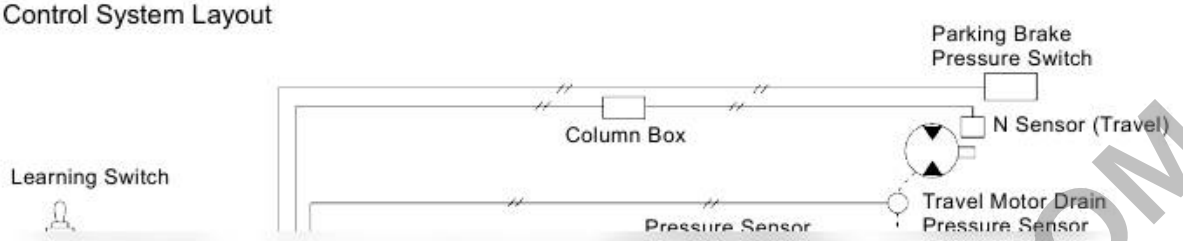
Engine Control System Layout




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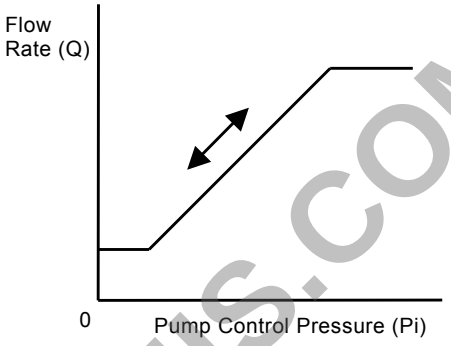
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**Regulator Control Function**

The regulator has the following four control functions.

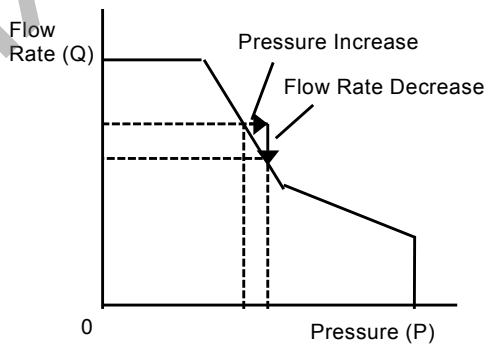
- Control by Pump Control Pressure

  When a control lever is operated, the pump flow rate control valve in the signal control valve regulates pump control pressure Pi in response to the lever stroke. Then, when the regulator receives pump control pressure Pi, the regulator controls the pump flow rate in proportion to pump control pressure Pi. When a control lever is operated, pump control pressure Pi increases. Thereby, the regulator increases the pump flow rate. When the control lever is returned to neutral, pump control pressure Pi decreases, causing the regulator to reduce the pump flow rate.




- Control by Own or Opponent Pump Delivery Pressure

  The regulator receives own pump delivery pressure Pd1 and opponent pump delivery pressure Pd2 as control signal pressures. If the two average pressures increase over the set P-Q line, the regulator reduces both pump flow rates by the excess pressure from the P-Q line so that the total pump output is returned to the set P-Q line. Thereby, the engine is protected from being overloaded. The P-Q line has been designated to jointly regulate both pump operations. Therefore, both pump flow rates are regulated almost equally to each other. Accordingly, although the higher-pressure side pump is loaded more than the lower-pressure side pump, the total pump output matches with the engine output. (Total Output Control)




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- Travel, Positioning/Auxiliary and Blade/Stabilizer Pilot Valves

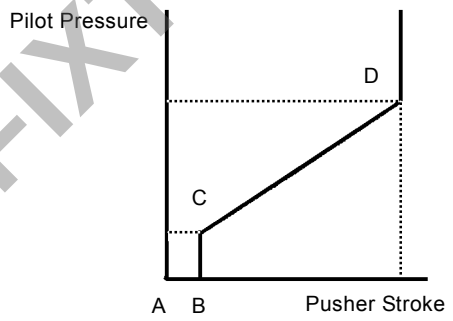
**Control Pedal-In Neutral (Pusher Stroke: A to B)**

1. When the control pedal is in neutral, spool (7) blocks the pressure oil in port P completely. The output port is connected to port T through the passage in spool (7), so the pressure at output port becomes equal to the hydraulic oil tank pressure.
2. When the control pedal is moved slightly, cam (1) moves and pusher (2) and spring guide (4) move downward together, compressing return spring (6).
3. At this time, balance spring (5) pushes spool (7) and spool (7) moves downward until clearance (A) becomes ZERO.
4. While spool (7) moves downward, the output port is connected to port T and the pressure oil does not flow into the output port.

*NOTE: The pedal stroke moved until clearance (A) becomes zero, corresponds to the pedal play in the neutral position.*

**Control Pedal-Operated (Pusher Stroke: C to D Metering)**

1. When the control pedal is moved further, the hole on spool (7) is connected to notch (B).
2. The pressure oil in port P flows into the output port via the hole in spool (7) from notch (B), so the pressure at output port increases.
3. The pressure at output port acts on the bottom of spool (7), to push spool (7) upward.
4. If the acting force on spool (7) is smaller than the spring force of balance spring (5), balance spring (5) will not be pressed. As a result, as port P is connected to the output port, the pressure at output port increases continuously.
5. If the pressure at output port increases further, the force to push up spool (7) increases. When this force becomes larger than the spring force of balance spring (5), spool (7) pushes balance spring (5), and moves upward.
6. When spool (7) moves upward, notch (B) closes, so the pressure oil does not flow into the output port from port P. Thereby, the pressure at port P stops raising.
7. Accordingly, the amount balance spring (5) is compressed is equal to the amount spool (7) is pressed down, so the balanced pressure between the spring force and the force acting on spool (7) becomes the pressure at output port.




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**SECTION AND GROUP CONTENTS**

**TECHNICAL MANUAL**

**(Operational Principle)**

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**TECHNICAL MANUAL (Troubleshooting)**


