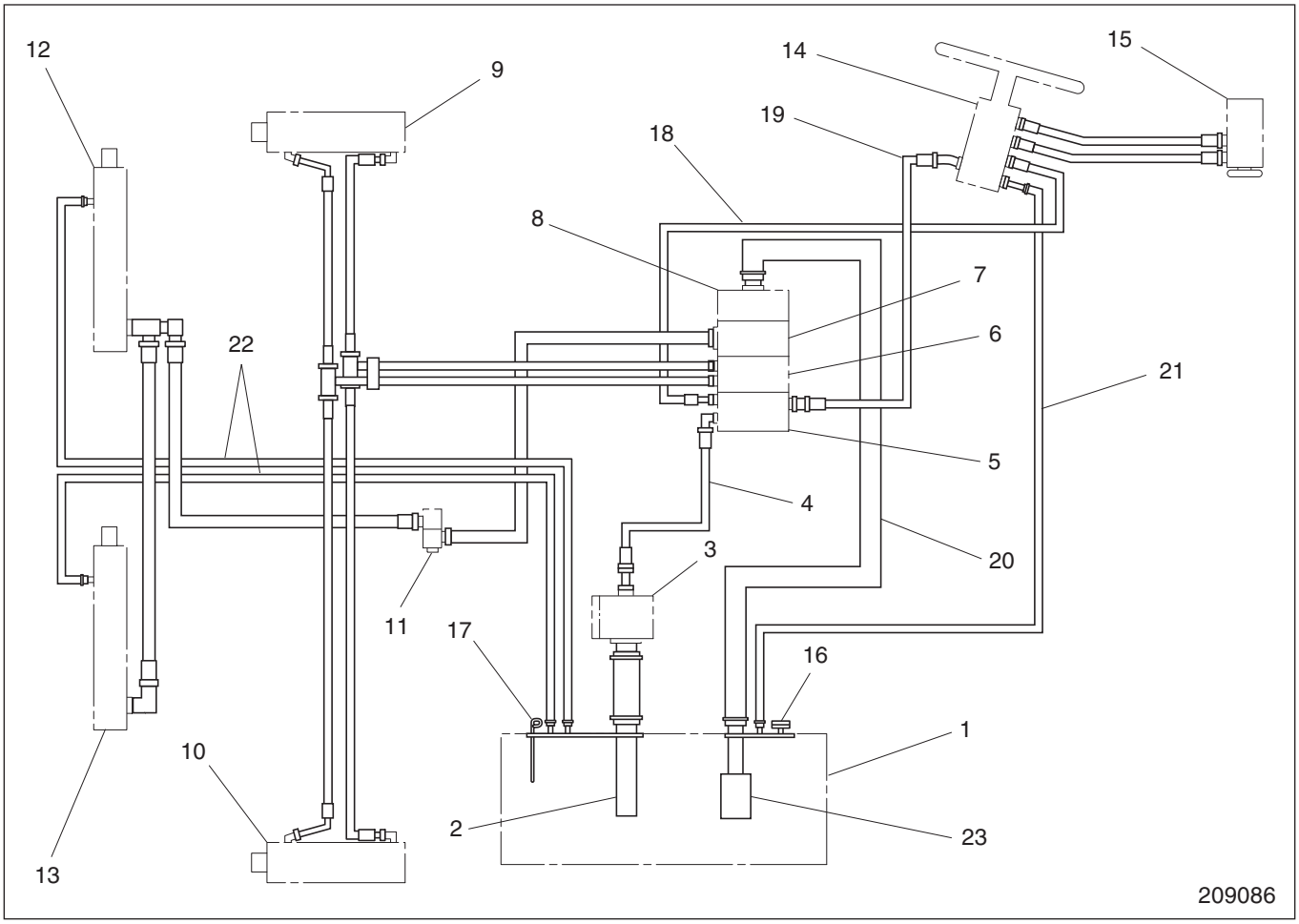
HYDRAULIC SYSTEM

Structure and Functions

General



1	Hydraulic tank	9	Tilt cylinder (R.H.)	17	Oil level gauge
2	Suction pipe	10	Tilt cylinder (L.H.)	18	Oil feed line of steering valve
3	Hydraulic pump	11	Flow regulator valve	19	Oil sensing pressure line
4	Pump delivery hose	12	Lift cylinder (R.H.)	20	Return line
5	Control valve inlet section	13	Lift cylinder (L.H.)	21	Return line
6	Control valve tilt section	14	Steering valve	22	Return line
7	Control valve lift section	15	Hydraulic motor	23	Return filter
8	Control valve end section	16	Breather		

The hydraulic system of this truck includes the mast control circuit and the full-hydraulic steering system circuit.

The oil drawn by the hydraulic pump 3 from the hydraulic tank 1 flows into the control valve inlet section 5 through the pump delivery hose 4.

The flow priority valve in the control valve inlet section 5 preferentially distributes the oil to the steering valve 14 through the oil feed line 18. The priority valve distributes the remainder of the oil to the mast control circuit. In the standard configuration, the following two valve sections are used for the mast control purposes:

(1) Lift control valve section

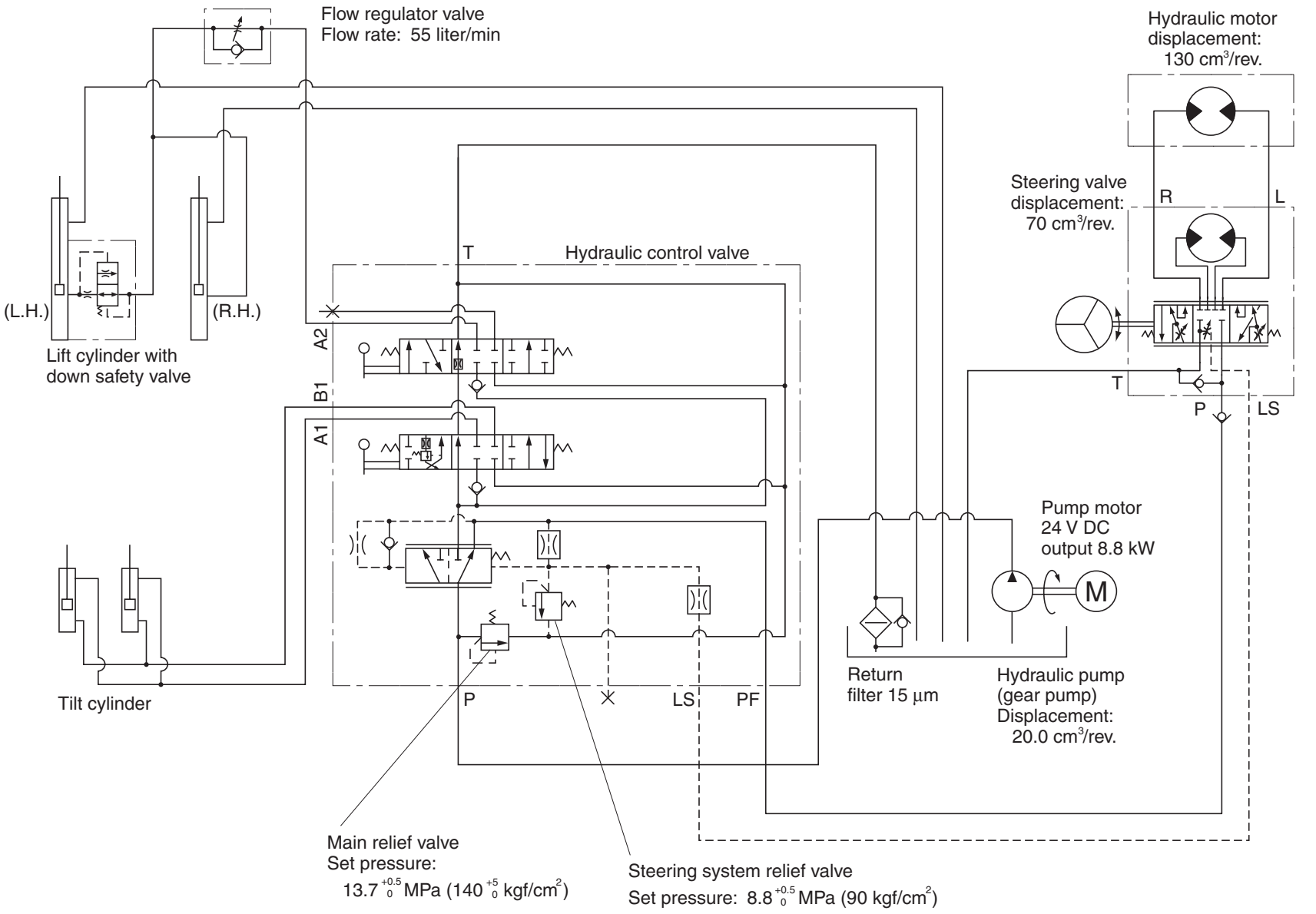
(2) Tilt control valve section

The tilt control valve section controls extension and retraction of the tilt cylinders 9 and 10 to cause the mast to lean forward or backward.

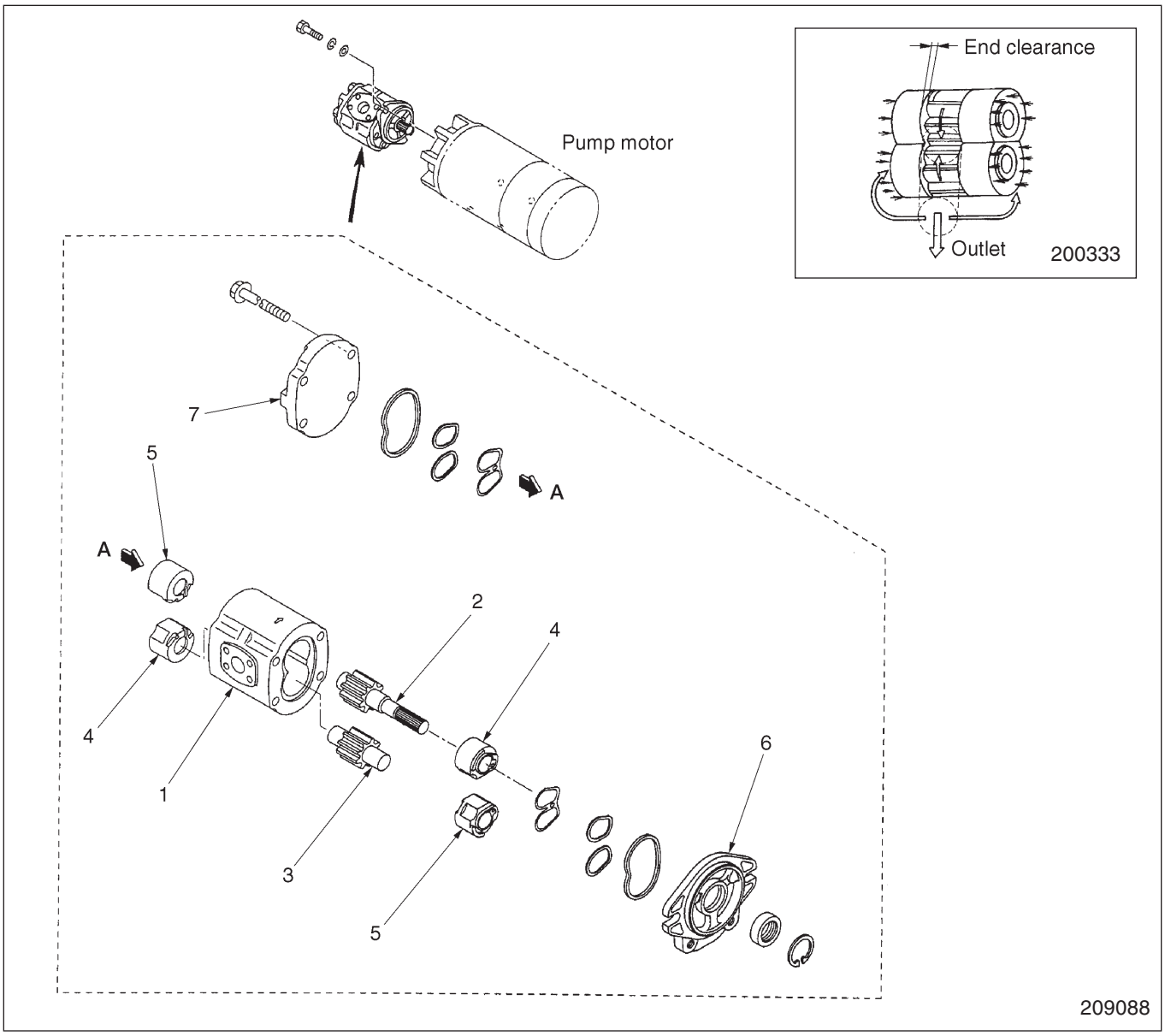
The lift control valve section controls the operation of the lift cylinders 12 and 13 to raise or lower the mast.

The return oils from the steering valve and mast control system go to the hydraulic tank through the return lines 20, 21 and 22.

