SPATMAT MANUTENTION

MANUEL D'UTILISATION

FB18SIGMA

Siége social
8 rue Jean Walter
92110 CLICHY
Tél : +33(0)1 55 90 58 30

SARL au capital de 280 150€ - SIRET : 309 214 781 00010

TABLE DES MATIÈRES

I. RÈGLES DE SÉCURITÉ POUR LA CONDUITE ET L'UTILISATION DU CHARIOT ÉLÉVATEUR

1.Les conducteurs de chariots élévateurs ainsi que le personnel de gestion doivent toujours garder à l'esprit le principe de « sécurité avant tout » et effectuer les opérations de manière sûre et conforme, conformément au manuel d'utilisation et de maintenance ainsi qu'au manuel du conducteur.

Norme applicable aux chariots élévateurs : JB/T2391

2. Transport du chariot élévateur

Lors du chargement du chariot élévateur, respecter les consignes suivantes :

(1) Appliquer le frein de stationnement ;

(2) Fixer le mât et le contrepoids à l'avant et à l'arrière à l'aide de câbles en acier, et caler les positions correspondantes des pneus avant et arrière ;

(3) Lever le chariot conformément aux indications figurant sur les points de levage signalés sur la machine.

3. Stockage du chariot élévateur

(1) Vidanger le carburant (si le liquide de refroidissement est un antigel anticorrosion, ne pas le vidanger) ;

(2) Appliquer une huile antirouille sur les surfaces non peintes et lubrifier les chaînes de levage ;

(3) Abaisser le mât en position la plus basse ;

(4) Appliquer le frein de stationnement ;

(5) Caler les roues avant et arrière.

4. Préparations avant utilisation

(1) Ne pas vérifier les fuites d'huile, le niveau d'huile ou les instruments électriques à proximité d'une flamme nue, et ne pas faire le plein pendant le fonctionnement ;

(2) Vérifier la pression des pneus ;

(3) Vérifier les dispositifs sonores, lumineux et d'alarme : feux, avertisseurs, klaxons (y compris les commandes arrière) ;

(4) Le levier de marche avant / marche arrière doit être en position centrale (point mort)

(5) Vérifier l'état de chaque levier et pédale ;

(6) S'assurer que toutes les conditions sont réunies avant le démarrage ;

(7) Desserrer le frein de stationnement ;

(8) Effectuer des essais de levage, descente, inclinaison avant et arrière du mât, direction et freinage ;

---

5. UTILISATION DU CHARIOT ÉLÉVATEUR

(1) Le chariot ne peut être conduit que par des opérateurs formés et titulaires d'une autorisation de conduite ;

(2) Les opérateurs doivent porter des équipements de protection : chaussures, casque, vêtements et gants ;

(3) Tous les dispositifs de commande et d'alarme doivent être vérifiés avant utilisation ; toute anomalie doit être réparée avant mise en service ;

(4) Lors de la manutention, la charge ne doit pas dépasser la capacité nominale. Les fourches doivent être entièrement engagées sous la charge et celle-ci doit être répartie uniformément ;

Il est interdit de soulever une charge avec une seule pointe de fourche ;

(5) Démarrer, tourner, rouler, freiner et s'arrêter en douceur ; réduire la vitesse sur sol humide ou glissant ;

(6) Lors du déplacement avec charge, maintenir la charge aussi basse que possible et incliner le mât vers l'arrière ;

(7) Faire preuve de prudence sur les pentes :

* en montée (>10%) → avancer en marche avant

* en descente → reculer

* éviter de tourner en pente

* éviter chargement/déchargement en descente

(8) Pendant la conduite, faire attention aux piétons, obstacles, trous et à la hauteur libre au-dessus du chariot ;

(9) Il est interdit de monter sur les fourches, et le chariot ne doit transporter aucune personne autre que le conducteur ;

(10) Il est interdit de se tenir ou de passer sous les fourches ;

(11) Ne pas utiliser le chariot ou ses accessoires depuis une position autre que le poste de conduite ;

(12) Pour les chariots à grande hauteur de levage (supérieure à 3 m), attention au risque de chute de charge ; prévoir des mesures de sécurité si nécessaire

(13) Pour un chariot à grande hauteur de levage, le mât doit être incliné vers l'arrière autant que possible ; lors des opérations de chargement et de déchargement, l'inclinaison vers l'avant doit être limitée au minimum ;

(14) Conduire avec prudence et à faible vitesse sur un quai ou sur des planchers temporaires ;

(15) Lors du contrôle du niveau de liquide de la batterie ou du réservoir de carburant, le conducteur ne doit pas être à bord et le chariot doit être arrêté ;

(16) Lorsqu'un chariot équipé d'accessoires fonctionne à vide, il doit être utilisé comme s'il était en charge ;

(17) Ne pas manipuler de charges non fixées ou instables ; manipuler avec précaution les charges volumineuses ;

(18) Avant de quitter le véhicule :

- abaisser les fourches au sol
- mettre le levier de vitesse au point mort
- arrêter le moteur et couper l'alimentation
- en pente : serrer le frein de stationnement
- en stationnement prolongé : caler les roues

(19) Les pressions des distributeurs hydrauliques (multi-voies) et des soupapes de sécurité sont réglées en usine. Il est interdit de les modifier, afin d'éviter tout dommage au système hydraulique et à ses composants dû à une pression excessive ;

(20) La pression des pneus doit être conforme aux indications figurant sur la plaque « pression des pneus » ;

(21) Le niveau sonore extérieur du chariot ne doit pas dépasser 80 dB(A), conformément à la norme *JB/T3300* ;

(22) Il est nécessaire de connaître et de respecter les indications de toutes les plaques et pictogrammes présents sur le chariot ;

(23) Afin de prévenir toute pollution, notamment dans les zones habitées ou d'élevage, les règles suivantes doivent être respectées :

- Il est strictement interdit de rejeter les huiles usagées dans les réseaux d'évacuation, les rivières ou tout autre milieu ;
- Les huiles vidangées doivent être récupérées dans un récipient approprié et ne doivent pas être déversées au sol ;
- Les lois et réglementations en vigueur doivent être respectées pour la gestion des substances dangereuses telles que : huiles lubrifiantes, carburants, liquides de refroidissement, solutions chimiques, filtres, batteries

6. ENTRETIEN COURANT DU CHARIOT ÉLÉVATEUR

(1) Vérifications avant démarrage

a) Niveau d'huile hydraulique : Le niveau doit se situer au milieu de la jauge ;

b) Contrôle des circuits : Vérifier les tuyaux, raccords, pompes et vannes afin de détecter toute fuite ou dommage ;

c) Contrôle du frein de service :

- Course libre de la pédale : 20 à 30 mm
- Écart entre la plaque de base avant et la pédale : supérieur à 20 mm

d) Contrôle du frein de stationnement : Lorsque le frein à main est serré à fond, le chariot doit rester immobilisé sur une pente de 15 % (à vide) ;

e) Instruments et éclairage : Vérifier le bon fonctionnement des instruments, feux, connecteurs, interrupteurs et circuits électriques ;

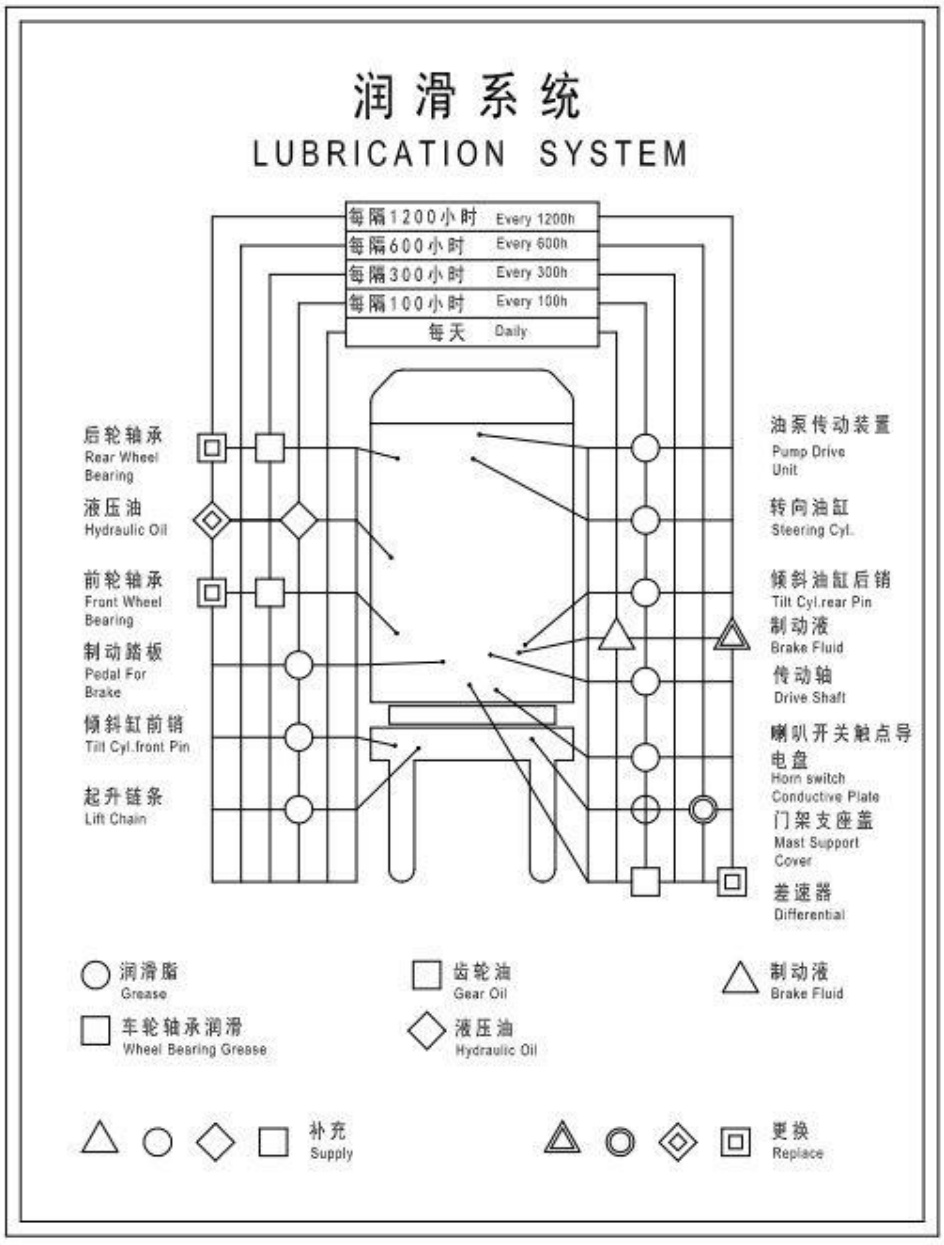
(2) Huiles et graisses pour chariot élévateur

Description	Huile d'origine	Grade, code et température d'utilisation		
Huile hydraulique	SINOPEC	Grade de viscosité	L-HM32 Huile hydraulique anti-usure	L-HV32 Huile anti-usure basse température
		Température de service (°C)	≥¯5	≥-20 (zones froides et humides)
Liquide de frein	Chongqing Yiping	4604 Liquide de frein synthétique GB12981HZY4		
Graisse	SINOPEC	Graisse lithium universelle n°3 (-20°C~+120°C)		
Huile de transmission (engins lourds)	Sea Brand	Grade de viscosité	85W/90GL-5	80W/90GL-5
		Température de service (°C)	-15~+49	-25~+49

Remarque
La graisse *NYOGEL782G* doit être appliquée sur la plaque conductrice au niveau du contact du klaxon sur le volant.Lubrication system diagram

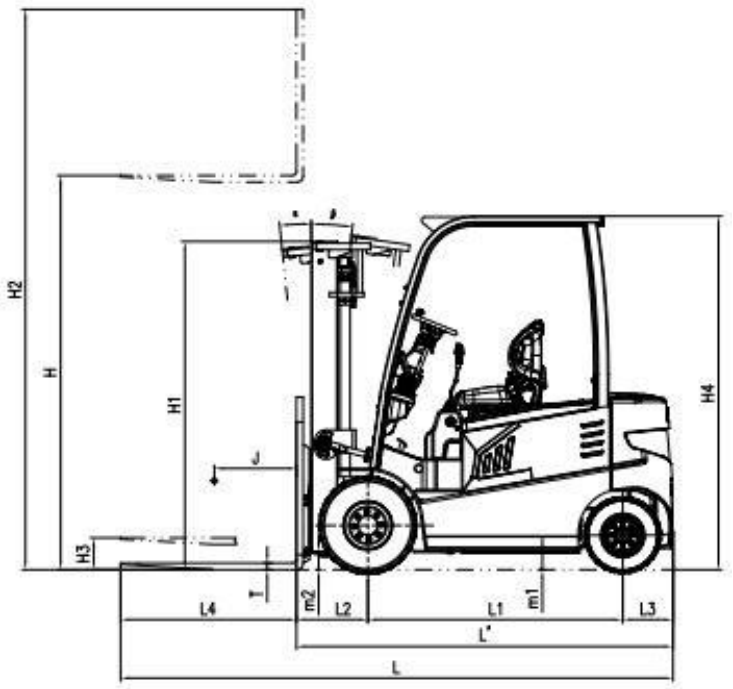
(3) Schéma du système de lubrification

润滑系统
LUBRICATION SYSTEM



I. MAIN TECHNICAL PARAMETERS OF FORKLIFT

Outline drawing of forklift



Ast：直角堆垛通道宽度

α：间隙

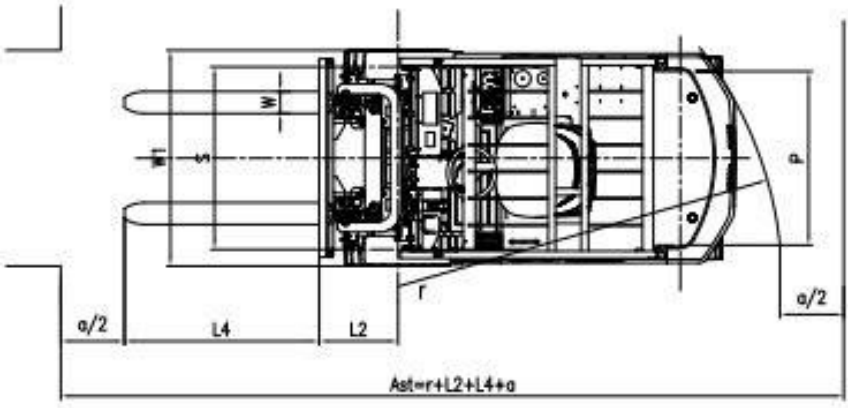


Table 1 Technical Parameters of E Series 1.5-1.8t Battery Forklift

Dimensional parameters	Model		Unit	CPD15-E	CPD18-E
	Design model			LG15BJ	LG18BJ
	Rated load		kg	1500	1800
	Load center distance: C		mm	500	
	Maximum lifting height H		mm	3000	
	Free lifting height H3		mm	155	
	Fork size L4×W×T		mm	920×100×35	
	Mast inclination (forward/backward) α/β		deg	6/12	
	Overall dimensions	Total length L	mm	3050	
		Total width W_1	mm	1084	
		Total height H4	mm	2160	
Performance	Outside minimum turning radius r		mm	1930	
	Front overhang L2		mm	425	
	Rear overhang L3		mm	335	
	Minimum straight stacking aisle width AST			3358	
	Wheel track	Front wheel W3	mm	901	
		Rear wheel W4	mm	920	
	Off ground Clearance	Mast H5	mm	110	
		Chassis H6	mm	102	
	Wheel base L1		mm	1370	
	Maximum speed (no load/full load)	Traveling V2	Km/h	14/13	
		Lifting V1	mm/s	370/270	
	Front axle load (no load / full load)		kg	1340/3940	1380/4330
	Rear axle load (no load / full load)		kg	1520/500	1620/540
	Maximum gradeability (no load / full load) a_m		%	20/15	20/15
	Descending speed	No-load V3	mm/s	≥300	
		Full load V3'	mm/s	≤600	
	Dead weight (including battery)		kg	2860	3000
	Tire	Front wheel		6.00-9-10PR	
		Rear wheel		16×6-8-10PR	
	Operating pressure		MPa	14.5	
	Working tank capacity		L	23	
Drive	Motor	Traveling motor	kW	48/8.0	
		Lifting motor	kW	48/7.5	
	Battery	Weight	kg	790	
			V/Ah	48/420	

Table 2 Technical Parameters of N Series 1.5-2.5t Battery Forklift

Dimensional parameters	Model		Unit	CPD15-N	CPD18-N	CPD20-N	CPD25-N
	Design model			LG15VI	LG18VI	LG20VI	LG25VI
	Rated load		kg	1500	1800	2000	2500
	Load center distance: C		mm	500			
	Maximum lifting height H		mm	3000			
	Free lifting height H3		mm	155		145	
	Fork size L4×W×T		mm	920×100×35		920×120×40	1070×120×40
	Mast inclination (forward/backward) α/β		deg	6/8			
	Overall dimensions	Total length L	mm	2982		3200	3360
		Total width W_1	mm	1086		1185	
		Total height H4	mm	2140		2148	
Performance	Outside minimum turning radius r		mm	1380		2000	2020
	Front overhang L2		mm	392		434	
	Rear overhang L3		mm	290		300	310
	Minimum straight stacking aisle width AST			3324		3720	3740
	Wheel track	Front wheel W3	mm	910		960	
		Rear wheel W4	mm	920		950	
	Off ground Clearance	Mast H5	mm	95		110	
		Chassis H6	mm	90		115	
	Wheel base L1		mm	1380		1550	
	Maximum speed (no load/full load)	Traveling V2	Km/h	13/12(15/14)		16/15	15/14.5
		Lifting V1	mm/s	515/365		500/350	430/300
	Front axle load (no load / full load)		kg	1580/4140	1585/4450	2032/5386	2000/6140
	Rear axle load (no load / full load)		kg	1520/560	1625/660	2113/834	2250/680
	Maximum gradeability (no load / full load) a_m		%	24/19		22/18	
	Descending speed	No-load V3	mm/s	≥300			
		Full load V3'	mm/s	≤600			
	Dead weight (including battery)		kg	3090	3310	4150	4250
	Tire	Front wheel		6.00-9-10PR		23×9-10-16PR	
		Rear wheel		16×6-8-10PR		18×7-8-14PR	
	Operating pressure		MPa	14.5		17.5	

	Working tank capacity		L	27	36	
Drive	Motor	Traveling motor	kW	48/8.2	48/11.5	
		Lifting motor	kW	48/10.6	18/15	
	Battery	Weight	kg	790	1135	1150
			V/Ah	48/480	48/700	

Table 3 Technical Parameters of N Series 3-3.5t Battery Forklift

Dimensional parameters	Model		Unit	CPD30-N	CPD35-N
	Design model			LG30VI	LG35VI
	Rated load		kg	3000	3500
	Load center distance: C		mm	500	
	Maximum lifting height H		mm	3000	
	Free lifting height H3		mm	150	
	Fork size L4×W×T		mm	1070×125×45	1070×125×50
	Mast inclination (forward/backward) α/β		deg	6/10	
	Overall dimensions	Total length L	mm	3550	3590
		Total width W_1	mm	1238	
		Total height H4	mm	2198	
Performance	Outside minimum turning radius r		mm	2230	2270
	Front overhang L2		mm	488	488
	Rear overhang L3		mm	308	348
	Minimum straight stacking aisle width AST			3920	3960
	Wheel track	Front wheel W3	mm	1004	1000
		Rear wheel W4	mm	956	
	Off ground Clearance	Mast H5	mm	135	
		Chassis H6	mm	125	
	Wheel base L1		mm	1685	
	Maximum speed (no load/full load)	Traveling V2	Km/h	460	370
		Lifting V1	mm/s	240	220
	Front axle load (no load / full load)		kg	2380/7320	2720/7820
	Rear axle load (no load / full load)		kg	2360/560	2700/890
	Maximum gradeability (no load / full load) a_m		%	12/13	11/11
	Descending speed	No-load V3	mm/s	≥300	
		Full load V3'	mm/s	≤600	
	Dead weight (including battery)		kg	4773	5143
	Tire	Front wheel		28×9-15-14PR	
		Rear wheel		18×7-8-14PR	

	Operating pressure		MPa	17.5
	Working tank capacity		L	36
Drive	Motor	Traveling motor	kW	48/11
		Lifting motor	kW	18/15
	Battery	Weight	kg	1250
			V/Ah	48/735

Table 4 Technical Parameters of NE Series 1.5-3.5t Battery Forklift

Model			CPD15-NE	CPD18-NE	CPD20-NE	CPD25-NE	CPD30-NE	CPD35-NE
Design model			CPD15NE	CPD18NE	LG20BNE	LG25BNE	CPD30NE	CPD35NE
Rated load		kg	1500	1800	2000	2500	3000	3500
Load center distance		mm	500					
Max. lifting height		mm	3000					
Free lifting height		mm	155			140		
Fork size S×E×L		mm	920×100×35		1070×120×40		1070×120×40	
Inclination angle of mast (forward/backward)		deg	6/8					
Overall dimensions	Total length (to fork back)	mm	2072	2122	2275	2320	2512	2564
	W overall width	mm	1086		1185		1238	
	Mast non-lifting height	mm	1985		1995		2245	
	Full height when the door frame is lifted	mm	4030		4042		4066	
	Safety frame height	mm	2140		2148		2198	
Minimum turning radius		mm	1815	1850	2035	2090	2290	2340
Front overhang		mm	392		434		492	
Wheel track width (front wheel)		mm	910		960		1000	
Wheel track width (rear wheel)		mm	920		950		950	
Ground clearance		mm	90		110		125	
Wheel base		mm	1380		1550		1685	
Fork spacing		mm	200/970		240/1040		250/1100	
width for stack	1000×1200 (transverse)	mm	3424	3459	3670	3725	4078	4128
	800×1200 (longitudinal)	mm	3606	3641	3773	3828	4188	4238
Speed	Traveling (no load/full load)	Km/h	14/13.5			15/14		
	Lifting (no load/full load)	mm/s	430/280			400/280		
Maximum gradeability (full load)		%	15					
Dead weight		kg	2760	2990	3180	3520	4400	4715
Tire (front wheel)			6.00-9-10PR		23×9-10-16PR		28×9-15-14PR	

Tire (rear wheel)		16×6-8-10PR		18×7-8-14PR		18×7-8-14PR	
Motor (traveling)	kw	7.5	7.5	10	10	10	10
Motor (lifting)	kw	9		12			
Controllers		Jiachen		Zapi			
Battery	V/Ah	80/135 (lithium battery)		80/135 (lithium battery)		80/280 (lithium battery)	
Operating pressure	Mpa	14.5		17.5		21	

Table 5 Technical Parameters of N Series 1.5-3.5t Lithium Battery Forklift

Model		Unit	CPD15-NL	CPD18-NL	CPD20-NL	CPD25-NL	CPD30-NL	CPD35-NL
Design model			LG15BHLVI	LG18BHLVI	LG20BHLVI	LG25BHLVI	LG30BHLVI	LG35BHLVI
Rated load		kg	1500	1800	2000	2500	3000	3500
Load center distance		mm	500					
Max. lifting height		mm	3000					
Free lifting height		mm	155		145			
Fork size S×E×L		mm	920×100×35		1070×120×40		1070×125×45	1070×125×50
Inclination angle of mast (forward/backward)		deg	6/8				6/10	
Overall dimensions	Total length (to fork back)	mm	2072	2122	2275	2320	2512	2564
	W overall width	mm	1086		1185		1238	
	Mast non-lifting height	mm	1985		1995		2070	2180
	Full height when the door frame is lifted	mm	4030		4042		4210	
	Safety frame height	mm	2140		2148		2201	
Minimum turning radius		mm	1815	1850	2035	2090	2290	2340
Front overhang		mm	392		434		488	
Wheel track width (front wheel)		mm	910		960		1000	
Wheel track width (rear wheel)		mm	920		950		950	
Ground clearance		mm	90		110		125	
Wheel base		mm	1380		1550		1685	
Fork spacing		mm	200/970		240/1040		250/1100	
Passage width for stack aisle	1000×1200 (transverse)	mm	3424	3459	3670	3725	4078	4128
	800×1200 (longitudinal)	mm	3606	3641	3773	3828	4188	4238

Speed	Traveling (no load/full load)	Km/h	15/14				15.5/15	15/14
	Lifting (no load/full load)	mm/s	500/350		430/300		460/340	450/325
Maximum gradeability (full load)		%	20				15	
Dead weight		kg	2810	3040	3520	3840	4400	4715
Tire (front wheel)			6.00-9-10PR		23×9-10-16PR		28×9-15-14PR	
Tire (rear wheel)			16×6-8-10PR		18×7-8-14PR		18×7-8-14PR	
Motor (traveling)		kw	8.2		11.5		16.6	
Motor (lifting)		kw	10.6		15		13.5	
Controllers			inmotion					
Battery		V/Ah	80/205 (lithium battery)		80/280 (lithium battery)		80/300 (lithium battery)	
Operating pressure		Mpa	14.5		17.5		21	

Table 3 Dimensions and Weight of Main Removable Parts

	Balance weight		Overhead guard		Mast (lifting height 3000 mm)	
	MAX. overall dimensions	Weight	MAX.overall dimensions	Weight	MAX. overall dimensions	Weight
Model	mm	Kg	mm	Kg	mm	Kg
CPD15-N	1070×303×910	500	1050×1426×1564	74	1010*500*1940	460
CPD18-N	1070×303×910	720	1050×1426×1564	74	1010*500*1940	460
CPD20-N	1150×372×926	785	1100×1487×1538	76	1080*540*1920	630
CPD25-N	1150×382×926	940	1100×1487×1538	76	1080*540*1920	630
CPD30-N	1225×400×950	1000	1140×1588×1693	83	1140*470*2000	680
CPD35-N	1225×440×950	1330	1140×1588×1693	83	1140*470*2100	750
CPD15-NL	1070×310×907	790	1050×1426×1564	74	1010*500*1940	460
CPD18-NL	1070×360×907	1024	1050×1426×1564	74	1010*500*1940	460
CPD20-NL	1150×407×926	1090	1100×1487×1538	76	1080*540*1920	630
CPD25-NL	1150×452×926	1378	1100×1487×1538	76	1080*540*1920	630
CPD30-NL	1225×460×950	1530	1140×1588×1693	83	1140*470*2000	680
CPD35-NL	1225×512×950	1845	1140×1588×1693	83	1140*470*2100	750
CPD15-E	1065×287×935	487	1032×1497×1638	75	1010*500*1940	460
CPD18-E	1065×287×935	619	1032×1497×1638	75	1010*500*1940	460
CPD15-NE	1070×310×907	790	1050×1426×1564	74	1010*500*1940	460
CPD18-NE	1070×360×907	1024	1050×1426×1564	74	1010*500*1940	460
CPD20-NE	1150×407×926	1090	1100×1487×1538	76	1080*540*1910	510
CPD25-NE	1150×452×926	1378	1100×1487×1538	76	1080*540*1910	510
CPD30-NE	1225×460×950	1530	1140×1588×1693	83	1140*465*2010	665
CPD35-NE	1225×512×950	1845	1140×1588×1693	83	1140*465*2010	665

II. STRUCTURE, PRINCIPLE, ADJUSTMENT AND MAINTENANCE OF FORKLIFT

1. TRANSMISSION SYSTEM

1.1 Overview

The transmission system of the forklift consists of a differential assembly and a box axle assembly. The driving gear is directly connected with the traveling motor. The traveling speed of the forklift increases with the increase of the rotating speed of the motor, and the traveling direction is changed by changing the rotating direction of the motor.

It consists of reduction gearbox assembly, differential assembly and drive axle. The driving gear of the reducer is directly connected with the traveling motor. The traveling speed of the forklift increases with the increase of the rotating speed of the motor, and the traveling direction is changed by changing the rotating direction of the motor.

1.2 Differential assembly

The differential assembly is installed on the main housing of reduction gearbox and axle housing shaft head assembly through bearings at both ends. The housing of 1.5-2.5t differential is integral (as shown in Fig. 1-1), and the 3-3.5t differential is made into left and right split type (as shown in Fig. 1-2). Both have two axle shaft gears and two planetary gears.

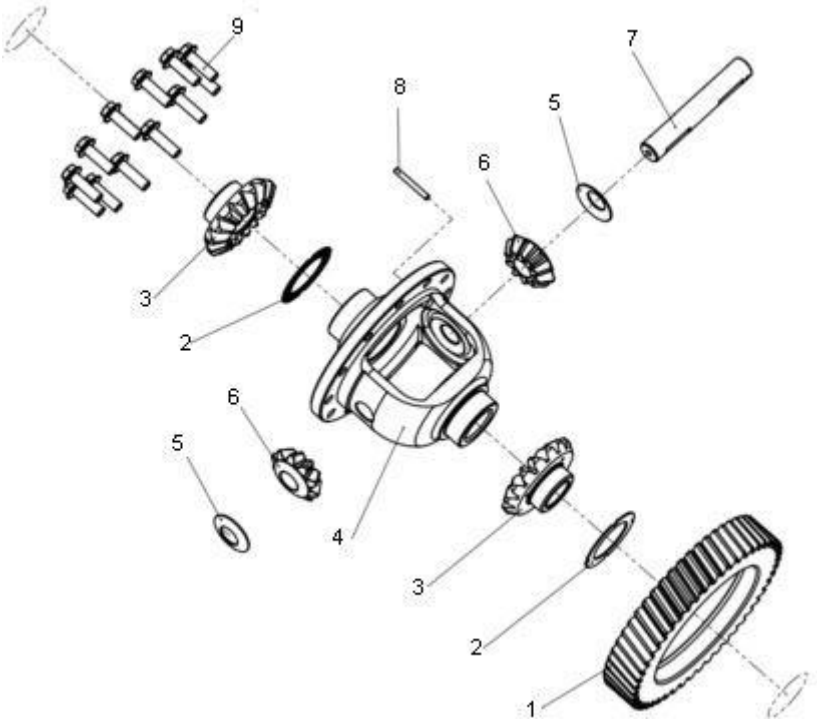


Fig. 1-1 Differential Assembly (1-2.5t)

1. Driven gear	4. Differential housing	7. Planetary gear shaft
2. Axle shaft gear washer	5. Planetary gear washer	8. Elastic cylindrical pin
3. Axle shaft gear	6. Planetary gear	9. Hexagon flange bolt

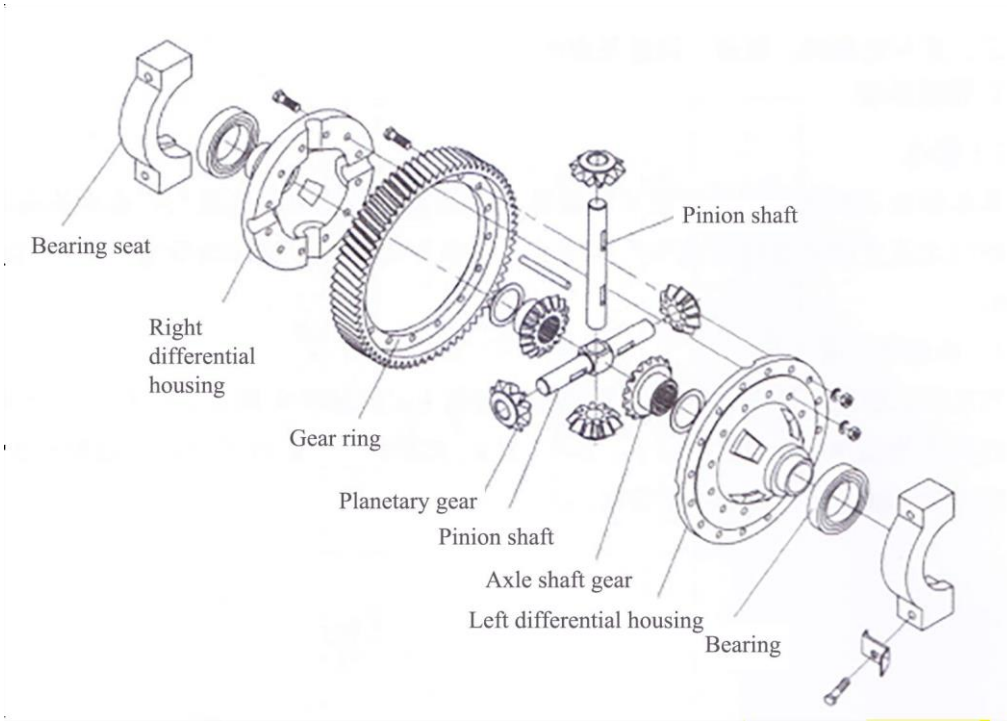


Fig. 1-2 Differential Assembly (3-3.5t)

1.3 Box Axle Assembly

The box axle assembly consists of axle housing, differential, gear, axle shaft, hub, brake and wheel, which is installed in the front of the chassis.

The 1-2.5t axle housing is of split casting structure, and the 3-3.5t axle housing is of integral casting structure. The tires are connected to the hub with bolts and nuts through the rim. The hub is supported on the axle housing by tapered roller bearings. The power is transmitted to the axle shaft through the differential. The hub is driven by the axle shaft and drives the front wheels to rotate. The axle shaft only bears the torque transmitted to the hub. An oil seal is installed inside the hub to prevent water and dust from entering or oil leakage. As shown in Fig. 1-3, 1-4 and 1-5.

Refer to Table 1-1 for models and tire pressures of front wheel tires and rims.

Table 1-1

Forklift tonnage	1.5-1.8t	2-2.5t	3-3.5t
Tire	6.0-9-10PR	23×9-10-16PR	28×9-15-14PR
Rim	4.00E	6.50F-10	7.00-15
Tire pressure	860kPa	1030kPa	830kPa

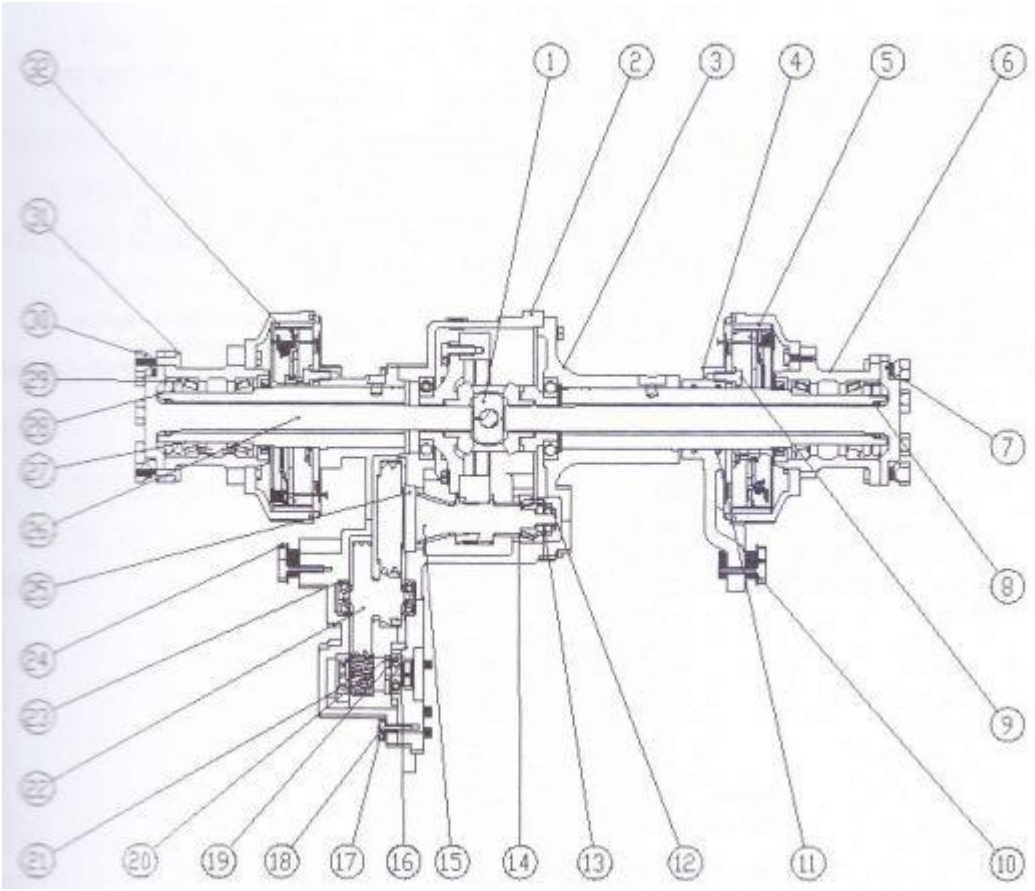


Fig. 1-3 Differential Assembly (3-3.5t)

1. Differential assembly
2. Main housing of reducer
3. Axle housing shaft head assembly I
4. Connecting plate
5. Brake assembly (right)
6. Brake drum hub assembly
7. Axle shaft I
8. Oil seal AE2483E0
9. Brake bolt
10. Washer 20
11. O-ring 90×5.3
12. O-ring 90×5.3
13. Nut M30*1.5
14. Bearing 32208
15. Duplex gear II
16. Bearing 6010/C3
17. Washer 12
18. Bolt 12×40
19. Oil seal AE279A0
20. Pinion
21. Bearing 6208
22. Duplex gear I
23. Bearing 6206
24. Bolt M20×1.5×55
25. Bearing 32915
26. Axle shaft II
27. Axle housing shaft head assembly II
28. Washer 75
29. Nut M75×2
30. Conical nut
31. Nut M18×1.5
32. Brake assembly (left)

Note: GY-340 locking adhesive shall be applied to (9) brake bolts, (18) housing connecting bolts and (24) drive axle and chassis connecting bolts. The O-ring shown in (11) is 75×5.3 for 1-1.5t, and the rest are consistent with the above figure.

