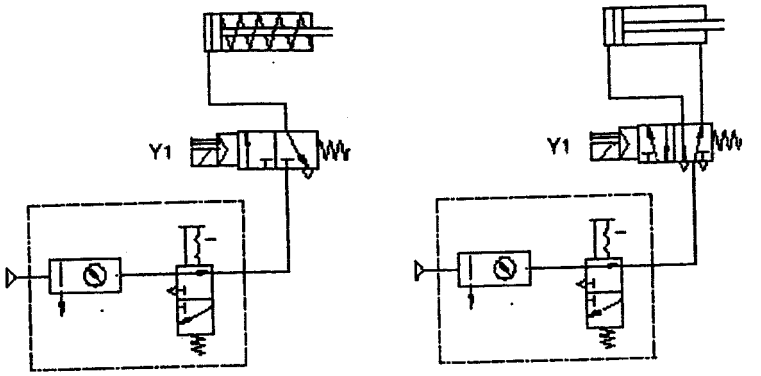
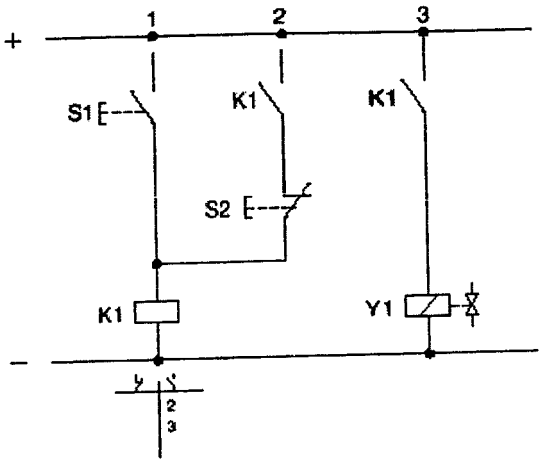
Control of cylinder using memory function (dominant on and single solenoid valve)



Electrical circuit

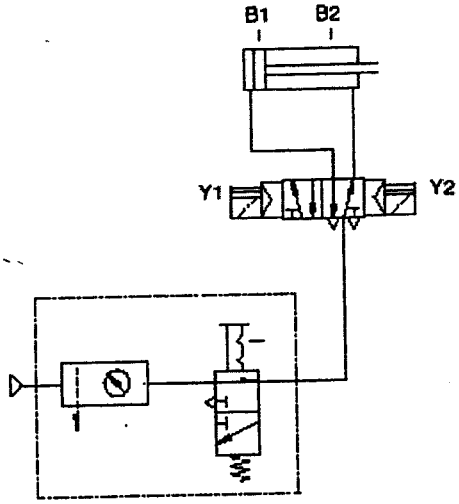


Solution description

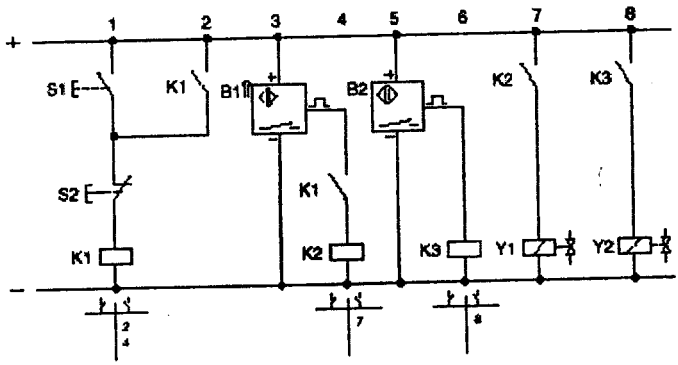
By pressing the pushbutton switch S1 (ON) the electric circuit for the relay K1 is closed and the bank of contacts is made. The latching circuit with contact K1 (13,14) via the **unactuated** pushbutton switch S2 (OFF) keeps the electric circuit closed for the relay K1 after the release of the pushbutton switch S1 (ON). The electric circuit for the solenoid coil Y1 is closed via the contact K1 (23, 24) and the 3/2- (5/2-) way solenoid valve is reversed. The piston rod of the single-acting (double-acting) cylinder advances to the forward end position. By pressing the pushbutton switch S2 (OFF) the electric circuit for the relay K1 is opened and the bank of contacts is brought into the nor-mal position. The electric circuit for the solenoid coil Y1 is opened and the 3/2- (5/2-) way solenoid valve is switched back to its initial position. The piston rod of the single-acting (double-acting) cylinder returns to the retracted end position.

Reciprocating motion using sensor and memory function

Power circuit



Electrical circuit (control circuit)

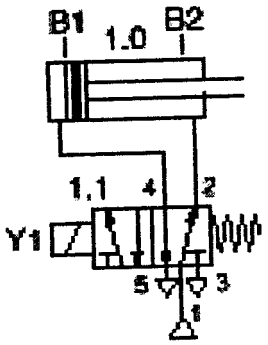


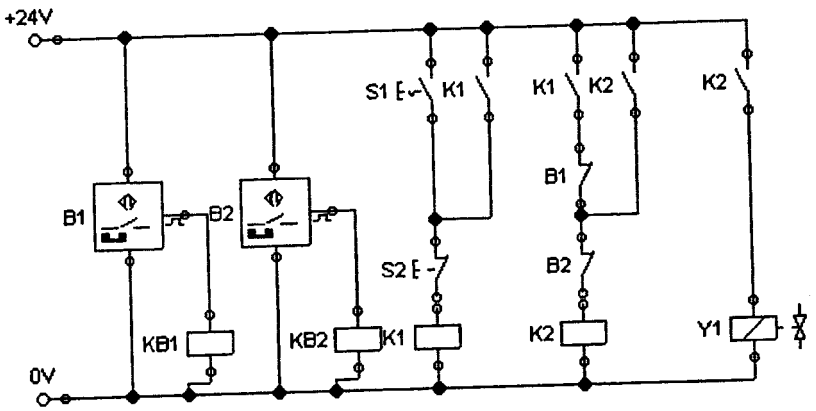
Solution description

By pressing the pushbutton switch S1 (ON) the electric circuit is closed for relay K1 via the unactuated pushbutton switch S2 (OFF) and the bank of contacts is made. After releasing pushbutton switch S1 (ON) the electric circuit for the relay K1 (23, 24) is kept closed via the latching circuit with contact K1 (13, 14). The electric circuit for the relay K2 is closed with contact K1 (23, 24) and the contact K2 is actuated. The electric circuit for the solenoid coil Y1 is closed and the 5/2-way double solenoid valve is reversed. The piston rod of the double-acting cylinder advances to the forward end position actuating sensor B2. After leaving the rear end position, the electric circuit for the relay K2 is opened via sensor B1 and the contact K2 is brought to the normal position.
The electric circuit for the relay K3 is closed via sensor B2 and the contact K3 is made. The electric circuit for the solenoid coil Y2 is closed and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod returns to the rear end position and actuates the sensor B1. After leaving the forward end position the electric circuit for relay K3 is opened via sensor B2 and the contact K3 is brought to the normal position.
The electric circuit for the relay K2 is closed via sensor B1 and the contact K2 is made. The electric circuit for the solenoid coil Y1 is closed and the 5/2-way double solenoid valve is reversed. The piston rod of the double-acting cylinder advances again to the forward end position.
By pressing the pushbutton switch S2 (OFF), the electric circuit for the relay K1 is opened and the bank of contacts is brought to the normal position.

