# SERVICE REPAIR

# MANUAL

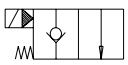
**Hyster C435 (R1.4, R1.4H, R1.6, R1.6H ,R1.6N, R2.0 ,R2.0H, R2.0W, R2.5) Forklift**

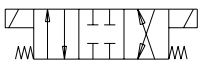
HYSTER

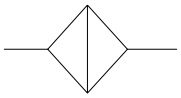
# HYDRAULIC SYSTEM

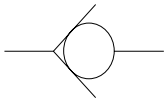
## 1.01 KEY TO HYDRAULIC SYSTEM SYMBOLS
## MODEL *ALL MODELS*

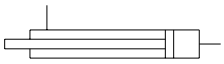
Here we give the symbols used in the diagrams in this section with their meanings.

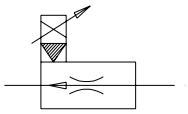

TWO-POSITION SOLENOID VALVE

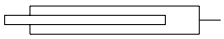

THREE-POSITION SOLENOID VALVE

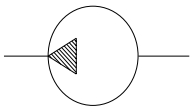

FILTER


CHECK VALVE

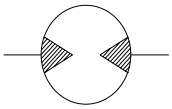

DOUBLE-ACTING CYLINDER


PROPORTIONAL VALVE


SINGLE-ACTING CYLINDER

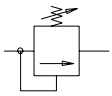

PUMP

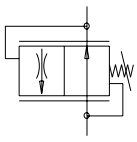

TANK

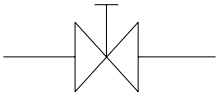

HYDRAULIC MOTOR


LINE CONNECTION

ELECTRIC MOTOR

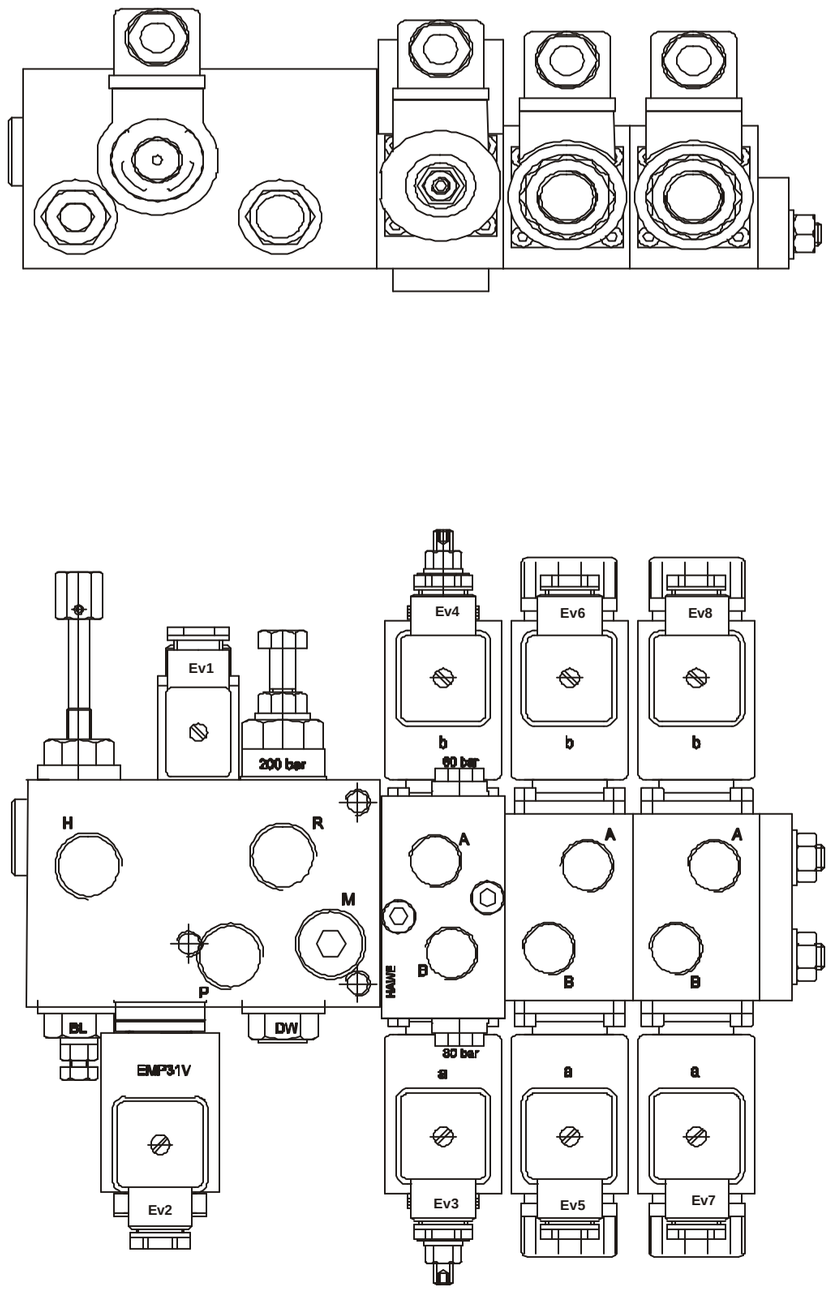

PRESSURE RELIEF VALVE

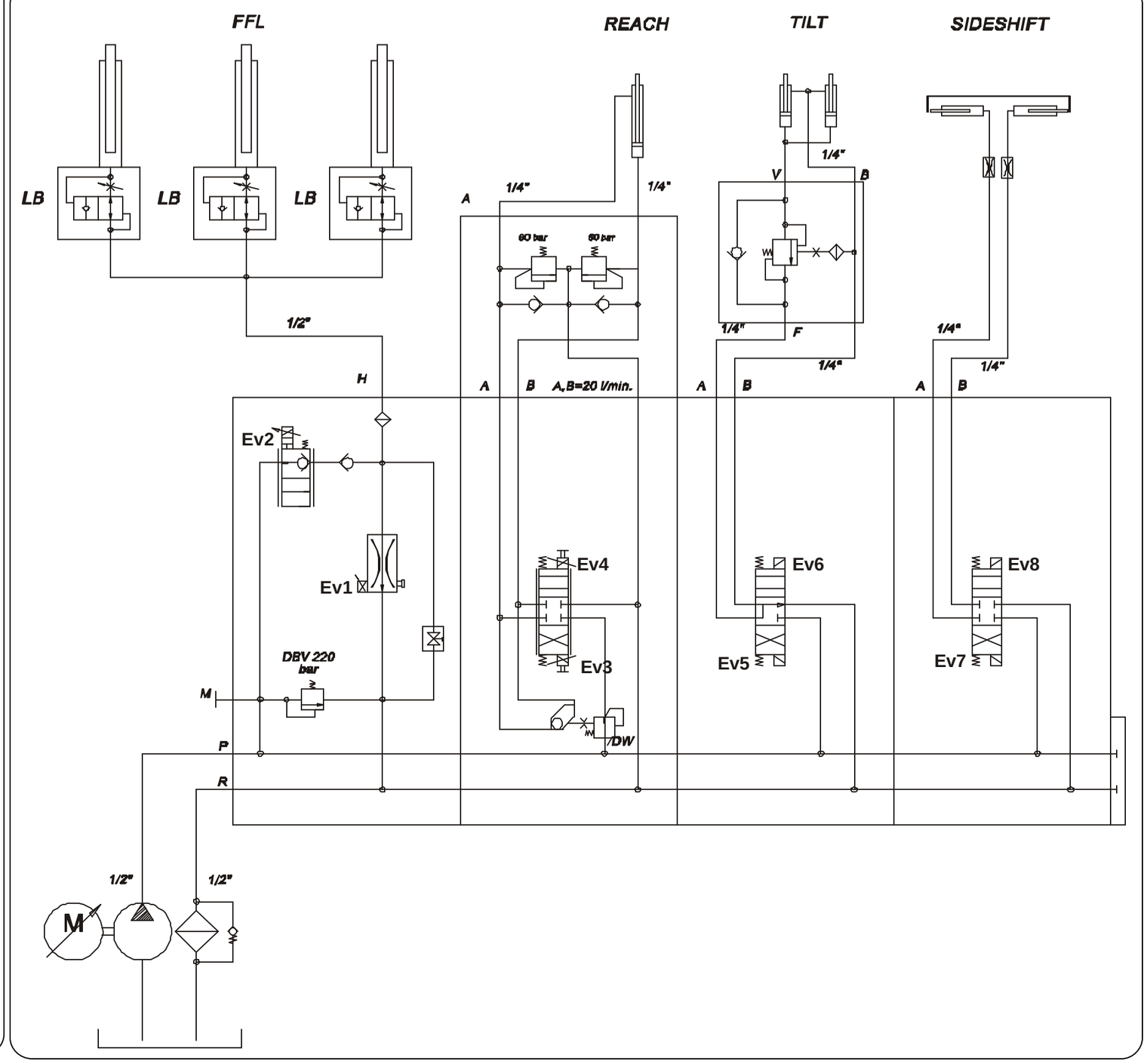

FLOW CONTROL VALVE


MANUAL VALVE

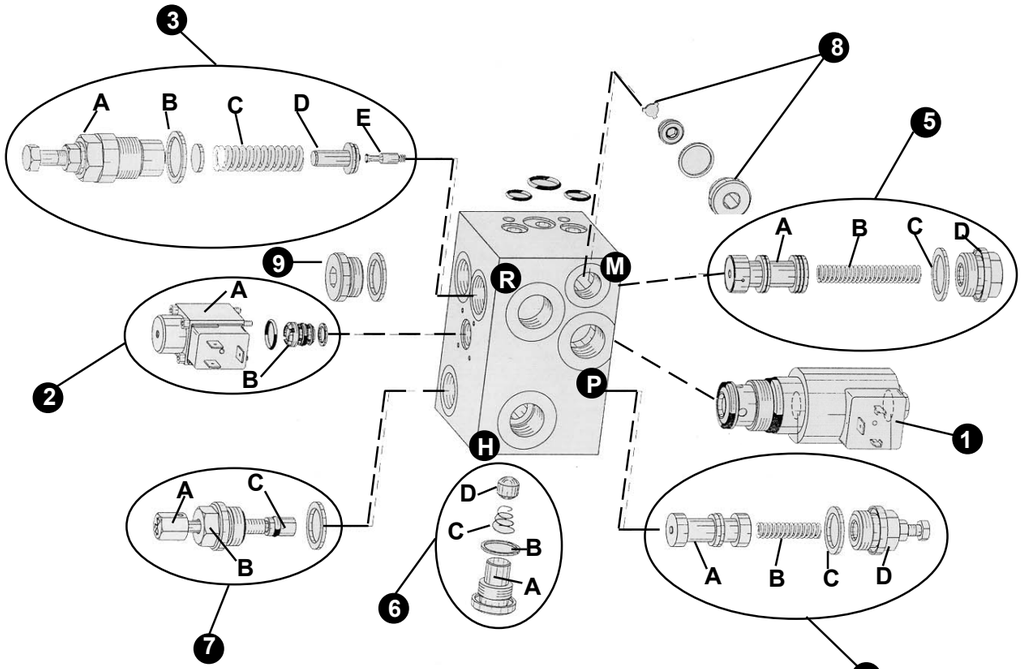

BY-PASS VALVE

**HYDRAULIC FUNCTIONAL DIAGRAM**
**MODEL *ALL MODELS***



**LIFTING AND LOWERING CONTROL VALVES BANK**
**MODEL *ALL MODELS***




**INPUT MODULE**

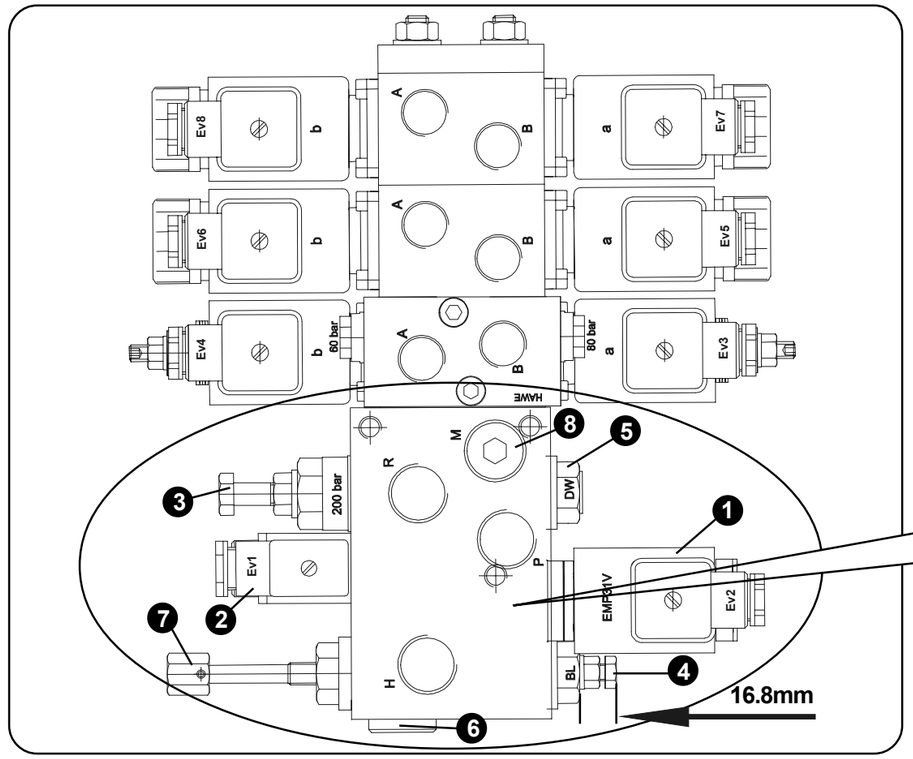
THE INPUT MODULE IS HMT TYPE FOR LIFT TRUCKS, DESIGNED TO RESTRICT INTERNAL LEAKAGE DURING DOWNWARD MOVEMENT TO 3 $CM^3$ PER MINUTE AT FULL LOAD.

## LIFTING VALVE

**(3)PRESSURE RELIEF VALVE**
Composed of adjuster screw (A), spring (C), spool (D) and poppet (E).
The function of this valve is to regulate pressure in the hydraulic circuit. The relief valve is calibrated at between 200 and 220 bar depending on the rated capacity of the truck

**(1) PROPORTIONAL VALVE**
This is a cartridge type valve
When it is activated it opens completely and the oil flow is proportional to the pump motor rpm.
It provides proportional operation exclusively for simultaneous movements (fork lift/reach carriage extension)
Min. opening 250mA
Max. opening 650mA

**(6) CHECK VALVE**
Composed of plug (A), spring (C), plunger (D)
The function of the check valve is to prevent oil from returning to tank through the valve and pump when the joystick is in the rest position




## LOWERING VALVES BANK

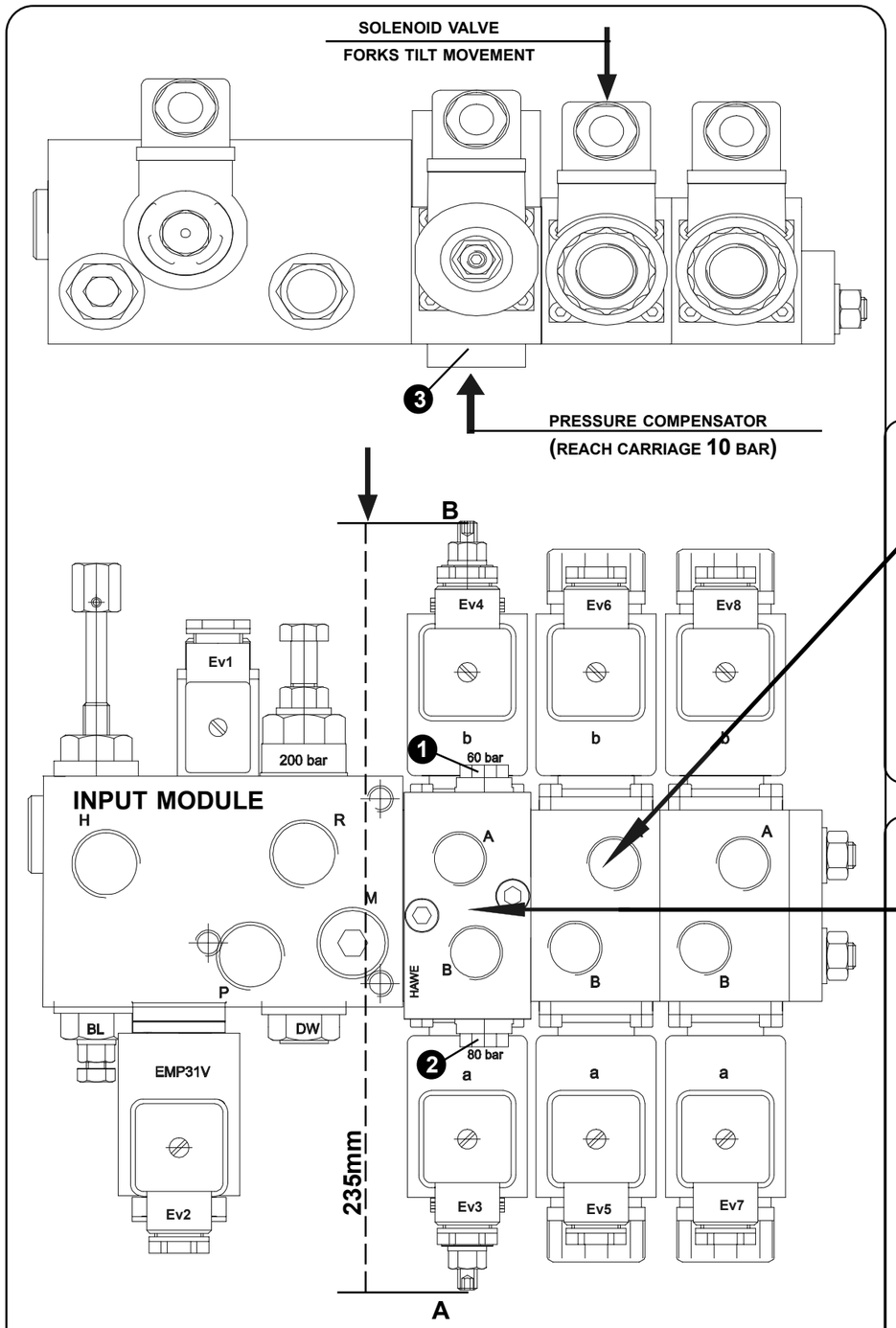
**(7) EMERGENCY LOWERING VALVE**
Composed of screw (A), sector (B), and spool (C).
This valve is used to lower the forks without electrical command signals