Schematic of Hydraulic System



Hydraulic Pump



Main Parts

1 Pump body
2 Drive gear
3 Driven gear
4 Bushing (R.H.)
5 Bushing (L.H.)
6 Mounting flange
7 Cover

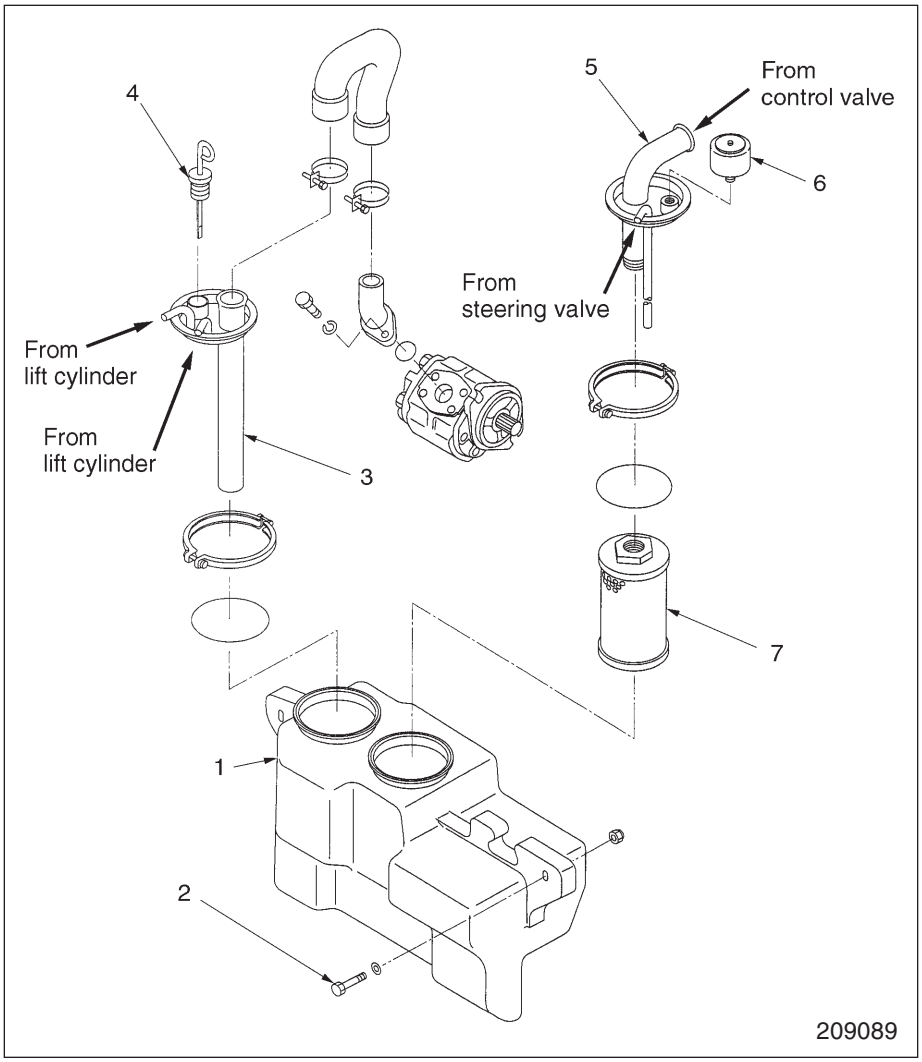
The hydraulic pump is a gear pump, driven by a pump motor.

The drive gear 2 is splined to the armature shaft of the pump motor.

With a high-pressure gear pump, oil tends to leak from the high-pressure side to the low-pressure side through clearances at the ends of each pump gear (internal oil leakage). This leakage reduces pumping efficiency (or pump's volumetric efficiency).

In order to prevent the internal oil leakage, this hydraulic pump is designed to direct a portion of pump delivery oil to the back of the bushings 4 and 5. The oil pushes the bushings against the ends of the gears 2 and 3, thus minimizing the clearances between the gears and bushings (see the drawing above). This design can ensure high pumping efficiency for an extended period of time by making up for the clearances as the bushings and gears wear.

Hydraulic Tank



1 Hydraulic tank
2 Tank mounting bolts
3 Suction pipe
4 Oil level gauge
5 Return pipe
6 Breather
7 Return filter

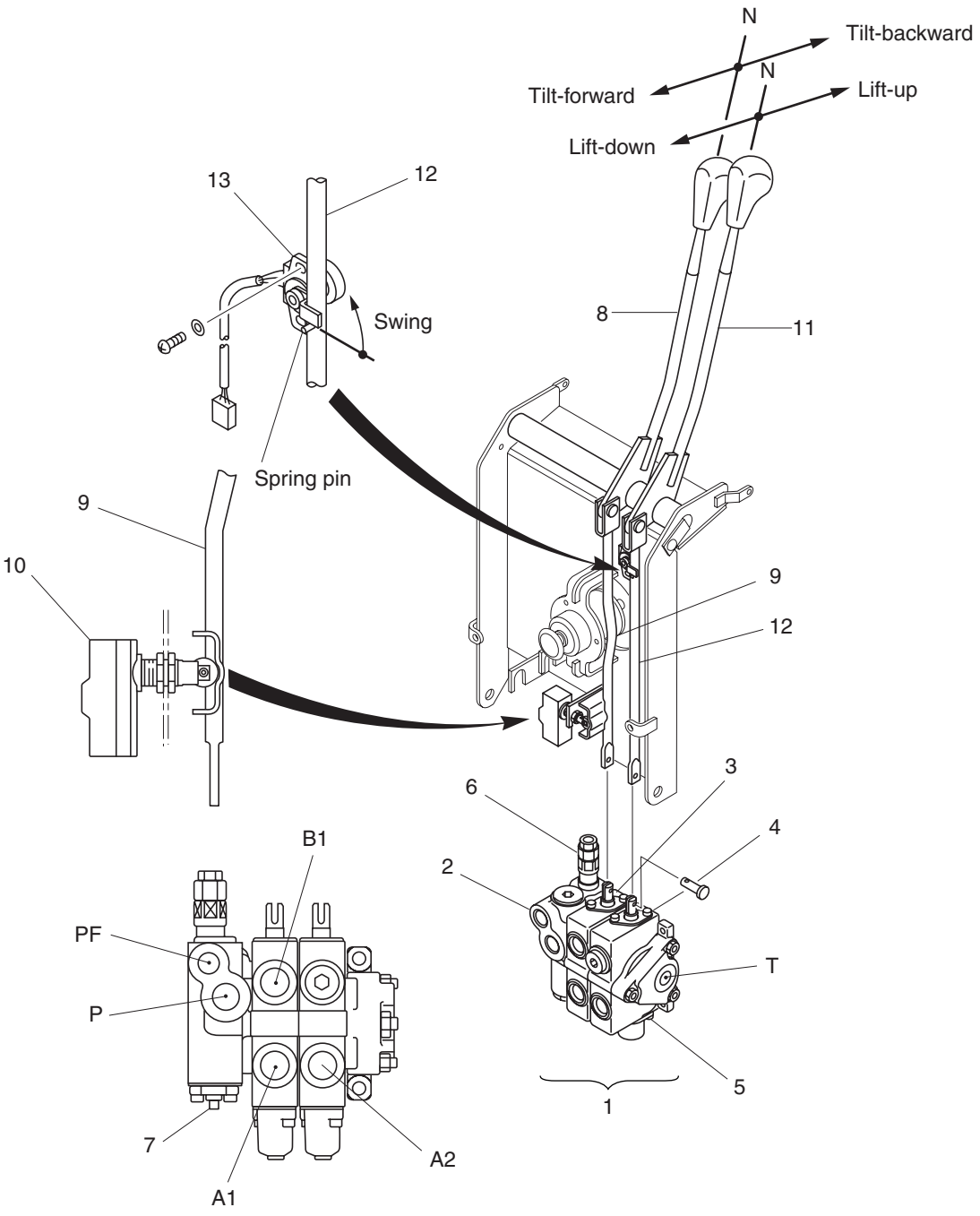
The hydraulic tank is made of plastic. It is mounted on the front portion of the truck frame (approximately at the center) using the tank mounting bolts 2.

In addition to the suction pipe 3 and return pipe 5, the hydraulic tank is fitted with the oil level gauge 4 and breather 6. The return pipe 5 is fitted with the return filter 7 (15 µm) to keep the hydraulic oil clean.

The return filter 7 has a built-in relief valve. The hydraulic oil normally flows through the filter before it returns to the hydraulic tank. If the filter is clogged, the relief valve opens, allowing the oil to bypass the filter and return directly to the tank. It is therefore important to periodically replace the return filter.

The oil level in the hydraulic tank changes as the mast is raised and lowered, causing air to flow out of and into the tank through the breather. The breather is fitted with a filter to prevent dust from entering the tank.

Hydraulic Control Valve and Control Levers



1 Control valve assembly (consisting of parts 2 to 6)
2 Inlet valve section
3 Tilt valve section
4 Lift valve section
5 End cover
6 Main relief valve
7 Steering relief valve
8 Tilt lever
9 Tilt rod
10 Switch
11 Lift lever
12 Lift rod
13 Stroke sensor

P: From pump
PF: To steering system
A1: From/to tilt cylinder
B1: From/to tilt cylinder
A2: From/to lift cylinder
T: To hydraulic tank

General

The drawing on page 10-5 shows the truck's hydraulic control valve, valve control levers and related electrical switch.

The control valve assembly 1 consists of the following five sections:

(1) Inlet valve section 2

(2) Tilt valve section 3

(3) Lift valve section 4

(4) End cover 5

(5) Main relief valve 6

Each valve section will be described briefly in the following paragraphs. For more details about their operation in the system, refer to the relevant sections in this manual.

1. Inlet Valve Section

The inlet valve section 2 incorporates the priority valve and steering system relief valve. Also contained in this section is the main relief valve.

Pump output oil enters the inlet section through port P and flows to the priority valve. The priority valve preferentially allows oil to be directed to the steering system through the PF port in as much an amount as the system requires.

The excess oil is directed to the tilt and lift sections as the mast operation control oil.

2. Tilt Valve Section

The tilt valve section 3 is a directional control valve. This valve switches the direction of oil flow to the mast tilt cylinder to cause the mast to tilt either forward or backward. It also controls the rate of oil flow to the cylinder.

The direction of oil flow depends on whether the control lever 8 is pushed forward or pulled backward, as shown in the drawing.

If the control lever is in the "tilt-backward" position, pressure oil flows into the tilt cylinder through the A1 port and the oil in the cylinder goes out through the B1 port.

If the control lever is in the "tilt-forward" position, the flow of oil is reverse to the above.

The rate of oil flow to the cylinder depends on how far the control lever is moved from the neutral position. The longer the distance from the neutral position, the larger the valve opening and, therefore, the greater the flow rate.

The volume of the oil flowing into the cylinder is equal to that of the oil going out of the cylinder.

The tilt rod 9 is linked to the switch 10. This switch senses the initial movement of the rod, i.e., the movement of the spool, and signals this to the electrical controller, which in turn increases the speed of the pump motor.

3. Lift Valve Section

The lift valve section 4 is a directional control valve. This valve switches the direction of oil flow to the mast lift cylinder to cause the mast to move either upward or downward. It also controls the rate of oil flow to the cylinder.

The direction of oil flow depends on whether the control lever 11 is pushed forward or pulled backward.

If the control lever is in the "lift-up" position, pressure oil flows into the lift cylinder through the A2 port. If the control lever is in the "lift-down" position, the oil in the cylinder goes out through the same port.

The rate at which oil flows into and out of the cylinder depends on how far the control lever 11 is moved from the neutral position. The longer the distance from the neutral position, the larger the valve opening and, therefore, the greater the rate at which oil flows through the A2 port.

The lift rod 12 is linked to the stroke sensor 13. This sensor senses the distance over which the spool has moved and signals it to the electrical controller, which in turn adjusts the pump motor speed accordingly.

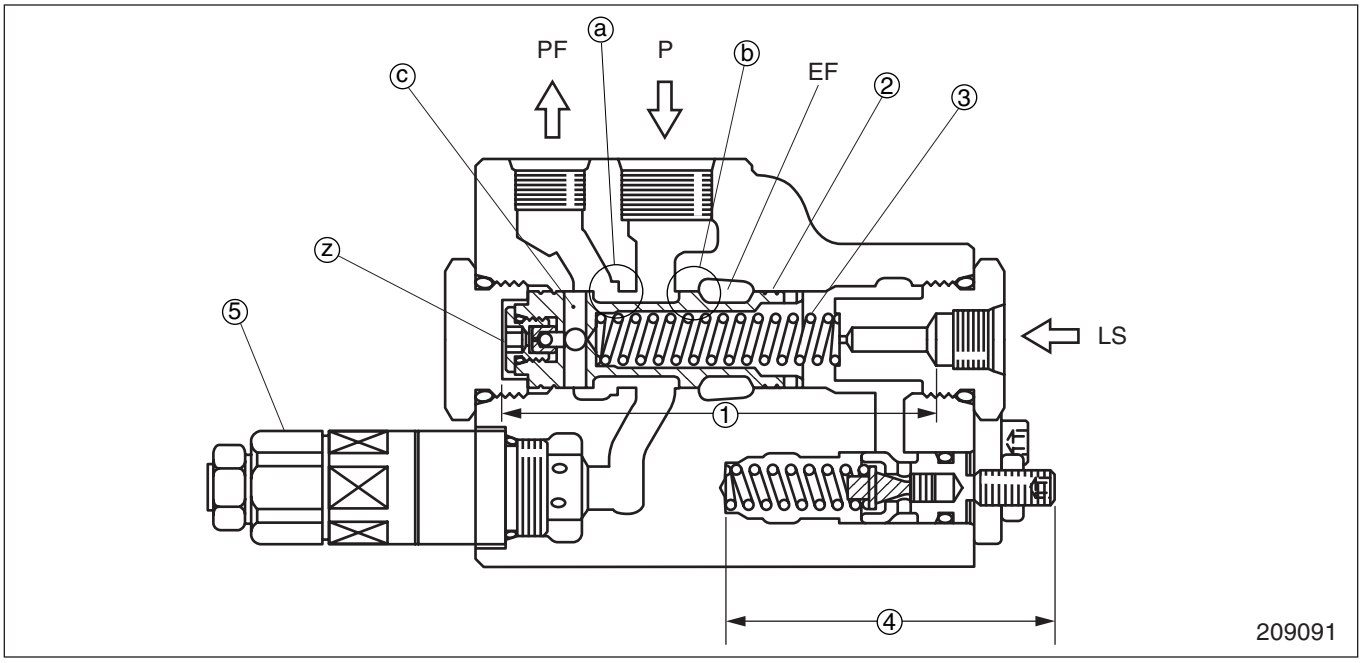
4. End Cover

The end cover terminates the control valve assembly and has the T port.

