

Manual No. : KM-18EE  
Vol. No. : TO18EE-00

# **Technical Manual**

**(Operational Principle)**

# **EX1200-5C**

## **Excavator**

Service Manual (Manual No. KM-18EE) consists of the following three separate volumes;

Technical Manual (Operational Principle)	: Vol. No. TO18EE
Technical Manual (Troubleshooting)	: Vol. No. TT18EE

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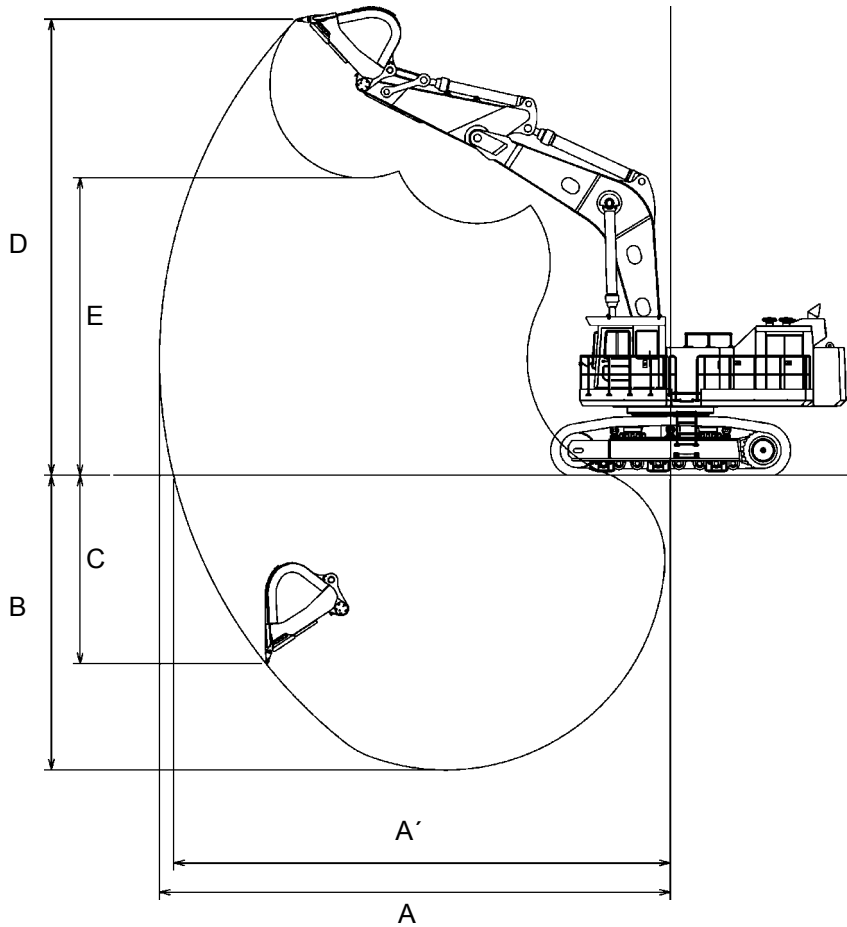


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## GENERAL / Specifications

### WORKING RANGE (BE BACKHOE)



M183-11-003

Boom Length	7.55 m (24' 9") BE boom
Arm Length	3.40 m (11' 2") BE arm
A : Maximum Digging Reach	13760 mm (45' 2")
A' : Maximum Digging Reach (on ground)	13380 mm (43' 11")
B : Maximum Digging Depth	*7940 mm (26' 1")
C : Maximum Vertical Wall	*5080 mm (16' 8")
D : Maximum Cutting Height	*12300 mm (40' 4")
E : Maximum Dumping Height	*8020 mm (26' 4")

 NOTE: \* The dimensions do not include the height of the shoe lug.

## GENERAL / Specifications

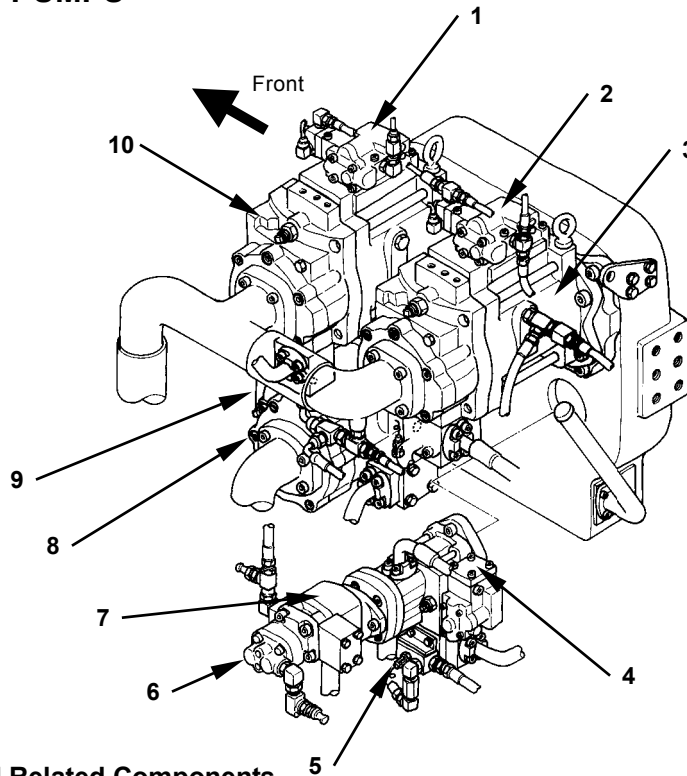
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# GENERAL / Component Layout