**(2) PILOT VALVE**
Composed of magnet (A) and pilot valve (B) screwed into the block. The pilot valve serves to drive the regulator spool

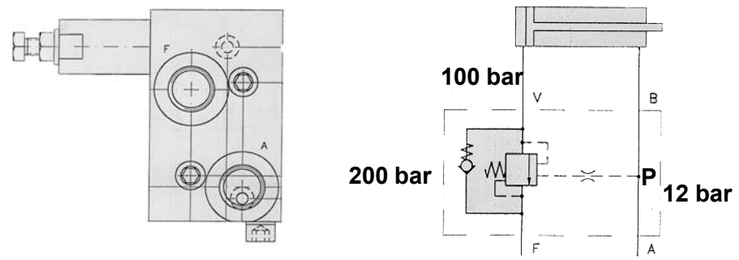
**(4) REGULATOR SPOOL**
Composed of spool (A), pre-calibrated spring (B) and adjuster screw (D).
The function of the regulator spool is to control oil flow during lowering movements.
**Screw:** adjustment for maximum speed (16.8 mm opening)

**(5) PRESSURE COMPENSATOR**
Composed of spool (A) and spring (B).
The pressure compensator serves to assure constant speed of hydraulic movements in loaded or unloaded conditions

**REACH CARRIAGE AND FORKS "UP"**
***TILT "BACK" / "FORWARD"***
***CONTROL VALVES BANK***
**MODEL *ALL MODELS***




**OVERCENTRE VALVE INSTALLED ON THE TILT CYLINDERS**




**VALVE PILOT TRANSMISSION RATIO 1-8** → If a load on the forks generates pressure of 100 bar, the pilot pressure required in point "P" will be: $\frac{200 - 100}{8} = 12$

**FORKS TILT VALVES BANK**

Closed centre solenoid valve on return line to prevent hydraulic accumulator effects resulting from the large amount of oil contained in the truck's hydraulic lines.
EV5 fork tilt "back" control
EV6 fork tilt "forward" control

→ After valve EV5 or EV6 opens oil flows through the overcentre valve located on the tilt cylinders, which operates on the tilt "forward" stroke

→ In the event of tilt problems, with the load tending to descend when no command is present, renew the overcentre valve - do not attempt to clean

**REACH CARRIAGEVALVES BANK**

Proportional 4-way closed centre solenoid valve
carriage retract control valve EV3
carriage extend control valve EV4

→ **1)** EV3 carriage retraction antishock valve EV3 calibrated at 60 bar.
**2)** EV4 carriage extension antishock valve calibrated at 80 bar.
Removing the plug reveals a spring that exerts pressure on a check ball; in the event of malfunctions remove the parts and clean the seat

→ **3)** Pressure compensator.
The pressure compensator performs a dual function in forks lifting and reach carriage extension movement. This component provides pressure compensation that eliminates performance differences in loaded and unloaded conditions

**Example** — **lifting 200 bar**, **carriage 50 bar**

**3) TRANSLATION MOVEMENT BLOCKED.**
The compensator closes and the oil is dumped to tank through the pressure relief valve. Remove the valve, unscrew the plug, clean the internal parts thoroughly and then refit

**A** and **B** proportional spools for maximum opening adjusted to a distance between stroke limits of 235 mm

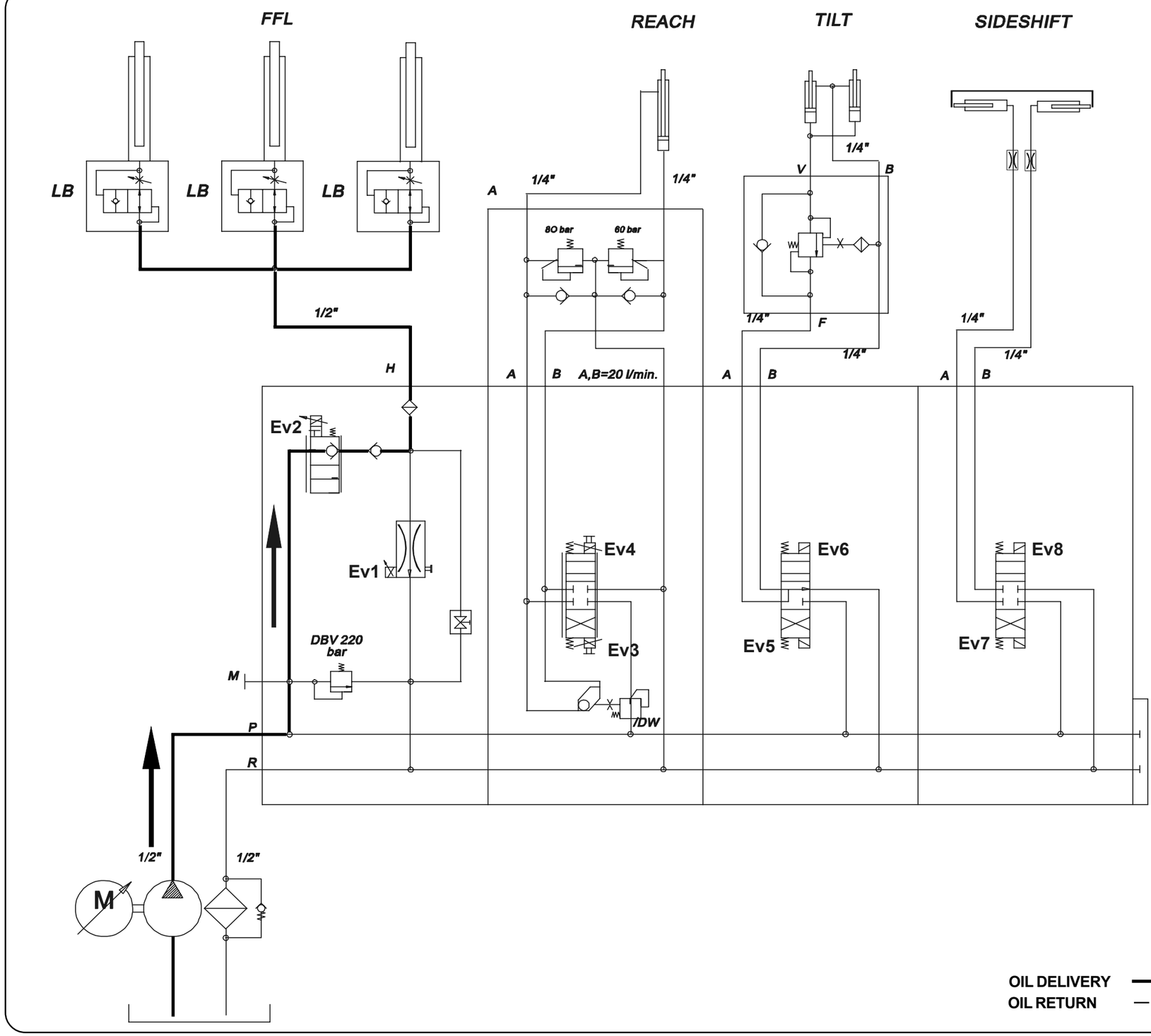
→ Solenoid valves proportional opening
min. 390 mA - max 900 mA