**SECTION 4 OPERATIONAL PERFORMANCE TEST**

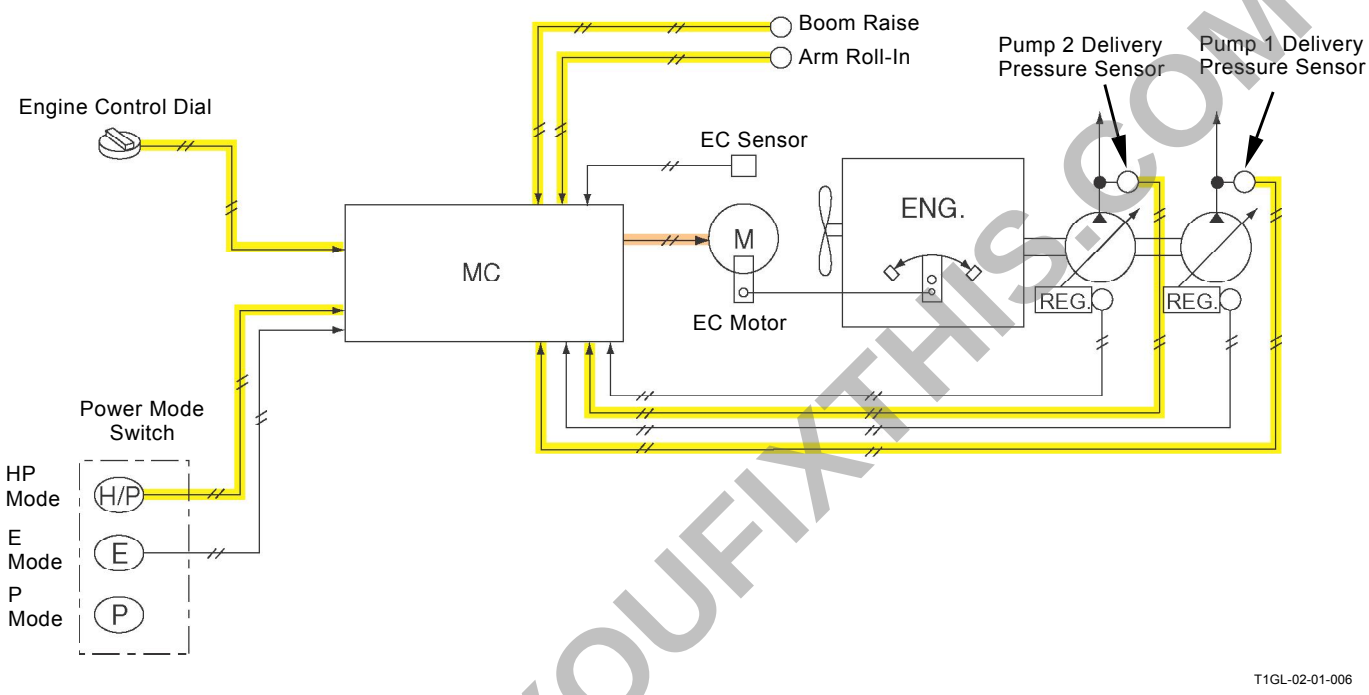
Group 1 Introduction
Group 2 Standard
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Group 1 Diagnosing Procedure
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## Valve Control

The valve control has the following functions.

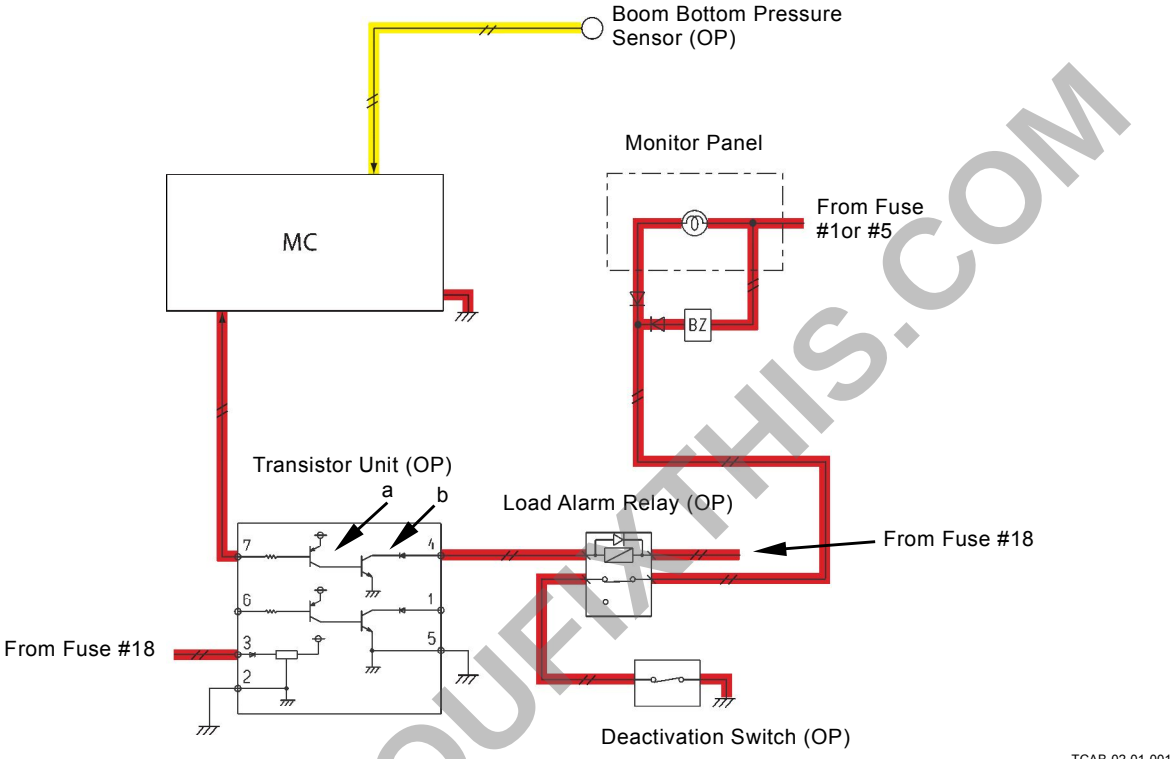
- Arm Regenerative Control
- Superfine Travel Speed Control
- Travel Motor Excessive Rotation Control
- Work Brake Control
- Auxiliary Flow Rate Control

*NOTE: OP: Optional*
**Control system available only on the machine equipped with the optional parts.*

