Logic Elements, Pressure Control Functions

In the introduction to 2 way logic elements it was mentioned that these could also be used as pressure control elements. In this respect, they are effectively pilot operated pressure valves which are available in the following models:

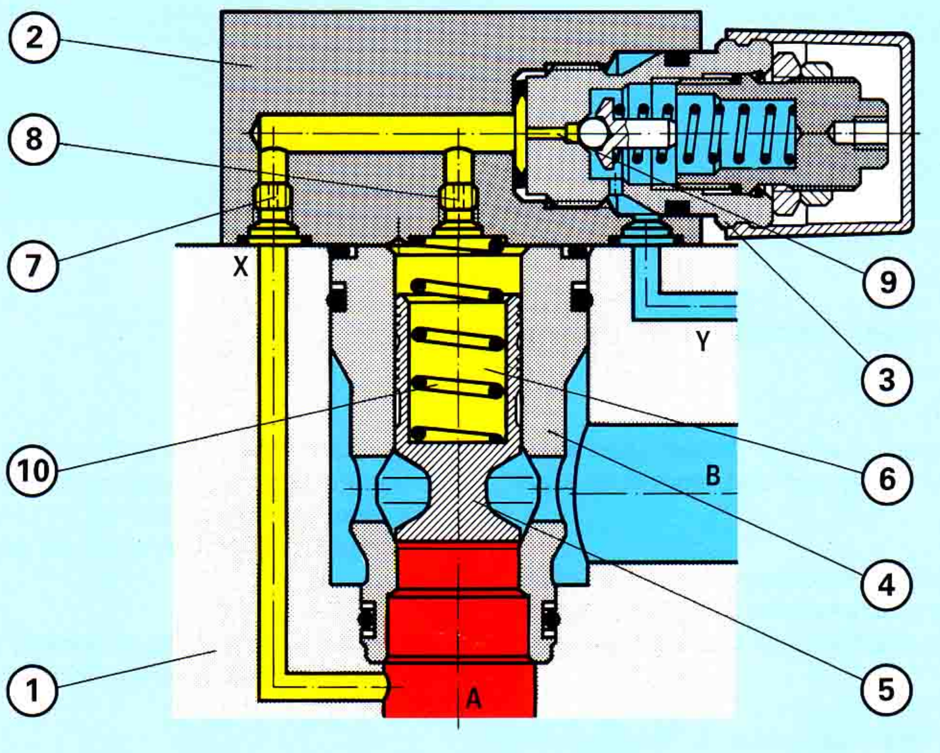
as pressure relief elements

as pressure reducing elements

as pressure sequence elements.

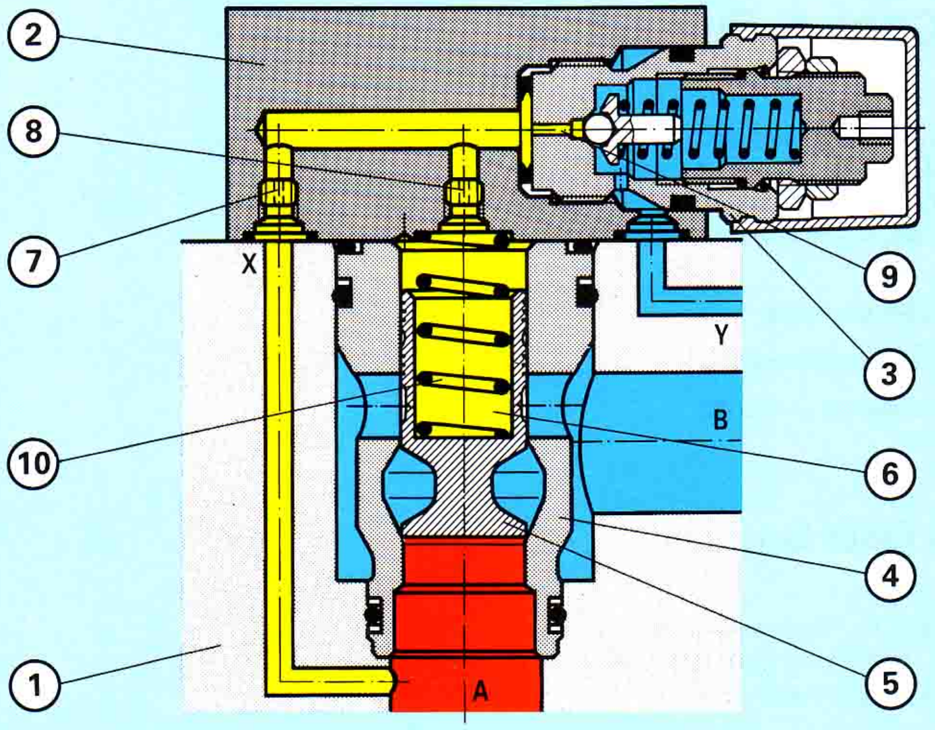
1 Pressure relief function

The cartridge element for the pressure relief function (bush (4), spool (5), and spring (10)) is available as a poppet valve or as a poppet/spool valve.



(1) Manifold block with logic cartridge (Bush, poppet valve and spring)
(2) Control cover
(3) Pilot valve (direct operated relief valve)
(4) Bush
(5) Main spool (poppet valve)
(6) Spring chamber
(7) and **(8)** Orifices in control line
(9) Control line
(10) Spring

Fig. 85: *Cartridge set with poppet element*



(1) Manifold block with logic cartridge (Bush, poppet valve and spring)
(2) Control cover
(3) Pilot valve (direct operated relief valve)
(4) Bush
(5) Main spool (poppet/spool valve)
(6) Spring chamber
(7) and **(8)** Orifices in control line
(9) Control line
(10) Spring

Fig.86: *Cartridge set with poppet/spool element*

1.1 Pressure relief function with manual pressure setting

At rest, the spool (poppet valve or poppet/spool valve) separates port A (the pressure port) from B (the tank port).

In contrast to a directional logic element, a pressure logic element for a pure pressure function, has no working area at port B. This means that the annulus area A_B is no longer present.

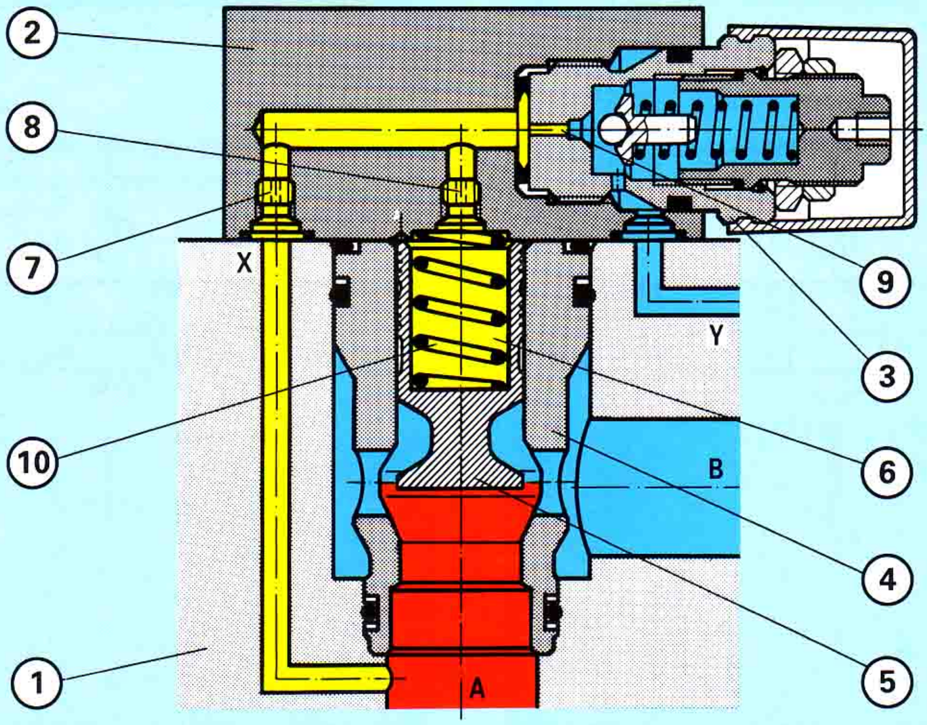
Pressure setting is via the pilot valve (3). The pilot valve itself is a direct operated pressure relief valve.

Function

Pressure present at port A passes to the pilot valve (3) via the control line *(yellow)*, orifice (7) and control line (9) and via the further orifice (8) to the spring loaded side of the main spool. At rest, i.e. when the pressure in the system is lower than the value set at the pilot valve, the same pressure is present on both ends of the spool. As the areas are the same, the forces are also equal. Spring (10) therefore holds the spool in the start position shown *(Figs. 85 and 86)* and ports A and B are separated from each other.

When the system pressure reaches the level set at the pilot valve (3), fluid flows via the orifices in the control line to tank via Y.

A pressure drop occurs across orifice (7) which causes a difference in pressure between the ends of the main spool. When the upward force produced by a product of the pressure drop and the spool area becomes greater than spring force 10, the spool moves upwards and excess fluid can flow from A to B and thus to tank. *(Fig.87)*. The pressure in port A is thus limited to the set value.



(1) Manifold block with logic cartridge (Bush, poppet/spool valve and spring)
(2) Control cover
(3) Pilot valve (direct operated relief valve)
(4) Bush
(5) Main spool (poppet/spool valve)
(6) Spring chamber
(7) and **(8)** Orifices in control line
(9) Control line
(10) Spring

Fig. 87

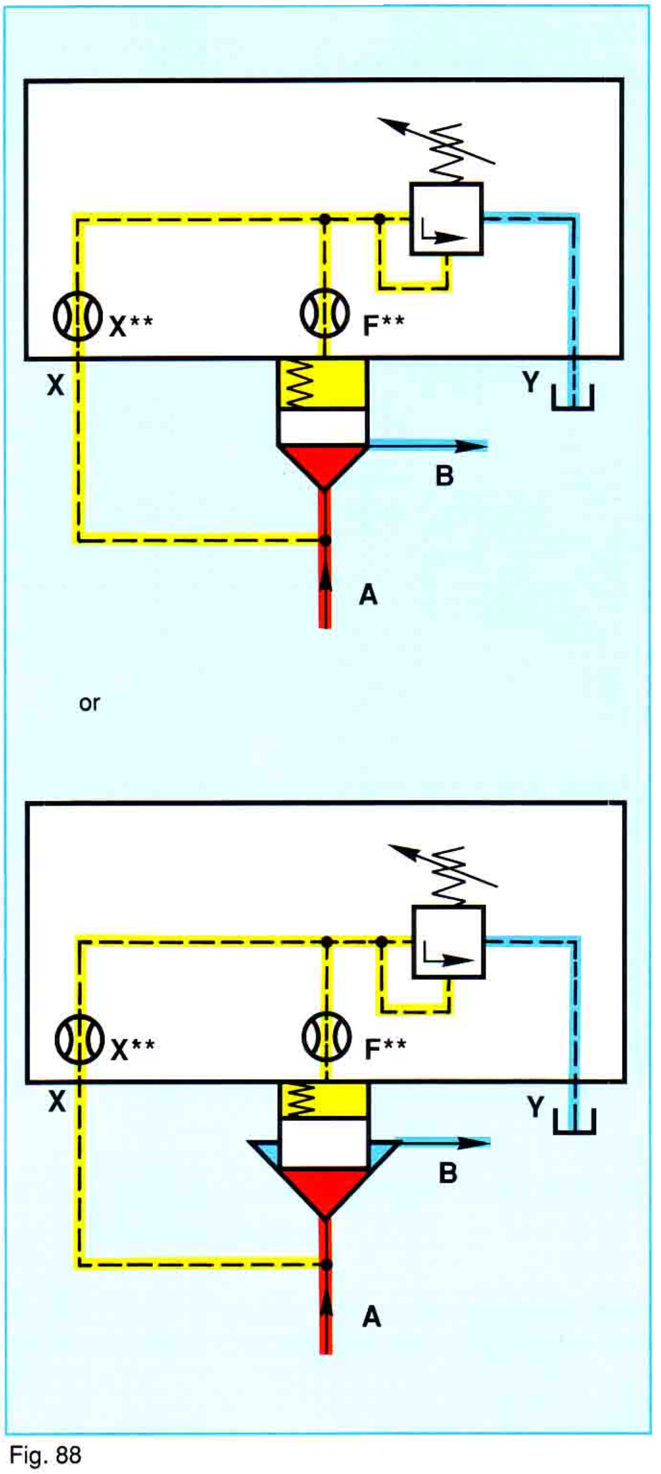


Fig. 88

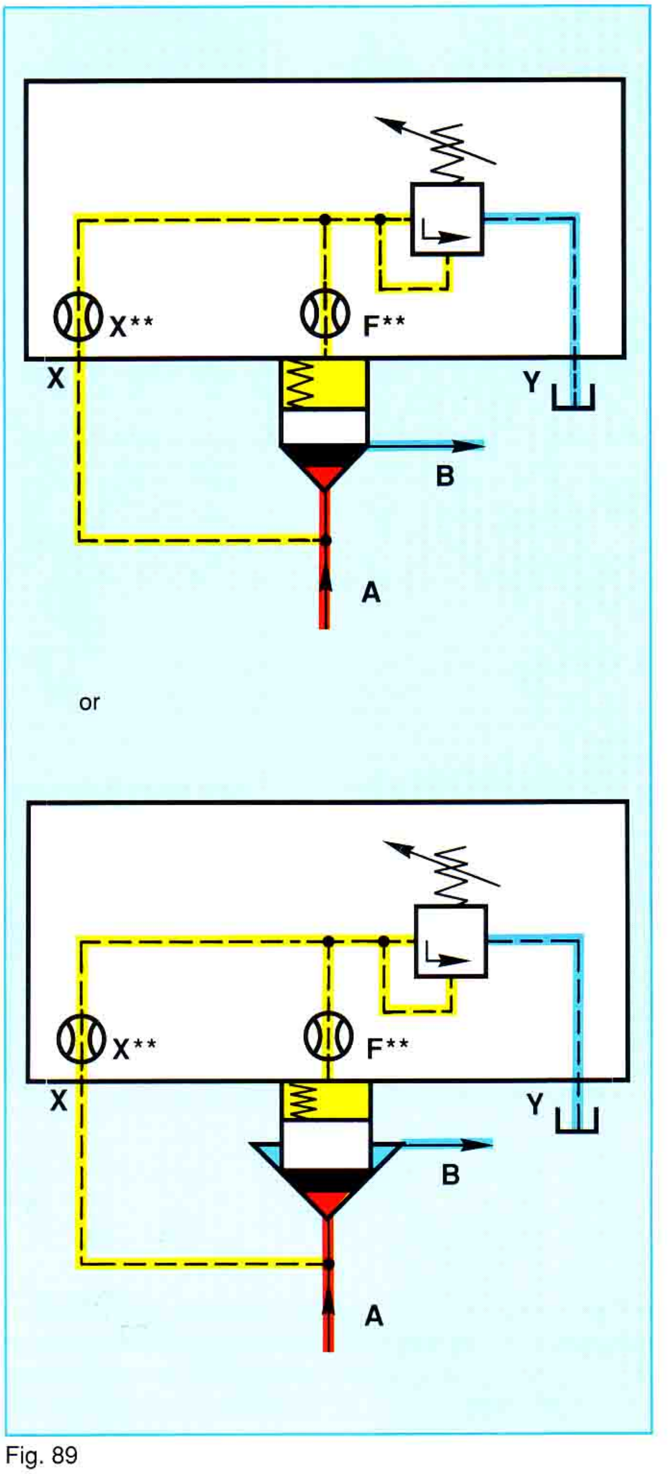


Fig. 89

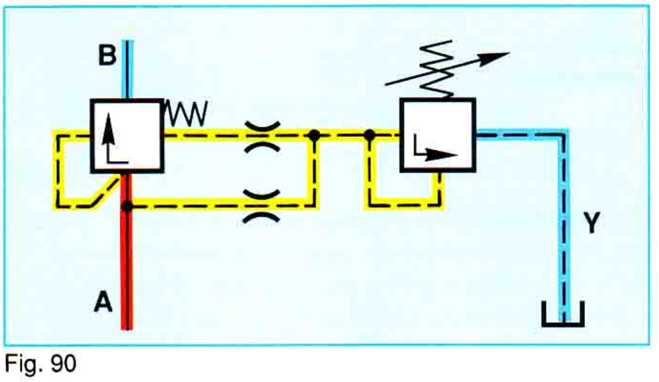


Fig. 90

Symbols for 2 way pressure logic elements with manual pressure setting

Fig. 88: *Symbol - schematic illustration - poppet valve*

Fig. 89: *Symbol - schematic illustration - poppet/spool valve*

Fig. 90: *Symbol - to DIN/ISO 1219 - poppet valve and poppet/spool valve.*

** = Orifice

What differences are felt in the system when using the poppet and poppet/spool valve configurations.?

Poppet valves

For low pressure by-pass situations, the poppet valve has a lower resistance to flow than the poppet/spool valve.

Poppet/spool valves

This design gives smoother operation i.e.a lower level of unloading shock when switching to low pressure by-pass.

The disadvantage is that the valve does not open immediately when the pressure rises rapidly and therefore pressure peaks must be expected .

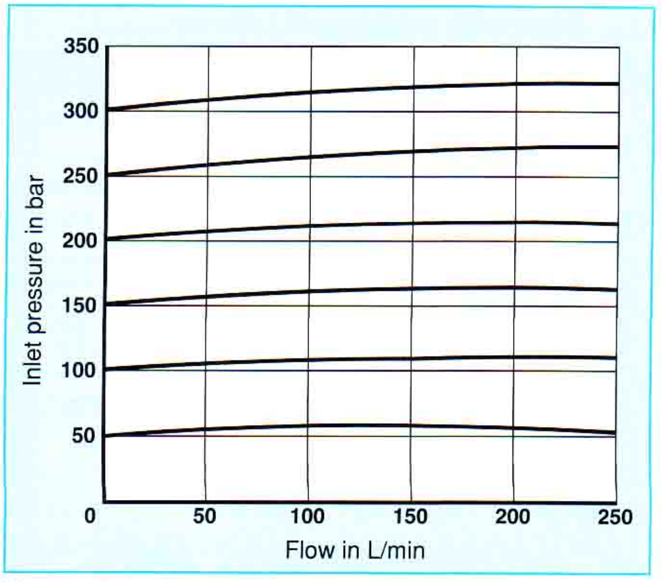


Diagram 5

Choice of springs

The preferred model has a spring corresponding to a cracking pressure of 2 bar at the main spool.

In addition to this, also as standards, variations are available without a spring or with a cracking pressure of 4 bar. Versions with cracking pressure of 5 or 8 bar are also possible. However, a special cover or a spacing piece is normally required for these in order to accommodate the larger spring.