## HYDRAULIC CIRCUIT STATUS IN FORKS LIFTING PHASE

SINGLE JOYSTICK HYDRAULIC CONTROL

2-JOYSTICK HYDRAULIC CONTROL

4-JOYSTICK HYDRAULIC CONTROL

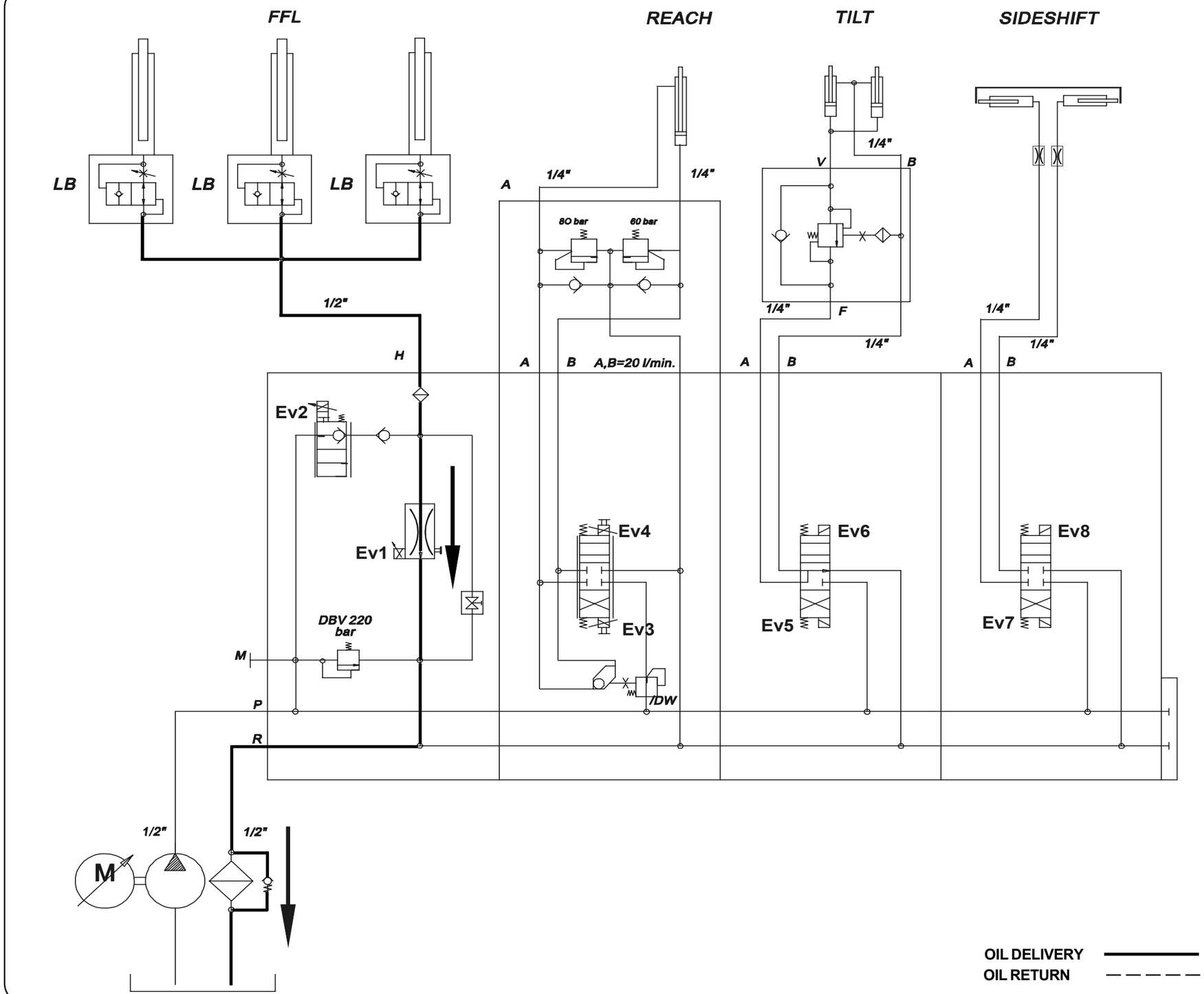


# HYDRAULIC CIRCUIT STATUS IN FORKS LOWERING PHASE

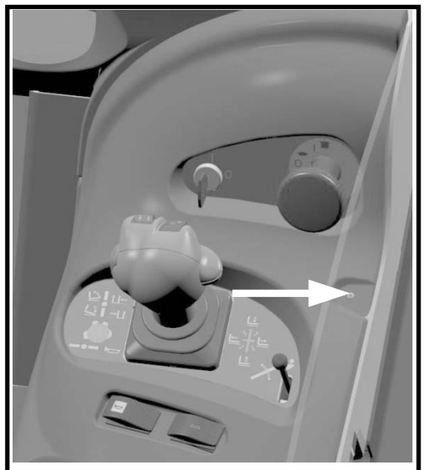
SINGLE JOYSTICK HYDRAULIC CONTROL

2-JOYSTICK HYDRAULIC CONTROL

4-JOYSTICK HYDRAULIC CONTROL



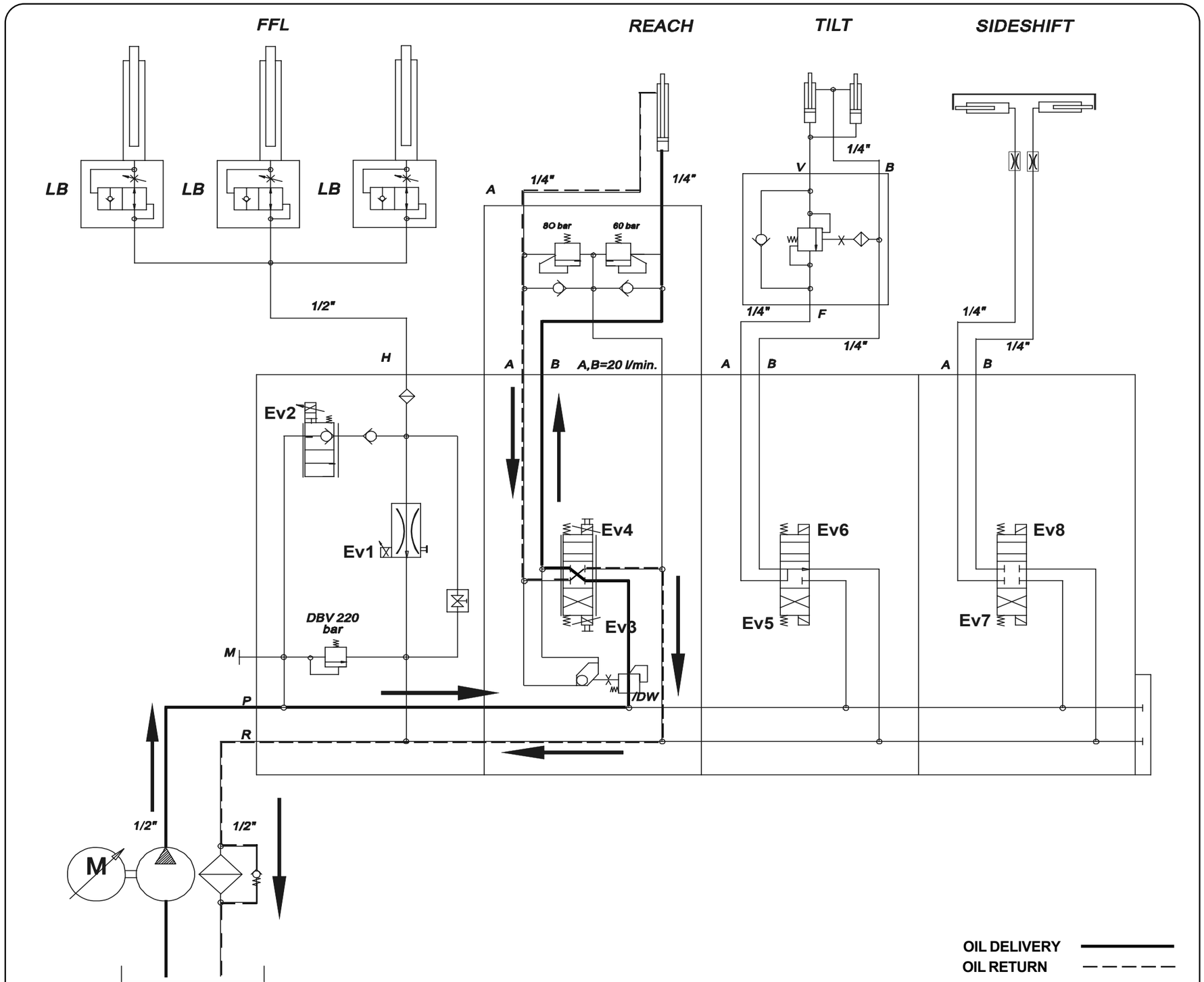
## HYDRAULIC CIRCUIT STATUS IN REACH CARRIAGE EXTENSION PHASE