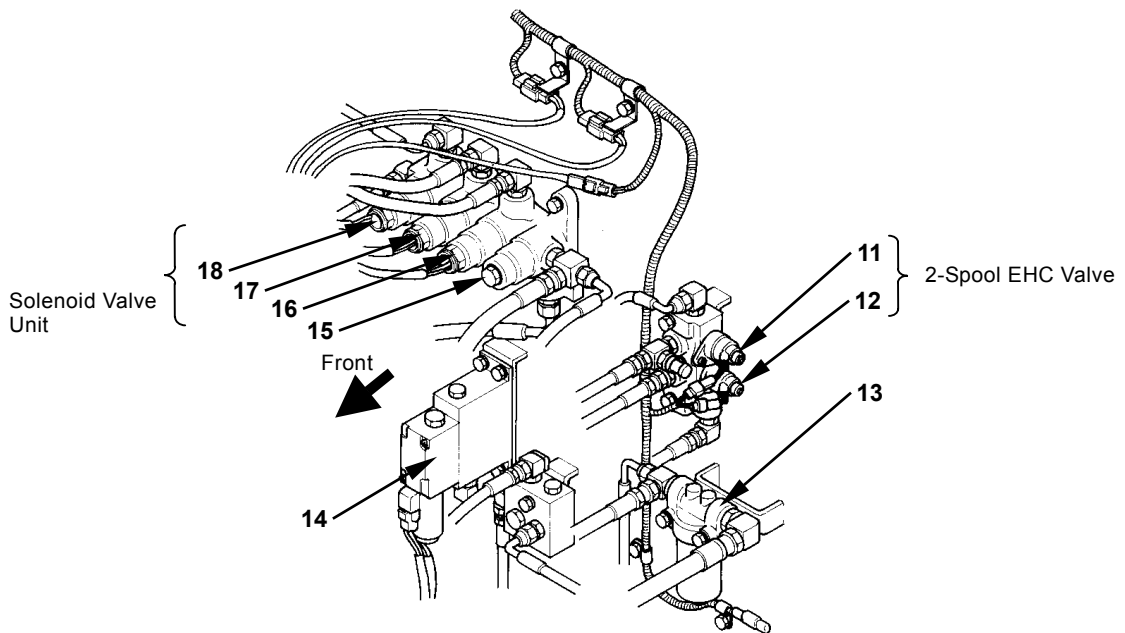
## ON AND AROUND PUMPS

### Pump Device



### Solenoid Valves and Related Components

T183-01-02-006



T183-01-02-007

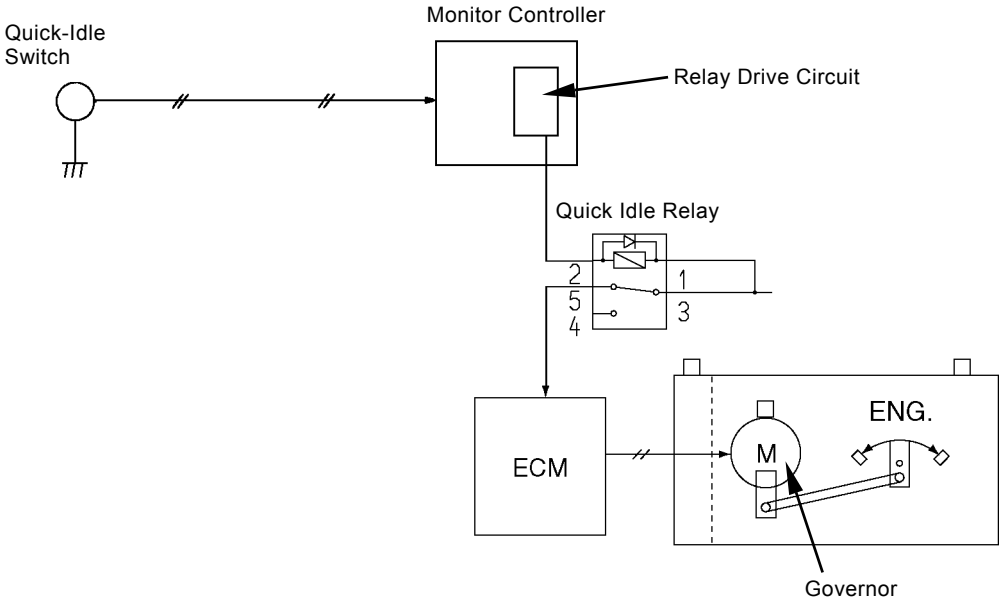
- |   |                                       |   |  |
|---|---------------------------------------|---|--|
| 1 - Main Pump 3 Regulator                 | 6 - Transmission Lubrication Oil Pump | 11 - Power Increase Solenoid Valve (ST)         | 15 - Pilot Relief Valve                      |
| 2 - Main Pump 1 Regulator                 | 7 - Pilot Pump                        | 12 - Oil Cooler Fan Control Solenoid Valve (SF) | 16 - Power Decrease Solenoid Valve (SA)      |
| 3 - Main Pump 1                           | 8 - Main Pump 2                       | 13 - Pilot Filter                               | 17 - Power Decrease Solenoid Valve (SB)      |
| 4 - Oil Cooler Fan Motor Drive Pump       | 9 - Main Pump 2 regulator             | 14 - Flow Rate Decrease Solenoid Valve          | 18 - Boom Mode Selection Solenoid Valve (SC) |
| 5 - Pump Transmission Oil Pressure Switch | 10 - Main Pump 3                      |   |  |

# SYSTEM / Control System

## Quick-Idle Control

**Purpose:** Reduces fuel consumption by quickly decreasing engine speed. This function will be effective when the machine waits for a period of time as when waiting for a dump truck to be set in a loading position.

**Operation:** When the quick-idle switch on the right control lever is turned ON, signals from the relay drive circuit in the monitor controller are delivered to the ECM. Then, the ECM drives the governor to reduce engine speed down to 850 min<sup>-1</sup>. When the quick-idle switch is turned OFF, engine speed resumes to the speed set by the engine control dial.



T18E-02-01-003

# SYSTEM / Control System

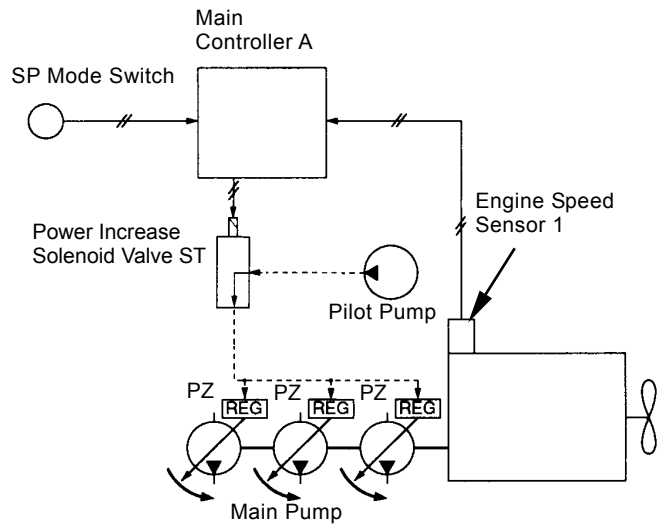
## PUMP CONTROL

### SP Mode Control

**Purpose:** Changes the pump flow rate in response to the engine speed change to utilize engine output effectively when the engine runs faster than the rated speed.

**Operation:** When engine speed increases over  $1550 \text{ min}^{-1}$  with the SP mode ON, main controller sends out signals to power increase solenoid valve ST in response to the signals from engine speed sensor 1. Therefore the signals from main controller A to power increase solenoid valve ST changes as engine speed changes. Power increase solenoid valve ST delivers the pilot oil pressure corresponding to the received signals to main pump regulator ports PZ, increasing the pump swash angle in proportion to the delivered pilot oil pressure. Then, the pump flow rate increases, accelerating actuator speeds and increasing the engine loads. This operation continues until engine speed is reduced to  $1550 \text{ min}^{-1}$ .

(Refer to the Regulator in the COMPONENT OPERATION / Pump Device group for regulator operation.)



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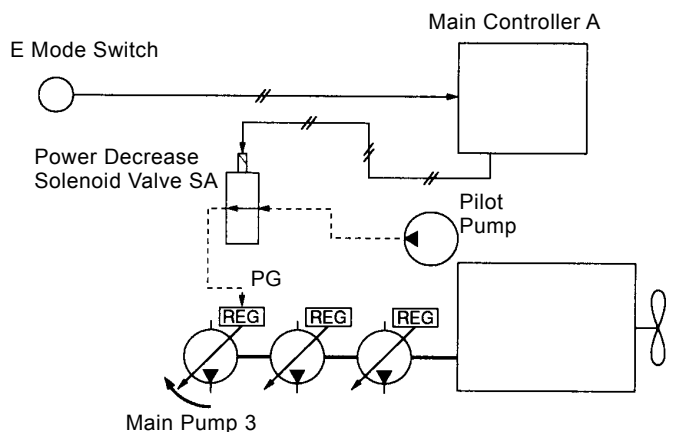
### E Mode Control

**Purpose:** Reduces pump 3 flow rate when the machine is engaged in less production work.

**Operation:** When the E mode switch is ON, main controller A sends out signals to power decrease solenoid valve SA, shifting power decrease solenoid valve SA. Then, the pilot oil pressure is delivered to main pump 3 regulator port PG, reducing the main pump 3 swash angle so that the pump 3 flow rate is reduced. Therefore, actuator operating speeds are reduced.

**NOTE:** Since no signals are delivered to power decrease solenoid valve SB from main controller A, main pumps 1 and 2 are not controlled.

(Refer to the Regulator in the COMPONENT OPERATION / Pump Device group for regulator operation.)



T142-04-03-006

## SYSTEM / Control System

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### Heavy Lift Control

Purpose: Increases the main relief set-pressure.

Operation: When the heavy lift switch is turned ON, main controller A receives signals from the switch and activates the heavy lift solenoid valve and activates the flow rate decrease solenoid valve. Then, the pilot oil pressure from the pilot pump is routed to the main relief valve via the heavy lift solenoid valve, increasing the relief set-pressure. (refer to the main relief pressure control on the COMPONENT OPERATION /Control Valve group.)

Other than the above, the pilot pressure oil from the pump flow rate control valve in signal control valve to main pump 1 and 2 regulator ports Pi is blocked by the flow rate decrease solenoid valve so that main pump 1 and 2 flow rates are reduced to minimum.

## **SYSTEM / Hydraulic System**

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### **PILOT CIRCUIT**

Pressure oil from the pilot pump is used as working pressure for the following pilot circuits.