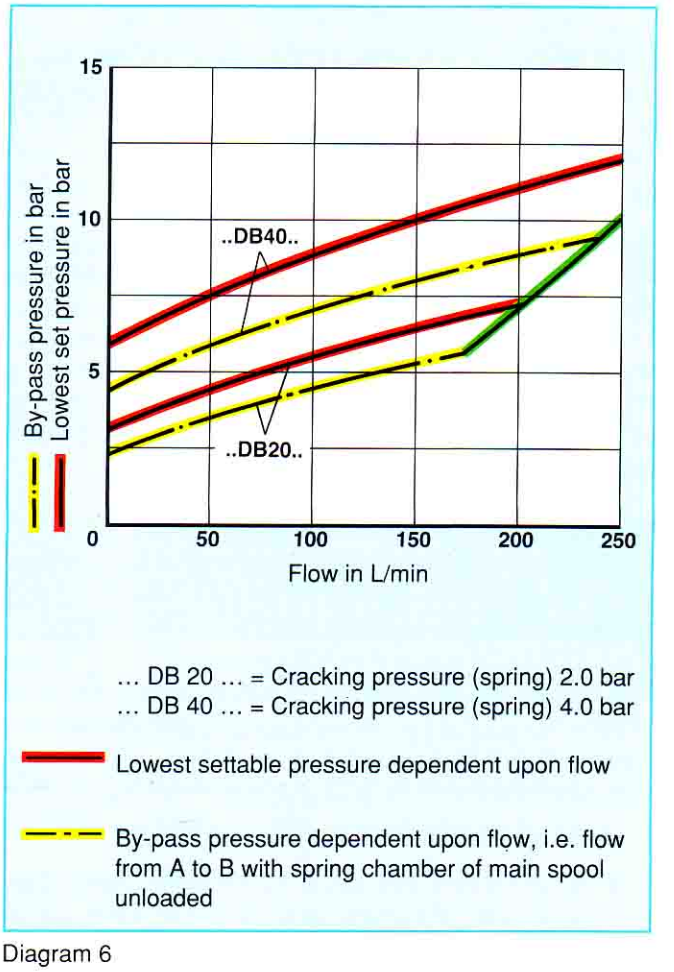


Diagram 6

Sizes and technical data

Pressure logic elements are available as pressure relief elements in sizes 16,25,32,40,50,63,80, and 100. These correspond to maximum flows between 250 and 7000 L/min.
As an example, *diagrams 5 and 6* show the curves for a size 16 element with manual pressure setting.

a) Model with poppet valve element.

The measurements were taken with no back pressure in the pilot line, i.e. with pilot port Y connected separately to tank. When Y and B are interconnected, the inlet pressure is raised by the pressure present in port B.

Diagrams 5 and 7 show the inlet pressure curves dependent on flow for the selected pressure settings.

b) Model with poppet/spool element

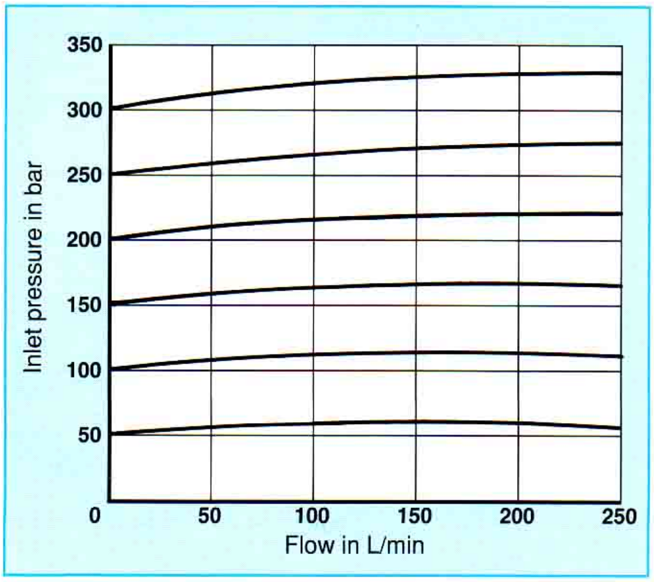


Diagram 7

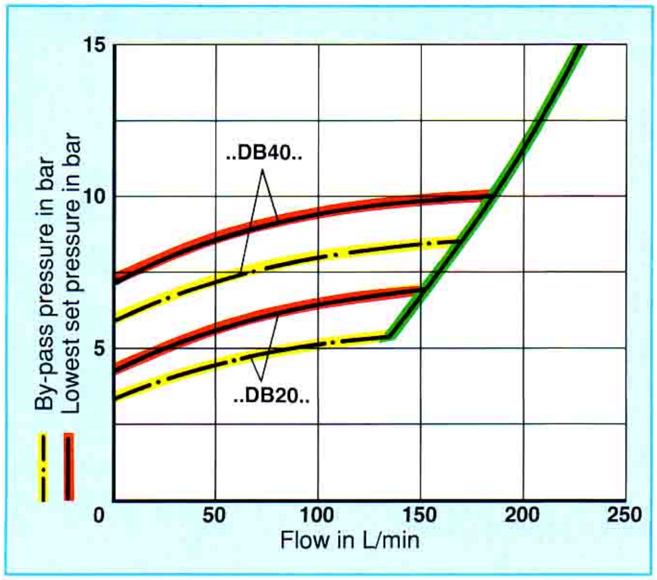


Diagram 8

If one compares the curve in *diagram 6* with that for a poppet/spool element *(diagram 8)*, the higher resistance to flow already mentioned is confirmed.

Orifices

The orifices shown in the control lines in the sectional diagrams and symbols are standard screw-in orifices. They are selected with relation to one another to suit the particular size of valve. The overview shown on this page shows an example of the orifice diameters in mm installed by Mannesmann Rexroth and also where they are placed within the control cover.

The flow pilot oil flow and with the valve operating characteristics are influenced by a single orifice, i.e. the opening and closing of the main spool are influenced by the arrangement of the damping orifices.

The orifices are arranged in the valve cover in 90 % of cases.

The advantages of this system are as follows:

- relatively easy access if they are blocked
- in certain cases the orifice size maybe changed in order to alter the characteristics of the valve. i.e. a change in pilot fluid flow.
- modifications on site are easily carried out.

In principle it is also possible fit the orifices in the main block or in the main spool.

As may be seen in *Fig. 4*, orifices X or D are selected according the size of the valve.

Orifice / Size	16	25	32	40	50	63	80	100
X **	0.8	0.8	—	—	—	—	3.0	3.0
F **	1.0	1.0	1.2	1.2	1.2	1.5	2.5	2.5
D **	—	—	0.8	1.0	1.2	1.5	—	—

Table 4

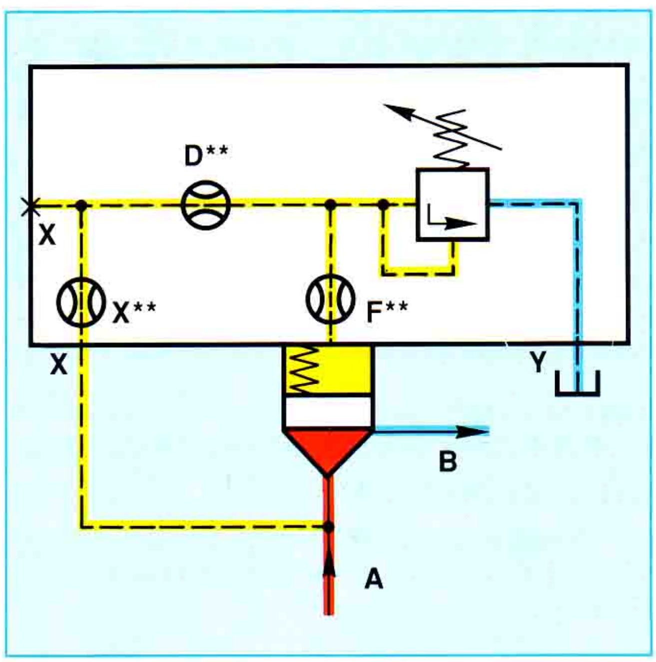


Fig. 91 ** = Orifice

In addition, there is a variant with an orifice in the main spool (usually drilled).

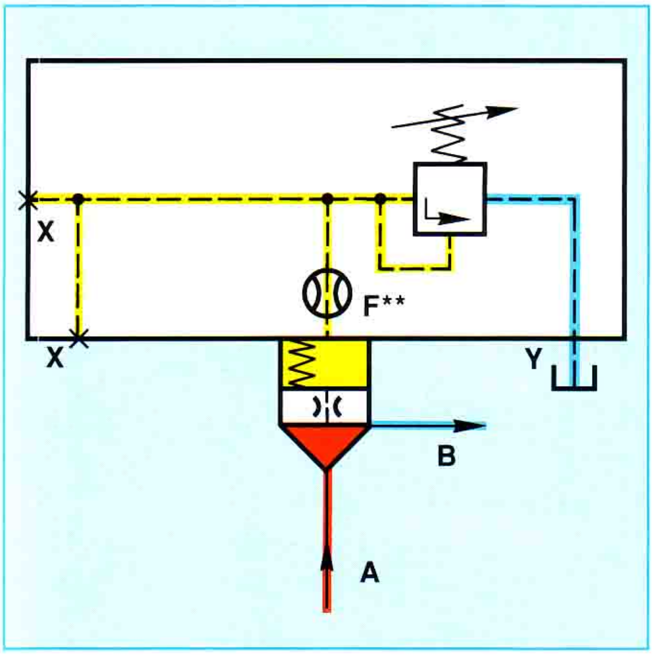


Fig. 92: Symbol - schematic illustration
** Orifice

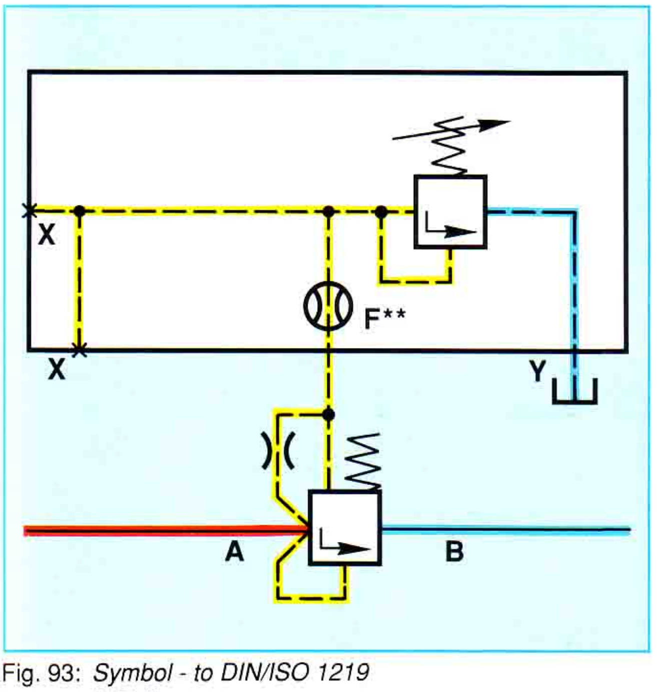


Fig. 93: *Symbol - to DIN/ISO 1219*
** Orifice

The advantages of this are:

- good bleeding irrespective installation position
- avoidance of oscillations due trapped air
- some saving of space as the X port is no longer required.

In principle, the orifice diameter is the same as X or D.

1.2 Pressure relief function with manual pressure setting and unloading via a directional valve.

Pressure relief function in the start position
(Figs. 94, 95 and 96).

If a directional valve (8) is installed correctly, it is possible to unload the spring chamber (6) of the main spool (5). In the start position, pressure at A is present via orifices X and D in the the pilot line (yellow) of the pilot valve (3) and at the same time via orifice F in spring chamber (6) of the main spool.

At the directional valve (8), port B is blocked (in the cover). We therefore have the pressure relief function. By operating the directional valve to position "a", spring chamber (6) is unloaded to port Y (tank) via orifices F, D and P. Only orifice P is effective when unloading.

As may be seen from *table 5*, orifice X is smaller than orifice P and the main spool can open fully (passive control). The "by-pass" pressure is mainly dependent upon spring (7), but the selection of the orifices is also important.

From *table 5* and also figures 94 to 101, it can be seen that dependent upon the size of the element and the pilot valve employed, different orifice sizes and arrangements and pilot drilling arrangements are used.

Orifice \ Size	16	25	32	40	50	63	80	100
X **	0.8	0.8	0.8	—	—	—	3.0	3.0
F **	1.0	1.0	1.2	1.2	1.2	1.5	2.5	2.5
D **	0.8	0.8	1.0	1.0	1.2	1.5	—	—
P **	1.0	1.0	1.0	1.2	1.5	1.8	3.5	3.5
A **	—	—	—	0.8	0.8	1.0	1.2	1.5
B **	—	—	—	—	—	—	3.0	3.0

Table 5 ** Orifice diameter in mm

With the pilot fluid arrangement shown in *Figs. 94 to 101* (which is employed for sizes 16,25 and 32) the arrangement is known as a "passive control". In this control, pilot fluid flows continuously when the valve is unloading.

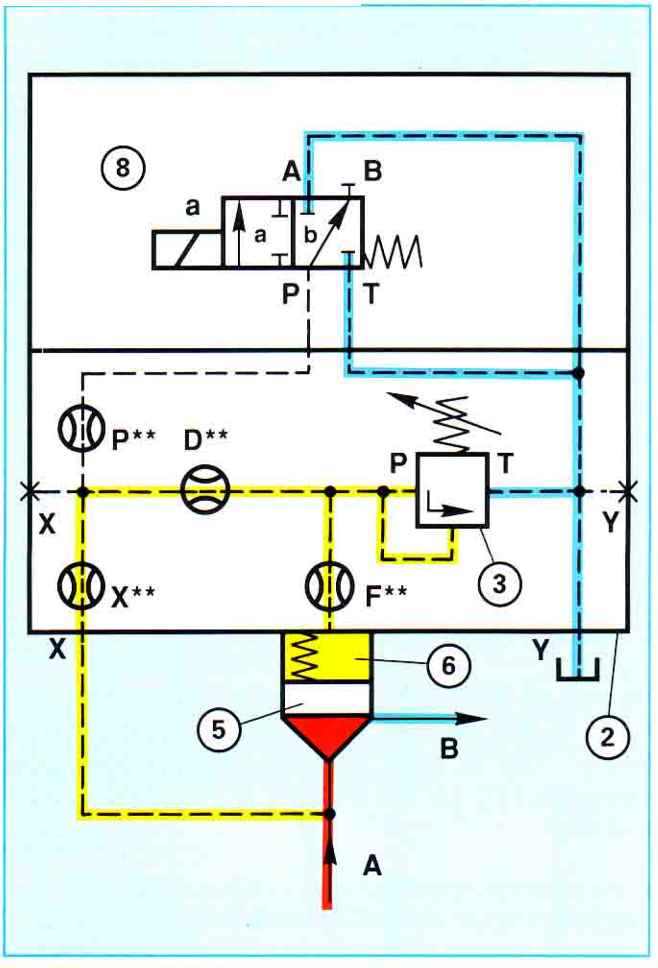


Fig. 94 ** = Orifice

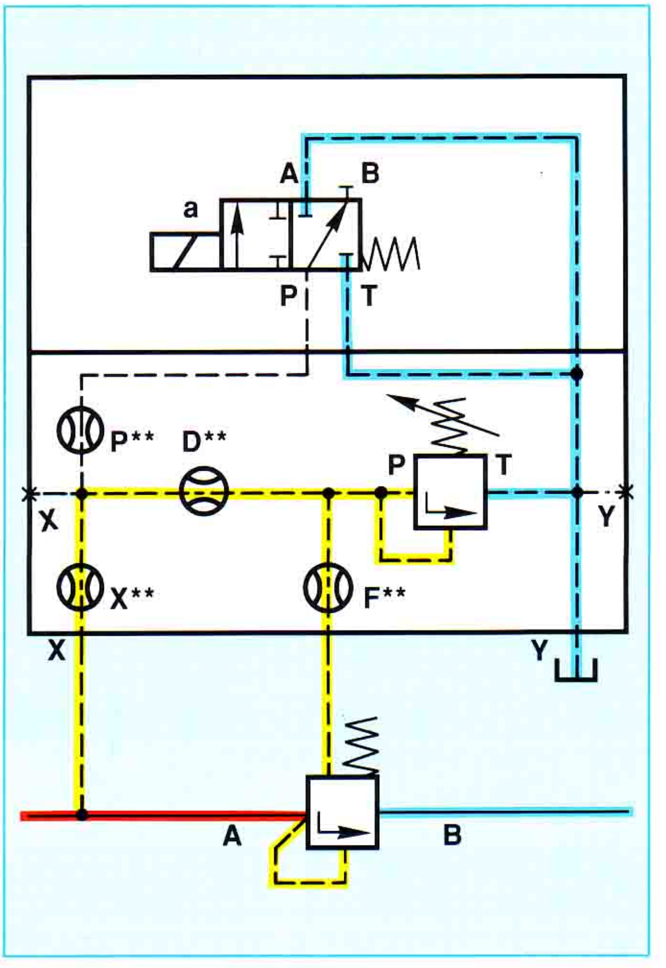
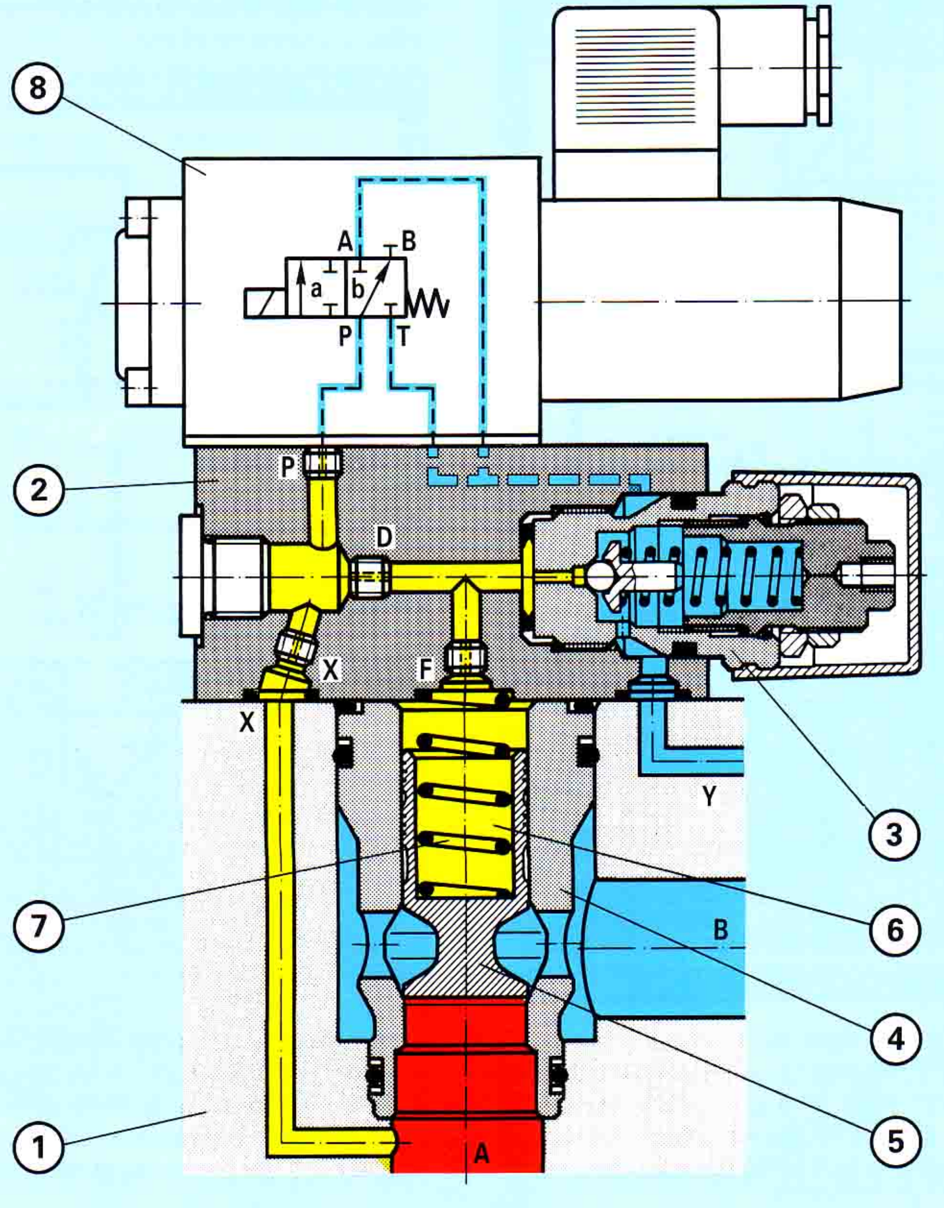


Fig. 95 ** = Orifice



(1) Manifold block
(2) Control cover with orifices X, D, F and P and also pilot valve
(3) Pilot valve
(4) Bush
(5) Main spool (in this case, a poppet valve)
(6) Spring chamber
(7) Spring
(8) Directional valve

Fig. 96

During the unloading operation (connection P to A in the directional valve) fluid also flows via orifice D from the spring chamber and via orifice X from the pressure side to orifice P. The small amount of fluid flowing from the spring chamber ((6) in *Fig. 96*) is increased by the flow of fluid from the feed orifice X.

