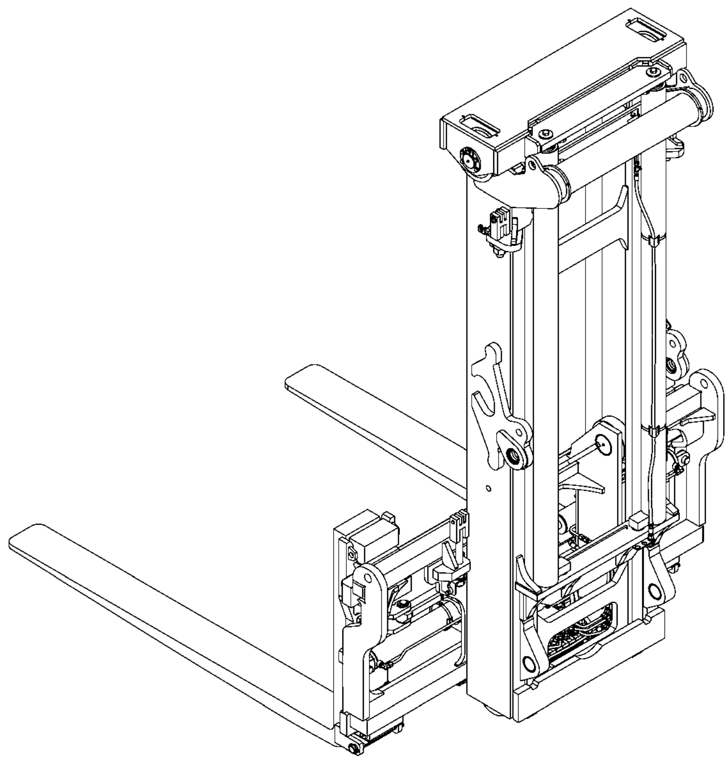
MAST

H16XM9-12, H18XM-7.5-9
(H360-36HD, H360-48HD) [A238] [B238]



HYSTER

PART NO. 4097319

4000 SRM 1664

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Hyster® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the WARNING symbol and word are on orange background. The CAUTION symbol and word are on yellow background.

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H16XM9-12, H18XM-7.5-9 (H360-36HD, H360-48HD) [A238] [B238]

General

This manual contains the description and repair procedures for the two stage mast and its components on the A238 and B238 truck series. The components of the mast include the inner and outer mast, the tilt and lift cylinders, the carriage, and the forks.

Description And Operation

MAST SYSTEM

The function of the mast assembly is to lift a load vertically. It consists of an outer mast, inner mast and a carriage. The outer mast is attached to the truck frame. Inside the channels of the outer mast, the inner mast moves up and down on rollers. Inside the channels of the inner mast, the carriage moves up and down on rollers. The carriage carries the lift forks or an attachment.

The vertical movement of the inner mast and carriage is provided by two lift cylinders and lift chains. Forward and backward tilting of the mast are provided by the tilt cylinders. Different carriage options exist for side shifting, fork positioning or for attachments.

The masts for H16XM-9, H18XM-7.5 (H360-36HD) and H16XM-12, H18XM-9 (H360-48HD) trucks are similar. The difference is in the dimensions of their components. See Figure 1.

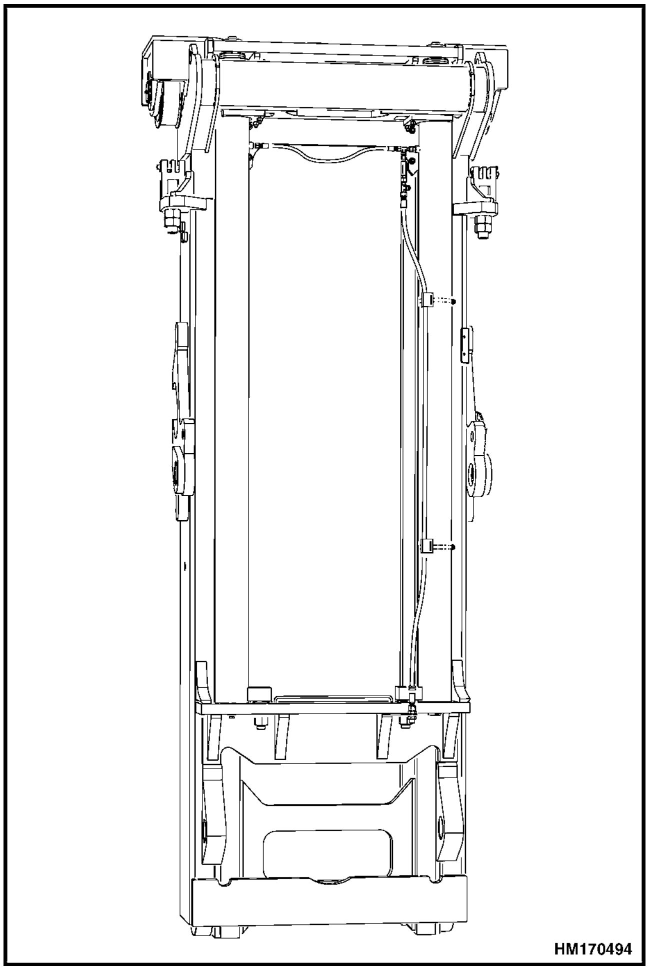


Figure 1. Two-Stage Mast

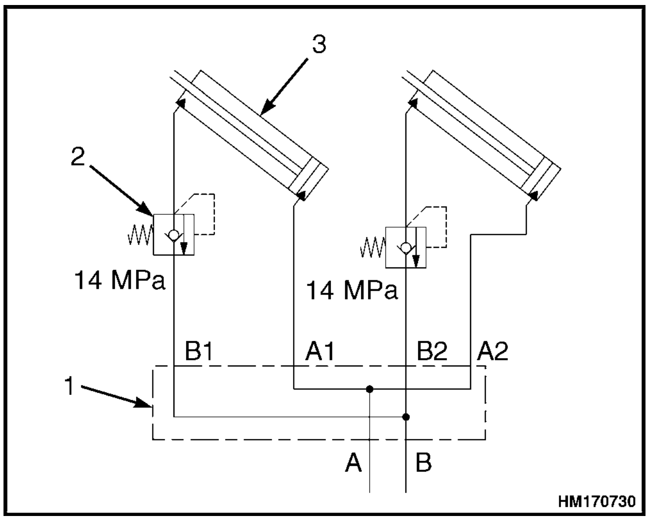
TILTING

The mast pivots on pins which are clamped to the frame in the mast mounts. Friction is reduced by bushings which are pressed into the mast hangers. The mast tilts forward or backward by extending or retracting the tilt cylinders. The maximum tilt angle is determined by the end stroke position of the tilt cylinders. The length of the two tilt cylinders must be adjusted to prevent that the tilt cylinders twist the mast in the maximum back tilted position.

The hydraulic pressure in the tilt cylinders is determined by the combined weight of the mast assembly and the load, and by the horizontal distance between the mast pins and the combined point of gravity of mast and load.