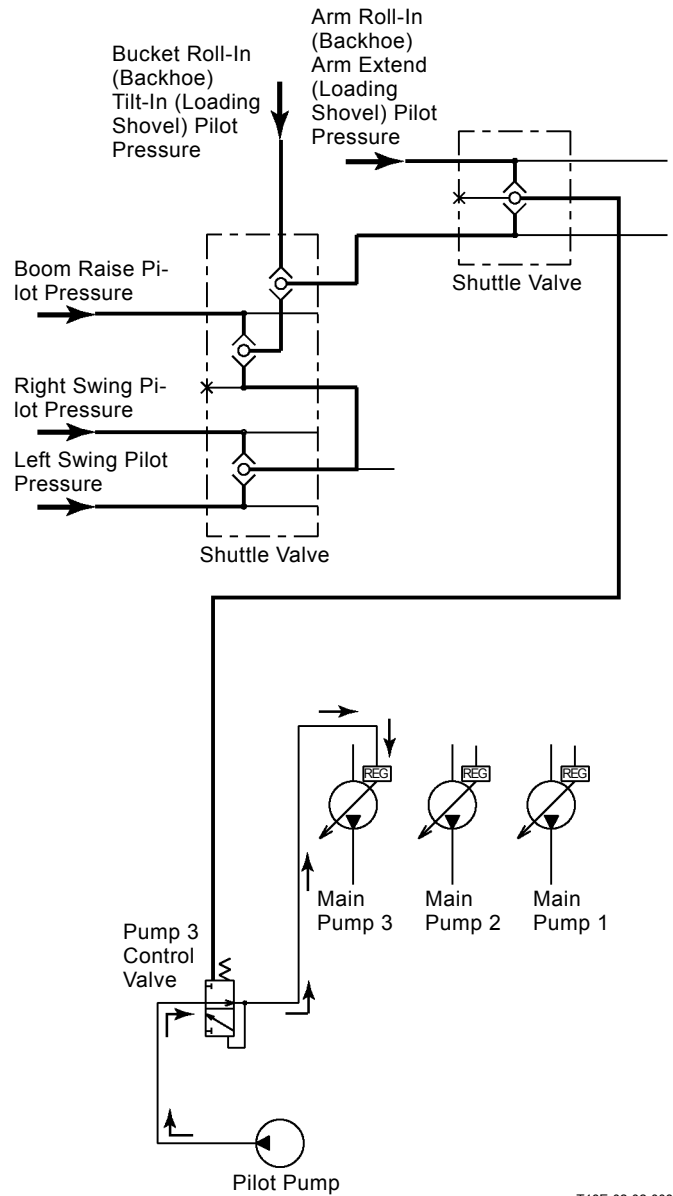
- Control Circuit
- Brake Release Circuit
- Travel Motor Overrunning Prevention Circuit
- Main Pump 3 Flow Rate Control Circuit
- Combined Operation Circuit of Arm Roll-Out (Backhoe) / Arm Retract (Loading Shovel), Bucket Roll-In (Backhoe) / Tilt-Out (Loading Shovel), Boom Raise and Swing
- Flow Rate Control Circuit for Boom Raise and Swing Combined Operation
- Mode Selection Circuit
- Auto-Idle Circuit
- Pump Flow Rate Control Circuit
- Main Relief Set-Pressure Control Circuit
- Boom Raise Priority Circuit
- Travel Mode Control Circuit
- Heavy Lift Circuit
- Boom Mode Selection Circuit

## SYSTEM / Hydraulic System

### Main Pump 3 Flow Rate Control Circuit

When either function of the arm roll-in (backhoe) / arm extend (loading shovel), bucket roll-in (backhoe) / tilt-in (loading shovel), boom raise or swing is operated, the pump 3 control valve is shifted. Then, pressure oil from the pilot pump is routed to the main pump 3 regulator as flow rate control pressure  $P_i$ , increasing the main pump 3 flow rate. Therefore, actuator operating speeds when a combine operation of arm roll-in (backhoe) / arm extend (loading shovel), bucket roll-in / tilt-in (loading shovel), boom raise or swing is made are ensured.

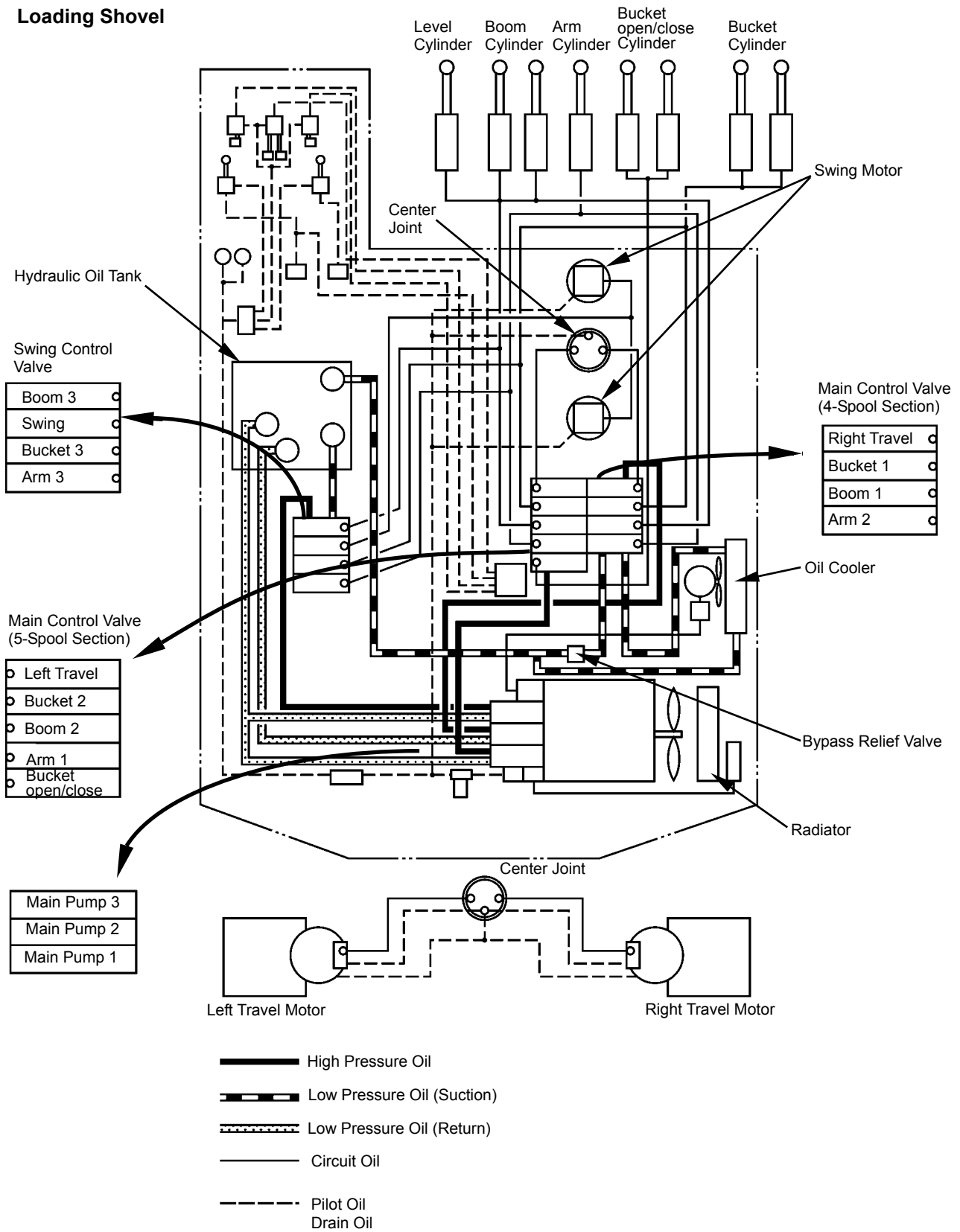
(Refer to the COMPONENT OPERATION / Pump Control Valve group.)



T18E-02-02-008

# SYSTEM / Hydraulic System

## Loading Shovel



T18E-02-02-025

## SYSTEM / Hydraulic System

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- Bucket Operation

Bucket Roll-In (Backhoe) / Tilt-In (Loading Shovel)  
Pressure oil from main pump 1, main pump 2, and main pump 3 flows to the bucket cylinder bottoms after passing through the bucket 2 spool in the 5-spool section of the main control valve, the bucket 1 spool in the 4-spool section of the main control valve, and the bucket 3 spool in the swing control.