5. Main Relief Valve

The main relief valve is a safety valve which protects all the hydraulic systems except the steering system from an excessively high pressure.

Inlet Valve Section



1 Priority valve assembly
2 Valve spool
3 Spring
4 Steering system relief valve
5 Main relief valve
a: Passage (P to PF)
b: Passage (P to EF)
c: Passage
z: Chamber
P: From pump
PF: To steering system
EF: Center bypass port of passage to tilt and lift sections
LS: Load sensing pressure

Hydraulic pump output oil flows through the P port into the inlet valve section.

Passage (a) is always open, allowing pressure oil from the P port to flow through the PF port toward the steering valve.

After passing through the PF port, pressure oil flows through passage (c) into chamber (z), pushing the valve spool 2 to the right against the combined force of LS pressure and the spring 3 (see the drawing above).

As a result, passage (b) is open, opening the P port to passage EF. This allows oil to flow from the EF port to the tilt and lift sections for the use in control of the mast.

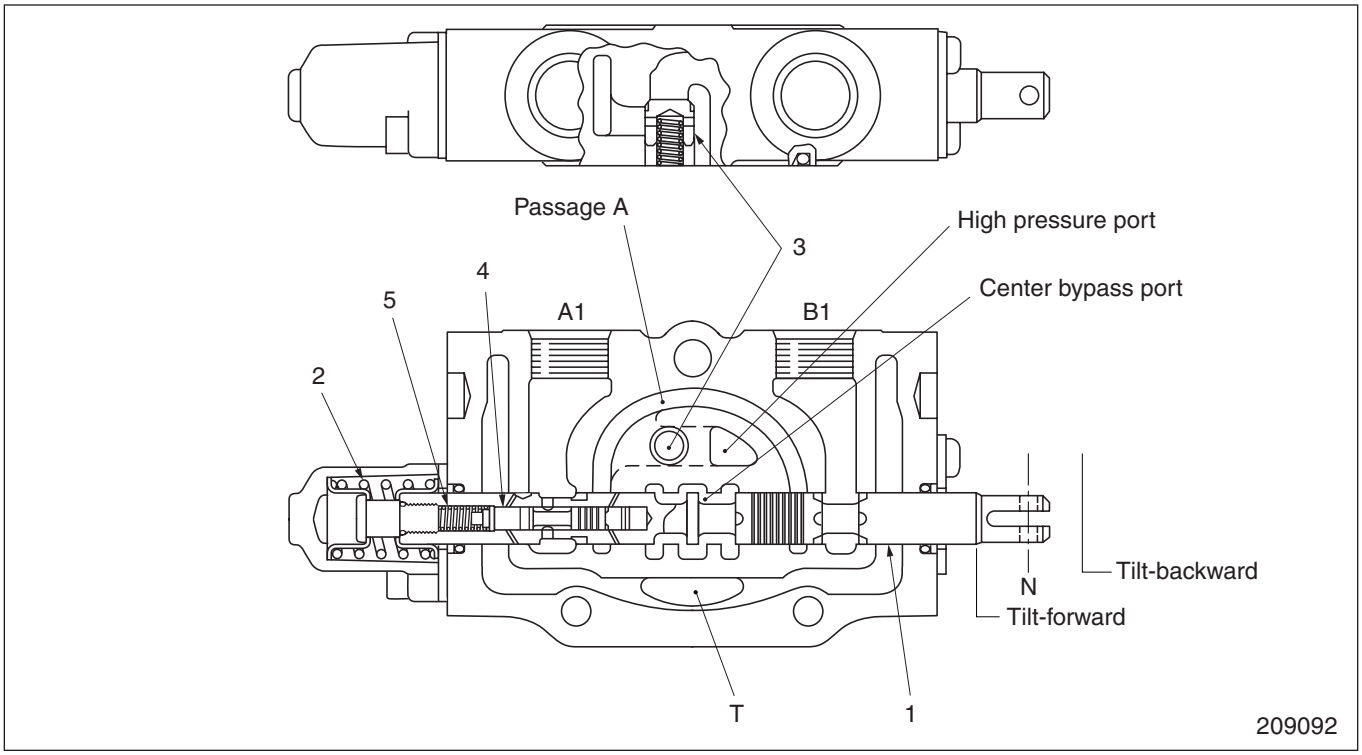
The priority valve 1 ensures that the steering system is always supplied with pressure oil through the PF port in an amount enough for its operation irrespective of variation in the oil flow rate and pressure at the P port and also in the steering resistance. The excess oil not used by the steering system flows out of the valve through the EF passage.

The rate at which oil flows through the PF port to the steering system is controlled by the movement of the valve spool 2. Passages (a) and (b) are correlated such that when one opens the other closes.

As the steering system demands higher rates of oil flow, the valve spool 2 moves toward the left. This opens passage (a) wider, achieving a higher rate of oil flow to the PF port and onwards. As the steering system demands lower rates of oil flow, the spool 2 moves toward the right. This opens passage (b) wider, achieving a higher rate of oil flow to the EF passage and onward.

The movement of the valve spool (2) is controlled by the relationship between the PF port pressure and LS port pressure. This is described in detail in the “Group 9 Steering Valve” of this manual.

Tilt Valve Section



1 Spool
2 Return spring
3 Load check valve
4 Tilt lock valve
5 Tilt lock valve spring
A1: To tilt cylinder rod end
B1: To tilt cylinder head end
T: Drain port

The drawing above shows the state of the tilt valve with the spool 1 in the neutral position.

Neutral position:

The center bypass port is open. This allows the pump-delivered oil to flow to the hydraulic tank through the center bypass port and port T in the end cover. The oil does not flow to ports A1 and B1 as the passages to the ports are blocked by spool 1.

Tilt-forward position:

The spool 1 is pushed to the left, closing the center bypass port. This causes the pressure in the high pressure port to rise. The increased pressure pushes open the load check valve 3 allowing pressure oil to flow into passage A. The pressure oil in passage A then flows into port B1 and acts on the tilt cylinder rod to extend it forward, that is, to tilt the mast forward.

The pressure oil in passage A also flows to the tilt lock valve 4 and pushes the valve to the left against the force of the spring 5. This opens port A1 to port T, allowing the oil in the rod end of the tilt cylinder to return to the tank. In combination with the oil flow mentioned above, this enables the tilt cylinder rod to extend forward.

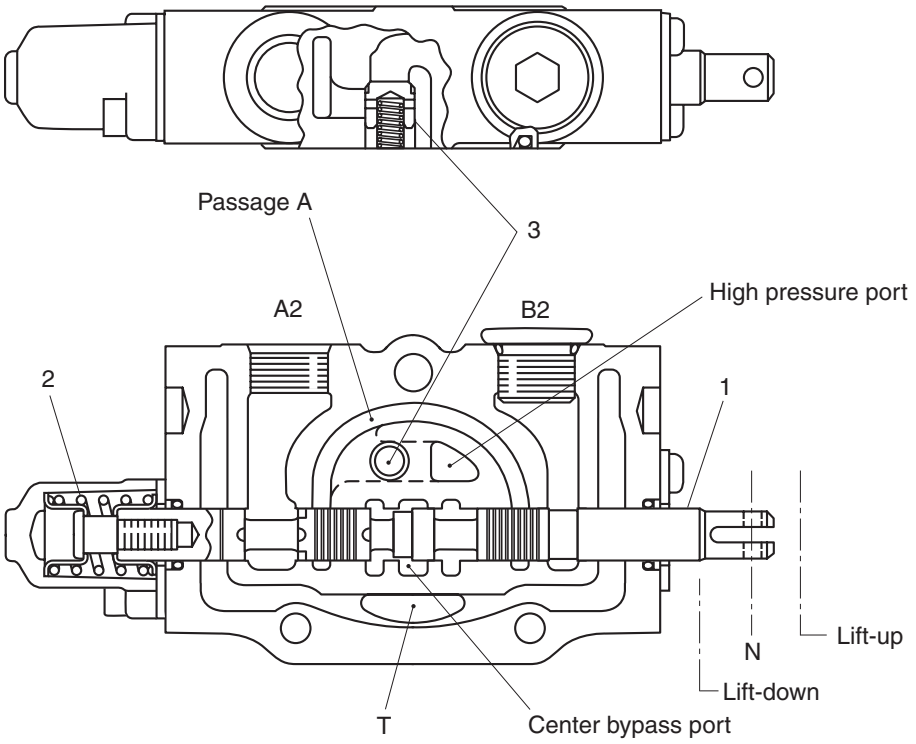
Tilt-backward position:

The spool 1 is moved to the right, closing the center bypass port. Since this blocks the flow of oil from the high pressure port, the oil of increased pressure pushes open the load check valve 3 and makes its way into passage A. As the spool 1 has moved to the right opening passage A to port A1, the oil flows to port A1 and its pressure acts in the direction in which the tilt cylinder rod is retracted in the cylinder.

As ports B1 and T are now open to each other, the oil in the head end of the tilt cylinder returns to the tank. In combination with the oil flow mentioned above, this enables the tilt cylinder rod to be retracted in the cylinder or the mast to be tilted rearward.

The tilt lock valve 4 is a safety valve, provided to prevent the mast from tilting forward when the pump motor is not running. With the motor stopped, pump pressure does not act on the tilt lock valve, so the valve blocks the oil in port A1. Since the oil cannot move anywhere, the tilt cylinder rod is kept unextended. The oil in port A1 remains blocked even if the valve is moved to “the tilt forward” side while the motor is stationary. This means that the mast does not tilt forward.

Lift Valve Section



1 Spool
2 Return spring
3 Load check valve

A2: To/from lift cylinder
B2: Blind (plugged)
T: Drain port (to hydraulic tank)

The drawing above shows the lift valve with the spool 1 in the neutral position.

Neutral position:

The center bypass port is open. This allows the pump-delivered oil to flow to the hydraulic tank through the center bypass port and port T in the end cover. The oil does not flow to ports A2 and B2 as the passages to the ports are blocked by spool 1.

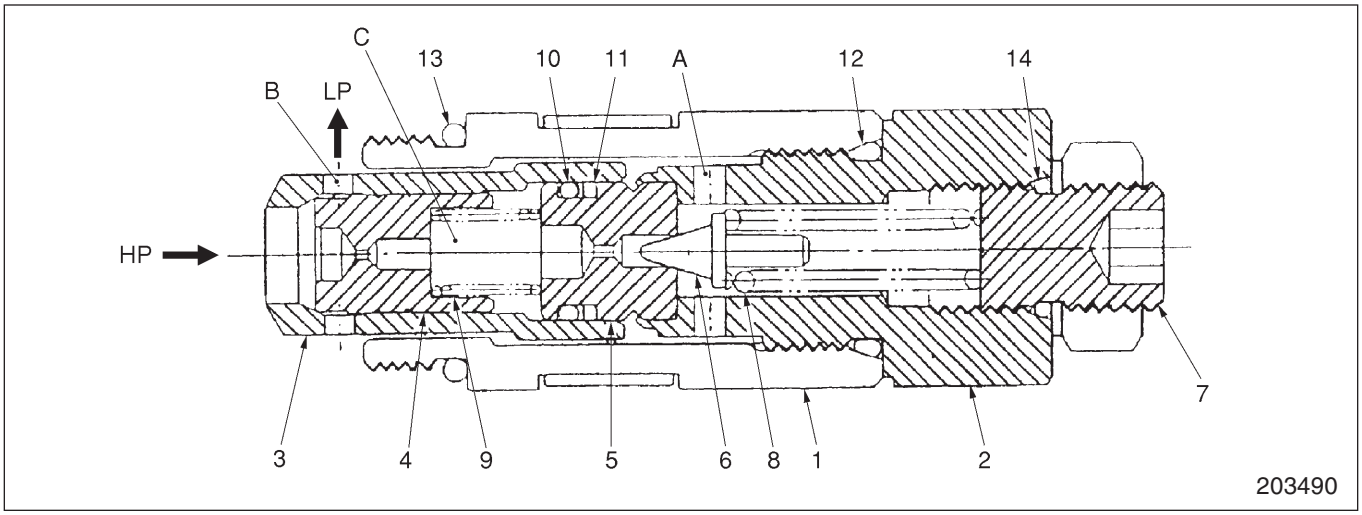
Lift-up position:

When the lift lever is pulled towards the operator, the spool 1 moves up (moves to the right in the drawing), opening passage A to port A2 while at the same time closing the center bypass port. This causes the pressure in the high pressure port to rise. The increased pressure pushes open the load check valve 3. As passage A opens to the high pressure port as a result, pressure oil eventually flows into port A2.

Lift-down position:

The spool moves to the left (in the drawing), opening port A2 to port T. The oil in the lift cylinder is then pushed out by the load acting on the cylinder piston and flows through ports A2 and T and back to the tank, at a rate controlled by the flow regulator valve and the amount of movement (distance from the neutral position) of the spool 1.

