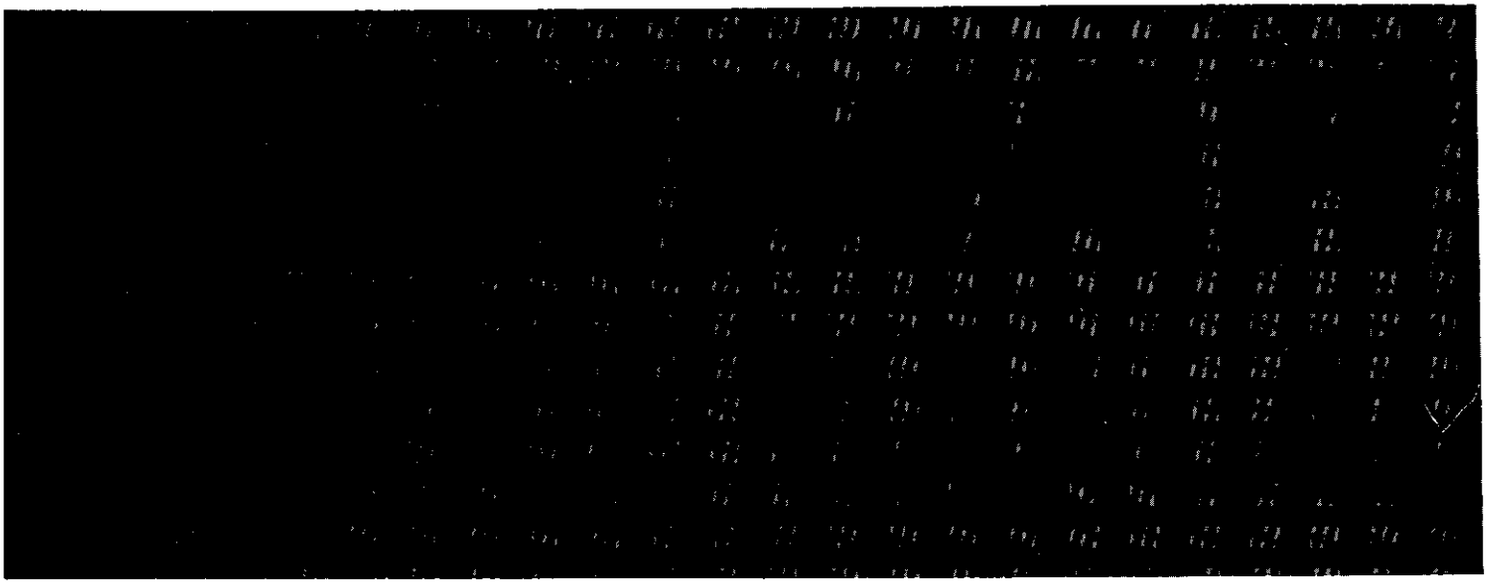
YANMAR

SERVICE MANUAL

YM195D/YM240D/YM330D



DIESEL TRACTOR

(SUPPLEMENT)

YM195D / YM240D / YM330D

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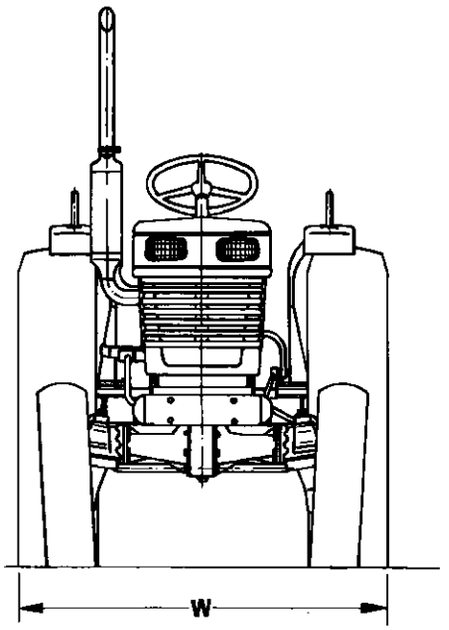
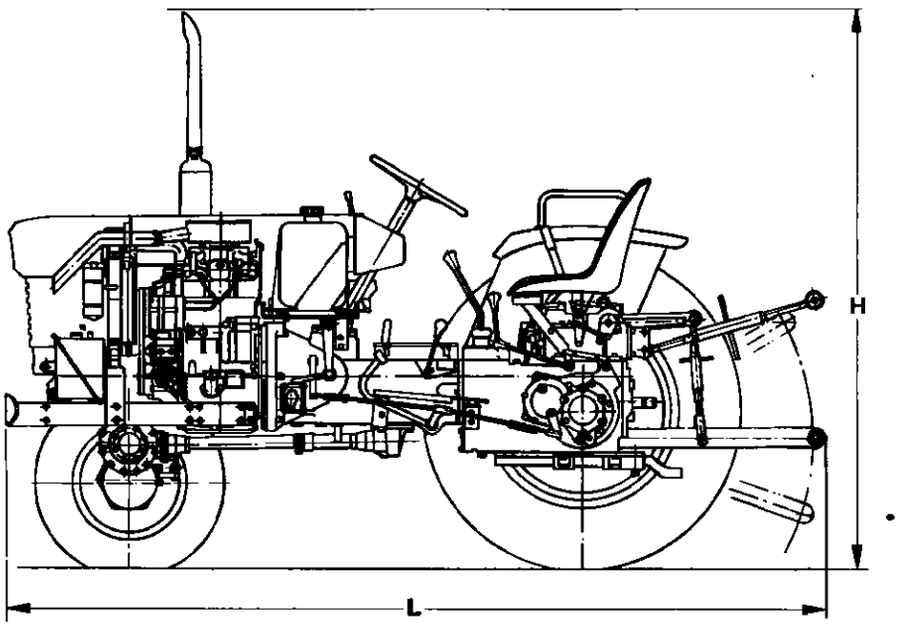
I. Specifications

1. Drawings

YM195D, YM240D



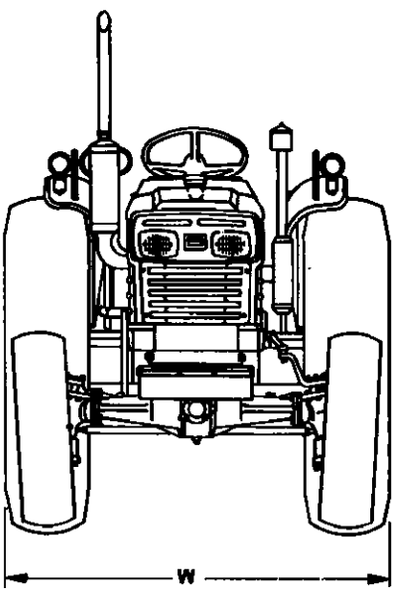


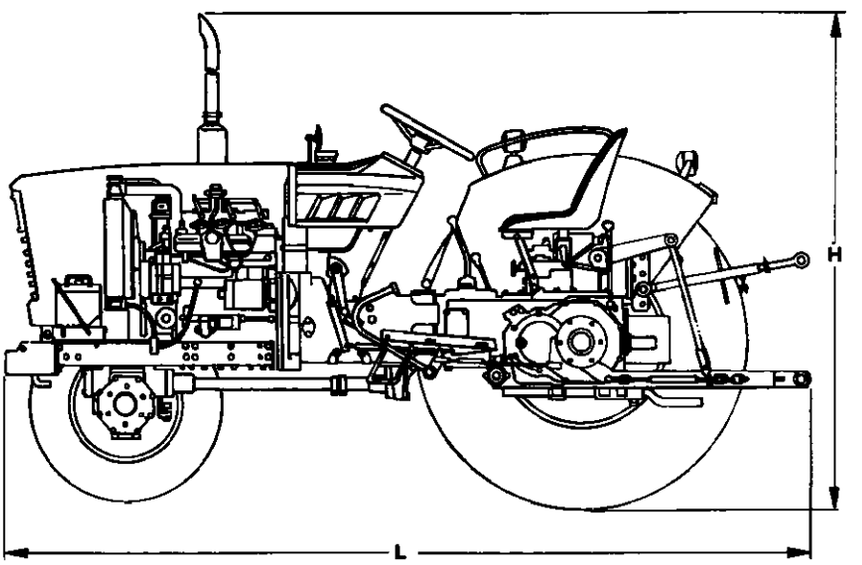
	YM195D	YM240D
W:	47.6(1,210)	50.2(1,276)
L:	111.2(2,825)	111.2(2,825)
H:	72.4(1,840)	73.3(1,860)

Unit: in.(mm)

YM330D

W: 57.9 (1,470)
L: 122.0 (3,100)
H: 77.1 (1,960)





2. Specifications

Item				Unit	YM195D	YM240D
Engine	Engine block	Engine model			2T84A	2TR20A-X
		Type of engine			Diesel engine	
		Number of cylinders			2	
		Cylinder arrangement			Vertical, inline	
		Bore x stroke		in.	3.307 x 3.543 (84mm x 90mm)	3.543 x 3.543 (90mm x 90mm)
		Cylinder liner type			Wet type	
		Cycle			4-stroke cycle	
		Combustion chamber type			Precombustion chamber	
		Valve system			Overhead valves	
		Displacement		cu.in.	60.84 (997cc)	69.87 (1,145cc)
		Compression ratio			21 : 1	20.1 : 1
		Maximum output		hp/rpm	19/2,400	24/2,400
		Maximum torque		ft.lbs/rpm	37.5/1,800 (5.2kg-m/1,800)	46.9/1,800 (6.5kg-m/1,800)
		Engine weight		lbs	373 (169kg)	380 (172kg)
		Piston rings	Compression rings		3	
			Oil scraper ring		1	
		Valve timing	Intake valves Open	degrees	22° before T. D. C.	
			Intake valves Close	degrees	52° after B. D. C.	
			Exhaust valves Open	degrees	52° before B. D. C.	
			Exhaust valves Close	degrees	22° after T. D. C.	
		Valve clearances	Intake valves	in.	0.0059 (0.15mm) (cold)	
			Exhaust valves	in.	0.0059 (0.15mm) (cold)	
	Fuel system	Engine starting			Electrical starting by starter motor	
		Ignition			Compression ignition	
		Injection timing			Before T. D. C. 22°± 2° (F. I. D.)	
		Injection pump type			Yanmar Bosch PFR2K	
		Injection pump plunger diameter		in.	0.2756 (7mm)	
		Injection cam lift		in.	0.2756 (7mm)	
		Injection valve type			Semi throttle type	
		Injection valve diameter		in.	0.1958 (5mm)	
		Injection pressure		psi	2,276 (160kg/cm^2)	
		Injection order			1–2	

YM330D	YM330D W/LIVE P.T.O.	
3T84A	3T84A-LP	
Diesel engine		
3		
Vertical, inline		
3.307 x 3.543 (84mm x 90mm)		
Wet type		
4-stroke cycle		
Precombustion chamber		
Overhead valves		
91.29 (1,496cc)		
21 : 1		
33/2,600		
70.7/2,200 (9.8kg-m/2,200)		
525 (239kg)	517 (235kg)	
3		
1		
22° before T. D. C.		
52° after B. D. C.		
52° before B. D. C.		
22° after T. D. C.		
0.0059 (0.15mm) (cold)		
0.0059 (0.15mm) (cold)		
Electric starting by starter motor		
Compression ignition		
Before T. D. C. 25° (F. I. D.)		
Yanmar Bosch PFR3K		
0.2756 (7mm)		
0.2756 (7mm)		
Semi-throttle type		
0.1958 (5mm)		
2,276 (160kg/cm^2)		
1–3–2		

		Item		Unit	YM195D			YM240D			
Engine	Fuel system	Fuel			Light diesel oil						
		Fuel tank capacity		U.S.gal.	5.8 (22 *l*)						
		Speed control method			All speed mechanical type						
	Lubricating system	Lubricating pump type			trochoid						
		Lubricating system			Forced circulation lubrication and splash lubrication						
		Lubricating oil capacity		U.S.gal.	1.0 (4*l*)			1.3 (5*l*)			
	Cooling system	Cooling system			Water-cooled						
		Heat dissipation method			Radiator with sub-tank						
		Coolant pump type			Centrifugal type						
	Electrical system	Starter motor type			S114-146 (Hitachi) DC compound motor						
		Starter motor capacity		V-KW	12-1.3						
		A.C. Generator type			LT115-52 (Hitachi) 3-phase revolving field type						
		Generator capacity		V-A	12-15						
		Regulator			TL1Z-86 (Hitachi) Tirrill type						
		Battery type			N70Z						
		Battery voltage, capacity		V-AH	12-75						
		Thermostart plug type (optional)			SH100-02 (Hitachi) Magnetic valve type						
		Thermostart capacity		V-A	12-13						
Chassis	Power train	Clutch	Clutch type		Mechanical dry single stage						
			Facing (out. dia. x inn. dia. thickness)	in.	7.87 x 5.51 x 1.38 (200mm x 140mm x 3.5mm)						
			Facing area	sq.in.	24.8 (160cm^2)						
			Static torque capacity	ft.lbs	130.8 (18.09kg-m)						
		Trans-mission	Transmission type		Mechanical, constant mesh combining selective mesh						
			Transmission speeds		8 forward, 2 reverse, 2 P. T. O.						
			Gear ratios and Travel speeds	(Forward)	Gear ratio	mph	(Km/h)	mph	(Km/h)	mph	(km/h)
				1st	13.58	0.51	(0.82)	0.54	(0.86)	0.56	(0.90)
				2nd	7.70	0.90	(1.44)	0.95	(1.52)	0.98	(1.58)
				3rd	5.06	1.37	(2.20)	1.44	(2.32)	1.50	(2.41)
				4th	3.61	1.91	(3.07)	2.01	(3.24)	2.09	(3.37)
				5th	3.19	2.17	(3.49)	2.28	(3.68)	2.38	(3.82)
				6th	2.05	3.37	(5.42)	3.55	(5.72)	3.69	(5.95)

YM330D	YM330D W/LIVE P.T.O.	
Light diesel oil		
8.45 (32 ℓ)		
All speed mechanical type		
Trochoid		
Forced circulation lubrication and splash lubrication		
1.69 (6.4 ℓ)		
Water-cooled		
Radiator with sub-tank		
Centrifugal type		
S12-23 (Hitachi) DC compound motor		
12-1.8		
LT115-52 (Hitachi) 3-phase revolving field type		
12-15		
TL1Z-86 (Hitachi) Tirrill type		
N100		
12-100		
SH100-02 (Hitachi) Magnetic valve type		
12-13		
Mechanical, single stage	Mechanical, dual stage	
8.27 x 5.91 x 0.14 (210mm x 150mm x 3.5mm)	9.18 x 5.91 x 0.14 (225mm x 150mm x 3.5mm)	
26.2 (169cm^2)	34.1 (220cm^2)	
149.7 (20.7kg-m)	243 (33.6kg-m)	
Mechanical, constant mesh/selective mesh		
8 forward, 2 reverse, 2 P. T. O.		

Gear ratio	mph	(Km/h)
9.93	0.90	(1.44)
6.95	1.28	(2.06)
4.70	1.89	(3.05)
3.18	2.80	(4.51)
2.11	4.22	(6.80)
1.48	6.02	(9.70)

Item						Unit	YM195D			YM240D			
Chassis	Power train	Transmission	Gear ratios and Travel speed	(Forward)			Gear ratio	mph	(Km/h)	mph	(Km/h)	mph	(km/h)
				7th			1.35	5.13	(8.26)	5.41	(8.71)	5.63	(9.05)
				8th			0.85	8.14	(13.10)	8.58	(13.80)	8.92	(14.36)
				(Reverse)									
				1st			7.70	0.90	(1.44)	0.95	(1.52)	0.98	(1.58)
				2nd			2.05	3.37	(5.42)	3.55	(5.72)	3.69	(5.95)
			Rear P.T.O.	(Speed)			Gear ratio	rpm		Gear ratio	rpm		
				1st			4.45	540(Engine speed at 2,200 rpm)		4.45	540(Engine speed at 2,200 rpm)		
				2nd			2.39	1,000(Engine speed) at 2,200 rpm)		2.39	1,000(Engine speed) at 2,200 rpm)		
				Shaft rotation			Clockwise viewed from rear						
				Shaft		in.	SAE 1–3/8 (6 x 28.14 x 34.7)						
				Shaft position			Rear end						
	Running gear	Differential					differential gear						
		One-way clutch					Claw clutch						
		Front axle type					Lemoine-type supported by center pin						
		Rear axle type					Semi-floating						
		Front wheel alignment	Toe-in			in.	0.16 – 0.32 (4 – 8mm)						
			Camber			degrees	3						
			Caster			degrees	2.0						
			Trail			in.	0.393 (10mm)			0.433 (11mm)			
			King-pin inclination			degrees	8						
		Steering system	Steering system				Ball-nut type						
			Gear ratio				18.9 : 1						
			Steering wheel diameter			in.	15 (380mm)						
			Gear box oil capacity			U.S. gal.	0.07 (0.26 *l*)						
		Tires	Front wheels	Tire size			5-14-4PR			6-14-4PR			
				Tire pressure		psi	28 (2kg/cm^2)						
				Rims			4-JA x 14WDC			5-JA x 14WDC			
			Rear wheels	Tire size			8.3/8-24-4PR			9.5/9-24-4PR		11.2/10-24-4PR	
				Tire pressure		psi	14 (1kg/cm^2)						
				Rims			DC-W7-24W			DC-W7-24W		DC-W9-24W	
		Brakes	Type of main brake				Mechanical, dry, internal expansion type						

YM330D	YM330D W/LIVE P.T.O.		
Gear ratio	mph	(Km/h)	
1.00	8.91	(14.33)	
0.68	13.16	(21.19)	
6.95	1.28	(2.06)	
1.48	6.02	(9.70)	
Gear ratio	rpm		
4.18	540 (Engine speed at 2,258 rpm)		
2.29	1,000 (Engine speed at 2,294 rpm)		
Clockwise viewed from rear			
SAE 1–3/8 (6 x 28.14 x 34.7)			
Rear end			
Differential gear			
Claw clutch			
Lemoine-type supported by center pin			
Semi-floating			
0.16 – 0.32 (4 – 8mm)			
3			
2			
0.472 (12mm)			
8			
Ball-nut type			
18.5 : 1			
15.75 (400mm)			
0.07 (0.26 *l*)			
7-16-4PR			
26 (1.8kg/cm^2)			
5-JA x 16 WDC			
12.4/11-28-4PR			
14 (1kg/cm^2)			
W-11-28W			
Mechanical, dry, internal expansion type			

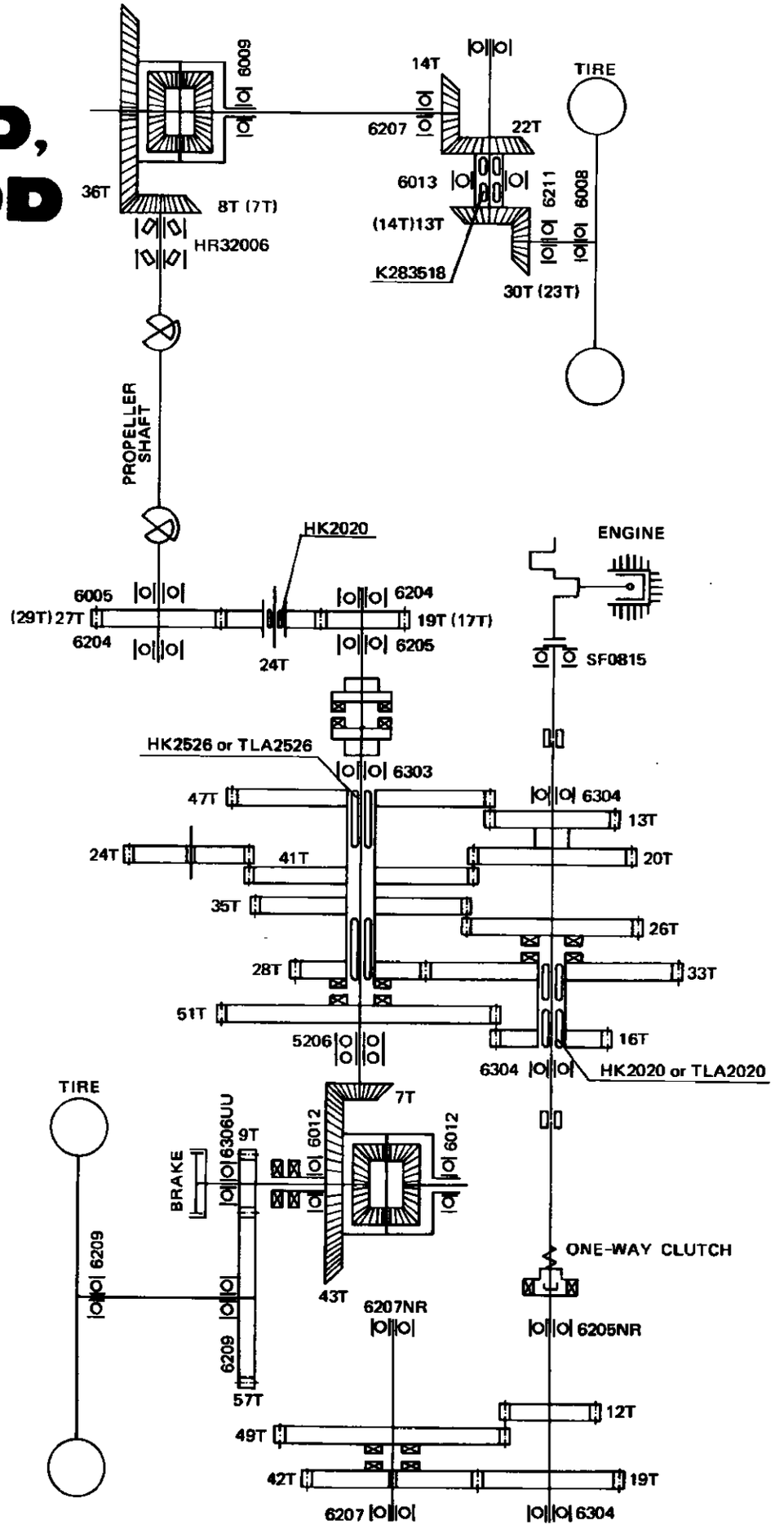
		Item		Unit	YM195D	YM240D	
Chassis	Running gear	Brakes	Parking brake type		Manual: activated by locking brake pedal		
			Lining surface area	sq.in.	27.8 (179cm^2)		
			Lining (width x thickness x length)	in.	1.50 x 0.20 x 4.65 (38mm x 5mm x 118mm)		
			Brake drum diameter	in.	4.72 (120mm)		
			Method of activation		Main brakes: Brake pedals Parking brake: Manual		
	Lifting system	Type			Hydraulic		
		Type of hydraulic pump			Gear pump		
		Position of pump			In front of engine governor chamber		
		Pump drive			Claw coupling		
		Pump discharge capacity		U.S.gal./min	4.25 (16 *l*) (Engine speed at 2,400 rpm)		
		Control system	Transmission/Hydraulic oil capacity	U.S. gal.	4.5 (17 *l*)		
			Control system		Hydraulic position control		
		Cylinder	Safety valve full-flow pressure	psi	2,200 (155kg/cm^2)		
			Type		Single acting		
			Bore x stroke	in.	2.36 x 3.53 (65mm x 89.7mm)		
			Total stroke volume	cu.in.	18.12 (297cc)		
		Total lift height		in.	23.38 (594mm)		
		Total lifting power		lbs	1,430 (650kg)		
		Implement fitting method			3-point hitch, category 1		
	Lighting etc.	Water temperature indicator light		V-W	12-3.4		
		Engine temperature indicator light		V-W	12-3.4		
		Charging indicator light		V-W	12-3.4		
		Headlight		V-W	12-35/25		
		Turn signal lights (optional)		V-W	12-20		
		Work light (optional)		V-W	12-18.4		
		Horn		V-A	12-1.5		
		Rear reflectors			Red reflectors		
	Dimensions	Overall length: With 3-point hitch		in.	111.2 (2,825mm)		
		Without 3-point hitch		in.	97.7 (2,480mm)	99.0 (2,515mm)	100.0 (2,540mm)
		Overall width		in.	47.6 (1,210mm)	48.8(1,240mm)	50.2(1,276mm)

YM330D	YM330D W/LIVE P.T.O.	
Manual; activated by locking brake pedal		
44.48 (287cm^2)		
1.58 x 0.20 x 7.07 (40mm x 5mm x 179.5mm)		
6.7 (170mm)		
Main brakes: Brake pedals Parking brake: Manual		
Hydraulic		
Gear pump		
In front of engine governor chamber		
Claw coupling		
6.18 (23.4 *l*) (Engine speed at 2,600 rpm)		
4.76 (18 *l*)		
Hydraulic position control (Draft control, option)		
2,200 (155kg/cm^2)		
Single acting		
3.15 x 4.58 (80mm x 116.5mm)		
35.75 (586cc)		
31.90 (810mm)		
2,866 (1,300kg)		
3-point hitch, category 1		
12-3.4		
12-3.4		
12-3.4		
12-35/25		
12-20		
12-18.4		
12-1.2A		
Red reflectors		
122.0 (3,100mm)		
112.6 (2,860mm)		
57.9 (1,470mm)		

		Item	Unit	YM195D	YM240D	
Chassis	Dimensions	Overall height: To tip of muffler	in.	72.4 (1,840mm)	73.3 (1,860mm)	
		To steering wheel	in.	53.5 (1,360mm)	54.3(1,380mm)	54.7(1,390mm)
		To hood	in.	46.3 (1,175mm)	47.0 (1,195mm)	
		Wheel base	in.	61.3 (1,557mm)	61.9 (1,571mm)	
		Tread: Front	in.	33.9 (860mm)	36.3 (922mm)	
		Rear	in.	39.4 (1,000mm)	39.4 (1,000mm)	
		Minimum ground clearance	in.	9.8 (250mm)	11.0(280mm)	15.0(382mm)
	Weights	Gross weight	lbs	1,830 (830kg)	1,930(875kg)	1,951(885kg)
		Front wheel load	lbs	893 (405kg)	957(434kg)	959(435kg)
		Rear wheel load	lbs	937 (425kg)	973(441kg)	993(450kg)
		Front bumper weight (optional)	lbs			
		Rear wheel weight (optional)	lbs			
	Performance	Minimum turning radius	ft.	8 (2,400mm) without using brakes		
		Maximum inclination	degrees	35		
		Braking distance	ft.	10 (3,000mm) at maximum speed		

YM330D	YM330D W/LIVE P.T.O.	
77.1 (1,960mm)		
59.4 (1,560mm)		
50.8 (1,290mm)		
68.9 (1,750mm)		
44.9 (1,140mm)		
45.3 (1,150mm), 49.2 (1,250mm), 55.1 (1,400mm), 59.1 (1,500mm)		
11.8 (300mm)		
2,880 (1,310kg)	2,910 (1,320kg)	
1,290 (583kg)	1,301 (590kg)	
1,590 (727kg)	1,609 (730kg)	
10 (3,000mm) without using brakes		
35		
20 (6,000mm) at maximum speed		