Tilt Control (for A238 and B238 until Mid-2017)

A 14 MPa (2031 psi) relief valve is installed in the connection with the rod side of the tilt cylinders to improve tilt movement control. When tilting backward, a check valve opens the connection to the rod side. Tilt cylinder movement is stopped by moving the tilt cylinder spool in the hydraulic control valve to the neutral position



A. TILT FORWARD
B. TILT BACKWARD

1. TILT MANIFOLD
2. RELIEF VALVE
3. TILT CYLINDER

Figure 2. Tilt Lock Valve Schematic for A238/B238 until Mid-2017

Tilt Control (for B238 after Mid-2017)

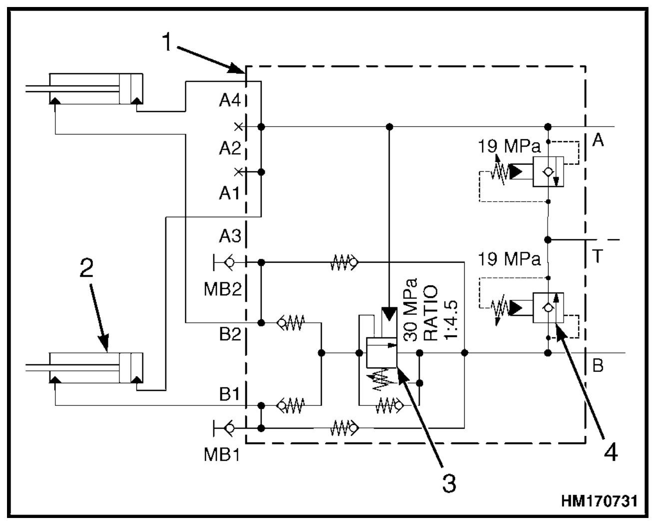
Latest B238 trucks have a tilt lock valve for dynamic tilt control. Different check valves in the tilt lock valve prevent the mast from falling forward in case one of the hoses at the rod side of the cylinders would fail.

When tilting forward, oil supply enters through port A and transfers directly to the piston side of the tilt cylinders. Pressure at the piston side is limited by the 19 MPa (2756 psi) relief valve at port A.

Extruded oil from the rod side has to pass the pilot operated check valve that opens if oil pressure at the piston side is at least 22% of the oil pressure at the rod side of the tilt cylinders. Extruded oil from the rod side of the tilt cylinders returns to tank through the tilt control spool in the main control valve.

When tilting backward, oil supply enters through port B and transfers directly to the rod side of the tilt cylinders. Admitted pressure to the rod side is limited by the 19 MPa (2756 psi) relief valve at port B. Extruded oil from the piston side of the tilt cylinders returns to tank through the tilt control spool in the main control valve.

Without supply pressure, the mast forward tilt movement is restricted by the 30 MPa (4351 psi) pilot operated check valve and mast backward tilt movement is restricted by the 19 MPa (2756 psi) relief valve at port A.



1. TILT LOCK VALVE
2. TILT CYLINDER
3. PILOT OPERATED CHECK VALVE
4. RELIEF VALVE

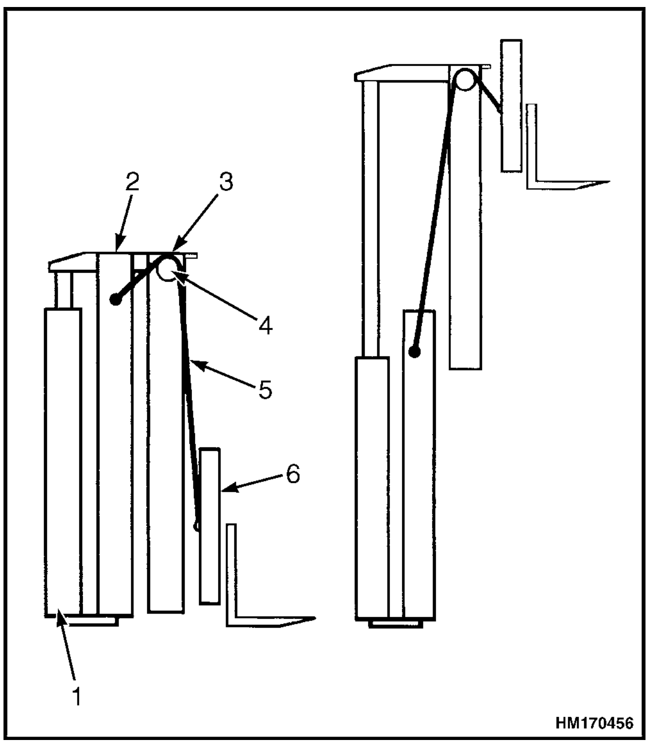
Figure 3. Tilt Lock Valve Schematic for B238 after Mid-2017

LIFTING

The lift cylinders are supported at the base of the outer mast. When the cylinders extend, they push the inner mast upwards. The chains are attached to the outer mast and the carriage, and they run over the chain sheaves at the top of the inner mast. When the inner mast moves upwards, the chains pull the carriage upwards to twice the distance that the lift cylinders have extended. See Figure 4.

Operation

The lift cylinders extend when the hydraulic pressure applied is sufficient to lift the combined weight of the load, forks, carriage and inner mast. The raised position of the mast is maintained by hydraulically closing off the piston side of the lift cylinders. Lowering is achieved by releasing hydraulic pressure, which is induced by the weight resting on the rod of the lift cylinders.



1. LIFT CYLINDERS
2. OUTER MAST
3. INNER MAST
4. CHAIN SHEAVE
5. LIFT CHAIN
6. CARRIAGE

Figure 4. Operation of a Two-Stage Mast

Lifting speed and lowering speed are controlled by the moved position of the lift spool in the main control valve. Maximum lifting speed is determined by maximum pump supply. Maximum lowering speed is determined by the lowering control valve at the bottom of each lift cylinder.

The lowering control valve is a pressure compensated valve. It allows an increasing flow with increasing pressure until a preset maximum flow is reached. The result is that similar lowering speeds are obtained for loaded and unloaded conditions. The primary function of the lowering control valve is to limit the lowering speed in case of a malfunction of the supply/return connection.

The different lift height capacities are determined by the dimensions of the various mast assemblies. The lowest position of the forks is determined by the adjustment of the chain anchors.

Pilot Operated Check Valves

The lift spool in the main control valve does not seal completely in the neutral position. To obtain zero leakage, a pilot operated check valve is mounted in the main control valve between lift spool and lift cylinder. See Figure 5.

When raising the mast, oil supply will pass through a check valve in the pilot operated check valve. To lower the mast, the pilot operated check valve must be moved into the open position.

The position of the pilot operated check valve, is determined by oil pressure at the cylinder side of the check valve, and by the combined force of a spring and the oil pressure at the pilot side of the check valve. Spring force will keep the check valve closed when equal pressures exist at the pilot side and cylinder side of the check valve.

The pilot operated check valve opens when pressure is removed from the pilot side of the check valve, which connects with the selector valve. The selector valve opens when the lift spool has moved into the lowering position, which allows pilot pressure from the spool to reach the selector valve. After the selector valve has opened and drained pilot pressure from the pilot operated check valve, the oil from the lift cylinders will drain through the check valve and lift spool to the tank.

