HERION Systemtechnik GmbH
When Safety Counts

Application Control Systems

Increased press performance and safety, reduced cost

General

Non-cutting shaping of metallic materials by mechanical presses has always been connected with numerous everyday problems like productivity raise, cost reduction, malfunctions, maintenance costs, and wear and tear.

Press users nowadays have the possibility, however, to reduce these problems
- by accelerating the exchange of press tools (production becoming more flexible)
- by shorter stop periods thanks to trouble-free operation and shorter maintenance time.

Herion has developed a complete control system for clutch and brake which decisively helps to reduce mechanical malfunctions.

Presses have always been regarded as “dangerous machines”. Great shock problems arise by accelerating or braking the plunger with the tool attached to it, and by press kinematics by which the stored energy is transferred from the flywheel to the tool.

The energy transfer from the flywheel to the tool is achieved by a pneumatically operated clutch or brake. The coupling moment is realized by compressed air, the braking moment by means of spring forces.

When the press is inoperative, spring force causes the clutch to remain in open and the brake in closed position. When the press is working, the clutch remains closed and the brake open by pneumatic pressure. For safety reasons the brake is closed by spring force in case of a pressure drop.

Press kinematics can be divided into two categories:
- Presses with a combined clutch and brake system (Fig. 1)
- Presses with a separate clutch and brake system (Fig. 2)

Clutch/brake combinations

Clutch and brake are actuated by means of a pneumatic cylinder. When at rest, the brake remains in closed and the clutch in open position by spring force.

When the directional control valve actuating the cylinder is energized, the pneumatic circuit opens: the pressure actuates the piston contrary to the spring force. The clutch closes and the brake opens.

The operating moment of the clutch depends on the pneumatic pressure (reduced by the spring forces of the brake).

In order to stop the machine, the air pressure must drop so the brake can be activated. In case of a malfunction of the directional control valve, however, the brake cannot be activated which means that the press cannot be stopped. This is a particularly dangerous situation both for the operating personnel and the tool.

To prevent this from happening, it is necessary to use a safety valve which reliably operates also in the event of a malfunction and thus guarantees a safe operation of the press.

The silencer mounted on the safety valve has a direct influence on the depressurization of the system and the braking times. The silencer, however, must be designed as a safety silencer in order to preclude any danger in case it should get clogged.

In order to shorten braking time and for reduced air consumption the safety valve must be placed as close as possible to the rotary union.

Non controllable elements such as quick exhaust valves, nozzles or non return valves must not be mounted between safety valve and rotary union.