Reciprocating motion using sensor, memory function and single solenoid valve

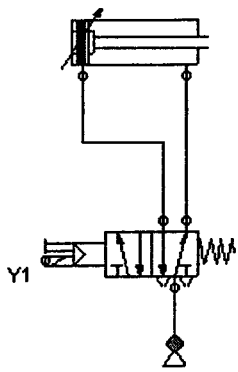
Power circuit



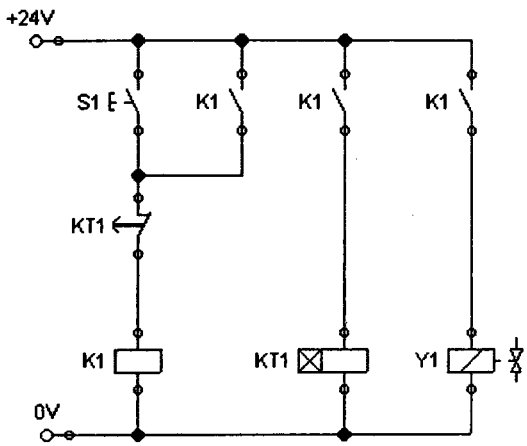


Time dependent reversal of double acting cylinder without checking of mechanical end position (single solenoid directional control valve)

Power circuit

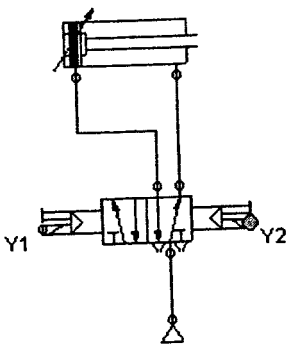


Electrical circuit (control circuit)

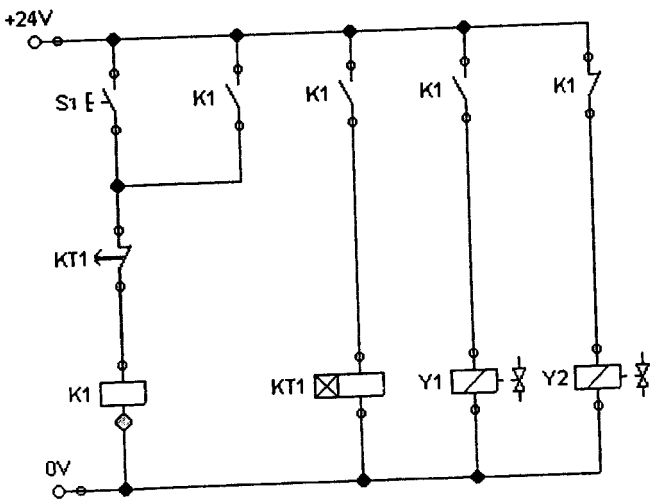


Time dependent reversal of double acting cylinder without checking of mechanical end position (double solenoid directional control valve)

Power circuit

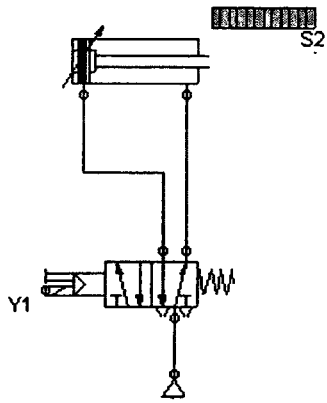


Electrical circuit (control circuit)

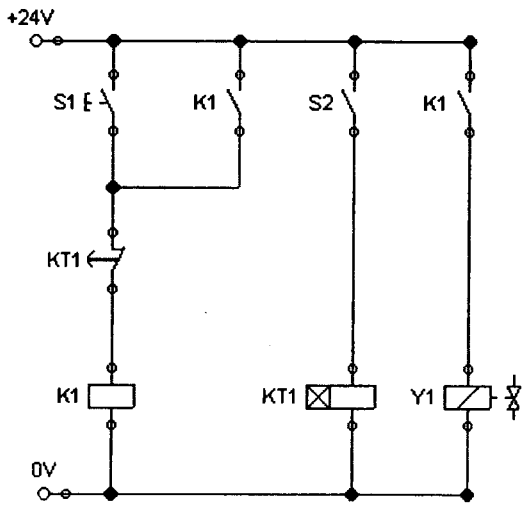


Time dependent reversal of double acting cylinder with checking of mechanical end position (single solenoid directional control valve)

Power circuit

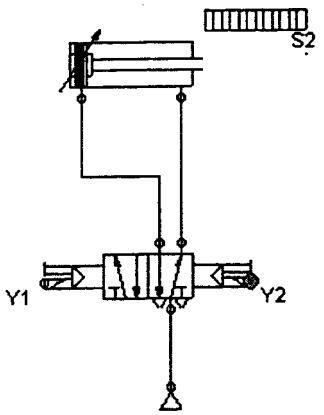


Electrical circuit (Control circuit)

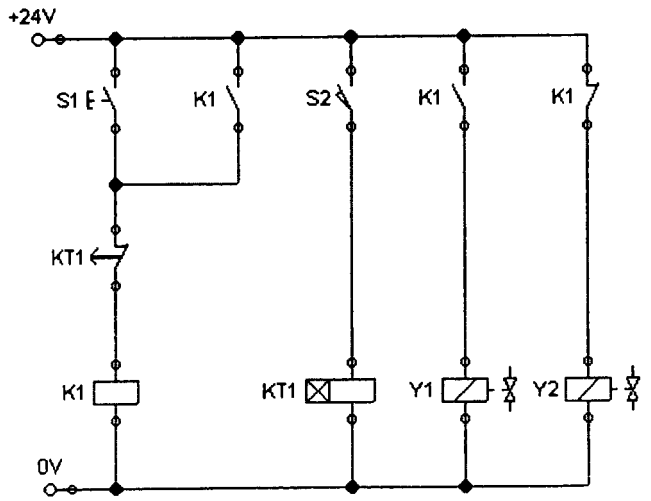


Time dependent reversal of double acting cylinder with checking of mechanical end position (double solenoid directional control valve)