Bucket Roll-Out (Backhoe) / Tilt-Out (Loading Shovel)

Pressure oil from main pump 1 and 2 is routed to the bucket cylinder rod side after passing through the bucket 2 spool in the 5-spool section and the bucket 1 spool in the 4-spool section of the main control valve, respectively. Pressure oil from main pump 3 doesn't flow to the bucket cylinder rod side because the oil circuit from the bucket 3 spool to the bucket cylinder is blocked.

## SYSTEM / Hydraulic System

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- Boom and Arm Combined Operation

Boom Lower and Arm Roll-In (Backhoe) / Arm Extend (Loading Shovel):

When boom lower and arm roll-in (backhoe) / arm extend (loading shovel) combine operation is made, both boom 1, 2, 3 spools and arm 1, 2, 3 spools are operated.

Pressure oil from main pump 1 is routed to the arm spool 1 via the auxiliary spool in the 5-spool section of the main control valve. Pressure oil from main pump 2 is routed to the boom 1 spool and the arm 2 spool via the parallel circuit in the 4-spool section of the main control valve.

When pressure in the bottom of the boom cylinder is higher than pressure in the boom cylinder rod side, pressure oil in the bottom of the boom cylinder flows into the boom cylinder rod sides via the boom 2 spool, accelerating the boom lower speed.

Pressure oil from main pump 3 is routed to the arm 3 spool in the swing control valve. Both pressure oil from the boom 1 spool and the boom 2 spool are jointly routed into the boom cylinder rod side.

Pressure oil from the arm 1, 2, and 3 spools are jointly routed into the arm cylinder bottom side.

The holding valve switch valves in the boom 1 and boom 3 raise circuits are shifted by the boom lower pilot pressure so that the holding valve check valve is opened.

The return oil from the boom cylinders flows back to the hydraulic oil tank through the holding check valve and the boom 1 and 3 spools.

The holding valve switch valves in the arm 1 roll-out (backhoe) / retract (loading shovel) circuit are shifted by the arm roll-out (backhoe) / retract (loading shovel) pilot pressure so that the holding valve check valve is opened.

The return oil from the arm cylinder is routed to the arm 1 spool via the holding check valve. The return oil flow from the arm cylinder is restricted by the orifice in the spool and the arm oil flow regenerative control valve. When the return oil pressure increases more than the bottom side pressure the return oil doesn't flow back to the hydraulic oil tank but is routed to the arm cylinder bottom through the arm 1 spool check valve.

(Refer to the COMPONENT OPERATION/Control Valve group for the boom and arm holding valve and the arm regenerative valve.)

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## SYSTEM / Electrical System

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### ENGINE START CIRCUIT

1. When the key switch is turned ON, current from key switch terminal M magnetizes battery relays 1 and 2 via fuse #10 in fuse box 1.
2. When battery relays 1 and 2 are magnetized, battery current is routed to starter motor (2 used) terminals B via battery relays 1 and 2.
3. Current from key switch terminal M also magnetizes the engine stop solenoid relay via fuse #3 in fuse box 2 and the engine stop relay.
4. Therefore, the engine stop solenoid relay is turned ON so that the engine stop solenoid is activated by current from the 1 pole junction. Then, the fuel injection pump rack connected to the engine stop solenoid with a link is moved from the engine stop position. Consequently, the fuel injection pump can be controlled by the governor, allowing the engine to start.
5. When the key switch is set to the START position, current from key switch terminal G2 is applied through fuse #19 in fuse box 1 and auto engagement relay in order to magnetize safety relay and starter relay.
6. When starter relay 1 is magnetized, battery current is routed to starter motor terminal C.
7. When current is routed to starter motor terminal C, the coil in the starter motor is magnetized, drawing main contactor so that the contact point is closed. At the same time, the pinion gear is extended to engage with the engine ring gear.
8. When the main contactor contact point is closed, battery current is routed to the motor from starter motor terminal B, rotating the motor.
9. Once the engine starts, the alternator begins to generate electricity and supplies current from alternator terminals B, L, and R.
10. Current from the alternator terminal L is applied to starter relay 2 terminal R to demagnetize starter relay 2.
11. Consequently, starter relay 2 is turned OFF so that starter relay 1 magnetizing current is cut off, turning starter relay 1 OFF.
12. When magnetizing current routed to starter motor terminal C from the starter relay 1 is cut off, the main contactor is turned OFF, causing the pinion gear in the starter to retract.
13. At the same time, battery current is cut off so that starter motor stops rotating.
14. While the engine is rotating (when the alternator is generating), no current is routed to starter terminal C. Therefore, even if the key switch is turned to the START position, the starter will not rotate.

 **NOTE:** *The start repeating relay is provided to always start the engine with two starter motors.*

*(Refer to T2-3-6 for start repeating relay operation.)*

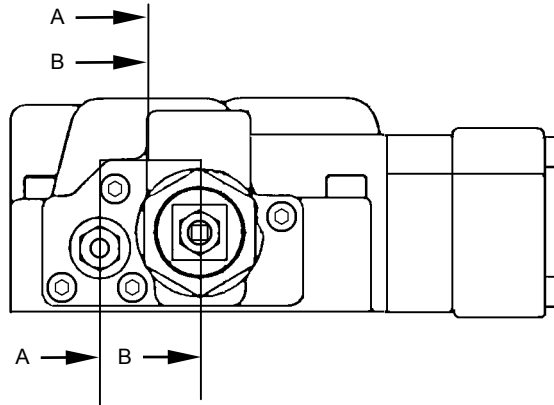
## SYSTEM / Electrical System

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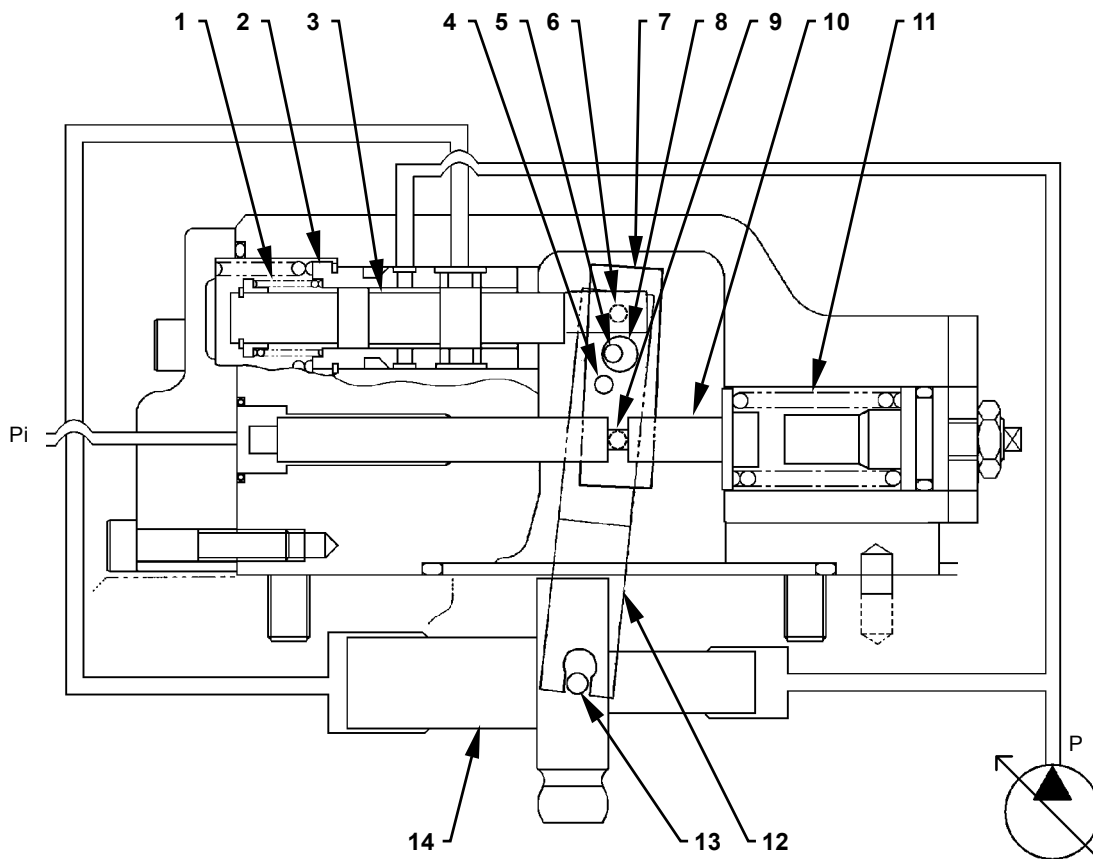
# COMPONENTS OPERATION / Pump Device