SINGLE JOYSTICK HYDRAULIC CONTROL

2-JOYSTICK HYDRAULIC CONTROL

4-JOYSTICK HYDRAULIC CONTROL

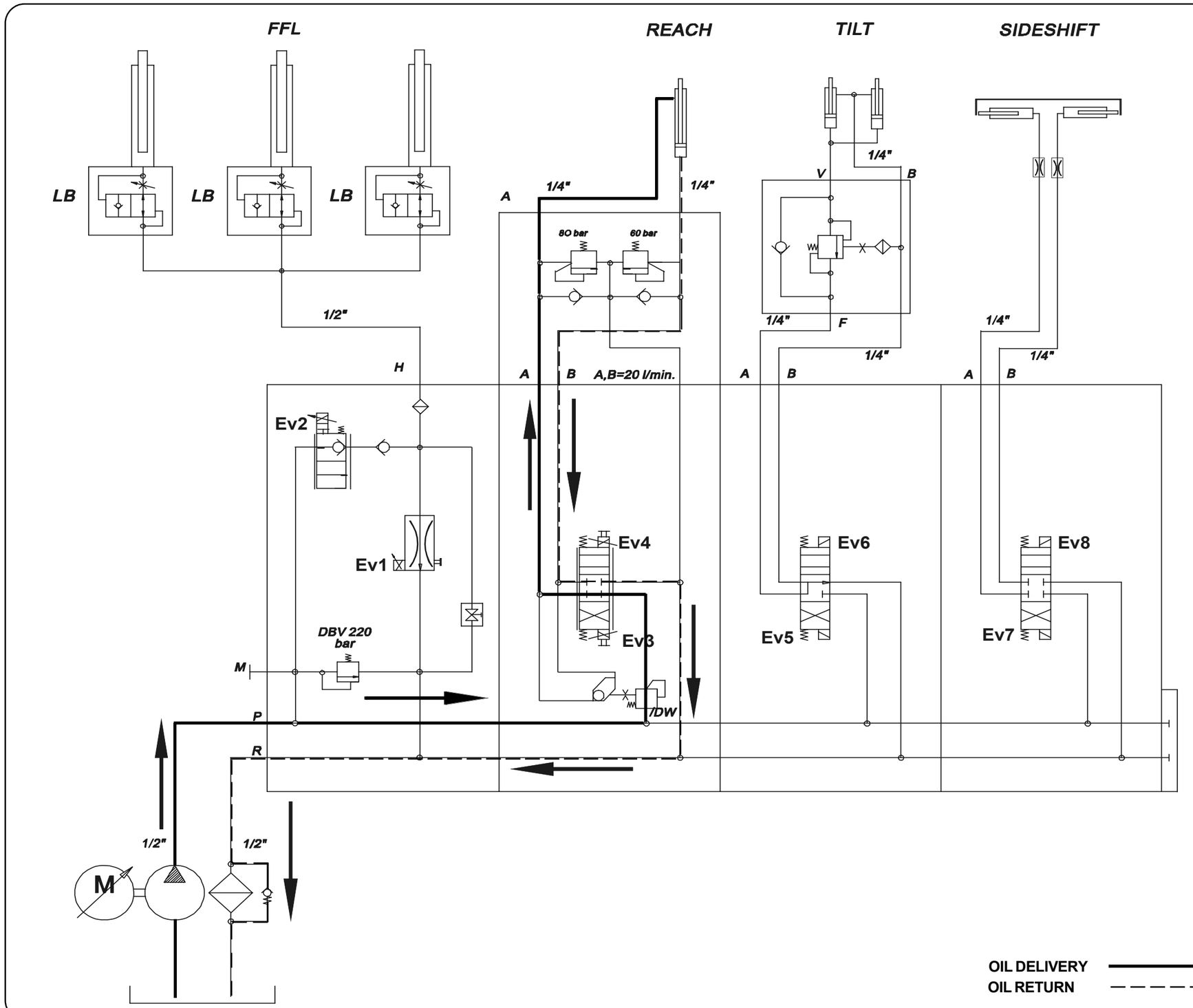


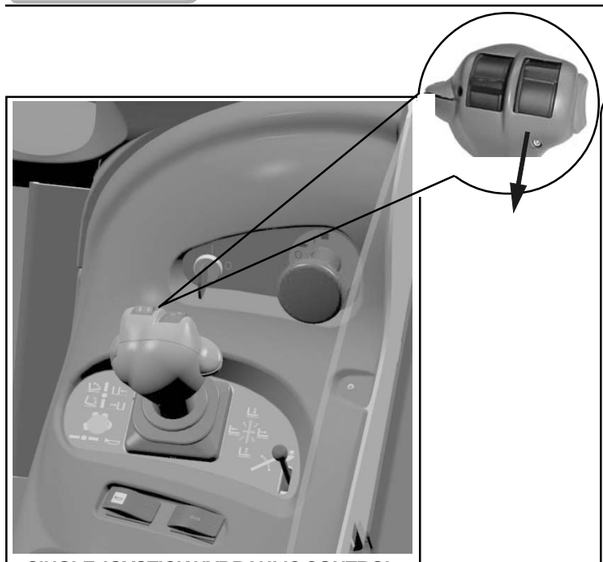
## HYDRAULIC CIRCUIT STATUS IN REACH CARRIAGE RETRACTION PHASE

