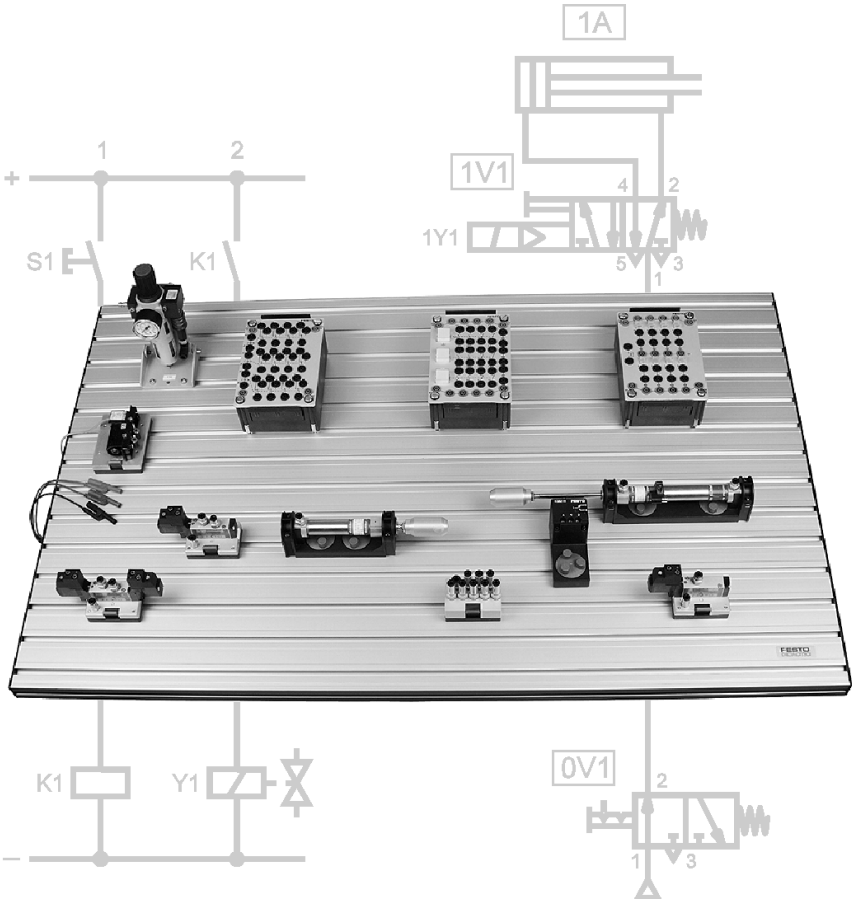
Learning System for Automation and Technology

Electropneumatics

Workbook Basic Level



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Preface

The Learning System for Automation and Technology by Festo Didactic is formulated according to various training prerequisites and vocational requirements. It has been divided into the following training packages:

- Basic packages which convey basic knowledge spanning a wide range of technologies
- Technology packages which deal with important subjects of open and closed-loop control technology
- Function packages to explain the basic functions of automated systems
- Application packages to facilitate practice-orientated vocational and further training.

The technology packages deal with the technologies of pneumatics, electro-pneumatics, programmable logic controllers, hydraulics, electro-hydraulics, proportional hydraulics and application technology (handling).

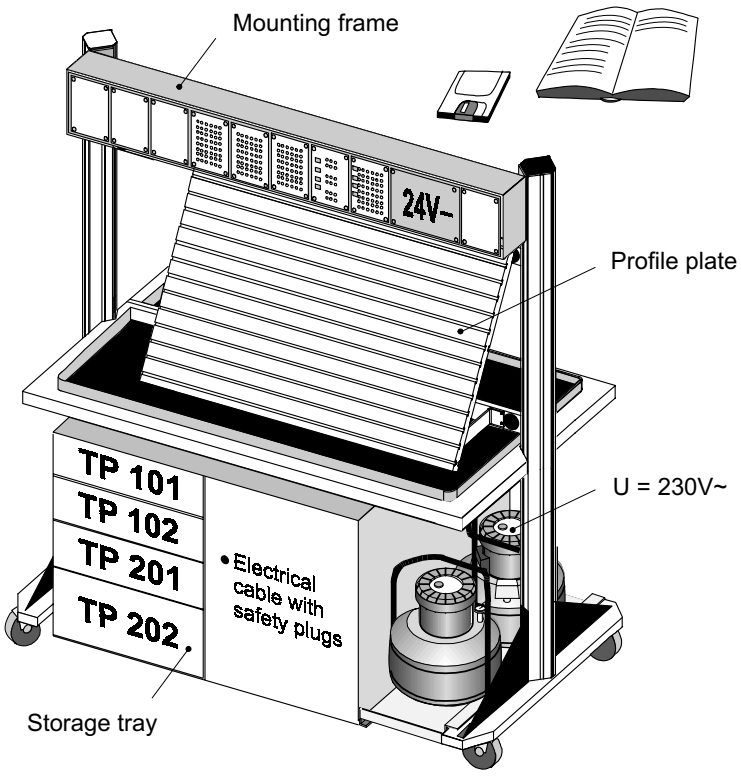

Fig. 1:
Pneumatics 2000 –
i.e. mobile workstation

The modular design of the Learning System permits applications beyond the scope of the individual packages. It is, for instance, possible to design PLC-controlled systems with pneumatic, hydraulic and electrical actuators.

All training packages are based on an identical structure:

- Hardware
- Teachware
- Software
- Seminars

The hardware consists of industrial components and systems which have been adapted for didactic purposes.

The courseware has been designed in line with didactic methods and coordinated for use with the training hardware. The courseware comprises:

- Textbooks (with exercises and examples)
- Workbooks (with practical exercises, explanatory notes, solutions and data sheets)
- Transparencies and videos (to create a lively training environment)

The training and learning media is available in several languages, which has been designed for use in the classroom as well as for self-tuition.

The software sector serves as a basis for providing computer training programs, simulation software for Pneumatics/Hydraulics and programming software for programmable logic controllers.

A comprehensive range of seminars on the subject of the various technology packages completes our program of vocational and further training.

Latest information about the technology package TP 201

New in Pneumatic 2000:

- All electrical connections with safety sockets.
- Industrial components on the profile plate.
- Fostering of key qualifications:
  Technical competence, personal competence and social competence form professional competence.
- Training of team skills, willingness to co-operate, willingness to learn, independence and organisational skills.