Main Relief Valve



1	Cap	8	Pilot spring	HP:	High-pressure oil
2	Plug	9	Spring	LP:	Low-pressure oil
3	Sleeve	10	O-ring	A:	Pilot pressure relief port
4	Main poppet	11	Backup ring	B:	Main pressure relief port
5	Pilot seat	12	O-ring	C:	Spring chamber
6	Pilot poppet	13	O-ring		
7	Adjusting screw	14	O-ring		

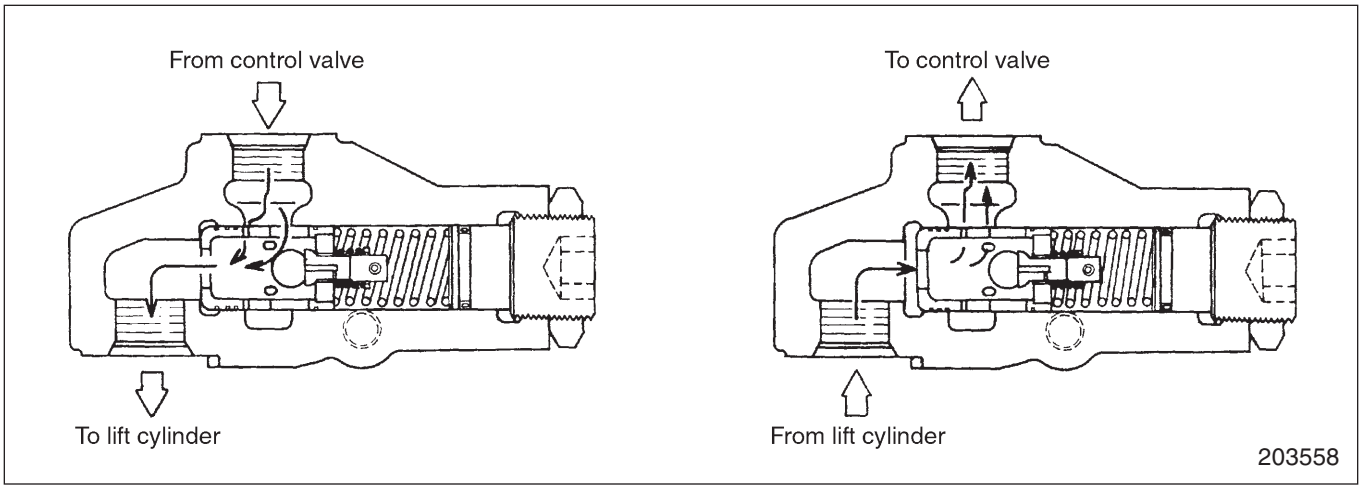
Pump pressure (HP) to the tilt and lift cylinders is always acting on the pilot poppet 6.

If the pump pressure exceeds the set pressure of the main relief valve, the poppet 6 moves to the right against the force of the spring 8. This allows the oil in the spring chamber C to escape through the A port into the low-pressure (LP) side of the system.

As a result, the pressure in the chamber C drops, which enables the pump pressure oil to push the main poppet 4 to the right. The high-pressure oil then flows through the B port into the LP side of the system.

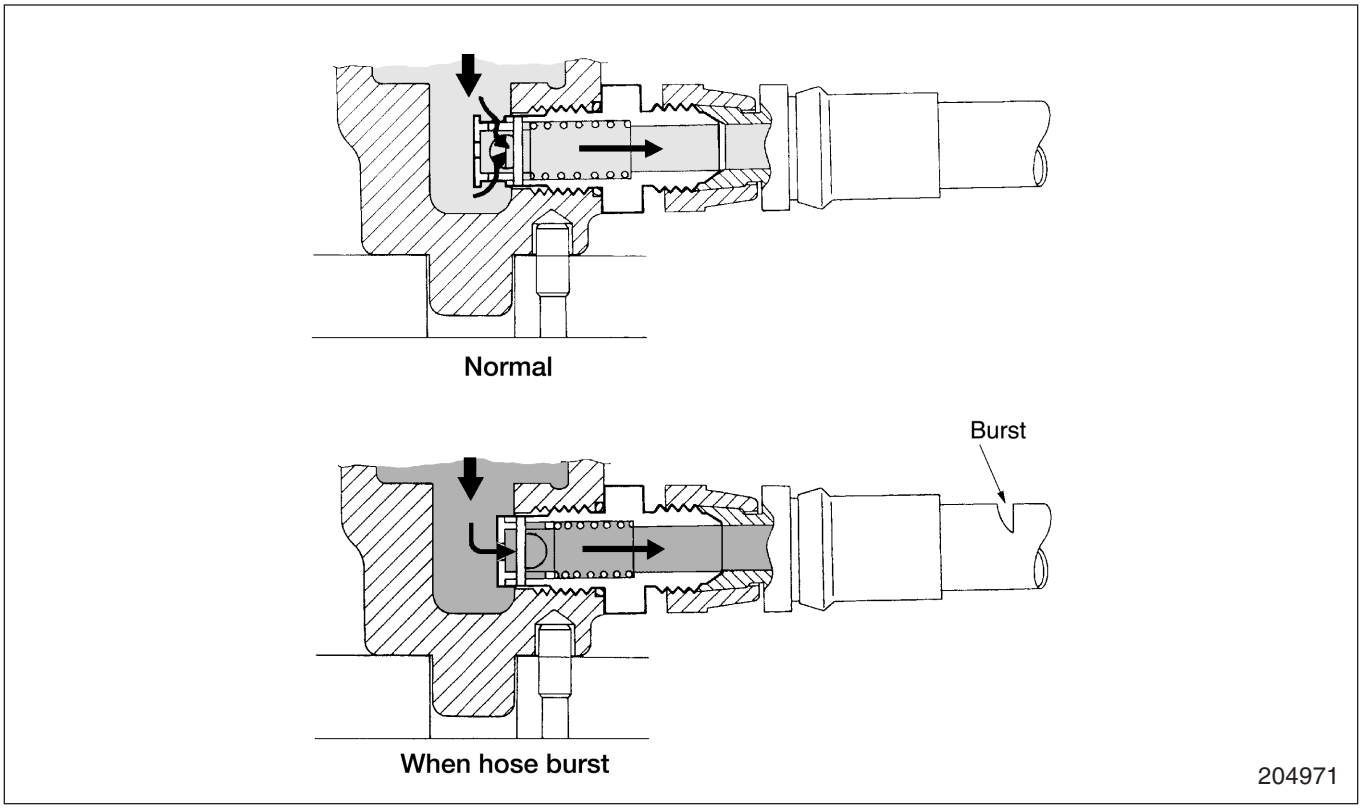
To adjust the set pressure of the main relief valve, turn the adjusting screw 7 in or out to change the preload on the spring 8.

Flow Regulator Valve



The flow regulator valve is located between each lift cylinder and control valve. It limits the flow of oil forced out of the cylinder when the loaded forks are lowered to keep a constant safe lowering speed regardless of load.

Down Safety Valve

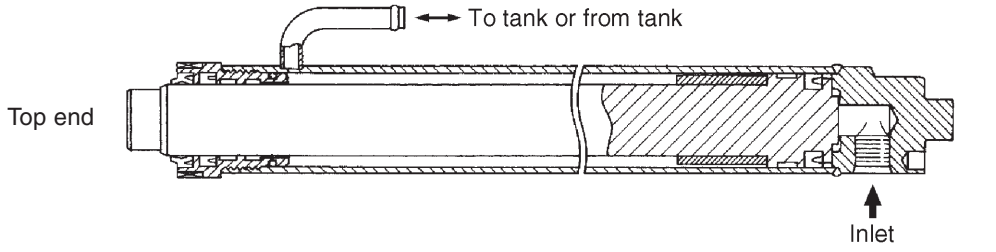


The down safety valve is located at the bottom side of left-hand lift cylinder. This valve provides a means of preventing the load from lowering, unsafely, rapidly, when the hose bursts.

Lift Cylinders

Lift cylinder

Type 1: Simplex mast and triplex mast second cylinder



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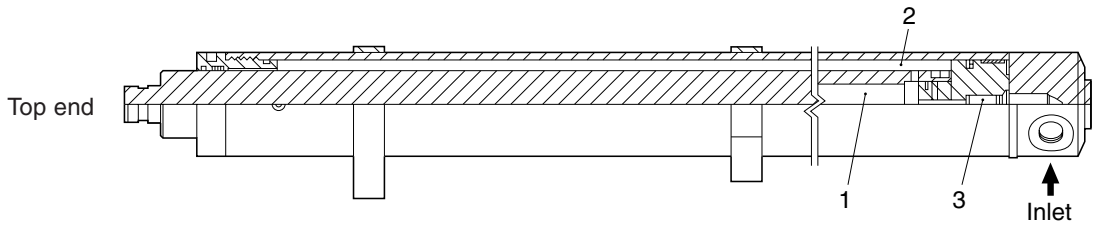
Type 2: Duplex and triplex mast first cylinder



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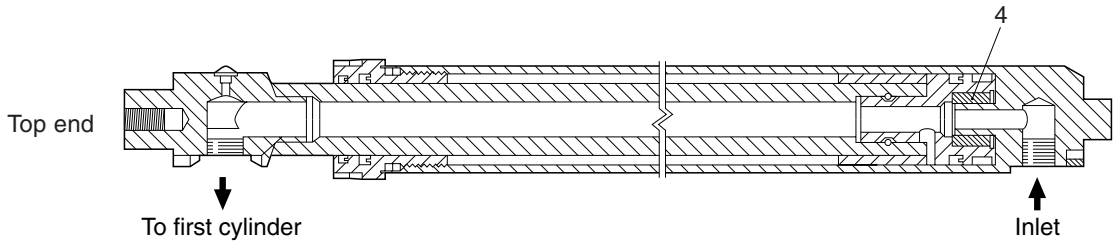
Type 3: Duplex mast second cylinder



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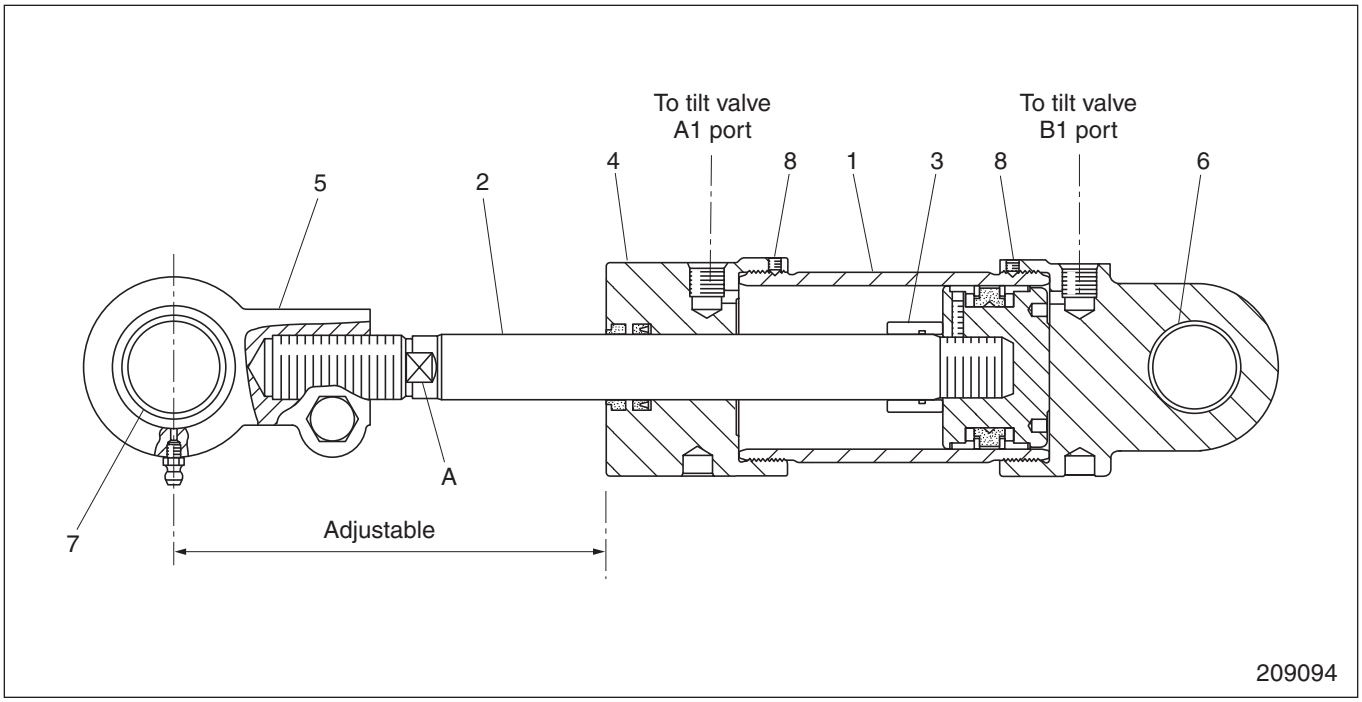
The lift cylinders (first cylinder and second cylinder) are of the single-acting type. The type 1 cylinder shown in the drawing above is used as the simplex mast's lift cylinder and as the triplex mast's second cylinder. When oil flows in from the bottom end, the rod is extended. Oil in the space between the rod and cylinder tube returns to the tank. When the rod moves downward, air from the tank is drawn into this space.

