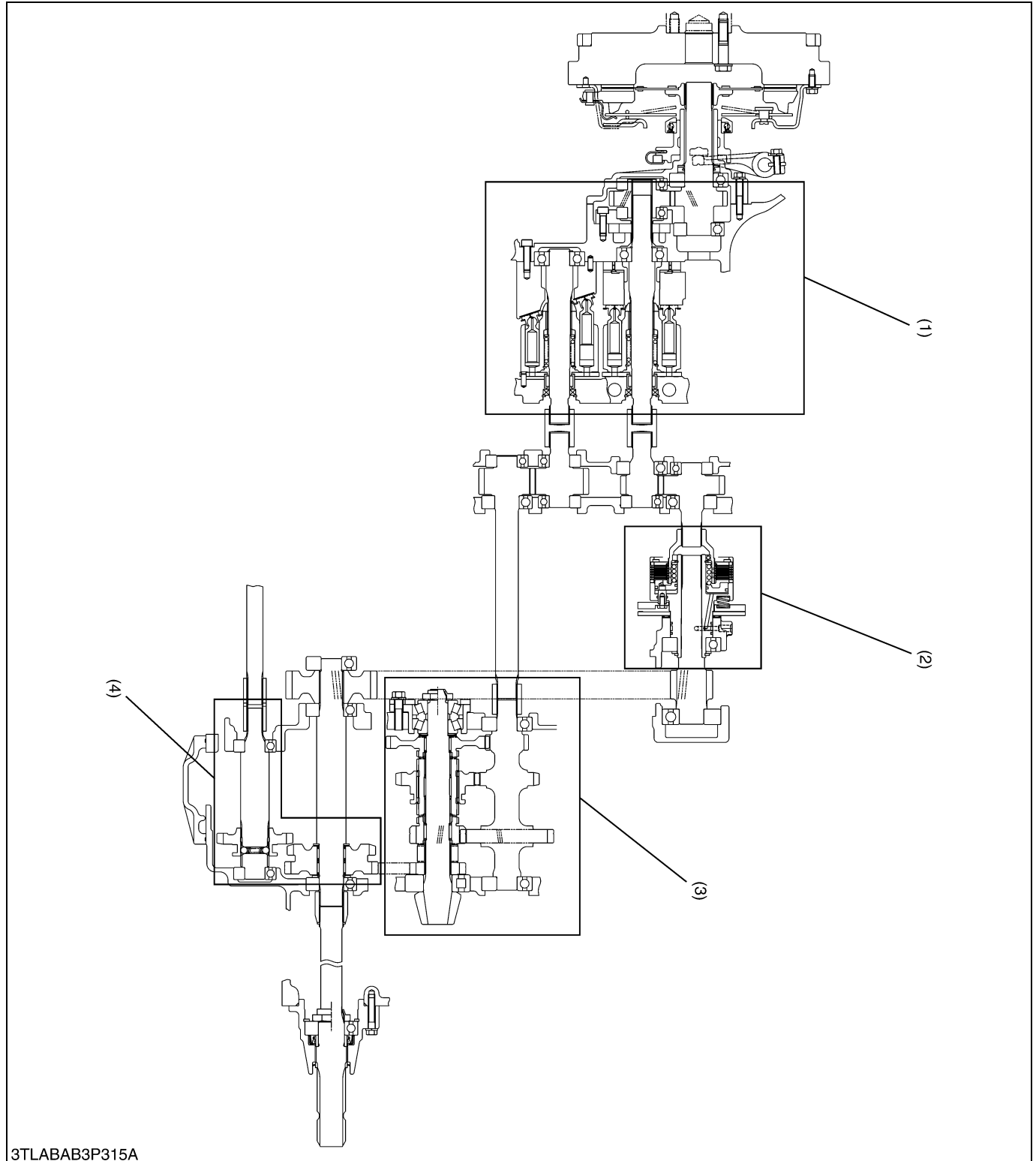


3. HYDROSTATIC TRANSMISSION (HST) MODEL

[1] STRUCTURE



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(1) Hydrostatic Transmission
Section

(2) PTO Clutch Section

(3) Range Gear Shift Section

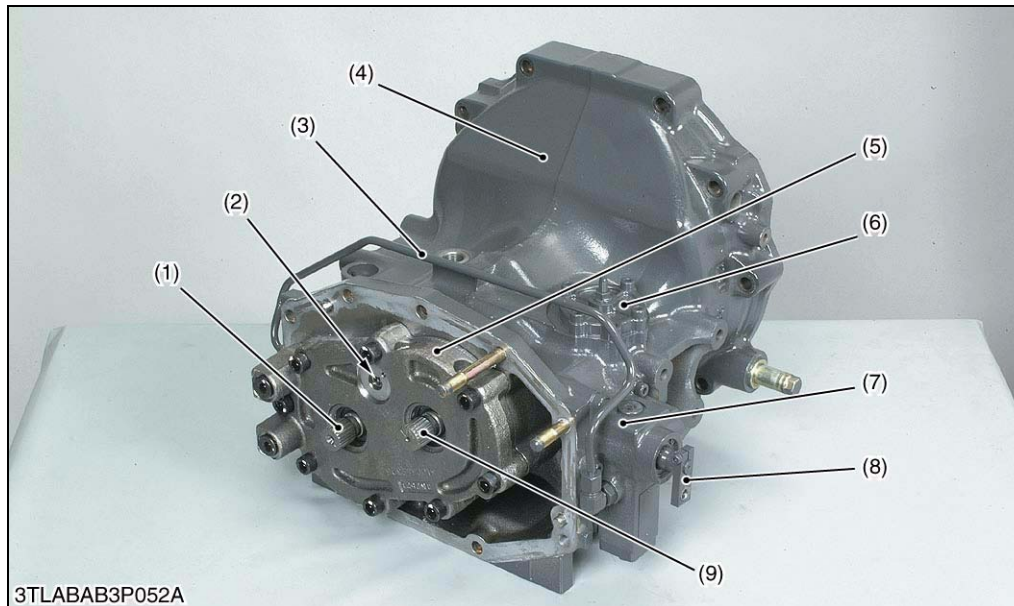
(4) Front Wheel Drive Shift
Section

[2] POWER TRAIN

The transmission of this model consists of a series of gears and shafts as shown in previous page. The traveling system is chiefly composed of hydrostatic transmission section, range gear shift section and front wheel drive section.

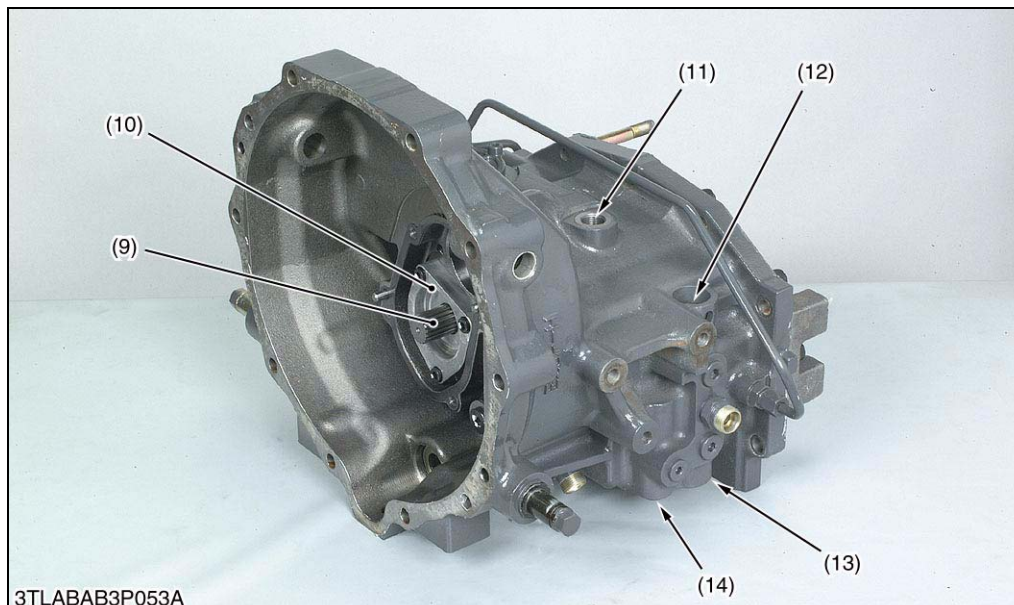
(1) Hydrostatic Transmission (HST)