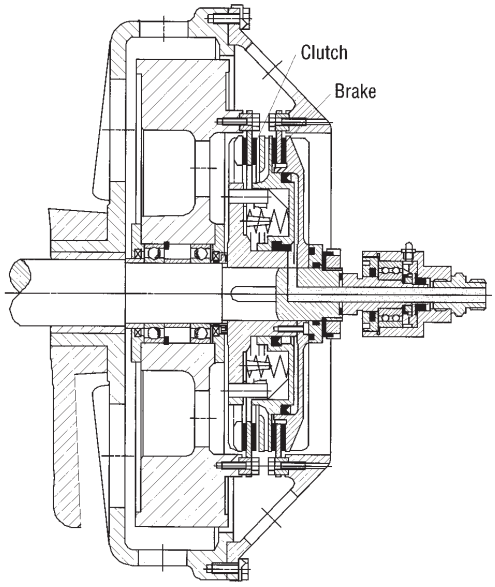


Fig. 1: Clutch/brake combination

Separate clutch/brake system

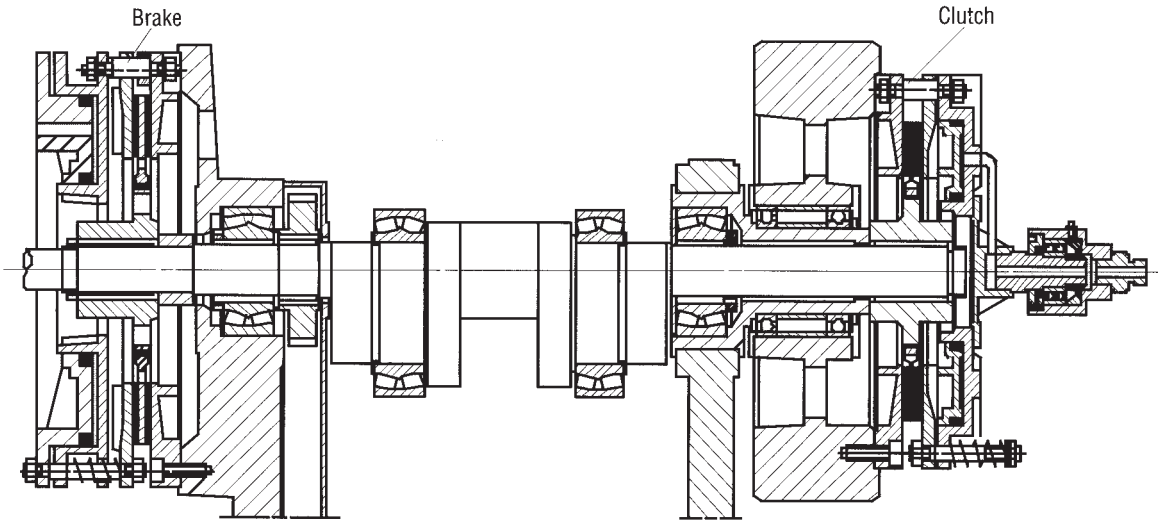


Fig. 2: Separate clutch/brake system

In this case clutch and brake are actuated by two single acting pneumatic cylinders with spring return. With this system the working cycles may overlap (Fig. 3). Therefore it is important, that

- when the machine starts, the brake opens before the clutch closes!
- when the machine stops, the clutch opens before the brake closes!

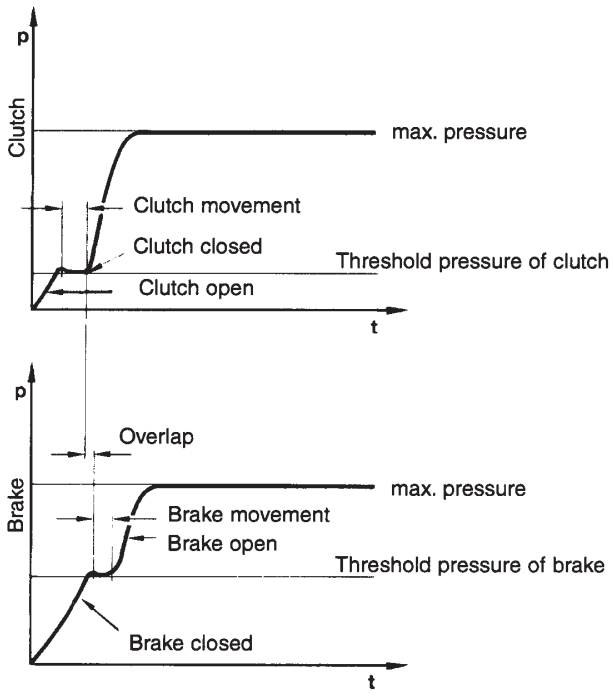


Fig. 3: Overlapping characteristics of clutch and brake

In order to solve the problem regarding the overlap, check valves and throttles are very often mounted between press safety valve, clutch and brake. This system, however - although solving the problems regarding the overlap - has the following disadvantage:
There is an element between safety valve and clutch and brake which cannot be controlled.

In order to solve both problems, Herion has developed a Safety Valve Range featuring the possibility of a time-delay both during the pressurization and depressurization phase (by means of nozzles mounted in the pilot stage).