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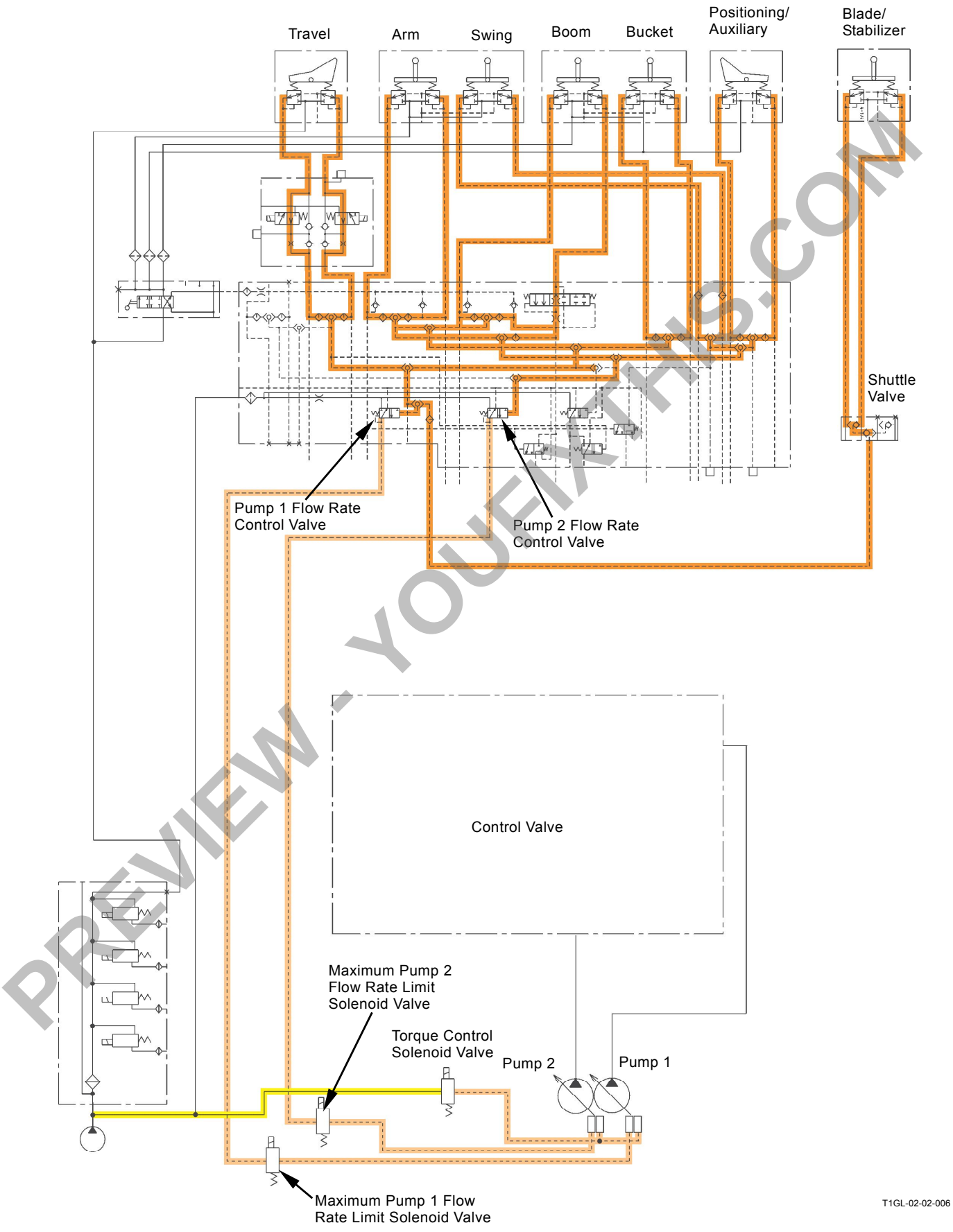
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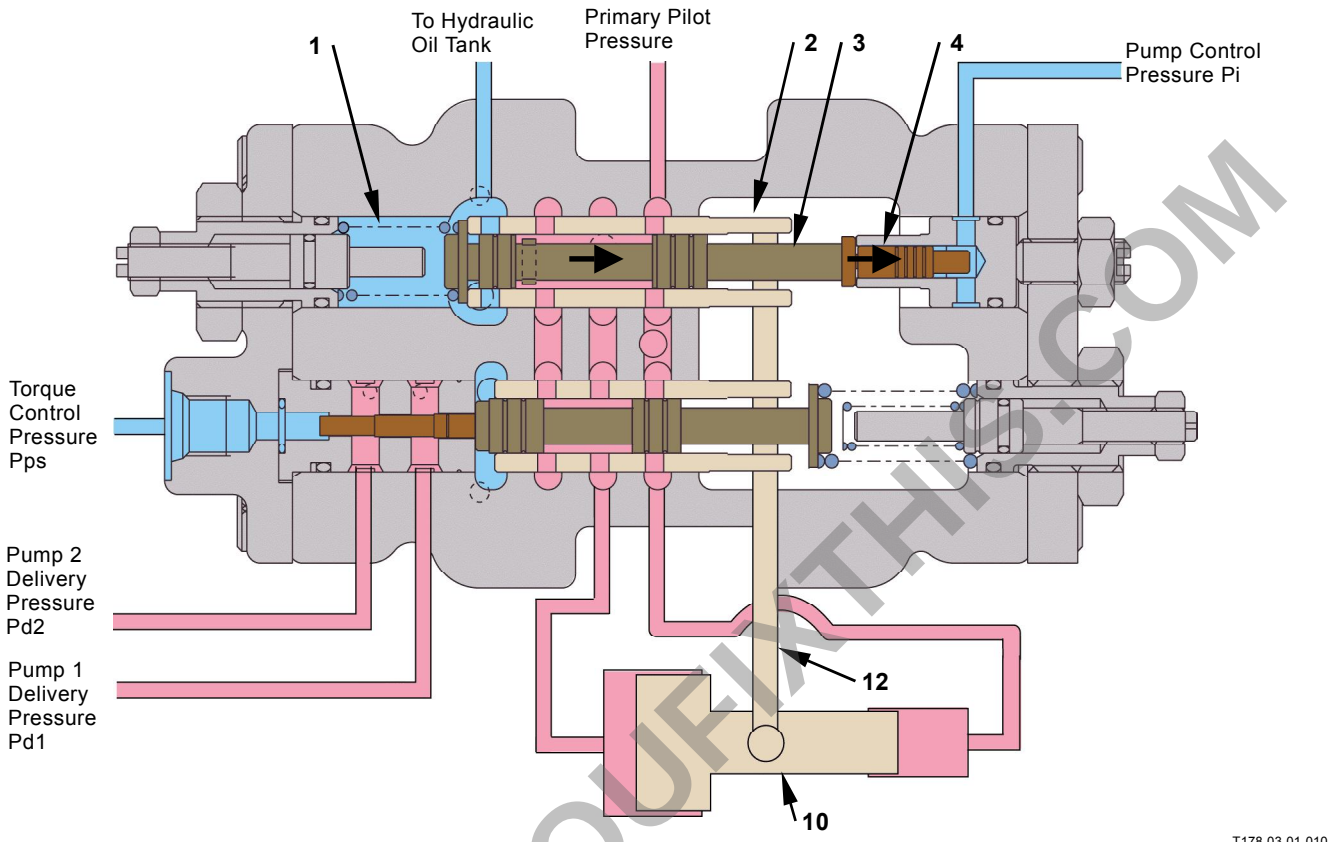
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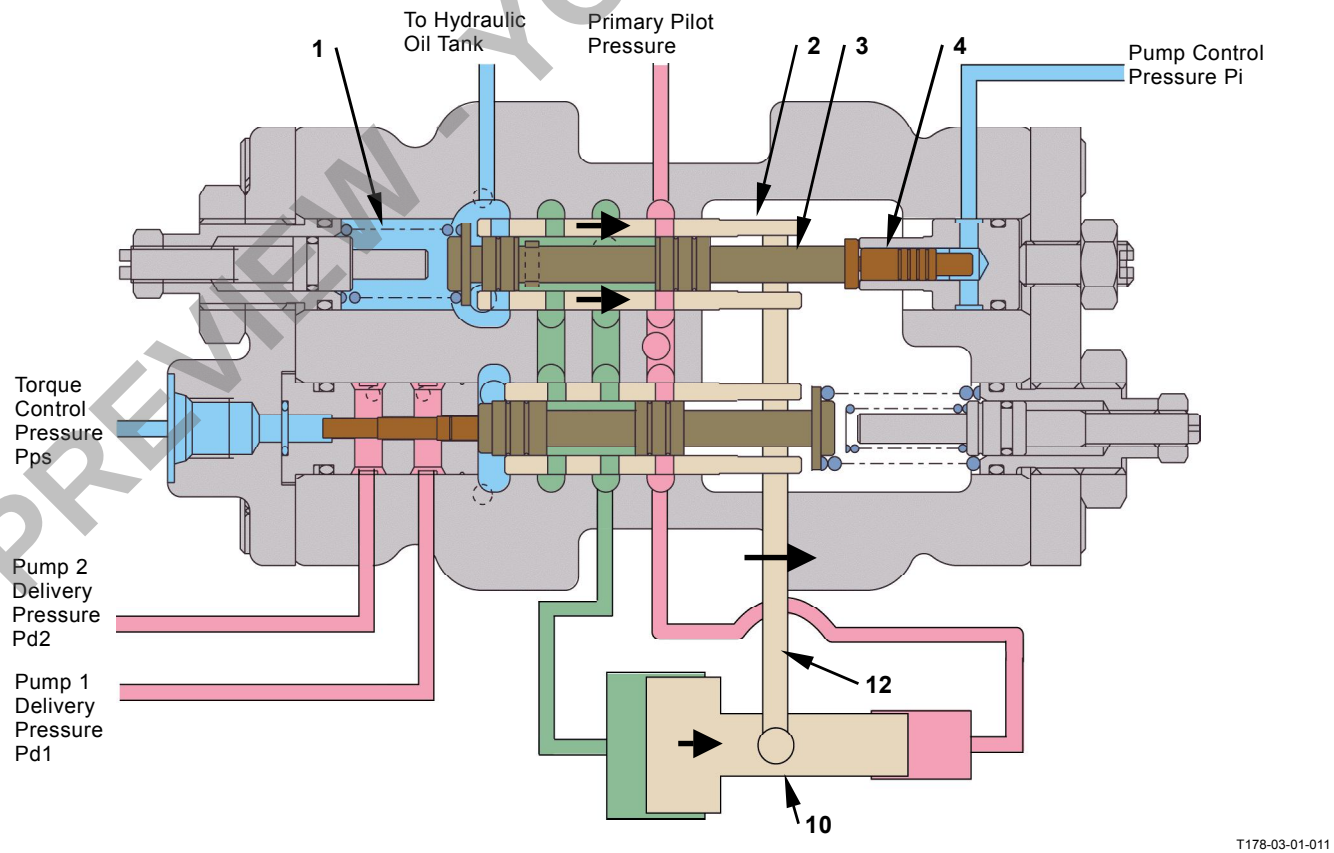