Power circuit

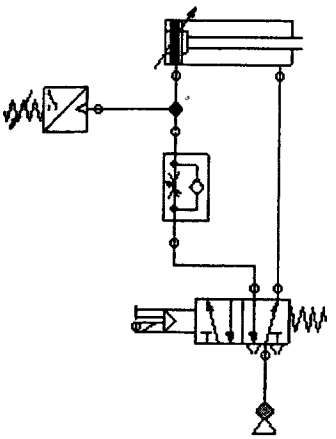


Electrical circuit (Control circuit)

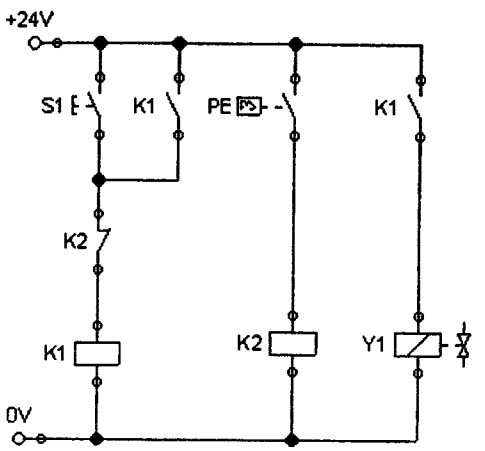


Pressure dependent reversal of double acting cylinder without checking of mechanical end position (single solenoid valve)

Power circuit

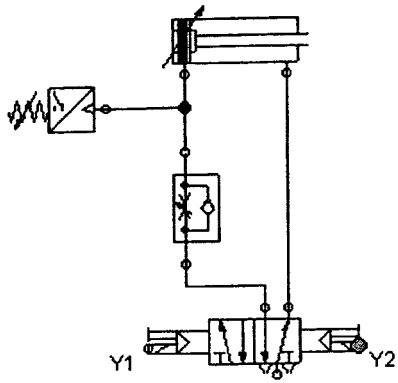


Electrical circuit (control circuit)

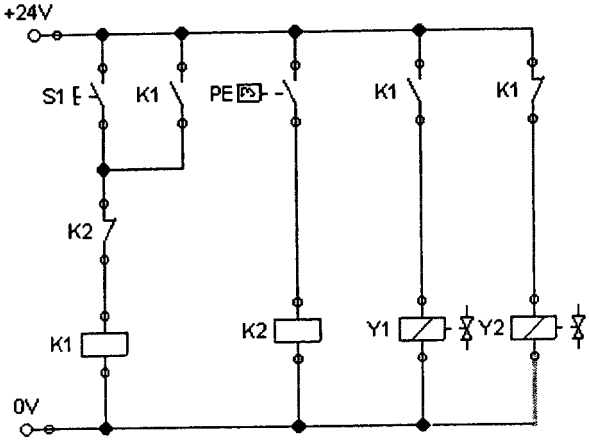


Pressure dependent reversal of double acting cylinder without ch
of mechanical end position (double solenoid valve)

Power circuit

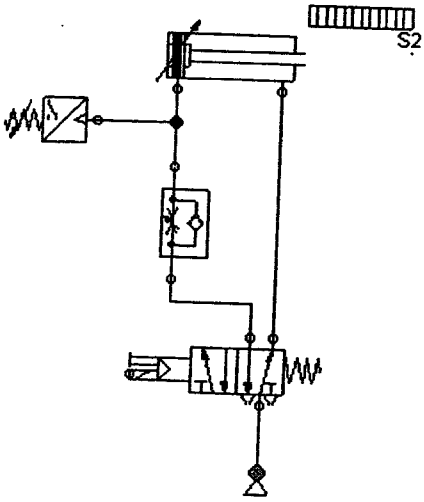


Electrical circuit (control circuit)

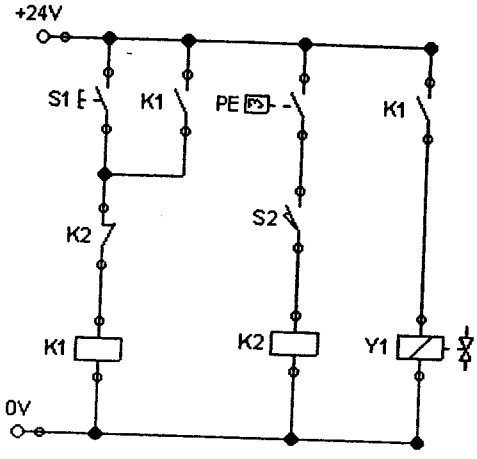


Pressure dependent reversal of double acting cylinder with checking of mechanical end position (single solenoid valve)

Power circuit

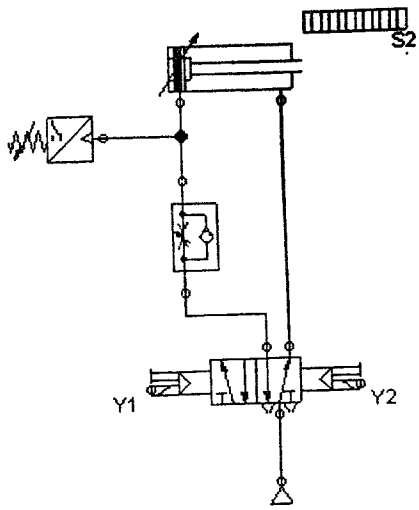


Electrical circuit (control circuit)

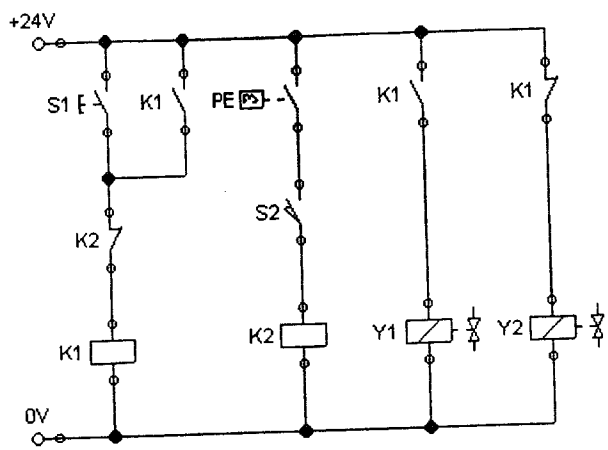


Pressure dependent reversal of double acting cylinder with checking of mechanical end position (double solenoid valve)