(A) Structure



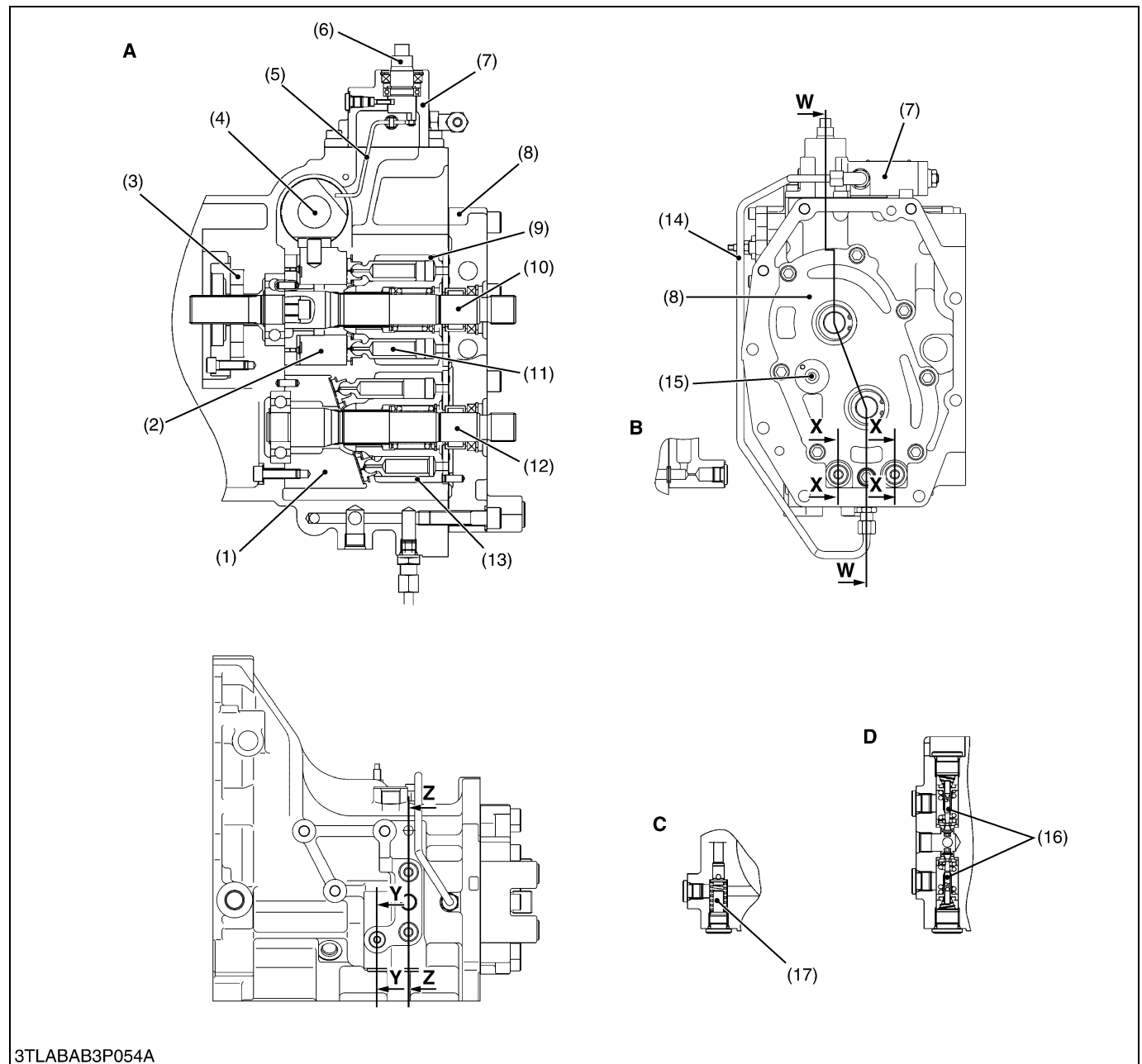
- (1) Output Shaft (Motor Shaft)
- (2) Case Relief Valve
- (3) Bypass Pipe (Servo Pipe)
- (4) HST Case (Clutch Housing)
- (5) Port Block Cover
- (6) Servo Piston
- (7) Servo Regulator
- (8) Control Lever (Connect to HST Pedal)
- (9) Input Shaft (Pump Shaft)
- (10) Charge Pump
- (11) Outlet Port (To Oil Cooler)
- (12) Check and High Pressure Relief Valve (Reverse)
- (13) Check and High Pressure Relief Valve (Forward)
- (14) Charge Relief Valve

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The HST of L30 series tractor is a built-in type to the clutch housing, and HST with the servomechanism is adapted. The servomechanism controls the pedal operation of HST hydraulically. As a result, the HST pedal feels extremely light and smoother pedal operation can be done.

HST assembly is chiefly composed of HST case (clutch housing), variable displacement piston pump, fixed displacement piston motor, charge pump, servo-regulator and various valves. Refer to the next page for detailed parts in the HST.

