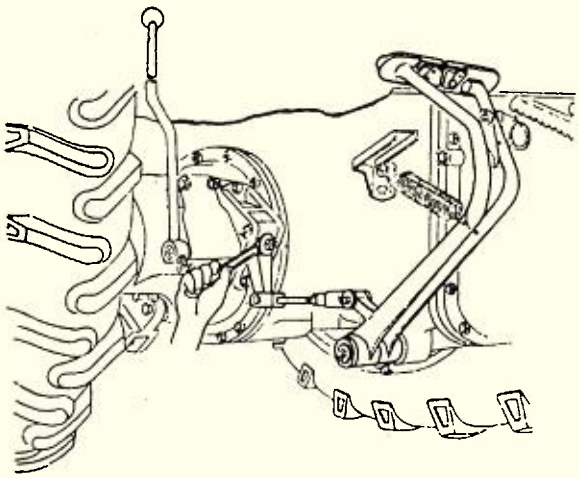


Fig. 14 - 5 Adjusting the free travel of the pedal

First, the return spring of the pedal should be removed, then make the interlock plates open and check and measure the free travel of the two pedals separately. If the specific value is not satisfied, the free travel should be adjusted by turning the adjusting rod nut, as shown in Fig. 14－5. Tighten the nut, the free travel will decrease, and conversely, it will increase. In adjustment, the free travel of the brake pedals(L.H. and R.H.) should be equal. After that, check the braking performance.

Ⅱ. Check of the braking performance

If lack experience, after having adjusted the free travel of the pedals, prop up the two rear driving wheels, turn the outer of the wheels slightly, if the wheels can be turned easily, it shows there is no jam in the brake (otherwise, remove the brake, check and adjust it); during the inspection, the two brake pedals should be interlocked. When the tractor makes an emergency brake application, the braking traces on the ground left by the two rear driving wheels should be of equal length and the braking distance should be in the rated range, if it is not so, make a readjustment.

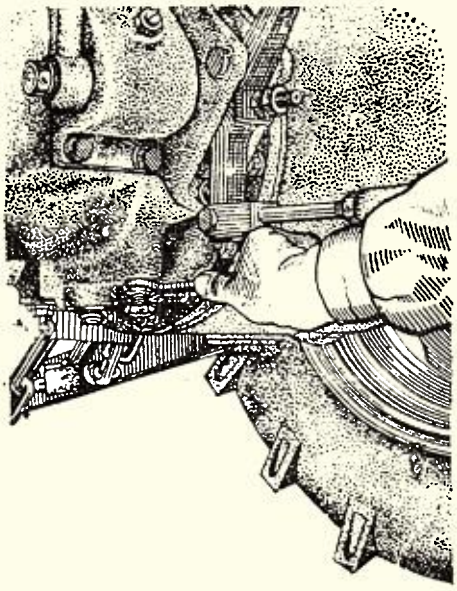


Fig. 14－6 Eliminating the impact sound of braking

Ⅲ. Elimination of the impact sound

There may be a sound of sudden impact on applying the brake, in that case, loosen the lock nut, as shown in Fig. 14－6, and slightly tighten the adjusting screw(see No. 8 in Fig. 14－2) until the impact sound is eliminated or greatly lowered.

Causion: Do not screw in the adjusting screw too much.

Section 4 Operation and Maintenance of Braking System

1. When the tractor is used for transportation, the brake pedals(L.H. and R.H.) should be interlocked to avoid serious accidents caused by single－sided braking during high speed running.

2. For the purpose of preventing the friction lining from being seriously worn, do not step on the brake pedals when the tractor is running.

3. Check the oil outlet plug regularly, if there is any oil leaking out, the oil sealer is no longer usable, so replace it in time. If there is any oil filth on the surface of the friction lining, wash it with gas and re－install it after it is dried.

4. In order to prevent the right pedal from getting rusted on the pedal shaft, add grease to it regularly, especially when the tractor is used in paddy field, otherwise, it will bring bad effect on its single－side braking function.

Chapter XV Running System

The function of the running system is to change the driving torque transmitted by the transmission into traction force via the interaction of the driving wheel and the ground and at the same time transform the rotation of the driving wheel into forward and reverse running. Additionally, the running system also supports the total mass of the tractor. It mainly consists of front axle and wheels.

Section 1 Structure and Adjustment of Front Axle

Ⅰ. Structure

Jiangsu－500 tractor adopts telescopic staged front axle. It consists of main sleeve assy., left and right auxiliary sleeve assy., and steering knuckle assy., as shown in Fig. 15－1.

The supporting tube for pivot shaft 22 is welded with the bottom of the main sleeve in the middle, and there are bushings in its both ends. The main sleeve assy. is articulated with the bracket 2 through the pivot shaft 1. The rear part of the bracket is connected with the engine by bolts, and the battery bracket is installed on its front.

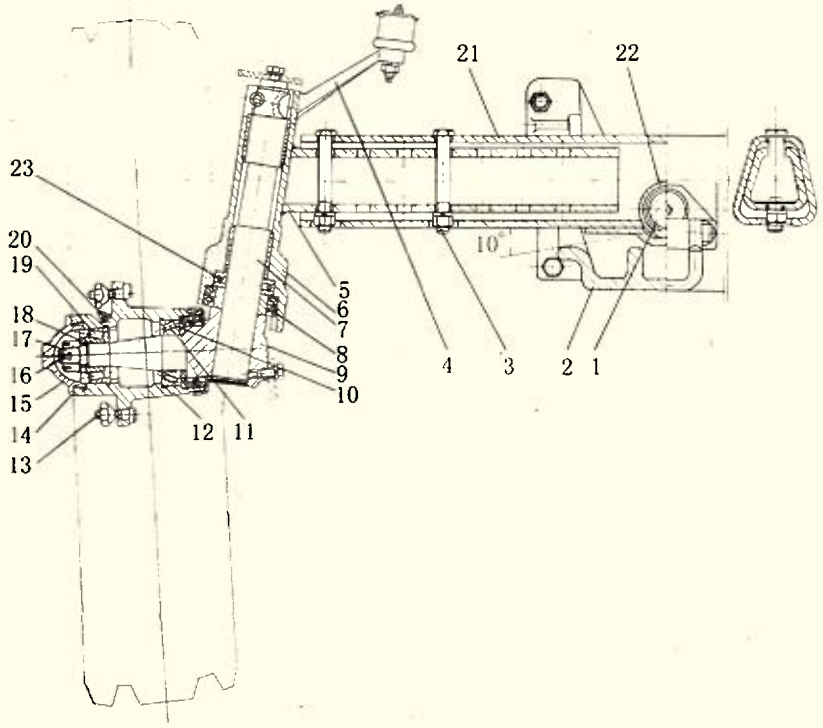


Fig. 15－1 Structure of Jiangsu－500 tractor front axle

1. Pivot shaft 2. Bracket 3. Bolt 4. Steering knuckle arm 5. Auxiliary sleeve 6. King pin sleeve 7. King pin 8. Oil seal 9. Steering knuckle shaft 10. Mantle ring 11. Conical roller bearing 12. Front wheel hub 13. Front wheel hub bolt 14. Paper gasket 15. Front wheel hub cap 16. Cotter pin 17. Nut 18. Washer 19. Conical roller bearing 20. Grease cup 21. Main sleeve 22. Supporting tube for pivot shaft 23. Thrust bearing

The main sleeve can rock around the pivot shaft 1 to fit the crosswise uneven ground, ensuring that the two front wheels touch the ground at the same time. The maximum rocking angle of the front axle is ± 10°, which is limited by the crosswise sunken edge of the bracket 2. Two holes are drilled in each end of the main sleeve to fix the auxiliary sleeve assy.

The auxiliary sleeve assy. is welded of auxiliary sleeve 5 and king pin sleeve 6. There are seven holes in a space of 50 mm each in the left and right auxiliary sleeves. Four different wheel treads can be obtained while inserting the bolt into different holes on the main sleeve (the distance between the two holes on each is 150 mm) on installing the auxiliary sleeve.

The king pin 7 in the steering knuckle assy. is installed in the king pin sleeve and between them there are 2 sliding bushings and a thrust bearing. The bottom of the king pin 7 is welded with the steering knuckle shaft 9, and the front wheel is fixed on the steering knuckle shaft by two conical roller bearings 11 and 19 in the front wheel hub 12. The upper end of the king pin 7 is joined with the steering knuckle arm 4 by woodruff key and bolt.

Ⅱ. Adjustment of front axle

1. Adjusting the axial play of front hub bearings

Axial play of the front hub bearing is normally 0.05～0.25 mm. In operation, the clearance may be widened due to the wearing of the bearing, if it is not adjusted in time, the bearing will be damaged easily. While checking, jack up the front wheel from the ground first, then push and pull the wheel along its axis, if there is apparent axial movement (the clearance exceeds 4 mm), it should be adjusted. In adjustment, dismantle the hub cap 2 and pull out the cotter pin 3. Then tighten the clip nut 1, meanwhile, rotate the front wheel with hand till the resistance torque starts to increase, then return the clip nut 1 by 1/15～1/6 of a turn. Finally lock in the clip nut with the cotter pin and mount the hub cap.

2. Adjusting the toe－in of front wheel

Because of the outward inclination of the front wheels, the distance between the midpoint of the supporting face and the axis of the king pin is shortened and the deflection resistance torque of the front wheel is reduced, which facilitates the tractor of turning a corner. But while running, the two front wheels have a trend to be away from each other, which may increase their wearing. In order to get rid of this bad effect, the toe－in of the front wheel is adopted, that is to bring the front of the two wheels together a little. When adjusting, leave the tractor on the level ground. Disassemlble the left and right drag links, turn the steering wheel to its straight－ahead position (i. e. the middle point of its rotating range), make the front wheels in a straight ahead position of symmtry, assemble the two drag links, and adjust their length respectively to make the value of B－A equal to 3～15 mm (as shown in Fig. 15－3). Tighten the nuts of the drag links after adjustment.

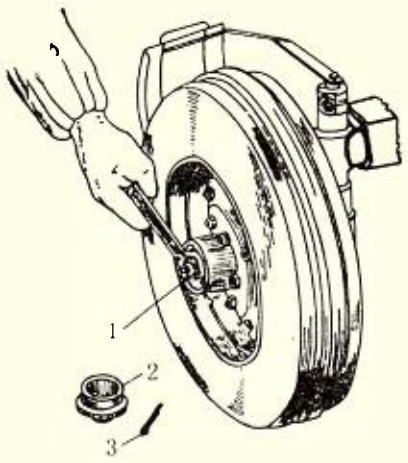


Fig. 15－2 Adjusting the axial play of front hub bearing

1. Clip nut 2. Hub cap 3. Cotter pin

The hydraulic steering plug of a 2WD tractor should be in the centre of the steering cylinder i.e. the length adjusted of the left and the right drag links (C & D) should be the same or the difference bwtween the length of them should not be more than 1 mm.

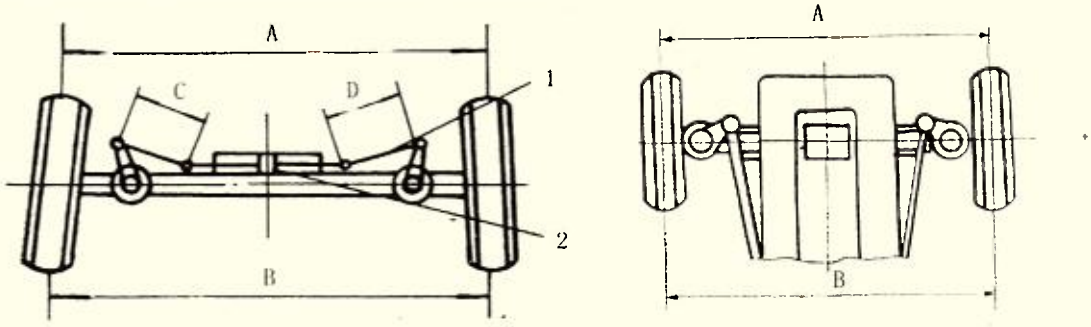


Fig. 15－3 Adjusting the toe－in of front wheel

1. Steering pull rod 2. Oil plug

3. Adjusting the wheel tread

Both of the front and rear wheel treads of Jiangsu－500 tractor can be adjusted according to different operating requirements.

(1) Adjusting the front wheel tread

When adjusting, jack up the front wheels from the ground. Loosen the nuts 2, and pull out the bolts 4. Move the auxiliary sleeve according to the required wheel track. Insert the bolts and tighten the nuts. (See Fig. 15－4).

The adjusting range of the front wheel tread for Jiangsu－500 tractor is 1300～1600 mm, which is divided into 4 steps of 100 mm, the one most in use is 1300 mm.

The adjusting range of the front wheel tread for Jiangsu－50H high ground clearance tractor is 1470～1570 mm, being divided into 2 steps of 100 mm and the one most in use is 1470 mm.

(2) Adjusting the rear wheel tread

The adjustment of the rear wheel tread is made by varying the fitting positions between the driving wheel shaft and its disc, and the fitting positions between the disc and the rim respectively. The adjustment value ranges from 1250 mm to 1650 mm, being divided into 5 steps of 100 mm, the one most in use is 1350 mm.

The adjustment of the rear wheel tread is made corresponding to that of the front wheel tread, as shown in Fig. 15－5.

Note: In the case of high lug tyres, the minimum rear wheel tread is 1450 mm.

4. Adjusting the ground clearance

In cultivation, higher ground clearance is required for the tractor, so considering this requirement, the Jiangsu－500 tractor is modified into Jiangsu－50H high ground clearance tractor .

The ground clearance for farm operation can be adjusted from 510 mm to 740 mm through installing the steering knuckle assy. with longer king pin and its auxiliary sleeve assy. Accordingly the final drive casing should be turned downward by 72°(two holes) in relation to the half shaft casing. The road clearance will also be changed from 370 mm to 600 mm after adjustment, and at the same

time the wheel base is shortened from 1950 mm to 1900 mm. Then the adjusted tractor can be used for cultivation.

Section 2 Structure and Operation of Wheels

Tractor wheels, except for the specialized steel wheels for paddy fields, all adopt low－pressure tyres. This type of tyres possess many merits, such as simple structure, light weight and reducing vibration.

Ⅰ. Structure of the wheel

1. Front wheel

The front wheel of Jiangsu－500 tractor adopts pneumatic tyres and the specification is 6.00－16－inch. The front wheel consists of inner tube, tyre, rim, disc and wheel hub. There are 3 guiding tire slits on the crown of the tyre to prevent sideslip. The valve on the inner tube is

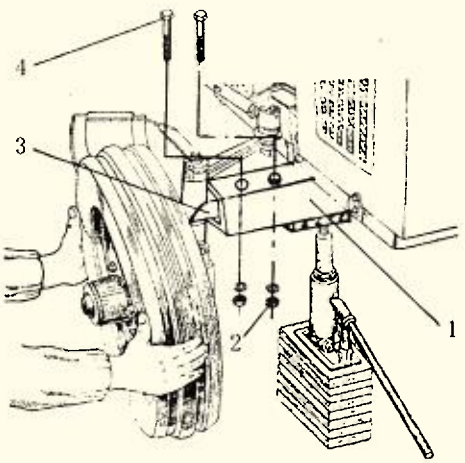


Fig. 15－4 Adjusting the front wheel tread
1. Main sleeve 2. Nut 3. Auxiliary sleeve 4. Bolt

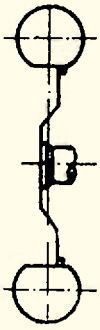
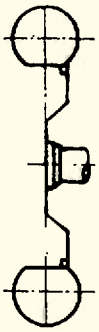
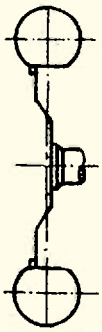
Rear Wheel Track	1250	1350	1450	1550	1650
Illustrative Diagram for Adjustment					
Front Wheel Track	1300 1st hole		1400 2nd hole	1500 3rd hole	1600 4th hole

Fig. 15－5 Illustrative diagram of adjusting front, rear wheel treads

used to inflate and prevent air leakage. The disc and the rim are welded together and the internal flange of the disc is tightened with the joint flange of the front wheel hub by bolts.

2. Rear wheel

The rear wheels of Jiangsu－500 tractor are driving wheels, which adopt pneumatic tyres of 11－32－inch. Each one consists of inner tube, tyre, disc, rim and wheel hub, etc. See Fig. 15－6.

There are six attaching lugs welded on the inner face of the rim 2 and they are joined with the disc by bolts. The disc 1 is fixed on the joint flange of the driving shaft by 8 bolts. Each driving wheel disc is provided with a ballast of 225 kg to improve the adhensive performance of the tractor.

On the crown of the tyre there are open－center lugs, which do not contact with each other so that

the mud on the tyre can be removed automatically to ensure excellent anti－sliding performance. However, its antiwear performance is not as good as that of the closed－center lug. The direction of the lug should not be installed wrongly and the top of the open－center lug (or the arrow on the side wall of the tyre) should be consistent with the forward direction of the tractor.

In paddy field operation, high lug pneumatic tyres of 11－32－inch which have relatively wider tire section and lower pressure could be used. The lugs on this type of tyre are 2－3 times higher than those of the normal tyres, and they adopt the open－center lug. For its high lugs, this type of tyre can catch the hard layer of the soil so that the tractor can provide certain traction force especially in shallow mud layer field. Meanwhile, the smooth－going performance of the high－lug－tyred tractor is much better than that of the steel wheeled tractor, so it can be used in the long－distance tranfer.

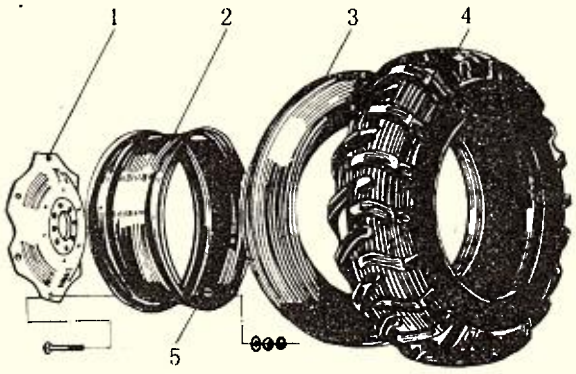


Fig. 15－6 Rear wheel

1. Disc 2. Rim 3. Inner tyre 4. Outer tyre 5. Attaching lug

Ⅱ. Use and maintenance of tyres

1. The tyre inflation pressure should accord with the stipulations: the inflation pressure for the 6.00－16－inch guide wheel is 200～300 kPa; for the 11－32－inch rear wheel is 80～120 kPa; for the high lug tyre is 180 kPa. The inflation pressure is measured by tyre pressure gauge.

2. If the slip of the driving wheel is serious, the tractor should not continue to run; if not in emergency, avoid emergency brake application to prevent early－worn of the tyres.

3. Do not travel at high speed on uneven ground; avoid travelling on macadam road, cinder road at high speed, and do not adopt emergency stop on these kinds of roads.

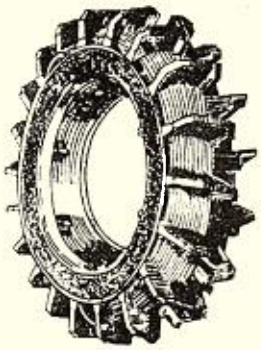


Fig. 15－7 High－lug tyre used in paddy field

4. Do not use high lug tyres for transportation, otherwise, the lugs will be broken or stripped off.

5. Do not make the tyres be stained with fuel, oil, acid or alkaline solution. If they are stained, clean them with water in time to prevent the tyres from corrosion.

6. Exchange the left and the right tyres when their wearing is not the same.

7. When parking for a long time, the tractor should be held up to make the tyres off the ground and bear no pressure; do not expose the tractor directly to open air to avoid early aging of tires.

Chapter XVI Tractor Working Equipment

The working equipment of Model Jiangsu Medium－size tractor includes PTO shaft, hydraulic suspension system, towing equipment, belt pulley and trailer braking mechanism. It can be used to transmit power to the equipped implements and help them accomplish the field operation and long－distance transportation. It also can be used as a power source of the stationary operation.

Section 1 PTO shaft

Ⅰ. Functions of PTO shaft

As a tractor tows the plough, harrow or other implements to perform the field operation, only towing force needs to be provided. If it is used for driving implements, such as cultivator, harvester, seeder and sprayer, some of their working parts need additional power to help them accomplish some specific acts(for example, rotation of the skim cutter shaft of the cultivator drives the rotor blades to move), and commonly, the power is transmitted to the implements through PTO shaft. In stationary operation, all of the tractor power can be transmitted through PTO shaft or the driving belt pulley on PTO shaft to drive the thresher, the water pump or other stationary implements.

Ⅱ. PTO shaft type and speed

1. Type

PTO shaft can be classified into two types according to whether its rotation speed can keep a specific value or change with the running speed of the tractor, one is standard speed type, the other is synchronous speed type. At present, most of the tractors are fitted with the standard speed PTO shaft.

The speed of the PTO shaft is at direct ratio with the running speed of the engine, and there is no relation with the gear of the gearbox, so the PTO shaft can get the constant standard speed when the engine runs at the standard speed. The types of the standard speed PTO shaft include: non－independent, semi－independent, independent.

(1)For the non－independent PTO shaft, the main drive line and the PTO drive line use the same single－acting clutch, so they "start" or "stop" at the same time, following the clutch "engagement" or "disengagement".

(2)For the independent PTO shaft, the main and the auxiliary clutches have a set of operating mechanism separately to avoid interference, but the structure is complex.

(3) For the semi－independent PTO shaft, the main and the auxiliary clutches in the double－acting clutch (Fig. 13－3) are controlled by a same clutch pedal. When the pedal is stepped down for a specific distance, the main clutch is disengaged first (the main drive line is cut off), as it is stepped down continuously, the auxiliary clutch is disengaged(the PTO drive line is cut off and the main drive line is still in the cut－off condition). When the pedal is released gradually, the auxiliary clutch is engaged first, then the main clutch is engaged. The order of the main drive line and the PTO shaft

"start" or "stop" is fixed, but the PTO shaft cannot operate independently, so it is called semi－independent type. This type is simple in structure and easy to operate, so it is used widely, although it cannot operate the PTO shaft when the tractor is running.

2. PTO speed

The PTO speed of Model Jiangsu Medium－size tractor is 540r/min, 1000r/min, or low 734r/min (optional) and high 978r/min (optional). The size of the spline at the shaft end is $6-35\times30\times8.69$ (as shown in Fig. 16－1) or $8-38\times32\times6$ (optional). The driving gear is sliding gear and driven gear is fixed gear.

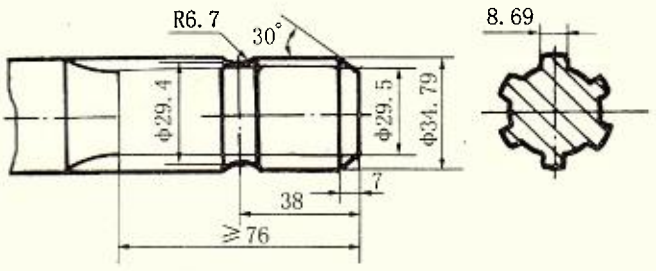


Fig. 16－1 **Size of shaft end spline , PTO shaft**

Ⅲ. Structure and characteristics of PTO shaft

1. Structure of PTO shaft

The PTO shaft of Model Jiangsu Medium－size tractor is of semi－independent type, its structure is shown in Fig. 16－2. It consists of auxiliary clutch shaft, drive shaft (hydraulic pump driving gear 26 and its inner splines are connected with the outer splines of the shaft 1 and the shaft 25), drive meshing gear and PTO shaft 19.

The power of the engine is transmitted from the auxiliary clutch to the auxiliary clutch shaft 1, then through the inner spline meshing sleeve of the gear pump driving gear 26 to the PTO shaft.

There are a fixed gear 13 on the shaft 25 and a sliding gear 22 on the PTO shaft 19, and the place of the sliding gear is controlled by the PTO control lever (No. 26 in Fig. 12－15) with the help of the shift fork shaft 9 and the shift fork 10. The two V－grooves on the shift fork shaft are locked by locking pin 6 and locking spring and their positions are neutral position and working speed position respectively. When the sliding gear is moving forward, it is the working speed, and the neutral position is shown in Fig. 12－15. Gear 26 and 5 in Fig. 12－15 are drive gears of the hydraulic suspension system gear pump and they transmit power to the gear pump shaft 4 to drive the gear pump.

2. Characteristics of PTO shaft

According to operational and technical requirements, the PTO shaft of Model Jiangsu medium－size tractor has following characteristics:

(1) The start of the PTO shaft is earlier than that of the tractor , which avoids overcoming the starting inertia resistance while overcoming the starting inertia resistance of the working parts on the implenemt, otherwise, it will lead to overload of the engine and increase of the clutch wearing.

(2) Gear shifting has no effect on the working of the PTO shaft, so the implement can work continuously.

(3) The PTO shaft can keep working in the case the tractor stops temporarily or starts again after stopping. For example, if the cutter of a harvester is blocked by straws, stop the tractor for a while to make the sickle knives continue working , then the straws can be cleared off.

Ⅳ. Adjustment of PTO shaft

1. Adjusting the limiting screw of PTO shift fork shaft

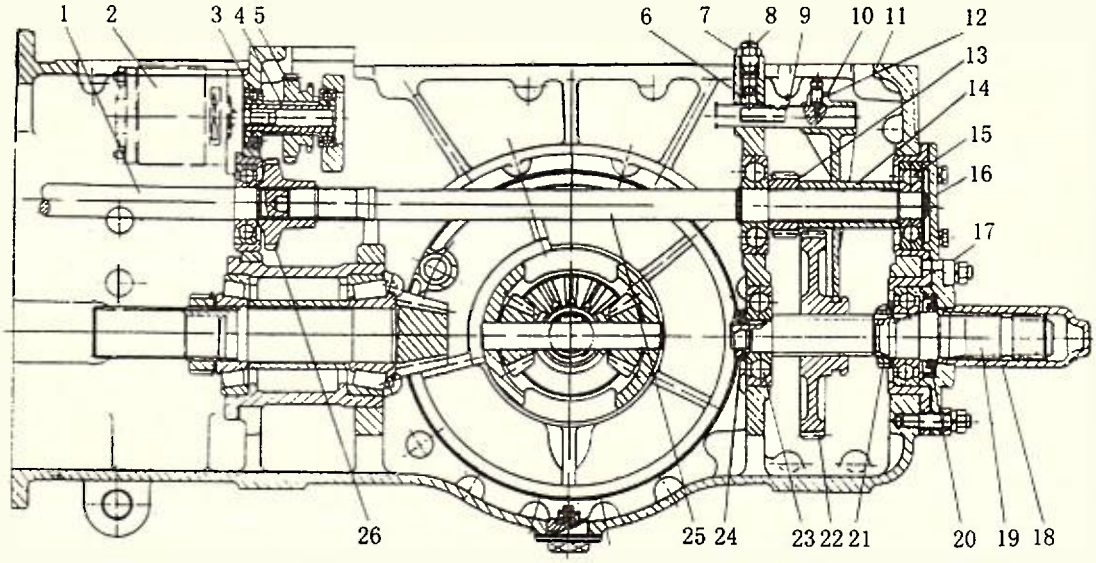


Fig. 16－2 PTO shaft

1. Auxiliary clutch shaft 2. Gear pump 3, 15, 23. Bearing 4. Gear pump shaft 5. Driven gear for gear pump drive 6. Locking pin 7. Locking nut 8. Cone－headed locking screw 9. Shift fork shaft 10. Shift fork 11. Rear axle housing 12. Lock screw 13. Drive gear 14. Space sleeve 16. Bearing cap 17. Bearing seat 18. PTO shaft guard 19. PTO shaft 20. Oil seal 21,24. Locking nut 22. Sliding gear 25. PTO drive shaft 26. Driving gear for gear pump drive

As shown in Fig. 16－3, the moving position of the shift fork shaft is limited by the limiting screw 3. If the moving travel is too big, the sliding gear will contact with the rear axle housing. When adjusting, loosen the locking nut 4 first, tighten the limiting screw 3 to its stop, then return it by 1/2～3/4 of a turn and finally fasten it with the locking nut 4. In this way, a specific clearance is left between the head of the limiting screw 3 and the bottom of the long groove on the shift fork shaft.

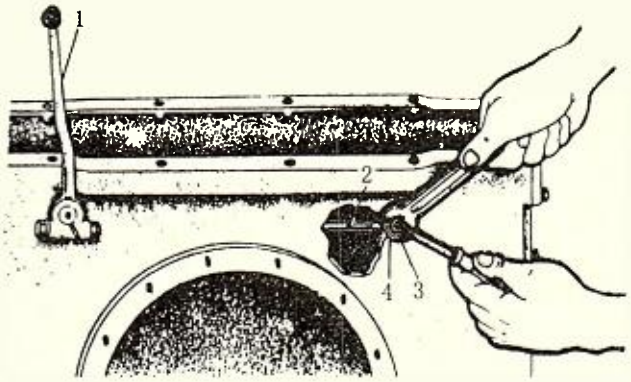


Fig. 16－3 Adjusting the limiting screw of PTO shift fork shaft

1. PTO control lever 2. Shift fork shaft 3. Limiting screw 4. Locking nut

2. Adjusting the tension of locking spring for PTO shift fork shaft

The locking spring tension for PTO shift fork shaft is adjusted by means of the cone－headed locking screw 4. The proper spring tension is to produce a gear shifting force of 90N when the PTO shaft control lever 1 is changing gear speeds (the value of the force may be measured on the ball knob with a spring balance). If the PTO shaft slides off automatically because of insufficient spring tension, loosen the locking nut 3, and adjust the locking

screw 4 with screwdriver. After adjustment, tighten the locking nut 3, as shown in Fig. 16－4.

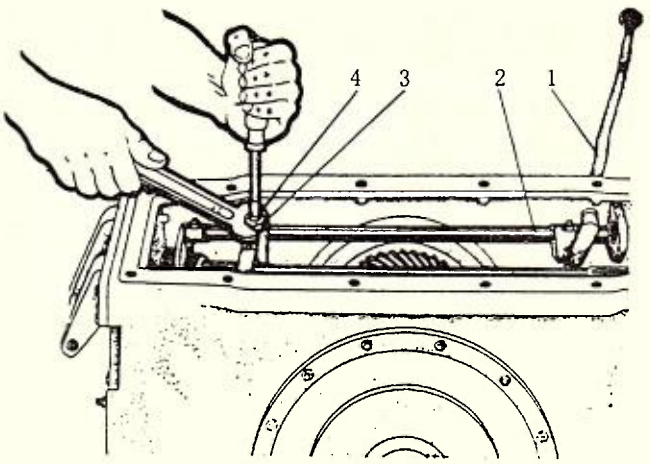


Fig. 16－4 Adjusting the locking spring tension of PTO shift fork shaft

1. PTO control lever 2. Shift fork shaft 3. Locking nut 4. Cone－headed locking screw

Section 2 Hydraulic Lift

Ⅰ. Working principle of hydraulic lift

The mechanism that is used for suspending mounted implements and lifting them with hydraulic equipment is the hydraulic lift. Its function is to take hydraulic as power to lift and lower a mounted implement and use the hydraulic to automatically control or adjust the ploughing depth and the height to the ground.

1. Components of hydraulic lift and hitch

The hydraulic lift and hitch consists of hydraulic system, hitch assy and control system, as shown in Fig. 16－5.

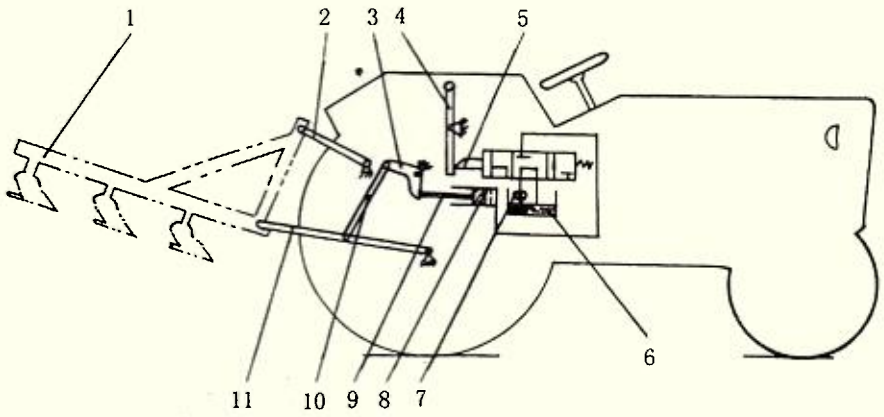


Fig. 16－5 Working principle of hydraulic lift and hitch

1. Implement 2. Upper link 3. Lift arm 4. Operating handle 5. Main control valve and distributor 6. Oil tank 7. Hydraulic pump 8. Hydraulic cylinder 9. Piston and piston rod 10. Lift link 11. Lower link

(1) Hydraulic system: as a power unit, which is used to lift implements, it consists of hydraulic pump 7, distributor 5, hydraulic cylinder 8, piston and piston rod 9, oil tank 6, oil filter and some other hydraulic elements.

(2) Hitch assy: used to hitch the mounted implement and lift and lower it under the action of hydraulic pressure. It consists of lift link 10, inner and outer lift arm 3, upper link 2 and lower link 11, etc.

(3) Operating mechanism: used to control the main control valve of the distributor and make it

function the "lifting ", "lowering " or "neutral" .

2. Working principle of hydraulic lift and hitch

Hydraulic pump 7 is driven by part of the power from the transmission system, so it suck in oil from the tank 6, compresses it into high－pressure and send it into the distributor 5.

When the main control valve is in the "lifting" position, the high－pressure oil from the pump flows through the inner cavity of the distributor into the hydraulic cylinder 8. The piston is pushed backward under the action of high－pressure oil, then it drives the inner and outer lift arm 3, the lift link 10 and the lower link 11 to lift the implement, at the same time, the oil passage leading to the tank in the distributor is closed by the main control valve 5.

As the main control valve 5 is in the "neutral" position, the high－pressure oil from the pump returns to the tank through the oil return passage in the distributor and stands in the no－load condition, so the oil pressure is very low. At this time, the oil passage to the cylinder is closed by the main control valve, and the oil amount in the cylinder is neither increased nor decreased, the place of the piston is unchangeable, therefore, the implement is also kept at its original place.

As the main control valve is in the "lowering" position, the oil from the pump and the oil from the cylinder return to the oil tank through the distributor, so the oil in the cylinder is drained out under the action of the weight of implement, then the implement is lowered.

The working order of the main control valve is controlled by the cooperation of the hand operation and the automatic control. The links, cams, and eccentric mechanism in the operating mechanism are used to help function hand operation and automatic control of the main control valve.

Ⅱ. Adjusting methods for ploughing depth of mounted implements

1. Height control

The main characteristics of this method are: a landwheel is installed on the implement and supports part of its weight, it can move up and down relative to the tractor and its height can be adjusted. If the landwheel passes the field where the soil specific resistance is slightly variant, the ploughing depth will be kept at a specific value, no matter how much the ground undulats and the soil resistance against the plow base change (as shown in Fig. 16－6).

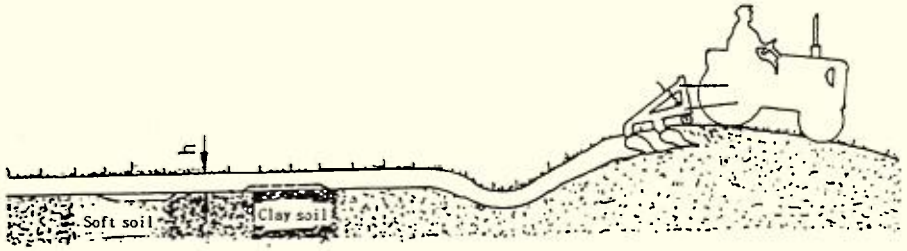


Fig. 16－6 Change of ploughing depth with height control

The main shortcoming of this method is that when the heavy implement is working in the field where the soil resistance is sharply variant, the ploughing depth is uneven. In addition, because of the action of the rolling resistance of the landwheel, the heavy implement even cannot be operated in the peddy field, and its weight－transfer effect for the driving wheels is not as good as position control and

draft control.

2. Position control

As the position control is adopted, according to the place of the lever, the implement is lifted and lowered to a specific place under the action of the oil pressure in the hydraulic suspension system. Then the hydraulic system will always be in the "neutral" position and the place of the implement will not change relatively to the tractor, both of which can be considered as a body. If the implement meets roots or rocks when it is ploughing, it is easy to be damaged. The ploughing depth is unchangeable on the smooth ground, but on the undulating ground it will change (as shown in Fig. 16－7), at the same time, the load of the tractor will change inconstantly also.

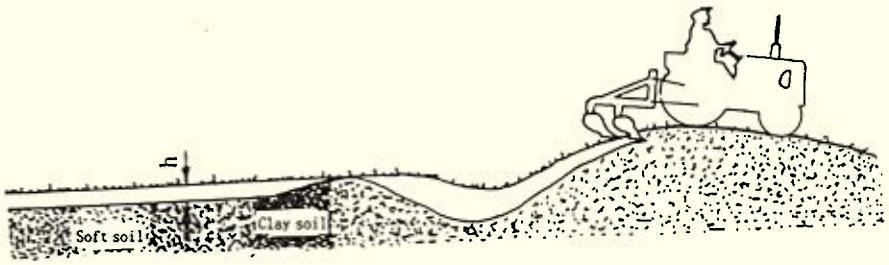


Fig. 16－7 Change of ploughing depth with position control

3 Draft control

As the draft control is used, according to the place of the lever, the draft resistance can be kept at a specific value when the ploughing operation is performed, because the draft resistance (the soil resistance against the plough base) increases (or decreases) with the increase (or decrease) of the ploughing width, depth and soil resistance. For a kind of implement, the ploughing width is fixed, so in ploughing, if the soil resistance is unchangeable, the ploughing depth will not change; if it increases, the ploughing depth will become more shallow automatically; and if it decreases, the ploughing depth will become deeper automatically. Draft control is suitable for the undulating ground(as shown in Fig. 16－8), and the load of the tractor will not change with the change of the soil resistance, but the phenomenon of uneven ploughing depth will exist. Generally speaking, draft control has high response and good effect on the hard soil or when the big ploghing depth is required.

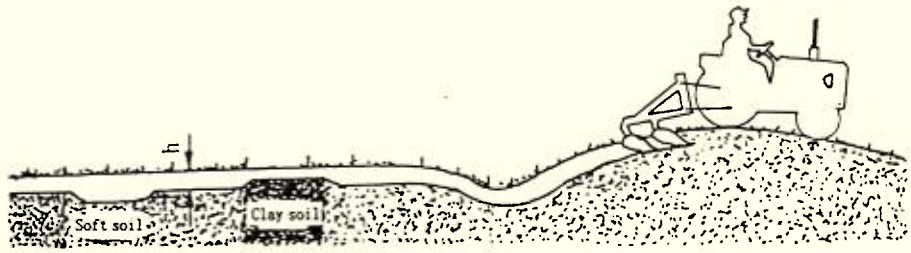


Fig. 16－8 Change of ploughing depth with draft control

Ⅲ. Hydraulic suspension system of Model Jiangsu Medium－size tractor

The hydraulic suspension system of Model Jiangsu Medium－size tractor is of semi－remotely type. It means that the hydraulic pump and the filter are placed separately and other hydraulic elements such as distributor, cylinder and control mechanism are mounted into the lift assy. , which is also used as the rear axle housing upper cover and the oil tank, as shown in Fig. 16－9.

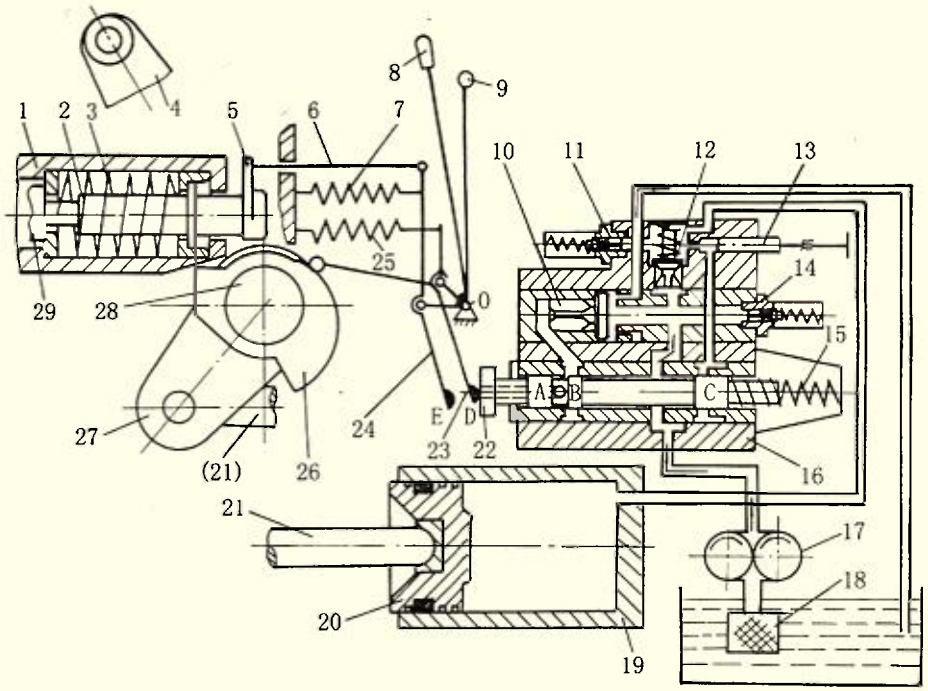


Fig. 16－9 Structure of hydraulic lift hitch

1. Lift housing 2. Draft control spring rod 3. Draft control spring 4. Lift arm 5. Knockout plate 6. Draft control push rod 7. Draft control pendulum lever spring 8. Draft control operating handle 9. Position control operating handle 10. Return valve 11. Hydraulic cylinder safety valve 12. Check valve 13. Lowering control valve 14. System safety control valve 15. Return spring of main control valve 16. Distributor assy. 17. Hydraulic pump 18. Filter 19. Hydraulic cylinder block 20. Piston 21. Piston rod 22. Main control valve 23. Position control pendulum lever 24. Draft control pendulum lever 25. Spring of position control pendulum lever 26. Position control cam 27. Inner lift arm 28. Lift shaft 29. Sensing head of draft control O－－Axial center of eccentric wheel D－－Control end of position control pendulum lever E－－Control end of draft control pendulum lever

Besides making use of the hydraulic pressure to lift the mounted implement, the hydraulic lift hitch of Model Jiangsu－500 tractor has two kinds of automatic ploughing depth controls: draft control and position control, and the functions of lowering speed control and hydraulic power output. The distributor is arranged between the hydraulic pump and the cylinder to control the hydraulic high pressure stage, so it is the hydraulic system of high pressure stage adjusted.

1. The hydraulic pump adopted by the hydraulic lift hitch of Model Jiangsu－500 tractor is Model CBN－E312, ("3" means the gear module is 3 mm, "12" means the nominal displacement of the pump is 12 ml/r). It can transfer the rotation mechanical energy into the pressure energy of the oil and make the hydraulic system produce oil with certain pressure and flow rate.

(1) Model CBN－E312 hydraulic pump consists of front cover 14, housing 8, rear cover 4, driving gear 11, driven gear 10, and integral bush 9, etc. (as shown in Fig. 16－10).

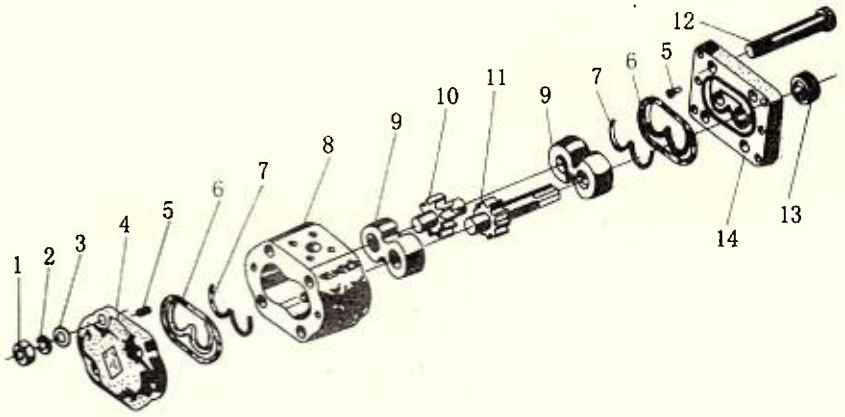


Fig. 16－10 Hydraulic pump

1. Nut 2. Spring washer 3. Flat washer 4. Rear cover 5. Dowel pin 6. Plastic shield plate 7. Nylon seal ring 8. Housing 9. Bush 10. Driven gear 11. Driving gear 12. Bolt 13. Skeleton oil seal 14. Front cover

(2) Working principle of Model CBN－E312 hydraulic pump is shown in Fig. 16－11. The oil suction chamber 1 and the pressure oil chamber 3 are separated by the gear meshing part into two chambers, which are not interlinked. When the pump is normally working, the chambers are filled with hydraulic oil. When the driving gear 2 turns clockwise and drives the driven gear 4 to turn, each pair of meshing gears disengage in the oil suction chamber, making the working capacity gradually increase and forming part of vacuum space. At this time, the hydraulic oil in the tank is sucked into the chamber through the filter and the oil pipe. It is brought into the pressure oil chamber by the turning gears and on one side of the pressure oil chamber, because gear teeth engage with each other, the working capacity is decreased gradually, the oil is drained out at specific pressure and the pressure oil is outlet through the oil pipe. The gears turn continuously and the oil is sucked in and drained out constantly, as a result, the hydraulic pump continuously outlets the high－pressure oil.

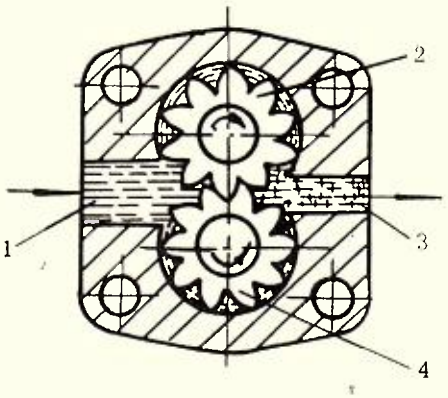


Fig. 16－11 Working principle of hydraulic pump

1. Oil suction chamber 2. Driving gear 3. Pressure oil chamber 4. Driven gear

(3) Hydraulic pump operating mechanism (as shown in Fig. 16－12) consists of lever 1, small lever 2 and finger fork head 8, etc, and it is installed on the side of the rear axle housing. In operation, when putting the handle 1 forward to the engaging position and moving the gear 5 (as shown in Fig.. 16－2)by means of the finger fork head 8 , the sliding gear 5 will engage with the driving gear 26. At this time, the power is transmitted by the auxiliary clutch through the driving shaft and the engaging gears to the hydraulic pump to make it work.

If the pump is not used, the lever should be put back to the disengaging position.

2. Oil suction filter

The oil of the hydraulic system is in the lift housing and it has to be filtered before entering the hydraulic pump to ensure good working state of the system and reduce the wearing of the lift and other working elements. Therefore, the oil suction filter is installed.

The oil suction filter assy. of Model Jiangsu Medium－size tractor is installed independently on the left outer side of the lift housing, so it is easy to perform maintenance. The filter assy. consists of housing, filter element assy., self－sealing valve, etc. (as shown in Fig. 16－13). Besides the general functions, the filter can also attract iron grindings by magnet.

Because a self－sealing valve is in the filter, the oil in the lift will not flow out when the filter element assy. is taken out.

The following steps (as shown in Fig. 16－14) should be followed to clean the filter element assy.: remove the fixing plug 3, take off the filter screen with skeleton 2, put the magnet and the skeleton screen into the diesel or kerosene and clean them with a soft－coir brush. If the screen is found being damaged, repair or replace it.

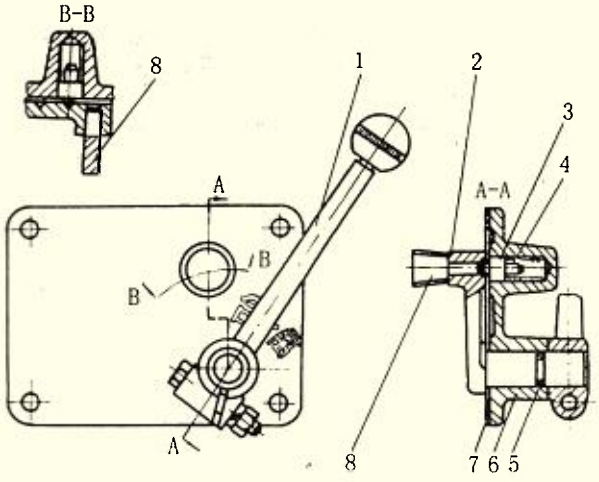


Fig. 16－12 Operating mechanism of hydraulic pump

1. Lever 2. Small lever 3. Locking pin 4. Locking spring 5. Seal ring 6. Side cover 7. Side cover paper gasket 8. Finger fork head

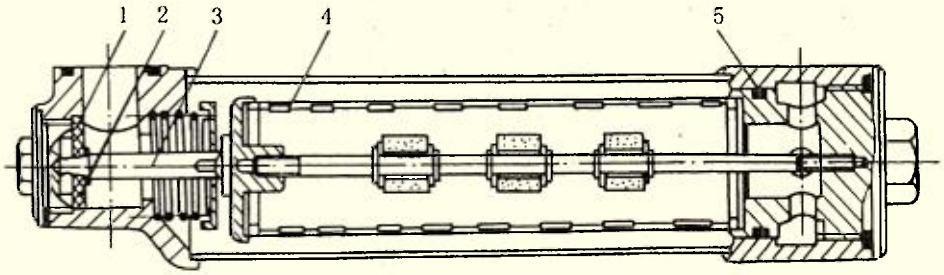


Fig. 16－13 Oil suction filter assy.

1. Self－sealing valve washer 2. Seal ring of self－sealing valve 3. Support rod of self－sealing valve 4. Filter element assy. 5. Housing

3. Distributor

Distributor is the master switch of the hydraulic system, the flowing direction of the high－pressure oil from the pump can be controlled and the mounted implement can be lifted or lowered with its control.