Power circuit

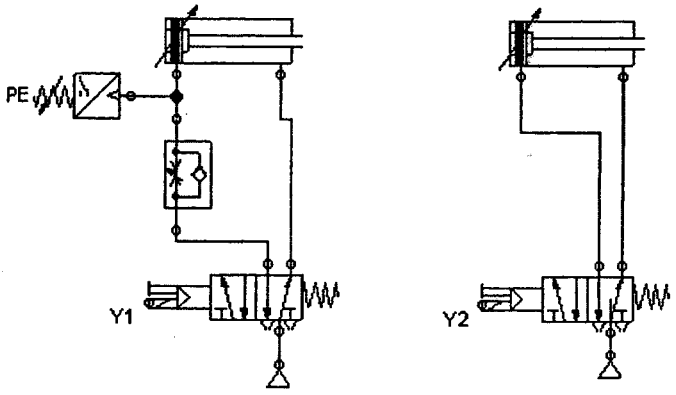


Electrical circuit (control circuit)

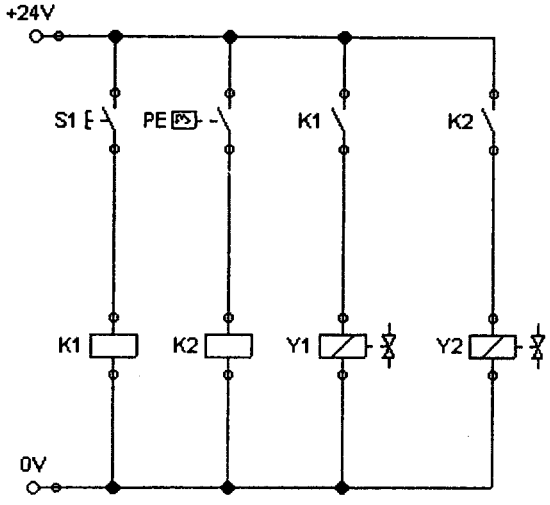


Sequential circuit using pneumatic electrical converter

Power circuit

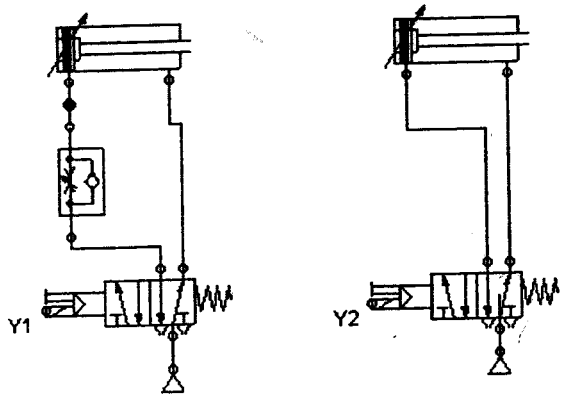


Electrical circuit (control circuit)

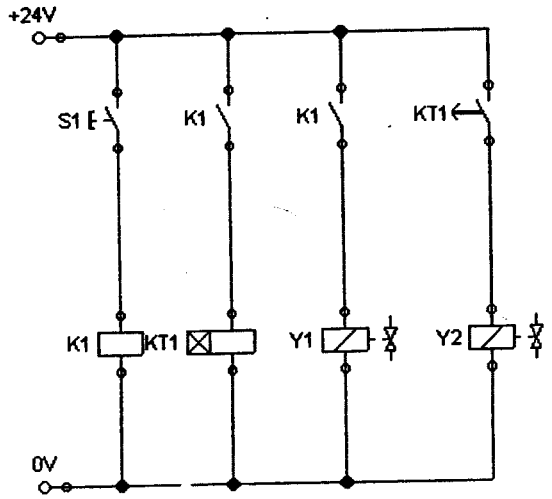


Sequential circuit using time delay valve

Power circuit

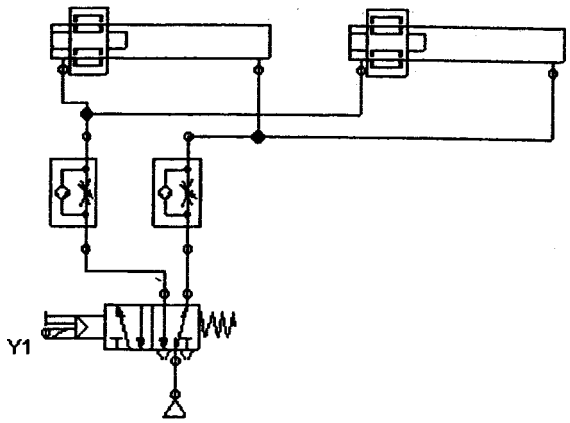


Electrical circuit (control circuit)

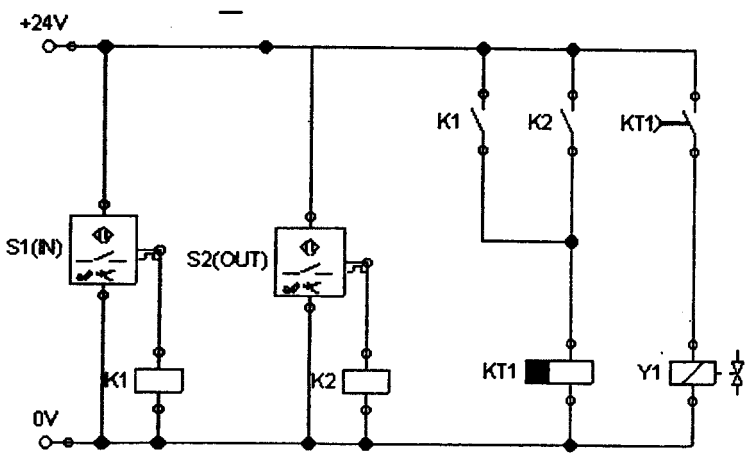


Delay off circuit using delay off timer (* Automatic door control)

Power circuit



Electrical circuit (control circuit)



Chapter 6

Functional Sequence and circuit diagram representation

Prepared by U Tint Zaw

Functional Sequence - Circuit Diagram Representation

The previous chapter 5 dealt with the most common basic circuits, a knowledge of which suffices to allow simple pneumatic controls to be built .As soon as control functions become more complicated however, and larger systems have to be installed or even repaired, circuit diagrams and charts showing the functional sequence of the systems are very important for the maintenance personnel.

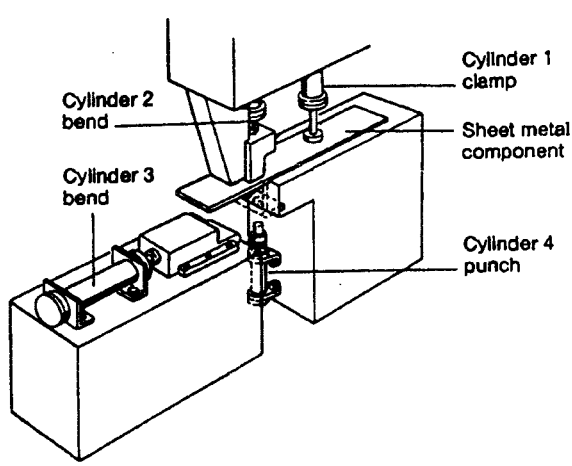
In most cases, charts exist but these do not correspond optimally to the functional sequences and they are not used by the maintenance personnel. The reason for this is a reluctance to use circuit diagrams which are not clear as well as incomprehensible representations of functional sequences. If uncertainty exists in reading symbols and hence complicated circuit diagrams, it is impossible to systematically build up pneumatic and electro-pneumatic controls and, especially, to perform "systematic fault tracing". A lot of time can be wasted in trying out, guessing, or searching unsystematically in circuit diagrams, functional sequences, or even in the completed control. Thus, it pays to get to know the pneumatic symbols, the layout of the circuit diagrams, and also the various possibilities for representing the functional sequences.