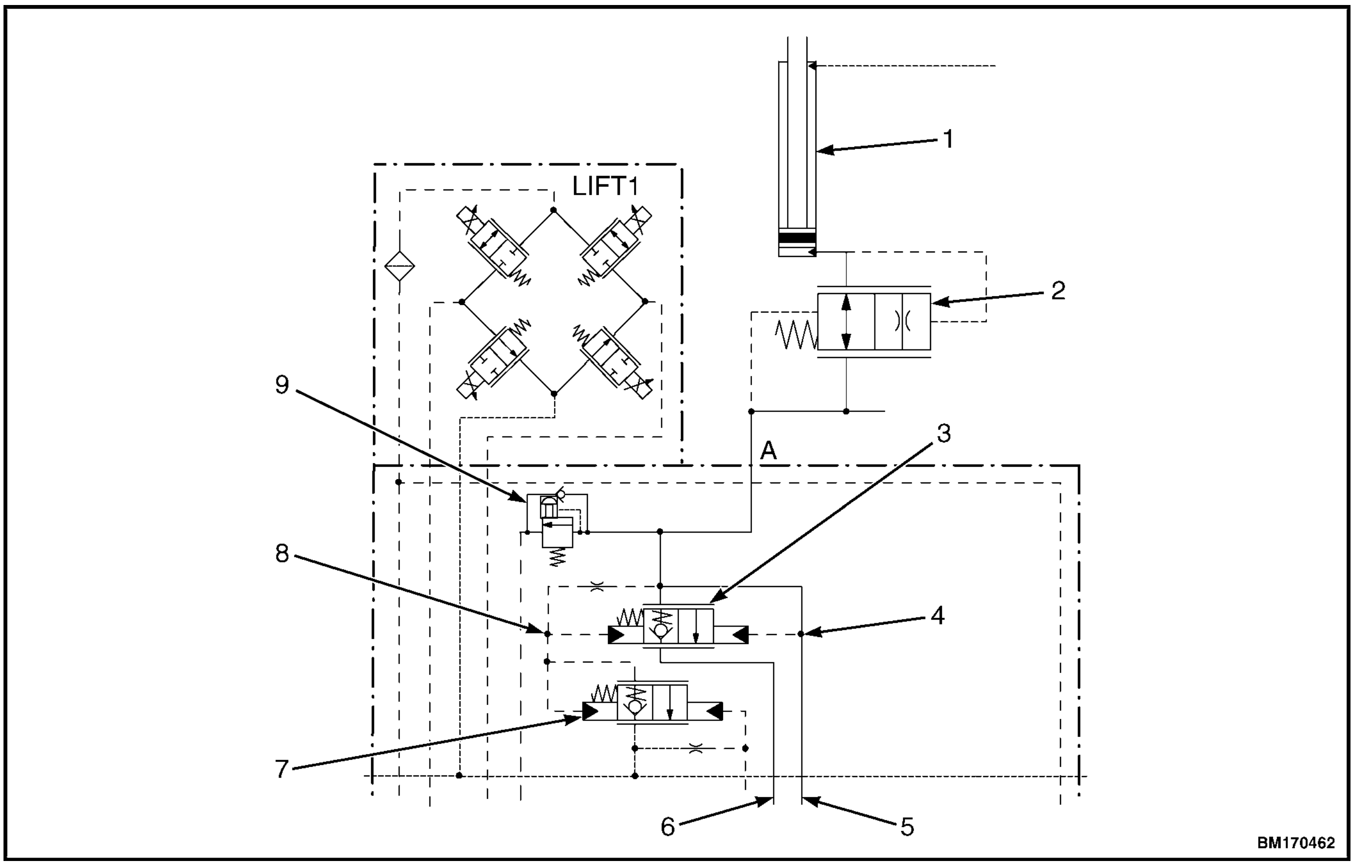
Lowering the lift cylinders can be interrupted by returning the lift spool into the neutral position. This closes the connection between lift cylinder and tank and also interrupts pilot supply to the selector valve, causing it to close. As a consequence lift cylinder pressure builds up at the spring side (= pilot side) of the pilot operated check valve, resulting that the pilot operated check valve closes as well. See Figure 5.

Gland Lubrication

To provide lubrication to the seals in the gland, the inside of the lift cylinder rod is filled with hydraulic oil. When the cylinder extends to the highest position, some of the oil moisturizes the gland seals.

The area between shell and rod is closed off by a 1 MPa (145 psi) check valve, which is located at the lower cross member of the outer mast. The function of the 1 MPa (145 psi) check valve is to retain air pressure at the rod side.

When the cylinder extends, the increasing air pressure between shell and rod pushes the oil through the holes into the inside of the rod. When the cylinder retracts, the reducing air pressure at the shell side allows oil to return form the rod inside to the highest possible position on the rod outside, providing lubrication to the gland seals.



1. LIFT CYLINDER
2. LOWERING CONTROL VALVE
3. PILOT OPERATED CHECK VALVE
4. CYLINDER SIDE
5. TO LIFT SPOOL
6. PILOT PRESSURE FROM LIFT SPOOL
7. SELECTOR VALVE
8. PILOT SIDE
9. EMERGENCY LOWERING VALVE

Figure 5. Pilot Operated Check Valves Schematic

Emergency Lowering Valve

The lift cylinders will NOT lower if lift cylinder pressure is insufficient to overcome the combined force of the spring and the oil pressure at the pilot side of the check valve. This situation occurs for instance, when the weight of the carriage has been removed from the lift cylinders. The emergency lowering valve provides the possibility to manually relieve lift cylinder pressure to tank.

The emergency lowering valve combines three functions in one assembly. The anti-cavitation valve opens when lift cylinder pressure is lower than tank pressure. The shock valve opens when (under extreme conditions) lift cylinder pressure exceeds 35 MPa (5076 psi). Turning the hand wheel clock wise, opens the shock valve against spring force.