(1) Structure of the distributor

The distributor consists of housing 17, main control valve 1, return valve 3, check valve 8, safety valves 5,12 and lowering control valve 13,etc. (as shown in Fig. 16－15).

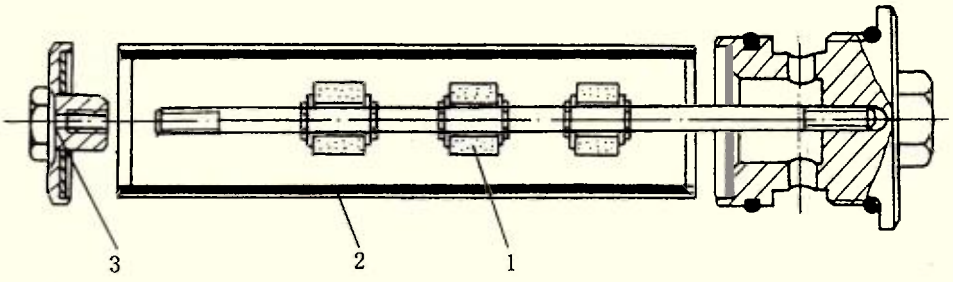


Fig. 16－14 Removing and cleaning filter element assy.

1. Magnet 2. Skeleton filter screen 3. Fixing plug

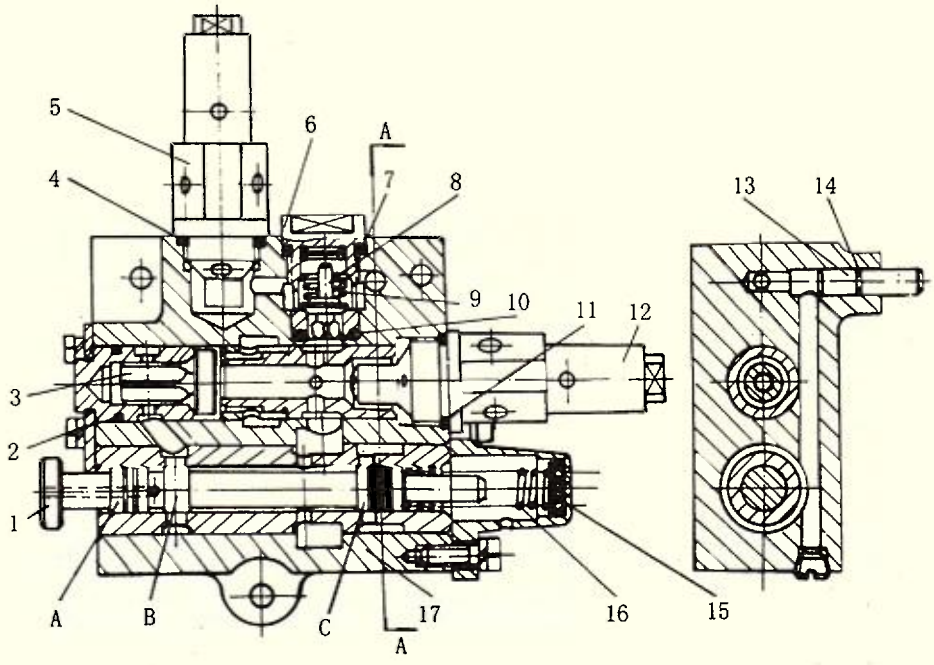


Fig. 16－15 Distributor assy.

1. Main control valve 2, 4, 7, 10, 11, 14. O－ring 3. Return valve 5. Safety valve (it has turned 90°in Fig. 16－15) 6. Check valve plug 8. Check valve 9. Check valve spring 12. System safety valve 13. Lowering speed control valve 15. Steel ball assy. 16. Return spring of main control valve 17. Housing

The main control valve 1 is installed in the valve guide bushing and can slide back and forth to control the oil flowing direction. On the valve stem there are A, B and C three ring type seals. On working, the main control valve has "lifting", "lowering" and "neutral" positions and a small axial hole on the front part of the valve stem communicates with the radial hole between A and B rings to drain out the oil from the back chamber of the return valve. There are lubrication ring belts on A and C rings. There are several radial fine－grained grooves on the face of the valve stem head and on the

bottom end of the stem are installed return spring 16, steel balls and gasket 15. When the control pendulum lever pushes the main control valve to move axially, the valve can be turned slightly to avoid the seizing phenomenon.

The return valve 3 is floatable in its valve guide bushing and limited by the acts of the main control valve to open or close the oil return hole. The return valve front face performs the seal function and the cross guide blade at the tail is used for axial sliding and oil flowing.

The check valve 8 is compressed on the valve seat by the spring and sealed with the conical face. There is a cross guide blade at the bottom of the valve to ensure the coaxial property of the valve and the valve hole and prevent the conical face sealing belt from being irregular worn. The high－pressure oil can only flow from the check valve into the hydraulic cylindrer and cannot flow backwards.

There are two safety valves: system safety valve and hydraulic cylinder safety valve. The former is installed in front of the check valve to protect the pump and the latter is installed at back of the check valve to protect the cylinder, which opening pressure is 2.5MPa higher than that of the system safety valve and reaches 20 MPa. The structure of the safety valves is shown in Fig. 16－16, the pre－tension of the spring can be adjusted by the adjusting screw to reach its specific opening pressure. This kind of adjustment should be performed on the test stand and do not disassemble or assemble the valves at will. If there is no system safety valve in the product, the opening pressure of the hydraulic cylinder safety valve should be $17^{+0.5}$MPa.

The lowering speed control valve is on the oil drain passage. It uses the way of changing the section area of the flowing oil in the drain passage to control the flow rate so as to change the lowering speed of the implements. In addition, when the tractor attached with the implement is used for long－distance transportation, the lowering speed control valve can close the drain passage completely to prevent the mounted implement from falling down due to oil leakage or improper operation.

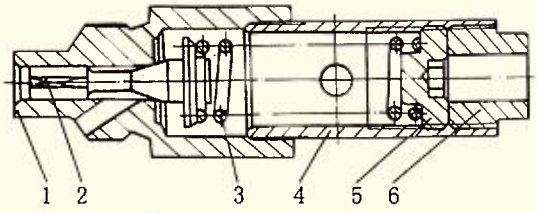


Fig. 16－16 Safety valve assy.

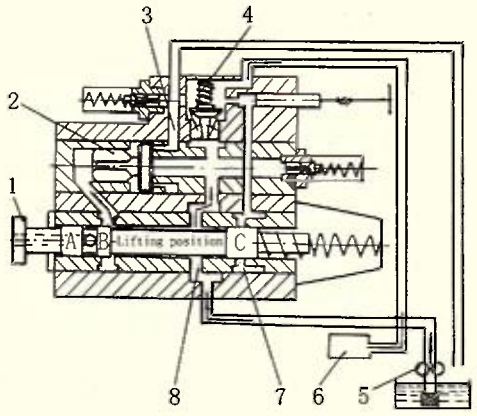
1. Safety valve seat 2. Safety valve 3. Safety valve spring 4. Safety valve cover 5. Adjusting screw 6. Locking bolt

(2) Working process of the distributor

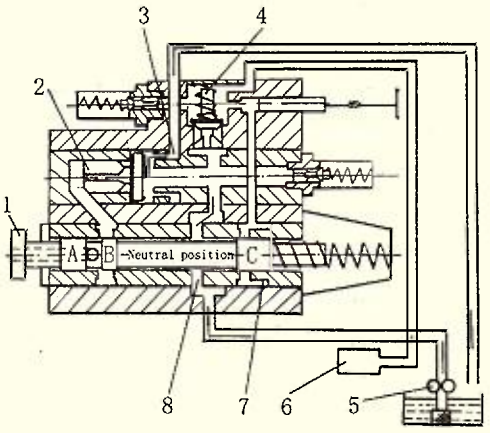
The distributor main control valve is directly controlled by the draft control pendulum lever and the position control pendulum lever of the operating mechanism. It can obtain "lifting", "neutral" and "lowering" positions and the oil flowing directions in these three positions are described respectively in the fol lowings.

1) "Lifting" position When the draft (position) control pendulum lever is completely away from the main control valve, the main control valve is pushed to the left under the action of the return spring (as shown in Fig. 16－17a), and the ring type seal C closes the drain passage 7, while the ring type seal B opens the oil passage leading to the left chamber of the return valve. The high－pressure oil from the hydraulic pump flows to the left and right sides of the return valve, at this time, if the return valve is at the left end and the oil return hole opens, because the oil on the left side is not flowing while the oil on the right side is flowing, the oil pressure of the left side is higher than that of the right side

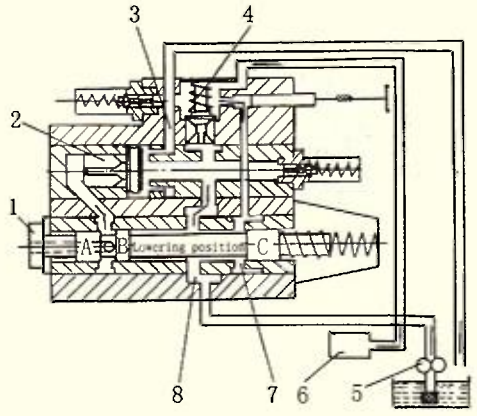
and the thrust force acted by the pressure oil on the left side is greater than that on the right side, as a result, the return valve moves right till the oil return hole is closed under the action of the pressure difference (in fact, the time is very short). Then the oil pressure from the hydraulic pump increases, and when it is higher than the spring tension of the check valve 4, the check valve is opened and the high - pressure oil enters the hydraulic cyliner to get the mounted implement lifted.



(a) "Lifting" position



(b) "Neutral" position



c) "Lowering" position

Fig. 16 - 17 Working process of the distributor

1. Main control valve 2. Return valve 3. Oil return hole
4. Check valve 5. Hydraulic pump 6. Hydraulic cylinder
7. Oil drain passage 8. Oil inlet

2) "Neutral" position Under the action of the draft (position) control pendulum lever, the main control valve moves 5.2 mm to the right from the left end and that is the "neutral" position (as shown in Fig. 16 - 17b). At this time, the ring B closes the passage, where the pressure oil gets into the left - side internal chamber of the return valve, and makes the left chamber open to the atmospheric air, then the oil in it can return to the oil tank through the axial hole on the main control valve. As the pressure oil still acts force on the right side of the return valve, the return valve moves leftward and opens the return hole 3, at this time, the oil from the hydraulic pump returns to the tank through the oil return hole and the check valve 4 is closed under the action of the pressure spring. Because the ring C closes the drain passage 7, the oil in the hydraulic cylinder neither increases nor decreases and the

mounted implement stays at a specific height.

3) "Lowering" position When the main control valve is pushed to the right end under the action of the draft (position) pendulum lever(as shown in Fig. 16－17c), the left chamber of the return valve is still open to the atmospheric air, while the drain passage 7 is opened by the ring C. Under the action of the weight of the mounted implement, on the one hand, the oil in the hydraulic cylinder closes the check valve; on the other hand, it combines with the oil from the hydraulic pump through the drain passage 7. Then the combined oil pushes the return valve to the left end and returns to the oil tank through the oil return hole 3, after that, the mounted implement is lowered.

4. Hydraulic cylinder

The function of the hydraulic cylinder is to transform the hydraulic energy of the pressure oil into the mechanical energy to lift the mounted implement.

The hydraulic cylinder adopted by Model Jiangsu Medium－size tractor is of single－acting type. It consists of cylinder block 4, piston 3 and sealing parts, etc. (as shown in Fig. 16－18). The O－ring 2 is installed in the piston ring groove and on its low－pressure side is installed the piston seal retainer used to prevent iron filings or other things from entering the front of the piston. In installation, do not make a mistake.

After the pressure oil from the distributor has entered the internal chamber of the hydraulic cylinder, it pushes the piston backwards to lift the mounted implement by means of the piston rod and other elements.

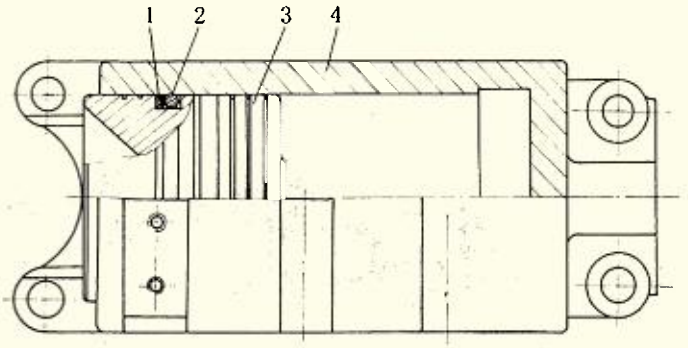


Fig. 16－18 Jangsu－500 tractor hydraulic cylinder assy.
1. Nylon retainer 2. O－ring 3. Piston 4. Cylinder block

5. Operating mechanism

The function of the operating mechanism is to control the main control valve to lift and lower the mounted implement or automatically control ploughing depth and the lifting position of the implement.

The operating mechanism of the hydraulic lift hitch for Model Jiangsu Medium－size tractor consists of position control operating mechanism and draft control operating mechanism, as shown in Fig. 16－19.

(1) Position control operating mechanism

It consists of lever 9, position control pendulum lever 18, spring 19, position control eccentric wheel 2 and position control cam 31, etc.

The position control eccentric wheel 2 is welded together with a rotating collar and the position control operating handle 9 is connected with the rotating collar through the woodruff key. The position control pendulum lever 18 covers on the eccentric wheel 2. When the operating handle moves back and forth, it will drive the rotating collar to make the lower end of the position control pendulum lever sway back and forth so as to control the place of the main control valve, then the implement will be lifted or lowered. Under the action of the spring 19, the upper end of the position control pendulum

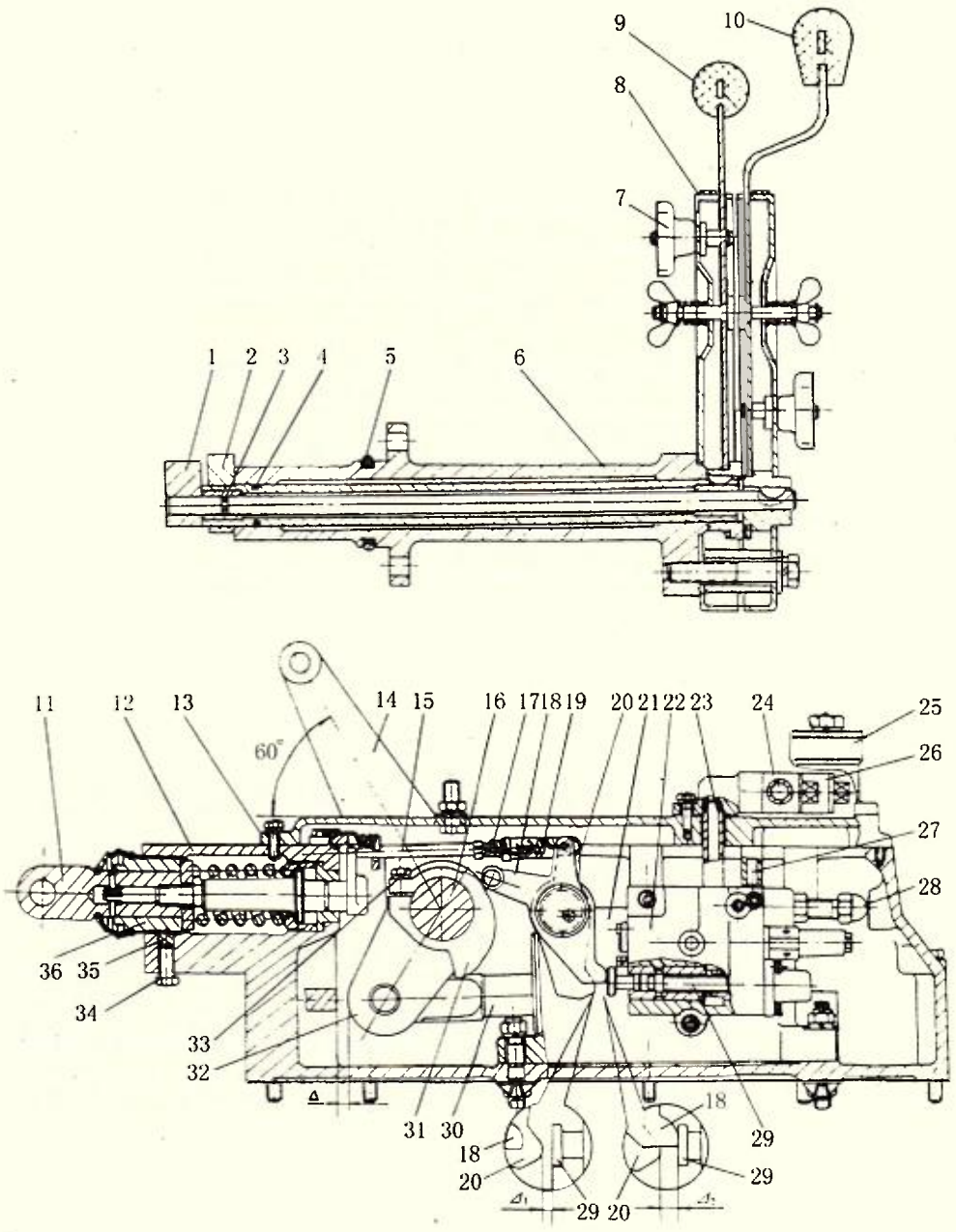


Fig. 16－19 Operating mechanism

1. Draft control eccentric wheel 2. Position control eccentric wheel 3,4,5. O－ring 6. Quadrant support 7. Locating handwheel assy. 8. Quadrant plate 9. Position control operating handle 10. Draft control lever 11. Sensing head of draft control 12. Lift housing 13. Lift cover 14. Lifting arm 15. Push rod 16. Lifting shaft 17. Tensile spring of draft control 18. Position control pendulum lever 19. Tensile spring of position control 20. Draft control pendulum lever 21. Hydraulic cylinder 22. Distributor 23. Oil inlet pipe of distributor 24. Oil inlet bent pipe 25. Filler 26. Hydraulic oil outlet 27. Hydraulic oil outlet pipe 28. Adjusting screw 29. Main control valve 30. Piston rod 31. Position control cam 32. Inner lifting arm 33. Screw 34. Locking screw 35. Locking block 36. Adjusting plug

lever contacts with the position control cam 31 that is fixed on the lifting shaft by the screw 33, therefore, when the implement is lifted or lowered, the position control cam turns with it. When the operating habdle stays at a certain position, the upper end of the position control pendulum lever sways with the turning of the position control cam so that the control end D at the lower part of the position control pendulum lever can control the place of the main control valve with the feedback of implement's height and make it return to the "neutral" position to make the implement be kept at a specific height.

(2) Draft control operating mechanism

It consists of draft control lever 10, draft control pendulum lever 20, spring 17, draft control eccentric 1 and draft control spring assy. etc.

Draft eccentric 1 is welded together with the rotating spindle, draft control lever 10 is connected with the rotating spindle by a woodruff key, draft control pendulum lever covers on eccentric 1. When handle 10 moves back and forth, draft control pendulum lever control end E will move back and forth to change the positon of main control valve, so the mounted implement can be lifted or lowered. Under the action of the spring, draft control push rod 15 installed on draft control pendulum lever 20 (Fig. 16 - 19) contacts with the thrust plate which is fixed on the front end of the draft control spring rod. When the tractor is ploughing in the field, the soil resistance against the plough base will change, the force on the top link of the lift hitch will also change, and the force will be transmitted to the sensing head of draft control 11 connected with it and compress draft control spring. Under the action of draft control spring and push rod 15, draft control pendulum lever will turn around the eccentric, and the control end E of draft control pendulum lever changes the place of main control valve.

So both draft and position operating handle can control the main control valve. But pay attention that position control operating handle 9 should be put to the "lifting" position when conducting draft control, while position control is conducted, draft control operating handle 10 should be put to the "lifting" position to avoid interference. When assembling, the turning of the draft and position operating handle should be smooth, and there should be no seizing.

6. Working process of hydraulic lift

For the hydraulic lift hitch system of Jiangsu Medium - size tractor, there are two ways - position and draft control to lift or lower the implements and control the ploughing depth, it can also conduct team operation together with implement with depth - control wheel.

(1) Position control

1) Starting stage of lifting

When lifting implement is required, turn the position control handle toward the "lifting" position on the quadrant (pull backward on the tractor). As the handle rotates, the position control eccentric wheel turns in counter clockwise around point "O". Under the action of the eccentric wheel, the position control pendulum lever moves leftward and upward. Because the roller on the upper end of the position control pendulum lever presses tightly against the position control cam under the action of the spring, so there will be a clearance H between the lower end D of the position control pendulum lever and the main control valve after the position control pendulum lever moves upward for a certain distance. At this time, the main control valve is at its extreme left position; the ring type seal B on the main control valve rod makes the pressurized oil to enter the left chamber of the return valve and then

the return oil passage is closed, meanwhile, the ring type seal C seals the oil outlet passage. Thus the pressurized oil from hydraulic pump pushes the check valve open and enters the oil cylinder. Then the implement begins to rise.

2) Lifting – neutral

As the pressurized oil constantly enters the oil cylider, the implement is gradually lifted and the lifting shaft turns clockwise, the position control cam rotates in the same way for it is fixed on the lifting shaft. At this time, the radial distance between the roller and the rotating center of the cam becomes shorter and shorter because the roller is always pressing against the surface of the cam. That is, as the position control cam rotates clockwise, the position control pendulum lever turns counter clockwise and the clearance between its end D and the valve stem head of main control valve becomes more and more narrow and finally fades out, then the pendulum lever begins pushing the main control valve rightward to the neutral position (as shown in Fig. 16 – 20b). At this time, the oil passage in the distributor is shown in Fig. 16 – 17b, the left chamber of the return valve exhausts oil and the return valve moves leftward, then the return oil hole is open; so the oil fom hydraulic pump returns to the oil tank from the return oil hole, and the hydraulic pump is under unloading condition. The check valve closes, oil outlet passage is closed too and oil in the oil cylinder is balanced, so the implement is kept at a certain height. It should be noticed that the more the position control lever moves in the "lifting" range in the quadrant, the higher the clearance H will be and the higher the implement will be lifted; on the contrary, it will be lift lower.

3) Starting stage of lowering

When lowering implement is required, move the position control lever toward the "lowering" position of the quadrant (turn it forward on the tractor). The position control lever drives the position control eccentric wheel to turn clockwise around the point O. Meanwhile, the position control pendulum lever moves rightwad and downward. Under the action of the tensile spring, the roller on the upper end of the position control pendulum lever contacts with the position control cam at the primary period, and the lower end D of the pendulum lever pushes the main control valve to the extreme right position, the roller goes away from the cam gradually and a clearance S appears (Fig. 16 – 20c). The value of S is variant correspinding to the distance that the position control lever is turned. At this time, the main control valve is at its extreme right position, the return valve is still on the left end, and the oil outlet passage is opened by ring type seal C. Under the action of the weight of the implement, the oil in the oil cylinder mixes with the oil from the hydraulic pump through oil outlet passage, and flows into oil tank through return oil hole, so lowering implement is realized (as shown in Fig. 16 – 20c) The lowering speed can be adjusted by the lowering speed control valve.

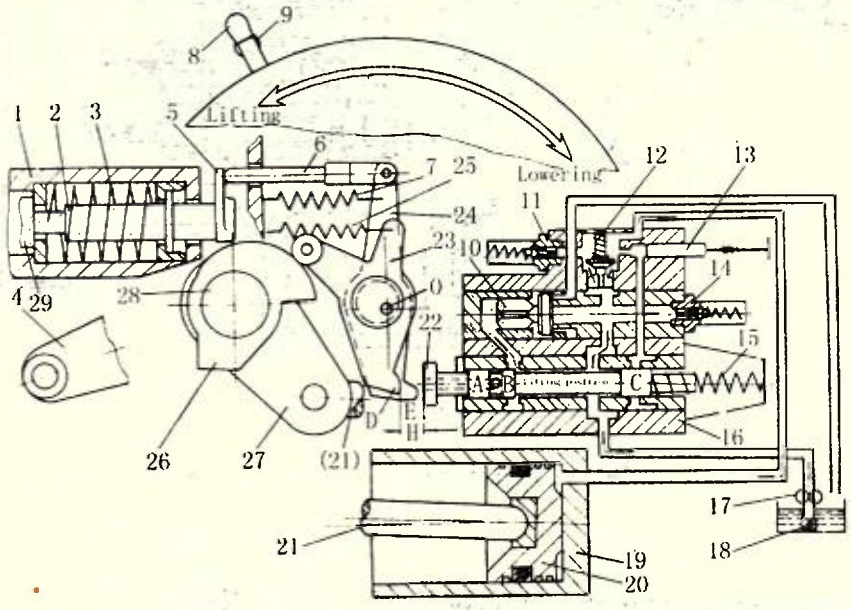
4) Lowering – neutral

While the implement is being lowered from a high position, the lifting shaft turns counter clockwise and the position control cam follows, then the clearance between the roller and the cam surface is shortened gradually. After the roller contacts the cam surface, the control end D of the pendulum lever begins moving leftward and the main control valve also moves leftward under the action of its return spring, when it reaches the point shown in the figure, the ring type seal C on the main control valve closes the oil outlet passage and the oil in the cylinder cannot flow out. At this time the distributor is at

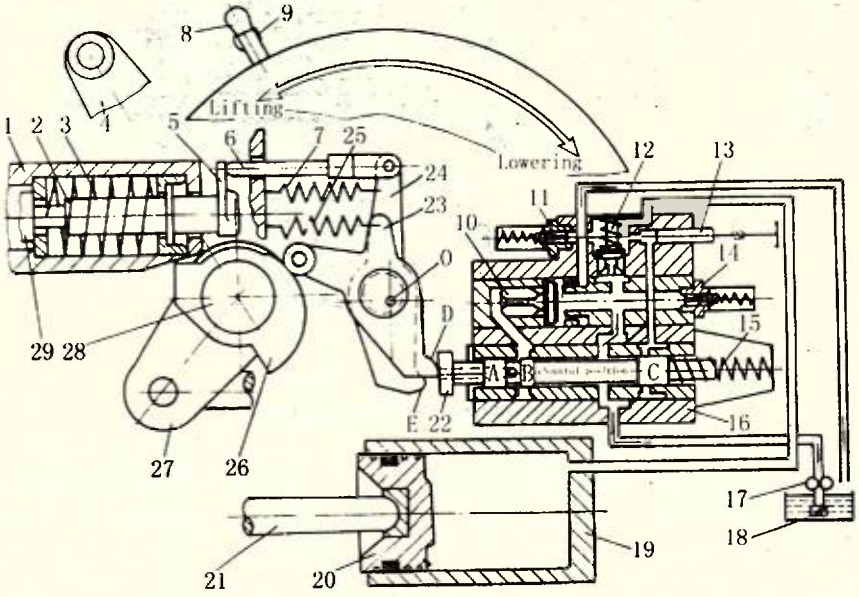
"neutral" position, the implement is no longer going downward. The oil from the hydraulic pump returns to the oil tank through return oil hole (see Fig. 16－20d). The lowering range of the implement is in proportion with the distance that the position control lever is moved in the "lowering" range of the quadrant. In other words, the more the lever is turned, the lower the implement will be.

(2) Draft control

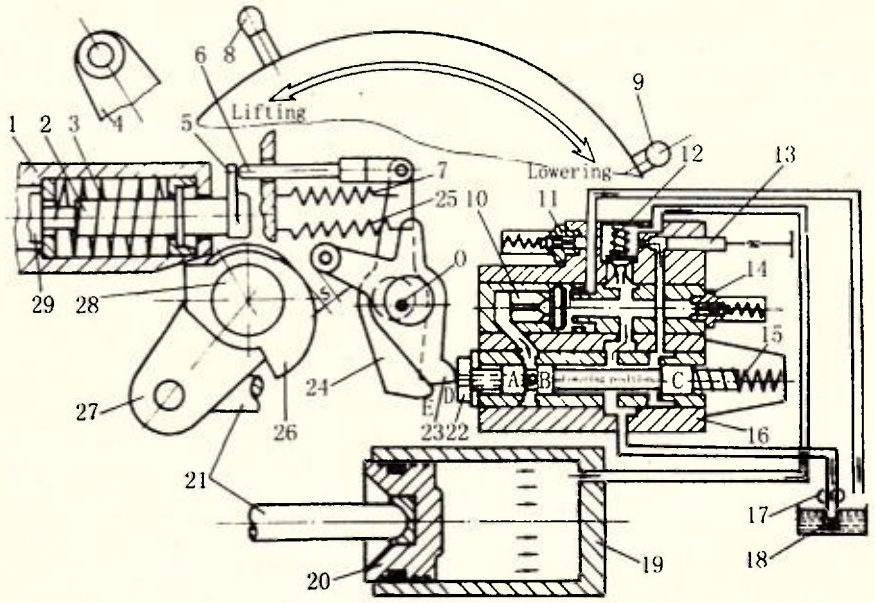
1)Starting stage of lowering



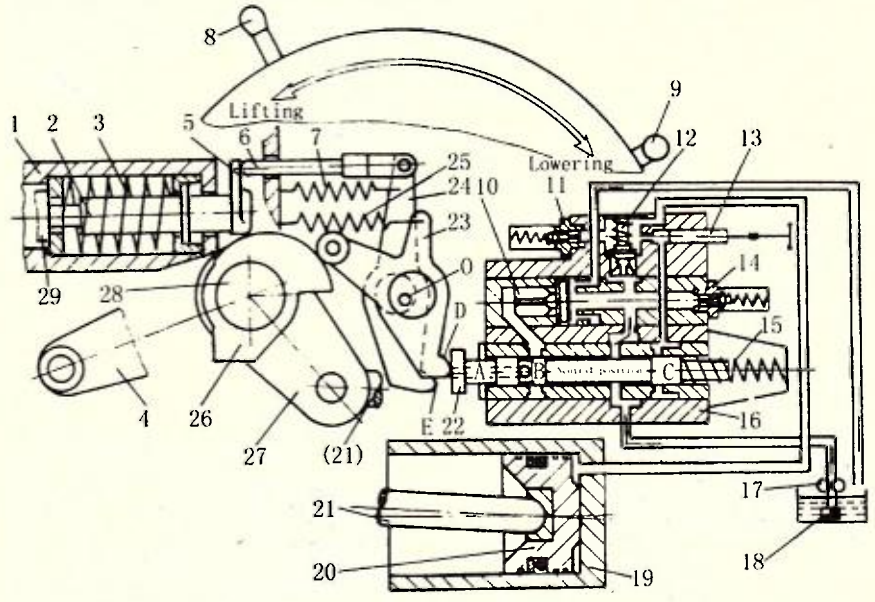
(a) Beginning position of lifting



(b) Lifting－neutral (the same with draft control)



(c) Beginning position of lowering



(d) Lowering – neutral position

Fig. 16 – 20 Working process of position control

1. Lift housing 2. Spring rod of draft control 3. Draft control spring 4. Lifting arm 5. Push plate 6. Draft control push rod 7. Tensile spring of draft control pendulum lever 8. Draft control lever 9. Position control lever 10. Return valve 11. Safety valve of cylinder 12. Check valve 13. Lowering speed control valve 14. System safety valve 15. Main control valve return spring 16. Distributor assy. 17. Hydraulic pump 18. filter 19. Oil cylinder block 20. Piston 21. Piston rod 22. Main control valve 23. Position control pendulum lever 24. Draft control pendulum lever 25. Tensile spring of position control pendulum lever 26. Position control eccentric cam 27. Inner lifting arm 28. Lifting shaft 29. Sensing head of draft control O——Axle centre of eccentric wheel D——Control end of position control pendulum lever E——Control end of draft control pendulum lever

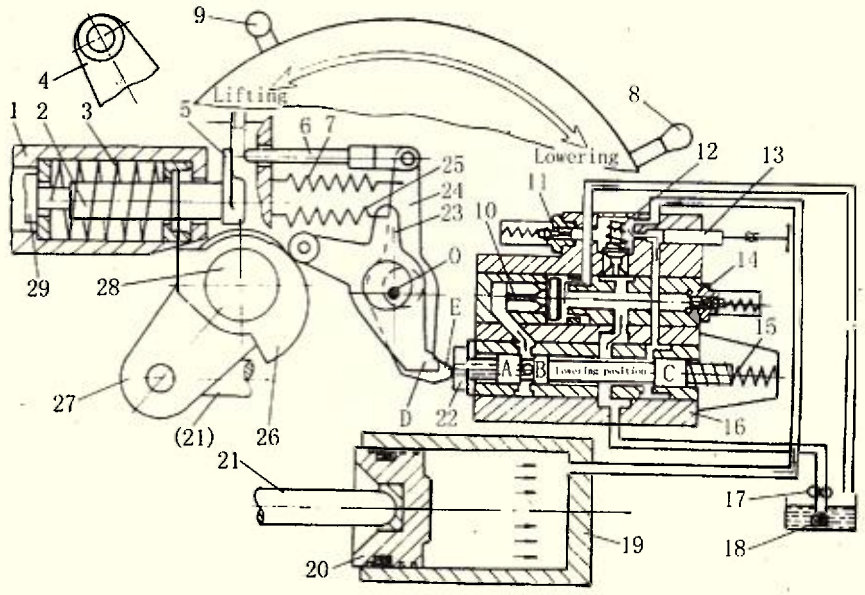
Pull the draft control lever toward the "lowering" direction of the quadrant. The draft control eccentric wheel being driven by the draft control lever rotates clockwise around point O, and the draft control pendulum lever which is fixed on it rotates in the same direction. In the beginning period, for the action of the tensile spring of draft control, the push rod fixed on the upper end of the draft control pendulum lever presses tightly against the push plate on the spring rod. After its lower end E pushes the main control valve to the extreme right position, its upper end pulls the push rod to move rightward, then a clearance L appears between the push rod and the push plate. The value of L will be variant corresponding to the distance that the draft control lever moves in the "lowering " range of the quadrant. At this time, the main control valve is at its extreme right position while the return valve of the distributor is still at the left side and the ring type seal C opens the oil outlet passage. Under the action of the weight of the implement, the oil in the cylinder mixes with the oil from hydraulic pump through oil outlet passage and flows into the oil tank through return oil hole. At the same time, the implement goes downward (as shown in Fig. 16－21a).

2) Lowering－neutral

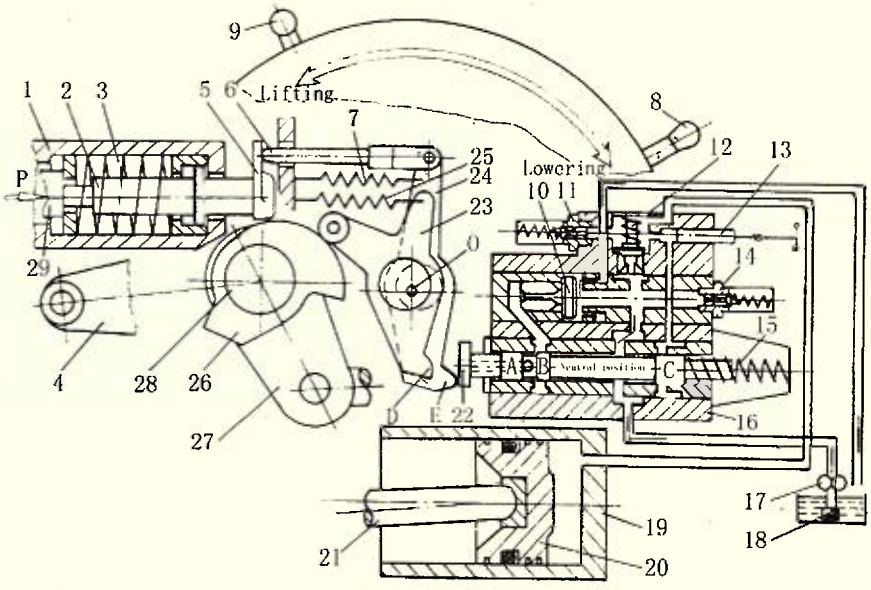
As the implement being lowered and the ploughing depth increasing, the pulling force that the top link bears changes into pressure, and this pressure is passed to the sensing head 29 , then the draft control spring is compressed. At the same time, the draft control spring rod 2 and push plate move rightward, which makes the clearance L decrease. When this clearance disappears, the push plate continues to push the draft control pendulum lever via push rod to rotate clockwise around point O, so the lower end E of the pendulum lever moves leftward. The main control valve also moves leftward under the action of its return spring. When it moves to the position shown in Fig. 16－21b, the ring type seal C closes the outlet passage, oil in the oil cylinder cannot flow out and the distributor is at its neutral position, so the oil from the hydraulic pump flows to the oil tank through oil return hole and the implement stops going downward, i.e. the ploughing depth will no longer increase, the pressure that the top link bears will not increase any more and the draft control spring will not be further compressed. In consequence, the main control valve maintains "neutral" position and the tractor works under a certain ploughing resistance. It could be known from the above－mentioned process: the more the draft control lever moves in the "lowering" range of the quadrant, the bigger the value of L is. If the main control valve is needed to back to the "neutral" position, the right ward travel of the draft control spring rod should be increased, i.e. the implement will plough deeper.

When the draft control lever is fixed at a certain place, the ploughing resistance is kept in a specific range. When the tractor is ploughing in uneven field with variant soil resistance, the ploughing depth is adjusted automatically. While the resistance of traction reduces (for example, the soil resistance decreases), the pressure on the sensing head reduces correspondingly and the draft control spring rod moves leftward. In consequence, the draft control pendulum lever rotates counter clockwise around the eccentric wheel under the action of the tensile spring of draft control. And the control end E of the draft control pendulum lever moves rightward , pushing the main control valve from "neutral" to "lowering" position, then the ring type seal C opens the outlet passage and oil cylinder begins exhausting oil, so the implement descends and the ploughing depth increases. Meanwhile, the pressure on the sensing head increases correspondingly, the spring rod of draft control moves rightward to pull the

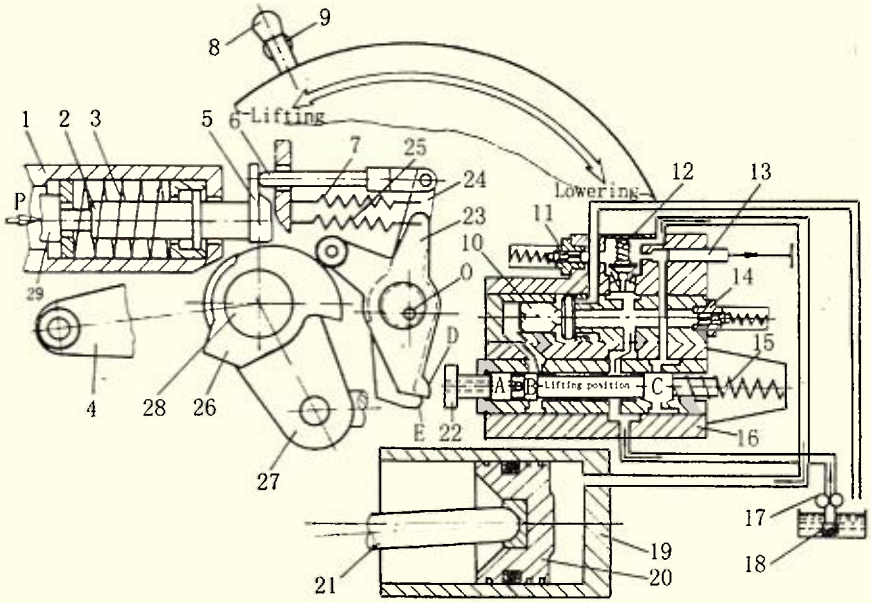
draft control pendulum lever rotates clockwise around the eccentric wheel and the control end E moves leftward, so the main control valve returns to its "neutral" position under the action of its return spring, then the implement stops descending. The implement continues to ploughing at a deeper ploughing depth (but the ploughing resistance is the same as the original because the draft control lever is maintaining the original position, so the ploughing resistance, i.e. tracting resistance, has not been changed).



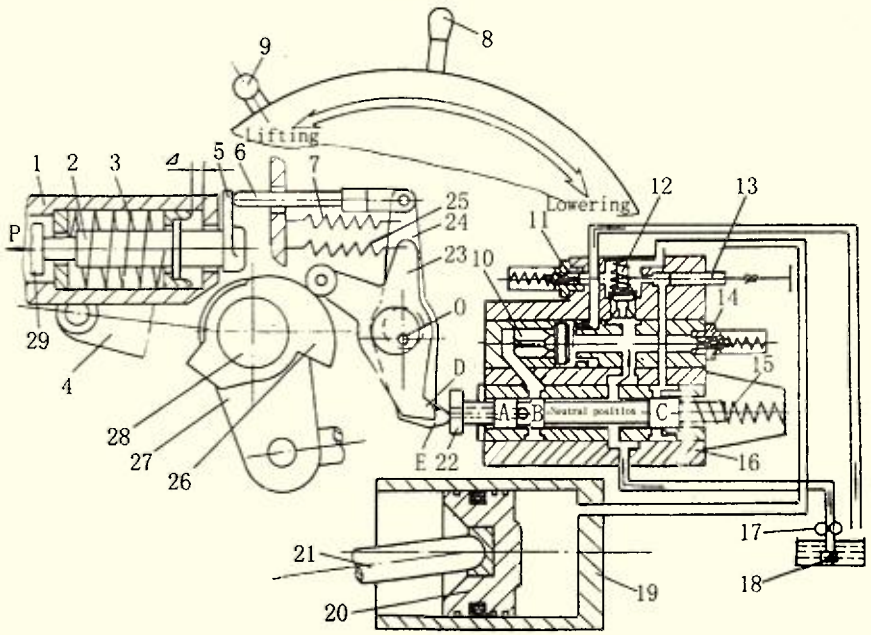
(a) Beginning position of lowering



(b) Lowering – neutral position



(c) Beginning position of lifting



(d) Neutral position for shallow plowing of heavy implement

Fig. 16－21 Working process of draft control

(The numbers are the same as those in Fig. 16－20.)

When the traction resistance increases (for example, the soil resistance increases), the automatic adjusting process is just on the contrary. In a ward, the ploughing resistance does not change after the automatic adjustment, that is, the the working load remains the same, only the ploughing depth is changed.

3) Starting stage of lifting

When lifting implement is required, pull the draft control lever to "lifting" range of the quadrant (as shown in Fig. 16－21c). Driven by the lever, the eccentric wheel rotates counter clockwise , which makes the lower control end E of the draft control pendulum lever to move leftward and the main control valve returns the "lifting" position under the action of its return spring. The return valve moves rightward and closes the return oil hole because of the pressure difference. Then the pressurized oil from hydraulic pump opens the check valve to enter the oil cylider and the implement is lifted. During the lifting, the position control cam which is fixed on the lifting shaft rotates clockwise, which causes the position control pendulum lever rotate counter clockwise and its lower control end D moves rightward. As a result, the main control valve is pushed to the neutral position and the implement stops going upward. It could be known from the above, while lifting the implement by draft control lever, the lifting height is determined by the position of the position control lever and it has nothing to do with the draft control lever, i.e. draft control lever cannot control the lifting height. While draft control is being conducted, the position control lever must be placed in the "lifting" range of the quadrant.

4) Shallow plowing of heavy implement

Because the draft control spring is double－acting, when heavy implement is mounted by the hitch, the top link bears pulling force, which makes the draft control spring be compressed, and an clearance Δ appears (as shown in Fig. 16－21d). So, even the control lever is not pulled, the spring rod of draft control has already moved leftward for a distance of Δ and the draft control pendulum lever has rotated a certain angle under the action of the tensile spring of draft control, also the control and E has pushed the main control valve rightward for a certain distance. In this condition, if the draft control lever is slightly moved toward the "lowering" range, the main control valve will be pushed to the "lowering" position and the implement will go downward.

After the implement penetrates the soil, as its ploughing depth increases, the soil resistance increases gradually, which may reduce the pulling force on the top link and the draft control spring is loosened, then the spring rod moves rightward and the clearance Δ is shortened correspondingly. At this time, if the main control valve has not returned to its "neutral" position, the implement will continue to go downward and the ploughing resistance will increase further. Then the pulling force that the top link bears changes into pressure, the spring rod of draft control takes further move toward the right. And through the push rod, the control end E moves leftward, the main control valve moves to its neutral position under the action of its return spring. At this time, the ring type seal C closes the outlet hole of the cylinder and the implement stops descending, then the implement is working under the provided ploughing depth.

In plowing, while the ploughing resistance varies, the ploughing depth of heavy implement can also be adjusted automatically (the principle is the same as that of the draft control). But there will be bigger rises and falls about the ploughed area, because the automatic adjustment is a little bit idle for the shallow ploughing of heavy implement.

While conduting shallow ploughing adjustment for heavy implement by draft control, the position control lever should be positioned in the "lifting" range of the quadrant.

3. Hydraulic oil outlet

When it is needed to send the hydraulic oil to the external cylinder (for example, the working cylinder of hydraulic dumping trailer), the hydraulic oil outlet can be controlled by the position control lever. Before using, the draft control lever must be placed in the "lifting" range of the quadrant. The inlet pipe of the external cylinder can be connected on the hydraulic oil outlet point (see No. 26 in Fig. 16－19).

Turn the position control lever out of the upper end of "lifting"on the quadrant to "hydraulic oil outlet" range. At this time, the position control eccentric wheel turns counter clockwise, the position control pendulum lever which is fixed on the eccentric wheel moves leftward and upward and reaches its extreme position. The control end D is completely away from the main control valve and a clearance bigger than the one in Fig. 16－20a appears. The main control valve moves to its "lifting" position and oil enters the oil cylinder, then the piston moves leftward till the inner lifting arm contacts the casing. Because the position control pendulum lever has been fixed and connot be moved, it is impossible to make the main control valve move rightward, so the oil from hydraulic pump continues to enter the oil cylinder and flows to the external cylinder 30 through the hydraulic oil outlet point (as shown in Fig16－22). When the piston travel of the external cylinder reaches the requirement, pull the position

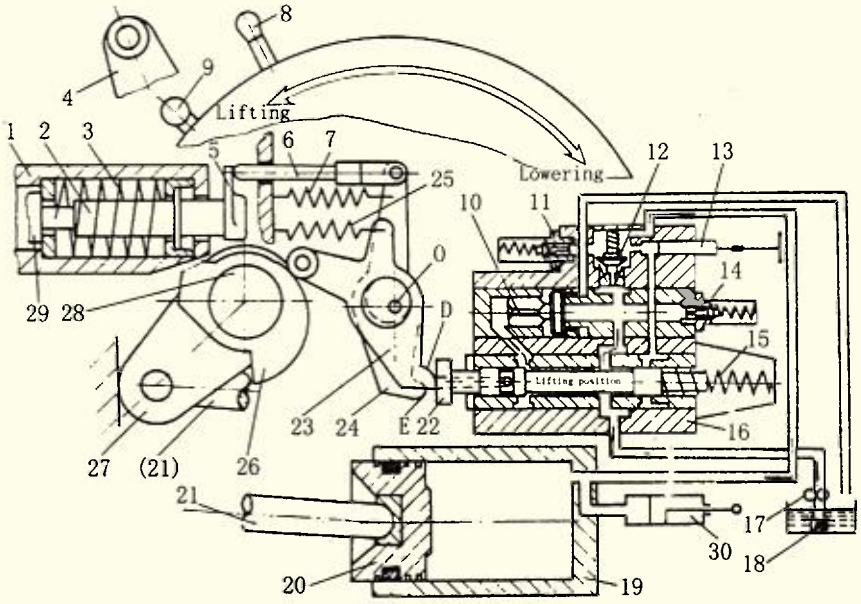


Fig. 16－22 Position control－hydraulic oil outlet

The numbers 1～29 are the same as those in Fig. 16－20. 30. External cylinder

control lever away from the "hydraulic oil outlet" range and put it in the "hydraulic oil outlet－neutral" position (i.e. the extreme end of the lifting range). At this time, under the action of position control cam, position control eccentric wheel, position control pendulum lever and its tensile spring, the main control valve is pushed to the "neutral" position by control end D of the position control pendulum lever, then the pressurized oil stops outleting. Because the oil in the cylinder has been balanced, the piston rod of the external cylinder remains its position. If the oil in the external cylinder needs to

be exhausted, pull the position control lever to the "hydraulic oil outlet – lowering" position (i.e. lower position in the lifting range). With the same principle, under the action of position control cam, position control eccentric wheel, position control pendulum lever and its tensile spring, the main control valve is pushed to the lowering position by the control end D. The outlet passage of the cylinder is open, oil in the external cylinder flows back via hydraulic oil outlet point to the oil outlet passage and joins the oil from hydraulic pump then returns to the oil tank.

It can be known from the above, while using hydraulic oil outlet, the three stages "inlet", "neutral" and "outlet" are realized by controlling the position control lever, and there is no automatic feedback control. So it is forbidden to place the position lever at "hydraulic oil outlet" position for a long time when the piston of external cylinder has reached its dead point or hydraulic oil outlet is not needed. Otherwise, the safety valve will be open under high pressure, which may cause rapid rising of oil temperature and damage to the parts.

7. Three – point linkage

The linkage device is used to link the implements and make the tractor and the implement have a definite relative position. The linkage device can be divided into two – point linkage and three – point linkage according to its hinging point. The Jiangsu Medium – size tractor adopts three – point linkage, which consists of lift arm, left and right lift rod, top link and lower link (see Fig. 16 – 23).

After the implement is hitched with the tractor, make a primary adjustment: When using the position control or operating with implement with a depth – control wheel, the front end of the top link should be jointed with the lower hole of the three in the connecting plate of top link; when using draft control and working with light load, it should be jointed with the upper one; when using draft control and working with medium load, it should be jointed with the middle one. There are also 2 holes in the joint position of the lift rod and the lower link, normal implement should be connected to the front hole of the lower link and heavy implement may be connected to the rear one.

While plowing, because the wheels on the right side travels in the furrow, the right side of the tractor is lower than the left side. In order to keep the implement horizontal, the length of the lift rod could be adjusted. Since the length of the left lift rod has been fixed when it is out of the factory, normaly it should not be changed; usually adjust the lift rod adjusting lever on the right lift rod to make the implement horizontal relative to ground.