In this chapter, the various possibilities of representing functional sequences and circuit diagrams are given for the benefit of the maintenance engineer, using an example taken from practice.

Example: Bending and punching fixture

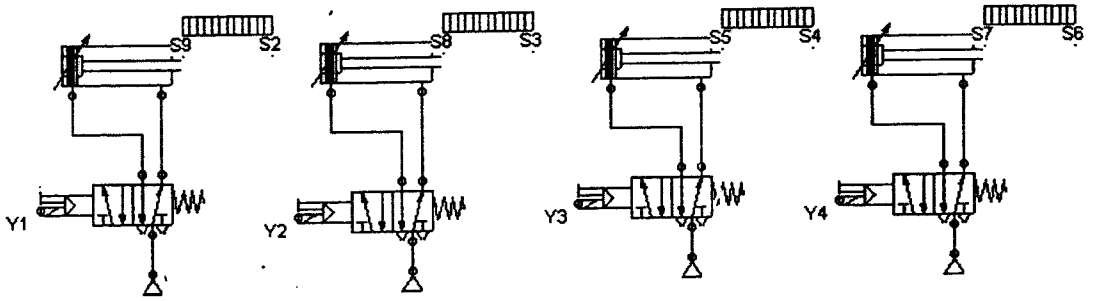
Sheet metal components are placed by hand in a holder. The sheet metal component is clamped by means of a pneumatic cylinder. Two other cylinders bend the component until another cylinder punches a hole.

Layout drawing

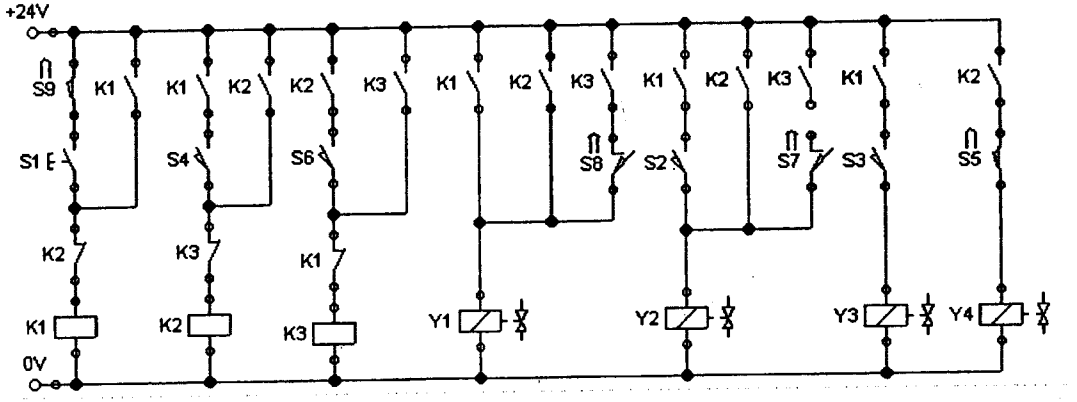


Circuit diagram

Power circuit



Control Circuit



Writing form of Representation

Listing in Chronological Order

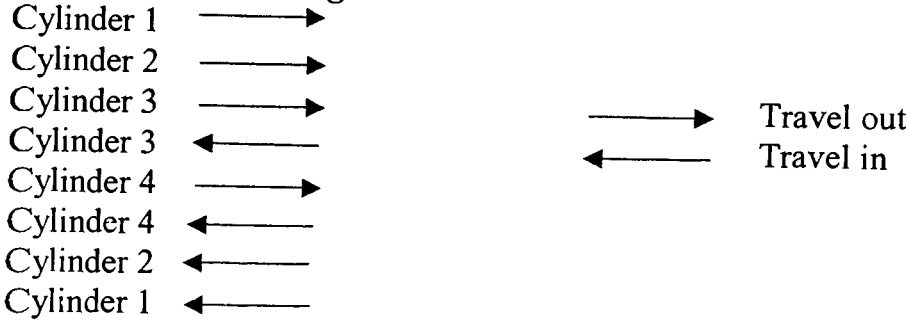
Cylinder 1 (A)	clamping the sheet metal component
Cylinder 2 (B)	first bending operation
Cylinder 3 (C)	second bending operation
Cylinder 3 (C)	travels with bending die into initial position
Cylinder 4 (D)	punch 4 mm hole
Cylinder 4 (D)	travels into the initial position
Cylinder 2 (B)	travels with bending die into initial position
Cylinder 1 (A)	unclamps finished sheet metal component

Tabular listing

Working step	Cylinder1	Cylinder 2	Cylinder 3	Cylinder 4
1	OUT	--	--	--
2	--	OUT	--	--
3	--	--	OUT	--
4	--	--	IN	--
5	--	--	--	OUT
6	--	--	--	IN
7	--	IN	--	--
8	IN	--	--	--

OUT - traveling out to forward end position
IN - traveling in to rear end position

Vector Diagram



Abbreviated Notation

Cylinder A +
Cylinder B +
Cylinder C +
Cylinder C –
Cylinder D +
Cylinder D _
Cylinder B –
Cylinder A –