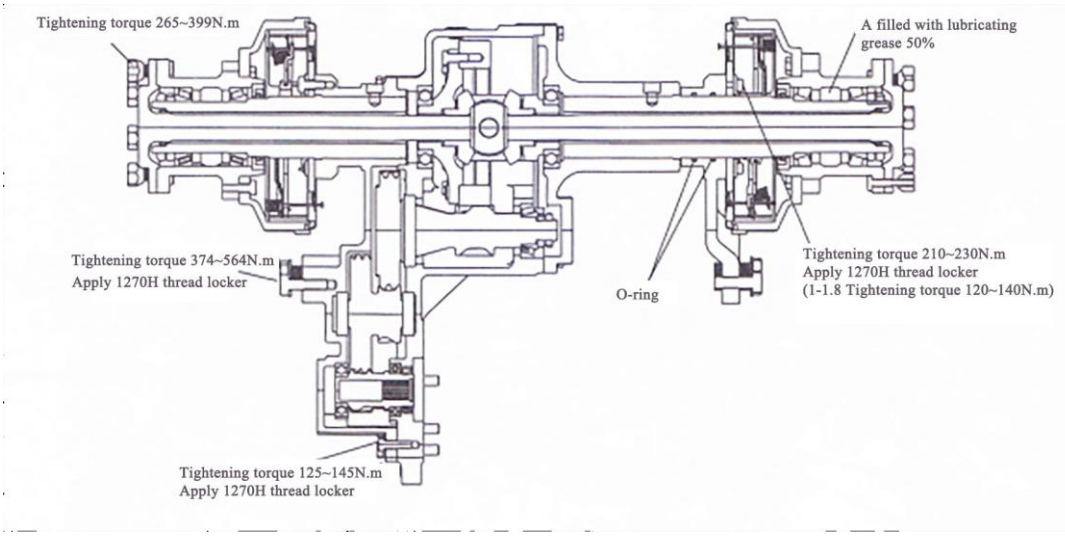


Fig. 1-4 Box Axle Assembly (1-2.5t)

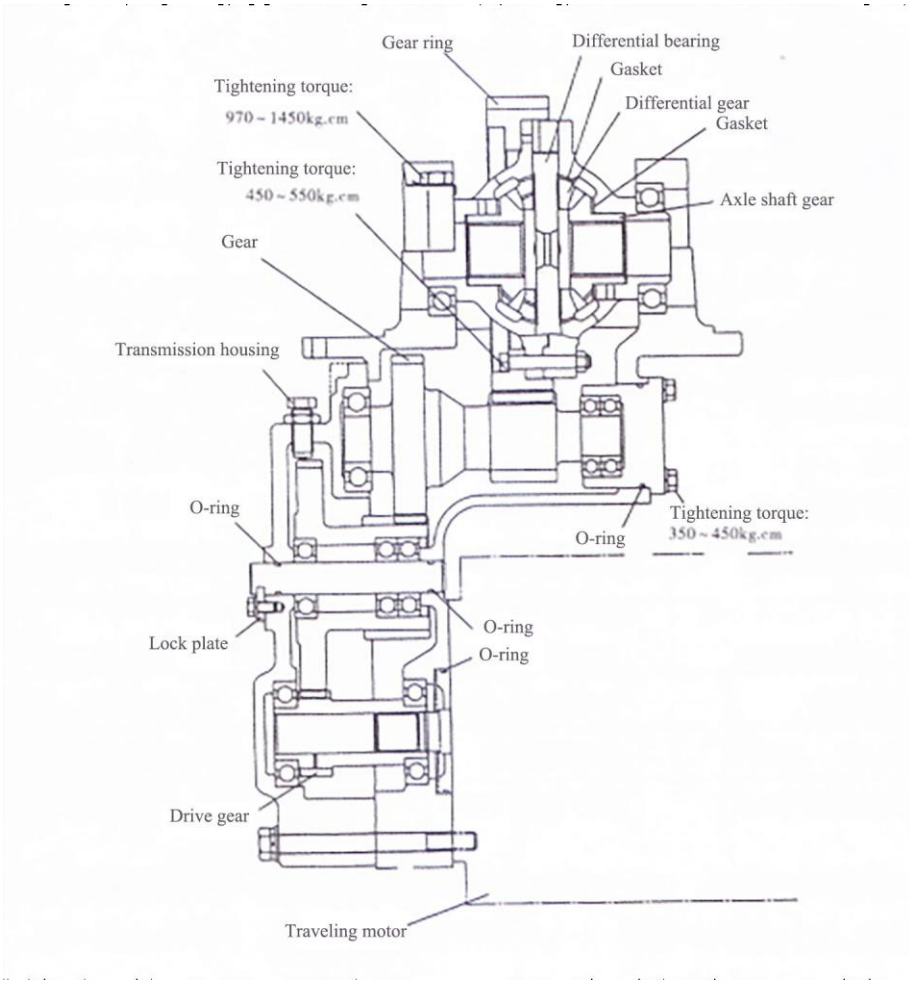


Fig. 1-5 Reducer and Differential (3-3.5t)

1.4 Installation of hub

(1) Fill the hub with 100cc grease and install it on the axle housing.

(2) Tighten the adjusting nut with torque of about 1Kg.m, and then turn it for 1/2 turn.

(3) Hang the spring scale on the bolt to measure the initial torque of the hub, and slowly lock the nut when the specified value is reached.

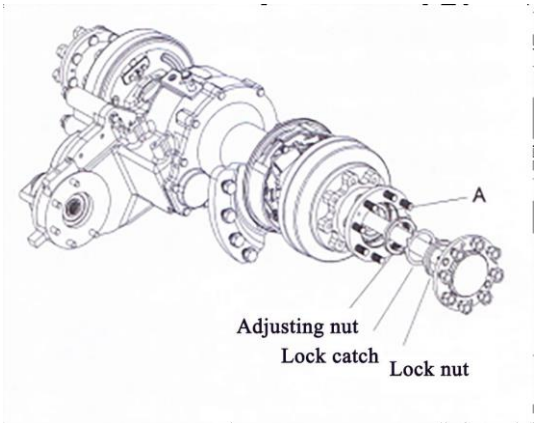


Fig. 1-6 Filling Grease

The initial torque: 5-15 kg.m.

(4) Install the lock plate and lock nut, and pull up the lock plate.

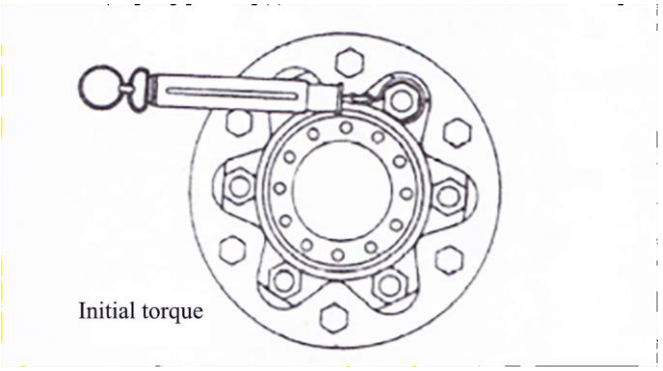


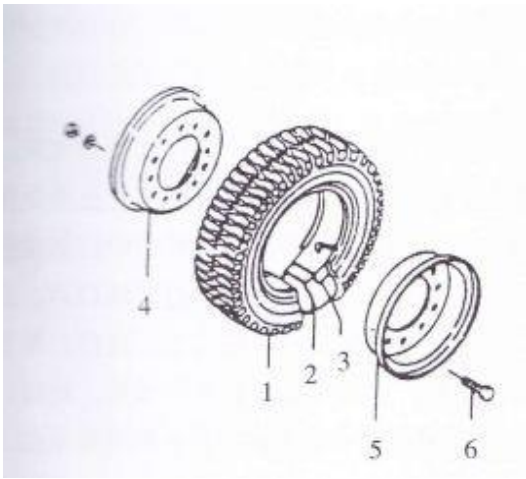
Fig. 1-7 Measurement of Initial Torque

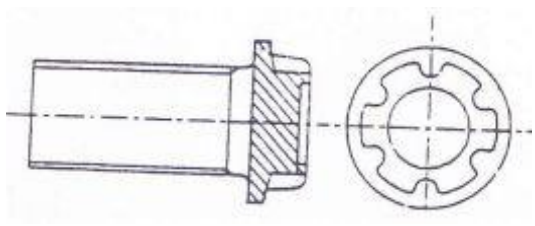
(5) Tire assembly

Install the connecting rod and cap on the tire, and assemble the rim. Pay attention to the following conditions:

Note: a) The air valve rod is at the rim gap and faces outward;

b) The rim bolt head shall be installed towards the outside of the forklift.





Structure of rim bolt

1. Tire	3. Cap	5. Outer wheel
2. Valve stem	4. Inner wheel	6. Rim bolt

Fig. 1-8 Wheel Assembly

2. BRAKE SYSTEM

2.1 General

The brake system is composed of brake pedal, brake master cylinder and wheel brake, and is of internal expansion oil pressure type for front two-wheel brake.

2.1.1 Brake Pedal

The brake pedal structure is shown in Fig. 2-1 and it is installed on the transmission through a bracket.

The foot power exerted on the pedal by the push rod of the brake master cylinder is converted into the brake oil pressure.

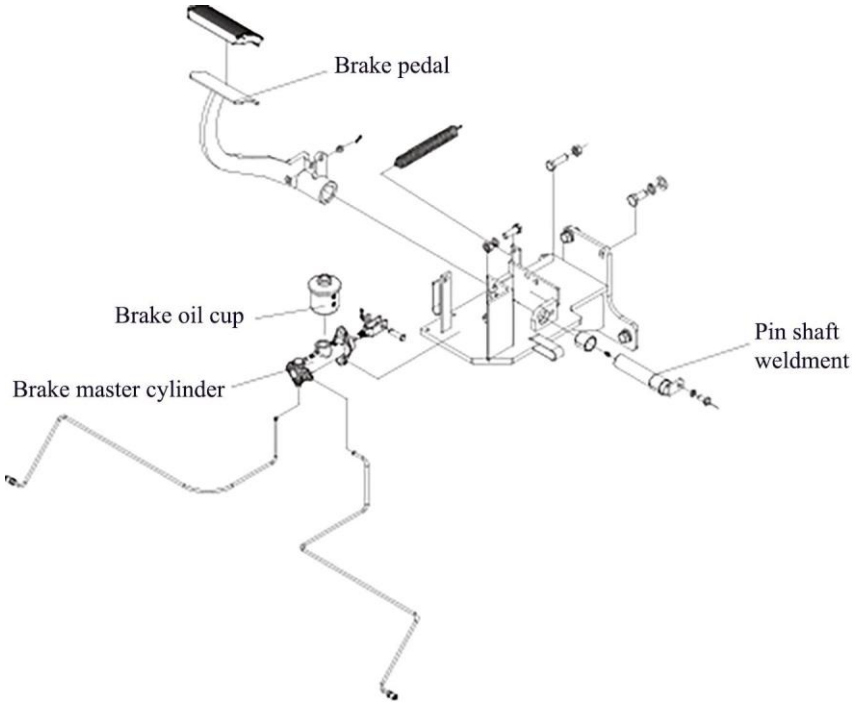


Fig. 2-1 Foot Brake Pedal

2.1.2 Brake master cylinder

The master cylinder includes a valve seat, a one-way valve, a return spring, a cup, a piston and an auxiliary cup. The end is fixed with a lock washer and a locking wire; the outside is protected with a rubber dust cover; the master cylinder piston is operated through a push rod by operating a brake pedal. When the brake pedal is depressed, the push rod pushes the piston forward, and the brake fluid in the pump body flows back to the oil storage tank through the oil return port until the main rubber cup blocks the oil return port. When the main rubber cup is pushed over the oil return port, the brake fluid in the front chamber of the master cylinder is compressed and makes the one-way valve open, so that the fluid flows to the slave cylinders through the brake pipeline. In this way, each slave cylinder piston extends outward, making the brake shoe friction disc contact with the brake drum, thus achieving the effect of deceleration or braking. At this time, the rear chamber of the piston is filled by the brake fluid from the oil return port. When the brake pedal is released, the piston is pressed back to its original position by the return spring, and the brake fluid in each slave cylinder is also compressed by the brake shoe return spring, so that the brake fluid returns to the master cylinder (piston front chamber) through the one-way valve. When the piston returns to its original position, the brake fluid in the master cylinder flows back to the oil tank through the oil return port. The pressure of the one-way valve is adjusted to be proportional to the residual pressure in the brake pipe and the

slave cylinder, so that the brake fluid in the slave cylinder flows back to the oil tank through the oil return port. The pressure of the one-way valve is adjusted to be proportional to the residual pressure in the brake pipe and the brake slave cylinder, so that the slave cylinder cup can be placed correctly to prevent oil leakage and eliminate possible air resistance during emergency braking.

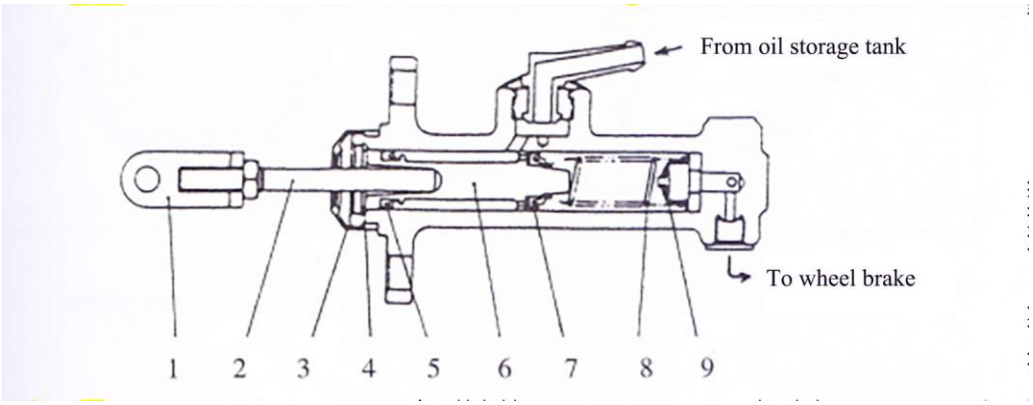


Fig. 2-2 Brake Master Cylinder

1. Connecting rod	4. Elastic retainer ring	7. Main rubber cup
2. Push rod	5. Auxiliary rubber cup	8. Spring
3. Dust cover	6. Piston	9. Check valve

2.1.3 Brakes

The brake is a double-shoe brake, which is installed on both sides of the box axle assembly. The brake consists of 2 groups of brake shoes, brake slave cylinder and slack adjuster. One end of the brake shoe is in contact with the fixing pin, and the other end is in contact with the clearance adjusting device. The parking brake shoe is pressed by the return spring and the compression spring pull rod. In addition, a parking brake mechanism and an automatic regulating device are assembled on the brake.

(1) Brake action

The brake slave cylinder applies the same pressure to the main brake shoe and the auxiliary brake shoe to press the brake drum until the upper end of the auxiliary brake shoe presses against the fixing pin, and then the brake shoe moves in the direction of the drum rotation.

The friction between the friction disc and the brake drum increases after the fixing pin is pressed, and the main brake shoe gives the auxiliary brake shoe the pressure much larger than that given by the brake slave cylinder, thus generating a great braking force. Refer to Fig. 2-4.

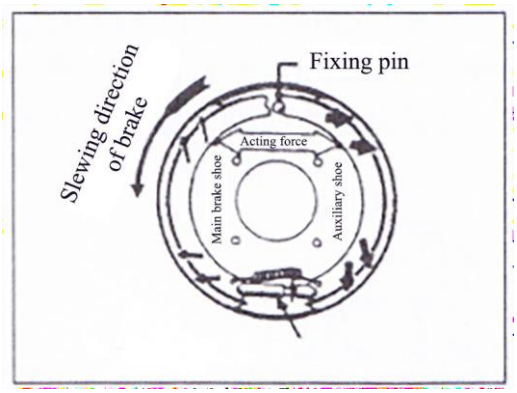


Fig. 2-3 Action When Moving Forward

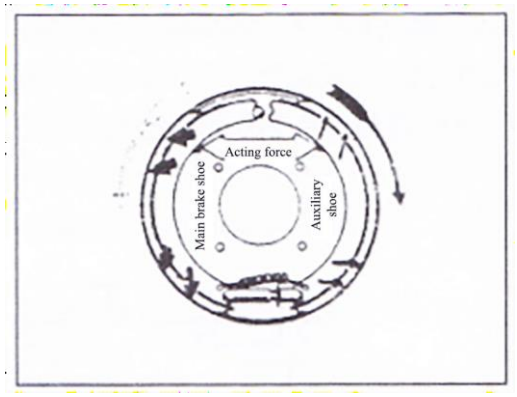


Fig. 2-4 Action When Moving Backward

(2) Parking brake

The parking brake device is assembled in the wheel brake and is composed of a pull rod and a stay rod.

The pull rod is installed on the side of the main brake shoe by the pin, and the action of the pull rod is transmitted to the side of the auxiliary brake shoe through the stay rod. as shown in Fig. 2-5.

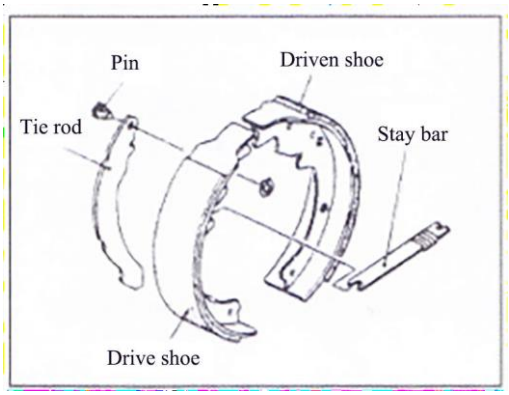


Fig. 2-5 Parking Brake Device

(3) Clearance self-adjusting mechanism

The clearance self-adjusting mechanism can keep proper clearance between the friction disc and the brake drum. The structure is shown in Fig. 2-6.

The clearance self-adjusting mechanism only acts during reversing and braking.

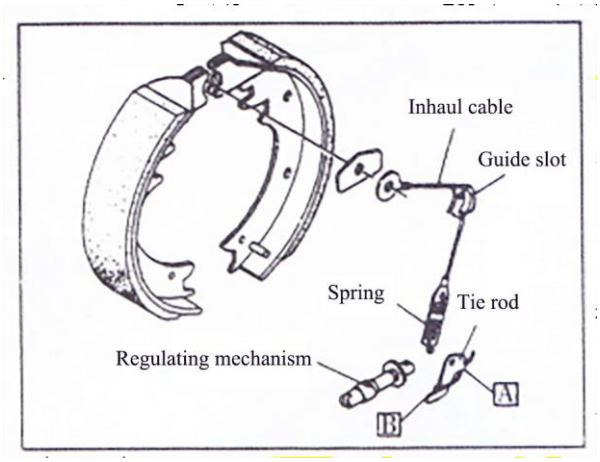


Fig. 2-6 Clearance Self-adjusting Mechanism

Action of clearance self-adjusting mechanism

When the forklift moves backward, brake operation is carried out. The auxiliary brake shoe contacts with the main brake shoe and rotates together to make the pull rod turn right around Point A. As shown in Figure 2-6, Point B is raised. After the brake is released, the pull rod turns left under the action of spring force and Point B is lowered. When the clearance between the friction disc and the brake hub becomes larger, the vertical distance of rotation at point B increases. The adjuster is moved by one tooth, and the adjusting rod becomes longer (see Fig. 2-7). The clearance then narrows. The clearance adjustment range is shown in the following table:

Unit: mm

	1.5~1.8t	2.0~2.5t	3.0~3.5t
Clearance	0.35~0.55	0.5-0.55	0.25-0.4

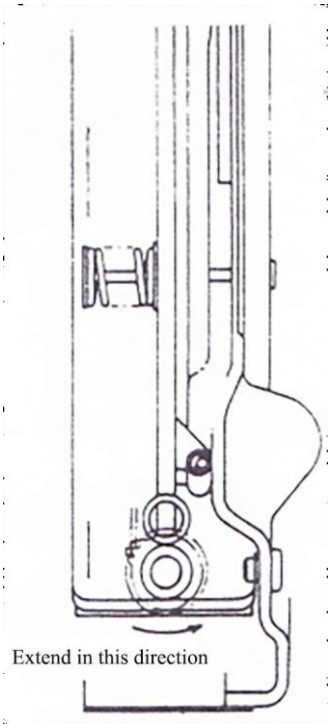


Fig. 2-7 Clearance Self-adjusting Mechanism

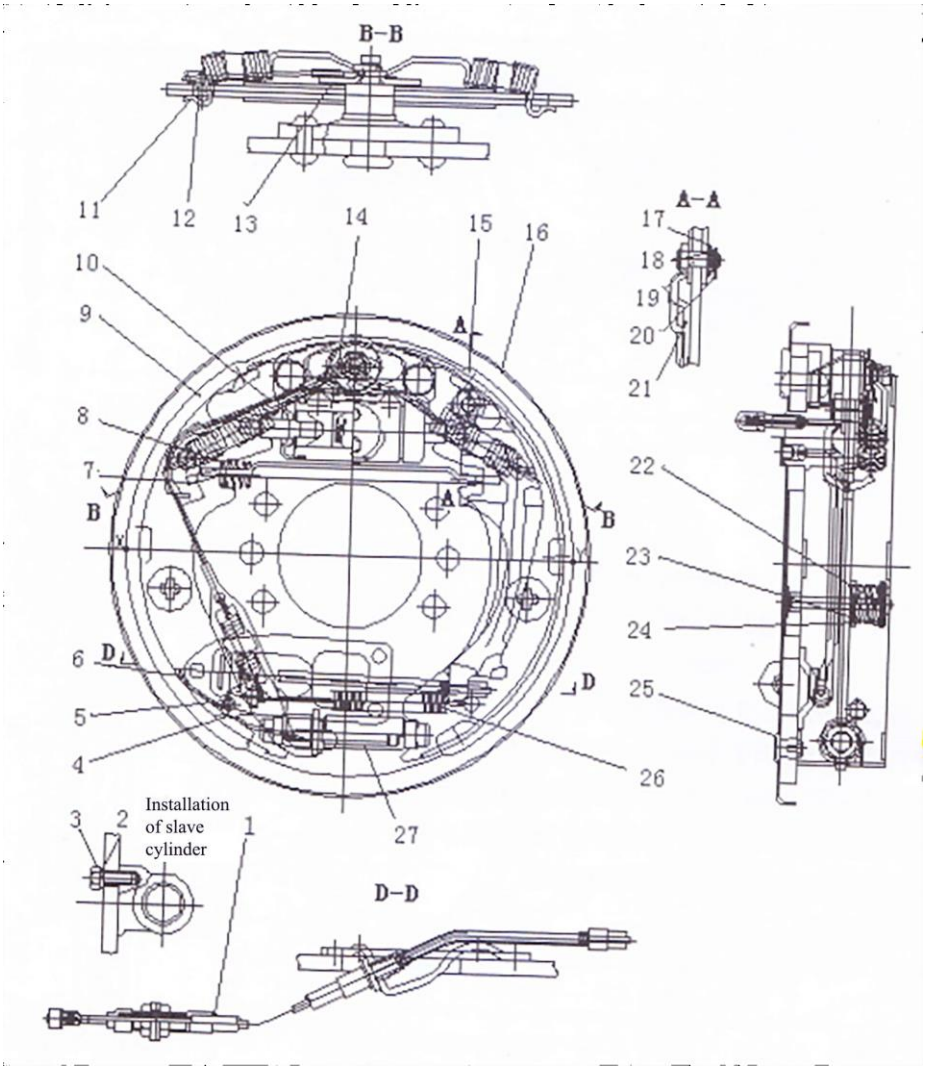


Fig. 2-8 Brake Assembly

1. Brake wire rope assembly
2. Washer 8
3. Bolt M8*20
4. Pawl
5. Pawl pin shaft
6. Torsion spring
7. Hand brake push rod
8. Spring
9. Rear brake shoe with friction disc assembly
10. Spring wire device
11. Brake shoe return device
12. Guide block
13. Guide plate
14. Brake slave cylinder assembly
15. Front brake shoe with friction disc assembly
16. Base plate assembly
17 Washer 10
18. Elastic washer
19. Pull rod pin shaft
20. Rod pin retainer
21. Hand brake pull rod
22. Compression spring pull rod
23. Compression spring seat
24. Compression spring
25. Sealant plugging
(26) Lower tension spring
27. Slack adjuster assembly

2~14Parking brake control device

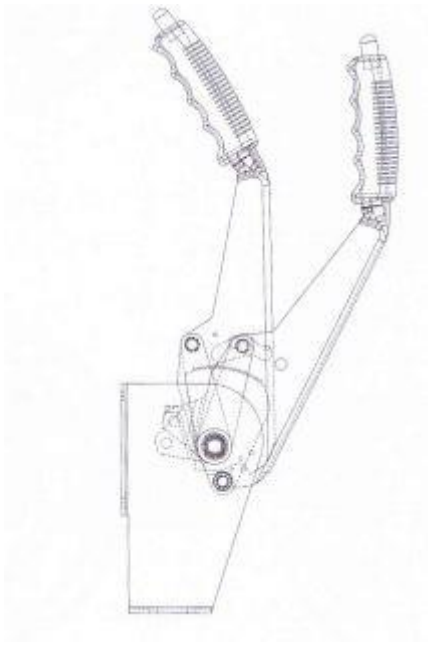
The parking brake handle is a ratchet-type hand brake, which can realize different braking forces on ramps and ground.

Adjustment of braking force: Turn the adjuster clockwise to increase the braking force and turn the adjuster counterclockwise to reduce the braking force.

As shown in Fig. 2-9

Tension: 20~30 kg

Note: The regulator is inside the housing which needs to be removed for adjustment.



2-9 Parking brake handle

2.2 MAIN POINTS OF BRAKE DISASSEMBLING, ASSEMBLING AND ADJUSTMENT

This section describes the disassembling, assembling and adjustment of the brake and the adjustment method of the brake pedal when the wheel and hub are disassembled.

This section is applicable to 2.5t brake. Although the structure of regulators is different for other models, the maintenance methods are basically the same.

2.2.1 DISASSEMBLY OF BRAKE

(1) Remove the support pin, adjusting rod, adjusting device and spring on the auxiliary brake shoe.

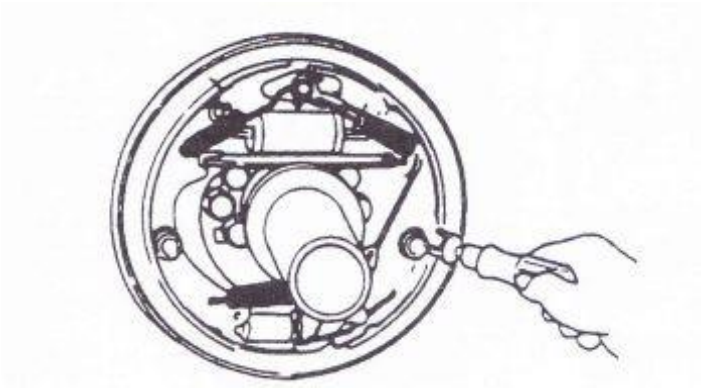


Fig. 2-10

(2) Remove the shoe return spring.

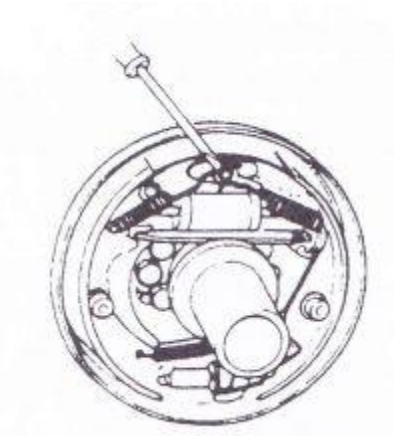


Fig. 2-11

(3) Remove the fixing spring on the main brake shoe.

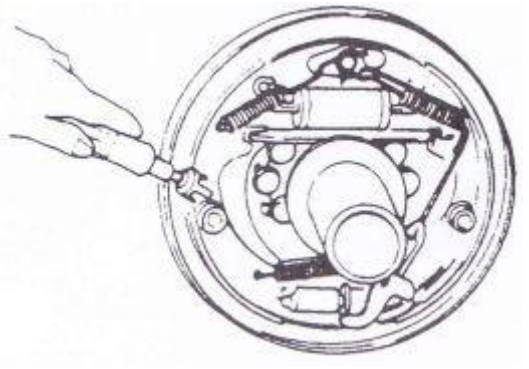


Fig. 2-12

(4) Remove the main brake shoe and auxiliary brake shoe.

Remove the adjuster and adjuster spring at the same time.

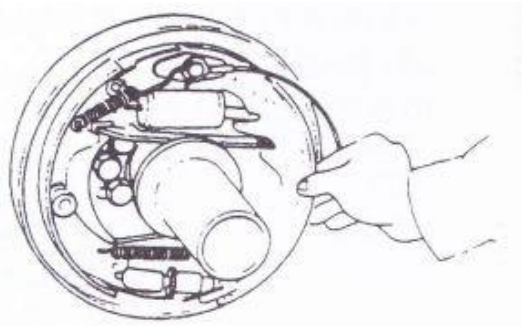


Fig. 2-13

(5) Remove the brake pipe from the brake slave cylinder. Then remove

Then remove the mounting bolts of the brake slave cylinder and remove the wiper slave cylinder from the brake base plate.

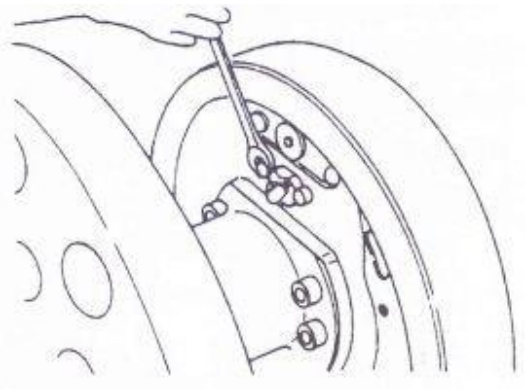


Fig. 2-14

(6) Remove the E-shaped retainer ring for fixing the brake cable on the brake base plate. Then, remove the bolts for mounting the brake backing plate.

Remove the brake backing plate from the drive axle.

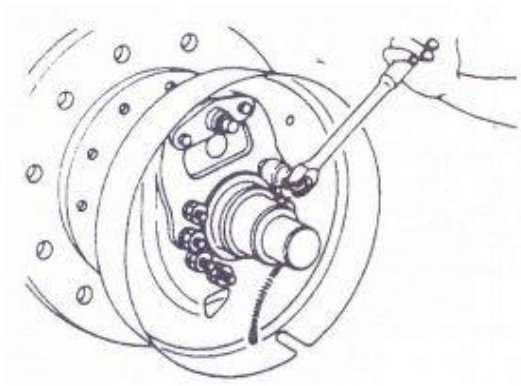


Fig. 2-15

(7) Disassemble the brake slave cylinder: Remove the dust ring. Press one piston at one side to push out the piston on the other side, and then press down the piston with fingers.

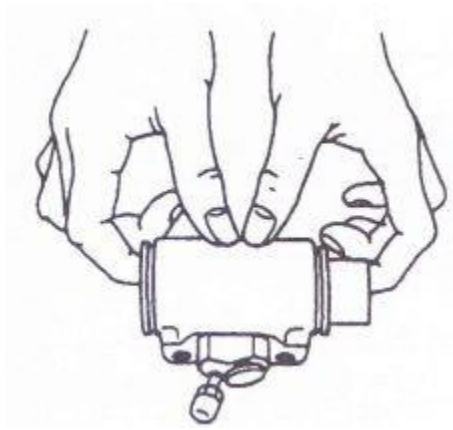


Fig. 2-16

2.2.2 INSPECTION OF BRAKE

Inspection of parts and components, repair or replacement of damaged parts and components

(1) Check whether there is rust on the inner surface of the slave cylinder and the periphery of the piston.

(2) Visually inspect whether the piston cup is damaged or deformed, and replace it if it is abnormal.

Then measure the clearance between the

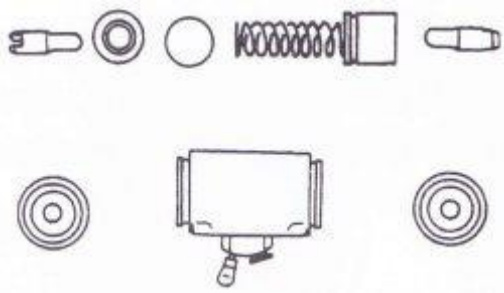


Fig. 2-17

piston and the cylinder.

Standard size: 0.03-0.10mm

Limit size: 0.15 mm

(3) Measure the free length of the brake slave cylinder spring, and replace it when it exceeds the reference value.

(4) Thickness measurement of friction disc, when exceeding the wear limit

it should be replaced in time.

Unit: mm

	1.5-1.8t	2-2.5t	3-3.5t
Standard value	4.8	5.7	8.0
Limit value	2.5	3.5	6.0

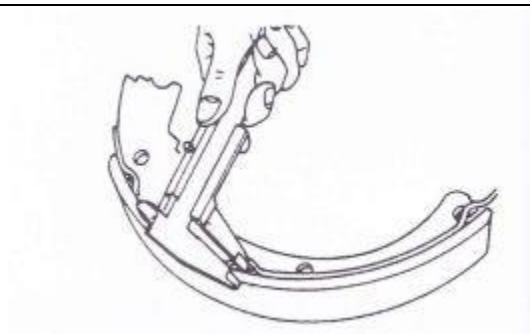


Fig. 2-18

(5) Visually check the inner surface of brake drum for damage
or unbalanced wear, and grind for correction;
if exceeding the correction limit,
replace it.

Unit: mm

	1.5-1.8t	2-2.5t	3-3.5t
Standard value	Φ254	Φ280	Φ314
Limit value	Φ256	Φ282	Φ316

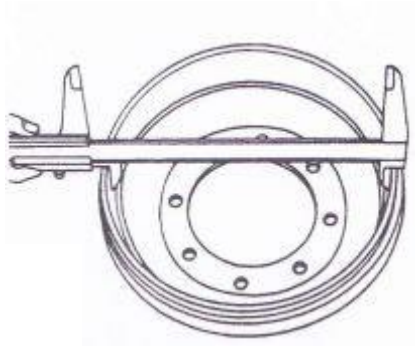


Fig. 2-19

2.2.3 ASSEMBLY OF BRAKE

(1) Apply brake fluid on the cup and piston of the brake slave cylinder, and assemble the spring, piston cup and piston dust ring in sequence.

(2) Install the brake slave cylinder on the brake base plate.

(3) The static brake sheet is installed on the drive axle.

(4) As shown in Figure 2-20, apply

(a) Contact surface between base plate and brake shoe

(b) Fixing pin

(c) Contact surface between shoe and compression spring seat

(d) Hand brake lever support pin

(e) Adjusting mechanism threads and other rotating parts

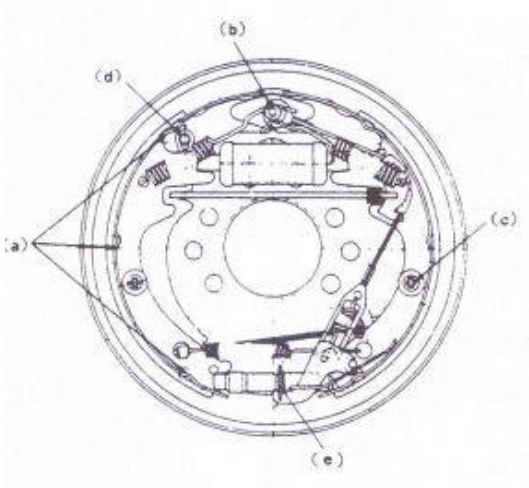


Fig. 2-20

(5) Lock the parking brake cable with the E-shaped retainer ring.