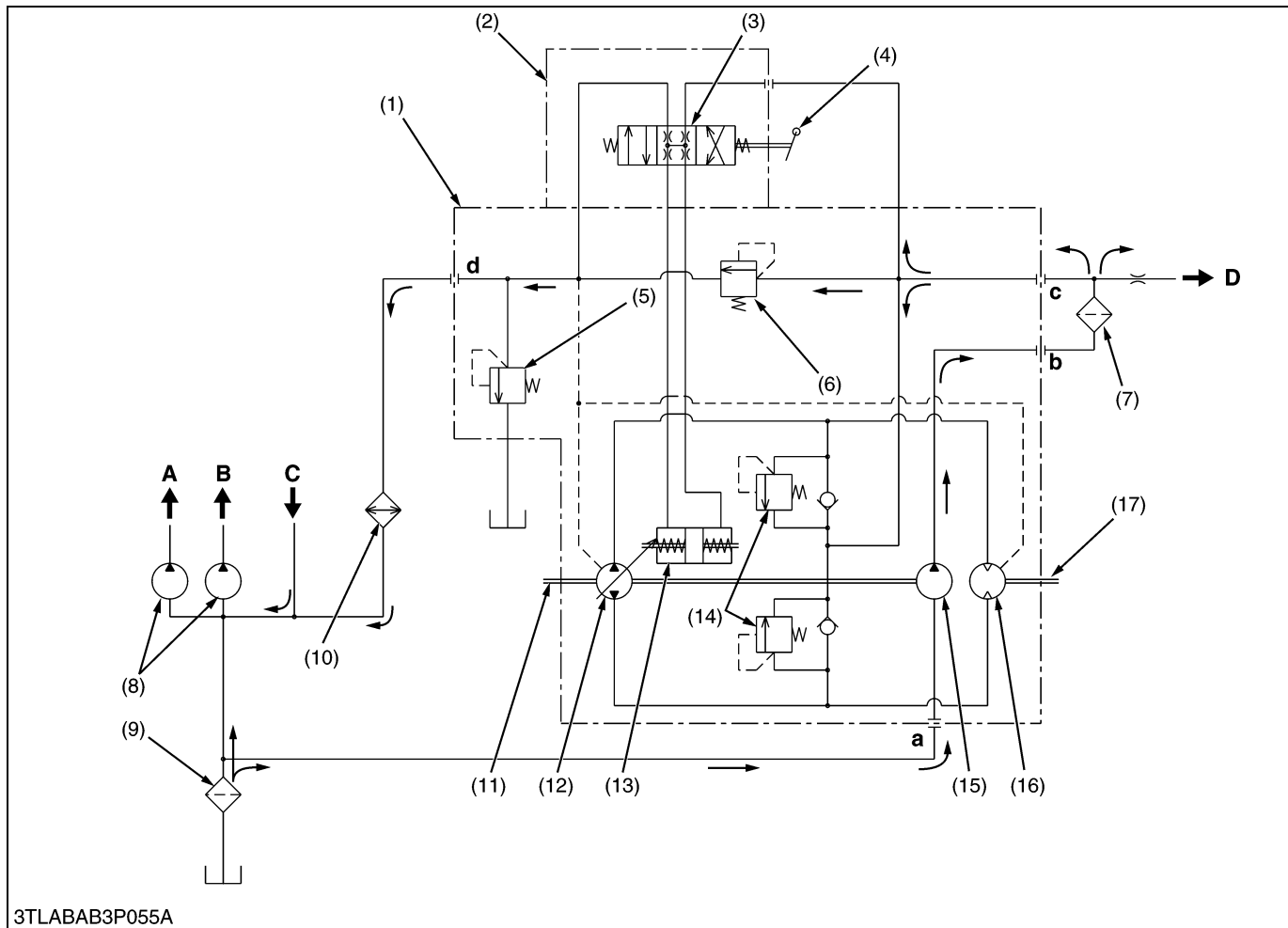


- (1) Fixed Swashplate
- (2) Variable Swashplate
- (3) Charge Pump
- (4) Servo Piston
- (5) Feedback Rod
- (6) Control Shaft

- (7) Regulator Assembly
- (8) Port Block Cover
- (9) Cylinder Block (Pump)
- (10) Input Shaft (Pump Shaft)
- (11) Piston
- (12) Output Shaft (Motor Shaft)

- (13) Cylinder Block (Motor)
- (14) Bypass Pipe (Servo Pipe)
- (15) Case Relief Valve
- (16) Check and High Pressure Relief Valve
- (17) Charge Relief Valve

- A : Sectional View W-W**
- B : Sectional View X-X**
- C : Sectional View Y-Y**
- D : Sectional View Z-Z**

(B) Oil Flow

- | | | | |
|-------------------------------|-------------------------------|---|--|
| (1) HST Assembly | (8) Hydraulic Pump | (14) Check and High Pressure Relief Valve | C : From Steering Controller |
| (2) Servo Regulator Assembly | (9) Filter | (15) Charge Pump | D : To PTO Clutch Valve |
| (3) Regulator Valve | (10) Oil Cooler | (16) Motor Cylinder Block | a : a-port (In from suction line) |
| (4) Control Lever (HST Pedal) | (11) Input Shaft (Pump Shaft) | (17) Output Shaft (Motor Shaft) | b : b-port (Out by charge pump) |
| (5) Case Relief Valve | (12) Pump Cylinder Block | A : To Hydraulic Block | c : c-port (In from charge pump) |
| (6) Charge Relief Valve | (13) Servo Piston | B : To Steering Controller | d : d-port (Out from HST circuit) |
| (7) Filter | | | |

Oil flows in HST case from **a**-port, and is sent to **b**-port with the charge pump (15). Oil from **b**-port is sent to the HST circuit and the PTO clutch circuit through the filter (7). Moreover, the oil of the HST circuit sent to **c**-port is flowed into the servo regulator (2) and HST main circuit. At this time, the pressure in the regulator, HST main circuit (closed circuit) and PTO clutch circuit is controlled with the charge relief valve (6). The oil in regulator is used for the movement of servo piston (13) which is operated by the regulator valve (3) and HST pedal (4). And the oil in the HST main circuit gets circulated between the variable displacement piston pump (12) and the fixed displacement piston motor (16), which forms a closed circuit.

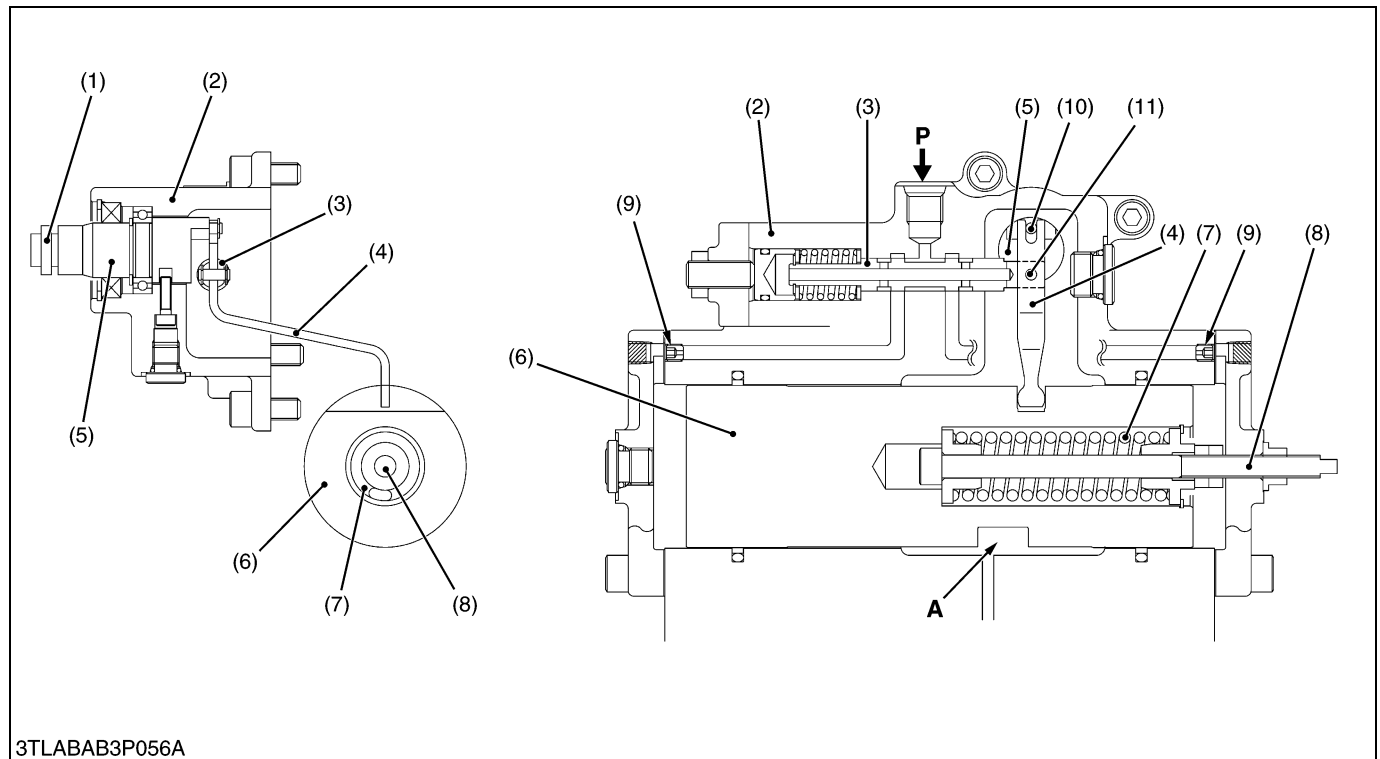
On the other hand, surplus oil with the charge relief valve (6) flows out from **d**-port, and is sent to the suction line through the oil cooler (10). And the case relief valve (5) controls pressure in the HST case.