## Cross Section (Regulator for Main Pump)



T183-03-01-002

## Cross Section A-A



T117-02-01-006

- |                  |             |                   |                     |
|------------------|-------------|-------------------|---------------------|
| 1 - Inner Spring | 5 - Pin     | 9 - Pin           | 12 - Feedback Lever |
| 2 - Sleeve       | 6 - Pin     | 10 - Pilot Piston | 13 - Pin            |
| 3 - Spool        | 7 - Lever 1 | 11 - Spring       | 14 - Servo Piston   |
| 4 - Pin          | 8 - Hole    |                   |                     |


## COMPONENTS OPERATION / Pump Device

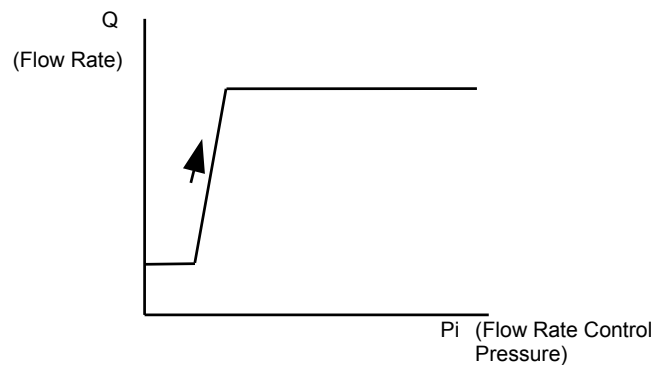
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### Flow Rate Control

- Flow Rate Increasing Operation

1. On the main pump, flow rate control pressure  $P_i$  acts on pilot piston (10) by operating the control lever. On the oil cooler fan motor drive pump, flow rate control pressure  $P_i$  from fan pump solenoid valve SF acts on pilot piston (10). As pressure  $P_i$  increase, pilot piston (10) is moved to the right until pilot piston (10) balances against spring (11).
2. As lever 1 (7) is connected to pilot piston (10) via pin (9), movement of pilot piston (10) rotates lever 1 (7) counterclockwise around pin (4) which is fixed to the support plug.
3. Because pin (5) on feedback lever (12) is inserted into hole (8) on lever 1 (7), feedback lever (12) rotates counterclockwise around pin (13) as lever 1 (7) rotates, moving spool (3) to the left.
4. As spool (3) is moved, pressure oil in the servo piston large chamber is routed to the hydraulic oil tank via spool (3). Since pump pressure  $P$  is routed to the servo piston small chamber all the time, servo piston (14) is moved to the left.
5. As servo piston (14) is moved to the left, the pump displacement angle increases corresponding to the distance that servo piston (14) has moved, increasing the pump delivery flow rate.
6. As servo piston (14) is moved and because pilot piston (10) and lever 1 (7) do not move, feedback lever (12), which is connected to servo piston (14) via pin (13), rotates clockwise around pin (5), moving spool (3) to the right until the notches on sleeve (2) are completely closed, thus closing the line from the servo piston large chamber to the hydraulic oil tank. As a result, movement of servo piston (14) stops.
7. With the above operation, the pump delivery flow rate is increased in proportion to the increment of pressure  $P_i$ .

 NOTE: Refer to the SYSTEM / Hydraulic System / Pilot Circuit description.



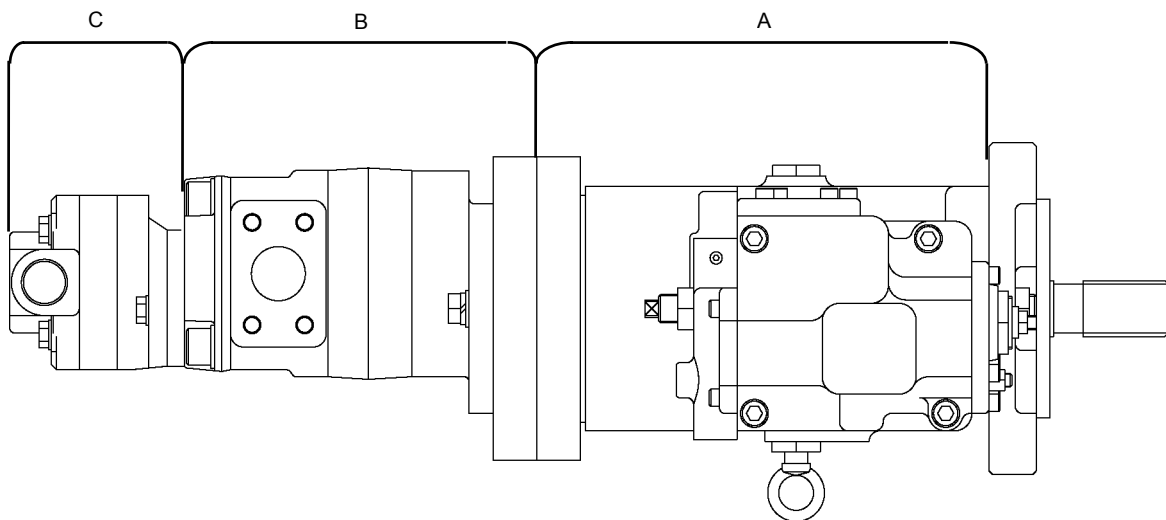
## COMPONENTS OPERATION / Pump Device

### 3-UNIT PUMP

The engine power is transmitted through the pump transmission to the shaft. As the shaft turns, the three pumps are operated simultaneously.

The oil cooler fan motor drive pump (A) is a variable displacement swash plate plunger type pump. It has the cylinder block splined to the shaft. As the shaft and cylinder block rotate, the plungers move in and out of their bores, drawing and pushing hydraulic oil.

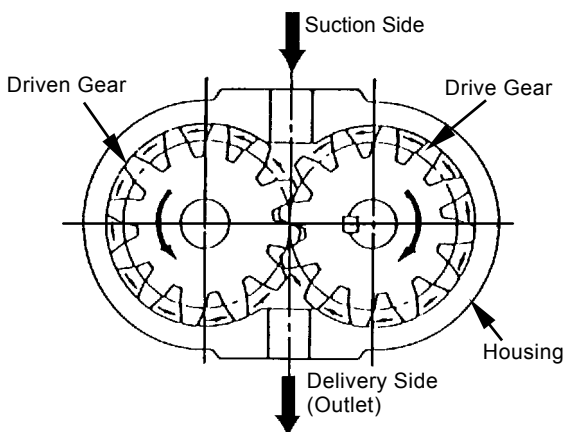
Pilot pump (B) and transmission oil circulation pump (C) are gear type pumps. The shaft drives the drive gear, and the driven gear are driven by the drive gear. Hydraulic oil drawn into the pump housings are delivered to the outlets along the housing inner surfaces.