If the ploughing depths of the front and rear plow shares are not the same, the length of the top link may be changed. If the front one ploughs shallower than the rear one, shorten the top link; conversly, it should be stretched. In addition, the plough body pitch is also affected by the length of the top link.

The lateral movement of the attached implement is reduced by adjusting the check chain adjusting sleeve. During ploughing the check chain should be loose, but during intercultivation or seeding, the loosening dimension should be shorten a little.

8. Use of hydraulic lift control lever (see Section 2 of Chapter XII Field operation techniques of tractor).

9. Adjusting of hydraulic lift

During operation, because of deformation and wear of the parts, the position may be different

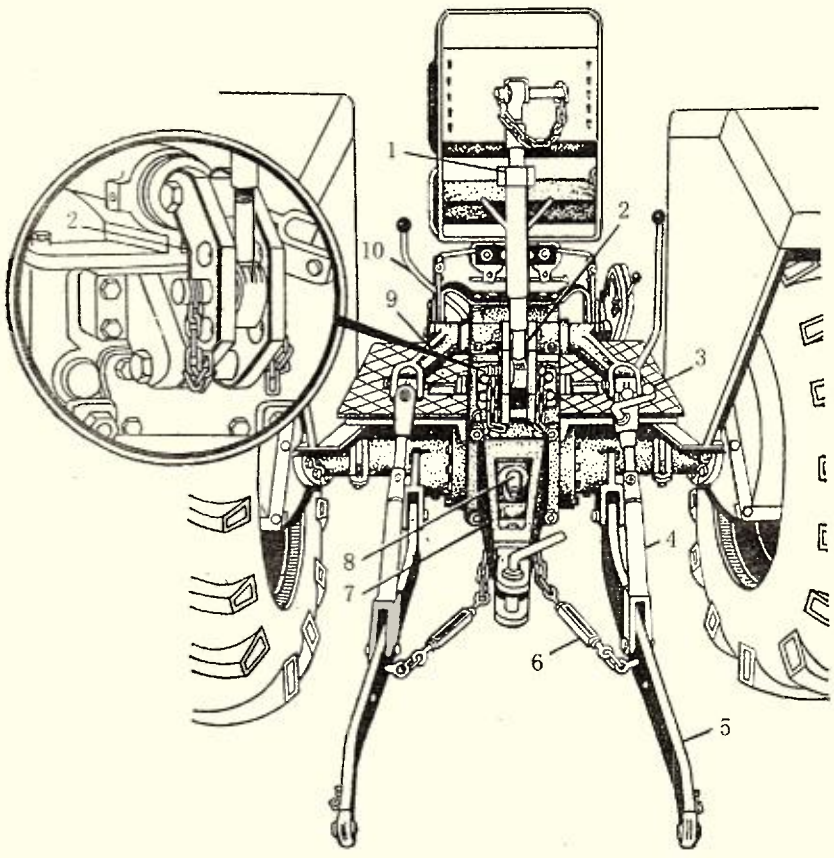


Fig. 16－23 Three－point linkage

1. Locking nut and top link 2. Connecting plate of top link 3. Lift rod adjusting lever 4. Lift rod 5. Lower link 6. Check chain adjusting sleeve 7. Towing hook 8. PTO shaft guard 9. Lift arm 10. PTO control lever

from the correct position which the lift has been adjusted originally. When the difference is enough to influence the normal working of the hydraulic lift hitch, the lift should be adjusted. In addition, it also should be adjusted after disassembling or assembling in maintenace or after changing parts.

(1) Adjustment of draft control spring assy(see Fig. 16－24).

Before the draft control spring assy. is installed into the hydraulic lift housing, first screw the spring rod into the sensing head and make sure that the spring is not compressed and also there does not exist axial play. Then lock it with the pin.

After it has been fitted to the hydraulic lift housing, turn adjusting plug 3 with a special spanner, push and drag the sensing head at the same time till the axial play of the draft control spring is not more than 0.20 mm. Finally put the locking block 35 (see Fig. 16－19) into the threaded radial hole in the rear part of the lift housing, and tighten screw 34 to press the locking block 35 to lock up the adjusting plug. After having properly adjusted it, put on the dust cover.

(2) Adjustment of the quadrant

First, put the hydraulic lift casing in level position and place the draft and position control levers in a position perpendicular to the bottom surface of the lift housing (as shown with dotted lines in Fig.

16－25). Then move the quadrants 3 and 4, till both levers are located between the two triangle marks. Finally tighten the two bolts 6 to fasten the quadrant.

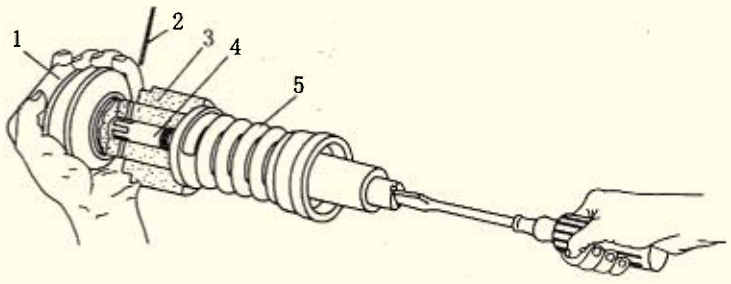


Fig. 16－24 Adjusting the spring assy. of draft control

1. Sensing head 2. Pin 3. Adjusting plug 4. Spring rod 5. Draft control spring

(3) Adjustment of the draft control pendulum lever

Move the draft and position control lever to the position in contact with the upper slotted hole of the quadrant (the lever is shown with solid lines in Fig. 16－25). Raise the lifting arm to horizontal position so that the control end of the position control pendulum lever is far away from the main control valve (to avoid interference). At this time, loosen the locking nut of the push rod 15(see Fig. 16－19) and turn push rod 15 to make the distance from the main control valve end (main control valve is at its most extruding position) to the control end E of the draft control pendulum lever equal to 3.5mm (Δ1 in Fig.16－19). After adjusting, tighten locking nut to lock the push rod 15.

(4) Adjustment of the position control pendulum lever

The draft control remains at the position of the upper stop on the quadrant. Slowly raise the lifting arm 14 until it reaches 60°from the horizontal position (i.e. Δ≈5 mm see Fig. 16－19). At this time the control end D of the position control pendulum lever pushes the main control valve forward by 5.2 mm (the main control lever is back at "neutral" position). Otherwise, loosen the fastening screw 33 of the position control cam 31 and turn the cam to make the adjustment. When the distance between the end of main control valve and the control end E is 8.7 mm(Δ2 in Fig. 16－19), tighten the screw.

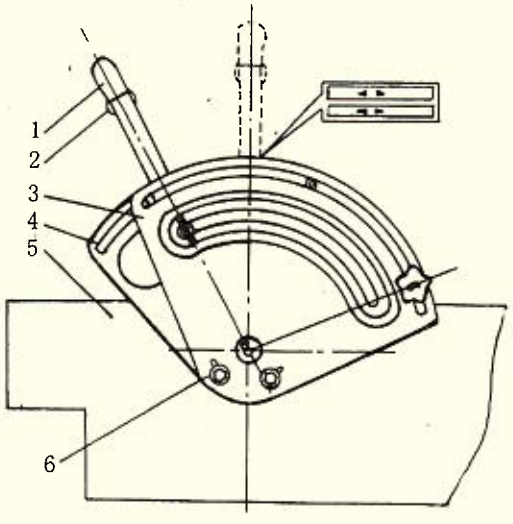


Fig. 16－25 Position of the quadrant

1. Draft control lever 2. Position control lever 3. Quadrant for draft control 4. Quadrant for position control 5. Hydraulic lift casing 6. Screw

After making the above－mentioned adjustments, operate repeatedly the two control levers several times and check whether the adjusting changes or not. If there is any variation, make the readjustment. After the adjustment is confirmed to be correct, fix the lift cover. The pipes, o－rings should

not be missed. Then tighten each bolt in provided order.

10. Maintenance of hydraulic lift and hitch

The oil for hydraulic lift and hitch is separate from that of the transmission system of the rear axle, choose proper oil according to the season.

The oil level in the hydraulic lift casing should be checked regularly. Before using the hydraulic output, add appropriate amount of oil according to capacity of the external cylinder.

The impurity or deteriation of the oil may affect the operation and service life of the hydraulic system, so renew oil at regular intervals.

The hydraulic pump, distributor and cylinder are all precision devices. Do not dismantle them unless it is absolutely necessary. When dismantling, pay special attention to the sanitation and do not strike the parts hard in order to prevent scratching. It is not allowed to grind the fitting faces with abrasive paper. Do not dismantle the safety valve unless there is adjusting device.

When cleaning, if any rubber sealing part is ageing, damaged or its sealing performance is less effective, replace it.

Section 3 Towing Device

The towing device is used to connect all kinds of trailed implements or trailers.

Model Jiangsu Medium－size tractor is equipped with stationary towing device, whose structure is shown in Fig. 16－26. It consists of towing hook, pin and clamp dog and it is fixed on the rear end face of the rear axle housing with 4 bolts. When using it, align the hook hole of the implement or trailer with that of the towing hook, insert the pin and press the clamp dog on the shoulder of the pin by screws to prevent the pin from scurrying out of the hole. For safer, there is a hole at the lower end of the pin for inserting the spring locking pin.

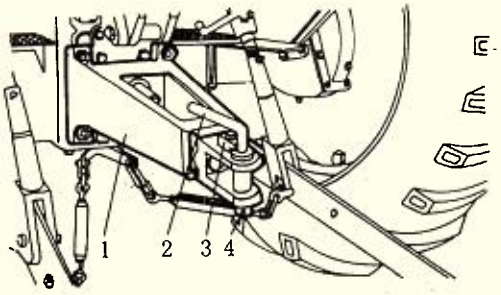


Fig. 16－26 Towing device

1. Towing hook 2. Pin 3. Clamp dog
4. Spring locking pin

Model Jiangsu 4WD tractor is equipped with swing type towing device, which consists of towing frame and towing rod. They are fixed in the back end of rear axle.

Chapter Ⅶ Battery

Section 1 Function and Construction of Battery

Ⅰ. Function of the battery

Battery should be usually matched with generator. It not only can store the electrical energy in the chemical form, but also can turn the chemical energy into the electrical energy to output. It provides huge current for the starting motor to realize the starting of the engine. When the generator stops running or idling the engine leads to insufficient generated energy, the battery will provide power for the lighting and signal equipment. When there is unnecessary electricity except normal operation required, the energy will be stored in the chemical form.

Ⅱ. Construction of the battery

The tractor usually adopts starting battery, as shown in Fig. 17－1. It mainly consists of positive and negative plate set, separator, cell cover, terminal and electrolyte.

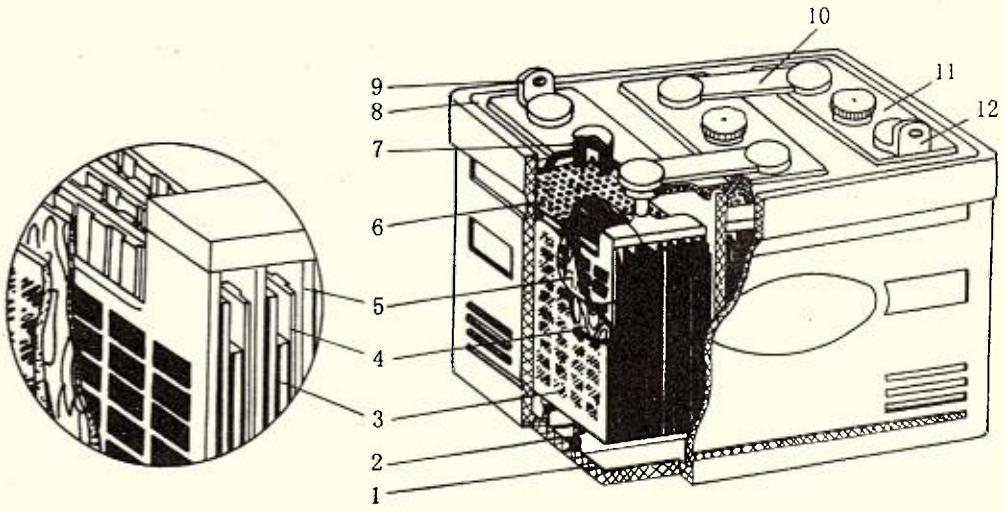


Fig. 17－1 Construction of the battery

1. Battery case 2. Plate bracket 3. Negative plate 4. Separator 5. Positive plate 6. Protective plate 7. Filling and inspection plug 8. Sealing material 9. Negative terminal 10. Cell－to－cell connector 11. Cell cover 12. Positive terminal

1. Plate

The plate is a major part of the battery and it consists of positive plate and negative plate, both of which are with check pattern surface. The positive plate check is filled with dark－brown lead superoxide (PbO_2), while the negative plate check is filled with green－gray pure spongy lead. The top ends of several positive and negative plates are respectively welded on a crosswise lead plate to form the

plate set. Usually there is one more negative plate than the positive plate set, therefore, when installing, insert the positive plates into the middle of the negative ones to ensure even discharge on both sides of the positive plates and avoid warping.

2. Separator

Separator is made of insulating material (such as wood, microporous plastics and glass fiber, etc.) special processed. It is inserted between the positive and negative plates to prevent them from contacting to cause short circuit. The separator also possesses good spongy property to facilitate the circulation of the electrolyte. If use the combined separator made of two kinds of material or the separator with groove on one surface, in installation, the one side with glass fiber or groove should face to the positive plates to facilitate the electrolyte circulation when the positive plates are under strong reaction.

3. Battery case

The battery case is usually made of plastics or hard rubber. Its internal cavity is divided into three cells insulating with each other. A set of positive and negative plates are put in each cell and after filled with electrolyte, it becomes a cell battery. At the bottom of each cell, there are raised brackets supporting the plate set and preventing the short circuit caused by the sediment.

4. Cell cover

There are three holes on each cell cover. The terminal head extrudes out of the cover through the two holes at the sides, while the one in the middle serves as the filling and inspection window, which is ordinarily screwed tight with filling plug. There are air holes on the plug to exhaust the gas produced by the chemical reaction. The cover is sealed with the case.

At present, some tractors adopt monoblock battery. A piece of big cover used together by the three cells is sealed with the case. On the cover there are 5 holes, and the head of the terminal sticks out through the ones in the diagonal position. The three holes in the middle are the separate filling and inspection windows of the three cells , which are screwed tight with plugs bearing air holes in the normal times.

5. Terminal

Each cell battery has two terminals, the one connecting with the positive plate set is called positive terminal, while the one connecting with the negative plate set is called negative terminal. Usually only the two positive and negative terminals in the two end cells are left for the purpose of connecting wire with the outside. The others are connected with condutors to make series connection with the three 2V cells to form a 6V battery to output.

6. Electrolyte

Electrolyte is compounded with pure sulfuric acid and distilled water at a certain proportion. According to the different temperature, its density is in the limit of $1.22 \sim 1.31\ g/cm^3$. In summer, the density should be a little smaller, while in winter, it should be a little bigger.

Section 2 Battery Charge and Discharge

I. Discharge process

Connect the battery circuit as shown in Fig. 17－2a, if the bulb illuminates, it proves that there

is electric current flowing in the circuit. At this time, both the lead superoxide on the positive plate and the spongy lead on the negative plate make chemical reaction with the sulfuric acid in the electrolyte, producing lead sulfate on both plates. During the chemical reaction process, the negative plate releases electrons, and because there are conducting wires connecting the positive and the negative plates, there is electric current passing through the circuit. With the performance of the chemical reaction, the density of the electrolyte gradually decreases and the voltage also reduces. Till the reaction stops and no current flows in the circuit, the bulb does not illuminate (Fig. 17－2b). At this time, the density of the electrolyte is usually lower than 1.15 g/cm^3.

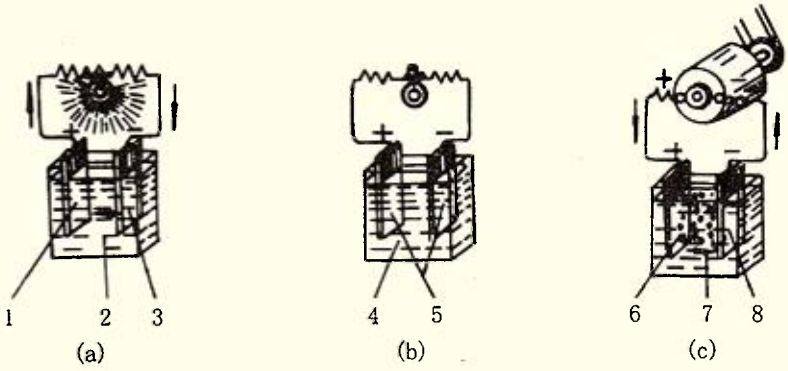


Fig. 17－2 Working principle of battery

(a) Beginning of discharge (b) End of discharge (c) End of charge

1, 6. Lead superoxide 2, 7. Sulfuric acid solution 3, 8. Pure spongy lead

4. Thin sulfuric acid solution 5. Lead sulfate

Ⅱ. Charge process

In order to make the battery restore its capacity of supplying power outside, a direct current mains, which has the voltage a little higher than the battery one, must be used to charge the battery (as shown in Fig. 17－2c). During the charge process, on the positive and negative plates takes place the chemical reaction opposite to the one on discharging. At last, the positive plate is reduced to lead superoxide and the negative plate is reduced to pure plumbum, the electrolyte becomes thicker, its density rising to more than 1.25g/cm^3, the voltage increases and the battery possesses the power supply capacity again. When continuing to charge, the water in the electrolyte begins to be resolved into oxygen and hydrogen, which may flee out through the filling and inspection window.

Section 3 Operation and Maintenance of Battery

Ⅰ. Proper operation of the battery

The proper operation and maintenance of the battery make a great influence on its service life and performance, therefore, in operation, pay special attention to the following points:

1. When the battery is installed on the tractor, first make clear the poles of the terminals. Jiangsu －500 tractor adopts thyristor generator with the negative grounded, so when operating, pay special attention and do not make a mistake.

(1) The terminal with the "＋" mark is positive terminal and the one with the "－" mark is neg-

ative terminal.

(2) When distinguishing from the painted color, the red terminal is positive and the one without painted color is negative.

(3) When the marks are not clear, connect a wire respectively with two terminals, then put them into the salt water, the one which releases more bubbles is the negative terminal.

(4) Distinguish them with a voltmeter or diode.

2. Put the rubber bumper pad under the battery and tightly press the battery with the clamp plate to avoid loosening to be damaged. When the positive and negative terminals are connected with the wires, fix them to prevent from being burnt due to loose contact on starting.

3. Do not swith on the starting motor more than 5 seconds, if the engine does not start, stop for a while and start again. If it is not successful in three successive times, check for the reason, otherwise, the long－time huge－current discharge will seriously affect the performance and the service life of the battery.

4. When the engine is under normal operation and the electrical facilities do not consume electricity, the indicator of the ammeter should be partial to the "＋" direction. If it is partial to the "－" direction, it shows that the battery is discharging, check for the reason at once and get rid of the trouble. In any case, it is not allowed to put metal tools on the battery to prevent short circuit of the cell.

5. Do not use the "contact sparking" method to check the electricity storage of the battery, otherwise, it is very easy to be damaged.

6. Usually the rated voltage of each cell is 2V and in normal discharge, its voltage should not be lower than 1.7V. In operation, charge the discharged battery in time.

7. For the tractor which has not run for a long time, take off the battery and preserve it in the room.

Ⅱ. Maintenance of the battery

1. Checking the electrolyte level

After the battery has been used for a period of time, due to the water evaporation and the ellectrolyte splash, the electrolyte level will fall. When the level is too low, the pole plates will be exposed in the air, causing the capacity decrease and the sulfation. Therefore , check the electrolyte level regularly (see Fig. 17－3). Usually the level is 10－15 mm higher than the pole plates. When finding the level falling is caused by water evaporation, only distilled water should be added; if the falling is caused by electrolyte splash, add electrolyte of the same density. Pay special attention that when compounding the electrolyte, except wearing protective articles, slowly pour the sulfuric acid into the distilled water. It is forbidden to pour the distilled water into the acid in order to avoid explosion. The compounding proportion of the electrolyte is shown in Table 17－1

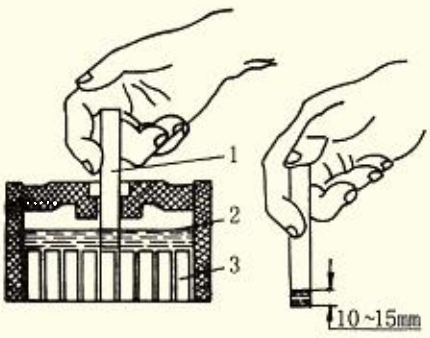


Fig. 17－3 Measuring the electrolyte level height with graduated tube

1. Glass tube 2. Electrolyte 3. Pole plate

Table 17－1 Percentage of the compounding composition of electrolyte

(1.83 g/cm³ sulfuric acid at 15℃)

Electrolyte density (g/cm³)		1.240	1.250	1.260	1.270	1.280	1.290	1.300	1.310
Weight (%)	Distilled water	68.0	66.8	65.6	64.4	63.2	62.0	60.9	59.7
	Concentrated sulfuric acid	32.0	33.2	34.4	35.6	36.8	38.0	39.1	40.3
Volume (%)	Distilled water	78.4	77.4	76.4	75.4	74.4	73.4	72.4	71.3
	Concentrated sulfuric acid	21.6	22.6	23.6	24.6	25.6	26.6	27.6	28.7

2. Checking the electrolyte density

The electrolyte density has certain relations with the amount of the electricity storage of the battery, therefore, if know the electrolyte density, then the degree of the storage and the discharge can be indirectly learned. The relationship between the density and the degree of the storage and the discharge of a cell is shown in Table 17－2.

Table 17－2 Electricity storage and discharge of battery

Degree of electricity Storage and discharge	Sufficient (100%)	Discharge 25% (Storage 75%)	Discharge 50% (Storage 50%)	Discharge 75% (Storage 25%)	Discharged battery
Electrolyte density	1.285	1.252	1.215	1.185	1.153
Load discharge tester measured value	1.7～1.8	1.6～1.7	1.5～1.6	1.4～1.5	1.3～1.4

The construction and the using method of the electrolyte densimeter is shown in Fig. 17－4. First insert the rubber tube into the filling hole of the battery, press the rubber ball, then loosen it to make the electrolyte be sucked into the glass tube 2, at this time, the density bottle of the densimeter 3 floats up and the graduation leveling with the electrolyte level is just the electrolyte density.

3. Checking degree of electricity storage and discharge of the battery with load discharge tester (also called high－efficiency discharge gauge)

Use the load discharge tester to measure the terminal voltage of a cell when the battery is discharging with huge current. On measuring, make its two contact pins tightly press against the positive and negative terminals of the cell, as shown in Fig. 17－5. When the indicator of the voltmeter is basically stable, write down the indication, which is just the measured terminal voltage of the cell, then compare with Table 17－2 to learn the electricity storage and discharge of the battery.

When conducting the measurement with load discharge tester, the measuring time is not allowed to exceed 20 seconds each time.

4. Maintaining the battery

(1) Keep the outside of the battery clean.

(2) When there is oxide on the terminals and the connectors, remove it in time.

(3) The small air hole on the filling hole plug must be unblocked so as to make the gas produced in the charge process flee out.

(4) Try to avoid the battery from being exposed under sunlight, and for the battery unused for a long time, even if it is stored in the room, it should be charged one time every month.

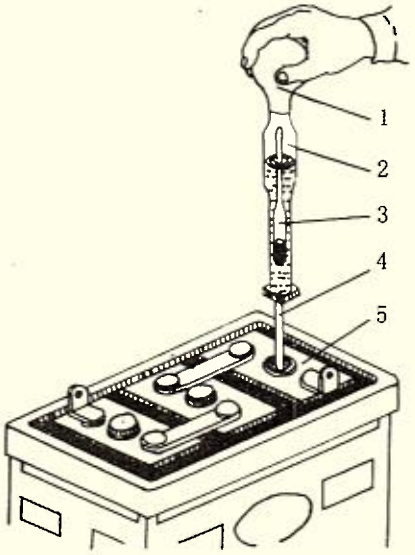


Fig. 17－4 Checking the electrolyte density

1. Rubber ball 2. Glass tube 3. Density bottle of the densimeter 4. Rubber tube 5. Battery

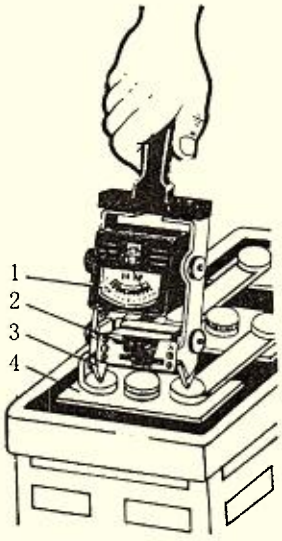


Fig. 17－5 Checking battery with load discharge tester

1. Voltmeter 2. Resistance 3. Contact pin of discharge tester 4. Battery

Chapter XVIII Generator and Regulator

Generator is driven by V－belt pulley of the engine. It transforms part of the mechanical energy of the engine into electrical energy to provide for the electric equipment and charge the battery with surplus electrical energy to supplement the discharge consumption. Jiangsu－500 tractor adopts 2JF200 thyristor generator.

Section 1 Working Principle and Structure of the Generator

Ⅰ. Working principle of the generator

When the generator is driven by the engine to rotate, the battery provides power for the field winding to excite and generate the magnetize flux. Because the pawl magnetic pole does relative motion with the stator winding, it makes the stator winding cut the magnetic lines to generate the alternating induction electromotive force and electric current. The alternating current passes through six silicon diodes of the three phase bridge rectifying circuit and is converted to direct current on the positive and negative terminals of the generator. When the output voltage amounts to a certain value, besides supplying power for the electric equipment and charging the battery, at the same time there is small part of current passing the field winding, whose induction magnetic field possesses the same direction with the original one to further strengthen the rotor magnetic field.

Ⅱ. Structure of the generator

Generator mainly consists of stator, rotor, silicon rectifying device , etc. Its structure is as shown in Fig. 18－1.

1. Stator

Stator is made up of the cylinder iron core piled up with silicon steel plates and the stator winding inserted into the inner－wall groove of the iron core. It is the armature of the generator and its winding is divided into 3 phases, forming a star－delta connection (Y－shaped), as shown in Fig. 18－2.

2. Rotor

Rotor is made up of pawl magnetic poles 3,5, field winding 4 and collectors 1,2 (as shown in Fig. 18－3). The magnetic poles are made into the jigsaw pattern and inserted with each other. Both ends of the rotor field winding are respectively connected on the two collectors, which insulate with the shaft, and then through the two brushes respectively connected on the earth terminal (negative terminal of the generator) on the end cap and the magnetic field terminal .

3. Rectifying device

On the back cover of the generator is installed a piece of component plate which insulates with the back cover. On the plate there are three silicon diodes with red marks, called positive diodes. Their leads are respectively joined with three terminals and their housings (negative) are pressed in the plate and insulatingly cross the end cap via bolts 23 (see Fig. 18－1), acting as the armature terminal B (+) of the generator. The other three silicon diodes with black marks are called negative diodes. Their

leads are also respectively joined with three terminals 3 and their housings(positive) are pressed in the rear end cap 17 and connected with the earth terminal (−) 26. These six silicon diodes are connected into the three phase bridge rectifying circuit (see Fig. 18 − 2c).

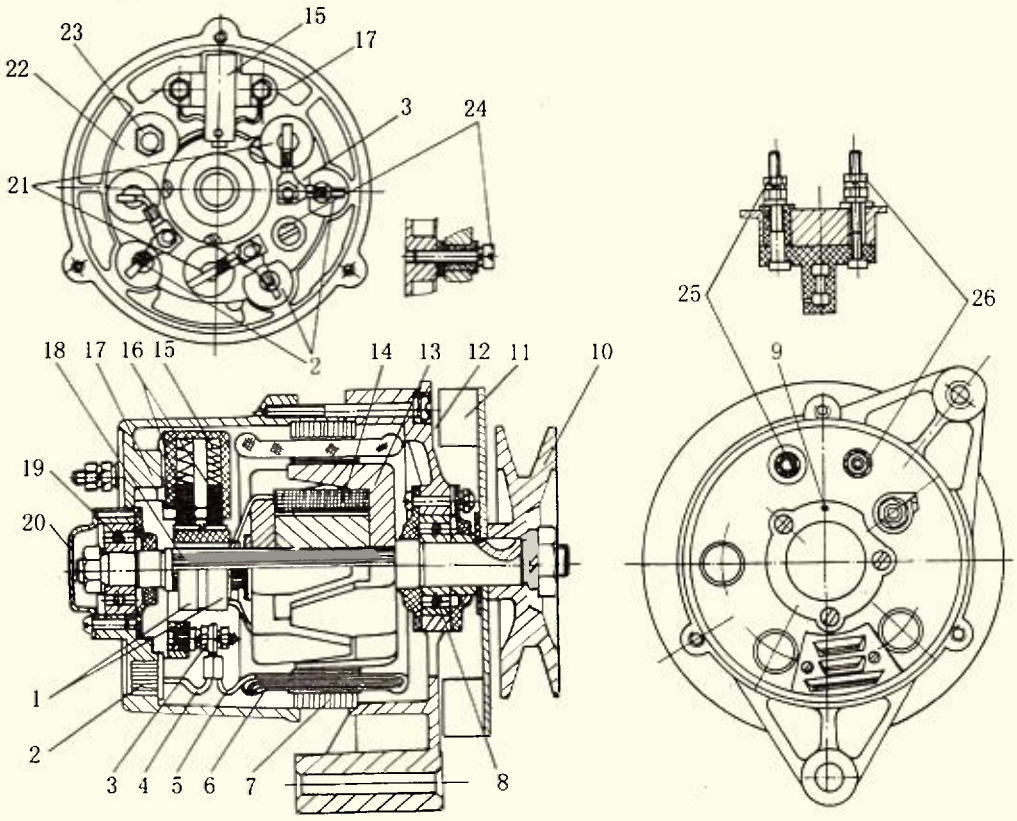


Fig. 18 − 1 Structure of thyristor generator

1. Collector 2. Silicon diode (black) 3. Silicon diode terminal 4. Lead of silicon diode 5. Lead of stator winding 6. Stator winding 7. Stator iron core 8. Front bearing 9. Small hole (used for installing brush and inserting steelwire) 10. Pulley 11. Fan 12. Front end cap 13. Rotor pawl magnetic pole 14. Rotor field winding 15. Brush bracket 16. Brush 17. Rear end cap 18. Rotor shaft 19. Rear bearing 20. Bearing cover 21. Silicon diode (red) 22. Component plate 23. Positive terminal bolt 24. Fixing screw of component plate 25. Magnetic field terminal 26. Negative terminal of the generator (earth terminal)

Section 2 Operation and Maintenance of the Generator

The abnormal operation of the generator exerts a direct influence on the power supply for the electric equipment, especially on the charge and the service life of the battery. Therefore, in normal times, make necessary maintenance and check to keep the generator in good technical state.

1. The generator is negative grounded, so the battery also should be negative grounded, in this way, they can be matched each other. Do not connect oppositely, otherwise, the silicon diodes will be burnt at once so as to make the generator unable to operate.

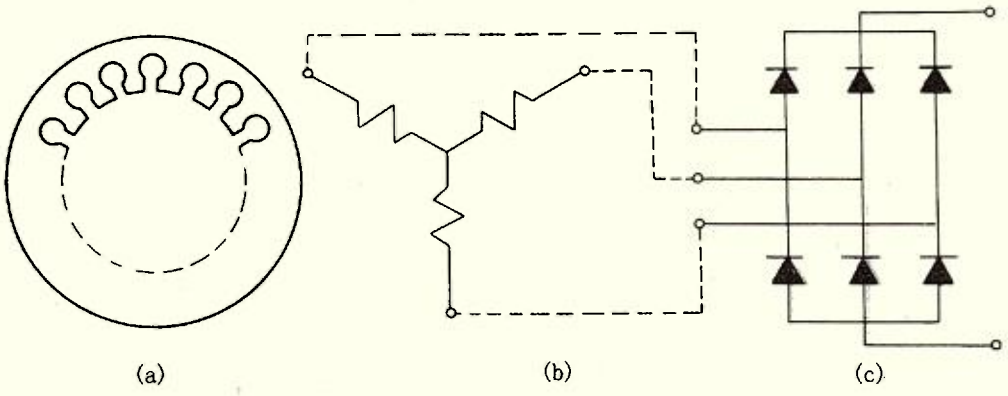


Fig. 18－2 Thyristor generator stator

(a) Shape of silicon steel plate (b) Connection diagram of stator winding

(c) Three phase bridge rectifying circuit

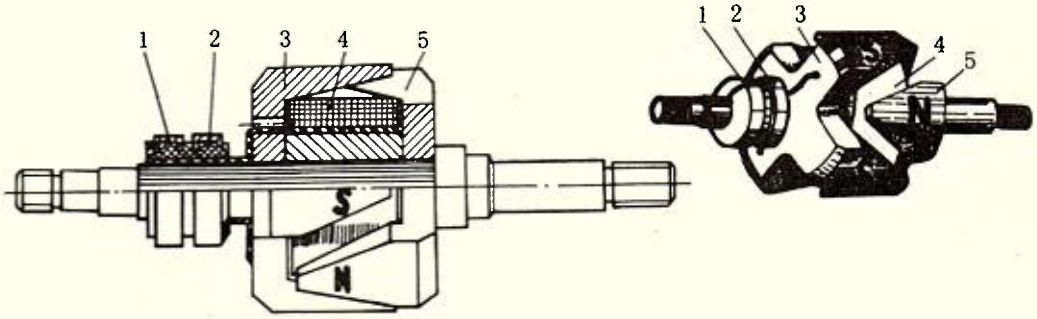


Fig. 18－3 Section and external form of the rotor

1,2. Collector 3,5. Magnetic pole 4. Field winding

2. It is strictly forbidden to adopt the "contact sparking" method (positive and negative terminals are connected in short circuit) to check if the generator supplies power, otherwise, the silicon diodes are easily to be burnt.

3. When checking the generator, it is absolutely not allowed to check the silicon diodes with megaohmmeter or 220V alternating mains and only avometer can be used to do the measurement. The forward resistance of each silicon diode is 8～10Ω and the backward resistance should be more than 10000Ω. The "test bulb" method can also be adopted to check the generator.

4. The generator has to be used with the battery, this is because the magnetic poles possess poor magnetic－hysteresis capacity and basically no residual magnetism and the electric current of the battery is needed to excite on starting. Also pay attention that after the tractor has stopped, the battery and the regulator should be broken via the electic switch lock to avoid that the battery charges the regulator and the generator winding for a long time.

5. The generator must operate with the corresponding regulator . It cannot operate itself or with the regulators of other models .

6. When the silicon diodes need replacing, pay attention to their polarity and do not install the

positive and negative diodes wrongly. Meanwhile, the leads of the diodes cannot contact with the end cap, or the generator cannot generate electricity.

7. In normal operation, keep the generator appearance clean at any time. Regularly clean the stator and the rotor and clear off dust and other filth on the parts. Be careful not to damage windings, silicon diodes and other parts.

8. After every 1000 working hours or so, check the bearing of the generator to see if there is radial loosening and change or fill grease, which should fill 2/3 of the bearing space. If it is too much, it is inclined to overflow to splash on the collectors and lead to poor contact. If there is loosening, replace the bearing with a new one, otherwise, the rotor and the stator will be colliding.

9. The brush of the generator can be gradually worn in the working process. When the wear is too much, the pressure between the brush and the collector will decrease, easily causing the strong sparks on their contact surface. Therefore, when the wearing value exceeds half of the brush height or there are cracks and burst phenomena on the bottom surface, it should be replaced. The new brush should be grinded with "00" abrasive paper until it has the same radial contact surface as the collector. Put the abrasive paper on the collector surface, the coarse face outward and contacting with the brush, and pull along the radial surface of the collector. When there is an oxide layer on the collector surface, grind with abrasive paper, then blow off the dirt.

The newly－grinded brush or collector should perform half－load operation for an hour to make their contact surface wear－in itself. The normal contact area should not be smaller than 3/4 of the brush radial surface. Slight sparks are permissible in working.

Section 3 Regulator

Ⅰ. Function of the regulator

In operation, the voltage of the generator is at direct ratio with its speed, that is, the speed is higher and the voltage is higher, therefore, when the speed of the engine changes, the voltage of the generator will change correspondingly, which is unable to ensure the normal operation of the electric equipment, even burning them when the voltage is too high. So the "voltage regulator" has to be used to adjust and keep the stable voltage value and make it not be influenced by the speed change.

As the silicon diode possesses one－way electric conductivity and the current of the battery will not flow back to the stator winding of the generator, there is no need to install "cutoff device"; as the inherent impedance of the stator winding increases when the speed becomes higher to automatically limit the output current, the amperiter is not needed.

In fact, the regulator is the "voltage regulator".

Ⅱ. Construction of the regulator

Jiangsu－500 tractor adopts FT111 regulator to work with 2JF200 alternator . The regulator adopts the single contact with arc－extinguishing circuit and the temperature－compensating device and can operate under the ambient temperature of －40～＋65℃.

The regulator consists of iron core 12, main magnetizing winding 5, vibration－assisting winding 7, vibration contact arm 8, contact bracket 6 and spring 11, etc, as shown in Fig. 18－4a. There are

additional resistance R_1, vibration－assisting resistance R_2 and temperature－compensated resistance R_3 under the bottom plate. Connecting the regulator and the outside circuit with three terminals: the terminal connecting the positive terminal of the generator (B), the terminal connecting the magnetic field terminal of the generator (F), the terminal connecting the negative terminal of the generator, as shown in Fig. 18－4b.

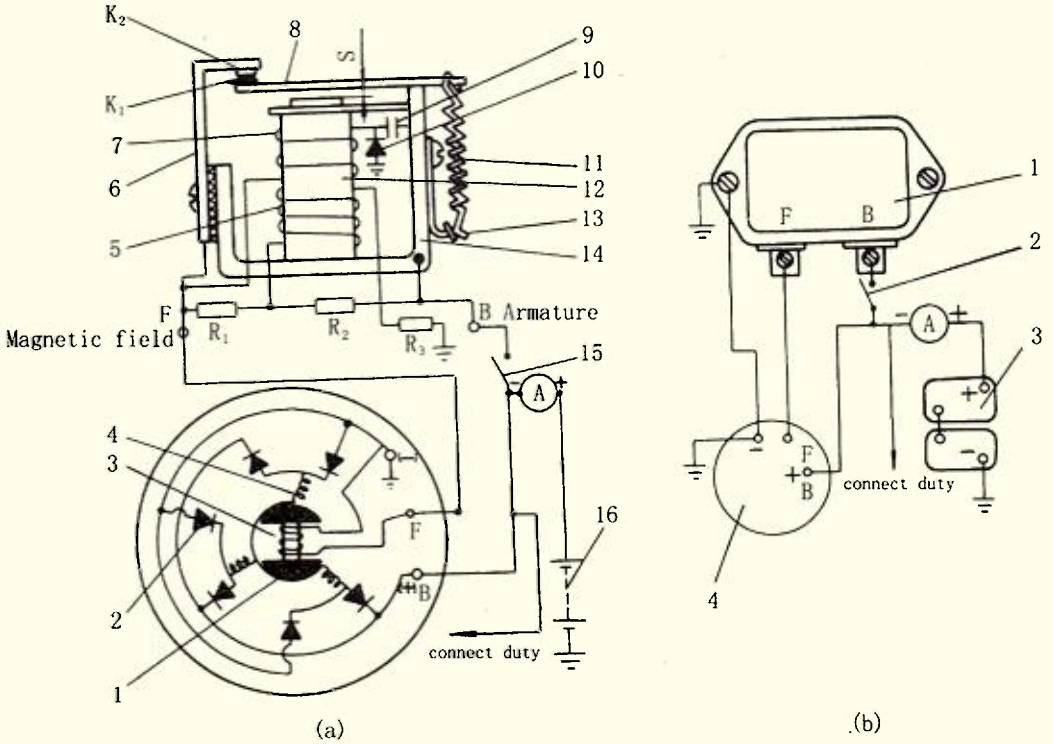


Fig. 18－4 Circuit diagram of generator and regulator

(a): Circuit diagram 1. Rotor 2. Silicon diode 3. Field winding 4. Stator winding 5. Main magnetizing winding 6. Contact bracket 7. Vibration－assisting winding 8. Vibration contact arm 9. Electric capacity 10. Diode 11. Spring 12. Iron core 13. Spring hook 14. Regulator frame 15. Switch 16. Battery K_1－Bottom contact K_2－Top contact R_1－Additional resistance R_2－Vibration－assisting resistance R_3－Temperature－compensated resistance S－Air gap

(b): Connection diagram 1. Regulator 2. Switch 3. Battery 4. Generator

Ⅲ. Working principle of the regulator

When the thyristor generator runs at a comparatively low speed, the contacts of the regulator K_1, K_2 are in the closed state, no additional resistance is joined into the rotor field winding, the current being huge and the magnetic field being strong, which is favorable to the further increase of the generator voltage.

When the speed of the generator increases and the voltage exceeds the limited value, the iron core of the regulator draws down the contact arm 8, the contacts K_1, K_2 open and the resistances R_1 and R_2 are connected in series in the rotor field winding circuit, then the excitation current becomes small, the

voltage decreases and the attraction of the iron core becomes weak. Under the action of the spring 11, the contacts K_1, K_2 close again and the voltage rises again. In this way, the voltage changes in the rising – – falling – – rising pattern to be kept in some range.

On the iron core of the regulator, besides the main magnetizing winding 5, there is vibration – assisting winding 7, which makes a parallel connection with the field winding via the diode 10. The vibration – assisting winding makes use of the self – induced current of the field winding to increase the vibration frequency of the contact on the contact arm, which is favorable to reducing the fluctuation extent of the voltage and maintaining the regulated range.

Section 4 Check and Adjustment of Regulator

In operation, do not disassemble and adjust FT111 regulator at will. Only when the trouble is certainly caused by the regulator, disassembly and adjustment can be performed according to the regulations. Generally speaking, first check if there is dirt on the contact, then check the clearance (called air gap) between the iron core and the contact arm, the value should be 1.4～1.5 mm, if it is not proper, make adjustment by moving the contact bracket up and down. Measure the output voltage of the generator with 0～30V DC voltmeter and 0～30A high – precision ammeter. The voltage should be at 13.5～14.5V when the generator load is 50%, otherwise, adjust the spring tension. When the voltage is relatively low, stretch the spring 11 (see Fig. 18－4) to increase the spring tension, on the contrary, compress the spring.

In the case of having no special equipment, perform static adjustment with battery or dry cell, then check on the tractor. When the voltage between the ignition terminal and the bottom plate is about 14V, the contacts are still, but when the voltage increases to 15V, they open. Then install the regulator on the tractor and measure the charging current or the adjusting voltage with ammeter or avometer's voltage function, if necessary, make adjustment again.

As the regulator is a piece of precision electric equipment, both check and adjustment have to be conducted by experienced personnel, otherwise, the improper adjustment will damage the parts.

Chapter XIX Starting Motor

Starting motor is supplied with power by the battery and it transforms the electric energy into the mechanical energy, then drives the flywheel to rotate via the overrunning clutch gear to start the engine . Jiangsu－500 tractor is equipped with Model QD1315D series DC starting motor.

Section 1 Working Principle and Construction of Starting Motor

Ⅰ. Working principle of starting motor

The live wires will move between the poles under the action of the magnetic field , this is just the working principle of the motor, as shown in Fig. 19－1. The current circuit is: positive of the battery→positive brush→commutator →armature winding→commutator→negative brush→field winding→earth→negative of the battery. Because the current in the upper half coil of the armature winding 3 flows inward, it receives the leftward acting force, and the lower half coil is to the opposite, receiving the rightward thrust. Consequently, the armature winding rotates counter clockwise and the rotation torque is output, i. e the starting motor has transformed the electric energy into the mechanical energy.

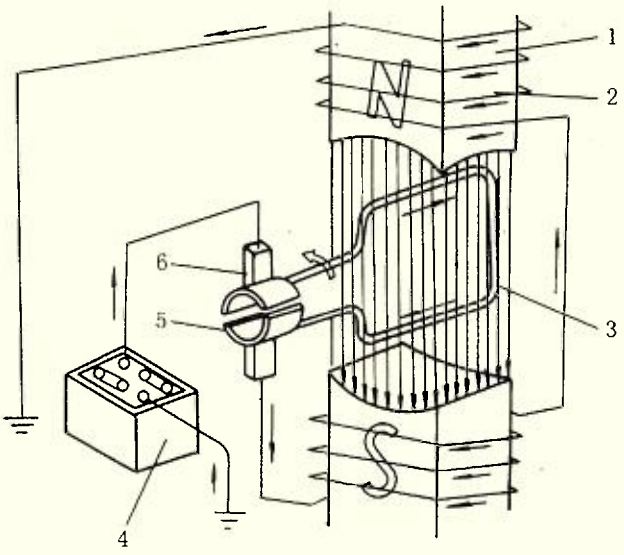


Fig. 19－1 Working principle of series DC starting motor
1. Magnetic pole iron core 2. Field winding 3. Armature winding 4. Battery 5. Commutator 6. Brush

The field winding of this type of motor is in series with the armature winding, so it is called series motor. The output torque is at direct rate with the square of the current flowing through the motor. As long as the battery provides it with enough current, there will be pretty big starting torque, which is favorable to the start of the engine.

Ⅱ. Construction of starting motor

Model QD1315D starting motor is made up of three parts: motor, electromagnetic switch and overrunning clutch. Its construction is as shown in Fig. 19－2.

1. Motor

Motor consists of housing, armature iron core 38 and winding 39, magnetic pole 22 and winding 35, commutator 37, brush 26, 33 and end caps, etc.

2. Overrunning clutch

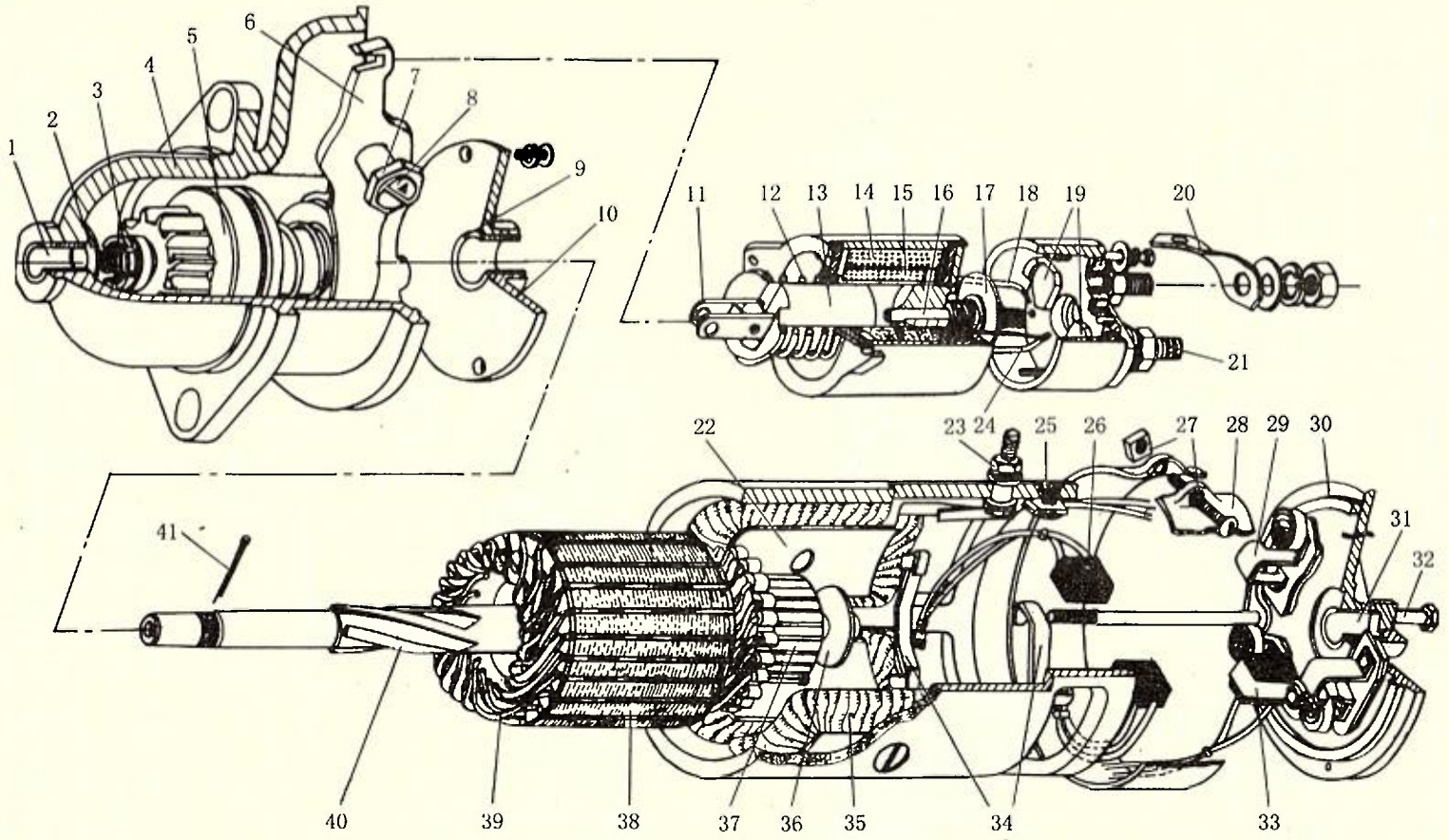


Fig. 19－2 The construction of starting motor

1. Rear bearing 2. Thrust washer 3. Adjusting nut 4. Driving end cover 5. Overrunning clutch assy. 6. Shift fork 7. Fastening nut 8. Eccentric screw 9. Intermediate bearing 10. Bearing seat 11. Meshing draglink 12. Return spring 13. Iron core 14. Attraction winding 15. Holding winding 16. Push rod of switch－over copper plate 17. Switch－over copper plate 18. Lead of attraction winding to motor 19. Contacts for terminal 20. Power source lead of motor 21. Power terminal 22. Magnetic pole 23. Lead of starting motor 24. Terminal to starting switch 25. Grounded screw 26. Negative brush 27. Dustproof clamp bolt 28. Dustproof clamp 29. Negative brush bracket 30. Front end cap 31. Front bearing 32. Penetrating screw arbor 33. Positive brush and bracket 34. Connecting strap for field winding 35. Field winding 36. Insulating washer 37. Commutator 38. Armature core 39. Armature winding 40. Armature shaft 41. Cotter pin

The motor transmits the power to the flywheel by means of the overrunning clutch to make the flywheel turn. When the engine starts, the overrunning clutch automatically make the starting motor gear separate from the ring gear of flywheel to avoid the starting motor from being damaged by the high－speed turning engine.