The type 2 cylinder is used as the duplex and triplex masts' respective first cylinders. When oil flows in from the bottom end, the rod is extended. Air and oil (mostly air) are contained in a chamber 1 inside the rod and in the space 2 between the rod and cylinder tube. As the piston moves upward, the oil in the chamber 1 and space 2 opens the check valve 3 and flows out of the inlet port. When the piston moves downward, the space 2 becomes empty.

The type 3 cylinder is used as the duplex mast's second cylinder. Oil flowing in from the bottom end first flows through a passage in the rod toward the first cylinder (see part 2 above). When the first cylinder's rod has been extended fully, the second cylinder's piston moves upward.

Part 4 is a down-stroke cushioning mechanism. This mechanism prevents the piston from bottoming hard against the head just as the rod completely retracts. This is achieved by narrowing the oil flowing gap between the piston and head further as the piston moves downward.

Tilt Cylinders



1 Cylinder assembly
2 Piston and rod assembly
3 Spacer
4 Guide
5 Tilt socket
6 Bushing
7 Spherical bearing
8 Set screw
A: Spanner fitting portion

The tilt cylinders are of a double-acting type.

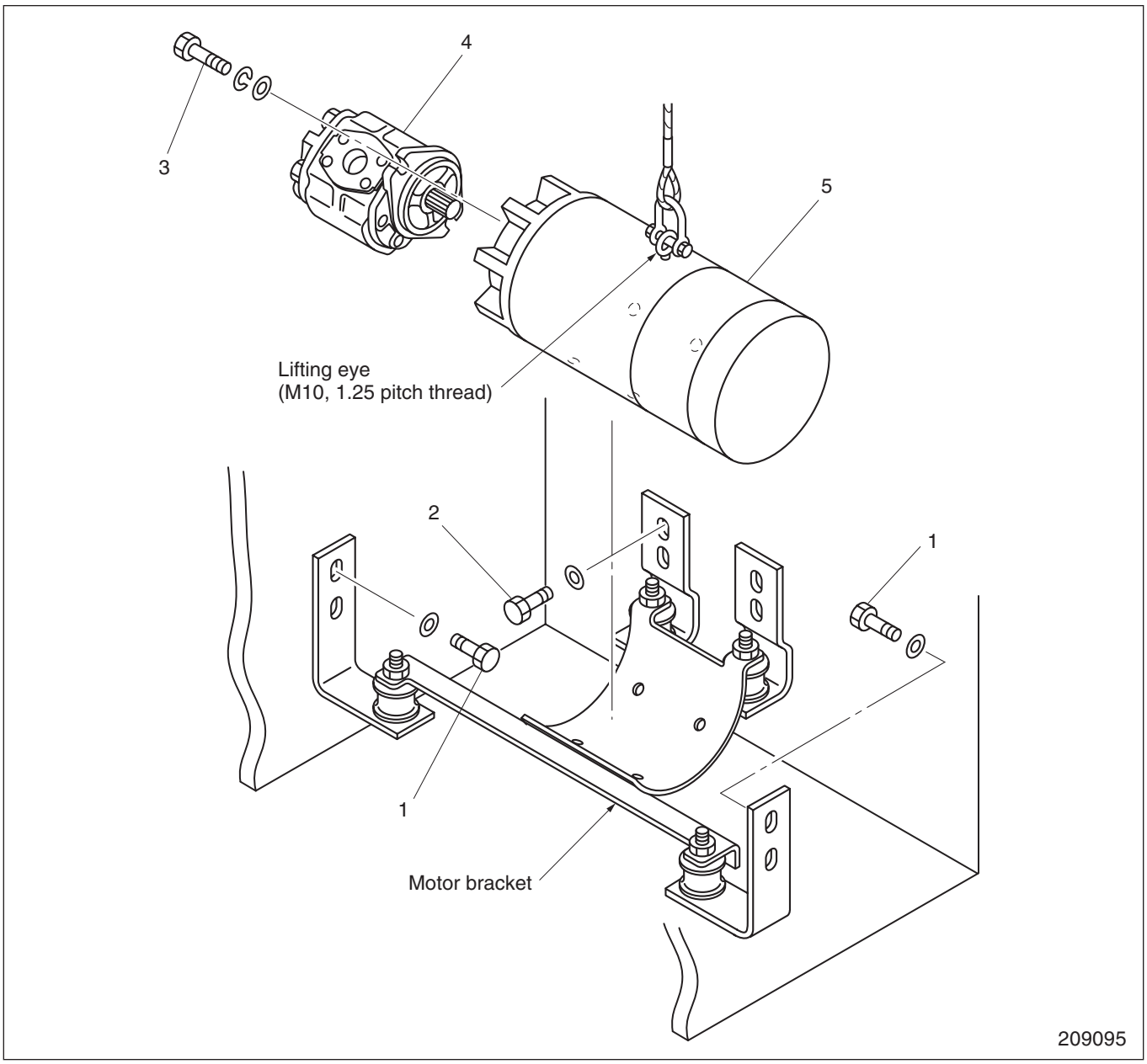
Each cylinder has the tilt socket 5 screwed onto the piston rod 2. This allows adjusting the length of a piston rod if necessary to make same the tilt angles on the right and left sides of the mast when the cylinders are connected to the mast.

To turn the rod 2 for adjustment, use a spanner fitted on portion A.

Removal and Installation

Hydraulic Pump

Removal



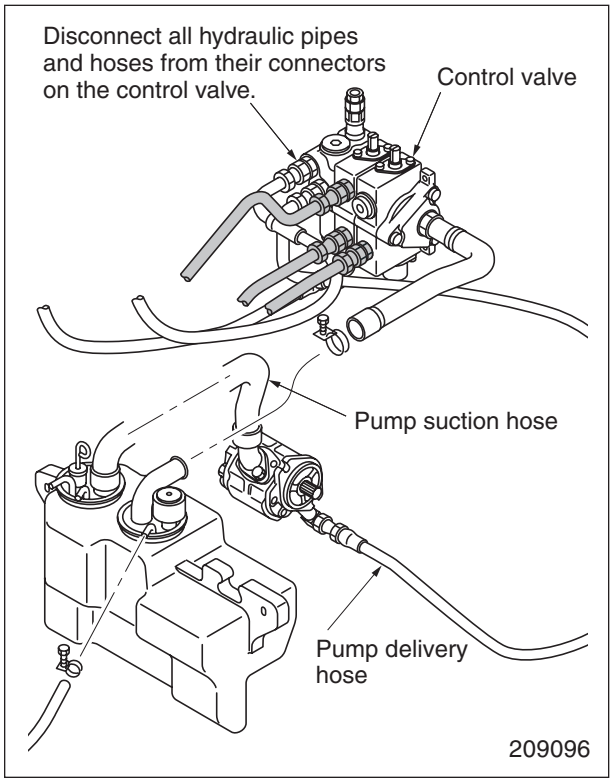
Sequence

1 Bolts
2 Bolts
3 Bolts
4 Hydraulic pump
5 Pump motor

Start by:

NOTE

1. Before disconnecting any hydraulic pipe or hose, take all necessary measures to prevent risk of injury by falling attachments and high-pressure oil jetting out of the system. For details, refer to the "Start by" part of the hydraulic valve removal section in this manual.
2. When disconnecting hydraulic pipes and hoses, cap or plug their disconnected ends and the openings from which they are disconnected to prevent dust and other foreign matter from entering the hydraulic system.



(1) Park the truck over the pit and lower the forks. Relieve oil pressure from the hydraulic system.

(2) Remove the floor mat and plate.

(3) Disconnect the brake pipe from the master cylinder.

(4) Remove the brake pedal assembly complete with the master cylinder. Refer to the "Group 8 Brake System" of this manual.

(5) Disconnect the hydraulic lines from the control valve (see the drawing on the right).

(6) Disconnect the pump suction and delivery hoses (see the drawing on the right).

Suggestions for Removal

1. To facilitate reassembly, put mating marks on the oil pipes and electric harness connectors before they are disconnected.
2. Disconnect the motor wiring harness from the connector on the motor.
3. Support the weight of the motor 5 using lifting eye bolts and a hoist.
4. Remove the bolts 1 and 2. Lower the motor complete with the motor bracket and hydraulic pump.
5. Remove the bolts 3 to separate the hydraulic pump 4 from the motor 5.

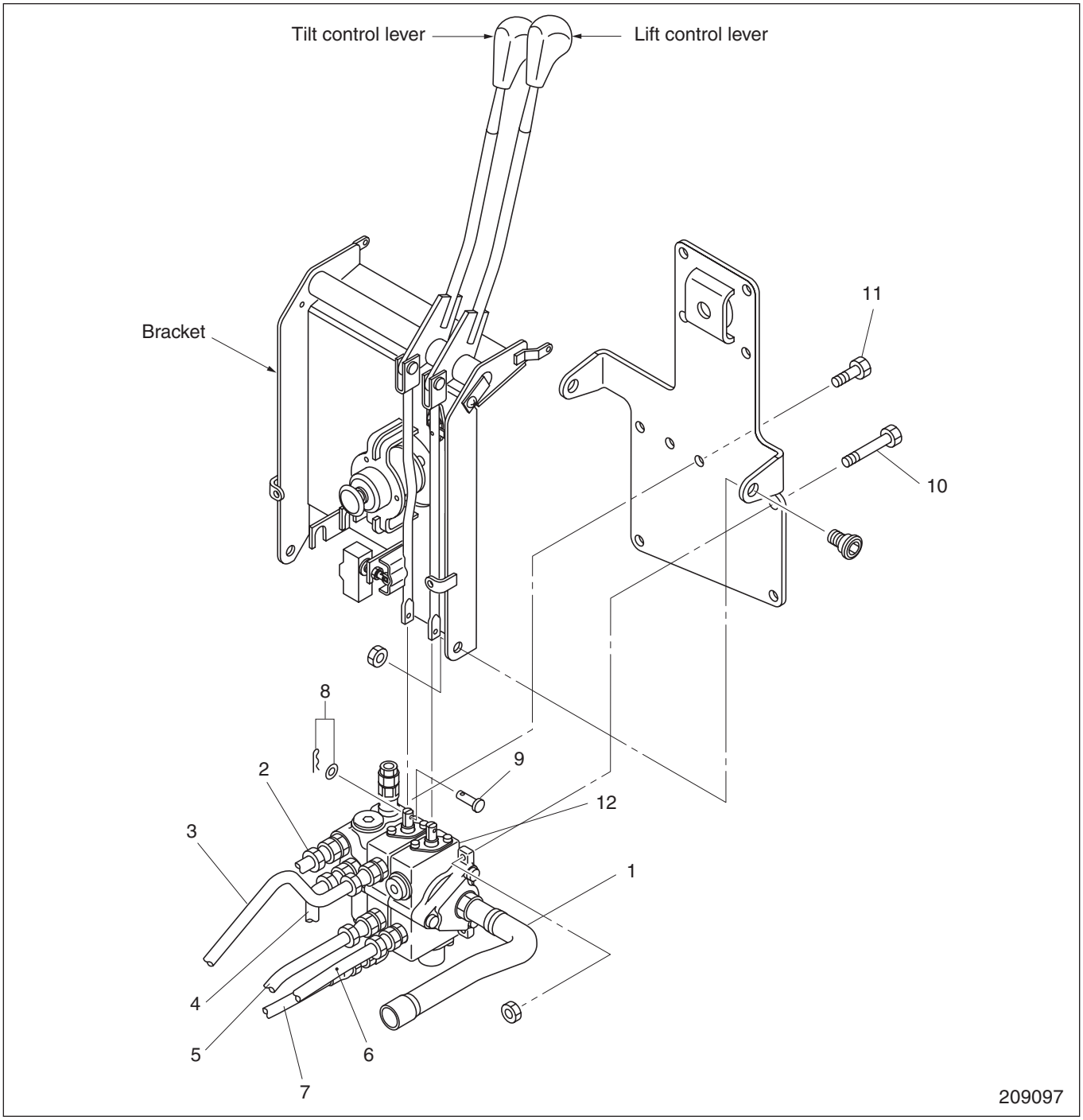
NOTE: It is recommended that the motor as well as the pump be inspected when the pump is separated from the motor.

Installation

Follow the removal procedure in reverse.

Hydraulic Control Valve Assembly

Removal



Sequence

1 Return hose
2 Hose (to steering system)
3 Tilt pipe
4 Pump delivery hose
5 Tilt pipe
6 Lift pipe
7 LS pressure hose
8 Snap pin, Washer
9 Pin
10 Bolt, Nut (x 2)
11 Bolt (screw type, x 1)
12 Hydraulic control valve assembly

Start by:

(1) Before disconnecting the pipes from the control valve, bring the mast to the vertical position and place the fork to the lowest position in order to release the residual pressure in the pipes.

(2) Support the weight of the mast with a crane.

(3) If an attachment is connected, take necessary measures to prevent it from moving.

(4) Remove the floor plate.

(5) Remove the battery box.

Suggestions for Removal

1. Disconnect all the hydraulic pipes and hoses from the control valve.
2. Remove the snap pin and washer 8, then pull out the pin 9. Separate the control rods from the valve spools.
3. While holding the control valve assembly by hand, remove the two bolts 10 and bolt 11. Remove the control valve assembly 12.