More fluid is thus available to damp the unloading shock. Damping orifices (D and P) must not be made too small.

This is an advantage of "passive control" which is used up to size 32 *(compare Figs. 99 to 101)*.

Under "passive control", it is important that the pilot fluid drillings and the pilot valve permit more fluid to flow away than can flow into the system via orifice X.

Normally open - i.e. normally by-passing.

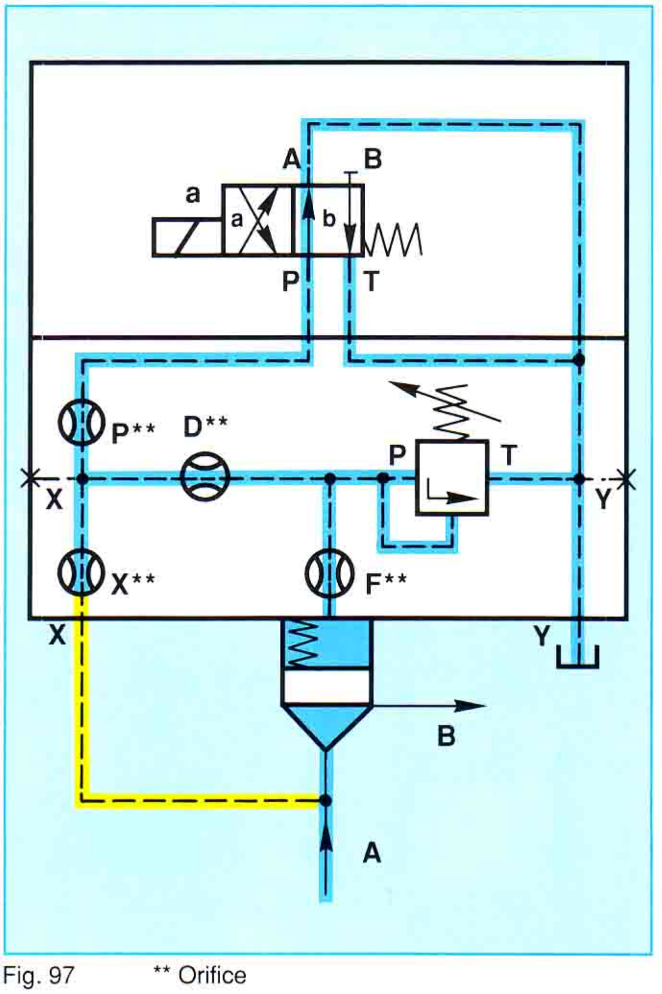


Fig. 97 ** Orifice

As illustrated in *Fig. 97*, dependent upon the choice of directional valve, it is possible to have a low pressure by-pass in the start condition. The spring chamber is unloaded to tank via the control line via orifices F, D and P and by the connection P to A in the directional valve.

When the directional valve is operated to position a, the connection between the control line and the tank is broken. (as port B of the directional valve is blocked). The valve now acts as a relief valve.

Pressure relief function with manual pressure setting and unloading via a directional poppet valve.

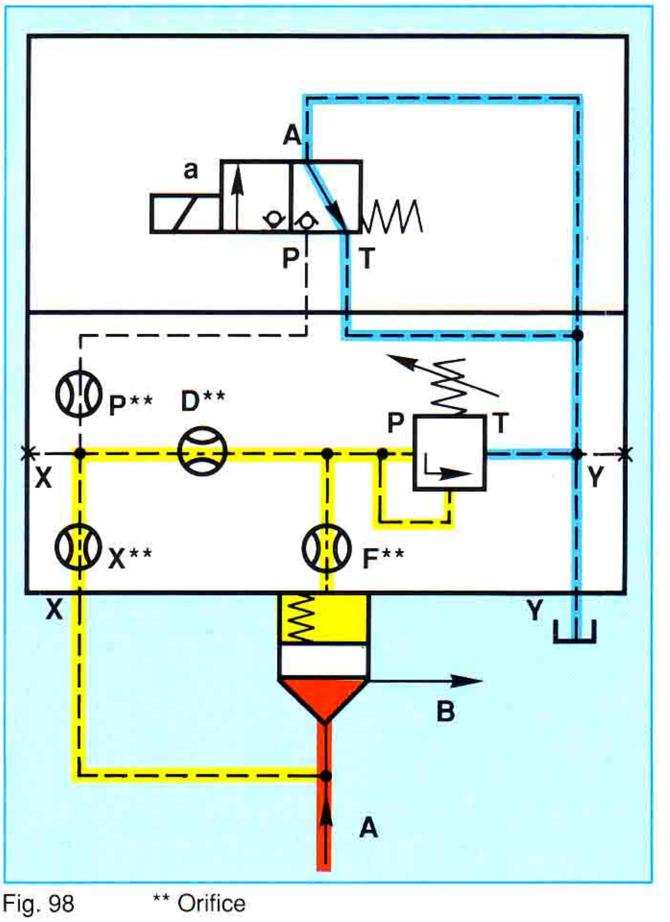


Fig. 98 ** Orifice

If a directional poppet valve is used instead of a directional spool valve, leakage via the pilot valve is avoided. In addition, dependent upon the pressure rating of the pilot valve, pressure ratings up to 420 bar (sizes 16,25 and 32) or up to 400 bar (sizes 40 to 100) are possible.

However,some leakage is still present at the main spool.

For larger sizes and with the larger flows involved, an "active control" can be employed *(Figs. 99, 100 and 101)*. In this case no additional pilot fluid flows when the valve is unloaded. Instead, only during the opening operation is fluid caused to flow directly to tank from the control chamber. The pilot line from X is blocked.

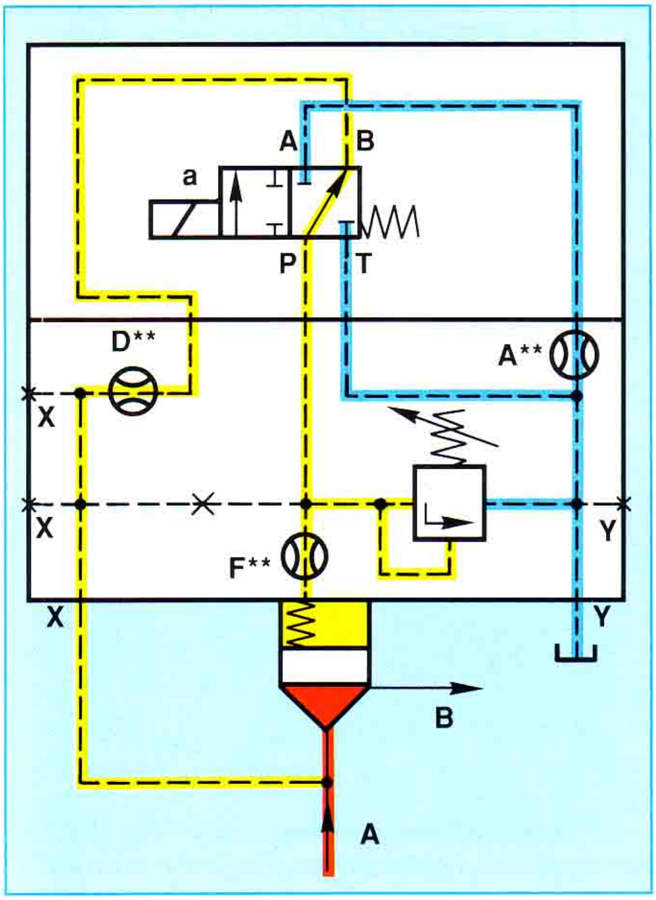


Fig. 99: *Sizes 40,50, and 63*
** = orifice

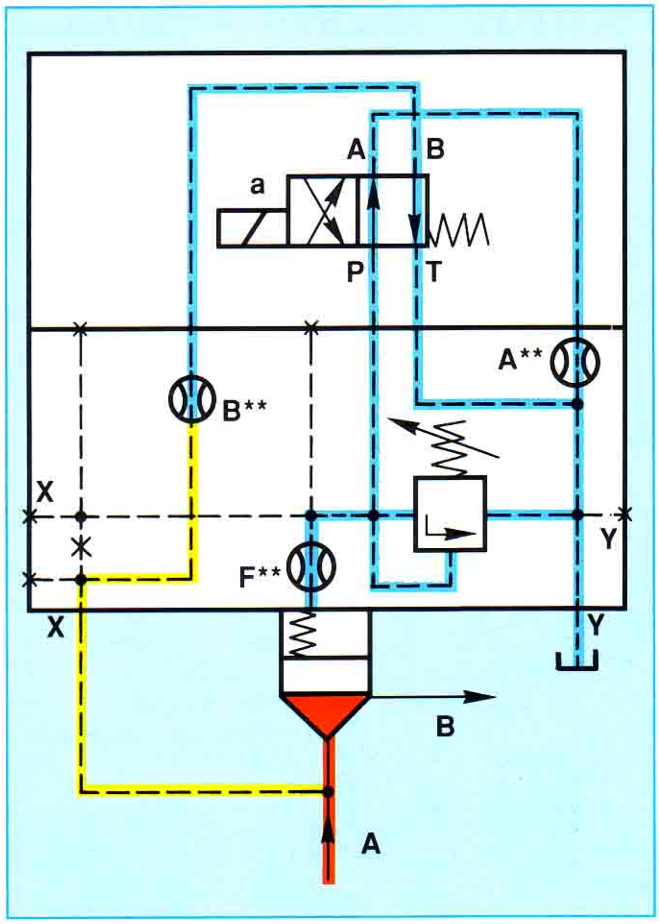


Fig. 100: *Sizes 80, and 100*
** = orifice

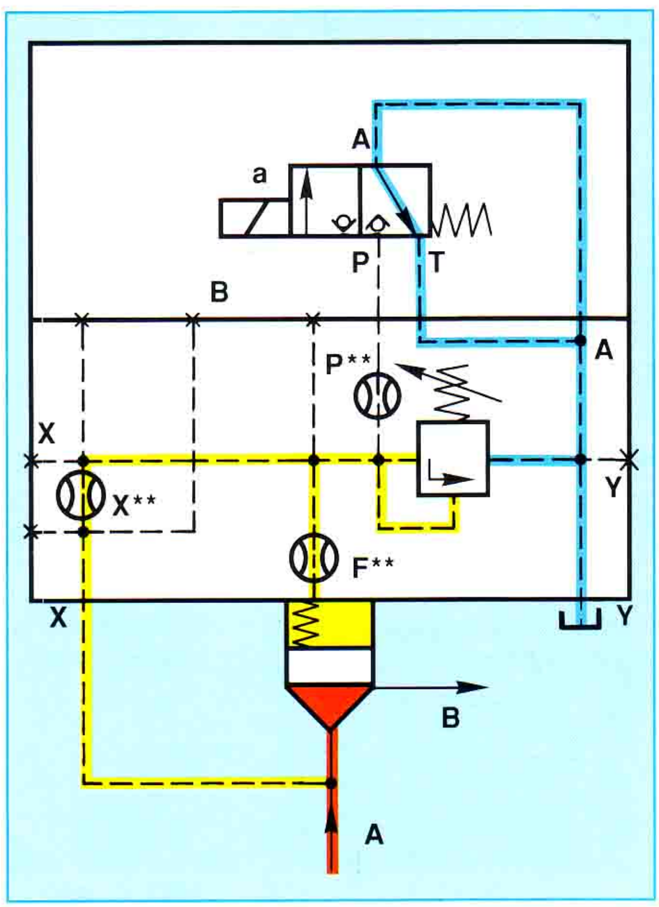


Fig. 101: *Sizes 80, and 100*
** = orifice

1.3 Pressure relief function with manual pressure setting and blocking function

Directional valve with a blocking function in the start position .

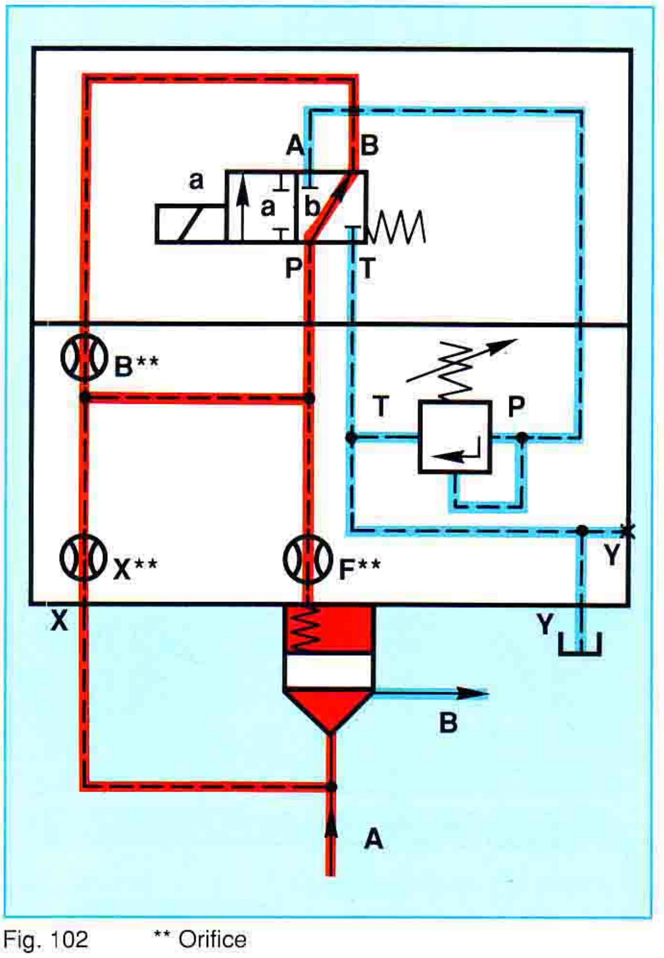


Fig. 102 ** Orifice

In the circuit shown in *Fig. 102*, a blocking function is obtained in addition to the relief function. In the start or rest position, pressure from port A of the logic element is also present on the spring loaded side of the main spool via control drilling *(port X, red)*. The direct operated pressure relief valve is isolated from the control line and is therefore inoperative.

The main valve is closed no matter what pressure is present at port A. When the directional valve is operated (solenoid a energised) the pilot line *(red)* is once more connected through the directional valve (P to A).

Pressure in the control line is now limited by the pilot valve and the logic element acts once more as a relief valve.

Directional valve in the start position: Pressure relief function

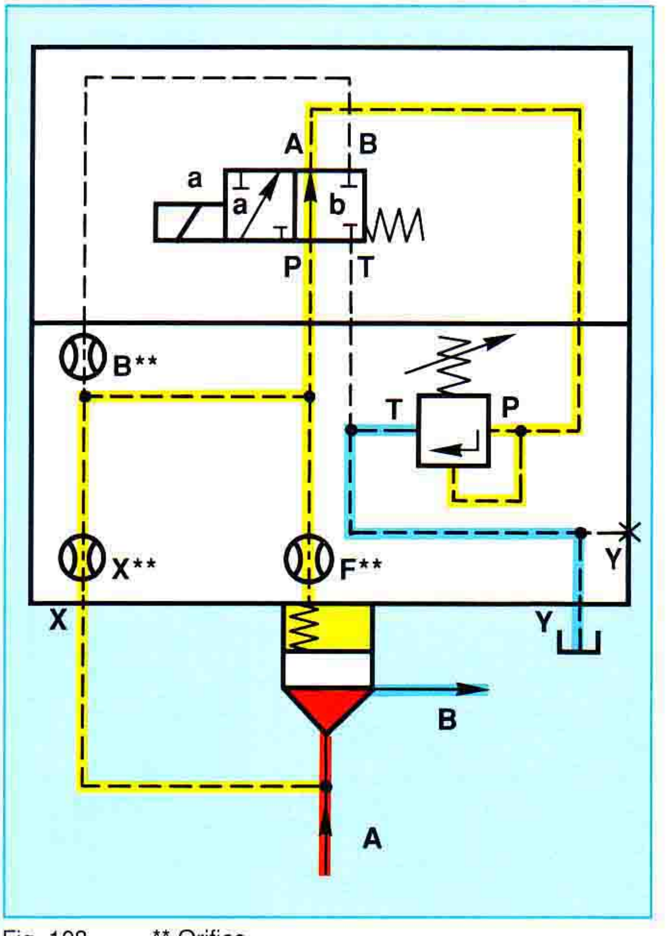


Fig. 103 ** Orifice

In comparison with the example shown in *Fig. 102*, the start position of the directional valve is now reversed.

The pressure relief function is obtained in the start position and the blocking function with the valve in position a.

Pressure relief, unloading and blocking

By utilising a 4/3 way valve as the pilot valve —with P, A and B connected in the neutral position— it is possible to achieve pressure relief, unloading and the blocking function.

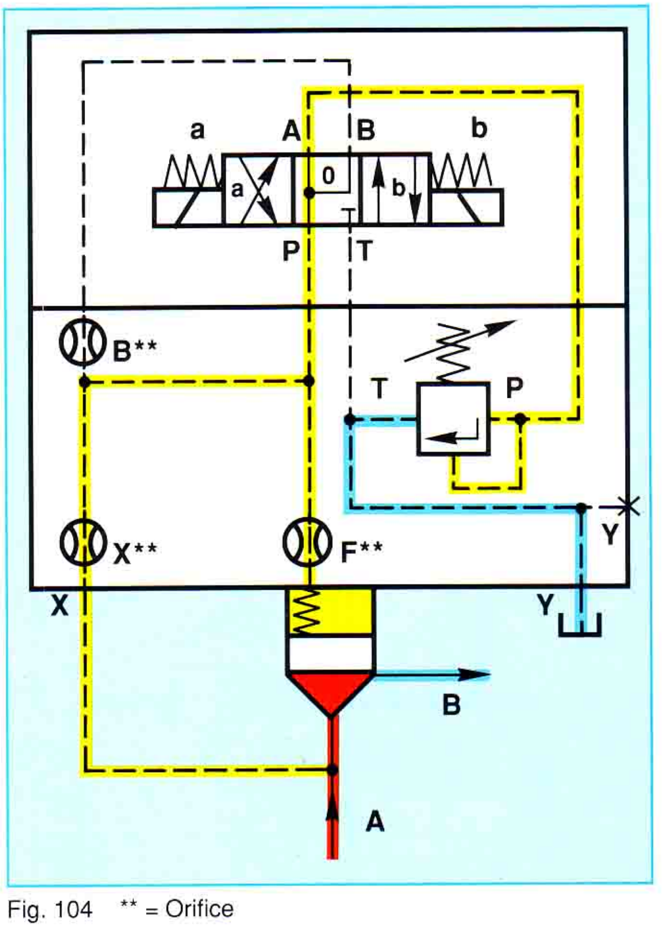


Fig. 104 ** = Orifice

Valve in neutral = Pressure relief function *(Fig. 104)*

With the directional valve in the neutral position, the logic element acts as a relief valve as a connection to the direct operated relief valve is established through orifices X and F and the control line.

Valve in position a = Blocking function *(Fig. 105)*

When the directional valve is in position a, (solenoid a energised), the pilot valve is isolated from the control line (red) and is connected to tank.
The same pressure is present at both sides of the main spool and port A is closed by the spring.

Valve in position b = Unloading function *(Fig. 106)*

When the directional valve is in position b, (solenoid b energised), both the pilot relief valve and the spring chamber of the main valve are connected to tank. Fluid may now flow at nominally zero pressure from A to B. The cracking pressure is dependent upon the the spring employed.