Aim – **Professional competence**

Content

Part A	Course	Exercises
Part B	Fundamentals	Reference to the text book
Part C	Solutions	Function diagrams, circuits, descriptions of solutions and quipment lists
Part D	Appendix	Storage tray, mounting technology and datasheets

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Exercise 5: Assembly station A-11
Exercise 6: Cutting device A-13
Exercise 7: Flap control A-15
Exercise 8: Tipping device A-17

Control systems with double solenoid valve

Exercise 9: Diverting device A-19
Exercise 10: Hopper control A-21
Exercise 11: Gravity feed magazine A-23
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Control systems with electrical latching

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Plastic tubing	D-5
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Introduction

This workbook forms part of the Learning System for Automation and Technology by Festo Didactic GmbH & Co. The system provides a solid framework for practically orientated vocational and further training. Technology package TP200 deals exclusively with electropneumatic controls.

Basic level TP201 provides initial training in electropneumatic control technology. Knowledge on the physical fundamentals of electropneumatics as well as of the function and application of electropneumatic components is conveyed. The set of equipment enables the construction of simple electropneumatic control circuits.

Advanced level TP202 aims to provide further training in electropneumatic control technology. The set of equipment can be used to build up extensive combination circuits with logic linking of the input and output signals, as well as programmed control systems.

Precondition for assembling control circuits is a fixed workstation equipped with a Festo Didactic profile plate. The profile plate has 14 parallel T-grooves at intervals of 50 mm each. A short-circuit-proof power supply unit (input: 230 V, 50 Hz; output: 24 V, maximum 5 A) is used for d. c. supply. For compressed air supply, a mobile silenced compressor (230 V, maximum 8 bar =800 kPa) is recommended.

Working pressure should be a maximum of p = 6 bar (= 600 kPa)

You will achieve maximum reliability of operation if the control system is run at a working pressure of p = 5 bar (= 500 kPa), with unlubricated air.

The set of equipment for basic level TP201 enables the assembly of complete control systems for solving the problems set in the 20 exercises. The theoretical basis required for an understanding of this collection of exercises can be found in the following textbook:

Learning System for Automation and Technology

- Electropneumatics, Basic Level TP201.

In addition, there are data sheets for the individual components (cylinders, valves, measuring devices etc.).

Notes on safety and operation

In the interest of your own safety you should observe the following:

- Pressurised air lines that become detached can cause accidents. Switch off pressure immediately!
- First connect all tubing and secure before switching on the compressed air.
- **Warning!**
  Cylinders may advance or retract as soon as the compressed air is switched on.
- Do not operate the electrical limit switch manually during fault finding (use a tool).
- Observe general safety regulations! (DIN 58126 and VDE 100).
- There are two different designs with electrical limit switches:
  – Actuation only from the **left**
  – Actuation only from the **right**.
- Limit switches should be fixed in such a way that they contact the trip cam of the cylinder only in the determined direction. Do not use them being in the mid-position. Do not actuate limit switches from the front.
- Do not exceed the permissible working pressure (see data sheets).
- Use only low voltages of $\leq$ 24 V.
- All components are provided with 4 mm safety sockets respectively safety plugs. For electical connections use only electrical cable with safety plugs.
- Pneumatic circuit construction:
  Use the silver-metallic plastic tubing of 4 mm external diameter to connect the components. The plastic tube is to be inserted fully into the CU-connector up to the stop; no tightening necessary!
- Releasing the CU quick push-pull connector:The tube can be released by depressing the collet (black ring) (releasing whilst pressurised is not possible!)
- Switch off the air and voltage supply before disconnecting the circuit.

- The mounting boards for the equipment are equipped with mounting alternatives A, B, C or D:

  Alternative A, Detent system
  Light, non-load bearing components (e.g. directional control valves). Simply clip the components into the groove on the profile plate; release is effected by actuating the blue lever.

  Alternative B, Rotational system
  Medium weight load-bearing components (e.g. actuators). These components are clamped on to the profile plate by means of T-head bolts. The components are clamped or released via the blue triple grip nut.

  Alternative C, Screw-in system
  For heavy load-bearing components or components, which are seldom removed from the profile plate (e.g. the service unit with on-off valve). These components are attached by means of cheese head screws and T-head nuts.

  Alternative D, Plug-in system
  For light, non-load bearing components with plug-in bolts (i.e. the indicator plate). These components are mounted via plug-in adapters.

- Observe the data given in the data sheets of section D for individual components.

Training contents of basic level and advanced level

Basic level (TP201)

- Physical fundamentals of electricity and pneumatics
- Function and application of electropneumatic components
- Designation and drawing of electropneumatic symbols
- Representation of motion sequences and switching statuses
- Drawing pneumatic and electrical circuit diagrams
- Assembly of control systems with relays
- Direct and indirect manual control systems
- Direct and indirect stroke-dependent control systems
- Logical AND/OR functions of the input signals
- Electrical latching circuits
- Using a magnetic proximity switch
- Using a pressure switch
- Fault finding in simple electropneumatic control systems

Advanced level (TP202)

- Function and use of electro-pneumatic components
- Stroke-dependent control systems with sensors
- Stroke-dependent control systems with preselect counter
- Control systems with marginal conditions
  (e.g. Single/continuous cycle, EMERGENCY-STOP)
- Position-scheduled control/process orientated sequence controls
- Timing controls/time orientated sequence controls
- Program control systems with latching and resetting sequence
- Fault finding in extensive electro-pneumatic control systems

Allocation of training aims and exercises (Table 1)

Training aim	*Exercises* 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Direct actuation of single acting cylinders	•				•		•		•											
Direct actuation of double acting cylinders		•			•		•		•		•		•							
Indirect actuation of single acting cylinders			•			•		•		•					•	•				
Indirect actuation of double acting cylinders				•		•		•		•		•		•	•	•	•	•	•	
AND-function of the input signals					•	•														
OR-funktion of the input signals							•	•												
Actuation from two different positions									•	•										
Reversal by means of an electric limit switch											•	•								
Oscillating motion of the piston rod													•	•						
Electric latching circuit with dominating switch-of signal															•					
Electric latching circuit with dominating switch-on signal																•				
Reversal by means of magnetic proximity switches																	•		•	
Reversal by means of pressure switches																		•	•	
Co-ordinated motion control with auxiliary conditions																				•

Set of equipment for basic level (TP201)

This set of equipment has been arranged for the purpose of basic training in electropneumatic control technology. It contains all components required for the teaching of the proposed syllabus aims and may be supplemented by other equipment sets as required. To construct fully operational control circuits, the profile plate, a power supply unit and a pressure source are also necessary.