(Reference)

- Valve Setting Pressure [Oil temperature : 40 to 60 °C (104 to 140 °F)]
 - Charge Relief Valve : 2.25 to 2.45 MPa (23 to 25 kgf/cm², 327 to 355 psi)
 - Check and High Pressure Relief Valve : 33.3 to 36.3 MPa (340 to 370 kgf/cm², 4836 to 5262 psi)
 - Case Relief Valve : 0.29 MPa (3.0 kgf/cm², 42.7 psi)

(C) Function of Components

■ Servomechanism



- | | | | |
|--|--------------------|-------------------------------------|--|
| (1) Control Lever (Connected to HST Pedal) | (4) Feedback Lever | (8) Piston Adjusting Screw | A : Slit for Connection of Swashplate |
| (2) Regulator Valve Assembly | (5) Control Arm | (9) Orifice | P : IN Port (From Bypass Pipe) |
| (3) Spool | (6) Servo Piston | (10) Pin A (Fixed with Control Arm) | |
| | (7) Spring | (11) Pin B (Fixed with Spool) | |

As for the servomechanism, the regulator (2) and servo piston (6) are chiefly composed. The regulator is connected to the HST pedal through linkages, and controls the flow of oil to the servo piston by the pedal operation.

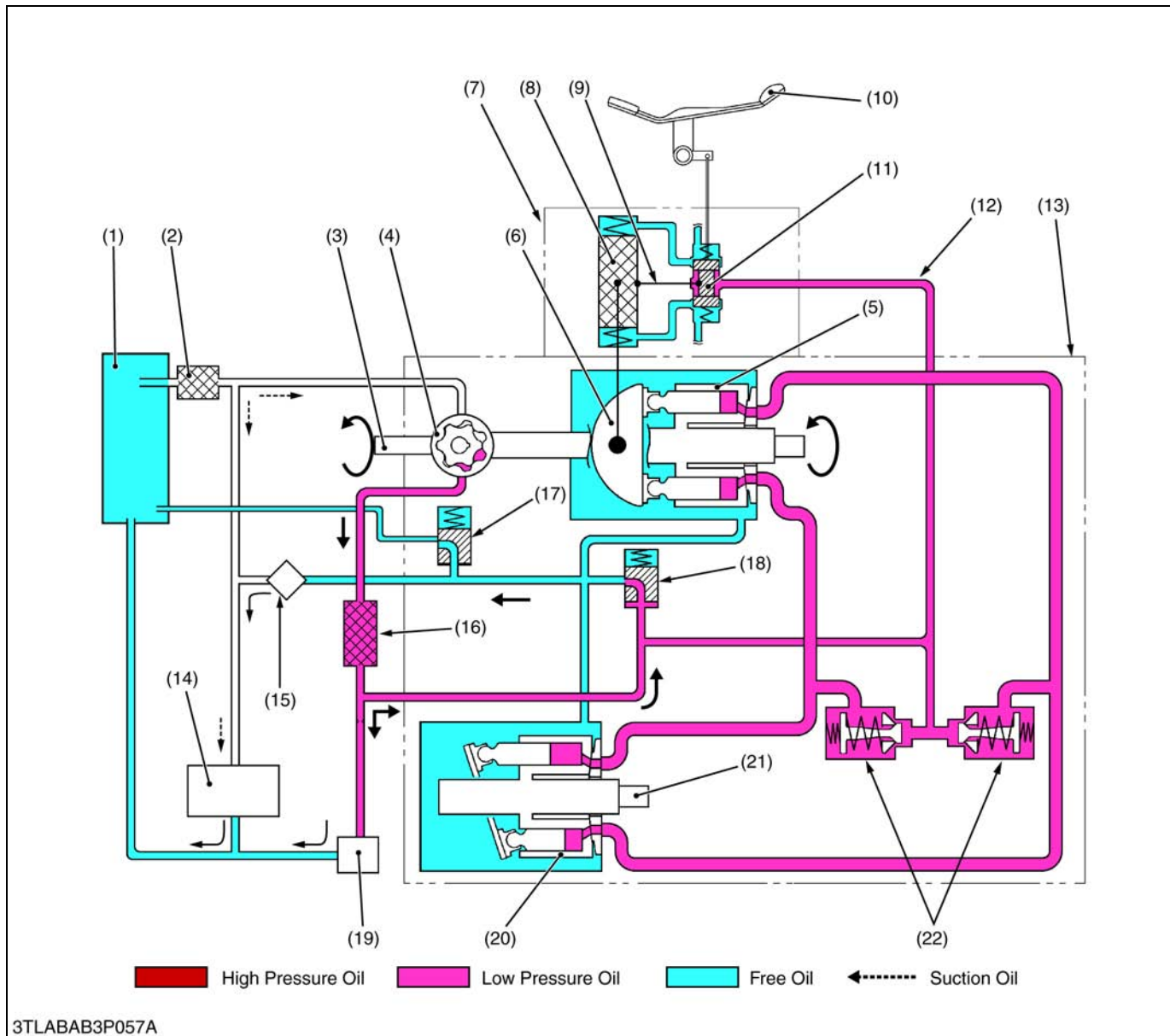
The servo piston moved by hydraulic force, is connected to the pump cylinder swashplate. Therefore, a tilt angle of swashplate is varied by servo piston movement.

As for the regulator and the servo piston, it is connected with feedback lever (4), and the movement of the piston is restricted according to the amount of depressing of the HST pedal.

Refer to Workshop Manual of “**TRACTOR MECHANISM**” (Code No. 97897-18200) for the operation of the servomechanism, that is, the operation of regulator and servo piston.

■ Valves

As for the mechanism and function of check and high pressure relief valve, charge relief valve and case relief valve, refer to Workshop Manual of “**TRACTOR MECHANISM**” (Code No. 97897-18200).