The construction of the overrunning clutch is as shown in Fig. 19－3a. The gear 1 and the outer ring 2 are made into one part and the bushing with spiral groove 9 and the cross ring 6 are connected. When the overrunning clutch makes the axial movement on the armature shaft, there is slight turning. In the four wedge grooves between the cross ring and the outer ring 2 are installed four sets of rollers , plungers 4 and springs 5. The end of the wedge groove bearing spring is comparatively wider, and under the action of the spring, the roller is pushed to the narrower end.

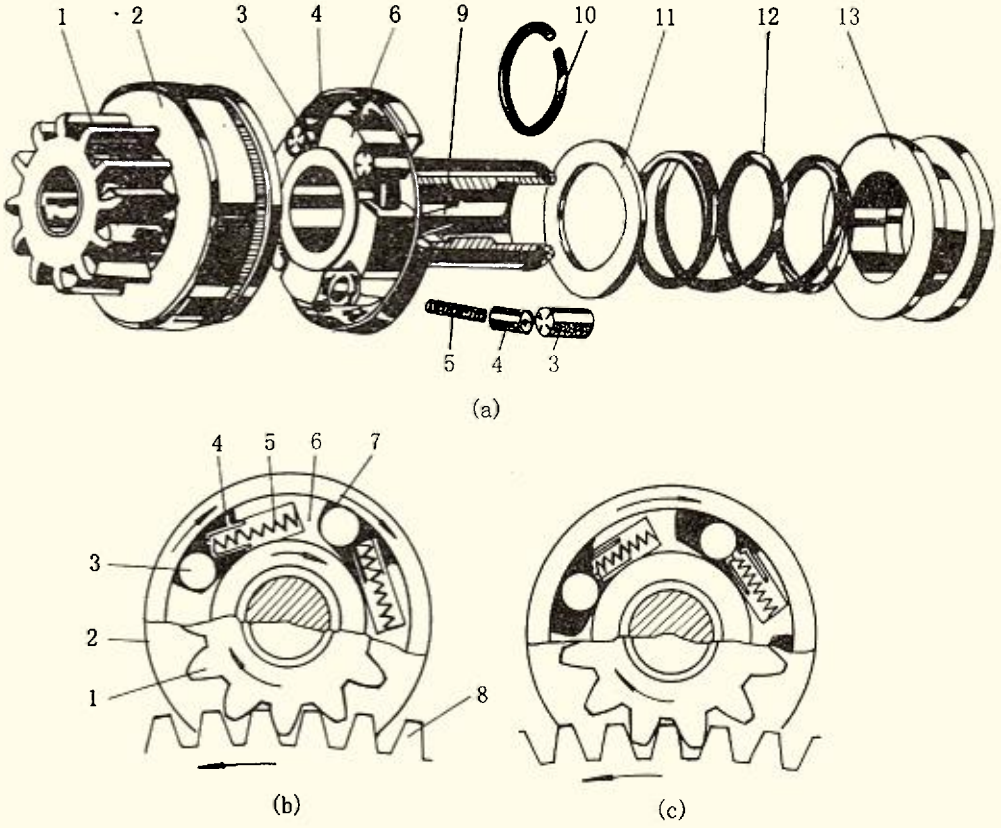


Fig. 19－3 Construction and working of the overrunning clutch

1. Gear 2. Outer ring 3. Roller 4. Plunger 5. Return spring 6. Cross ring 7. Wedge groove 8. Flywheel ring gear 9. Bushing spiral groove 10. Snap ring 11. Spring seat 12. Buffer spring 13. Shift sleeve

When the armature of the starting motor turns, with the turning of the cross ring, four rollers push to the narrower end. At this time, the outer ring and the cross ring appear to be combined into one part and the motor drives the flywheel ring gear 8 to turn via the overrunning clutch gear (as shwon in Fig. 19－3b). When the engine starts and its speed becomes highter, the flywheel conversely drives the outer ring to turn at a higher speed than the motor one, in this way, the rollers are pushed toward the wider end of the wedge groove (as shwon in Fig. 19－3c). Then the outer ring and the

cross ring loosen, power being cut off, the motor and the engine are separated at once.

3. Electromagnetic switch

The electromagnetic switch is used to control the shift fork of the starting motor and open/close of its main circuit. The construction of the electromagnetic switch is shown in Fig. 19－2 and its circuit principle is shown in Fig. 19－4.

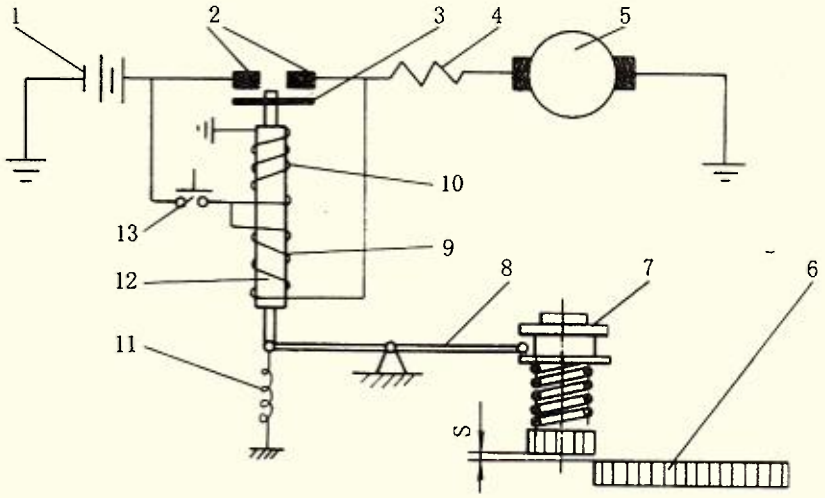


Fig. 19－4 Circuit principle of electromagnetic switch

1. Battery 2. Terminal contact 3. Switch－over copper plate 4. Field winding 5. Armature winding 6. Flywheel ring gear 7. Overrunning clutch 8. Shift fork 9. Attraction winding 10. Holding winding 11. Return spring 12. Armature core 13. Starting switch S=2.5～5 mm

On starting the motor, after switching on the starting switch on the instrument panel, there is current flowing in the holding winding 10 and the attraction winding 9 respectively. The magnetic field generated by the two windings attracts the iron core to overcome the elastic force of the return spring to move upward, pushing out the overrunning clutch by means of the driving shift fork, meanwhile, the gear of the overrunning clutch meshes with the flywheel ring gear. As there is current flowing through the field winding and the armature winding, in the meshing process, the armature of the motor rotates at a slow speed to make the overrunning clutch gear mesh into the flywheel ring gear under the slow rotating. In this way, the meshing is relatively soft.

After the meshing of the gears, the iron core 12 pushes the switch－over copper plate to contact with the terminal contact. By means of the field winding and the armature winding, the huge current from the battery produces normal torque to drive the flywheel , providing power for the starting of the engine. After the switch－over copper plate contacts with the terminal contact, the attraction winding is made short circuit, at this time, the magnetic field generated by the holding winding is strong enough to attract the iron core to keep the close contact between the copper plate and the terminal.

After the starting of the engine, quickly release the starting switch, at this time, the switch－over copper plate does not lose contact with the contact and the current circuit is positive of the battery →switch－over copper plate→attraction winding→holding winding→earth→negative of the battery.

On winding, the direction of the two windings are opposite, so their electromagnetic pulling forces are also opposite, as a result, under the action of the return spring, the switch－over copper plate immediately draws back and cuts off the power of the motor. At the same time, the shift fork brings the overrunning clutch gear to draw back at once and the starting motor stops running.

Section 2 Operation, Check and Adjustment of Starting Motor

Ⅰ. Proper operation and maintenance of the starting motor

1. The starting time of the motor should not exceed 5 seconds every time. If unable to start the engine one time, stop for 1～2 minutes, then start again, otherwise, the windings of the motor will be made overheated, even the insulation will be damaged. If the engine cannot be started in three successive times, make check.

2. When starting in winter, first cranking the crankshaft for a few turns and depress down the clutch pedal, then make use of the preheating plug and the decompression mechanism to aid the motor starting.

3. After the motor is started, immediately release the starting switch to make the drive gear withdraw from the meshing state, so as to reduce the wear of the overrunning clutch.

4. In normal times, it is not allowed to start the motor by switching on with screwdriver at the electromagnetic switch, otherwise, the switch is greatly susceptible to be damaged.

Ⅱ. Check and adjustment of the starting motor

1. Often check if the connecting parts of the starting motor are secure and if the wire connection is reliable, and clean the greasy dirt on th surface.

2. Regularly check the contact condition between the brush and the commutator. When the brush is worn to less than 20 mm, replace it with a new brush and the method is similar to that of replacing the generator brush. The elastic force of the spring should be 9～15N, when it is smaller than 9N, replace the spring.

3. Dismantle and check the copper bushings and gears of the front end, middle and rear end caps, and the seriously worn ones should be replaced. In installation, add grease to lubricate the three copper bushings.

4. Regularly check and adjust the clearance between the overrunning clutch gear and the thrust washer. Move the gear outward and the clearance between the end face of the gear 2 and the thrust washer 1 should be 1.5～3.0 mm (as shown in Fig. 19－5), otherwise, it should be adjusted. Usually it would be best if the mark of the head of the eccentric screw (▲ or ●) is at the position shown in Fig. 19－6 and it can also turn in the range of 90° leftward and rightward each. If the clearance is too small, the mark should be placed toward the front of the tractor, and conversely, it should be placed toward the back.

5. When installing the starting motor, the distance between the end faces of the drive gear and the flywheel ring gear should be 2.5～5 mm (see S in Fig. 19－4). If it does not meet the requirement, make adjustment by increasing or reducing gaskets between the flange surface of the starting motor and the motor installation hole on the engine block.

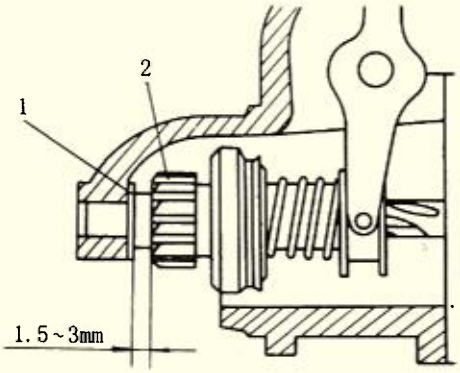


Fig. 19－5 Check and adjustment of overrunning clutch gear and thrust washer

1. Thrust washer 2. Gear

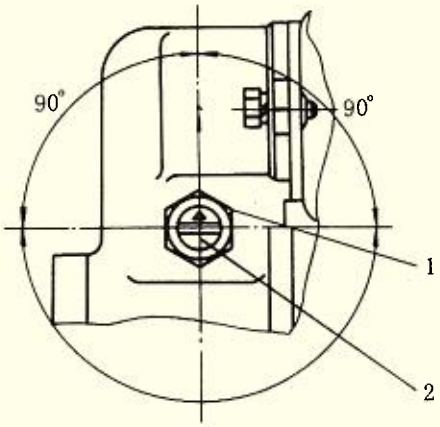


Fig. 19－6 Adjustment of eccentric screw

1. Lock nut 2. Eccentric screw

Chapter XX Lighting and Other Electrical System

Section 1 Lighting Equipments

In order to be capable of night operation, the tractor is equipped with two front headlights, a rear headlight, two pairs of instrument lamps and the switch.

Ⅰ. Lights

1. Front headlight

There are two front headlights on the left and right of the tractor separately, each one consists of bilux bulb, reflector, light casing and wires.

2. Rear headlight

The rear headlight is installed on the upper face of the right fender, it is used to lighting the implement behind the tractor.

3. Instrument lamp

Four instrument lamps are installed in the two pairs of lamp seats under the instrument panel. They are used to lighting all the instruments.

Ⅱ. Light switch

The operation of lights switch has been described in section 1 of chapter Ⅱ.

Section 2 Horn and Signal Installation

Ⅰ. Horn

Model Jiangsu medium－size tractor is equipped with Model DL41DS/12 electromagnetic horn, its structure is shown in Fig. 20－1.

The volume of the horn is determined by the clearance A, and the tone is determined by the air gap between iron core 18 and vibrating element 2. Both of them can be adjusted by adjusting the screw 12 or changing the relative position of iron core 18.

Ⅱ. Signal installation

1. Direction and width indicator

Direction and width indicator are installed on the two sides of the engine hood and the fenders of the left and right driving wheels. In the indicator bulb, there are two filaments of different power, the one with high power is the director filament and the other one is the width indicator filament.

When the tractor is ready to turn to another direction, the filament with high power on this direction is turned on under the control of the turning signal switch, and gives off flashing light by the help of a flasher, indicating the travel direction of the tractor to the pedestrians or other vehicles to ensure safe driving.

The filament with low power is controlled by the headlight switch, it is used to indicate the width of the tractor in darkness.

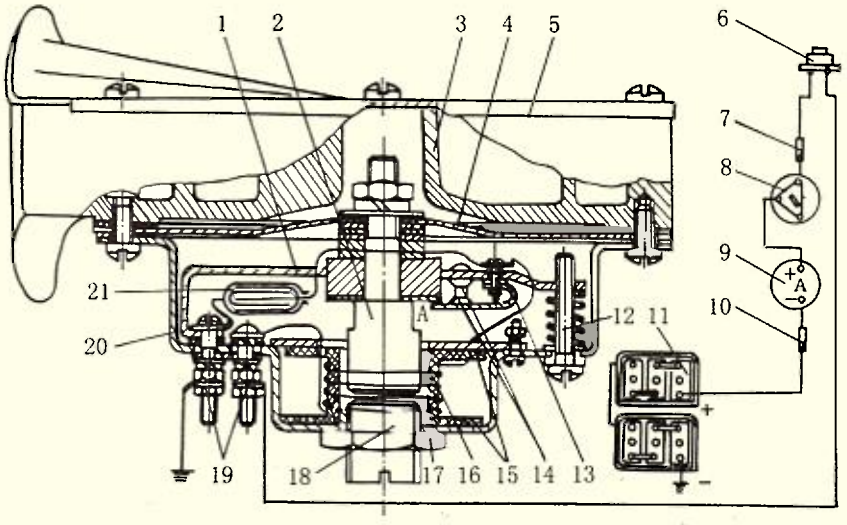


Fig. 20－1 Electromagnetic horn and its wiring diagram

1. Contact bracket 2. Vibrating element 3. Volute casing 4. Vibrating membrance 5. Cover 6. Horn button 7,10. Fuse 8. Battery switch 9. Ammeter 11. Battery 12. Adjusting screw 13. Elastic contact arm 14. Contact set 15. Winding support 16. Field winding 17. Lock nut 18. Iron core 19. Terminal 20. Casing 21. Condeser A－Clearance at shoulder

2. Brakelight (also called tail lamp)

The Brakelight is used to give the vehicles behind the tractor signal of braking. Its switch is interlocked with the brake pedal . There are a pair of filaments in its bulb, each one with a lead. Both of the two filaments have the same earthing in the bulb. As to the filaments, the one with high power is brake signal, being controlled by the brake pedal; the one with low power is license plate lamp, being controlled by the headlight switch. Since this light is installed on the rear part of the fender, it is also called tail lamp.

3. Flasher

Model Jiangsu medium－size tractor adopts SG124C bounce flaser, whose function is to make the direction indicator give off flashing light. The flasher is connected in series in the circuit before the switch, so there should be no earthing or short circuit, otherwise, the flasher will be burnt because of intensive current.

4. Brakelight switch (brake signal switch)

When the tractor is braking, the brakelight circuit can be switched on automatically.

Section 3 Instrument and Circuit Protection Equipment

Ⅰ. Ammeter

The ammeter is connected in the circuit between the generator and the battery to indicate the current intensity of charge or discharge of the battery, so the graduation "0" is in the middle of the ammeter. While connecting wires, the negative terminal of the ammeter should be connected with the positive terminal of the battery through fuse. There are two wires connected with the positive terminal

of the ammeter, one is from the "+" terminal of the thyristor generator by way of the fuse, the other one is from the mains switch. When the generator is charging the battery, the needle of the ammeter should be partial to "+"; when the battery is discharging, the needle should be partial to "−".

Ⅱ. Water temperature gauge and water temperature sensor

The water temperature gauge is used to indicate the temperature of the cooling water of the engine, it should work in cooperation with temperature sensor. The structure and electrical working principle is shown in Fig. 20−2.

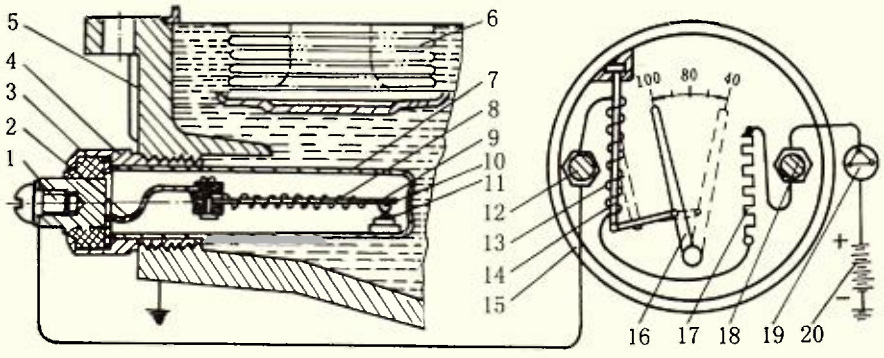


Fig. 20−2 Structure and electrical working principle of water temperature gauge and sensor

1. Connecting screw 2. Contacting plate 3. Insulating ring 4. Casing 5. Front covering plate of cylinder head 6. Thermostat 7. Sleeve 8, 13. Constantan winding 9, 14. Bimetallic plate 10. Movable contact 11. Stationary contact 12, 18. Terminal 15. Water temperature gauge casing 16. Needle 17. Additional resistance 19. Main switch 20. Battery

The water temperature gauge mainly consists of bimetallic plate, winding, additional resistance, needle, etc. and it is installed on the instrument panel.

The water temperature sensor mainly consists of bimetallic plate, winding, movable and stationary connects, etc. It is installed in the front water passage in the cylinder head under the thermostat.

When the mains is switched on, current from its positive →mains switch 19→terminal 18→additional resistance 17→water temperature gauge winding 13→terminal 12→connecting screw 1→sensor winding 8→movable contact 10→stationary contact 11→sleeve 7→earth→negative of mains, forming up a closed circuit. As the current flows through winding 8, heat is generated, which causes deformation of bimetallic plate 9. Since the expanding coefficient of the lower layer is bigger than that of the upper layer, the bimetallic plate bends upwards, so contacts 10 and 11 are seperated and the circuit is cut off. It is connected when the bimetallic plate is cooled. So the contacts perform like this repeatedly . Under normal temperature, there is a certain pressure between the contacts, i. e. when the water temperature is low, it needs a relatively longer period for the current to flow through winding 8 to cause more deformation of the bimetallic plate so as to cut off the circuit. Since the water temperature is relatively low at this time, the bimetallic plate is cooled rapidly and the contacts contact with each other soon, obviously, the average effective current is bigger at this time and more heat is produced by the winding 13, which makes more deformation of the plate 14, and the needle of the gauge turns clockwise under the action of a lever. In the same principle, when the water temperature is high, the

average effective current is weak and the deformation of the bimetallic plate is small, so the angle that the needle turns is small.

The needle should point at graduation "100℃" while the circuit is cut－off.

Ⅲ. Oil pressure gauge

Model 308－A electrothermal oil pressure gauge is used in cooperation with oil pressure transducer, and its structural principle is similar with that of the water temperature gauge. When the average effective current in the gauge is strong, the angle that the needle turns is big; conversely, it is just the opposite.

When installing, the surface with an arrow should be placed upward, and the angle from the arrow to the vertical position should not exceed 30°, otherwise, the readings will not be precise.

Ⅳ. Speedometer

Jiangsu－500 tractor adopts GS145 speedometer which is in cooperation with a sensor. It can accumulate the working time of the engine and indicate its running speed. The accumulation of the working hours is conversed from the rated speed 2000r/min. When the current is cut off, it is normal for the needle to stay at any position.

The sensor is installed on the cover of engine timing case. The sensor is screwed into the cover and there should be an clearance of 1.5～2 mm from its end face to the top of the gear (the clearance has been adjusted when out of the factory). If adjustment is neccessary, it should be conducted when the engine stops running. Screw the sensor until it contacts the gear top, then return for 1(1/3) of a turn, and tighten the locking nut.

Ⅴ. Fuse box

The fuse box is the protection equipment of the electric system of the tractor. When the circuit is overloaded or there is a short circuit , the fuse will blow automatically to cut off the circuit in order to protect the mains and other electrical equipments. The fuse is made of thin tinning copper wire. Select the thinness of the fuse according to the working current of the electrical equipment (see table 20－1).

Table 20－1 Specifications of fuses

Position (from top downward)	1st	2nd	3rd	4th	5th	6th	7th	8th
Rated working current(A)	30	20	30	10	6	6	6	10
Protected elements	Generator	All elements	Battery	Headlight, rear headlight and instrument lamp	Left turn signal and right turn signal	Brakelight, left width indicator, right width indicator, roof light and wiper	Water temperature gauge, oil pressure gauge, fuel gauge and speedometer	Horn
Diameter of substitute copper wire (mm)	0.7	0.4	0.7	0.24	0.16	0.16	0.16	0.24

If the electrical system does not work properly, check the fuse first, see if it blows out. Replace with a new one of the same specification after finding out the reason and getting rid of the trouble. In

order to prevent damage of the electric elements and wires, it is not allowed to replace with a thicker fuse in any case.

Section 4 Auxiliary Starting Electric Facilities

Ⅰ. Preheating start switch (Model JK290A)

The preheating start switch is a built－in lock switch which is turned by a key. It has four positions: when the key is at "0" position , all the electrical equipment is switched off, and the key can be pulled out at this time; insert the key in and turn it counter －clockwise for 20° to "Q" position, the electric equipment and starting are connected with the mains and the key can return to "0" position automatically; turn the key clockwise for 20° from "0" position to "Ⅰ" or "Y" position and stay at this position, all the electrical facilities are connected with the mains; turn it clockwise for another 20° to "Ⅱ" position, the electric facilities and preheating plug are connected with the mains for preheating the diesel engine, it can return to "Ⅰ" position automatically when loosened. When preheating some time, turn the key clockwise further for 20° to "Ⅲ" position, the electric facilities and the starting circuit are connected with the mains, the key can return to "0" position automatically.

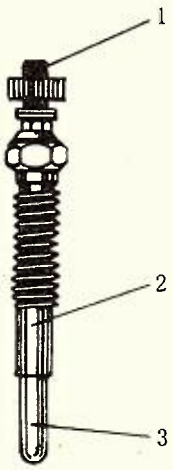


Fig. 20－3 Appearance of electrothermal plug
1. Terminal 2. Casing
3. Heat generator

Ⅱ. Preheating plug

Jiangsu－500 tractor is equipped with Model 1F2 electrothermal plug. The 1F2 plugs are inserted into the swirl chambers of each cylinder separately. Its function is to preheat the swirl chamber, so as to facilitate starting in cold. The direct injecting diesel engine is not equipped with the plug.

The appearance of 1F2 plug is shown in Fig. 20－3, the porcelain stick in the casing is wound with resistance wire. After electrified, the resistance wire gives off heat to increase the temperature of the swirl chamber.

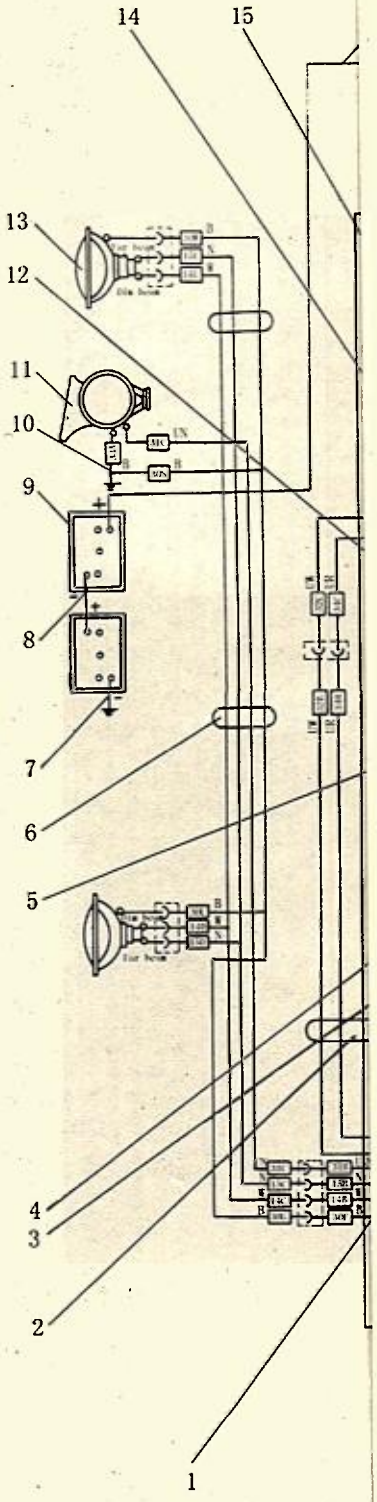
About 6 mm of the heat generator protrudes in the swirl chamber. The heat generator is easy to be burnt, so avoid using the preheating plug if possible, so as to prolong its service life. The preheating time normally should not exceed 30 seconds each time.

Section 5 Circuit of Electrical System

Ⅰ. Characteristics of wire connection

1. Model Jiangsu medium－size tractor adopts negative grounded single line connection. The negative terminals of all the electrical facilities are connected with the tractor block and all the positive terminals are connected with wires. This method is favorable of saving material and simplizing circuits, it also facilitates getting rid of troubles.

2. One of the terminals of each electrical element is connected with the positive terminal of the mains by way of switch or ammeter, and the other terminal is grounded, connecting with the negative terminal of the mains through the tractor block. The battery and generator provide electricity in parallel



Note: wiring colour

R ——Red
Y ——Yellow
G ——Green
U ——Blue
W ——White
O ——Orange
P ——Purple
S ——Grey
N ——Brown
B ——Black

Fig. 20－4 Wiring diagram of electrical system

1	Fuel gauge
2	Engine harness assy
3	Oil pressure gauge
4	Speedometer
5	Water temperature gauge
6	Front harness assy
7	Ground wire assy of battery
8	Series－connected wire assy of battery
9	Battery
10	Ground wire assy
11	Horn
12	Instrument lamp
13	Front headlight
14	Ammeter
15	Preheating plug
16	Wire assy of battery and motor
17	Silicon－rectified generator
18	Water temperature sensor
19	Rotary speed sensor
20	Starter
21	Oil pressure transducer
22	Fuel lever sensor
23	Horn button
24	Master lamp switch
25	Preheating start switch
26	Direction indicator switch
27	Regulator
28	Front righthand direction indicator
29	Rear headlight
30	Right rear combinatory lamp
31	Flash lamp
32	Harness assy of right mud guard
33	1st shift switch
34	2nd shift switch
35	Electric coupler
36	Harness assy of left mud guard
37	Left rear combinatory lamp
38	Brake switch
39	Fuse box
40	Rear harness assy
41	Switch panel harness assy
42	Instrument harness assy
43	Connector for rectiried generator
44	Resistor

while the switches, fuses and ammeter are connected in series in the circuit. The connection between each electric equipment is parallel, each of them can form a closed circuit with the mains individually.

3. The starting current of the starter is very strong, so the starter is supported with electricity directly by the battery while the other electric equipments are all in series with ammeter. The charging current flows through ammeter while the generator is charging the battery, but the electric equipment is supplied with power by the generator, the current does not flow through the ammeter.

Ⅱ. Circuits

The general circuits diagram of Jiangsu medium－size tractor is shown in Fig. 20－4.

1. Circuit of mains

It mainly includes generator, regulator and battery.

2. Starting circuit

The staring circuit usually consists of battery, starer, starting switch, preheating plug and switch, etc. In cold season, the preheating plug and the starter can be used together to start the diesel engine. After it is started, cut off the mains of the starter, then the preheating plug stops working together with the starter.

3. Instrument circuit

The instrument circuit usually includes ammeter, water temperature gauge, oil pressure gauge and speedometer, etc. Almost all the electric instruments are connected in parallel except that the ammeter is connected in series.

4. Circuit of the lighting and signal equipment

This circuit mainly includes front and rear headlights, tail lamp, instrument lamp, etc. All equipment in this circuit is controlled by Model JK833B switch.

Section 6 Maintenance of Lighting and Other Electrical Equipment

1. All the eletrical equipments should be connected strictly according to the circuit diagram, and the earthing polarity must be same.

2. After the lighting and other electrical equipments are connected, test them for 1～2 times. The reaction of the direction indicators should be corresponding to each function of the switch.

3. Keep all the equipments clean.

4. Every fuse in the fuse box should accord with the required specifications.

5. When connecting the light switch wires, ensure that each light corresponds to the provided sequence.

6. The time of using direction indicator should be as short as possible, to prevent the flasher from damaging.

7. In operation, check and clear off the oxide on the terminals of the battery regularly to avoid excessive line drop caused by corresponding strong current.

8. The electric elements should not be dismantled casually to avoid damaging.

9. The irradiating angle of the front and rear headlight can be properly adjusted, fix it after adjustment.

Chapter XXI Running－in of the Tractor

Section 1 Purpose of Running－in

It is neccessary to conduct the running－in of a new or an overhauled tractor according to the procedure before opertion. The purpose of the running－in is as following:

1. A tractor has many important motion fitting parts, although their surfaces have been precision－worked, and the processing marks left will cause the surfaces uneven, so, in working, only the buldging parts contact with other fitting surfaces, which makes the actual pressurized area far smaller than the theoretical area. If a tractor runs bearing load at this time, the pressure that the contacting part bears will be far beyond the normal value and the lubricant oil film will be damaged seriously, the high temperature is produced on the motion fitting surfaces, even causes squeezing damage, scratching or seizing, etc. Running－in can prevent this kind of troubles. Running－in can grind the uneven surfaces, expand the actual contacting area and obtain the suitable fitting clearance, so as to improve the working performance and prolong the service life of a tractor.

2. Although the elements of tractor have been checked strictly in the assembling line, there may be some defects. Through running－in, the defects can be discovered and removed in time. It also can check and adjust the cooperation of each part to improve the reliabilty of the tractor.

3. After running under load, some of the connecting and transmitting parts may get initially loose or deformed, through running－in, these parts can be tightened and adjusted in time.

Section 2 Running－in Procedure

Ⅰ. Preparation before running－in

1. Check all connecting parts to see whether they are intact, and get them ready if necessary, check and tighten all fasteners according the requirement.

2. Check the lubricity according to the lubrication chart, check the oil level, quality and variety of lubricant to see whether they can meet the requiements.

3. Add fuel and cooling water.

4. Check tyre inflation pressure.

5. Check the technical state of eletric equipment.

6. Recognize the technical performance of the tractor and functions of the operating mechanisms.

After these preparations, begin the running－in according to the "running－in procedure".

Ⅱ. Running－in procedure

1. Running－in of engine under no load

First start the engine according to the reqired procedure, make the running－in of the engine under no load at low speed range(800～900r/min.), medium speed (1400～1500r/min.) and high speed (1900～2000r/min.) respectively, 5 minutes for each speed. During the running－in of engine, listen

carefully whether there is any unusual sound, and check the engine carefully whether there is any leakage of water, oil and air, at the same time, inspect the reading of gauges, if there is any trouble, stop the engine in time and remove it. Further running－in can be carried out only when it is confirmed that everything is normal.

2. Running－in of hydraulic system

Start the engine, put hydraulic pump control lever to the engaging position, control the lever to make the hitch rise and fall for several times by operating the position control lever, check the hitch system to see whether there is any seizing, then attach an implement the weight of which should be less than 300kg, run the engine at rated speed, make the implement rise and fall smoothly by shifting the position control lever for no less than 20 times.

During the running－in check the hydraulic lift hitch to see whether there is any oil leakage or any froth in the oil. The controlling of the levers should be smooth and their positioning should be reliable.

3. Running－in of tractor under no load

Running－in of the tractor under no load could be done according to the table 21－1. Perform the steering operations of the tractor during the running－in.

Table 21－1 Procedure of running－in under no load

Gear	Ⅲ	Ⅳ	Ⅴ	Ⅵ	Rev. Ⅰ
Running－in time for each gear (minute)	40	40	40	30	30

During the running－in, attention should be paid to the following:

(1) Check the functions of the engine, transmission, travel and steering system as well as the readings of all instruments.

(2) Check that the functions of the clutch, gearbox and brake are normal.

(3) Whether the differential lock can be engaged and disengaged.

(4) Check the function of the electrical system.

If any trouble occurs, it should be removed before running－in under load.

4. Running－in of the tractor under load

The running－in time and load in each period are shown in table 21－2. The points for attention are the same as those described in "running－in of tractor under no load", maintain the tractor according to the maintenance procedure.

Ⅲ. Work after running－in

1. Drain the oil from the gearbox－rear axle housing, final drive casing and lift casing when still warm. Clean the oil drain plug and the magnet. Add some kerosene or diesel and run the tractor at gear Ⅱ and the reverse speed separately for 2～3 minutes. Meanwhile, perform the lifting operation several times. After that, drain the kerosene or diesel and refill it with fresh oil.

Table 21－2 **Procedure of running－in under load**

Running－in period	Load on towing hook(N)	Equivalent operation	Running－in time of each gear(hour)				Total hours of cach period
			Ⅱ	Ⅲ	Ⅳ	Ⅴ	
Ⅰ	2000～3000	Transporting with a fully loaded 3t trailer	2	2	4	4	12
Ⅱ	5000～6000	Ploughing with a 3－furrow plough on sand soil (its specific resistance is 30 kPa). Ploughing depth is about 20 cm	4	4	6	6	20
Ⅲ	7000～8000	Ploughing with a 3－furrow plough on loam (its specific resistance is 45 kPa). Ploughing depth is about 20 cm	4	4	5	－	13
Total							45

2. Drain oil from the engine oil sump when still warm. Wash the sump and the oil strainer. Then, refill it with fresh oil.

3. Tighten the nuts of the cylinder head in turn, When the water temperature is not less than 70℃.

4. Wash or replace the element of the oil filter. Wash the fuel filter.

5. Check and adjust the valve clearance. Check the connecting rod bolts.

6. Drain the used cooling water and fill in fresh soft water.

7. Tighten all bolts, nuts and screws on the exterior part of the tracor.

8. Check the toe－in of the front wheel, the free travels of the brake pedal and the clutch pedal. Adjust them if necessary.

9. Refill grease as described in the lubrication chart.

Chapter XXII Tractor Driving and Operating Techniques

Section 1 Driving of the Tractor

Ⅰ. Controls and instruments

Controls and instruments of the tractor are shown in Fig. 2－1.

Ⅱ. Preparations before starting and starting of the engine

1. Preparations before the starting

(1) Have the engine maintained according to the "shift maintenance schedule".

(2) Open the cock of the fuel tank (on the sediment bowl).

(3) Bleed the air from the fuel feeding circuit (Fig. 22－1).

(4) Put the main gear shift lever 22 (Fig. 2－1), the PTO control lever 23 and the hydraulic pump control lever 19 to the neutral position.

(5) Push in the cutoff lever 21 to make the injection pump at its feeding position.

(6) Insert the key into the switch 6 and turn it clockwise to the position Ⅰ to make the electrical circuit closed.

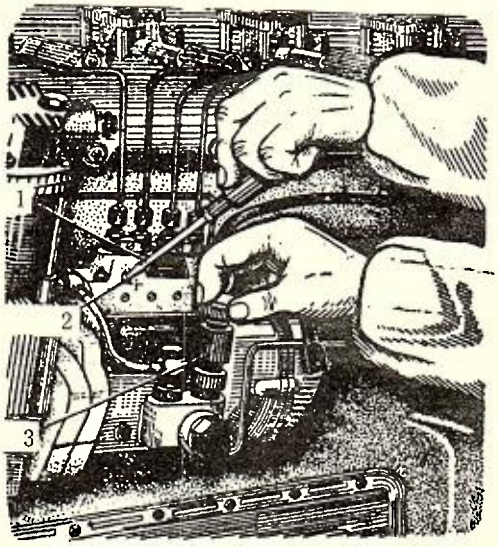


Fig. 22－1 Bleeding the fuel feeding circuit

1. Screwdriver 2. Bleeding screw 3. Hand pump

2. Starting of the engine

(1) Starting at normal temperature Put the hand throttle lever 7 in the middle position and turn the pre－heating and starting switch 6 clockwise to the position Ⅱ. As soon as the engine fires properly, return it to position Ⅰ. If the engine cannot be started within 5 seconds, the handle should be turned back to the position Ⅰ and make another attempt after one minute pause. If the engine fails to start after three successive attempts, stop the staring ,find out the cause and get rid of the trouble.

(2) Starting at low temperature In the case of low temperature(below 5℃), start the cold engine with the help of the heater and the decompressor. Set the hand throttle lever at the high－gear position, turn the decompressing lever 24 (Fig. 2－1 and 22－2) rightwards to lower the pressure in the engine cylinder. Push the pre－heating switch 8 into the "pre－heating" position, turn the starting switch 6 counter clockwise to the "pre－heating" position and stay for 15～20 seconds, then turn the switch 6 clockwise to the position Ⅱ, the starting motor drives the engine to race at once. At this time, turn the decompressing lever back, as soon as the engine fires, return the starting switch 6 to the position Ⅰ, and set the hand throttle lever in the low－gear position. Cautions in this operation

are the same as those in the "starting at normal temperature".

(3) Starting in extremely cold weather If the engine fails to start after performing the above－mentioned operations because of extremely low temperature, the following procedures should be carried out:

1) Drain out the oil from the engine oil sump (it would be best to do so when the engine stopped working last time and the oil was warm), heat it to 70～90℃ and make a refilling. While heating the oil, it is neccessary to evenly stir the oil for the purpose of preventing it from being partly heated and deteriorated. After refilling, cranking the crankshaft for several turns.

2) Fully fill the cooling system with hot water of 80～90℃ and drain it out after pausing for a while. Repeat this operation until the drained water reaches 40℃. Then start the engine according to the procedures specified for "Starting at low temperature".

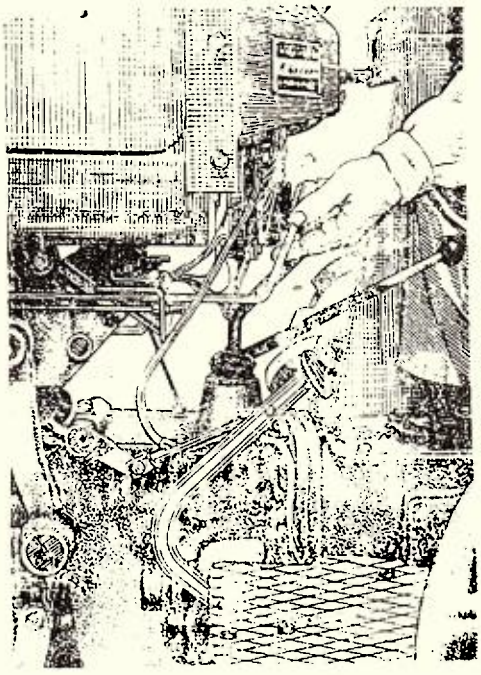


Fig. 22－2 Turning the decompressing lever

Ⅲ. Operation of the tractor

1. Starting the tractor

(1) Before starting the tractor, press the horn button and check if there are any people or obstacles around it.

(2) Release the brake pedal latch so as to release the brake pedal.

(3) Depress the clutch pedal quickly when the engine is running at the low gear, then smoothly shift the main and auxiliary shift levers to the desired positions. The gear shift lever positions are shown in Fig. 22－3.

If the gear is unable to be engaged one time, slightly release the clutch pedal, then depress the pedal and put into gear again.

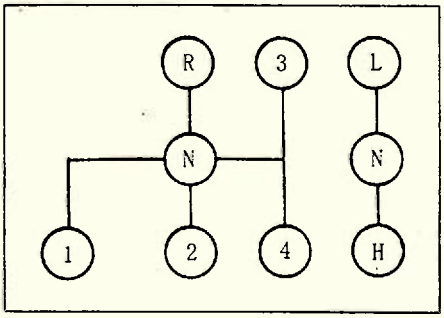


Fig. 22－3 Gear shift lever positions

(4) Accelerate the engine and slowly release the clutch pedal at the same time to get the tractor started smoothly. It is not allowed to release the clutch pedal suddenly, otherwise, it is easy to damage the clutch by the impact, and because the load is added suddenly, the governor cannot adjust the fuel supply rate so as to cause the engine to go dead.

The function of the foot throttle pedal 13 is the same as that of the handle throttle lever 7 (see Fig. 22－1). Select either of them for the operation convenience.

2. Shifting gears of the tractor

(1) In shifting gears, first depress the clutch pedal to make the main clutch released and shift the gearbox shift lever to the desired positions. When the gear needs to be changed from forward to re-

verse, stop the tractor completely.

(2) Select the tractor speed according to the load variation, to make sure that the engine has enough reserve power. When the load is light and very high working speed is not desirable, select the high-range gears with the engine running at a low speed so as to save the fuel. When the engine sound is heavy, the engine speed slows down and there is black smoke out of the exhaust pipe, shift to a lower gear to prevent the engine from being overloaded. Speeds at all gears(design values) and their main uses are shown in the following table.

Table: Speeds and main uses of them

<table>
<tr><td rowspan="2">Gear</td><td colspan="8">Forward</td><td colspan="2">Reverse</td></tr>
<tr><td>Ⅰ</td><td>Ⅱ</td><td>Ⅲ</td><td>Ⅳ</td><td>Ⅴ</td><td>Ⅵ</td><td>Ⅶ</td><td>Ⅷ</td><td>Ⅰ</td><td>Ⅱ</td></tr>
<tr><td rowspan="2">Main uses</td><td>Trans planting</td><td>Harve-sting</td><td colspan="3" rowspan="2">Ploughing</td><td colspan="2" rowspan="2">Harrowing; On-farm transportation</td><td colspan="2" rowspan="2">Road transportation</td><td colspan="2" rowspan="2">Reversing</td></tr>
<tr><td colspan="2">Rotary tilling; Transferring in fields</td></tr>
</table>

Note: Forward gears Ⅰ and Ⅱ can also be used to drive the tractor out of the heavy ground, but not regarded as reserve gears suitable for very heavy work, such as ploughing and harrowing.

3. Steering the tractor

(1) When the tractor needs to turn, lower the speed properly and make the turn slowly, and take care of the turning of the trailer and the matched implement. Pay attention not to make a sharp turn when the tractor is running at high speed, otherwise, it is easy to lead to overturning and other accidents.

(2) In case of making a small turn or turning on the soft ground, sideslip of the front wheels makes the steering difficult, at this time, disengage the two brake pedals interlock plate at low speed and use the single-sided braking to help steering.

(3) When the tractor makes a small turn with a trailer or a matched implement, pay attention to prevent the tractor rear wheels from rubbing and touching the implement, at the same time, notice that because the inner trace or traces of the front and rear wheel are different and the rear wheel trace is closer to the inside, do not turn the tractor too close to the inner side; make sure the inner-side rear wheel can pass smoothly to prevent it from being out of the road or hitting obstacles.

4. Braking the tractor

(1) The braking system of the tractor should be kept in a good technical state. In the transportation operation, interlock the left and right brakes pedals and make the braking on both sides in accordnance to prevent the tractor braking bias.

(2) In the normal cases, according to the terrain and traffic conditions, throttle down the engine and reduce the tractor speed gradually, or first adopt intermittent-braking to reduce the tractor speed to a specific value, then release the clutch and finally stop the tractor with the brakes.

(3) In the special cases, when the tractor needs emergency braking, hold the steering wheel

tightly, throttle down the engine quickly and depress the clutch and the brake pedals at the same time to make the tractor stop in the short stopping distance. Emergency braking is easy to lead to slipping of the wheels, causing serious wearing and damage of the parts, so advice not to adopt it if not necessary.

(4) When the tractor is running at the high speed, do not use the single-sided braking.

5. Stopping the tractor

(1) Throttle down the engine to reduce the tractor speed.

(2) Depress the clutch pedal and at the same time smoothly step down the brake pedals to make the tractor stop smoothly and straightly.

(3) Put the main gear shift lever to the neutral position, then release the clutch and brake pedals. If stop the tractor for a short time, make the engine idle at the low speed, if stop it for a long time, cut off the fuel feeding by pulling out the fuel cutoff lever, then push the lever back after the engine stops.

(4) Cautions:

1) A suitable place should be selected for stopping the tractor.

2) When the tractor is to be parked on the slope, lock the parking latch(see Fig. 22-4) of the brake pedal after the engine stops, meanwhile shift the tractor into gears: on the upward slope, in forward gears and on the downward slope, in reverse gears.

3) When the tractor is parked out-doors, the mouth of the exhaust pipe should be masked to prevent rain water from falling into the cylinder of the engine.

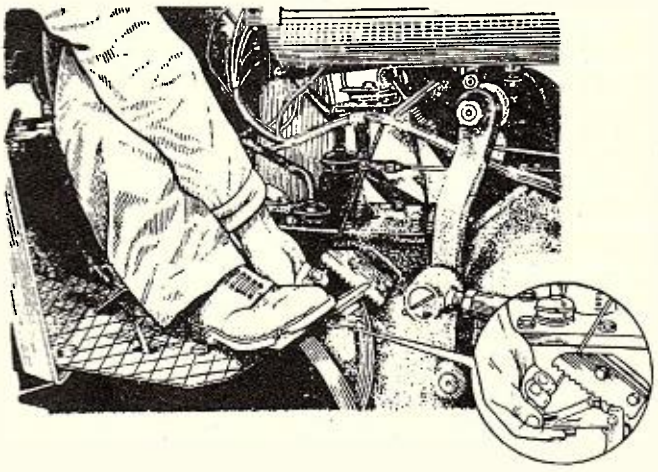


Fig. 22-4 Locking brake with the parking latch

4) When the tractor is to be parked for a long time below 5℃, drain off the cooling water in the cylinder and the radiator to prevent them from getting frozen. Note: open the cocks of the cylinder block and the radiator, at the same time, screw the radiator cover open to facilitate the drain. In cold seasons, for the purpose of completely draining off cooling water in the engine block, before the engine stops, open its cock, make it idle at the low speed for a while, and after having drained off the cooling water, stop the engine, as shown in Fig. 22-5.

5) When the tractor is to be parked for a long time, it is necessary to remove the earth lead of the battery to prevent the battery from being damaged by self-discharge.

6. Backing the tractor

(1) When the tractor runs backwards, shift into reverse gears and try to control the speed at the low gear, meanwhile take care of the conditions around the tractor and see whether there are any people or obstacles. Especially on running backwards to attach the implement, the tractor should be operated with concentration and carefulness, and prepare to brake at any time to avoid damaging the implement or injuring its operator.

(2) When the tractor performs the ploughing operation, equipped with the mounted implement, sometimes for single－line or one－way ploughing, the tractor needs to run backwards for a long distance, at this time, make the tractor run at high reverse gears so as to improve its working efficiency.

(3) It is not allowed for the tractor to run backwards with the towing type implement, otherwise, the implement will be damaged. When the tractor needs to run backwards, equipped with a trailer, operate it carefully. Because the trailer is connected with the tractor by a hinge, it is hard to control its direction on running backwards, therefore, the driver should have enough operation skill and experience.

(4) Steering operation on running backwards is the same as that on running forward, if want to make the tail to the left, the steering wheel should be turned left; if want to make the tail to the right, the steering wheel should be turned right.

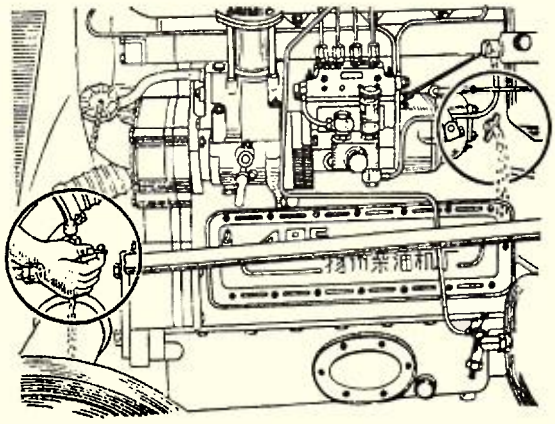


Fig. 22－5 Draining off cooling water

Ⅳ. Attention points for the operations of the tractor

1. If the engine is started with the towing method, make sure that the PTO control lever and the hydraulic pump lever are at the neutral position, the auxiliary gear shift lever is at the high gear position, and the main gear shift lever is at the fourth speed position. The towing speed should not exceed 15 km/h.

2. When driving the tractor, pay attention to the readings of the gauges at any time. The normal values should be as follows:

Water temperature	70～90℃
Oil pressure	0.2～0.4MPa
Ammeter	"0" or slightly lean to "＋"

Do not run the engine for a long time with the water temperature lower than 70℃. If the water temperature is excessively low, the radiator should be shielded with a curtain－type shutter. When it exceeds 95℃, stop the tractor to check.

3. When the tractor needs emergency braking, never use the brake pedals alone. Depress the clutch and brake pedals together so as to prevent the brakes and other parts from being damaged.

4. Select a suitable speed before driving the tractor up or down the slope. When the tractor is running on the slope, neither shifting gears nor sliding is permitted.