(6) Install the brake shoe with the fixing spring.

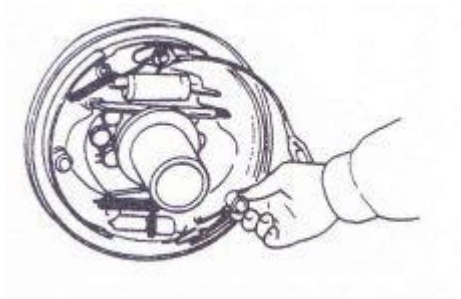


Fig. 2-21

(7) Install the compression spring on the push rod of the hand brake, and then install the push rod on the brake shoe.

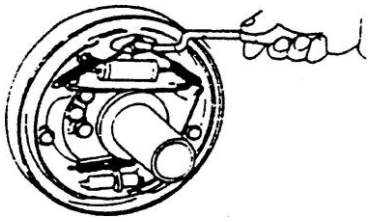


Fig. 2-22

(8) Install the guide plate of brake shoe on the support pin, and then install the return spring of the brake shoe.

(9) Install the adjuster, adjuster spring, ejector rod and ejector rod return spring. Pay attention to the following points:

a) Thread direction and installation direction of the adjuster;

b) Adjustment direction of the air spring (the contact between adjuster teeth and spring is not allowed);

c) Ejector rod return spring direction (the spring hook at the end of the support pin shall be fixed on the opposite side of the ejector rod);

d) The lower end of the adjusting lever must be in contact with the adjuster teeth.

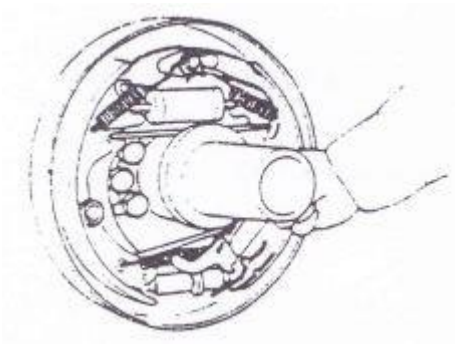


Fig. 2-23

(10) Connect the brake oil pipe to the slave cylinder.

(11) Measure the inner diameter of brake drum and the outer diameter of brake shoe, and adjust the adjuster so that the difference between the inner diameter of brake drum and the outer diameter of brake shoe friction disc reaches 1 mm.

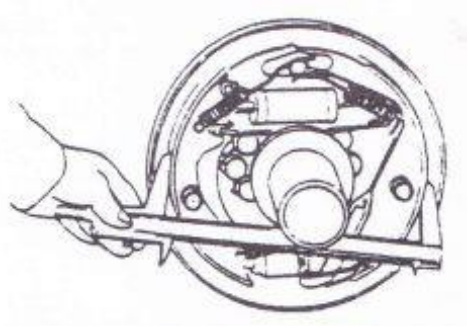


Fig. 2-24

2.2.4 OPERATION TEST OF AUTOMATIC CLEARANCE ADJUSTER

(1) First, make the diameter of brake shoe close to the specified installation dimension. Pull the adjusting lever by hand to rotate the adjuster.

When the hand is released, the adjusting lever returns to its original position and the adjuster

gear does not rotate.

Note: Even when the gear of the adjuster returns together with the adjusting lever as it is released, the adjuster can still function well after loading.

(2) If the adjuster cannot act as above mentioned when the adjusting lever is pulled, the following inspection must be carried out:

a) Fix the adjusting lever, ejector rod, ejector rod spring and compression spring seat;

b) Check whether the ejector rod return spring and adjuster spring are damaged, whether the rotation of adjuster gear and its meshing parts are excessively worn or damaged, and whether the lever is in contact with the gear, and replace damaged parts.

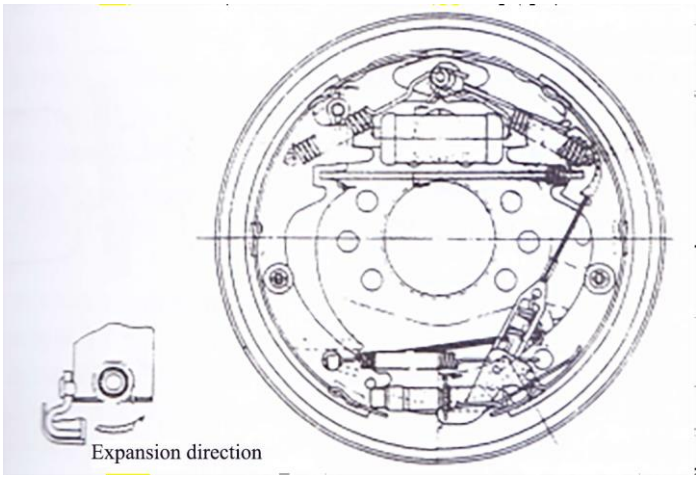


Fig. 2-25

2.2.5 BRAKE PEDAL ADJUSTMENT:

(1) Shorten the push rod;

(2) Adjust the stop bolt, as shown in Figure 2-26, to adjust the pedal height;

(3) Depress the brake pedal and lengthen the push rod until the front end of the push rod contacts the piston of the master cylinder;

(4) Tighten the push rod lock nut.

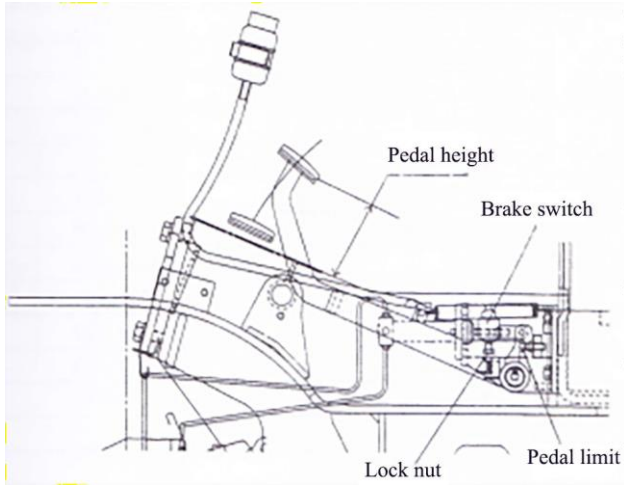
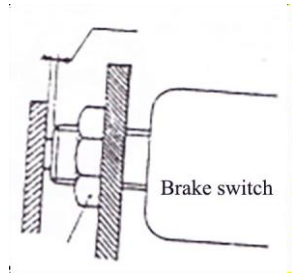


Fig. 2-26

▲ Adjustment of brake switch a) After the brake pedal height is adjusted, release the brake switch lock nut; b) Disconnect the plug to separate the wires; c) Turn the switch to make the clearance A = 1 mm; d) Confirm that the brake lamp shall be on when the brake pedal is depressed.	 Lock nut

2.2.6 FAULT DIAGNOSIS

Symptoms	**Cause analysis**	**Troubleshooting method**
Poor braking	1) Repair of brake system oil leakage	Repair
	2) The brake shoe clearance is not properly adjusted.	Adjust the adjuster
	3) Brake overheating	Check for slipping
	4) Poor contact between brake drum and friction disc	Readjust
	5) Impurities are attached to the friction disc	Readjust
	6) Impurities mixed into brake fluid	Inspect the brake fluid
	7) The brake pedal (inching valve) improperly adjusted	Adjust
Brake noise	1). The friction disc is hardened or impurities are attached to it	Repair or replace it
	2) The base plate is deformed or the bolts are loosened	Repair or replace it
	3) The brake shoe is deformed or is incorrectly installed	Repair or replace it
	4) The friction disc is worn.	Replace it
	5) The wheel bearing is loosened	Repair
Uneven braking	1) Oil stain on the surface of the friction disc	Repair or replace it
	2) The brake shoe clearance is not properly adjusted.	Repair or replace it
	3) Failure of slave cylinder	Repair or replace it
	4) The return spring of brake shoe is damaged	Replace it
	5) The brake drum is deflected	Repair or replace it
Failure to brake	1) Oil leakage of brake system	Repair or replace it
	2) Clearance of brake shoe not well adjusted	Adjust the adjuster
	3) Air in the brake system	Deflating
	4) The brake pedal is incorrectly adjusted	Readjust

3. STEERING SYSTEM

3.1 General

The function of the forklift steering system is to change the driving direction of the truck or keep the truck running straight. The performance of the steering system is directly related to the driving safety, working efficiency and driver's labor intensity of the forklift. The steering system is classified into mechanical steering system (manual steering system) and power steering system according to the power source used in steering. A mechanical steering system completely relies on the driver's physical ability to control steering and overcome steering resistance torque. In a power steering system, the energy consumed to overcome the steering torque is provided by the prime mover, and the driver operates the system with only a small force to control steering.

Due to the requirements of the working characteristics of the forklift, the working site, and the driving passage are narrow, the steering is frequent during operation, and it is often necessary to turn with the minimum radius, so the steering system is required to work reliably and be easy to operate. When the forklift is unloaded, the steering axle load accounts for about 60% of the forklift weight. To reduce the labor intensity of the driver, N series 1.5-3.5t forklift produced by our company adopts a full hydraulic power steering system.

3.2 WORKING PRINCIPLE

To turn the forklift, the driver applies steering torque on the steering wheel (steering control mechanism) to cause the steering wheel to generate rotational displacement, which is transmitted to the steering gear through the steering shaft. According to the turning angle of the steering wheel, the steering gear transmits the appropriate volume of pressure oil to the steering cylinder through the pipeline, and the oil cylinder pushes the steering wheel through the steering trapezoidal mechanism to realize steering.

The difference between the full hydraulic steering gear and the hydraulic power steering gear is that the full hydraulic steering gear replaces mechanical components such as the mechanical steering gear, and the full hydraulic steering gear and the steering cylinder are connected by a high-pressure oil pipe. The load-sensing full hydraulic circuit is equipped with a priority valve to ensure that the flow is distributed to the steering system first under any working condition and that only a small amount of flow passes through the steering gear when the steering gear is in the middle position, so as to realize energy saving of the system.

3.3 COMPOSITION OF STEERING SYSTEM

(1) Steering control mechanism

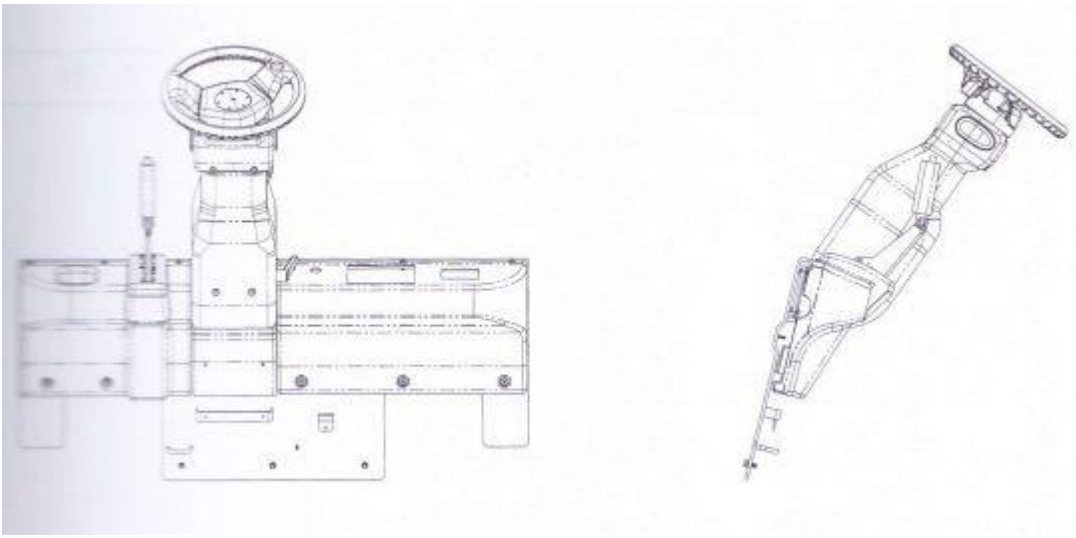


Fig. 3-1 Steering Operation Device

The steering control mechanism of N series 1.5-3.5t forklift is mainly composed of steering wheel, column, coupling shaft, steering gear and mounting bracket (as shown in Fig. 3-1). They are fixed on the instrument frame panel by the mounting bracket. The steering wheel, column and coupling shaft are connected together, and the steering gear is fixed at the lower end of the coupling shaft. The rotation of the steering wheel drives the steering gear to rotate. The steering wheel can be adjusted to a comfortable position for the driver by adjusting the handle.

(2) Steering gear

N series 1.5-3.5t adopts cycloid rotary valve type full hydraulic steering gear, which is a closed dynamic load steering gear. (See the hydraulic system for details).

(3) Steering transmission mechanism

The steering transmission mechanism deflects the left and right wheels according to a certain relationship through the power output by the steering gear through the oil cylinder and the steering mechanism, which is achieved through the transverse oil cylinder steering axle components (see relevant steering axle chapters for more information).

3.4 Steering axle

The cast steering axle consists of steering axle body, steering cylinder, connecting rod, steering knuckle and other parts and components (as shown in Fig. 3-2). The steering trapezoid adopts a crank slider mechanism, and the steering knuckle is pushed by the cylinder piston rod through the connecting rod to offset the steering wheel, thus realizing steering. The steering axle is fixed on the tail frame at the rear of the frame by bolts after the installation of damping blocks on the front and rear end plates, so that the axle body can swing around the pin shaft on the end plate, and a certain damping effect can be obtained due to the damping blocks. There is a steering knuckle on the left and right sides of the steering axle respectively. The rear hub is

installed on the steering knuckle shaft with two conical roller bearings. The oil seal is installed inside the bearing to keep the grease in the hub and knuckle cavity.

See Table 3-1 for steering axle tire, rim model and tire pressure:

Table 3-1

Forklift tonnage	1.5-1.8t	2-2.5t	3t-3.5t
Tire	16×8-8-10PR	18×7-8-14PR	18×7-8-14PR
Rim	4.33R		
Tire pressure	860kPa	970kPa	970kPa

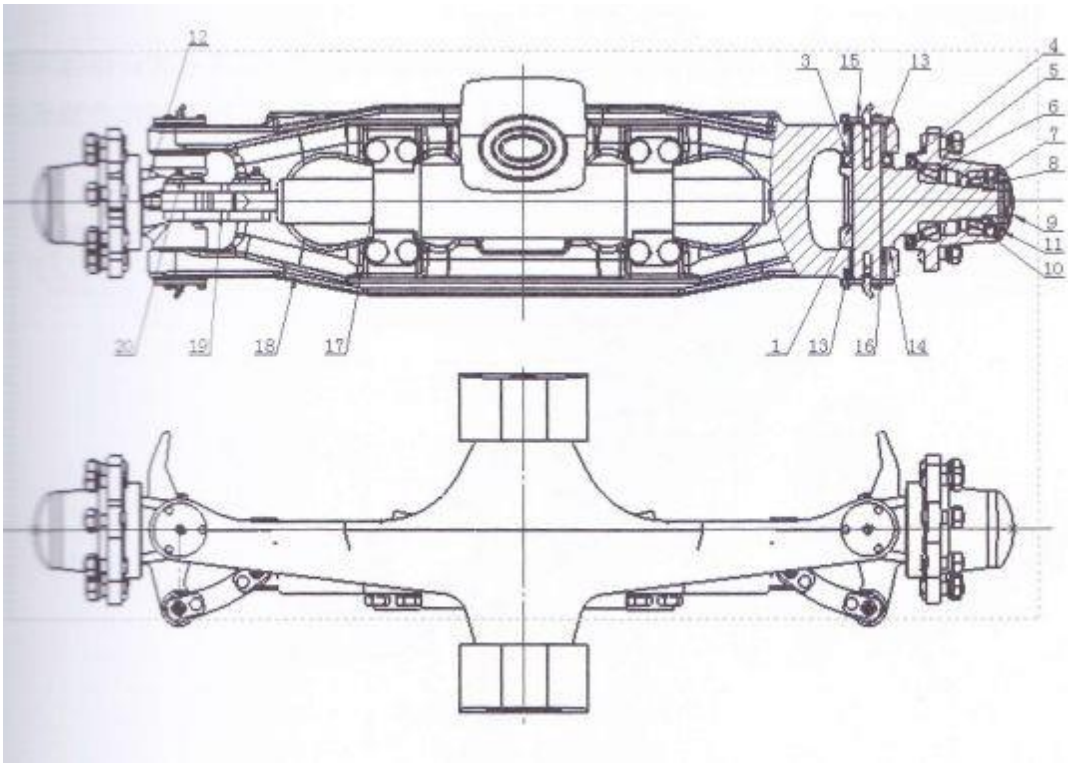


Fig. 3-2 Steering Axle

1. Steering knuckle kingpin
2. Needle bearing
3. Thrust bearing
4. Oil seal
5. Steering hub
6. Tapered roller bearing
7. Washer
8. Lock nut
9. Hub cover
10. Tapered roller bearing
11. Locking pin
12. Steering knuckle
13. Needle bearing
14. Adjusting washer
15. Dust ring
16. Sealing ring
17. Steering cylinder
18. Steering axle body
19. Connecting rod
20. Pin shaft

(1) Steering knuckle

The steering knuckle is installed between the upper and lower ends of the steering axle body with a master pin, thrust bearing, dust cover, needle bearing and sealing ring. The upper and lower ends of the master pin are fixed on the axle body with needle bearings, and supported by the thrust bearing pressed on the axle body. As shown in Fig. 3-3

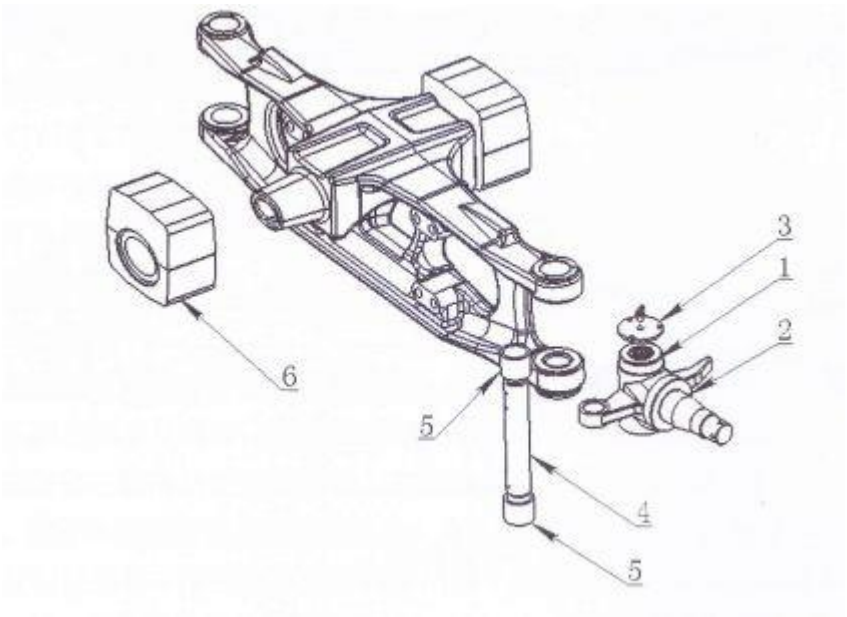


Fig. 3-3 Steering Knuckle

1. Thrust bearing	3. Dust cover	5. Needle bearing
2. Steering knuckle	4. Steering knuckle kingpin	6. Shock absorber

2. Steering cylinder

The steering cylinder is a double-acting piston cylinder. Both ends of the piston rod are connected with the steering knuckle through the connecting rod. The pressure oil from the full hydraulic steering gear moves the piston rod left and right through the steering cylinder to realize left and right steering. The piston seal is a combined part of the support ring and O-ring, the cylinder head and piston rod are axially sealed by U-ring, and the oil cylinder is fixed on the steering axle through the cylinder heads on both sides. (See Fig. 3-4)

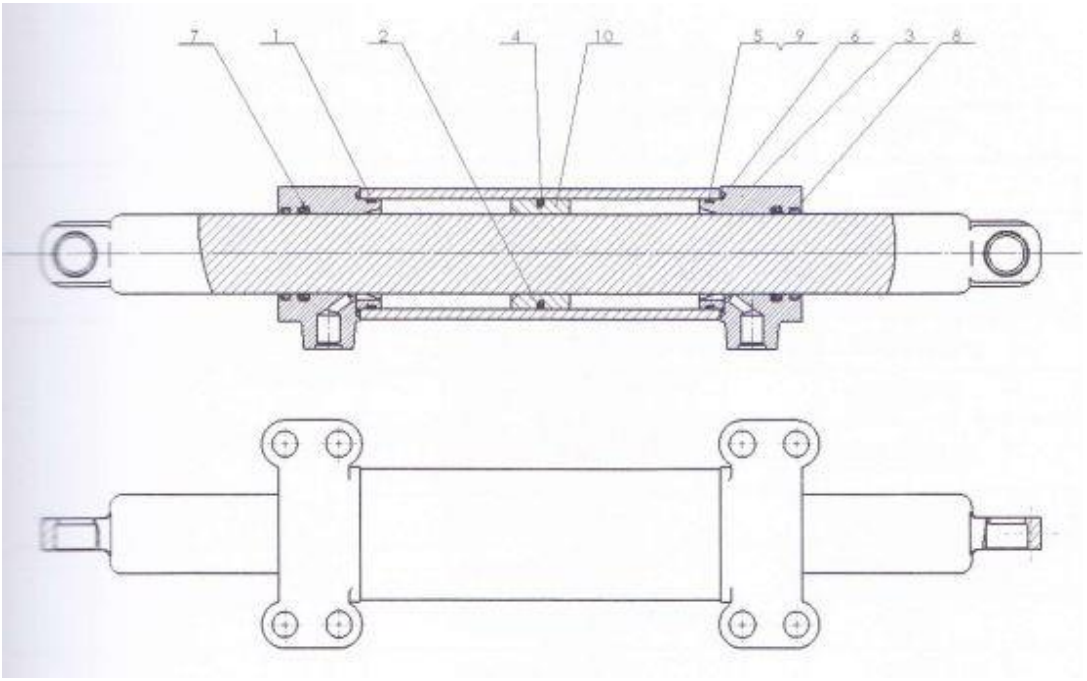


Fig. 3-4 Steering Cylinder

1. Cylinder barrel
2. Support ring
3. Cylinder head
4. O-ring
5. O-ring
6. O-ring
7. U-ring
8. Dust ring
9. Retainer ring
10. Piston rod assembly

(3) Hub

The hub is installed on the steering knuckle with two tapered roller bearings. The wheel is pried to the hub through the rim. An oil seal is installed on the inner side of the bearing to keep the grease in the hub and steering knuckle cavity. The tightness of the bearing is adjusted with nuts.

3.5 INSTALLATION, COMMISSIONING, AND MAINTENANCE

3.5.1 ADJUSTMENT STEPS OF THE PRE-TIGHTENING LOAD OF THE STEERING WHEEL BEARING

(1) As shown in Fig. 3-5, apply grease to the inner cavity of the hub, inner and outer bearings and hub cover, and apply some grease to the lip of the oil seal;

(2) Fix the outer bearing ring on the hub before installing the hub on the steering knuckle shaft;

(3) Install the flat washer and tighten the castle nut with a torque of 206-235N.m (21-24kgm); loosen the castle nut, and then tighten it with a torque of 9.8N.m (1kgm);

(4) Gently knock the hub with a wooden hammer and turn the hub for 3-4 turns to ensure that the hub is not loose;

(5) Tighten the slotted nut so that the slot is aligned with the cotter pin hole on the steering knuckle;

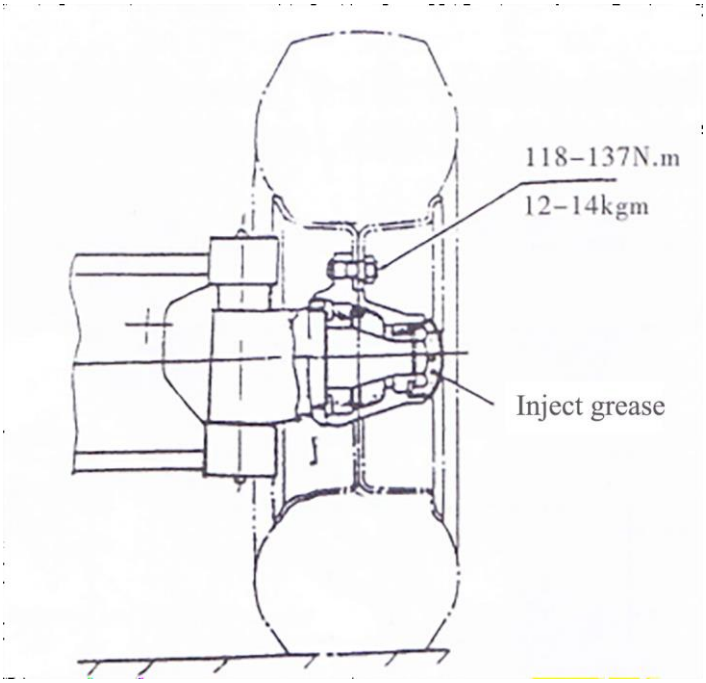


Fig. 3-5 Adding Lubricating Grease and Pre-tightening Load Adjustment

(6) Tap the hub gently with a wooden hammer, rotate the hub by hand for 3~4 turns to ensure stable rotation, and measure the rotating torque of the hub, which is 2.94~7.8N.m (0.3~0.8kgm);

(7) When the rotation torque is more than the specified value, turn the hub in the reverse direction by 1/6 turn and then measure the rotation torque again;

(8) When the specified rotation torque is reached, lock the channel nut with a cotter pin.

During tire replacement, after installing a new tire, apply sealant on the hub bolt, and ensure that the tightening torque of the hub nut is 120-160N.m for a 1~3.5t forklift.

3.5.2 MAINTENANCE OF STEERING SYSTEM

(1) The steering kingpin shall be checked every 40 hours, and the up-and-down elbow lubricating nozzle of the kingpin shall be replenished with lubricating grease every 300 hours. Rotary joints between the piston rod and the connecting rod of steering cylinder, between the left and right steering knuckle arms and the connecting rod shall be checked every 40 hours, and grease shall be replenished every 300 hours.

(2) The grease of the bearing at the steering hub needs to be replaced every 1200 hours;

(3) Check the working status of the steering system during routine maintenance. When steering, the manual operating force on the steering wheel should be

6-20N; the difference between left and right steering forces shall not exceed 5N; when the forklift is traveling straight at the maximum speed,

there shall not be obvious serpentine phenomenon. If there is any fault, it shall be analyzed and eliminated by referring to Table 3-2 Steering System Fault Analysis Table.

3.6 MAIN FAULTS AND TROUBLESHOOTING OF THE STEERING SYSTEM

3.6.1 INSPECTION STEPS AFTER REINSTALLATION OF STEERING SYSTEM

(1) Turn the steering wheel to the left and right limits to see if the leftward and rightward force is even and the rotation is smooth;

(2) Check whether the oil pressure pipeline layout is correct and whether the left and right steering devices are installed oppositely;

(3) Jack up the rear wheel, slowly turn the steering wheel left and right, and repeat several times to remove the air in the hydraulic pipeline and oil cylinder.

3.6.2 REMOVAL OF FAULTS OF STEERING SYSTEM

Table 3-2 Steering System Fault Analysis Table

Symptoms	**Cause analysis**	**Troubleshooting method**
Steering wheel does not turn	The oil pump is damaged or faulty	Replace it
	The diverter valve is blocked or damaged	Clean or replace
	Rubber hose or joint is damaged or pipe is blocked	Replace or clean
Heavy steering	The pressure of diverter valve is too low	Adjust pressure
	Air is in oil circuit	Exhaust air
	The steering gear fails to reset, and the positioning spring plate is broken or lacks elasticity	Replace the spring plate
	Excessive internal leakage of steering cylinder	Check the piston seal
Forklift truck snaking or swinging	The steering flow is excessively large	Adjust the flow of diverter valve
	Spring is broken or provides no elastic force	Replace it
Working noise is loud	Low oil tank level	Refuel
	Suction pipe or oil filter is blocked	Clean or replace
Oil leakage	The steering cylinder guide sleeve seal is damaged or the pipeline or joint is damaged	Replace it

4. ELECTRICAL SYSTEM

4.1 OVERVIEW

The standard configuration of N series 1.5-3.5t counterweight forklift is a dual electric control system, which enables quiet, efficient, smooth and safe control of the whole vehicle.

It is mainly composed of combination instrument, control system, traction motor, pump motor, battery pack, control switch and lighting device, connecting harness, etc.

Note: The manufacturer reserves the right to continuously improve the product. If the actual product is inconsistent with the Manual, please consult the manufacturer.

The schematic diagram of the electrical system is shown in Fig. 4-1 ~ Fig. 4-8.

Electrical Schematic Diagram：

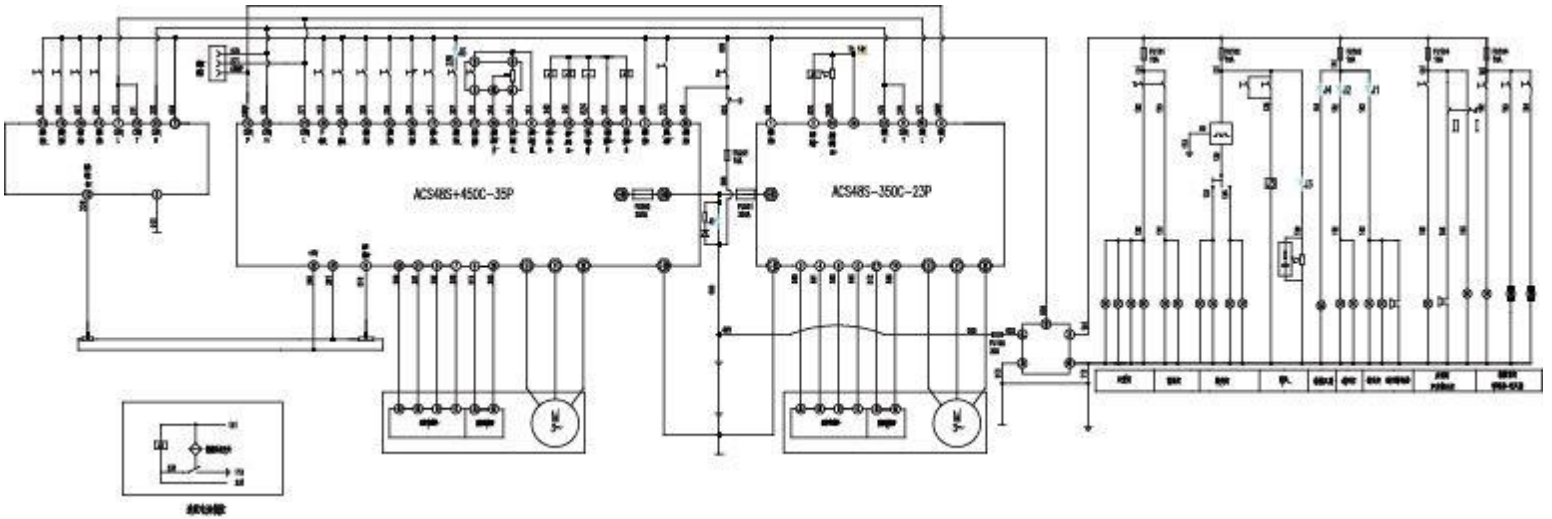


Fig. 4-1Schematic Diagram of Electrical System (LG15BVI - LG18BVI)

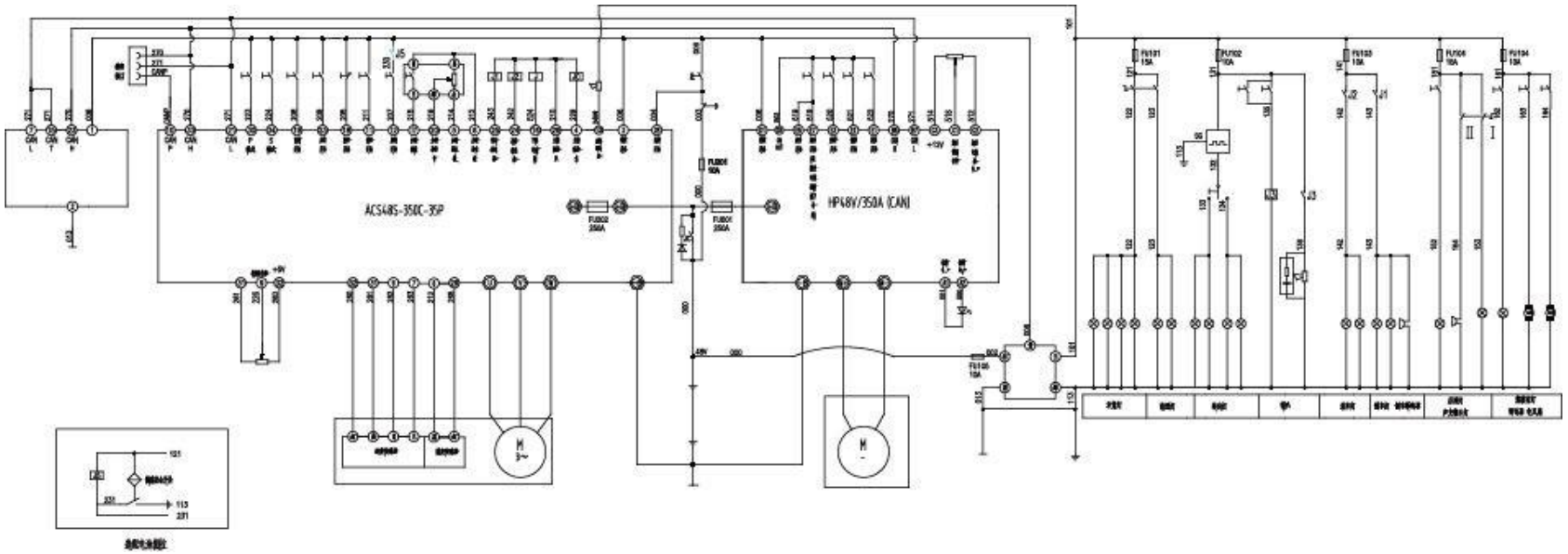


Fig. 4-2 Schematic Diagram of Electrical System (LG15BJVI - LG18BJVI)

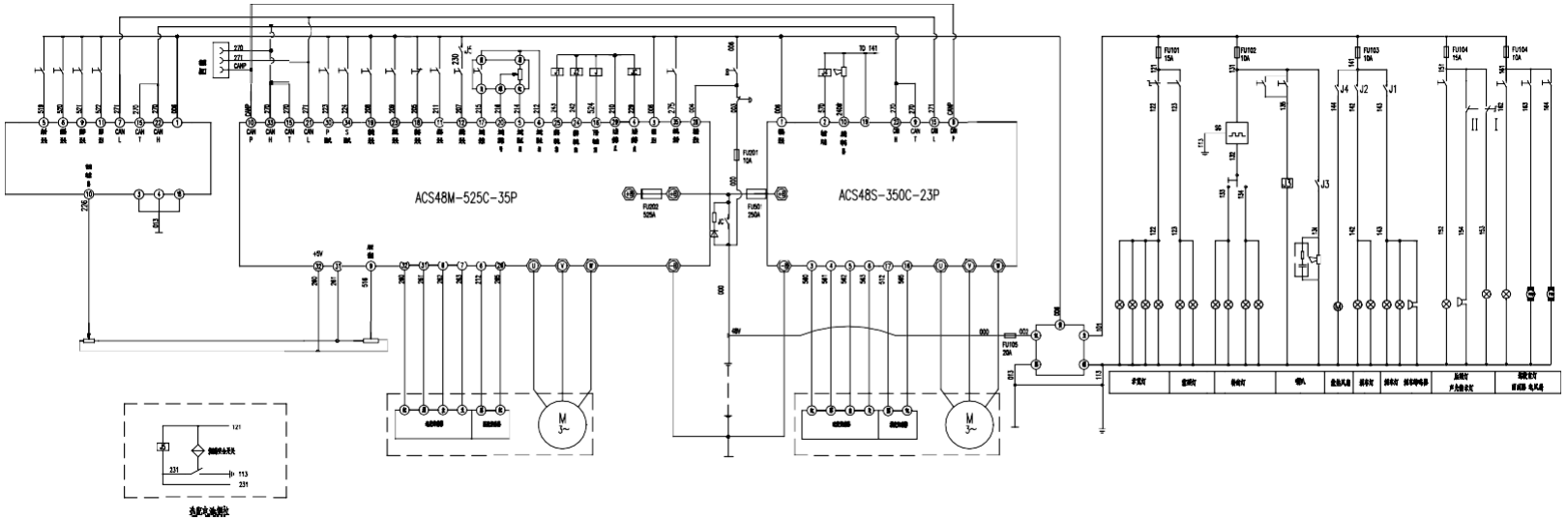


Fig. 4-3 Schematic Diagram of Electrical System (LG20BVI - LG25BVI)