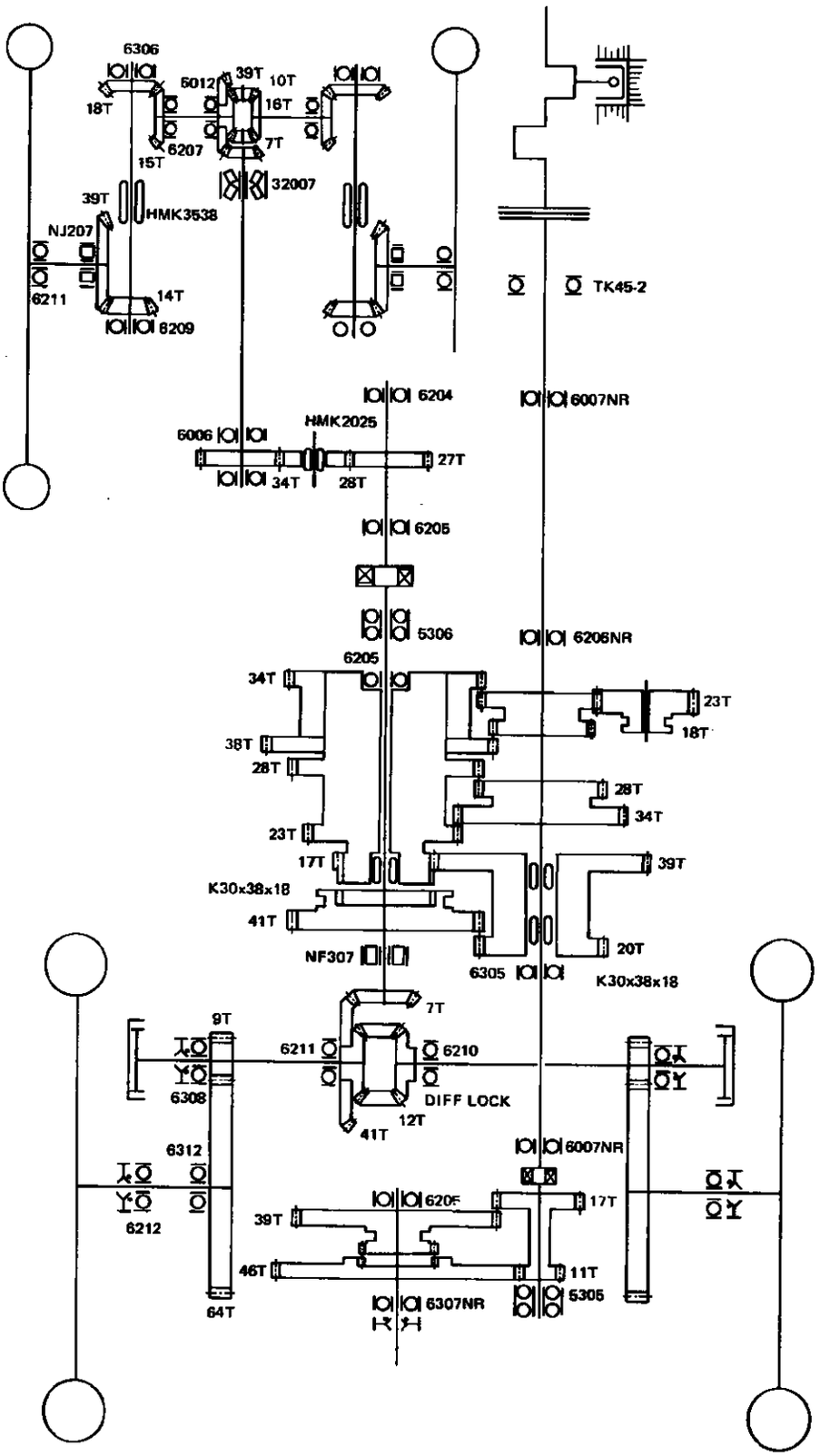
YM195D, YM240D



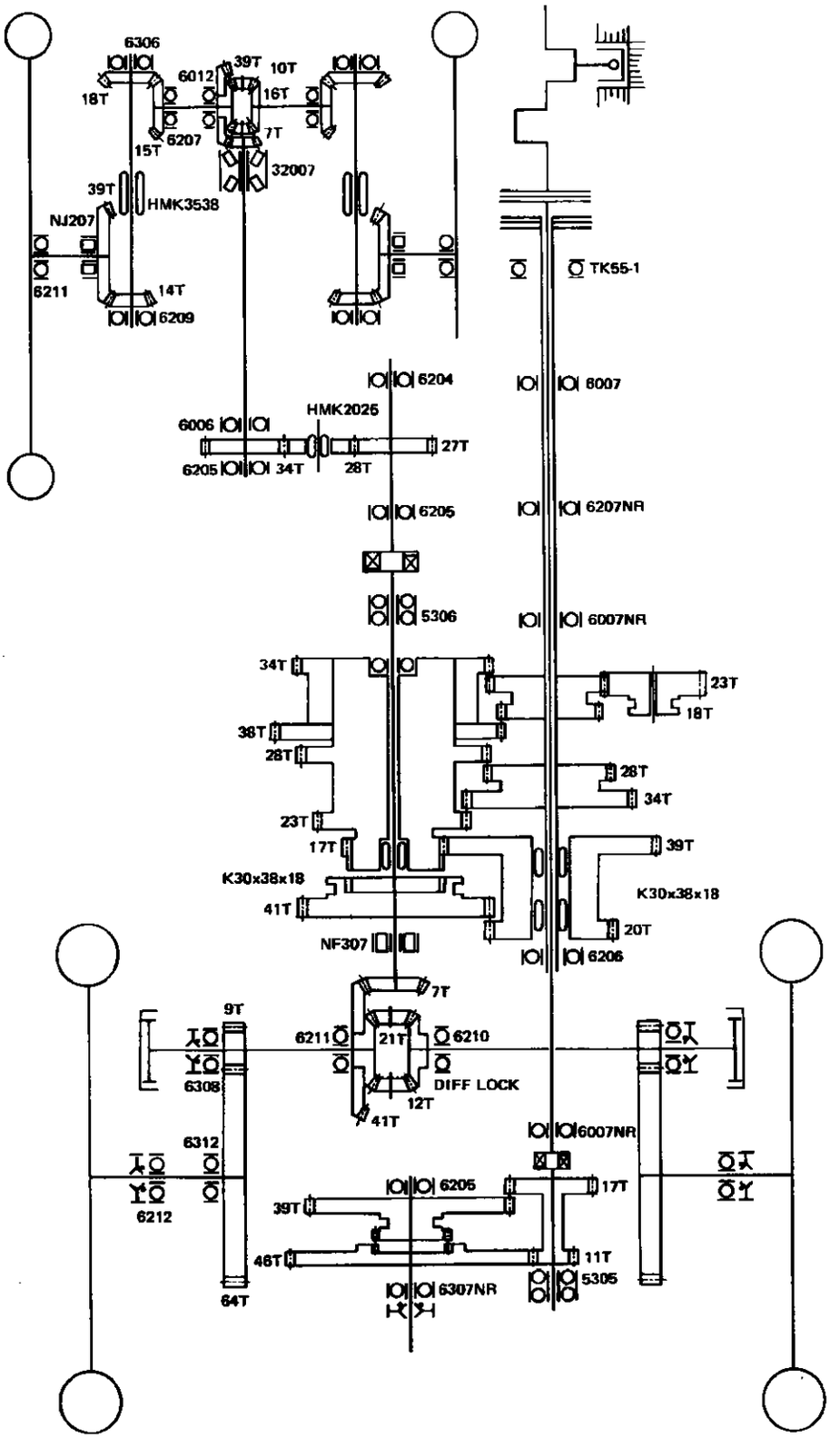
* *Parentheses: YM195OD only*

YM330D

a) Single stage



b) Dual stage

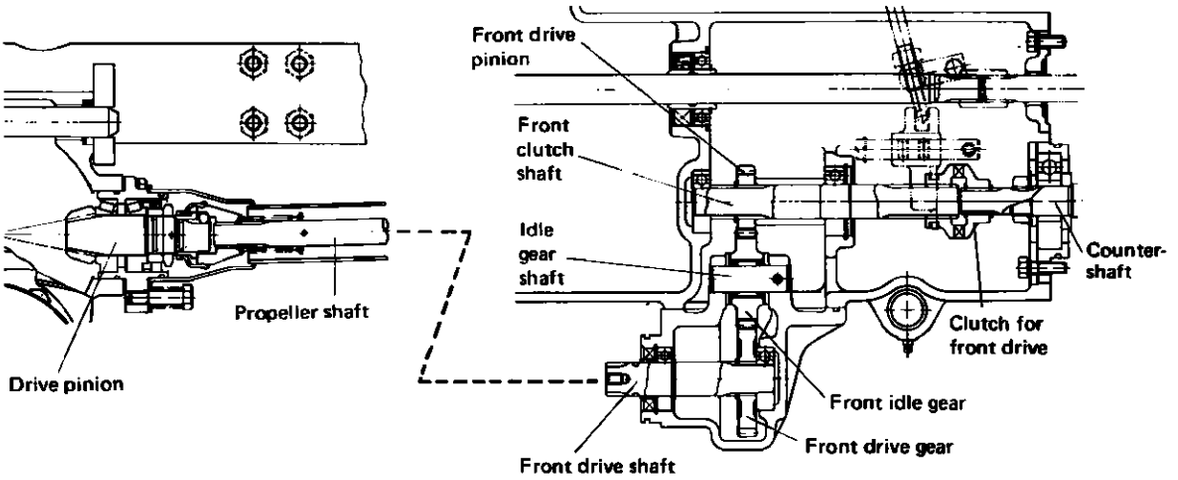

6306
18T
6012
39T
10T
16T
7T
15T
6207
32007
39T
HMK3538
NJ207
6211
14T
6209
TK55-1
6204
6007
HMK2025
6006
27T
6205
34T
28T
6205
6207NR
5306
6007NR
34T
23T
18T
38T
28T
28T
34T
23T
17T
39T
K30x38x18
41T
K30x38x18
20T
NF307
6206
7T
9T
6211
21T
6210
6308
DIFF LOCK
12T
41T
6007NR
6312
6205
17T
39T
6212
46T
11T
5305
6307NR
64T

II. 4-Wheel Drive

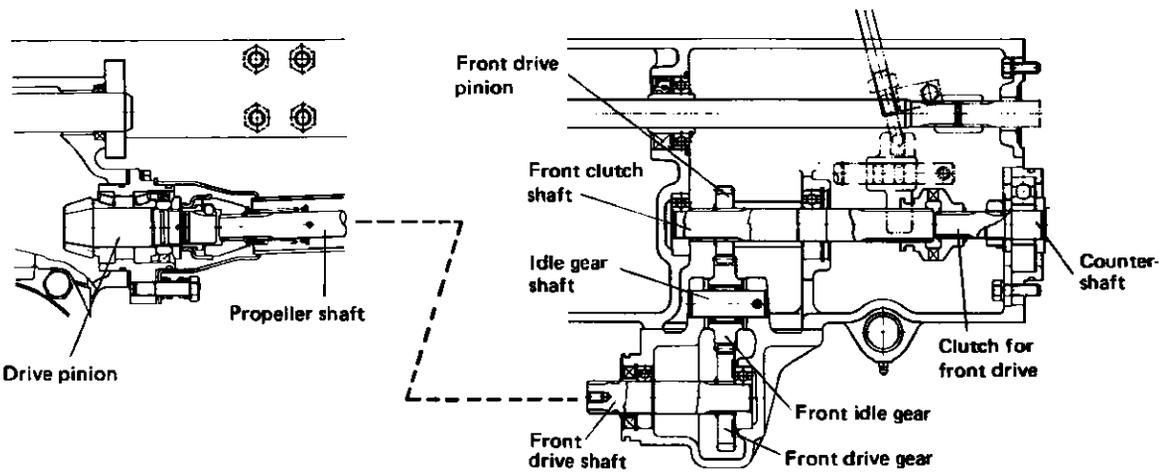
1. Front drive power take-off section

As illustrated below, the front drive gears and the clutch are placed in the clutch housing. Power is transmitted to the drive pinion from the front drive shaft via the propeller shaft.

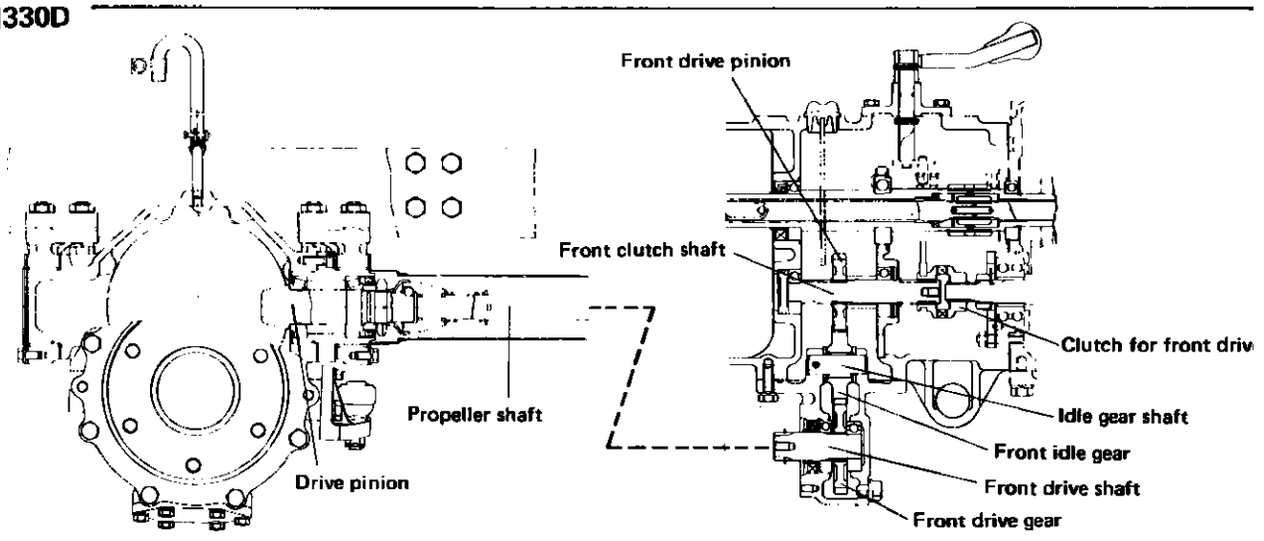
YM195D



YM240D



YM330D

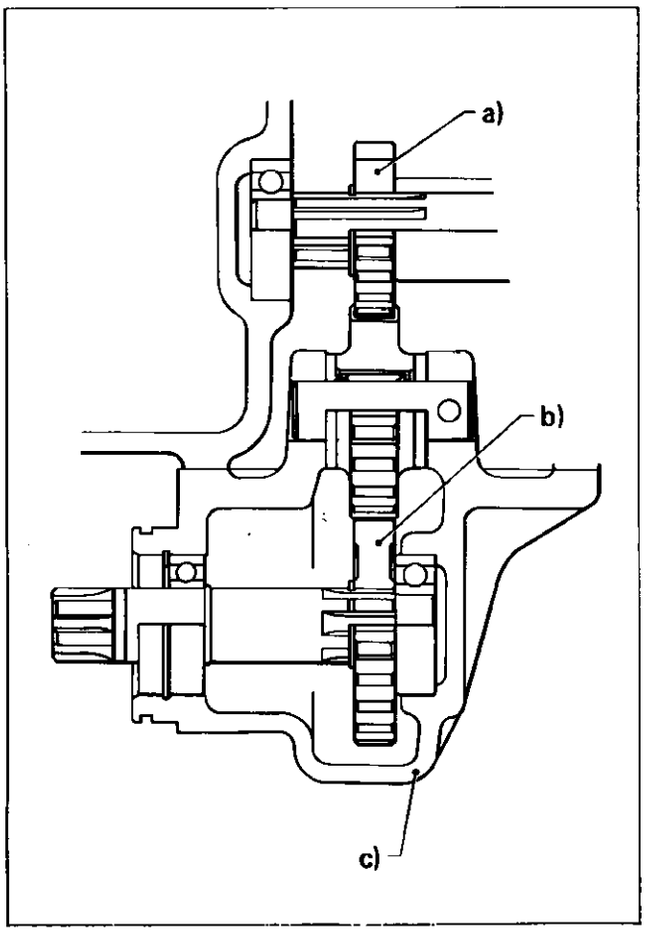


2. Front drive gear unit

The combination of the gears differs depending upon the specification of the tires.

2-1. YM195D, YM240D

The transmission unit of Model YM195D is in common use with that of Model YM240D, except for the front drive pinion, gear and case. The front drive pinion, gear and case come in a combination of parts as shown in Table 2. When replacing parts or at the time of service disassembly, it is essential to ensure that the correct set is purchased or that the wheels are properly aligned otherwise velocity difference will occur.



Confirm the ID Mark of the following parts.

a) Front drive pinion
ID Mark (1-line) for Model YM195D
none for Model YM240D

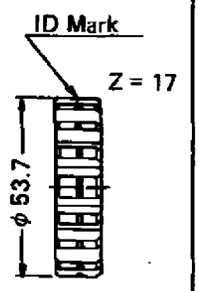
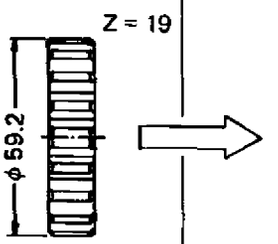
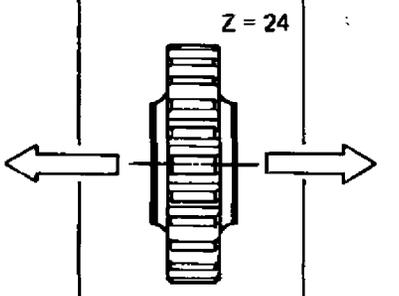
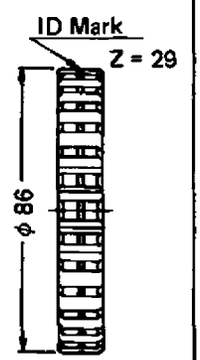
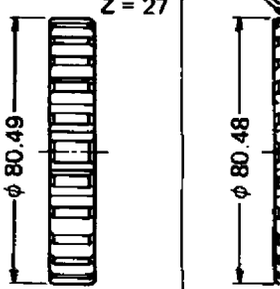
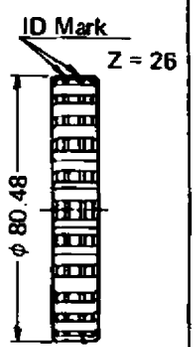
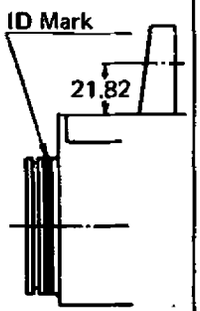
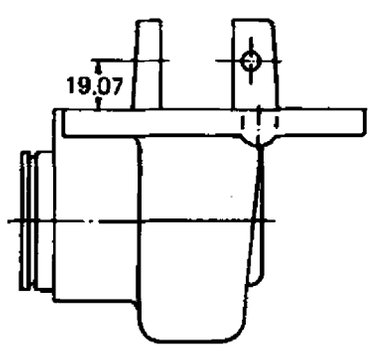
b) Front drive gear
ID Mark (1-line) for Model YM195D
(2-lines) for Model 240D w/rear tires 10–24
none for Model 240D w/rear tires 9–24 or turf tires

c) Front drive case
ID Mark (1 groove) for Model YM195D
none for Model YM240D

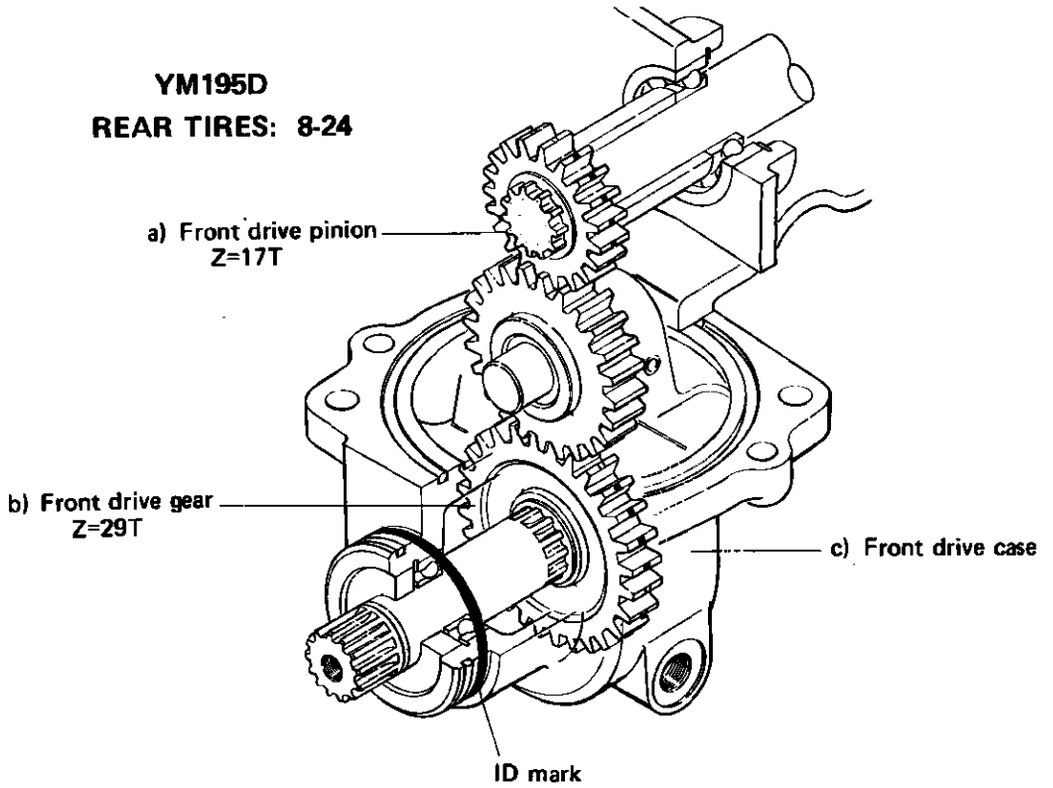
Table. 1. Velocity Ratio of Front and Rear Wheels

Item \ Model		YM195D	YM240D		
Front tire	Size	AG 5–14	AG 6–14	AGP 27 x 8.50–15	AG 6–14
	Effective radius	11.38 in. (289mm)	12.20 in. (310mm)	12.48 in. (317mm)	12.20 in. (310mm)
Rear tire	Size	AG 8–24	AG 9–24	AGS 11/10–24	AG 10–24
	Effective radius	18.90 in. (480mm)	19.84 in. (504mm)	20.35 in. (517mm)	20.63 in. (524mm)
Reduction gear ratios of front drive take-off power section		$\frac{24}{17}\times\frac{29}{24}=1.706$	$\frac{24}{19}\times\frac{27}{24}=1.421$	$\frac{24}{19}\times\frac{27}{24}=1.421$	$\frac{24}{19}\times\frac{26}{24}=1.368$
Total reduction gear ratios (at 8th speed)	Front	19.22	19.66	19.66	18.95
	Rear	33.01	33.01	33.01	33.01
Velocity ratio of front and rear wheels (VF/VR)		1.034	1.033	1.030	1.031

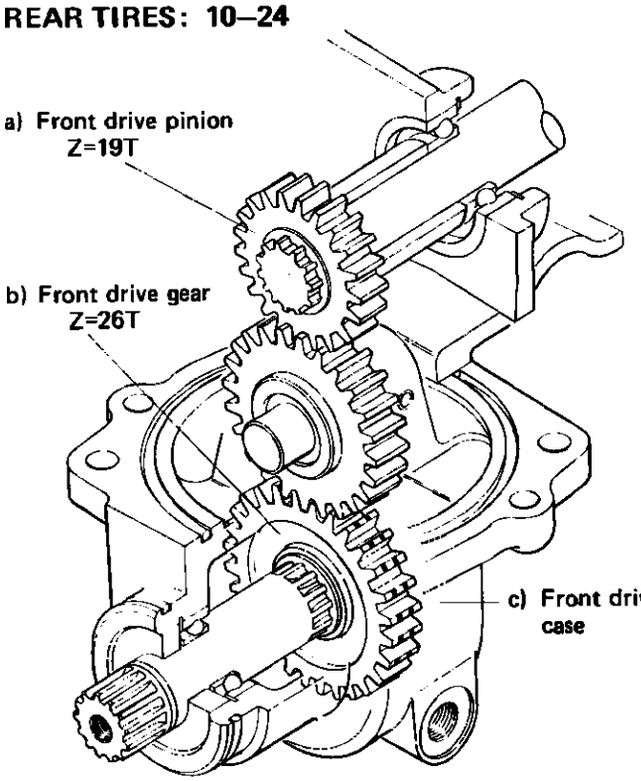
Table 2. Combinations of Parts by Models & Specifications

Model	YM195D	YM240D	
	REAR TIRE: 8–24	REAR TIRES: 9–24 REAR TIRE: TURF	REAR TIRES 10–24
FRONT DRIVE PINION (to be fitted into clutch shaft)	 (194158–28580)	 (194241–28580)	
FRONT IDLE GEAR		 (194241–28160)	
FRONT DRIVE GEAR (to be fitted into front drive shaft)	 (194158–28220)	 (194241–28220)	 (194241–28230)
FRONT DRIVE CASE	 (194158–28110)	 (194241–28110)	

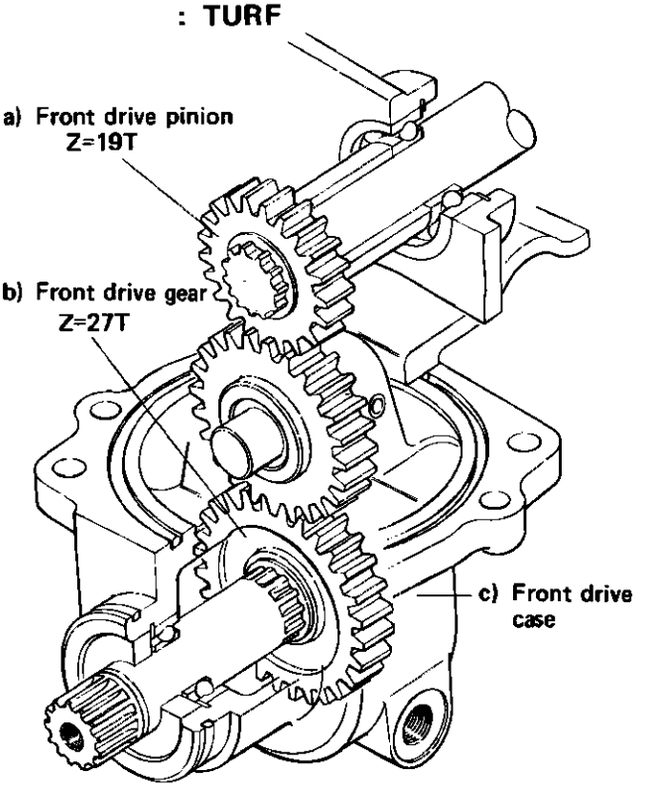
YM195D
REAR TIRES: 8-24



YM240D
REAR TIRES: 10–24



YM240D
REAR TIRES: 9–24
: TURF



2-2. YM330D

The front drive pinion, gear and case come in combination set of parts as shown in Table 4. When replacing parts or at the time of service disassembly, it is essential to ensure that the correct set is purchased and that the wheels are properly aligned otherwise velocity differences will occur.

Confirm the ID Mark of the following parts.

a) Front idle gear
ID Mark (2-lines) for specification with turf tires.
none for specification with A.G. tires.

b) Front drive gear
ID Mark (2-lines) for specification with turf tires.
for specification with A.G. tires.

c) Front drive case
ID Mark (1 groove) for specification with turf tires.
none for specification with A.G. tires.

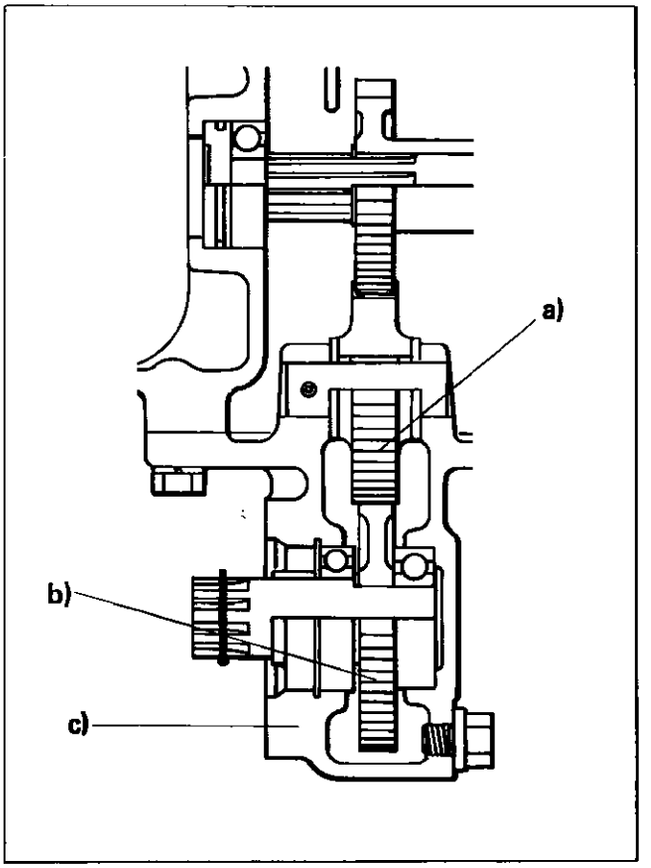
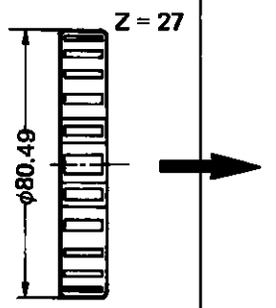
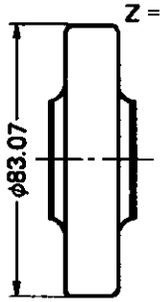
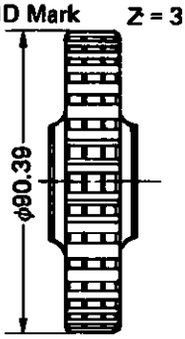
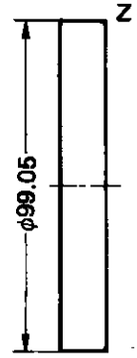
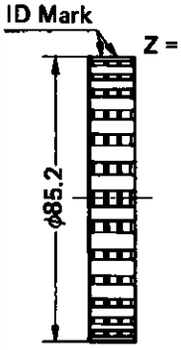
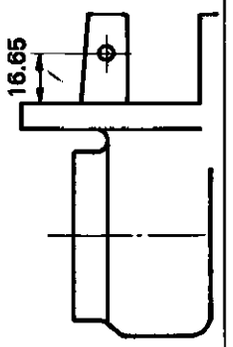
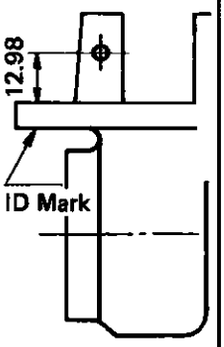


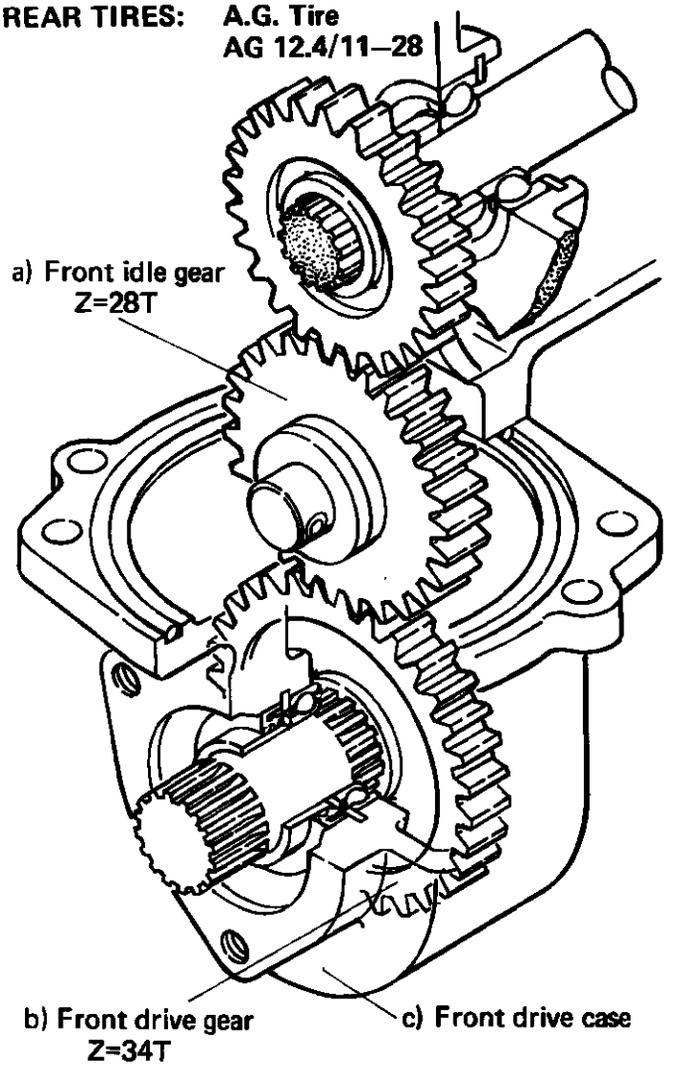
Table 3 Velocity Ratio of Front and Rear Wheels

Item \ Specifications		with A.G. Tire	with Turf Tire
Front tire	Size effective radius	AG 7-16 13.86 in. (352 mm)	AGP27 x 8.50 – 15 12.09 in. (307 mm)
Rear tire	Size effective radius	AG 12.4/11 – 28 23.98 in. (609 mm)	AGS 13.6/12 – 28 24.65 in. (626 mm)
Reduction gear drive take-off	Ratio of front	$\frac{28}{27} \times \frac{34}{28} = 1.259$	$\frac{31}{27} \times \frac{29}{31} = 1.074$
Total reduction gear ratios (at 8th speed)	front	15.9	13.6
	rear	28.2	28.2
Velocity ratio of front & rear wheels (VF/VR)		1.026	1.021