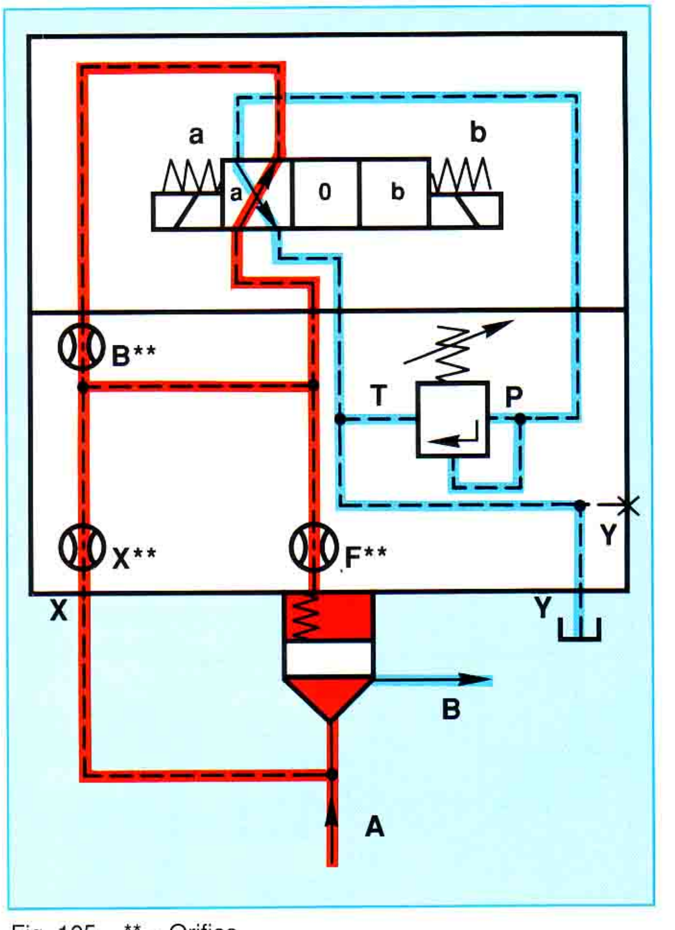


Fig. 105 ** = Orifice

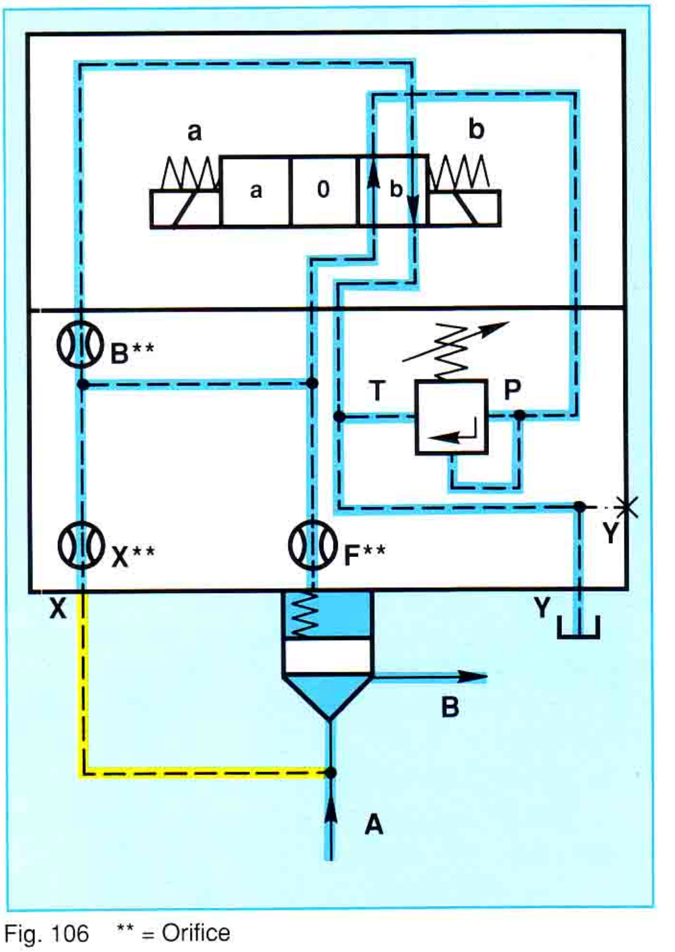


Fig. 106 ** = Orifice

1.4 Pressure relief function with two pressure settings

With this combination of components, it is possible to select two pre-set pressures, DB_1 and DB_{max} by means of a 4/2 way directional valve.

Directional valve in start position, pressure DB_1 *(Figs. 107 and 108)*

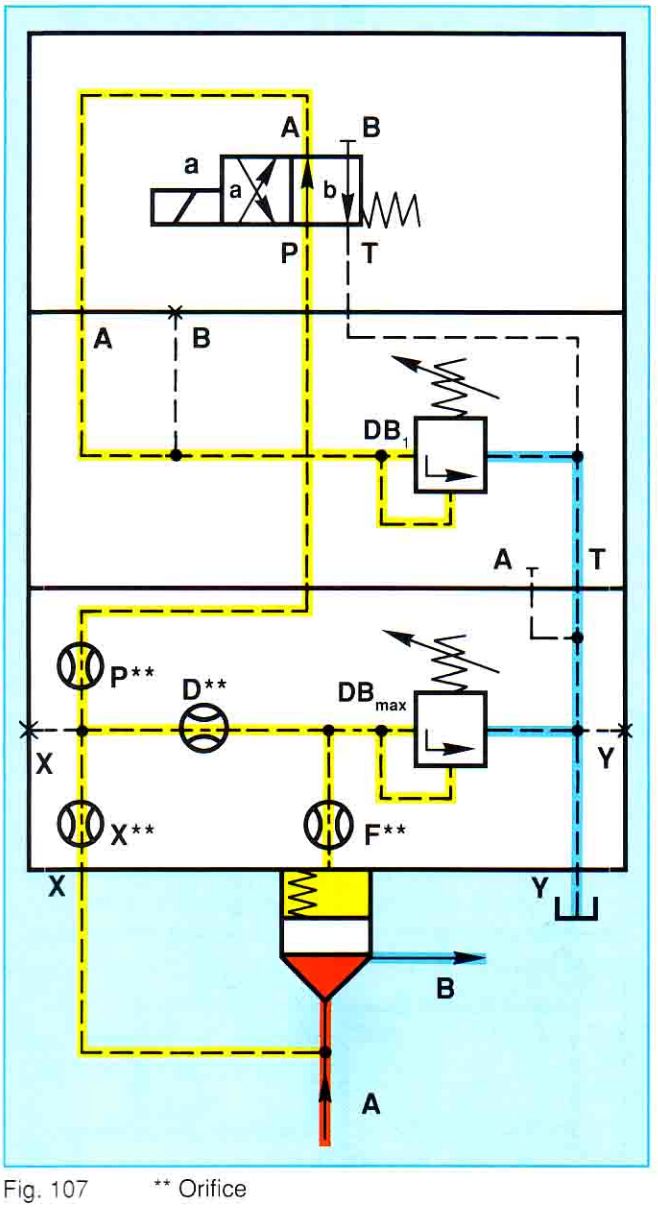


Fig. 107 ** Orifice

The pressure in port A (red) of the logic element is also effective at the following points:

- the control line (yellow) via orifices X and D at the pilot valve DB_{max}
- via orifice F in the spring chamber of the logic element
- via orifice P and the 4/2 way valve (P to A) at the pilot valve DB_1.

The maximum system pressure is set at pilot valve DB_{max} and the second pressure required is set at pilot valve DB_1.

The pressure set at valve DB_1 must be lower than that set at DB_{max}, as the latter always has a direct connection to the circuit.

In the start condition shown *(Figs. 107 and 109)*, the main spool reacts to the pressure set at DB_1.

With the directional valve in position a, the connection to pilot pressure relief valve DB_1 is interrupted. Thus only pilot pressure relief valve DB_{max} is operative. Maximum system pressure may then occur.

Directional valve in the start position, pressure DB_{max}. *(Fig.108)*

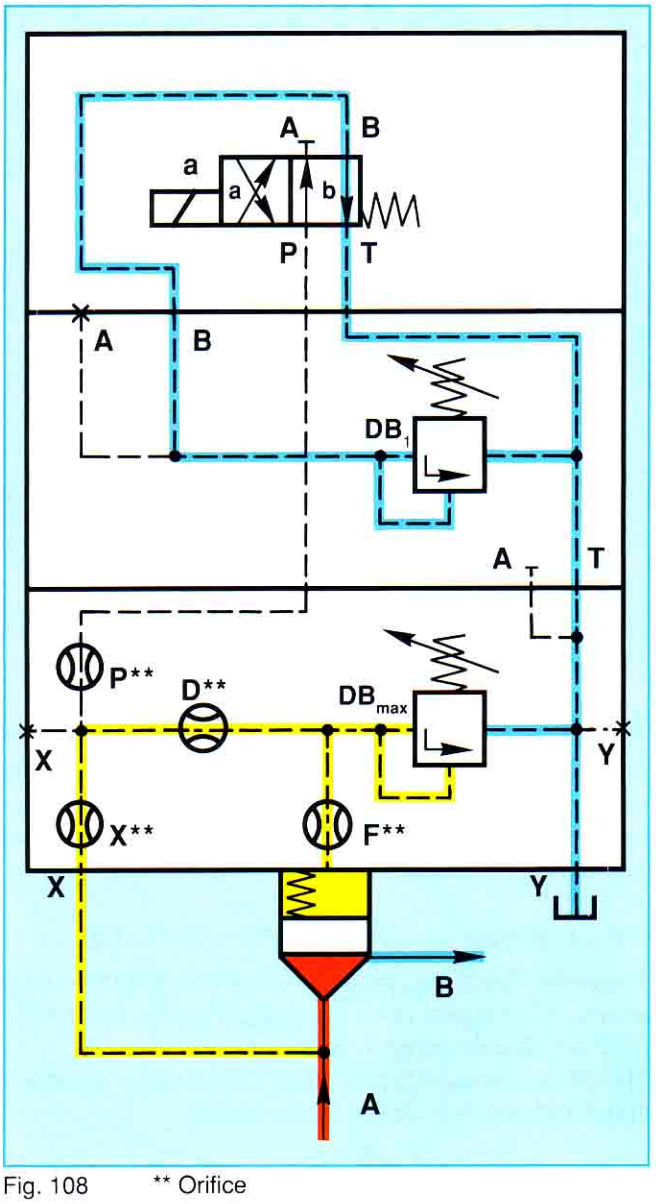


Fig. 108 ** Orifice

When port A of the 4/2 way directional valve is closed and port B is connected to the control line DB_1, then pressure DB_{max} is effective in the start position. When the directional valve is now moved to position a, DB_1 is connected is also connected to the control line *(yellow)* (via P to B). The pressure in the system is now limited to the setting of DB_1.

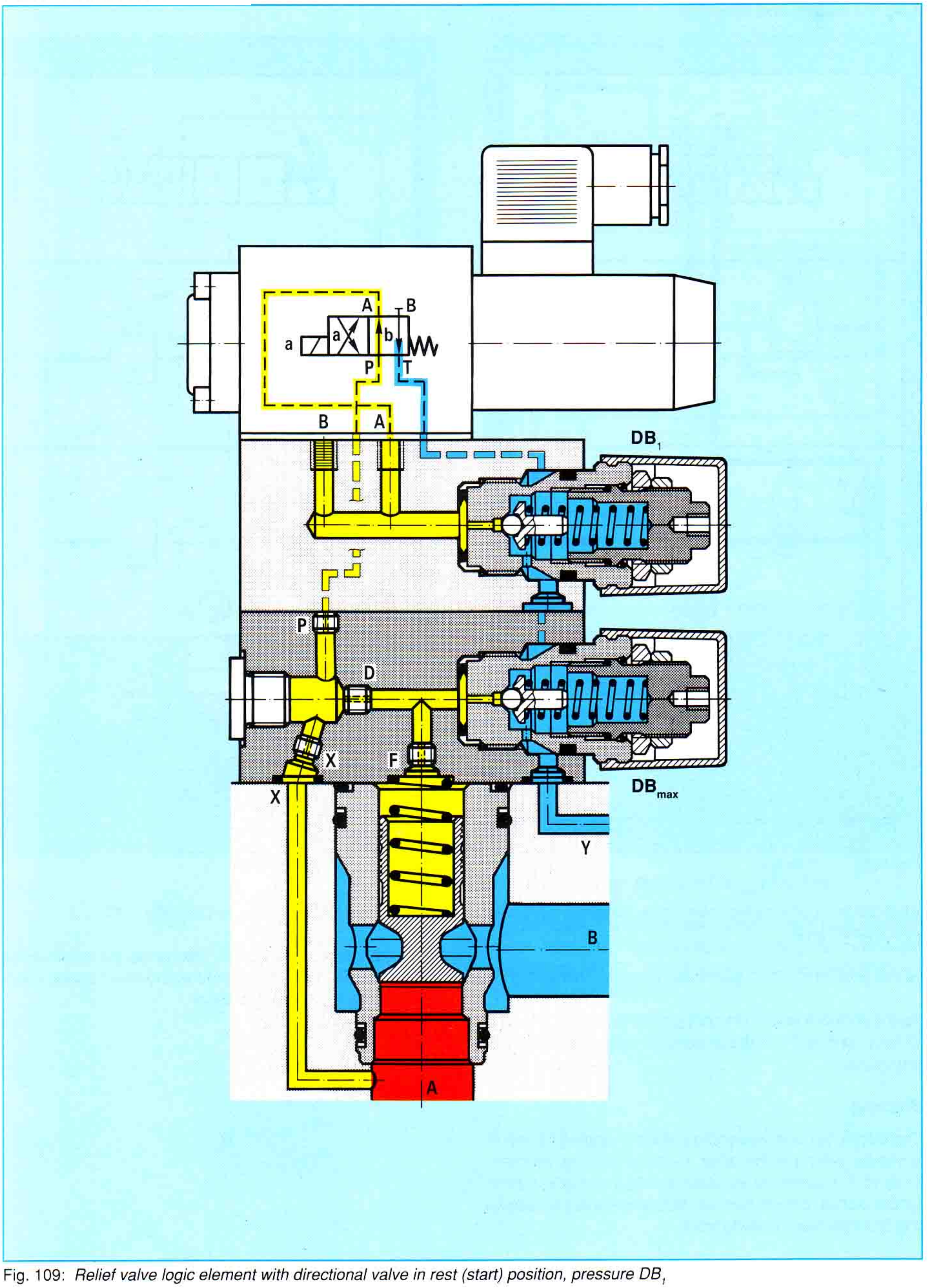


Fig. 109: *Relief valve logic element with directional valve in rest (start) position, pressure DB_1*

Two Pressures and Unloading

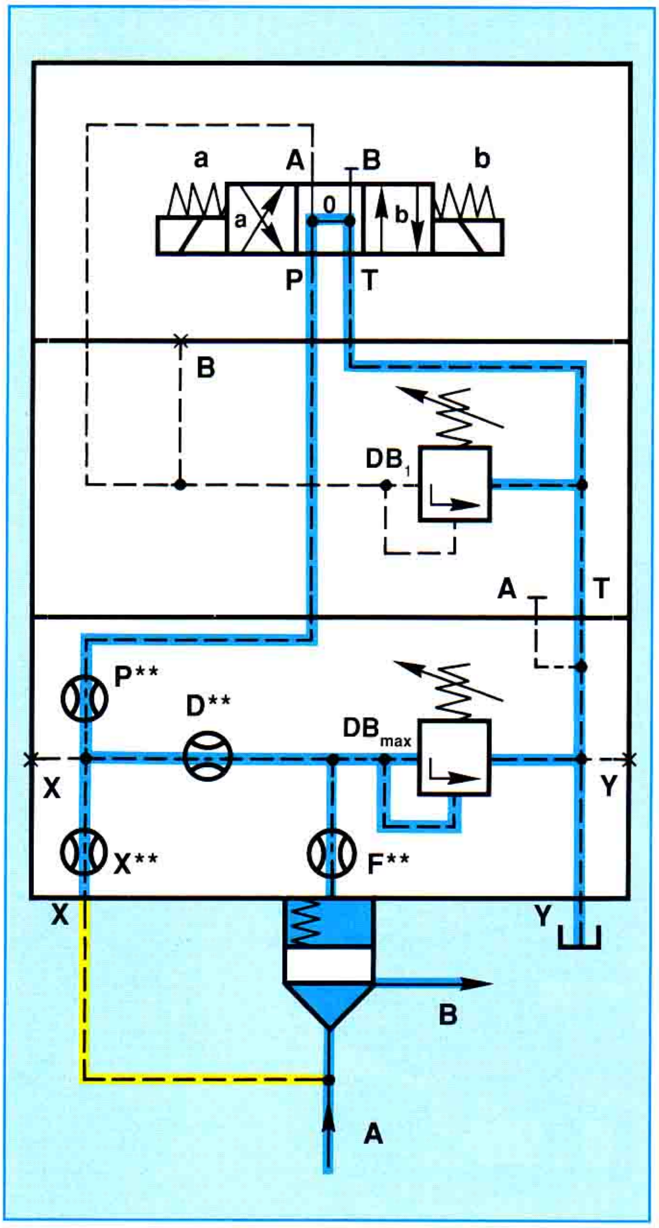


Fig. 110 ** Orifice

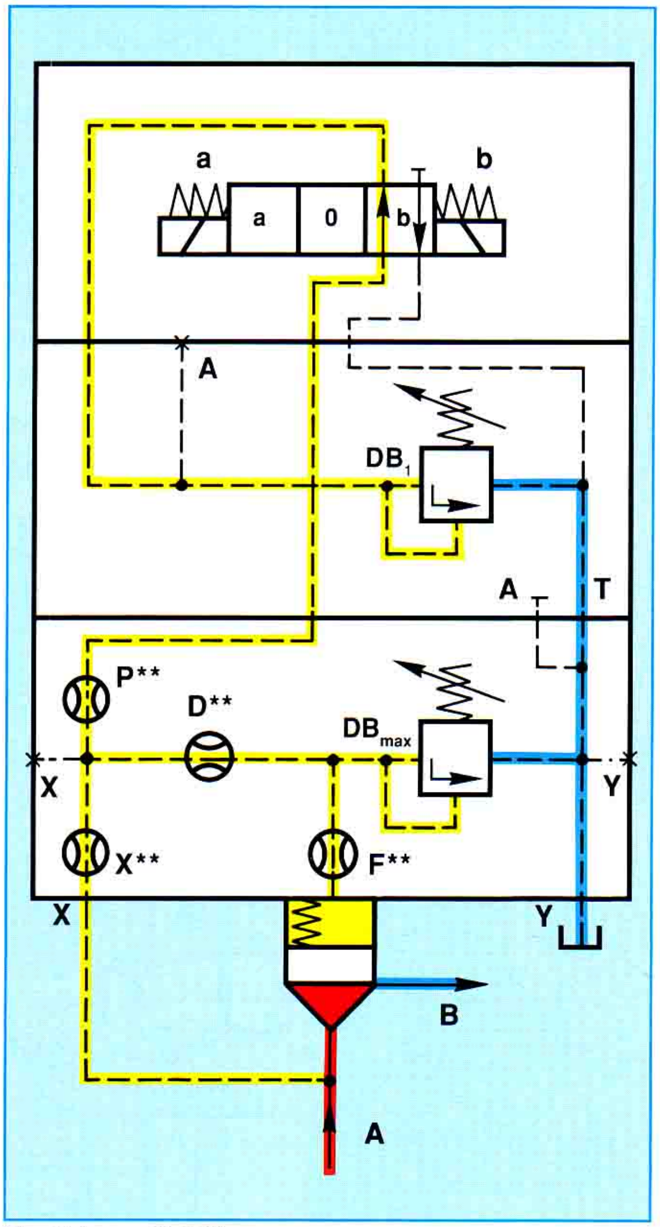


Fig. 111 ** Orifice

An extra function may be obtained by installing a 4/3 way directional valve.

Spool position 0 = low pressure by-pass (unloading)

As the control line and the spring chamber are connected to tank via P and T in the directional valve, the system is unloaded.