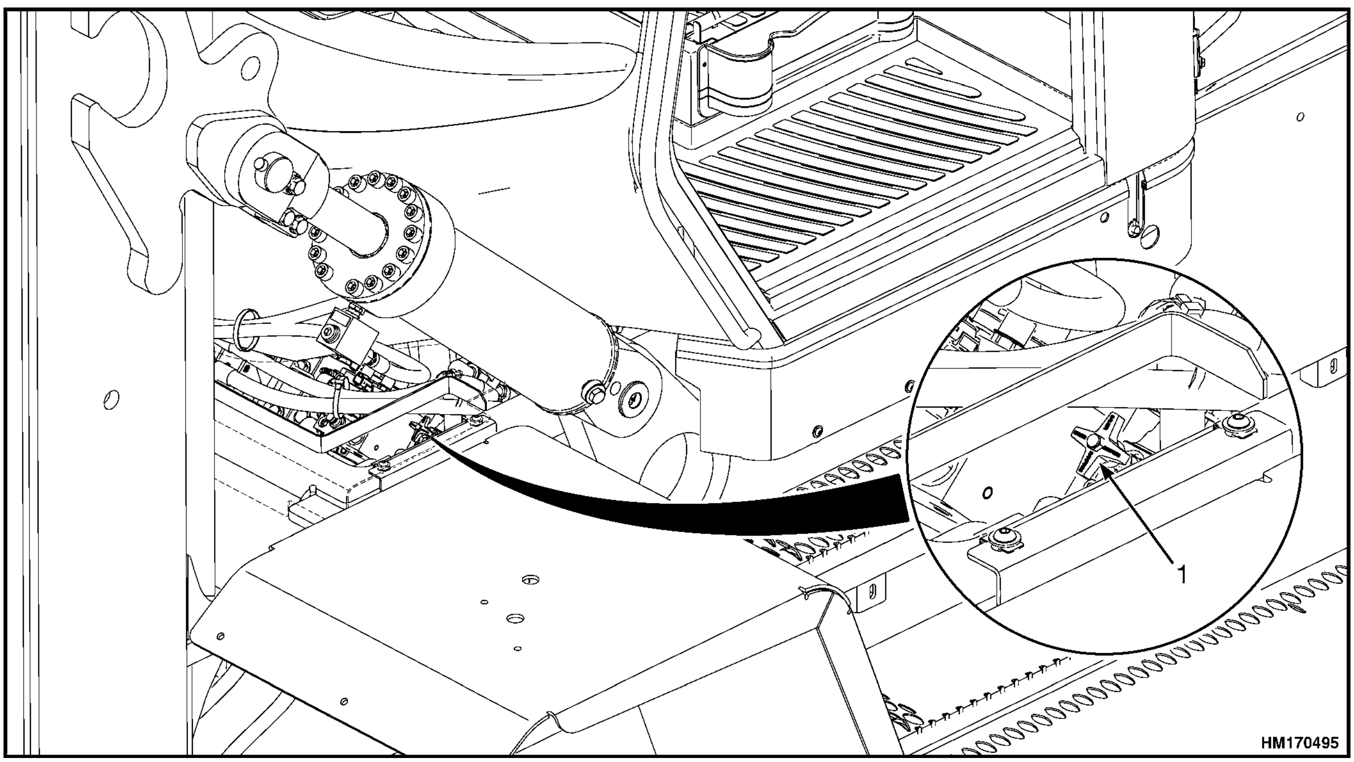
Operation

The emergency lowering valve is located at the left hand side of the main control valve, and can be accessed after removal of the cover above it. See Figure 6.

Initial turning of the hand wheel **CLOCKWISE** will remove play between spindle and shock valve. Continued turning clockwise opens the shock valve against spring force and allows oil from the lift cylinders to drain to tank. See Figure 7.

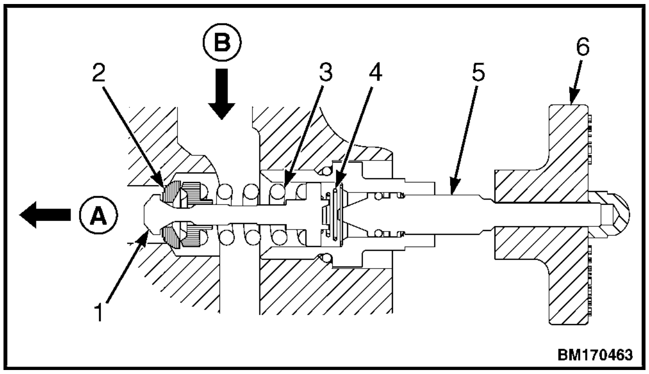
The emergency lowering valve closes by turning the hand wheel **COUNTER CLOCKWISE**. After the spindle loses contact with the shock valve, continue to turn the hand wheel counter clockwise as far as it goes. This allows the Anti-Cavitation Valve to open when necessary.

Immediately after, turn the hand wheel one turn back to prevent damage in case an operator is not familiar with the correct direction of hand wheel rotation.



1. EMERGENCY LOWERING CONTROL VALVE

Figure 6. Emergency Lowering Control Valve - Location



A. TO TANK
B. FROM CYLINDER

1. SHOCK VALVE
2. ANTI-CAVITATION VALVE
3. SHOCK VALVE SPRING
4. ANTI-CAVITATION SPRING
5. SPINDLE
6. HAND WHEEL

Figure 7. Emergency Lowering Valve Assembly

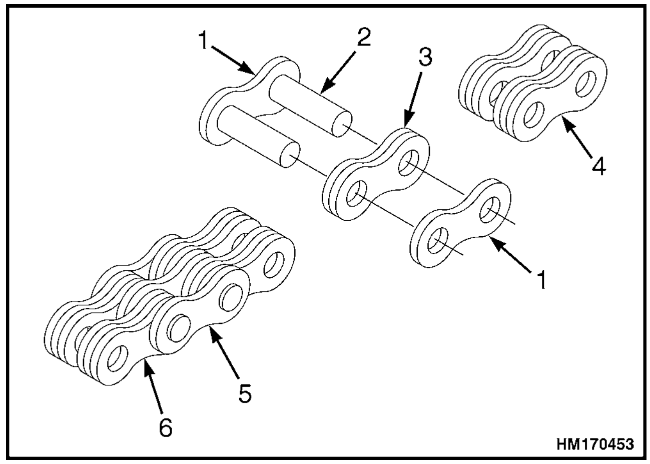
Lift Chains

The lift chains are leaf type chains. A leaf chain consists of link pins and plates that are made of special steel. Heat treatment and mechanical processing give the pins and plates their final strength, but they also make these components more vulnerable to fatigue fractures, if pin and plate surfaces are damaged.

The link pins are riveted into the outer plates. The press fit of the link pins in the outer plates is essential for the integrity of the chain.

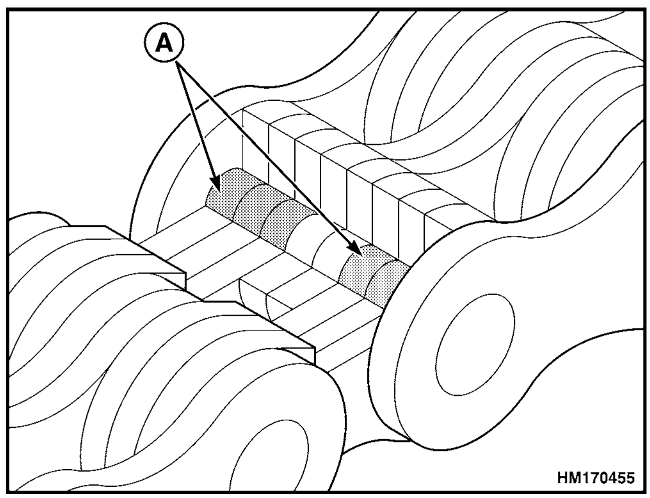
The inner plates have a tight sliding fit for an optimized carrying area that also allows rotation over the link pin.

The chains are connected to the carriage and outer mast through chain anchors. The pin between chain anchor and chain is secured with a snap ring. See Figure 8 and Figure 9.