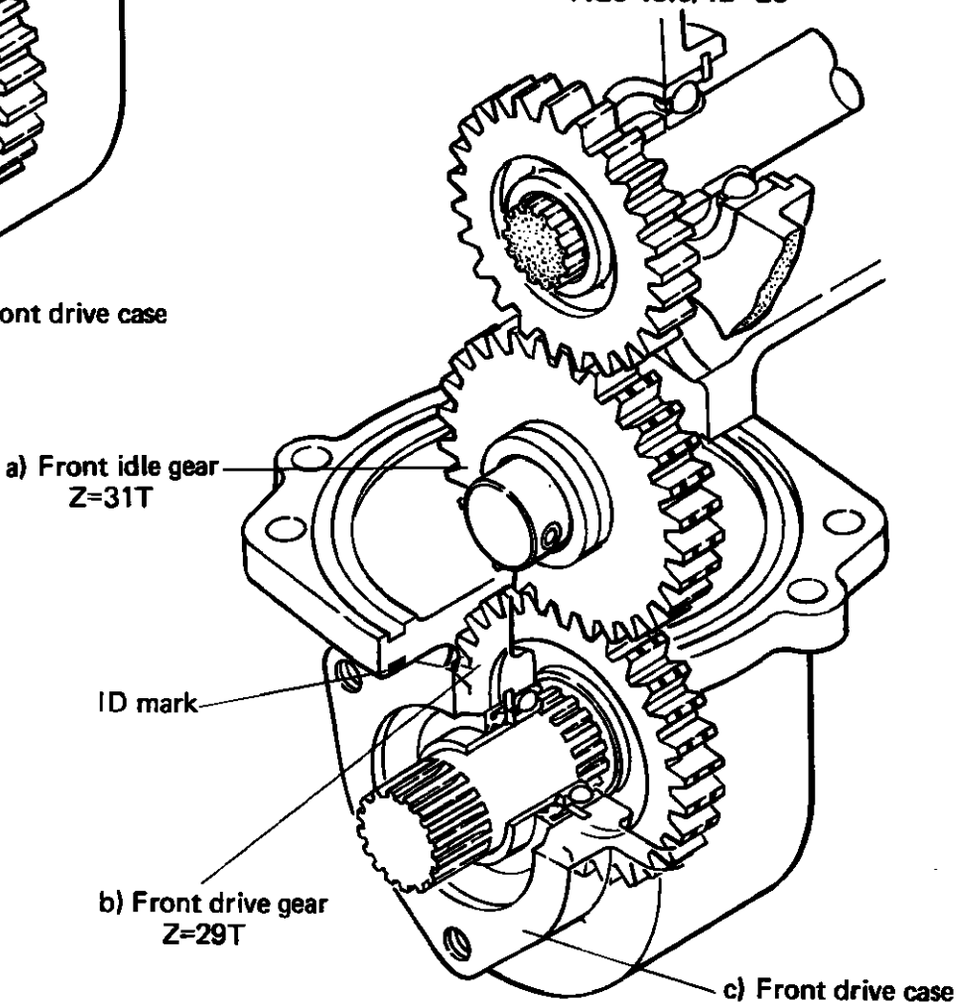
Table 4. Combinations of Parts by Specifications

Model / Rear Tire	YM330D	
	A.G. Tire	Turf Tire
	AG 12.4/11-28	AGS 13.6/12-28
FRONT DRIVE PINION (to be fitted into clutch shaft)	 (194241–28220)	
FRONT IDLE GEAR	 (194274–28160)	 (194274–28170)
FRONT DRIVE GEAR (to be fitted into front drive shaft)	 (194274–28220)	 (194274–28230)
FRONT DRIVE CASE	 (194274–28110)	 (194274–28130)

YM330D
REAR TIRES: A.G. Tire
AG 12.4/11–28



YM330D
REAR TIRES: Turf Tire
AGS 13.6/12–28



2-3. Inspection and Maintenance

Applicable for models YM195D, YM240D and YM330D

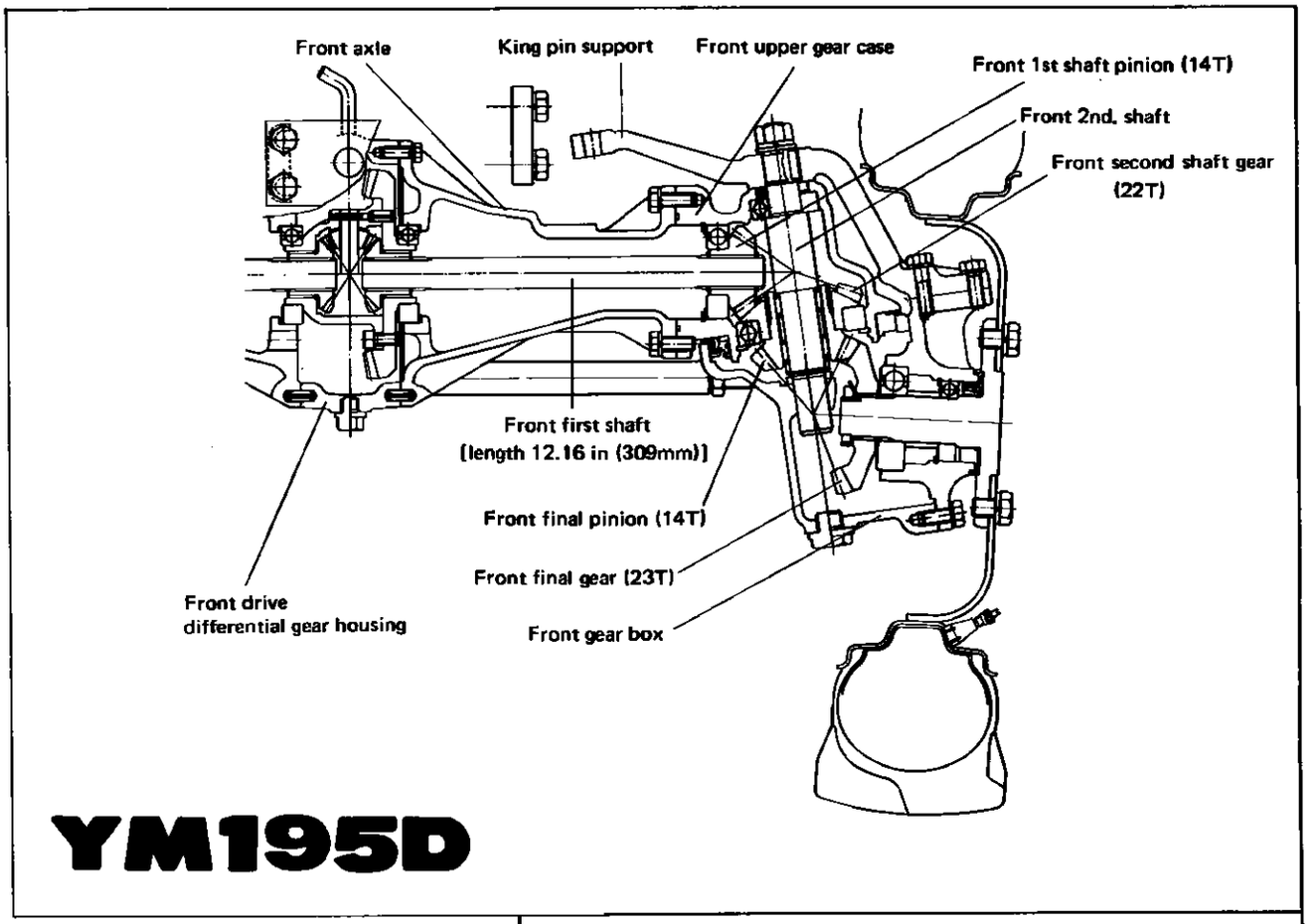
Unit: in. (mm)

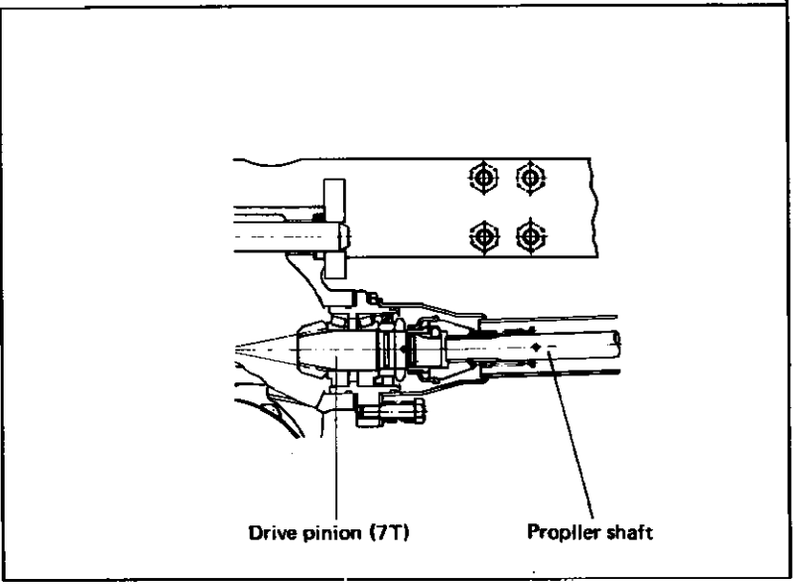
	Item	Standard valve	Replacement limit	Testing equipment
1.	Front clutch shaft axial play	0.0079–0.0236 (0.2–0.6)	0.0315 (0.8)	Dial gauge
	Front drive shaft axial play	0.0114–0.0272 (0.29–0.69)	0.0315 (0.8)	
2.	Inner diameter of front shift fork	0.5906–0.5922 ($15\ ^{+0.043}_{0}$)		Cylinder gauge
	Outer diameter of front fork shaft	0.5892–0.5899 ($15\ ^{-0.016}_{-0.034}$)		Micrometer
	Clearance	0.0006–0.0030 (0.016–0.077)	0.008 (0.2)	
3.	Inner diameter of needle bearing	0.7882–0.7890 ($20\ ^{+0.041}_{+0.020}$)		Cylinder gauge
	Outer diameter of idle gear shaft	0.7870–0.7874 ($20\ ^{0}_{-0.011}$)		Micrometer
	Clearance	0.0008–0.0020 (0.020–0.052)	0.016 (0.4)	
4.	Play in direction of rotation between all gears and shaft splines		0.0118 (0.3)	

3. Front axle section

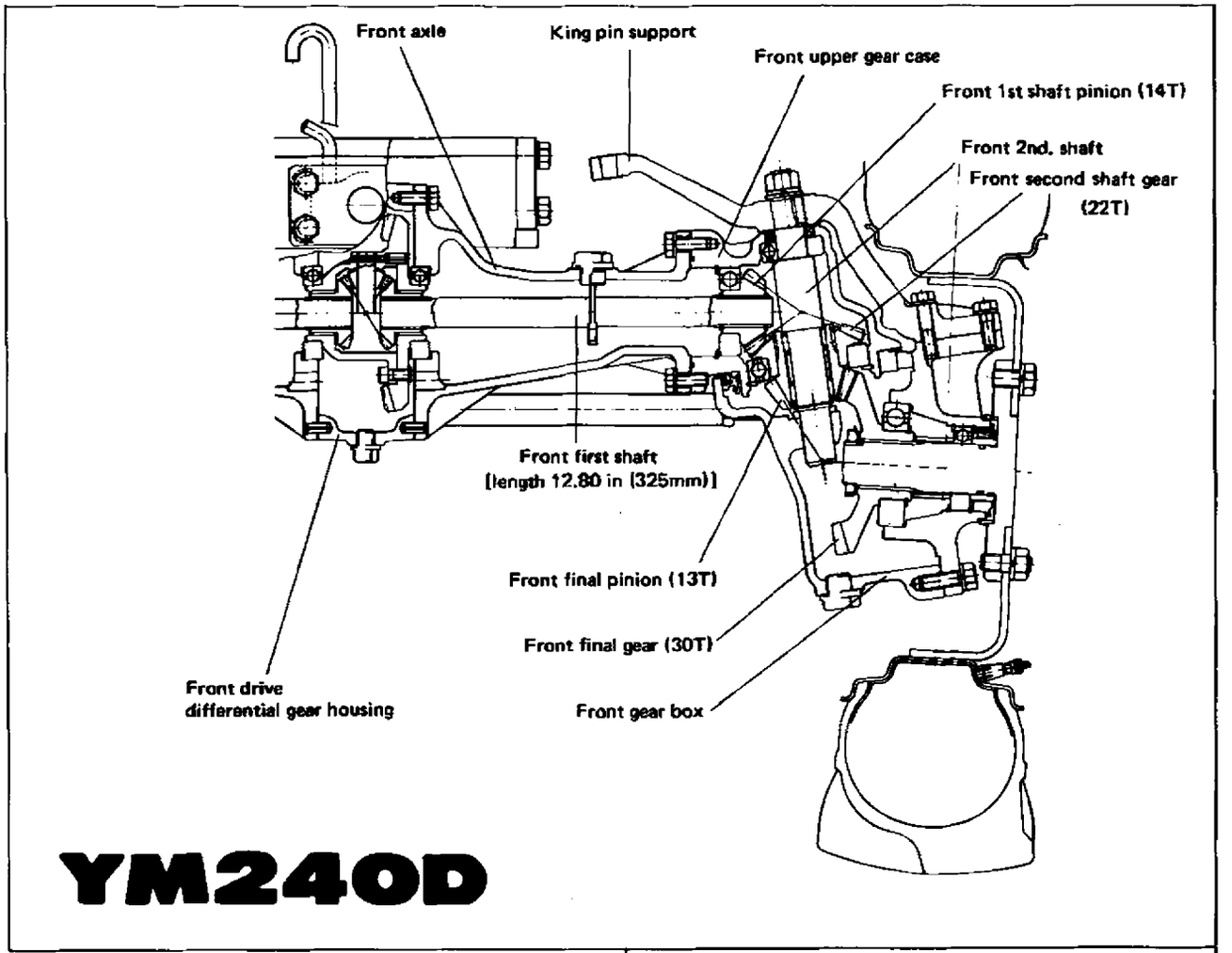
The front axle section employs a level gear driving method. Its construction is as illustrated below:

3-1. YM195D





3-2. YM240D



Number of gear teeth

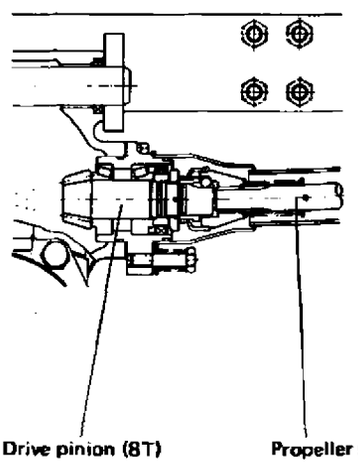
Model	YM195D	YM240D
Front 2nd shaft gear	22	22
Front 2nd shaft pinion	14	13
Front final gear	23	30
Drive pinion	7	8

Note: When assembling

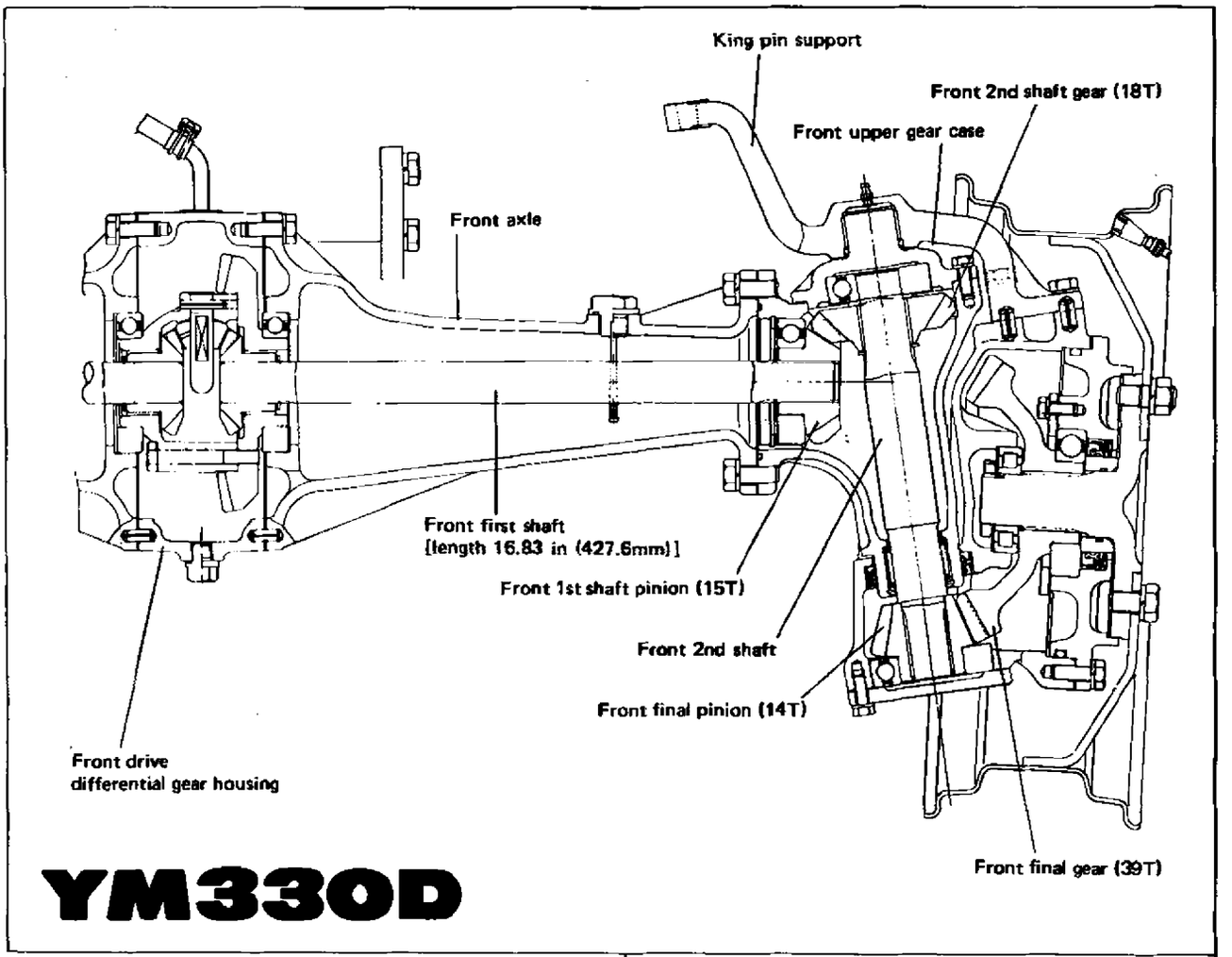
(1) The preliminary pressure of the taper bearing should be adjusted by adjusting the shim so that the starting torque of the drive pinion becomes 0.232 – 1.158 ft-lb (0.032 – 0.16 kg-m).

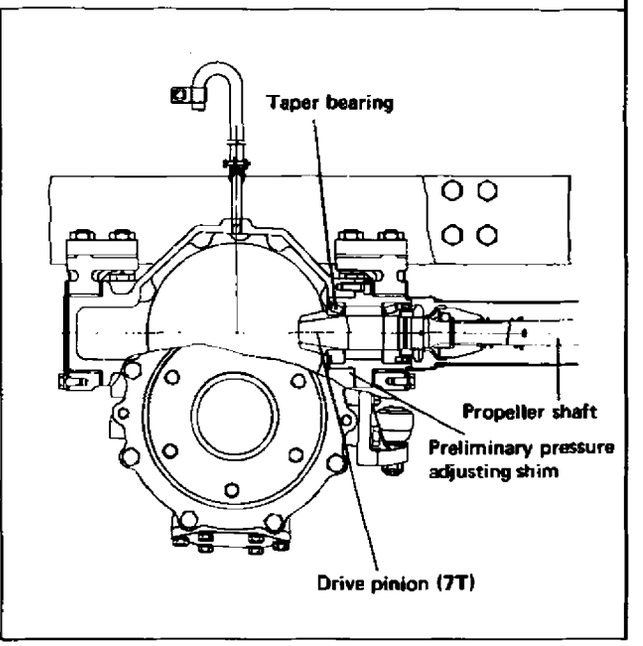
(2) Adjust the horizontal play of the center box by the center pin shim so that it is below 0.0236 in. (0.6 mm).

(3) Apply Screw Lock to the bolt which fixes the front axle.



3-3. YM330D





Number of gear teeth

Model	YM330D
Front 2nd shaft gear	18
Front 2nd shaft pinion	14
Front final gear	39
Drive pinion	7

Note: When assembling, follow the same cautions as those for YM195D and YM240D.
(Refer to page 24)

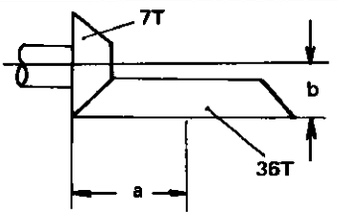
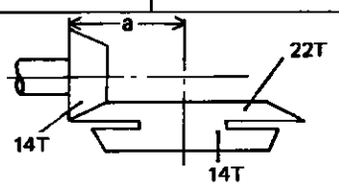
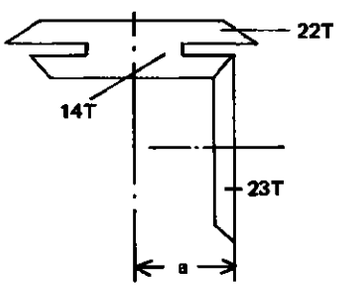
3-4. Inspection and maintenance

a) Applicable for model YM195D

Unit: in. (mm)

	Item	Standard value	Replacement limit	Testing equipment
1.	Outer diameter of front 2nd shaft	1.1018–1.1024 ($28\ ^{0}_{-0.013}$)		Micrometer
	Inner diameter of needle bearing	1.1031–1.1045 ($28\ ^{+0.053}_{+0.020}$)		Cylinder gauge
	Clearance	0.0008–0.003 (0.020–0.076)		
2.	Inner diameter of center pin bushings	0.8705–0.8683 ($22\ ^{+0.110}_{+0.055}$)		Cylinder gauge
	Outer diameter of center pin	0.8661–0.8641 ($22\ ^{0}_{-0.052}$)		Micrometer
	Clearance	0.0020–0.0064 (0.052–0.162)	0.016 (0.4)	
3.	Fore and aft play in center pin	0–0.0078 (0-0.2)	0.039 (1.0)	Thickness gauge
4.	Play between kingpin support and front upper gear case	0–0.0118 (0–0.3)	0.024 (0.6)	Thickness gauge
5.	Inner diameter of differential side gear bushing	1.2598–1.2614 ($32\ ^{+0.039}_{0}$)		Cylinder gauge
	Outer diameter of differential side gear	1.2557–1.2567 ($32\ ^{-0.080}_{-0.105}$)		Micrometer
	Clearance	0.0031–0.0057 (0.080–0.144)	0.016 (0.4)	
6.	Backlash between drive pinion and ring gear	0.0067–0.0091 (0.17–0.23)	0.020 (0.5)	Lead wire Micrometer
7.	Backlash between differential pinion and side gear	0.008–0.012 (0.2–0.3)	0.020 (0.5)	Lead wire Micrometer
8.	Inner diameter of differential pinion	0.5518–0.5525 ($14\ ^{+0.034}_{+0.016}$)		Cylinder gauge
	Outer diameter of differential pinion shaft	0.5498–0.5506 ($14\ ^{-0.016}_{-0.034}$)		Micrometer
	Clearance	0.0013–0.0027 (0.032–0.068)	0.016 (0.4)	

Unit: in. (mm)

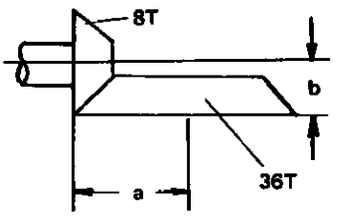
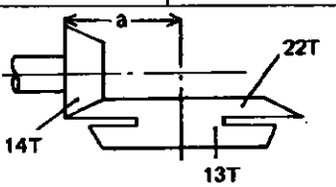
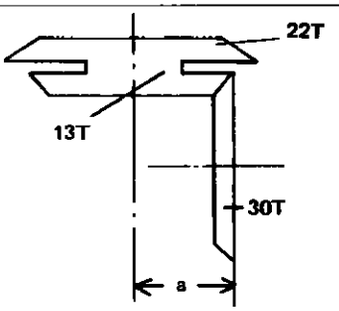
	Item	Standard value	Replacement	Testing equipment
9.	Thickness of differential pinion liner	0.033–0.029 (0.8±0.05)	0.024 (0.6)	Calipers
10.	Thickness of differential side gear thrust liner	0.033–0.029 (0.8±0.05)	0.024 (0.6)	Calipers
11.	Clearance between drive pinion 7T and ring gear 36T	 a: adjusting shims 0.0079, 0.0118 (0.2 & 0.3) b: adjusting shims 0.0079, 0.0118 (0.2 & 0.3)		Dial gauge
12.	Backlash between front 1st shaft pinion 14T and front 2nd shaft gear 22T	0.0039–0.0059 (0.1–0.15)	0.020 (0.5)	Dial gauge
13.	Backlash between front final pinion 14T and front final gear 23T	0.0039–0.0059 (0.1–0.15)	0.020 (0.5)	Dial gauge
14.	Clearance between front 1st shaft pinion 14T and front 2nd shaft gear 22T	 a: adjusting shims 0.0079, 0.0118 (0.2 & 0.3)		Dial gauge
15.	Clearance between front final pinion 14T and front final gear 23T	 a: adjusting shims 0.0079, 0.0118 (0.2 & 0.3)		Dial gauge
16.	Play in direction of rotation between all gears and shaft splines		0.0118 (0.3)	

b) Applicable for model YM240D

Unit: in. (mm)

	Item	Standard value	Replacement limit	Testing equipment
1.	Outer diameter of front 2nd shaft	1.1018–1.1024 ($28\ ^{0}_{-0.013}$)		Micrometer
	Inner diameter of needle bearing	1.1031–1.1045 ($28\ ^{+0.053}_{+0.020}$)		Cylinder gauge
	Clearance	0.0008–0.003 (0.020–0.076)		
2.	Inner diameter of center pin bushings	1.1835–1.858 ($30\ ^{+0.12}_{+0.06}$)		Cylinder gauge
	Outer diameter of center pin	1.1791–1.1811 ($30\ ^{-0}_{-0.052}$)		Micrometer
	Clearance	0.0024–0.0068 (0.06–0.172)	0.016 (0.4)	
3.	Fore and aft play in center pin	0–0.0078 (0–0.2)	0.039 (1.0)	Thickness gauge
4.	Play between kingpin support and front upper gear case	0–0.0118 (0–0.3)	0.024 (0.6)	Thickness gauge
5.	Inner diameter of differential side gear	1.2598–1.2614 ($32\ ^{+0.039}_{0}$)		Cylinder gauge
	Outer diameter of differential side gear	1.2557–1.2567 ($32\ ^{-0.080}_{-0.105}$)		Micrometer
	Clearance	0.0031–0.0057 (0.080–0.144)	0.016 (0.4)	
6.	Backlash between drive pinion and ring gear	0.0067–0.0091 (0.17–0.23)	0.020 (0.5)	Lead wire Micrometer
7.	Backlash between differential pinion and side gear	0.008–0.012 (0.2–0.3)	0.020 (0.5)	Lead wire Micrometer
8.	Inner diameter of differential pinion	0.5518–0.5525 ($14\ ^{+0.034}_{+0.016}$)		Cylinder gauge
	Outer diameter of differential pinion shaft	0.5498–0.5506 ($14\ ^{-0.016}_{-0.034}$)		Micrometer
	Clearance	0.0013–0.0027 (0.032–0.068)	0.016 (0.4)	

Unit: in. (mm)

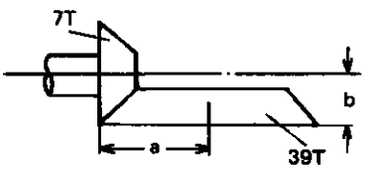
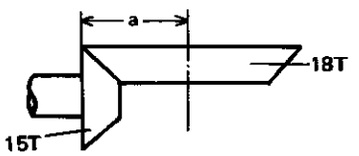
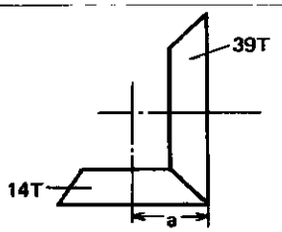
	Item	Standard value	Replacement limit	Testing equipment
9.	Thickness of differential pinion liner	0.033–0.029 (0.8±0.05)	0.024 (0.6)	Calipers
10.	Thickness of differential side gear thrust liner	0.033–0.029 (0.8±0.05)	0.024 (0.6)	Calipers
11.	Clearance between drive pinion 8T and ring gear 36T	 a: adjusting shims 0.0079,0.0118 (0.2 & 0.3) b: adjusting shims 0.0079,0.0118 (0.2 & 0.3)		Dial gauge
12.	Backlash between front 1st shaft gear 14T and front 2nd shaft gear 22T	0.0039–0.0059 (0.1–0.15)	0.020 (0.5)	Dial gauge
13.	Backlash between front final pinion 13T and front final gear 30T	0.0039–0.0059 (0.1–0.15)	0.020 (0.5)	Dial gauge
14.	Clearance between front 1st shaft gear 14T and front 2nd shaft gear 22T	 a: adjusting shims 0.0079, 0.0118 (0.2 & 0.3)		Dial gauge
15.	Backlash between front final pinion 13T and front final gear 30T	 a: adjusting shims 0.0079, 0.0118 (0.2 & 0.3)		Dial gauge
16.	Play in direction of rotation between all gears and shaft splines		0.018 (0.3)	

c) Applicable for model YM330D

Unit: in. (mm)

	Item	Standard value	Replacement limit	Testing equipment
1.	Front gear case cover outer diameter	1.3770–1.3780 ($35\ ^{0}_{-0.025}$)		Micrometer
	Inner diameter of bushing	1.3789–1.3809 ($35\ ^{+0.075}_{+0.025}$)		Cylinder gauge
	Clearance	0.0010–0.0039 (0.025–0.10)		
2.	Inner diameter of center pin bushing	2.9539–2.9575 ($75\ ^{+0.120}_{+0.030}$)		Cylinder gauge
	Outer diameter of front axle case	2.9516–2.9528 ($75\ ^{0}_{-0.030}$)		Micrometer
	Clearance	0.0012–0.0059 (0.030–0.150)	0.016 (0.4)	
3.	Fore and aft play in center pin	0–0.078 (0–0.2)	0.039 (1.0)	Thickness gauge
4.	Play between kingpin support and front upper gear case	0–0.0118 (0–0.3)	0.024 (0.6)	Thickness gauge
5.	Inner diameter of differential side gear bushing	1.5748–1.5763 ($40\ ^{+0.039}_{0}$)		Cylinder gauge
	Outer diameter of differential side gear	1.5707–1.5717 ($40\ ^{-0.080}_{-0.105}$)		Micrometer
	Clearance	0.0031–0.0057 (0.08–0.144)	0.016 (0.4)	
6.	Backlash between drive pinion 7T and ring gear 39T	0.0051–0.0071 (0.13–0.18)	0.020 (0.5)	Lead wire Micrometer
7.	Backlash between differential pinion and side gear	0.0051–0.0098 (0.13–0.25)	0.020 (0.5)	Lead wire Micrometer
8.	Inner diameter of differential pinion	0.6306–0.6313 ($16\ ^{+0.034}_{+0.016}$)		Cylinder gauge
	Outer diameter of differential pinion shaft	0.6286–0.6293 ($16\ ^{-0.016}_{-0.034}$)		Micrometer
	Clearance	0.0013–0.0027 (0.032–0.068)	0.016 (0.4)	
9.	Thickness of differential pinion liner	0.0378–0.0409 (1.0±0.104)	0.024 (0.6)	Calipers

Unit: in. (mm)

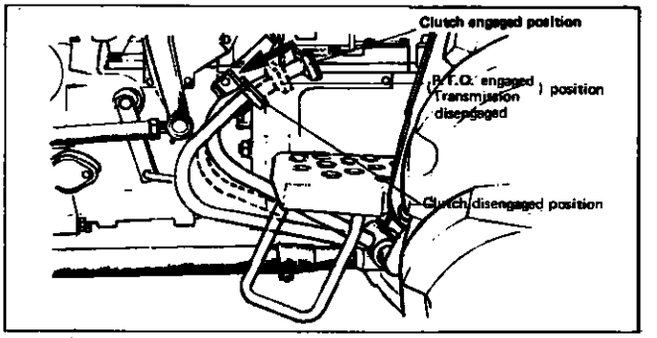
	Item	Standard value	Replacement limit	Testing equipment
10.	Thickness of differential side gear thrust liner	0.0378–0.0409 (1.0±0.04)	0.024 (0.6)	Calipers
11.	Clearance between drive pinion 7T and ring gear 39T	 a: adjusting shims b: adjusting shims	 0.0079, 0.0118 (0.2 &0.3) 0.0079, 0.0118 (0.2 & 0.3)	Dial gauge
12.	Backlash between front 1st shaft pinion 15T and front 2nd shaft gear 18T	0.0039–0.059 (0.1–0.15)	0.020 (0.5)	Dial gauge
13.	Backlash between front final pinion 14T and front final gear 39T	0.0039–0.0059 (0.1–0.15)	0.020 (0.5)	Dial gauge
14.	Clearance between front 1st shaft pinion 15T and front 2nd gear 18T	 a: adjusting shims	 0.0079, 0.0118 (0.2 &0.3)	Dial gauge
15.	Clearance between front final pinion 14T and front final gear 39T	 a: adjusting shims	 0.0079, 0.0118 (0.2, 0.3)	Dial gauge
16.	Play in direction of rotation between all gears and shaft splines		0.0118 (0.3)	
17.	Outer diameter of front 2nd shaft	1.3776–1.3783 (35±0.008)		Micrometer
	Inner diameter of needle bearing	1.3789–1.3799 $(35^{+0.050}_{+0.025})$		Cylinder gauge
	Clearance	0.0013–0.0023 (0.033–0.058)		

III. Dual Stage Clutch

Dual stage clutch (applicable for YM330 and YM330D only)

A dual stage clutch (both PTO shaft and only transmission) is used to provide continuous PTO operation for your tractor.