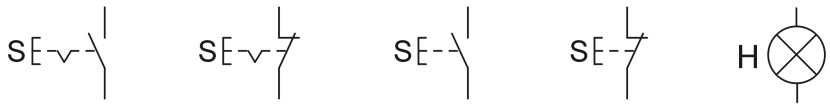
Set of equipment for basic level (TP201) (Order No.: 184460))

Description	*Order No.*	*Qty.*
Relay, 3-off*	162241	1
Signal input plate, electrical*	162242	1
Indicator and distributor plate, electrical*	162244	2
Plastic tubing, 10 m, silver-metallic	151496	1
Single-acting cylinder	152887	1
Double-acting cylinder	152888	2
Service unit with on-off valve	152894	1
Manifold	152896	1
Proximity switch with cylinder mounting	167060	2
Limit switch, electrical, actuated from the left	183322	1
Limit switch, electrical, actuated from the right	183345	1
Pneumatic-electrical converter	177459	1
3/2-way single solenoid valve, normally closed	167073	1
5/2 way-single solenoid valve	167074	2
5/2-way double solenoid valve	167076	1

* These components can be mounted to the profile plate by means of 4 adapters (Order No. 323571).

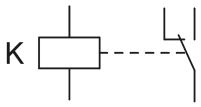
Symbols of the basic level

Signal input plate, electrical

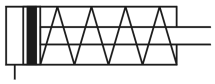


Indicator and distributor plate, electrical

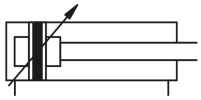
Relay, 3-off



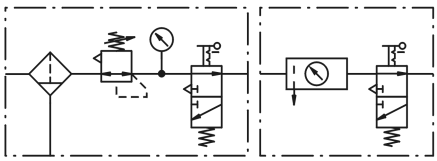
Single-acting cylinder



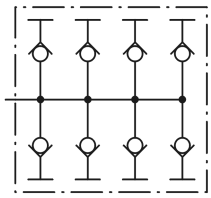
Double-acting cylinder



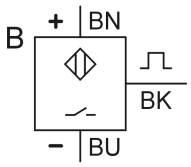
Service unit with on-off valve



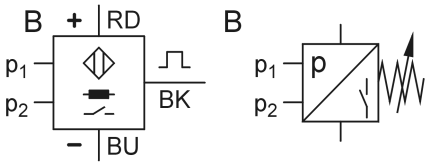
Manifold



Proximity switch with cylinder mounting

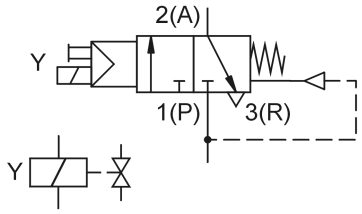


Pneumatic-electrical converter

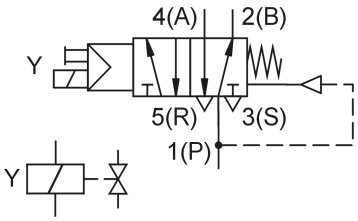


Limit switch, electrical,
actuated from the right or the left

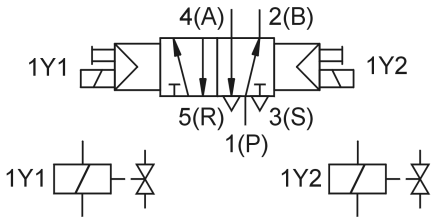
3/2-way single solenoid valve,
normally closed



5/2-way single solenoid valve



5/2-way double solenoid valve



Set of equipment for the advanced level (TP202)

This set of equipment has been arranged for the purpose of advanced training in electropneumatic control technology. Both sets of equipment (TP201 and TP202) contain components required for the teaching of the proposed syllabus aims and may be supplemented by other sets of equipment of the Learning System for Automation and Technology.

Set of equipment for the advanced level (TP202) (Order No. 184461)

Description	*Order No.*	*Qty.*
Relay, 3-off*	162241	4
Signal input plate, electrical*	162242	1
Time relay, 2-off*	162243	1
Counter preselect, electrical, adding*	162355	1
EMERGENY-STOP button	183347	1
Proximity sensor, inductive	178574	1
Proximity sensor, capacitive	178575	1
Proximity sensor, optical	178577	1
5/2-way double solenoid valve	167076	2

* These components can be mounted to the profile plate by means of 4 adapters (Order No. 323571)

Allocation of components and exercises (Table 2)

	Exercises																			
Description	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Relay, 3-off			1	1		1		1		1		1		1	1	1	1	1	1	1
Signal input plate, electrical	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Indicator and distributor plate, electrical	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
Single-acting cylinder	1		1		1	1	1	1	1	1					1	1				
Double-acting cylinder		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Service unit with on-off valve	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Manifold	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Proximity sensor with cylinder mounting																	2		2	2
Limit switch, electrical, actuated from the left											1	1	1	1						1
Limit-switch, electrical, actuated from the right													1	1						1
Pneumatic-electrical converter																		1	1	
3/2-way single solenoid valve, normally closed	1		1		1	1									1	1				
5/2-way single solenoid valve	1	1	1	1	1	1	1	1							1	1				1
5/2-way double solenoid valve									1	1	1	1	1	1			1	1	1	1
Number of components	4	7	8	8	11	11	11	15	10	12	14	21	12	12	16	17	17	21	25	19

Methodical structure of the exercises

All 20 exercises in Part A are compiled in the same methodical way.

The two exercise sheets are divided into:

- Subject
- Title
- Training aim
- Problem

as well as

- Problem description
- Positional sketch.

The proposed solutions in Part C cover at least four pages and are divided into:

- Pneumatic circuit diagram
- Electrical circuit diagram
- Solution description

as well as

- Pneumatic circuit design
- Electrical circuit design
- Component list.