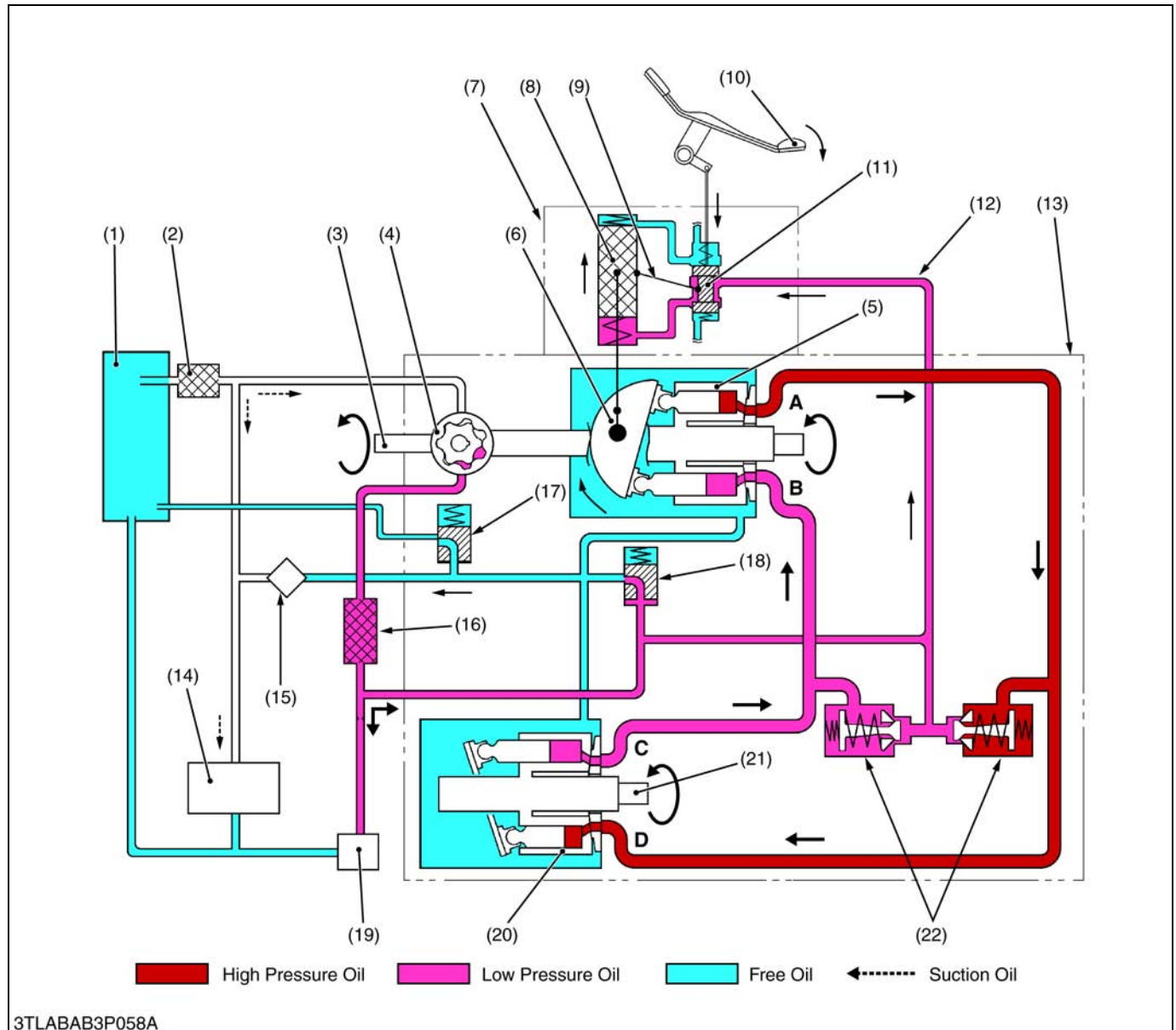
(D) Operation**■ Neutral**

- | | | | |
|-------------------------|------------------------------|--|---|
| (1) Transmission Case | (7) Regulator Valve Assembly | (13) HST Assembly | (18) Charge Relief Valve |
| (2) Filter | (8) Servo Piston | (14) Main Circuit and Steering Circuit | (19) PTO Clutch Valve Circuit |
| (3) Input Shaft | (9) Feedback Lever | (15) Oil Cooler | (20) Motor Cylinder |
| (4) Charge Pump | (10) HST Pedal | (16) Filter | (21) Output Shaft |
| (5) Pump Cylinder | (11) Regulator Valve | (17) Case Relief Valve | (22) Check and High Pressure Relief Valve |
| (6) Variable Swashplate | (12) Bypass Pipe | | |

The sucked oil from the transmission case (1) by the charge pump (4) flows into the HST housing (13) and regulator valve (7) through the oil filter (16) and charge relief valve (18). Overflow oil from HST housing (13) flows to the suction line through the oil cooler (15).

When the HST pedal (10) is in neutral, regulator valve (7) is not activated, so the variable swashplate (6) is at right angle to the pump pistons and they only rotate with cylinder (5) without reciprocation. Since the oil is not being pumped to motor, the cylinder block in the motor (20) is stationary and the output shaft (21) does not rotate.

■ Forward



- | | | | |
|------------------------------|--|---|-------------------------|
| (1) Transmission Case | (9) Feedback Lever | (16) Filter | A : Pump Port A |
| (2) Filter | (10) HST Pedal | (17) Case Relief Valve | B : Pump Port B |
| (3) Input Shaft | (11) Regulator Valve | (18) Charge Relief Valve | C : Motor Port C |
| (4) Charge Pump | (12) Bypass Pipe | (19) PTO Clutch Valve Circuit | D : Motor Port D |
| (5) Pump Cylinder | (13) HST Assembly | (20) Motor Cylinder | |
| (6) Variable Swashplate | (14) Main Circuit and Steering Circuit | (21) Output Shaft | |
| (7) Regulator Valve Assembly | (15) Oil Cooler | (22) Check and High Pressure Relief Valve | |
| (8) Servo Piston | | | |

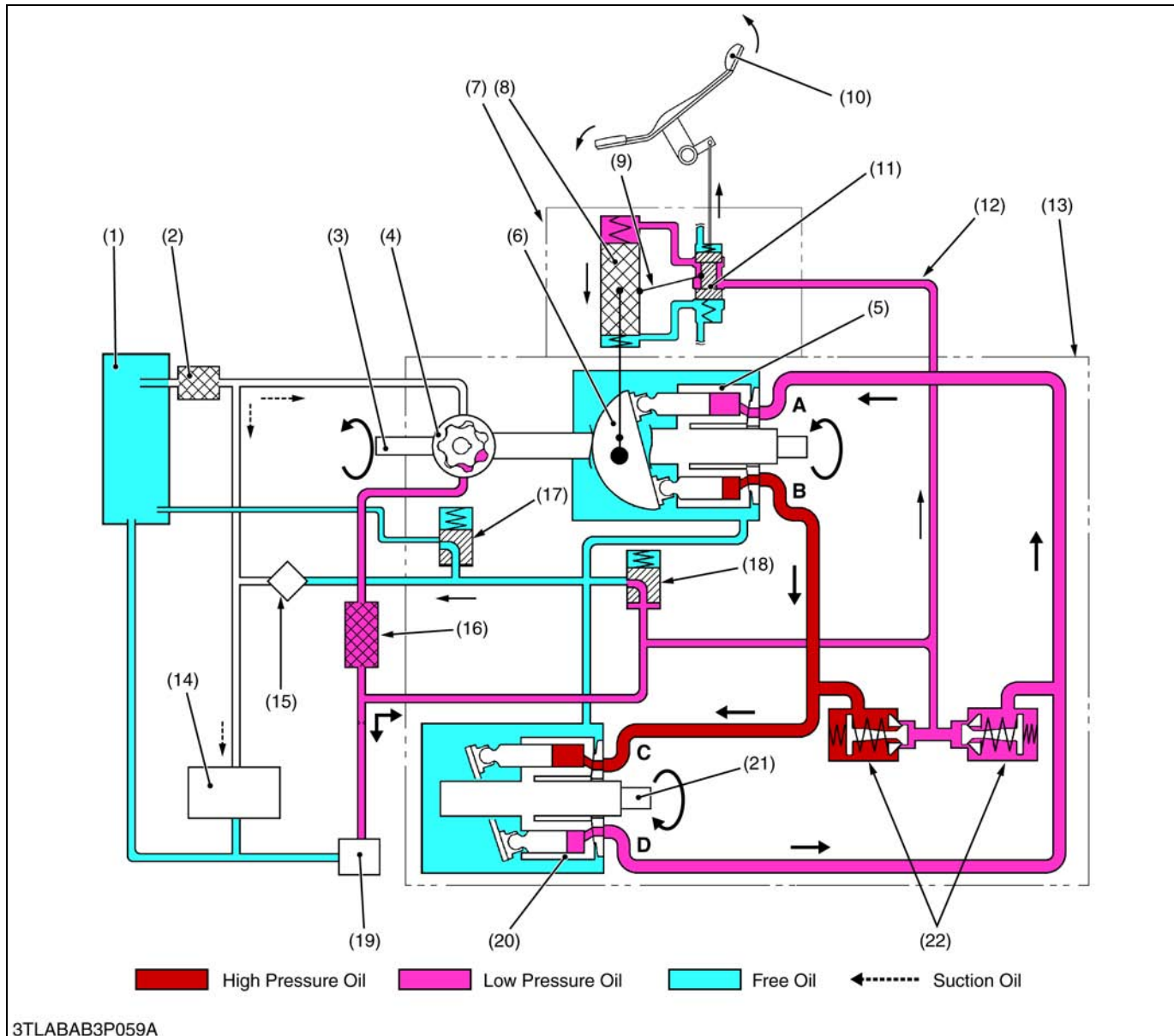
When the HST pedal (10) is stepped on and in forward, so the variable swashplate (6) is tilted by the servo piston (8) and regulator valve (11) as shown in figure above.