5. Do not rest the foot on the clutch pedal while the tractor is running. Do not control the tractor speed with the clutch.

6. When the tractor is pitched up during the operation (pitching takes place when the tractor is working in muddy paddy fields), declutch immediately for unloading to avoid longitudinal overturning.

7. Do not use the tractor for transportation when it is equipped with steel wheels for paddy fields,

but transfering it over a short distance at a speed not exceeding 8 km/h is allowable.

8. When the engine runaway occurs, unloading is not allowed. Just turn the decompressing lever immediately to decompress the engine and at the same time cut off the fuel feeding by pulling out the fuel cutoff lever.

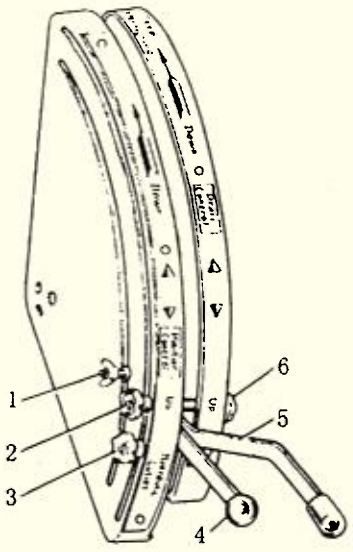
Section 2 Field Operation Techniques of the Tractor

As a power source, a tractor attached with different implements can perform different field operations. Most of the implements that are widely used at present, such as plough, harrow, cultivator and harvester are of mounted type or semi－mounted type, so the driver should master the correct operation techniques of the hydraulic lift hitch.

Ⅰ. Operation of the draft and position control levers

1. Lifting implememt position

When the tractor attached with an implement is running to the fields and making a turn, or is being transferred over a long distance, the position control lever 4 and the draft control lever 5 must be limited in the "lift" range of the quadrant by means of the locking knobs 2 and 6 (Fig. 22－6). At the same time, screw in the adjusting knob for lowering speed to the end. Thus, the implement is locked at the lifting position (Fig. 22－10).



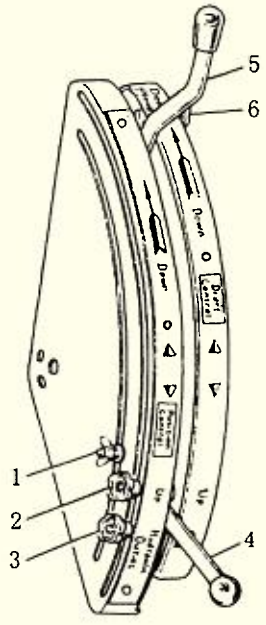


Fig. 22－6 Lifting implement positions **Fig. 22－7 Draft control position**

1. Wing nut 2. Locking knob of position control lever 3. Locking knob of lifting height 4. Position control lever 5. Draft control lever 6. Locking knob of draft control lever

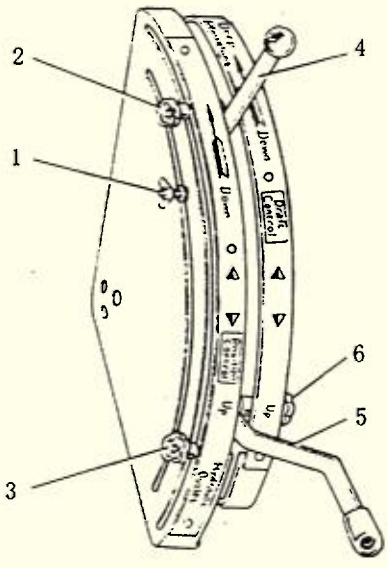
2. Draft control position

The draft control is used when ploughing and other kinds of operations are performed in the fields

where the soil specific resistance is quite variant or on the undulating ground (Fig. 22－7). In this case, the position control lever 4 is limited in "lift" range on the quadrant. The implement is controlled by the draft control lever 5. The implement is lowered with the draft control lever being in the "lower" range and is raised to the height for transferring with the draft control lever being in the "lift" range. The lower the lever is raised, the lower the implement is and vice versa. When the required working depth of the implement is obtained, move the locking knob 6 to the front of the lever and tighten it so that the certain working depth can be maintained with the draft control lever 5 pushed to the locking knob 6, for every falling of the implement during the operation.

3. Position control position

The position control is used for rotary cultivating, harvesting and other operations or for ploughing on the smooth ground and the soil specific resistance is slightly variant (Fig. 22－8). In this case, the draft control lever 5 is limited in "lift" range on the quadrant. The implement is controlled by the position control lever 4. It is lowered with the lever being in the "lower" range and is raised to the height for transportation with the lever in the "lift" range.



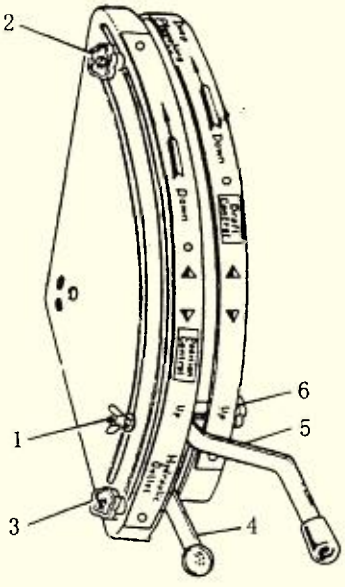


Fig. 22－8 Position control position **Fig. 22－9 Hydraulic outlet position**

1. Wing nut 2. Locking knob of position control lever 3. Locking knob of lifting height 4. Position control lever 5. Draft control lever 6. Locking knob of draft control lever

The movement of the implement is proportional to that of the position control lever 4. The lower the lever is in the "lower" range, the lower the implement is and vice versa. The range of each lowering or lifting operation of the position control lever 4 is limited by locking knobs 2 and 3.

4. Hydraulic outlet position

When hydraulic is delivered to the external equipment (Fig. 22－9), limit the draft control lever 5 in the "lift" range on the quadrant. And turn the position control lever 4 out of the upper end of the

quadrant to "hydraulic outlet" range. Thus, through the hydraulic outlet point on the hydraulic lift housing, the oil flows into the external cylinder under high pressure. If the lever 4 is turned back into the "lift" range, the oil in the external cylinder returns into the hydraulic lift housing.

Note: it is forbidden to place the position control lever at "hydraulic outlet" position when hydraulic outlet is not needed. Otherwise, the safety valve has to be frequently opened, which may cause damage to the parts.

5. Selecting the lowering speed of the implement

During the operation, select a proper lowering speed for the implement according to its weight and the type of soil to avoid the damage of the implement resulting from lowering too fast. The lowering speed of the implement decreases with the adjusting knob screwing in and vice versa. When the adjusting knob is screwed in to the end, the implement is locked at the lifting position (Fig. 22－10).

Ⅱ. Use of the three－point linkage

When the tractor is attached with an implement, it should be first connected to the left－hand lower link, then adjust the length of the right－hand lift rod, as required, by means of the lift rod adjusting lever 3 (Fig. 16－23), so as to connect the implement to the right－hand lower link. After the implement is connected to the top link, adjust the implement by turning the adjusting lever on the top link, it is kept at an appropriate body pitch with the angle generally being 3°～5°in the case of ploughing.

The lower links are equipped with check chains, which, during transporting operation, serve to prevent the lateral movement of the attached implement from damaging the parts or touching the rear wheels, and during ploughing operation, serve to make the implement keep a sideway movement. The required length of the check chain can be obtained by turning the check chain adjusting sleeve 6.

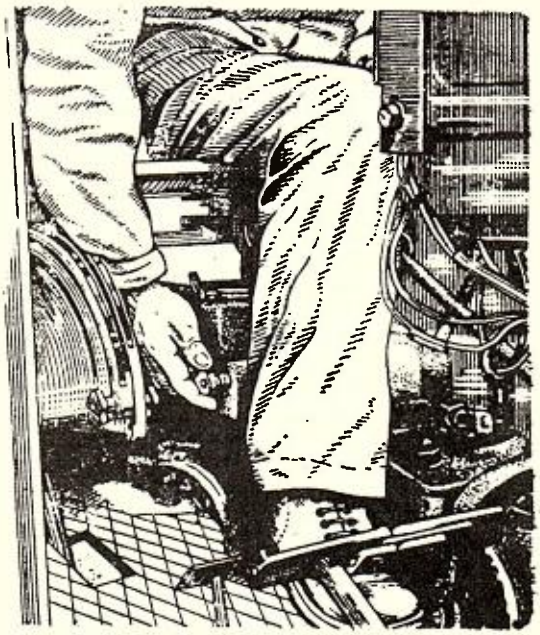


Fig. 22－10 Screwing lowering speed adjusting knob in

Ⅲ. Selecting the connecting point of the top link

There are three connecting holes on the connecting plate of the top link 2 (Fig. 16－23). In the case of the draft control operation, the front end of the top link is generally connected to the middle hole. The connection to the upper hole is for light work. The top link should be connected to the lower hole when performing heavy work and the work is done under position control or by the implement attached with a depth－limit wheel. Never take the three holes on the connecting plate of the top link as a towing hook, as the spring of the draft control may be damaged.

There are two holes on the lower link. In normal condition, the lift rod is connected to the front hole. In this case, the rated lifting force of the hydraulic lift can be obtained at hitch point. The connection to the rear hole is used in special cases, the maximum lifting force can be increased by a per-

centage of 20%.

Section 3 Transporting Operation Techniques of the Tractor

As the power source, through the towing hook, the tractor can drive the trailer to perform on-farm or road transporting. The structure of the towing hook is shown in Fig. 16-26, after a trailer is coupled with the towing hook, lock the pin by inserting the spring locking pin into the hole at the bottom of the pin. In transporting operation, pay attention to the following points:

1. Before transporting, strictly check the tractor and the trailer to see whether their technical state is qualified and make preparations carefully.

2. Start the tractor at the low gear, check if there are any people around the trailer and if there are any obstacles on the road and send out the starting signals.

3. On turning, take care that the trailer can pass smoothly, never make a sharp turn while the tractor is running at high speed and it is forbidden to make a sharp turn by means of the single-sided braking.

4. Pay special attention to the safety problem on slopes. When driving the tractor up or down the slope, neither shifting the neutral position nor sliding with stalled engine is permitted. Select a suitable speed and try to avoid shifting when the tractor is running on the slope; try to avoid braking when the tractor attached with the trailer is running down the slope, otherwise, it is easy to lose control or cause overturning for being pushed by the trailer (if the trailer is equipped with a brake, use the intermittent brake to control the speed).

5. Try to avoid parking on the slopes, if the tractor needs to be parked on the slope temporarily, first depress the brake pedal, then release the clutch. If necessary, stop the engine, then depress the brake pedal, and make use of the engine and the brake to brake at the same time.

6. When starting the tractor on the slope, do not release the brake, first depress the clutch pedal, shift to the low gear and release the clutch pedal slowly. After the driving begins, release the brake and pay attention to fit the throttle control tightly.

Section 4 Safety Regulations

In order to ensure the safety of the tractor/implement and the driver, maintenance personnel should observe the following safety regulations:

1. Perform running-in of the new tractor according to the technical manual and select the suitable implement in operation.

2. Only licensed drivers who observe strictly the traffic regulations are allowed to drive the tractor and the tractor should own its license plate.

3. Drunkers, mental patients, color blindness patients, pragnants and people suffering from serious illness are not allowed to drive the tractor; non-licensed drivers also cannot drive the tractor, trainees must be guided by licensed drivers and accept the training course in the designated places.

4. Start the tractor according to the operation manual. After starting, check carefully to hear if

there are any unusual sounds and observe the readings of all instruments.

5. Drive the tractor at low speed when it is running into or out of garage, up and down the slopes, passing through the bridges, towns, villages, tunnels, ferrying crossings and bent or narrow roads. And learn in advance the load－bearing limit of the bridges, height and width of the tunnels, the slope and the loading capacity of the ferrying boats, only when they are in the safety limit, the tractor can pass.

6. When passing the railways crossing, first observe carefully to ensure there is no train passing; drive the tractor carefully when it is on the railway and never make the engine go dead.

7. Exceeding seating capacity is not allowed and the seats should be fixed. Do not carry people if there are no seats on the implement.

8. When performing the field operations, first learn the terrain, the quality of soil and the operation field area; learn and mark the places of the filled manure pits, the old river courses, the pools and the ditches to prevent the tractor from getting sunk.

9. When performing the field operations, lift or lower the mounted implement in the running process of the tractor, and after having lifted the implement, then make the turn.

10. Before stopping the engine, do not go under the tractor or the implement to maintain the tractor or remove the obstacles.

11. In night operation, the lighting equipment must be in good condition; in driving, it is not allowed to get on or off the tractor, and the driver must concentrate on the driving and not doze off.

12. When performing the stationary operations, the operator is not allowed to leave the tractor t prevent other persons from being close to the driving belts, and women operators should wear safet helmets.

13. When checking the fuel level and adding fuel, keep far away from fire. In dry seasons, a fire－resisting cover should be attached to the end of the exhaust pipe as operating in the places where crop are stacked.

Chapter XXIII Technical Maintenance of Tractor

Section 1 Significance and Objective of Technical Maintenance

In the operational process of the tractor, due to the running, friction, vibration of the parts and changes of load, and soak and corrosion by outside impurities such as muddy water, there will appear the loosening of the connecting components, the wearing, fatigue, ageing of the parts, passages blocked - up by foreign substance and other phenomena, which lead to decrease in horsepower and work efficiency, increase in fuel consumption and poor technical status. In order to avoid the above - mentioned phenomena and ensure the normal operation of the tractor, regularly adopt a series of technical maintenance measures, which include cleaning, check, fixation, adjustment, lubrication or replacement of some parts. The objectives are: to slow the worsening speed of the technical state of each part, to prolong the service life of the tractor, to guard against the accidental damage and to prevent accidents.

Section 2 Maintenance Intervals

The technical maintenance of the tractor is divided into shift maintenance and regular maintenance. At present, there are two usually used methods for measuring maintenance intervals, one is to measure the maintenance intervals according to the working hours, the other is according to fuel consumption amount. The maintenance intervals of Jiangsu Medium - size tractor is classified according to the accumulated load working hours, see Table 23 - 1.

Table 23 - 1 Maintenance intervals table

Accumulated working hours	Maintenance level
8~10	Shift naintenance
125	First class maintenance
500	Second class maintenance
1000	Third class maintenance

Section 3 Rules of Maintenance and Points for Attention

Ⅰ. Shift maintenance

1. Clear off dirt and filth on the tractor and wipe each lubrication filler clean.

2. Check the oil level in the oil sump of the engine and the injection pump, if insufficient, add oil to the regulated height.

3. Check the liquid level in the radiator and the fuel tank, when lacking, add to be enough.

4. Check if there are filth and accumulated water in the fuel sediment bowl, if necessary, clean them. After cleaning, bleed the air in the fuel system.

5. If operate in the dusty circumstances, clean the air cleaner every day.

6. Check the pressure of the tyres and inflate them if insufficient.

7. Check and get rid of the trouble of air leakage, oil leakage and water leakage.

8. Check the external fastening nuts and bolts on the tractor. Pay special attention to the connecting plates, bolts of the lower link, the connecting bolts between the final drive casing and the half shaft housing, between the engine and the front axle bracket, and the bolts in the connecting places of each drive wheel and the web, if there is any loosening, tighten them in time.

9. Before working in paddy field, grease the lubricating nipples according to the lubrication schedule (in dry land operation, the lubrication is performed every other shift). It should be noted that, on injecting grease, the dirt and water must be extruded out until clean grease appears.

10. Screw off the drain plugs at both left and right brakes and at the bottom of the clutch and drain off the deposited oil from the housings. In the case of excessive oil, locate the trouble and remove it (as shown in Fig. 23－1 and Fig. 23－2).

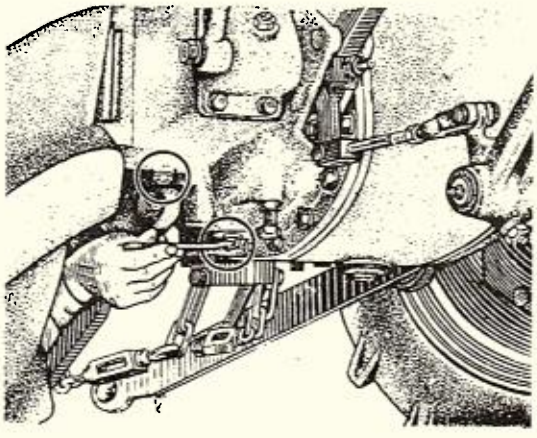


Fig. 23－1 Draining deposited oil from brake housing

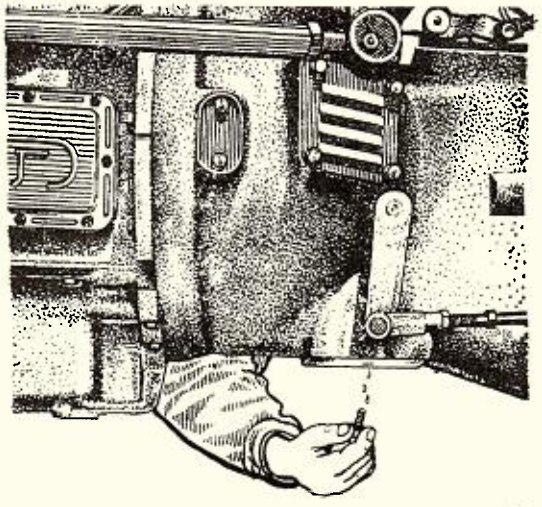


Fig. 23－2 Draining deposited oil from clutch housing

Ⅱ. First class Maintenance

Besides performing the contents in the shift maintenance, the following points also should be done.

1. Check for the tightness of the fan belt and perform adjustment if necessary.

2. Add grease to the grease nipple of the fan water pump bearing.

3. Check the oil levels in the gearbox－rear axle and the hydraulic lift housing and add oil if necessary.

4. Check the free travels of the clutch and both left and right brake pedals, make adjustment if necessary.

5. Check the electrolyte in the battery. The liquid level should be 10～15 mm higher than the pole plates, if not as required, add distilled water. If the insufficiency of the electrolyte is surely caused by accidental splash, add 1.28g/cm^3 electrolyte to the regulated height. At the same time, check if the vent on the battery cap is unblocked.

6. Maintain the oil filter and clean the filter element in diesel. (Note: do not remove the bypass valve).

7. Screw off the air plug and the drain plug of the fuel filter and drain out the sedimentary water and impurity.

8. After the first 100 working hours of a new tractor, perform the following additional maintenance.

(1) Replace the oil in the engine oil sump and the hydraulic lift housing. In replacement, clean their internal cavities and filter screen.

(2) Replace the filter element of the oil filter.

(3) Replace the oil in the injection pump housing.

(4) Check and adjust the toe－in of the front wheels.

Ⅲ. Second class maintenance

Besides completing the contents required for first class maintenance, the followings also should be done.

1. Check and adjust the cylinder valve clearance. Check the cylinder valve sealability and do a lap if necessary.

2. Check the fixation condition of the connecting rod bolts and the main bearing nuts.

3. Check the injection pressure of the injector and atomization of fuel and adjust if necessary.

4. Check and adjust the advance angle of fuel supply.

5. Clear off the deposited carbon in the muffler of the exhaust pipe.

6. Replace the oil in the engine oil sump and clean the sump and the filter screen.

7. Replace the filter element and seal ring of the oil filter and clean the filter housing.

8. Clean or repalce the filter element of the fuel filter, after installation, bleed the air in the fuel line.

9. Check and adjust the free travel of the steering wheel.

10. Check the oil levels in the steering box and the final drive casing and add oil if necessary.

11. Check and adjust the toe－in of the front wheels.

12. Check if the three release lever heads of the clutch are on the same plane. The error should not exceed 0.2 mm and make adjustment if necessary.

13. Check for the tightness of the bearings of the final drive and adjust them if necessary.

14. Check the response pressure of the safety valve in the lift and make adjustment if necessary.

Ⅳ. Third class maintenance

Besides completing the contents required for the second class maintenance, perform the followings:

1. Replace the filter element and the seal ring of the fuel filter.

2. Completely bleed the water in the cooling system, clear off the water scale, then top up it with

clean soft water.

3. Replace the oil in the air cleaner (according to the dust amount in the operation area, properly move up or postpone the replace interval).

4. Replace the oil in the injection pump housing and the lift housing.

5. Drain off the lubricating oil in the gearbox－rear axle housing and the final drive casing, clean the cavities and refill the drained oil in after the clean processing. If the oil is not sufficient, add it.

6. Check the clearance of the main drive gear pair bearings and make adjustment if necessary.

7. Wash the battery with lukewarm water and wipe it clean. Check the electrolyte density and the battery voltage. In summer, the electrolyte density is 1.24～1.27g/cm^3 and the cell voltage is 1.50～1.80V; in winter, 1.28～1.30g/cm^3 and 1.60～1.80V respectively measured with load discharge tester. When finding the unusual discharge, check and repair immediately and charge outside the tractor.

8. Recognize if the engine can continue to operate without check and repair according to its technical state. If necessary, disassemble the related parts of the diesel engine, check and measure the wear of the piston rings, the cylinder sleeve, the connecting rod bushing and the main bushing, etc. Clear off the deposited carbon on the cylinder head, the piston, the piston ring and the cylinder sleeve.

9. Check the working surface of the generator brush and repair or replace it if necessary. Check the collector, if there is oil stain, wipe it off with cloth soaked with gasoline. If there is uneven phenomenon or burr, grind it with "00" abrasive paper and remove the filings. If the burning of the collector amounts to 0.5 mm and above, repair has to be performed.

10. According to the wear of the front wheels, decide whether to exchange the left and right wheels or not.

Ⅴ. Points for attention

1. The rules for maintenance are worked out according to the change law of parts technical state during the operational process. The drivers should follow the rules and maintain the tractor on time, on item and on quality. Especially in the busy operation seasons, do not greatly cut the maintenance contents or prolong the maintenance intervals at will with the excuse of being busy.

2. The rules for maintenance are drawn up according to the general operation conditions of the tractor, but under the special conditions, the technical state is obviously influenced. At this time, properly change the maintenance contents or intervals according to the actual circumstances. For example, when operating in the dry windy and dusty season, the maintenance intervals of the air cleaner should be shortened, however, when operating in the southern paddy field, it should be appropriately extended.

3. It would be best to perform the high class maintenance indoors, especially when maintaining the internal parts, for which have to be avoided from the environmental pollution.

4. Some technical－intensive and complicated maintenance operation or adjustment should be performed by expert technical personnel or specialized workshop. For the technical maintenance lubrication schedule of Jiangsu Medium－size tractor, see (Appendix E table E－3.)

Section 4 Fuel and Cooling Water for Tractor

Ⅰ. Fuel

Oil that is usually used by tractors includes diesel, lubricating oil and grease. To learn and master the property of the oil most in use, to properly choose and apply and to tighten its management are the important steps to ensure the normal operation of the tractor, to prolong the service life and to decrease the operating cost.

1. Diesel

Diesel is the main fuel of the tractor and it is divided into two types: light diesel and agricultural diesel.

(1) Light diesel

According to condensation point, light diesel is divided into 10, 0, −10, −20, −35, −50, six numbers. The condensation point refers to the temperature when fuel loses fluidity. The higher the number is, the lower the condensation point is. The selection of the diesel is determined by the engine speed and the local temperature. Light diesel applies to the high − speed engine of more than 1000r/min. and the applied number should be 5～10℃ lower than the actual temperature.

(2) Agricultural diesel

This kind of diesel has low price and high condensation point and contains relatively more wax grease. The other indexes are basically the same as those of No. 0 light diesel. The agricultural diesel is divided into agricultural No. 1, agricultural No. 2 and agricultural No. 3. At present, Agricultural No. 2 diesel is mostly in use and its condensation point is 20℃. When applying agricultural diesel in winter and spring, the pre − warming device has to be used.

2. Lubricating oil

Lubricating oil is mainly applied on the surfaces of the parts doing mutual friction motion to reduce their wearing, performing the functions of lubrication, cooling, cleaning and antirust. It is divided into motor oil and gear oil.

(1) Motor oil

Motor oil is divided into two types: gasoline engine oil (motor oil for vehicle), used for the carburetor engine lubrication system and divided into No. 6, No. 6D, No. 10, No. 15; diesel oil, being the special − purpose motor oil.

Because the diesel engine has high compression ratio and high temperature and its antiwear alloy bearings are easy to be corroded, the motor oil for it has to possess high quality. Apply the special − purpose oil and do not replace it with gasoline engine oil. The motor oil for diesel engine is classified into No. 20, No. 30, No. 40 according to kinematic viscosity. The bigger the number is, the higher the viscosity is, used in the warm season; the smaller the number is, the lower the viscosity is, used in the cold season.

(2) Gear oil

It is a kind of high − viscosity black motor oil and mainly used to lubricate the gears and bearings in the gearbox, rear axle, etc. According to kinematic viscosity, it is divided into No. 20 and No. 30.

No. 30 is used in summer while No. 20 is used in winter. The steering box of Jiangsu－500 tractor is filled with gear oil.

3. Grease (hard fat)

It is a kind of dry and soft yellow fat and used for bearing lubrication. Grease is divided into calcium base grease, sodium base grease and calcium sodium base grease. Calcium base grease is waterproof but does not resist high temperature (used below 60℃) and it is generally used. Sodium base grease is not waterproof but resists high temperature and generally used in the places without water and of high temperature, which is 100～135℃. Calcium sodium base grease is waterproof and resists high temperature, used in the range of 85～100℃.

Add 3%～5% molybdenum sulphide powder into the grease, then it is made into molybdenum sulphide grease, which can be used to improve the lubrication and extent the maintenance intervals.

4. Fuel management

(1) Fuel must be stored in the closely covered way to prevent evaporation and deterioration caused by rain water. In addition, it should be far away from the fire sources to avoid fire.

(2) Fuel should be kept clean. Fuel in big tank can be used after 96 hours of precipitation and fuel in canister should be precipitated for 48 hours. When refueling, adopt the sealed refueling. It is strictly forbidden to add the fuel below the 20 cm surface from the canister bottom into the fuel tank of the tractor.

(3) Keep the refueling tools clean. The canister and the funnel used for refueling should have filter screens and be sealed to preserve after using. In addition, regularly clean the tank and the canister.

(4) Economize on fuel and adopt all kinds of technologies to stop up the oil leakage points and recover the waste oil. Make the full use of the effective power of the tractor and reduce the idle motion to improve the economic benefit.

Fuel, lubricating oil and grease for Jiangsu Medium－size tractor, see Appendix E Table E－2.

Ⅱ. Water for tractor

It would be best to use clean soft water (such as rain water, snow water) as cooling water so as to prevent the cooling system of the engine from producing incrustation. If use hard water (such as well water, spring water, river water), boil it to make it softened before using.

Water used by the battery is distilled water.

Chapter XXV Tractor Diagnosis and Trouble Shooting

Section 1 Tractor Diagnosis

Ⅰ. Trouble symptoms

All kinds of the tractor troubles possess one or several peculiar manifestations, which are called trouble phenomena or symptoms. There are approximately six kinds of symptoms:

1. Function being abnormal

For example, difficult to start, failure in lifting under heavy load and heavy steering, etc.

2. Sound being abnormal

For example, the sound of knocking cylinder, unusual sound in the rear axle, etc.

3. Temperature being abnormal

For example, the engine overheated, high oil temperature of the gearbox or the lift, overheated brake or clutch, the generator being overheated, etc.

4. Appearance being abnormal

For example, white smoke from the exhaust pipe, the front wheel shaking, the lift shaking, a great amount of bubbles in the hydraulic system, and the circuit being abnormal when checking with the test bulb.

5. Smell being abnormal

For example, the friction disks of the clutch or the brake and the insulating material of the electrical equipment are burnt and give off the foul smell.

6. Consumption being abnormal

For example, excessive consumption of fuel, oil and cooling water, unusual change of the oil level in the lift, etc.

The trouble of the tractor is usually followed by several symptoms. For example, if the draft control of the lift is not sensitive, the trouble is usually accompanied by several symptoms, for example the bottom of the furrow appears the saw tooth shape on ploughing, the plough fluctuates up and down within a wide range, while under load the sound of the engine is sometimes heavy and sometimes light.

Ⅱ. Principles for trouble analysis

There are two types of trouble causes.

The first type is troubles caused by wear, corrosion, fatigue, loosening and blocking of parts. This type belongs to natural causes and the troubles caused by these usually come into being in a slow process.

The second type is troubles caused by human being, which include manufacture, repair quality, improper maintenance and adjustment, improper operation and insufficient supply of fuel or other things. This type of troubles usually come into being in a short time, even suddenly.

In the case of lacking experience, analyse the troubles according to the following principles: from simple to complicated; from surface to inside; first common then rare; first distinguish the system and the mechanism that have trouble, then according to the system check at each section and eliminate

some possible causes which are not consistent with the fact through logic analysis, finally find out the realcauses. However, there is no need to apply the principles mechanically in the working process. For the experienced person, based on the full exposition and the thorough observation of the trouble symptoms and strict logic analysis, they can directly disassemble and check the parts concerned if they can determine the cause for certain.

Ⅲ. Method of trouble diagnosis

To make the trouble symptoms clear is the prerequisite to the trouble analysis and shooting, therefore, all kinds of methods are generally adopted, such as interrogation, auscultation, observation, feeling, smelling and control, and at present, the checking method without dismantling is also popular.

In order to make it easy to analyse and diagnose the troubles, some simple methods are often adopted, for example, the method of changing working conditions, partially stopping mehtod, comparison method, exploration method , disproof method and logic analysis method.

1. Method of changing working conditions

The symptoms of some trouble sometimes are hidden, sometimes appear, being difficult to ascertain. In fact, this usually has relationship with the working state (working condition) of the tractor, such as speed, temperature, pressure, time, load, oil and other elements. therefore, consciously change these elements to completely expose the symptoms, thus finding out the trouble cause.

For example, when finding the lift lacks strength in the lifting process, change the speed, oil temperature and load elements to help define the cause. Another example, change the throttle repeatedly to make the knocking sound of the engine more clear.

2. Partially stopping method

Partially stopping method is to stop the operation of some section or some parts for a short period to observe the changes of the trouble symptoms or make them being clearly exposed so as to determine the exact position or parts with the trouble.

For example, when judging the trouble of a multi－cylinder engine, often adopt the cylinder stopping method, that is, stop supplying fuel for the cylinders one by one, distinguish the changing of trouble symptoms, then decide which cylinder is in trouble. Another example, when judging the abnormal noise from the chassis, cut off the power section by section, distinguish the change of noise to make sure the position of the noise.

3. Comparison method

Comparison method is to replace the suspected parts of the tractor with those of normal technical state or exchange the same parts with each other and judge their technical state by comparing the changes of the trouble symptoms.

For example. exchange the injector assemblies of two cylinders to see if the trouble symptoms shift so as to determine the techanical state of the injectors. This method can also be adopted with suspected parts of electrical equipment.

4. Exploration method

When arousing suspection about some place, adopt exploratory adjustment or exploratory remedies to try to change its technical state or working condition and observe the changes of the trouble symptom to confirm whether there is trouble in the suspected position.

For example, when the ammeter shows the charging current is insufficient and the regulator adjustment of the thyristor generator is suspected to have problems, tighten the adjusting spring of the regulator. If the charging current becomes huge, the spring is proved to be too loose.

5. Disproof method

By means of positive proof or positive reasoning, a preliminary conclusion has been made, however, in order to be cautious, sometimes the disproof method needs to be used to test if there is contradiction with the preliminary conclusion.

For example, knowing the tractor is out of power on lifting, the static lowering is good in testing. In order to make the problem analysis simple, simplify the lift into three parts: the hydraulic pump in the front, the connector in the middle and the oil cylinder distributor at the back (see Fig. 16 -17a,b). After the exploratory disassembling and check, the middle connector is proved to be good, and after the logic analysis of the oil line diagram, the hydraulic pump is determined to have problems.

Now make a disproof. If the gear pump is considered to be good, it contradicts with being out of order on lifting; if the distributor is thought to be bad, then it contradicts with the good static lowering. Therefore, the disproof method also shows there is trouble in the gear pump.

6. Logic analysis method

As to some special troubles that have not appeared before, it is not easy to find out the cause with the common mehtods, then the close logic analysis method should be adopted.

For example, one tractor performs good lifting qulity in the test of lifting one - ton blocks in the factory, but when lifting the plough in the field, it fails.

By means of interrogation, both the hydraulic pump and the distributor of this tractor are good on the testing table. According to the logic analysis, the problem lies in their different working states. When lifting the heavy blocks, they are connected on the lower link (two - point connection); when it ploughs the field, the plough is connected on the lower link and the top link (three - point connection). Obviously, there is one more point (top link) to bear the pulling force and that is the basic cause of being unable to lift. Then according to the structure analysis, the possibilities of generating this phenomenon are the adjusting plug of the draft control spring (No. 36 in fig. 16 - 19) becomes seriously loose or the 3.5 mm clearance between the draft control pendulum lever and the main control valve is adjusted into a negative value by mistake.

Section 2 Engine Common Trouble and Remedies

Ⅰ. Diesel engine is difficult or unable to start

Starting of the diesel engine must satisfy the following requirements: all parts are installed reliably; the electrical system circuits are connected correctly and there are no loose connectors; no air enters the fuel system; the combustion chamber should be supplied with enough well - atomized diesel fuel and fresh air; the starting motor should possess enough speed and there are qualified high pressure and high temperature after the compression stroke is completed.

In the general conditions, the engine can be started only one time, however, if not, after the starting motor armature and the diesel engine flywheel stop turning completely, make another attempt. If

the engine fails to start after several successive attempts, which means it is difficult or unable to start, find out the trouble causes and get rid of them before re－starting. The trouble can be checked from the following respects.

1. The speed of the starting motor is too low and the starting is out of power, which cause that the fuel cannot be fired because of too low temperature and pressure after the piston compression stroke is completed. Treat it by "poor quantity of electricity for battery or starting motor trouble".

2. On starting, the diesel engine does not fire properly and has not exhaust smoke, but if the starting speed is normal, it means that the injection system does not supply fuel. The trouble can be checked from the low pressure fuel line to the high pressure fuel line. For example, there is insufficient fuel in the fuel tank and the vent is blocked; if air gets into the fuel system, bleed the air in the fuel filter and the injection pump; check and see whether the fuel supply line is blocked, pressed flat or folded, which prevents fuel from flowing smoothly; if the filter is blocked so that there is no or insufficient fuel in the fuel line, clean or replace the filter element; if the fuel supplied for the fuel pump is insufficient because of the fuel pump trouble, repair the pump in time; if the injection pump does not supply fuel, send it to the factory for repair.

3. On starting, if the exhaust pipe sents out thick white smoke, which means the incomplete combustion of the diesel fuel, check the injector and the advance angle of fuel supply. If the injection pressure of the injector is too low and the atomization is poor, check if the injector is seized or the injector needle valve is worn.

Both big and small advance angle of fuel supply will lead to low injection pressure and poor atomization of fuel, so if there is no trouble in it, check fuel angle of fuel supply.

4. When turning the crankshaft, feel the compression pressure of the cylinder is insufficient, and on working see too much gas come out of the crankcase breather or the filler. Wearing and seizing of the piston ring and air leakage from the valves will lead to decrease in compression pressure of the cylinder.

5. If the air cleaner and the air intake pipe are blocked, the fresh air cannot enter the cylinder smoothly, then the engine will be difficult or fail to start.

6. The temperature is too low, but have not taken necessary measures. In extremely cold seasons, add hot water, heat oil or pre－heat the diesel engine.

7. In winter the low－numbered oil is not used, the oil viscosity is too high and the starting resistance is too huge so as to make it difficult to start the engine.

Ⅱ. Engine stops itself after turning a few turns

1. Air enters the fuel system. The air in the fuel line affects the continuity of fuel supply, and causes unsteady running, even stops the engine. Check and bleed the air in the fuel line.

2. Stopping of fuel supply causes the engine to go dead. For example, the diesel filter and the fuel pipes are blocked.

3. Bushing burnt or cylinder sleeve scratched causes the engine to stop. When cranking the crankshaft with hands, feel fairly heavy or unable to turn.

4. If the air cleaner is blocked, check the filter element and replace it if necessary.

Ⅲ. Bushing burnt

The diesel engine stops suddenly in the running process, the crankshaft cannot normally operate and the main bearing bushing or the connecting rod bushing is burnt.

1. The oil pressure is low or there is no oil pressure. The bearing surfaces lack or have no lubricating oil, which leads to bushing burnt.

2. If deteriorated or dirty oil is used, replace it.

3. The bearing clearance cannot satisfy the technical requirements. Too big clearance causes leakage of lubricating oil; too small clearance cannot ensure that the lubricating oil film is formed. Keep the normal clearance, check and adjust it in time.

4. In assembly, there are iron filings or other impurities left on the surface of the bearing bushing.

5. If the tractor operates with overload for a long time, the engine overheating will lead to bushing burnt.

Ⅳ. Cylinder sleeve scratched

Cylinder sleeve scratched refers to the cylinder sleeve and the piston being mechanically damaged and even the piston being seized in the cylinder.

1. The normal clearance of the motion parts are damaged because of the overheating of the engine.

2. The fitting clearances among the cylinder sleeve, the piston and the piston ring are too small.

3. The piston ring is broken.

4. The piston pin shield ring loses its function so that the axial moving travel of piston pin is too large and the scratching marks are left on the cylinder sleeve surface.

If the above-mentioned phenomena occur, find out the causes and get rid of them, if necessary, replace the trouble parts.

Ⅴ. Diesel engine power is insufficient

Under the rated load, the engine runs at low speed and exhausts black smoke, which means the diesel engine is lack of power. There are many causes to lead to the trouble, so find out the causes according to the concrete condition and get rid of the trouble in time.

1. Air enters the fuel system, the engine runs unsteadily and the horsepower decreases.

2. The air cleaner is blocked, which causes that the air intake resistance increases, the inflated air is insufficient, the black smoke is exhausted and the engine power is lowered.

3. The fuel filter is blocked, which results in lack in fuel supply.

4. The overheating of the engine causes the engine power to lower.

5. Air leakage from the valves leads to insufficient compression pressure of the cylinder.

6. The valve clearance is too big or too small.

7. The connecting face of the cylinder head and the block leaks air. Check if the connecting faces of the cylinder gasket and the cylinder head and the block are flat.

8. The injector needle valve pair is worn seriously, which results in low injection pressure and poor atomization of the fuel.

9. The piston ring is excessively worn, causing insufficient compression pressure of the cylinder.

10. The trouble of the injection pump or the governor leads to insufficient fuel supply and low rated speed. Check the injection pump and the governor in time.

11. The advance angle of fuel supply is incorrect.

12. The exhaust pipe being blocked is usually caused by too much deposited carbon.

Ⅵ. Diesel engine exhausts black smoke

Exhausting black smoke means the incomplete combustion of the fuel and a lot of carbon being exhausted. All possible causes should be thought over, for example, the mixing proportion of the diesel fuel and the air is not correct (overrich mixture); the parts are not adjusted well and not in the good technical conditions.

1. The air cleaner or the air intake pipe is blocked, as a result, the air－intake resistance increases, at the same time, the air supply amount reduces and the fuel combusts incompletely.

2. The injector needle valve pair is seized, the diesel engine exhausts thick smoke and there are unusual sounds. In general conditions, it is impossible for all four injectors to have the same trouble, so the trouble can be checked by the cylinder cut－out method.

3. The valve clearance is incorrect, the valve stem is not flexible or the valve and the valve seat are not tightly sealed.

4. The injector needle valve is not well sealed and there are serious fuel leakage, poor atomization and low injection pressure phenomena, all of which cause the incomplete combustion.

5. Too much fuel supply amount of the injection pump causes the incomplete combustion of the fuel so as to exhaust black smoke.

6. The advance angle of fuel supply is too small, the time of the fuel injection is too late, even part of the fuel is combusted in the exhaust pipe, which cause the engine to exhaust black smoke and the flame to appear.

Ⅶ. Diesel engine exhausts blue smoke

Exhausting blue smoke from the exhaust pipe means that the oil enters the combustion chamber and is burnt to send out blue smoke.

1. The oil level in the oil sump is too high, a lot of oil splashes to the cylinder sleeve and part of the oil enters the combustion chamber to be burnt. The oil level in the oil sump should be between the upper and lower graduations of the dipstick.

2. The piston ring is worn seriously or seized to make oil flee; the 2nd and 3rd rings are mounted oppositely; the piston upper oil－return hole is blocked by deposited carbon.

3. The valve guide is worn seriously, through which oil leaks into the cylinder to be combusted.

4. The cylinder sleeve is worn seriously.

5. The cylinder sleeve and the piston ring in the new or newly overhauled tractor engine have not been ground－in well; oil flees to the combustion chamber so that blue smoke is exhausted. After they have been ground－in correctly, the blue smoke will disappear.

Ⅷ. Diesel engine exhausts white smoke

Exhausting white smoke means that part of the fuel spray is not burnt or the steam is exhausted from the exhaust pipe, appearing white smoke.

1. Too low engine temperature makes part of the fuel sprayed into the cylinder unable to be burnt so that white smoke is exhausted.

2. There is water in the fuel or because the cylinder head gasket is damaged and the bolts have not

being tightened to the rated tightening torque, the cooling water enters the cylinder, and white smoke is exhausted.

3. The time of fuel supply is too late, the engine cannot be started, so when driving the engine with the starting motor, white smoke is exhausted from the exhaust pipe.

Ⅸ. Diesel engine gives out abnormal sounds during operation

During the normal operation, there are clear and even sounds in the engine. If there are abnormal sounds, find out the causes according to the different sounds in different parts.

1. The advance angle of fuel supply is too big, the fuel supply time is too early, and there are regular and clear knocking sounds in the cyliner.

2. The advance angle of fuel supply is too small, the fuel supply time is too late, and there are low and irregular knocking sounds in the cylinder.

3. The clearance between the piston and the cylinder sleeve is too big, and there are muffled lick sounds, sometimes like the scraping sounds, which will disappear after the engine becomes heated in the running process. If cut－out the cylinder for 3～5 seconds, the sound will also become weaker.

4. The clearance between the piston pin and the connecting rod bushing is too big and there are shrill clank sounds. When the engine runs at idle speed, the sounds are clear, especially as being heard from the left upper part of the engine. When the load and the speed increase, they will become louder.

5. The connecting rod bearing clearance is too big, when the engine speed is suddenly lowered from the rated one, there will be deep and strong knocking sounds. At this time, the oil pressure will obviously decrease.

6. The clearance of the crankshaft main bearing is too big and low and deep impact sounds can be heard in the place of the crankshaft main bearing of the cylinder block.

7. The valve clearance is too big and there are continuous metal knocking sounds. When the engine runs at low speed, the sounds will become clear and change with the change of the engine speed.

8. When the valve collides with the piston top, there are clear and regular knocking sounds. If put the fingers on the cylinder head cover bolt, the shake produced by the collision can be felt. The common causes include: the timing phase is not correct, the valve spring is broken and the valve falls to be collided by the piston when the piston moves up. At this time, the engine power will decrease obviously and black smoke is exhausted.

9. The timing gears are worn seriously, and the gear backlash is too big, when the engine speed is suddenly lowered, there are knocking sounds of the gear faces. If the gear backlash is too small, not only there are abnormal gear meshing sounds, but also the engine power decreases.

Ⅹ. The oil pressure is low or there is no oil pressure

The pressure value in the oil pressure gauge is the main oil passage pressure. A specific pressure value should be kept when the engine is running, and after it has been started, check the oil pressure gauge immediately, if there is no pressure, stop the engine to check. Otherwise, the parts will be worn seriously, even causing accidents.

1. There is no oil in the oil sump or the oil level is too low.

2. The oil pressure gauge is out of order or damaged.

3. The oil suction strainer is blocked and the oil suction resistance increases so as to make the oil

pumping amount decrease.

4. The lubricating oil passage is blocked and the oil cannot enter the main oil passage.

5. The oil filter elements are blocked and the safety valve is out of order, so that the oil cannot enter the main oil passage. Perform check and repair, if necessary, replace the filter elements and the safety valve.

6. The opening pressure of the pressure adjusting valve is low and the oil pumping amount decreases. The opening pressure of the pressure adjusting valve can be adjusted. If the pressure adjusting valve spring is broken or the steel ball and the valve seat are not tightly sealed, make replacement or repair.

7. The oil viscosity is too high and the oil suction resistance is big.

8. The oil pump is worn seriously and the clearances in several regulated places are too big, which cause the oil pumping amount to decrease.

9. The fit clearances of the lubricating parts are too big. Especially the crankshaft main bearing and the connecting rod bearing are worn seriously and the bearing clearances are too big, so that oil leakage increases and the main oil passage pressure is lowered.

10. The engine is overheated, the oil temperature is too high and the oil becomes thinner. Check the causes for the engine being overheated and remove the trouble, if necessary, replace the oil.

Ⅺ. Oil pressure is too high

When the engine runs at rated speed of 2000r/min, the oil pressure should be 0.2~0.4MPa. If it increases gradually during the operation, check and remove the trouble. The main causes include:

1. The oil cannot satisfy the requirements, it is so thick that the oil pressure of the main oil passage increases. Different oil should be selected in different seasons. When the engine is started at cold, the low temperature and the thick oil will cause the pressure of the main oil passage to increase. As the temperature rises, the oil pressure will return to the normal, which is a normal phenomenon.

2. The opening pressure of the oil pump adjusting valve is too high, at normal speed the oil return amount is small and the oil amount in the main oil passage increases, so that the oil pressure increases. The adjustment of the pressure adjusting valve should be based on the oil pressure gauge being correct.

3. The safety valve is incompletely sealed and the opening pressure is too low. As for a long period part of the oil does not pass through the oil filter and directly gets into the main oil passage, the oil pressure of the main oil passage is increased.

4. The lubricating oil passage is blocked or the fit clearance of the crankshaft main bearing or of the connecting rod bearing is too small. Check and remove the trouble in time to avoid the serious accidents.

Ⅻ. Oil temperature is too high

The normal oil working temperature should be 10℃ lower than the water temperature. If it is too high, the oil viscosity will be decreased, not only influencing the lubrication, but also easily leading to oxidation. The main causes include:

1. The diesel engine runs in the overload state for a long time.

2. There is too much oil in the oil sump and the crank violently stirs the oil, which cause the oil temperature to rise.

3. Air leakage from the compression system makes the high – temperature gas flee into the crankcase.

4. The oil pumping amount of the oil pump is insufficient, the oil circulation radiation function weakens, so that the oil temperature is too high.

XIII. Oil consumption is too much

The rated oil consumption of the diesel engine should not exceed 1.84g/kW·h. Too much oil consumption not only wastes oil but also leads to the engine trouble. The main trouble causes include:

1. There is oil leakage in the crankshaft oil seal and other gaskets, oil passage connectors, etc.

2. Oil is burnt, for the trouble causes, see "diesel engine exhausts blue smoke".

XIV. Oil level in oil sump rises

Rise of the oil level in the oil sump is an abnormal phenomenon. When the diesel engine is running, the oil only will become less, and it is impossible for it to become more automatically. If the oil becomes more, it is because the cooling water enters the oil sump or there is diesel flows into it.

When judging it is water or diesel that enters the oil sump, take oil out from the oil sump, put it into the glass and make it quitely stay for one hour, if there is water sediment, it means that it is water that enters the oil sump, at this time, the oil appears yellow foam ; if no water, it means it is diesel fuel. In addition, if there is water in the oil, when the engine is running, there is yellow foam flowing out of the filler.

The causes of cooling water entering the oil sump include:

1. The cylinder head gasket is not installed correctly or damaged and the cooling water leaks into the oil sump.

2. The cylinder head or block cracks make the cooling water leak into the oil sump.

The main trouble cause of diesel fuel entering the oil sump is the fuel system trouble, such as internal leakage of the injection pump, etc. Find out the cause and remove the trouble in time.

XV. Diesel engine is overheated

When the diesel engine is overheated, that is, the water temperature is higher than 98℃, the load should be removed to make the engine idle for some time, and after the water temperature has lowered, stop the engine to check. The trouble causes include:

1. Lack in cooling water causes the engine to be overheated, at this time, add enough cooling water in time. In order to avoid the trouble, before starting the engine, add enough cooling water, and pay attention to checking and eliminate the water leak.

2. The fan rubber belt is loose and easy to slip so as to make the speed of the water pump and the fan lower, thus, decreasing the flow rate of the water pump and the wind rate of the fan and weakening the cooling function. At this time, adjust the tension of the fan rubber belt in time, if the belt is damaged, replace it.

3. Working in the overload state for a long time makes the water temperature higher than 98℃, so the load should be reduced.

4. The water temperature gauge is out of order and the readings are not exact.

5. There is too much scale in the cooling water jacket, the radiator is blocked, and there is deposited dust on the radiator fins, which lead to blocked water flow and poor radiation.

6. The pump trouble and the insufficient water－pumping amount lead to too high water temperature.

Ⅵ. Diesel engine speed rapidly increases(runaway of diesel engine)

When the diesel engine speed suddenly rises over the maximum value with unusual sounds, the runaway occurs. At this time, do not be too nervous, take the following measures at once: close the throttle, close the diesel fuel line switch or block the air intake pipe, and decompress the engine.

The main causes include:

1. The injection pump is not adjusted properly.
2. The governor spring is broken.
3. The pull rod spring comes off.

According to the concrete causes, take the corresponding repair measures.

Ⅶ. Engine speed is unsteady

The cause of unsteady engine speed is the governor trouble, such as permanent deformation of the governor spring, poor governor spring rigidity and huge governor motion parts resistance, etc. At this time, the tractor should be sent to the factory to repair. In addition, the big axial clearance of the injection pump camshaft and too much deposited carbon in the injector will also lead to unsteady speed of the engine. The axial clearance of the camshaft can be adjusted and the deposited carbon can be cleared off if it is serious.

Section 3 Chassis Common Trouble and Remedies

Ⅰ. Clutch trouble (see Fig. 12－3):

1. Clutch slip

Symptoms:

(1) Starting is difficult. When the tractor with no load is started at the Hi－Ⅳ gear, it cannot be started immediately, the loading sound of the engine is soft and there is no clear smoke.