1. OUTER PLATES
2. LINK PIN (RIVETED TO OUTER PLATES
3. INTERMEDIATE PLATES
4. INNER PLATES
5. OUTER LINK
6. INNER LINK

Figure 8. Chain Components



A. CONTACT AREA

Figure 9. Contact Area Between Link Pin and Inner Plates.

Elongation Through Wear

When the chain articulates, the inner plates rotate over the link pin and cause wear. Wear reduces the pin diameter and enlarges the hole in the plate, which results in chain elongation. When elongation has reached 3%, the entire chain must be replaced.

Speed of Wear

The speed of wear of link pin and inner plates depends on the following factors:

- **Load and impact load**. The chain load depends on the weight lifted and the weight of the carriage and forks. Impact loads occur, when the truck drives over uneven surfaces. The forces generated by an impact load can be a multiple of those of normal chain load.
- **Number of link movements**. The number of link movements directly relates to the number of times the chain passes over the sheave when the mast is raised or lowered. Chain elongation must therefore be measured at that chain section that runs over the sheave most often. The chain section close to the carriage will have the lowest number of articulations and is irrelevant for measuring chain elongation.
- **Lubrication**. An oil film at the contact area between link pin and inner plates reduces wear and preserves the smooth surface of this contact area. The oil film is particularly important for new chains, when the contact areas are being broken in. Therefore, it is essential that new chains are lubricated with oil before they are put into service. See Figure 9.

Plate Height Wear

The chain plates also wear at the contact area between chain and chain sheave. When the chain moves onto the sheave, the plates rotate slightly to follow the radius of the sheave. In combination with the high pressure between chain plates and sheave, this movement causes wear, which affects the strength of the plates. The maximum allowed wear is 5% of the original link plate height.

Lubrication

An oil film at the contact area between link pin and inner plates reduces wear and preserves the smooth surface of this contact area. See Figure 9.

The oil film between pin and plates is pushed away under load conditions and must be allowed to restore daily by removing the load and allowing oil to penetrate again. Restoring the oil film is effected by the capillary action of oil. This process is to be considered separately from applying new oil to the chain.

Insufficient lubrication causes damage to the smooth contact area between pin and plates. The resulting increased friction can cause that the inner plates rotate the pin in the outer plates, which destructs the integrity of the chain structure.

Restoring the Oil Film

The capillary action of oil allows restoring the oil film between chain pin and inner plates, provided that sufficient free flowing oil is present between the plates, and provided that chain tension is as low as possible during a certain time.

The required time to maintain this low chain tension varies with chain cleanliness and availability of free flowing oil between the plates. This time can be as short as 30 minutes or extend infinitely when conditions are unfavorable.

Chain tension should not exceed the own weight of the chain when restoring the oil film. This means that chains must be slack.

Interruption of the oil film between pin and chain outside reduces the capillary action, but also allows entry of humidity. Humidity activates the formation of corrosion products, making it even more difficult for oil to reach the pin contact area. This means that new fresh oil must be applied to the chain before the oil film on the outside is interrupted.

Maintenance

The purpose of applying new oil to chain is to replenish free flowing oil and restore outside oil film. Adding new oil will extend the proper conditions for restoring the oil film at the pin area.

The interval for applying new oil depends on applied load, the number of chain articulations, and ambient conditions like rain, temperature, presence of dust and dirt.

In many cases the simple application of oil on the chains is sufficient to cover the period until the next planned service interval. Main pre-condition is that contamination has not progressed too far, which would prevent oil to penetrate.

Periodically the chains will have to be removed from the truck for cleaning, inspection and re-lubrication by immersion in oil. Cleaning must allow thorough visual inspection and must be aimed at the removal of wear particles and used oil at pin contact area.

Maintaining the Presence of Oil

Insufficient lubrication permanently damages the smooth contact area between chain pin and inner plates. Re-lubricating a damaged contact area afterwards, will not restore the smooth finish of the contact area. A damaged contact area causes accelerated wear and increased friction.

Increased friction may allow the inner plates to rotate the pin in the outer plates. Once the pin has rotated in outer plate, integrity of the chain structure is lost. Rotation of a pin in the outer plate is visible when the beveled end of a pin no longer runs parallel to the length of chain. A chain must be replaced if a pin is at an angle or if a pin has protruded.

Sufficient lubrication is particularly important for new chains, which require a breaking in of the contact area. Proper breaking in also requires low load conditions during initial lifting and lowering. At least avoid lifting high capacity loads initially.

Corrosion Protection

Link pins and chain leaves are made of a steel type that is vulnerable to corrosion. Corrosion causes pits which are the starting point for fatigue fractures. Corrosion preventing coatings, e.g. paint or grease, cannot be applied to the chain as these would obstruct the penetration of oil for re-lubrication.

Therefore, the applied lubricating oil must also serve as a protection against corrosion. This outside oil film must always remain intact to make sure that humidity does not reach the components of the chain, and certainly not the contact area between pin and plate.

Circumstances like temperature, dust and rain will dictate the frequency of re-application of oil to the chain to restore a protecting film. Re-apply oil before the oil film is interrupted.

Requirements for Chain Lubricant

The chain lubricant must be a mineral or synthetic engine oil. Oil viscosity must match the ambient temperature, so that the oil remains viscous and can penetrate to the contact area between link pin and intermediate link.

- Use SAE 20W to 30W oil in ambient temperatures of −30 to 5°C (−22 to 41°F).
- Use SAE 40 oil in ambient temperatures of 5 to 45°C (41 to 113°F).
- Use SAE 50 oil in ambient temperatures above 45°C (113°F).

DO NOT use the following lubricant types:

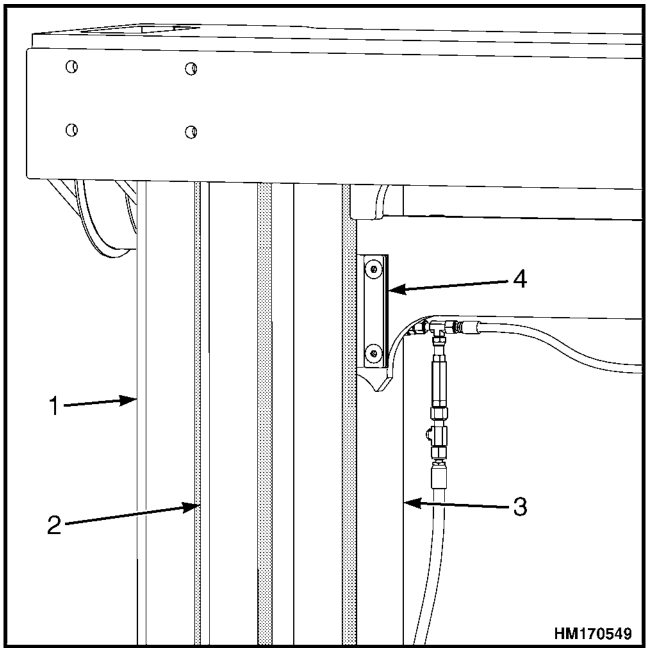
- Lubrication products that contain solids such as graphite or molybdenum disulfide. Solids will not penetrate between the plates, and over time, they will form a barrier that prevents oil penetration.
- Grease or lubrication products that stiffen or form a greasy film. Stiffening products do not penetrate sufficiently. Grease does not penetrate at all. Stiffening products and grease form a barrier that prevents penetration of oil for re-lubrication. Without proper lubrication, the service life of a lift chain is minimized.
- Penetrating fluid Penetrating fluids or aerosol spray lubricants containing penetrating fluids do not provide adequate lubricity, adhesion or corrosion protection, and they do not form a film.