Part A – Course

Control systems with final control valve with spring return

Exercise 1: Sorting device A-3
Exercise 2: Opening and closing device A-5
Exercise 3: Turning device A-7
Exercise 4: Lid fitting device A-9
Exercise 5: Assembly station A-11
Exercise 6: Cutting device A-13
Exercise 7: Flap control A-15
Exercise 8: Tipping device A-17

Control systems with double solenoid valve

Exercise 9: Diverting device A-19
Exercise 10: Hopper control A-21
Exercise 11: Gravity feed magazine A-23
Exercise 12: Multi-track gravity feed magazine A-25
Exercise 13: Conveyor belt control A-27
Exercise 14: Rotary indexing table A-29

Control systems with electrical latching

Exercise 15: Sliding table A-31
Exercise 16: Clamping device A-33
Exercise 17: Diverting device A-35

Control systems with pneumatic–electrical converter

Exercise 18: Stamping device A-37
Exercise 19: Heat sealing device A-39
Exercise 20: Transfer station A-41

Electropneumatics — *Subject*

Sorting device — *Title*

- Direct actuation of a single-acting cylinder — *Training aim*

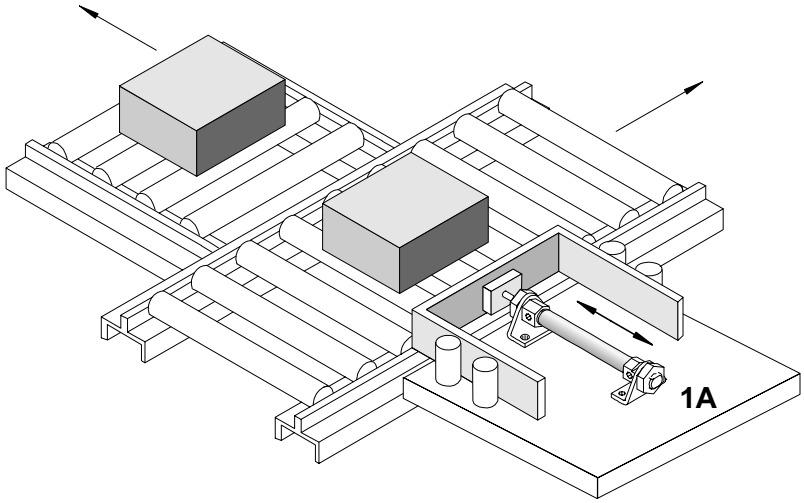
- Drawing the pneumatic and electric circuit diagram — *Problem*
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a sorting device, parts are to be transferred from a conveyor belt.

By pressing the pushbutton switch, the piston rod of a single-acting cylinder pushes the part off the conveyor belt. When the pushbutton is released, the piston rod returns to the retracted end position.

Fig. 1/1: Positional sketch



Electropneumatics — *Subject*

Opening and closing device — *Title*

- Direct actuation of a double-acting cylinder — *Training aim*

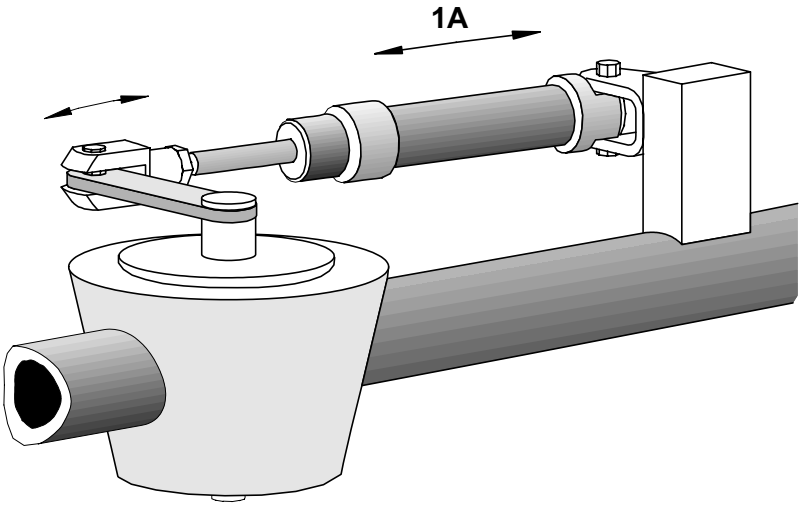
- Drawing the pneumatic and electric circuit diagram — *Problem*
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a special device, the valve in a pipe line is to be opened and closed.

The valve is opened by pressing the pushbutton switch. When the pushbutton is released the valve is closed.

Fig. 2/1: Positional sketch



Electropneumatics — *Subject*

Turning device — *Title*

- Indirect actuation of a single-acting cylinder — *Training aim*

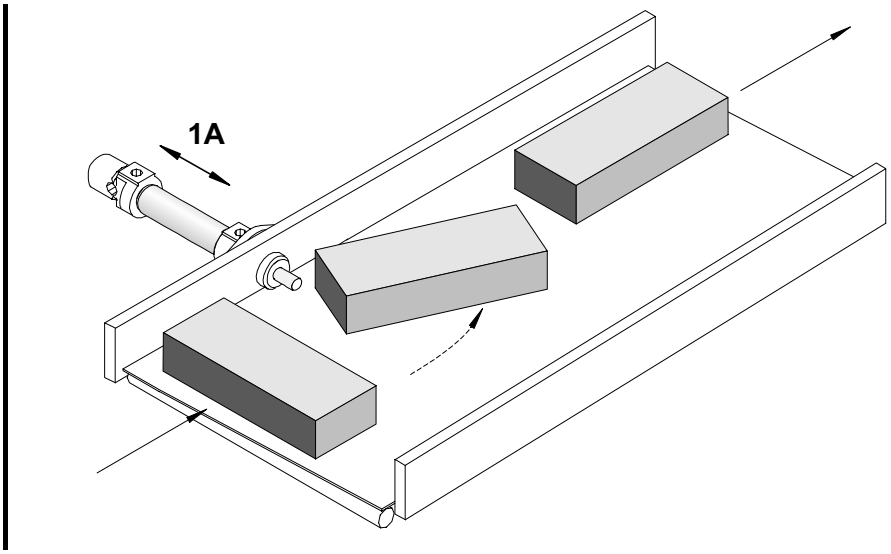
- Drawing the pneumatic and electric circuit diagram — *Problem*
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

By using a turning device parts are to be further transported on a conveyor track facing the right direction.

By pressing the pushbutton switch parts are turned by the piston rod of a cylinder and proceed, correctly positioned. When the pushbutton is released the piston rod is returned to its start position.