(2) When the tractor is operating with load, if the load is added, the tractor speed will be lowered quickly, but the engine speed is not lowered.

(3) The clutch slips when the tractor is running under heavy load, at this time, there are special hum sounds and the smoke with burnt foul smell comes out of the clutch inspection window.

Causes:

(1) There is no clutch pedal free travel. In the operational process, due to excessive wear of the friction disk and the pressure plate, the pedal free travel gradually reduces, even disappears, if serious, the clutch can be made in the semi－engagement state, causing it to slip. At the same time, the release bearing is easy to be burnt out because it rotates with the clutch for a long time.

(2) On driving, rest the foot on the clutch pedal or lower the tractor speed by means of the semi－disengagement of the clutch.

(3) The friction disk is stained with grease dirt. Screw out the drain plug in the lower part of the clutch and see if there is any deposited oil. If there is, it can be distinguished from the color whether it is from the rear part of the engine or the front part of the gearbox. If there is little oil deposit, wash

the clutch with kerosene or gasoline.

(4) The clutch surface is hardened and burnt because the clutch slips seriously, and the rivets appear, the surface of the pressure plate is worn and become uneven, which causes the friction coefficient to decrease further. If the clutch slips seriously under the action of high temperature, the disk spring will lose elasticity because of the annealing of the spring, which exacerbates slipping of the clutch, so it is not suitable for a trouble clutch to go on working. Try to avoid overloading, especially when the tractor is slipping or is sunk in a pitfall, it is not allowed to release the clutch suddenly in order to rush out of this area.

2. Incomplete disengagement

Symptoms:

(1) Knock－on teeth in gearbox. The driving gears of Model of Jiangsu－500 tractor gearbox are not soaked into the oil and lack of oil resistance, so after having depressed the primary clutch and cut off power, the driving gears can still rotate for several seconds under the action of inertia. So when gearing up the first time, a light sound of knock－on teeth is permissible; do not release the clutch and gearing up for the second time, there should be no such sound, otherwise, it is incomplete disengaged.

(2) When the main clutch does not disengage seriously, the tractor can go on running under no load after gearing up and depressing the clutch pedal.

(3) Depress the clutch pedal to the extreme position, that is, when the auxiliary clutch is released, if the PTO shaft cannot stop turning, that means the auxiliary clutch cannot be disengaged thoroughly.

Causes:

(1) The clutch pedal free travel is too big, which causes insufficient actual disengaging travel.

(2) Three release lever heads are not in the same plane, or the clearances between three adjusting nut end faces and the main clutch pressure plate is not the same as 1.5 ± 0.05 mm, and the pressure plate will be in inclination state while the clutch pedal is depressed (Fig. 12－7).

(3) The travel from the release lever head to the flywheel outer end face is smaller than 89^{+1} mm, which shortens the actual disengaging travel (Fig, 12－8).

(4) After repairing, the friction disk assy. is excessively thick.

(5) Because the clutch often slips or always start the loaded tractor sharply, the driven plate is deformed and the friction disk is cracked, even the fragments fall into the clutch.

(6) The support pin is loose and the release lever is damaged.

(7) When the tractor performs operations in paddy fields or crosses the river, if the drain plug is not tight, the clutch will be blocked by mud or the spline shaft will get rusted, which causes that the driven plate cannot slide smoothly along the spline shaft.

(8) The new tractor has parked for a long time and the friction disk sticks to the flywheel and the pressure plate.

Remedies: gearing up first, depress the clutch pedal to the end, at the same time, depress the brake pedal, after decompression , cranking the crankshaft, strike the clutch with a wooden bar to force the friction disk disengaging.

(9) Incomplete disengagement which causes insufficient actual disengaging travel often occurs to

the auxiliary clutch, the main cause is that the clearances between the three adjusting nut end faces and main clutch pressure plate are adjusted too big (exceeds 1.5 ± 0.05 mm) or the three clearances are not the same. And sometimes the deformation of the clutch housing and the release lever caused by the decreasing of their rigidness makes insufficient release clearance.

3. The release bearing is burnt out and the release lever is worn out.

Symptoms:

If the release bearing is damaged seriously, the creaking sound can be heard from the clutch inspection window, the release bearing oscillates or it is burnt black and there is a little amount of smoke coming out.

Causes:

(1) Insufficient clutch pedal free travel or insufficient tension of the release lever tensile spring. When the clutch is turning at high speed with throttle wide open, under the action of the centrifugal force, the release lever will fly out toward the direction of increasing 2 ± 0.05 mm around the shaft pin, which makes it in constant contact with the release bearing and turn with it for a long time till it is burnt out.

Because the release bearing is an oilless one, there is no filling point on it, when checking and fixing it, put it into grease and boil it.

It should be emphasized that it is not allowed to reduce the clutch free travel to make the auxiliary clutch disengage.

(2) Improper operation, which makes the release bearing in constant contact with the release lever.

Ⅱ. Gearbox trouble

1. Gears disengage by themselves

When the tractor is travelling under a certain gear, the shift lever returns to the neutral gear position automatically and the gears disengage by themselves.

A simple way of checking the automatic disengagement of main shift lever: start the engine, put the auxiliary shift lever at neutral position and put the main shift lever into each gears which are to be checked, after releasing the clutch pedal, if the lever could be pulled back to the neutral position with a force a little bit stronger than normal shifting, then the gears are easily to disengage by themselves in working.

Checking method of auxiliary shift lever automatic disengagement: loosen the auxiliary shift adjusting screw on the side face of the gearbox for several turns (see Fig. 12－14), to make the control force of the auxiliary shift lever reduce to 30－40N, and drive the tractor under no load on macroscopically uneven road with a high speed, if the gears disengage by themselves when reduce the throttle suddenly, then they will disengage automatically under heavy load, even if adjust the control force of the lever to the normal valve of 130N.

Because automatic disengagement is very dangerous while the tractor is travelling on a slope with high speed, repair it in time.

Causes for automatic disengagement of main shift lever:

(1) Inefficiency of locking mechanism. Such as interlock lock pin and V－groove of shift fork

shaft seriously worn, fatigued locking springs, loosened lock screw of shift fork, etc, all of which may result in unreliable location.

(2) Inefficiency of interlocking mechanism. Such as interlock connecting fork sprained, position bolt too tight, interlock torsion spring broken, etc, which makes the interlock mechanism unable to return to its locking position automatically.

(3) Excessive axial force of meshing gears. For example, the taper of gear splined hole is excessively big and the tooth is worn into tapershape (i.e. form a boss in the direction of its length), the shift fork is deformed or sprained, or the supporting bearings are seriously worn to make the shaft incline, etc. All these phenomena may result in producing axial force.

Causes for automatic disengagement of auxiliary shift lever:

(1) The main cause is that the main shaft of gearbox is not concentric with the driving spiral bevel gear in the rear axle. The reason for this possibly is that the two position pin holes in the gearbox housing and the rear axle housing are not precise in manufacturing, or the position pin is not struck into the hole properly.

(2) After a long time operation, the inner spline of the Hi – Lo gear meshing sleeve and the meshing face of the main shaft of gearbox are worn seriously, forming tapers (i.e. bosses).

(3) The shift fork of Hi – Lo gear is deformed or sprained.

(4) The V – groove of auxiliary shift fork shaft and the lock pin are worn seriously.

(5) The locking force of auxiliary shift lever is adjusted too weak.

2. Gears confused

That is, the shift lever cannot put into the needed gear or put into two gears at the same time.

Symptoms:

(1) Failure in gearing is because the fork head of the shift lever is not in the groove, so there is no resistance in controlling the lever and it can be swayed freely.

(2) The engine stops when engaging with two gears at the same time.

Causes for failure in gearing:

(1) The fork head of shift lever and the groove are seriously worn.

(2) The lock nut on the shift lever seat (see Fig 12 – 9) gets loose.

Causes for engaging two gears at the same time:

(1) The gear lever lock, fork head of shift lever and the groove are seriously worn, so the "derailment" of the fork head may result in engaging two gears simultaneously.

(2) The bolt of the gear lever lock get loose.

(3) The fixing bolt on the front end of the main shaft get loose, so the main shaft oscillates violently, this is the cause of failure gearing or two gears engaged simultaneously and there may be noise of gear impacting.

3. Difficult to engage gears

Symptoms:

(1) Depress the clutch pedal, there is noises of gear impact while shifting the lever, and it is difficult to engage gears.

(2) Depress the clutch pedal, it is unable to move the shift fork shaft while shifting the lever and

the engagement fails.

(3) The auxiliary shift lever fails for engaging gears.

Causes:

(1) The clutch is not disengaged completely.

(2) There is serious peeling or burr on the face of the sliding gear, which makes the gear difficult to mesh.

(3) Pull the shift lever hard only to make the shift fork deform or make the fixing screw loose.

(4) Cause for this problem with the auxiliary shift lever is possibly the position pin was not struck in properly during repairing, which makes the pin holes of the gearbox and rear axle not concentric.

(5) If sense that the auxiliary shifting is engaged but the tractor still does not move, it is possibly because the annular ring gear of Hi－Lo gear flees out(See No. 6 Fig. 12～10).

Difficulty in shifting gear also has something to do with the driver's operating method. When the tractor is used for transportation, drivers usually shift gears without stopping the tractor, so the essence of it is to make the linear velocities of the driving and driven gears as close as possible at the shifting moment so as to prevent gear impact.

Ⅲ. Trouble of rear axle

1. Overheated oil in rear axle housing

Causes:

(1) The oil level is too high, when the gears are running in high speed, the gears soaked in the oil stirs it and the loss of mechanical energy increases, then the oil temperature rises.

(2) The pretension of the bearings of the driven and driving spiral bevel gear is too big and their temperature increases in running, even cause the bearing burnt.

(3) The backlash of the driven and driving spiral bevel gears is too small.

2. PTO shaft slips out of gear automatically

Causes:

(1) The V－groove of shift fork shaft and the lock pin are worn or the lock pin is not adjusted properly. The provided actuate force at the shift lever is 90N.

(2) There is taper in the gear inner spline and the surface of the teeth are worn into bosses.

3. PTO shaft is broken

Causes:

(1) When hitching implements with universal joint such as rotary cultivator, etc, if it is lifted too high without releasing the lever, the PTO shaft will be broken because of the serious shaking of the universal joint and the PTO shaft.

(2) When attached with heavy load implement such as rotary cultivator, if working under overload very often, especially when the rotor of rotary cultivator has penetrated into soil too deep and the tractor starts to move suddenly, the PTO shaft will be damaged very easily. The correct operating method is to start the tractor and lower the implement gradually so as to increase the load gradually.

(3) The rotary implement comes across unexpected stone, root, etc.

(4) The lock nut on the front end of PTO shaft get loose.

(5) The bearing seat (No. 17 in Fig. 16－2) of the PTO shaft cracks.

Ⅳ. Brake trouble

1. Braking is out of order

Trouble symptoms:

(1) When depressing the brake pedal with moderate force, the wheels cannot be stopped quickly and the imprints on the road are not clear.

(2) When depressing the brake pedal intermittently with moderate force (commonly called point braking), there are no intermittent braking tyre imprints on the ground.

As to the two above-mentioned tests, if the braking tyre imprints appear only when depressing the brake pedal with huge force, it is also not qualified.

As for which brake is out of order (or too heavy), it can be tried out with the single-sided braking method. If the single-sided braking is too heavy or the pulling imprints of the tyres are not clear when the tractor turns in the original place at the low speed, the braking on this side is proved to be out of order.

Trouble causes:

(1) The friction disk surface is stained with oil. It is generally caused by oil leakage because the two oil seals on the bearing seat on the inner side of the brake is not effective or the oil seal on the outer side has no effect (see Fig. 12-15).

According to the regulations, every ten hours , drain off the oil from the drain plug at the bottom of the brake. When there is a little amount of oil leakage, remove rocker arm seat of the brake and fill with some gasoline or kerosene to clean.

(2) Muddy water gets into the brake. When the tractor operates in paddy field or crosses a river, because the drain plug or the impact noise adjusting screw is not installed, muddy water enters the brake casing to get the friction disk spline rusted, even too rusty to move.

(3) The friction lining is burnt, the rivets are exposed outside, and the friction lining is loose and broken.

(4) The free travel of the brake pedal is too big so as to make the braking insensitive.

(5) In disassembling and assembling, the friction disk assy. is installed oppositely. The correct installing mehtod is to make the end with longer hub face the pressure plate (see Fig. 12-15). In overhaul, if the cotter pin of the link plate bolt bends outward to prop against the half shaft housing surface, the braking will also be made out of order.

(6) The nylon sleeve of the brake pedal shaft is excessively loose or comes off. At this time, the left and right braking tyre imprints always chop and change while adjusting the brake, while the single-sided braking is normal when the tractor turns in the original place.

2. Braking is unbalanced (or called braking bias)

Trouble symptoms:

When stepping down the braking pedal in high-speed driving, because the two wheels obviously not stop at the same time, the tractor slips to one side and the starting points of the braking imprints of the two tyres differ too much.

Trouble causes:

(1) The internal cavity of one side brake leaks oil.

(2) The friction lining on one side of the brake is damaged or broken.

(3) The free travels of the two brake pedals are not adjusted consistently. In adjustment, some people always alternately reduce the free travel of the side with poor braking tyre imprints to reach the consistence of both sides, in this way, the free travel becomes smaller and smaller, finally probably leads to burning the brake. Therefore, the free travel must be guaranteed in the range of 60～80 mm. In test, feel with hand if the temperature rise of the brake is normal.

(4) The left and right brake pedals are not interlocked . When the tractor runs on the road, the left and right brake pedals must be interlocked, otherwise, the single－sided braking is easily to cause accidents. Only in the field operations, sometimes in order to make a small turn by using single－sided braking, the interlock plates of both brake pedals are separated.

3. Brake is unable to return

Trouble symptoms:

In the high－speed driving, when the brake pedal is released after heavy braking, the tractor fails to start, starts heavily or chatters as starting to move. This phenomenon is called brake being unable to return or self braking. If the tractor is forced to run, the brakes and other parts may be damaged. Therefore, at this time, put the tractor into the reverse gear, continuously tread the brake pedal and depress the clutch pedal, thus it might possiblly get "released" temporarily.

Trouble causes:

(1) The brake free travel disappears.

(2) The nylon sleeves of the brake pedal shafts are too tight, becomes tighter after the temperature rises and cannot return automatically, the two nylon sleeve holes are not concentric; the return spring of the brake pedal comes off or lacks elasticity.

(3) Muddy water enters the brakes, the splines of the friction disk assy. get rusted and tightened and the steel balls are braked in the bevel groove. The friction lining expands after soaked in water, which makes the brake clearance too small.

(4) After the brakes are burnt, five return springs of the pressure plate become soft so the pressure plate gets more difficult to return automatically.

(5) When replacing parts, there might appear the following phenomena: the fitting between the pressure plate and three lug latch radial surfaces of the half shaft housing is too tight, or the pressure plate ball groove is not smooth, or there are uneven bosses on the bevel groove and the elastic force of the return springs is insufficient.

4. Impact noise of the brakes is too loud

When depressing the brake pedals, there is clear impact noise in the brakes. This is because the clearance between the press plate lug latch and the half shaft housing lugs are too big and the adjusting screw (No. 8 in Fig. 14－2) is not used to make it smaller.

5. Differential lock is out of function

That is, the differential is unable to be locked or after it is locked, the differential lock is unable to disengage.

Trouble symptoms:

Holding rearward the differential lock lever , when the tractor turns in the original place on the ce-

ment ground at low gear with the throttle open in its half way, if the inner－side rear wheel does not leave clear black rolling imprints, it means that the differential lock has not locked the differential. If it locks, because the inner and outer rear wheels rotate synchronously, the inner－side wheel are forced to leave clear black rolling imprints. After the differential lock lever is released, if the black imprints continue to appear, it means that the differential has not been disengaged, that is it does not return, as result, when making a turn, the steering force is heavy and the steering radius is too big.

Trouble causes:

(1) The fixing nut of the differential lock lever get loose and the lever is in idle state.

(2) The holding screw of the differential lock shift fork is loose. (See Fig. 12－19).

(3) The differential lock collar has been damaged. The main cause is when the tyre on the one side crossing the puddle with slip, the differential lock is forced to engage without depressing the clutch pedal.

The causes of differential lock being unable to disengage:

(1) The limit pin of the return spring seat on the diffential lock shift fork shaft has been damaged.

(2) The shift fork shaft gets rusted after it has not been used for along time. (In installation, it is required to apply molybdenum sulphide grease on the shift fork shaft.)

(3) In overhaul, the two holes used for installing the shift fork shaft on the replaced half shaft housing are not concentric and the shift fork shaft takes a lot of effort to move.

Ⅴ. Final drive trouble

1. The bolt of the connecting flange plate between final drive casing and half shaft housing get loose.

Serious loosening will lead to getting the casing scrapped. As this part suffers from strong vibration and is easy to get loose in long－term operation, therefore, apply anaeglue on this stud and screw it tight in the casing. The nut tightening torque is 80～90 N·m and the positioning bolt cannot be missed or installed wrongly. In normal times, the stud should often be checked and tightened.

2. Drive shaft end nut loosens, see No. 11 in Fig. 12－21.

The loosening of this nut affects the driving safety. When checking, shake the tyre with hands to feel the clearance, if the axial clearance is too big, It is possible that the shaft end nut is loose. The tighten torque of the nut is 80～100 N·m and it should be locked with lock plate.

Ⅵ. Noise in transmission system

1. Noise in the clutch casing

(1) The release bearing is burnt and the release lever is worn out so as to give out sounds. When stepping down or slightly depressing the clutch pedal at low gear, there appears continuous switching sounds, and when releasing the pedal, the sounds disappear. At this time, make it clear from the clutch inspection window after the engine goes dead.

(2) The connecting bolt between flywheel and crankshaft gets loose, the flywheel sways and trembles during the operation. When the engine speed suddenly changes, heavy bangs can be heard from the clutch inspection window.

2. Noise of the gearbox

When finding there is noise in the transmission system, if it disappears at the time of stepping down the clutch pedal, it is proved to come from the gearbox and its rear part. At this time, put the auxiliary shift lever into the neutral gear, if the noise disappears, then it comes from the auxiliary gear shift and its rear part; if the noise does not disappear, put the main shift lever into Ⅰ－Ⅳ gears alternately to determine which gear sounds. If at the Ⅳ gear, there are rhythmical slight creaking sounds and when accelerating the engine, the sounds disappear due to steady speed, the noise is considered to be permissible. However, when accelerating the engine, the creaking sounds still exist and there is vibriation as feeling the gearbox with hand, the noise is considered to be abnormal and need to be examined and repaired.

The causes of big noise from the gearbox:

(1) The precision of the gears is poor.

(2) The gears are seriously worn and there appears bosses on the gear surfaces. After overhaul, the meshing position of the gears has changed.

(3) In overhaul, the driving and driven gears are not replaced in pairs.

(4) Because of improper operation in shifting gears, the gear end faces are damaged or the teeth are partially broken.

(5) The gearbox bearing is excessively worn so as to oscillate.

(6) The auxiliary gear shift planetary mechanism is damaged.

(7) The shaft end bolt of the gearbox main shaft becomes loose, which is accompanied by the gear knocking sounds, even engaging two gears at the same time.

(8) There is lack of oil.

3. Noise in rear axle and its rear part

When the tractor runs at the high speed, the noise in the transmission system is too loud, and after the auxiliary gear shift is suddenly put to the neutral gear, the tractor continues to run under the action of inertial force, at this time, if the noise still exists, it generally comes from the rear axle and its back part.

(1) When the tractor runs at the Hi－Ⅳ gear, suddenly decrease the throttle, if high－frequency "hush－－" sounds can be heard from the rear axle, there is possibility that the gear clearances of the driven and driving spiral bevel gears are too small; if high－frequency creaking sounds can be heard and as the throttle is changed suddenly and repeatedly, there are knocking creaking sounds, which disappear after the speed gets steady, this phenomenon is possibly caused by the loosen adjusting nut of the driving spiral bevel gear(see Fig. 12－17)

(2) Generally it can be heard directly which side of the final drive gives off sounds, if necessary, jack up the tractor and adopt the single －sided braking to check. However, if the noise obviously becomes louder during the single－sided braking, the noise may be caused by the loosened differential.

(3) If have known there are sounds on the one side and when the gear changes, there are low－frequency shaking sounds on the inner side of the rear wheel, then there is possibility that they are caused by the loosening of the drive shaft end nut, at this time, as moving the rear wheel with hands, there is the feeling of axial shake. (See Fig. 12－21)

(4) If ballast of the rear wheel loosens, there are lower－frequency shaking sounds.

Ⅶ. Front axle and steering gear trouble

1. The front wheels wobble

Trouble symptoms:

When the tractor runs straightly at the high speed, the front wheels rapidly wobble, now to the left and then to the right. When being serious, the wobble force is transmitted to the steering wheel through the connecting parts to make it tremble, which affects the driving safety and accelerates the wearing of tyres and other related parts.

Trouble causes (see Fig. 13－1):

(1) The toe－in is not adjusted well. If the toe－in is too small or too big, when the tractor runs , the front wheels suffer from additional acting force, which prevents the tyres from normal rolling and gets the front wheels rapidly worn.

(2) The steering ball joint, steering pitman arm and steering knuckle arm are loose.

(3) The clearance of the thrust bearing on the top of the steering gear is too big (see Fig. 13－4).

(4) The clearance between the steering nut and the stationary peg is too big (see Fig. 13－5).

(5) The front wheel conical bearings are loose.

The above points can be adjusted.

(6) The clearance between the segment gear and the segment gear driving shaft is too big, and the clearance between the shaft and the copper bushing is too big.

(7) The clearance between pitman arm pin and the bracket is too big.

(8) The clearance between the king pin and its sleeve is too big.

(9) The ballasts of the two front wheels are not balanced.

(10) The front axle is deformed due to accidental knock and the positioning of the front wheels is abnormal.

In fact, the (2)－(8) causes are reflected on the free travel of the steering wheel. When checking, one person turns the steering wheel back and froth while another person could look for the shaking location.

2. Steering is heavy

Trouble symptoms:

When the tractor makes an eight shape turning test on the road at the comparatively low gear (such as Lo－Ⅲ gear) under no load, the steering should be easy and convenient and the steering force should not be more than 60N. After releasing the steering wheel, there should the phenomenon of steering reversal, otherwise, it is generally called that the steering is heavy or not quick －acting.

Trouble causes:

(1) The adjustment of the toe－in is not proper.

(2) The air pressure of the front wheels is insufficient.

(3) The clearance between the steering column thrust bearing or the steering nut and the stationary peg is adjusted too tight.

(4) The steering box and the side cover are not concentric. There are no axial clearances between the steering sector, the steering segment gear shaft with the box.

(5) The king pin and its nylon sleeve are fitted too tight, they are not concentric or muddy water gets into them.

(6) The double oil seal of the king pin sleeve is not installed on the proper position and the oil seal scrapes the steering knuckle.

(7) Poor lubrication of the related parts of the steering gear and the front axle.

(8) The differential lock is unable to return and seized in the locking position.

(9) The obvious change of the positioning of the front wheels due to collision shocked front axle can also lead to difficult steering.

In order to distinguish the excessive resistance comes from the steering gear or the front axle, remove the drag link end, hold the steering wheel with hand and separately test if it is too tight, then hold the front and back sides of the front wheel, imitate the steering back and forth, and it will be known whether it is too tight or not.

Ⅷ. Lift trouble

1. Unable to lift under no load

The essence of the trouble is that the hydraulic pump does not supply oil or the distributor does not distribute oil, in very special cases, it shows some parts are damaged. In order to find out the location of the trouble, first loosen the nut in the oil outlet pipe assy. between the hydraulic pump and the distributor, at this time, two cases may take place:

(1) If the oil pipe does not ooze oil, it proves that the hydraulic pump does not supply oil. the concrete causes probably are (see Fig. 16－21c):

1) The hydraulic pump is seriously burnt or the pump housing is cracked or broken.

2) The driving gear shaft of the hydraulic pump is broken. This is because there is a bulging platform propping against the connecting flange between the hydraulic pump connecting plate and the rear axle casing, which makes the driving gear shaft be broken.

(2) If the oil pipe ooze oil, the trouble lies in the distributor and the hydraulic cylinder, or damage of some parts, in most cases, it can be simplified into the distributor being unable to distribute oil. the concrete causes are:

1) The main control valve is seized in the lowering or neutral position or the system adjustment of the draft and position control pendulum lever is seriously wrong (see Fig. 16－19). On checking, dismantle the lift cover 13, drain off the oil and pull and push the draft and position control levers up and down at the same time. When the levers are in the lifting position (at this time, the lift arm is still in the lowering position), the main control valve should spring to the farthest extending position, however, if it does not spring out, then it is seized in the lowering or neutral position, at this time, move it out with a screwdriver. If it cannot be moved, it shows the main control valve is seriously seized. This may be caused by serious lack of oil and long－term storage or because the tractor runs for a long time without using the lift to cause the main control valve to get rusted. In observation, pay attention that if the main control valve is not seized but does not extend enough, (that is, it does not spring to the lifting position), the adjustment of the draft and position control pendulum levers is proved to have obvious mistake. The common trouble also includes the serious loosening of the adjusting plug against the draft control spring (No. 3 in Fig. 16－24).

2) The oil return valve is seized in the opening position or iron filings are hold up on the sealing end face of the return valve (see Fig. 16－15). At this time, accelerate the engine, constantly move the lift lever up and down and throw the lower link up and down to make the oil return valve back to the normal position. If it is not effective, dismantle and wash it.

3) The safety valve is broken or the O－ring at the joint place between the safety valve assy. and the distributor housing is washed off (see Fig. 16－15).

4) The draft control thrust plate 5 comes off (see Fig. 16－20).

5) The position control cam clamp bolt (No. 33 in Fig. 16－19) seriously looses.

6) The distributor oil inlet insertion pipe 23 or the O－ring on it is missed in installation (see Fig. 16－19). This trouble is easy to be ignored. If the hydraulic pump and the distributor are in good state, but the lift is unable to rise under no load, according to logic analysis, the trouble perhaps lie in the middle parts, probably the distributor oil inlet insertion pipe is missed.

2. Lift is able to rise under light load, rises slowly or unable to rise under heavy load

The essence of the trouble is that the hydraulic system cannot build up enough working pressure. On checking, first make clear the trouble lies in the hydraulic pump filter or in the distributor and the hydraulic cylinder. In order to do that, when engaging the hydraulic pump to run, move the draft and position control levers to the lifting position and help lift the mounted implement with manpower, after the manpower is removed and the engine stops, the two following cases will take place:

(1) If the implement can be kept in the lifting position, it proves that there is no leakage in the check valve and the following oil line and the trouble is caused by the insufficient oil pressure in front of the check valve (see Fig. 16－20b). Generally speaking, the following method can be adopted to check the working state of the hydraulic pump filter:

1) Crankshaft turning resistance method

Dismantle the front top cover on the rear axle casing and put a piece of copper sheet between the gear pump housing 3 and the oil outlet flange 2 (Fig. 24－1). After tightening the flange bolt, block up the oil outlet of the hydraulic pump, then decompress the engine and turn the crankshaft with hand. If be able to feel from light to heavy, the working pressure of the hydraulic pump is proper; if feel light all the time, the pressure is insufficient.

2) Pressure gauge method. Install a special purpose flange on the oil outlet of the hydraulic pump, put through the pressure gauge, then turn the crankshaft at the speed of 50～60r/min. after decompression. the pressure of a new pump, if installed, should amount to 15－17 MPa and the pressure of an old pump, if not changed, should not be lower than 10 MPa.

3) Dismantle the front top cover on the rear axle casing, interruptedly release and depress the hydraulic pump lever with throttled－down and observe if there are bubbles in the oil flow. However, if observe the oil flow height at the high gear to judge the technical state of the hydraulic pump, it is easy to make a mistake, because the pump can also make the oil flow comparatively high when there is no system resistance, even if it is not in good state.

4) If the lift rises slowly and intermittently with the mounted implement and there is tremble feeling, it is proved air has entered the system. At this time, disconnect the mounted implement and let someone stand on the lower link. If there is tremble in the lifting process and elasticity feeling when

pressing down the lower link with foot after the lifting has neutralized, the phenomenon of air entry is serious.

The common hydraulic pump filter troubles are as following:

1) Oil inlet pipe assy. (front section) i. e. rubber pipe leaks air; the O－ring of the oil inlet connecting pipe (No. 4 in Fig. 24－1) is damaged; the O－ring of the oil suck in pipe joint (No. 5 in Fig 24－1) is damaged, aged and lack of precompression amount; the reinforced oil seal 13 of the hydraulic pump driving gear shaft is damaged or comes off, etc. (See Fig 16－10)

2) The filter is blocked. As dismantling the top cover to observe the oil flow height, if the height lowers after accelerating the engine, that is the symptom of the filter being seriously blocked.

3) The hydraulic pump is seriously worn or damaged. For example, the housing runs in, the shaft sleeve end face is seriously worn, the ring is damaged.

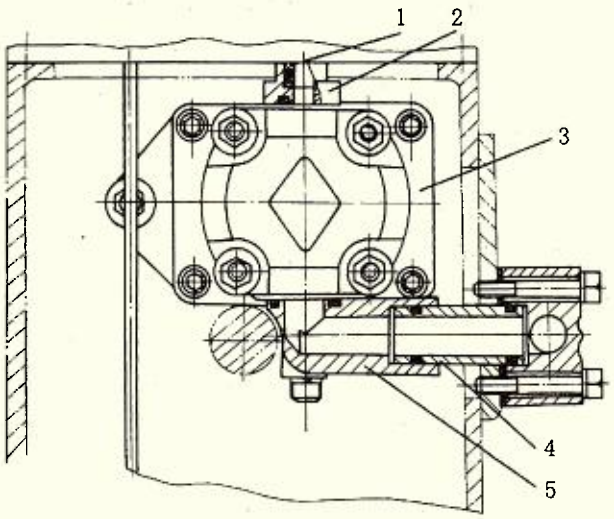


Fig. 24－1 Installing gear pump

1. Distributor oil inlet pipe 2. Oil outlet flange 3. Gear pump housing 4. Gear pump oil inlet connecting pipe 5. Oil suck in pipe joint

4) The O－ring of the hydraulic pump oil outlet flange 2 (Fig. 24－1) is damaged and the O－ring of the distributor oil inlet insertion pipe is damaged (Fig. 16－19).

(2) If help lift the mounted implement with manpower, after the manpower is removed and the engine stops, the implement falls quickly (that is, static drop control is very poor). At this time, disconnect the implement, stand on the lower link when the hydraulic pump is operating, there is serious nodding phenomenon.

The trouble essence is that the distributor and the hydraulic cylinder behind the check valve leaks a great amount of oil, however, the lack of working pressure in hydraulic pump cannot be ruled out. Therefore, distinguish the major causes from the secondary ones before disassembling, which should be determined by means of experience. Now illustrate with examples.

If the static drop control is poor, but the implement falls to the ground after more than ten minutes, such oil leakage amount will not lead to failure in lifting under heavy load and it only influence the lifting speed. Therefore, oil leakage of the distributor and the hydraulic cylinder is the secondary cause, while insufficience of the hydraulic pump working pressure is the major cause.

If the implement falls to the ground within 3～5 minutes, a great amount of oil leakage behind the check valve is the major cause and the insufficient working pressure of hydraulic pump is the secondary cause. Usually perform disassembly directly against the major cause first. Of course, the performance of the hydraulic pump also should be made sure with the above－mentioed crankshaft turning resistance method.

The following are the concrete position of oil leakage behind the check valve, which lead to slow down lifting speed under heavy load (see Fig. 16－20b):

1) The sealed conical surface of the safety valve leaks oil, the O－ring at the junction of the safety valve and the distributor housing is damaged and leaks oil.

2) The seal ring of the hydraulic cylinder piston is damaged.

3) There are small amount of cracks on the hydraulic cylinder.

4) The O－ring between the distributor and the hydraulic cylinder is missed in installation or damaged due to the loosened screw.

5) The O－ring of the hydraulic outlet bent pipe joint 26 is missed in installation or damaged. (See Fig. 16－19).

6) The O－ring of the lowering speed valve is damaged.

7) The O－ring on the check valve plug is damaged.

3. Mounted implement trembles after being lifted (commonly called"nodding")

The mounted implement trembles up and down after the lifting neuralization, which is commonly called "nodding" and it is another expression of poor static drop control(see Fig. 16－20b). The process is: in the lifting neutralization state, oil leakage at the check valve and its following parts makes the implement drop itself, to drive the position control pendulum lever to move, returning the main control valve to the lifting position, then the hydraulic pump supplies oil for the cylinder and the implement is lifted, and the process repeats in this way. Therefore, "nodding" is a kind of function of capacity compensation, while serious nodding belongs to a trouble. At this time, the hydraulic pump is made to bear frequent hydraulic shock, the oil temperature rises and the accelerating system is damaged.

The trouble essence is that the oil leakage of the parts behind the check valve damages the oil sealed state of the hydraulic cylinder in its neutral position.

Beside those listed in trouble 2, which lead to slow lifting with heavy load and lie behind the check valve, the concrete oil leakage parts also include:

(1) The check valve leaks oil. This is the important element influencing nodding. Its characteristics are there is nodding but the lifting speed is not affected.

(2) The hydraulic cylinder wall is scratched. Sometimes when the piston lies in the scratched position of the hydraulic cylinder, the static drop control is poor, but the static drop control at other position obviously gets better. Besides dirty oil and too small fit clearances of the cylinder pistions, this is also because the long－term transportation causes the oil level to be insufficient and the cylinder to get seriously rusted. When suddenly using the lift, it is very easy to be scratched.

(3) The ring type seal C on the main control valve at lowering oil passage and the valve sleeve are seriously worn. This phenomenon generally occurs to old lift. The simple judging method is to screw tight the lowering speed valve, that is, to separate the ring type seal C from the sealing oil passage of the hydraulic cylinder. If the nodding stops, it proves to have this trouble.

4. The longer the sustained operation time is, the slower the lifting speed is

The typical symptoms are: at the beginning of the ploughing, the lifting is good, but after half an hour or so, it is gradually lack of power, the longer the sustained time is, the poorer the lifting capabil-

ity is. Sometimes after resting for about an hour, the lifting capability gets better, repeating in this way. If keep on working with this phenomenon, it will lead to "pump burnt". It is not difficult to learn that the lowering of the lifting capability has relationship to the operating sustained time, which means it probably has something to do with the oil temperature. The higher the oil temperature is, the more serious the system leakage is and the slower the lifting speed is. It probably also has something to do with the amount of the drawn in air.

The concrete causes are:

(1) The hydraulic pump is seriously worn and both the internal leakage and the external leakage are serious. If the internal leakage is serious, it is easy to make the pump overheated, further accelerating its wear.

(2) The hydraulic pump draws in a great deal of air (commonly called"suck in nothing"), making it entering the oil. As the compressibility of the air is 1000 times that of the oil liquid, a great amount of bubbles lowers the working pressure of the pump. If the sustained time is too long, even close to be unable to suck in oil, it will lead to"pump burnt" by dry friction. The cause for why the pump draws the air in should only be found from the oil suction line (see Fig. 24－1).

In the case of insufficient precompression amount of the O－ring, in cold, the oil is sticky and the strength of the oil film around the O－ring is huge, barely enough preventing air from passing; in hot, the oil becomes thinner, the sealability of the O－ring gets poor and air gets in.

This kind of trouble is seldom caused by the serious leakage of the distributor and the hydraulic cylinder.

5. Pump burnt

The so－called pump burnt is due to drawing in air, overloading and other causes, the temperature of the hydraulic pump becomes too high, it creates dry friction and finaly leads to pump burnt. As the hydraulic pump is installed in the rear axle casing, "pump burnt" is not easy to be found in time. When the pump sends off smoke and gives out creaking sounds, the lift is unable to rise with light load, the pump has already been burnt.

Trouble caues:

(1) The filter is blocked and the hydraulic pump seriously draws air in.

(2) The main control valve cannot automatically return to the neutral position and the hydraulic pump works under overload state for a long time. At the beginning, it will not influence the lifting and the lowering, but the continuous creaking sounds of the safety valve responsing can be heard. The concrete causes are:

1) The adjustment of the position control cam is improper and the lifting height is too high.

2) The position control lever is moved to the hydraulic outlet position by mistake.

3) Position control elements are seized.

4) The position control tensile spring is too weak or the push rod support plate is bent inward.

The method of distinguishing these causes is to lower the position control lever slightly, if the safety valve does not make any sound, the adjustment of the position control is proved to be improper.

(3) Serious nodding and throttle make the hydraulic pump nearly constantly work under load, which accelerates the wear and has a little indirect influence on burning pump.

6. The draft control is not sensitive

Trouble symptoms:

(1) When adopting the draft control to plough and not moving the lever, the sounds of the engine change greatly, while serious, the ploughing depth becomes deeper and deeper till the engine stops. When making a little change of the position of the draft control lever, the ploughing depth cannot be changed correspondingly.

(2) When looking from the back, as adopting the draft contrl to plough, the lift arm sways up and down in a wide range.

(3) The bottom of the furrow appears sawtooth－shaped.

Troubles causes:

(1) The draft control spring clearance is too big, the adjusting plug of the draft control spring looses or the pretension of the draft control spring is too large (See Fig. 16－24). When checking in the field, remove the bolt behind the top link, erect the top link and press it on the draft control sensing head. When pushing it slightly, there should be no loosening and shaking on the draft control spring and when pushing hard, the spring moves.

(2) The bolts at both ends of the top link are worn too thin or replaced with very thin screws.

(3) The working pressure of the hydraulic cylinder is not in enough, that is, insufficient hydraulic pump working pressure or serious oil leakage of the hydraulic cylinder makes the capacity of automatic adjustment of ploughing depth poor (see Fig. 16－21c).

(4) The improper installation position of the top link at three holes on the connecting plate also bring some bad influence. If the top link is connected on the lower hole, the senstivity of the draft control will be poor.

Because of the above－mentioned causes, after the draft control signal is sent out, the draft control mechanism transmits it idly and actuate poorly, that is the draft control is not sensitive.

7. Lift is unable to lower

Trouble causes:

The lowering－speed control valve is seized in the closing position, as a result, although lowering speed control handle is already screwed out to the opening position, the implement still cannot lower (see Fig. 16－20c).

Remedies:

After making sure that the control handle of the lowering speed control valve has been screwed out, throw the lower link up and down to shake the valve out. If there is no effect, move the position control lever at low gear to the hydraulic outlet position for a short time (1～2 seconds), making use of the hydraulic outlet high－pressure oil stream to push the valve out.

As a matter of fact, the oil return valve and the main control valve cannot be seized in the closing position and the lifting position respectively, therefore, they will not affect the trouble of being unable to lower. Only when the lift lacks oil seriously and in the process of long－term transportation, it is not used so as to get seriously rusted, the oil return valve will be seized in the closing position and the main control valve be seized in the lifting position.

8. Lift housing is broken

Trouble cause (see Fig. 16－19):

(1) The main control valve cannot return to the neutral position automatically or the position control lever is put in the hydraulic outlet position for a long time by mistake.

(2) The shaft pin of the inner lift arm shakes off so as to damage the housing.

(3) The hydraulic cylinder fixing bolt is not screw tight so as to make the stop adjusting screw (No. 28 in Fig. 16－19) stand too much force to make the housing broken. Note: the nut tighten torque of the hydraulic cylinder fixing bolt is 75～85 N·m and it is covered with Letai 271 anaeglue; the pretension torque of the hydraulic cylinder stop screw adjusting screw is 2 N·m.

(4) When the tractor with the lifted implement runs at the high speed on the uneven road, because of strong jolt, the inner lift arm continuously collides the housing to make it damaged.

9. Hydraulic cylinder is cracked

Trouble causes:

(1) Four fixing screws of the hydraulic cylinder are not screwed tight; the hydraulic cylinder adjusting screw 28 is not adjusted well; on working, the hydraulic cylinder moves slightly to make the lugs at the fixing place broken.

(2) It works at the hydraulic outlet position for a long period of time.

(3) The safety valve response pressure is adjusted too high.

(4) When the tractor with the lifted implement runs at a high speed on the uneven road, due to strong jolt, huge hydraulic shock force throbs in the hydraulic cylinder. The shock force is transmitted at a fairly high speed to make the safety valve unable to response in time, emerging the "over adjusted pressure" phenomenon to crack the cylinder.

10. Oil in the lift housing leaks out completely

Besides external oil leakage, the causes are:

(1) The self－tightening oil seal of the hydraulic pump driving gear shaft is damaged or shakes off.

(2) The O－ring on the four fixing bolts between the lift hydraulic cylinder and the housing are damaged.

Section 4 Common Trouble and Remedies of Electric Facilities

Ⅰ. Checking methods of circuit trouble

1. Observation method

Check for places of poor contact, wire breaking and short circuit along the circuit. This method is generally adopted to the broken filaments and fuses, the contact contacting state and the connect state, etc.

2. Short circuit connection method

Connect the two terminals of some control element which is in series with the circuit to make it in short circuit, then the live wire directly connects with the following equipment beyond this part, in this way, check the part which is made in short circuit. This method is generally adopted to diagnose contact, switch, electric meter and series resistance, etc.

3. Test bulb method

Test bulb is a bulb (a bulb of headlight is the best) welded with two wires of about a meter long

on its negative and positive respectively. There are two ways of checking the circuit with the test bulb method .

One is parallel connection, i.e. parallel with the load. On checking , one end is grounded, one end contacts with each connecting point orderly. If the test bulb beams, it means that there is electricity in the checked connecting point; if the bulb is dim, it means that there is poor contact in the circuit and the resistance is large (see Fig. 24 – 2).

The other way is series connection. Make the test bulb be connected in the circuit in series, then check the circuit resistance according to its brightness. For example, because the fuse blows, the short circuit point should be checked. At this time, do not connect a new fuse , place the test bulb on the fuse position (see Fig. 24 – 3). As the circuit is in short circuit, the resistance is small so the bulb is bright. After the trouble has been remedied, the bulb becomes dim because the tested bulb connected in the circuit in series and the resistance is larger than normal.

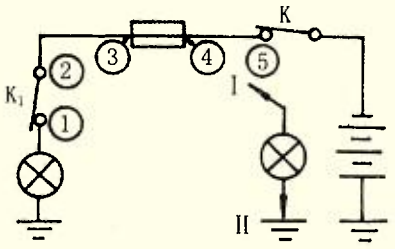


Fig. 24 – 2 Checking circuit with test bulb

4. Avometer method

Measure with avometer, the resistance value of the circuit and the facilities and the voltage between the power and each contact point can be read out, so this method is comparatively precise. Pay attention to the following points when using the avometer.

(1) On measuring resistance, it is appropriate to use the R×1 range or the R×10 range for the tractor system. Before the measurement, correct the "0" point of the indicator. Generally, there is no need to pay attention to the " + ", " – " polarity of the probe, but when checking the diode, its polarity have to be made clear.

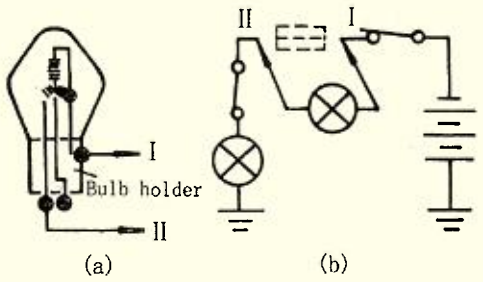


Fig. 24 – 3
(a) Test bulb (b) Series connected test bulb for point short connected locating

(2) On measuring voltage, the range conversion switch should be shifted to DC voltage and the 12V range circuit requires the 20 ~ 30V voltage range. Pay attention to the polarity of the probe, the positive probe should connect with the positive of the power and the negative probe should connect with the negative of the power, otherwise, the needle will be broken.

(3) Do not measure the current of the tractor electric system with avometer, because the circuit current is huge, while the current measuring range of the avometer is small. It should be emphasized that the circuit of the thyristor generator cannot be checked with the "contact sparking method".

Ⅱ. Thyristor generator trouble

1. After starting the engine, do not charge the battery

Preliminary check:

After checking and making sure that the connecting wire between the battery and the generator is

well connected, open the regulator cover and connect the fixed contact bracket and the movable contact with screwdriver to make the exciting current be not controlled by the regulator but directly flow through the screwdriver. Stabilize the engine at its middle speed or above and observe the ammeter. If there is charging current of more than 15A showing in the ammeter, it proves that the generator is under normal condition, but the regulator has trouble; if there is no charging indication in the ammeter, it proves that the generator does not charge the battery. The causes are:

(1) The wire from the battery to the generator is interrupted or comes off.

(2) The generator does not generate electricity.

1) The diode is punctured.

2) The brush is seized in its carrier, the generator can not be excited.

3) The two leads of the rotor field winding come off in the welding place of the collector or the turning place of the lead of the field winding is broken.

4) The stator winding is at phase fault or grounded.

(3) The regulating voltage of the regulator is too low, there is poor contact in the terminals, there is cutoff or short circuit in the interior or the contacts are melted together.

As to the cause of diode burnt, one reason is adopting the "contact sparking" method, (that is, the positive terminal touches with the negative terminal or the positive terminal touches with the phase winding of magnetic field) to check if the thyristor generator generates electricity, thus causing the huge current to pass the diode to make it burnt. Another cause is the load is short circuited.

Check of the diode:

Diode is divided into two types: one is positive (+) lead and the housing being the negative, commonly called positive diode. There are three positive diode and their housings are red (See Fig. 24 -4). The other is negative (-) lead, the housing being the positive, commonly called negative diode. There are also three negative diodes and their housings are black.

The circuit after connection between the diode and the stator winding is shown in Fig. 18-4a.

The quality of the diodes can be checked with the test bulb method.

When checking the positive diode (red mark), connect the circuit as shown in Fig. 24 - 5 (left), if the bulb illuminates, it proves that the diode is good; if the bulb does not illuminate, it proves that the diode is bad. If connect the circuit as shown in the right figure, the bulb being bright proves the diode has been damaged, otherwise, it is good.

Check the negative diode with the same principle, but pay attention to the connected polar.

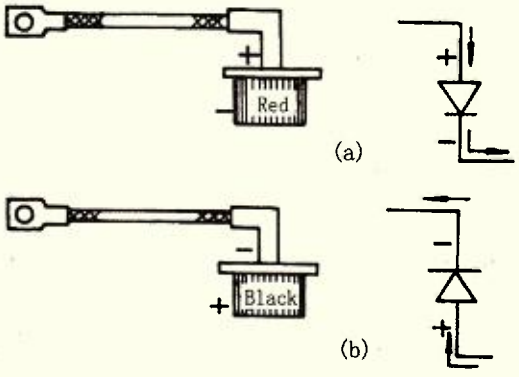


Fig. 24 - 4 Difference between positive and negative silicon diodes

(a) positive diode (b) negative diode

Therefore, generally speaking, connect both ends of the test bulb twice with the two ends of the diode alternatively. If the bulb is bright once , it shows that the diode is good; if the bulb is bright twice, it shows that the diode is punctured; if the bulb is not bright twice, it shows that the interior of

the diode is interrupted (Fig. 24 – 5).

2. Charging current is relatively weak (less than 8A)

Trouble causes:

(1) The belt slips.

(2) One phase of the stator winding connects poorly or comes off.

(3) There is deposited dirt on the collector and poor contact between the brush and the collector.

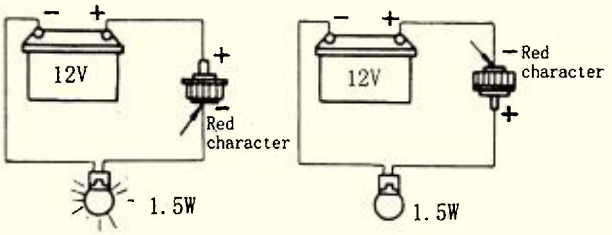


Fig. 24 – 5 Checking diodes

(4) One or two diodes are damaged.

(5) The regulating voltage of the regulator is too low and the contacts are burnt. The magnetic field coil or the resistance connecting wire is interrupted.

3. The ammeter indicates the generator sometimes charge the battery, but the charging current is unsteady.

Trouble causes:

(1) The belt slips.

(2) The connecting wire from the battery to the armature of the generator connects poorly or will be interrupted.

(3) There are poor connection and loosening in the interior of the generator.

(4) The collector deposits dirt, the brush is excessively worn and the elastic force of brush spring is not enough.

(5) The regulator contacts are dirty, the voltage adjustment is improper and the connecting wire is to be interrupted.

(6) The regulator vibration – assisting resistance and vibration – assisting winding and the diodes in the regulator are damaged or of poor contact to make the contact arm move slowly, causing large – range fluctuation in the output voltage, even the abnormal operation.

4. There is abnormal sound in the generator

Trouble cause:

(1) The installation of the generator is not proper.

(2) The bearings are damaged.

(3) The rotary parts run into the fixed parts.

(4) The diode is shorted out.

(5) The stator coil is shorted out.

5. The battery is overcharged.

Trouble Causes:

(1) The interior of the battery is shorted out.

(2) The regulating voltage of the regulator is too high, there is poor contact for the grounded connection, the contacts are out of order or dirty and the regulator coil or the resistance connecting wire is interrupted.