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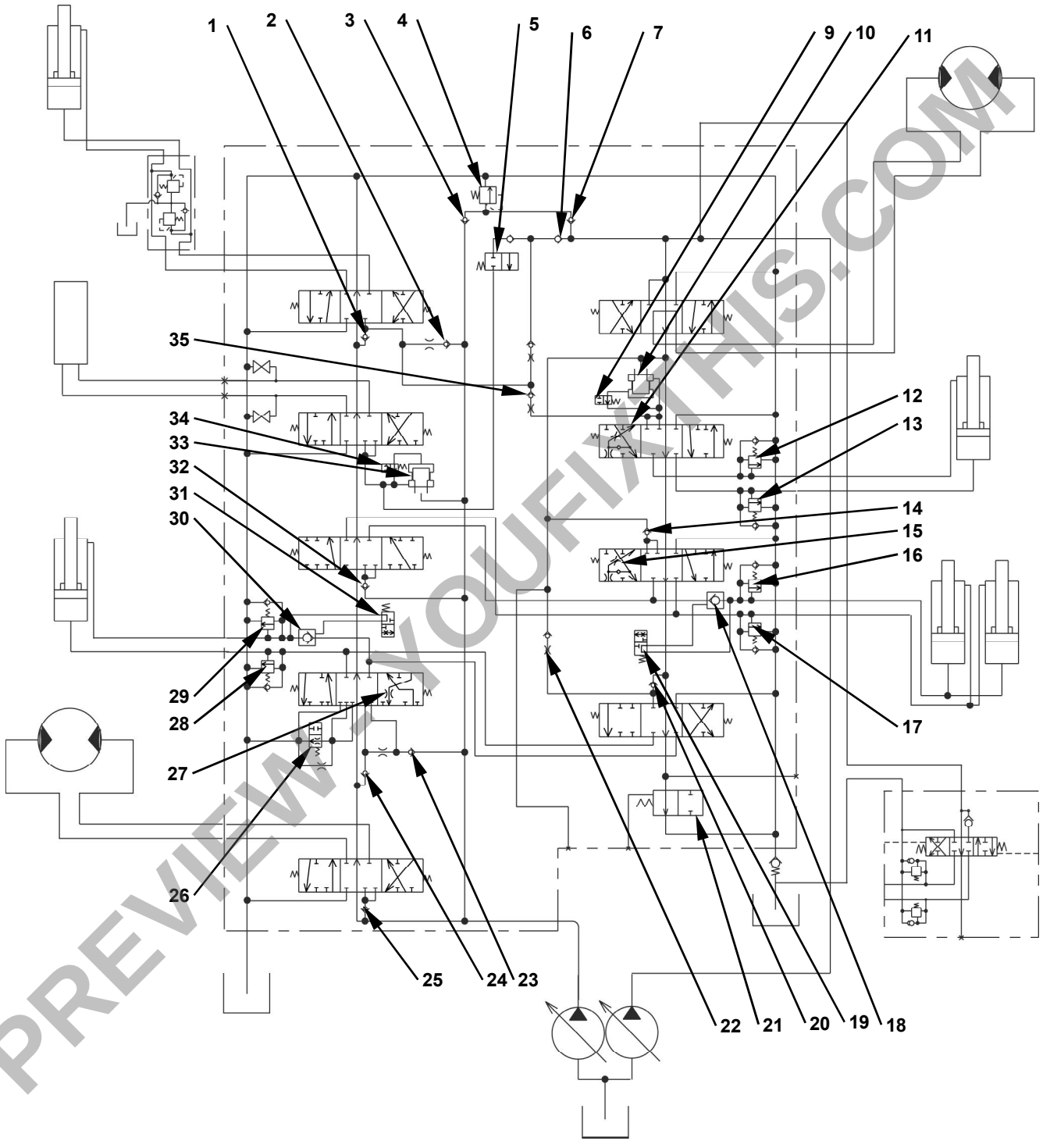



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## FLOW RATE CONTROL VALVE

The flow rate control valve is located in the bucket and auxiliary circuits. When a combined operation is made, the flow rate control valve restricts the oil flow so that the other actuators are given priority to operate.

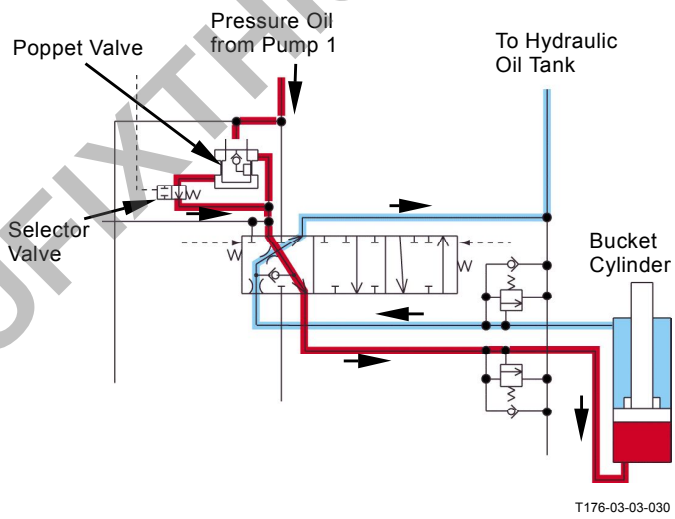
**When bucket (auxiliary) single operation is made:**

1. The pressure oil from pump 1 acts on the check valve in the poppet via port P1.
2. Normally, the selector valve is kept open so that the pressure oil from pump 1 unseats the check valve and flows into the main spool through the selector valve.
3. Thereby, the poppet valve is opened, allowing the pressure oil to flow to the bucket spool.