When continuous-running PTO operation is desired, depress the clutch pedal to the operating position. This disengages the transmission clutch (the forward motion of the tractor stops) and allows the PTO shaft to continue in operation. When it is desirable to have the PTO shaft motion as well as tractor travelling motion stopped, completely depress the clutch pedal.



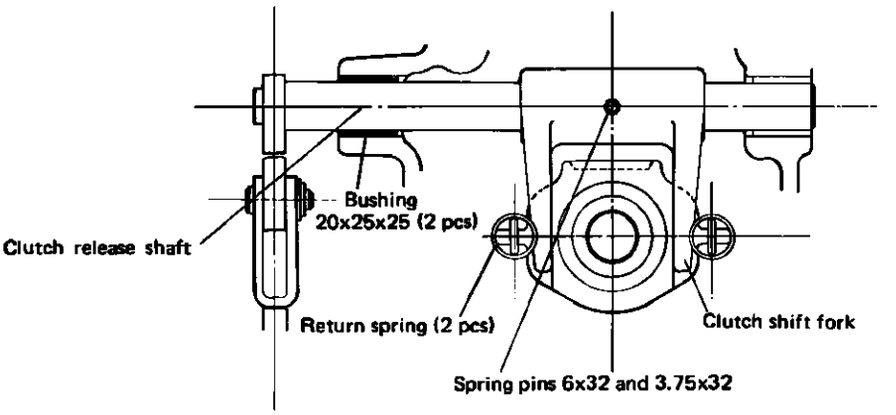
1. Specifications

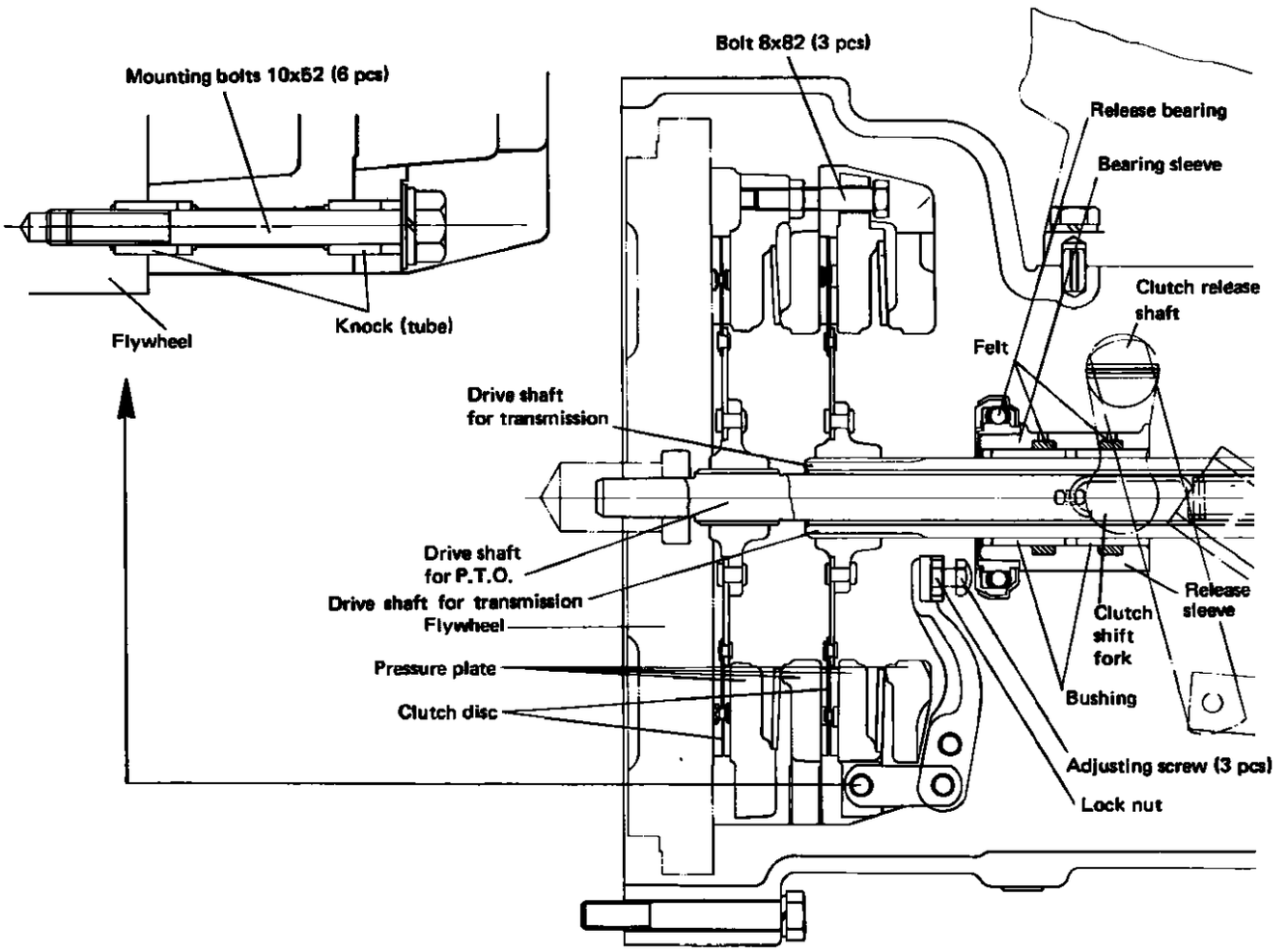
Item	Specifications
Type	Mechanical, dry dual stage
Friction disc	Woven type reinforced with wire
Friction disc (outer diameter x inner diameter x thickness)	9.18 x 5.91 x 0.14 in. (225mm x 150mm x 3.5mm)
Friction disc surface area	34.1 (220 cm^2)
Static torque capacity	243ft-lbs (33.6 kg-m)
No. of clutch plates	2
No. of friction discs	2
Clutch spring	Diaphragm spring type
Release bearing	Oil-less bearing
Height of release lever	4.42–4.48 in. (113±0.7mm) from the face of flywheel.
Clutch activation	Mechanical

2. Visual inspection

- Check the release bearing for traces of seizure.
- Depress and lock the clutch pedal when storing the tractor for a long time. (To prevent the clutch plate from rusting.)
- In case when the clutch does not disengage due to clutch sticking, separate the clutch from between the flywheel end and the pressure plate by using a screw driver etc., while looking into the check window,
- Check the friction disc for traces of scoring, glazing, burning, discoloring, or oil adherence.
- Check the damper plate for wear.
- Check the splines for wear.
- Check the pressure plate for distortion of the friction surface, scratches, or ridge formations.

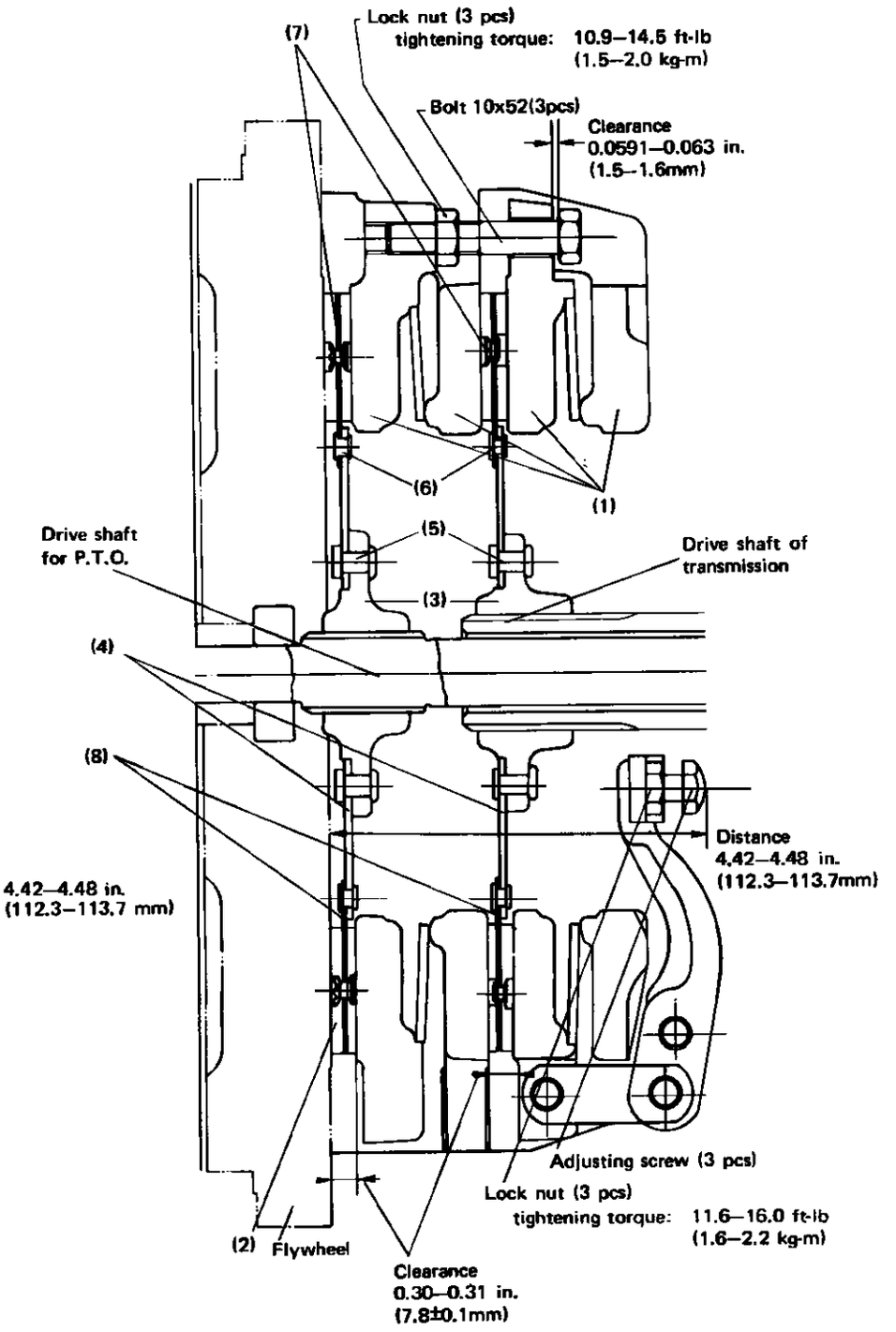
Clutch Housing





Dual stage clutch

(1) Pressure plate
(2) Clutch disc
(3) Spline hub
(4) Clutch plate
(5) Stop pin
(6) Dumper spring rivet
(7) Facing rivet
(8) Dumper spring plate

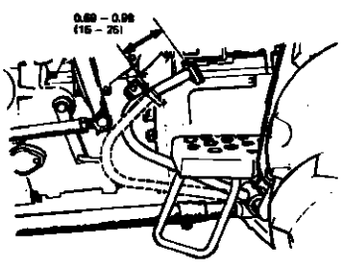


3. Inspection and maintenance

Unit: in. (mm)

	Item	Standard value	Replacement limit	Testing equipment	Illustration
1.	Friction disc thickness	0.13 – 0.14 (3.5 ±0.1)	–	Calipers	
2.	Depth of rivet head	0.06 (1.5)	0.012 (0.3)	Calipers	
3.	Thickness of the assembled clutch disc				
	(When assembled)	0.33 – 0.35 (8.6 ±0.3)	0.30 (7.6)	Calipers	
	(When pressed)	0.31 (7.8)	–		
4.	Disc play				
	Axial	Within 0.01 (0.3)	0.03 (0.7)	Dial gauge	
	Radial	–	0.04 (1.0)		
5.	Friction disc flatness	–	Within 0.016 (0.4)	Dial gauge	
6.	Pressure plate flatness	Within 0.003 (0.07)	0.008 (0.2)	Dial gauge	
7.	Flywheel flatness	Within 0.003 (0.07)	0.008 (0.2)	Dial gauge	
8.	Play in direction of rotation between drive shaft and disc splines	0.002 – 0.006 (0.05 – 0.15)	0.012 (0.3)	Dial gauge	
9.	Release lever height*	4.42 – 4.48 (112.3 – 113.7)		Block and Calipers	
10.	Inner diameter of release bearing	2.1655 –2.1646 $(55\ ^{+0.004}_{-0.019})$		Cylinder gauge	
11.	Outer diameter of bearing sleeve	2.1662 –2.1654 $(55\ ^{+0.021}_{+0.002})$		Micrometer	
12.	Release bearing interference	(0 –0.0001) (0 –0.002)	Clearance 0.001 (0.025)		
13.	Inner diameter of release bearing bushings	1.3807 – 1.3791 $(35\ ^{+0.070}_{+0.030})$		Cylinder gauge	

Unit: in. (mm)

	Item	Standard value	Replacement limit	Testing equipment	Illustration
14.	Outer diameter of drive shaft for tractor transmission	1.3701 – 1.3661 ($34.8\ ^{0}_{-0.1}$)	0.9785 – 0.9777 ($24.9\ ^{-0.046}_{-0.060}$)	Micrometer	
15.	Clearance between release sleeve bushings and main drive shaft	0.009 – 0.015 (0.23 –0.37)	0.039 (1.0)		
16.	Inner diameter of clutch shift yoke	0.7901 – 0.7879 ($20\ ^{+0.068}_{+0.012}$)		Cylinder gauge	
17.	Outer diameter of clutch release shaft	0.7874 – 0.7854 ($20\ ^{+0}_{-0.052}$)		Micrometer	
18.	Clearance between clutch shift yoke and clutch release shaft	0.0005 –0.005 (0.012 – 0.120)	0.0197 (0.5)		
19.	Free length of release bearing return springs	5.98 (152)		Straight scale	
20.	Mounting load for item 19	28.7lbs/3.54in (13kg/90mm) 57.3lbs/7.28in (26kg/185mm)	– for P.T.O. clutch – for transmission clutch	Spring balancer, straight scale	
21.	Total stroke of clutch pedal	7.28 (185)		Straight scale	
22.	Clutch pedal play	0.59 – 0.98 (15 – 25)	–	Straight scale	

Unit: in. (mm)

	Item	Standard value	Replacement limit	Testing equipment	Illustration
23.	Height of safety start switch*	0.22 – 0.26 (6±0.5)	–	Calipers	
24.	Outer diameter of pedal shaft	1.2598 – 1.2574 $(32\ ^{+0}_{-0.062})$		Micrometer	
25.	Inner diameter of pedal bushings	1.2618 – 1.2602 $(32\ ^{+0.050}_{+0.010})$		Cylinder gauge	When press-fitted in position
26.	Clearance between pedal bushings and shaft	0.0004 – 0.0044 (0.010 – 0.112)	0.039 (1.0)		
27.	Outer diameter of pedal shaft	1.2598 – 1.2574 $(32\ ^{+0}_{-0.062})$		Micrometer	
28.	Inner diameter of pedal	1.2654 – 1.2629 $(32\ ^{+0.142}_{+0.080})$		Cylinder gauge	
29.	Clearance between inner diameter of pedal and pedal shaft	0.0031 – 0.0080 (0.080 – 0.204)	0.039 (1.0)		

* See notes.

Note: *(1) Both of the transmission and the P.T.O. driving discs are same, but each hub dimension is different.*

(2) When mounting the clutch assembly, tighten the mounting bolts on to the flywheel while inserting both transmission and P.T.O. driving shafts in order to obtain specified alignments.

(3) Tighten the pressure plate mounting bolts (10 x 52,3pcs) so that the clearance between the face of the pressure plate and the neck of the mounting bolt falls within 0.0591 – 0.0630 in. (1.5 – 1.6mm).

(4) The dynamic balance of the clutch assembly was tested at our factory. Accordingly, before disassembling make a mark and ensure there is alignment with this mark when reassembling.

(5) When the sliding face of the clutch shift fork becomes excessively worn, reassemble it in the opposite position.

(6) Measuring the height of the release lever referred to in Item 9 above, is carried out in the following manner:

(i) Insert a 0.307 in. (7.8mm) block gauge in position in place of the friction disc;

(ii) The clutch cover is fitted to the flywheel face and tightened as prescribed;

(iii) The depth (height) from the face of the flywheel to the tip of the release lever is measured using a pair of calipers and a straight scale.

(7) The clearance referred to in Item 23 above is adjusted after the total stroke of the clutch pedal and the clutch pedal play have been adjusted to the standard value.

IV. Draft Control

1. Outline of Bosch type Yanmar hydraulic control unit

The Bosch type Yanmar hydraulic control unit is designed to automatically control the height of the implement of the Yanmar tractor, as well as the draft force applied thereto, by means of a simple changeover operation. Its functions and features are shown below.

1-1. Functions

1) By manipulating the changeover lever, it is possible to carry out the following 2 types of control.

- Control of the position of the implement — position control
- Control of the draft force applied to the implement — draft control

2) By changing the position of the control lever, both the position of, and the draft force applied to the implement can be automatically controlled to any desired value.

3) The control valve contains the following 3 units.

a) A relief valve which maintains the pressure of the oil in the hydraulic circuit within a safe range

b) A slow return valve which is used to adjust the descent speed of an implement

c) An unloading unit which is used when the control lever is in the neutral position

1-2. Features

1) Operation is extremely simple. Everything can be done by manipulating a single control lever.

2) The construction of the overall unit is simple, facilitating maintenance, inspection and adjustment.

3) The unit is robustly constructed to enable it to be used at a pressure as high as 2844 lb/sq. in. (200kg/cm^2) and also at flow rates up to 10.57 U.S.gallon/min. (40l/min.). Durability is excellent.

4) Two poppet valves are used as the control valves in order to maintain an oiltight construction. As a result, there is minimum leakage of oil from the unit, and almost no free descent in the height of the implement.

5) The relief valve has good pressure and flow characteristics, with minimum chattering and noise. Further, because of the completely oiltight construction, it is possible to effectively use the output of the pump to drive heavy loads right up to the point at which the valve opens.

6) Because the control lever has the right suitable degree of friction, it can be left in any desired position without the use of a stopper.

2. Position control and draft control

2-1. Position control

The position control is used to maintain as constant the relative positions of the tractor and implement. Control is effected by moving the control lever to vary the setting of the control valve.

a) On flat ground, the plowing depth remains constant regardless of changes in

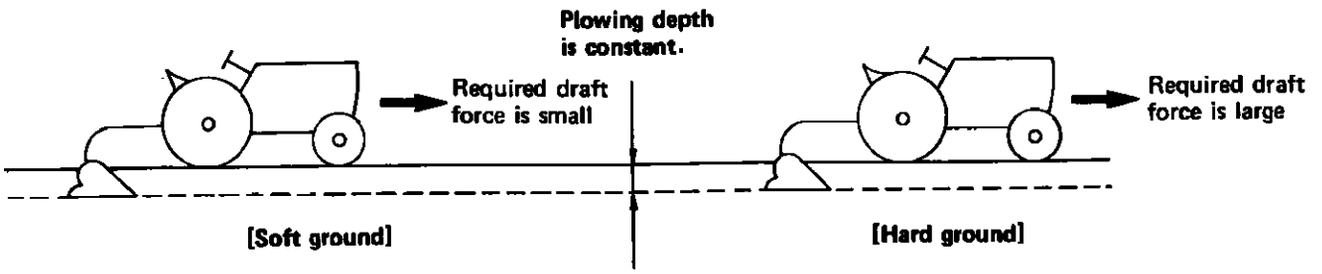


Fig. 1

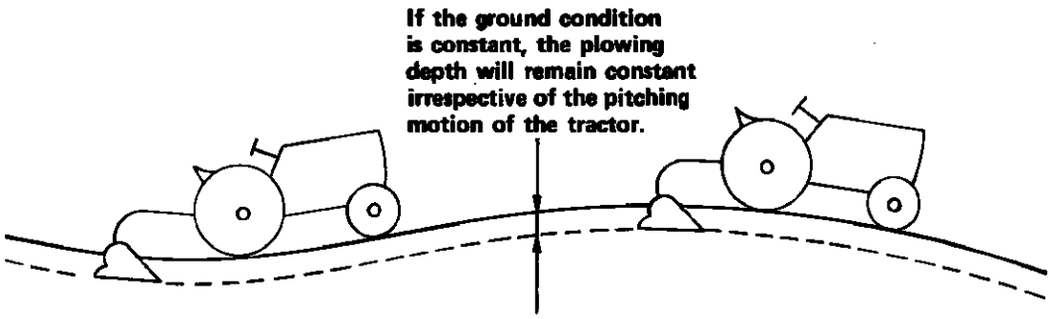


Fig. 2

the hardness of the soil. Accordingly, the draft resistance will vary depending upon the difference in soil condition.

b) On rough or undulating ground, the plowing depth will vary with the pitching motion of the tractor.

2-2. Draft control

The draft control is used to vary draft force on the implement in accordance with draft resistance, thereby maintaining as constant the resultant force on the implement. Control is effected by moving the control lever to vary the setting of the control valve.

a) Even on rough or undulating ground, the plowing depth will remain constant regardless of the pitching motion of the tractor, provided that the soil condition is constant.

b) Even on flat ground, if the soil hardness varies, the plowing depth will vary in accordance wtth the draft resistance. Thus, even if there are obstacles such as tree roots, etc., the tractor will not slip.

3. Principle of hydraulic control

3-1. Position control

1) The height of the lift arm is detected by means of the cam which feeds back a signal to the control valve.

2) At the control valve, the setting signal outputted by the control lever is compared with the above feedback signal to put the hydraulic circuit in either the 'raise' 'neutral' or 'lower' position.

3) When the hydraulic circuit is in the 'raise' position, hydraulic oil is fed to the cylinder to raise the lift arm. The movement of the lift arm is transmitted to the control valve, so that when the hydraulic circuit reaches the neutral position the lift arm stops and remains in that position.

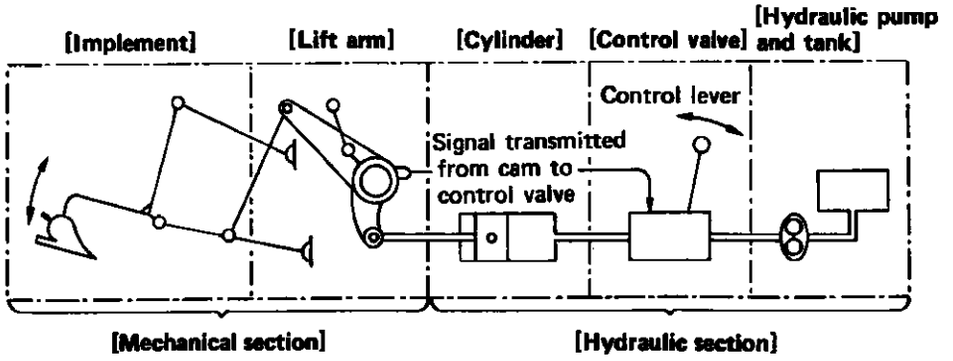


Fig. 3

4) When the hydraulic circuit is in the 'lower' position, hydraulic oil is returned to the tank to lower the lift arm. When the control valve reaches the 'neutral' position the lift arm stops and remains in that position.

5) In this way, the control valve will always go to the 'neutral' position for each setting of the control lever, thus controlling the position of the lift arm.

3-2. Draft control

1) The draft force applied to the implement is transmitted to the top link of the 3-point link mechanism shown in Fig. 4, causing the sensor spring to be compressed.

2) The deflection of the spring (i.e. the draft force) is fed back to the control valve where it is compared with the setting signal from the control lever, causing the control valve to switch into either the 'raise', 'neutral' or 'lower' position.

3) When the draft force becomes too large for the control lever position, the control valve will switch into the 'raise' position to feed hydraulic oil to the cylinder, thus causing the lift arm and implement to be raised. When the implement rises up, the plowing depth will be reduced and hence the draft force will also be reduced. This will cause the deflection of the sensor spring to be reduced so that the implement stops when the hydraulic circuit reaches the 'neutral' position.

4) When the draft force becomes too small for the control lever position, the control valve will switch into the 'lower' position to return hydraulic oil to the tank, thus causing the implement to be lowered. The plowing depth will thus be increased until the control valve reaches the 'neutral' position.

5) In this way, the control valve will always go to the 'neutral' position for each setting of the control lever, thus controlling the deflection of the sensor spring, i.e. the draft force.

4. Construction of hydraulic control unit

As previously explained, the complete hydraulic lift device comprises a hydraulic section (hydraulic cylinder) and a mechanical section (lift arm, link mechanism and sensor). The control unit consists of the following 4 main components.

4-1. Sensor spring

The sensor spring is used to detect the draft force by converting it into a deflection which is then transmitted to the link mechanism.

4-2. Link mechanism

The link mechanism is used to transmit the feedback signal from the sensor spring during draft control, or the feedback signal from the

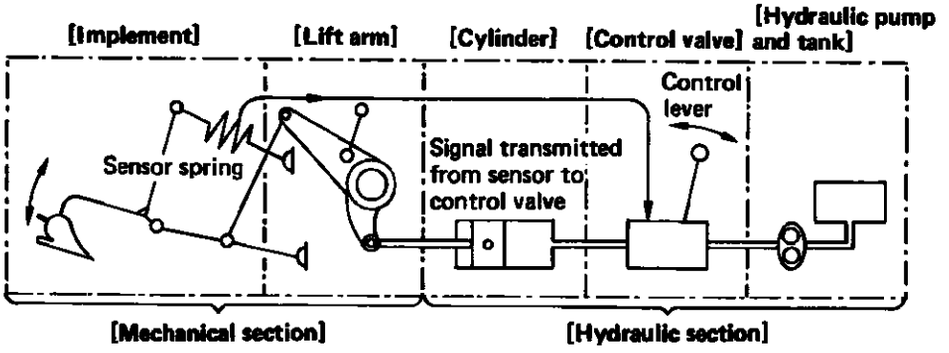


Fig. 4

lift arm shaft during position control, to the control valve.

4-3. Control valve

The control valve compares the setting signal of the control lever with the feedback signal, and switches the hydraulic circuit to either 'raise', 'neutral' or 'lower'. The power unit operates accordingly.

4-4. Power lift

The power lift consists of a piston, cylinder, lift arm, lift arm shaft, hydraulic tank, etc. It operates in response to the control valve to raise, lower or maintain the implement in a fixed position.

A detailed description of the link mechanism and the control valve follows.

1) Link mechanism

As shown in Fig. 15, the link mechanism consists of the following 3 parts.

Draft feedback rod: Transmits the signal from the sensor spring.

Position feedback rod: Transmits the signals from the sensor spring and the lift arm shaft to the control valve.