Fig. 3/1: Positional sketch



Electropneumatics — *Subject*

Lid fitting device — *Title*

- Indirect actuation of a double-acting cylinder — *Training aim*

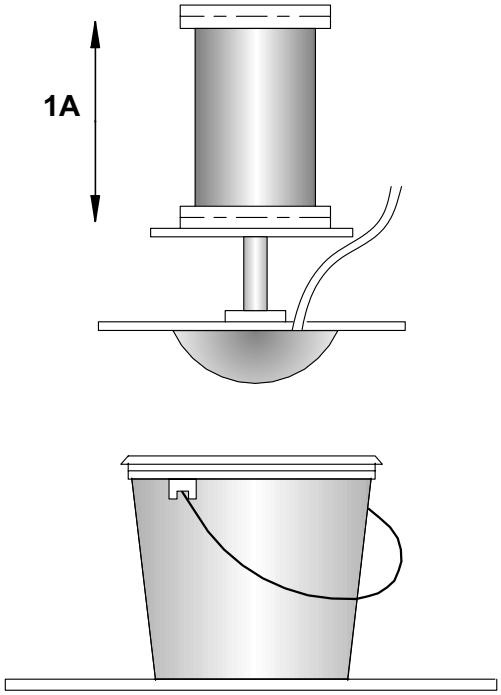
- Drawing the pneumatic and electric circuit diagram — *Problem*
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a lid fitting device snap-on lids are to be pressed onto plastic buckets.

By pressing a pushbutton switch the domed press is advanced and the snap-on lid is pressed on. When the pushbutton switch is released, the domed press is returned to its start position.

Fig. 4/1: Positional sketch



Electropneumatics — *Subject*

Assembly station — *Title*

Training aim

- Single-acting cylinder / Double-acting cylinder
- Direct actuation with AND-function of the input signals

Problem

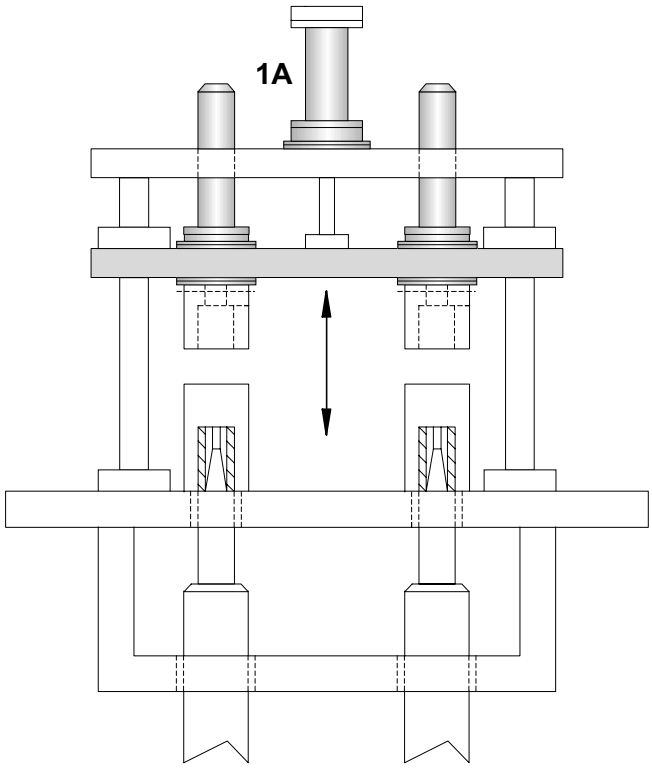
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit.

Problem description

In an assembly station components are to be put together.

By pressing two pushbutton switches the device is advanced and the components are assembled. After releasing the pushbutton switches, the device is returned to its start position.

Fig. 5/1: Positional sketch (side view)



Electropneumatics — *Subject*

Cutting device — *Title*

Training aim

- Single-acting cylinder / Double-acting cylinder
- Indirect actuation with AND-function of the input signals

Problem

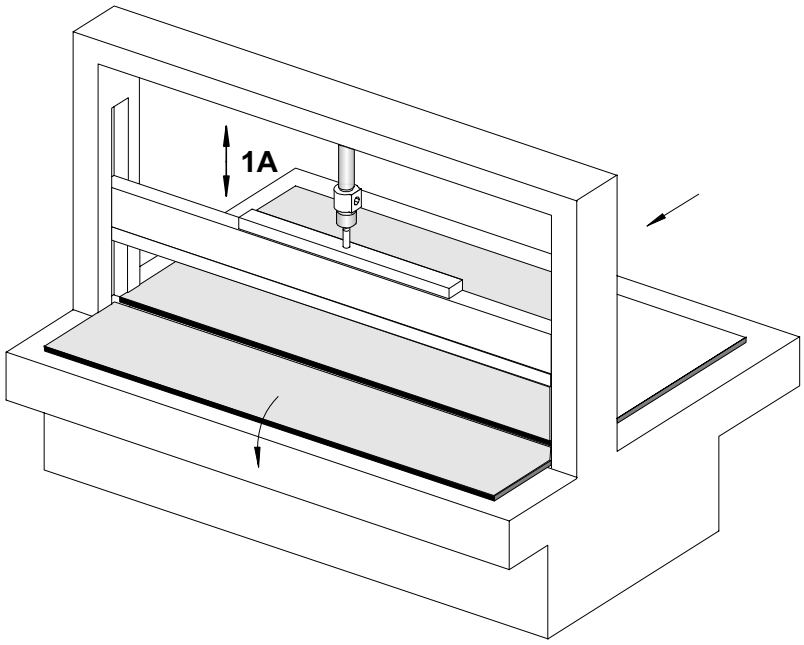
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a cutting device sheets of paper are to be cut to size.

By pressing two pushbutton switches the cutting blade is advanced and the sheet of paper is cut. After releasing one pushbutton switch the cutting blade is returned to its start position.

Fig. 6/1: Positional sketch (front view)



Electropneumatics — *Subject*

Flap control — *Title*

Training aim

- Single-acting cylinder / Double-acting cylinder
- Direct actuation with OR-function of the input signals

Problem

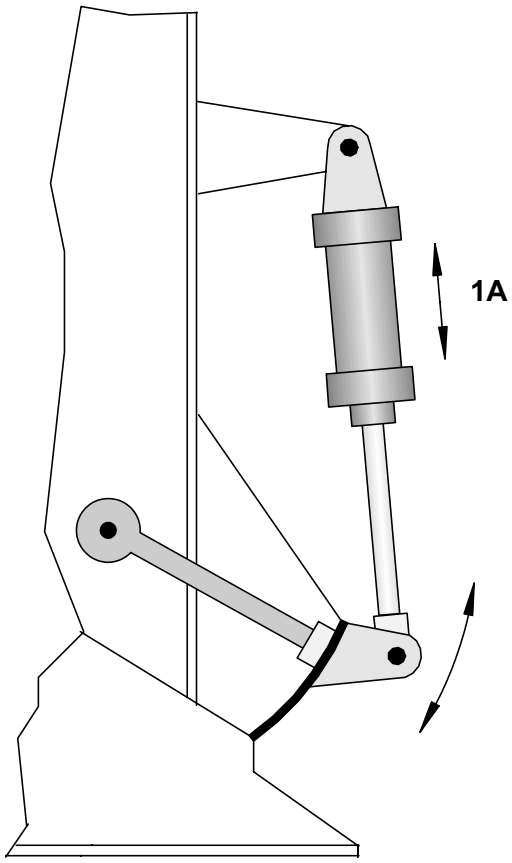
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

A flap control is used to empty granular material from a container.