As the pump cylinder block (5) rotates with the input shaft (3), oil is forced out of pump port **A** at high pressure. As pressure oil enters motor port **D**, the pistons, which align with port **D**, are pushed against the thrust plate and slide down inclined surface.

Then the output shaft (21) rotates with the motor cylinder block (20). This drives the machine forward and the angle of pump swashplate determines the output shaft speed.

As the motor cylinder block continues to rotate, oil is forced out of motor port **C** at low pressure and returns to the pump port **B**.

■ Reverse



- | | | |
|------------------------------|--|---|
| (1) Transmission Case | (9) Feedback Lever | (16) Filter |
| (2) Filter | (10) HST Pedal | (17) Case Relief Valve |
| (3) Input Shaft | (11) Regulator Valve | (18) Charge Relief Valve |
| (4) Charge Pump | (12) Bypass Pipe | (19) PTO Clutch Valve Circuit |
| (5) Pump Cylinder | (13) HST Assembly | (20) Motor Cylinder |
| (6) Variable Swashplate | (14) Main Circuit and Steering Circuit | (21) Output Shaft |
| (7) Regulator Valve Assembly | (15) Oil Cooler | (22) Check and High Pressure Relief Valve |
| (8) Servo Piston | | |

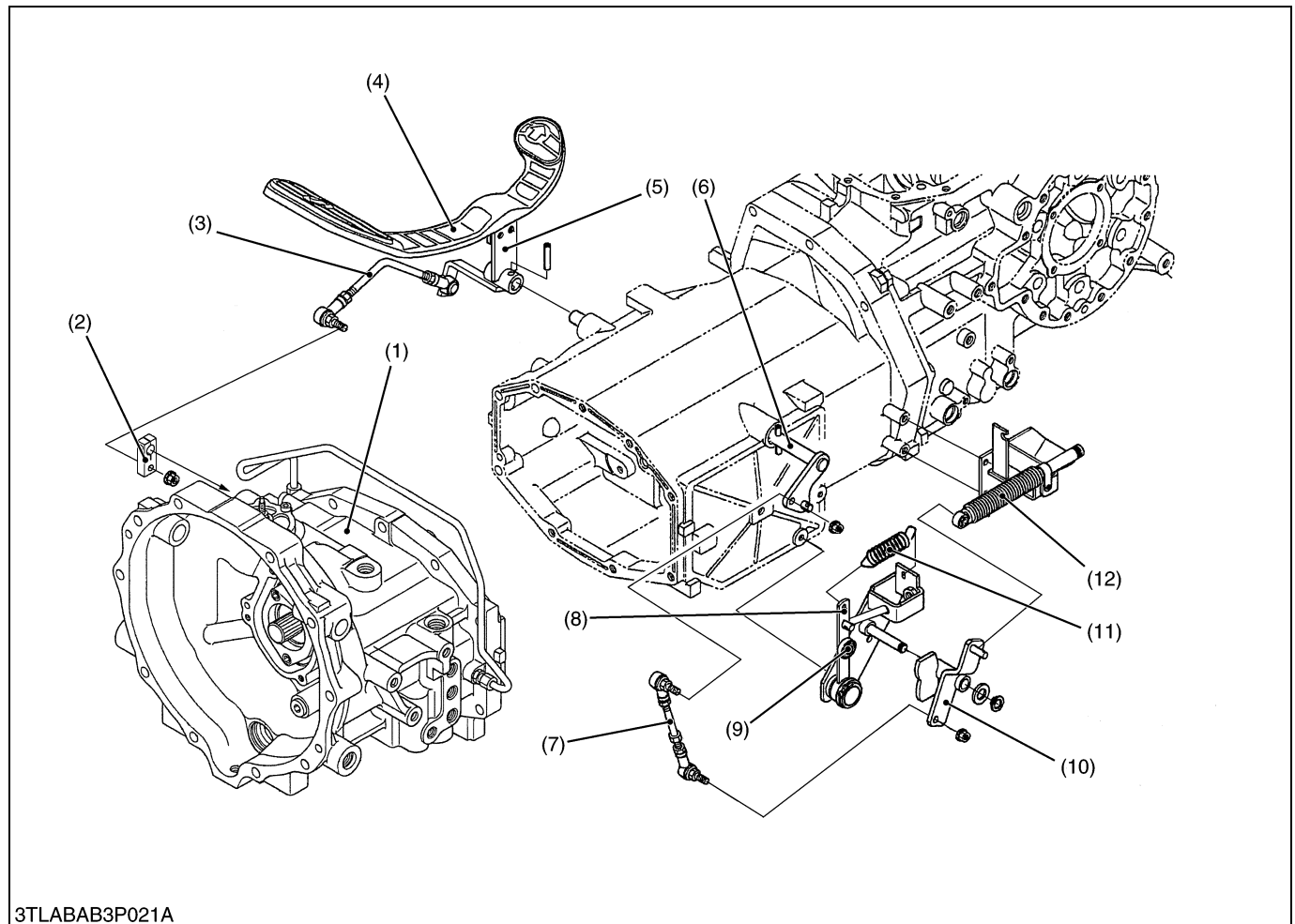
- A : Pump Port A**
B : Pump Port B
C : Motor Port C
D : Motor Port D

When the HST pedal (10) is stepped on and in reverse, the variable swashplate (6) is tilted by servo piston (8) and regulator valve (11) as shown in figure above.

As the pump cylinder block (5) rotates with the input shaft (3), oil is forced out of pump port **B** at high pressure. As pressure oil enters motor port **C**, the pistons, which align with port **C**, are pushed against the thrust plate and slide down inclined surface.

Then the output shaft (21) rotates with the motor cylinder block (20). This drives the machine rearward and the angle of pump swashplate determines the output shaft speed.

As the motor cylinder block continues to rotate, oil is forced out of motor port **D** at low pressure and returns to the pump port **A**.