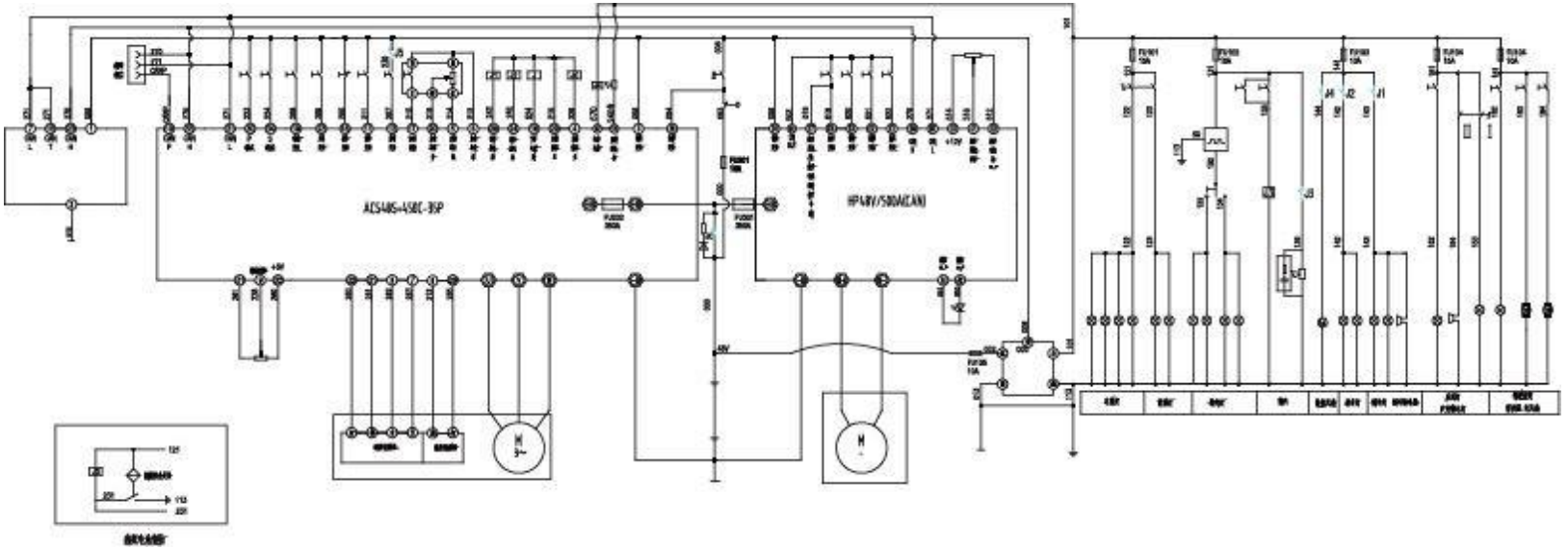


Fig. 4-4 Schematic Diagram of Electrical System (LG20BJVI - LG25BJVI)

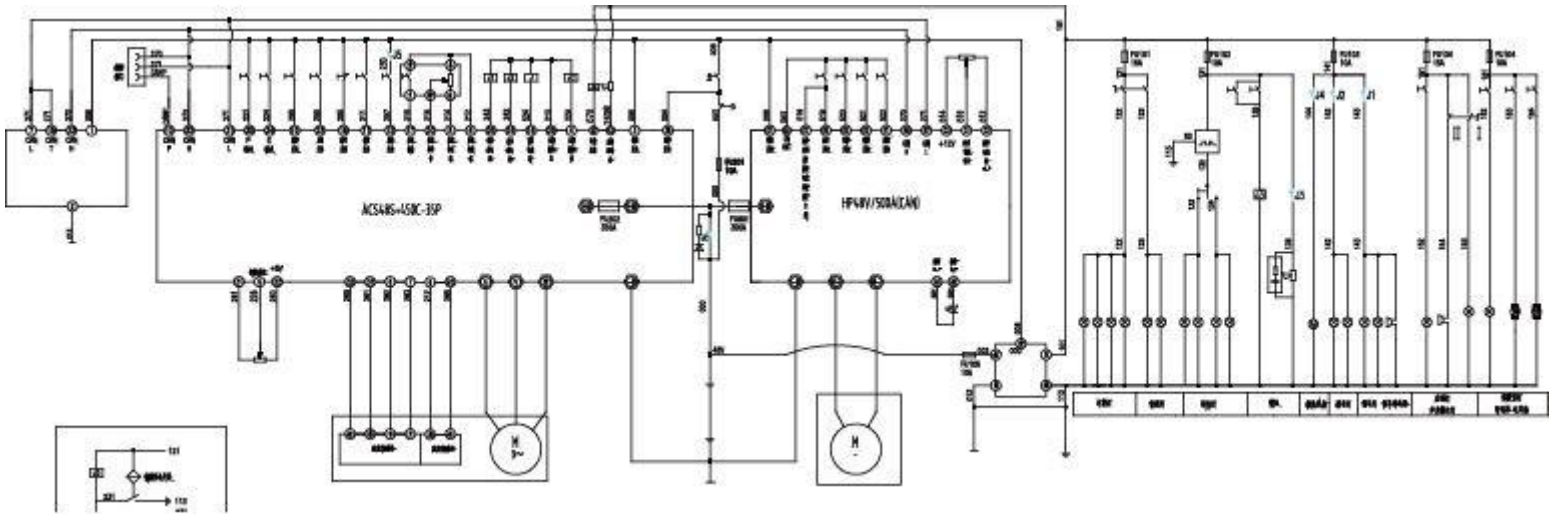


Fig. 4-5 Schematic Diagram of Electrical System (LG30BVI - LG35BVI)

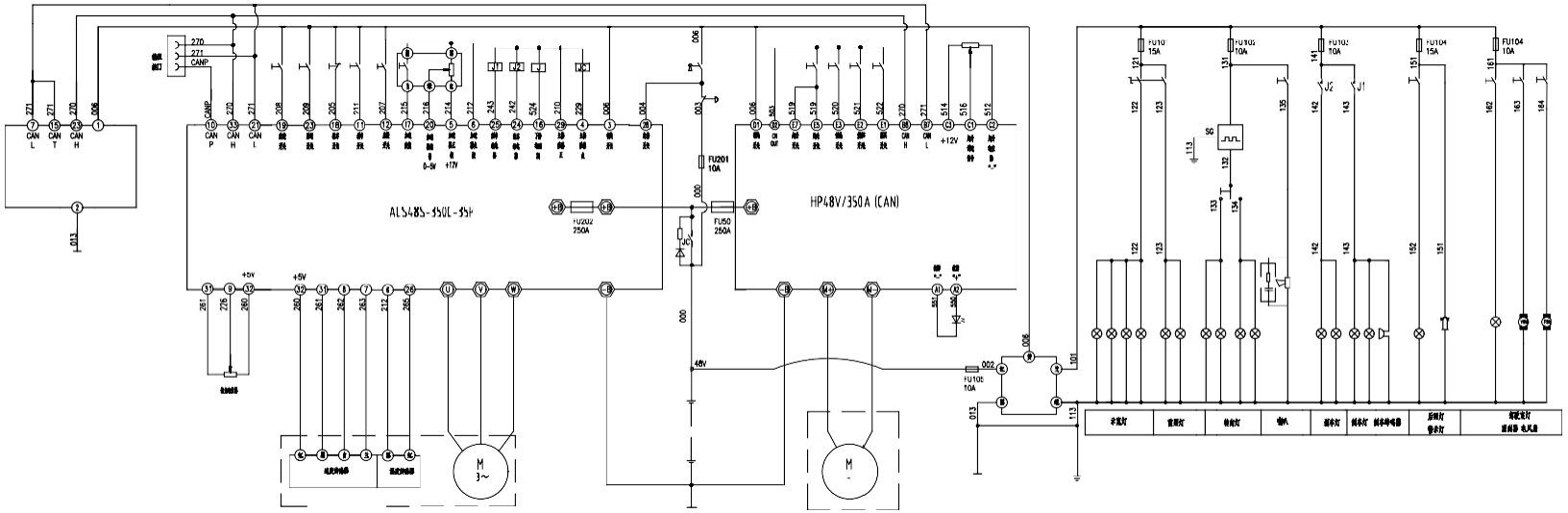


Fig. 4-6 Electrical System (CPD15E- CPD18E)

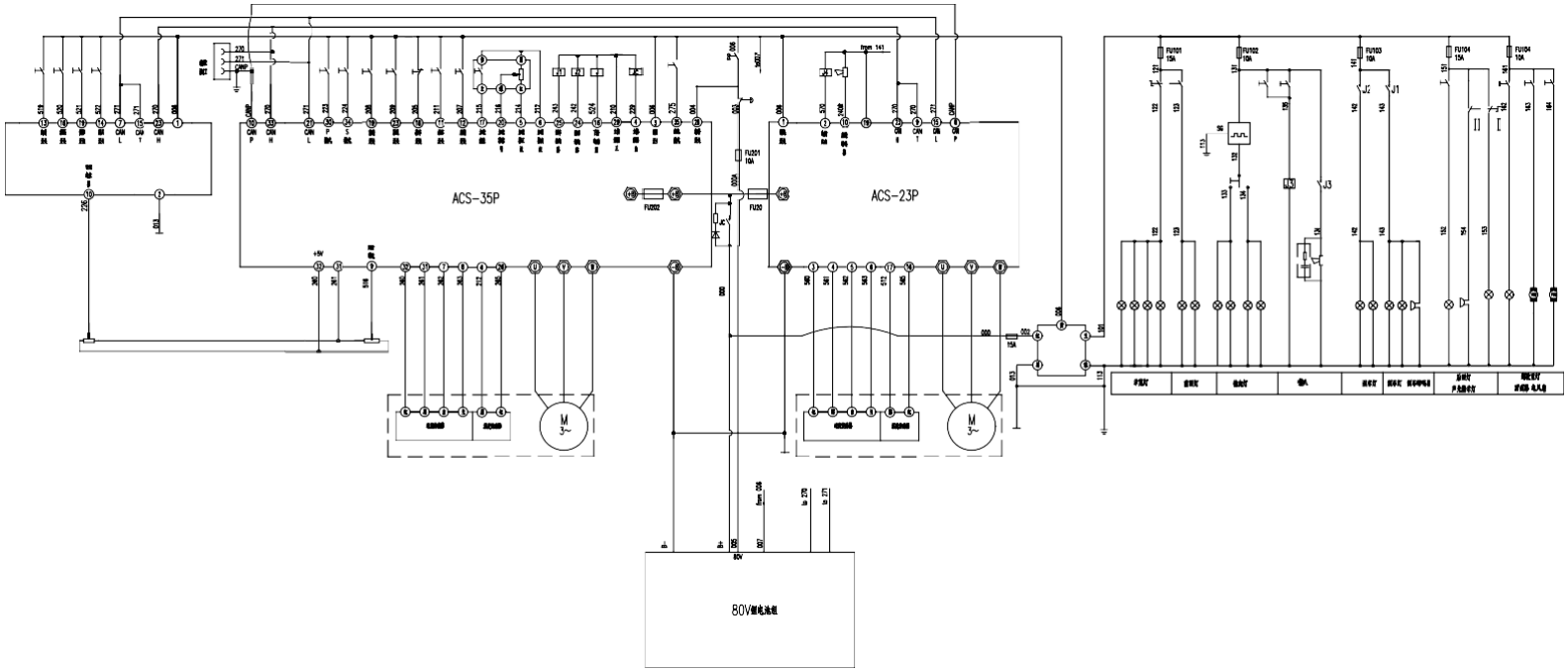


Fig. 4-7 Electrical System (CPD15NE- CPD18NE)

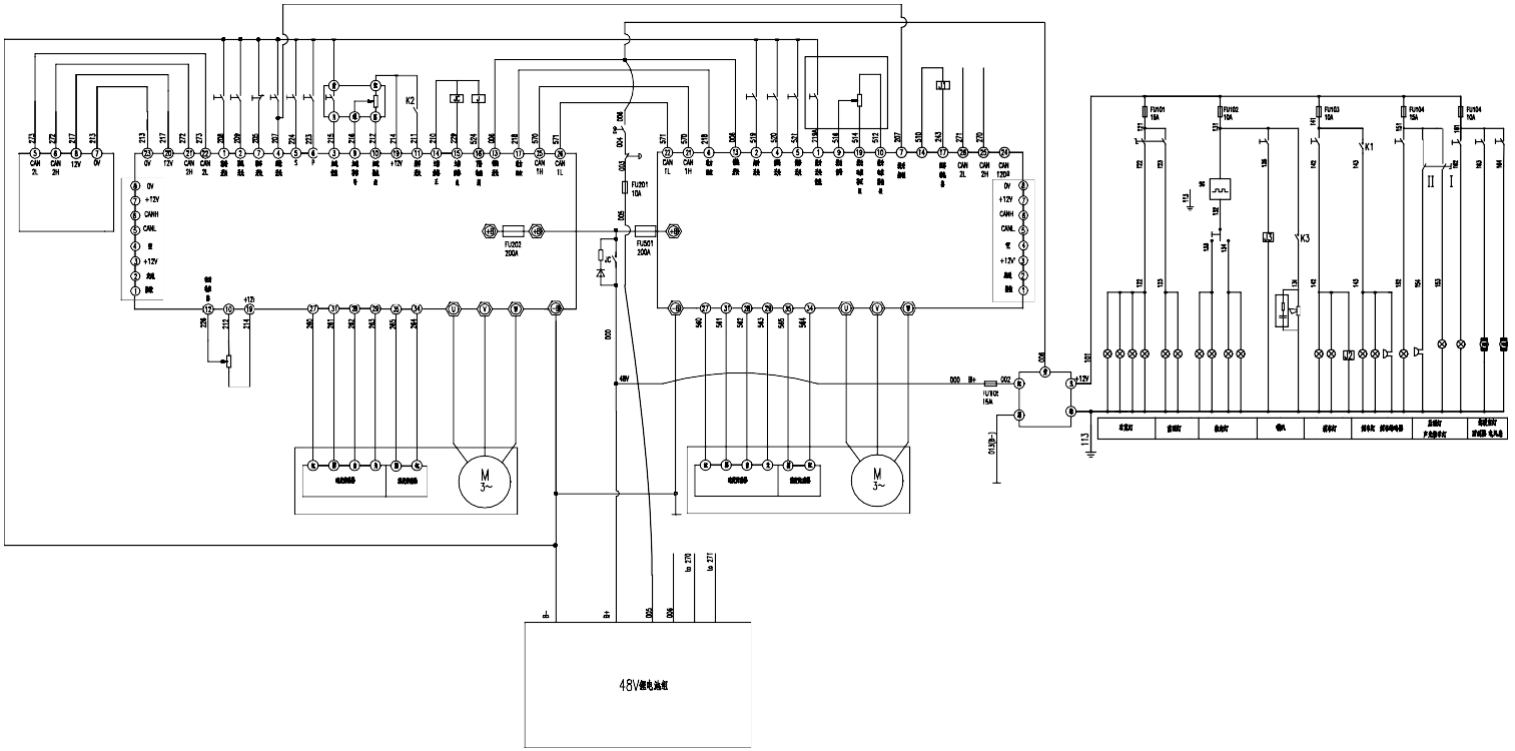
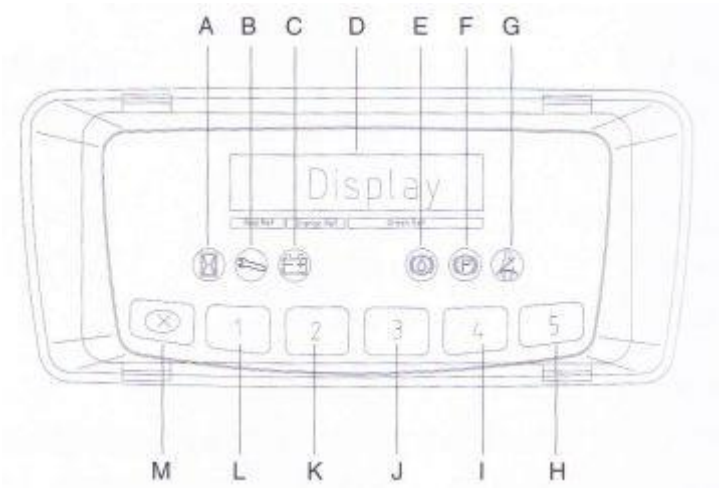


Fig. 4-8 Electrical System (CPD20NE- CPD35NE)

4.2 INSTRUMENT

4.2.1 ZAPI Instruments

(1) Panel layout



A. Low battery indication

B Fault display

C Battery capacity display

D. Display screen

E Traction at medium-speed indication

F Hand brake status indication

G Seat switch alarm

H Exit button

I Parameter setting - decrease button

J Parameter setting - increase button

K Menu down button

L Menu up button

M Menu function button

Fig. 4-6 SMART Instrument Panel

(2) Function and application

SMART DISPLAY is a smart instrument panel connected to vehicle systems via CAN bus. This instrument panel provides diagnostics and settings for the entire vehicle system.

By connecting the smart display to a ZAPI handheld device or single screen device, the settings of all modules in the CANbus network can be read or modified. The display forms an interface with the operator through a home page and many submenus.

a) Turn on the key switch. After the instrument is powered on, "ACSYSTEM" will appear on the LCD screen to complete a pack of system self-inspection. The home page displays the battery capacity, vehicle speed, current default mode (E) and traction hour meter.

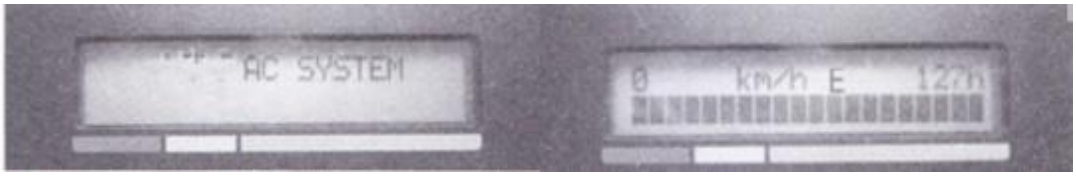


Fig. 4-7 Display Interface on ZAPI Instrument (without Fault)

b) Battery capacity display: The battery capacity (BDI) bar has a total of 20 grids. When the vehicle is powered on and the battery is full, the bar is full (i.e. 20 grids). With the battery discharging, the number of grids decreases showing the reduction of battery capacity. Battery power drop prompt: When the battery power drops to all 20 grids disappear, the fault prompt signs "  " and "  " will flash at the same time, while the traveling speed will slow down, and the lifting action will be cut off. At this time, the battery shall be charged in time.

c) Display of driving mode in traction movement: The driver can select the driving mode through the mode switch, and the current mode is displayed in the instrument interface (see Fig. 4-9). The system has three mode settings: E is the economy mode (default setting), P is the strong mode, and S is the slow mode.

d) Fault code display: If a fault occurs, the instrument icon "  " is steady on, and the window displays the fault code (the first line) and the control module number in the CAN bus network where the fault occurs (the second line). See Table 4-2 for the CAN bus network information of ZAPI system.

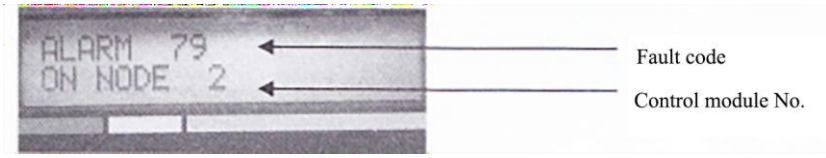


Fig. 4-8 ZAPI Instrument Fault Display Interface

Table 4-2 CAN Bus Network Information of ZAPI System

CAN bus network control module number	**Module Information**
01	SICOS
02	Traction type
03	Traction active model
04	Traction driven model
05	Lifting type
06	EPS-AC
09	MHYRIO
16	Smart display

4.3 MOTOR CONTROLLER

4.3.1 OVERVIEW

This series of counterweight forklift are equipped with CURTIS motor controller from the US, ZAPI ACE2 motor controller from Italy and Inmotion motor controller from Sweden. It has advanced high-frequency MOS technology, excellent speed regulation performance, good safety, flexibility and first-class protection.

The controller assembly includes motor controller, contactor, relay set, fuse, OPS warning buzzer, electronic protector, cooling fan and related harness.

Inmotion Control Device Assembly

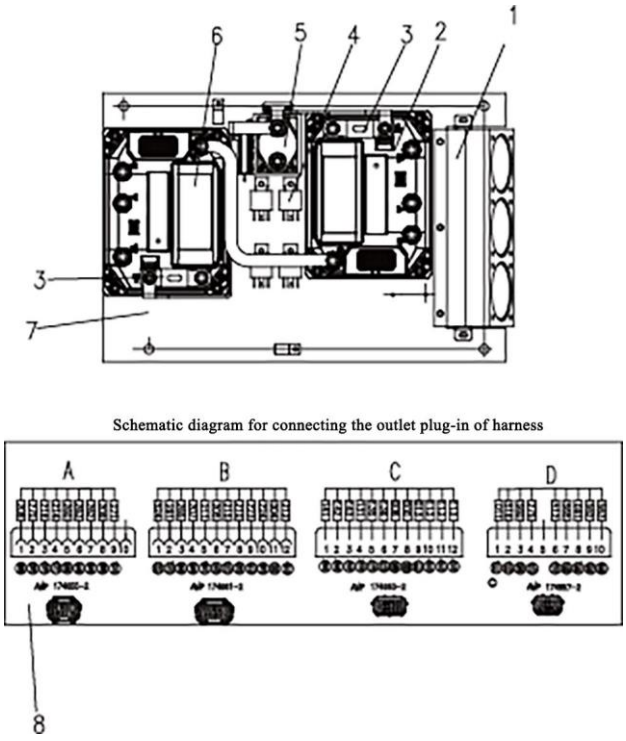


Fig. 4-9 LG15BVI - LG18BVI control device assembly

1. Fan assembly
2. Traction controller
3. Fuse and holder
4. Relay
5. Main contactor
6. Pump controller
7. Heat dissipation base plate
8. Electric control harness

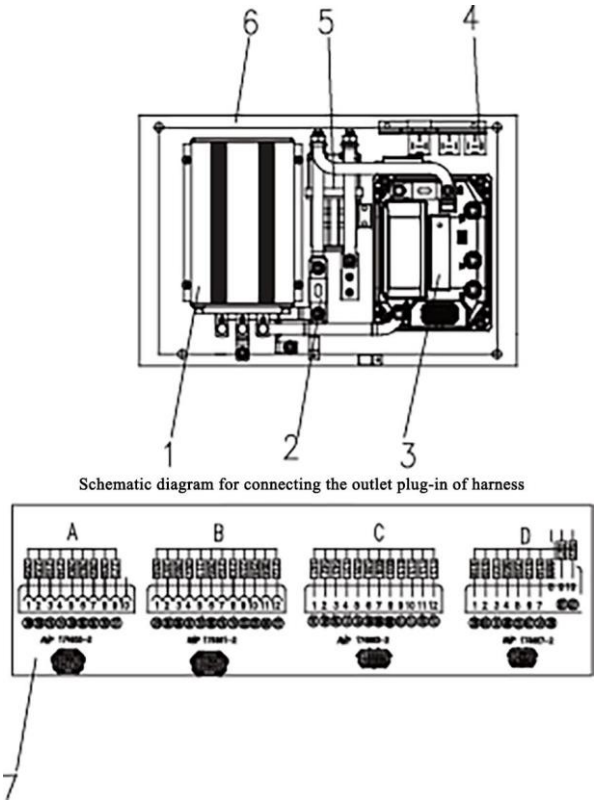


Fig. 4-10 LG15BJVI-LG18BJVI Control Device Assembly

1. Pump controller
2. Fuse and holder
3. Traction controller
4. Relay
5. Main contactor
6. Heat dissipation base plate
7. Electric control harness

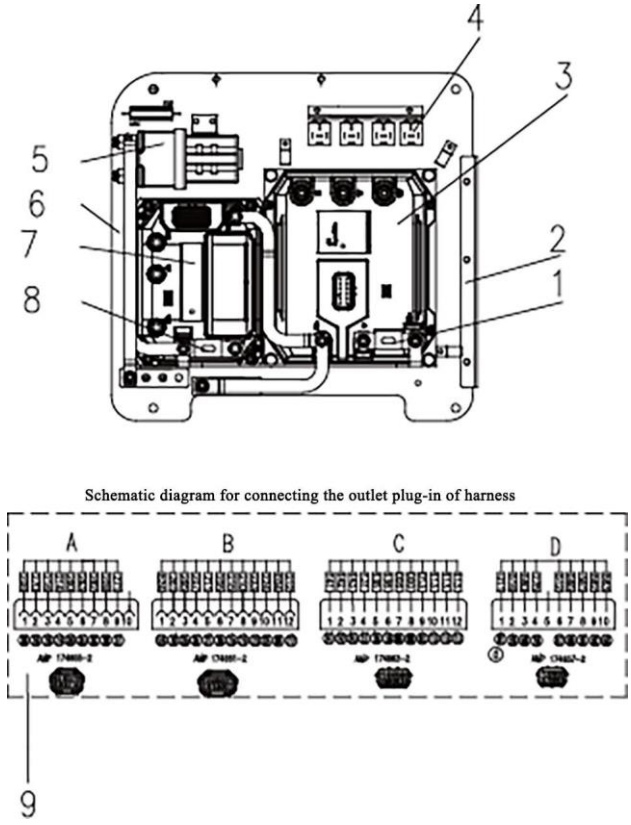


Fig. 4-11 LG20BVI-LG25BVI control device assembly

1. Fuse and holder	5. Main contactor	9. Electric control harness
2. Fan assembly	6. Heat dissipation base plate	
3. Traction controller	7. Pump controller	
4. Relay	8. Fuse and holder	

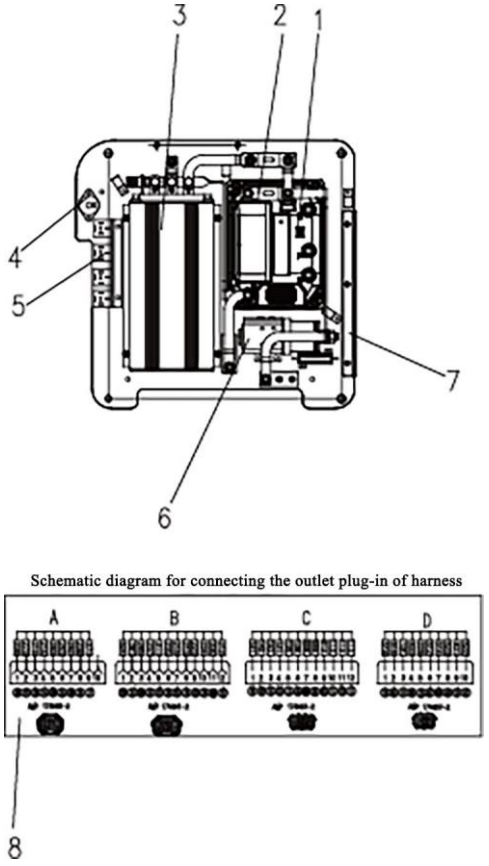


Fig. 4-12 LG20BJVI-LG25BJVI Control Device Assembly

1. Traction controller	4. Relay	7. Fan assembly
2. Fuse and holder	5. Heat dissipation base plate	8. Electric control harness
3. Pump controller	6. Main contactor	9.

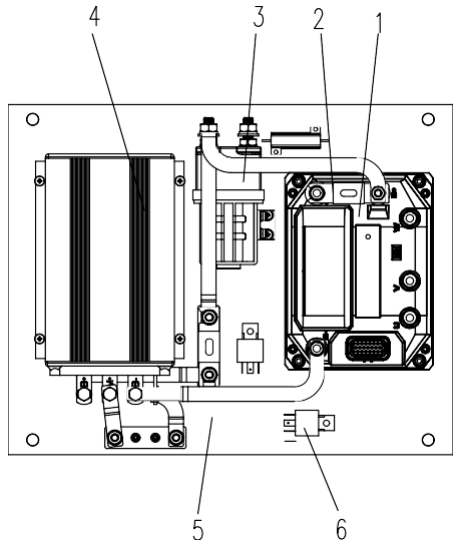


Fig. 4-13 CPD15/18-E Control Device Assembly

1. Traction controller
2. Fuse and holder
3. Main contactor
4. Pump controller
5. Electronic control base plate

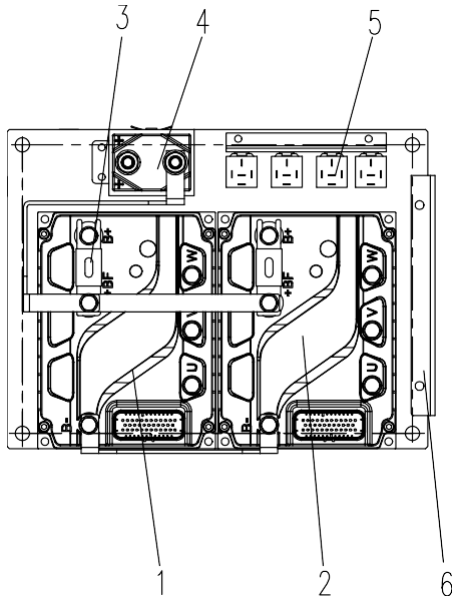


Fig. 4-14 CPD15/18-NE Control Device Assembly

1. Fuel pump controller
2. Traction controller
3. Fuse
4. Contactor
5. Relay
6. Cooling fan

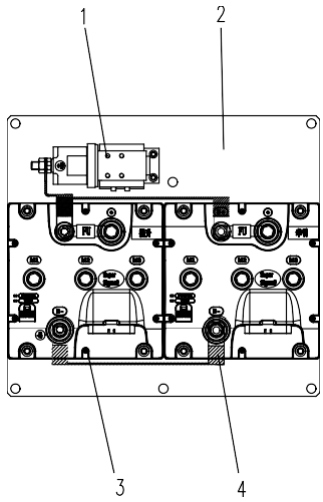


Fig. 4-14 CPD20/25-NE control device assembly

1. Fuel pump controller	3. Fuse	5. Relay
2. Traction controller	4. Contactor	6. Cooling fan

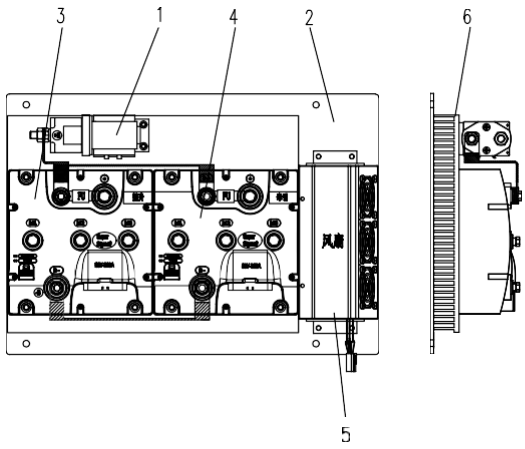


Fig. 4-14 CPD30/35-NE Control Device Assembly

1. Main contactor	3. Pump controller	5. Fan assembly
2. Base plate	4. Traction controller	6. Heat dissipation base plate

Note: The manufacturer shall provide quality assurance for the motor controller. In case of failure, the manufacturer shall be notified in time to provide after-sales service. Please do not open it for maintenance without authorization and approval of the manufacturer. The user shall be liable for personal and property losses caused by his/her unauthorized maintenance.

4.4 Motor

4.4.1 Motor specification

Table 4-3 Motor Specification

Model Items	CPD15-N	CPD18-N	CPD20-N	CPD25-N	CPD30-N	CPD35-N
Traveling motor model	JXQ-8.2-W	JXQ-8.2-W	JXQ-11.5-W	JXQ-11.5-W	TSW180/4-140LT35	TSW180/4-140LT35
Rated power	8.2Kw	8.2Kw	11.5Kw	11.5Kw	11Kw	11Kw
Rated voltage	32.3V	32.3V	33V	33V	31V	31V
Rated current	214A	214A	260A	260A	329A	329A
Rated speed	1140r/min	1140r/min	1800r/min	1800r/min	1450r/min	1450r/min
Model of DC lifting motor	XQD-7.5-3S	XQD-7.5-3S	XQD-10-4S	XQD-10-4S		
Magnetic excitation mode	Series excitation	Series excitation	Series excitation	Series excitation		
Rated power	7.5Kw	7.5Kw	10Kw	10Kw		
Rated voltage	45V	45V	45V	45V		
Rated current	210A	210A	275A	275A		
Rated speed	1550r/min	1550r/min	1600r/min	1600r/min		
AC lifting motor model	JXQD-10.6-W	JXQD-10.6-W	JXQD-15-W	JXQD-15-W	XYD-15HL	XYD-15HL
Rated power	10.6Kw	10.6Kw	15Kw	15Kw	15Kw	15Kw
Rated voltage	31V	31V	31V	31V	31V	31V
Rated current	262A	262A	395A	395A	385A	385A
Rated speed	2200r/min	2200r/min	2200r/min	2200r/min	2200r/min	2200r/min

4.4.2 INSPECTION AND MAINTENANCE OF DC MOTOR

(1) Routine inspection of motor

a) Insulation resistance of motor. Limit (not less than 1MΩ)

b) The motor rotor shall rotate flexibly without friction.

c) Check whether the wiring of the motor is correct and firm.

d) Check whether the commutator segments on the commutator are clean.

Note: During maintenance, wipe the oil stains on the commutator with lint-free cloth dipped in alcohol, and the brush powder between the commutator segments shall be

cleaned with a brush.

e) Check whether the fasteners are loose and whether the brush holder is firm.

f) Check whether the distance between brush holder and commutator surface is appropriate or deformed. (2-4mm)

g) Check whether the brush is complete and can slide freely in the brush holder box, and whether the pressure of compression spring is normal.

h) The contact area between the brush and commutator surface shall not be less than 80%, and No.00 fine abrasive cloth shall be used for polishing before replacement.

(2) Routine maintenance of motor

Pay attention to daily cleaning of motor surface, such as sand or other adhesives on the housing, to avoid poor heat dissipation of the motor.

Normally, it shall be checked once every six months, and the main work is as follows:

a) Carry out external inspection and surface cleaning of the motor, and remove dust from the motor.

b) Check, clean and replace the motor bearing, and listen carefully for abnormal noise during operation.

c) Inspection and replacement of motor brush, inspection and maintenance of commutator surface.

It is normal if the commutator surface appears basically consistent light red after using for a period of time.

Brush polishing:

a) The brush shall be polished with No. 0 fine abrasive cloth, which can be pulled left and right when polishing.

b) After polishing the brush with abrasive cloth and cleaning the commutator, the motor shall run at limited speed to ensure safety until

the working surface of the brush is polished to lustrous.

(3) Operating conditions of motor

a) The altitude shall not be more than 1200 m

b) Ambient air temperature range: -25℃~+40℃;

c) When the relative humidity reaches 100%, condensation will form on the motor surface.

(4) Motor faults and treatment

The faults of DC motor are mainly in the commutator, and the fault symtoms and treatment are as follows (see Table 4-4):

Table 4-4 Troubleshooting Methods of Motor

No.	**Commutator fault symptom**	**Cause**
1	Blackening of all copper sheets	Wrong brush pressure
2	Regular blackening of commutator segment	Short circuit between commutator segments or armature windings, poor welding or open circuit of commutator segments and armature windings.
3	Irregular blackening of commutator segments	Commutator centerline displaced, and the commutator surface not round or uneven.
4	Brush wear, discolored and chipping	Motor vibration, large clearance between brush holder and brush, excessive distance between brush holder and commutator surface, mica protrusion between commutator segments, wrong brush material or model.
5	Large spark of commutator	Motor overloaded, commutator not clean, brush in poor contact, insufficient pressure or stuck brush, brush holder loose or vibrating, and wrong polarity and arrangement sequence of magnetic poles.
6	Brush and braid heating	large brush spark, poor contact between brush and flexible wire, and too small sectional area of the flexible wire.
7	Brush noise during operation	Commutator surface not smooth enough

Note: During the inspection and maintenance of the motor, the power must be cut off to avoid accidents.