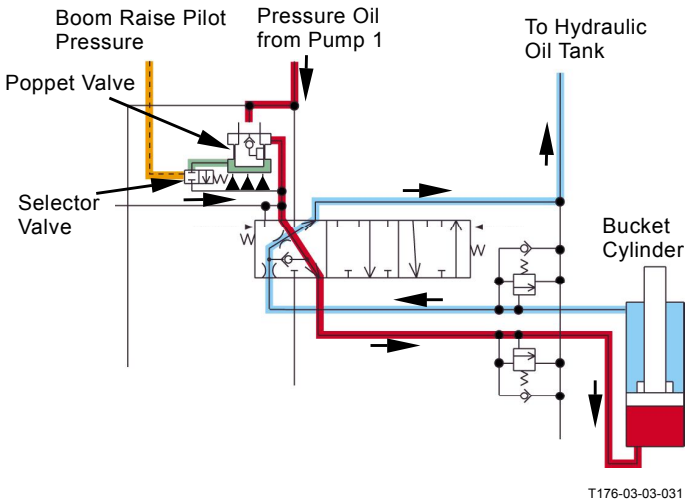
**When the combined operation of the bucket (auxiliary), boom raise, and arm roll-in is made:**

1. When the boom raise and arm roll-in functions are operated simultaneously, the selector valve is shifted so that the bucket flow rate control valve in the signal control valve is shifted by the boom raise pilot pressure.
2. Then, the oil pressure behind the poppet valve increases, and the force to close the poppet valve appears.
3. Consequently, the opening clearance of the poppet valve is reduced so that oil flow to the bucket spool is restricted, allowing the pressure oil to be routed to the high-pressure side of the boom raise circuit.

*NOTE: The bucket flow rate control valve restricts the bucket circuit oil flow when the bucket, boom raise and arm roll-in operations are made simultaneously. The auxiliary flow rate control valve restricts the auxiliary circuit oil flow when a combined operation with the auxiliary and other front attachment is made. The bucket flow rate control valve is used here as an example.*




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T176-03-03-031

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**Shift Interlock Control**

The shift interlock controller prevents the shift lever from moving from the D (Hi) position to the L (Low) position during travel operation, protecting the travel motor from being damaged. Even if the shift lever is moved from the D (Hi) position to the L (Low) position while traveling in the high travel mode, the machine continues to travel in the high travel mode. Then, after the travel speed is reduced to the gear-shift speed range (about 75 % of the maximum speed), the transmission is automatically shifted to the low travel mode.

*NOTE: The shift interlock controller doesn't prevent the machine from running away while traveling on a down slope. The travel motor brake valve makes travel speed control on a down slope.*

1. As the travel speed is accelerated with the shift lever in the D position, the travel motor rotation speed increases so that the delivery pressure of rotary pump (3) increases.
2. When the delivery pressure of the rotary pump overcomes the spring force, gearshift piston (1) is shifted.
3. Thereby, even if the shift lever is moved to the L position at this time, as the travel motor continues to rotate at a high speed, the delivery pressure from rotary pump (3) is kept at a high pressure.
4. Then, gearshift piston (1) remains in the shifted position so that the machine travel speed remains unchanged in the D mode even if the shift lever is in the L position.
5. After the machine travel speed decreases to the gearshift speed range, gearshift piston (1) is returned to the original position by the spring force so that the machine travel speed mode is automatically shifted.
6. Consequently, the travel motor is prevented from running at an excessive speed.

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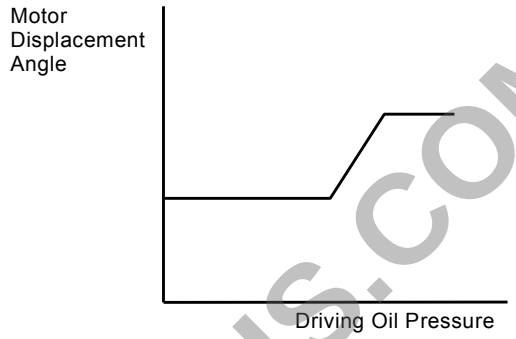


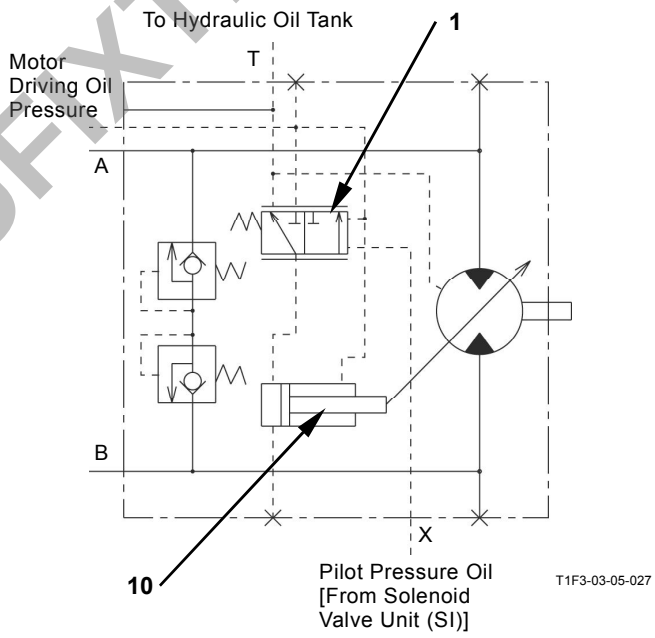
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**Control Function of Regulator**

The pressure oil routed to pilot piston (1) controls the displacement angle of the travel motor. Pilot piston (1) controls the pressure oil routed into the large diameter chamber of servo piston (10) to control the motor displacement angle. The regulator is controlled by the following two methods.

- Control by motor driving oil pressure
  When the motor driving oil pressure increases to more than the set-pressure, the regulator increases the motor displacement angle to reduce the motor rotation speed so that the machine travels at a slow speed. When the motor driving oil pressure decreases to lower than the set-pressure, the regulator decreases the motor displacement angle to increase the motor rotation speed so that the machine travels at a fast speed.
- Control by pilot pressure oil
  When solenoid valve (SI) is shifted by the signal from MC (main controller), the pilot oil pressure is routed to the regulator so that the motor displacement angle is increased. Then, the machine travel speed is reduced (Superfine travel speed control) (Travel motor excessive speed rotation preventive control) (Refer to the SYSTEM / Control System group.)