Cam: Performs changeover between position control and draft control, and also detects movement of the lift arm shaft during position control.

a) **Draft control**

i) Pull the changeover lever forward.

ii) Because the draft cam, which is concentric with the lift arm shaft, comes into contact with the control ring, movement of the lift arm shaft does not occur.

iii) Because pin A, which is attached to the position cam, is in contact with the draft feedback rod, a signal from the sensor spring occurs.

iv) When the lift arm shaft approaches the uppermost position, the control ring comes into contact with the depressed part of the draft cam, thus putting the unit into the position control mode.

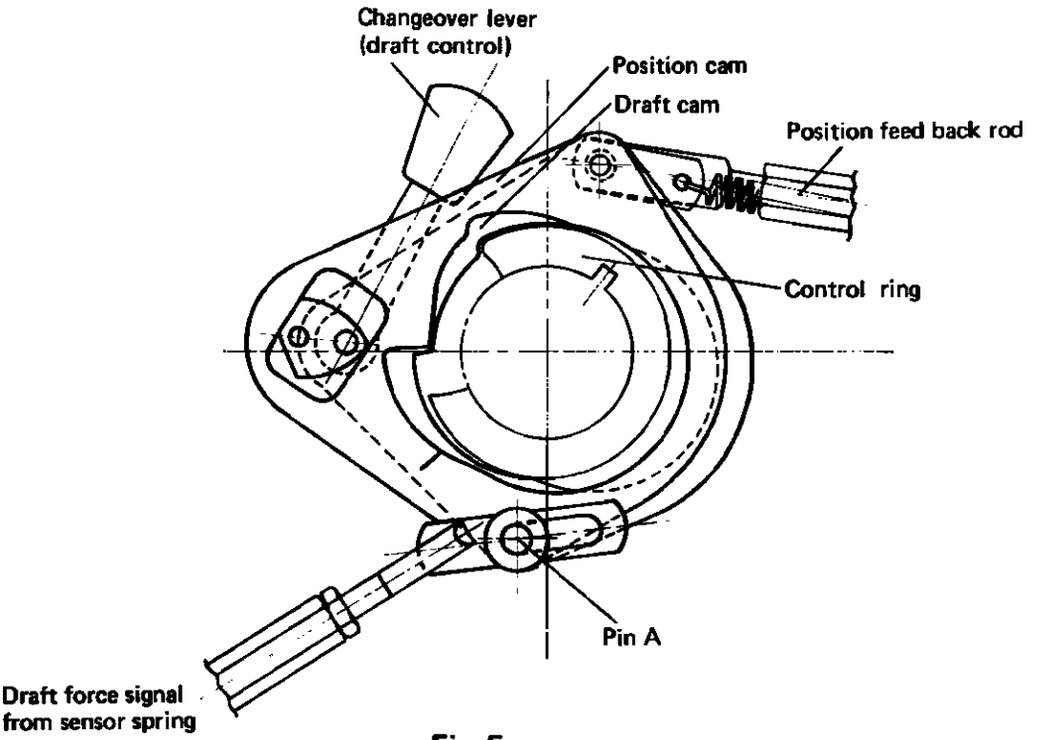


Fig. 5

b) Position control

i) Push down the changeover lever.

ii) Because pin A moves forward and separates from the slot of the plate of the draft feedback rod, a signal from the sensor spring does not occur.

iii) Because the position cam, which is eccentric to the lift arm shaft, comes into contact with the control ring, the movement of the lift arm shaft will be detected. The whole cam will rotate about pin B, which is welded to the back of the draft cam and stopper.

iv) When an extremely large traction force is applied, pin A will come into contact with the slot on the lower link, thus putting the unit into the draft control mode.

2) Control valve

The control valve has basically the following 3 functions.

a. Signal comparator section
b. Control section
c. Ancillary function section

a) Signal comparator section

This section consists of the control lever, feedback lever, driver and positioning plate. The feedback signal from the position feedback rod is transmitted to the feedback lever, thus determining the position of the driver, which will rotate concentrically with the feedback lever. The position of the driver and also the angle of the control lever will determine the position of the positioning plate, while the spring will determine the position of the pilot spool which is pushed forward.

b) Control section

This section consists of the pilot spool, shut-off spool, eccentric pin, lowering valve and check valve. It is used to switch the hydraulic circuit into the 'raise', 'neutral' or 'lower'

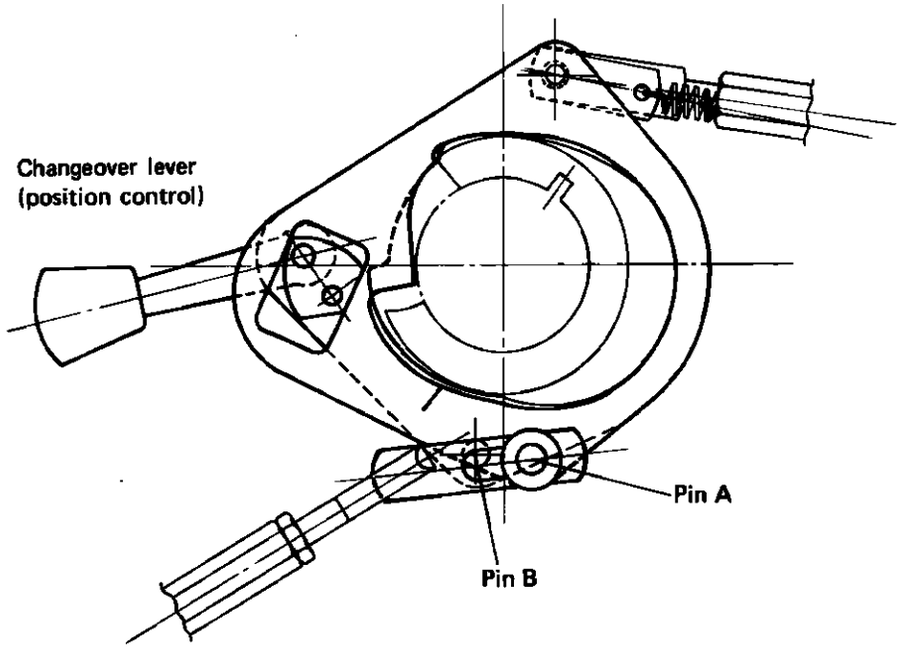


Fig. 6

position in accordance with the position of the pilot spool.

i) 'Raise' (Control edge A – open, B – closed)

With reference to Fig. 15 on page 48, the pilot spool is pushed backwards by the spring, and when the pressure of chamber D falls off, the low pressure side of chamber C opens. This causes the shut off spool to be pushed back by the shut off spring. Passages E and F are thus connected. As a result, the hydraulic oil which is unable to flow to the low pressure side pushed open the ckeck valve to enter the cylinder and cause the lift arm to be raised.

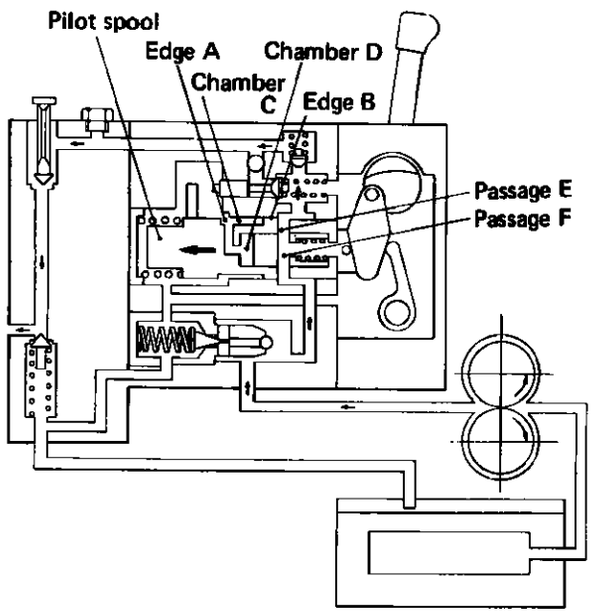


Fig. 7 'Raise'

ii) 'Neutral' (Control edge A – closed, B – open)

The pilot spool is pushed ahead of the 'raise' position. This connects the loop chamber C and the low pressure chamber, Hydraulic oil thereby flowing into chamber D. This causes the shut off spool to be pushed forward by the back pressure, which in turn results in passages E and F opening up to circulate hydraulic oil through the low pressure chamber. Meanwhile because the eccentric pin, which moves together with the pilot spool, does not succeed in pushing open lowering valve, the hydraulic oil inside the cylinder becomes trapped by the lowering valve and the check valve, and hence the implement is maintained at a constant height.

iii) 'Lowering' (Control edge A – closed, B – open)

In this condition, the pilot spool is pushed forward further than the 'neutral' position by means of the spring. In the same way as when the unit is in the 'neutral' condition, the hydraulic oil circulates through the low pressure side. Meanwhile, the spring pushes against the eccentric pin, causing it to push open the lowering valve. As a result, the hydraulic oil in the cylinder is returned to the low pressure side causing the implement to be lowered.

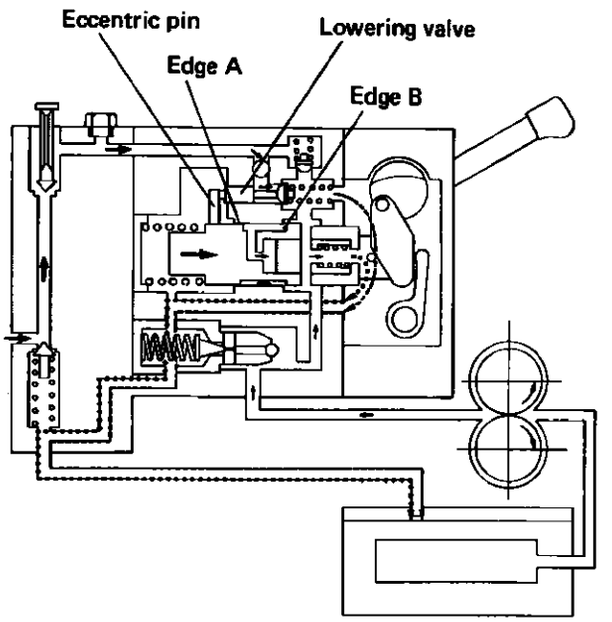


Fig. 8 'Lower'

c) Ancillary function section

i) Relief valve

The inlet from the pump contains a relief valve fitted with a damper spool. This relief valve serves to maintain the pressure in the hydraulic circuit at or below a cer-

tain value, when either a fault arises in the hydraulic circuit including the control valve, or an excessive load is applied to the implement.

ii) Slow return valve

The slow return valve is contained in the circuit between the cylinder and the lowering valve. It is designed to permit free adjustment of the descent speed of the implement using the slow return valve lever.

iii) 'Free-float'

When the control lever is pushed down past the 90° control range, the lowering valve will remain open, and hence the operating piston will go into a 'Free-float' condition, enabling it to move freely inside the cylinder.

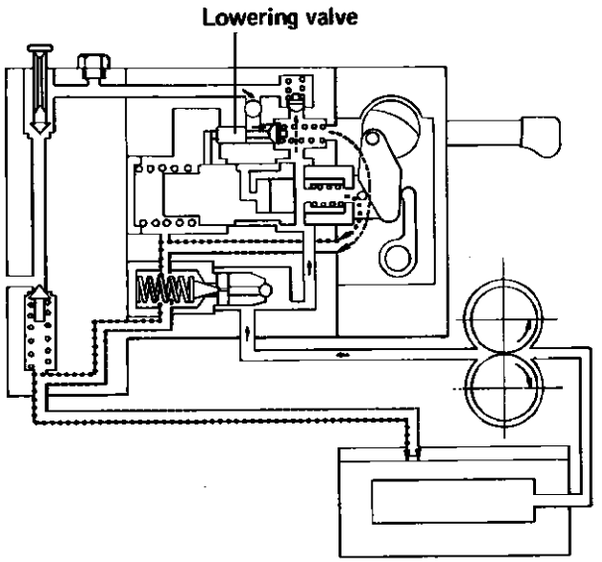


Fig. 9 'Free float'

5. Control Process

Based on the foregoing descriptions, a description of the overall control process follows, taking position control as an example.

5-1. 'Raising'

i) Raise the control lever.

ii) Because of the driver the positioning plate, which is set in one position, is pushed downwards.

iii) Consequently, pilot spool will be pushed towards the rear; thus putting the unit in the 'raise' position.

iv) Hydraulic oil will be fed into the cylinder, and the lift arm shaft will swing upwards.

v) The movement of the lift arm will be detected by the cam, and the position feedback rod will transmit the movement of the lift arm shaft to the feedback lever.

vi) When the lift arm shaft moves upward, the feedback lever will swing forward, causing the driver to move forward as well.

vii) As a result, the positioning plate will swing forward, causing the pilot spool to move forward as well.

viii) The above movement will continue until the spool reaches the 'neutral' position, at which point the implement will be hydraulically locked, thus completing control.

5-2. 'Lowering'

i) Lower the control lever.

ii) The positioning plate will be raised up.

iii) Through the action of the pilot spool spring, the pilot spool will be removed in the forward direction, thus putting the unit in the 'lower' position.

iv) The lowering valve will open up to send the oil in the cylinder back to the tank, and the lift arm shaft will swing downwards.

v) When the lift arm shaft moves downwards, the feedback lever will swing to the rear, causing the driver to move back also.

vi) As a result, the positioning plate will swing backwards, causing the pilot spool to move backwards as well.

vii) The above movement will continue until the spool reaches the 'neutral' position, at which point the implement will be hydraulically locked, thus completing control.

As described above, the movement of the lift arm shaft is continually controlled so that, for any position of the control lever, the pilot spool is maintained at the 'stop' position.

6. Operating Method

6-1. Switching between position control and draft control

Switching between position control and draft control can be simply performed by means of the changeover lever mounted on the cam.

1) Position control

Push the changeover lever hard down to the rear.

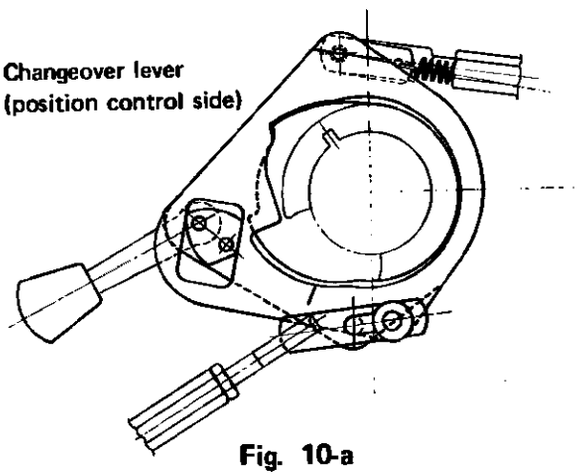


Fig. 10-a

2) Draft control

Pull the changeover lever forward to the fullest extent.

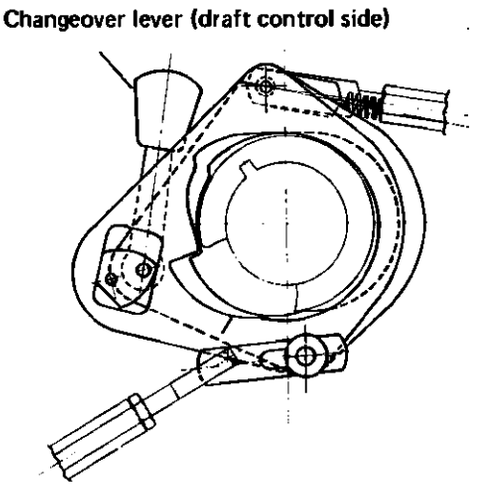


Fig. 10-b

6-2. Handling the control lever

1) Position control

- Within the 90° control range, the height of the implement can be set to any desired value.
- When increasing the plowing depth, push the control lever downwards, and vice-versa.

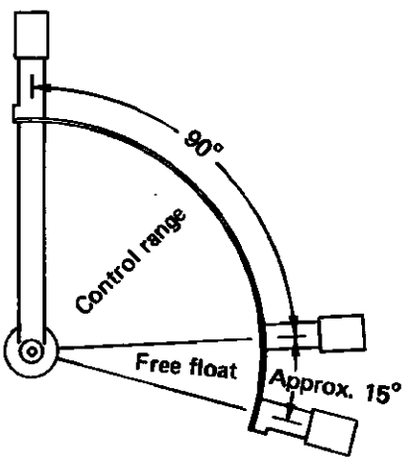


Fig. 11

2) **Draft control**

- The uppermost segment of 30° or so corresponds to position control. In this area, it is possible to freely vary the height above ground of the implement within certain limits.
- The lower segment of approximately 60° corresnponds to draft control. When it is desired to increase the traction force, push the control lever down, and vice-versa.

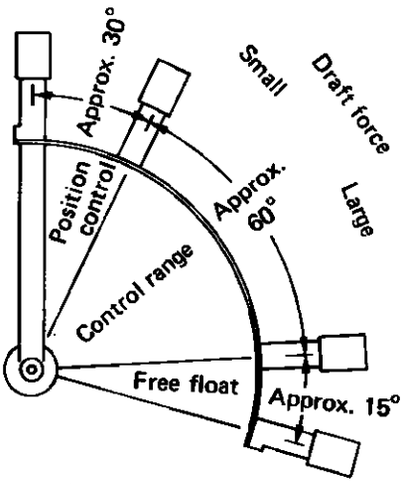


Fig. 12

3) **Free float**

If the control lever is pressed down to its fullest extent, for either position or draft control, the unit will go into the free float mode, enabling the implement to be freely raised or lowered.

6-3. Adjustment of descent speed of implement

When the slow return valve lever is pushed right back, the slow return valve becomes fully open, and the descent speed of the implement will be increased. Conversely, when the slow return valve lever is turned forward the descent speed will be reduced.

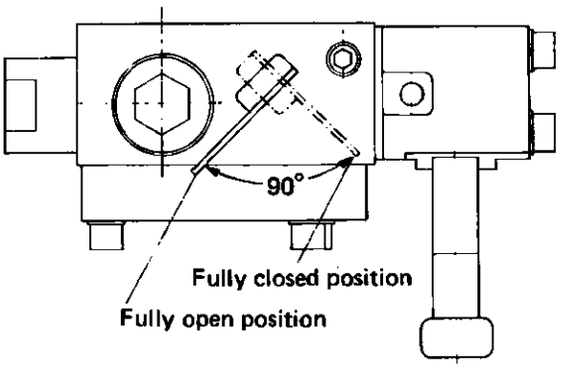


Fig. 13

6-4. Selection of mounting hole for top link

1) When the unit is in the position control mode, hole (1) is generally used; however, it is possible to use any hole to suit the implement used.

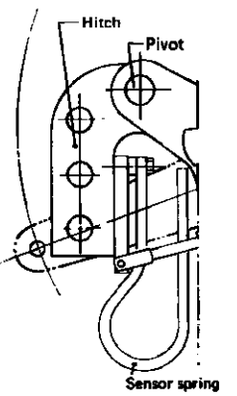


Fig. 14

2) When the unit is in the draft control mode, hole (1) is used for large draft forces, and hole (3) is used for small draft forces. Selection should be determined on the basis of soil conditions, plowing depth and the implement used.

7. Precautions during Handling

7-1. Always first put the position/draft change-over lever in the exact position when changing from one mode to another.

7-2. Check whether or not the slow return valve lever used for adjusting the descent speed is in the correct position. If it is throttled to an excessive degree, it may not be possible to lower the implement.

7-3. Always use Yanmar oil filters, about 50 to 100μ for the gear pump, and periodically clean or replace it.

7-4. Be particularly careful when maintaining the cam part of the link mechanism. Remove any mud, dirt or dust on the cam.

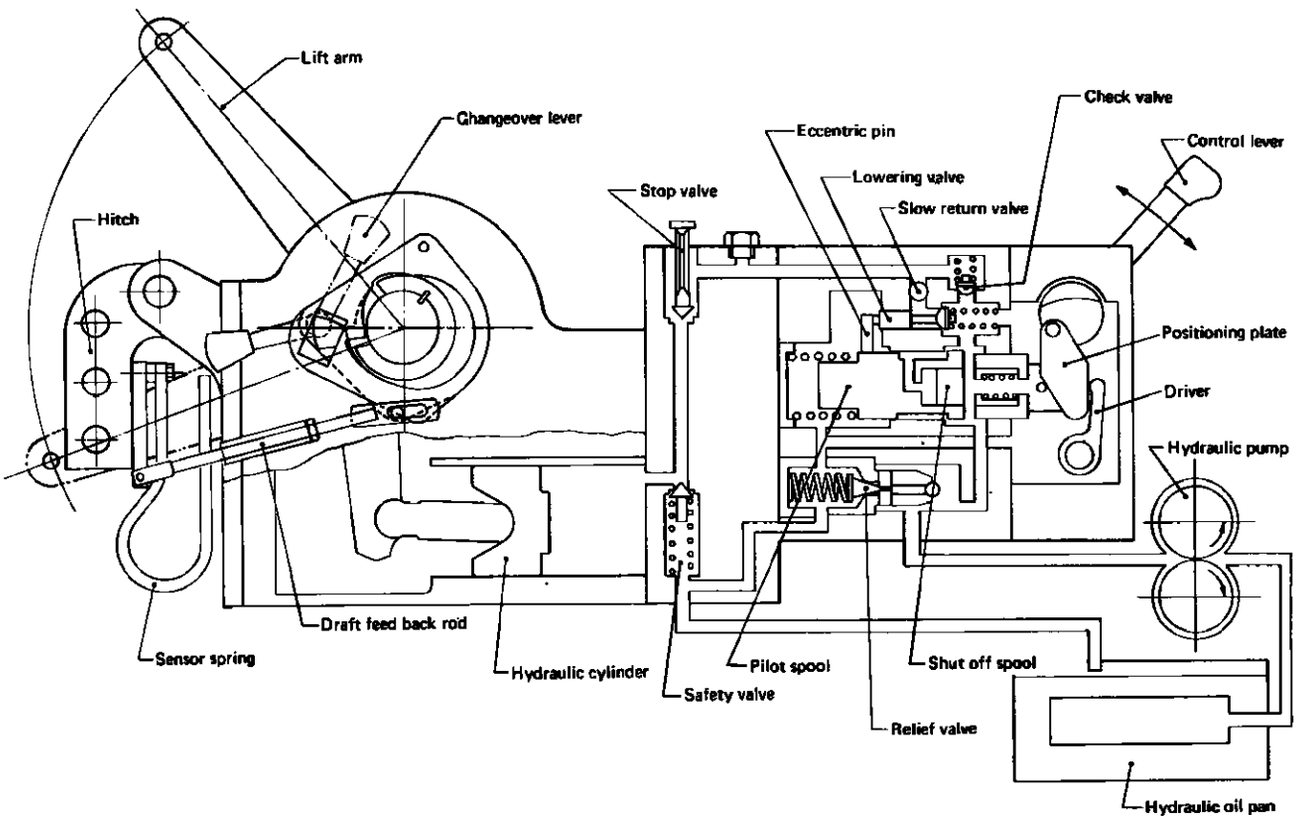
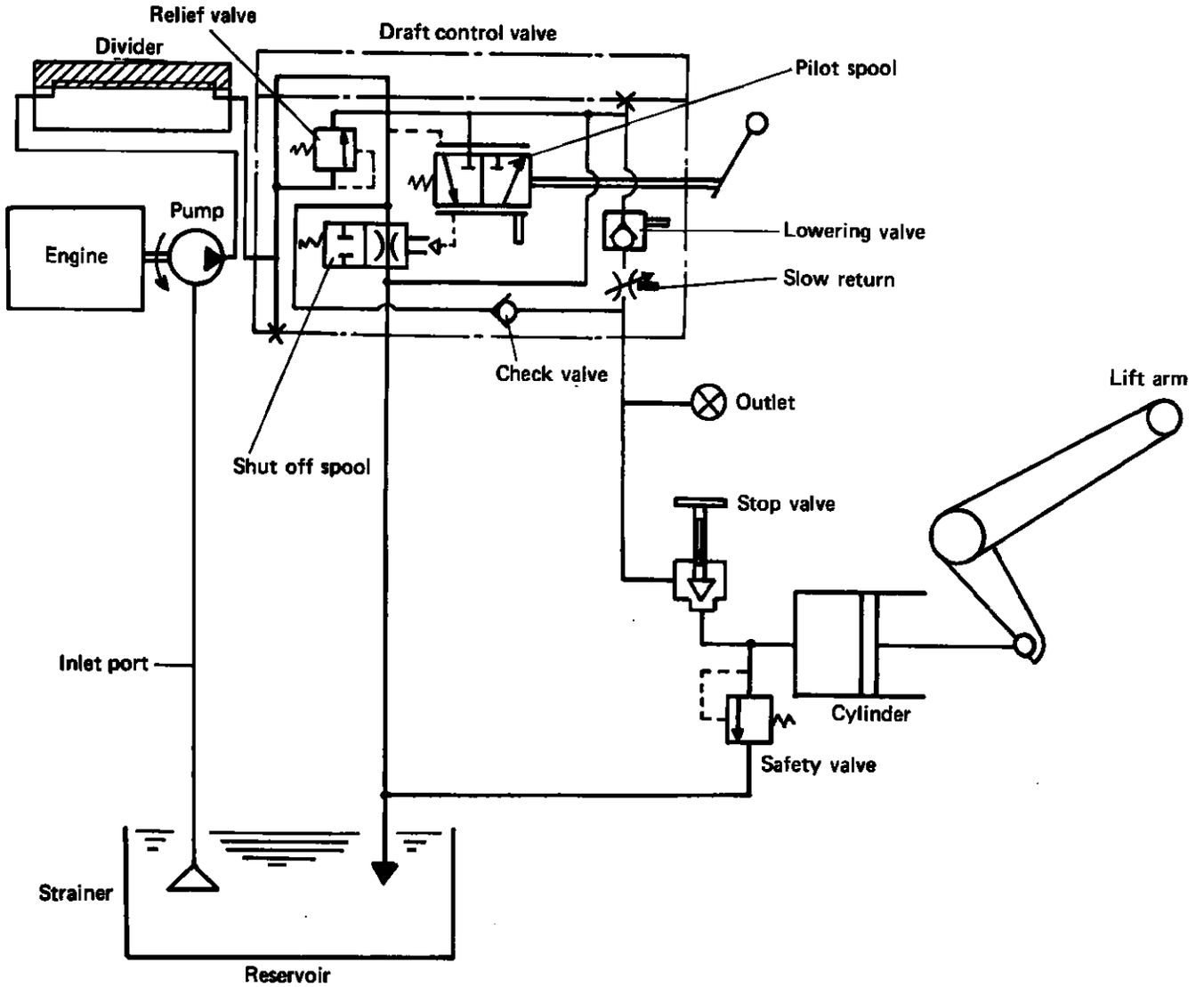
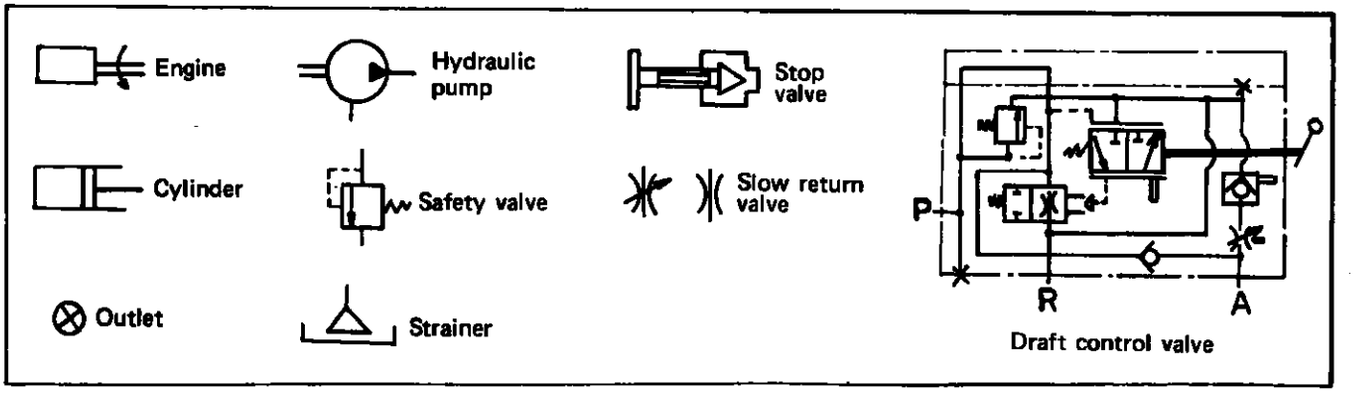