Ⅲ. Starting motor trouble

1. The starting motor does not turn

Trouble cause (see Fig. 24－6):

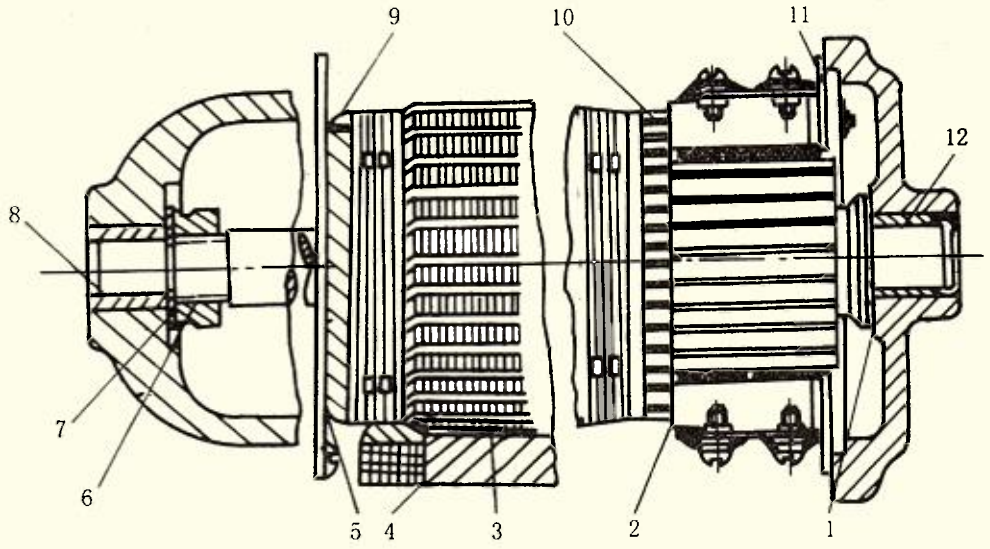


Fig. 24－6 Rotor parts susceptible to trouble

1. Washer being worn 2. Rotor end face rubbing against brush carrier 3. Rotor rubbing against magnetic pole 4. Edge insulating being worn 5. Rotor end face rubbing against middle cover 6. Thread stripping of the shaft head nut 7. Housing being worn 8,12. Shaft sleeve being worn 9. Coil being fallen apart 10. Welding position easy to sealed off 11. Shaft head of field winding rubbing against end face

(1) The commutator surface is seriously burnt.

(2) The rotor runs into the stator caused by serious wearing of the copper sleeve, the shaft head nut thread stripped. The gasket wearing causes both ends of the rotor to rub against the middle cover or the brush carrier.

(3) The welding place between the shaft head of the field winding and the connecting screw or between the armature winding and the commutator is sealed off and loose.

(4) The brush is excessively worn, the insulating brush carrier is grounded, the field winding and the armature winding are grounded with the motor housing or there is short circuit between the turns of the winding.

(5) The connecting wires are broken or there is poor contact for the wires and the switch contacts.

(6) The two contacts of the electromagnetic switch are not in the same plane.

(7) The fuse box fuses.

(8) There is no electricity or too low voltage for the battery.

2. The starting motor is lack of power

Trouble causes:

(1) The copper sleeve is worn, which makes the armature frictionize the magnetic pole.

(2) There is poor contact between the brushes and the commutator. The commutator surface is burnt or stained with grease dirt.

(3) The armature winding and the commutator are sealed off.

(4) The wire connection is poor.

(5) The electromagnetic switch contacts are burnt and have poor contact.

(6) There is insufficient electricity for the battery or the terminal is corroded.

(7) In winter, the engine lubricating oil becomes solid and the starting resistance is too strong.

3. After the engine is started, the starting motor is still running and the small gear is unable to be disengaged.

Trouble causes:

(1) The electromagnetic switch contacts are melted together.

(2) The adjustment of the eccentric screw is not proper.

(3) The overrunning clutch is seized.

4. Before the starting motor gear is put into mesh, the motor has rotated to strongly collide with the end face of the ring gear

Trouble causes:

The adjustment of the eccentric screw is improper and the clearance between the iron core and the contact copper plate push rod is too small.

Ⅳ. Battery trouble

(1) The generator or the regulator has trouble and there is no charging current or it is too weak.

(2) There is loosening or rust for the connecting wires in the charging circuit and the resistance increases.

(3) The pole pieces are sulfurated and the battery become aged.

(4) There is too little electrolyte in the battery or its density is not correct.

(5) The installation of the battery is improper, vibration is serious in running, the seal is open, active substance has come off and the pole pieces are shorted out.

2. Battery overcharge

The distilled water is consumed too much and there is electrolyte out of the vent.

Trouble cause: the regulator is unable to maintain the generator voltage in the limit.

3. Battery explosion

Trouble cause: When the charging is excessive or the discharging time is too long at huge current, the vents on the battery cover are blocked, the explosion will probably occur.

4. Capacity abviously decreases

After charging, the increase of the electrolyte density is not remarkable, the discharging voltage is low and the charging voltage is high.

Trouble causes:

(1) The pole pieces are sulfurated. It is because: the charging is often insufficient and the battery is placed for a long time without charging in time or discharging for a long time under weak current; the battery discharges excessively or is not charged in time after discharge; the electrolyte level falls and the pole pieces are exposed in the air; the high－density electrolyte is added by mistake.

(2) Sulfuric acid is not pure. The standard sulfuric acid for battery should be used to compound the electroylte and charge again.

Chapter XXV 4WD Tractors

Driving with rear wheels and taking a certain percentage of the mass distributed on rear axle as adhension mass, Jiangsu－500, Jiangsu－550 and Jiangsu－650 tractors which can not deliver their rated traction due to drive wheels slipping seriously caused by insufficient adhensive force when they work on soft and wet land; and provide insufficient tractive force with the two rear drive wheels as they work on heavy soil land have been modified as 4WD tractors. 4WD tractors, all of the front and rear wheels are drive wheels, will be accepted and wide used because the traction performance of them have been improved compared with two rear wheels driving one, and they have high level of performance of multipurpose use, high annual utilization ratio and low manufacturing cost in compitition between them and crawler tractors.

Jiangsu－504, Jiangsu－654 and Jiangsu－704 tractors, modifications of Jiangsu－500 tractor, are equipped with front wheels drivetrain (transfer case and front drive axle) and full hydraulic steering system with the final drive housing turning downwards 36° against the half shaft housing (to the next hole) based on reserved rear wheels drivetrain of Jiangsu－500 tractor. 70 percent of the components of them are exchangeable with those of Jiangsu－500 tractors to simplified the manufacturing of them. The drivetrain sketch of a 4WD tractor is shown in Fig. 25－1.

Section 1 Transfer Case and Front Drive Axle

Ⅰ. Transfer case

The transfer case which is attached just below the drive spiral bevel gear of rear axle main drive i. e. the longitudinal symmetic plane of the tractor is a reducing gearbox. The layout as this type makes the main shaft of transfer case and front main drive spiral bevel pinion to be simply connected by drive shaft to transferring power without complex universal joint.

The transfer case consists of idle gear, idle shaft, driven gear, main shaft and housing etc., see Fig. 25－2. The idle gear 9 meshes with the drive gear fixed on the main drive spiral bevel pinion shaft and the driven gear 13 is sliding fitted on the PTO shaft 12 which is supported by bearings in the housing 3. As the driven gear 13 meshes with idle gear 9, part of the engine power are transferred to front drive axle via transfer case. When the front driving is not needed for field operating and road service, put the transfer case control lever forward to shift the driven gear 13 to neutral position so as to cut－off the power to front wheels.

Ⅱ. Front drive axle

The front drive axle of a 4WD tractor consists of main drive, differential, front axle housing and final drive etc., see Fig. 25－3.

1. Front axle main drive

(1) The functions and structure of front main drive

The front axle main drive has its functions of increasing reduction ratio, decreasing speed, increas-

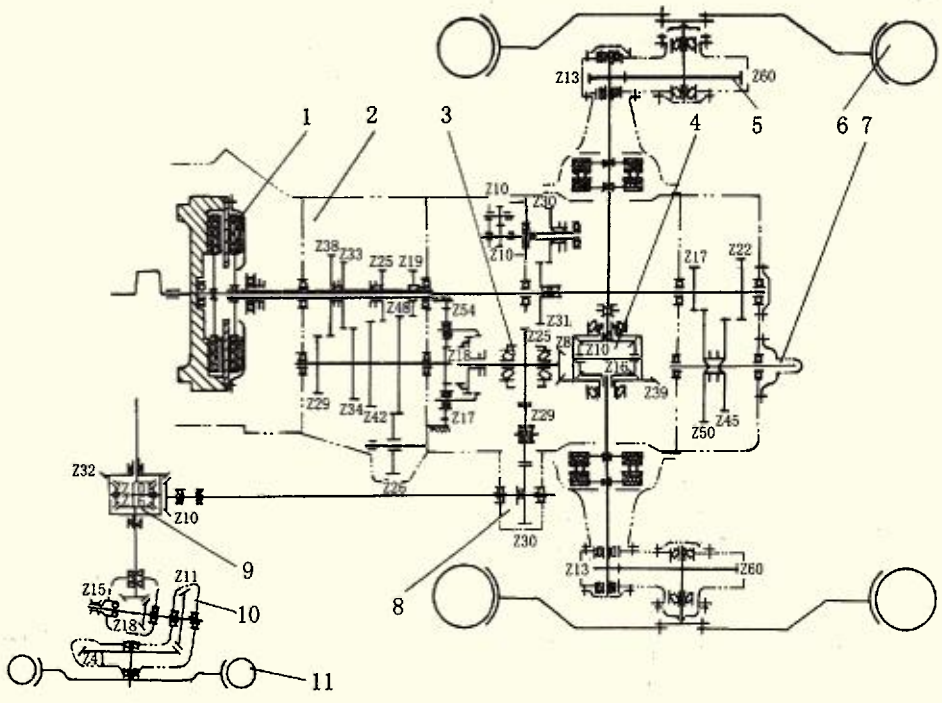


Fig. 25－1 Drivetrain sketch of Jiangsu 4WD tractors

1. Clutch 2. Gearbox 3. Main drive 4. Differential 5. Final drive 6. Drive wheel 7. PTO shaft 8. Transfer case 9. Front main drive 10. Front final drive 11. Front drive wheel

ing driving torque and changing the driving direction of the torque chain to meet the requirement of the front wheels driving.

The front axle main drive consists of a pair of spiral bevel gears of which the spiral bevel pinion shaft is supported with two taper roller bearings and that its shaft end spline is connected by splined tube with the drive shaft connected with the main shaft by another splined tube in the transfer case. The driven spiral bevel gear is tightened with bolts at the right side of differential housing supported on the left and right taper roller bearings with a tighten torque of 80～90 N·m (see Fig. 25－3).

(2) Checking and adjusting of the front axle main drive

Take the checking and adjusting method and procedure for the rear axle main drive of model Jiangsu－500 tractor as a reference.

1) Checking and adjusting of the bearing clearance of driving bevel pinion shaft

The two bearings supporting the driving bevel pinion shaft are mounted under a preload at assembly. The driving bevel pinion will have an axial play as a result of wear during its operation. The preload torque should be adjusted if the play exceeds 0.1 mm (measured with a dial gauge). Remove the driving bevel pinion assembly, release locking nut 12, pull out a certain number of adjusting shims 5, then tighten the locking nut 12 with a tighten torque of 180～220 N·m to acquire a preloading torque of 0.8～1.5 N·m on the two roller bearings. Drive the rear end of the locking nut in the locking groove and make it locked while the preloading torque meets the requirement, see Fig. 25－4.

2) Checking and adjusting of the bearing clearance of the driven bevel gear shaft

The left and right bearings for the driven bevel gear shaft are preloaded at assembling the tractor. There will be an axial play on the differential assy as a result of the wear of the two bearings during operation. The preloading torque should be adjusted if the play exceeds 0.15 mm (measured with a dial gauge).

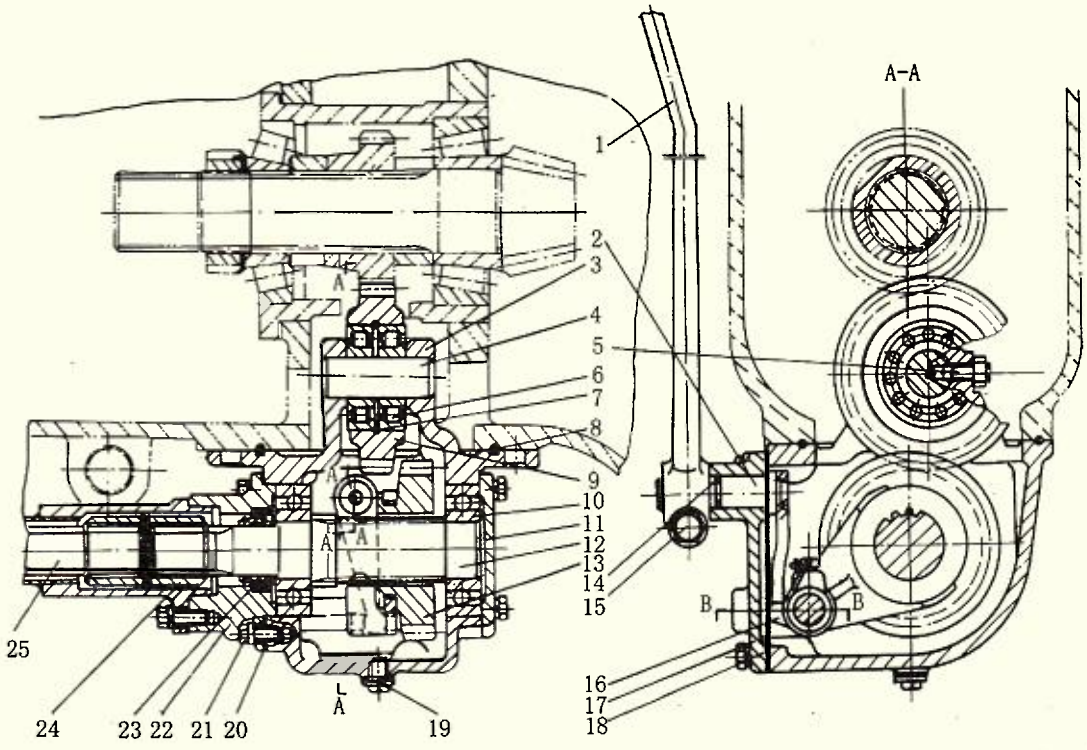


Fig. 25-2 Transfer case assy

1. Control lever 2. Drawing arm welding assy 3. Transfer housing 4. Idle shaft 5. Screw 6. Roller bearing 7. Washer retainer 8. O-ring 9. Idle gear 10. Roller bearing 11. Bearing cover 12. Main shaft 13. Driven gear 14. Seal ring 15. Bolt 16. Shift fork for driven gear 17. Side cover 18. Paper gasket 19. Plug 20. Paper gasket 21. Screw 22. Oil seal seat 23. Oil seal 24. Drive shaft collar 25. Drive shaft

Unscrew screw 4 and pull out a certain number of adjusting shims 2 at B when adjusting. Before the driving bevel pinion assy is attached, the frictional torque on the two bearings under preload should be 1~1.5 N·m, see Fig. 25-5.

3) Inspecting the gear meshing

The correct meshing of the front axle main drive is acquired with the assembling dimension of the driving bevel gear assy and the differential assy.

The adjustment of the assembling dimension of the driving bevel gear should be carried out after the preloading torque of its shaft bearings have been correctly adjusted. The adjusting method, see Fig. 25-4, is as follows: first measuring the distance H counted from the small end face of the driving bevel gear to the outer end face of the flange of the bearing seat, then calculating the thickness of the shims $\delta = H - 38.5^{\pm 0.05}$ mm.

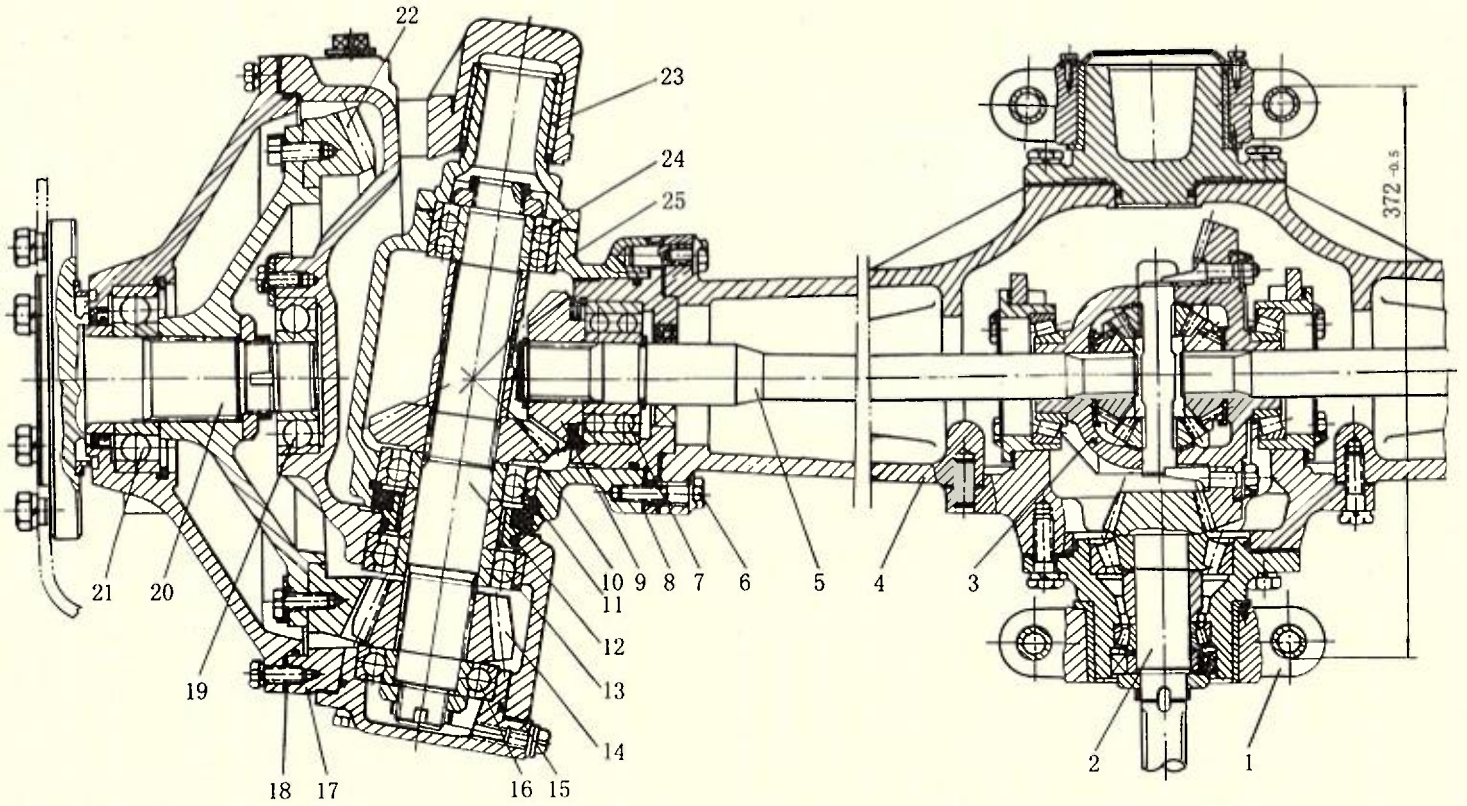


Fig. 25 – 3 Front drive axle assy

1. Bearing seat combined parts for pivot shaft 2. Driving bevel pinion assy 3. Differential assy 4. Front axle housing 5. Front drive half shaft 6. Bolt 7. Bearing 3056308 8. Adjusting shims 9. Driving spiral bevel pinion of left final drive 10. Driven spiral bevel gear of left final drive 11. Bearing 309 12. Kingpin 13. Bearing 309 14. Straight bevel pinion 15. Adjusting shims 16. Bearing 46308 17. Left final drive casing of front drive axle 18. Adjusting shims 19. Bearing 309 20. Front axle drive shaft 21. Bearing 311 22. Driven straight bevel gear of final drive 23. Kingpin support assy 24. Bearing 3056307 25. Kingpin casing

Having the preloading torque of the two bearings adjusted, the driven bevel gear can make axial movement with adding or pulling out shims to / from the sets of adjusting shims of A and B to acquire the assembling dimension of the differential of front drive axle (see Fig. 25－5). For not changing the preloading torque of the driven bevel gear, adding lefthand shims by pulling out shims from the right shims set or vice versa.

4) Checking of the meshing trace and the backlash of gear teeth

The gear meshing of the front axle main drive obtained can be assessed with the meshing trace and the backlash of gear teeth, so after inspecting the gear meshing, it is necessary to check meshing trace and backlash of gear teeth.

The checking method and procedure for the rear axle main drive bevel gear meshing can be taken as a reference. The correct gear meshing trace of the teeth should be the length not less than 16 mm, and the width not less than 4 mm on the drive bevel gear, and the trace made on the middle part of the teeth which is nearer to the toe end of teeth is 3～5 mm from its end.

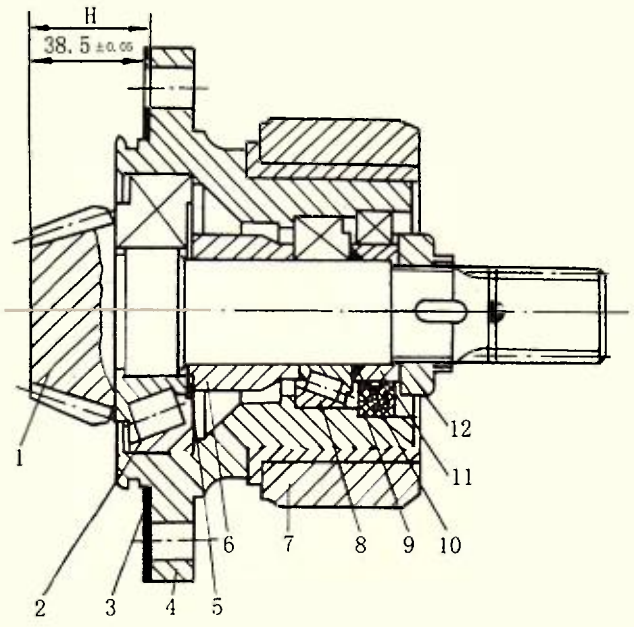


Fig. 25－4 The preloading of bearings of the front axle drive bevel gear

1. Drive bevel gear 2. Bearing 3. Adjusting shims 4. Bearing seat for drive bevel gear 5. Adjusting shims 6. Spacer 7. Bearing seat combined parts for rear pivot shaft 8. Bearing 9. Oil seal 10. Sealing ring 11. Spacer 12. Locking nut

2. Front axle differential

The front wheels of a 4WD tractor are either steering wheels or drive wheels, so its front drive axle should be equipped with differential gear which has the same function of rear axle differential, the structure of the differential is shown in Fig. 25－5. A closed bevel gear differential supporting by differential housing via two bearings seated on the left and right bearing seats on the differential supporters is attached in the front drive axle. Two half shaft gears are sliding fitted in the bore in the differential housing and connected with the left and right front drive shaft via internal splines. The two planetary gears are sliding fitted on their shaft which is installed in the shaft hole in the differential housing. The axial force acting on half shaft gear and on planetary gear is born by corresponding friction washer.

3. Front axle final drive

(1) The functions and structure of the front axle final drive

The front axle final drive has the functions of increasing driving torque as a final step and a reduction gear to make the front wheels with a flexible steering and prevent muddy water from getting into the final drive housing during the tractor is working in paddy field.

The final drive of the front axle is a closed reduction gear which combines a pair of spiral bevel

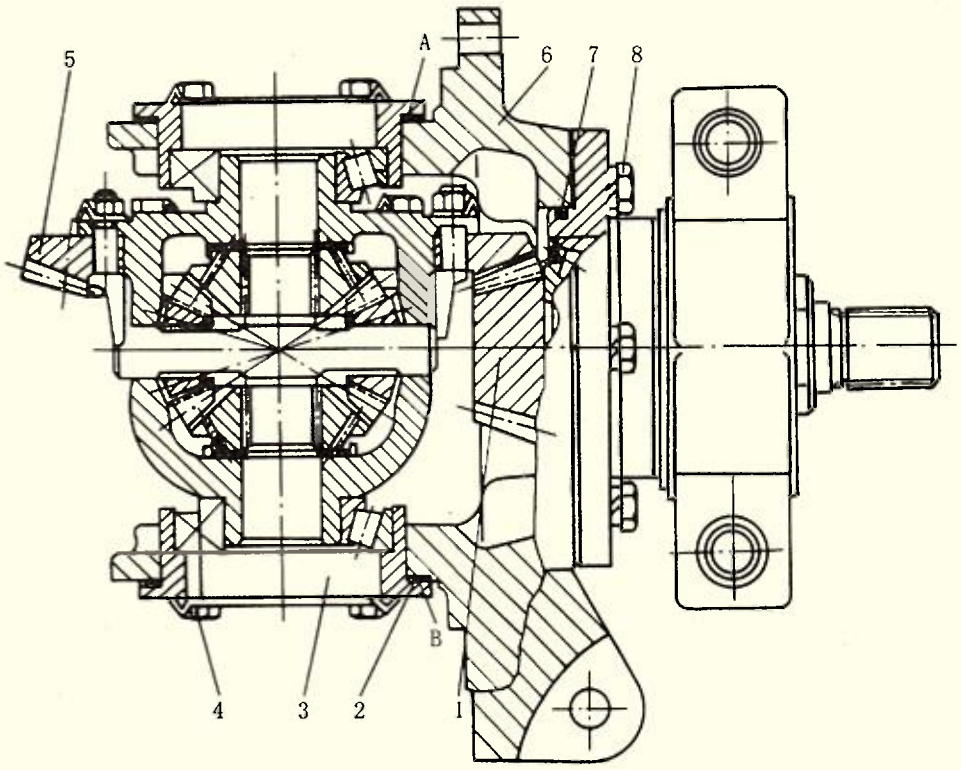


Fig. 25－5 The preloading of the bearings of the front axle differential

1. Drive bevel gear assy 2. Adjusting shims 3. Bearing seat 4. Screw and locking plate
5. Differential assy 6. Differential support 7. Sealing ring 8. Bolt and washer

gears and a pair of straight bevel gears together (see Fig. 25－3). One end of the front axle drive half shaft 5 is connected with the drive bevel gear 9 via splines, another end is inserted into the internal splines of the half shaft in the differential. The two ends of the half shaft are supported by bearing 7 and bore hole in differential housing correspondingly in the front axle casing. The driven spiral bevel gear 10 of the final drive is fixed on the middle of the kingpin 12 via splines; and the kingpin is supported by bearings 11 and 24 in the kingpin housing 25 which is bolted together with front axle casing with bolt 6. The upper end of drive straight bevel pinion 14 of final drive is fixed on the lower end of the kingpin 12 via splines. The final drive housing 17 covers on the kingpin with its lower end supporting by two bearings 13 and 16, and its upper end supporting by sliding bearing 24.

Assemblied as above mentioned, the final drive housing can turn around kingpin to meet the requirement of steering. The driven straight bevel gear 22 of the final drive is fixed on the final drive shaft 20 supported by bearings 19 and 21 in final drive housing via splines, therefore, the power from front axle main drive is transferred to drive shaft via two pairs of bevel gears to realize front wheel driving.

This kind of front axle final drive, compare with a conventional universal joint drive, has some advantages to be a typical structure of 4WD tractors for paddy job such as, a relatively big cramp angle of the front drive wheels that facilitates steering; easily front axle sealing design and maintenance that

is more suitable for paddy field operating and simply structure due to itselves characters.

(2) Checking and adjusting of the front axle final drive

1) Checking and adjusting the meshing of the final drive spiral bevel gears

a) Adjustment of the gears meshing

Determine the thickness of the set of shims to control the axial movement of drive bevel gear by adding or subtracting adjusting shims 3 (see Fig. 25 – 6) to obtain an assembling dimension equals to $77_{-0.05}$ mm ensuring correct meshing of this pair of gears.

b) Checking tooth contact

Correct contact is on the middle of pinion tooth and nearer to the toe end with a length of not less than 14 mm and width not less than 5 mm. When checking, apply oiled red lead on teeth of driven bevel gear evenly and then turn the gear (exert a certain resisting force on it) to get clear contact on drive bevel pinion. For forward gears, the servicing surface of the pinion teeth are concave, while those of driven bevel gear are convex and vice versa for reverse gears.

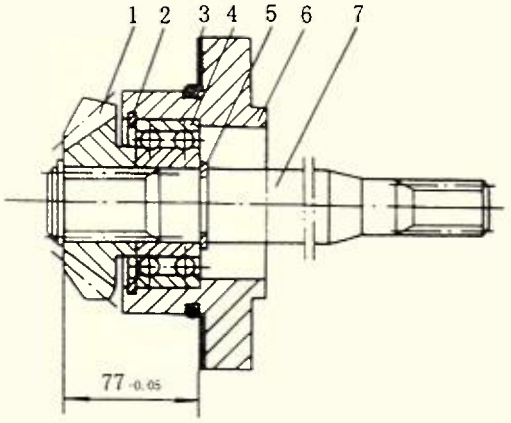


Fig. 25 – 6 Meshing adjustment of the front final drive spiral bevel gear pair

1. Spiral bevel pinion of final drive 2. Retainer 3. Adjusting shims 4. Bearing 5. Retainer 6. Bearing seat for spiral bevel pinion of final drive 7. Front drive half shaft

c) Checking the backlash

Backlash for new pair of gears is 0.15 ~ 0.25 mm, it is normal that backlash getting more due to wearing of the tooth surface in service and no adjustment is required. The checking method is similar to that for main drive bevel gears.

2) Adjusting of front final drive straight bevel gears

Guarantee the assembling dimension equals

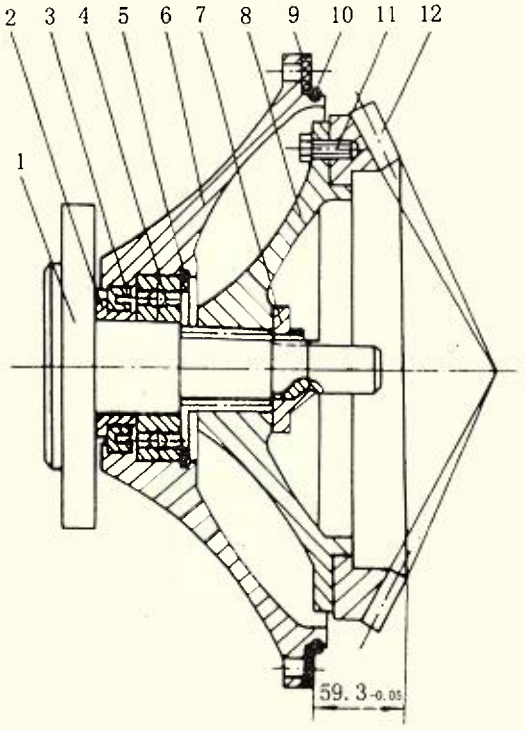


Fig. 25 – 7 Meshing adjustment of the front final drive straight bevel gear pair

1. Front drive shaft welding assy 2. Oil seal washer 3. Oil seal 4. Bearing 5. Retainer 6. Side cover for front final drive 7. Front drive shaft nut 8. Drive shaft flange 9. Adjusting shims 10. Sealing ring 11. Bolt 12. Driven straight bevel gear of front final drive

to $59.3_{-0.05}^{0}$ mm by adding or subtracting shims 9 (see Fig. 25－7) to make a correct meshing of final drive straight bevel gears. The correct contact of the teeth of this pair of gears is on the middle of drive bevel pinion nearer to toe end with the contact length not less than 20 mm and width not less than 7 mm.

Ⅲ. Operating and maintenance of the front drive axle

1. Front drive may be engaged to improve the adhensive character and traction performance when the tractor is used for heavy field jobs or works on soft and wet land. When engaging the front drive, put the transfer gearbox control lever under the rigth side of the driver (No. 32 in Fig. 2－1 i.e. No. 1 in Fig. 25－2) to its rear position and the power is transferred from the rear axle to the front drive axle via transfer gearbox. If the tractor works well with the two rear driving wheels, do not engage the front drive as possible.

2. Do not engage front drive for normal transporting on hard surface road, otherwise the front tires will wear quickly. Only when the rear wheels are slipping during road service in rainy or snowy weather, on a wet slippery road or on driving up a steep slop, can the front drive be engaged. As soon as the tractor drives out of the difficult areas, put the transfer gearbox control lever forward to its neutral position.

3. Since front tires wear more quickly and the left and right tire lugs wear unevenly, exchange them according to their worn condition. It is advisable to mount the front wheels with tire tread direction changed.

4. The maintenance method, procedure and maintenance intervals of the front drive axle are similar to those of the rear axle of model Jiangsu－500 tractors. The lubricant in the front drive axle housing and front final drive housing is mixed oil and other lubrication fillers can be filled with No. 2 calcium base grease. See a) and b) in Fig. 25－8.

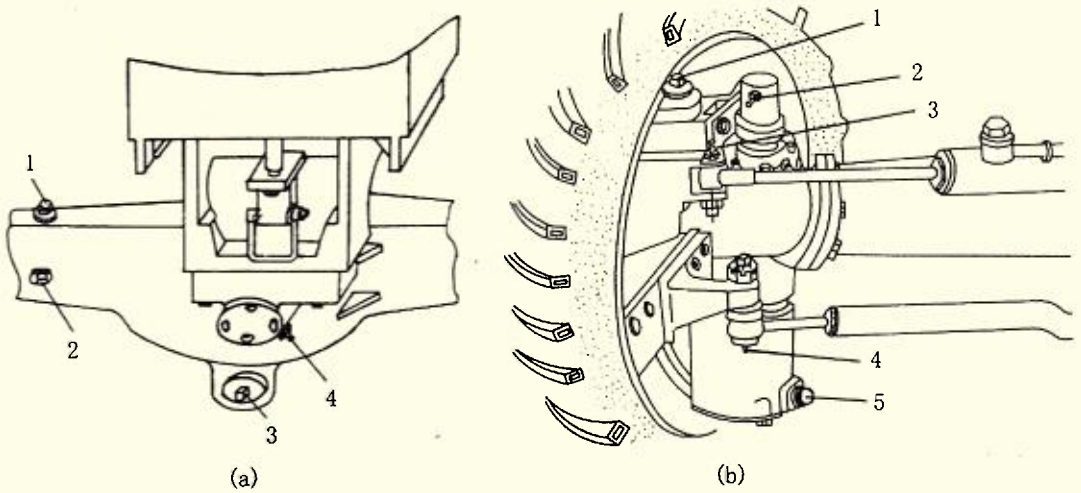


Fig. 25－8 Lubrication chart for the front drive axle

(a) 1. Mixed oil filler 2. Oil level inspection window 3. Drain port 4. Front and rear grease cups for pivot shaft

(b) 1. Mixed oil filler 2. Left and rigth grease cups for kingpin 3. Grease cups for the two trunnions of steering cylinder 4. Grease cups for the left and right spherical joint 5. Drain port

Section 2 Full Hydraulic Steering System

The tractor is equipped with a static hydraulic steering gear 5, relief valve system, see Fig. 25－9 which consists of steering wheel 6, static hydraulic steering gear 5, combined relief and flow control valves 4, steering cylinder 8, oil gear pump 3, oil filter 2, tie rod 7 and reservior.

Ⅰ. Static hydraulic steering gear

1. The functions and structure of the static hydraulic steering gear

The model BZZ static hydraulic steering gear equipped on the 4WD tractor, Jiangsu－550E and Jiangsu －650 tractor consists of spool 16, valve sleeve 14, valve body 10, rotor 23 and stator 24 etc., see Fig. 25－10. There are twelve milling grooves for oil return and twelve drilling holes on the surface of spool 16 which connected with steering column by connecting block 1. Valve sleeve 14 drilling with many holes is sliding fitted over the outer surface of spool 16. Three sets of torsion bar spring 15 assemblied together back to back are inserted into the grooves of the valve sleeve via the long hole of the spool to keep the relative position between the every oil return groove on the spool and the every inlet / outlet in the valve sleeve. One end with cross groove of gang shaft 26 is inserted in the valve sleeve by actuating pin 13, and the another end with splines insertes into the internal splines of the rotor 23 to perform a function of transferring torque, therefore, the rotating rotor 23 will drive the valve sleeve 14 turning together with it to combine the spool 16, valve sleeve 14 and valve body 10 as a servo spool valve which can control the direction of oil flow.

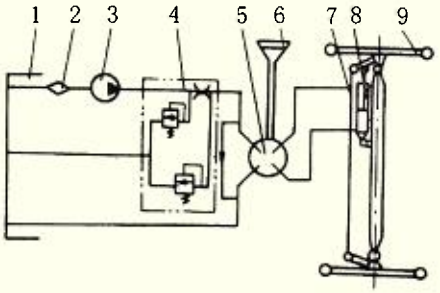


Fig. 25－9 Static hydraulic steering gear diagram

1. Reservior 2. Oil filter 3. Oil gear pump 4. Combined relief and flow control valve 5. Cycloidal static hydraulic steering gear 6. Steering wheel 7. Tie rod 8. Power steering cylinder 9. Front wheel

Meshing teeth of rotor 23 with six teeth and of stator 24 with seven teeth form a cycloidal meshing pair with seven closed oil chambers connecting with seven oil holes in valve body 10. The revolution speed of rotor is six times the counter rotational rotation speed of it . The functions of them are: as a servo metrical motor ensuring the quantity of oil flowing into the steering cylinder to be direct proportion to the angle of turn of the steering wheel; as a handpump while a hand steering is applied.

2. The working phases of static hydraulic steering gear

(1) Neutral position

See Fig. 25－11, when no attempt is made to turn the steering wheel 13, spool 10 is held in its neutral position by torsion bar spring, the oil from gear pump flows into the ring groove of the inlet of valve body 8 along the direction as arrow shown in this figure. At this time, valve sleeve 9 and spool 10 are opened to the oil return passage and all of the other oil passages are now blocked, while the oil returns back to the reservior 1 through the spool valve. Therefore, the hydraulic steering gear does not function. The oil in the chambers at the two sides of the internal chamber of steering cylinder can neither outflow nor inflow as its two oil passages are both blocked by spool of the valve, the tractor keeps

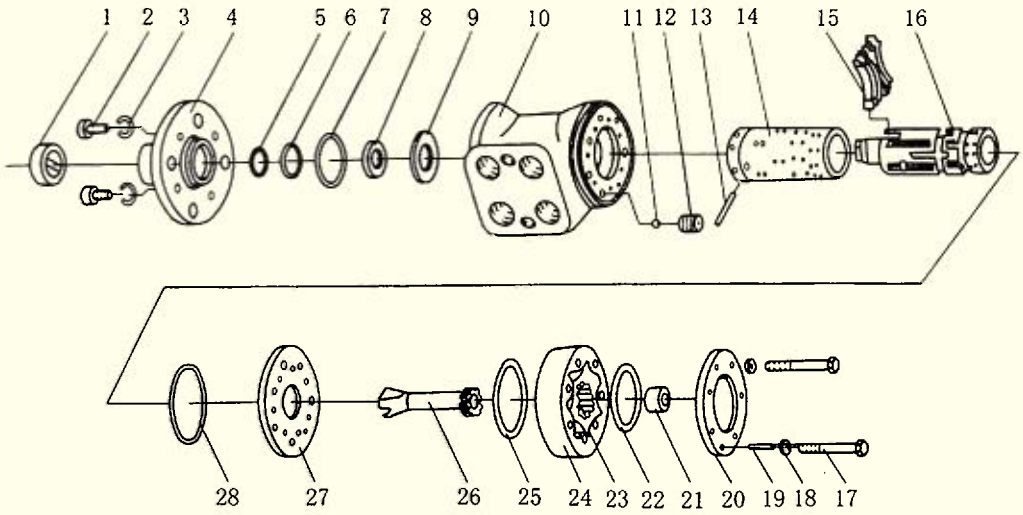


Fig. 25 – 10 Static hydraulic steering gear part drawing

1. Connecting block 2. Screw 3. Washer 4. Front cover 5.6.7. Seal ring 8. Retainer 9. Slide ring 10. Valve body 11. Steel ball 12. Threaded bushing 13. Actuating pin 14. Valve sleeve 15. Torsion bar spring 16. Spool 17. Limiting bolt 18. Copper washer 19. Limiting pin 20. Rear cover 21. Limit stop 22. Seal ring 23. Rotor 24. Stator 25. Seal ring 26. Gang shaft 27. Spacer 28. Seal ring

its original operating direction.

(2) Steering phase

As shown in Fig. 25 – 12, as the steering wheel is turned to the right, it drives the spool 10 turn by overcoming the spring resistance of the torsion bar spring 12, changing the relative position of the spool 10 and the sleeve 9 with an angle. Meanwhile, the spool valve performs four functions: staggering the inflow passage in the spool 10 and the oil return hole in the sleeve 9; connecting three oil return grooves with the left chamber of the steering cylinder; connecting three inflow passages on the spool 10 with three oil chambers of the rotary pump; connecting the other three chambers of the rotary pump with the right chamber of the steering cylinder.

The oil in three chambers of the rotary pump drives the rotor 6 to run with the same rotation direction of the steering wheel under the pressure of high pressure oil, therefore the volume of the other three chambers decreases, the oil pressed out flowing into the right chamber of the steering cylinder makes the piston move to the left. At this time, the oil in the left chamber of the steering cylinder returns to the reservior. This, in turn, allows the tractor to turn to the right.

At the movement of stop turning the steering wheel, the spool and valve sleeve return to the neutral position under the force of torsion bar spring, and the oil return holes in spool and thase in valve sleeve are connected at the same time by the rotating of valve sleeve driven by rotor 6 via gang shaft to block other oil passages, then the tractor will make its turning according to the angle turned of the steering wheel.

As the steering wheel is turned to the left, the oil flow path is shown in Fig. 25 – 13. The turning of the tractor is carried out by high pressure oil, the driver's steering force needed is just the force

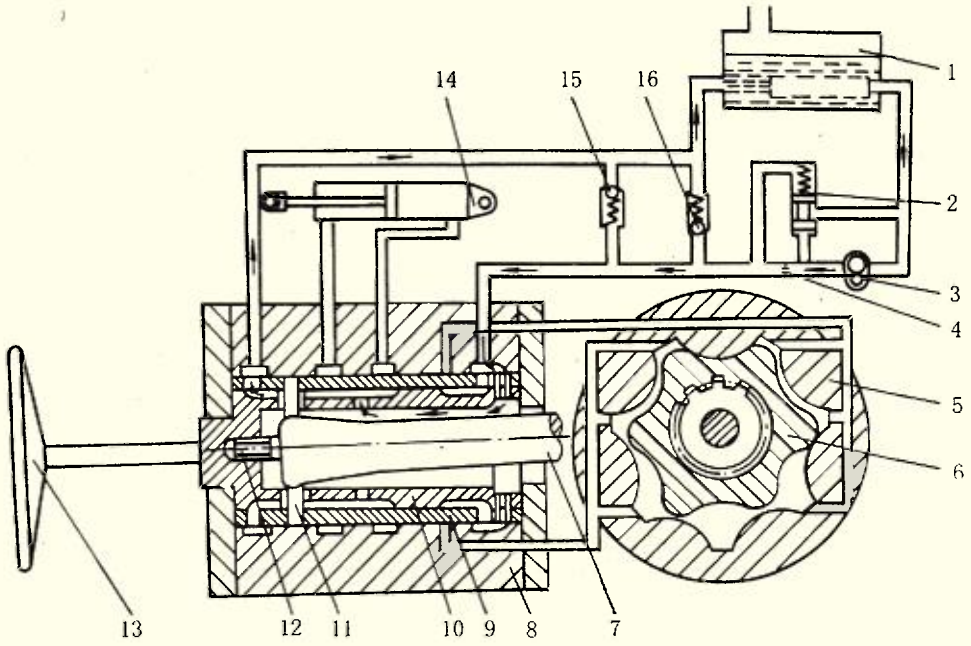


Fig. 25 – 11 Oil flow path in neutral position

1. Reservior 2. Flow control valve 3. Gear pump 4. Orifice 5. Stator 6. Rotor 7. Gang shaft 8. Valve body 9. Valve sleeve 10. Spool 11. Actuating pin 12. Torsion bar spring 13. Steering wheel 14. Power steering cylinder 15. Check valve 16. Relief valve

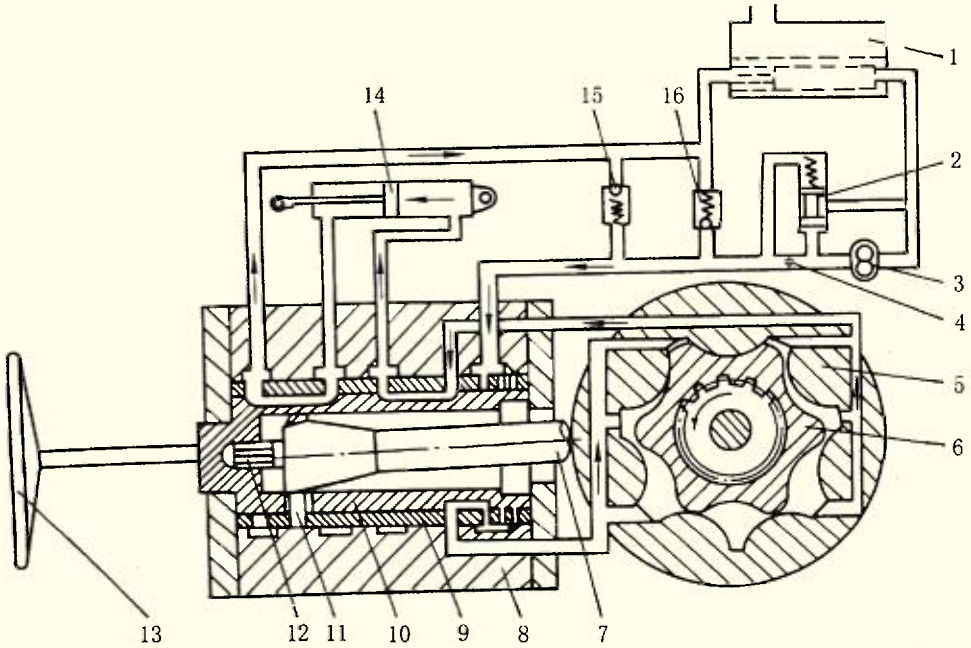


Fig. 25 – 12 Oil flow path in right turn position

Part number and designation are as in Fig. 25 – 11.

overcoming the spring force of the torsion bar spring 12 to turn the spool valve, so it is needless to turn the steering wheel hard.

(3) Servo－effect

As the steering wheel is turned, the rotor 6 of the rotary pump runs under the pressing of high pressure oil, meanwhile the valve sleeve 9 is driven via gang shaft with the turning direction of the steering wheel and the piston of steering cylinder is pushed to move. When the sleeve 9 turns a same angle with that of the steering wheel under the driving of rotor 6, the sleeve 9 will turn still under the driving of rotor 6 if stop turn the steering wheel i.e. the spool 10 stops , the oil return hole of spool 10 and that of the sleeve 9 are connected with all of the other oil passages being blocked. The piston of steering cylinder stops and the tractor has finished a turning.

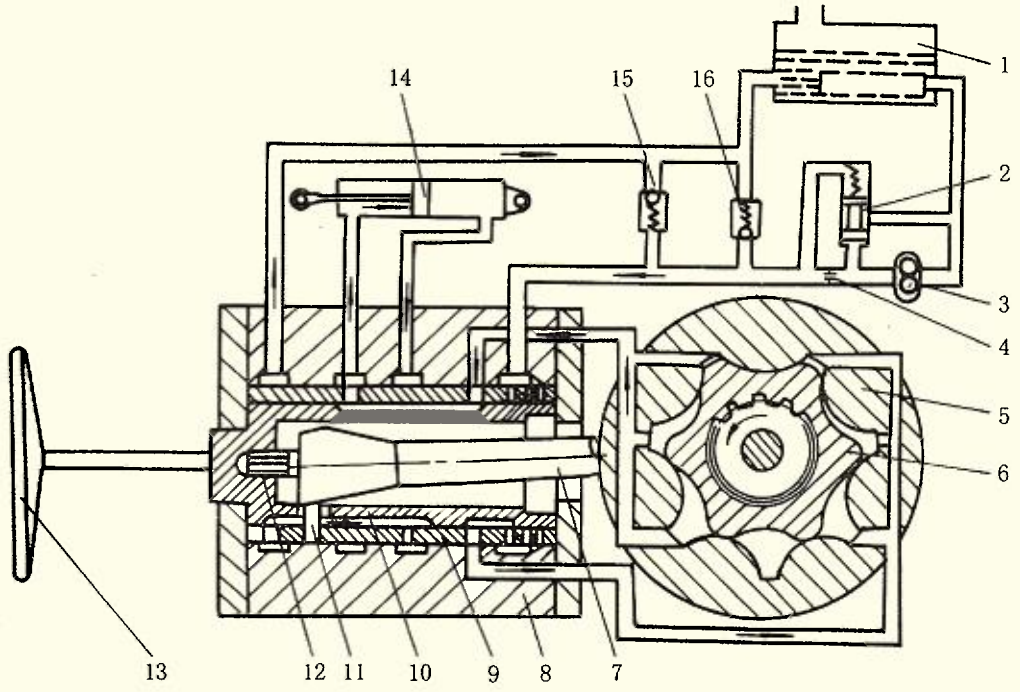


Fig. 25－13 Oil flow path in left turn position

Part number and designation are as in Fig. 25－11.

The movement effect of the piston will vary with the oil outflowing from three chambers of the rotary pump and the oil quantity outflowing depends on the angle of rotor 6 that it has rotated. For the angle of the rotor is the same as that of the steering wheel, the movement effect of the piston of the steering cylinder is direct proportion to the angle of turn of the steering wheel i.e. the servo effect. If the steering wheel turns further, the procedure mentioned above will be repeated with the moving of the piston of the steering cylinder further.