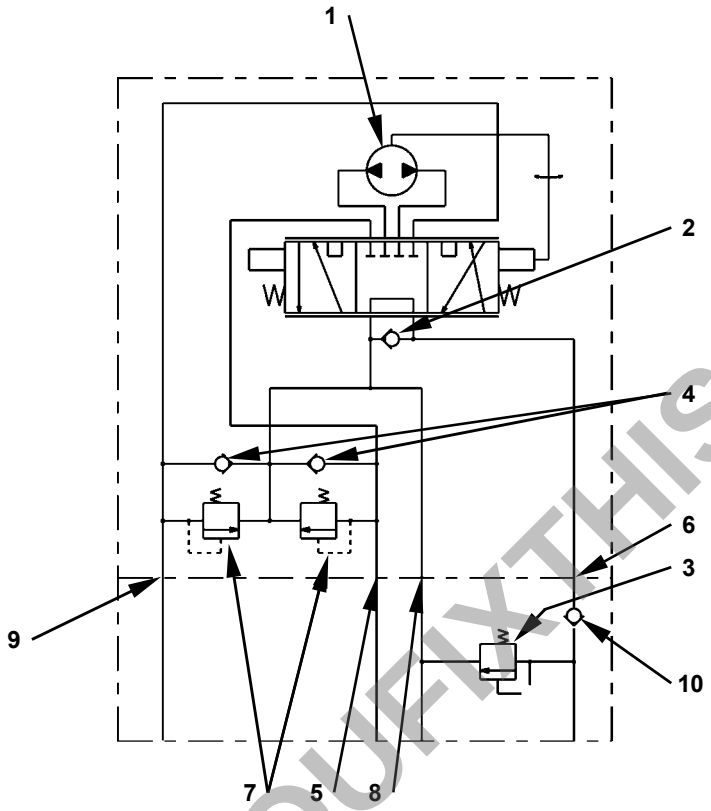




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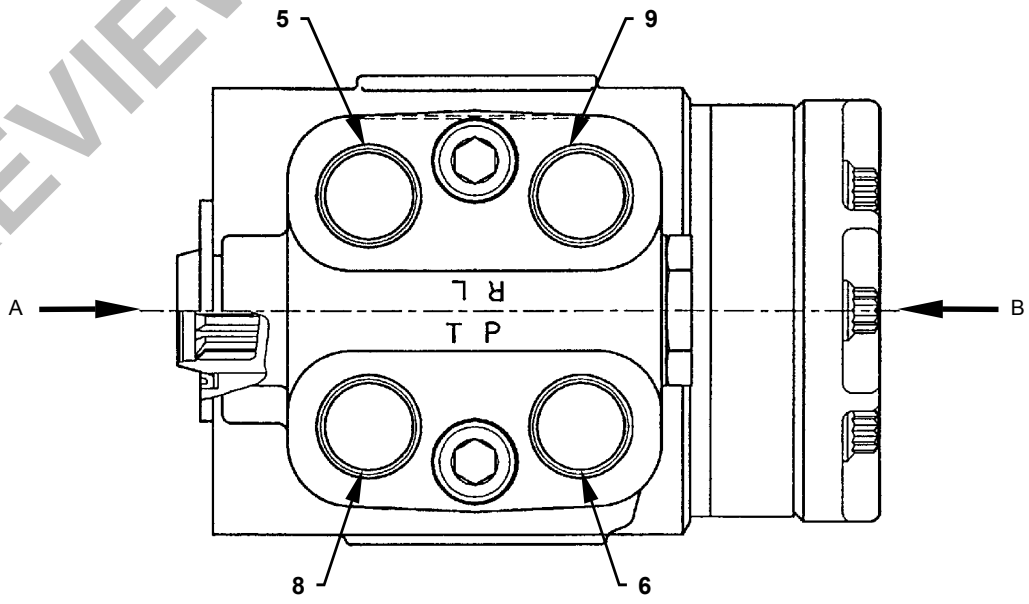
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**System Layout**




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1 - Gerotor
2 - Check Valve
3 - Relief Valve
4 - Make-Up Valve
5 - Port L
(To the Steering Cylinder)
6 - Port P
(From the Steering Pump)
7 - Overload Relief Valve
8 - Port T
(To the Hydraulic Oil Tank)
9 - Port R
(To the Steering Cylinder)
10 - Check Valve




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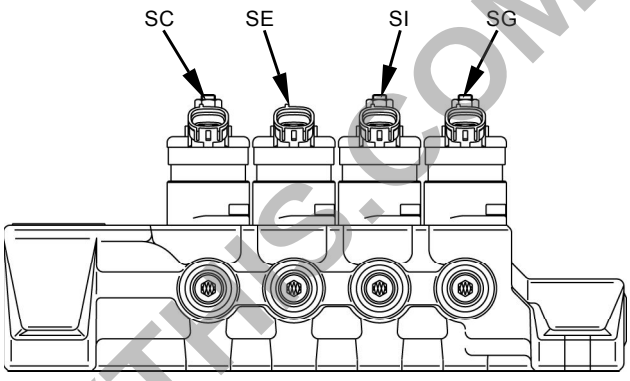
## SOLENOID VALVE UNIT

This machine is equipped with the 4-unit solenoid valve for valve control and the pump control solenoid valve for pump 1 control, the 2-unit solenoid valve (optional) for auxiliary flow rate control, and the 2-unit solenoid valve (optional) for blade/stabilizer control.
(Refer to the SYSTEM / Control System group for regulation of each solenoid valve.)

**Solenoid Valve Unit**

The solenoid valve unit consists of four (SC, SE, SI, and SG) proportional solenoid valves and controls the control valve, the check valve (axle lock cylinder), the travel motor valve and brake valve in response to the signals from the MC (main controller).

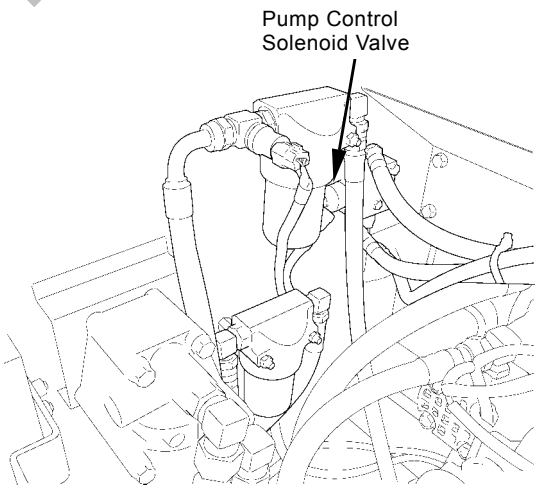
SC : Controls the arm regenerative valve in the control valve.
SE : Controls the check valve (axle lock cylinder).
SI : Controls the travel motor displacement angle control valve.
SG : Controls the brake valve.



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**Pump Control Solenoid Valve**

The pump control solenoid valve for pump 1 control consists of the maximum pump 1 flow rate shift solenoid valve, the maximum pump 1 flow rate limit solenoid valve.
Each solenoid valve is a proportional type solenoid valve and controls the pump flow rate in response to the signals from the MC.