NOTE: If an aerosol spray lubricant is used, always check that it deposits an engine oil equivalent, with the minimum viscosity as listed under Viscosity, after the dispersing agent has evaporated.

Load Rollers

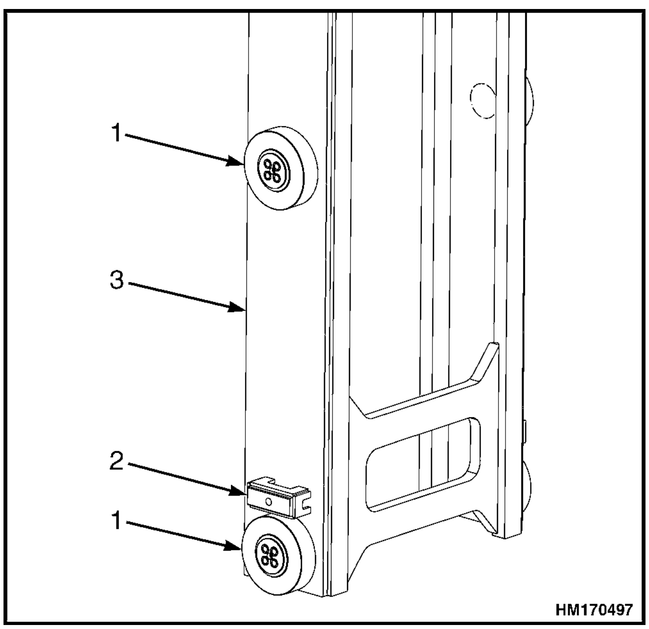
Movement of the inner mast within the outer mast, and movement of the carriage in the inner mast are guided by load rollers, which reduce friction. The load on the carriage causes forces on the load rollers in different directions. The lower load rollers are pushed against the rear of the mast channels. The upper load rollers are pushed against the front of the mast channels. See Figure 11.

When the mast is tilted completely backward and the carriage is raised, it is possible that the upper load rollers of the inner mast travel from the front to the rear of the outer mast channel. To reduce the related backward movement of the inner mast inside the outer mast, two mast support pads are installed at the top of the outer mast. See Figure 10.



1. OUTER MAST
2. INNER MAST
3. LIFT CYLINDER
4. MAST SUPPORT PAD

Figure 10. Mast Support Pad



1. LOAD ROLLER
2. BEARING BLOCK
3. INNER MAST

Figure 11. Bearing Blocks and Load Rollers on Inner Mast

Bearing Blocks

The carriage and inner mast are equipped with bearing blocks. These absorb sideways forces, which cannot be absorbed by the load rollers. The bearing blocks are shimmed close to the mast channels. Reshimming is required when sideways movement causes shocks that affect load handling.

On the carriage the bearing blocks are located just above the load rollers. On the mast the lower bearing blocks are above the lower rollers on the inner mast. The upper bearing blocks are at the upper channel end of the outer mast. See Figure 11.

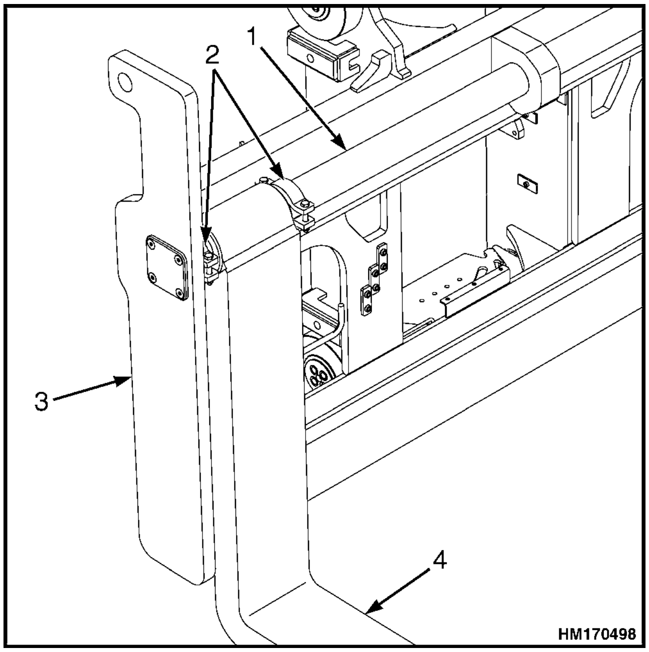
CARRIAGE

Three different types of carriages are available for different combinations of side shifting and fork positioning.

- The standard pin type carriage can have manual or hydraulic fork positioning.
- The carriage with integral side shifting has a separate apron, which carries a pin type carriage.
- The dual function carriage has fork carriers, which allow side shifting under load.

Standard Carriage with Manual Fork Positioning

The pin-type forks are kept in position by two clamps. Loosening the clamps allows manual repositioning of the forks on the fork pin. See Figure 12.



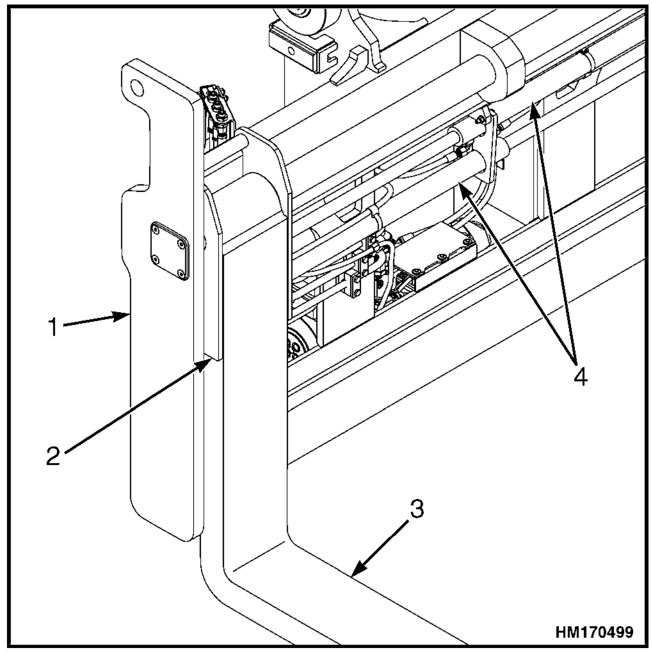
1. FORK PIN
2. FORK CLAMP
3. CARRIAGE
4. FORK

Figure 12. Standard Carriage with Manual Fork Positioning

Standard Carriage with Hydraulic Fork Positioning

The pin-type forks are positioned by fork guides that are attached to the fork positioning cylinders. By activating the directional control valve the cylinders move the guides and forks individually or simultaneously. See Figure 13.