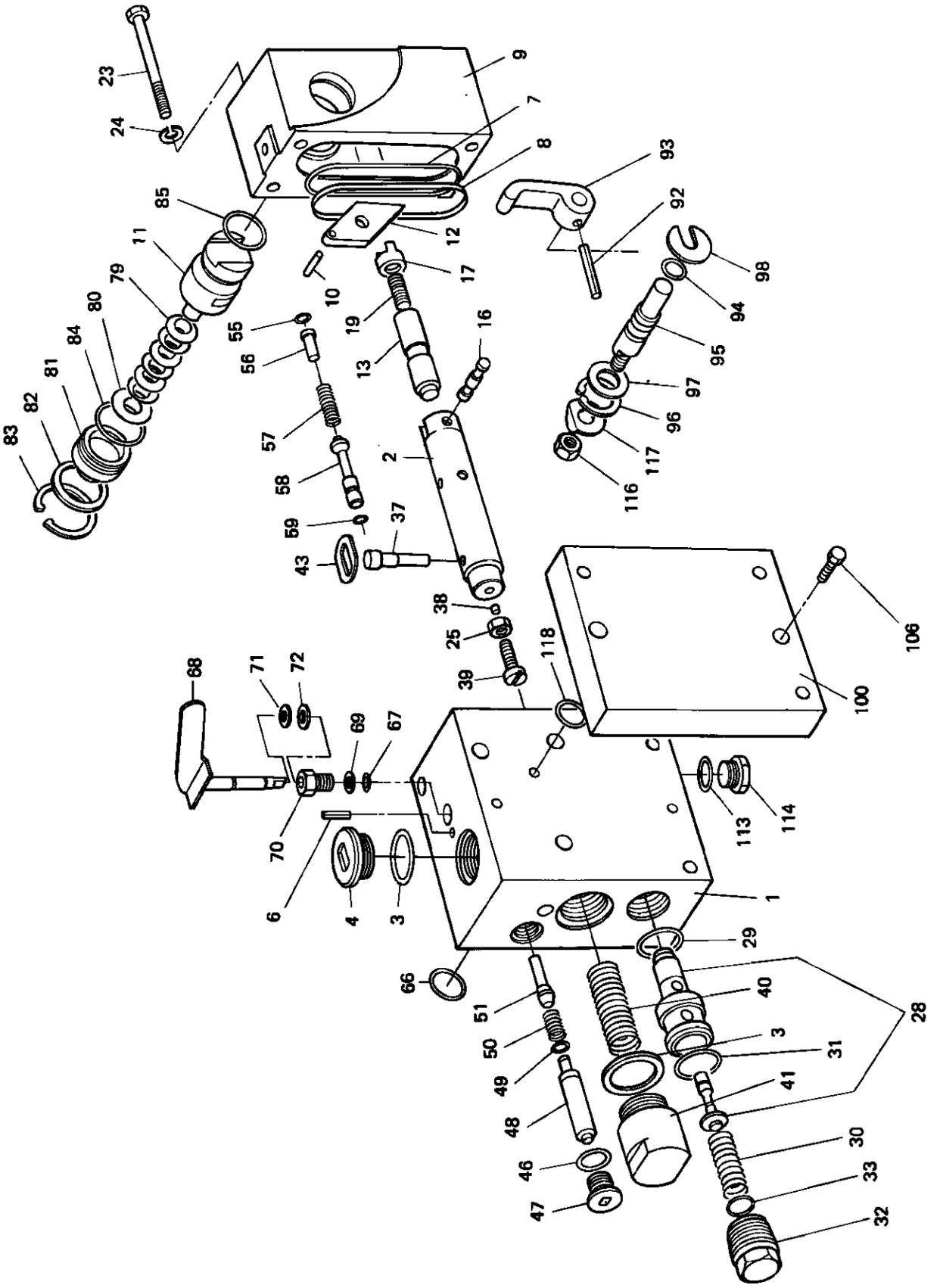
Fig. 15

8. Control valve diagram





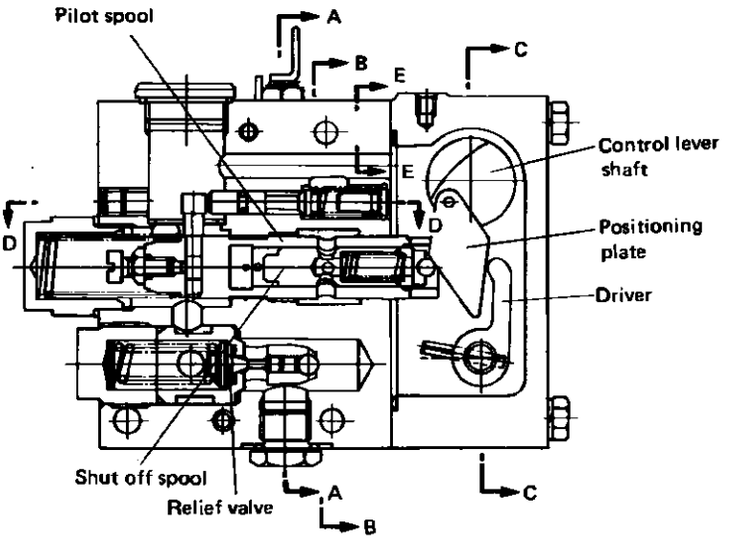
9. Component parts of control valve



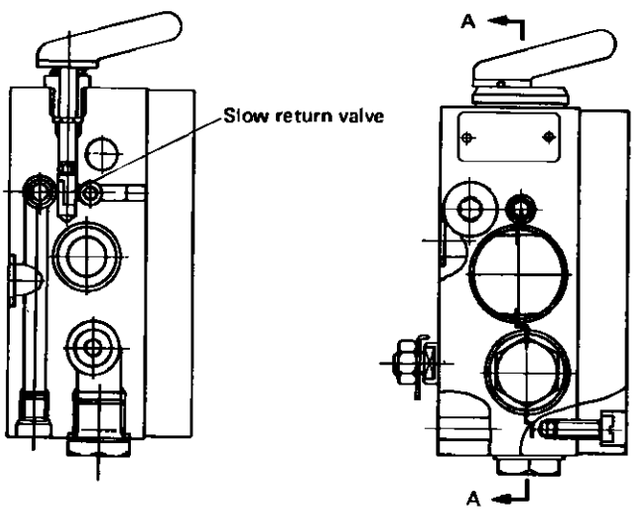
Refer. No.	Q'ty	Part No.	Description	Remarks
1	1	26530-364	Housing	
2	1		Pilot spool	
3	2	26530-364	Gasket	
4	1		Screw	
6	1		Spring pin	
7	1	29637-004	O ring, Selector housing	
8	1		Leaf spring, Selector housing	
9	1		Selector housing	
10	1		Pin	
11	1		Control shaft	
12	1		Positioning plate	
13	1		Shut off spool	
16	1		Pin	
17	1		Spring seat	
19	1		Spring, Shut off spool	
23	4		Bolt	
24	4		Spring washer	
25	1		Nut	
28	1	71041-112	Relief valve assembly	
29	1	29332-006	Gasket	
30	1		Spring, relief valve	
31	1	29632-301	O ring, relief valve	7150-064
32	1		Plug, relief valve	
33	*		Shim	
33	*		Shim	
33	*		Shim	
37	1		Eccentric pin	
38	1		Plug	
39	1		Screw	
40	1		Spring, pilot spool	
41	1		Cap	
43	1		Washer	
46	1	26516-204	Gasket	
47	1		Plug	
48	1	71041-210	Stopper, check valve	
49	1	26800-832	O ring, check valve	
50	1		Spring, check valve	
51	1	71041-230	Check valve	

Refer. No.	Q'ty	Part No.	Description	Remarks
55	1		Snap ring	
56	1		Stopper, Lowering valve	
57	1		Spring, Lowering valve	
58	1		Lowering valve	
59	1	26800-511	O ring, Lowering valve	
66	6	29631-610	O ring	
67	1	26800-521	O ring	
68	1		Slow return valve	
69	1		Snap ring	
70	1		Screw	
71	1		Wave washer	
72	1		Shim	
79	*		Spring	
80	*		Shim	
80	*		Shim	
81	1		Cap	
82	1		Washer	
83	1		Snap ring	
84	1	26802-532	O ring	
85	1	26802-521	O ring	
92	1		Spring pin	
93	1		Driver	
94	1	29630-905	O ring	
95	1		Shaft, driver	
96	1		Snap ring	
97	1		Washer	
98	1		Snap ring	
100	1		Cover	
106	2		Screw	
113	1	26518-224	Gasket	
114	1		Plug	
116	1		Nut	
117	1		Washer	
118	1		O-ring	

10. FUNCTION OF EACH COMPONENT PART

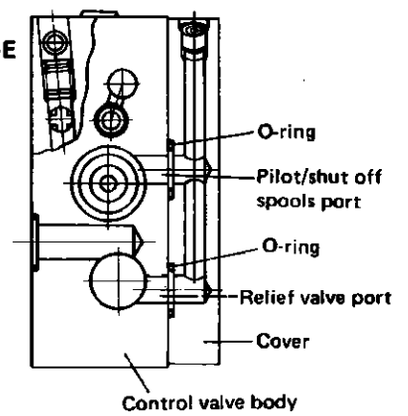


Cross-section at A-A

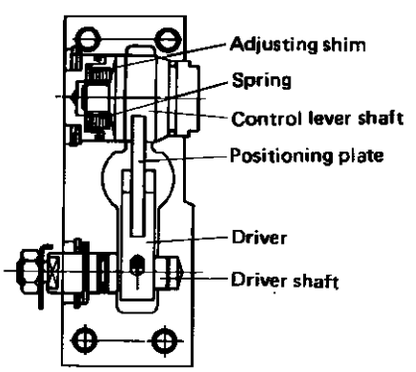


Cross section at E-E

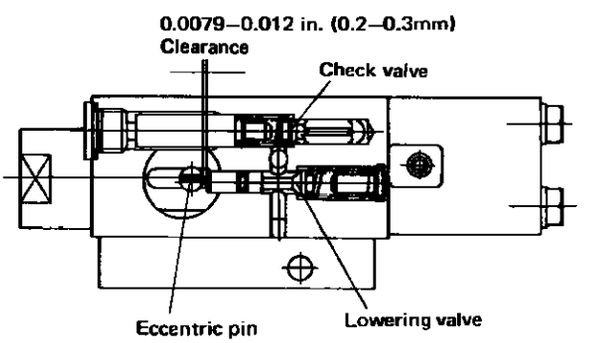
Cross-section at B-B



Cross-section at C-C



Cross-section at D-D



10-1. Relief valve

The relief valve is mounted in the draft control valve in order to ensure the safety of the hydraulic line.

Cracking pressure: 2062 + 114 lb/sq. in
(145 + 8 kg/cm²)

Note: If the cracking pressure of the relief valve is lower than the specified value, adjust the pressure in order to insert the adjusting shim by the pressure gauge.

10-2. Shut off spool

a) When the control lever is in the raised position, the shut off spool is closed. Pressured hydraulic oil passes to the check valve. Nothing passes through the shut off spool.
b) When the control lever is in the lowered position, the shut off spool is opened by means of back pressure which appears when hydraulic oil is sent from the pilot spool.
c) The spring force of the shut off spool controls the movement of the shut off spool in balancing the back pressure.

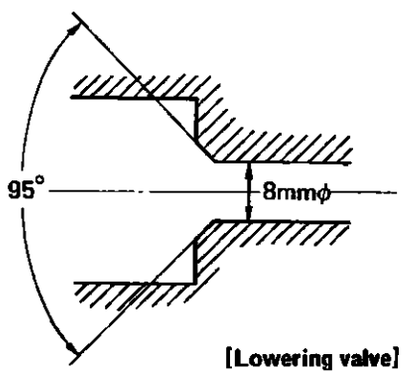
10-3. Pilot spool

The pilot spool has two functions; one is the control of the hydraulic oil flow to the shut off spool; and the other is the control of the hydraulic oil flow for the lowering valve.

10-4. Lowering valve

When the lift arm is lowered, the returned oil from the hydraulic cylinder passes to the hydraulic oil-pan through the lowering valve.

Seat angle of lowering valve: 95 degree



[Lowering valve]

10-5. Slow return valve

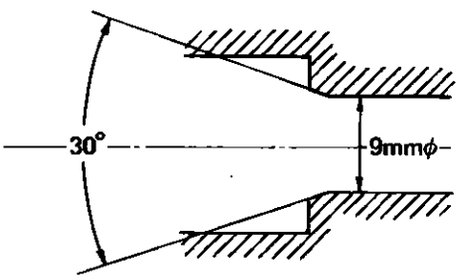
The descent speed of the implement is controlled by throttling the returned oil from the hydraulic cylinder. The descent speed can be adjusted by the degree of the open angle of the slow return valve. The slow return valve cannot raise the speed.

10-6. Check valve

When the lift arm is raised, high pressured hydraulic oil passes to the hydraulic cylinder through the check valve.

Though the check valve can control the flow of high pressured oil to be delivered to the hydraulic cylinder, it cannot control the flow of low pressured oil from the hydraulic cylinder.

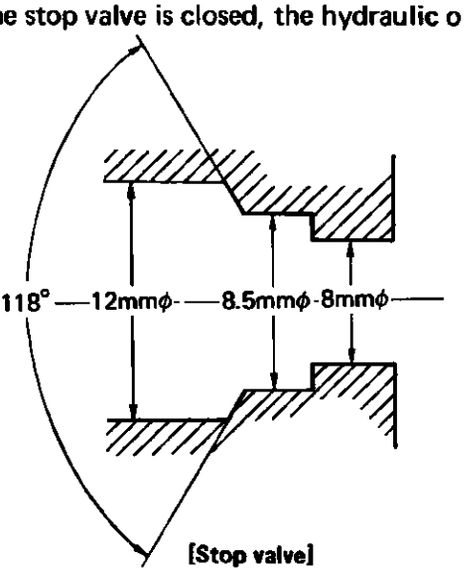
Seat angle of check valve: 30 degree



[Check valve]

10-7. Stop valve

When the stop valve is closed, the hydraulic oil in



[Stop valve]

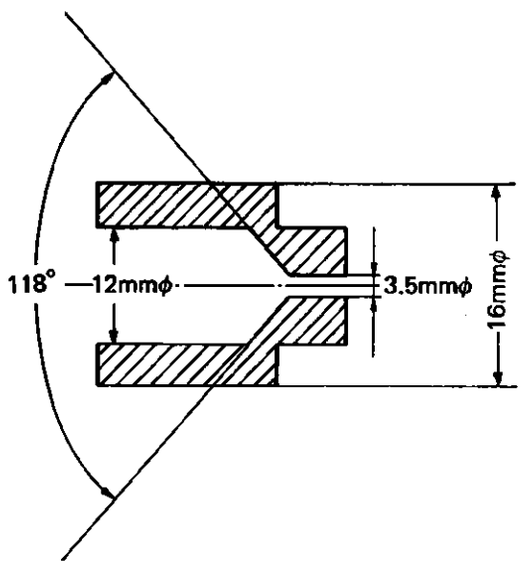
the hydraulic cylinder cannot be discharged outside. Furthermore the hydraulic oil to be delivered from the hydraulic pump cannot enter the hydraulic cylinder.

Seat angle of valve: 118 degree

10-8. Safety valve

If there is abnormally high pressure in the hydraulic cylinder due to an impact load from the lift arm, the safety valve can be opened in order to reduce the abnormally high pressure in the hydraulic cylinder. The hydraulic oil discharged through the safety valve enters the hydraulic oil pan.

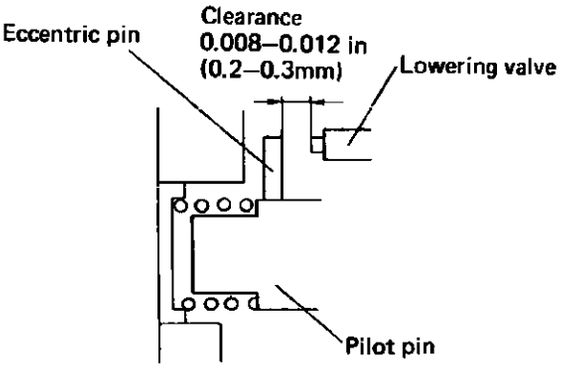
Seat angle of safety valve: 118 degree



[Safety valve]

10-9. Eccentric pin

In order to adjust the dead zone of the draft control valve, clearance between the eccentric pin and the lowering valve should be adjusted by the eccentric pin. If the clearance is too much, dead zone of the draft control will be small.

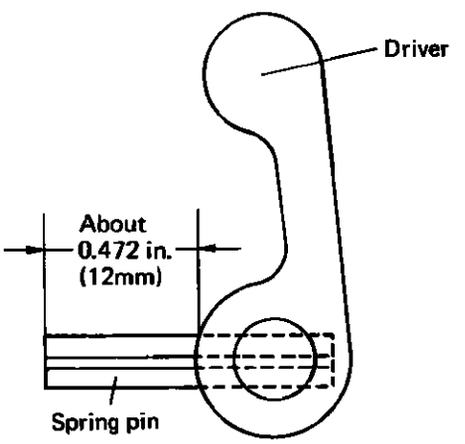


10-10. Positioning plate

The positioning plate can control the amount of movement given to the pilot spool by both the driver and the control lever.

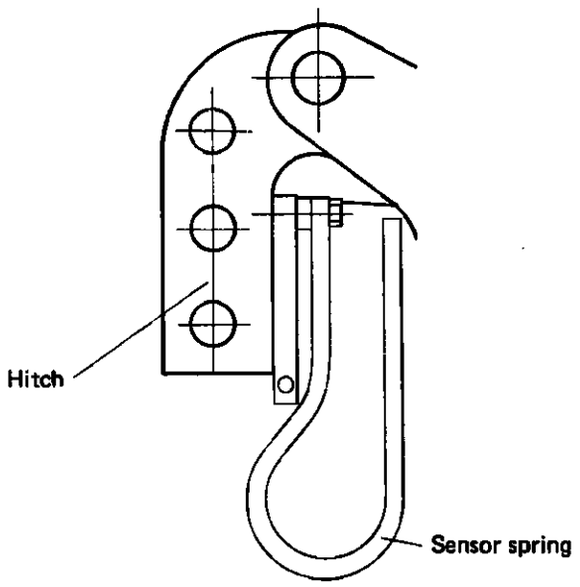
10-11. Driver

The movement given from the position feedback rod is transferred to the positioning plate through the driver. When reassembling the driver on the selector, the amount of housing projection for the driver spring pin should be about 0.472 in. (12mm).



10-12. Sensor spring

The sensor spring can sense the changing amount of draft resistance in load condition. Sensitive reaction should be determined by the spring factor.



10-13. Draft feedback rod

The draft feedback rod transfers the movement of draft resistance to the draft control cam.
The standard length of the draft feedback rod should be 8.307 in. (211mm).

The adjusting method for the draft feedback rod is shown below:

1) Set the changeover lever to the DRAFT side.
2) Loosen the lock nut of the turn buckle.
3) Adjust the length so that the pin of the draft control cam located on the lifting shaft comes into slight contact with the hole end of the draft feedback plate.
4) After adjusting to the specified length, tighten the lock nut.

10-14. Position feedback rod

The movement of the draft control cam is transferred to the driver shaft through the position feedback rod. If the length of the position feedback rod is too short, the pilot spool will remain in the raised position due to pushing by the driver. In this case, the noise of the hydraulic oil discharging from the relief valve will be heard.
As this shows an abnormal condition, the length should be adjusted to the correct value.

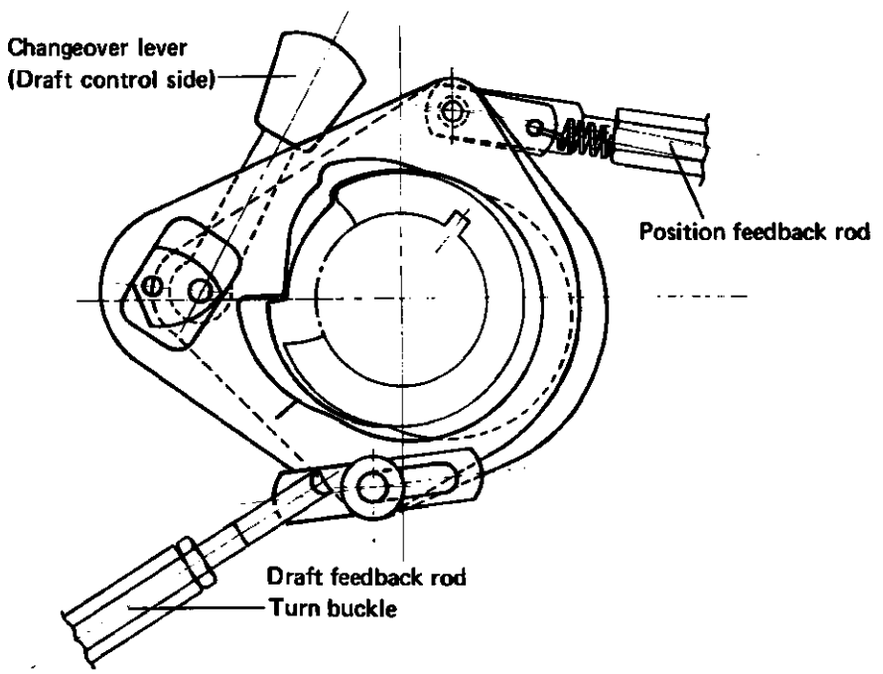
Standard length: 10.236 in. (260mm)

10-15. Changeover lever

This lever can be switched to both position control and draft control.

10-16. Draft control cam

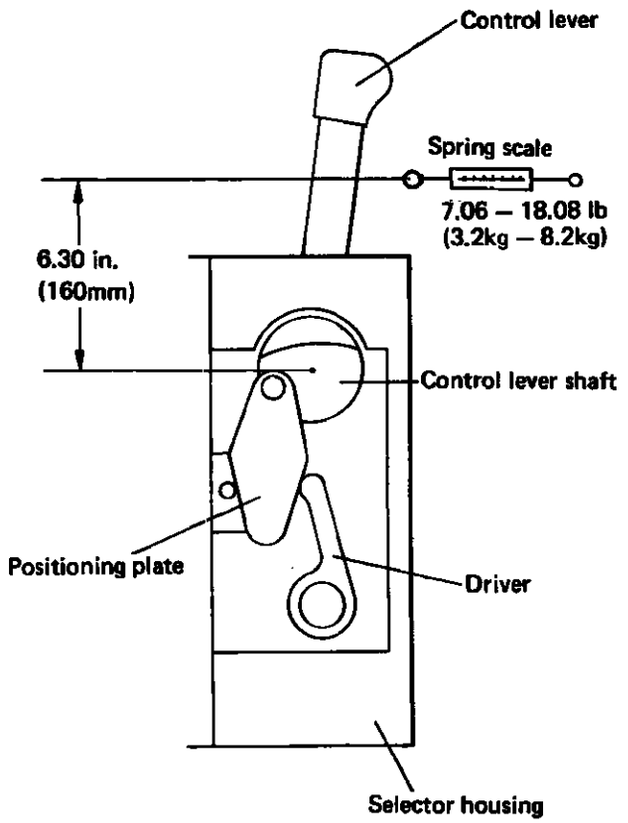
This cam is mounted on the lifting shaft and the movement of the draft resistance is fed back to the control valve via the draft control cam.



10-17. Control lever

The control lever can be operated by the operator to control the lift arm height. When the control lever is reassembled, the operating force of the control lever should be adjusted to remove and/or insert the shim onto the control lever shaft.

Operating force of control lever: 7.06—18.08 lbs (3.2—8.2 kg)
or equivalent torque: 3.6—9.4 ft-lb (0.5—1.3 kg-m)



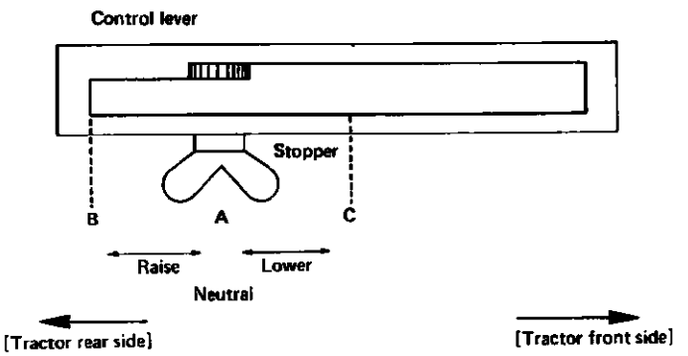
11. How to Obtain Hydraulic Power from the Tractor

11-1. In cases where the single action pump is used

1) Hydraulic power can be obtained from an outlet located on the hydraulic cylinder block. When hydraulic power is released through this outlet, the lift arm and outside implement can be operated at the same time the stop valve is opened.

2) Stroke adjustment of the control lever when the single action pump is mounted.
   i) Set the position-draft changeover lever to the POSITION side.
   ii) Set the control lever to position A.
   iii) Close the stop valve.
   iv) Loosen the stopper and shift it back towards the lowering side.

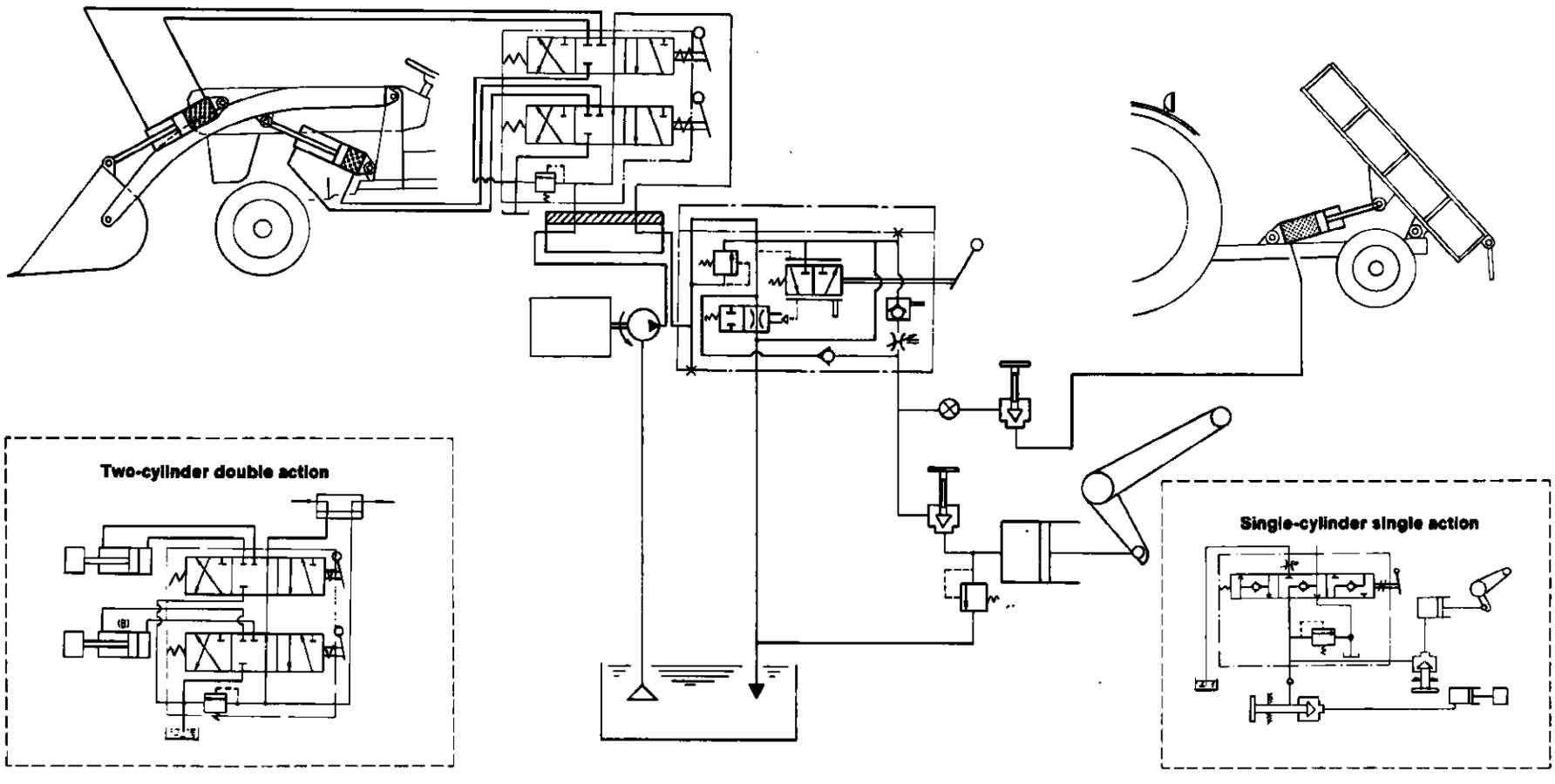
   When the control lever is moved to the B side from the position A, the implement can be lowered.



11-2. In cases where the double action pump is used

Hydraulic power should be obtained through the hydraulic divider.
When the hydraulic line is connected to this divider, the control valve must also be mounted; in other words, the control lever mounted on the tractor as standard cannot be controlled by the implement itself.