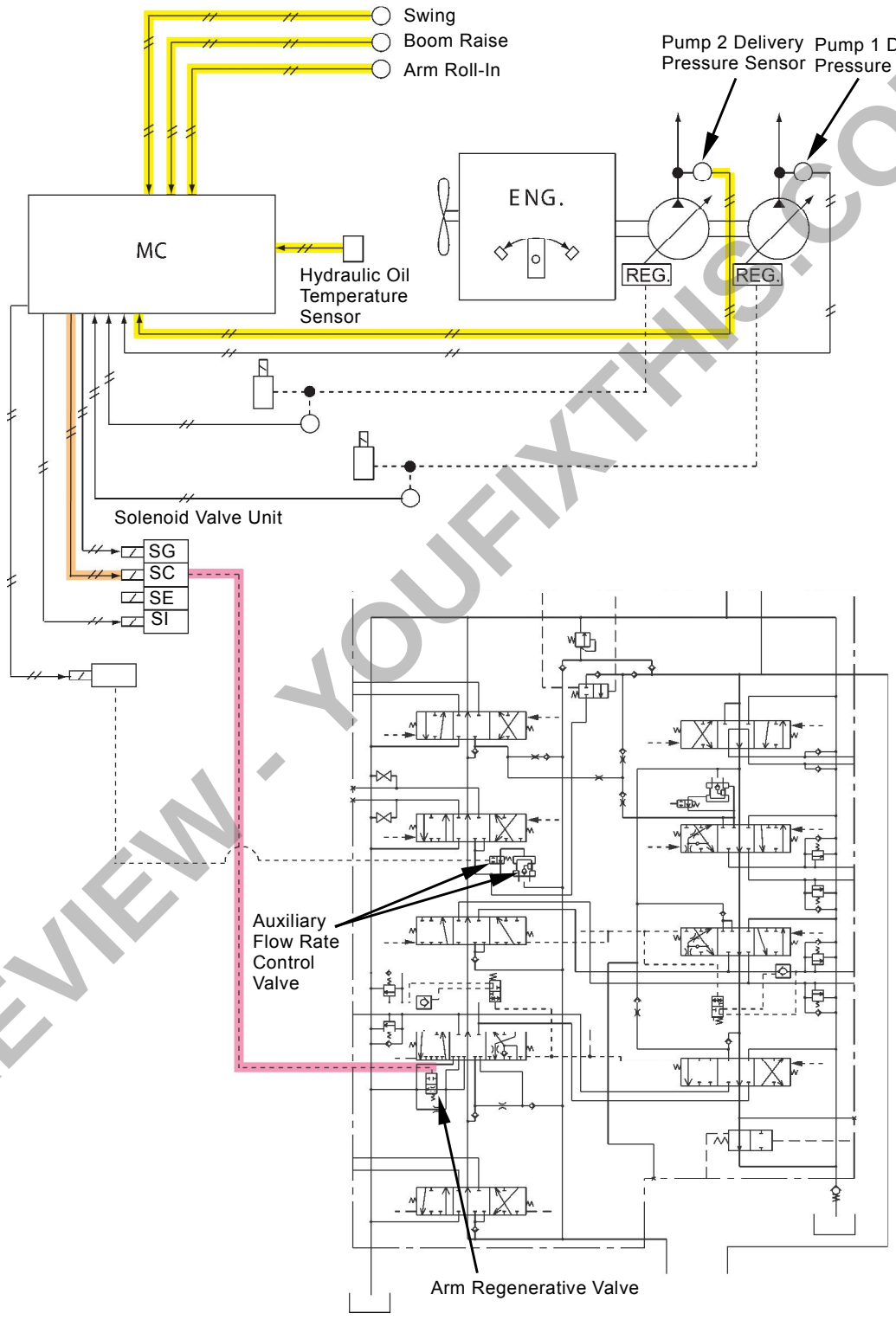


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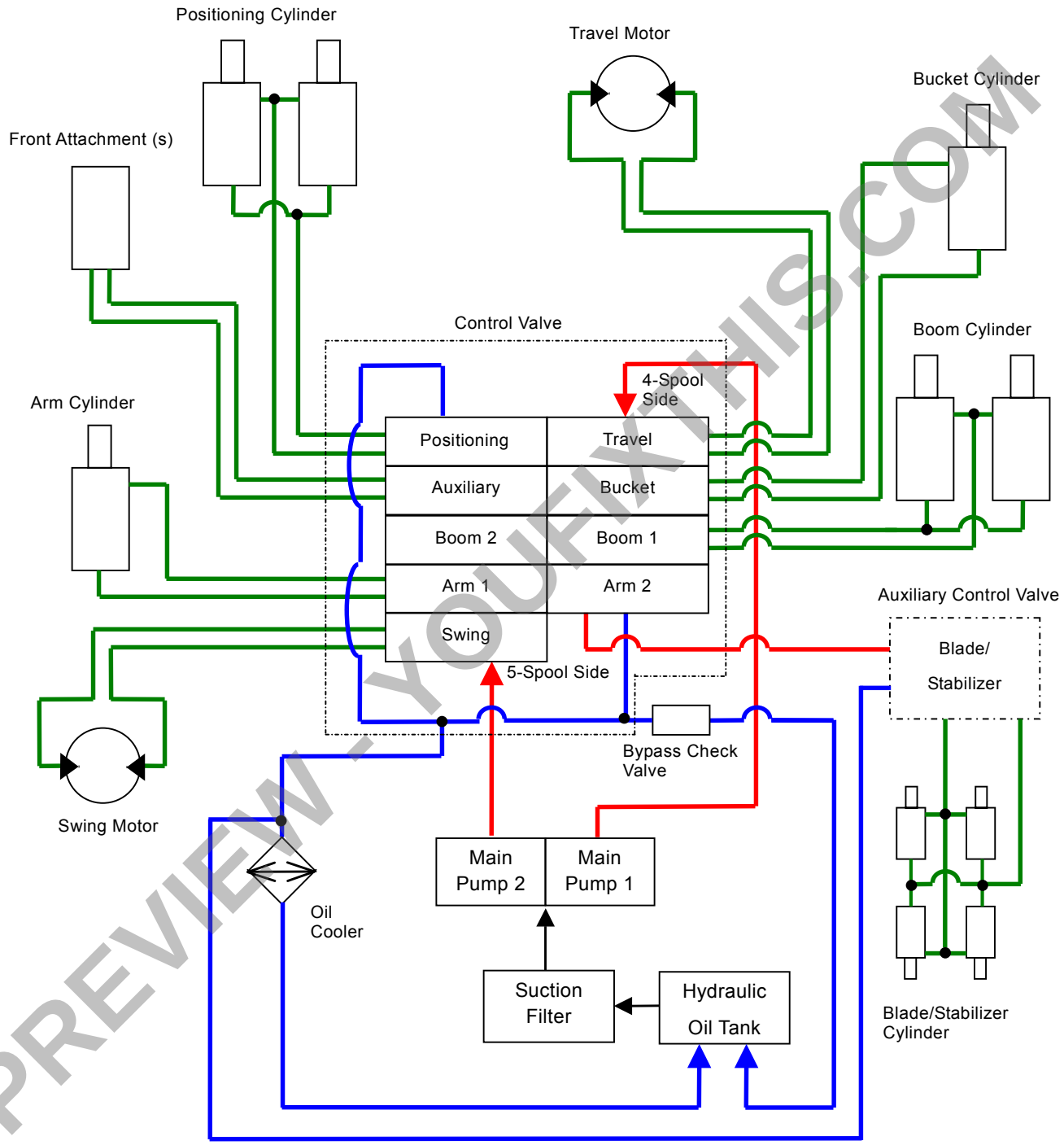