(E) Control Linkage

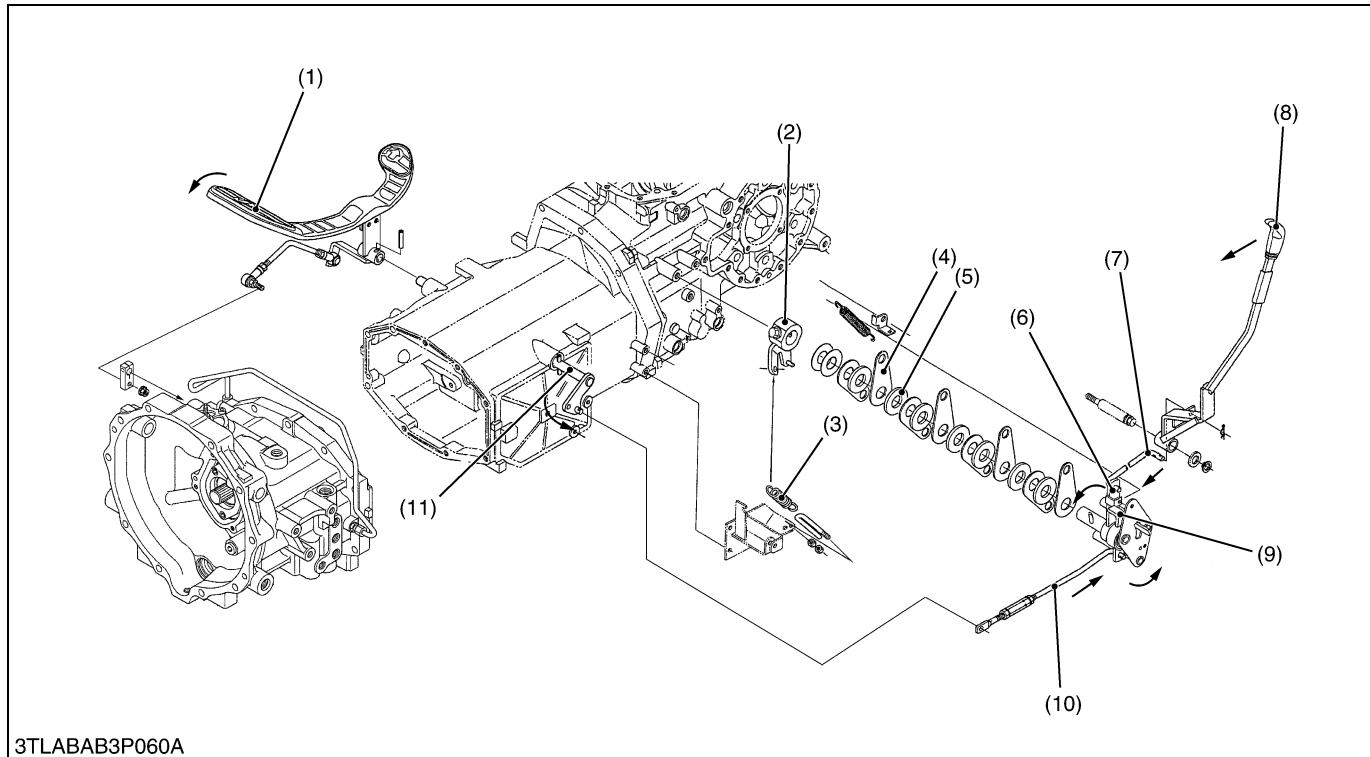
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- | | | | |
|-----------------------|----------------------|--------------------|-------------------------|
| (1) HST Assembly | (4) HST Pedal | (7) Neutral Rod | (10) Neutral Holder Arm |
| (2) HST Control Lever | (5) Pedal Bracket | (8) Neutral Holder | (11) Neutral Spring |
| (3) HST Control Rod | (6) Connecting Shaft | (9) Ball Bearing | (12) Damper |

The speed control pedal (HST pedal) (4) and the HST control lever (servo control lever) (2) are linked with the pedal bracket (5) and HST control rod (3). And HST pedal (4) and the neutral holder arm (10) are linked with pedal bracket (5) and neutral rod (7) through connecting shaft (6).

As the HST pedal (4) is depressed to forward, the HST control lever (2) is rotated, then the swashplate is tilted by servomechanism and forward travelling speed increases. Then, the swashplate is returned to neutral with the neutral holder arm (10), when the pedal is released. The ball bearing (9) on the neutral holder (8) pulled with the neutral spring (11) seats the detent of the neutral holder arm (10) so that the neutral holder arm returns to neutral.

The damper (12) is connected to the HST pedal (4) through connecting shaft (6), neutral rod (7) and neutral holder arm (10), restricts the movement of the linkage to prevent abrupt operation or reversing.

(F) Cruise Control**■ Speed Set**

- | | | | |
|-------------------|--------------------|--------------------------|---------------------------|
| (1) HST Pedal | (4) Plate | (7) Lever Rod | (10) Cruise Adjusting Rod |
| (2) Release Lever | (5) Rubber | (8) Cruise Control Lever | (11) Connecting Shaft |
| (3) Cruise Spring | (6) Cruise Lever 2 | (9) Cruise Lever 1 | |

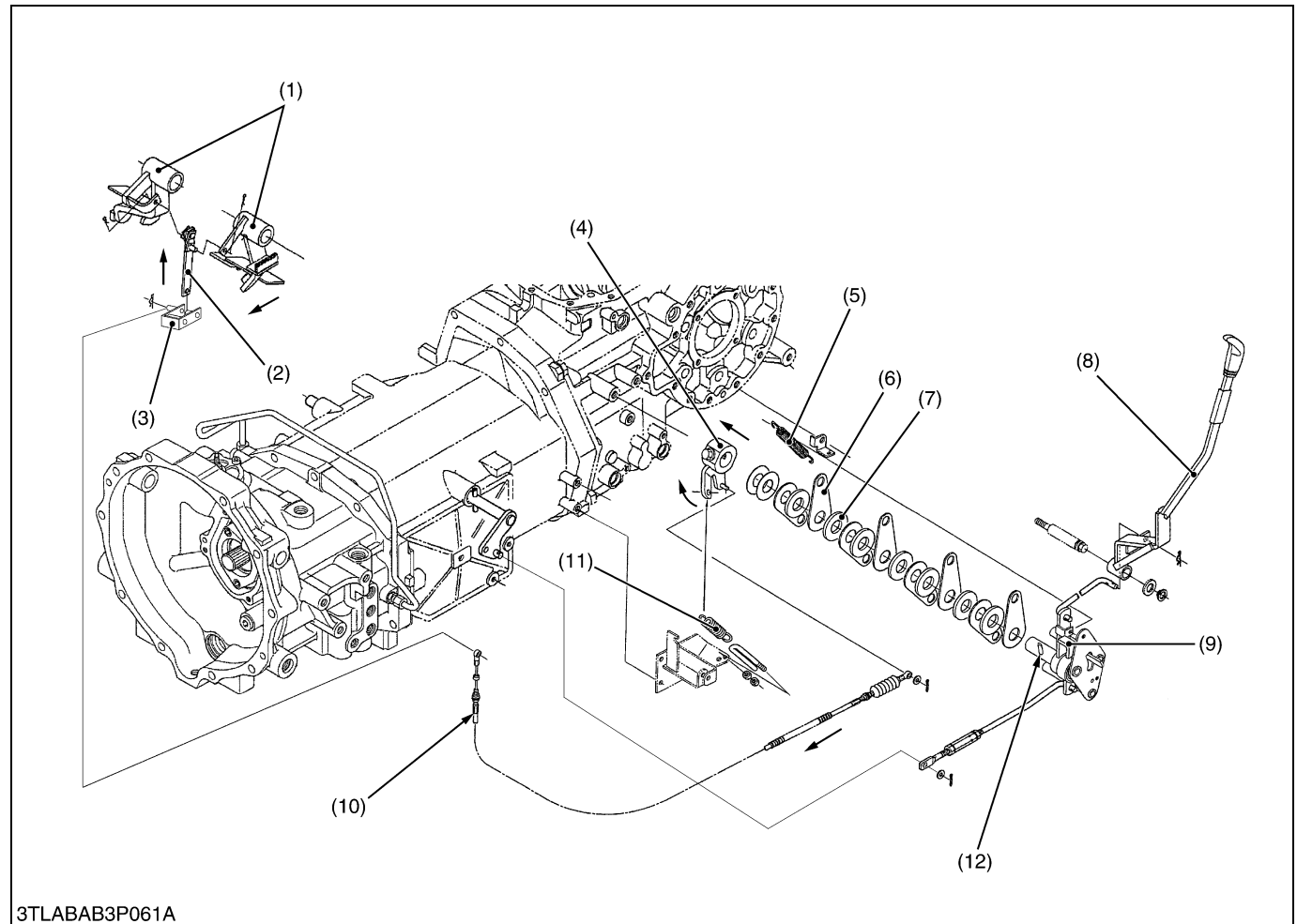
The cruise control lever (8) and HST pedal (1) are linked with the lever rod (7), cruise lever 1 (9), cruise lever 2 (6), cruise adjusting rod (10) and connecting shaft (11).