Installation

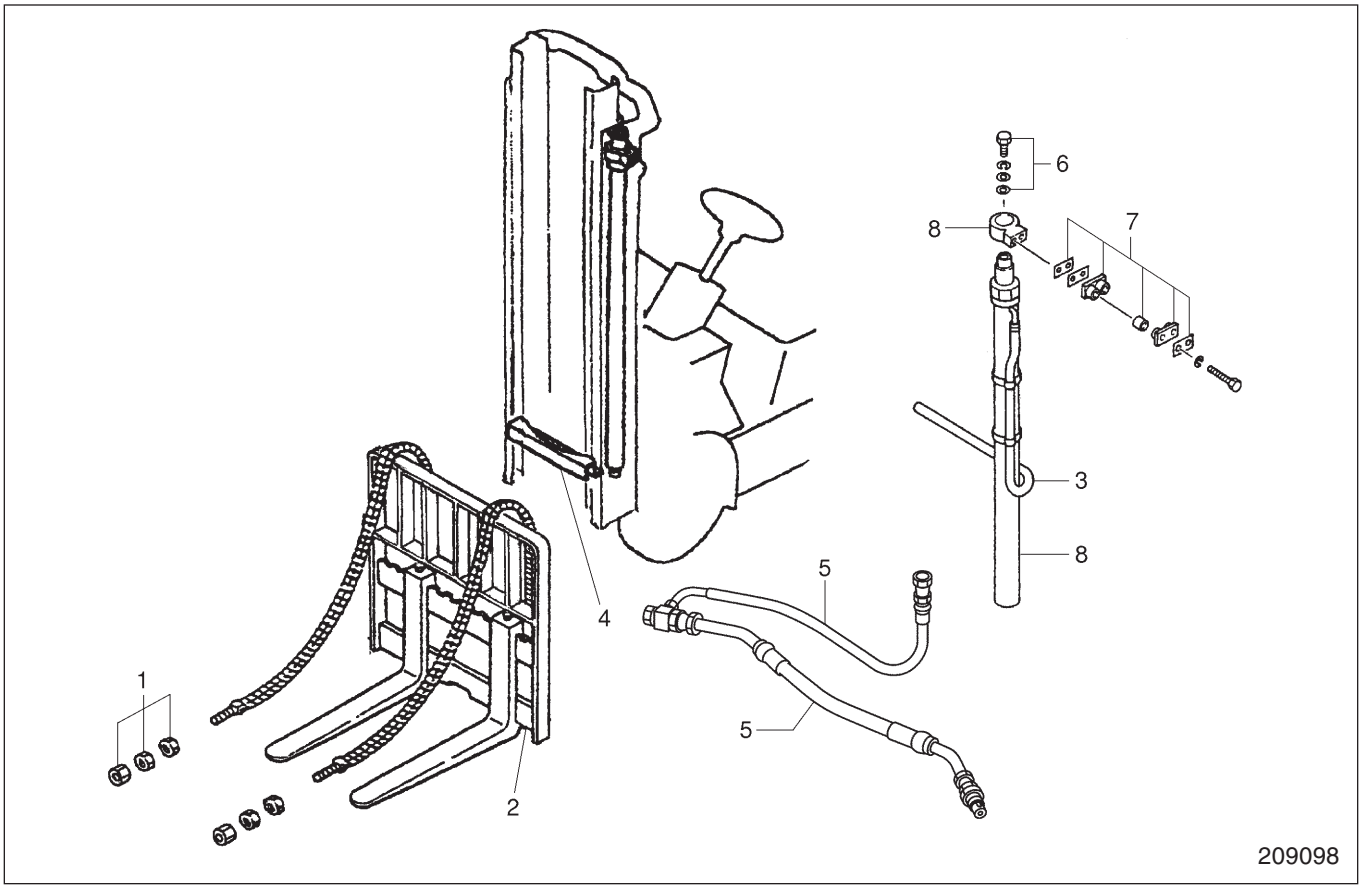
Follow the removal procedure in reverse.

NOTE

Avoid applying undue force to electrical devices such as the stroke sensor and microswitch when they are removed and installed. Using excessively large forces can damage these devices.

Lift Cylinders (Simplex Mast)

Removal



Sequence

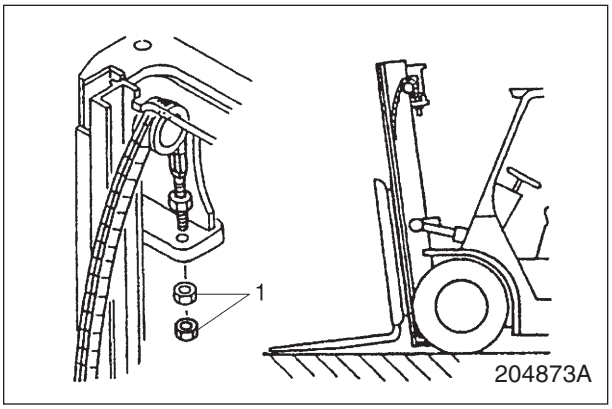
1 Nuts
2 Lift bracket assembly
3 Low-pressure (return) hose
4 Hose guard
5 High-pressure hose
6 Set bolt, Shims
7 Cylinder clamp, Cushion, Collar, Shims
8 Lift cylinder, Bracket

Suggestions for Removal

1. Removing lift bracket assembly 2

(1) Tilt the mast forward, and lower the inner mast to the bottom. Slacken the lift chains, and remove the nuts 1 from the anchor bolts.

(2) Tilt the mast back to vertical position. Raise the inner mast until the lift bracket becomes free. Then, back the truck away from the lift bracket and fork assembly.



2. Removing low-pressure (return) hoses for lift cylinder 3

Disconnect the return hose from the right and left lift cylinders at the connectors.

Removing hose guard

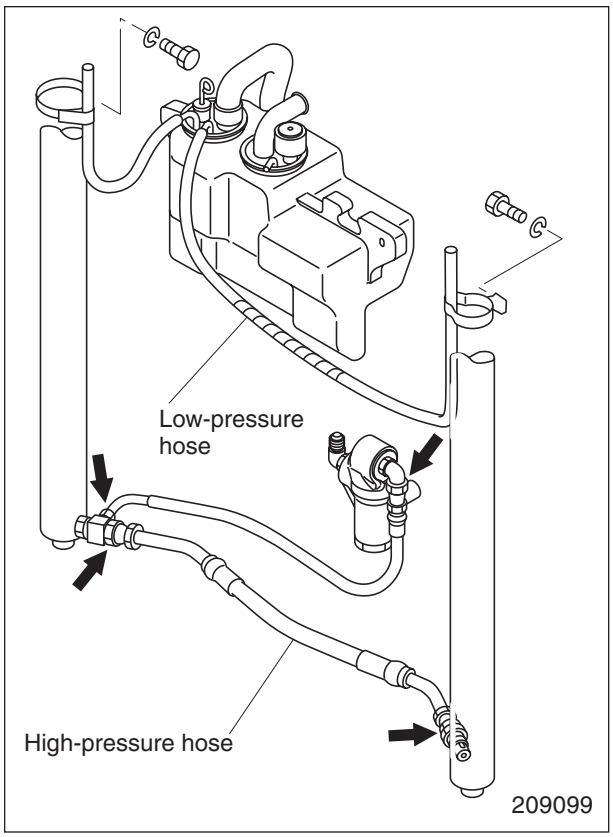
With the masts at the maximum lift position, remove the hose guard from the front side.

Lowering masts

Operate the lift lever gradually to lower the masts.

3. Disconnecting high-pressure hoses 5

Disconnect the high-pressure hoses at the joints indicated by arrows. Use a drip pan to catch oil flowing out of the hoses.

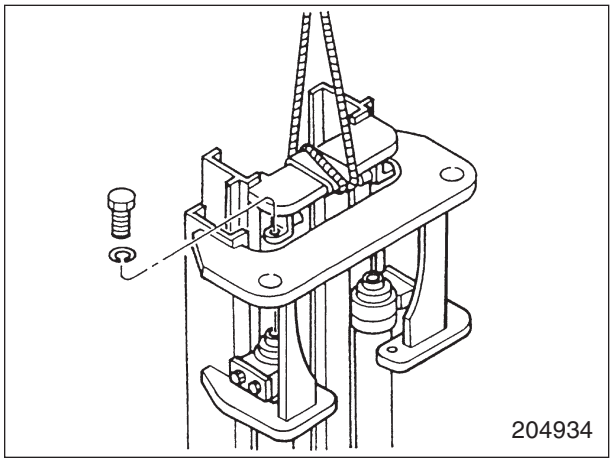


4. Removing set bolts 6

(1) Remove the set bolt at the top of each lift cylinder. Lift the inner mast to separate the cylinder rod ends. To lift the inner mast, hitch a sling around the mast with protective rag.

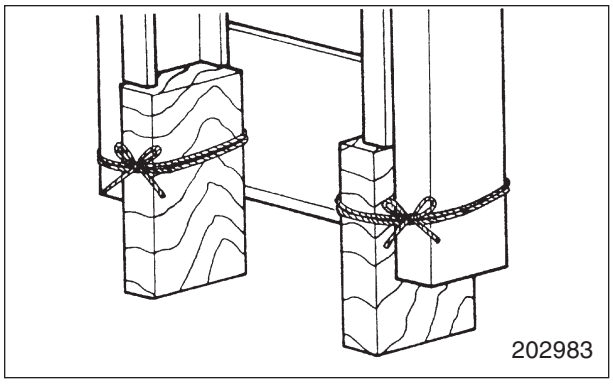
NOTE

The rod end of either lift cylinder is shim adjusted to eliminate the difference in stroke between the cylinders. Before removing the set bolts, make a record of the amount of shims and cylinders to which the shims are fitted.



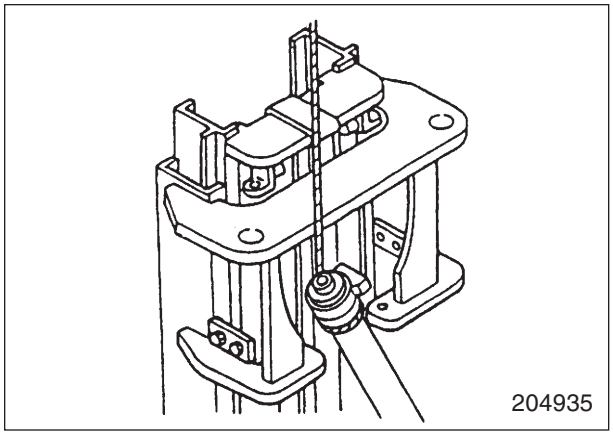
(2) Tie wood blocks under the inner mast and detach the sling. Use blocks strong enough to support the mast.

Make sure the right and left wood blocks are the same in height.



5. Removing lift cylinders 8

Hitch a sling to the lift cylinder from the rear side of the mast, and remove the cylinder. Hitch the sling before removing the cylinder clamp.



Installation

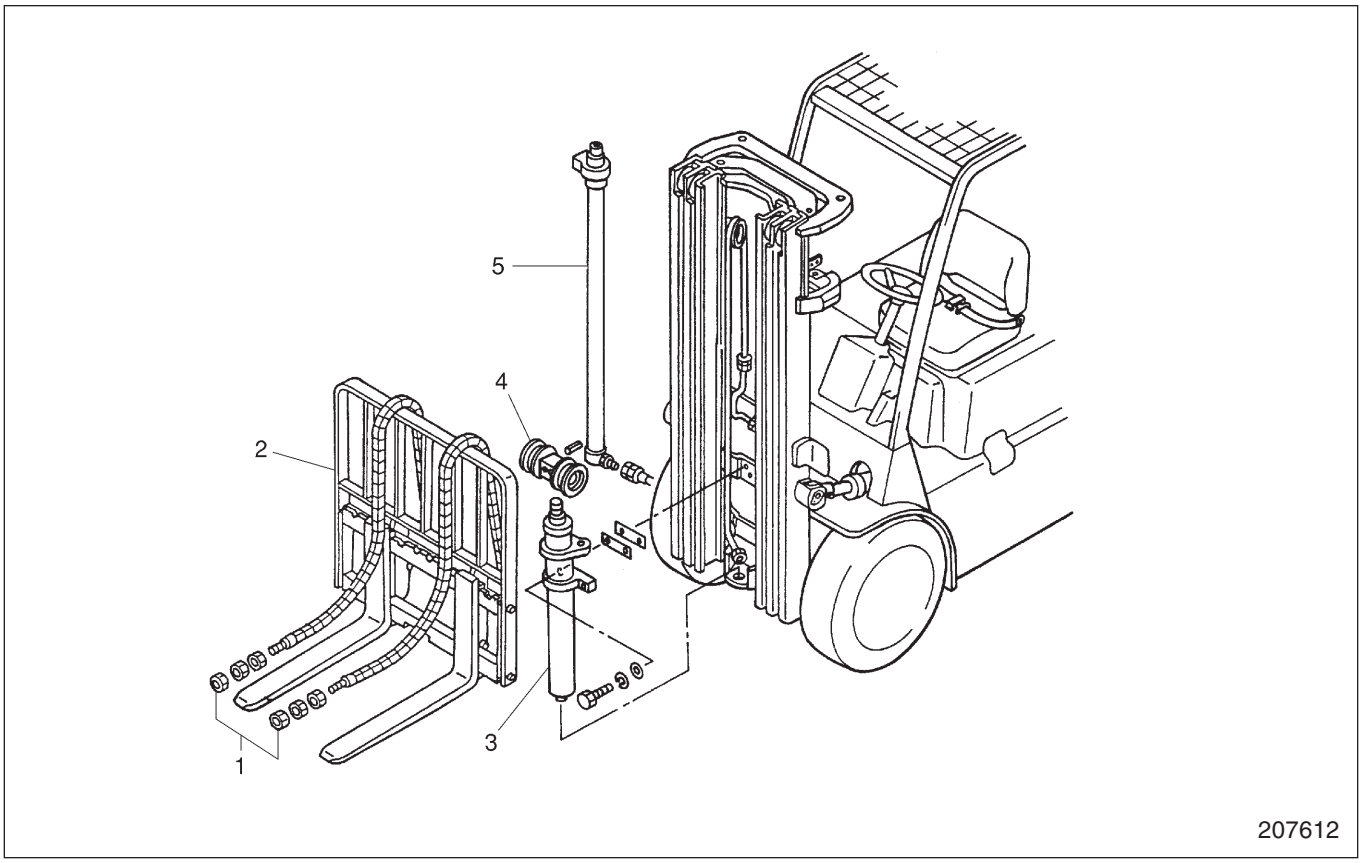
To install, follow the reverse of removal sequence, and do the following steps:

1. Extend and retract the lift cylinders several times under no load condition to bleed air out of the cylinder circuits and to make sure that the cylinders move smoothly.
2. Check the oil level in the hydraulic tank with an oil level gauge.
3. Check to make sure that the lift height is correct.
4. After the lift cylinders or piston rods have been replaced, check for difference in stroke between the two cylinders. (Refer to “Group 11 Mast and Fork”.)