4.5 Battery

4.5.1 Battery Specifications

Table 4-5 Battery Specifications (Standard)

Model Items	CPD15/18-N	CPD20/25-N	CPD30/35-N	CPD15/18-E
Model	4PZS420	5PZS600	7PZS700	10DB420H
Capacity	420Ah	600Ah	700Ah	420Ah
Voltage	48V	48V	48V	48V
Number of cells	24 Pcs.	24 Pcs.	24 Pcs.	24 Pcs.
Model Items	CPD15/18-NE	CPD20/25-NE	CPD30/35-NE	
Model	CPD15NE.01.01	LG0020BNE.01.01	CPD30NE..01.01	
Capacity	135Ah	135Ah	280Ah	
Voltage	80V	80V	80V	

Note: Imported batteries can be configured according to user requirements.

4.5.2 USE OF BATTERY

The correct use and routine maintenance of the lead-acid battery make a major difference to the performance and service life of the battery. Therefore, the user must carry out maintenance according to the provisions of the operation and maintenance instructions provided by the manufacturer and the actual situation.

4.5.3 BATTERY MAINTENANCE AND PRECAUTIONS

(1) The surface of the battery shall be kept clean and dry. Poles, bolts, and wiring parts shall be maintained frequently. Loose or poor contact shall be eliminated in time.

(2) No conductive objects are allowed to be placed on the battery to avoid short circuit of the battery.

(3) The first charge of the new battery before use is the initial charging, and all subsequent charges during use are normal charges. The charging time of normal charge varies based on the battery capacity and discharge degree, and it usually takes about 8~12 hours to charge continuously for discharge of 70%~100%.

(4) During battery charging, the gas cap of the filling hole shall be opened, and then closed after charging.

(5) When the battery is charged, oxygen-hydrogen gas will be separated out, so good ventilation conditions shall be ensured, and smoking or open flames are strictly prohibited to prevent explosion.

(6) During the use and charging of the battery, the water in the electrolyte will naturally evaporate and electrolyze resulting in a lower liquid level and higher density of the electrolyte. Therefore, distilled water shall be added frequently to maintain the normal height and density of the electrolyte.

(7) Over-discharge (i.e., the voltage drop of battery cell is below 1.70V) and over-charge shall be avoided as far as possible during the use of the battery. Because over-discharge and overcharge of the battery will seriously affect the service life and performance of the battery.

(8) After use, the battery shall be charged in time within 24h. If the battery is often not charged in time, undercharged, over-discharged, or not used for a long time and not recharged, the battery plate will be vulcanized, resulting in degradation of battery performance and difficulty in use in serious cases.

(9) During the use of the battery, equalizing charge shall be carried out once a month to make all battery cells in a balanced and consistent state.

4.5.4 STORAGE AND PRESERVATION OF BATTERY

(1) The battery shall be stored in a dry, clean and well-ventilated warehouse at 5℃~40℃.

(2) Battery must not be exposed to direct sunshine, solarization or rain, and shall be at least 2m from the heat.

(3) Battery must not be placed inversely or horizontally, and must not be thrown, rolled or pressed.

(4) Contact with any poisonous and corrosive articles shall be avoided, and no metal or impurity may fall into the battery.

(5) The battery shall not be stored with electrolyte. If it is required to be stored in case of special circumstances, it shall be fully charged and the electrolyte level and density shall be adjusted. During the storage period, the battery shall be charged once a month by the normal charging method.

Note: (1) During battery charging, when the electrolyte temperature exceeds 40℃, the charging shall be suspended.

(2) During battery charging, when the electrolyte temperature exceeds 50℃, the service life of the battery will be affected.

(3) Do not charge the battery at low temperatures (such as cold outdoor), otherwise, the service life of the battery will be affected.

Notes: (1) The rated voltage of the traction battery is not safe, so there is a risk of electric shock injury if the battery is touched. Pay attention to your safety.

(2) The traction battery is a lead-acid battery, and the electrolyte is dilute sulfuric acid. During the operarions of testing, acid filling, adjusting,

Attention shall be paid to wearing protective equipment to avoid accidents.

(3) The charger shell is a metal conductor. In order to prevent electric shock accidents, the grounding protection wire of the charger shall be reliably connected.

(4) The battery connector shall not be unplugged when the charger is not turned off, which will cause the battery to be undercharged and thus generate a dangerous electric spark. Therefore, great attention shall be paid.

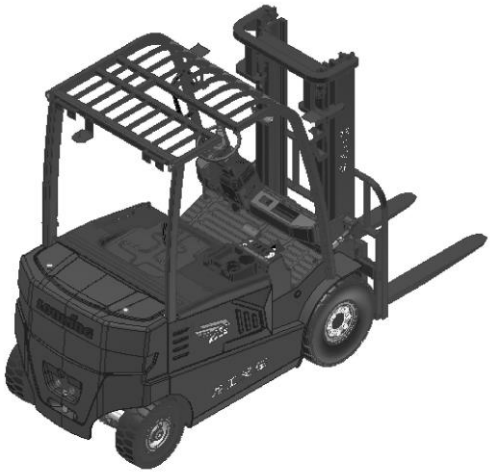
4.5.5 MALFUNCTION AND TREATMENT OF BATTERY

There are many reasons for battery faults. Except for the influence of manufacturing quality and transportation and storage, most of them are caused by improper maintenance. When faults are found, analyze the causes in time and take effective measures to eliminate them as soon as possible.

4.5.6 Introduction to Removal of Battery from Forklift side

Traditional hoisting method is standard for battery replacement of our electric forklift, while a simpler side removal method can be selected to configure for all N series 1-3.5t. There are two ways for side removal: side shovelling and side pulling. Side shovelling is to use another forklift to shovel out the battery out when replacing the battery from a forklift. This is recommended because the 3-3.5t electric forklift has a heavy battery. Side pulling is to pull the battery onto a transfer trolley for replacement. The 1-2.5t electric forklift battery is light, so side pulling can be adopted. These two replacement methods are described as follows:

4.5.6.1 Replacement method of battery by side shovelling:

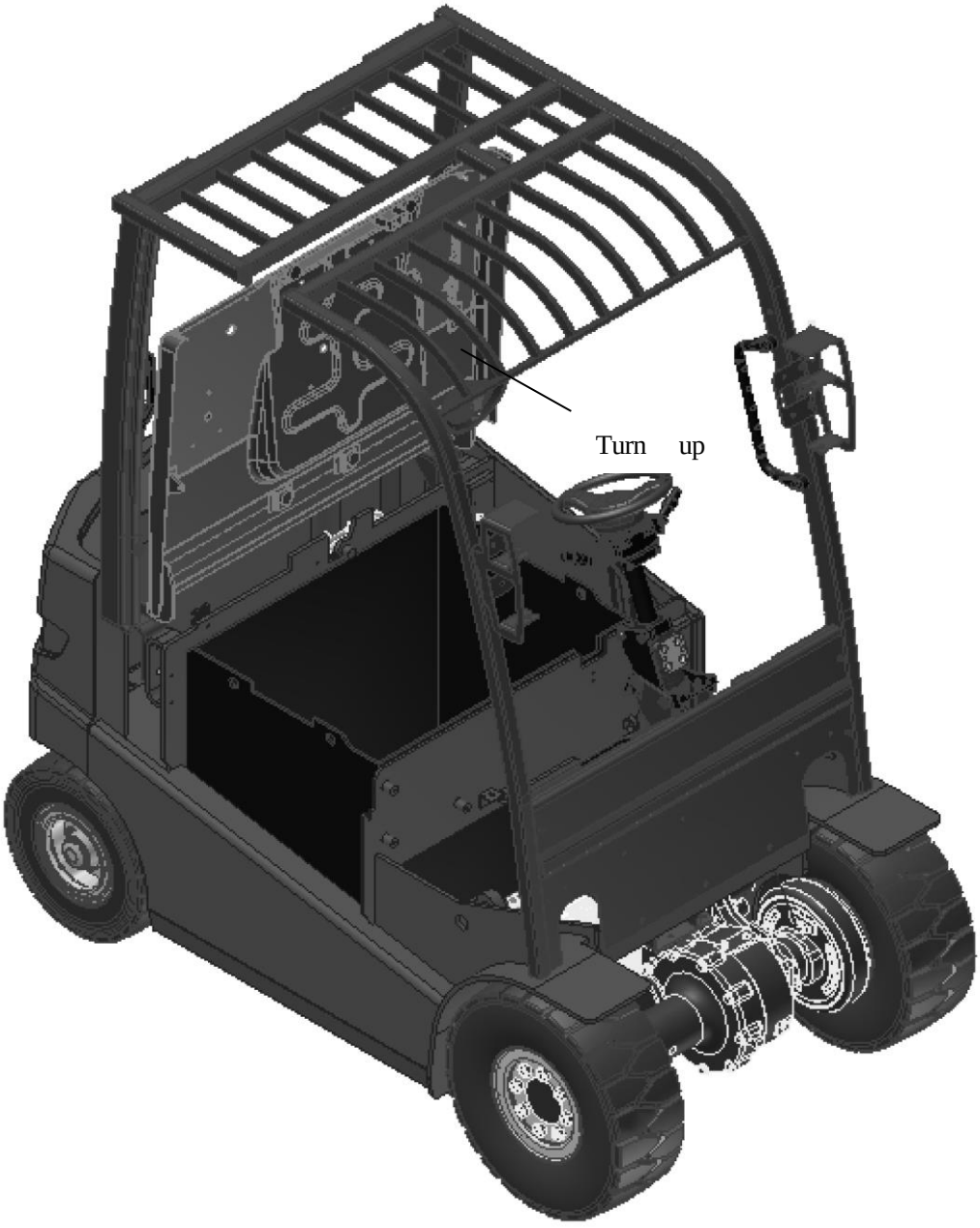


(1) Turn the forklift key switch to the OFF position, unlock the valve control and turn up the valve control bracket.

(2) Open and turn over the hood, and unplug the power plug-in.

(3) Remove the right side plate and side door of forklift body.

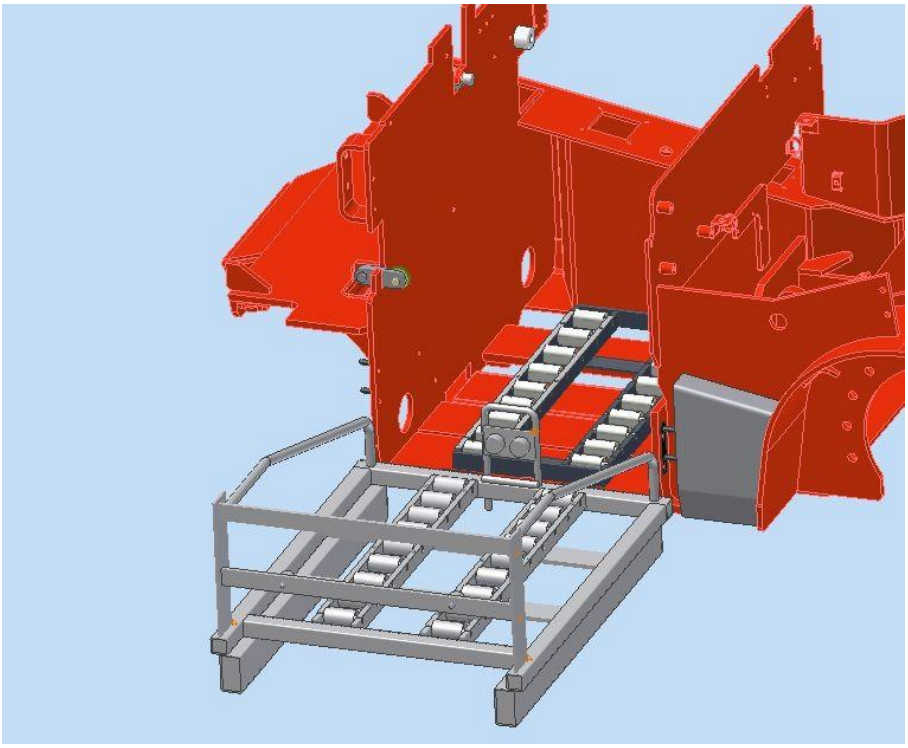
(4) Loosen the locking screws and turn up the battery lock plate.



(5) Use another forklift to replace the battery by inserting the fork into the fork insertion port at the bottom of the battery.

(6) Install the battery in an order reverse to its removal.

4.5.6.2 Replacement method of battery by side pulling:

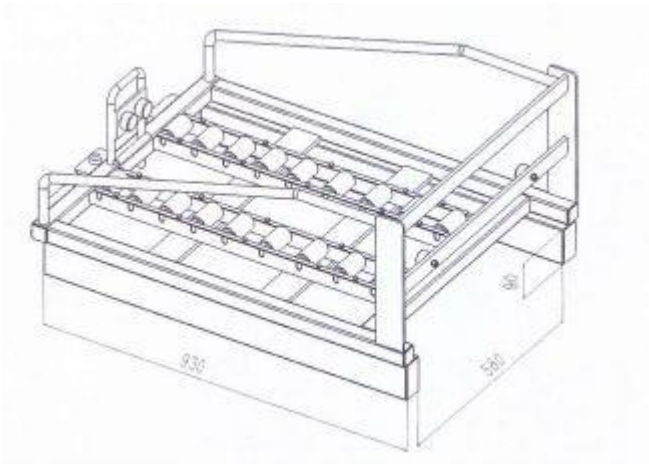


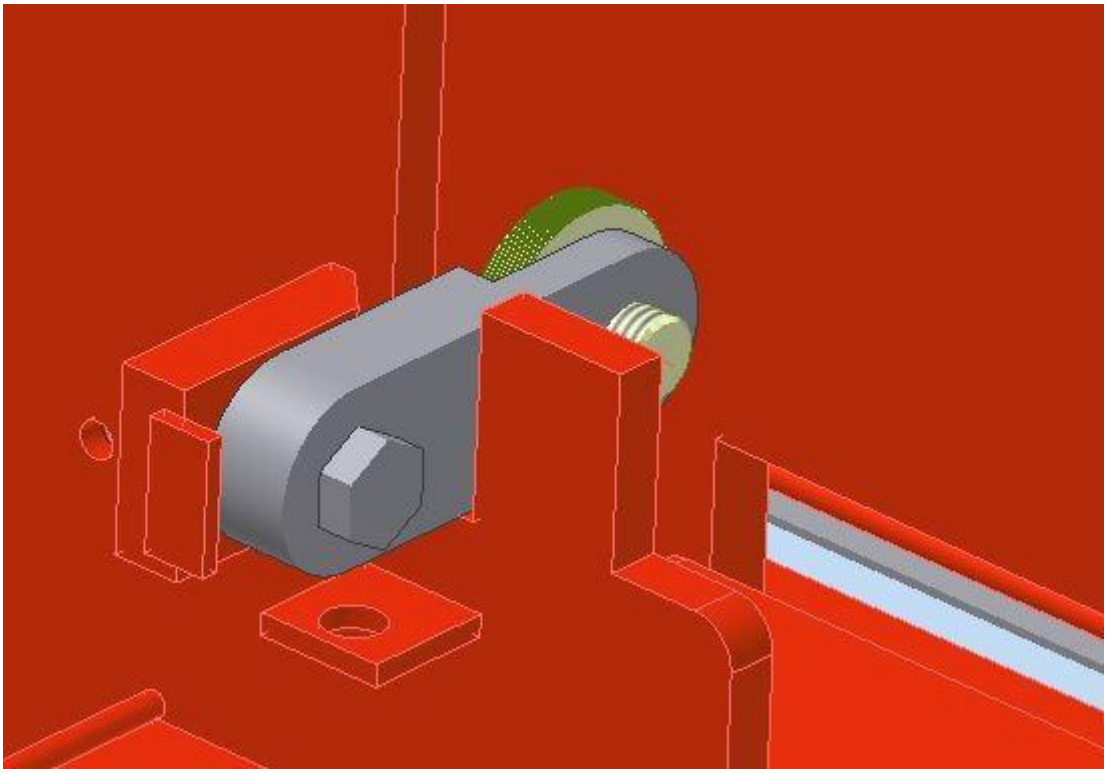
(1) Turn the forklift key switch to the OFF position, unlock the valve control and turn up the valve control bracket.

(2) Open and turn up the hood, and unplug the power plug-in.

(3) Remove the right side plate and side door of forklift body.

(4) Align the battery trolley guardrail with the chassis plate until the trolley guardrail contacts the forklift body, before begin side pulling the battery.





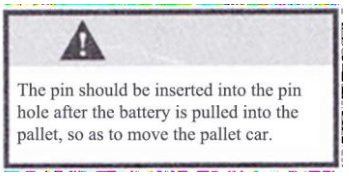
(5) Loosen the locking screws and turn up the battery lock plate.

(6) Take out the battery limit pin on the trolley and move the battery to the trolley.

(7) Install the battery in an order reverse to its removal.

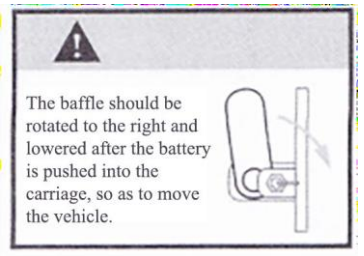
4.5.6.3. PRECAUTIONS

(1) When handling the battery with a pallet truck, be sure to insert the battery limit pin of the transfer trolley in place.



(2) After the battery is installed in the forklift body, insert the pre-tightening strip into the notch of the lock plate.

Be sure to put down the battery lock plate and insert the pre-tightening strip into the notch of the lock plate.



(3) After the battery is installed in the forklift body, be sure to install the battery lock pin at the correct position.

(4) Do not extend your feet under the transfer rack at any time.

(5) If conditions permit, it is better to wear protective clothing and gloves.

(6) It is strictly prohibited to knock the battery pole and wire lead clamp with an tool.

(7) Strong impact and collision shall be avoided during handling.

(8) Check again that the battery is completely in place before the whole machine can be powered on.

Table 4-6 Faults and Treatment Methods of Battery

Fault	**Characteristic**	**Cause**	**Remedial and preventive measures**
Sulfuration of plate	1) Low capacity 2) The electrolyte density is lower than the normal value. 3) The battery terminal voltage is too high at the beginning and end of charging. 4) The electrolyte temperature rises too fast during charging. 5) Bubbles are formed prematurely when charging starts.	1) Insufficient initial charging. 2) Long-term undercharge. 3) Frequent overdischarge. 4) After discharging, failure to charge in time and out of service for a long time 5) Too high electrolyte density 6) Too low electrolyte level causing the plate to be exposed. 7) Failure to perform equalizing charge in time. 8) Discharge current too high or too low. 9) Electrolyte is impure 10) Internal local short circuit or electric leakage.	1) In mild cases, equalizing charge shall be adopted. 2) In severe cases, "hydrotherapy" shall be adopted 3) Do not overdischarge. 4) The electrolyte density shall not exceed the specified value. 5) The electrolyte level and impurity content shall be within the specified range.

Internal short circuit	1) The battery terminal voltage is very low or even close to zero during charging. 2) No or very few bubbles exist at the end of charging. 3) During charging, the electrolyte temperature rises rapidly, and the density rises slowly or does not rise. 4) Battery open-circuit voltage low, dropping to final voltage too early during discharge. 5) Severe self-discharging	1) Plate bending, and active substance expansion or falling off, resulting in damage to the partition and short circuit. 2) Excessive sediment, causing short circuit. 3) Conductive foreign matters fall into the battery causing short circuit.	1) Replace the partition. 2) Remove deposits and conductive materials. 3) Replace the plate
Active materials on plate falling off	1) The battery capacity is reduced. 2) The electrolyte is turbid. 3) Excessive sediment.	1) Electrolyte not up to standard. 2) Too frequent charging and discharging or overcharging and overdischarging. 3) During battery charging the electrolyte temperature is too high. 4) During discharging, the external circuit has short circuit Short circuit	Remove sediment in mild cases, and scrap in severe cases.

4.6 ROUTINE MAINTENANCE

(1) Check the wear condition of the contacts. Replace the contacts when they are worn. The contacts shall be checked once every three months.

(2) Check the of pedal or handle microswitch, and measure the voltage drop at both ends of the microswitch. There shall be no resistance when the microswitch is on or off, and there shall be clear sound when it is released. Check once every three months.

(3) Check the main circuit: battery-inverter-motor connecting cable. Ensure that the cable is well insulated and the circuit is tightly connected. Check once every three months.

(4) Check the mechanical movement of the pedal or handle. Check whether the spring can deform normally and whether the potentiometer spring can stretch to the maximum level or set level. Check once every three months.

(5) Check the mechanical movement of the contactor. It shall move freely and not stick, and the mechanical action of the contactor shall be checked once every three months. If any condition that may cause damage or endanger safety is found during the inspection, the agent of ZAPI shall be notified immediately, and the agent shall decide the operation safety of the vehicle.

Note: After the chopper is installed and the electric lock switch is disconnected, the filter capacitor still retains a certain voltage for a period of time. If the inverter needs to be maintained at this time, the battery must be cut off first, and then 10-100 shall be used. The forklift wheels shall be lifted (off the ground) for test, so that no danger will occur even if there is any connection error.

The resistance of Ohm is connected to the positive and negative poles of the inverter to short circuit the residual voltage on the capacitor.

4.7 LITHIUM BATTERY

4.7.1 Instructions for use

Basic Parameters of Lithium Battery (Standard)

Model Items	CPD15-N	CPD18-N	CPD20-N	CPD25-N	CPD30-N	CPD35-N
Model	4PZS420	4PZS420	5PZS600	5PZS600	7PZS700	7PZS700
Capacity	200Ah	200Ah	400Ah	400Ah	300Ah	300Ah
Voltage	48V	48V	48V	48V	80V	80V

Battery operating temperature

The operating temperature requirements of the battery include charging temperature requirements and discharging temperature requirements:

(1) Charging temperature range: 0~40°C. Large-rate charging in a low-temperature environment below 0°C will cause damage to the battery;

(2) The discharge temperature range is :-20~60℃. The discharge capacity at low temperature (-20~0°C) may be lower than that at normal temperature, which is normal. The battery can be used at an ambient temperature of 40~60°C. However, if the ambient temperature of the battery is too high, especially when the battery is in a high temperature environment for a long time, it

will accelerate the aging of the internal materials of the battery and shorten the service life of the battery. Therefore, it is not recommended to use the battery at this temperature for a long time;

If the ambient temperature is beyond the above charging and discharging temperature range, it will have a negative impact on or damage to the battery performance and may greatly shorten the service life of the battery. Therefore, use at the above temperature should be avoided.

Please use the battery pack in strict accordance with the conditions specified in the operation manual; otherwise, it may not be covered by the warranty:

(1) Do not operate the electric vehicle equipped with a power battery pack where the ambient temperature exceeds 60°C;

(2) When the ambient temperature is lower than 0°C, please stop charging the power battery pack/vehicle;

(3) Try to prevent the power battery pack from water;

(4) When the battery pack is stored for a long time (more than 6 months), it shall be completely powered off. The manufacturer recommends that the battery pack should be stored in 60% SOC with an ambient humidity of not less than 95%RH;

The following table is for reference.

Storage environment Temperature	Storage environment Relative humidity	Storage time
-10~0℃	5%~95%	≤6 months 60%SOC
0~40℃	5%~95%	≤6 months 60%SOC
40~45℃	5%~95%	≤2 months 60%SOC

5) Lithium batteries are maintenance-free. If there is no fault during the warranty period, it is not necessary to maintain the battery pack. In case of a fault, do not touch, move or disassemble the battery pack or the corresponding high voltage cables, or other components with high voltage warning signs without the consent of our technical support personnel;

(6) If the vehicle suffers a heavy impact while traveling, please park the vehicle in a safe place and check whether the battery pack is damaged;

(7) If the battery is found to be leaked (liquid or smoke) or damaged, please keep a safe distance and contact the manufacturer's after-sales service personnel;

(8) Do not contact the leaked electrolyte; in case of contact due to carelessness, wash

immediately with water; in case of eye contact, wash with the boric acid solution and seek medical advice immediately;

(9) When the vehicle or power battery pack catches fire, quickly leave the vehicle to a safe distance and use a special fire extinguisher for electric fire. Using water or an incorrect extinguisher to extinguish a fire can result in electric shock.

(10) Due to the characteristics of the battery, it is allowed that the attenuation rate of battery capacity is between 10% and 30% within the warranty period.

Transportation

1. During loading, unloading and transportation, violent vibration and large external impact shall be avoided. Throwing, rolling, upside down, squeezing and high stacking are prohibited;

2. Prevent rain during transportation;

Warning!

In order to avoid personal injury and property loss, please read the following terms before using the electric forklift, and normal use and operation shall be according to the procedures or methods specified in the terms.

The first use is recommended to be carried out with the participation of engineering technicians with electrical and electronic knowledge of lithium battery forklift truck or under the correct guidance of battery company technicians. It is forbidden to disassemble and assemble the forklift lithium battery pack without authorization.

In case of any doubt or uncertainty, please contact the relevant technical department or after-sales service department.

Notes:

1. Ensure that the battery or battery pack is far away from hazardous goods or hazardous materials, such as corrosive chemicals, hazardous mechanical equipment, and high temperature environment;

2. Unreasonable use of this series of products, such as external short circuit, overcharge and excessive ambient temperature, may lead to smoking. In case of smoking, please cut off the power supply immediately, use carbon dioxide or dry powder fire extinguisher, and cover it with sand or soil. At the same time, people shall be evacuated and alarm issued immediately (if necessary);

3. Unreasonable use of this series of products may cause the battery cell to bulge, or even cause the plastic shell to break or crack. In this case, please stop using the battery immediately and contact the relevant technical department or after-sales service department of our company without delay to obtain the handling method;

4. It is forbidden to disassemble, squeeze, puncture, put or bake the battery and battery box at high temperature, so as to prevent the battery from being subjected to excessive vibration, external impact, falling from high altitude, etc. These operations may cause personal injury or property loss;

5. ·It is forbidden to expose the battery or keep it in an environment above 60 ℃ for a long time. It is forbidden to heat the battery or put it into fire, which may cause personal injury or property loss;

6. It is forbidden to charge the battery without installing a reasonable charging protection device (lithium-ion battery protection circuit board, battery management system, etc.) or using charging equipment (charger, DC power supply, etc.) not authorized by the battery manufacturer, which may cause personal injury or property loss;

7. The battery shall not be immersed in water or other conductive liquids, which may cause personal injury or property loss;

8. Do not allow children or other people lacking knowledge of safe use of lithium-ion batteries to use this series of products. This operation may cause personal injury or property loss;

9. It is forbidden to use this series of products in series or in parallel with other models or types of batteries, as this operation may cause personal injury or property loss;

10. It is forbidden to connect the whole power supply system containing lithium-ion battery protection circuit board or battery management system in series or in parallel. This operation may lead to personal injury or property loss. If necessary, please contact the relevant technical department of the manufacturer for correct technical support.

Charging safety warning:

Notice before charging:

Please charge the battery in a relatively safe environment (e.g. avoid liquid, fire, etc.).

The charger shall be equipped with necessary fire extinguishing devices (yellow sand and dry powder fire extinguishers) around, so as to carry out emergency fire extinguishing in extreme cases.

Before charging, make sure that the charging plug and the charging socket are free of dust, water and other foreign matters. If there is any foreign matter, clean it before charging. Otherwise, the poor contact of the charging plug and the charging socket will lead to heating and even fire.

Do not modify or remove the charging interface and charging equipment, which may result in charging fault or fire;

In order to avoid serious personal injury, the following precautions shall be taken when the vehicle is charging:

(1) Do not touch the metal terminal in the charging port or charging plug;

(2) When there is lightning, do not charge the vehicle or touch the vehicle. Lightning strike may cause damage to the charging equipment and personal injury.

After charging, do not disconnect the charging equipment with wet hands or standing in water, because this may cause electric shock and personal injury;

After charging, please close the protective cover of the charging port of the vehicle to avoid foreign matters entering the charging port during the operation of the vehicle, because this may cause damage to the charging port.

To avoid damage to the charging equipment, please pay attention to the following items:

(1) Don't close the charging port hatch when the charging port cap is opened.

(2) Do not roughly pull or twist the charging cable;

(3) Don't let the charging equipment be subject to impact;

(4) Don't store or use charging equipment in any environment with a temperature higher than 50°C;

(5) It is forbidden to directly plug or unplug the charging plug when the charger still outputs the charging current, which may cause electric arc, property loss and personal injury

(6) Do not place the charging equipment near the heater or other heat sources.

Operation steps of the main power supply

1. Charging preparation

(1) Make sure that the key switch of the vehicle to be charged is off, i.e. the vehicle is not charged, as shown in Fig. 1(a);

Switch off the key

(2) Remove the charging plug head from the charger (note: The charging plug head is integrated with a button lock as shown in Fig. 1(b), which must be pressed before normal plugging and unplugging operations), and check the charging plug and the lithium battery charging port at the vehicle end

Lock button

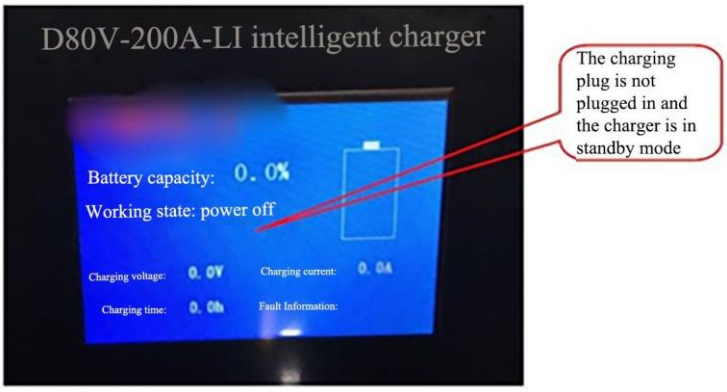
, ensure that there is no water or foreign matters in the port, and metal terminals are not damaged or not rusted or affected by corrosion, as shown in Fig. 1(c) and (d);

(3) There is a power switch on the rear side of the charger. Push up the power switch, and then the power indicator (green) flashes quickly. The instrument display is shown in Fig. 2. At this time, since the charging plug is not connected to the vehicle, the charger is in standby mode.

(4) Plug and unplug only after the button lock is pressed

	
Check that the terminals inside the charging plug are free of foreign matters. Inspection of gun head terminal	Check that the internal terminals of charging socket are free of foreign matters Socket terminal inspection

Instrument display in standby mode



2. Charging connection completed

Insert the charging plug into the lithium battery charging socket at the forklift body. The charger performs self-inspection and communicates with the lithium battery. When there is no fault in the whole system, about 15S later, the relay inside the charger closes to start charging, and the charging indicator (red) lights up. At the same time, the instrument will display information such as charging voltage, charging current, charging time and charging fault, as shown in Fig. 3.

Fig. 3 Normal Charging Display

3. Power-off after charging

When the lithium battery is fully charged, the charger will automatically stop charging. At this time, the green light stays on to indicate that it is fully charged, and the output voltage and current on the instrument are 0, as shown in Fig. 4. Press the pause button and then pull out the charging plug head, as shown in Fig. 5. If charging needs to be stopped before the lithium battery is fully charged, press the stop button on the screen first. After the charging current drops to 0A, turn off the emergency stop switch and then pull out the charging plug head.

Fig. 4 Charging Finish Display

3. Before transportation, ensure that the battery or battery pack has been disconnected from the vehicle and charging equipment without any form of charge/discharge.

4.8 FAULT DIAGNOSIS

4.8.1 ZAPIHP-CAN Controller

This series of controllers can obtain diagnostic information through the number of LED

flashes and the fault code sent to the instrument.

(1) Fault code and troubleshooting method of HP-CAN controller (the second line of the instrument displays "ONNODE5", see Table 4-7 for details).

Table 4-7 Fault Code and Treatment of HP-CAN Controller

CODE	**NOTE**	**Fault description**
13	EEPR0M KO	EEPR0M Error
241	CAN BUS KO	CAN BUS not connected
243	KEYOFF	Short circuit of key switch
244	WATCHDOG	Logic card self-check fault
76	COIL SHORTED	Coil short circuit
74	DRIVER SHORTED	Drive short circuit
53	STANDBY HIGH CURRENT	High current in standby
30	VMN LOW	-M voltage detection low
49	CURRENT ALWAYS EQUAL 0	0 current detected
33	FULL CONDUCTION KO	Not fully conducted
78	VACC NO OK	Speed regulating sensor fault
62	THERMIC SENSOR KO	Fault in temperature sensor
66	BATTERY LOW	Insufficient battery power
79	INCORRECT START	Start-up sequence protection
7	CHOPPER NOT CONFIG	Logic card data memory failure
242	BATTERY VOLTAGE	The battery charge is too high
246	WAIT MAIN CONTAC	Main contactor is not on

(2) Description of some fault information of HP-CAN controller

a) <WATCHDOG>

The self-diagnosis of the logic card is tested in real time during operation and standby; if this fault occurs, the logic card needs to be replaced.

b) <INCORRECT START>

This fault is a controller safety protection caused by an incorrect starting sequence.

Possible causes:

- Adhesion of valve control switch or wrong connection of lines;
- Wrong operation sequence. Control valve lever is pulled before opening the electric lock.

c) <VMNLOW>

This test is carried out when the vehicle is in a use state. If the voltage between the battery negative pole and the pump controller -M terminal is lower than 1/3 of the battery voltage, this fault message will be displayed.

Possible causes:

- 30 motor connection error;
- Controller 49 is damaged and needs to be replaced.

d) <FUL33LCONDUCTIONKO>

The controller detects the input voltage at -M terminal when 79 fully conducted. If it is higher than 1/3 of the battery voltage, the controller stops working and displays this 62 fault; if this fault occurs, replace the logic card.

e)<VACCNOTOK66>

The controller 79 detects the output voltage of the speed regulating sensor when the vehicle is in standby, and this fault occurs if the output voltage is detected 1V greater than the minimum voltage value stored in the setting menu (PROGRAMVA7CC).

Possible cause: 242

- Fault of speed regulation sensor 246; (replace)
- Wiring error of speed regulation sensor; (port C2 of controller is not connected)
- The setting value in the accelerator signal menu (PROGRAMVACC) is wrong.

f) <STANDBYHIGHCURRENT>

When the vehicle is standby, the controller detects whether the pump motor current is 0; if not, the controller immediately stops working and displays this fault.

Possible causes:

- The logic card in the controller is faulty; (replace the logic card)
- The current sensor in the controller is faulty. (Replace the controller)

g) <DRIVERSHORTED>

The controller checks whether the driving voltage of (G port) contactor is consistent with the preset value when the vehicle is standby; if not, this fault occurs.

Possible causes:

- Logic card is damaged. (The contactor coil discharging circuit or the driver circuit

fails, and the logic card needs to be replaced)

h)<COILSHORTED>

(G port) Contactor drive output overloaded or short-circuited to battery B+.

Possible causes:

- The contactor coil is short-circuited or the contactor coil current is greater than 6A;
- Short circuit between the contactor coil connecting wire and battery B+, resulting in overload protection of the drive;
- Contactor connection fault or logic card fault.

j) <CHOPNOCONF.>

The memory storing parameters such as controller operation mode and function setting is faulty. If the fault still exists after repeatedly closing the electric lock, replace the logic card. If the fault disappears, the originally stored parameters have changed, and parameters need to be reset.

(3) Common faults of ZAPI instrument system (the second line of the instrument displays "0NNODE16", see Table 4-12 for details)

Table 4-8 Common Faults of ZAPI Instrument System

Fault code	**Definition**	**Description**	**Measures**
13	EEPROM KO	EEPM damaged	The failure occurs in the memory that stores the adjustment parameters. When this fault occurs, the machine stops automatically. If the fault still exists after the electric lock is turned off and then turned on, replace the controller. If the fault disappears, the previously stored parameters will be replaced with default values.
18	LOGIC FAILURE #2	Logic card fault	The circuit of A19 or A20 output port is faulty, which is irrelavant to external components. Replace the instrument.
76	COIL SHORT	Coil short circuit	If the drive coil is short-circuited, check whether there is a short

			circuit in the equipment connected to the instrument output port. Otherwise, replace the instrument.
102	CAN BUS KO MASTER	CAN communication fault	The instrument no longer receives data from the CAN BUS data line. If this fault code is displayed together with other alarm signals, the fault may occur on the CAN interface of the instrument because the instrument seems unable to receive any information. Therefore, it is recommended to check the instrument CAN wiring and its connection; otherwise, there will be a CAN interface fault of other modules on the CAN network.
103	SERVICE REQUIRED	Service required	It is time for maintenance and repair.
104	HYDRAULIC OIL		The hydraulic oil level input is valid at start-up. Fault diagnosis: Check that the relevant digital inputs on the instrument (A9) are valid, (see TESTER MENU). Check the effective level form (+VB or GND) of this input terminal (see SET0PTI0NMENU). 1) If the input is valid, check the relevant switch status, circuit and oil level. 2) If the input is invalid, there may be a fault in the input circuit of the smart instrument.