When the cruise control lever (8) is moved to forward direction, cruise lever 2 (6) is moved to arrow direction by the lever rod (7). The cruise lever 1 (9) is moved forward by being pushed to the cruise lever 2 (6), and cruise adjusting rod (10) is pulled backward. Because cruise adjusting rod (10) and the HST pedal (1) are connected by the connecting shaft (11), the HST pedal is moved and HST becomes forward position.

On the other hand, because the plate (4) and the rubber (5) are suppressed outside by the release lever (2) and the cruise spring (3), cruise lever 1 (9) and cruise lever 2 (6) are fixed at the position. As a result, cruise control lever position can be infinitely set.

In addition, because the movement of the cruise lever 1 (9) is restricted by the cruise lever 2 (6), the backward pedal operation cannot be done while the cruise control lever (8) is operating.

■ Release



- | | | | |
|-----------------|--------------------|--------------------------|--------------------|
| (1) Brake Pedal | (4) Release Lever | (7) Rubber | (10) Release Wire |
| (2) Brake Lever | (5) Release Spring | (8) Cruise Control Lever | (11) Cruise Spring |
| (3) Bracket | (6) Plate | (9) Cruise Lever 2 | (12) Groove |

The cruise control can be returned to neutral automatically when brake pedals (1) are depressed.

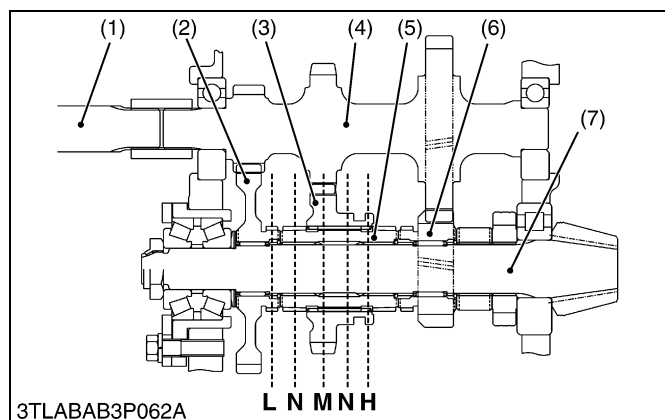
The cruise control lever (8) is set with plates (6) and rubbers (7) by the release lever (4) and cruise spring (11). When brake pedals (1) are depressed, brake lever (2) to pull the release lever (4) via release wire (10). The release lever (4) is moved along grooves (12).

As a result, the holding force of cruise control lever (8) is lost and the cruise control lever (8) returns to neutrality by force of the release spring (5).

■ NOTE

- The cruise control will release when both brake pedals are depressed.
- The cruise control does not release when the individual right or left brake is applied.

(2) Range Gear Shift Section



The range gear shift section is located in the differential gear case.

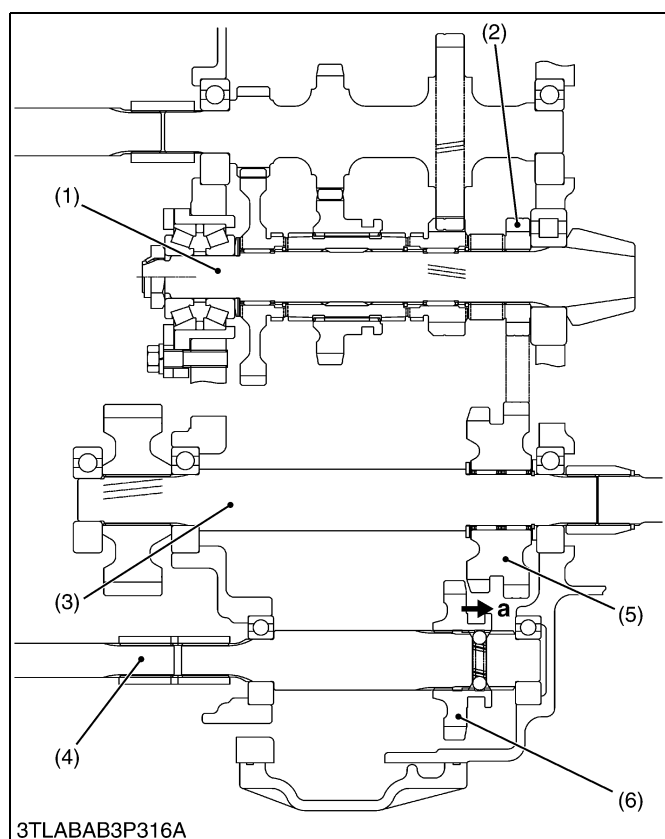
It changes the speed to five positions (**L**, **N**, **M**, **N** and **H**) by shifting of shifter gear (3) in the straight line on bevel pinion shaft (7).

- (1) Counter Shaft
- (2) Gear (for L)
- (3) Shifter Gear (for M)
- (4) Range Gear Shaft
- (5) Spline Boss
- (6) Gear (for H)
- (7) Spiral Bevel Pinion Shaft

L : Low Speed Position
N : Neutral Position
M : Middle Speed Position
H : High Speed Position

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(3) Front Wheel Drive Section



Front wheel drive section is located in the differential gear case.

2 wheel drive or 4 wheel drive is selected by operating the front wheel drive lever to shift the shifter gear (6).

- (1) Spiral Bevel Pinion Shaft
- (2) Front Wheel Drive Output Gear
- (3) PTO Drive Shaft
- (4) Front Wheel Drive Shaft

- (5) Front Wheel Drive Gear
- (6) Shifter Gear

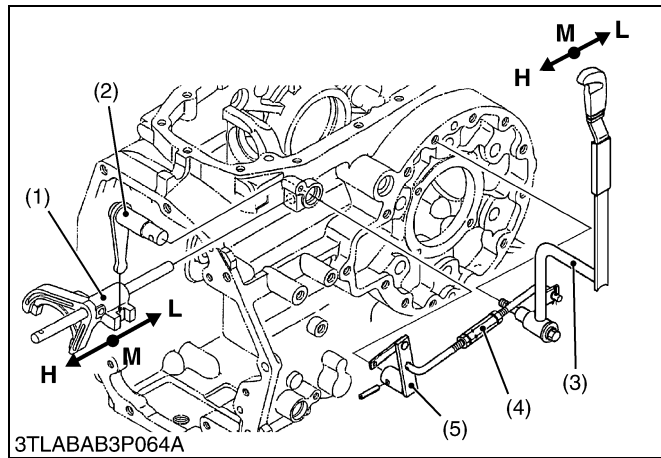
a : 4 Wheel Drive Position

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[3] SHIFT LINKAGE MECHANISM

The shift linkage mechanism of “Front Wheel Drive Lever”, refer to page 3-M6.

(1) Range Gear Shift Lever



The links are connected from the shift lever (3) to the shift fork (1) as shown in figure.

- | | |
|----------------------------|-------------------------|
| (1) Shift Fork | H : High Speed |
| (2) Shift Arm | M : Middle Speed |
| (3) Range Gear Shift Lever | L : Low Speed |
| (4) Rod | |
| (5) Sub-arm | |

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