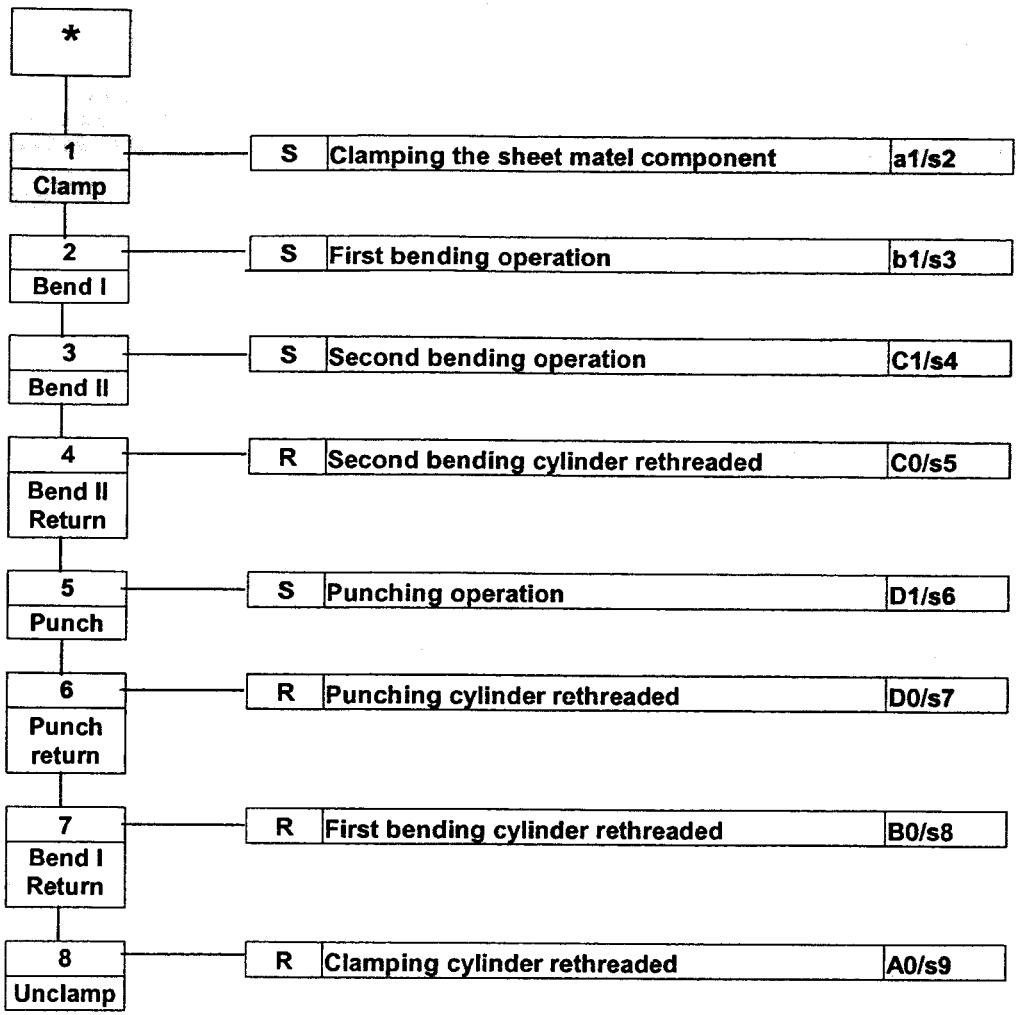
\+ Travel out
\- Travel in

In the next written form of representation (sequence chart ,function chart) not only is the movement of the working element recorded, but the signal input and signal processing element are also included.

Sequences chart

Working Step	Operation of sensor	By	Operation of stepping relay	Processing step by stepping relay	Operation of output solenoid	Working Element travels to		Comment
						Forward	Rearward	
1	s1	Hand	k1(ON)/k3(OFF)	1	y1(ON)	A	-	
2	s2	A	k1(ON)	1	y2(ON)	B	-	
3	s3	B	k1(ON)	1	y3(ON)	C	-	
4	s4	C	k2(ON)/K1(OFF)	2	y3(OFF)	-	C	
5	s5	C	k2(ON)	2	y4(ON)	D	-	
6	s6	D	k3(ON)/k2(OFF)	3	y4(OFF)	-	D	
7	s7	D	k3(ON)	3	y2(OFF)	-	B	
8	s8	B	k3(ON)	3	y1(OFF)	-	A	

Function chart



Graphical form of representation (Diagrams)

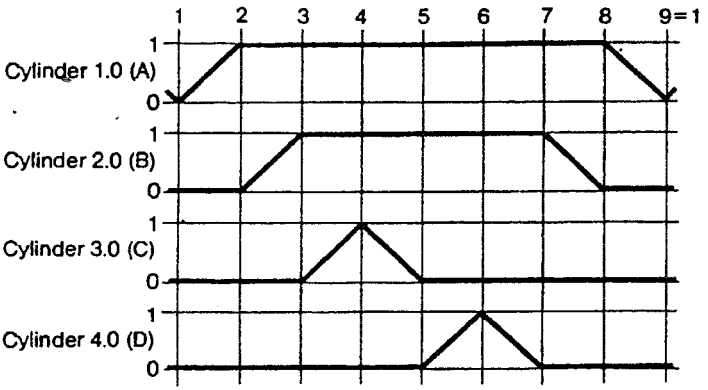
Motion Diagram

The sequences and states of the working elements (cylinders, assemblies) etc. are shown in the motion diagram. Two co-ordinates are used for this representation. In one coordinate, the displacement (stroke of the working element) is entered, and in the other the steps **(displacement-step diagram.**

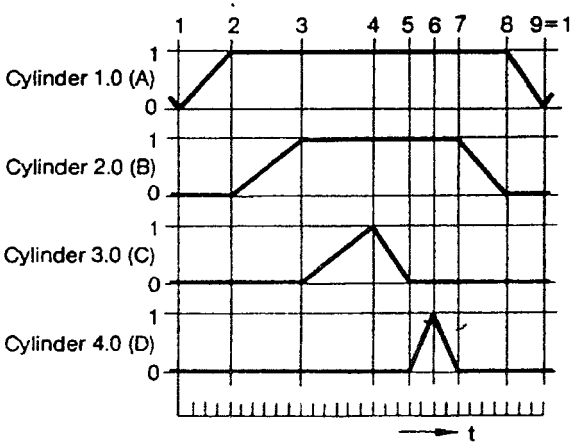
In addition to this diagram, it is also possible to record the time **(displacement-time diagram).** These forms of representation of functional sequences are contained in the VDI Recommendations 3260.

Diagrams for the example: Bending and stamping fixture.

Displacement-step diagram

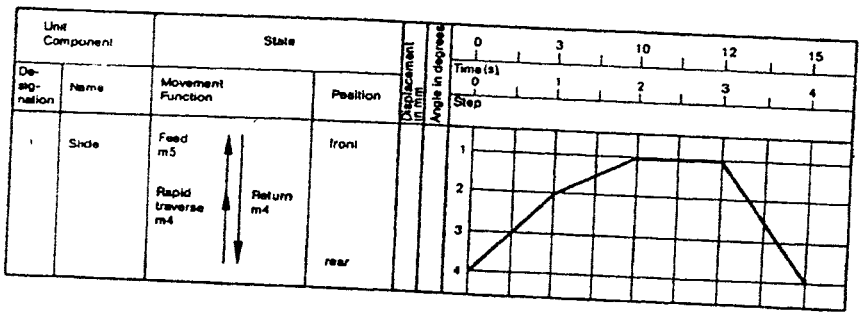


Displacement-time diagram



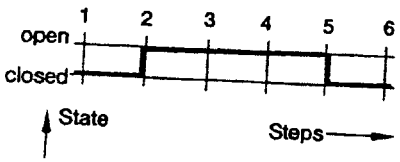
These diagrams allow the sequence of motions of the machines to be easily recognised.
The operating sequence can also be represented in terms of pressure, power, and angle.