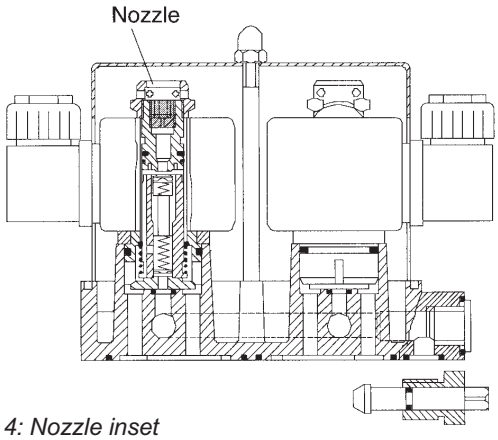


Fig. 4: Nozzle inset

A delay of the pressurization phase is achieved by means of nozzles mounted on the clutch valve between the pilot and main piston.

In order to achieve a slight delay of the depressurization phase, the nozzles of the brake valve are fitted in the exhaust line of the pilot stage (valve sizes 20 and 32, see Fig. 4) or directly in the quick venting valve (valve size 50).

Several nozzle kits are available in order to comply with the requested delay times. They are specified in the respective literature.

Soft brake

Two braking procedures are necessary in order to achieve an optimal press performance (Fig. 5):

- Between TDC and BDC (emergency stop/short braking time). A stop in this range is either an emergency stop or a controlled stop during the set-up phase of the machine.

- Between BDC and TDC (normal stop/damped braking).

The machine stops in TDC at each stroke. A damped braking in the TDC both helps to protect the press mechanism and reduces the mechanical wear and tear of the press.

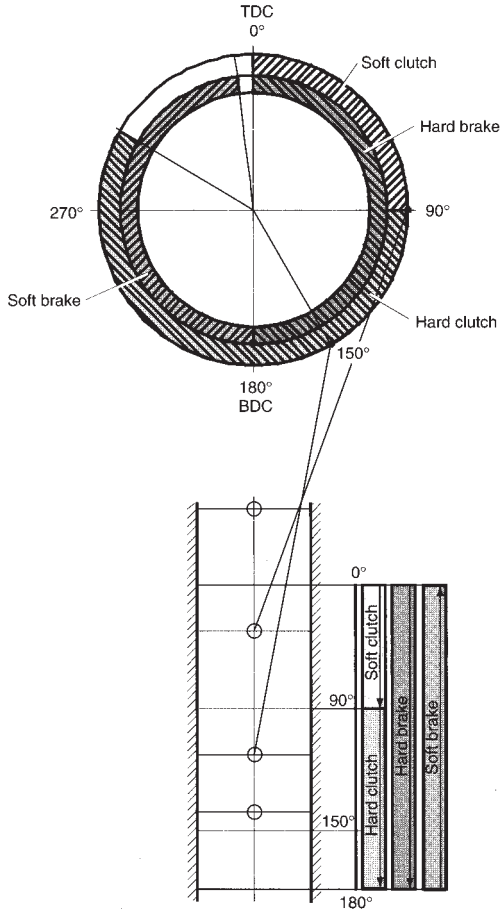


Fig. 5: Clutch and brake radii during a stroke of the press

The valve function “soft/hard braking” is achieved by an additional valve flanged on the port 3 (R) of the safety valve (type XS and XSz). Please see Figure 6 below.

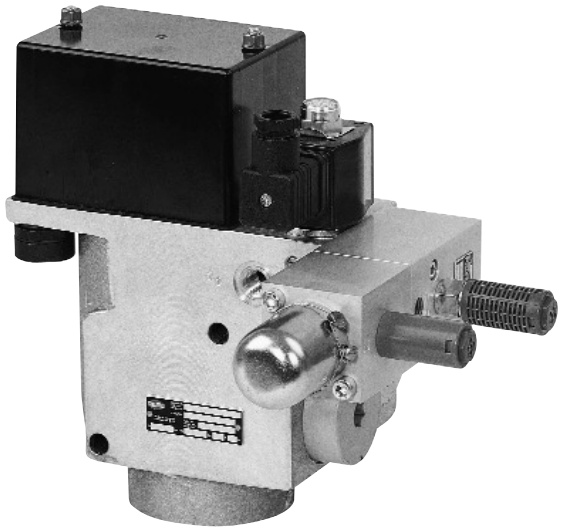


Fig. 6: Safety valve XSz with flanged damping block

Valve function “soft brake” by means of damping blocks

Between TDC and BDC:

The soft stop valve is open, the safety valve exhausts. The braking times is short, the braking procedure is hard.