Lift Cylinders (Duplex and Triplex Mast)

Removal

The procedures that follow apply to the lift cylinders of the Triplex Mast models. However, you can follow them to remove the cylinders of the Duplex Mast models as well.



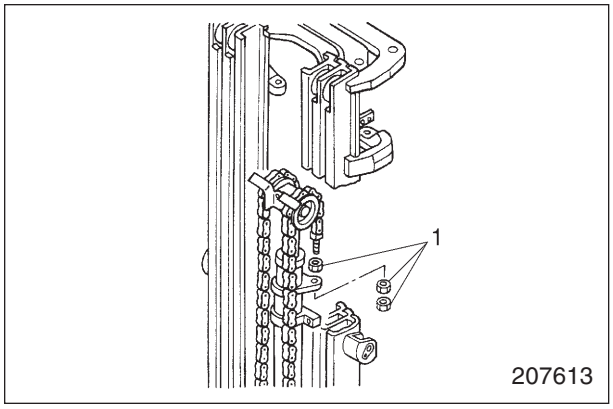
Sequence

1 Nuts
2 Lift bracket assembly
3 First lift cylinder
4 Chain wheel support assembly
5 Second lift cylinder

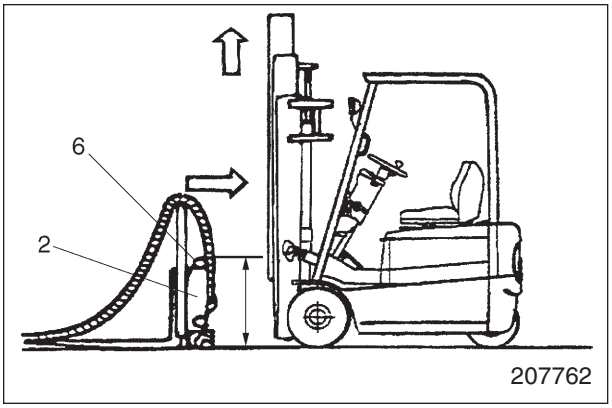
Suggestions for Removal

1. Removing lift bracket assembly 2

(1) Lower lift bracket assembly 2, and place wood blocks under the assembly. Tilt the mast forward, lower the inner mast to the bottom, then remove nuts 1 from the anchor bolts of the first lift chains.



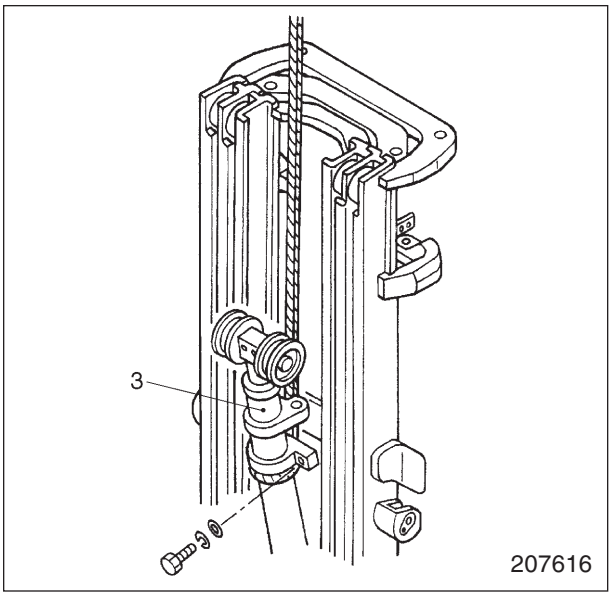
(2) Position the mast upright. Raise the inner mast until main rollers 6 of lift bracket assembly 2 become free. Then, slowly move the vehicle in reverse to separate from lift bracket 2.



2. Removing first lift cylinder 3

(1) Hitch a sling to first lift cylinder 3, and suspend the cylinder with a hoist. Wind the sling securely to prevent slipping.

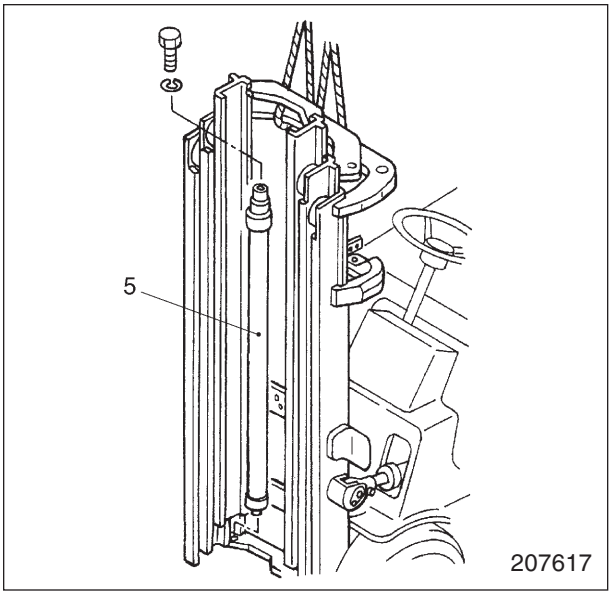
(2) Remove the lift cylinder connecting and mounting bolts, and gently dismount first lift cylinder 3.



3. Removing second lift cylinders 5

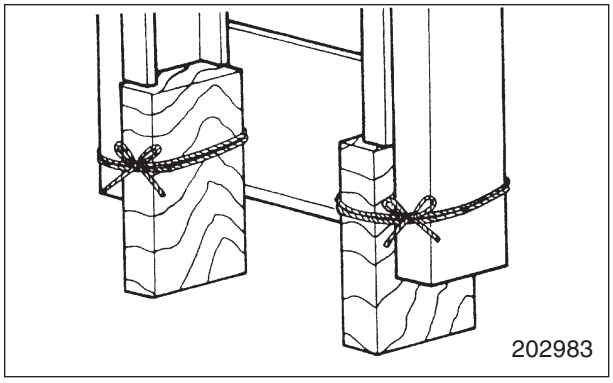
(1) Disconnect hoses from second lift cylinders 5.

(2) Remove stopper bolts at the upper sections of second lift cylinders 5, and lift the inner mast (duplex mast) or middle mast (triplex mast) approximately 550 mm using slings.



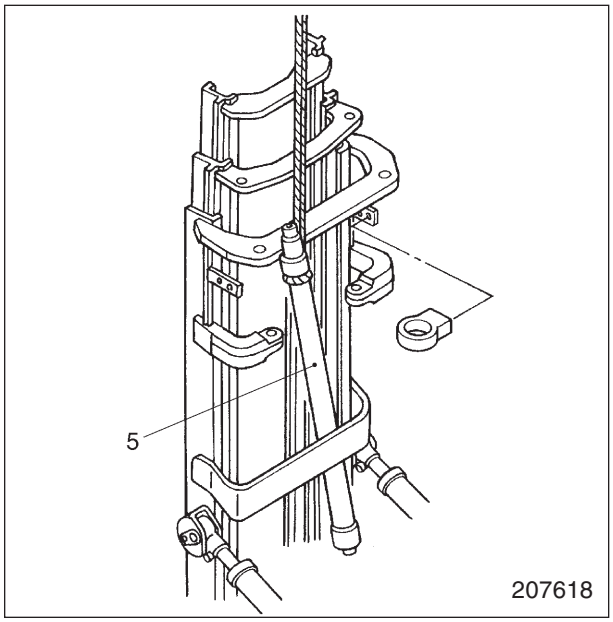
(3) Place wood blocks under the inner mast (duplex mast) or middle mast (triplex mast).

Make sure the right and left wood blocks are the same in height.



(4) Hitch a sling to second lift cylinder 5 behind the mast, remove cylinder clamp retaining bolts, and gently remove second lift cylinder 5.

Hitch the sling securely to the cylinder. The cylinder cannot be lifted straight up since the mast cross-member is located above the cylinder. Tilt the cylinder and move it away from the cross-member to remove. Be careful not have the hands caught between the cylinder and mast.



Installation

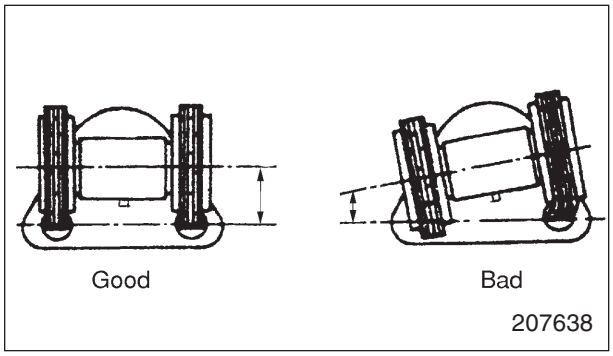
To reinstall, follow the removal sequence in reverse, and service as follows.

(1) Install chain wheel support assembly 4 parallel to a line connecting the centers of chain anchor bolt holes on first lift cylinder 3 to prevent chains from twisting.

(2) Adjust the chain tensions.
(Refer to “Inspection and Adjustment” in “Group 11 Mast and Fork”.)

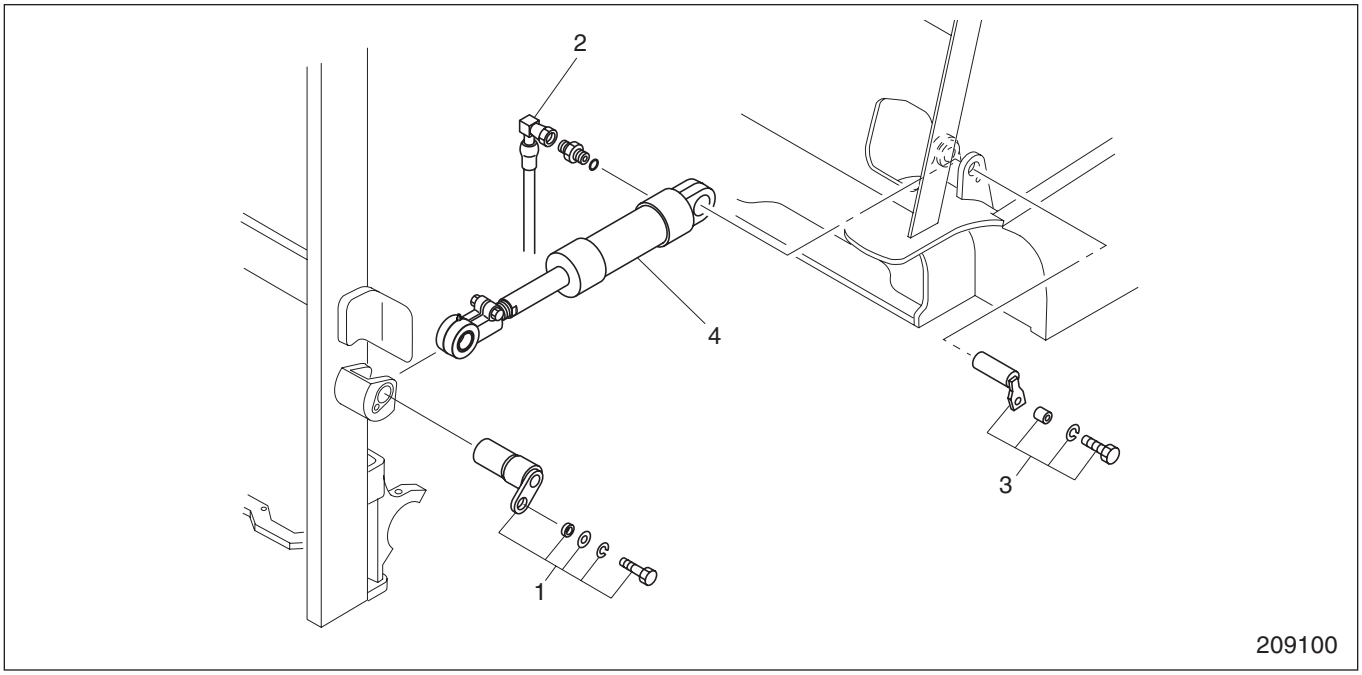
(3) Extend and retract the lift cylinders several times under no load condition to bleed air out of the cylinder circuits and to make sure that the cylinders move smoothly.

(4) After proper operation is confirmed, check the oil level.



Tilt Cylinders

Removal



Sequence

1 Tilt cylinder pin
2 Hoses (two for each cylinder)
3 Tilt cylinder pin
4 Tilt cylinder

Start by:

(1) Lower the forks to the bottom, and tilt the mast fully forward.