Warning

The circuit has a disadvantage when changing from one pressure setting to the other, in that it will drop momentarily to low pressure by-pass during the change-over. Under certain circumstances, this is not only be disturbing, but can also be dangerous.

Spool position b = Pressure DB_1 *(Fig. 111)*

With the spool in position b, both pressure relief valves DB1 and DB_{max} are connected to the main spool. Pressure DB_1 is therefore operative.

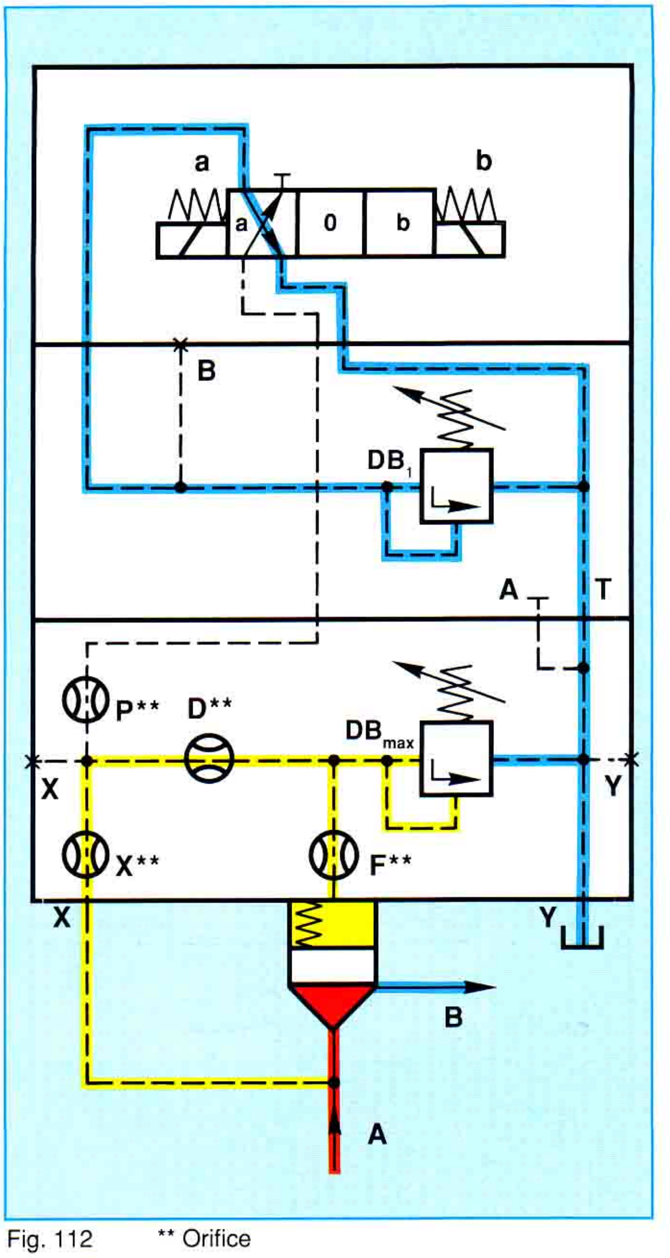


Fig. 112 ** Orifice

Spool position a= pressure DB_{max} *(Fig. 112).*

Spool position a blocks the connection to pilot pressure relief valve DB_1. The pressure in A (red) can now reach the setting of DB_{max} and the maximum system pressure has now been selected.

1.5 Pressure relief function with 3 pressure settings - maximum pressure + two electrically selectable pressure settings.

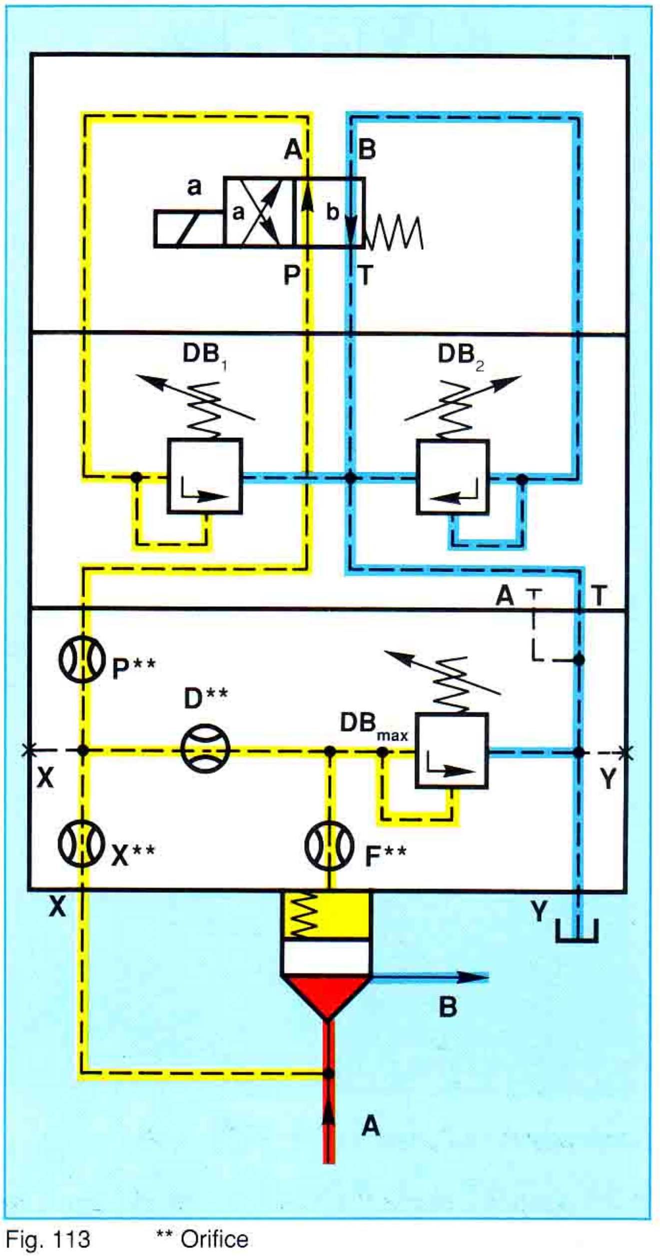


Fig. 113 ** Orifice

By selecting various directional valve configurations, a number of optional functions may be obtained.

The version shown in *Fig. 113* could be described as the "standard" version, in that it is most widely used. This system has two truly selectable pressure settings DB_1 and DB_2 whilst the 3rd. pressure is always present as a maximum pressure setting. In the start position, (directional valve position b) pressure DB_1 is operative. Pressure DB_2 is obtained with the directional valve in position a.

DB_{max} operates as a system safety valve (as it cannot be isolated from the circuit), for example if DB_1 or DB_2 does not operate correctly (if they are incorrectly set) a pressure peak occurs during the pressure change-over (e.g. if the directional spool sticks due to dirt, excess temperature, incorrect fixing or spool overlap).

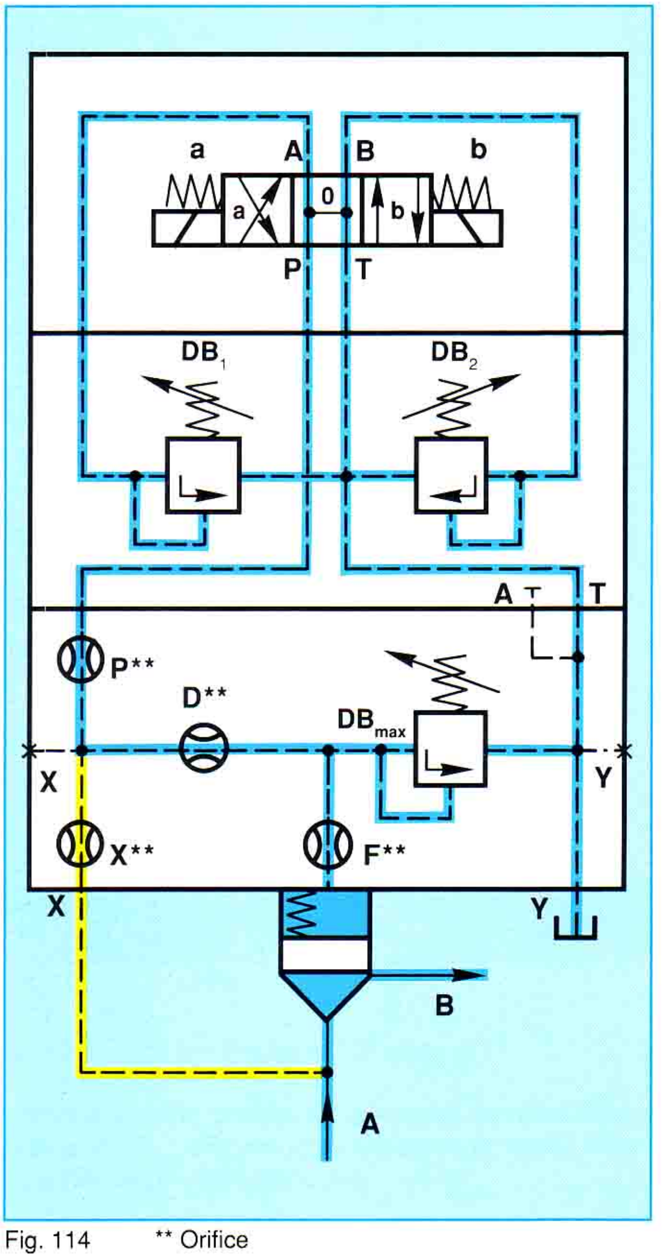


Fig. 114 ** Orifice

Spool position 0 = low pressure by-pass (unloading)

In addition to the functions shown in *Fig. 113*, a low pressure by-pass may be obtained with an open centre 4/3 way directional valve *(Fig. 114)*.

Figure 115 show the practical set-up. The 3 pressure relief valves are stacked relief valves and are connected to tank with the directional valve in the neutral position.

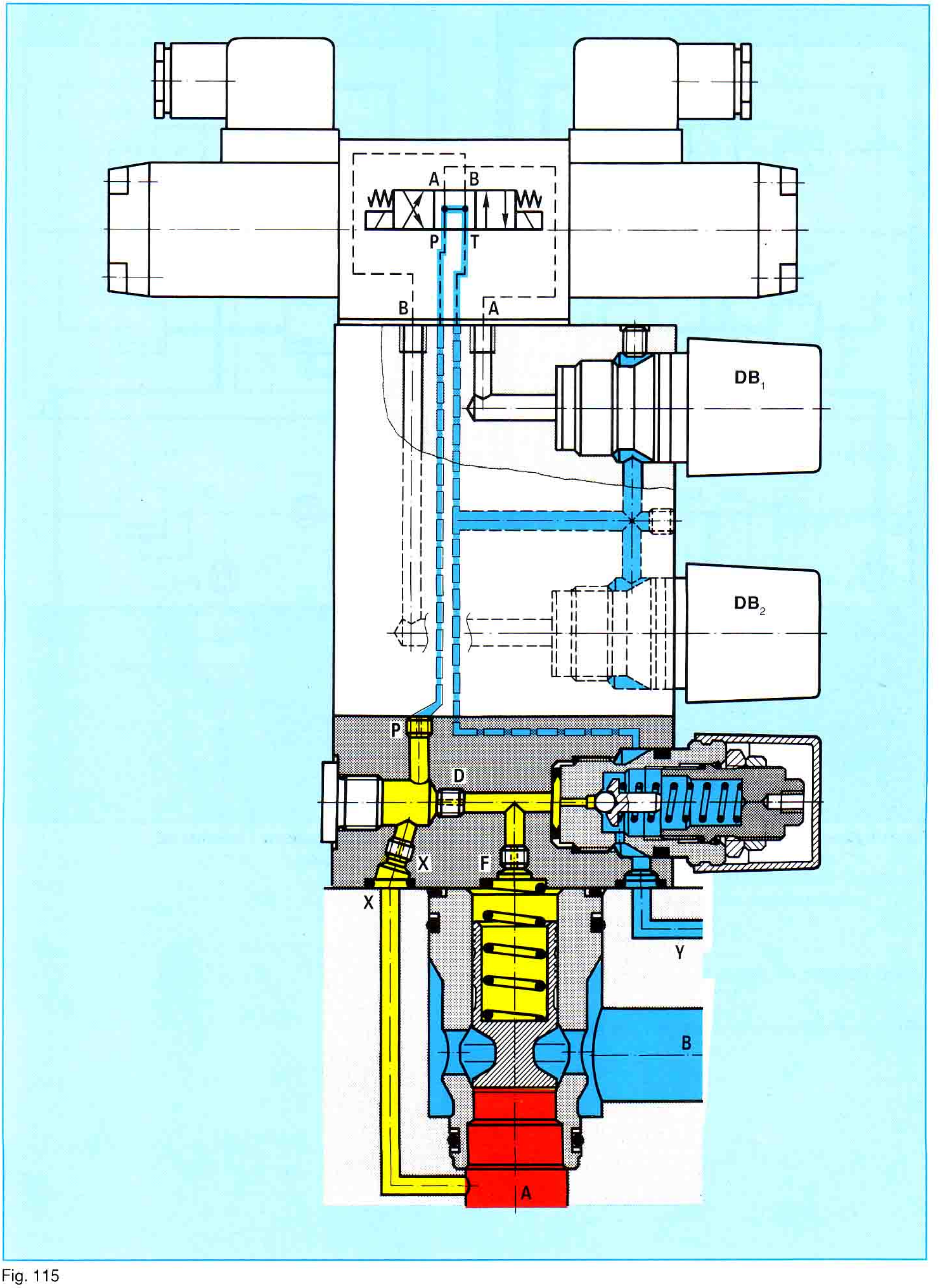


Fig. 115

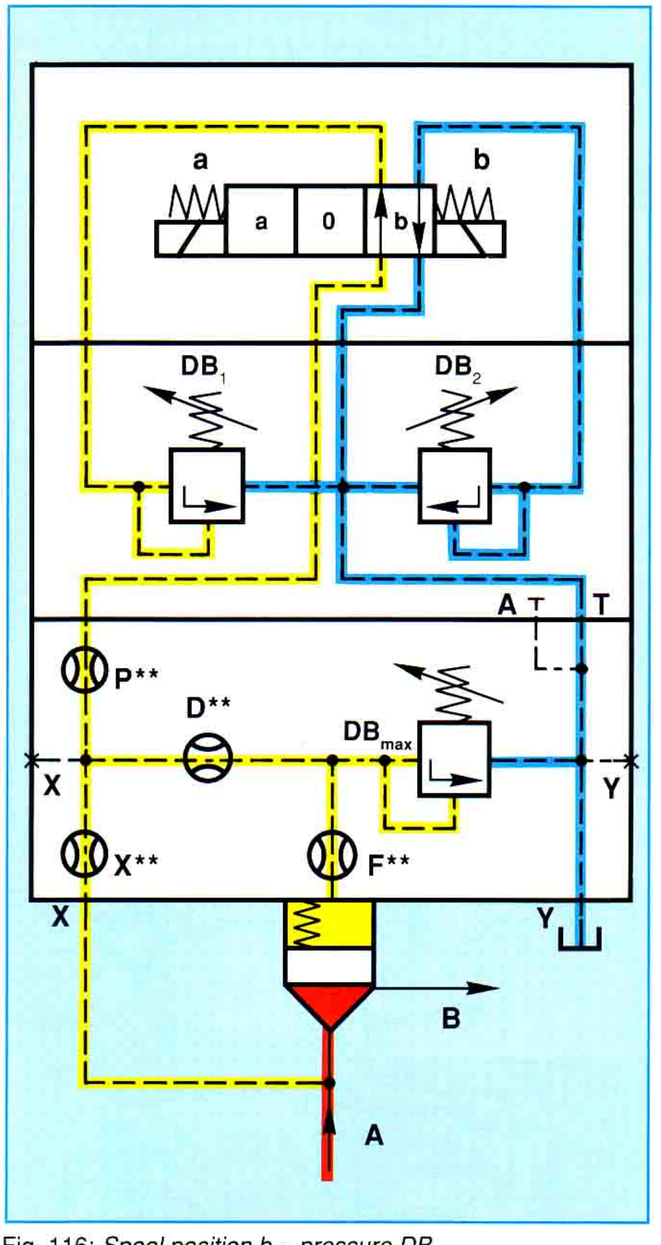


Fig. 116: *Spool position b = pressure* DB_1
** = Orifice

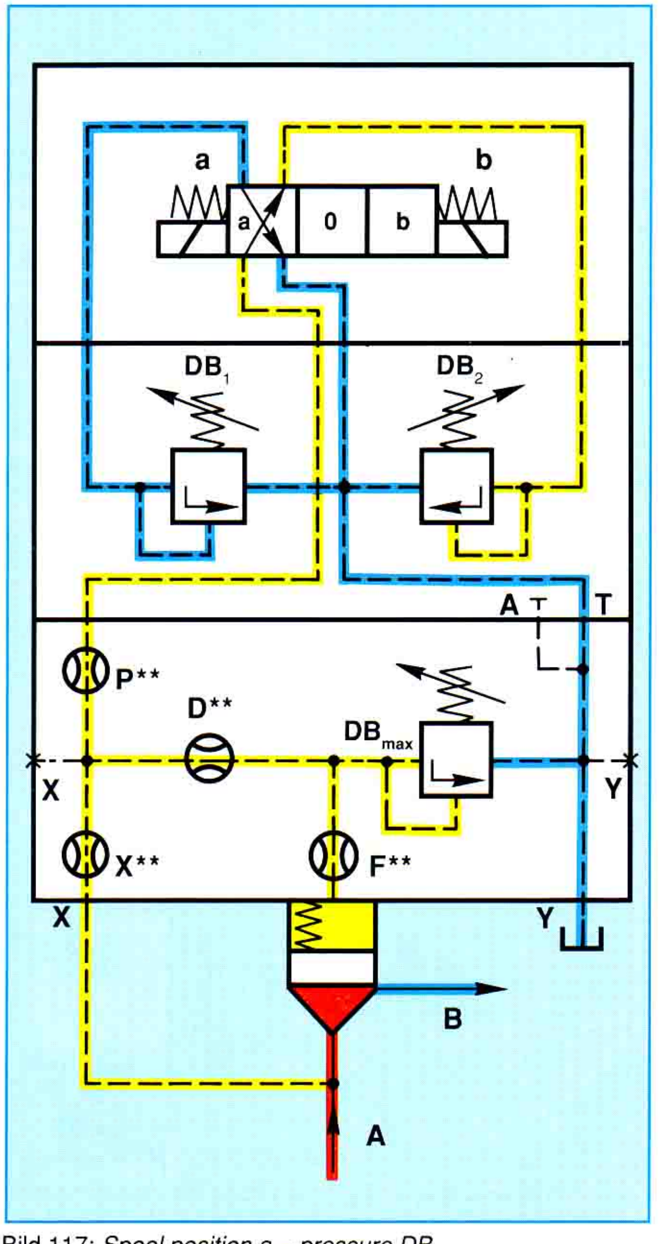


Bild 117: *Spool position a = pressure* DB_2
** = Orifice

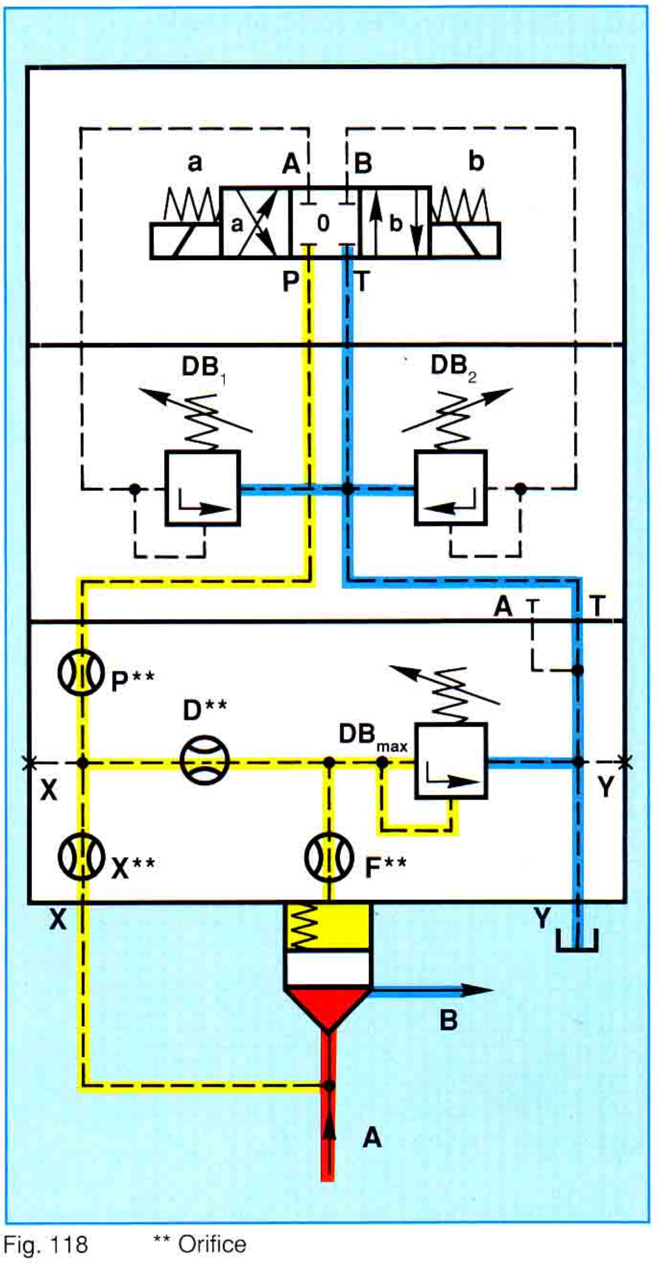


Fig. 118 ** Orifice

With the directional valve closed in the neutral position, 3 electrically selectable pressures are obtained.