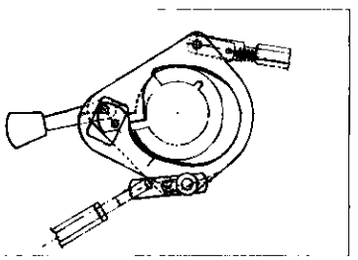
Link Mechanism and Hydraulic oil flow

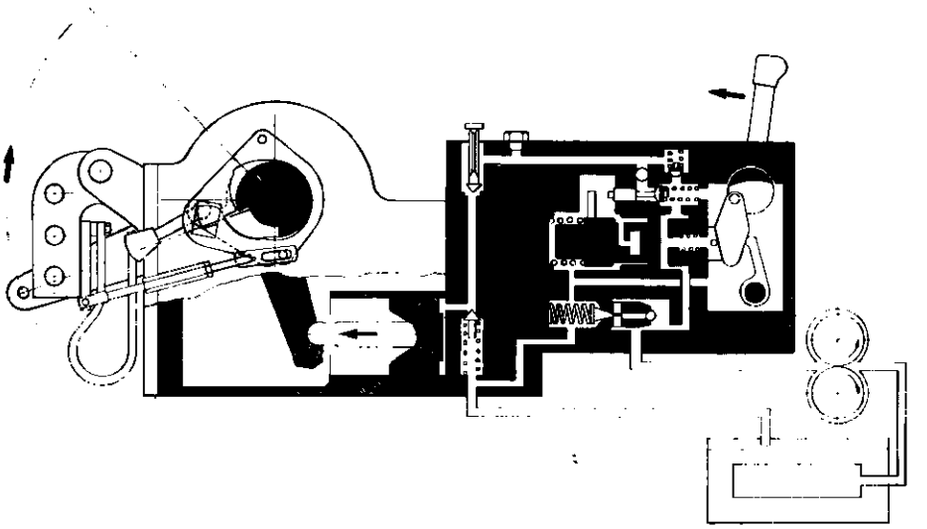


12. Link Mechanism and Hydraulic Oil Flow

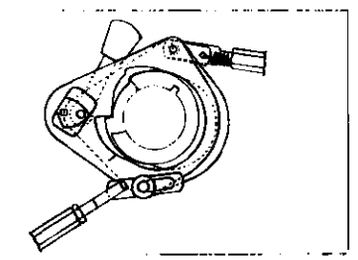
12-1. Raising

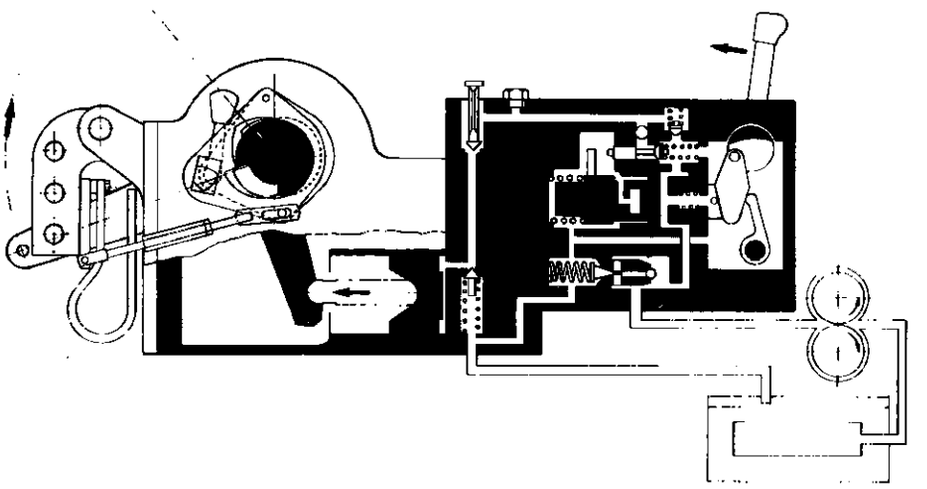
a) Position control



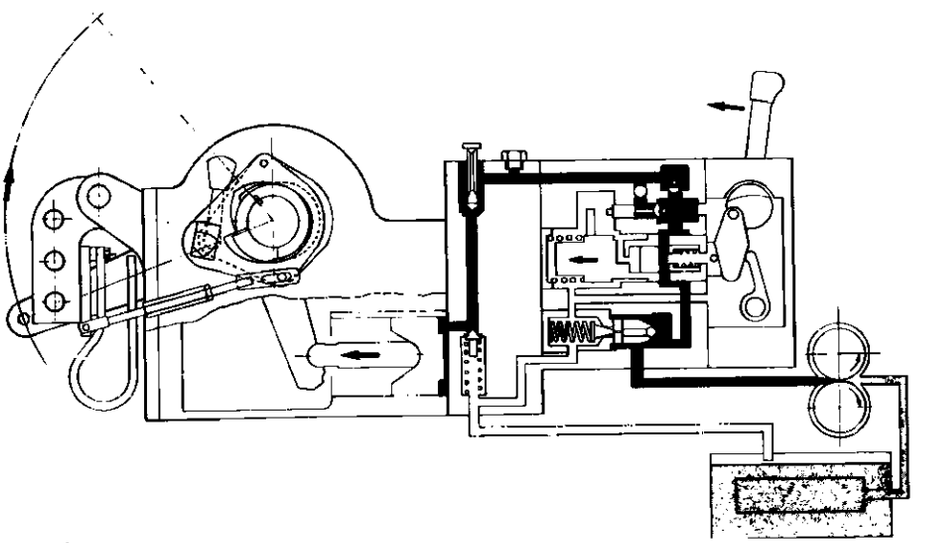


b) Draft control



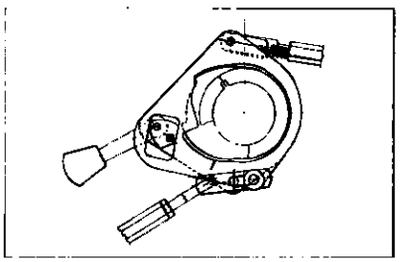


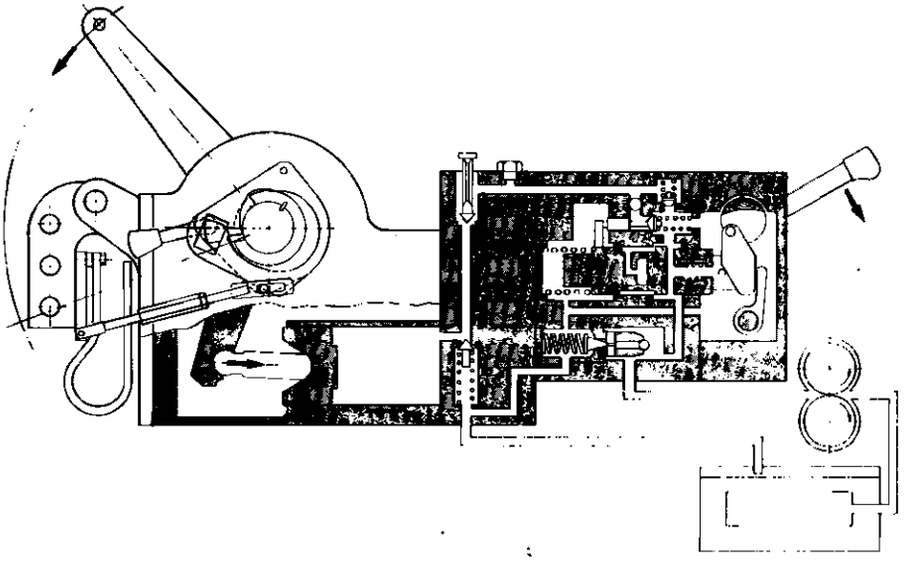
c) Hydraulic oil flow



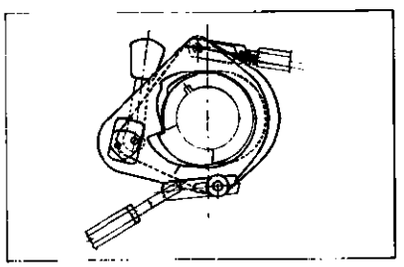
12-2. Lowering

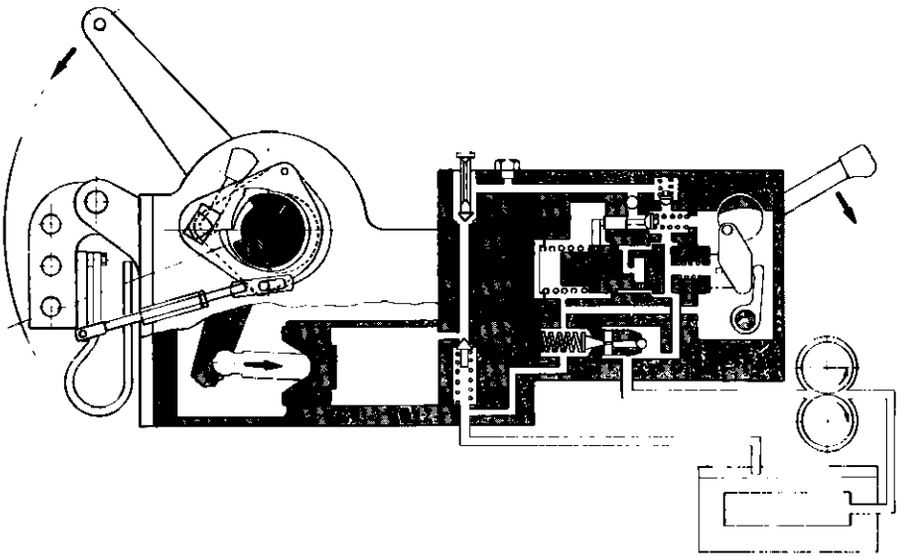
a) Position control



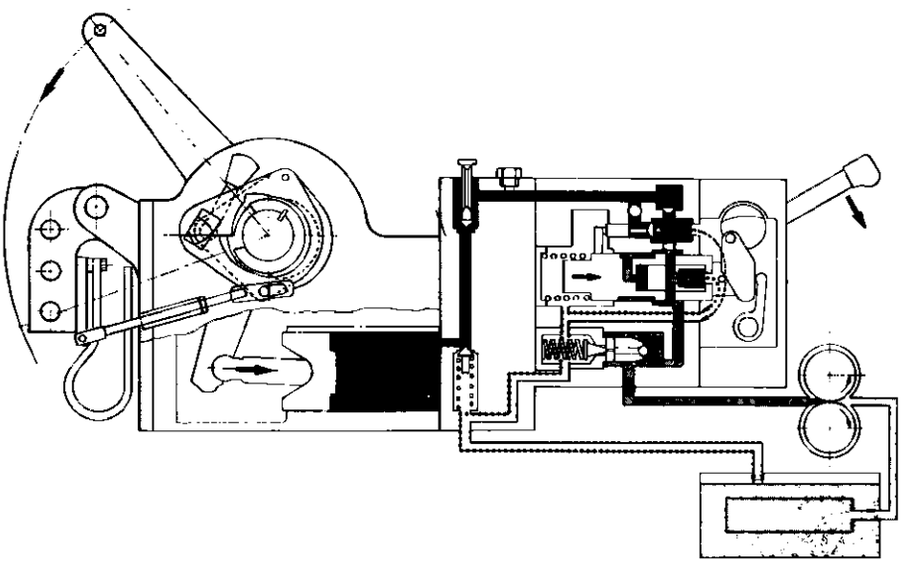


b) Draft control



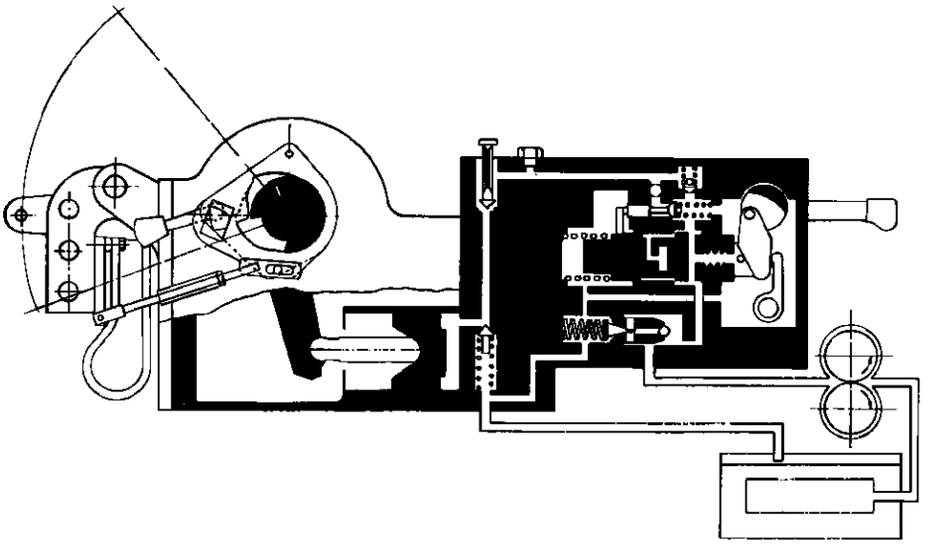


c) Hydraulic oil flow

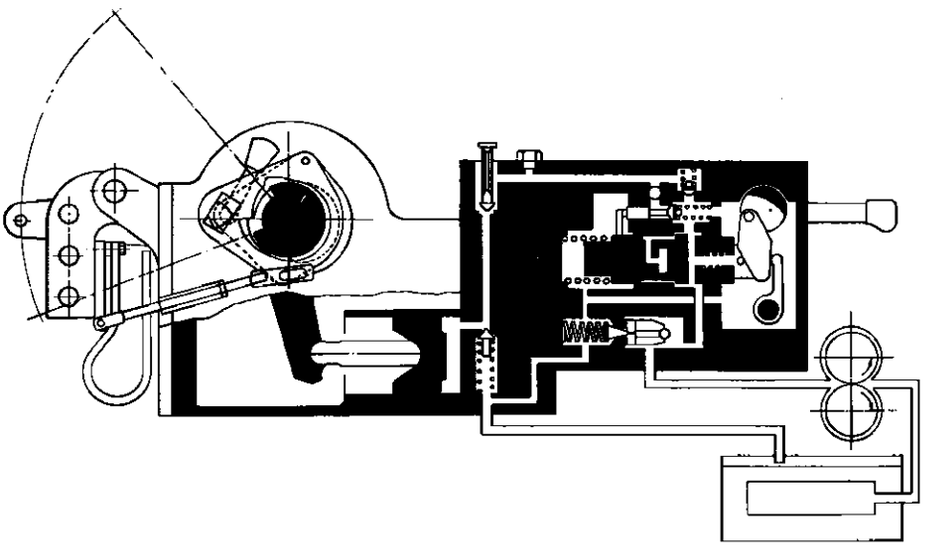


12-3. Free Float

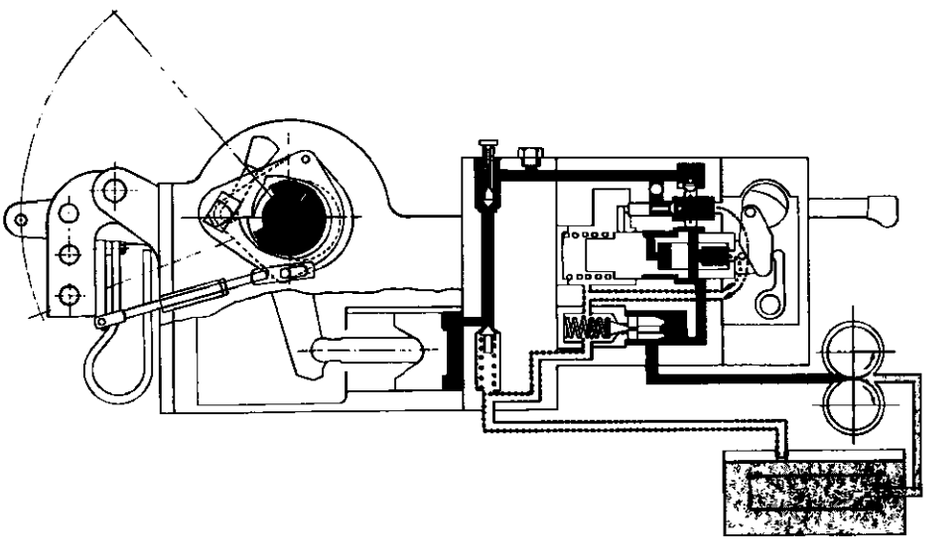
a) Position control



b) Draft control



c) Hydraulic oil flow



13. Maintenance Table

(1) Tightening torque

a) Relief valve cap 72.3 ft-lb (10kgm)
b) Check valve stopper plug 43.4 ft-lb (6kgm)
c) Screw 115.7 ft-lb (16kgm)
d) Excentric pin stopper screw 9.4 ft-lb (1.3kgm)
e) Selector housing bolt 18.8 ft-lb (2.6kgm)
f) Control lever 3.6–9.4 ft-lb (0.5–1.3kgm)

(2) Adjusting pressure

a) Relief valve 2176 lb/in^2 (153kg/cm^2)
b) Safety valve 2560 lb/in^2 (180kg/cm^2)

(3) Adjusting length & clearance

a) Projection length of roll pin
b) for driver 0.472 in (12mm)
b) Position feed back rod 8.307 in (211mm)
c) Draft feed back rod 10.236 in. (260mm)
d) Clearance between excentric pin and lowering valve end 0.008–0.012 in. (0.2–0.3mm)

(4) Seat angle

a) Check valve 30°
b) Lowering valve 95°
c) Safety valve 118°
d) Stop valve 118°

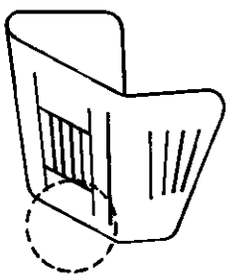
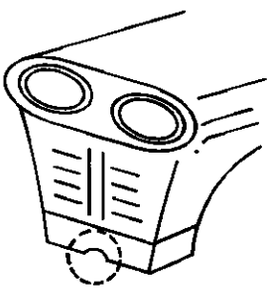
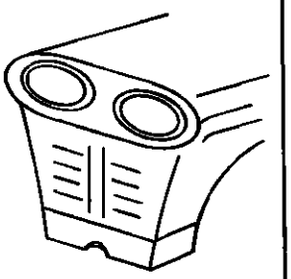
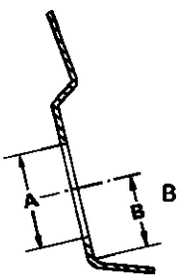
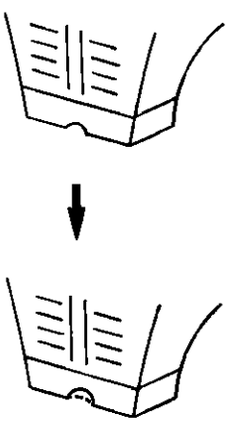
14. Trouble Shooting

Trouble	Probable cause	Remedy
When the implement cannot be lifted or the lifting speed is too slow	1. Hydraulic pump drive shaft damaged. 2. Stop valve closed. 3. Faulty hydraulic pump. 4. Hydraulic oil has excessive viscosity 5. Excessively worn relief valve. 6. Dirt in relief valve seat. 7. Seized shut off spool. 8. Pilot spool hole clogged.	1) Replace 2) Open 3) Replace 4) Exchange oil 5) Replace 6) Clean 7) Replace 8) Clean
Implement does not drop	1. Stop valve closed. 2. Pilot spool and/or shut off spool seized. 3. Lowering valve seized. 4. Slow return valve closed.	1) Open 2) Replace 3) Replace 4) Open (Adjust discharge volume by opening it
Rate of free descent is too fast *Note: When the rate of free descent is reduced by closing the stop valve, the lowering valve seat is worn.*	1. Damaged or worn valve and/or lowering valve. 2. Dirt in check valve. 3. Dirt in safety valve 4. Faulty hydraulic cylinder.	1) Replace 2) Clean 3) Clean 4) Replace
At the highest position of the lift arm, hydraulic oil is discharged from the relief valve	1. Position feedback rod too short. 2. Pilot spool seized in raise position. 3. Shut off spool seized in closed position.	1) Adjust length (Standard length: 8.307 in. [211mm]) 2) Replace 3) Replace
Unstable lift arm height	1. Faulty valves (Safety valve, check valve, relief valve) 2. Faulty length of position feedback rod. 3. Faulty length of draft feedback rod. 4. Faulty sensor spring. 5. Faulty adjustment of eccentric pin	1) Find faulty valve and replace 2) Adjust the length (Standard length: 10.236 in. [260mm]) 3) Adjust the length (Standard length: 8.307 in. [211mm]) 4) Spring 5) Adjust clearance (Standard clearance: 0.008–0.012 in. [0.2–0.3mm])

V. Front P.T.O.

* **Applicable for models YM195(D) and YM240(D)**

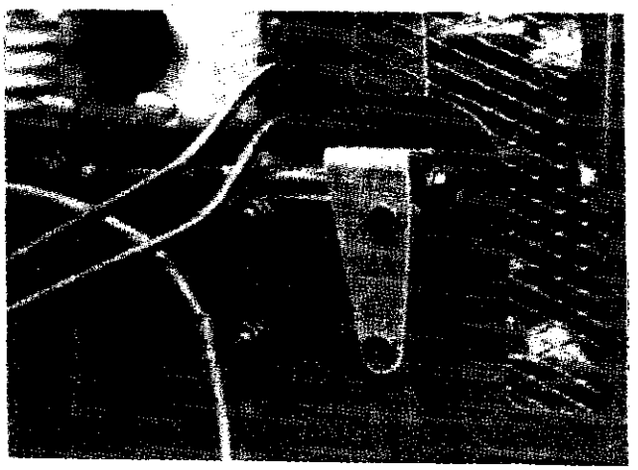
There are 3 kinds of hoods and 2 kinds of Front P.T.O. kits. Accordingly take careful note of the following.

Front PTO kit	(794240-83110)	(794240-83111)	
	Type A	Type B	Type C
Hood			
YM195	None	o	o
YM195D	None	None	o
YM240	o	o	o
YM240D	None	None	o
Suggestions for additional work	A hole should be drilled in the shell to attach the Front P.T.O. The diameter of the hole: A A: 1.57 in. (40 mm)  B: 2.48 in. (63 mm)	Unless the concave is made larger, the hood cannot be opened. 	

1. Procedure

1) Remove the hood.
2) Remove the tube attached to the subtank.
3) Remove the sub-tank.
4) Remove the battery plus and minus cables.
5) Remove the battery.
6) Remove the cushion rubbers (4 rubbers).
7) Fit the sub-tank bracket to the timing gear case with the bolts (2 bolts) originally mounted on the case.

(Note): In this case, put the cupper packings (2 packings) into their original position.

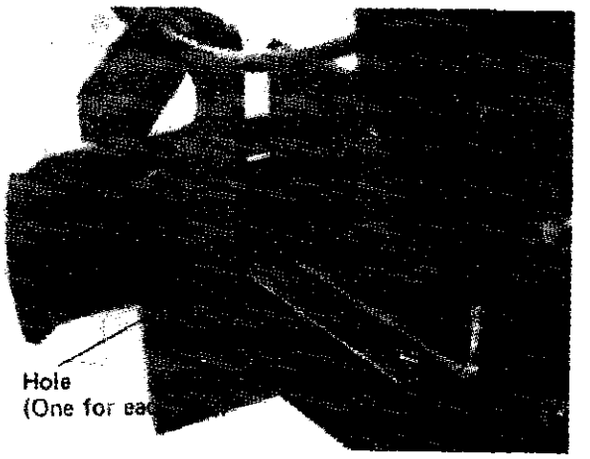


8) Set the sub-tank to the sub-tank bracket and connect the tube.

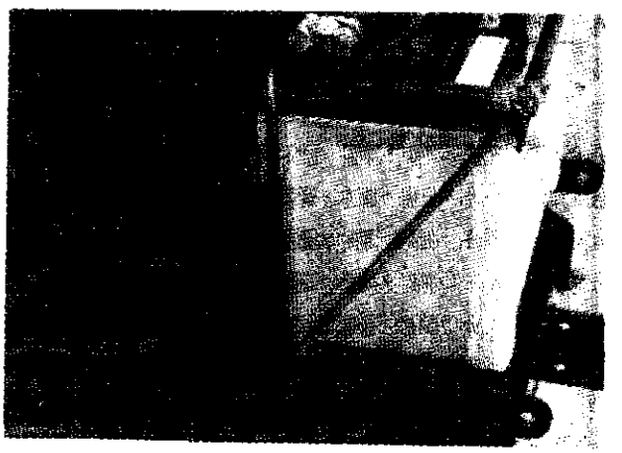
(Note): If the original tube is not long enough, use the tube in the kit.

9) Install the battery bracket on the front axle bracket with the bolts (M8x20), nuts (8) and spring washer (8) (4 of each).

(Note): There are tractors with only 2-holes. In this case, make two additional holes to attach the battery bracket.



10) Attach the cushion rubbers (4).
11) Set the battery on the battery bracket and fix it with the battery clamp, battery clamp rods (2 rods) and nuts (4 nuts).



12) Press fit the ball bearing onto the P.T.O. shaft and fix the circlip 25.

(Note): 1. Be sure to apply grease up to the shaft.
2. There are two kinds of shafts for the YM240 only.
- *194240-83271 (22.64 in; 575 mm) length for hood type B and C.*
- *194240-83270 (21.4 in; 537 mm) length for hood type A.*

13) Insert the assembly described in step 12 into the unit bracket, and fix circlip 52.
14) Insert the P.T.O. shaft into the P.T.O. adapter at the front end of the crank shaft, and fix the unit bracket to the outside of the front bumper plate with the bolts. (M10x30) and spring washers (10) - (4 of each).

(Note): Tighten the bolts after confirming the centering of the P.T.O. shaft and P.T.O. adapter.

15) Set the field core of the clutch assembly to the unit bracket with bolts M6x8 (4 bolts).
16) Insert the 4x16 key into the groove of the P.T.O. shaft, and set the clutch pulley to the P.T.O. shaft with bolts M8x34 and plain washers.

(Note): Turn the pulley by hand and ensure that the pulley turns smoothly.

17) Install the front P.T.O. switch in the panel box.

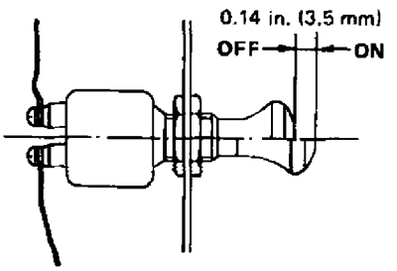
(Note): In this case, make a hole on the panel box in the correct place.

18) Set the wiring.
    1) Connect the lead wire A (longer) to the front P.T.O. switch and the wire from the clutch.
    2) Connect the lead wire B (shorter) to the front P.T.O. switch and the 15A fuse.
19) Attach the battery plus and minus cables.

(Note): If the original cables are not long enough, use the cables in the kit.

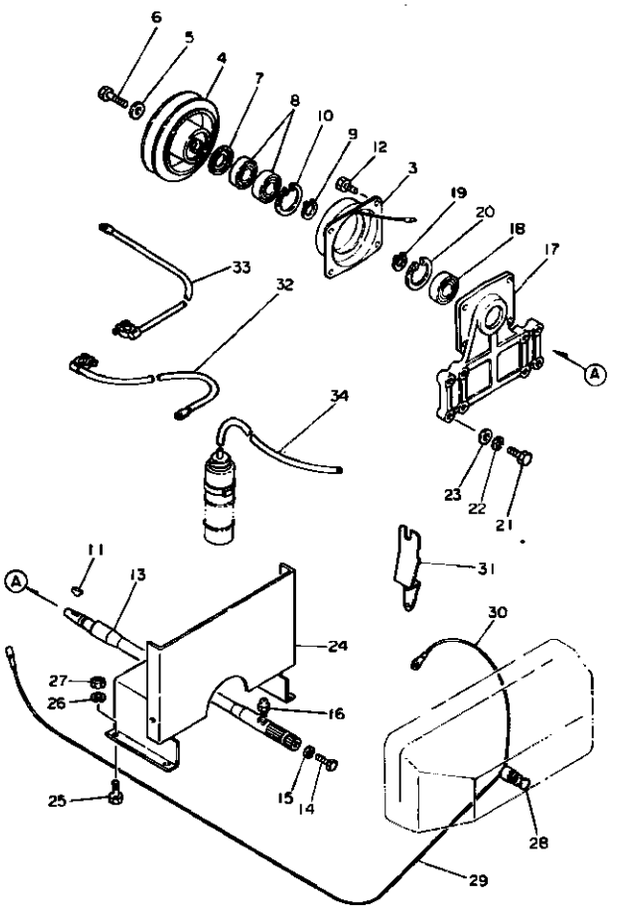
20) Attach the hood.
21) Grease up to the P.T.O. shaft.
22) Test operation
Start the engine and check the front P.T.O. kit at low engine speed.

(Note): Before starting the engine, make sure the front P.T.O. switch is off.



[Front P.T.O. Switch]

2. FRONT P.T.O. KIT

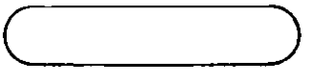
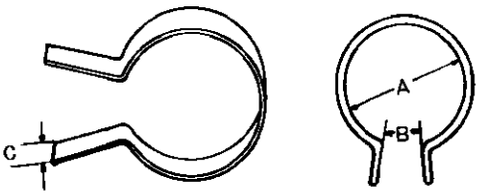


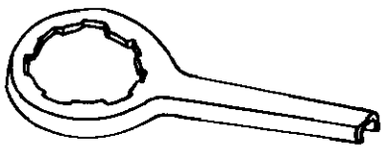
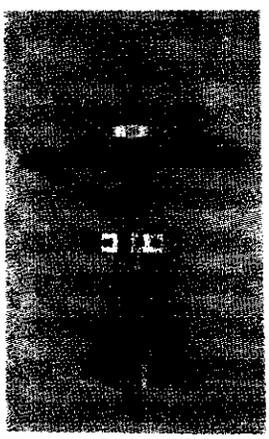
Ref. No.	Part No.	Description	Q'ty/Unit			
			YM195	YM195D	YM240	YM240D
1	794240-83110	Front P.T.O. Assembly			1	
	794240-83111	Front P.T.O. Assembly	1	1	1	1
2	194240-83200	Clutch Assembly	1	1	1	1
3	*	Coil	1	1	1	1
4	*	V-Pulley, clutch	1	1	1	1
5	194240-83220	Washer	1	1	1	1
6	194240-83230	Bolt M8 x 34	1	1	1	1
7	194240-83240	Plate	1	1	1	1
8	24105-060064	Ball Bearing	2	2	2	2
9	22242-000300	Circlip 30	1	1	1	1
10	22252-000550	Circlip 5	1	1	1	1
11	22522-040160	Key 4 x 16	1	1	1	1
12	194240-83250	Bolt M6 x 8	4	4	4	4
13	194240-83270	Shaft, P.T.O.			1	
	194240-83271	Shaft, P.T.O.	1	1	1	1
14	26116-060102	Bolt M6 x 10	1	1	1	1
15	22217-060000	Spring Washer 6	1	1	1	1
16	24764-010000	Grease Nipple	1	1	1	1
17	194240-83280	Bracket	1	1	1	1
18	24107-062054	Ball Bearing	1	1	1	1
19	22242-000250	Circlip 25	1	1	1	1
20	22252-000520	Circlip 52	1	1	1	1

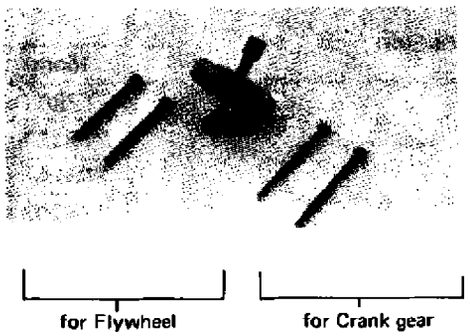
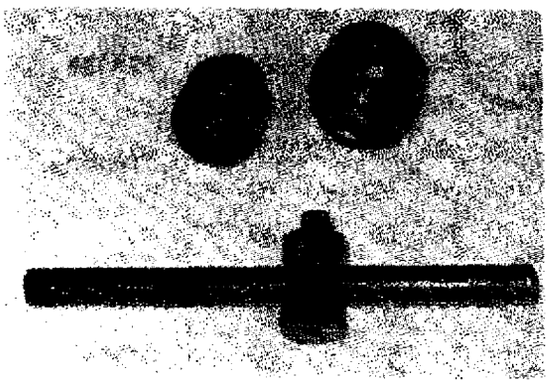
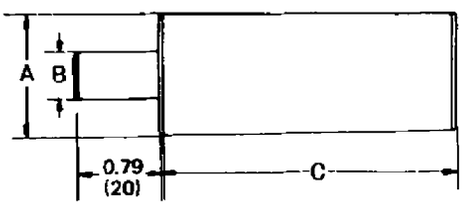
Ref. No.	Part No.	Description	Q'ty/Unit			
			YM195	YM195D	YM240	YM240D
21	26116-100302	Bolt M10 x 30	4	4	4	4
22	22217-100000	Spring Washer 10	4	4	4	4
23	22137-100000	Washer 10	4	4	4	4
24	194240-83330	Bracket, battery	1	1	1	1
25	26116-080202	Bolt M8 x 20	4	4	4	4
26	22217-080000	Spring Washer 8	4	4	4	4
27	26716-080002	Nut M8	4	4	4	4
28	194240-83300	Switch, front P.T.O.	1	1	1	1
29	194240-83310	Lead Wire (A)	1	1	1	1
30	194240-83320	Lead Wire (B)	1	1	1	1
31	194240-83400	Bracket, sub-tank	1	1	1	1
32	194240-83410	Cable	1	1	1	1
33	194240-83420	Cable, earth	1	1	1	1
34	194240-83430	Tube	1	1	1	1