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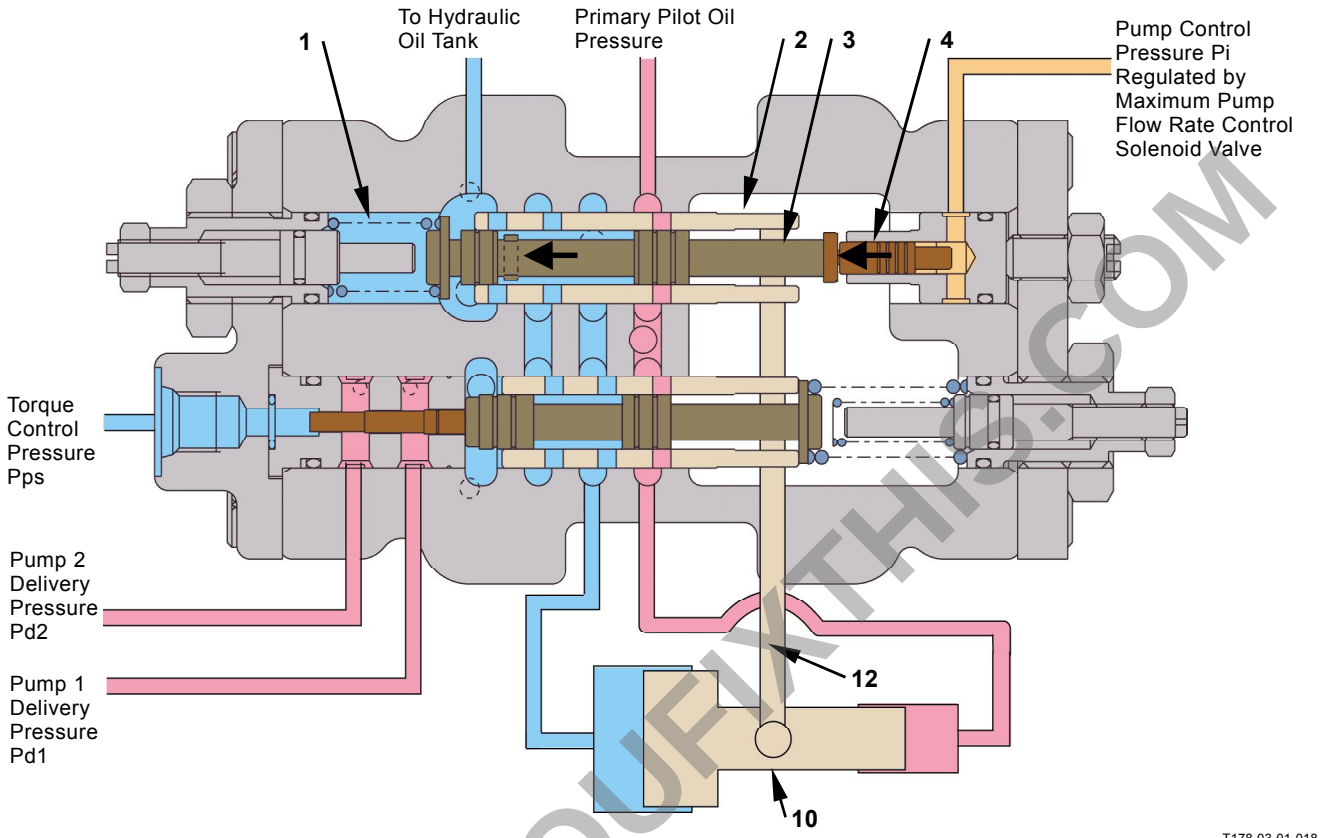
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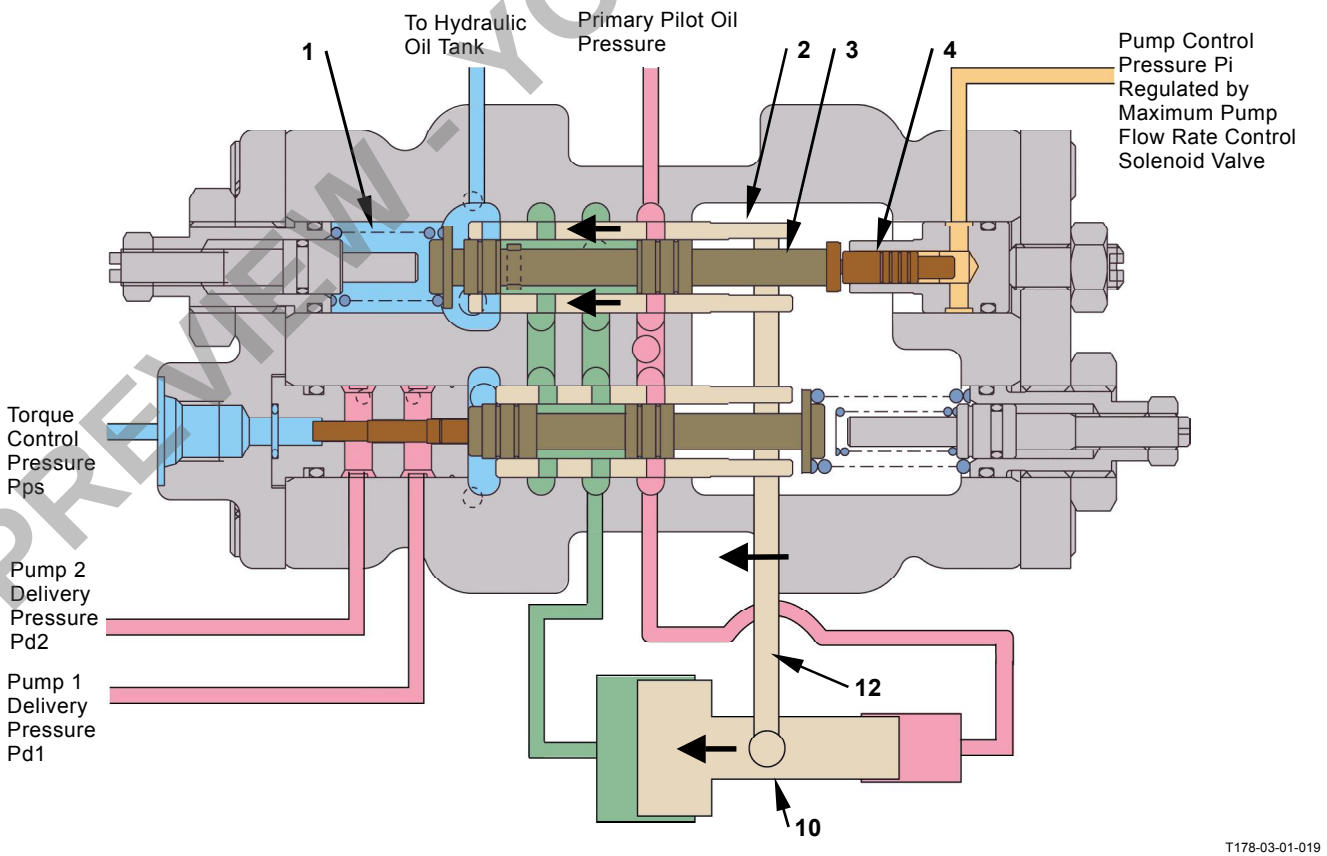

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