By pressing a pushbutton switch the flap control is opened and the granular material is emptied from its container. After releasing the pushbutton the flap control is closed again.

Fig. 7/1: Positional sketch



Electropneumatics — *Subject*

Tipping device — *Title*

Training aim

- Single-acting cylinder / Double-acting cylinder
- Indirect actuation with OR-function of the input signals

Problem

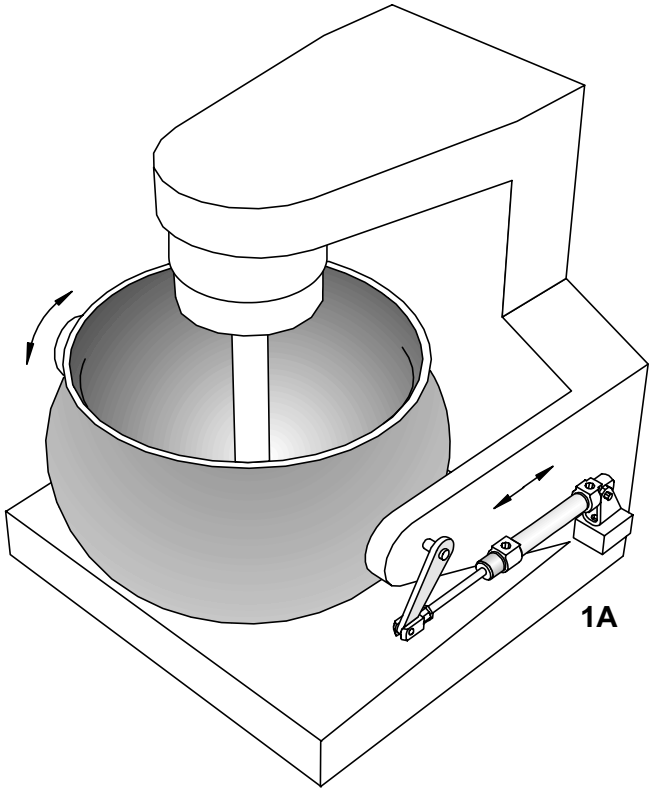
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a tipping device liquid is to be poured from a vat.

By pressing a pushbutton switch the vat is tilted and the liquid is emptied. After releasing the pushbutton switch the vat is returned to the upright position.

Fig. 8/1: Positional sketch



Electropneumatics — *Subject*

Diverting device — *Title*

- Single-acting cylinder / Double-acting cylinder — *Training aim*
- Direct actuation from two different positions

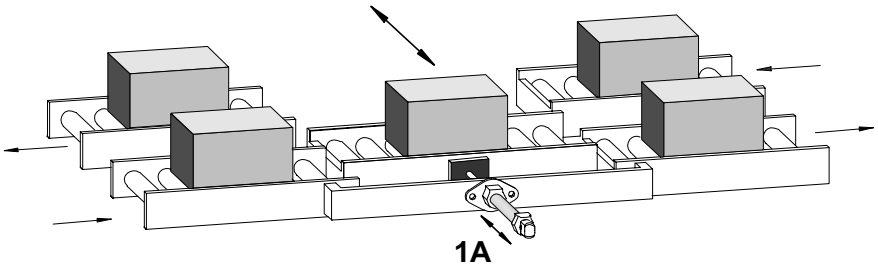
- Drawing the pneumatic and electric circuit diagram — *Problem*
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a diverting device parts are to be moved from one conveyor track to another conveyor track.

By pressing a pushbutton switch the frame of the diverting device is pushed forward. The part is moved over and transported onwards in the opposite direction. By pressing another pushbutton switch the frame is returned to its start position.

Fig. 9/1: Positional sketch



Electropneumatics — *Subject*

Hopper control — *Title*

Training aim

- Single-acting cylinder / Double-acting cylinder
- Indirect actuation from two different positions

Problem

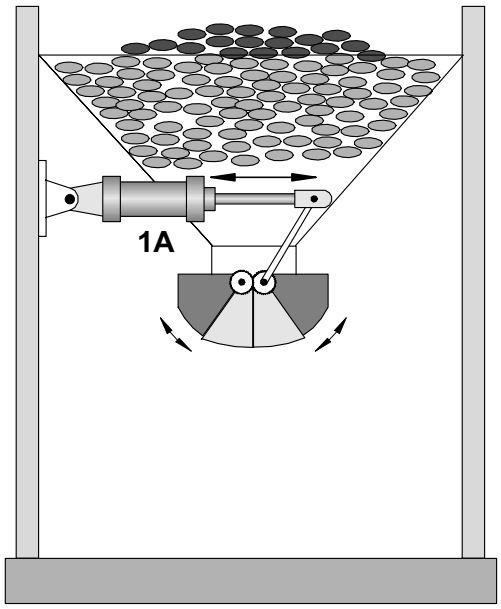
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Bulk material is to be emptied from a hopper.

By pressing a pushbutton switch the hopper is opened and the bulk material is emptied out. By pressing another pushbutton switch the hopper is closed again.