T183-03-01-003

- A- Oil Cooler Fan Motor Drive Pump  
(Variable Displacement Swash Plate Plunger Type Pump)
- B- Pilot Pump (Tandem Gear Pump)

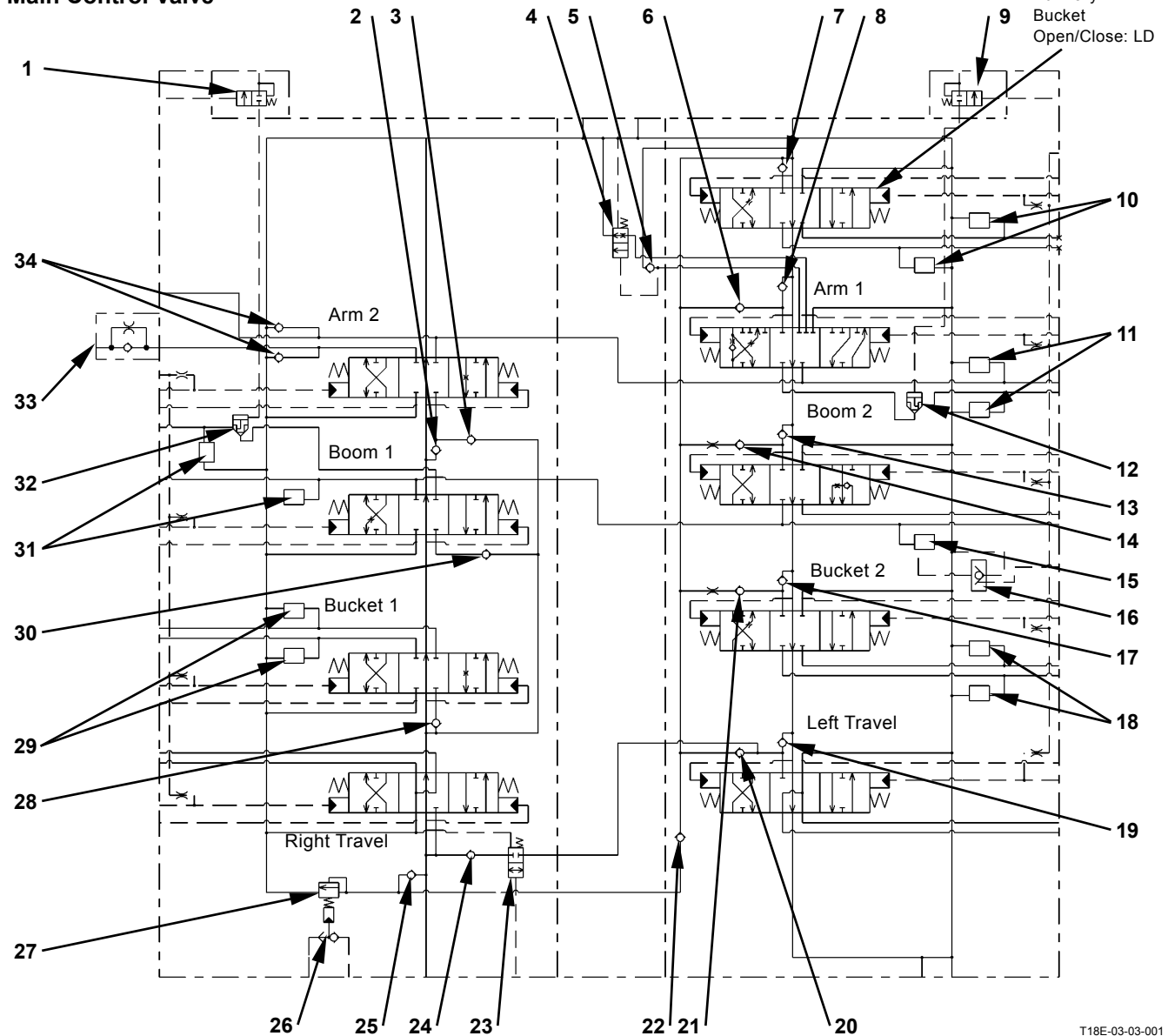
- C- Transmission Oil Circulation Pump  
(Tandem Gear Pump)



T137-02-03-005

# COMPONENT OPERATION / Control Valve

## Main Control Valve



T18E-03-03-001

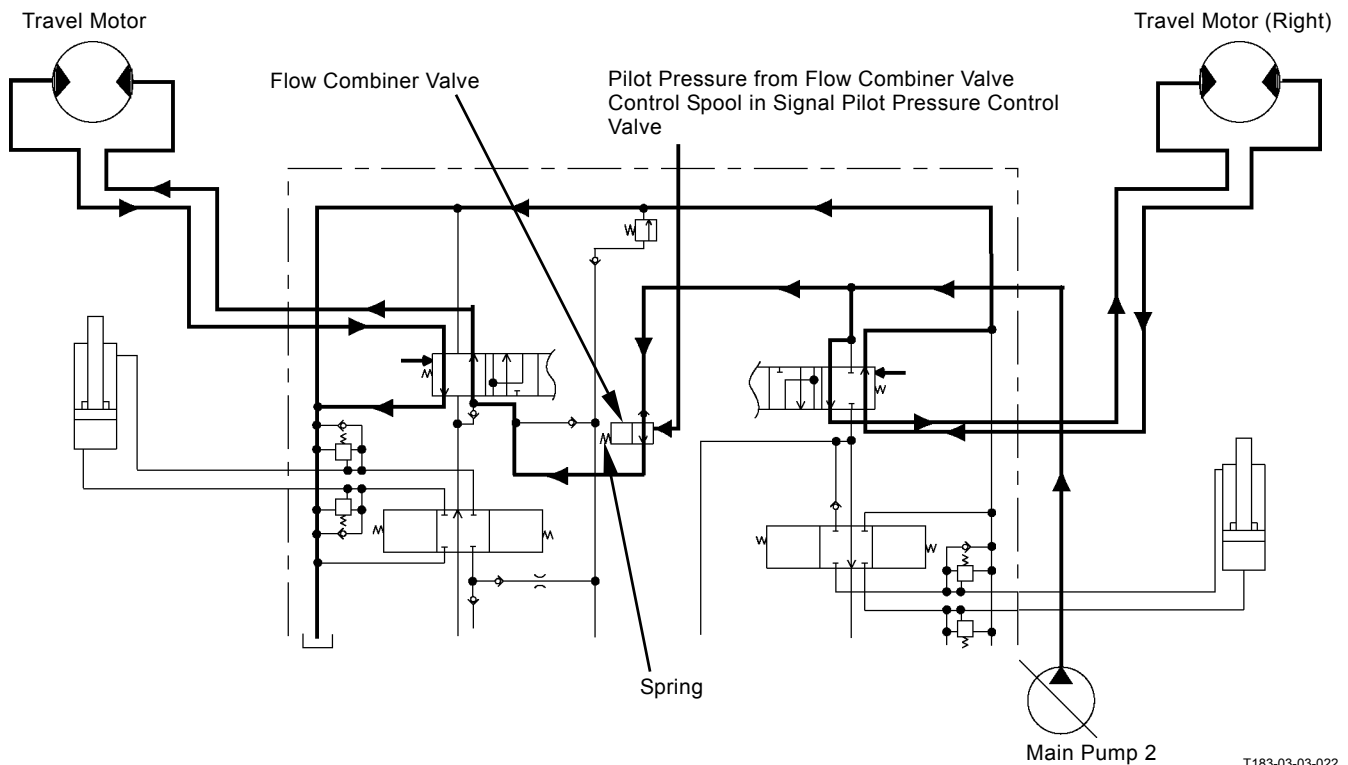
**NOTE:** BH: Backhoe  
LD: Loading Shovel

- |   |  |   |   |
|---|--|---|---|
| 1 - Holding Valve Switch Valve (Boom)           | 10 - Overload Relief Valve (Aux.: BH, Bucket Open/Close: LD) | 19 - Load Check Valve (Left Travel Tandem Circuit)        | 27 - Main Relief Valve                          |
| 2 - Load Check Valve (Arm 2 Tandem Circuit)     | 11 - Overload Relief Valve (Arm)                             | 20 - Load Check Valve (Left Travel Parallel Circuit)      | 28 - Load Check Valve (Bucket 1 Tandem Circuit) |
| 3 - Load Check Valve (Arm 2 Parallel Circuit)   | 12 - Holding Valve Check Valve (Arm)                         | 21 - Load Check Valve (Bucket 2 Parallel Circuit)         | 29 - Overload Relief Valve (Bucket 1)           |
| 4 - Arm Regenerative Valve                      | 13 - Load Check Valve (Boom 2 Tandem Circuit)                | 22 - Check Valve (Main Relief Pressure Combining Circuit) | 30 - Load Check Valve (Boom1 Parallel Circuit)  |
| 5 - Load Check Valve (Arm 1 Parallel Circuit1)  | 14 - Load Check Valve (Boom 2 Parallel Circuit)              | 23 - Flow Combiner Valve                                  | 31 - Overload Relief Valve (Boom)               |
| 6 - Load Check Valve (Arm 1 Parallel Circuit2)  | 15 - Overload Relief Valve (Boom Mode Selection)             | 24 - Check Valve (Travel Flow Combine Circuit)            | 32 - Holding Valve Check Valve (Boom)           |
| 7 - Load Check Valve (Auxiliary Tandem Circuit) | 16 - Boom Overload Relief Pressure Switch Valve              | 25 - Check Valve (Main Relief Pressure Combining Circuit) | 33 - Slow Return Valve                          |
| 8 - Load Check Valve (Arm 1 Tandem Circuit)     | 17 - Load Check Valve (Bucket 2 Tandem Circuit)              | 26 - Shuttle Valve  | 34 - Make-Up Valve (Arm 2)                      |
| 9 - Holding Valve Switch Valve (Arm)            | 18 - Overload Relief Valve (Bucket 2)                        |   |   |