4.7.2 INMOTION CONTROL SYSTEM

Table 4-9 Fault codes and troubleshooting methods of INMOTION controller

Fault	**Interpretation**	**Solution**

code		
20	ERROR (Accelerator pedal switch active at start)	Release accelerator pedal
21	ERROR (Direction switch active at start)	Set the direction switch to neutral
22	ERROR (Front and rear direction switches activated simultaneously)	Direction switch fault
23	ERROR （Accelerator pedal analog value out of range）	Accelerator pedal fault or the analog value needs to be recalibrated
24	ERROR (Accelerator pedal analog fault)	
31	CAN communication fault of ERROR Driver	Please check whether CAN line or controller and instrument are disconnected
32	ERROR (Low battery voltage)	Charging required
34	ERROR (CPU internal error)	It is recommended to replace the hardware for detection.
36	ERROR (Tilt switch active at start)	Reset the tilt switch
37	ERROR (Side shift switch active at start)	Reset the side switch
38	ERROR (Accessories switch active at start)	Reset accessory switch
39	ERROR (Lift switch activated at start)	Reset the lift switch
40	ERROR (Lift analog value out of range)	Lift analog value is damaged or needs to be recalibrated.
43	ERROR (Angle analog value out of range)	The angle analog value is damaged or needs to be recalibrated.
44	WARNING (Drive speed protection)	Alarm for high vehicle speed;
45	WARNING (Traction drive encoder error)	Check whether the encoder harness is in poor contact
81	WARNING (Traction drive temperature low)	Too low ambient temperature
82	WARNING (Traction drive temperature high)	Traction drive temperature too high, power limited
83	ERROR (Traction driver temperature sensor error)	Replace the drive
84	WARNING (Traction motor temperature low)	Too low ambient temperature
85	WARNING (Traction motor temperature high)	Traction motor temperature too high, power limited
86	WARNING tractor high temperature	Traction motor temperature too high, power limited
87	ERROR (Traction motor temperature	Traction motor temperature sensor

	sensor error)	abnormal. Check the sensor or wiring harness
88	WARNING (High DC bus voltage of traction driver)	Input voltage to the drive detected too high
89	WARNING (igh DC bus voltage of traction driver	Charging or inspection of the power wiring harness is required
90	WARNING (The default value of traction driver is loaded)	Refresh the protection after the program and restart the key.
91	WARNING (Traction driver energy-limited mode)	Low battery and vehicle performance limited
97	ERROR (Traction driver output port error)	Check the outlet harness for short circuit and open circuit (e.g., main contactor and reversing relay)
98	WARNING (Traction driver overcurrent or short circuit)	Check power wiring harness
101	ERROR (Traction motor driver shorted)	
102	ERROR (Traction driver temperature high)	Drive temperature is too high, please cool down
103	ERROR (Traction motor temperature high)	Motor temperature is too high. Please cool down
104	ERROR (Traction driver overcurrent)	Check power wiring harness;
105	ERROR (Traction driver precharge timeout)	Replace precharge resistor
110	ERROR (Traction driver DC bus voltage low)	Driver input voltage is too low. Check the battery voltage or whether the contactor is closed
111	ERROR (Traction driver DC bus voltage high)	Drive input voltage is too high. Check the battery voltage
112	ERROR (Traction driver DC bus voltage high (hardware monitoring))	
114	ERROR internal electric supply fault 内部供电故障	Check wiring harness of motor encoder and temperature sensor
121	WARNING (Pump driver temperature low)	Too low ambient temperature
122	WARNING (Pump driver temperature high)	The pump driver temperature is too high, and the power limited
123	ERROR (Pump driver temperature sensor error)	Replace the drive
124	WARNING ING pump motor temperature low	Too low ambient temperature
125	WARNING (Pump motor temperature	Pump motor temperature is too high

	high)	and the power limited.
126	ERROR (Pump motor temperature sensor fault)	The pump motor temperature sensor is abnormal. Check the sensor or harness
127	ERROR (Pump driver speed sensor fault)	The pump motor speed encoder is abnormal. Check the encoder or wiring harness
128	WARNING (Pump driver DC bus voltage high)	Input voltage to the drive is detected
129	WARNING (Pump driver DC bus voltage low)	Charging or inspection of the power wiring harness is required
130	WARNING (Default value of pump driver is loaded)	Refresh the protection after the program and restart the key.
132	WARNING (Pump driver energy limit)	The battery is low and needs to be charged
137	ERROR (Pump driver output fault)	Check the outlet harness for short circuit and open circuit
138	WARNING (Pump driver overcurrent or short circuit) Check power wiring harness	Check power wiring harness
141	ERROR (Pump driver shorted)	
142	ERROR (Pump driver temperature high)	Drive temperature too high; cool down
143	ERROR (Pump motor temperature high)	Motor temperature is too high. Please cool down
144	ERROR (Pump driver current calibration error)	Reboot
145	ERROR (Pump driver precharge timeout)	Replace precharge resistor
150	ERROR DC bus voltage low	Driver input voltage is too low. Check the battery voltage or whether contactor is closed
151	ERROR (Pump driver DC bus voltage high)	Drive input voltage is too high. Check the battery voltage
152	ERROR (Pump driver DC bus voltage high) (Hardware monitoring)	
153	ERROR Pump driver internal error	Check wiring harness of motor encoder and temperature sensor
154	ERROR (Pump driver speed control fault)	Check the encoder or wiring harness

Notes

1. When all signals or no signal of three driving modes (P/E/S) of the traction system are input to the controller at the same time, the vehicle runs in the default mode (E).

2. When the turn signal device fails, the vehicle runs at the speed limited.

5. HYDRAULIC SYSTEM

5.1. OVERVIEW

The hydraulic system consists of oil pump, multi-way valve, priority valve, lift cylinder, tilt cylinder, high and low pressure oil pipes, joints and other parts. The lifting motor drives the oil pump, which marks the conversion of mechanical energy into hydraulic energy. The pump provides oil for the system, which is distributed to each oil cylinder through the multi-way valve.

5.1.1 OIL PUMP

A pair of external gears mutually engaged serve as the main parts of the gear oil pump used in the forklift. The working principle is shown in Fig. 5-1.

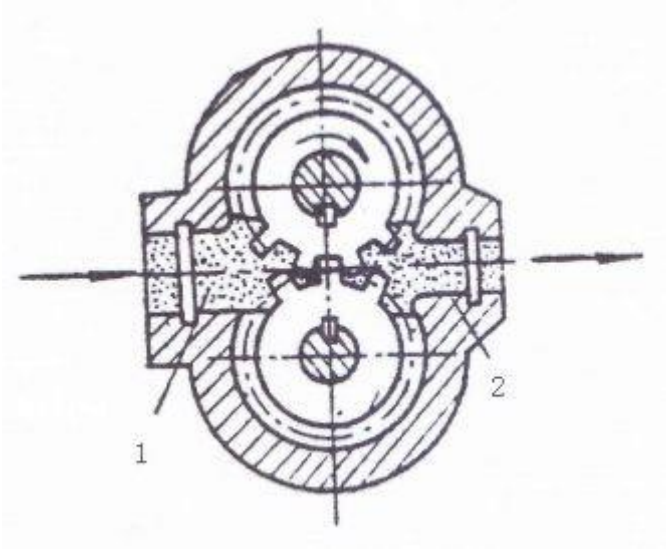


Fig. 5-1 Working Principle of Gear Pump

1. Oil suction chamber 2. Oil pressing chamber

A pair of meshing involute gears are installed inside the housing, and both ends of the gears are

sealed. The gears divide the pump housing into two sealing oil cavities, i.e., the spaces marked 1 and 2 in the figure. When the gear of the gear pump rotates in the direction shown in the figure, the volume of the space (where the gear teeth are disengaged) indicated by the number 1 increases, forming a vacuum. Under the action of atmospheric pressure, the oil in the oil tank enters the oil suction cavity through the oil suction pipe of the pump and fills the space between the teeth. However, the volume of the space (gear meshing position) indicated by the number 2 decreases, and the oil is hydraulically fed into the pressure oil circuit. That is, 1 is the oil suction cavity, 2 is the oil pressure cavity, and they are separated by the meshing points of two gears. When the gear rotates continuously, the oil suction and discharge port of the pump continuously sucks and discharges oil.

The oil pump converts the mechanical energy of motor into hydraulic energy, so the oil pump is the power mechanism of forklift hydraulic system. The main pump consists of pump body, a pair of gears, liner plate and oil seal. The pressure balance bearing and special lubrication method are used to minimize the gear backlash. The pressure balance method is to press the liner plate against the side of the gear due to the oil discharge guide between the liner plate and the pump body, as shown in Fig. 5-2.

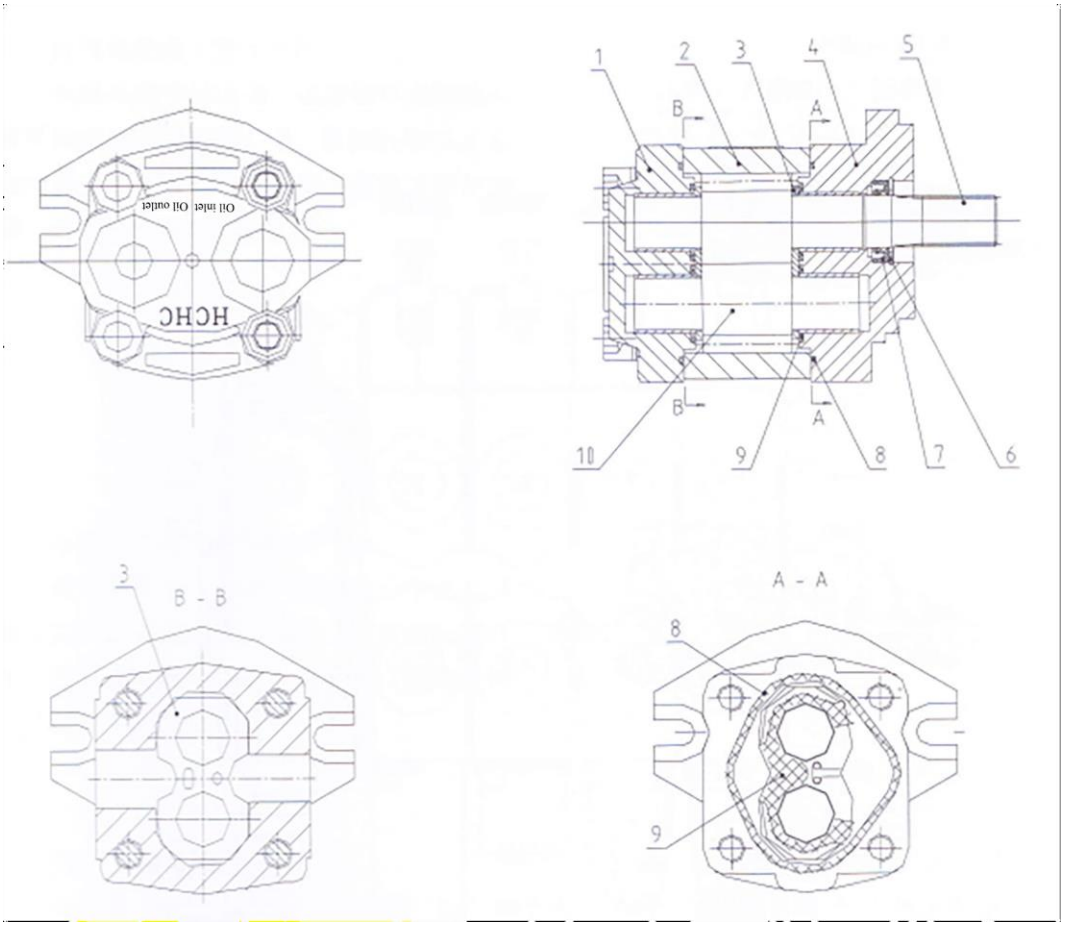


Fig. 5-2 Outline Drawing of Gear Pump Structure

1. Pump body
2. Drive gear
3. Driven gear
4. Rear end cover
5. Rear end cover
6. Liner plate
7. Sealing ring
8. Retainer ring
9. Oil seal
10. Elastic retainer ring

5.1.2 MULTI-WAY VALVE

The appearance of the multi-way valve is shown in Fig. 5-3.

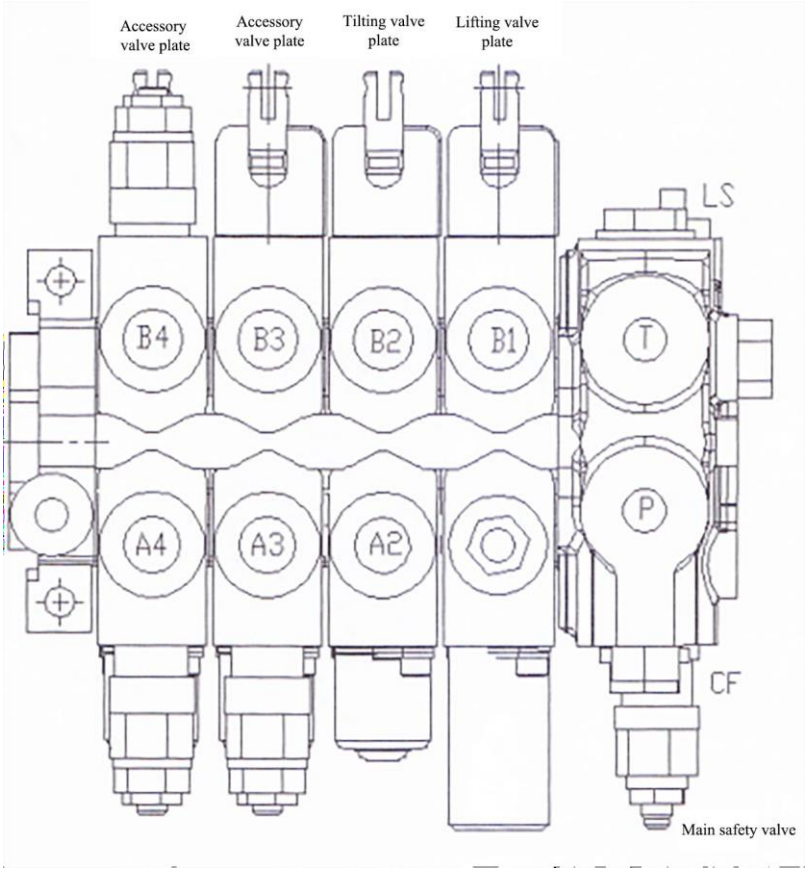


Fig. 5-3 Outline Drawing of Multi-way Valve

The multi-way valve is of two-piece four-body type, and the hydraulic oil from the working oil pump is controlled by the valve stem of the multi-way valve, and the high-pressure oil is distributed to the lift cylinder or the tilt cylinder. Safety valve and self-locking valve are installed inside the multi-way valve. The safety valve is arranged on the oil inlet plate of the multi-way valve to control the system pressure; and the self-locking valve is arranged on the tilting valve plate, which is mainly used to prevent serious consequences caused by incorrect operation of the operating rod when the tilt cylinder has no pressure source. Check valves are installed between the oil inlet and the oil suction of the lifting valve plate and between the oil inlet of lifting valve plate and the oil inlet of tilting valve plate.

(1) operation of slide valve (taking the inclined slide valve as an example)

a) Neutral position (Fig. 5-4)

At this time, the high-pressure oil discharged from the oil pump returns to the oil tank through the neutral position.

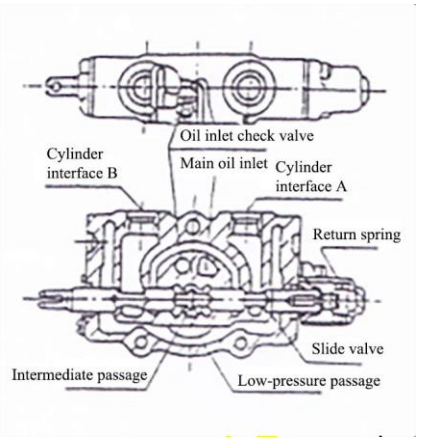


Fig. 5-4 Push-in Slide Valve

b) Push the slide valve (Fig. 5-5)

At this time, after the middle passage is closed, the oil from the oil inlet flows to the oil cylinder interface B by opening the check valve, and the oil from the oil cylinder interface A flows to the oil tank through the low pressure channel. With the help of the return spring, the slide valve can return to the neutral position.

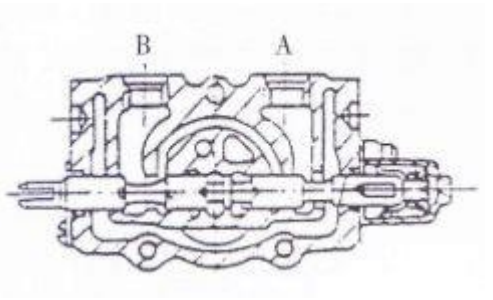


Fig. 5-5 Push-in Slide Valve

c) Pull out the slide valve (Fig. 5-6)

At this time, after the neutral position is closed, the oil from the oil inlet flows to the oil cylinder interface A by opening the check valve, and the oil from the oil cylinder interface B flows to the oil tank through the low pressure passage. With the help of the return spring, the slide valve can return to the neutral position.

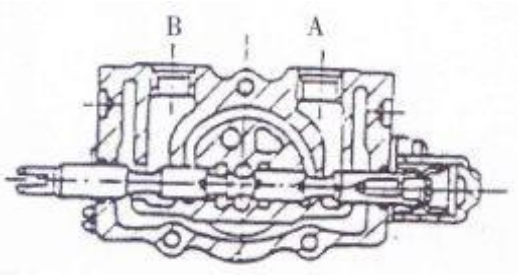


Fig. 5-6 Pull Out Slide Valve

(2) Action of safety overflow valve

An overflow valve is installed between the oil pump "HP" port and the low pressure passage "LP". The oil passing through the poppet valve "C" acts on the area L with different diameters "A" and "B", so that both the check valve "K" and the overflow poppet valve "D" fall on the valve seat. See Fig. 5-7.

The set pressure in the "HP" passage acts on the spring of the guide valve, and the one-way valve "E" will open. The oil flows into the low pressure "LP" side from the through hole around

the valve. See Fig. 5-8.

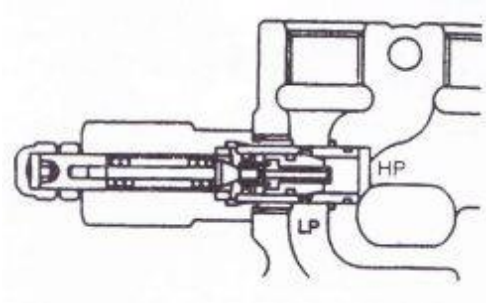


Fig. 5-7

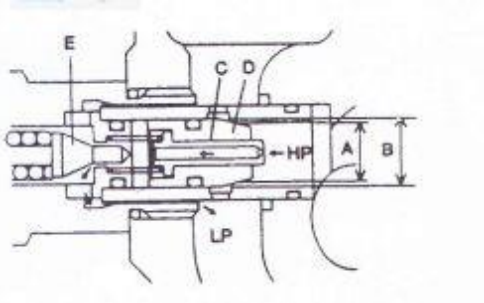


Fig. 5-8

Once the guide valve "E" is opened, the pressure inside the valve "C" will drop, and both valves "E" and "C" will fall on the valve seat.

The liquid flow behind the valve "D" is closed, so the pressure in the inner side is reduced. See Fig. 5-9.

The pressure between the "HP" passage side and the inner side of oil pump is unbalanced. Under the action of pressure difference, the valve "D" opens, and the oil directly flows into the low-pressure circuit "LP". (See Fig. 5-10)

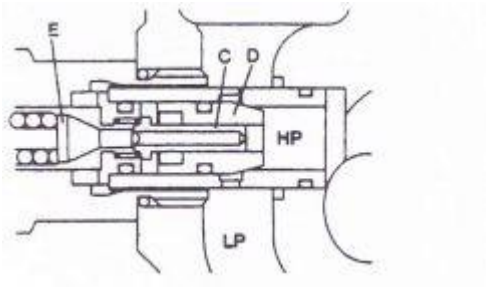


Fig. 5-9

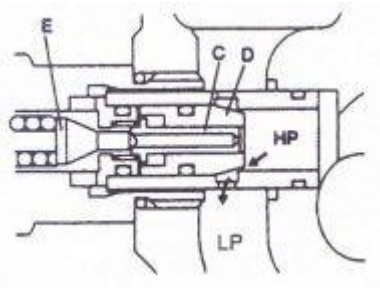


Fig. 5-10

(3) Action of tilt self-locking valve

The valve plate of tilt cylinder is equipped with a tilt self-locking valve. When negative pressure is generated in the oil cylinder, the mast is prevented from falling suddenly, and at the same time danger is prevented when the tilt valve stem is operated by mistake. With this kind of self-locking valve, when the forklift motor stops working, even if the operating rod is pushed hard, the mast cannot tilt forward.

When the valve core is pulled out, the flow direction of oil is the same as that in Fig. ~s-6, and at this time the mast is in a backward tilting state. The following shows the state when the valve core is pushed in.

a) When pushing in the valve core (the pump works)

The oil from the main pump flows to the tilt cylinder through the interface "B", and the oil returned from the cylinder acts on the piston through port A. The oil returns to the oil tank through the upper hole A and B of the valve core and the low oil passage.

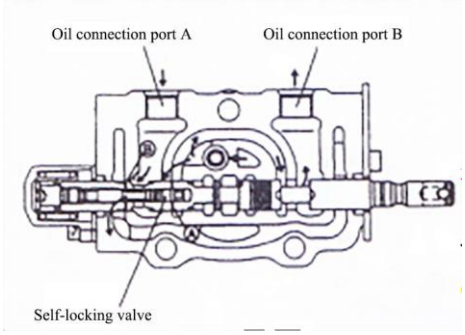


Fig. 5-11

b) When pushing in the valve core (the pump does not work)

When the oil pump does not work, the valve core is pushed in, and no oil enters the cylinder interface "B", so that the pressure will not rise. Therefore, the piston does not move, the oil at the cylinder interface "A" cannot return to the oil tank, and the cylinder does not move.

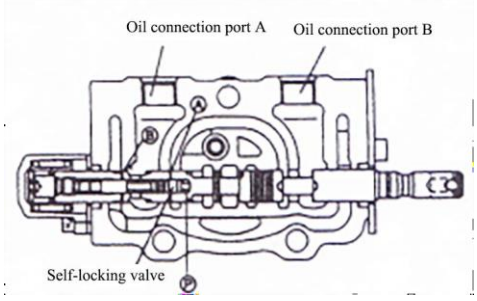


Fig. 5-12

(4) Multi-way valve operation

The multi-way valves are operated with the operating rod, all of which are installed on a connecting shaft. The shaft is fixed on the right valve connecting plate L of the frame through the support, and the operating rod operates the multi-way valve through the connecting rod, as shown in Fig. 5-13.

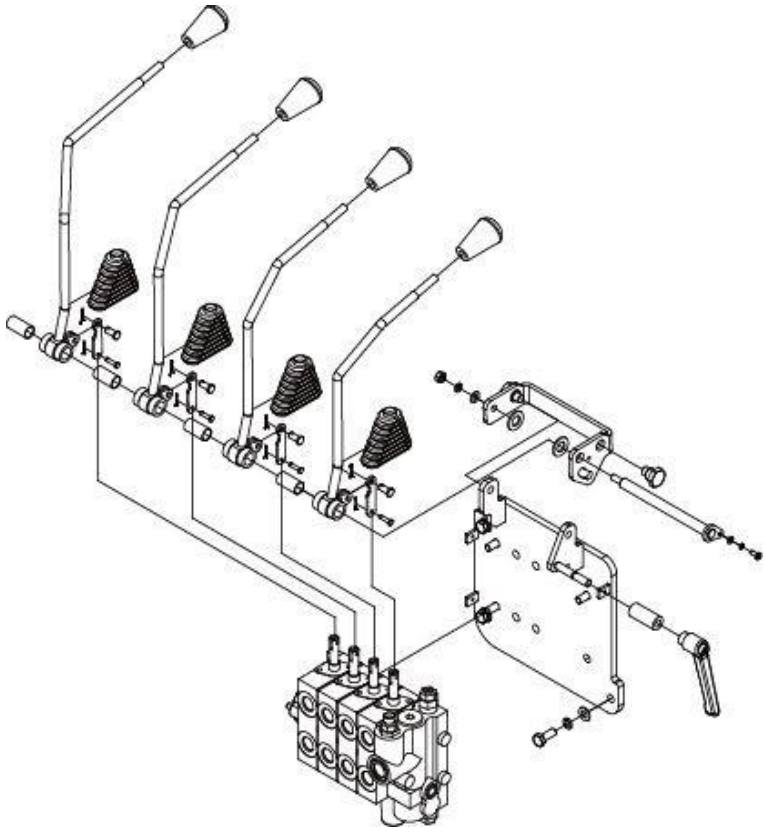
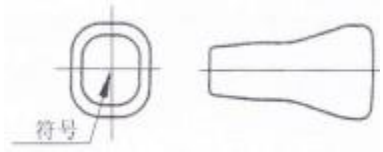


Fig. 5-13 Multi-way Valve Control Device

Push forward and pull back the lifting handle according to the arrow direction shown in Fig. 5-14, and the mast will rise and fall respectively. Push forward and pull back the tilting handle, and the mast will tilt forward and backward respectively.



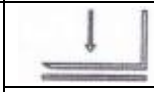
No.	Symbol	Description
1		Lifting
		
2		Tilt
		

Fig. 5-14 Multi-way Valve Control Handle Identification

(5) Adjustment of multi-way valve pressure

Pressure adjustment of safety valve. Fig. 5-15

The pressure of the safety valve shall not be adjusted at will. If it must be adjusted, please follow the steps below.

a) Unscrew the plug of the measuring hole at the inlet of the multi-way valve and install an oil pressure gauge that can measure at 25MPa.

b) Operate the tilting handle, and measure the pressure when the cylinder stroke reaches the bottom.

c) When the oil pressure is different from the specified value, loosen the lock nut of relief valve, and turn the adjusting screw left and right to the specified value. Turn left when the pressure is high, and turn right when the pressure is low.

d) Tighten the nut after adjustment.

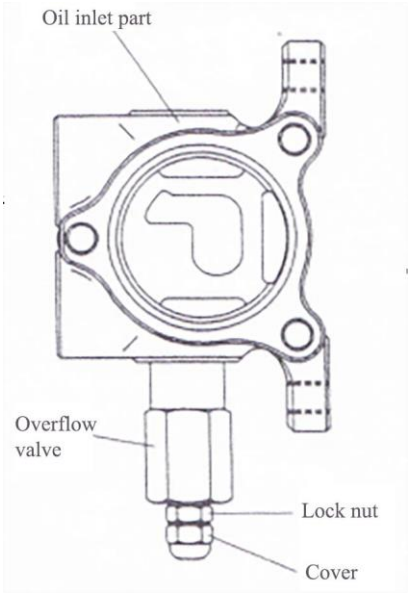


Fig. 5-15

5.1.3 LIFT CYLINDER

The lift cylinder is a single-acting piston type hydraulic cylinder. It consists of cylinder block, piston and piston rod, cylinder head, cut-off valve, seal, etc. (Fig. 5-16). The cylinder head is equipped with the steel-backed bearing and oil seal to support the piston rod and prevent dust from entering.

When the lifting slide valve of the multi-way reversing valve is placed in the rising position, the hydraulic oil enters reversing valve from the priority valve and then enters the lower part of the oil cylinder piston, pushing the piston rod upward and thus lifting the goods. When the lifting slide valve of the multi-way reversing valve is placed in the lowering position, the piston rod is lowered under the action of the mass of the goods, mast, carriage and piston, and the hydraulic oil is pressed back to the oil tank. A cut-off valve is installed at the bottom of the cylinder (Fig. 5-17). If the mast rises, the high-pressure pipe can be broken for safety protection.

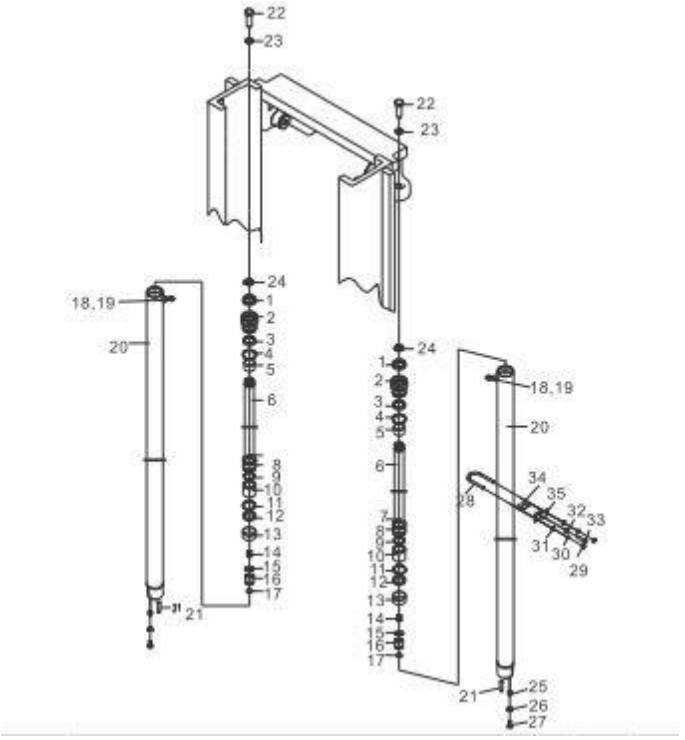


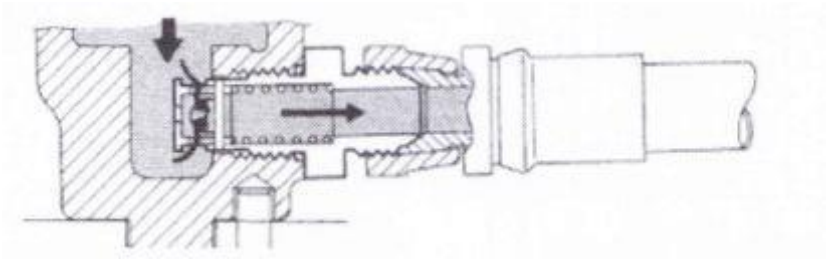
Fig. 5-16 Lift Cylinder

1. Dust ring 40×52×7	13. Support ring 50×45×9.7	25. Shaft sleeve
2. Guide sleeve	14. Valve assembly	26. Washer 12
3. Shaft seal ring 40×50×7	15. Washer 14	27. Bolt M12×1.25×25
4. O-ring 50.47×2.62	16. Buffer sleeve	28. Clamp
5. Steel-backed bearing 40×44×30	17. Retainer ring 30	29. Nut M10×1.25
6. Piston rod	18. Bonded washer 5	30. Washer 10
7. Piston	19. Screw M5×6	31. Washer 10
8. Retainer ring 30	20. Cylinder block	32. Nut M12×1.25
9. O-ring 40×1.8	21. Cylindrical pin 10×26	33. Bolt M12×1.25×50
10. Spacer sleeve	22. Bolt M16×40	34. Rubber gasket
11. Retainer ring 40×50×3	23. Washer 16	35. Hoop seat
12. Piston sealing ring 50×40×7	24.Adjusting shim	

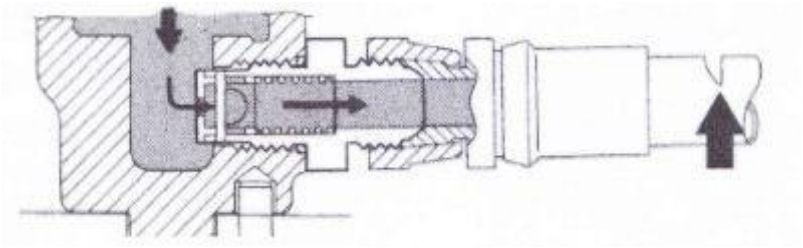
5.1.4 CUT-OFF VALVE

The cut-off valve is installed at the bottom of the lift cylinder (see Fig. 5-17). When the high-pressure pipe suddenly breaks, it can prevent the goods from descending sharply. When the oil from the lift cylinder returns to the oil tank, it will pass through the hole A on the outer circumference of the valve element. If the flow rate of oil through the hole is lower than the set

value for the valve and the pressure difference between the front and rear of the valve element is lower than the spring force, the valve element will not move and the slide valve will not act. If the flow rate through the valve element hole exceeds the set value when the high-pressure pipe breaks or for other reasons, the pressure difference between the front and rear of the valve element will be greater than the spring force to make the valve element move to the left. In this way, the hole A is closed, and only a small amount of oil flows out of the gap between the valve element and the valve bush, so the goods are lowered gradually.



When the flow is lower than the set value



When the flow is higher than the set value

Fig. 5-17 Working Principle of Cut-off Valve

5.15 SPEED LIMIT VALVE

The speed limit valve is installed in the lifting oil circuit to limit the lowering speed of the fork under heavy load. Its mechanism is shown in Fig. 5-18. When the slide valve of multi-way valve is in the "lifting" position, the high-pressure oil from the multi-way valve flows into the lift cylinder through chambers A and B, holes C, D, E and F and chamber G without throttling. When the slide valve of multi-way valve is in the "lowering" position, the oil from the lift cylinder flows through chamber G, oil holes F, E, D, C and chambers B and A and through the whole valve. At this time, a pressure difference is generated between chamber A and chamber B, and the ball valve (Item 8) is opened. When the pressure difference exceeds the spring force of spring 2, the valve element 7 moves to the right, and the oil flow decreases as holes D and C become smaller. It thus reduces the flow through the orifice.

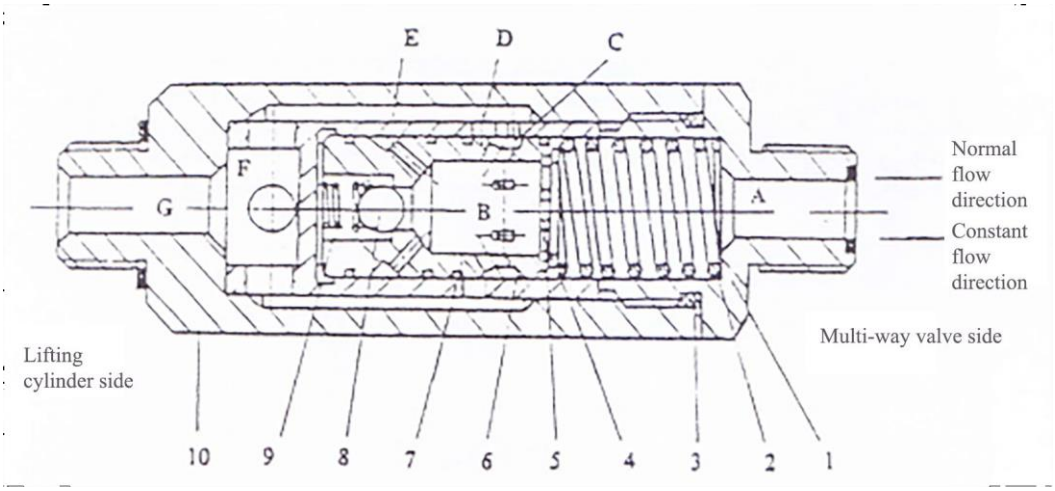


Fig. 5-18 Speed Limit Valve

1. Speed limit valve connector
2. Spring
3. Seals
4. Clamp ring
5. Throttle plate
6. Valve element
7. Valve bush
8. Steel ball
9. Check valve spring
10. Valve body

5.1.6 TILT CYLINDER

The tilt cylinder is a double-acting piston type hydraulic cylinder, and installed on both sides of the brake frame. Its piston rod end is connected with the mast, and the bottom of the tilt cylinder is connected with the mast with pins. The forward tilting and backward tilting of brake frame are done by the action of the tilt cylinder.