Fig. 10/1: Positional sketch



Electropneumatics — *Subject*

Gravity feed magazine — *Title*

Training aim

- Double-acting cylinder
- Direct actuation with reversal by means of an electric limit switch

Problem

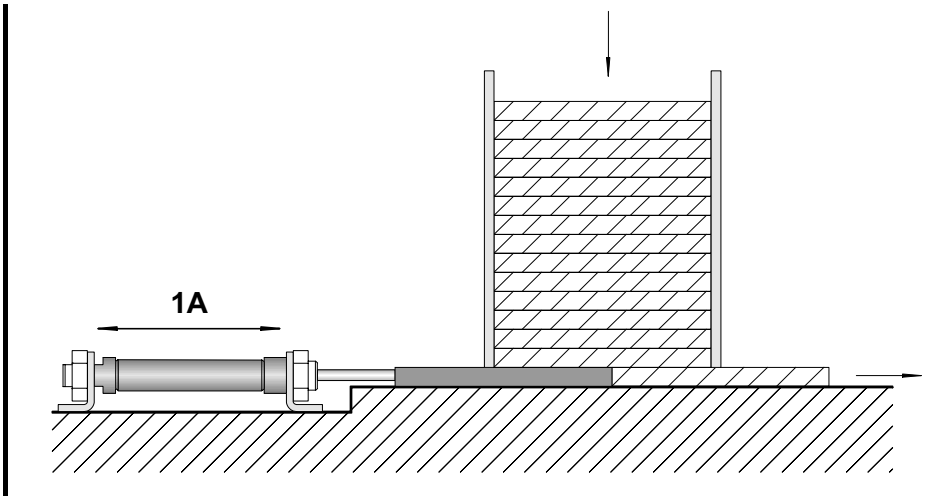
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Wooden planks are to be pushed along from a gravity feed magazine to a clamping device.

By pressing a pushbutton switch one plank is pushed by the slide out of the gravity feed magazine. After the slide has reached the forward end position it is returned to its start position.

Fig. 11/1: Positional sketch



Electropneumatics — *Subject*

Multi-track gravity feed magazine — *Title*

Training aim

- Double-acting cylinder
- Indirect actuation with reversal by means of an electrical limit switch

Problem

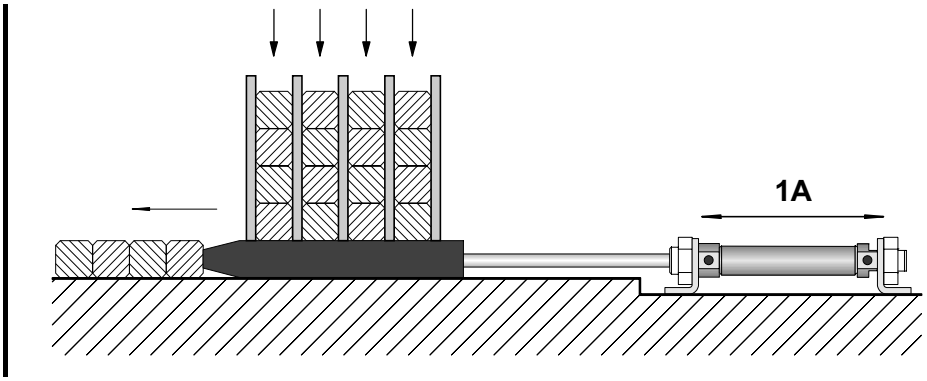
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Parts are to be pushed away from a multi-track gravity feed magazine into a clamping device.

By pressing a pushbutton switch the parts are pushed out of the multi-track gravity feed magazine by a slide. After the slide has reached the forward end position it is returned to its start position.

Fig. 12/1: Positional sketch



Electropneumatics — *Subject*

Conveyor belt control — *Title*

Training aim

- Double-acting cylinder
- Direct actuation with oscillating motion of the piston rod

Problem

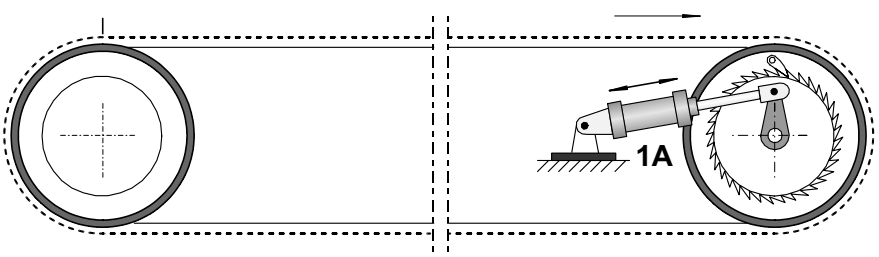
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a conveyor belt, parts are to be transported in linear timed sequence to work stations which are arranged in line after one another.

When the latching pushbutton switch is pressed the main wheel is indexed by the oscillating piston rod of a cylinder via a pawl. When the pushbutton switch is pressed again the drive is switched off.

Fig. 13/1: Positional sketch



Electropneumatics — *Subject*

Rotary indexing table — *Title*

Training aim

- Double-acting cylinder
- Indirect actuation with oscillating motion of the piston rod

Problem

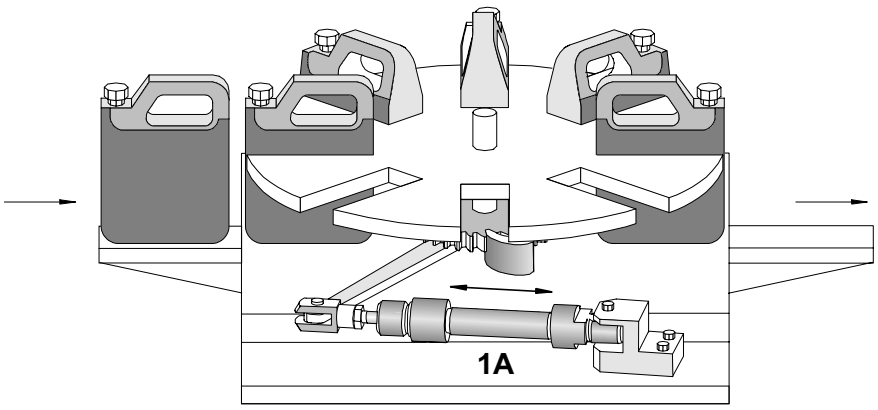
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a rotary indexing table plastic containers are to be separated in linear sequence.

By pressing a pushbutton switch the oscillating piston rod of a cylinder drives the rotary table in sequence via a pawl. When the pushbutton is pressed again, this drive is switched off.