## COMPONENT OPERATION / Control Valve

### FLOW COMBINER VALVE

1. Normally, the spring pushes the spool, blocking the valve ports.
2. When the front attachment and travel control levers are operated at the same time, the right travel pilot oil pressure shifts the flow combiner valve control spool in the signal control valve so that the pilot pressure shifts the flow combiner valve spool.
3. When the flow combiner valve spool is shifted, pressure oil from main pump 2 is routed to the left travel spool.
4. Therefore, pressure oil from main pump 2 is routed to the left travel spool in parallel with the right travel spool and pressure oil from main pump 1 is routed to the front attachment. Consequently, the machine can travel straight when a combine operation of travel and front attachment is performed.



T183-03-03-022

## COMPONENT OPERATION / Control Valve

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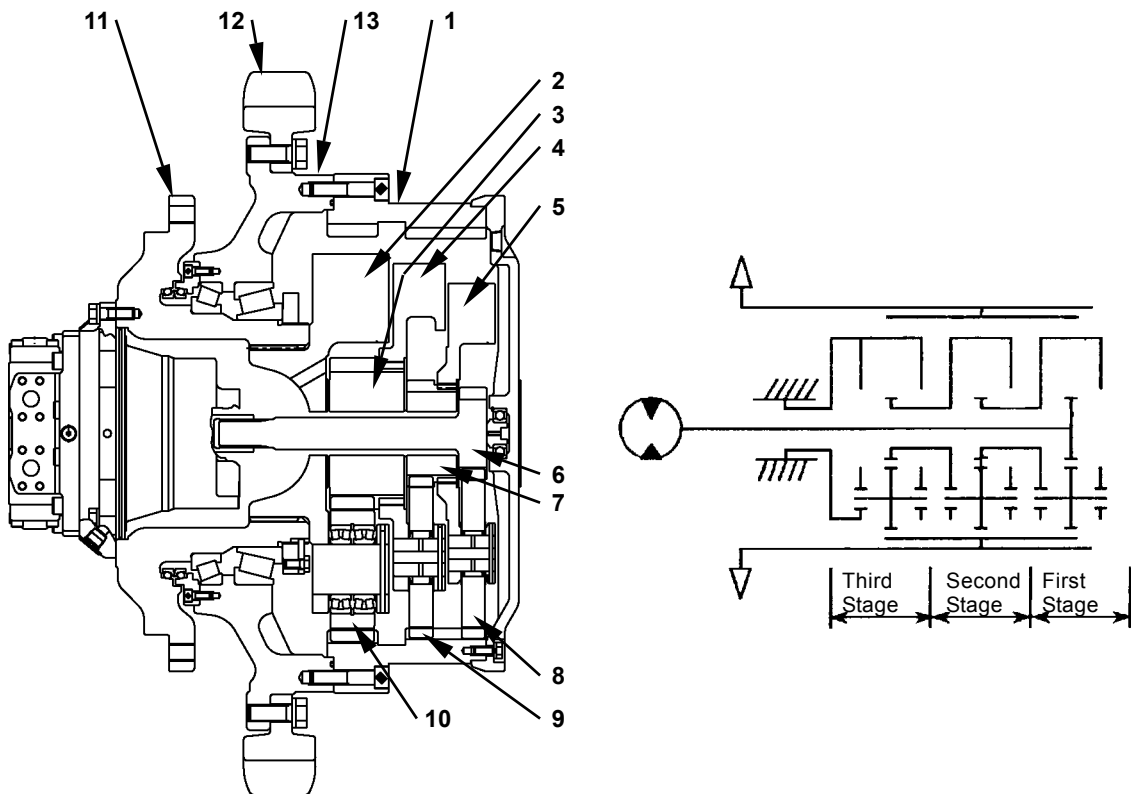
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## COMPONENT OPERATION / Travel Device

### TRAVEL REDUCTION GEAR

The travel reduction gear is a three stage planetary gear. When the travel motor rotates clockwise, shaft (6) rotates clockwise, transmitting this motor driving power to ring gear (1) via first stage planetary gears (8), first stage carrier (5), second stage sun gear (7), second stage planetary gears (9), second stage carrier (4), third stage sun gear (3), third stage planetary gears (10) and third stage carrier (2).

As third stage carrier (2) is held stationary with housing (11), ring gear (1) rotates. Ring gear (1) is bolted to drum (13) so that sprocket (12) is rotated.



T183-03-05-002

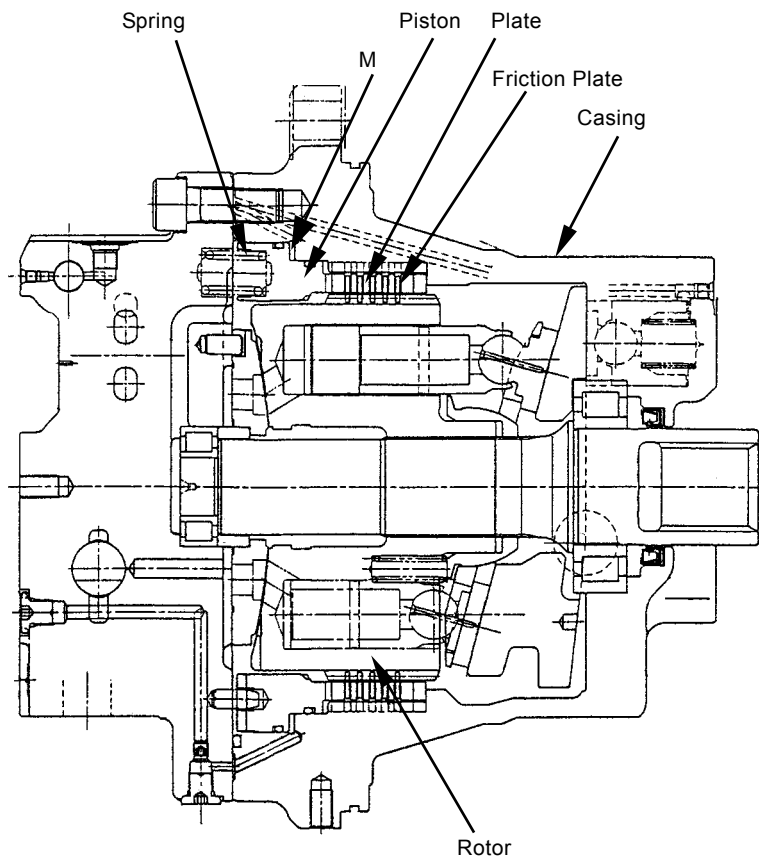
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|--------------------------|---------------------------|---------------------------------|-----------------------------|
| 1 - Ring Gear            | 5 - First Stage Carrier   | 8 - First Stage Planetary Gear  | 11 - Housing (Travel Motor) |
| 2 - Third Stage Carrier  | 6 - Shaft                 | 9 - Second Stage Planetary Gear | 12 - Sprocket               |
| 3 - Third Stage Sun Gear | 7 - Second Stage Sun Gear | 10 - Third Stage Planetary Gear | 13 - Drum                   |
| 4 - Second Stage Carrier |                           |                                 |                             |