The tilt cylinder is mainly composed of piston, piston rod, cylinder block, cylinder bottom, guide sleeve and seal. The piston and the piston rod are of a welded structure. The outer edge of the piston is equipped with a support ring and two Yx seal rings. The inner hole of the guide sleeve is equipped with a shaft sleeve and a Yx seal ring, a stopper and a dust ring. The shaft sleeve supports the piston rod. The seal ring, the stopper and the dust ring P and I can prevent oil leakage and dust, and are screwed onto the cylinder block together with the O-ring. When the piston moves, the oil is fed from one port and discharged from the other, and the piston rod is provided with an adjusting thread to adjust the difference between the inclination angles. (as shown in Fig. 5-19).

When the slide valve is pushed forward, the high-pressure oil enters from the bottom of the cylinder, thus pushing the piston forward to make the mast tilt forward; when the slide valve is pulled back, the high-pressure oil enters from the front of the cylinder block, pushing the piston backward until the mast tilts backward and reaches a proper position.

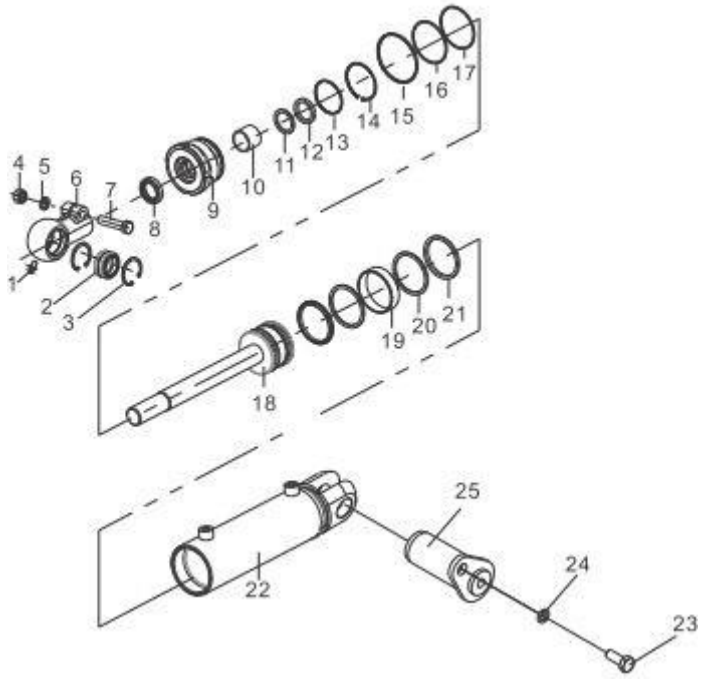


Fig. 5-19 Tilt Cylinder

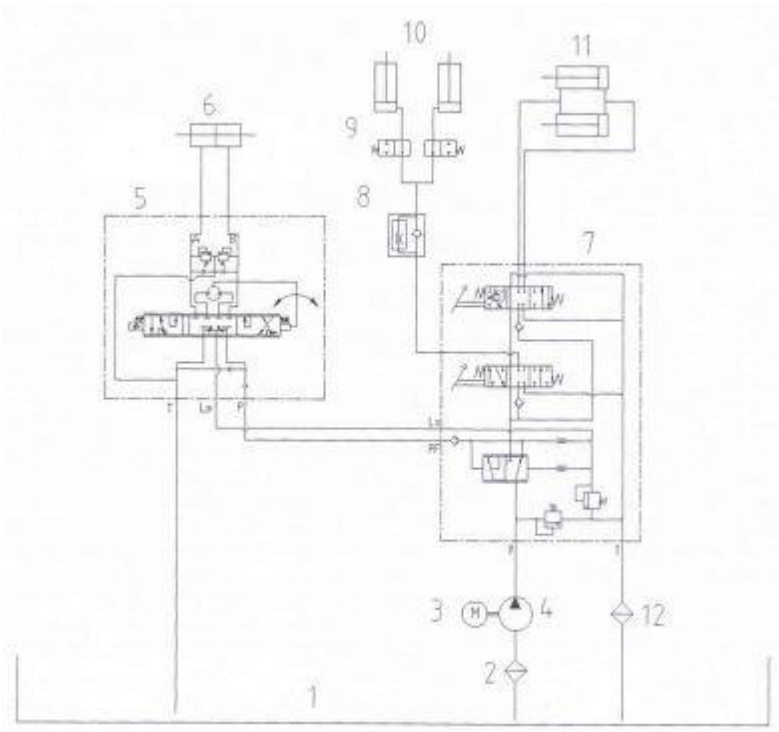
1. Oil cup PT1/8	10. Steel-backed bearing 32×36×25	19. Support ring 65×70×20
2. Knuckle bearing GE30ES	11. Shaft seal ring 32×48×11	20. Piston seal ring 70×60×7
3. Retainer ring 47	12. Retainer ring 32×48×3	21. Retainer ring 70×60×3
4. Nut M14×1.5	13. Baffle 52x40x2	22. Cylinder block
5. Washer 14	14. Retainer ring 52	23. Pin shaft welding
6. Rod head	15. O-ring 66.34×2.62	24. Washer 10
7. Bolt M14×1.5×55	16. Retainer ring 65×70×1.25	25. Bolt M10×1.25×20
8. Dust ring 32×52×8	17. O-ring 64.4×3.1	
9. Guide sleeve	18. Piston rod assembly	

5.1.7 HYDRAULIC OIL TANK

The hydraulic oil tank is equipped with an oil suction filter, an oil return filter and a respirator to ensure the cleanliness of oil in the hydraulic system.

5.1.8 HYDRAULIC SYSTEM OIL CIRCUIT

The schematic diagram of the hydraulic system is shown in Fig. 5-20. The hydraulic pipeline is shown in Fig. 5-21.



1. Hydraulic oil tank
2. Oil suction filter
3. Pump motor
4. Gear pump
5. Steering gear
6. Steering cylinder
7. Multi-way valve
8. Speed limit valve
9. Cut-off valve
10. Lift cylinder
11 Tilt cylinder
12. Return fuel filter

Fig. 5-20

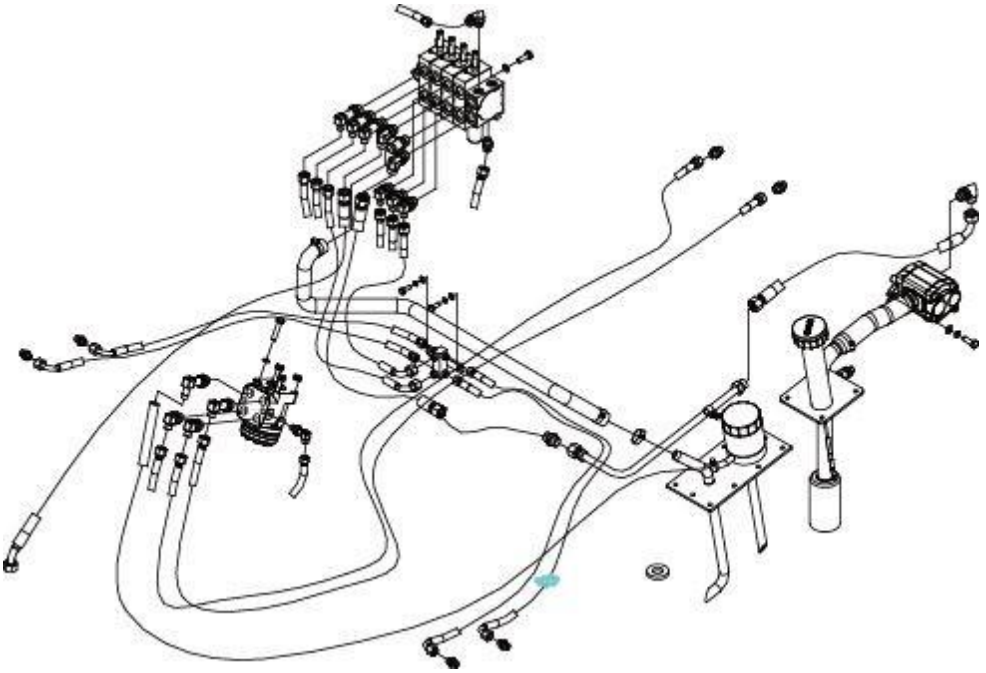


Fig. 5-21 Hydraulic Pipeline

5.2 MAINTENANCE, FAULT ANALYSIS AND TROUBLESHOOTING

5.2.1 MAINTENANCE AND UPKEEP

Check the pipe joint, lifting cylinder, tilting cylinder, oil pump, full hydraulic steering gear and steering cylinder of the hydraulic transmission system for leakage or serious oil leakage before and after work; check whether the working oil in the working oil tank is sufficient; check and clean the strainer installed in the working oil tank once a week.

Under normal circumstances, the oil in the working oil tank shall be replaced every 1200-1,500 hours of operation. Oils of various grades shall not be mixed.

5.2.2 MAINTENANCE OF LIFT OIL PUMP

(1) Disassembling

Clean thoroughly before disassembling. The removed parts shall be placed on clean paper or cloth, and care shall be taken not to stain or damage the parts, as shown in Fig. 5-23.

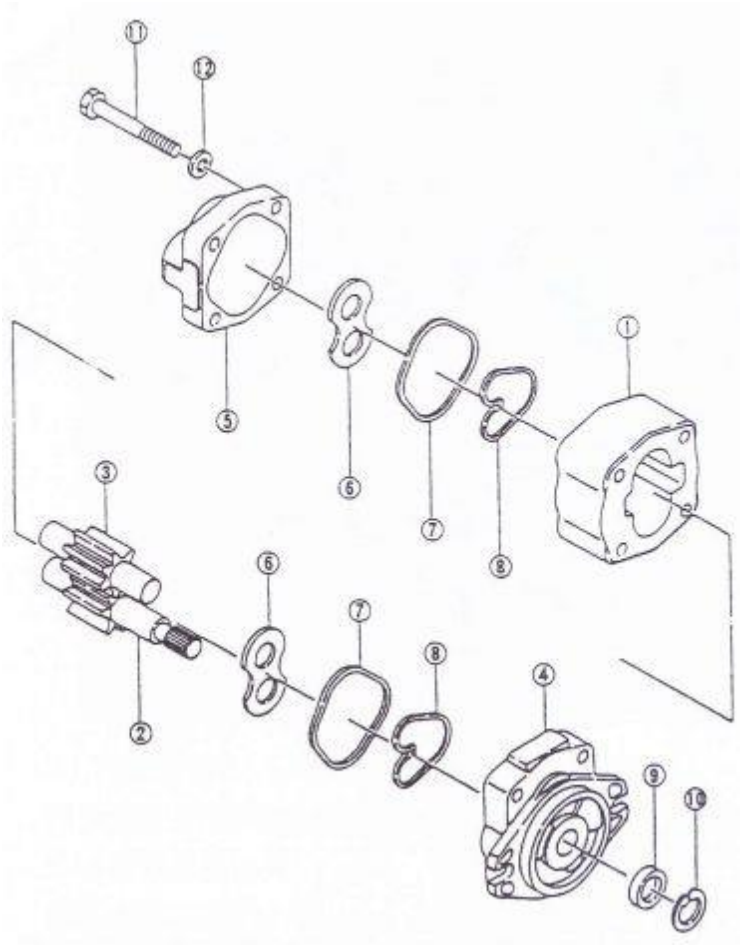
a) Clamp the flange part of the pump on the clamp table.

b) Remove the connecting bolt 11, pump cover ⑤ and pump case ①.

c) Remove the lining plate ⑥, drive gear ② and driven gear ③.

d) Remove the sealing ring ⑦ and retaining ring ⑧ from the front and rear end covers.

Note: If the sealing ring is not replaced, do not remove it from the front end.



1. Pump body
2. Drive gear
3. Driven gear
4. Front end cover
5. Rear end cover
6. Sealing ring of lining plate
7. Baffle ring
8. Retainer ring
9. Oil seal
10. Elastic retainer ring
11. Bolt

Fig. 5-22 Gear Pump

(2) Inspection

Check the disassembled parts and clean them with gasoline (except rubber parts).

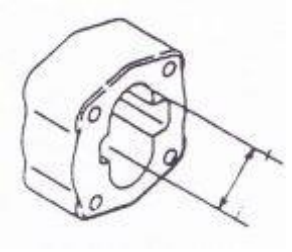


Fig. 5-23

a) Inspection of pump body

If the contact length between the cavity in the pump body and the gear is greater than 1/2 of the circumference, replace the pump body.

b) Inspection of lining plate

Check the contact surface of the lining plate. If the surface is damaged or the thickness of the liner plate is less than the specified value, replace the liner plate.

Specified thickness of the lining plate: 4.94mm.

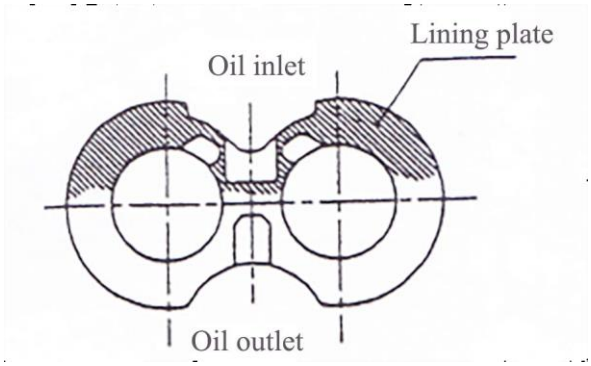


Fig. 5-24

c) Front and rear pump covers

If color change (brown) of inner surface of the bush exceeds 150°, replace it.

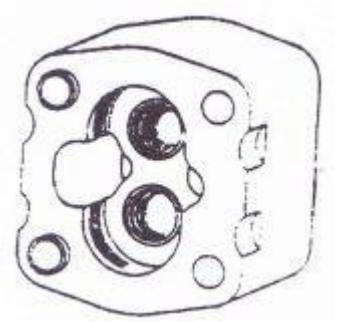


Fig. 5-25

d) Check the drive and driven gears at the front and rear. Replace both in case of any excessively worn. If dimension D is less than the specified value, replace it in pairs, with D=20.961mm.

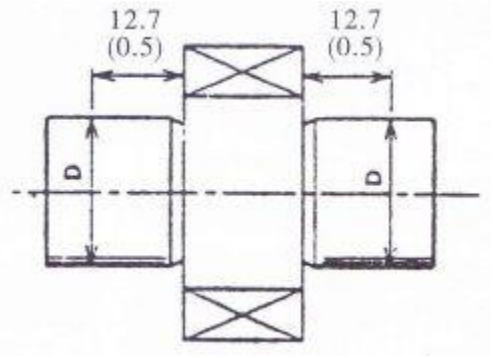


Fig. 5-26

e) Replace the sealing ring, bushing seal, retainer ring, oil seal and spring retainer ring as required.

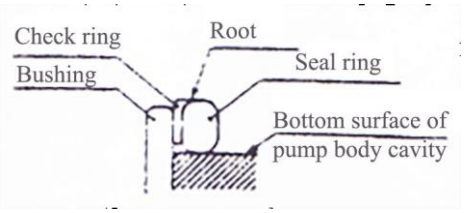


Fig. 5-27 Bush Seals

(3) Assembly

a) Fix the front end on the bench as shown in Fig. 5- 28.

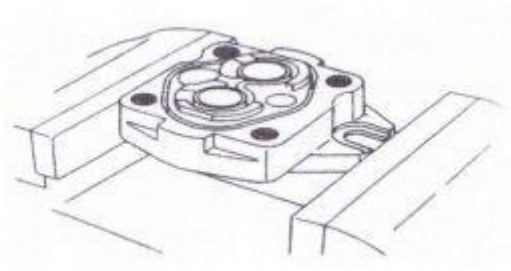


Fig. 5-28

b) Install a new sealing ring on the front end cover of pump. Note: Do not twist.

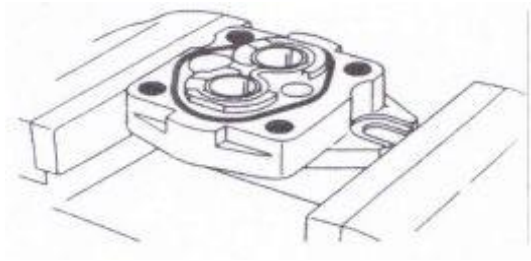


Fig. 5-29

c) Install a new retainer ring on the front end cover of pump. Refer to Fig. 5-30 for the installation direction.

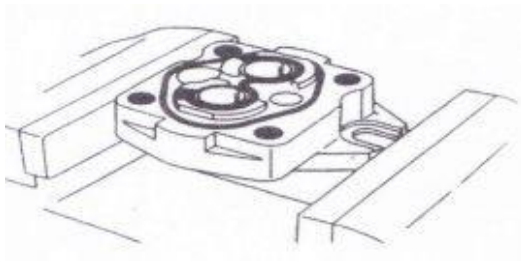


Fig. 5-30

d) Install the pump body into the front end cover and pay attention to the direction of the pump body.

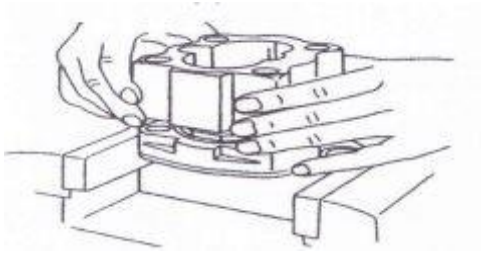


Fig. 5-31

e) Install a liner plate at the groove of the front end cover. Be careful not to mix the oil suction port with the oil discharge port, and pay attention to the direction of the liner plate.

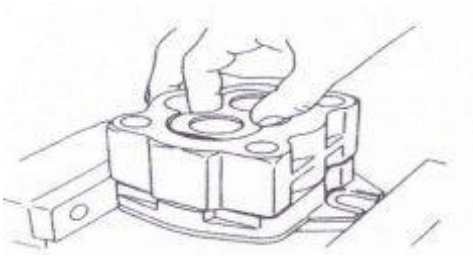


Fig. 5-32

f) Install the spline side of the drive gear downward into the pump body.

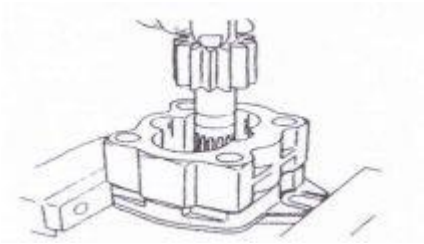


Fig. 5-33

g) Install the driven gear into the pump body in the direction shown in Fig. 5-34.

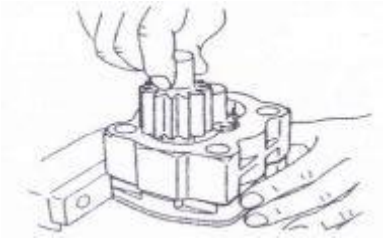


Fig. 5-34

h) Install the rear lining plate into the pump body, and install a lining plate on the gear side to align the groove with the gear point. Be careful not to mistake the oil suction port side with the oil discharge port side.

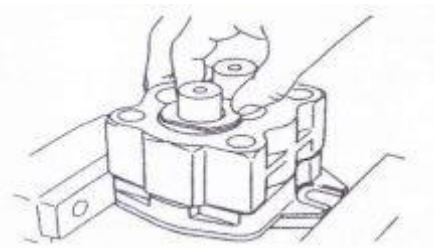


Fig. 5-35

i) Install the sealing ring and retainer ring in the groove of rear cover, and apply lubricating grease to the sealing ring.

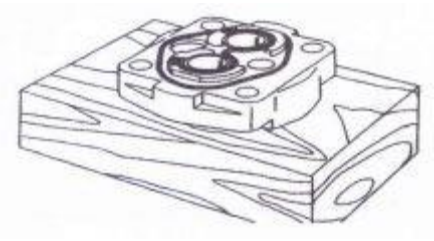


Fig. 5-36

j) Install the sealing ring of the rear end cover facing downward into the pump body. Pay attention not to mix the oil suction port with the oil discharge port.

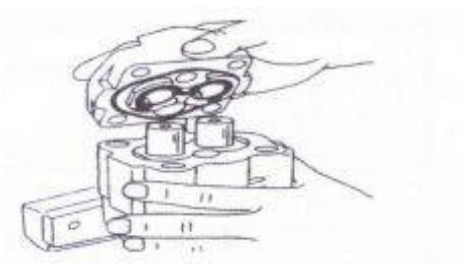


Fig. 5-37

k) Install and tighten the connecting bolts to the specified torque of 9-10kg.m

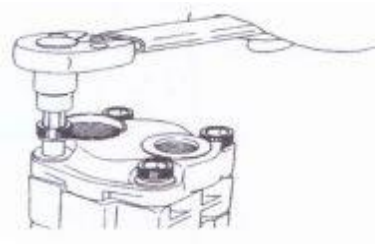


Fig. 5-38

l) Remove the pump from the vice bench, apply grease to the oil seal outer ring and lip, and install it into the front end cover with a mold.

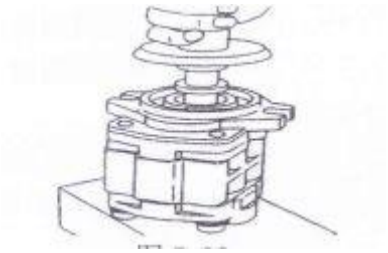


Fig. 5-39

m) Install the spring retainer ring with a caliper and fix the oil seal.

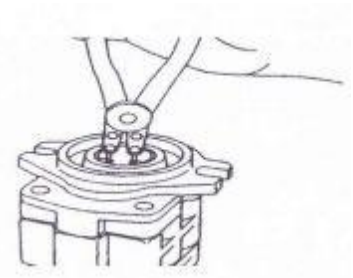


Fig. 5-40

(4) Trial operation: Test run and check whether the oil pump runs normally. It is better to test the oil pump on a test bench, but it can also be tested on a forklift according to the following steps (If the oil pump is disassembled and repaired due to serious wear or jamming caused by hydraulic oil, replace the hydraulic oil and filter before trial operation on the forklift.

a) Install the pump on the forklift, and install the pressure gauge at the pressure detection port on the multiway valve.

b) Loosen the adjusting screw of overflow valve to make the pump run at 5000-10000rpm for about 10 minutes. Ensure that the oil pressure is lower than

10kg/cm^2

c) Increase the pump speed to 1500-2000 rpm and run for about 10 minutes.

d) Keep the pump running speed at 1500-2000MapA, make the pressure increase 20-30kg/cm^2 each time and run for 5 minutes until it reaches 210kg/cm^2. Then each oil circuit works for 5 minutes and the oil return filter is replaced. When increasing the oil pressure, pay attention to detecting the oil temperature, the temperature of the pump surface and the running sound. If the oil temperature or the pump surface temperature rises excessively, reduce the load to lower oil temperature, and then resume the test.

e) After the test, keep the overflow pressure at 210kg/cm^2 and measure the flow. Oil quantity is measured by lift speed.

5.2.3 FAULT ANALYSIS AND TROUBLESHOOTING METHODS

Fault	Cause	Troubleshooting method
Weak lifting	1) Excessive wear and clearance between oil pump gear and pump body.	Replace the worn parts or oil pump.
	2) The piston seal of the lift cylinder is worn, the clearance is too large, and there is too much internal leakage.	Replace with a new piston seal ring.
	3) The safety spring in the multi-way reversing valve fails.	Replace with a new spring.
	4) Excessive wear and oil leakage of multi-way reversing valve control valve stem and valve body.	After the valve stem is coated with chrome, the clearance between the valve stem and the hole is 0.01~0.02.
	5) Oil leakage between multi-way reversing valves.	Replace the seal ring and tighten the screws in sequence.
	6) Oil leakage from hydraulic pipeline.	Check the sealing gasket and connecting nut for damage, and tighten the pipe joint.
	7) The hydraulic oil temperature is too high (≤80°C), the oil is too thin, and the flow is insufficient.	Replace the unqualified hydraulic oil and shut down to reduce the oil temperature and find the cause of excessive oil
	8) Too much load.	

		temperature. Lift according to the specified lifting capacity.
The piston rod of the lift cylinder sliding down largely	1) There is leakage in the Yx seal ring of the lift cylinder. 2) Internal leakage of A-type slide valve of multi-way reversing valve. 3) The oil circuit of the lifting part leaks.	Replace the Yx seal ring. Replace the O-ring in the slide valve. Replace the O-ring in the hinged joint and tighten the joint bolt.
Insufficient oil pump pressure	1) Oil leakage caused by wear of seal ring at fasteners. 2) The hydraulic oil is mixed with air for foaming, the oil suction pipeline leaks air, and the hydraulic oil is insufficient. 3) The seal ring in the pump cover groove is damaged. 4) The end face of the bearing sleeve is worn 5) The oil pump gear is worn. 6) Incorrect rotating direction of oil pump.	Replace seal rings Exhaust the air and refill the hydraulic oil. Replace it Replace it Replace it Replace the oil pump. Correct.
Large self-tilting amount of tilt cylinder	1) Internal leakage of multi-way reversing valve. 2) The O-ring of the tilt cylinder piston rod is damaged with internal leakage. 3) The YX seal ring and O-ring in the guide sleeve are damaged with oil leakage.	Replace the O-ring, repair the valve stem and re-adjust the fit clearance between the valve stem and the hole to 0.01-0.02. Replace it Replace it
Hard steering	1) The oil supply of the oil pump is insufficient, and it feels light during slow steering and heavy during fast steering. 2) There is air in the steering system, foam in the oil, and irregular noise. The oil cylinder	Select an appropriate oil pump or check whether the oil pump is normal Remove the air from system, and check the suction pipeline Check whether the steel ball exists and whether it is stuck by

	does not move sometimes when the steering wheel rotates. 3) The one-way valve of the steel ball in the valve body fails; it feels heavy during fast and slow steering, and the steering is weak. 4) If the overflow valve pressure is lower than the working pressure or the overflow valve is stuck by dirt, it feels light when steering with light or no load, and heavy when load is increased. 5) Excessively high oil viscosity.	dirt. Adjust the relief valve pressure or clean the relief valve Use the oil of recommended viscosity

6. LIFTING SYSTEM

6.1 Overview of basic lifting system

The basic lifting system is a two-stage roller-type vertical ascending and descending system, which is composed of inner and outer masts, two rear lift cylinders, and carriage.

6.1.1 Inner and outer masts

The inner and outer masts are welded parts, and mainly supported on the axle housing. The bottom of the outer mast is connected with the axle housing through a support shaft, and the middle part is connected with the frame through a tilt cylinder, which can tilt forward and backward under the action of the tilt cylinder. The outer mast channel steel is of C type, and the main and side rollers are installed at the upper part. The inner mast channel steel is of Jb type, and the main and side rollers are installed at the bottom. Through the rolling of main and side rollers, the inner mast always maintains the established relative position with the outer mast in the process of movement.

The upper main rollers and side rollers of inner and outer masts are maintained at a high position, so attention should be paid to your safety.

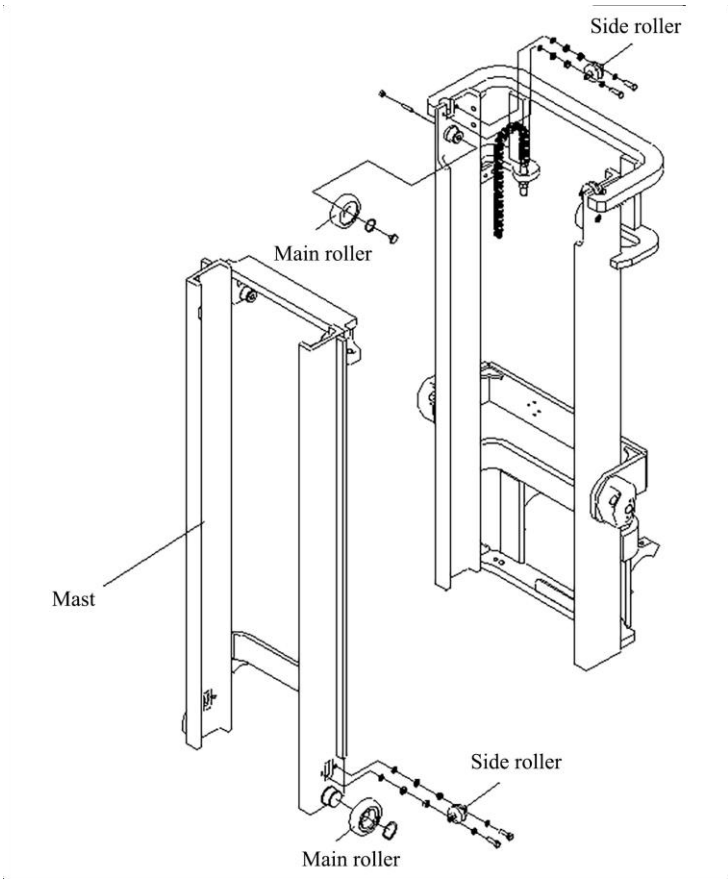


Fig. 6-1 Inner and outer gantries

6.1.2 Carriage

The fork arm carrier rolls in the inner mast through the main roller, which is installed on the roller shaft and clamped with a spring retainer ring. The intermediate roller is a composite roller: the main roller shaft is welded on the fork arm carrier, and the column plate side roller is fixed on the fork arm carrier by bolts. The longitudinal load is borne by the main roller. When the fork rises to the top, the upper roller is exposed from the top of the mast, and the transverse load is borne by the composite roller and the lower side roller.

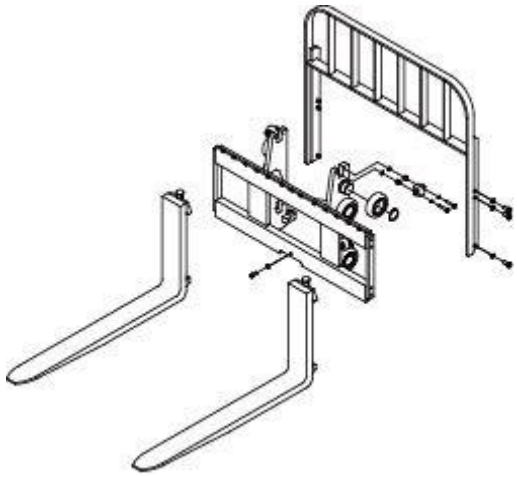


Fig 6-2 Carriage

6.1.3 Roller adjustment method

There are 10 main rollers, which are installed at the upper end of outer mast (2), lower end of inner mast (2) and both sides of fork arm carrier column plate (6) respectively .

Side rollers (10 pcs.) are installed at the upper end of the outer mast (2 pcs.), the lower end of the inner mast (2 pcs.) and carriage (6 pcs.) respectively.

Except that the middle composite rollers of the carriage column plate bear both front and rear loads and lateral loads, the rest main roller only bears front and rear loads, and the side roller bears left and right lateral loads. The main roller is used in conjunction with the side roller to make the inner mast and the carriage move freely.

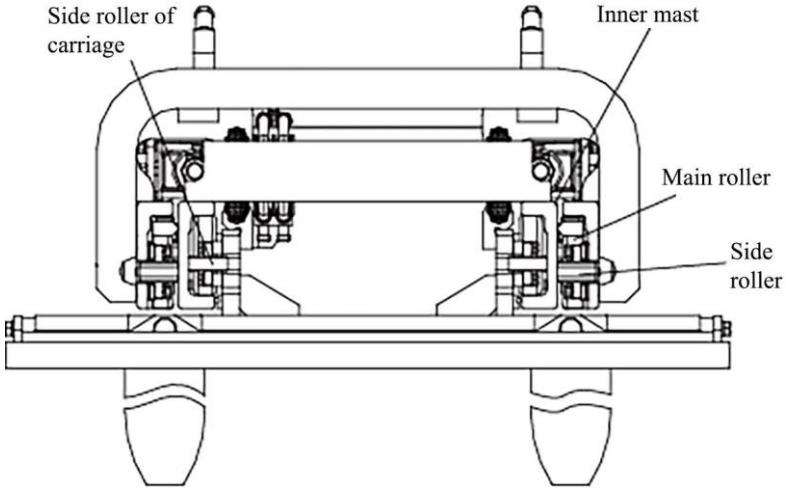


Fig. 6-3 Layout of Rollers

Note: (a) Adjust the side roller clearance to 0~0.5mm;

(b) Apply grease on the surface of the main roller and the contact surface of mast.

6.1.4 Maintenance

a Adjustment of lift cylinder

When the lift cylinder, inner or outer mast is removed and replaced, the stroke of the lift cylinder needs to be readjusted. The adjustment method is as follows:

(1) Install the piston rod head into the upper cross beam of the inner mast without the adjusting shim.

(2) Slowly lift the mast to the maximum stroke of the oil cylinder, and observe whether the stroke ends of the two oil cylinders are synchronized. If not stop at the same time,

it indicates that the strokes of the left and right cylinders are not synchronized; add or remove shims on the top of the piston rod to adjust the stroke synchronously;

add adjusting pads with a thickness of 0.2mm and 0.5mm between the piston rod head and the upper cross beam of the inner mast.

(3) Then slowly lower the inner mast and observe whether the stroke terminals of two cylinders are synchronized. Refer to the adjustment method of lifting synchronization.

(4) Adjust the tension of the chain.

The adjustment of the lift cylinder also belongs to high-position maintenance, so attention should be paid to your safety.

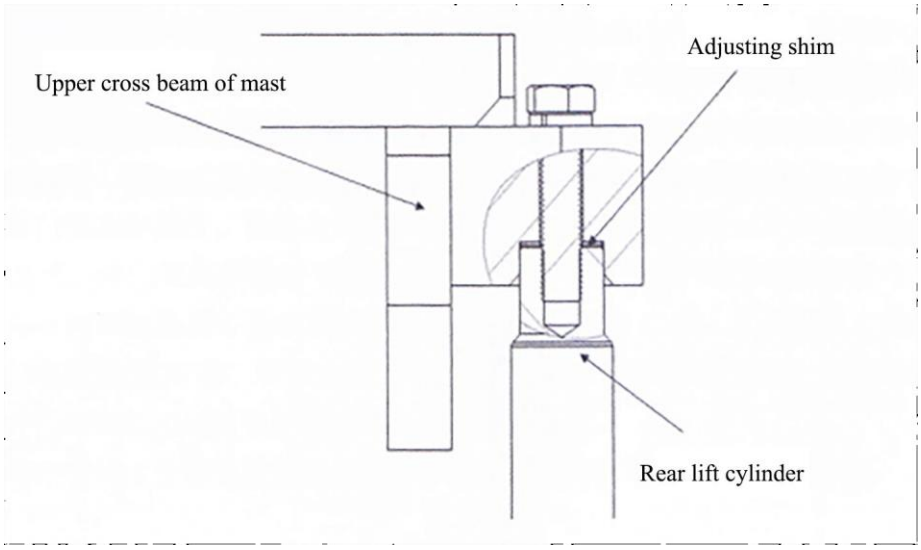


Fig. 6-4

b Height adjustment of carriage

(1) Park the forklift on a horizontal ground and make the mast vertical.

(2) Make the fork bottom contacting the ground, adjust the adjusting nut of the upper end joint of the chain so that there is a distance A between the main roller and the lower end face of the mast channel steel.

Type of Forklift	Amm
1.5-1.8t	36~41
2-2.5t	24~29
3-3.5t	19-24

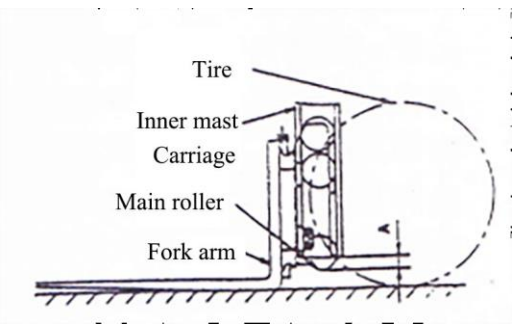


Fig. 6-5

(3) Lower the forks to the ground and tilt backward in place, adjust the upper end joint of the chain, and adjust the nut to make the tension of the measuring chains the same.

c Replacement of carriage roller

(1) Put a pallet on the fork and park the forklift on flat ground.

(2) Make the forks and pallets fall to the ground.

(3) Remove the upper end joint of the chain and remove the chain from the sprocket as shown in Fig. 6.6.

(4) Lift the inner mast.

(5) After confirming that the carriage has been disengaged from the inner door frame, remove the carriage.

(6) Replacement of main roller:

a) Remove all spring collars, remove the main roller with a drawing tool, and keep the adjusting shim.

b) Confirm that the new roller is the same as the replaced roller, replace the original roller with a new one, and clamp the elastic retainer ring in place at the same time.

The ring is clamped in place.