(2) Attach a sling to the round holes, right and left, in the top crossmember of outer mast, and support the weight of the mast with a hoist.

Suggestions for Removal

1. Retracting piston rod

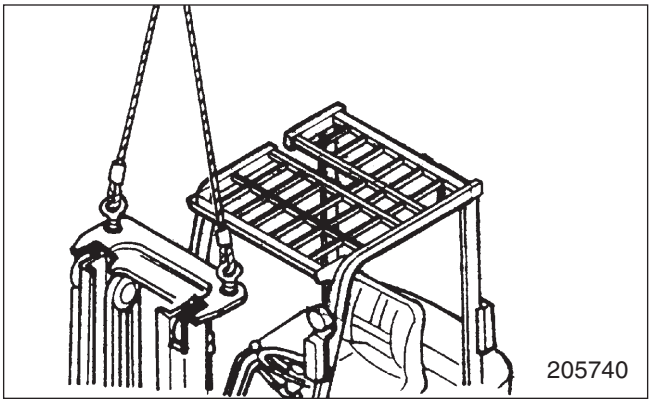
Remove tilt cylinder pin 1, start the pump motor and retract the piston rod fully, then stop the pump motor.

2. Disconnecting hoses

Disconnect hoses 2 from the cylinder at the connectors. Use a drip pan to catch oil flowing out of the cylinder. Attach caps to the connectors of the cylinder to protect the threads of the connectors and to prevent oil from flowing out of the cylinder when the cylinder is removed.

3. Removing tilt cylinders

Remove the tilt cylinder pin 3, then remove the tilt cylinders 4.



Installation

Follow the removal procedure in reverse.

(1) Install the tilt cylinder pin 3 by tightening the bolt to the following torque.

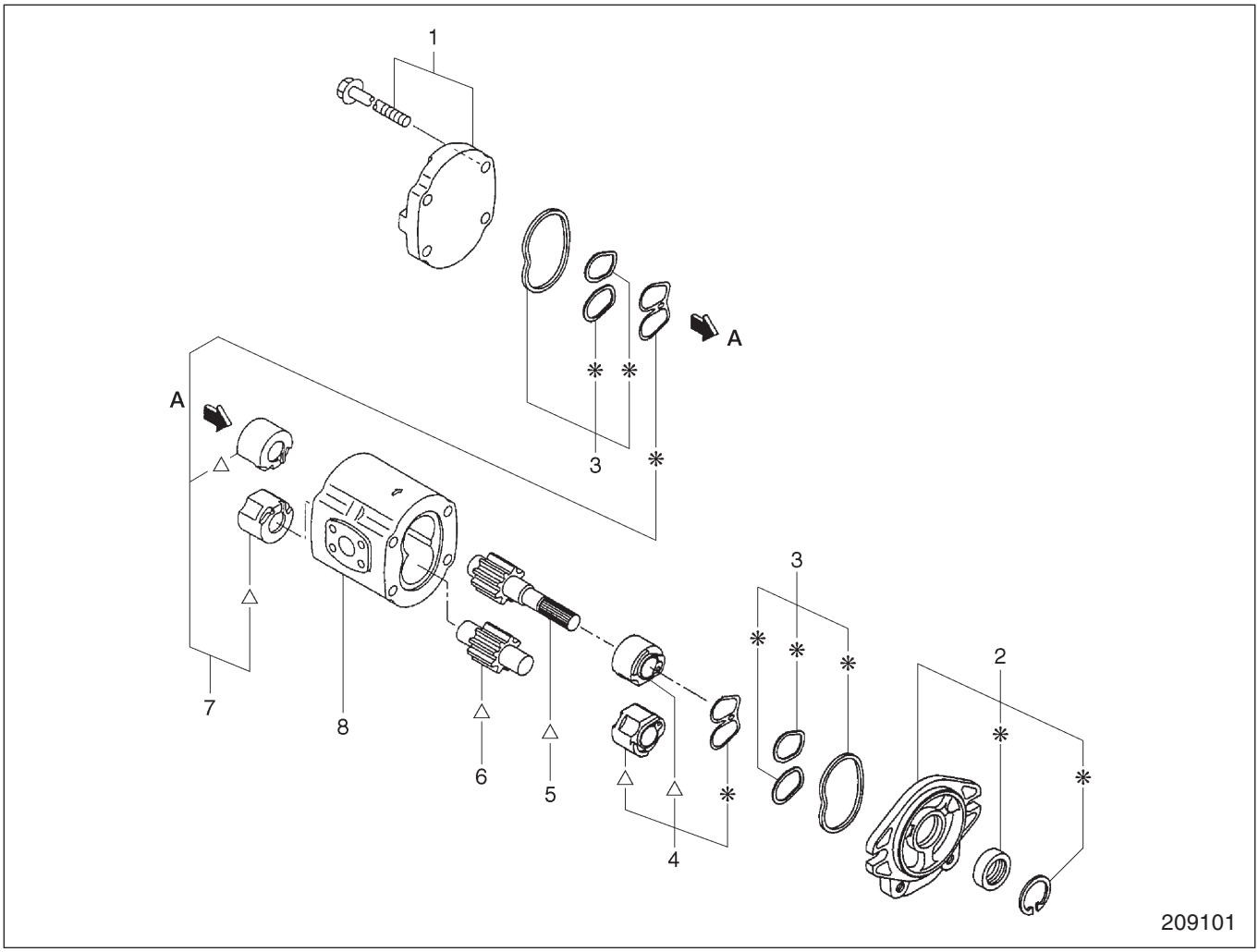
Tightening torque	33.3 N·m (3.4 kgf·m)

(2) Make sure that the tilt angles on the right and left of the mast are not different. If necessary, perform adjustment by turning the piston rod.

Disassembly and Reassembly

Hydraulic Pump

Disassembly and Reassembly



Sequence

1 Cover, Bolt
2 Mounting flange, Snap ring, Oil seal
3 Body seal, Bushing seal
4 Backing ring, Bushing
5 Drive gear
6 Driven gear
7 Backing ring, Bushing
8 Body

NOTE

The primary cause of faults that necessitate disassembly of the hydraulic pump is contamination of oil. If this is the case, you should not only repair the hydraulic pump but also flush the hydraulic system and fill the system with new oil. Another cause of faults in the hydraulic pump is an excessive pressure in the system due to a faulty relief valve.

NOTE

1. It is recommended that parts marked with ✻ in the drawing above be replaced whenever the hydraulic pump is disassembled. These parts are available as a seal kit.
2. The parts marked with △ in the drawing above should be replaced as an assembly. They are available as a repair kit.

Suggestions for Disassembly

Do not use a hammer or similar tool in an attempt to loosen or force out cover 1 and mounting flange 2. Use a soft head mallet.

Do not remove the oil seal in mounting flange 2 if it does not show any abnormality.

Inspection and Repair

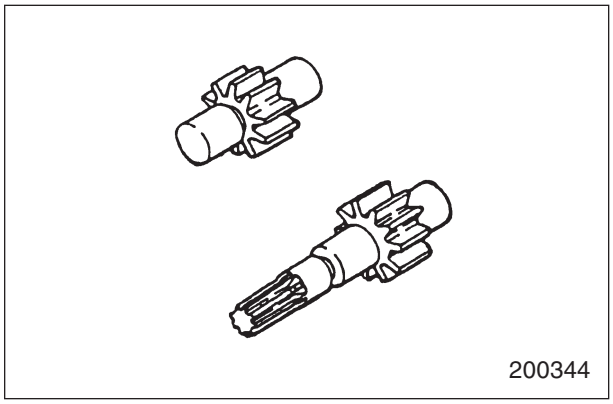
1. Drive and driven gears

(1) Check the gear teeth for wear, chipping or other defects.

(2) Check the end faces of the gears for wear or damage.

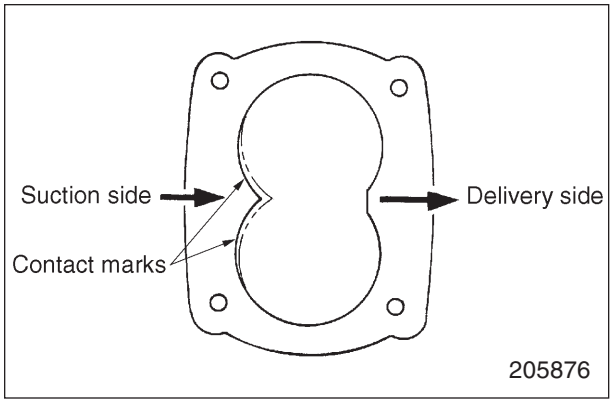
(3) Check the journals and splines of the shafts for wear or damage.

NOTE: Roughness or discoloring of gear surfaces is a sign indicating that there may be defects in the bushings and pump body. If this is the case, check the bushings and pump body as well.



2. Covers, body and bushings

Check these parts for wear or damage. There may be wear (contact marks) found on the inner surfaces of the pump body on the suction side where the gears come into contact with them. Such wear is normal unless it is excessive.



Suggestions for Reassembly

(1) Before starting reassembly, visually inspect all parts to be sure they are perfectly clean, and apply hydraulic oil to the sliding surfaces or the gear pump.

(2) Reassemble using new seals marked with ✻ in the drawing on Page 10-25.

(3) Apply a thin coat of grease to the seals and seal lips.

(4) Take care that the four bushings are correctly paired.

(5) Insert the bushings into the pump body making sure that the flats of the two bushings face each other squarely. Do not insert them at an angle or forcefully.

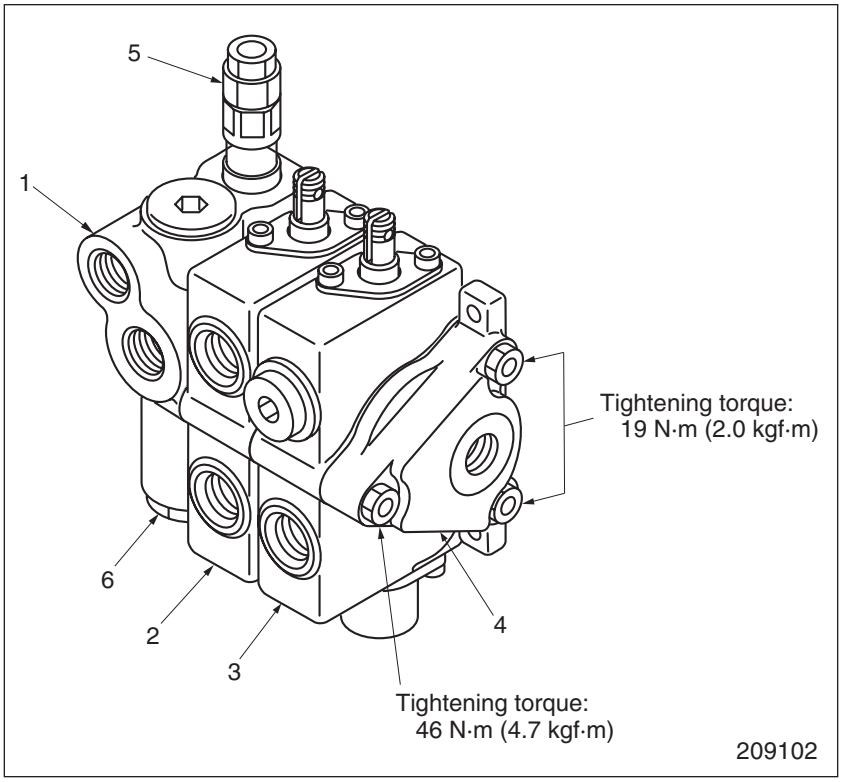
(6) Install the mounting flange taking care not to damage the seal lips with the splines on the drive gear.

(7) Tighten the bolts evenly.

(8) The fit of the pump gears in the reassembled pump may be satisfactory if the pump shaft rotates smoothly and lightly when turned by hand with pipe wrench.

Hydraulic Control Valve Assembly

Disassembly and Reassembly



Control valve assembly (2-valve type)

Main Component

1 Inlet valve section
2 TIlt valve section
3 Lift valve section
4 End cover
5 Main relief valve
6 Steering relief valve

Suggestions for Disassembly and Reassembly

(1) Do not disassemble main relief valve 1 or steering system relief valve 2 unless it is impossible to adjust the setting of the valve.

(2) Tighten the tie bolts (securing the valve housings) as evenly as possible to prevent distortion of the housings. Remember, a failure to follow this precaution will result in sluggish movement of the spools.

General Rules for Disassembly, Inspection and Reassembly of Valve Sections

Suggestions for Disassembly

(1) The control valve assembly is made up of precision parts. Handle it carefully.

(2) The valve body and spool are matched parts. If one of them is faulty, replace both as an assembly.

Inspection and Repair

(1) Check the valve housings for cracks and sliding surfaces for wear. Also, inspect the load check valve seat for wear.

(2) Check the spools for damage, seizure or distortion. Also, check for operating effort.

Operating effort of spool	Neutral N (kgf)	71 (7.2)
	Full stroke N (kgf)	88 (9.0)

Reassembly

To reassemble, follow the reverse of disassembly sequence, and do the following steps:

(1) Clean the disassembled parts with high flash-point solvent. Blow them dry with compressed air; however, this does not apply to rubber parts.

(2) Apply hydraulic oil to the spools when inserting them into the valve body.

(3) Position the poppet (tilt lock valve) correctly.

(4) Apply grease to the O-rings when fitting them between the valve housings to prevent them from twisting.

(5) Do not use any type of sealant.