After the BDC, the soft stop valve is energized and closes. When reaching the BDC, the operating personnel may release the two-hand control as the take-over function is now activated in this point.

When stopping in the TDC, pressurization is achieved in two steps:

- Quick pressure drop
- Exhaust via nozzles

In the first phase, the pressure quickly drops down to the minimum threshold pressure of the brake. In the second phase, the pressure drops slowly. Thus a soft (damped) braking procedure is realized which decisively helps to preserve the machine mechanism.

Prior to a renewed start, the opening procedure of the soft stop valve is being monitored by an inductive switch (Fig. 8). If the valve gets stuck in closed position, the contact for the “readiness to work” function is interrupted and a new stroke cannot be initiated.

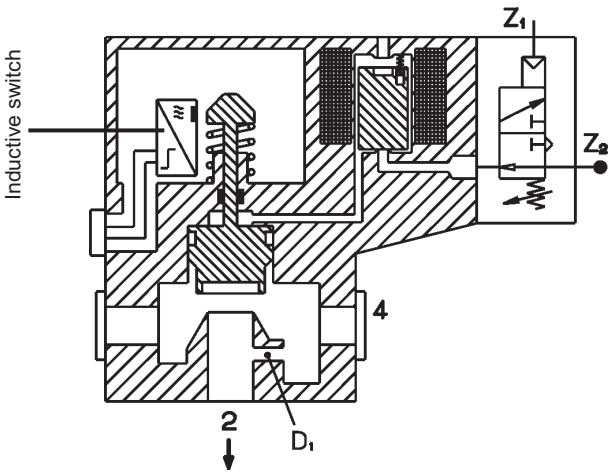


Fig. 8: Inductive switch incorporated in damping block

The soft stop function in TDC is achieved in two steps:
- Quick pressure drop (valve open)
- At the minimum threshold pressure of the brake, the valve closes via the pressure switch. Final depressurization via nozzle.

This system has the following advantage: Due to the pressure shut-off, a change in volume becomes ineffective. Possible wear and tear of the brake does not adversely effect the control times.

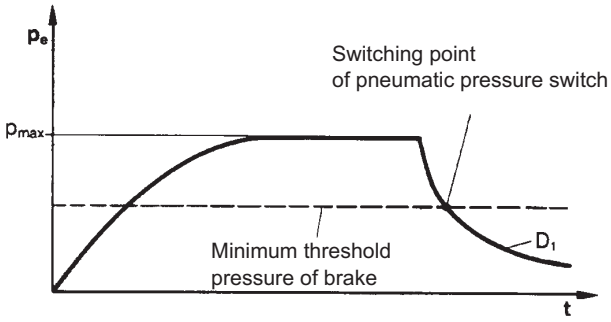


Fig. 10: Pressure drop when stopping in TDC - “soft brake” with pneumatic pressure switch

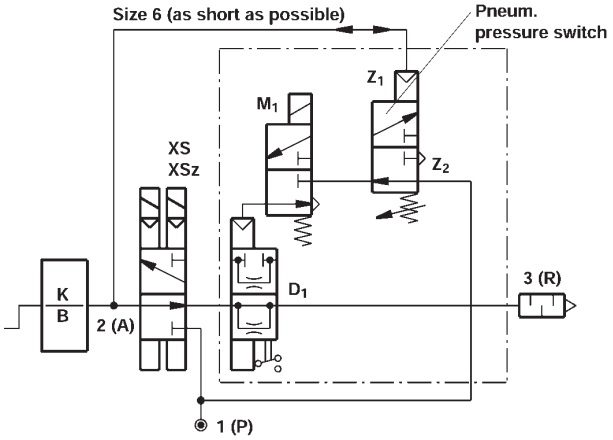


Fig. 9: Circuit diagram “soft brake”, with pneumatic pressure switch

Soft clutch

In order to protect the press mechanism against shocks (less defects and less extensive repairs), soft engagement of the clutch is required when the machine starts in UDC.