ITT JOYSTICK HYDRAULIC CONTROL

2-JOYSTICK HYDRAULIC CONTROL

4-JOYSTICK HYDRAULIC CONTROL



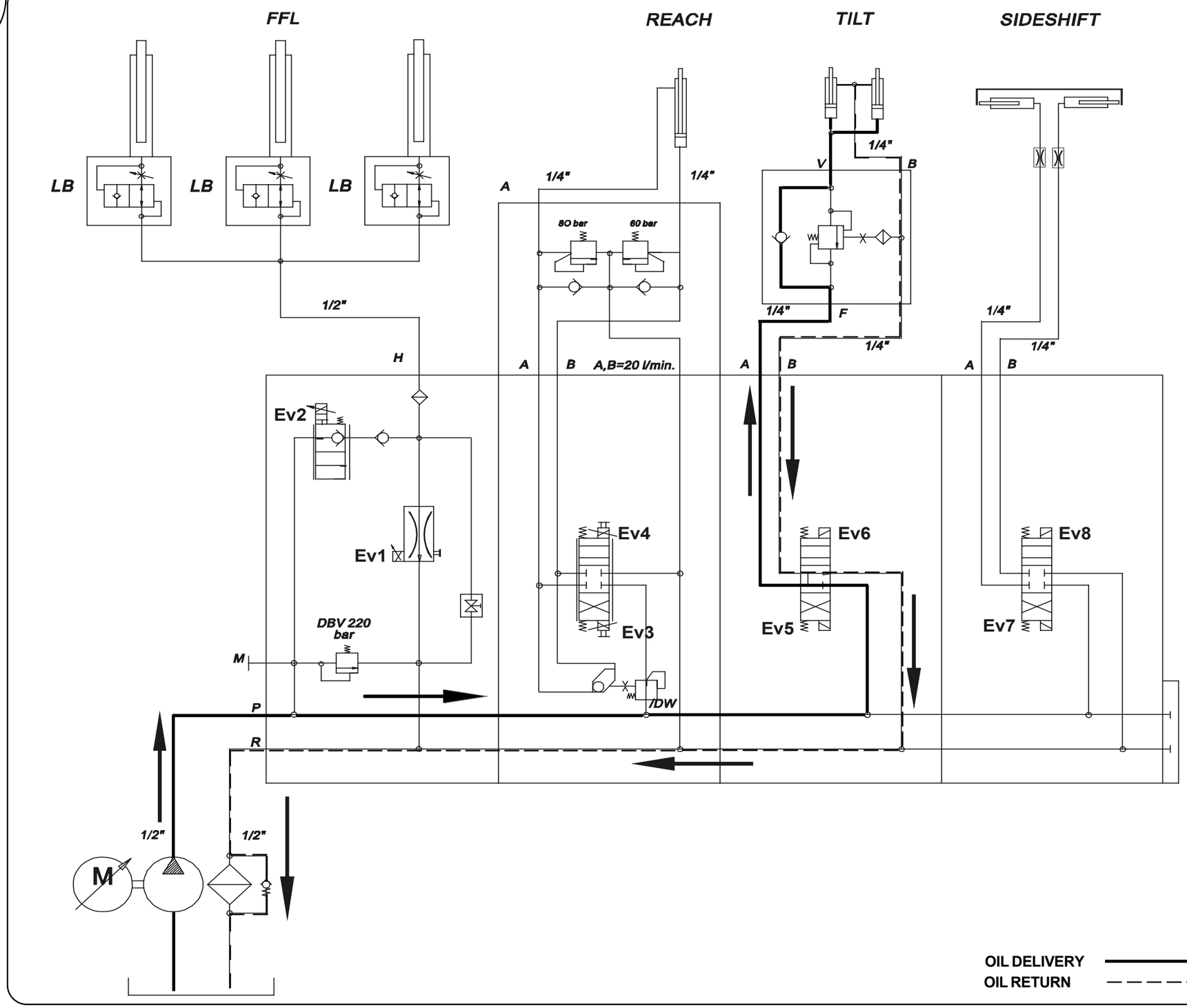


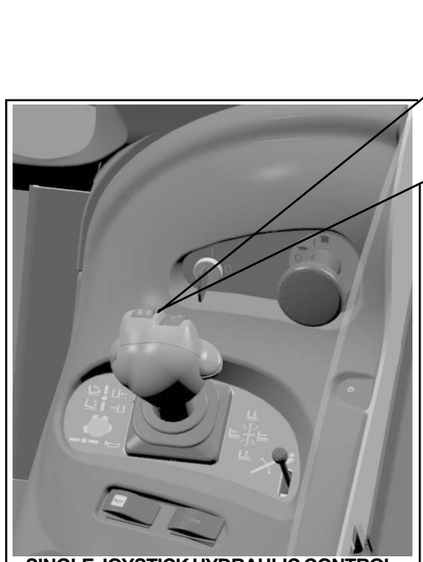
SINGLE JOYSTICK HYDRAULIC CONTROL

2-JOYSTICK HYDRAULIC CONTROL

4-JOYSTICK HYDRAULIC CONTROL

## HYDRAULIC CIRCUIT STATUS IN FORKS UPWARD TILT PHASE



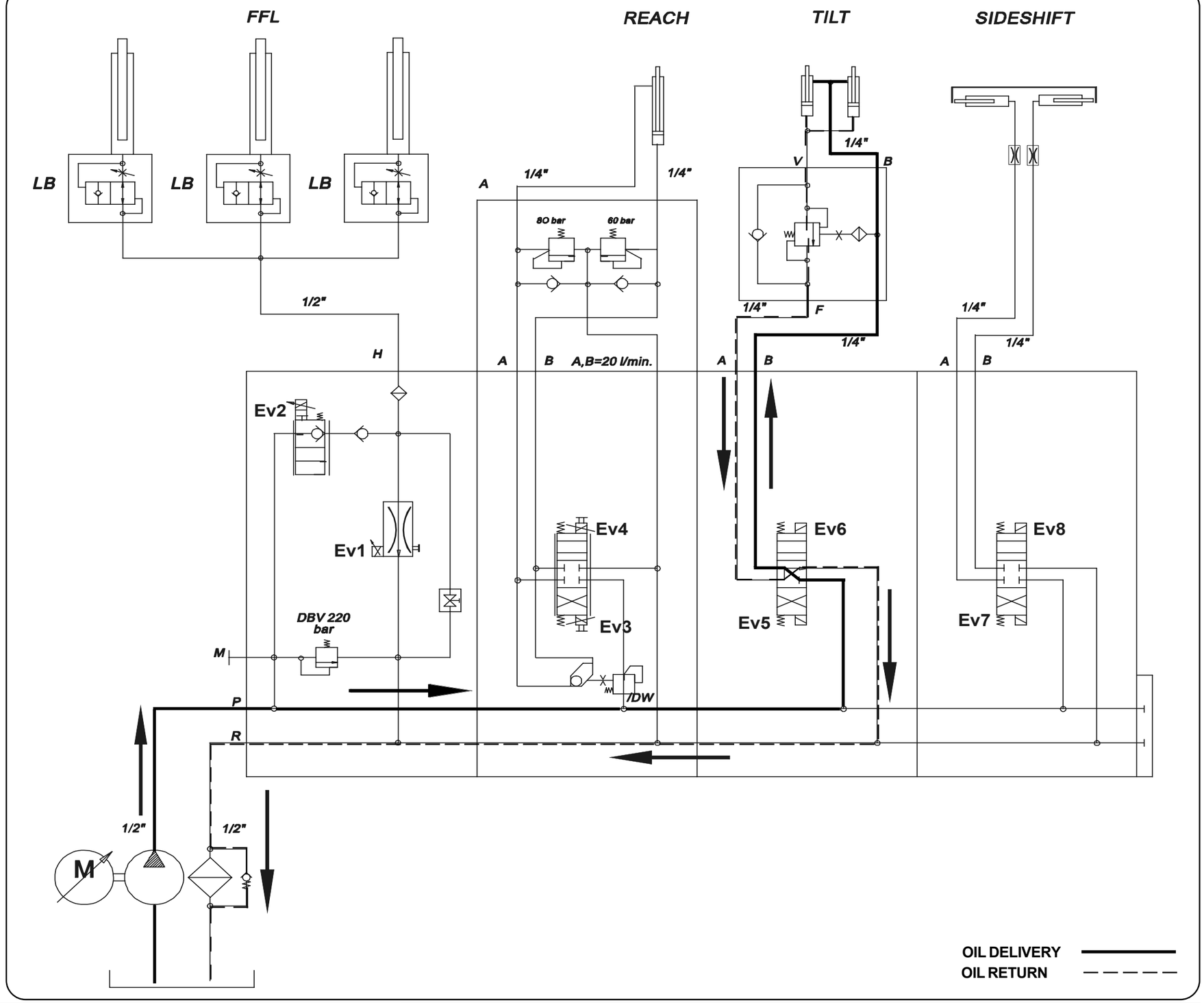


SINGLE JOYSTICK HYDRAULIC CONTROL

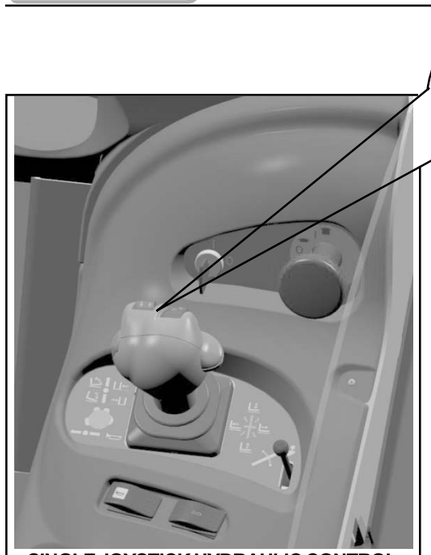
2-JOYSTICK HYDRAULIC CONTROL

4-JOYSTICK HYDRAULIC CONTROL

## HYDRAULIC CIRCUIT STATUS IN FORKS FORWARD TILT PHASE



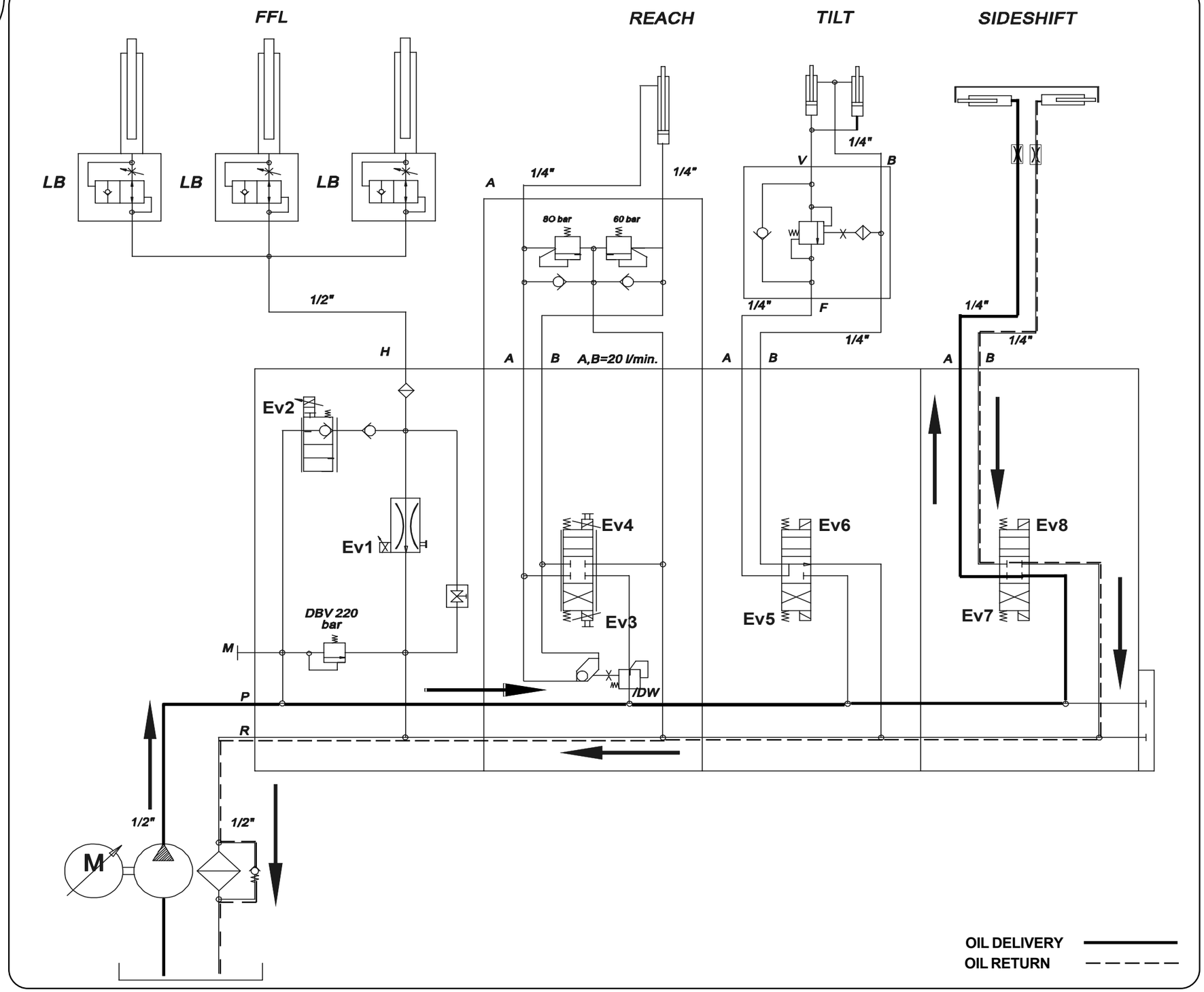
# HYDRAULIC CIRCUIT STATUS IN FORKS SIDESHIFT TO LEFT



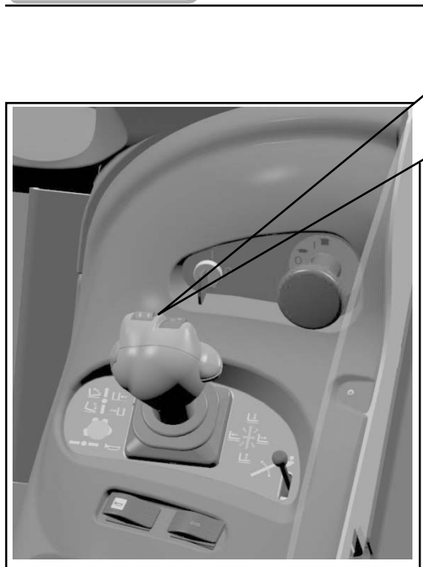
SINGLE JOYSTICK HYDRAULIC CONTROL

2-JOYSTICK HYDRAULIC CONTROL

4-JOYSTICK HYDRAULIC CONTROL



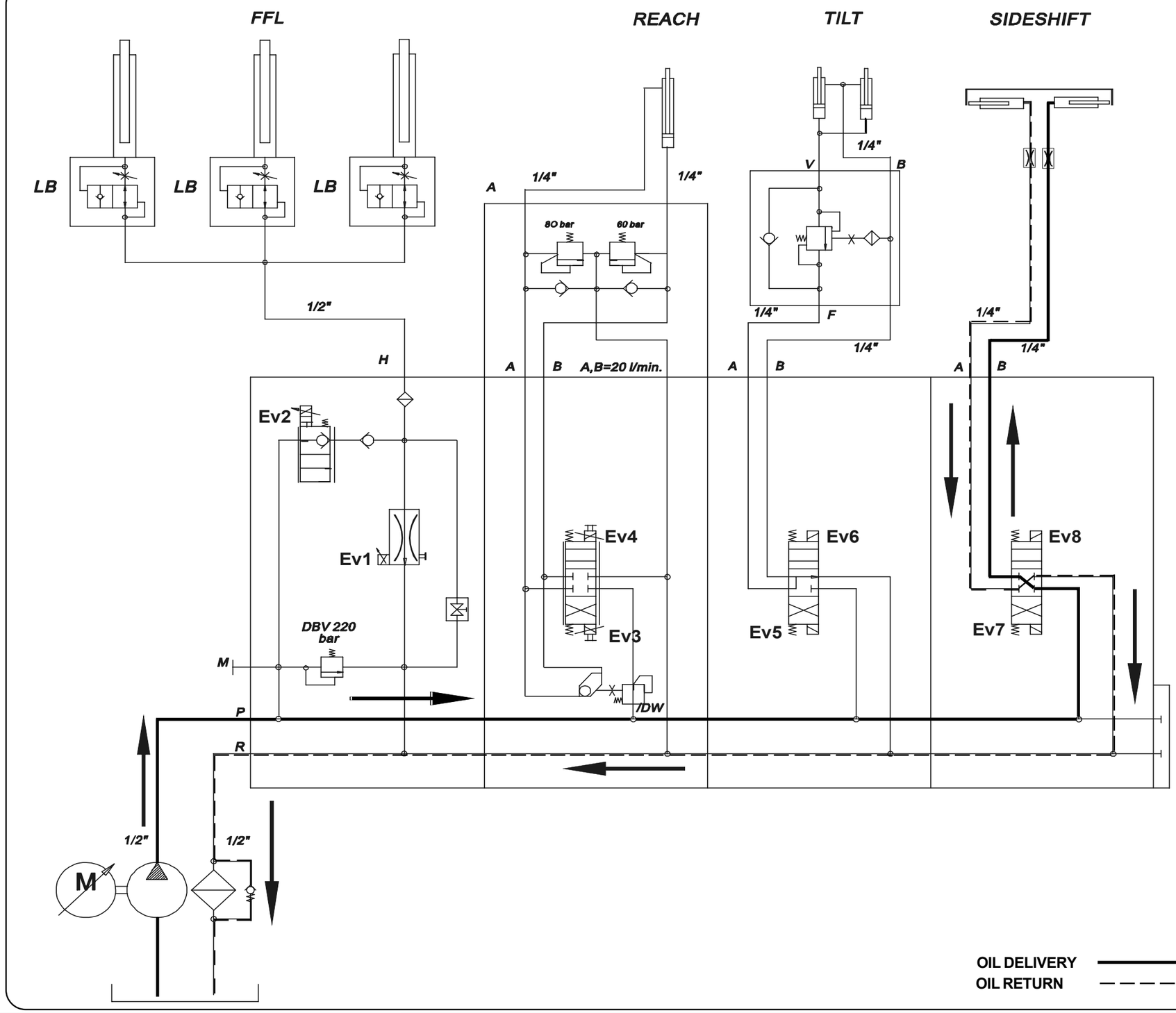
## HYDRAULIC CIRCUIT STATUS IN FORKS SIDESHIFT TO RIGHT



SINGLE JOYSTICK HYDRAULIC CONTROL

2-JOYSTICK HYDRAULIC CONTROL

4-JOYSTICK HYDRAULIC CONTROL



## 1.02 CORRECT ASSEMBLY METHOD FOR FEMALE UNIONS

To ensure an oil-tight connection between the female unions and adapters shown in this manual, observe the following procedure, which differs from that used for flexible hoses.

FEMALE UNIONS WITHOUT SEALS (METAL TO METAL COUPLING)

Snug the nut by hand and then tighten with a wrench by no more than **1/4 turn**.

FEMALE UNIONS WITH O-RING SEAL

Snug the nut by hand and then use a wrench to tighten by no more than a further **1/2 turn**.

In all cases, ensure that the line is correctly aligned before tightening the adapter nut.