Displacement-step diagram in accordance with VDI 3260

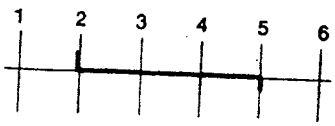


Control Diagram

The switched states of the signal elements and control elements over the steps are drawn in the control diagram. The switching time is neglected here. Only the open or closed state of a switch is of importance.



In the above example, a limit switch opens at step 2 and closes again at step 5.
The control diagram can also be represented in such a way that the state is drawn only on the line.

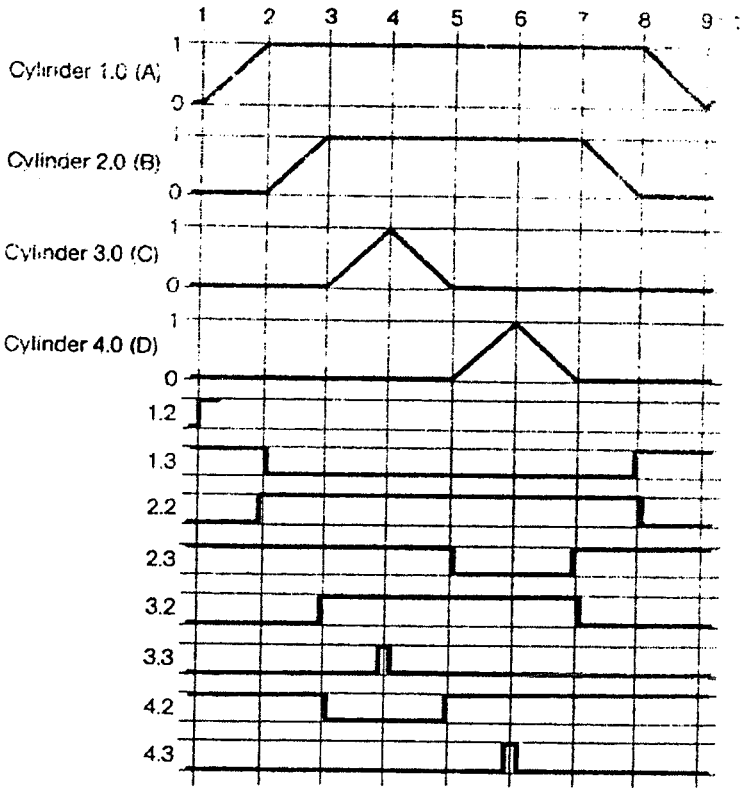


Chapter 7
Reading circuit diagram

Prepared by U Tint Zaw

Function diagram

The motion and control diagram s each represent a functional sequence for a particular group of components . For this reason, the expression "function diagram" is also used frequently.
In most case, the motion diagram and the control diagram are drawn together as a single diagram is known as the complete function diagram.
The function diagram is shown here for the bending and punching fixture example.



Reading circuit diagram

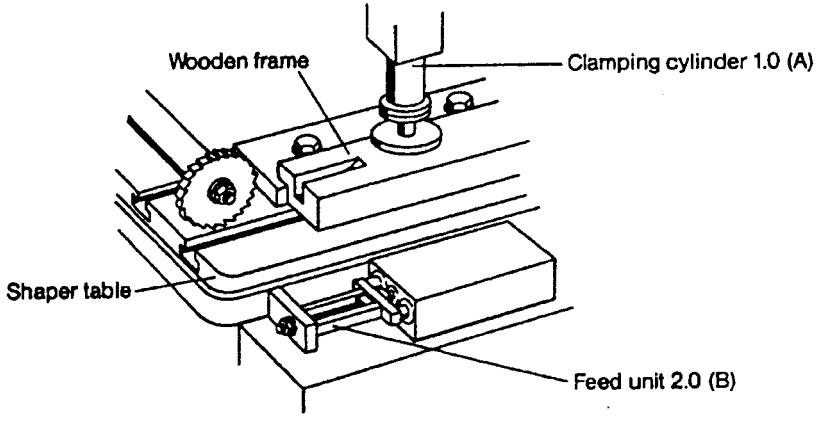
In order to be able to read circuit diagrams properly, it is important to know the meaning of the recommendations and standards for circuit diagram construction, designation of circuit diagrams and charts, functional sequences.
The various forms a control can take are shown by mean of the following examples .Systematic reading of circuit diagrams and drawing functional sequences should be practiced with these examples

Example : Hand Lever Shaper

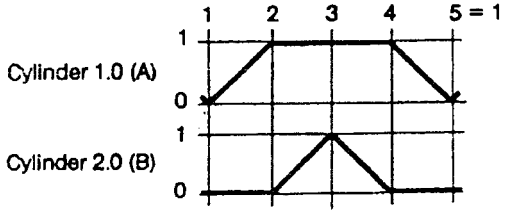
Groove cutting

Groves are to be cut in wooden frames on a shaper . The wooden frame is clamped with a pneumatic cylinder . The feed of the shaper table is performed by a pneumatic –hydraulic feed unit.