A soft overtravelling of the threshold pressure is most important so the clutch can engage softly. This is achieved by a control valve which is mounted on port 1 (P) of the safety valve (Fig. 11).

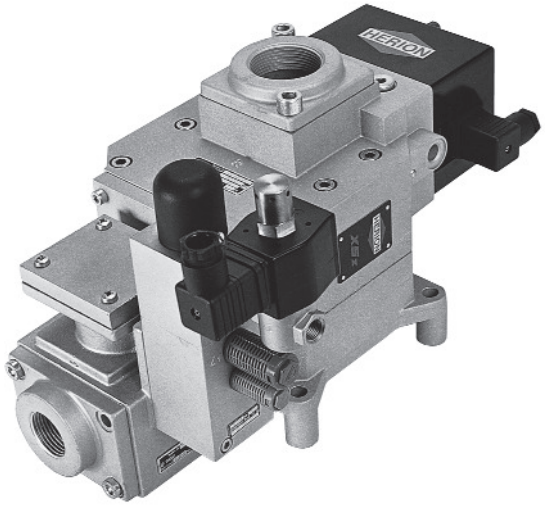
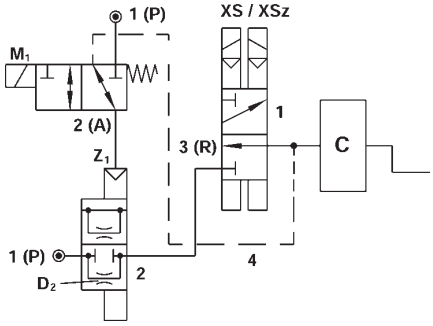


Fig. 11: Safety valve with mounted control valve

Clutch with a threshold pressure between 0 and 2 bar



from TDC to 90°: M1 not energized
>90°: M1 energized

Fig. 12

Pressurization is achieved by the soft clutch valve in two steps:
- Slow pressure build-up via nozzle D2: Soft start
- Opening of the main valve by means of the pressure switch: Maximum pressure reached

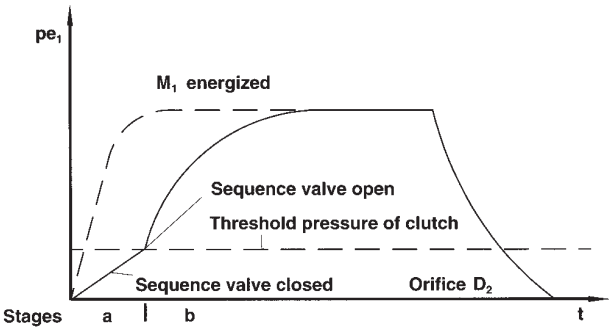
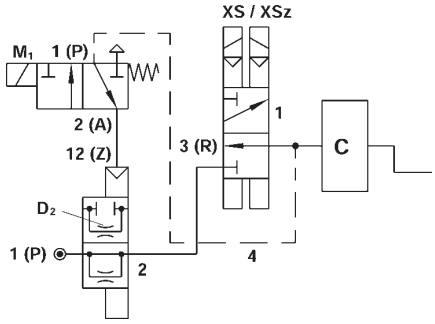


Fig. 13: Pressurization at threshold pressure between 0 and 2 bar

Clutch with threshold pressure higher than 2 bar



from TDC to 90°: M1 not energized
>90°: M1 energized

Fig. 14: Circuit diagram "soft clutch" at threshold pressure >2bar

Pressurization is achieved via the soft start valve in two steps:
- Rapid pressure build-up through the open valve
- Before the threshold pressure of the clutch has been reached, the soft start valve is actuated by the pressure building up and closes. Further pressurization is achieved via nozzle D2 (soft start).