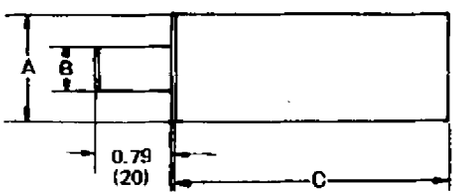
VI. Maintenance Equipment and Tools

1. Special tools

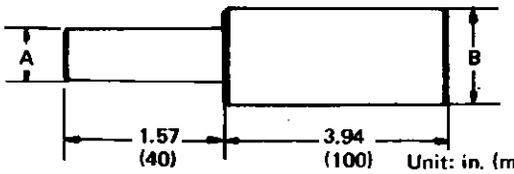
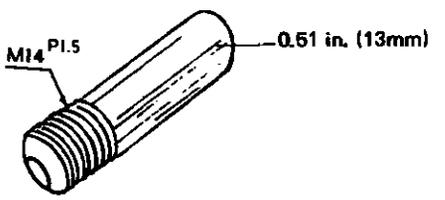
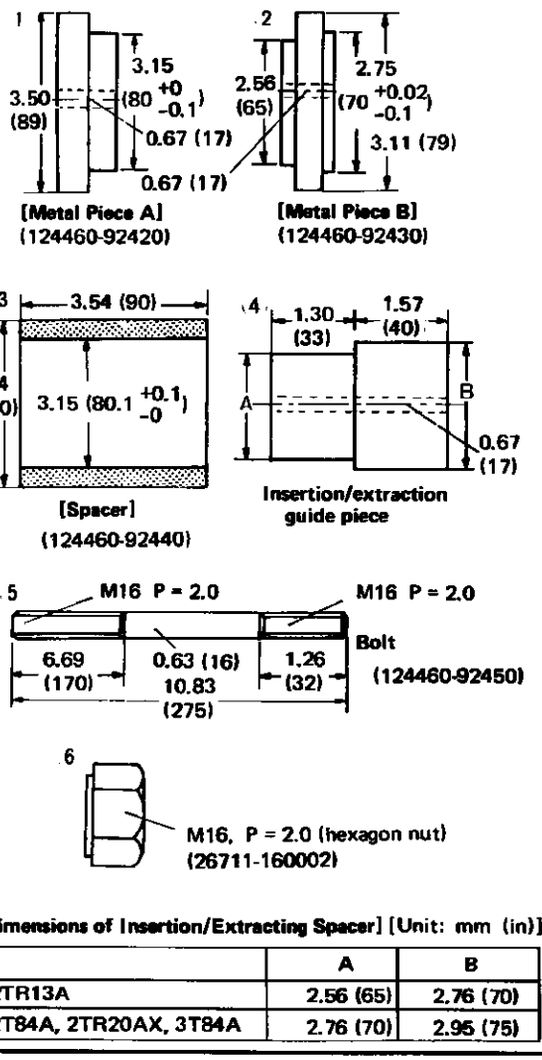
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Name</th><th rowspan="2">Description</th><th colspan="2">Model / Cord No.</th><th rowspan="2">Remarks</th></tr>
<tr><th>Model</th><th>Cord No.</th></tr>
<tr><td>1.</td><td>Thickness gauge</td><td>  </td><td>2T73A
2TR13A</td><td>28312 – 020750</td><td></td></tr>
<tr><td></td><td></td><td></td><td>2T84A
2TR20AX
3T84A</td><td>102552 – 92200</td><td></td></tr>
<tr><td>2.</td><td>Piston insertion tool</td><td> 

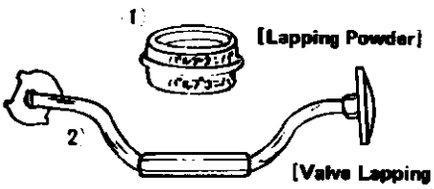
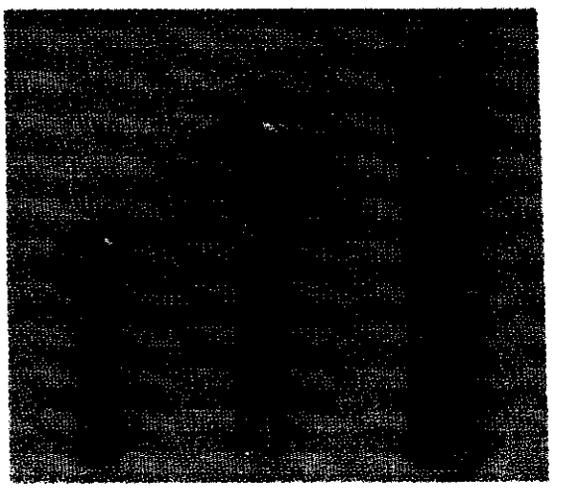
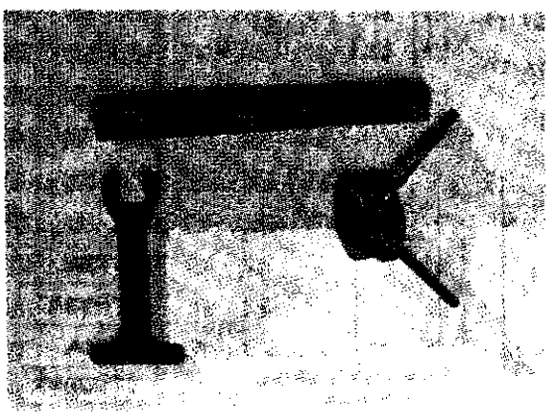
Unit: in. (mm)
<table>
<tr><th rowspan="2">Model</th><th colspan="3">Size</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>2T73A
2TR13A</td><td>3.15
(80)</td><td>0.87
(22)</td><td>1.02
(26)</td></tr>
<tr><td>2TR20AX</td><td>3.54
(90)</td><td>0.98
(25)</td><td>1.02
(26)</td></tr>
<tr><td>2T84A
3T84A</td><td>3.54
(90)</td><td>0.87
(22)</td><td>1.02
(26)</td></tr>
</table></td><td>2T73A
2TR13A</td><td>101300 – 92140</td><td></td></tr>
<tr><td></td><td></td><td></td><td>2TR20AX</td><td>101400 – 92140</td><td></td></tr>
<tr><td></td><td></td><td></td><td>2T84A
3T84A</td><td>101404 – 92140</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td>Lubricating oil filter case removing tool</td><td>  </td><td>All models</td><td>124550 – 35350</td><td></td></tr>
<tr><td>5.</td><td>Cylinder liner puller</td><td>  </td><td>All models</td><td>TOL – 92010000</td><td></td></tr>
</table>

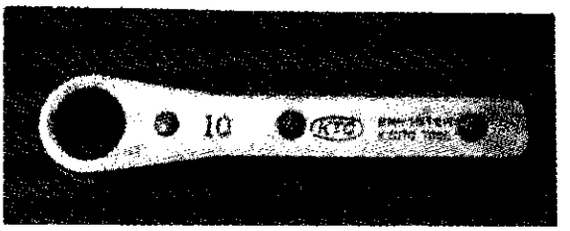
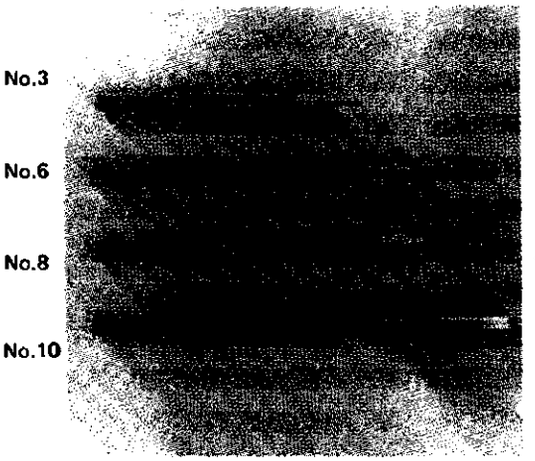
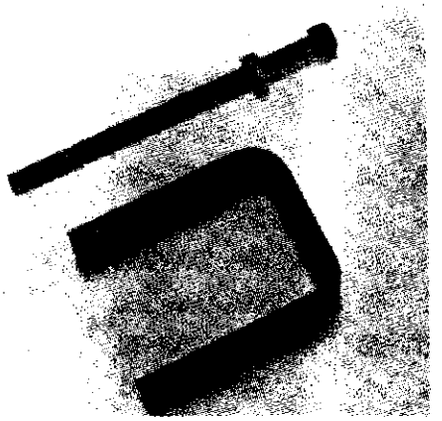
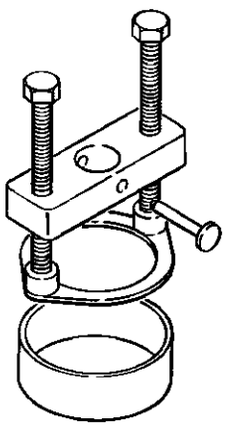
<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Model</th><th>Cord No.</th><th>Re-marks</th></tr>
<tr><td>6.</td><td>Flywheel puller
Crank gear puller</td><td> 
</td><td>All models</td><td>TOL – 92000000</td><td></td></tr>
<tr><td>7.</td><td>End nut fixing tool for V-pulley of crankshaft</td><td>  </td><td>2T73A
2TR13A</td><td>–</td><td></td></tr>
<tr><td></td><td></td><td></td><td>2T84A
2TR20AX</td><td>TOL – 92020000</td><td></td></tr>
<tr><td></td><td></td><td></td><td>3T84A</td><td>–</td><td></td></tr>
<tr><td>8.</td><td>Piston pin puller</td><td> 

Unit: in. (mm)
<table><tr><th rowspan="2">Model</th><th colspan="3">Size</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>2T73A
2TR13A</td><td>0.91 (23)</td><td>0.49 (12.5)</td><td>2.95 (75)</td></tr><tr><td>2T84A
2TR20AX
3T84A</td><td>1.13
(29 $^{-0.2}_{-0.3}$)</td><td>0.59 (15)</td><td>3.54 (90)</td></tr></table></td><td>2T73A
2TR13A</td><td>124064 – 92310</td><td></td></tr>
<tr><td></td><td></td><td></td><td>2T84A
2TR20AX
3T84A</td><td>121420 – 92310</td><td></td></tr>
<tr><td>9.</td><td>Connecting rod small-end bushing tool</td><td> 

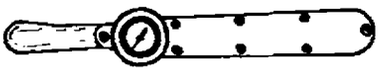
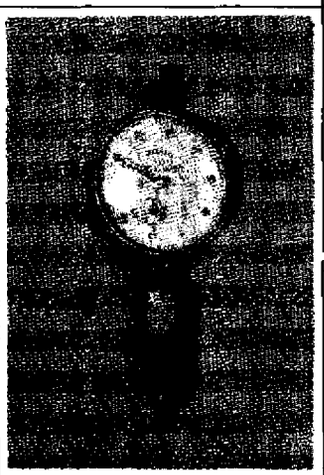
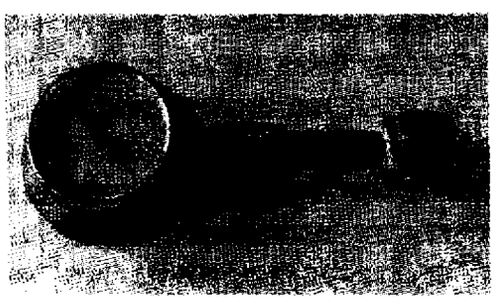
Unit: in. (mm)
<table><tr><th rowspan="2">Model</th><th colspan="3">Size</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>2T73A
2TR13A</td><td>0.98 (25)</td><td>0.47 (12)</td><td>3.15 (80)</td></tr><tr><td>2T84A
2TR20AX
3T84A</td><td>1.30 (33)</td><td>0.91 (23)</td><td>3.74 (95)</td></tr></table></td><td>2T73A
2TR13A</td><td>124064 – 92320</td><td></td></tr>
<tr><td></td><td></td><td></td><td>2T84A
2TR20AX
3T84A</td><td>121420 – 92320</td><td></td></tr>
</table>

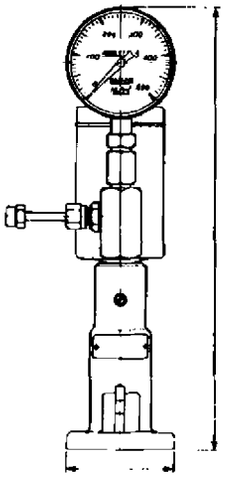
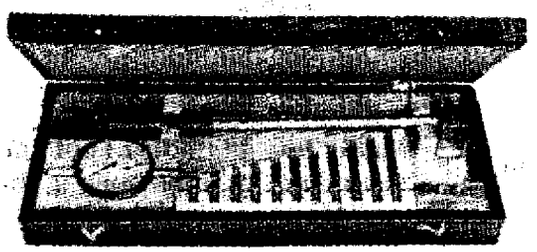
No.	Name	Description	Model	Cord No.	Remarks
10.	Intake/exhaust valve guides puller & drive-in tool	 **Model / Size** A: 2T73A, 2TR13A: 0.26 (6.5); 2T84A, 2TR20AX, 3T84A: 0.30 (7.5) B: 2T73A, 2TR13A: 0.43 (11); 2T84A, 2TR20AX, 3T84A: 0.50 (13 $^{-0.2}_{-0.3}$)	2T73A 2TR13A	124064 – 92300	
			2T84A 2TR20AX 3T84A	121420 – 92300	
11.	Nozzle body puller		All models	101104 – 92180	
12.	Crank bearing replacement tool	 **[Dimensions of Insertion/Extracting Spacer]** [Unit: mm (in)] 2TR13A: A 2.56 (65), B 2.76 (70) 2T84A, 2TR20AX, 3T84A: A 2.76 (70), B 2.95 (75)		124460 – 92420 124460 – 92430 124460 – 92440	① ② ③
			2T73A 2TR13A	124064 – 92410	④
			2T84A 2TR20AX 3T84A	124060 – 92410	
				124460 – 92450 26711 – 160002	⑤ ⑥

No.	Name	Description	Model	Cord No.	Remarks
13.	Intake/exhaust valves lapping tool		All models	28210 – 000070 28210 – 000031	① ②
14.	Engine lifting adaptor		All models	TOL – 92030000	
15.	Differential Lock spring replacer		All models	TOL – 93030000	
16.	Relief valve replace tool	[O-ring replacer for relief valve]  (TOL-93021010) [Driver for relief valve]  (TOL-93021000)	All models	TOL – 93020000	

No.	Name	Description	Model	Cord No.	Remarks
17.	Wrench for Hydraulic pipe fixing bolts		All models	TOL – 93010000	
18.	Spring pin punch-set		All models	TOL – 91010000	
19.	P.T.O. pinion shaft puller		YM330(D)	TOL – 93060000	
20.	P.T.O. shaft puller		YM330(D)	794145 – 82500	

2. Testing equipment and gauge

No.	Name	Description	Model	Cord No.	Remarks
1.	Torque wrench	 15 – 130 ft-lb (2 – 18kg-m)	All models	–	
2.	Compression gauge	 1 (Complete set)  2 (Adaptor)	All models	Complete set 194240 – 82610	1
				Adaptor only TOL – 92050000	2
3.	Dial gauge	 1 (Complete set)  2 (Adaptor)	All models	Complete set 194240 – 82600	1
				Adaptor only TOL – 92060000	2
4.	Oil pressure gauge		All models	194240 – 82560	

No.	Name	Description	Model	Cord No.	Remarks
5.	Nozzle tester		All models	DT-60	
6.	Cylinder gauge	 Range: 1.97 – 3.94 (50 – 100) Graduation: 0.0004 (0.01) Max. Depth: 9.84 (250)	All models	BC-50	

VII. Dry Battery

INITIAL CHARGING OF BATTERY FOR YANMAR DIESEL TRACTOR

The initial charge given a new battery is very important not only because the battery, if given an incomplete initial charge, would be unable to provide full capacity performance in service but also because its service life may be unduly affected.

The procedures for giving the tractor battery a correct initial charge are given below. Exact conformity to these procedures is recommended in proceeding with the initial charging of a new battery.

1. Main specification of battery installed

Table 1

Battery type	Voltage (V)	Rated capacity (Ah/20 hrs rating)	Current for initial charge (A)	(*) Time for initial charge (hr)	Current for recovery charge (A)
Y60-S4P	12	35	3.5	20	3.5
Y60-S4LP	12	35	3.5	20	3.5
N70Z	12	70	4.8	30	7.0
N100	12	100	6.5	30	10.0

Battery type	Approx. volume of electrolyte U.S. gal. (liter)	Filled electrolyte specific gravity (20°C)	Specific gravity when fully charged	Tractor Model
Y60-S4P	0.66 (2.5)	1.260	1.260 ± 0.01	YM135/YM135D
Y60-S4LP	0.66 (2.5)	1.260	1.260 ± 0.01	YM155/YM155D
N70Z	1.32 (5)	1.260	1.260 ± 0.01	YM195/195D YM240/YM240D
N100	1.72 (6.5)	1.260	1.260 ± 0.01	YM330/YM330D

*Notes: * The battery gradually looses its charge during long storage. The longer the storage the longer the time that is required for the initial charge, approximately as below.*

Table 2

Storage period:	Up to 6 months	7 to 9 months	10 to 12 months	13 to 24 months
Charging time:	20 hrs	30 hrs	40 hrs	50 hrs or longer

2. Initial charge

2.1 Preparation

1) Remove battery from the tractor, and remove seal tape from each vent plug. (Fig. 1)

2) Remove cables from each battery terminal. (Fig. 2)

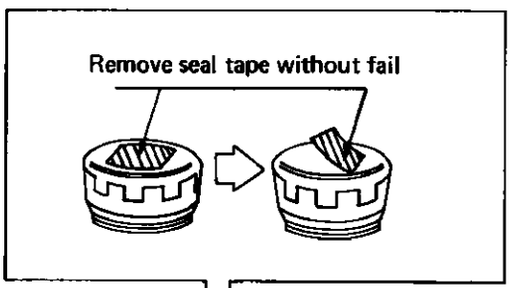


Fig. 1

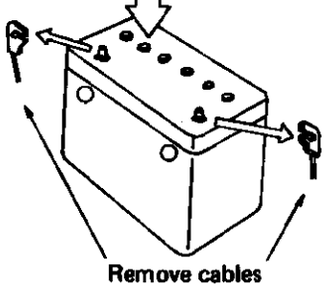
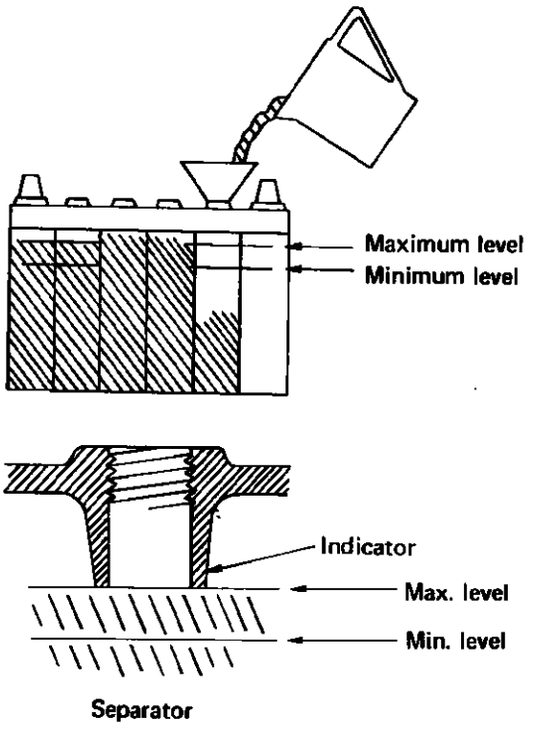


Fig. 2



(an example of the battery type in which the liquid level can be seen through container)

Fig. 3 Specified level

3) Provide 1.260 or 1.280 specific gravity (20°C) electrolyte held at a temperature not exceeding 85°F (30°C).

2.2 Initial charge

1) After making sure seal tape has been removed, remove vent plug.

2) Pour in the electrolyte (diluted sulfuric acid) up to the specified level and let stand for a while. If the level drops, replenish by adding the same acid. (Fig. 3)

3) After filling, start the current flowing within one hour.

4) After the electrolyte temperature drops to 95°F (35°C) or below, connect the battery to the charger and make the initial charge at the current specified for the type of battery being charged.

5) If, during charging, the battery temperature looks like exceeding 115°F (45°C), temporarily suspend the charge or reduce the current to 1/2 to prevent the temperature rising. (Fig. 4)

3. Completion of charge

1) Continue charging until the battery freely generates gases, the battery voltage rises above 15 volts, the specific gravity reading reaches 1.260 – 1.280 (at 20°C), and the voltage and the temperature readings become constant for over one hour or longer. (Fig. 5)

[Completion of Initial Charge]

Pay attention so that the liquid temperature does not exceed 115°F (45°C) during the initial charge

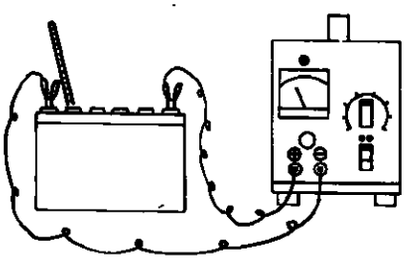


Fig. 4

Specific gravity 1.250 or higher (1.270 or higher for Y60-S4P and Y60-S4LP)

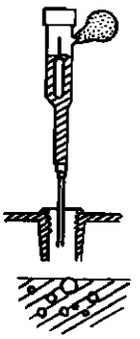
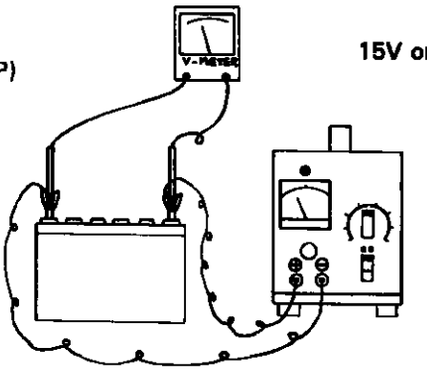


Fig. 5

15V or higher



Gases freely generate

Fig. 6

2) The times described above (in Table 2) as being required for initial charging depending on the storage length are only a rough general standard and will vary depending on the storage conditions. Accordingly, continue the charge until conditions described in (1) above are satisfied even if this takes longer than the above approximations for the initial charge. (Refer to Table 2)

3) After the charge, lightly shake the battery to adjust the liquid level and degass. (Fig. 6)

4) Reattach and tighten each vent plug, in position and then wash the battery with fresh water so that the outside surface is free of any acid. Then remove the water from the battery surface by wiping with a waste cloth or blasting with compressed air.

5) After washing, store the charged battery as below until it is fixed on the tractor and delivery is made.

* *The storage location should be cool, dry, and properly shielded from rain and direct sunlight.*

4. Cautions during charging

1) Whenever the battery electrolyte, which is diluted sulfuric acid harmful to the skin as well as to clothes, sticks to the skin (hands or face), immediately wash it off with plenty of water.

If it gets into the eyes, immediately wash with plenty of fresh water and seek medical attention without delay.

If the electrolyte gets onto your clothes, promptly take them off, wash with water, and then completely neutralize the acid by using a weak alkaline soap.

2) In connecting the battery to the charger, make sure that the charger switch is OFF. In connecting do not mistake the (+)/(–) polarity. Also make sure that the contacts between the charger clips and the battery terminals are in good order.

3) As the battery generates hydrogen gas during charging, sparking at the terminals or naked flame (such as a lighted cigaret) are dangerous.

Caution: *Whenever the battery is given any type of charge, ensure that the vent plug is removed, otherwise the battery may explode.*

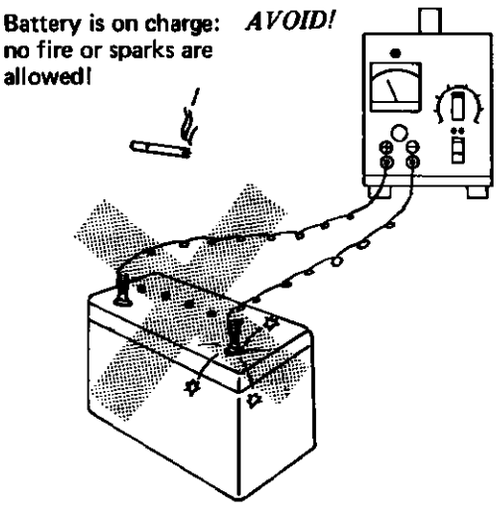


Fig. 7

5. Cautions for giving initial charge to battery installed on tractor.

When it is unavoidable to give the initial charge to battery whit installed on the tractor, observe following cautions.

1) When pouring the electrolyte into the battery, do not spill it onto the tractor.

2) As the acid will corrode metal, immediately neutralize any spilled electrolyte with sodium bicarbonate, slaked lime, or other chemicals. After completing the initial charge, wash off with plenty of water.

3) To give the initial charge, follow procedures described above in item 1 through 4.

6. Care and maintenance of charged battery until the shipment of tractor

6.1 Storage

1) To avoid long storage of particular batteries, store charged batteries by arranging them into groups, each group consisting of batteries given their initial charge on the same date, so that the oldest batteries are shipped first. A first-in first-out stock rotation. (Fig. 8)

2) During storage, do not short battery terminals and do not allow sparks and naked flame in the vicinity. (Fig. 9)

3) Keep the battery clean and ensure the vent plug does not become clogged, otherwise the battery may explode.

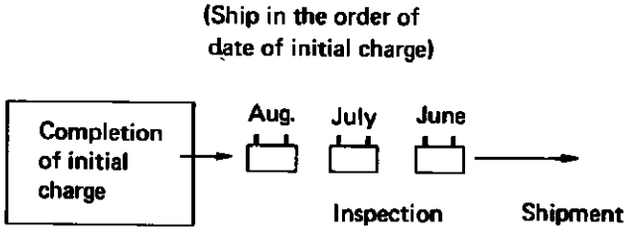


Fig. 8

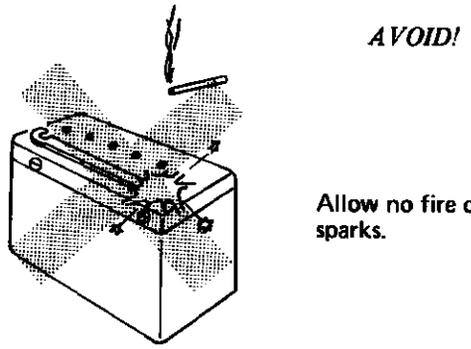


Fig. 9

6.2 Supplementary charge

1) Where batteries are to be stored for an extended period, since the battery will spontaneously discharge, fully charge the battery as below:

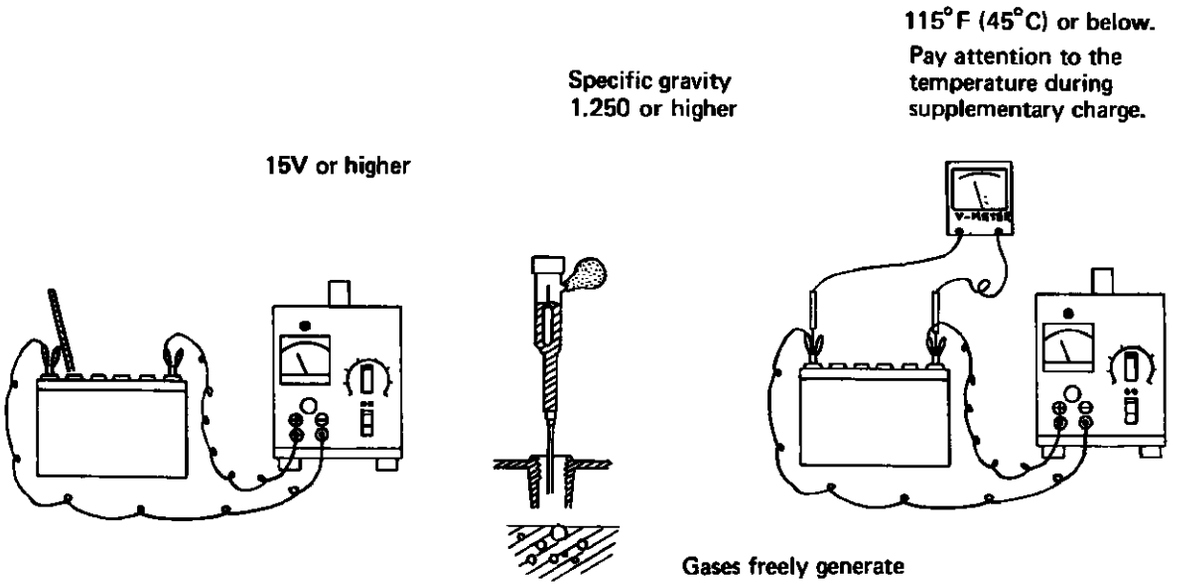
Average temperature exceeding 60°F (15°C): once a month
Average temperature below 60°F (15°C): once every 2 months

2) For the supplementary charge, use the recovery

charge current as given in Table 1 "Main specification of battery installed"

3) "Completion of charge" also applies to the completion of the supplementary charge, as illustrated below.

[Completion of Supplementary Charge]



6.3 Cautions for supplementary charge

Refer to item 4.

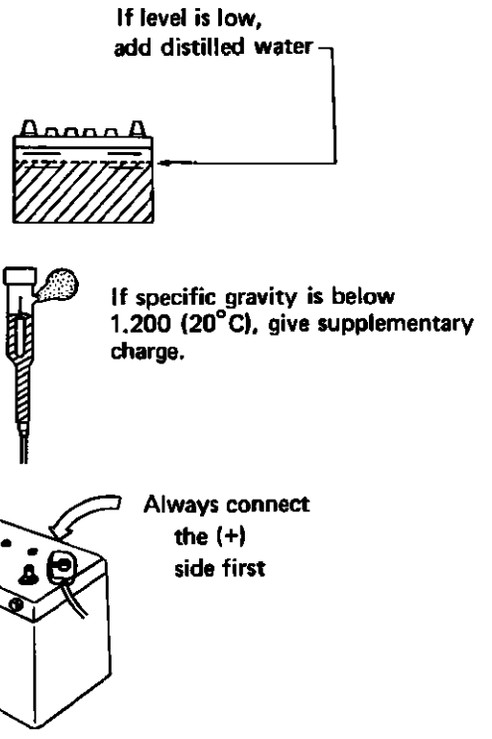
7. How to ship battery with tractors

1) Prior to shipment, check the level and specific gravity of the electrolyte. If the level is low, add distilled water. If the specific gravity is below 1,200 at 20°C, give a supplementary charge and bring the battery to a full-charge state for shipment.

2) Position and securely fix battery in each tractor.

3) Connect the cables to the battery, starting with the (+) side. In doing this, always connect the (–) side afterwards. Never short the (+) and (–).

4) After the installation, again check the connections for correct polarity before starting the tractor engine.



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