## COMPONENT OPERATION / Travel Device

### PARKING BRAKE

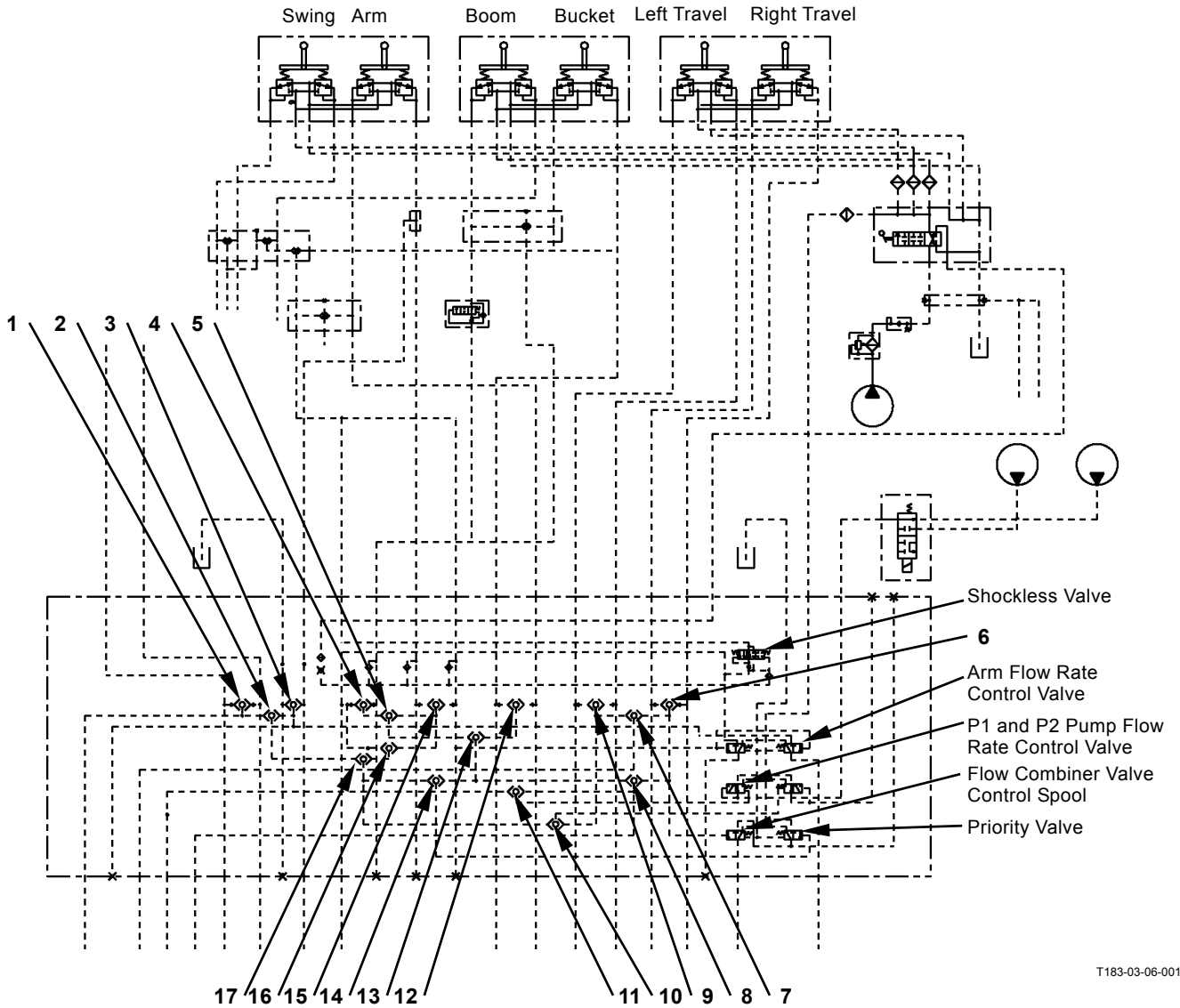
The parking brake is a negative-type brake released when pilot oil pressure is applied to parking brake chamber M. Whenever the travel control valve spools are in neutral, the parking brake is automatically applied.

The friction plates are connected to the rotor, and the plates to the casing via spline couplings respectively. When the spring pushes the piston to the right, the friction plates come into contact with the plates, applying the parking brake. (Refer to the pilot circuit diagram in the Hydraulic Circuit Group, the SYSTEM Section, for pilot oil flow.)




T183-03-05-003

# COMPONENT OPERATION / Signal Control Valve



T183-03-06-001

 **NOTE:** BH: Backhoe  
LD: Loading Shovel

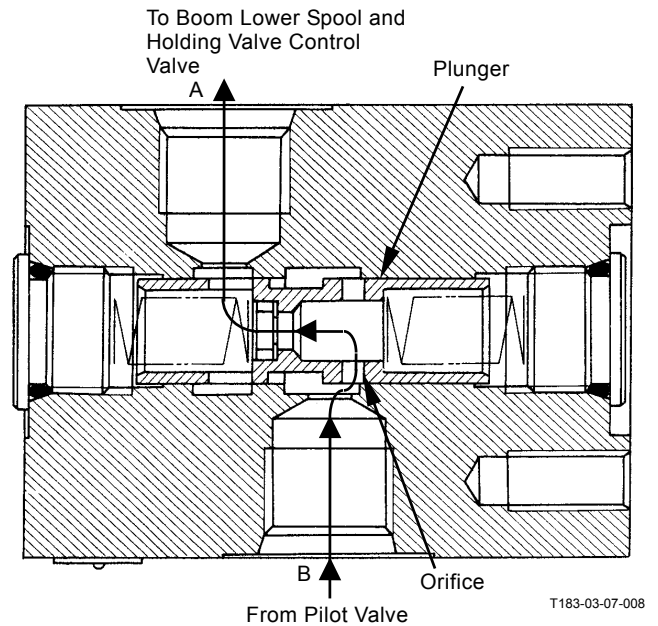
## COMPONENT OPERATION / Others (Upperstructure)

### SHOCKLESS VALVE

The shockless valve is located in the boom lower pilot operation circuit and pump 2 regulator Pi pressure circuit. The shockless valve in the boom lower pilot operation circuit controls boom lower pilot pressure and the flow of the holding valve control valve for boom lowering to cushion abrupt movement at the boom lower spool and holding valve control valve.

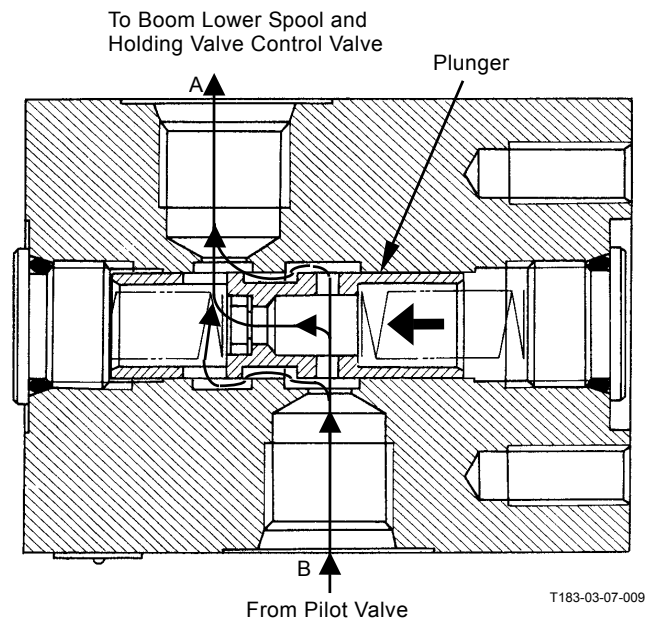
The shockless valve of the pump 2 regulator Pi pressure circuit controls the flow between port Pi of the regulator in the pump 2 and the pilot valve at the swing stopping operation to prevent rapidly decrease of the delivery amount from pump 2.

(Refer to the Hydraulic Pressure System Group in the SYSTEM Section for the swing motor make-up circuit.)



#### Shockless Valve in Boom Lower Pilot Operation Circuit

- When a control lever is operated, the pilot valve routes the pilot pressure to port B of the shockless valve. Just after the control lever operation, the pilot pressure oil flows to Port A through the shockless valve only via orifice of the plunger. When pressure from the pilot valve increases further, the plunger moves to the left, so that hydraulic oil volume increases.



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