**Note: The values supplied in the tables are typical for the recommended assembly method in the case of galvanized unions. Unions made of different materials call for the use of alternative values.**

TORQUE VALUES

| TORQUE VALUES | | | |
|---|---|---|---|
| METRIC FEMALE UNION | | | |
| METRIC THREAD | OUTSIDE ø | Nm NOMINAL | Nm MIN./MAX |
| M12x1,5 | 6 | 20 | 15-25 |
| M14x1,5 | 8 | 38 | 30-45 |
| M16x1,5 | 8<br>10 | 45 | 38-52 |
| M18x1,5 | 10<br>12 | 51 | 43-58 |
| M20x1,5 | 12 | 58 | 50-65 |
| M22x1,5 | 14<br>15 | 74 | 60-88 |
| M24x1,5 | 16 | 74 | 60-88 |
| M26x1,5 | 18 | 105 | 85-125 |
| M30x2 | 20<br>22 | 135 | 115-155 |
| M36x2 | 25<br>28 | 166 | 140-192 |
| M42x2 | 30 | 240 | 210-270 |
| M45x2 | 35 | 290 | 255-325 |
| M52x2 | 38<br>42 | 330 | 280-380 |

**Table 1**

| TORQUE VALUES | | | |
|---|---|---|---|
| ORFS | | | |
| UNF THREAD | SIZE | Nm MIN | Nm MAX |
| 9/16-18 | -4 | 14 | 16 |
| 11/16-16 | -6 | 24 | 27 |
| 13/16-16 | -8 | 43 | 47 |
| 1-14 | -10 | 60 | 68 |
| 1.3/16-12 | -12 | 90 | 95 |
| 1.3/16-12 | -14 | 90 | 95 |
| 1.7/16-12 | -16 | 125 | 135 |
| 1.11/16-12 | -20 | 170 | 190 |
| 2-12 | -24 | 200 | 225 |

**Table 2**

| TORQUE VALUES | | | |
|---|---|---|---|
| JIC 37° FEMALE UNION | | | |
| UNF THREAD | SIZE | Nm NOMINAL | Nm MIN./MAX |
| 7/16-20 | -4 | 15 | 9-21 |
| 1/2-20 | -5 | 20 | 13-27 |
| 9/16-18 | -6 | 30 | 18-42 |
| 3/4-16 | -8 | 50 | 30-70 |
| 7/8-14 | -10 | 69 | 44-94 |
| 1.1/16-12 | -12 | 98 | 63-133 |
| 1.3/16-12 | -14 | 118 | 73-163 |
| 1.5/16-12 | -16 | 140 | 90-190 |
| 1.5/8-12 | -20 | 210 | 135-285 |
| 1.7/8-12 | -24 | 290 | 200-380 |
| 2.1/2-12 | -32 | 450 | 300-600 |

**Table 3**

| TORQUE VALUES | | |
|---|---|---|
| FEMALE UNION BSP | | |
| BSPP THREAD | Nm NOMINAL | Nm MIN./MAX |
| G1/4 | 20 | 15-25 |
| G3/8 | 34 | 27-41 |
| G1/2 | 60 | 42-76 |
| G5/8 | 69 | 44-94 |
| G3/4 | 115 | 95-135 |
| G1 | 140 | 115-165 |
| G1.1/4 | 210 | 140-280 |
| G1.1/2 | 290 | 215-365 |
| G2 | 400 | 300-500 |

**Table 4**

## 1.03 HYDRAULIC UNIT COMPONENTS

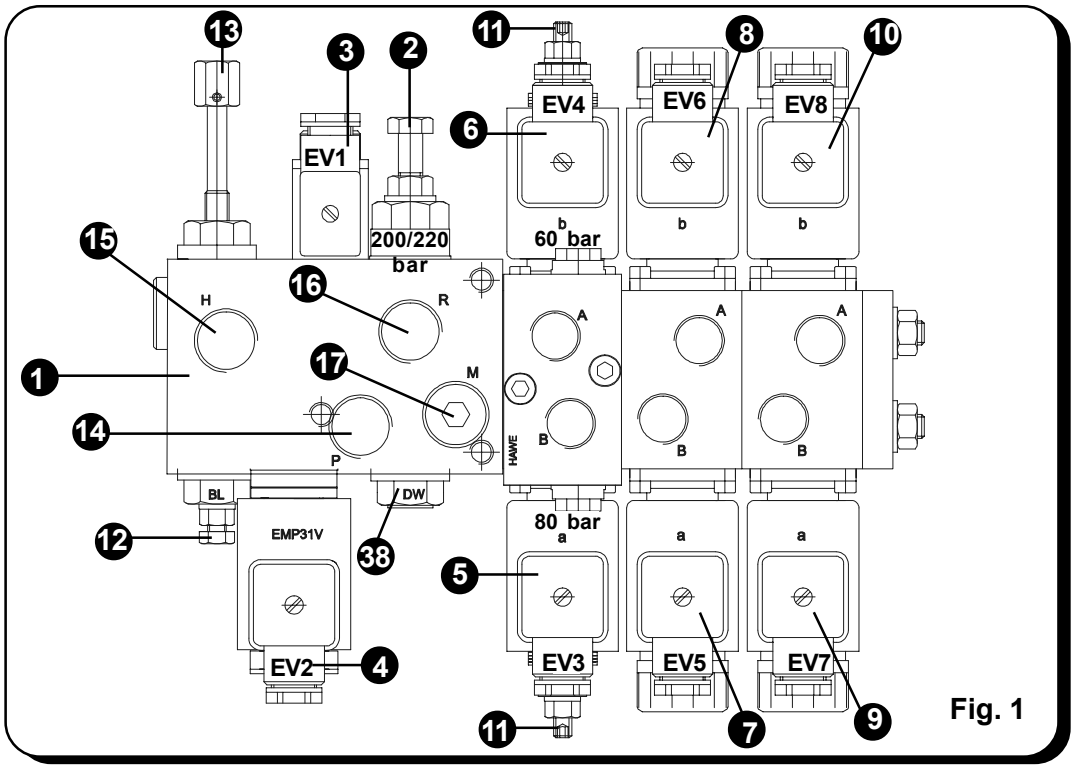



Fig. 1

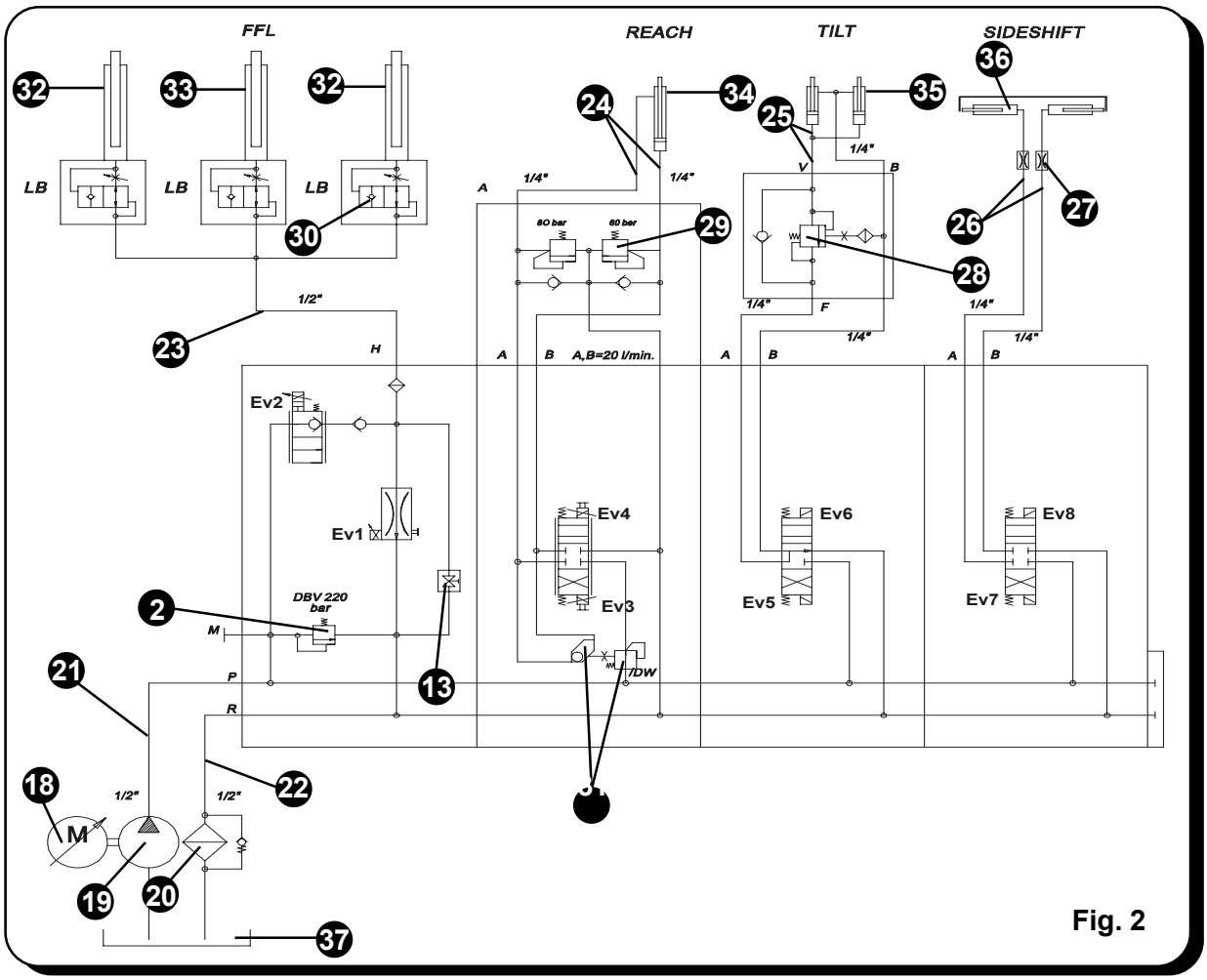



Fig. 2

## 1.04 TABLE OF HYDRAULIC UNIT COMPONENTS
## MODEL *ALL MODELS*

The hydraulic unit components illustrated on the previous page are described in the following table.

*Key:*

**Ref.** Component reference in exploded view
**Ref. Diagram** Reference to symbol in functional diagram
**Component Description** Function of component



| Ref. | Ref. Diagram | Component description |
|---|---|---|
| 1 | | Oil inlet module |
| 2 | | Hydraulic pressure regulator valve (set at between 200 and 220 bar) |
| 3 | EV1 | Mast lowering proportional solenoid valve |
| 4 | EV2 | Mast lifting proportional solenoid valve |
| 5 | EV3 | Reach carriage cylinder "retract" proportional solenoid valve |
| 6 | EV4 | Reach carriage "extend" proportional solenoid valve |
| 7 | EV5 | Tilt cylinder "back" solenoid valve |
| 8 | EV6 | Tilt cylinder "forward" solenoid valve |
| 9 | EV7 | Forks sideshifter cylinder "Lh" movement solenoid valve |
| 10 | EV8 | Forks sideshifter cylinder "Rh" movement solenoid valve |
| 11 | | Adjustment of proportional spools for maximum opening of the reach carriage valve |
| 12 | | Lowering movement oil flow regulator spool adjusted with maximum capacity at 51 l. and at 155 bar (screw adjusted for maximum speed 16.8 mm opening). |
| 13 | | Valve for emergency lowering when no electrical controls are available |
| 14 | P | Connection union for oil delivery hose arriving from pump |
| 15 | H | Connection union for lift cylinders delivery hose |
| 16 | R | Connection union for oil return line to tank |
| 17 | M | Pressure gauge connection union for system pressure testing |
| 18 | | Pump motor |
| 19 | ▲ | Lift pump |
| 20 | ◇ | Return oil filer |
| 21 | | Valve bank hydraulic supply line (lift pump to valves bank) |
| 22 | | Oil return line (valves bank to tank) |
| 23 | | Lift cylinders supply line (valves bank to cylinders) 3/8" |
| 24 | | Reach carriage cylinder supply lines (valves bank to cylinder) 1/4" |
| 25 | | Tilt cylinders supply lines (valves bank to cylinders) 1/4" |
| 26 | | Forks sideshifter cylinders hydraulic supply lines (valves bank, cylinders) |
| 27 | | Valve controlling oil flow to forks sideshifter cylinders |
| 28 | | Tilt cylinders pressure relief valve |
| 29 | | Reach cylinder anti-shock valve located internally to the valves bank |
| 30 | LB | Valve controlling oil flow of cylinders during lowering |
| 31 | DW | Pressure compensation valve for simultaneous activation of lift function and reach |
| 32 | | Mast lifting lateral cylinders |
| 33 | | Mast lifting central cylinder |
| 34 | | Extend/Retract reach carriage cylinder |
| 35 | | Forks "back/forward" tilt cylinders |
| 36 | | Forks right/left sideshift cylinder |
| 37 | | Oil tank |
| 38 | DW | Pressure compensator valve for mast descent |