Spool position 0 = DB_{max}

Spool position b = DB_1 and maximum pressure safety relief

Spool position a = DB_2 and maximum pressure safety relief.

1.6 Pressure relief function with proportional pressure setting

Without maximum pressure safety limitation

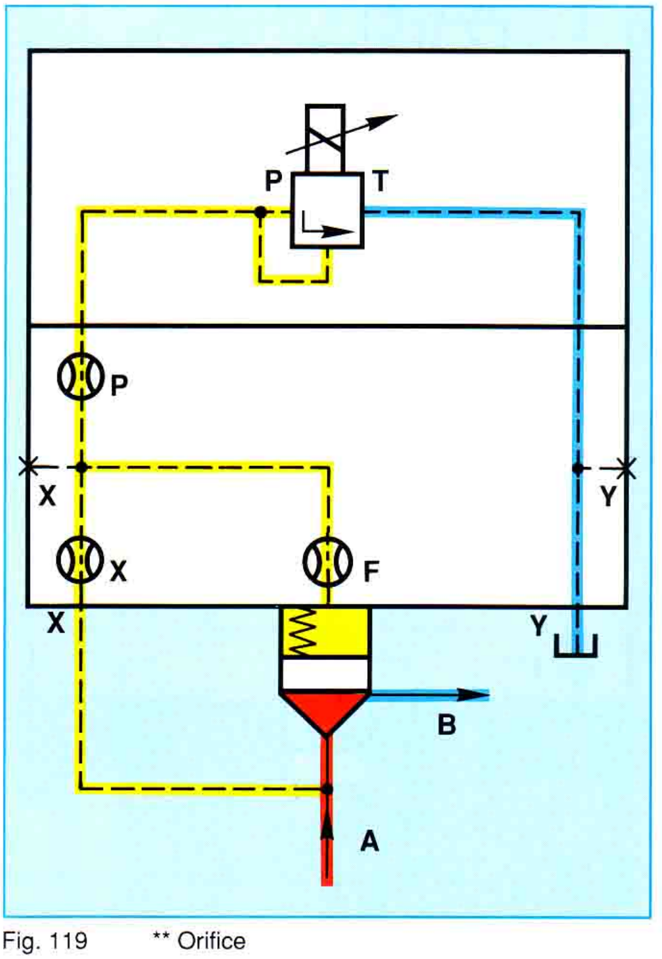


Fig. 119 ** Orifice

With maximum pressure safety limitation

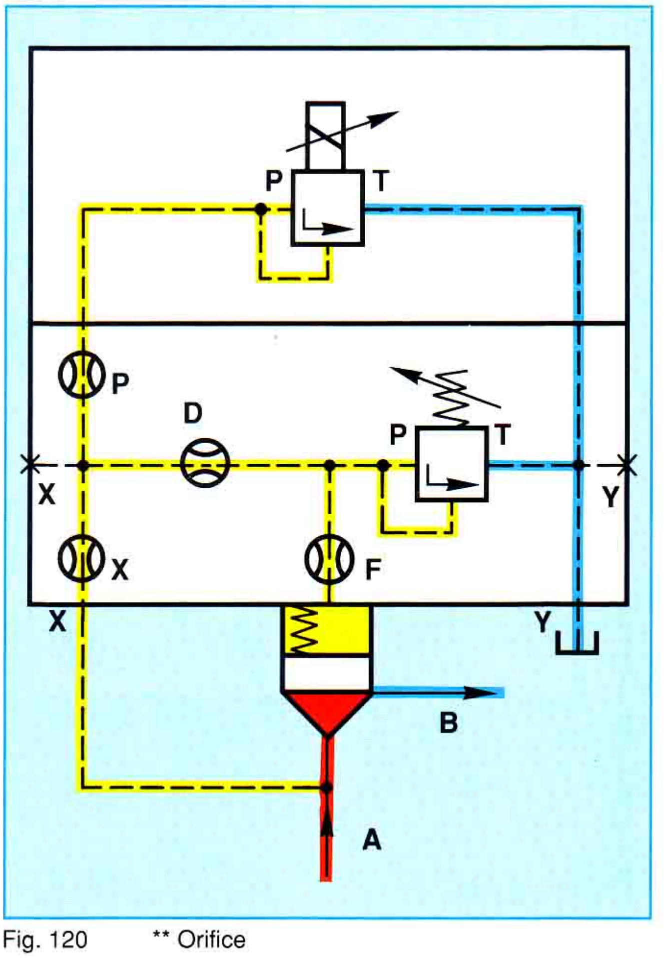


Fig. 120 ** Orifice

If a proportional pressure relief valve is used as the pilot valve, the maximum pressure in the system can be set steplessly via the amplifier card or set in fixed preset stages.

In this case, pressure can be varied with time (see also proportional information sheets).

For the valve to function correctly, the port Y of the pilot pressure relief valve should be connected separately to tank.

In order to protect the system against excessively high current in the proportional valve (and the unacceptably high pressures associated with them) an additional spring loaded standard relief valve is also installed as a maximum pressure safety relief valve.

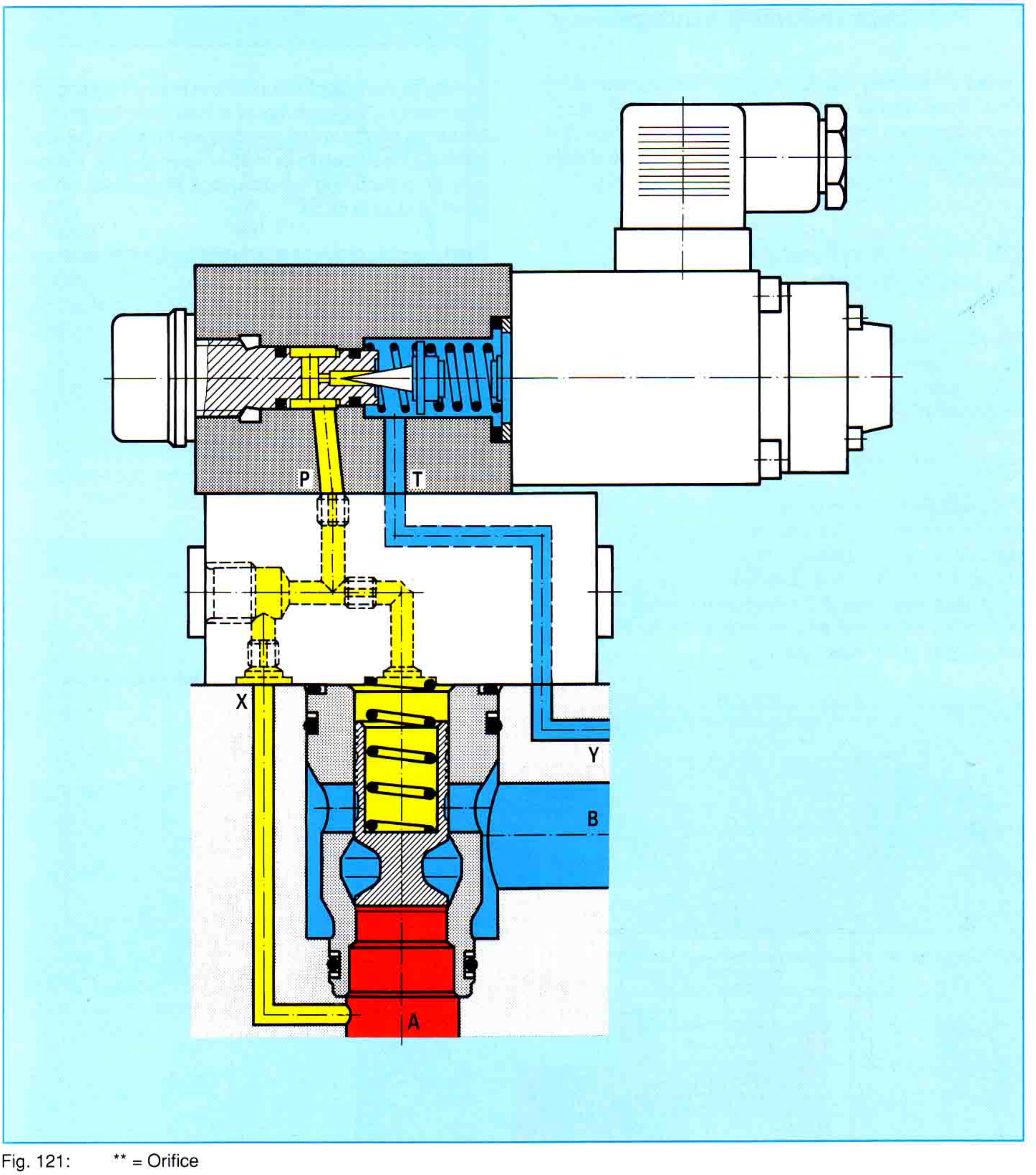


Fig. 121: ** = Orifice

2 Pressure reducing function

Pressure reducing valves may be constructed using either spool type or poppet /spool type logic elements. Dependent upon the design of the logic element and the pilot valve, the pressure reducing function can be obtained either a closed or an open in the start position.

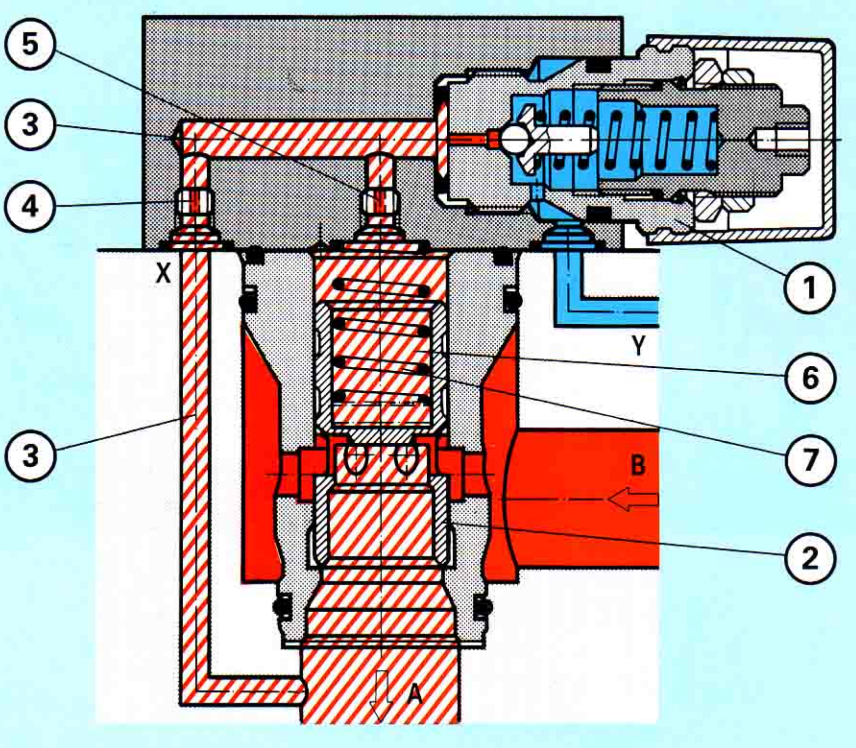
2.1 Pressure reducing valve, normally open

The pilot operated reducing valve shown in *Fig. 122* can be considered as the "standard" model. It consists of a logic element with spool type main valve (2) with no secondary effective area at B and a direct operated pressure relief valve as a pilot valve. It is thus identical with valves for the pressure relief function.

The direction of flow in the logic element is from B to A. In the start position, fluid may flow freely from B to A. The required secondary pressure is set at the pilot valve (1). Pressure in A acts on the underside of the main spool (2) and also passes through the control line (3) and orifice (4) to the pilot valve and also via orifice (5) to the spring loaded side of the main spool.

As long as the inlet pressure is less than the setting of the pilot valve (1) the main spool is held open by spring (7). When the pressure at A reaches the pressure set at pilot valve (1), control oil flows via this valve to tank. The pressure drop occurring across orifice (4) causes the main spool to start to close.

Fluid then continues to flow from port A of the main valve provided that the pressure setting is not exceeded. If no further flow is taken by the system, the main valve closes. During this time control oil passes continuously via the pilot valve to tank.



(1) Pilot valve
(2) Main spool
(3) Control line
(4) Orifice
(5) Orifice
(6) Spring loaded area
(7) Spring

Fig. 122

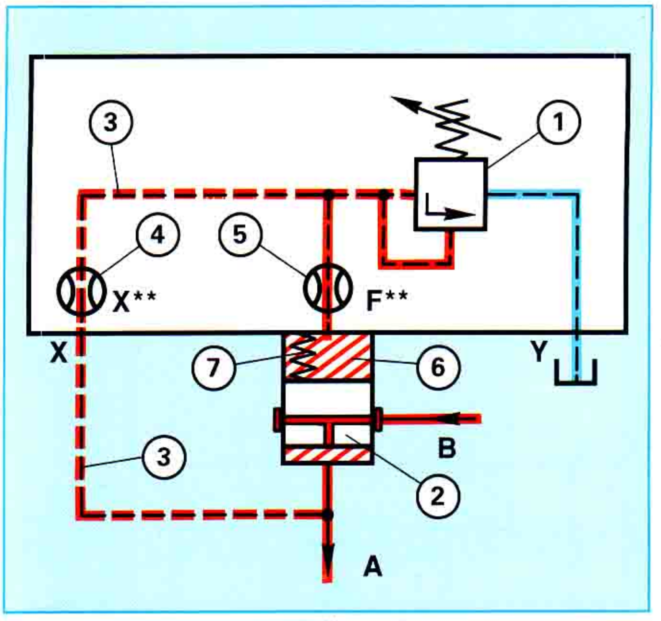


Fig. 123: *Symbol - schematic illustration*
** Orifice

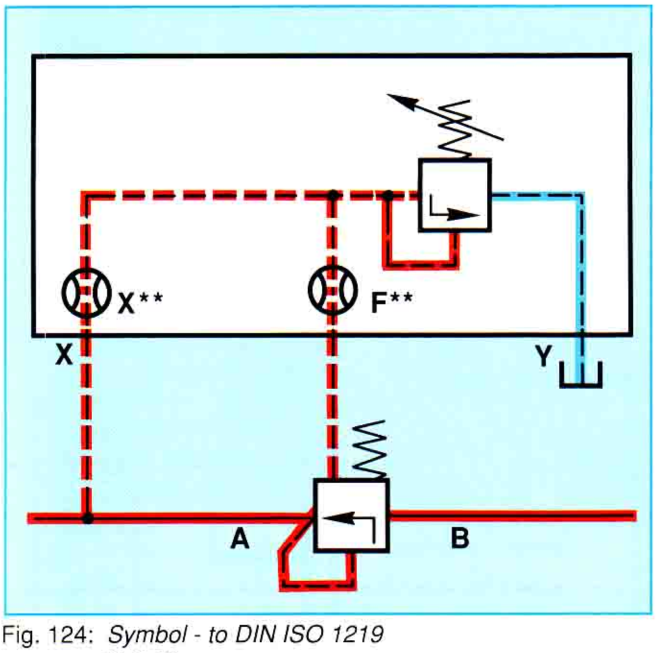
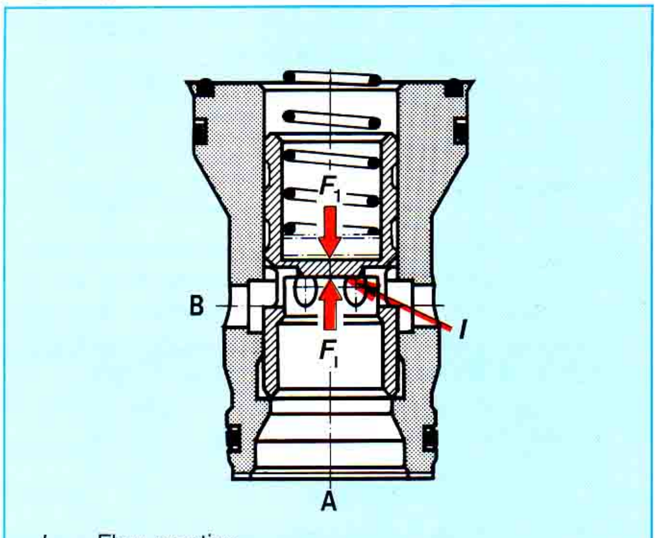


Fig. 124: *Symbol - to DIN ISO 1219*
** Orifice

Operating Curves/Power Limits

In the pressure reducing function, pilot control oil is taken immediately from the outlet of the logic element *(Fig. 123).*



I = Flow reaction
F_I = Axial forces resulting from flow reaction
F_1 = Spring force

Fig. 125

The power limit is reached when the spring force is balanced by the reaction forces of the flow. The spool starts to close (moving upwards) when F_I is greater than F_1, e.g. the flow can no longer increase.

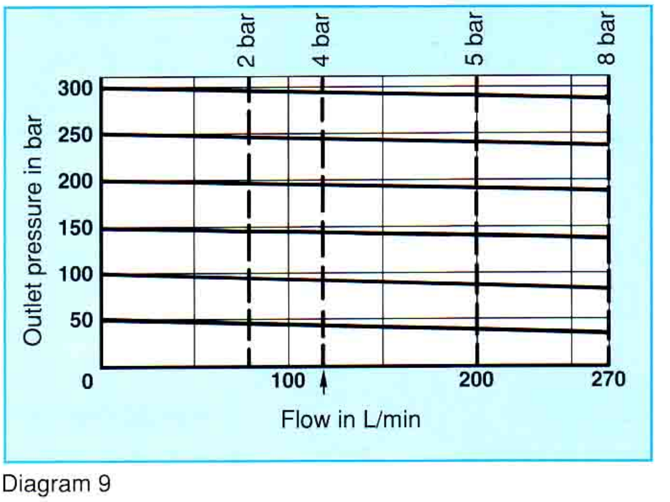


Diagram 9

The vertical dotted lines *(diagram 9)* indicate the limit of performance (flow limit).

e.g.
4 bar spring — $Q_{max.}$ = approx. 120 L/min.