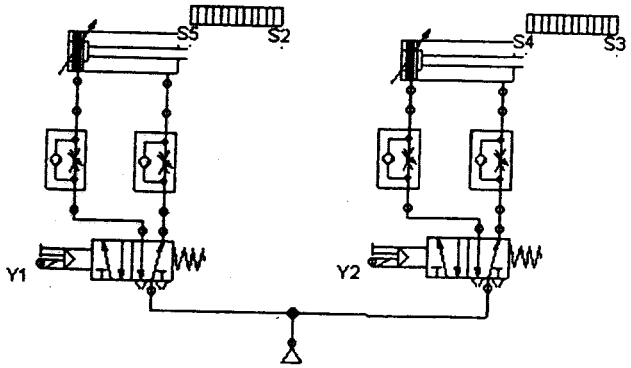
Layout drawing



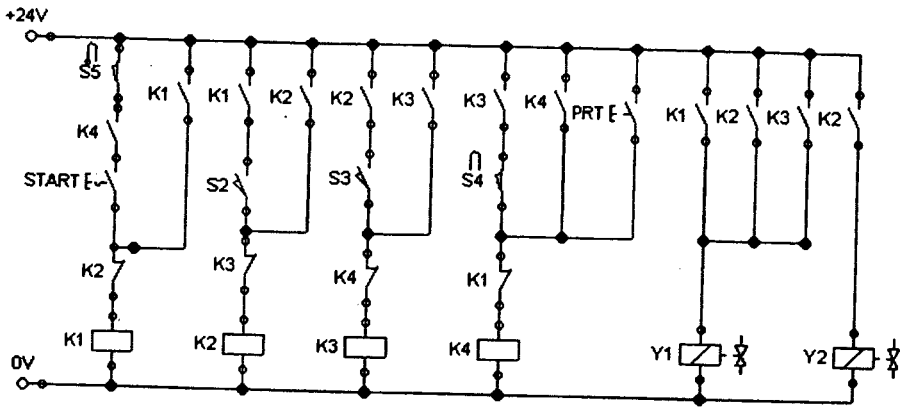
Displacement-step diagram



Power circuit



Control circuit



Sequence chart

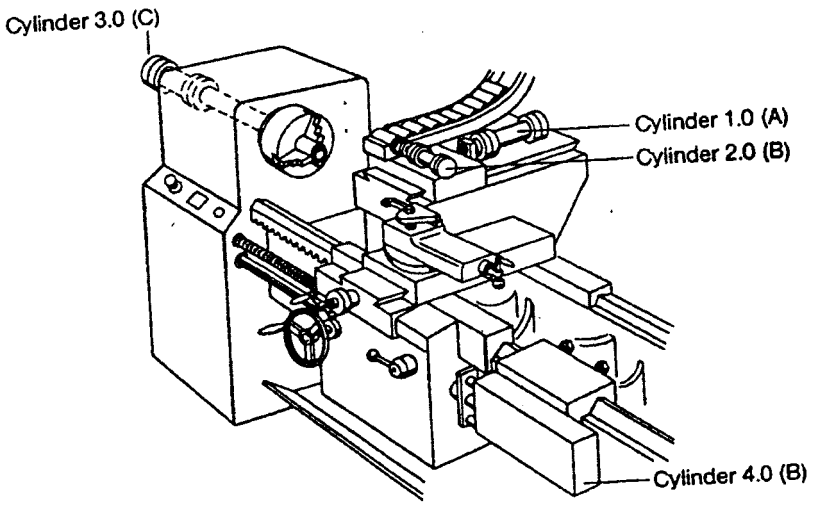
Working Step	Operation of sensor	By	Operation of stepping relay	Processing step by stepping relay	Operation of output solenoid	Working Element travels to		Comment
						Forward	Rearward	
1	s1	Hand	k1(on)/k4(off)	1	y1(on)	1		
2	s2	1	k2(0n)/k1(off)	2	Y2(on)	2		
3	s3	2	k3(on)/k2(off)	3	y2(off)		2	
4	s4	2	k4(on)/k3(0ff)	4	y1(off)		1	

Example :Lathe (Semi-Automatic)
Machining of bushings (inside diameter)

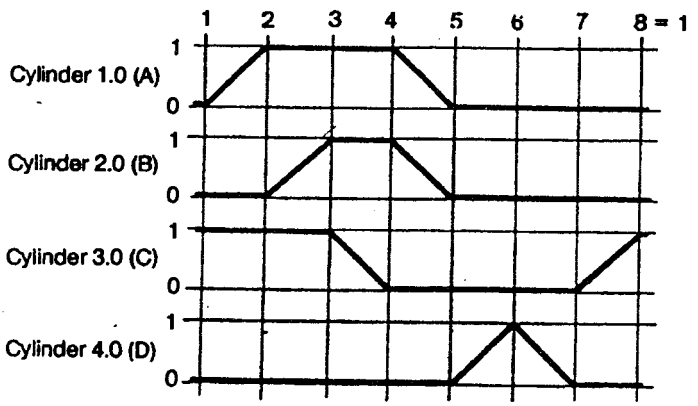
Layout drawing

The bushing are to fed to the lathe from a slide. Cylinder 1.0 (A) move the carriage into position . Cylinder 2.0 (B) pushes the part into the collect chuck. Cylinder 3.0 (C) clamps the bushing. Feed unit 4.0 (D) machines the inside diameter of the bushing. The part is unclamped and removed by hand. A new start signal causes a new cycle to be parformed.

Layout drawing

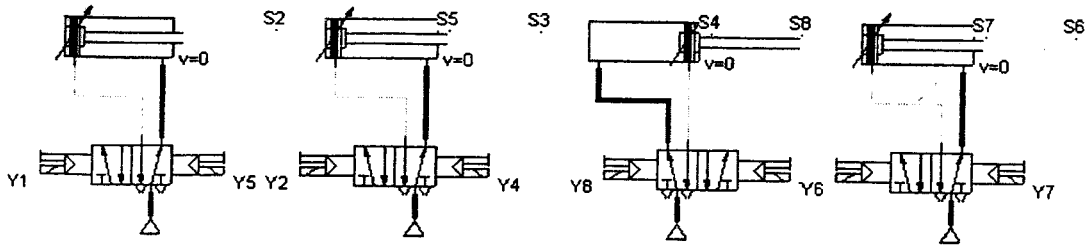


Displacement –step diagram

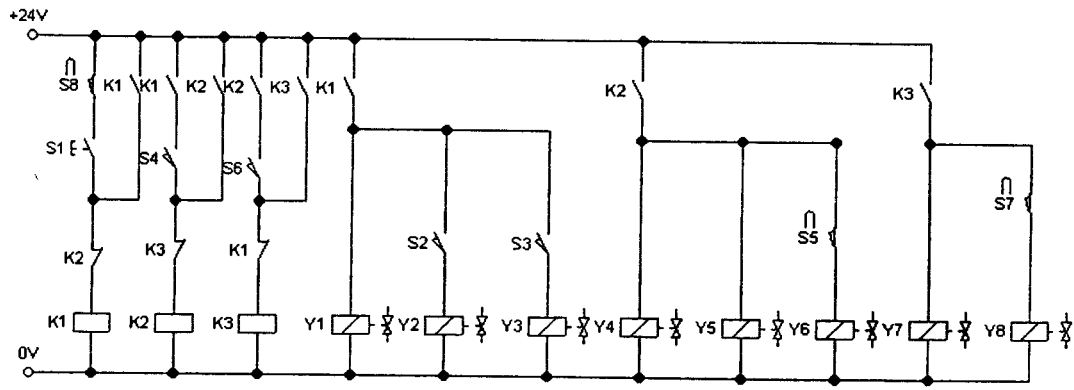


Circuit diagram

Power circuit



Control circuit



Sequence chart

Working Step	Operation of sensor	By	Operation of stepping relay	Processing step by stepping relay	Operation of output solenoid	Working Element travels to		Comment
						Forward	Rearward	
1	s1	Hand	k1(on)/k3(off)	1	y1	1		
2	s2	1		1	y2	2		
3	s3	2		1	y3		3	
4	s4	3	k2(on)/k1(off)	2	y4/y5		1and 2	
5	s5	2		2	y6	4		
6	s6	4	k3(on)/k2(off)	3	y7		4	
7	s7	4		3	y8	3		