The fork pin and the lower carriage bar must be sufficiently greased to reduce friction and wear during fork positioning.



1. CARRIAGE
2. FORK GUIDE
3. FORK
4. FORK POSITIONING CYLINDERS

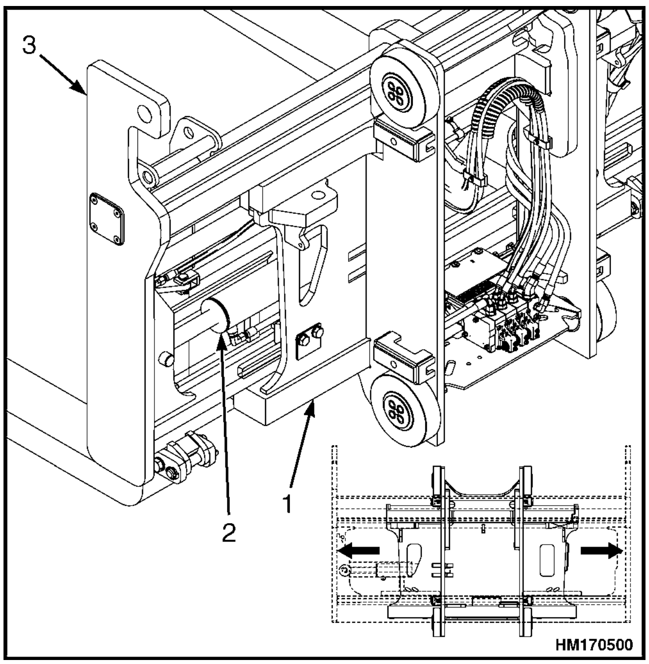
Figure 13. Standard Carriage with Hydraulic Fork Positioning

Integral Side Shift (ISS) Carriage with Pin-Type Forks

The carriage with integral side shift has a separate apron, which can be moved by activating the side shift cylinder. To reduce friction during side shifting, the carriage has bearing blocks, which carry the apron. See Figure 14.

Dual Function Side Shift and Fork Positioning Carriage (DFSSFP)

DFSSFP carriages are designed to side shift the forks under loaded conditions. Depending on the lever operated in the cab, the forks can be side shifted, positioned individually or positioned simultaneously. The forks are either (quick disconnect) hook type forks or they have a design which integrates the function of the fork hanger.

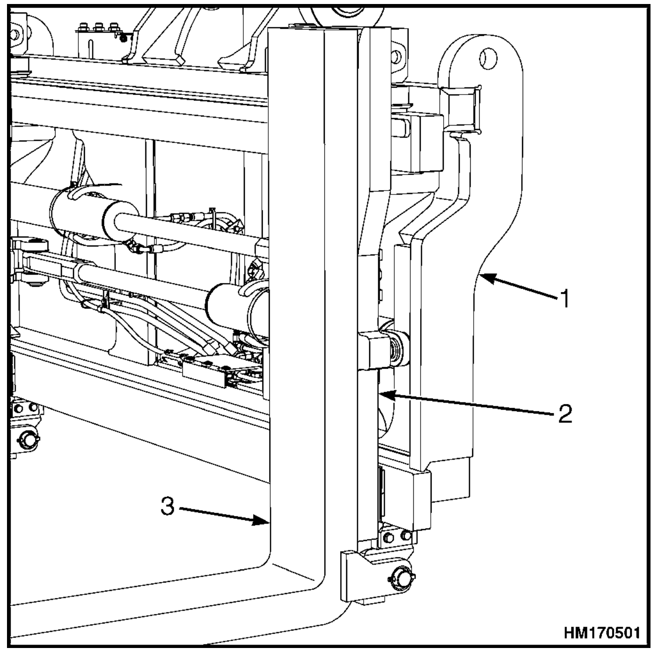


1. APRON
2. SIDE SHIFT CYLINDER
3. CARRIAGE

Figure 14. Integral Side Shift

DFSSFP Carriage with Quick Disconnect Forks

The DFSSFP carriage with Quick Disconnect Forks has two fork hangers that are installed on the carriage. The hook-type forks are attached to the fork hangers. See Figure 15.

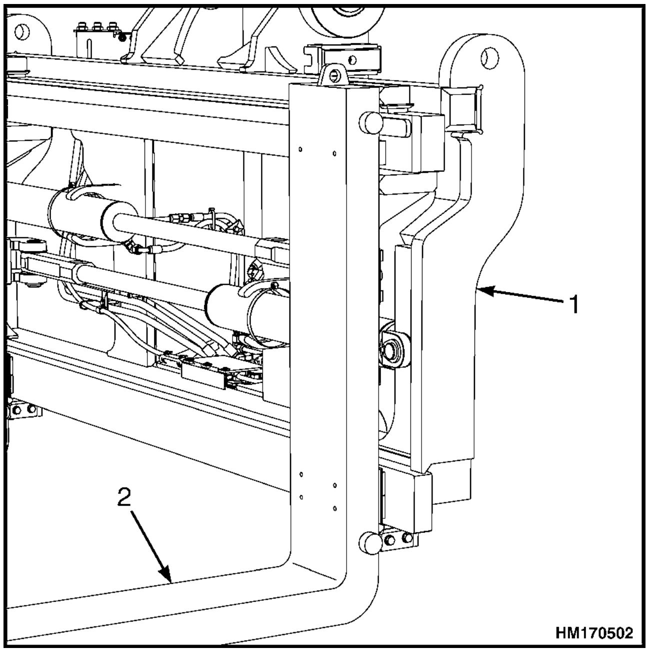


1. CARRIAGE
2. FORK HANGER
3. QUICK DISCONNECT FORK

Figure 15. Dual Function Carriage with Quick Disconnect Forks

DFSSFP Carriage with Integrated Forks

The forks for the DFSSFP carriage with Integrated Forks are directly installed on the carriage, which reduces the distance between load and truck. See Figure 16.



1. CARRIAGE
2. INTEGRATED FORK

Figure 16. Dual Function Carriage with Integrated Forks

Carriage Valve

Trucks with one (side shift) function only, do not have a directional control valve because the carriage function is directly operated by the auxiliary section of the main control valve. The corresponding alternating Pressure and Tank (P & T) system uses two colored straps to identify the two header hoses, which are routed over hose sheaves at the top of the mast:

- Green-Yellow is connected with control valve port Aux A.
- Green-Green is connected with control valve port Aux B.

Trucks with several auxiliary functions have a Directional Control Valve that has a spool section for each function. Oil supply is through a fixed Pressure and Tank (P & T) system, which requires three header hoses with following strap marking:

- Green is connected with control valve port Aux A.
- Yellow is connected with control valve port T3.
- White-Yellow is connected with control valve port T Aux.

Alternating Pressure and Tank (P & T)

Alternating P & T is applied when a limited number of functions allow the control valve on the truck to determine the direction of the oil flow. Examples are: one single function, Simultaneous Fork Positioning only, and Dual Function with Fork Positioning only.

For alternating P & T systems there are two header hoses, which are marked with two colored straps.