2.2 Pressure reducing valve, normally closed with manual pressure setting.

With the arrangement shown in *Figs. 126 to 128*, the pressure reducing valve is closed in the start position. For this purpose, a pressure relief logic element (1) is used as the main valve and a pressure reducer valve (2) as the pilot valve. Pilot control oil is taken from the inlet side (port A) of the main valve via control line (3), orifice D and the open reducer valve (P to A) to the outlet side (port B).

Due the pressure drop between A and the spring chamber (5), the main spool opens allowing flow from A to B. Pressure at port B passes via the control line (6) at port A of the pressure reducing valve and via control line (7) to spool area (8) to work against spring (9). When the pressure at port B of the main spool reaches the pressure set at spring (9), spool (10) moves to the left and reduces (or closes) the opening P to A.

Pressure then rises in the control line *(yellow)* and in the spring chamber (5). Poppet/spool (4) starts to close and only permits sufficient fluid to flow from A to B so that the pressure set a spring (9) is not exceeded.

Any small pressure increase on the outlet side (port B) due to external forces at the actuator (cylinder or motor) are passed to tank via the third flow path in the pilot valve (A to T) For this to occur, pilot spool (10) moves slightly further to the left to permit the connection A to T.

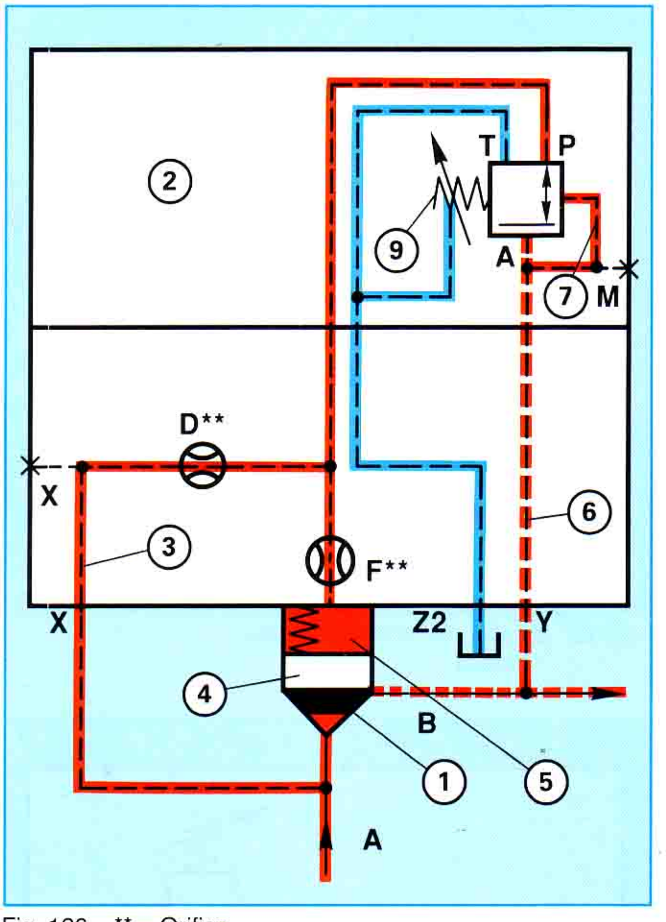


Fig. 126 ** = Orifice

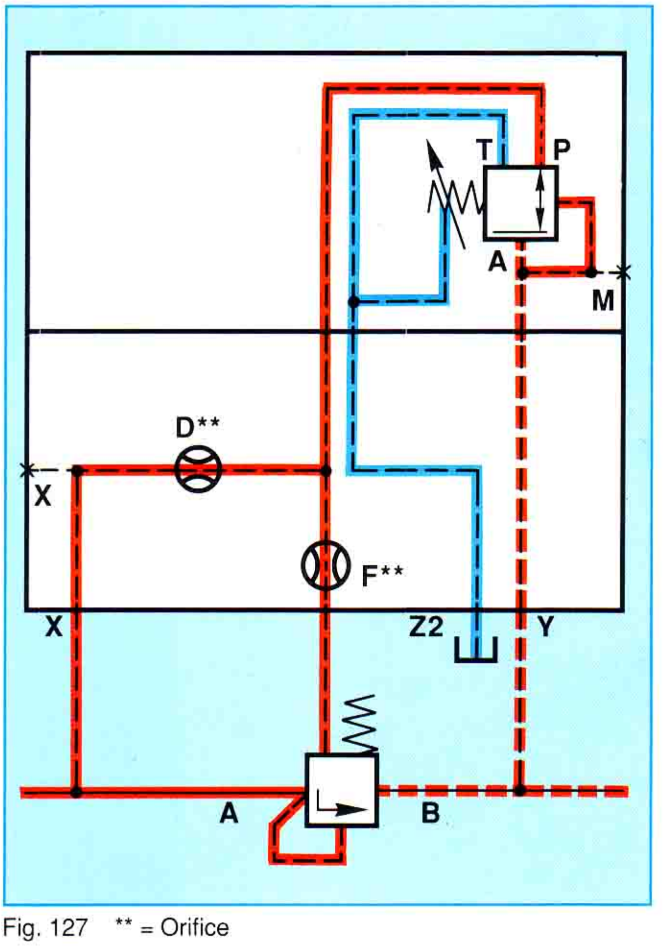
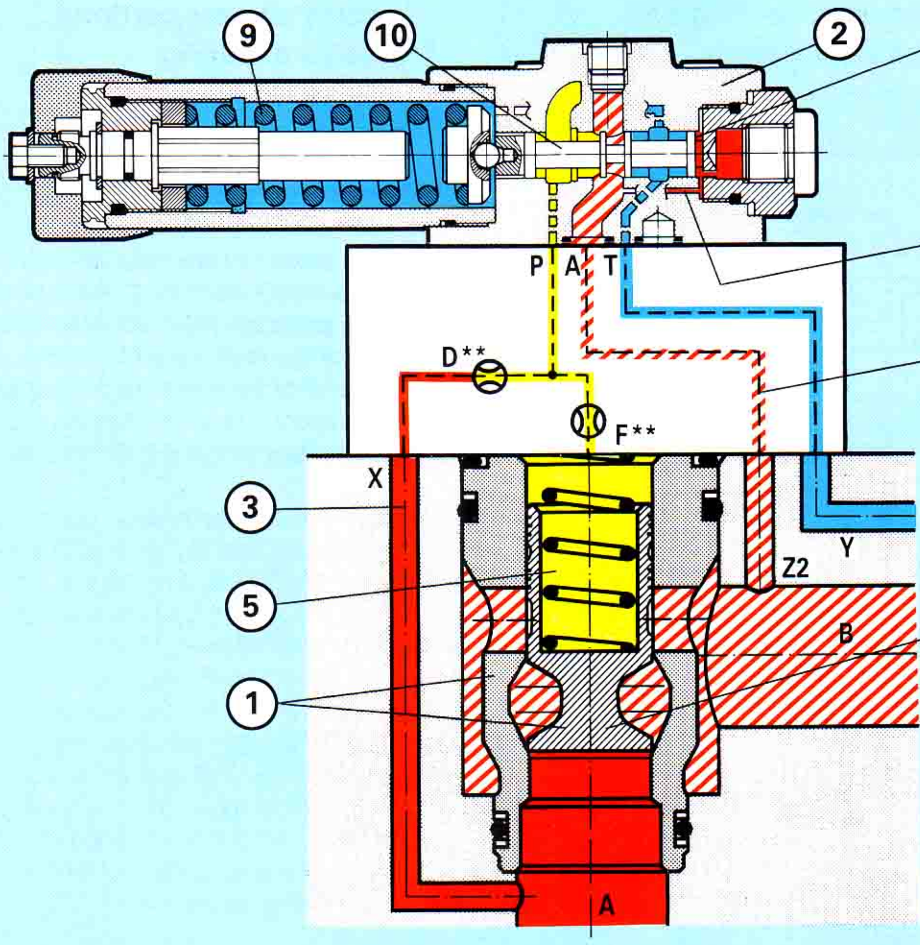


Fig. 127 ** = Orifice



(1) Pressure relief cartridge element
(2) Pressure reducing valve
(3) Control line
(4) Main spool (poppet valve)
(5) Spring chamber
(6) Control line
(7) Control line
(8) Spool control area
(9) Spring
(10) Pilot valve spool

Fig.128: *Pressure reducing function, normally closed*

2.3 A comparison between normally open and normally closed reducer functions

Normally open

- Flow from B to A
  (standard pressure reducing valve)
- Better control accuracy
  as the reaction forces on the spool are lower
- May also be used as a pressure compensator

Normally closed

- Flow from A to B
  (main valve is a pressure relief element)
- Higher power limit
- Soft starting of systems due to opening characteristics
- Quicker closing
- Possible blocking function *(see section 2.4)*
- Possible throttling function (with stroke limiter)

2.4 Pressure reducing function, normally closed at start with manual pressure setting and additional blocking function

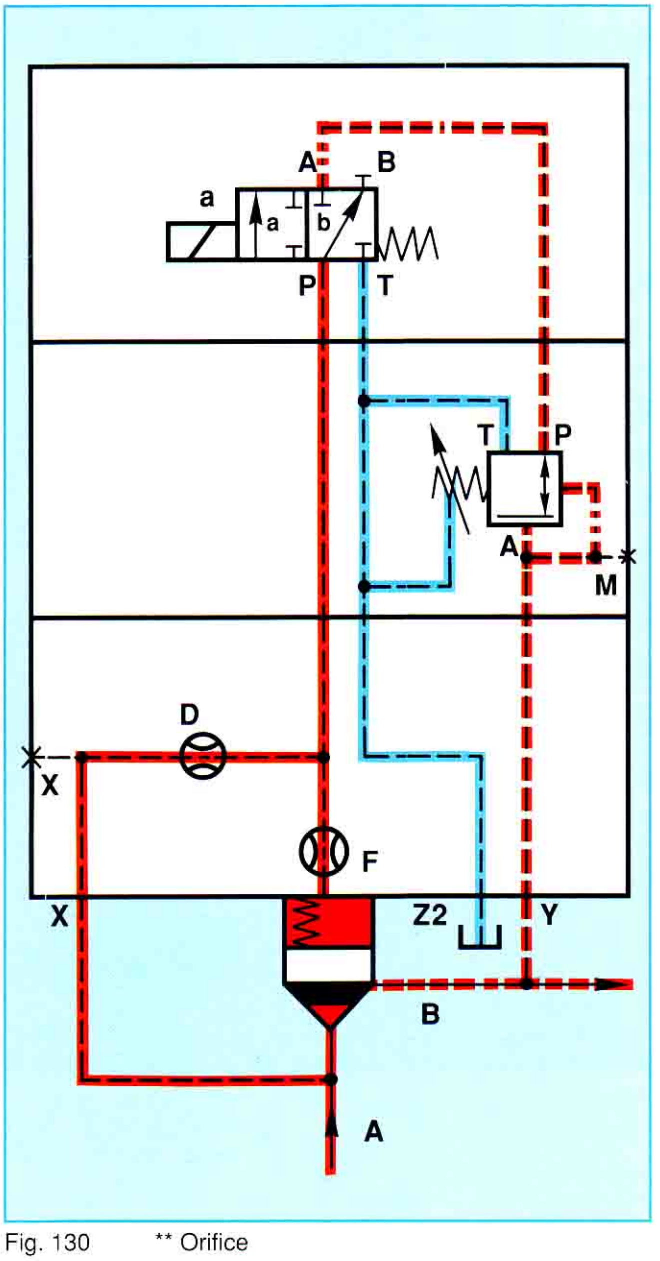


Fig. 130 ** Orifice

By installing a directional valve in the control line to port P of the pilot valve *(Fig.129)*, an additional blocking function is achieved.

In the start position shown, the control line is closed at port B of the directional valve. The same pressure can thus build up in the spring chamber of the main spool as at port A. The logic element thus remains closed.

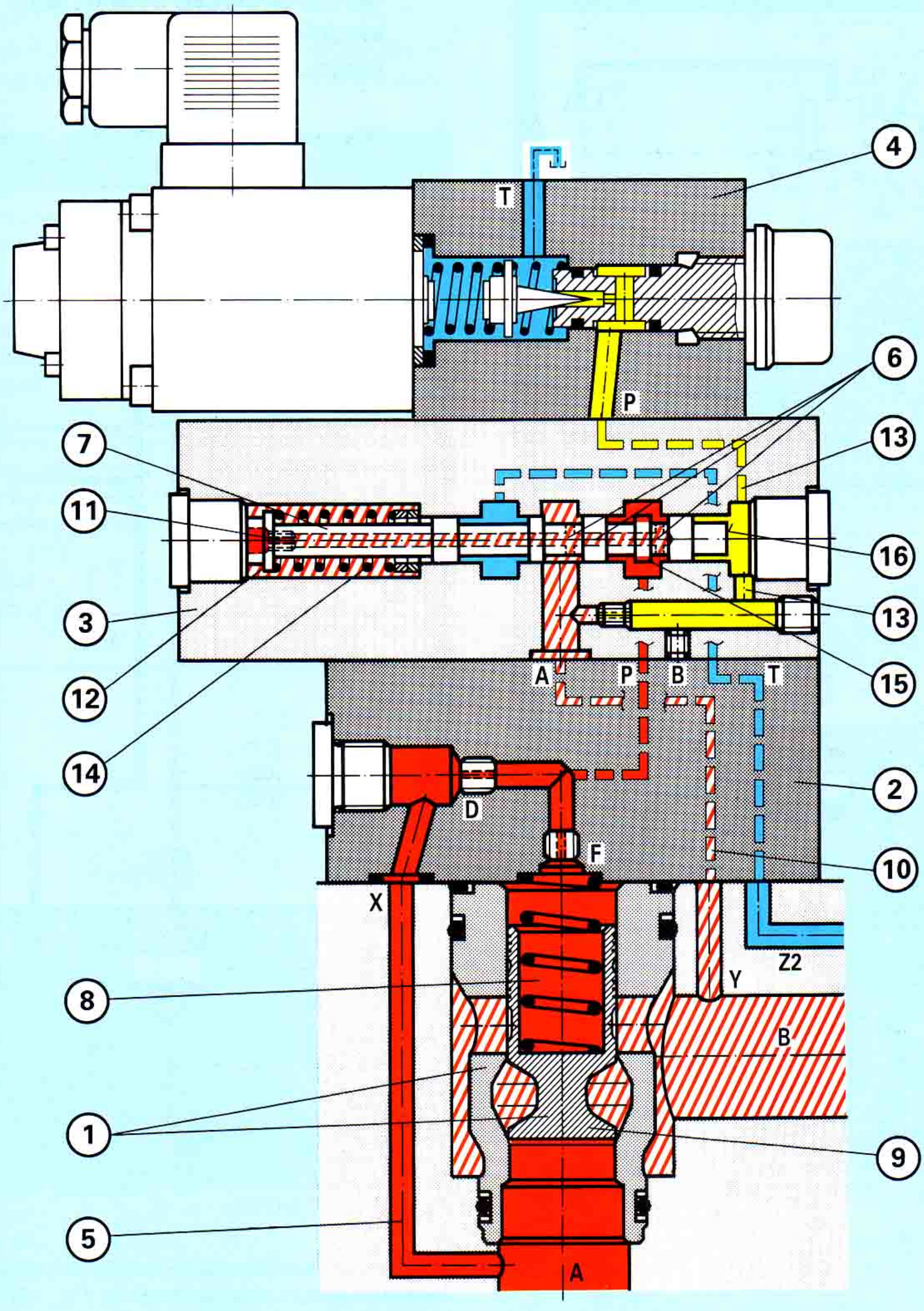
When the directional valve is moved to position a, the function described in section 2.2 *(Figs. 126 and 128)* is achieved.

2.5 Pressure reducing function, normally closed at start with electrically proportional pressure setting

In the variation shown in *Figs. 130 and 131*, the normally closed logic element permits the outlet (reduced pressure at port B of the main spool) to be set by means of an electro-hydraulic proportional valve. The main components of this assembly are the main valve (1) , the cover (2), the pressure compensator(3) and the direct operated proportional pressure relief valve(4). Pilot fluid passes from port A of the main valve(1) via the control line (5), orifice D, port P of the pressure compensator(3), drilling (6) in control spool (7) and port A of the pressure compensator to the outlet port (port B of the main spool(1)).

Due to the pressure drop between port A of the main valve (1) and spring chamber (8), the main spool(9) opens and allows flow from A to B. Pressure in port B passes via control line (10) at port A of the pressure compensator and via drilling (6) in spool (7) and orifice (11) to spool area (12). If control line (13) *(yellow)* to the proportional pressure relief valve is at zero pressure, spool (7) moves to the right when the pressure set by spring (14) is reached and reduces the opening at point (15) from P to A. The main valve poppet (9) closes sufficiently to maintain the pressure set in the outlet side (port B). This is then the minimum pressure setting of the valve and corresponds to the spring force (14).

Control spool thus only moves to the right (closing direction) when the pressure in port B has reached the pressure set by spring force (16) plus the pressure on the control area (14). The poppet spool (9) reacts accordingly to reduce the flow from A to b in order to maintain the set outlet pressure.