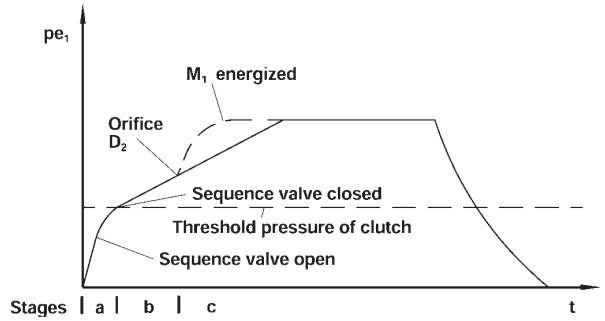


Fig. 15: Pressurization at threshold pressure >2 bar

When starting in the TDC, the soft start valve helps to protect the mechanism of the press due to the soft transmission of the momentum.

In case of an emergency stop, the press is able to stop before the working zone. At a renewed start, the soft start function must be inactive, otherwise the clutch will slip within the working zone for lack of full momentum.

In order to prevent this from happening, a cam switch transmits an electrical signal to the pilot valve as soon as the 90° position has been reached.

Press control

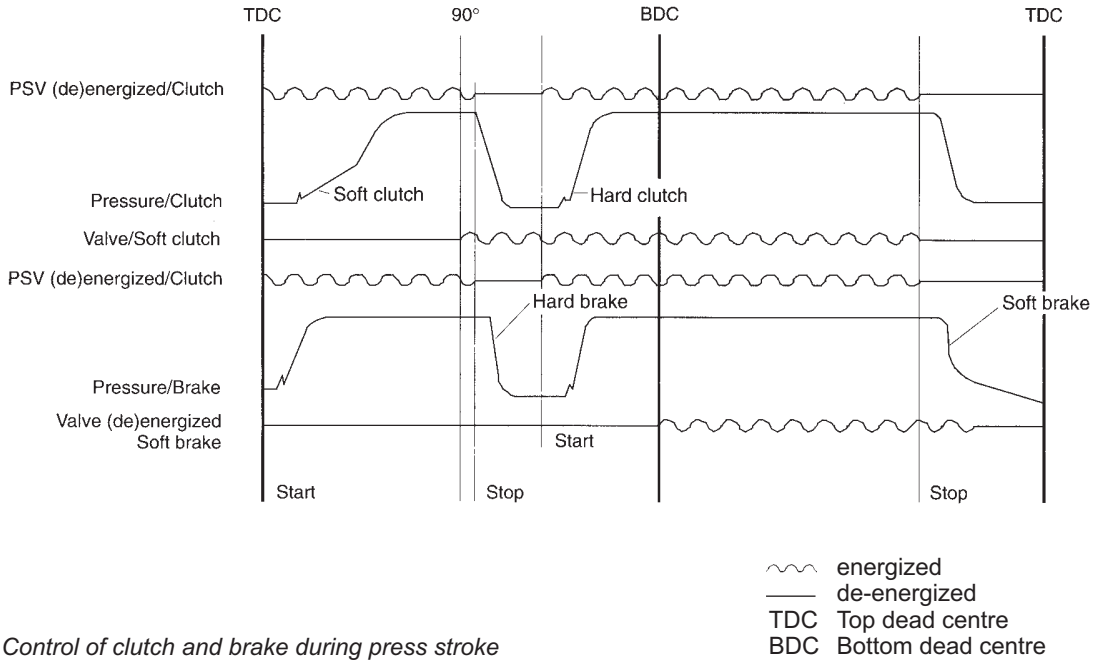


Fig. 16: Control of clutch and brake during press stroke

Presses equipped with the Herion safety valve type XS and XSz with soft clutch engagement and soft braking function improve the working conditions of the press mechanism and further increase the press safety.

The safety valve helps to considerably lessen the impact stress during start thus reducing both mechanical damages to the press and press maintenance costs.

Thanks to the small braking angle between TDC and BDC it is possible to reduce the stroke of the feeding device (saving of time).

A relatively small investment in the clutch/brake control system helps to considerably reduce repair costs.

Many press manufacturers and end users are convinced of the advantages offered by this system and successfully incorporate it into their equipment.

Please note: When installing this safety system it is important, however, to observe the local safety regulations.

Finally it should be stressed that Herion has gathered experience in the field of press components and control systems over more than 40 years. The technical know-how thus acquired is of a great advantage to our customers, i.e. the press manufacturers and the press users.

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