- Green-Yellow is connected with control valve port Aux A.
- Green-Green is connected with control valve port Aux B.

For alternating P & T systems, two different carriage control valves are used:

- Flow divider for simultaneous Fork Positioning.
- Valve for Dual Function with Side Shift and Fork Positioning (DFSSFP).

The header hoses connect with the inlet module, which transfers oil supply to identical spool sections. The function of each spool evolves from its electrical and hydraulic connection. The sequence of these functions is different for carriages with pin type forks and for DFSSFP type carriages. An overview of the location of the spool connections is in Table 1.

NOTE: Nomenclature for the right and left fork positioner cylinder can be confusing. The right fork positioner cylinder moves the right fork, however the right fork positioner cylinder is located at the left side of the carriage.

Table 1. Directional Control Valve Connections

	1st Spool	2nd Spool	3rd Spool	4th Spool	5th Spool
Pin Type					
Connector	CPS152	CPS151	CPS149	–	–
Function	Aux 3	Aux 2	Aux 0	–	–
Hydraulic Connection	LH Fork Positioner	RH Fork Positioner	Side Shift	–	–
DFSSFP					
Connector	CPS152	CPS149	CPS151	CPS150	–
Function	Aux 3	Aux 0	Aux 2		–
Hydraulic Connection	LH Fork Positioner	RH Fork Positioner	LH and RH Fork Positioner	Auxiliary	–
DFSSFP with simultaneous fork position *					
Connector	CPS153A	CPS149	CPS153B	CPS151	CPS152
Function	Aux 1A	Aux 0	Aux 1B	Aux 2	Aux 3
Hydraulic Connection	LH Fork Positioner	LH and RH Fork Positioner	RH Fork Positioner	5th Function	6th Function
NOTE: * An additional Splitter Harness connects CPR150 with both 1st spool and 3rd spool.					

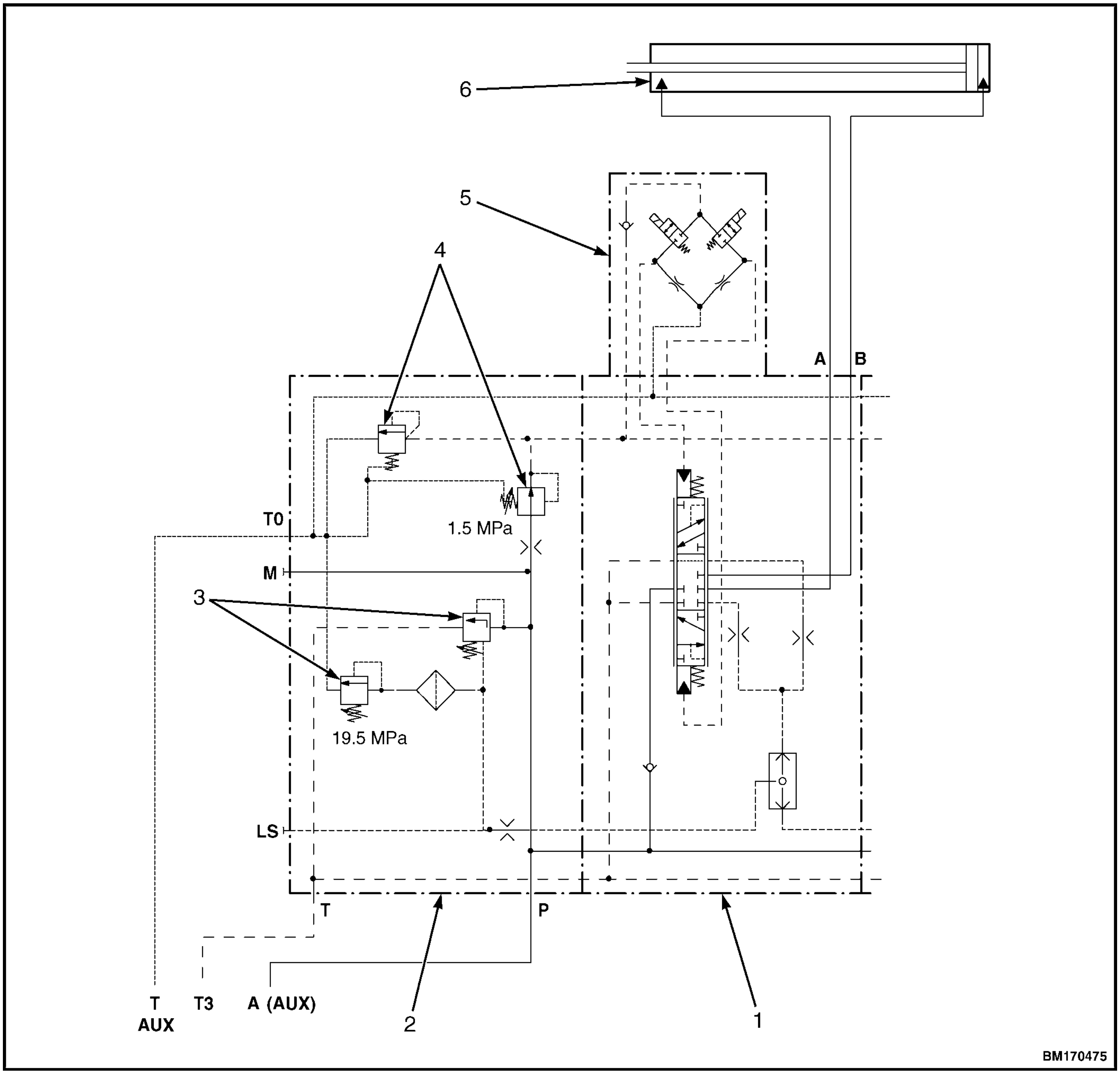
Electrical supply is through the mast wire harness, which is routed over the hose sheaves, parallel with the header hoses. The mast wire harness connects with the carriage wire harness, which is identical for all versions of the directional control valve. Harness connectors for unused functions are folded back and taped in. An additional splitter harness is installed for DFSSFP carriages with simultaneous fork positioning.

Hydraulic operation of the spools in the directional control valve is similar to those in the main control valve.

Different in the inlet module is the absence of an LS connection with the pump, the addition of a two stage relief valve and the addition of a pilot pressure supply valve.

The function of the two stage relief valve is to maintain supply pressure just above the required pressure as signaled by the internal LS line. Oil supply pressure is regulated by relieving excess pressure through port T, which leads to port T3 in the main control valve. Maximum supply pressure is regulated by the 19.5 MPa (2828 psi) MPa relief valve, which reliefs through port T0, which leads to port TAUX in the main control valve.

The function of the pilot pressure supply valve is to admit and maintain oil pressure to a maximum of 1.5 MPa (218 psi) for the operation of the auxiliary spools. See Figure 17 and Figure 18.



1. VALVE HOUSING
2. INLET MODULE
3. RELIEF VALVE
4. PILOT PRESSURE SUPPLY VALVE
5. SOLENOID
6. CYLINDER

Figure 17. Directional Control Valve – Schematic (SS Carriage with FP shown)