(1) Main valve
(2) Cover
(3) Pressure compensator
(4) Proportional pressure relief valve
(5) Control line
(6) Drilling
(7) Pilot valve spool
(8) Spring chamber
(9) Main spool
(10) Control line
(11) Orifice
(12) Control spool area
(13) Control line
(14) Spring
(15) Area open to flow at control land
(16) Control spool area

Fig.130: *Pressure reducing function, normally closed with electrically proportional pressure setting*

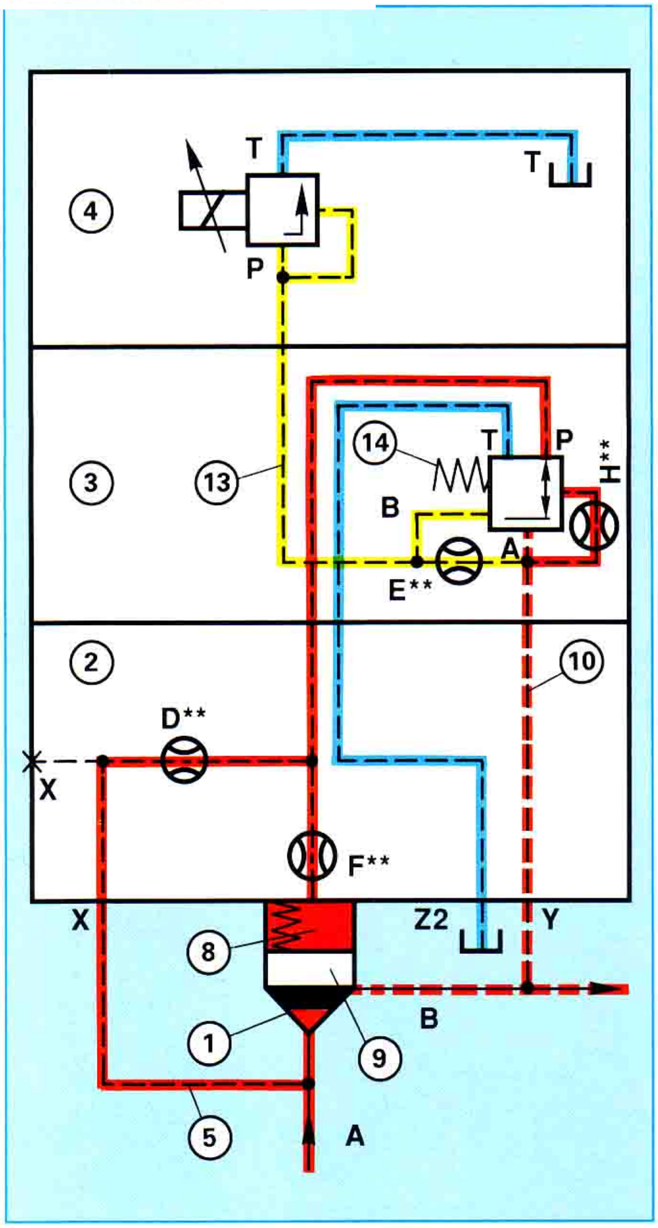


Fig. 131: ** = Orifice

2.6 Pressure reducing function, normally closed at start with electrically proportional pressure setting

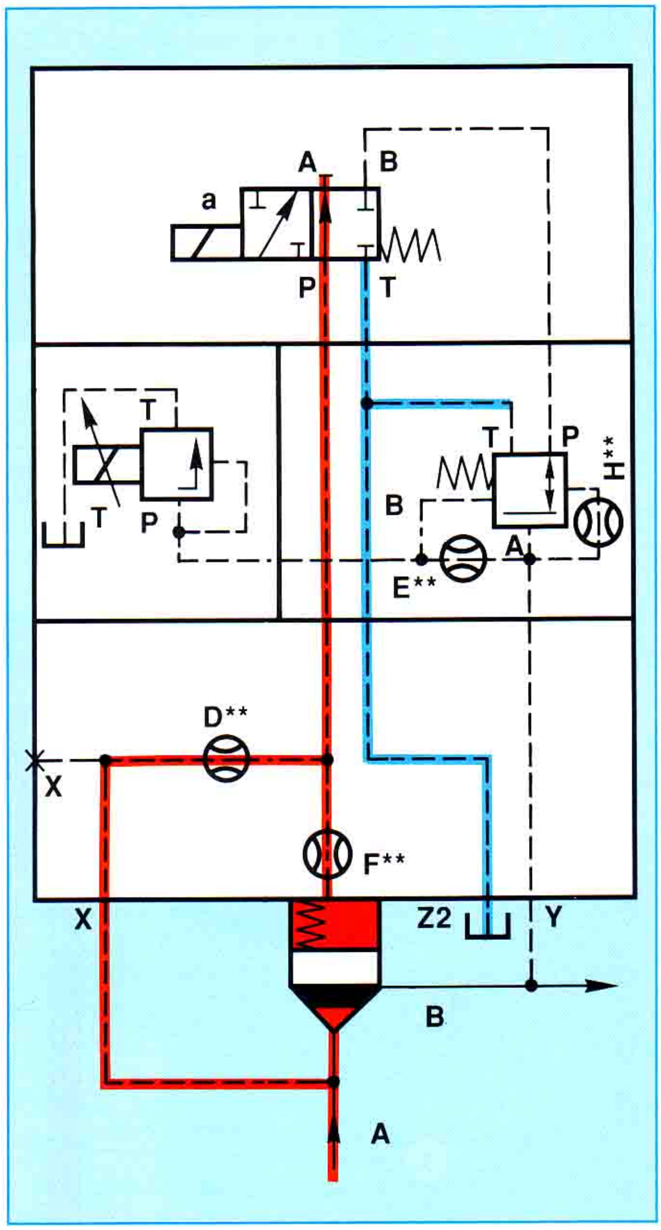


Fig. 132: ** = Orifice

If the version described in *section 2.5* is extended by adding a directional valve as shown in *Fig. 132*, a blocking function as described in *section 2.4* is obtained in addition to the electrically proportional pressure setting.

3 Pressure sequence function

The variation shown in *Fig. 133* permits a secondary circuit to be sequentially switched dependent on pressure.

The main element is a pressure relief valve element. A pressure reducing valve is used as a pilot valve.

The required sequencing pressure is set via the pilot valve built into the control cover.

The pilot oil supply can be derived either externally (pilot port X) or internally (from port A via control port X or Z2). The spring chamber of the pilot control valve is led directly to tank via ports Y or Z1.

When the pressure set at the pilot control valve spring is reached, the valve responds and unloads the spring chamber of the main valve to tank via port Z1. The main spool opens and permits flow from A to B.

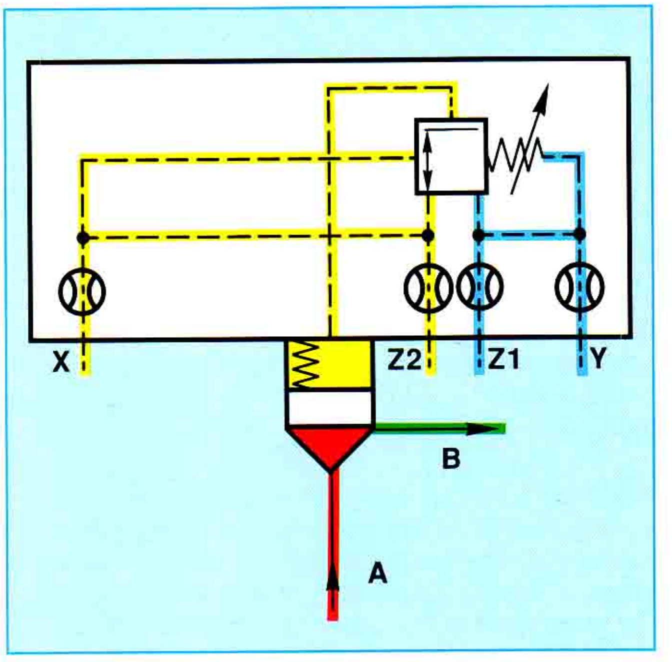


Fig. 133: *Symbol - schematic illustration*
** Orifice

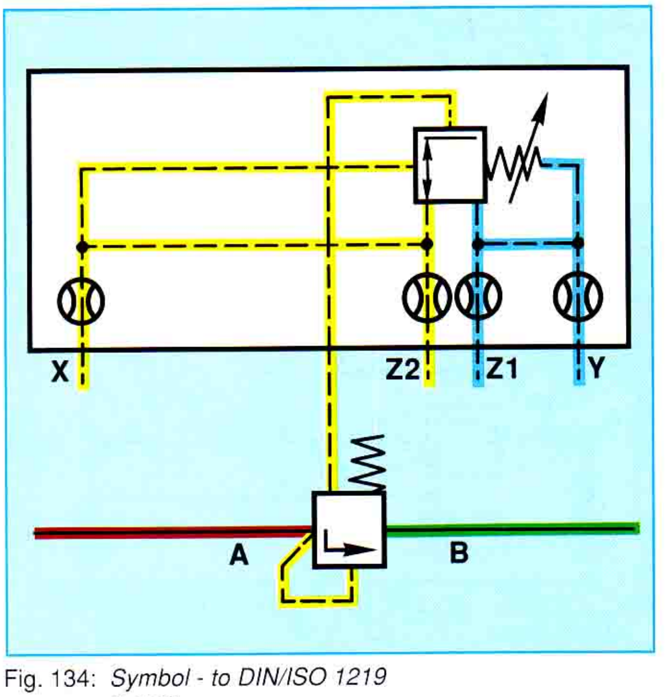


Fig. 134: *Symbol - to DIN/ISO 1219*
** Orifice

Typical Circuits

Example 1

In the circuits shown *(figs. 135 and 136)*, system p_s is fed by a high pressure and a low pressure pump.

Function

At the start, both pumps are engaged and supply fluid to the system. Logic element (1) is held closed by pressure from the low pressure pump via control line (2), port Z2 and the pressure reducing valve (3). Port A is isolated from port B.

System pressure in line (4) after the non return valve passes via control Line (5) and works against the spring of the pilot valve (3). When the pressure in the system exceeds the pressure setting of spring (6), the connection between the low pressure pump and the spring chamber 97) is broken and the latter is is unloaded via Z1 to tank. Logic element (1) opens and the low pressure pump is unloaded to tank. Non return valve RV prevents the high pressure pump also passing to tank via the low pressure circuit.

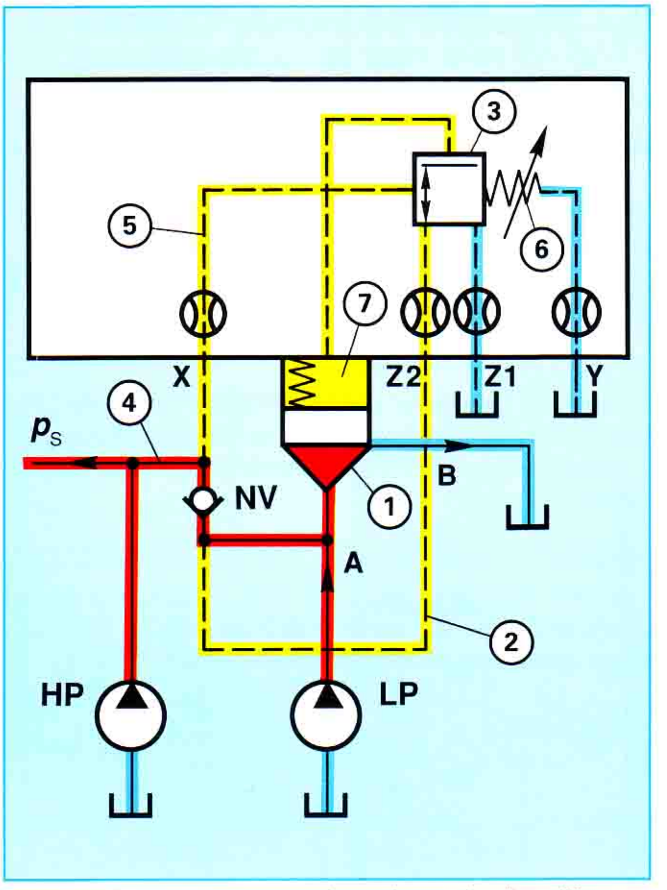


Fig.135: *Circuit for pressure dependent unloading of low pressure pump*

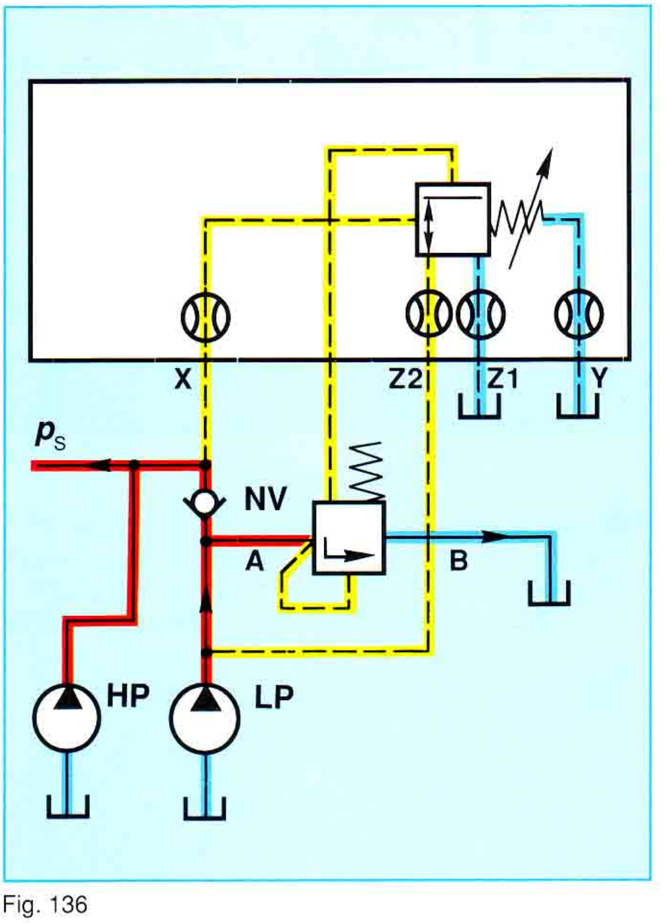


Fig. 136

Legend to Figs. 135 and 136

HP = High pressure
LP = Low pressure
NV = Non-return valve
p_S = System pressure

Example 2

With the circuit shown in *Fig. 137*, fluid is only permitted to flow into system 2 when the pressure in system 1 reaches the set level. Pilot oil flow is taken internally from port A of the main spool.

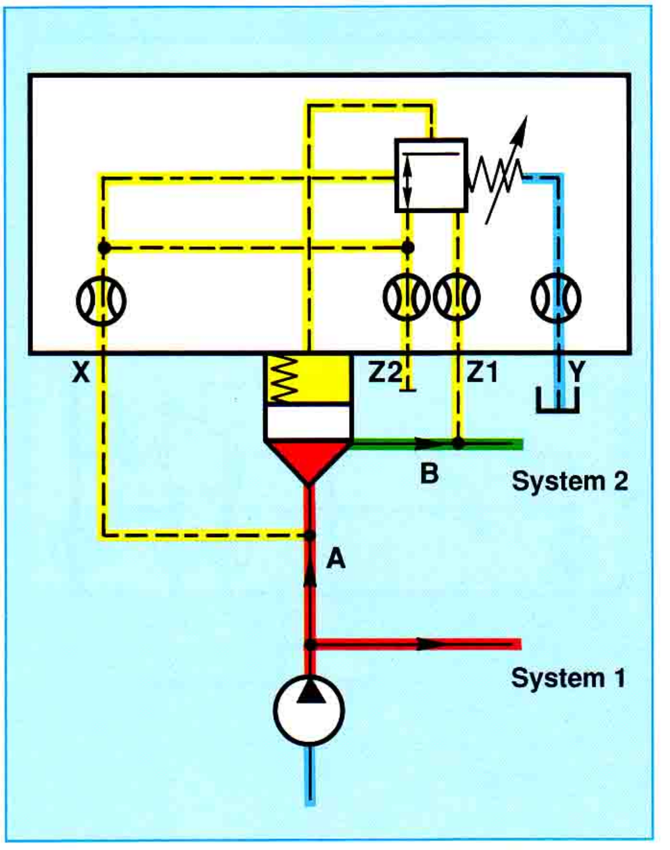


Fig.137: *Circuit for pressure dependent sequencing of a second circuit*

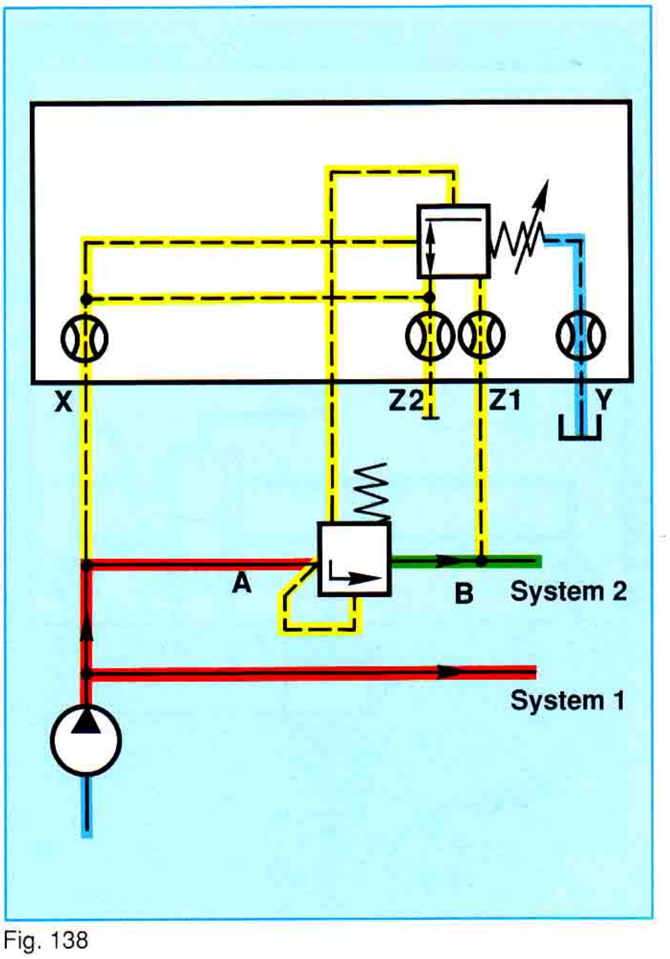


Fig. 138

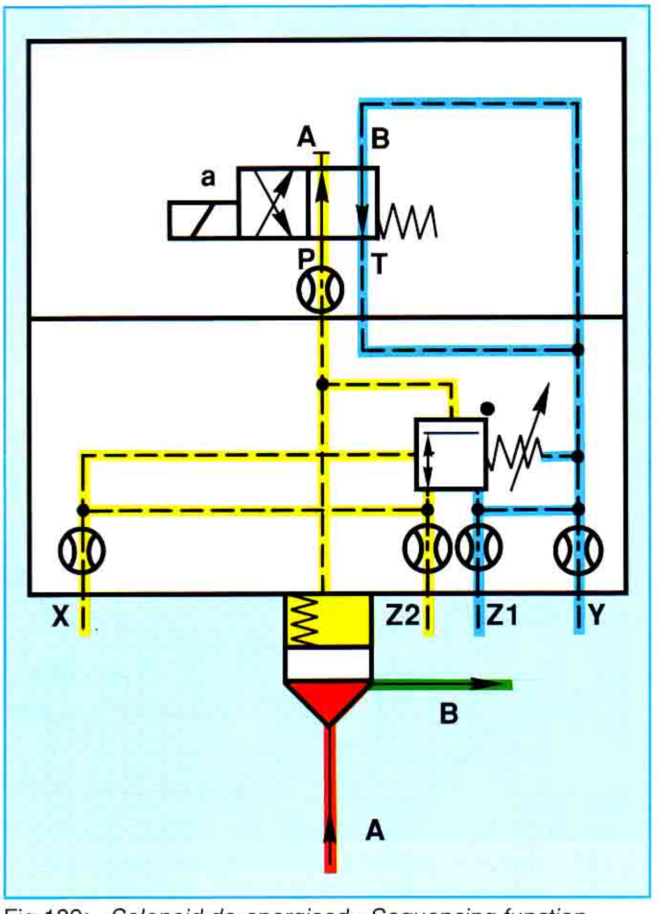


Fig.139: *Solenoid de-energised - Sequencing function*

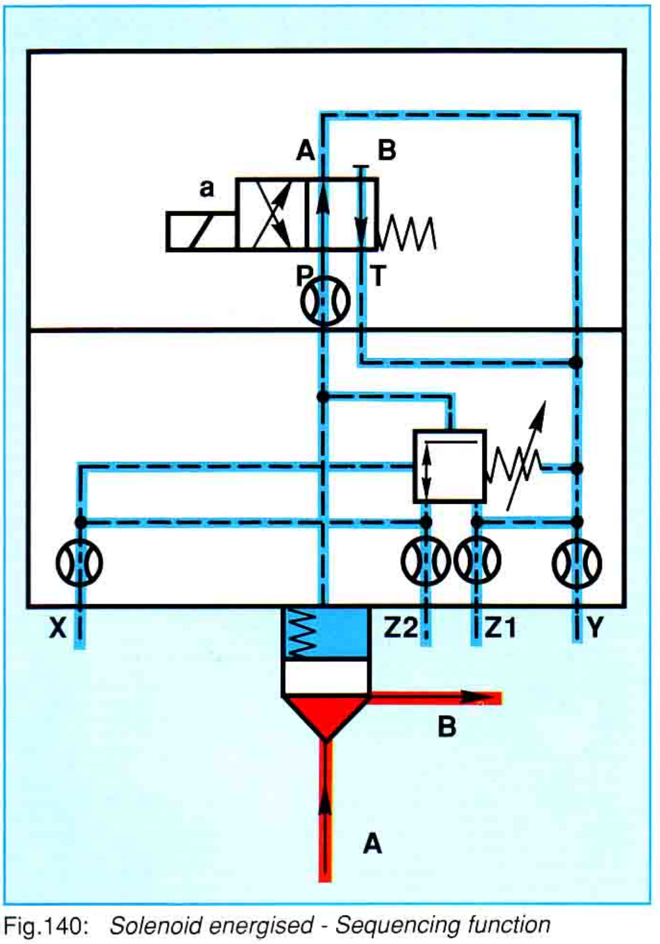


Fig.140: *Solenoid energised - Sequencing function*

By means of a built on directional valve *(Figs. 139 and 140)*, the secondary circuit can be sequenced either by the directional valve or by the pressure control valve.