(4) Hand steering

Hand steering is needed while the engine stops or the rotary pump stops caused by its damaging. Check valve 15 positioned between the oil inlet passage and the oil outlet passage is a valve forming in-

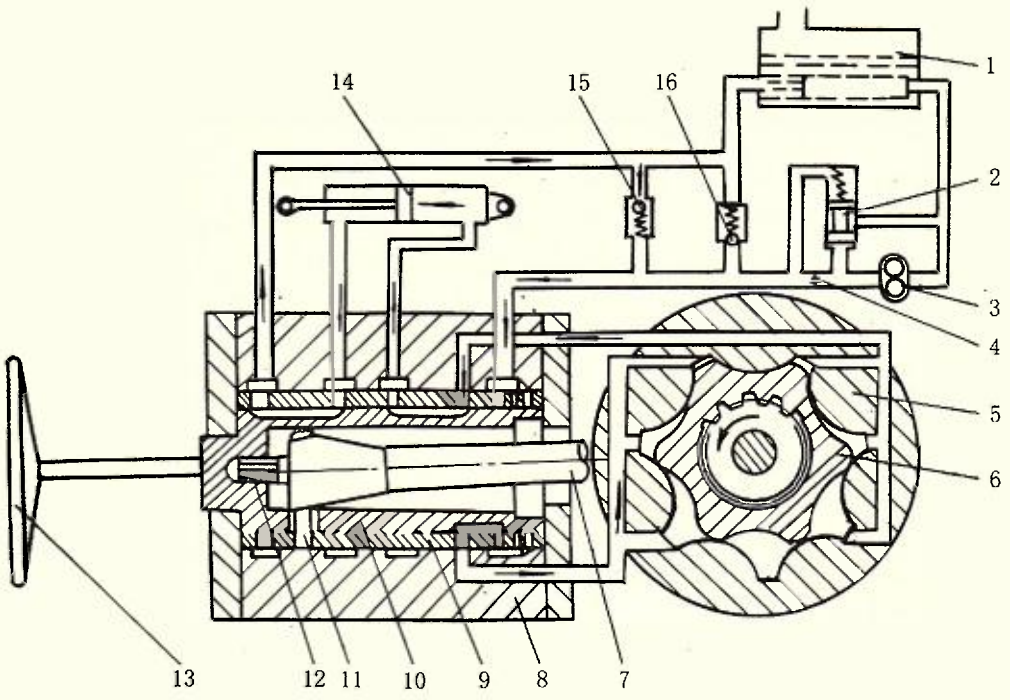


Fig. 25－14 Oil flow path in hand steering for right turn

Part number and designation are as in Fig. 25－11.

ternal oil flow path when steering the tractor at the time that the engine is shut off. Turning the steering wheel with hands drives the rotor 6 via spool 10, actuating pin 11 and gang shaft 7 to press the oil in the steering cylinder from one chamber to the other as the engine is shut off. The rotary pump now is used as a handpump to achieve manual steering.

Ⅱ. Relief and flow control valve

1. The functions of the relief and flow control valve

To guarantee a good sensitivity of the power steering gear and prevent the static hydraulic steering system from overloading, the oil quantity supplied to the hydraulic steering gear by rotary pump must be kept as a constant, and the oil pressure in the steering system should have nothing to do with the engine speed. A combined relief and flow control valve is designed at where the oil inlet passage and the oil outlet passage staggered.

2. The structure of the relief and flow control valve

To fully use the limited space of the tractor and simplified the hydraulic lines so as to minimize possible leakage, the relief valve and the flow control valve are integrated as a combined valve which has some advantages of compact integrated, easy of control and economically repairable. The structure of it is shown in Fig. 25－15.

The flow control valve consists of orifice 1, spool 2, valve body 3, flow control spring 4 and adjusting shims 5 etc..

The relief valve that consists of valve seat 6, steel ball 7, relief valve spring 8 and adjusting shims

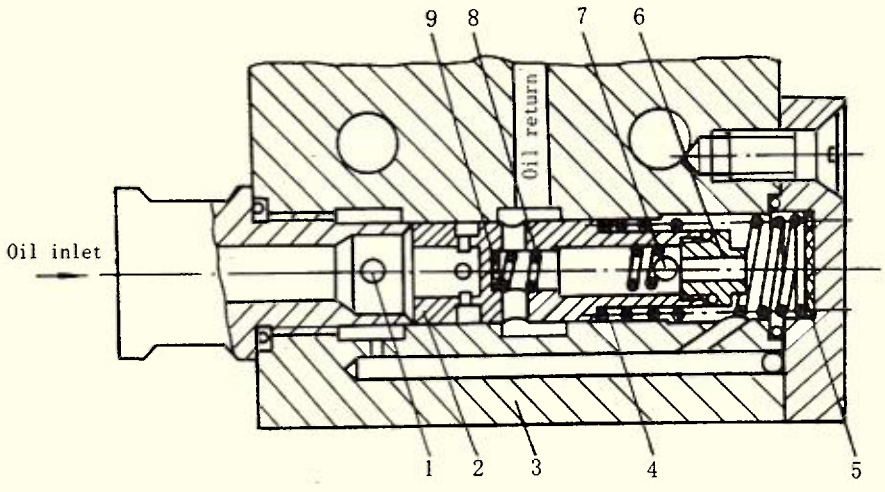


Fig. 25－15 Structure parts of combined relief and flow control valve

1. Orifice 2. Spool 3. Valve body 4. Flow control valve spring 5. Adjusting shims 6. Valve seat 7. Steel ball 8. Relief valve spring 9. Adjusting shims

9 etc. is integrated in the spool 2 of the flow control valve.

3. Working principle

The overflowing function of the flow control valve is designed according to the formula of the flow quantity characters of a thin wall orifice restrictor:

$$Q_A = kd_0^2\sqrt{\Delta p}$$

of which: d_0— orifice diameter; Δp — orifice differential; k — orifice coefficient.

If the Δp is controlled as a constant by a certain special design, thus $Q_A = k'd_0^2$, varying flow quantity Q_A which has nothing to do with the inflowing quantity Q_p and loading pressure P_A can be obtained by changing the orifice diameter d_0 therefore Q_A has a character of constant.

To keep Δp as a constant, the flow control valve has been designed with a pressurized spool (see Fig. 25－13) of which the left end is connected with oil inlet chamber and the right end is connected with the rear chamber of the orifice via the damping hole in valve body 3. This makes the movement of the spool 2 to be controlled by the pressure differential Δp between the front and the rear of the orifice and be balanced by the flow control valve spring 4. The active area of the pressure exerting on the both ends of spool 2 is approximately the same by neglecting the effects of oil passage resistance, the mechanical resistance of the spool and hydraulic power. The pressure differential can be written as follows:

$$\Delta P = P_p - P_A$$

of which: P_p— oil pressure at front of the orifice; P_A— oil pressure at rear of the orifice.

As the engine speed increases, the inflowing quantity $Q_P > Q_A$, and the pressure differential Δp between the front and the rear of the orifice is more than the constant specified, the spool valve functions the throttling effect. So that the rightward movement of the spool 2 exceeds (covered area), the oil return passage is opened and the unnecessary oil $Q_P - Q_A$ overflows to keep the flow quantity

through the orifice not be influenced by the inflowing Q_P ensuring the oil inflowing into the power steering gear to be around 7.5 L/ min.

The pilot valve of the relief overflowing valve is installed in the spool 2 of the flow control valve (see Fig. 25－15). As the pressure P_A(steering system operating pressure) in the rear chamber of the orifice 1 exceeds the adjusted value, the pilot valve is opened and a certain quantity of the oil in the orifice rear chamber flows into the oil return hole in the valve body 3 through damping hole, steel ball hole and oil return hole in spool 2.

The oil pressure in the right chamber of the spool 2 is less than P_A due to the damping action of the damping hole, this allows the pressure differential between the two ends of the spool 2 to be increased and the spool 2 moves rightward to allow a great deal of the oil overflows via oil return passage.

4. The adjustment of the relief and flow control valve operating pressure

The designed constant flow quantity of the flow control valve is 7.5 L/ min, the response pressure of the relief valve is 7 ± 0.5 MPa, which is adjusted and checked before delivering.

Decreased constant flow quantity can be restored to setting value by adding adjusting shims 5 and increasing the preload of the flow control valve spring 4. The dropped pressure in power steering system can be adjusted by adding adjusting shims 9 and increasing the compressing stress of the relief valve spring to raise the response pressure of the relief valve.

Ⅲ. The functions and structure of the steering cylinder

The 4WD tractor is equipped with single rod piston and double acting power steering cylinder which drives the front wheels turning leftward or rightward under the action of high pressure oil to allow the tractor to turn. The power steering cylinder consists of cylinder block 1, piston 4, piston－rod 8, guide bush 9 and snap ring 11 etc..

The guide bush 9 is fixed in the cylinder block with screwing the snap ring 11 clockwise into the cylinder block 1 and the groove of the guide bush 9. If repairing is necessary, remove the snap ring by screwing out the guide bush 9 counter clockwise.

Ⅳ. The operating and maintenance of power steering system

1. Release the threaded connector of the steering cylinder when the steering gear is put into running－in to allow the oil rotary pump bleed out under low speed until the oil overflowed without bubbles. Check the oil level in the reservior of the power steering system and place the ends of the oil suction pipe and oil return pipe under the oil surface to prevent gases from getting into the hydraulic system.

2. Fasten all of the screws at pressure hose connectors (doing this under not pressurized steering system). Check if the steering gear functions normal under all of the operating conditions. If the steering is hard or abnormal, do checking carefully and do not disassembling the BZZ－100 steering gear without realized troubles on it. Do not turn the steering wheel too hard to prevent the actuating pin and torsion bar spring etc. from being damaged.

3. Check if the steering system pressure is under specific value as the steering gear turning to its limit, and adjust it if necessary. The relief valve sounds out of chirp when the overflowing occurs, meantime the steering wheel should be turned back a little to prevent the steering gear from overloading for a long time.

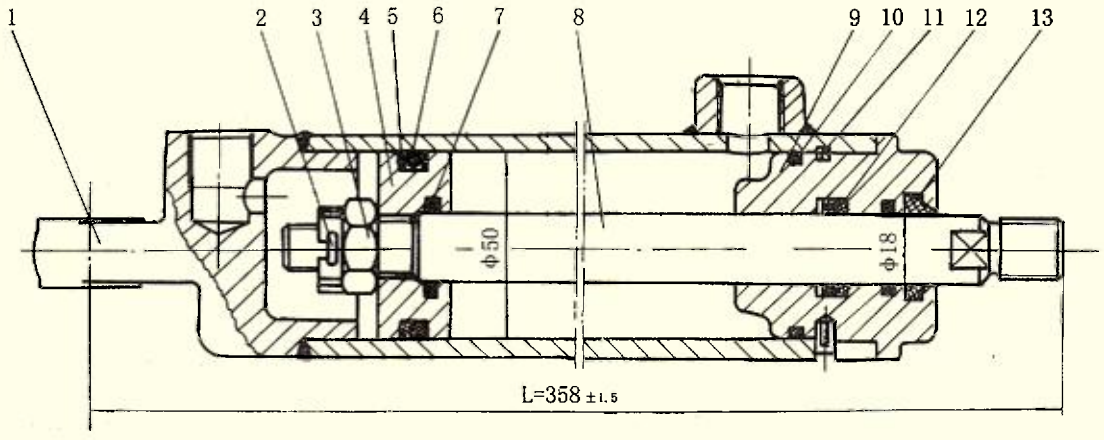


Fig. 25－16 Structure of the steering cylinder

1. Welded cylinder block 2. Cotter pin 3. Nut 4. Piston 5. Retainer 6. Seal ring 7. Seal ring 8. Piston rod 9. Guide bush 10. Seal ring 11. Snap ring 12. Y－shaped seal ring 13. Dust ring

4. In case of making a sharp turn or the tractor operating on soft land or in paddy field, the driver may depress the brake pedal corresponding to the steering direction to help the turning when the sideslip of the front wheels makes the steering out of normal function (two brake pedals should be divided beforehand).

5. If the tractor is to be towed, the straight towing speed should not exceed 15 km/hr, and turning towing speed not exceed 5 km/hr as hand steering is slow and hard to avoid accident caused by abnormal steering under high towing speed.

6. When the tractor is used under a ambient temperature of －15～－30℃ in bitter cold area, antifreezer should be added to the oil of power steering system or replace the steering system oil with HQB－10 gasoline engine oil.

APPENDIX

Appendix A Tightening Torque for the Main Connecting Parts of Jiangsu Medium－size Tractors

Item No.	Installing	Tightening position	Tightening torque (N·m)		
			495T	495A	LR4105T
1	Engine	Nut of main bearing cover of crankshaft	160～180	160～180	205～210
		Bolt of connecting－rod	100～120	100～120	210～215
		Nut of cylinder head	140～160	180～200	185～190
		Flywheel and crankshaft	130～150	100～120	125～130
2	Transmission system	Bracket and engine	120～140		
		Clutch housing and flywheel	60～70		
		Gearbox and engine	60～70		
		Gearbox and bearing seat of primary shaft	30～36		
		Gearbox and bearing cover of main shaft	30～36		
		Gearbox and inner planetary gear	60～70		
		Gearbox and rear axle	60～70		
		Transfer case and rear axle	60～70		
		Casing and cover of differential	60～70		
		Differential housing(front and rear axle) and driven spiral bevel gear	80～90		
		Rear axle and half shaft housing (L.H. & R.H.)	60～70		
		Final drive and half shaft housing (L.H. & R.H.)	100～120		
		Differential bracket and front axle case	60～70		
		Front differential bearing seat	40～50		
		Pivot shaft and front axle case	60～70		
		King pin housing and front axle case	60～70		
		F & R pivot shafts and brackets	120～140		
		Final driven bevel gear and drive shaft flange	80～90		
		Final drive housing and side cover	30～40		
		King pin housing and bearing seat	60～70		
		King pin support and final drive housing	120～140		
3	Working equipment	Lift casing and rear axle	60～70		
		Oil cylinder and lift casing	100～120		
		Lower link connecting plate and half shaft housing	180～220		
		Towing hook and rear axle	120～140		
4	Running gear	Disc and rim of front wheels	70～80		
		Drive shaft and disc of front wheels	120～140		
		Drive shaft and disc of rear wheels	120～140		
		Disc and rim of rear wheels	120～140		
		Final drive housing and steering arms (L.H. & R.H.)	60～70		
		Primary sleeve and secondary sleeve of front axle (L.H. & R.H.)	80～90		
		Drag link and pitman arm (L.H. & R.H.)	60～70		
		Drag link and knuckle arm (L.H. & R.H.)	60～70		
		Hub and disc of front wheels	120～140		

Appendix B Specifications of Rolling Bearings, Needles and Steel Balls of Jiangsu Medium－size Tractors Chassis

Series No.	Name	Model No.	Installing position	Qty.
1	Single－row with shield radial ball bearing	60204	Front end of PTO drive shaft (inside the flywheel)	1
2	Single－row thrust ball bearing	688713	Release bearing seat of clutch	1
3	Steel ball	5/16″	Inside the steering nut	28
4	Steel ball	3/8″	Ball seat of steering column	12
5	Single－row radial ball bearing	308	Rear end of driving shaft of gearbox	1
6	Single－row radial ball bearing	205	Front end of drive shaft of hydraulic pump	1
7	Single－row radial ball bearing	306	Rear end of PTO driving shaft	1
8	Single－row radial ball bearing	205	Rear end of drive shaft of hydraulic pump	1
9	Steel ball	1/8″	Main control valve of distributor	6
10	Single－row conical roller bearing	7216	Right end of differential	1
11	Single－row radial ball bearing	406	Front end of PTO driving shaft	1
12	Single－row radial ball bearing	406	Front end of PTO shaft	1
13	Single－row radial ball bearing	405	Rear end of PTO driving shaft	1
14	Single－row radial ball bearing	8105	Righthand lift rod	1
15	Single－row radial ball bearing	308	Rear end of PTO shaft	1
16	Single－row conical roller bearing	7516	Left end of differential	1
17	Single－row conical roller bearing	7310	Driving shaft inner end	1×2
18	Single－row conical roller bearing	7214	Driving shaft outer end	1×2
19	Single－row radial cylindrical roller bearing with short rollers	12310	Both ends of half shaft gear	2×2
20	Steel ball	7/8″	Inside the brake disc	5×2
21	Single－row conical roller bearing	7610	Rear end of driving spiral bevel gear	1
22	Single－row conical roller bearing	7310	Front end of driving spiral bevel gear	1
23	Roller	Φ4×30	Planetary gear shaft of gearbox	18×3
24	Single－row radial ball bearing (with stop groove on outer side)	50309	Rear end of main shaft, gearbox	1
25	Single－row radial ball bearing	308	Front end of main shaft of gearbox	1
26	Single－row radial ball bearing (with stop groove on outer side)	50309	Front end of driving shaft, gearbox	1
27	Single－row radial thrust ball bearing	8209	Lower end of king pin of front axle	1×2
28	Single－row conical roller bearing	7509	Inner end of front wheel shaft	1×2
29	Single－row conical roller bearing	7506	Outer end of front wheel shaft	1×2
30	Single－row radial cylinder roller bearing with short roller	42305	Idle gear shaft of transfer case	2
31	Single－row radial ball bearing	307	Transfer case main shaft	2
32	Steel ball	ϕ6.5	Safety valve for hydraulic steering	1
33	Steel ball	ϕ8	Check valve for valve body of hydraulic steering	1
34	Steel ball	ϕ5	Flow control valve for hydraulic steering	1

(Continued)

Series No.	Name	Model No.	Installing position	Qty.
35	Single－row radial ball bearing	311	Outer end of final driven bevel gear shaft	1×2
36	Single－row radial ball bearing	309	Inner end of final driven bevel gear shaft	1×2
37	Double－row radial thrust ball bearing	3056307	Top end of king pin	1×2
38	Single－row radial ball bearing	309	Middle－upper of king pin	1×2
39	Double－row radial thrust ball bearing	3056308	Final drive bevel gear shaft	1×2
40	Single－row tapered roller bearing	7209	Both ends of front differential	1×2
41	Single－row tapered roller bearing	2007108	Front bevel pinion rear end	1
42	Single－row tapered roller bearing	7608	Front bevel pinion front end	1
43	Double－row radial thrust ball bearing	46308	Lower end of king pin	1×2
44	Single－row radial ball bearing	309	Middle－upper of king pin	1×2
45	Single－row tapered roller bearing	7606	Outer end of front wheel hub	1×2
46	Single－row tapered roller bearing	7509	Inner end of front wheel hub	1×2

Appendix C Oil Seals and Sealing Rings of Jiangsu Medium－size Tractors Chassis

Installing position		Specifications	Qty.	Remarks
Gearbox	Front end of driving shaft	Oil seal PD45×62×10	1	50.37.019
	Inner cavity of rear end of driving shaft	Combined oil seal 30×40×11	1	50.37.015
Rear axle	PTO shaft	Oil seal SG45×75×12	1	
	PTO shaft control lever and control handle of hydraulic pump	O－ring 20×2.4	2	
	Blocking plug of end face of rear axle casing	O－ring 20×2.4	1	
Final drive	Drive shaft	Oil seal SD85×110×12	2	
Brake	Inner end of differential control lever	Oil seal PD18×30×10	1	
	Inner end of half shaft	Oil seal PD40×62×12	4	
	Outer end of half shaft	Oil seal PD50×80×12	2	
Hydraulic hitch	Regulative valve	O－ring 8×1.9	1	
	Draft control eccentric wheel welded assy	O－ring 10×1.9	1	
	Control rod of regulative valve	O－ring 13×1.9	1	
	From distributor to outlet port of hydraulic cylinder	O－ring 13×1.9	1	
	Joint bolt of hydraulic cylinder and lift casing	O－ring 16×2.4	4	
	Inlet pipe of distributor	O－ring 16×2.4	4	
	Outlet pipe of hydraulic pump	O－ring 16×2.4	2	
	Inlet pipe of distributor	Retainer A16×12	2	
	Outlet pipe of hydraulic pump	Retainer A16×12	2	
	Connection of safety valve and distributor	O－ring 20×2.4	1	
	Drain plug	O－ring 20×2.4	1	
	Check valve	O－ring 20×2.4	1	
	Position control eccentric wheel welded assy	O－ring 20×2.4	1	
	Return valve bush	O－ring 22×2.4	1	
	Spring push rod of draft control	O－ring 22×2.4	1	
	Check valve	O－ring 24×2.4	1	

(Continued)

Installing position		Specifications	Qty.	Remarks
Hydraulic hitch	Inlet pipe of hydraulic pump	O-ring 24×2.4	2	
	Outlet joint	O-ring 26×2.4	1	
	Oil outlet flange	O-ring 26×2.4	2	
	Inlet pipe of hydraulic pump(rear part)	O-ring 32×3.1	1	
	Between suction filter assy and lift casing	O-ring 32×3.1	1	
	Qudrant seat	O-ring 40×3.1	1	
	Drain plug	O-ring 40×3.1	1	
	Front blocking plug of suction filter	O-ring 40×3.1	1	
	Lift shaft	O-ring 60×5.7	2	
	Element assy	O-ring 60×5.7	1	
	Element assy	O-ring 73×5.7	1	
	Piston	O-ring 95×5.7 or 110×5.7	2	
	Piston	Retainer A95×85 or A110×100	2	
	Lift casing and lift shaft	Reinforced oil seal 75×50×12	2	
	Driving gear shaft of hydraulic pump	Reinforced oil seal 75×50×12	1	
Front axle	Steering knuckle assy	O-ring 51×3.5	1×2	
	Under thrust bearing of king pin	Oil seal W65×90×12	2×2	
	Inner side of front wheel shaft	Oil seal W65×90×12	2×2	
Steering gear	Steering pitman arm shaft (L.H. & R.H.)	Oil seal PD32×45×7	1×2	
Hydraulic steering system	Steering shaft bearing cover	O-ring 20×2.4	1	
	Flow control valve exports	O-ring 24×2.4	22	
	Oil return pipe connectors	O-ring 26×2.4	5	
	Strainer connector	O-ring 40×3.1	1	
	Safety valve end	O-ring 11×1.9	1	
	Connecting plate	O-ring 16×2.4	1	
Steering cylinder	Guide sleeve inner hole	Y-shaped seal 24×18	1	Special, YA24
	Piston outer diameter	O-ring 50×3.5	2	
	Piston inner diameter(guide sleeve inner hole)	O-ring 22×2.4	2	
Power transfer case	Shaft cover front end	O-ring 54×3.5	1	
	Shifting arm shaft journal	O-ring 20×2.4	1	
	Between mating surface of power transfer case and rear axle housing	O-ring 150×3.1	1	
	Main shaft journal	Oil seal 50×30×16	1	special
Front driving axle	King pin oil seal bush (inner hole) and front pivot	O-ring 50×3.5	3	
	Lower end of king pin bearing seat	O-ring 56×3.5	2	
	Oil seal seat outer diameter	O-ring 85×3.1	2	
	Bearing cover outer diameter	O-ring 105×3.1	2	
	Final drive spiral bevel bearing seat outer diameter	O-ring 120×3.1	2	
	Drive bevel pinion bearing seat outer diameter	O-ring 110×3.1	1	

(Continued)

Installing position		Specifications	Qty.	Remarks
Front driving axle	Drive bevel pinion spacer	O－ring 45×3.1	1	special
	Steering cylinder trunnion	O－ring 28×2.4	2	
	Front final drive side cover	O－ring 360×3.5	2	
	Drive bevel pinion rear end	Oil seal SG 50×72×12	1	
	King pin oil seal seat outer surface	Oil seal SG 75×100×12	2	
	Drive shaft journal	Oil seal PD 70×90×12	2	
	Final drive spiral bevel pinion bearing seat inner hole	Oil seal PD 40×62×12	2	

Appendix D Fit Clearance and Wear Limit of Main Parts of Jiangsu Medium－size Tractors

Table D－1 Fit Clearance and Wear Limit of Main Parts of Modle 495T Diesel Engine

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
1	Main journal of crankshaft and main bearing hole	Shaft $\Phi70_{-0.02}^{0}$ Hole $\Phi70_{+0.07}^{+0.13}$	Clearance	0.07～0.15	0.25
2	Axial clearance of crankshaft			0.07～0.34	0.40
3	Journal of connecting－rod and hole connecting－rod big end	Shaft $\Phi65_{-0.02}^{0}$ Hole $\Phi65_{+0.050}^{+0.098}$	Clearance	0.05～0.118	0.25
4	Journal opening of connecting－rod and thickness of connecting－rod big end	Crankshaft $38_{0}^{+0.10}$ Connecting－rod $38_{-0.25}^{-0.15}$	Clearance	0.15～0.35	0.7
5	Connecting－rod small end and external diameter of connecting－rod small end bushing	Shaft $\Phi39_{+0.043}^{+0.068}$ Hole $\Phi39_{0}^{+0.027}$	interference	－0.068～ －0.016	
6	Bushing hole of connecting－rod small end and piston pin	Shaft $\Phi35_{-0.007}^{0}$ Hole $\Phi35_{+0.020}^{+0.045}$	Clearance	0.020～0.052	0.12
7	Piston pin and pin hole of piston	Shaft $\Phi35_{-0.007}^{0}$ Hole $\Phi35_{-0.02}^{-0.005}$	Transition	－0.02～ 0.002	
8	(Round piston) Piston skirt and boring of cylinder sleeve (Elliptical skirted piston)	Shaft $\Phi95_{+0.22}^{-0.19}$ Hole $\Phi95_{0}^{+0.035}$ Shaft $\Phi95_{-0.19}^{-0.16}$ Hole $\Phi95_{0}^{+0.035}$	Clearance	0.19～0.255 0.16～0.225	0.42 0.38
9	Piston ring groove and 1st compression ring	Ring $3_{-0.012}^{0}$ Piston $3_{-0.03}^{+0.050}$	Clearance	0.05～0.087	0.2

(Continued)

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
10	Piston ring grooves and 2nd and 3rd compression ring	Ring $3_{-0.012}^{0}$ Piston $3_{+0.03}^{+0.05}$	Clearance	0.03～0.062	0.18
11	Piston ring groove and oil ring	Ring $6_{-0.012}^{0}$ Piston $3_{+0.03}^{+0.05}$	Clearance	0.03～0.062	0.18
12	End gap of 1st compression ring (measured by a Φ95. 035 feeler gauge)	0.30～0.50		0.30～0.50	2.5
13	End gaps of 2nd, 3rd compression ring and oil ring (measured by a Φ95.035 feeler gauge)	0.25～0.40		0.25～0.40	2.5
14	Valve stem and valve guide hole	Shaft $\Phi9_{-0.055}^{-0.040}$ Hole $\Phi9_{0}^{+0.022}$	Clearance	0.04～0.077	0.2
15	External diameter of valve guide and hole on the cylinder head	Shaft $\Phi17_{+0.029}^{+0.048}$ Hole $\Phi17_{0}^{+0.019}$	interference	−0.01～−0.048	
16	Insertion seat of intake valve and hole in the cylinder head	Shaft $\Phi46_{-0.114}^{+0.139}$ Hole $\Phi46_{0}^{+0.027}$	interference	−0.087～ −0.0139	
17	Insertion seat of exhaust valve and hole in cylinder head	Shaft $\Phi40_{+0.094}^{+0.019}$ Hole $\Phi40_{-0.02}^{+0.027}$	interference	−0.067～0.119	
18	Inserted piece of swirl chamber and hole in the cylinder head	Shaft $\Phi40_{+0.050}^{+0.077}$ Hole $\Phi40_{-0.027}^{0}$	interference	−0.05～−0.104	
19	Rocker arm hole and external diameter of rocker arm bush	Shaft $\Phi22_{+0.035}^{+0.056}$ Hole $\Phi22_{0}^{+0.033}$	interference	−0.002～−0.056	
20	Rocker arm bush hole and rocker arm shaft	Shaft $\Phi16_{-0.012}^{0}$ Hole$\Phi16_{+0.016}^{+0.040}$	Clearance	0.016～0.052	0.2
21	Camshaft and camshaft bushing	Shaft $\Phi46_{-0.115}^{-0.075}$ Hole $\Phi46_{0}^{+0.027}$	Clearance	0.075～0.142	0.25
22	Camshaft bushing and hole in engine body	Shaft $\Phi52_{+0.53}^{+0.83}$ Hole $\Phi52_{0}^{+0.30}$	interference	−0.023～−0.083	
23	Valve tappet and hole in engine body	Shaft $\Phi16_{-0.033}^{-0.016}$ Hole $\Phi16_{0}^{+0.019}$	Clearance	0.016～0.052	0.2
24	Flange of cylinder sleeve and height of the top stop end on engine body	Cylinder sleeve $10_{0}^{+0.05}$ Engine body $10_{-0.11}^{-0.06}$		0.06～0.16 (difference of each engine <0.05)	

(Continued)

No.	Name	Stardard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
25	Idler gear shaft and bushing hole	Shaft $\Phi30^{-0.02}_{-0.053}$ Hole $\Phi30^{+0.033}_{0}$	Clearance	0.02～0.086	0.2
26	External diameter of bushing and idler gear hole	Shaft $\Phi35^{+0.068}_{+0.043}$ Hole $\Phi35^{+0.027}_{0}$	interference	−0.016～−0.068	
27	Clearance between internal and external rotors of oil pump		Clearance	0.06～0.15	0.25
28	External diameter of external rotor and hole of oil pump body	Shaft $\Phi41^{-0.075}_{-0.115}$ Hole $\Phi41^{+0.027}_{0}$	Clearance	0.075～0.142	0.25
29	End faces of internal rotor and oil pump cover		Clearance	0.04～0.08	0.25
30	Hole of internal rotor and oil pump shaft	Shaft $\Phi13^{0}_{-0.012}$ Hole $\Phi13^{0}_{-0.019}$	Transition	0.012～−0.019	
31	Oil pump shaft and hole of oil pump cover	Shaft $\Phi13^{0}_{-0.012}$ Hole $\Phi13^{+0.040}_{+0.016}$	Clearance	0.016～0.052	0.2

Table D－2 Fit Clearance and Wear Limit of Main Parts of Modle 495A Diesel Engine

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
1	Main journal of crankshaft and main bearing hole	Shaft $\Phi70^{0}_{-0.019}$ Hole $\Phi70^{+0.130}_{+0.070}$	Clearance	0.070～0.149	0.25
2	Axial clearance of crankshaft			0.11～0.26	0.50
3	Journal of connecting－rod and hole of connecting－rod big end	Shaft $\Phi65^{0}_{-0.019}$ Hole $\Phi65^{+0.099}_{+0.050}$	Clearance	0.050～0.118	0.25
4	Thickness of connecting－rod big end and journal opening of connecting－rod	Connecting-rod $34^{-0.25}_{-0.35}$ Crankshaft $34^{+0.10}_{-0.10}$	Clearance	0.15～0.45	0.70
5	Connecting－rod small end bushing and its hole	Shaft $\Phi39^{+0.073}_{+0.048}$ Hole $\Phi39^{+0.025}_{0}$	Interfernce	−0.073～−0.023	
6	Piston pin and bushing hole of connecting－rod small end	Shaft $\Phi35^{0}_{-0.011}$ Hole $\Phi35^{+0.050}_{+0.025}$	Clearance	0.025～0.061	0.12

(Continued)

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
7	Piston pin and pin hole of piston	Shaft $\Phi35_{-0.011}^{0}$ Hole $\Phi35_{-0.016}^{-0.005}$	Transition	−0.016～0.006	
8	Piston skirt (long axis) and cylinder sleeve	Shaft $\Phi95_{-0.170}^{-0.140}$ Hole $\Phi95_{0}^{+0.035}$	Clearance	0.140～0.205	0.45
9	End gap of 1st compression ring			0.30～0.50	1.5
10	End gaps of 2nd and 3rd compression ring			0.25～0.40	1.8
11	End gap of oil ring			0.25～0.45	2.0
12	1st compression ring and piston ring groove	Ring $3_{-0.014}^{0}$ Groove $3_{+0.060}^{+0.074}$	Clearance	0.060～0.088	0.30
13	2nd and 3rd compression ring and piston ring groove	Ring $3_{-0.014}^{0}$ Groove $3_{+0.034}^{+0.048}$	Clearance	0.034～0.062	0.25
14	Oil ring and piston ring groove	Ring $6_{-0.018}^{0}$ Groove $6_{+0.030}^{+0.048}$	Clearance	0.030～0.066	0.20
15	Cylinder sleeve and bore of cylinder block	Shaft $\Phi101.5_{-0.034}^{-0.012}$ Hole $\Phi101.5_{0}^{+0.035}$	Clearance	0.012～0.069	
16	Valve tappet and hole of cylinder head	Shaft $\Phi16_{-0.068}^{-0.050}$ Hole $\Phi16_{0}^{+0.027}$	Clearance	0.050～0.096	0.25
17	Camshaft bushing and hole of engine body	Front bearing: Shaft $\Phi52_{+0.053}^{+0.072}$, Hole $\Phi52_{0}^{+0.030}$ Middle bearing: Shaft $\Phi50_{+0.053}^{+0.072}$, Hole $\Phi50_{0}^{+0.030}$ Rear bearing: Shaft $\Phi50_{+0.053}^{+0.072}$, Hole $\Phi50_{0}^{+0.030}$	Transition	−0.072～−0.023	
18	Camshaft journal and its bushing hole	Front bearing: Shaft $\Phi46_{-0.089}^{-0.050}$, Hole $\Phi46_{+0.035}^{+0.100}$ Middle bearing: Shaft $\Phi45.5_{-0.089}^{-0.050}$, Hole $\Phi45.5_{+0.035}^{+0.100}$ Rear bearing: Shaft $\Phi45_{-0.089}^{-0.050}$, Hole $\Phi45_{+0.035}^{+0.100}$	Clearance	0.085～0.189	0.35
19	Camshaft and thrust plate	Shaft opening $6_{0}^{+0.08}$ Plate thickness $6_{-0.118}^{-0.070}$	Clearance	0.07～0.198	0.50

(Continued)

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
20	Valve guide and hole in cylinder head	Shaft $\Phi15^{+0.046}_{+0.028}$ Hole $\Phi15^{+0.027}_{0}$	Interference	−0.046～−0.001	
21	Valve stem and valve guide hole	Shaft $\Phi9^{-0.056}_{-0.078}$ Hole $\Phi9^{+0.022}_{0}$	Clearance	0.056～0.100	0.20
22	Insertion seat of intake valve and hole in cylinder head	Shaft $\Phi44^{+0.150}_{+0.125}$ Hole $\Phi44^{+0.025}_{0}$	Interference	−0.150～−0.100	
23	Insertion seat of exhaust valve and hole in cylinder head	Shaft $\Phi38^{+0.150}_{+0.125}$ Hole $\Phi38^{+0.025}_{0}$	Interference	−0.150～−0.100	
24	Rocker arm and its hole	Shaft $\Phi22^{+0.056}_{+0.035}$ Hole $\Phi22^{+0.033}_{0}$	Interference	−0.056～−0.002	
25	Rocker arm shaft and rocker arm bush hole	Shaft $\Phi16^{-0.016}_{-0.034}$ Hole $\Phi16^{+0.043}_{+0.016}$	Clearance	0.032～0.087	0.20
26	Idler gear bush and seat hole	Shaft $\Phi54^{+0.051}_{+0.032}$ Hole $\Phi54^{+0.030}_{0}$	Interference	−0.051～−0.002	
27	Idler gear shaft and bushing hole	Shaft $\Phi50^{0}_{-0.016}$ Hole $\Phi50^{+0.089}_{+0.050}$	Clearance	0.050～0.105	0.20
28	Width of idler gear shaft case and idler gear shaft shouldr	Shaft $\Phi28^{0}_{-0.084}$ Hole $\Phi28^{+0.194}_{+0.110}$	Clearance	0.110～0.278	0.50
29	Meshing clearance between timing gear and idler gear			0.17～0.21	0.40
30	Meshing clearance between idler gear and camshaft gear			0.17～0.21	0.40
31	Gear bushing of fuel pump and seat hole	Shaft $\Phi76^{+0.078}_{+0.059}$ Hole $\Phi76^{+0.032}_{0}$	Interference	−0.078～−0.029	
32	Gear shaft of fuel pump and gear bushing hole	Shaft $\Phi66^{0}_{-0.019}$ Hole $\Phi66^{+0.130}_{+0.100}$	Clearance	0.01～0.149	0.25
33	Meshing clearance between idler gear and gear of fuel pump			0.17～0.21	0.40
34	Bearing bushing of oil pump and seat hole	Shaft $\Phi19^{+0.055}_{+0.022}$ Hole $\Phi19^{+0.021}_{0}$	Interference	−0.055～−0.001	

(Continued)

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
35	Oil pump shaft and bearing bushing hole	Shaft $\Phi14_{-0.008}^{0}$ Hole $\Phi14_{+0.050}^{+0.093}$	Clearance	0.050～0.098	0.15
36	Meshing clearance between internal and external rotor of oil pump			0.06～0.15	0.25
37	External rotor and hole of oil pump body	Shaft $\Phi50_{-0.089}^{-0.050}$ Hole $\Phi50_{0}^{+0.025}$	Clearance	0.05～0.114	0.25
38	End faces of rotors and oil pump cover		Clearance	0.062～0.178	0.25
39	Meshing clearance between drive gear and gear of oil pump			0.13～0.17	0.40
40	Water pump shaft and blade carrier hole	Shaft $\Phi16_{+0.033}^{+0.051}$ Hole $\Phi16_{+0.095}^{+0.138}$	Clearance	0.044～1.05	
41	Water pump shaft and fan pulley hole	Shaft $\Phi16_{-0.090}^{-0.078}$ Hole $\Phi16_{-0.119}^{-0.101}$	Interference	−0.041～−0.011	
42	Water pump shaft and bearing hole	Shaft $\Phi17_{+0.001}^{+0.012}$ Hole $\Phi17_{-0.008}^{0}$	Interference	−0.020～−0.001	
43	Water pump bearing and seat hole	Shaft $\Phi40_{-0.011}^{0}$ Hole $\Phi40_{-0.018}^{+0.007}$	Transition	−0.018～0.018	
44	Meshing clearance between drive gear of speedometer and driven shaft gear			0.085～0.130	0.40
45	Gear of oil pump and drive gear of hydraulic pump, meshing clearance			0.13～0.17	0.40

Table D－3 Fit Clearanee and Wear Limit of Main Parts of Model LR4105T Diesel Engine

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
1	Main jounal of crankshaft and main bearing	Shaft $\Phi85_{-0.02}^{0}$ Hole $\Phi85_{+0.046}^{+0.086}$	Clearance	0.046～0.106	0.30
2	Axial clearance of crankshaft		Clearance	0.05～0.192	0.40
3	Journal of connecting－rod and bearing	Shaft $\Phi72_{-0.02}^{0}$ Hole $\Phi72_{+0.040}^{+0.075}$	Clearance	0.040～0.095	0.30

(Continued)

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
4	Connecting－rod big end and crankshaft opening	Shaft $\Phi35^{-0.100}_{-0.200}$ Hole $\Phi35^{+0.100}_{0}$	Clearance	0.100～0.300	0.70
5	Piston skirt and cylinder sleeve	Shaft $\Phi105^{-0.110}_{-0.175}$ Hole $\Phi105^{+0.025}_{0}$	Clearance	0.11～0.20	0.30
6	Piston pin and connecting－rod bushing	Pin $\Phi36^{+0.002}_{-0.003}$ Hole $\Phi36^{+0.047}_{+0.027}$	Clearance	0.025～0.050	0.15
7	Piston pin and pin hole	Pin $\Phi36^{+0.002}_{-0.003}$ Hole $\Phi36^{+0.005}_{0}$	Transition	－0.002～0.008	0.05
8	1st compression ring and piston ring groove	Ring $3^{-0.010}_{-0.035}$ Groove $3^{+0.080}_{+0.055}$	Clearance	0.065～0.115	0.40
9	2nd compression ring and piston ring groove	Ring $3^{-0.010}_{-0.035}$ Groove $3^{+0.055}_{+0.030}$	Clearance	0.04～0.09	0.30
10	Oil ring and piston ring groove	Ring $5^{-0.010}_{-0.035}$ Groove $5^{+0.060}_{+0.030}$	Clearance	0.040～0.095	0.25
11	End gap of 1st compression ring	Filler gauge $\Phi105^{+0.000}$	Clearance	0.50～0.70	3.00
12	End gap of 2nd compression ring	Filler gauge $\Phi105^{+0.000}$	Clearance	0.45～0.65	3.00
13	End gap of oil ring	Filler gauge $\Phi105^{+0.000}$	Clearance	0.40～0.65	3.00
14	Camshaft journal and bearing	Shaft $\Phi54^{0}_{-0.026}$ Hole $\Phi54^{+0.102}_{+0.060}$	Clearance	0.060～0.127	0.25
15	Camshaft thrust plate and journal (axial clearance)	Shaft $6^{-0.05}_{-0.10}$ Hole $6^{+0.05}_{0}$	Clearance	0.05～0.15	0.40
16	Valve tappet and tappet hole	Shaft $\Phi30^{-0.025}_{-0.040}$ Hole $\Phi30^{+0.022}_{0}$	Clearance	0.025～0.062	0.20
17	Idler gear shaft and gear bushing	Shaft $\Phi50.8^{-0.025}_{-0.050}$ Hole $\Phi50.8^{+0.025}_{0}$	Clearance	0.025～0.075	0.20

(Continued)

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
18	Meshing clearance between timing gears		Clearance	0.010～0.15	0.60
19	Intake valve and valve guide	Guide $\Phi 9.5^{+0.010}_{0}$ Stem $\Phi 9.5^{-0.025}_{-0.045}$	Clearance	0.025～0.064	0.20
20	Exhaust valve and valve guide	Guide $\Phi 9.5^{+0.010}_{0}$ Stem $\Phi 9.5^{-0.038}_{-0.058}$	Clearance	0.038～0.077	0.30
21	Rocker arm shaft and bushing	Shaft $\Phi 25^{-0.020}_{-0.040}$ Hole $\Phi 25^{+0.021}_{0}$	Clearance	0.020～0.061	0.20
22	Oil pump shaft and bushing	Shaft $\Phi 16^{-0.016}_{-0.027}$ Hole $\Phi 16^{+0.018}_{0}$	Clearance	0.016～0.045	0.20
23	Radial clearance between oil pump gear and pump body	Shaft $\Phi 47.34^{-0.050}_{-0.080}$ Hole $\Phi 47.34^{+0.030}_{0}$	Clearance	0.050～0.073	0.30
24	Clearance between oil pump gear and end face of pump body		Clearance	0.020～0.073	0.20
25	Meshing clearance between drive and driven gear of oil pump		Clearance	0.80～1.00	1.50
26	Water pump blade and pump housing		Clearance	0.08～1.27	
27	Water pump blade and rear cover		Clearance	0.395～1.365	

Table D－4 Fit Clearanee of Main Parts of Tractor Chassis

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
1	Front pivot shaft and bushing hole	Shaft $\Phi 50^{-0.025}_{-0.087}$ Hole $\Phi 50^{+0.30}_{+0.25}$	Clearance	0.275～0.387	
2	King pin and bushing hole	Shaft $\Phi 45^{0}_{-0.016}$ Hole $\Phi 45^{+0.29}_{+0.07}$	Clearance	0.07～0.306	
3	Every shift fork shaft and its shaft hole	Shaft $\Phi 19^{-0.020}_{-0.072}$ Hole $\Phi 19^{+0.052}_{0}$	Clearance	0.02～0.124	
4	Reverse gear inner and reverse shaft	Shaft $\Phi 25^{-0.007}_{-0.020}$ Hole $\Phi 25^{+0.11}_{+0.07}$	Clearance	0.077～0.130	

(Continued)

No.	Name	Standard dimension	Fitting quality	Standard for new installation	Wear limit permitted (reference)
5	Planetary gear hole and shaft	Shaft $\Phi25^{-0.007}_{-0.020}$ Hole $\Phi25^{+0.194}_{+0.116}$	Clearance	0.109～0.214	
6	Steering segment gear shaft and its bushing hole	Shaft $\Phi32^{-0.025}_{-0.050}$ Hole $\Phi32^{+0.025}_{0}$	Clearance	0.025～0.075	
7	Hydraulic lift cylinder block and piston (4 sets in assembling)	Shaft $\Phi95^{-0.050}_{-0.065}$ Hole $\Phi95^{+0.06}_{0}$	Clearance	0.05～0.08	
8	Main control valve sleeve and distributor housing(10 sets in assembling)	Shaft $\Phi22^{+0.056}_{+0.026}$ Hole $\Phi22^{+0.021}_{-0.009}$	Interference	−0.032～−0.038	
9	Return valve seat and distributor housing (10 sets in assembling)	Shaft $\Phi26^{+0.032}_{+0.002}$ Hole $\Phi26^{+0.021}_{-0.009}$	Interference	−0.008～−0.014	
10	Main control valve and valve sleeve hole	Shaft $\Phi14^{+0.004}_{-0.016}$ Hole $\Phi14^{+0.01}_{-0.01}$	Clearance	0.004～0.008	
11	Pivot shaft of front & rear axle and bushing hole	Shaft $\Phi87^{-0.036}_{-0.071}$ Hole $\Phi87^{+0.087}_{0}$	Clearance	0.036～0.158	
12	King pin bearing seat and bushing hole	Shaft $\Phi50^{-0.120}_{-0.150}$ Hole $\Phi50^{+0.046}_{0}$	Clearance	0.120～0.205	
13	Steering hydraulic cylinder piston and cylinder block hole	Shaft $\Phi50^{-0.025}_{-0.050}$ Hole $\Phi50^{+0.05}_{0}$	Clearance	0.025～0.100	
14	Hydraulic steering valve plug and valve body hole	Shaft $\Phi16^{+0.004}_{-0.014}$ Hole $\Phi16^{+0.018}_{0}$	Clearance	0.008～0.020	
15	Hydraulic steering cylinder trunnion and pin	Shaft $\Phi16^{0}_{-0.027}$ Hole $\Phi16^{+0.07}_{+0.02}$	Clearance	0.02～0.034	

Note: No. 11～15 are for 4WD tractors.

Appendix E Fuel, Lubricating Oil and Grease for Jiangsu Medium-size Tractors

Table E-1 Specifications of Fuel (GB 252-87)

Main quality index	Fuel specifications					
	No. 10 (RC-210)	No. 0 (RC-0)	No. -10 (RC-10)	No. -20 (RC-20)	No. -35 (RC-35)	Diesel for farming (SY1077-77)
Value of cetane≥	50	50	50	45	43	40
Kinematic viscosity(mm^2/s) 20℃≤ 50℃≤	3.0～8.0	3.0～8.0	3.0～8.0	2.5～8.0	2.5～7.0	- 6

(Continued)

Main quality index	Fuel specifications					
	No. 10 (RC-210)	No. 0 (RC-0)	No. -10 (RC-10)	No. -20 (RC-20)	No. -35 (RC-35)	Diesel for farming (SY1077-77)
Temperature of distillation (℃)≤						
50% distillate	300	300	300	300	300	
90% distillate	355	355	355	355	355	
95% distillate	365	365	-	-	-	
Condensation point(℃)≤	10	0	-10	-20	-35	20

Table E-2 Fuel, Lubricating Oil and Grease for the Tractors

Position	Season	Specifications
Fuel tank	Summer 20℃ and above 5~20℃ Winter 5~-15℃	Agricultural diesel(SY1077-77) No. 0 or No. 10 light diesel(GB252-87) No. -10 or No. -20 light diesel(GB252-87)
Oil sump of engine	Summer Winter	No. 40 CA diesel engine oil(GB5323-85) No. 20 or No. 30 CA diesel engine oil (GB5323-84)
Gearbox and Hydraulic lift Hydraulic steering reservoir	Summer Winter	HQB-15 gasoline engine oil(GB485-84)or No. 30 CA diesel engine oil (GB5323-85) HQB-10 gasoline engine oil(GB485-84) or No. 20 CA diesel engine oil(GB5323-85)
Steering box		Gear oil (SH0350-92)
Grease nipples		No. 2 calcium base grease(GB491-87)
Final drive casing Front drive axle		Mixture of 40% of ZN-2 sodium base grease(GB492-77)and 60% of diesel engine oil (GB5323-85)

Table E-3 Lubrication Schedule of Jiangsu Medium-size Tractors

No.	Position	No. of points	Lubricant	Interval of maintenance	Remarks
1	Pivot shaft of front axle	1	Calcium base grease	Each shift or every other	Inject grease
2	Ball joint of drag link	4	Calcium base grease	Each shift or every other	Inject grease
3	King pin	2	Calcium base grease	Each shift or every other	Inject grease
4	Front wheel hub	2	Calcium base grease	Each shift or every other	Inject grease
				Each 500 hours	Change grease
5	Oil sump of engine	1	Diesel engine oil	Each shift	Check oil level and top up
				First 100 hours for new tractor or each 500 hours	Change oil

(Continued)

No.	Position	No. of points	Lubricant	Interval of maintenance	Remarks
6	Injection pump	1	Diesel engine oil	Each shift	Check oil level and top up
				First 100 hours for new tractor or each 500 hours	Change oil
7	Steering column	1	Calcium base grease	125 hours	Inject grease
8	Steering gear housing	1	Gear oil	500 hours	Check oil level and top up
9	Both ends of generator	2	Calcium base grease	1000 hours	Change grease while disassembling or repairing bearings
10	Fan－water pump shaft	1	Calcium base grease	125 hours	Inject grease
11	Clutch pedal shaft	1	Calcium base grease	Each shift or every other	Inject grease
12	Brake pedal shaft	1	Calcium base grease	Each shift or every other	Inject grease
13	Left and right lift rods	3	Calcium base grease	Each shift or every other	Inject grease
14	Gearbox－rear axle	1	Gasoline engine oil or diesel engine oil	Every 50 hours	Check oil level and top up
				500 hours	Drain off oil, clean and refill
				1000 hours	Change oil
15	Hydraulic lift casing	1	Gasoline engine oil or diesel engine oil	Each shift or every other	Check oil level and top up
				500 hours	Drain off oil, clean and refill
				First 100 hours for new tractor or each 1000 hours	Change oil
16	Final drive casing	2	Mixture of 40% of sodium base grease and 60% of diesel engine oil	Each 125 hours	Check oil level and top up
				Each 1000 hours	Change oil
17	Pivot shaft of front drive axle	2	Calcium base grease	Each shift or every other	Inject grease
18	Hydraulic steering cylinder trunnion	2	Calcium base grease	Each shift or every other	Inject grease
19	Ball joint (L. H. & R. H.)of tie rod	2	Calcium base grease	Each shift or every other	Inject grease
20	Front drive axle casing	1	Mixture of 40% sodium base grease and 60% diesel engine oil	Each 125 hours	Check oil level and top up
				1000 hours	Change oil
21	Front final drive housing	2	Mixture of 40% sodium base grease and 60% diesel engine oil	Each 125 hours	Check oil level and top up
				1000 hours	Change oil
22	Hydraulic steering reservoir	1	Oil for gasoline or diesel engine	Every shift	Check oil level and top up
				First 100 hours for new tractor or each 500 hours	Change oil

Note: No. 17～22 are for 4WD tractors.

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