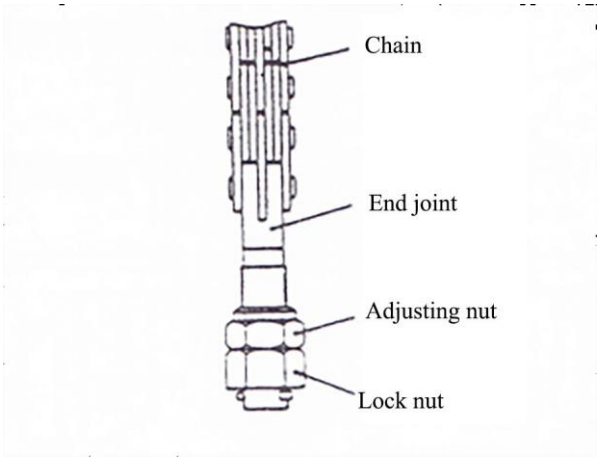


Fig. 6-6

d Replacement of mast roller

(1) Remove the carriage from the inner mast in the same way as described in c Replacement of Carriage Roller.

(2) Drive the forklift to a flat ground, and underlay the front wheels by 250~300 mm.

(3) Pull up the hand brake and pad the rear wheels with wedges.

(4) Remove the fixing bolts of the lift cylinder and inner mast.

Lift the inner mast, and be careful not to lose the adjusting shim at the head of the piston rod.

(5) Remove the connecting bolts between the lift cylinder and the bottom of the outer mast. Remove the oil pipe between lift cylinder and measuring cylinder. Do not loosen the oil pipe joint.

(6) Lower the inner mast and remove the main roller at the bottom of the inner mast.

(7) The main roller on the upper part of the outer mast will also be exposed from the top of the inner mast, so that the main roller can be removed.

(8) Replacement of main roller:

a) Remove the upper main roller with a drawing tool, and do not lose the adjusting shim.

b) Install the new roller with the adjusting shim removed in (a).

(9) Lift the inner mast until all rollers enter the mast.

(10) Install the lift cylinder and carriage in the reverse order of removal.

6.2 OVERVIEW OF TWO-STAGE FULL FREE LIFTING SYSTEM

The two-stage full free lifting system is a two-stage roller-type vertical ascending and descending system, which is composed of inner and outer masts, two rear lift cylinders, an early

lift cylinder and a carriage.

6.2.1 Inner and outer masts

The inner and outer masts are welded parts, and mainly supported on the axle housing. The mast assembly is connected with the axle and frame in the same way as the two-stage basic type. The bottom of the outer mast is connected with the axle housing through a support shaft, and the middle part of the outer mast is connected with the frame through a tilt cylinder, which can tilt forward and backward under the action of the tilt cylinder. The outer mast channel steel is of C type, and the rollers and side rollers are installed at the upper part. The inner mast channel steel is of Jb type, and the main and side rollers are installed at the bottom. Through the rolling of main and side rollers, the inner mast always maintains the established relative position with the outer mast in the process of movement.

The upper main rollers and side rollers of inner and outer masts are maintained at a high position, so attention should be paid to your safety.

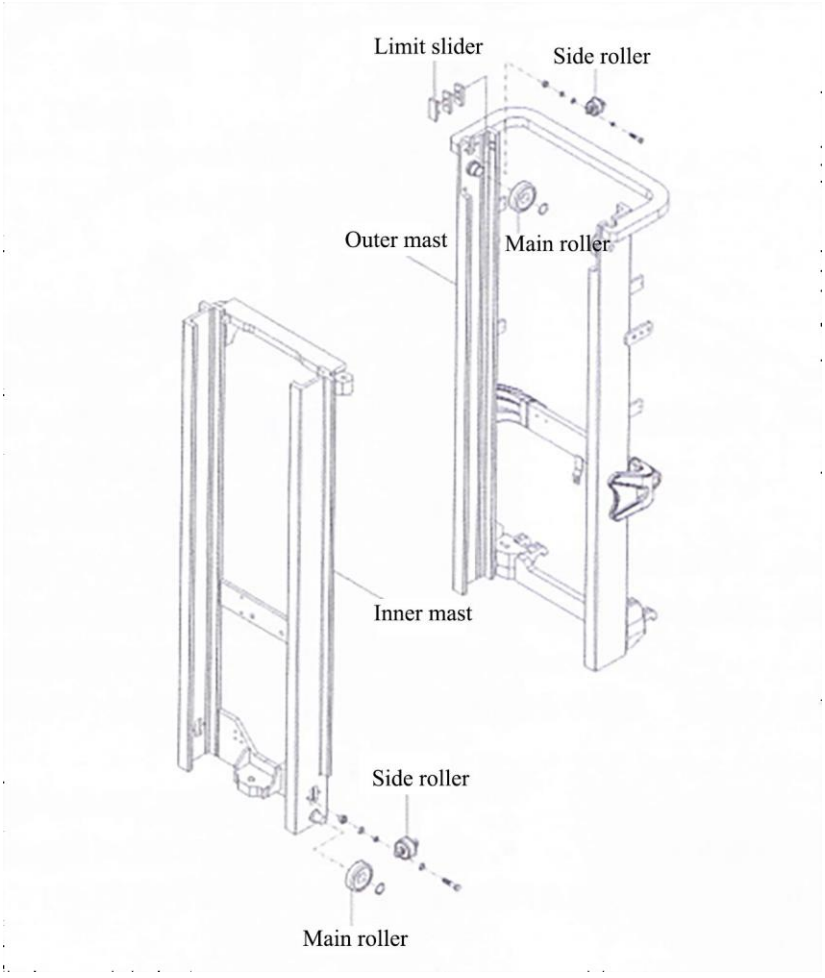


Fig. 6-7 Inner and Outer Mast

6.2.2 Carriage

The carriage rolls in the inner door frame through the main roller that is installed on the main roller shaft and clamped by the elastic retainer ring, and the intermediate roller is a composite roller. The main roller shaft is welded on the carriage, and the roller on the column plate side is fixed on the carriage by bolts. The longitudinal load is borne by the main roller. When the fork rises to the top, the upper roller is exposed from the mast top. The transverse load is borne by the composite roller and the side roller at the lower end.

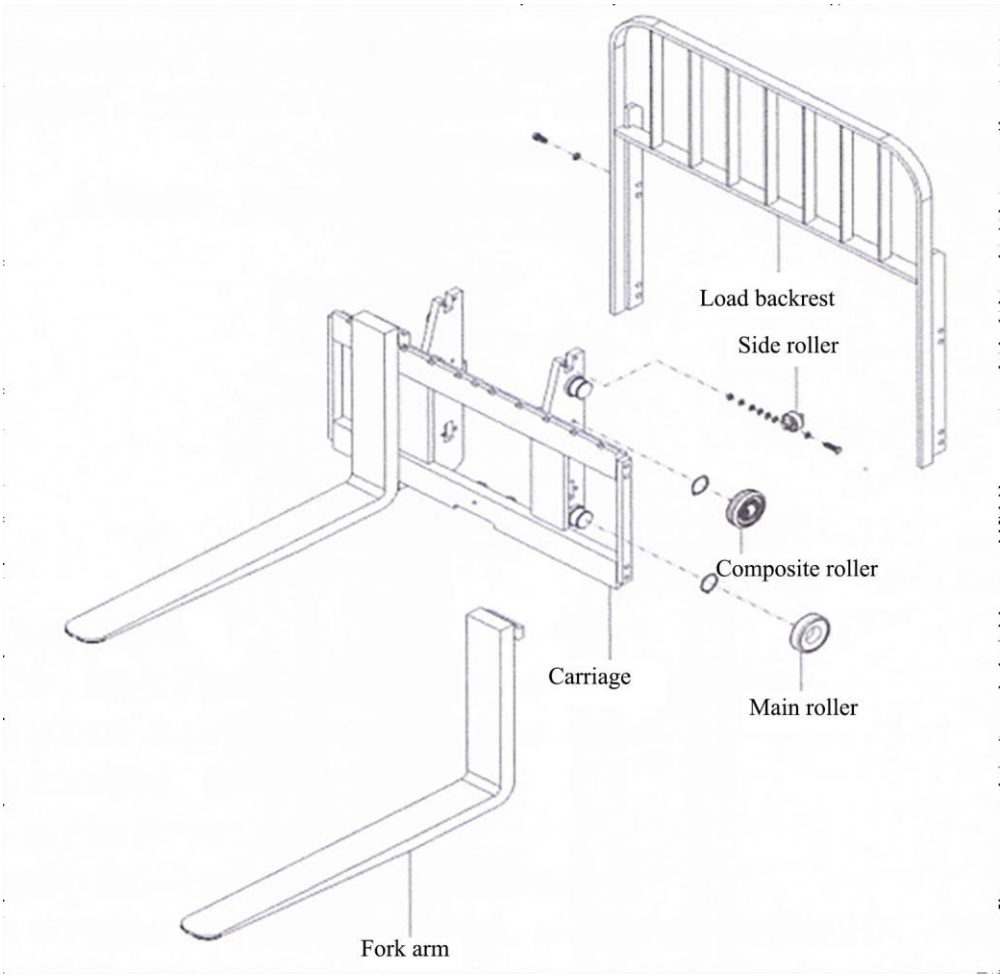


Fig. 6-8 Carriage

6.2.3 Roller adjustment method

Side rollers (10 pcs.) are installed at the upper end of the outer mast (2 pcs.), the lower end of the inner mast (2 pcs.) and both sides of the carriage (6 pcs.) respectively.

Side rollers (10 pcs.) are installed at the upper end of the outer mast (2 pcs.), the lower end of

the inner mast (2 pcs.) and the carriage (6 pcs.) respectively.

Except that the middle composite rollers of the carriage column plate bear both front and rear loads and lateral loads, the rest main roller only bears front and rear loads, and the side roller bears left and right lateral loads. The main roller is used in conjunction with the side roller to make the inner mast and the carriage move freely.

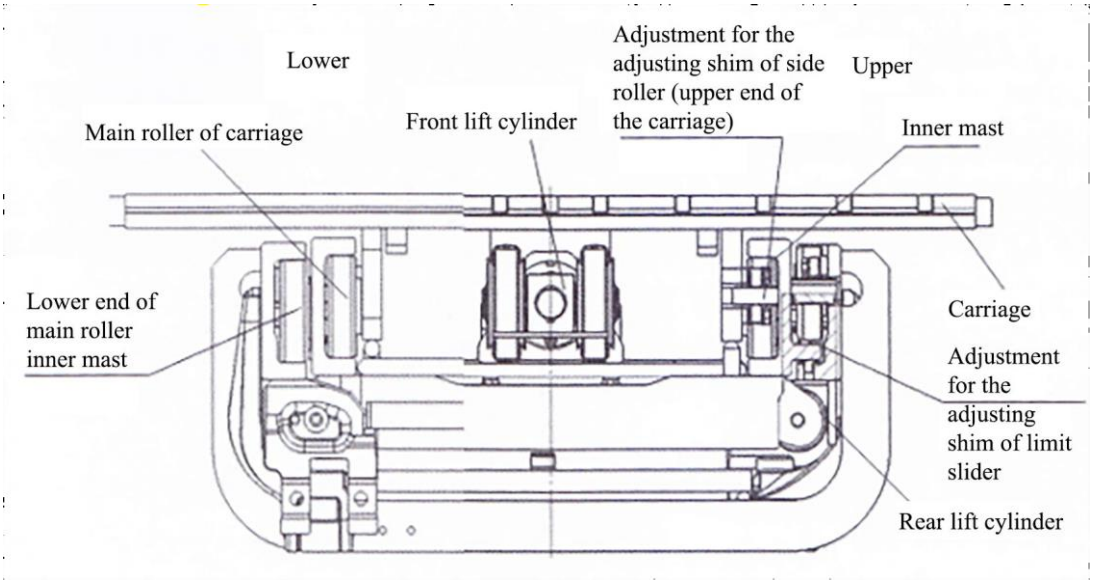


Fig. 6-9 Layout of Rollers

Note: (a) Adjust the side roller clearance to 0~0.5mm;

(b) Apply grease on the surface of the main roller and the contact surface of mast.

6.2.4 Maintenance

a Adjustment of lift cylinder

When the lift cylinder, inner mast or outer mast is removed and replaced, the stroke of the rear lift cylinder needs to be readjusted (note: It is not required for the front lift cylinder). The adjustment method is as follows:

(1) Install the piston rod head into the upper cross beam of the inner mast without the adjusting shim.

(2) Slowly lift the mast to the maximum cylinder stroke, and observe whether stroke terminals of two cylinders are synchronized. If they are not stopped at the same time, it indicates that the left and right cylinder strokes are not synchronized. Increase or decrease the number of gaskets at the top of the piston rod to synchronize the stroke. Add adjusting gaskets with thicknesses of 0.2 mm and 0.5 mm between the head of piston rod and the upper cross beam of inner mast.

(3) Then slowly lower the mast and observe whether the two-cylinder stroke terminals are

synchronized. Refer to the adjustment method of lifting synchronization.

(4) Adjust the tension of the chain.

The adjustment of the lift cylinder also belongs to high-position maintenance, so attention should be paid to your safety.

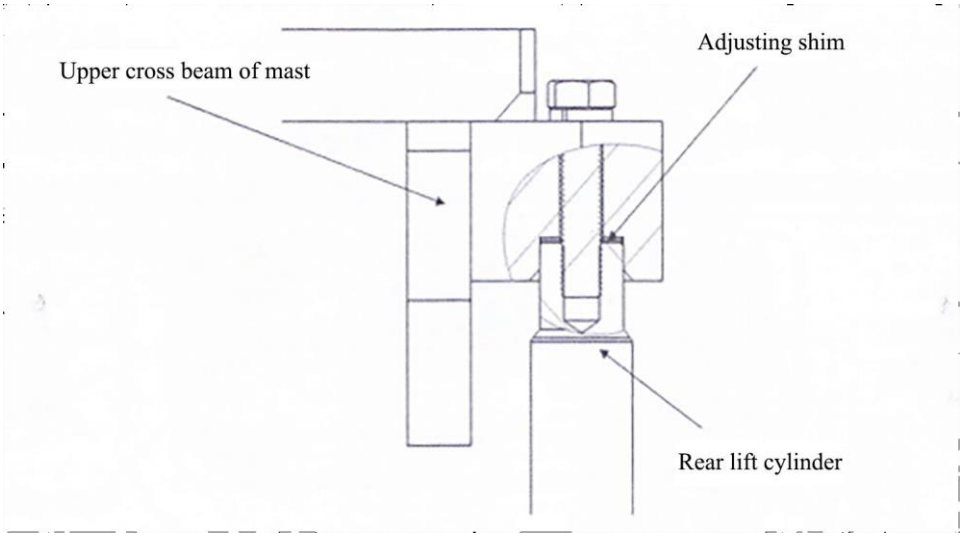


Fig. 6-10

(5) When the front cylinder needs to be replaced, it is necessary to remove the carriage in the same way as c. Remove the carriage as a whole before removing and replacing the front lift cylinder, as shown in the figure below.

B Height adjustment of carriage

(1) Park the forklift on a horizontal ground and make the mast vertical.

(2) Make the fork bottom contacting the ground, and adjust the adjusting nut of the upper end joint of the chain so that there is a distance A between the main roller and the lower end face of the mast channel steel.

Type of Forklift	**Amm**
1.5-1.8t	36~41
2-2.5t	24~29
3-3.5t	19-24

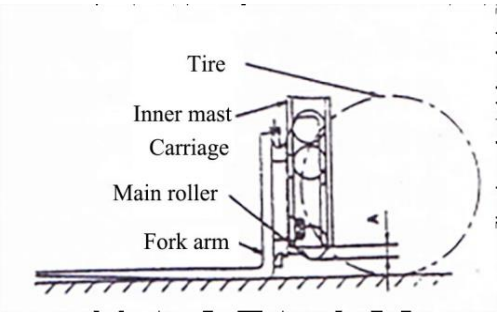


Fig. 6-11

(3) Lower the forks to the ground and tilt backward in place, adjust the upper end joint of the

chain, and adjust the nut to make the tension of the two chains the same.

C Replacement of carriage roller

(1) Put a pallet on the fork and park the forklift on flat ground.

(2) Make the forks and pallets fall to the ground.

(3) Remove the upper end joint of the chain and remove the chain from the sprocket as shown in Fig. 6-12.

(4) Lift the inner mast.

(5) After confirming that the carriage has been disengaged from the inner door frame, remove the carriage.

(6) Replace the main roller.

a) Remove all spring collars, remove the main roller with a drawing tool, and keep the adjusting shim.

b) Confirm that the new roller is the same as the replaced roller, replace the original roller with a new one, and clamp the elastic retainer ring in place at the same time.

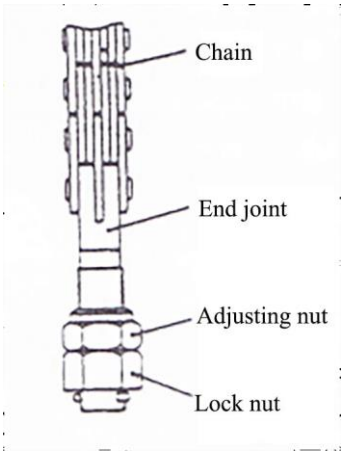


Fig. 6-12

d Replacement of mast roller

(1) Remove the carriage from the inner mast in the same way as described in c Replacement of carriage roller.

(2) Drive the forklift to a flat ground, and underlay the front wheels by 250~300 mm.

(3) Pull up the hand brake and pad the rear wheels with wedges.

(4) Remove the fixing bolts of the lift cylinder and inner mast.

Lower the inner mast and remove the main roller at the bottom of the inner mast.

(5) Remove the connecting bolts between the lift cylinder and the bottom of the outer mast. Remove the lift cylinder and the oil pipe between the two cylinders. Do not loosen

Oil pipe connector

(6) Lower the inner mast and remove the main roller at the bottom of the inner mast.

(7) The main roller on the upper part of the outer brake frame will also be exposed from the top of the inner brake frame, so that the main roller can be removed.

(8) Replacement of main roller:

a) Remove the upper main roller with a drawing tool, and do not lose the adjusting shim.

b) Install the new roller with the adjusting shim removed in Step (a).

(9) Lift the inner mast until all rollers enter the mast.

(10) Install the lift cylinder and carriage in the reverse order of removal.

6.3 Three-stage full free lifting system

The three-stage full free hoisting system is a three-stage roller vertical lifting and retracting system, which consists of three masts (inner, middle and outer) and two rear lifting cylinders, a front lifting cylinder and a fork arm carrier.

6.3.1 Inner, middle and outer masts

The inner, middle and outer mast are welded parts, and mainly supported on the axle housing. The bottom of the outer mast is connected with the axle housing through a supporting shaft and can tilt back and forth under the action of the tilt cylinder.

The outer mast channel steel is of C type, and the main and side rollers are installed at the upper part. The middle mast channel steel is of Jb type, and a pair of main and side rollers are installed at the upper and lower parts respectively. The inner mast channel steel is of Jb type, and a pair of main and side rollers are installed at the bottom. Through the rolling of main and side rollers, the inner mast always maintains the established relative position with the outer mast in the process of movement.

The upper main rollers and side rollers of the inner, middle and outer masts are maintained at a high position, so attention should be paid to your safety.

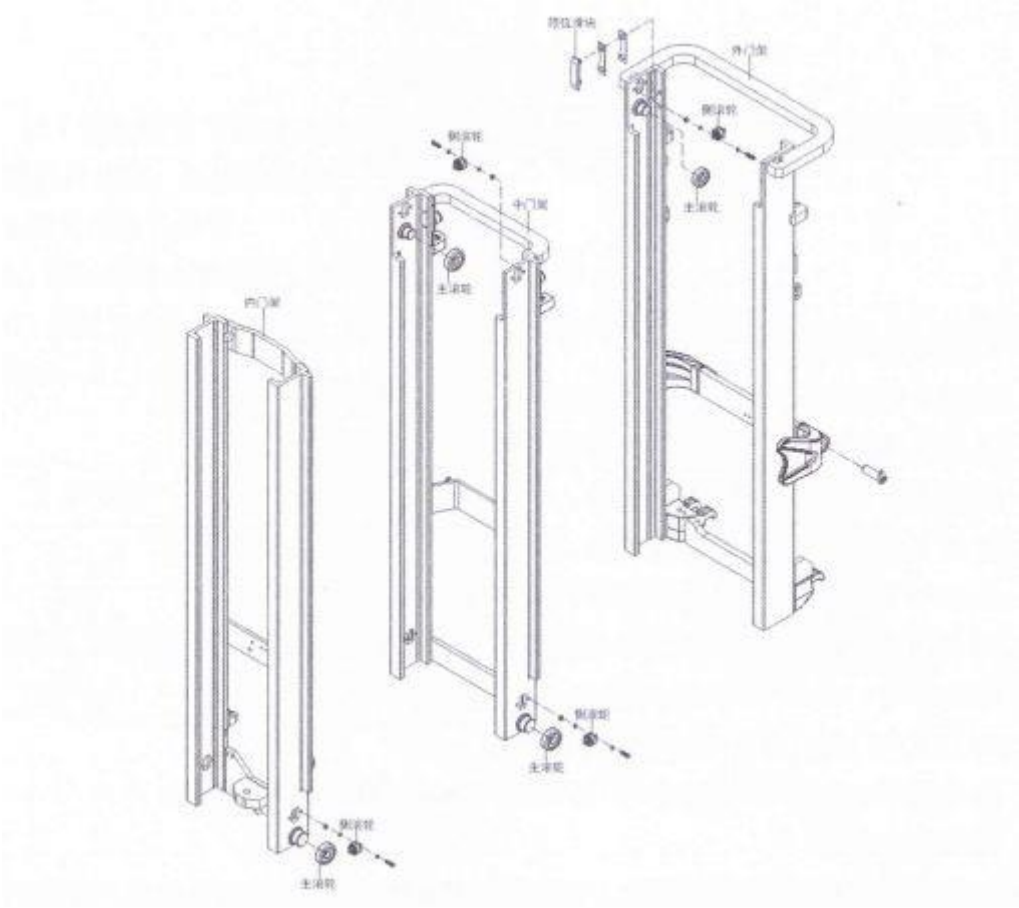


Fig. 6-13 Inner, Middle and Outer masts

6.3.2 Carriage

The carriage rolls in the inner door frame through the main roller that is installed on the main roller shaft and clamped by the elastic retainer ring, and the intermediate roller is a composite roller. The main roller shaft is welded on the carriage, and the roller on the column plate side is fixed on the carriage by bolts. The longitudinal load is borne by the main roller. When the fork is lifted to the top, the upper roller is exposed from the top of the mast, and the lateral load is borne by the composite roller and the side roller at the lower end.

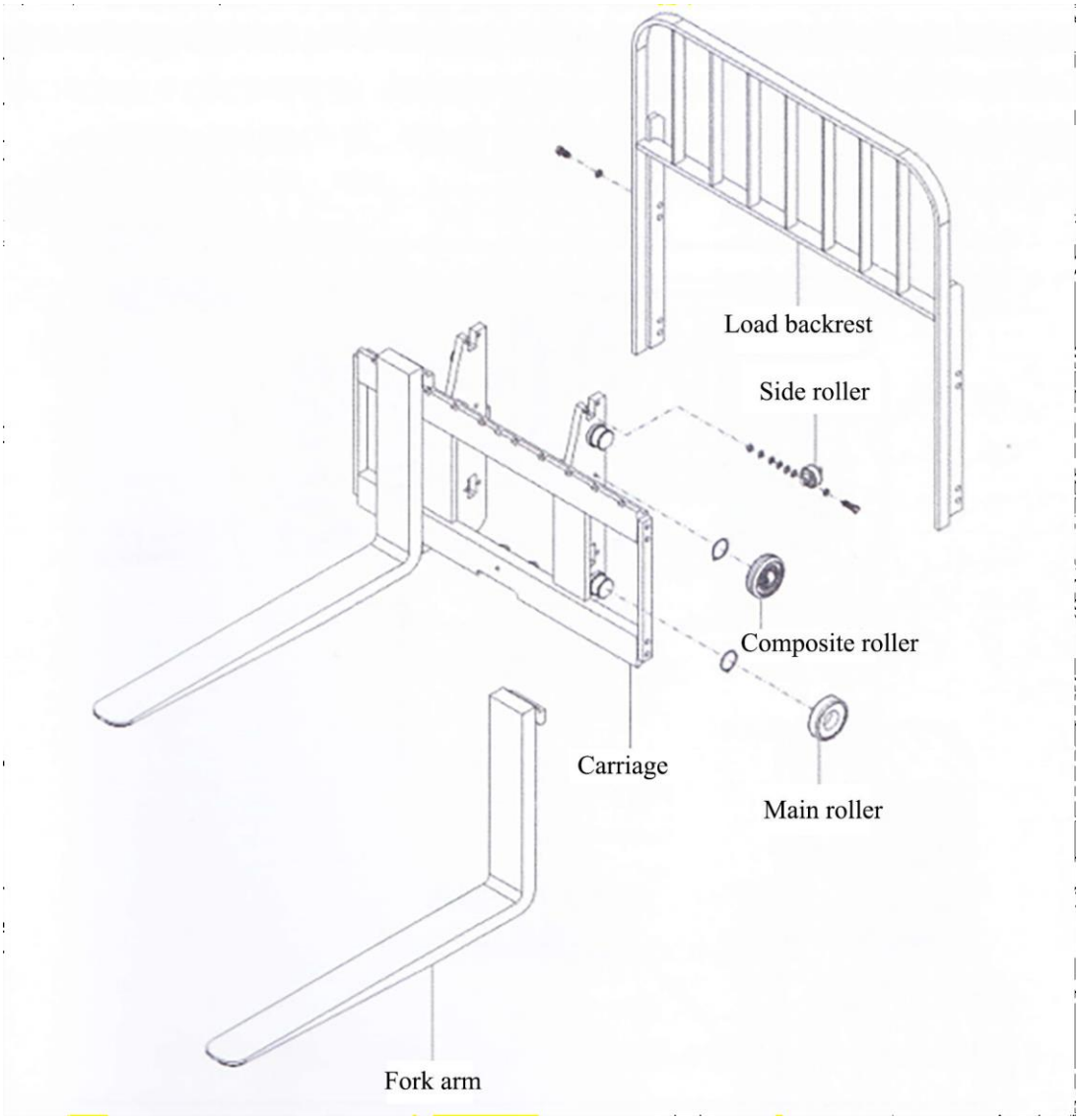


Fig. 6-14 Carriage

6.3.3 Roller adjustment method

There are 14 main rollers, which are respectively installed at the upper end of outer mast (2), upper end of middle mast (2), lower end of middle mast (2), lower end of inner mast (2) and both sides of fork arm carrier column plate (6, including 2 composite rollers).

There are 14 side rollers, which are respectively installed at the upper end of outer mast (2), upper end of middle mast (2), lower end of middle mast (2), lower end of inner mast (2) and fork arm carrier (6, including 2 composite rollers).

Except that the middle composite rollers of the carriage column plate bear both front and rear loads and lateral loads, the rest main roller only bears front and rear loads, and the side roller bears left and right lateral loads. The main roller is used in conjunction with the side roller to

make the inner mast and the carriage move freely.

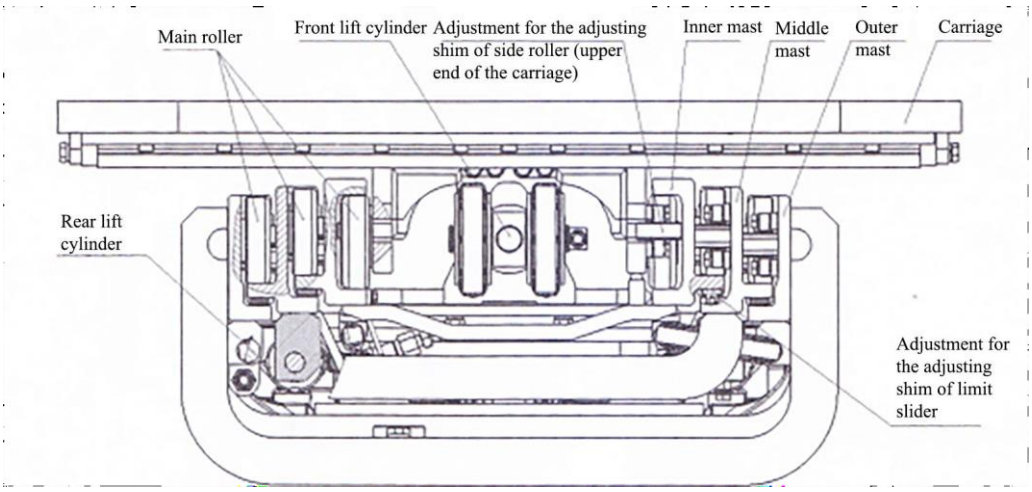


Fig. 6-15 Roller Layout

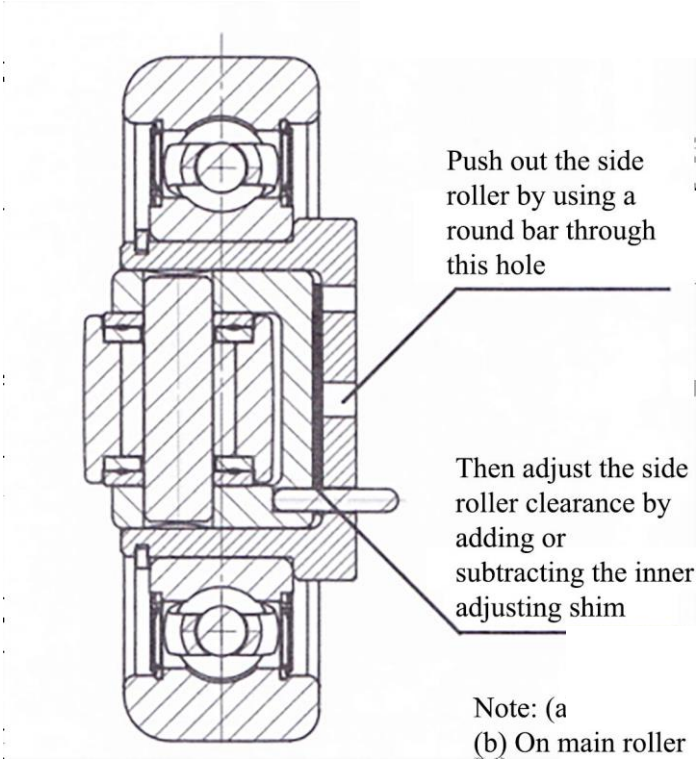


Fig. 6-16 Composite Roller
Note: (a) Adjust the clearance of side roller to 0-0.5mm.
(b) Apply grease on the surface of the main roller and the contact surface of mast.

6.3.3 Maintenance

a Adjustment of lift cylinder

When the lift cylinder, inner mast or outer mast is removed and replaced, the stroke of the rear lift cylinder needs to be readjusted (note: It is not required for the front lift cylinder).

The adjustment method is shown in Fig. 6-17 below:

(1) Install the piston rod head into the middle mast cylinder support without adjusting shim.

(2) Slowly lift the mast to the maximum stroke of the oil cylinder, and observe whether the stroke ends of the two oil cylinders are synchronized. If not stop at the same time,

it indicates that the strokes of the left and right cylinders are not synchronized; add or remove shims on the top of the piston rod to adjust the stroke synchronously;

Adjusting pads with a thickness of 0.2mm and 0.5mm shall be added between the oil cylinder supports of the middle mast.

(3) Then slowly lower the inner mast and observe whether the stroke terminals of two cylinders are synchronized. Refer to the adjustment method of lifting synchronization.

(4) Adjust the tension of the chain.

The adjustment of the lift cylinder also belongs to high-position maintenance, so attention should be paid to your safety.

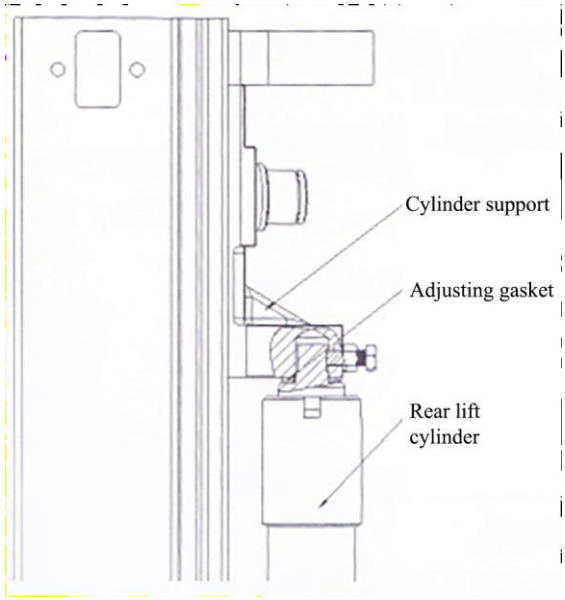


Fig. 6-17 Synchronous Adjustment of Rear Lifting Cylinder

(5) When the front cylinder needs to be replaced, it is necessary to remove the carriage in

the same way as c. Remove the carriage as a whole before removing and replacing the front lift cylinder.

b Height adjustment of carriage

(1) Park the forklift on a horizontal ground and make the mast vertical.

(2) Make the fork bottom surface touch the ground, and adjust the adjusting nut of the upper end joint of the chain in such way that there is a distance A between the main roller and the lower end surface of mast channel steel.

Type of Forklift	Amm
1.5-1.8t	36~41
2-2.5t	24~29
3-3.5t	19-24

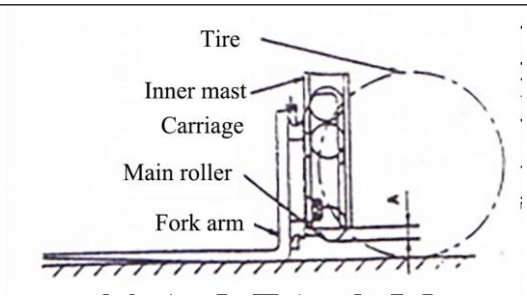


Fig. 6-18

(3) Lower the forks to the ground and tilt backward in place, adjust the upper end joint of the chain, and adjust the nut to make the tension of the two chains the same.

c Replacement of carriage roller

(1) Put a pallet on the fork and park the forklift on flat ground.

(2) Lower the forks and pallets fall to the ground.

(3) Remove the upper end joint of the chain, and remove the chain from the sprocket as shown in Fig. 6-7.

(4) Lift the inner mast.

(5) After confirming that the carriage has been disengaged from the inner door frame, remove the carriage.

(6) Replacement of main roller:

a) Remove all spring collars, remove the main roller with a drawing tool, and keep the adjusting shim.

b) Confirm that the new roller is the same

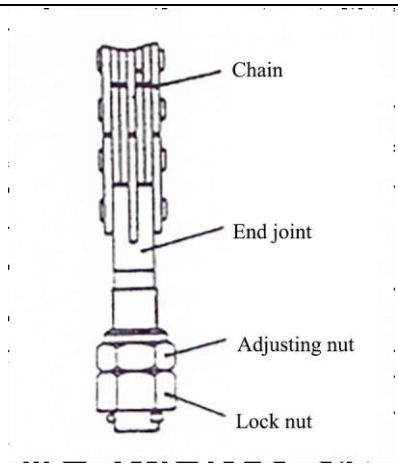


Fig. 6-19

as the replaced roller, replace the original roller with a new one, and clamp the elastic retainer ring in place at the same time.	

d Replacement of mast roller

(1) Remove the carriage from the inner mast in the same way as described in c Replacement of carriage roller.

(2) Drive the forklift to a flat ground, and underlay the front wheels by 250~300 mm.

(3) Pull up the hand brake and pad the rear wheels with wedges.

(4) Remove the upper end joint of the chain on the rear cylinder head and remove the chain from the sprocket.

(5) Lower the inner mast until the rollers at the lower part of inner mast and the upper part of middle mast are exposed.

(6) Replacement of main roller:

a) Remove the upper main roller with a drawing tool, and do not lose the adjusting shim.

b) Install the new roller with the adjusting shim removed in Step o).

(7) Remove the fixing bolts of the lift cylinder and the middle mast. Lift the inner and middle masts together, taking care not to lose the adjusting pads at the head of the piston and

the piston rod.

(8) Remove the connecting bolts between the lift cylinder and the bottom of the outer mast. Remove the lift cylinder and the oil pipe between the two cylinders without looseness.

Oil pipe connector

(9) Lower the inner and middle masts until the rollers at the lower part of middle mast and the upper part of outer mast are exposed.

(10) Replace the main roller, same as (6).

(11) Lift the inner and middle masts until all rollers enter the corresponding masts.

(12) Install the lift cylinder and carriage according to the reverse procedure of removal.