**NOTE: All Hyster Part Numbers are given in the parts catalogue.**

## 1.05 BASIC TRUCK HYDRAULIC SYSTEM MODEL *ALL MODELS*

HYDRAULIC SYSTEM COMPONENTS

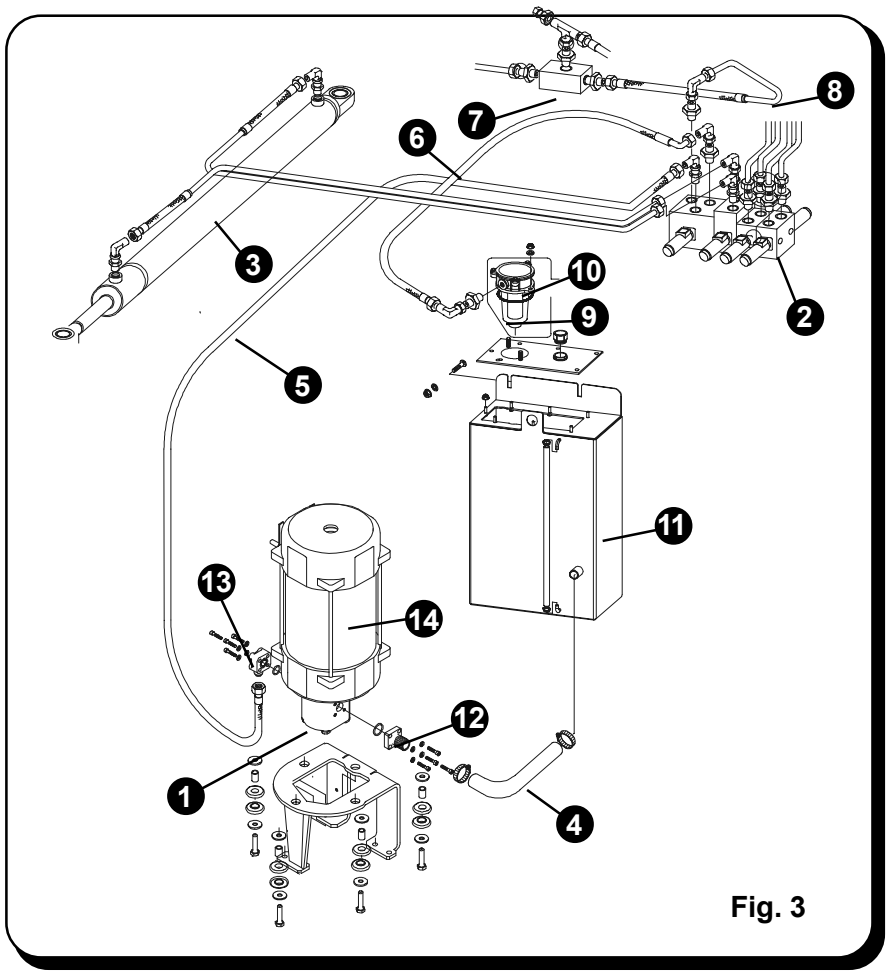



Fig. 3

## 1.06 TABLE OF BASIC TRUCK HYDRAULIC SYSTEM COMPONENTS

| Ref. | Component description |
|---|---|
| **1** | Lift pump l. 11 - R2.0 - R2.5 |
| **1** | Lift pump l. 16 - R1.4 - R1.4H - R1.6 - R1.6H - R2.0H - R2.0W |
| **2** | Solenoid valves bank |
| **3** | Reach carriage cylinder |
| **4** | Oil suction line (tank/pump) |
| **5** | Oil pressure line (pump/valves bank) |
| **6** | Oil return line (valves bank/tank) |
| **7** | Cylinders delivery diverter block |
| **8** | Connection line between valves bank and cylinders delivery diverter block |
| **9** | Return oil filter |
| **10** | Oil filter housing |
| **11** | Oil tank |
| **12** | Pump suction line union |
| **13** | Pump pressure line union |
| **14** | 11 KW pump unit |

**NOTE: All Hyster Part Numbers are given in the parts catalogue.**

## 1.07 MAST HYDRAULIC SYSTEM
## MODEL *ALL MODELS*

HYDRAULIC SYSTEM COMPONENTS

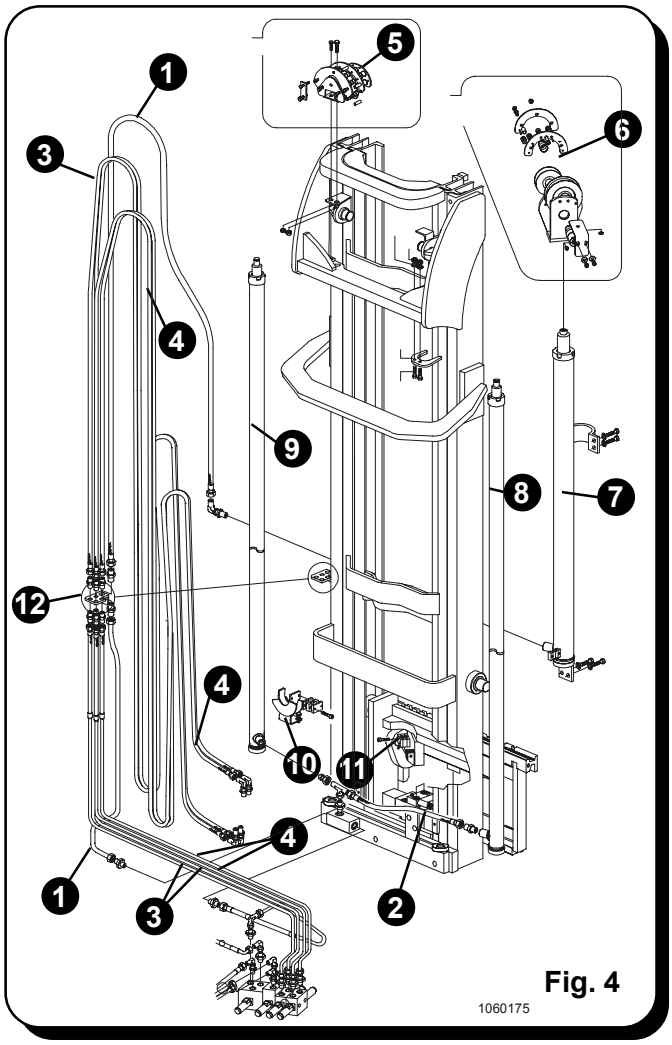



**Fig. 4**

## 1.08 TABLE OF MAST HYDRAULIC SYSTEM COMPONENTS

| Ref. | Component description |
|---|---|
| 1 | Connection hose to central cylinder |
| 2 | Connection hose to lateral cylinders |
| 3 | Twin connection hoses to forks sideshifter cylinder |
| 4 | Twin connection hoses to tilt cylinder |
| 5 | Pulleys unit for hoses on mast |
| 6 | Pulleys unit for hoses on central cylinder |
| 7 | Single-acting central lift cylinder with upward stroke cushioning |
| 8 | Single-acting Rh lateral lift cylinder with downward stroke cushioning |
| 9 | Single-acting Lh lateral lift cylinder with downward stroke cushioning |
| 10 | Bracket for twin hoses and central cylinder |
| 11 | Bracket for twin hoses |
| 12 | Hose connecting bracket |

**NOTE: All Hyster Part Numbers are given in the parts catalogue.**

## 1.09 SINGLE ACTING LATERAL LIFT CYLINDER WITH SELF-BRAKING DURING LOWERING MODEL *BETA - HE140L - HE140*

CYLINDER COMPONENTS

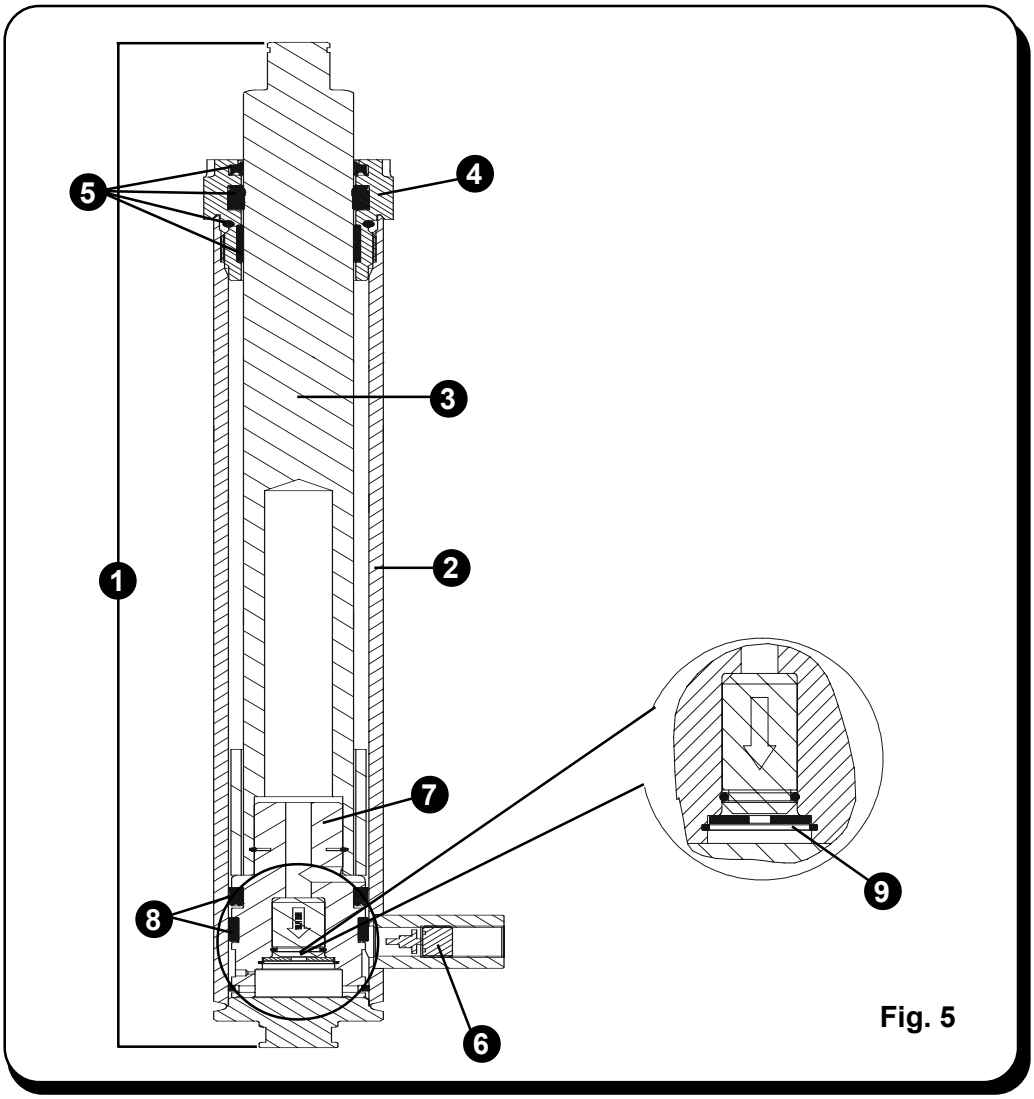



Fig. 5

## 1.10 TABLE OF LATERAL SINGLE ACTING CYLINDER COMPONENTS

| Ref. | Component description |
|---|---|
| 1 | Complete cylinder |
| 2 | Cylinder barrel |
| 3 | Cylinder rod |
| 4 | Gasket bushing |
| 5 | Set of seals for gasket bushing |
| 6 | LB hose break safety valve (prevents oil flow in the event of a hose break) |
| 7 | Seals holder piston and lowering cushioning valve |
| 8 | Set of cylinder piston seals |
| 9 | Cushioning valve |

**NOTE: All Hyster Part Numbers are given in the parts catalogue.**

## 1.11 CENTRAL SINGLE ACTING LIFT CYLINDER WITH SELF-BRAKING DURING LIFTING MODEL *BETA - HE140L - HE140*

CYLINDER COMPONENTS

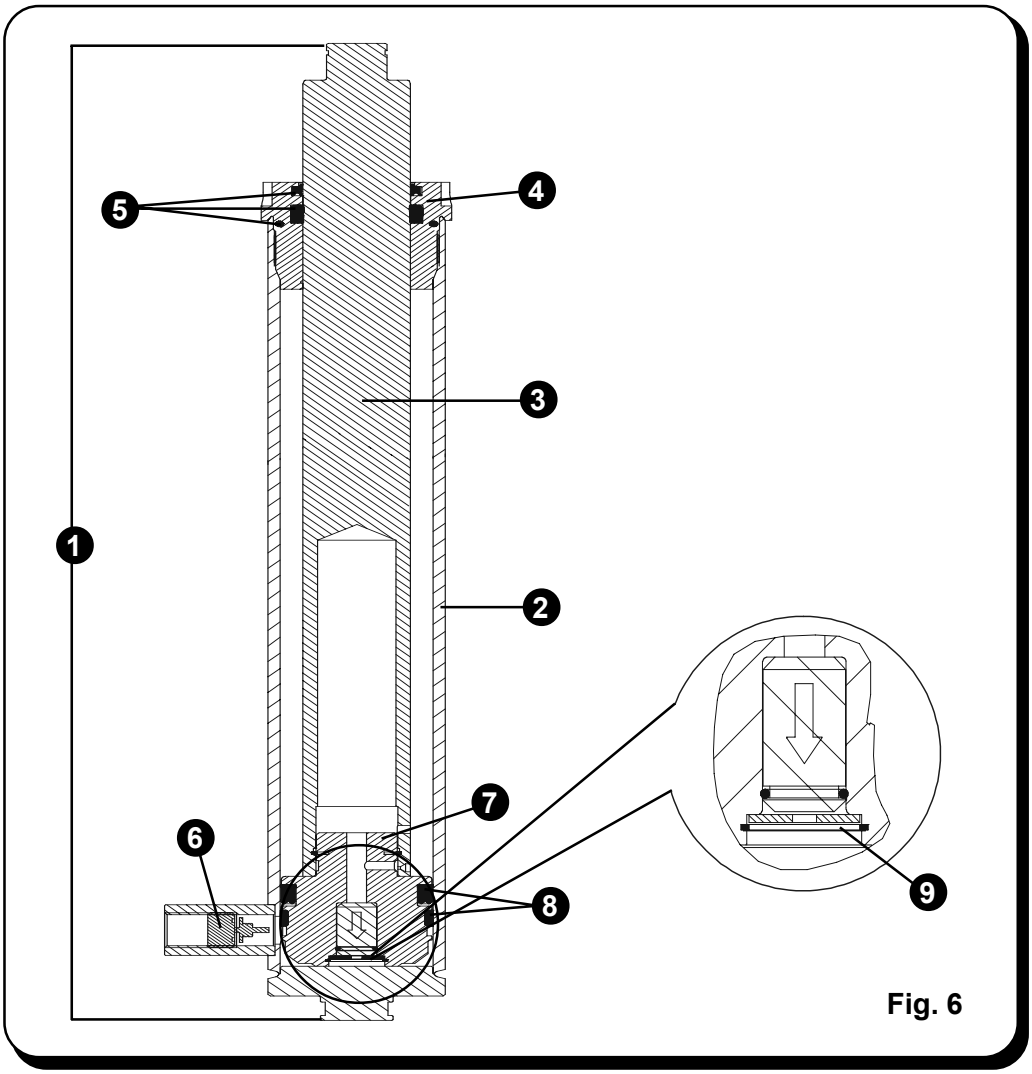



Fig. 6

## 1.12 TABLE OF SINGLE ACTING CENTRAL CYLINDER COMPONENTS

| Ref. | Component description |
|---|---|
| 1 | Complete cylinder |
| 2 | Cylinder barrel |
| 3 | Cylinder rod |
| 4 | Gasket bushing |
| 5 | Set of seals for gasket bushing |
| 6 | LB hose break safety valve (prevents oil flow in the event of a burst supply hose) |
| 7 | Sealks holder piston and lift stroke cushioning valve |
| 8 | Set of seals for cylinder piston |
| 9 | Cushioning valve |

**NOTE: All Hyster Part Numbers are given in the parts catalogue.**

## 1.13 SINGLE ACTING LIFT CYLINDERS WITH HYDRAULIC STROKE-END CUSHIONING IN LOWERING AND LIFTING

The cylinders with hydraulic cushioning are designed using special features that provide hydraulic cushioning at the end of each lift or lower cycle, thereby eliminating mechanical impact at the stroke end positions.

OPERATION OF LATERAL LIFT CYLINDER WITH CUSHIONING IN LOWERING

During lowering movement, when the piston guide ring (Ref. A Fig. 7) reaches the position of the oil return port (Ref. B Fig. 7), it partially restricts the outward oil flow thus causing the descent movement to decelerate through the final 40 mm.

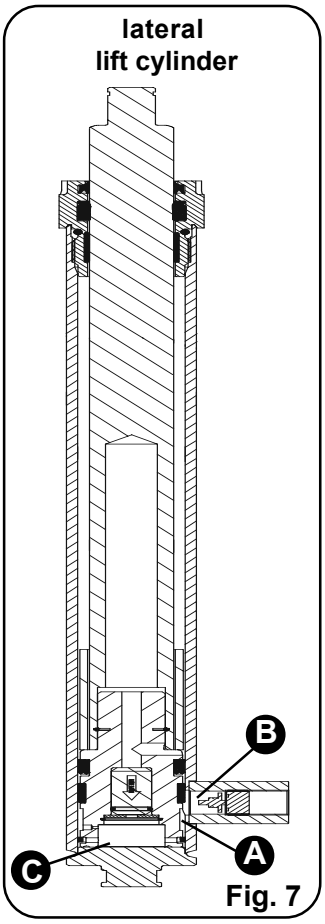


Fig. 7

OPERATION OF CENTRAL CYLINDER WITH CUSHIONING ON LIFT STROKE

The cylinder rod features a hollow core (Ref. G Fig. 8) which is terminated with a seals holder piston (Ref. F) complete with valve (Ref. E Fig. 8); the rod also features two oilways for forced oil flow (Ref. C-D Fig. 8).

Before starting the lifting movement pour 150 cc of oil inside the cylinder barrel through the plug (Ref. A Fig. 8).

During the lift stroke, when the piston (Ref. F Fig. 8) reaches its stroke limit it causes the oil previously poured into the barrel to be compressed against the bush (Ref. B) thus causing a pressure rise that causes the oil to enter the hollow core in the piston rod by way of the hole (Ref. C) thus compressing the air in the hollow core (Ref. G) and resulting in the slowing of upward movement during the final 40 mm of the stroke.

During the lowering stroke the thrust exerted by the rod decreases as the air pressure in the core decreases, thus causing the 150 cc of oil to flow out of the rod core into the cylinder barrel.

The function of the valve (Ref. E Fig. 8) is that of maintaining constant pressure in the rod cavity at the time of ingress of the oil compressed the bushing.
The valve is calibrated in order to witstand the compression of 150cc of oil.
Any excess oil unloaded to the conventional circuit through the valve.
If no deceleration occur over the final 4-5 mm of stroke this indicates that the valve has ceased functioning and must therefore be replaced.

Through prolonged use and with constant pressure changes inside the cylinder, the oil in the barrel tends to return to the normal hydraulic circuit due to infiltration past the piston seals. To counter this problem, 150 cc of oil must be poured into the cylinder barrel through the plug (Ref. A) every 500-600 duty hours.

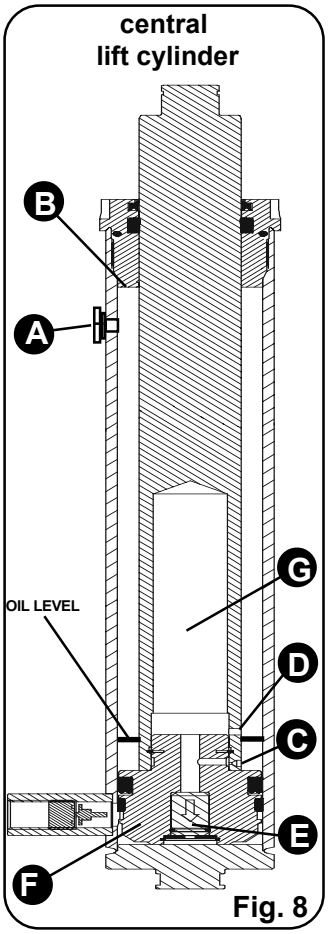


Fig. 8

## 1.14 LATERAL PLUNGER TYPE LIFT CYLINDER MODEL *HE140 - HE140R*

CYLINDER COMPONENTS

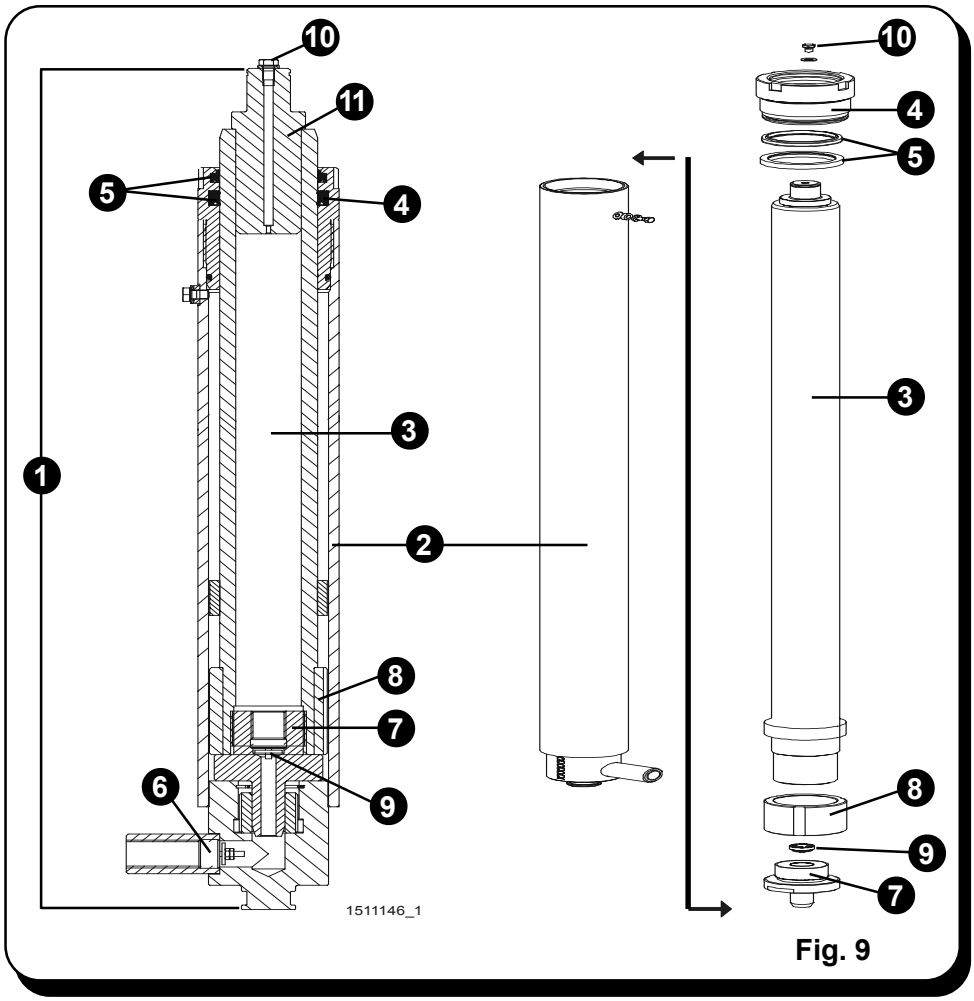



Fig. 9

## 1.15 TABLE OF LATERAL PLUNGER TYPE LIFT CYLINDER COMPONENTS

| Ref. | Component description |
|---|---|
| **1** | Complete cylinder |
| **2** | Cylinder barrel |
| **3** | Hollow rod |
| **4** | Gasket bushing |
| **5** | Set of seals for gasket bushing |
| **6** | LB hose break safety valve (prevents oil flow in the event of a hose burst) |
| **7** | Hollow rod lower plug |
| **8** | Rod guide bush |
| **9** | Valve for oil flow to rod cavity |
| **10** | Rod air bleed plug |
| **11** | Hollow rod upper plug |

**NOTE: All Hyster Part Numbers are given in the parts catalogue.**