Fig. 14/1: Positional sketch



Electropneumatics — *Subject*

Sliding table — *Title*

Training aim

- Single-acting cylinder / Double-acting cylinder
- Electric latching circuit with dominating switch-off signal

Problem

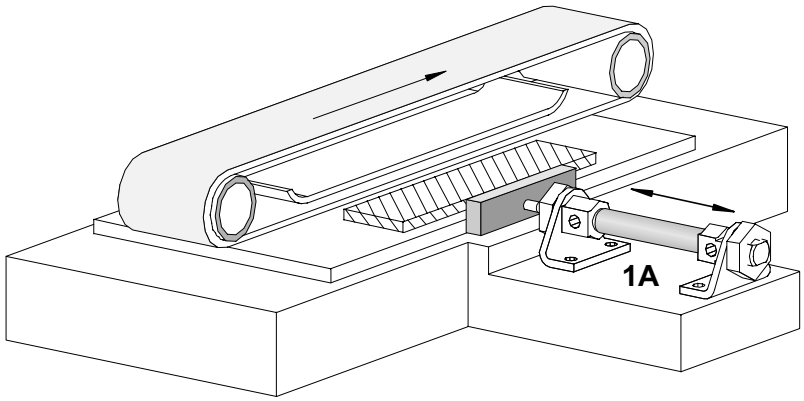
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a sliding table a plank of wood is to be pushed under a belt sanding machine.

By pressing a pushbutton switch the sliding table with the plank of wood positioned on it is pushed under the belt sanding machine. By pressing another pushbutton switch the sliding table is returned to its start position.

Fig. 15/1: Positional sketch



Electropneumatics — *Subject*

Clamping device — *Title*

Training aim

- Single-acting cylinder / Double-acting cylinder
- Electric latching circuit with dominating switch-on signa

Problem

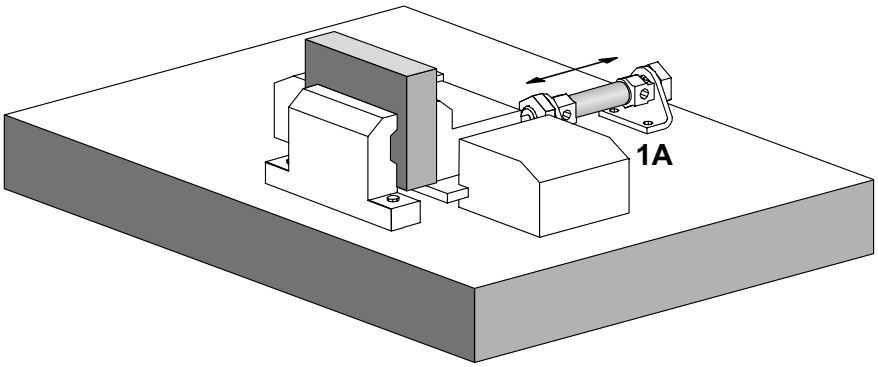
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Parts are to be clamped using a clamping device.

By pressing a pushbutton switch the moveable clamping jaw is pushed forward and the part is clamped. By pressing another pushbutton switch the clamping jaw is returned to its start position.

Fig. 16/1: Positional sketch



Electropneumatics — *Subject*

Diverting device — *Title*

Training aim

- Double-acting cylinder
- Oscillating motion of the piston rod with monitoring of the end position by means of magnetic proximity switches

Problem

- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

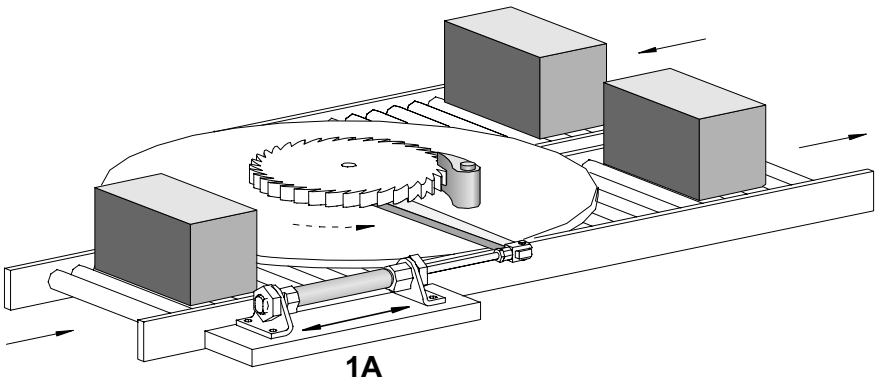
Aufgabe 17

Problem description

Using a diverting device parts are to be removed from one conveyor track onto another in linear sequence.

By pressing a pushbutton switch the oscillating piston rod of a cylinder pushes the turntable via a pawl in stepped sequence. The parts are diverted and transported onwards in the opposite direction. By pressing another pushbutton switch the drive unit is switched off.

Fig. 17/1: Positional sketch



Electropneumatics — *Subject*

Stamping device — *Title*

Training aim

- Double-acting cylinder
- Pressure-dependent reversal

Problem

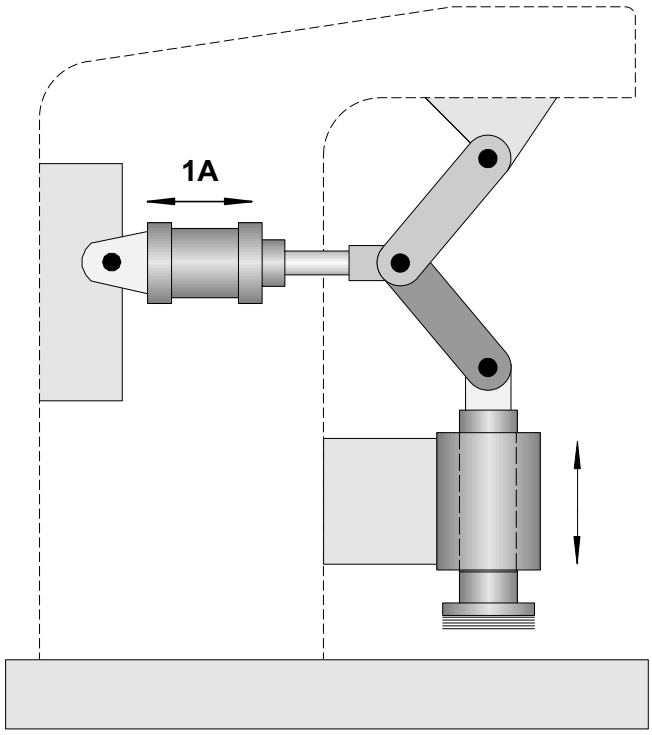
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Parts are to be stamped with a stamping device.

By pressing two pushbutton switches the die is pushed down and the part is stamped. When the stamping pressure has been achieved the die is returned to its start position.

Fig. 18/1: Positional sketch



Electropneumatics — *Subject*

Heat sealing device — *Title*

Training aim

- Double-acting cylinder
- Pressure dependent reversal with monitoring of the end position by means of magnetic proximity switches

Problem

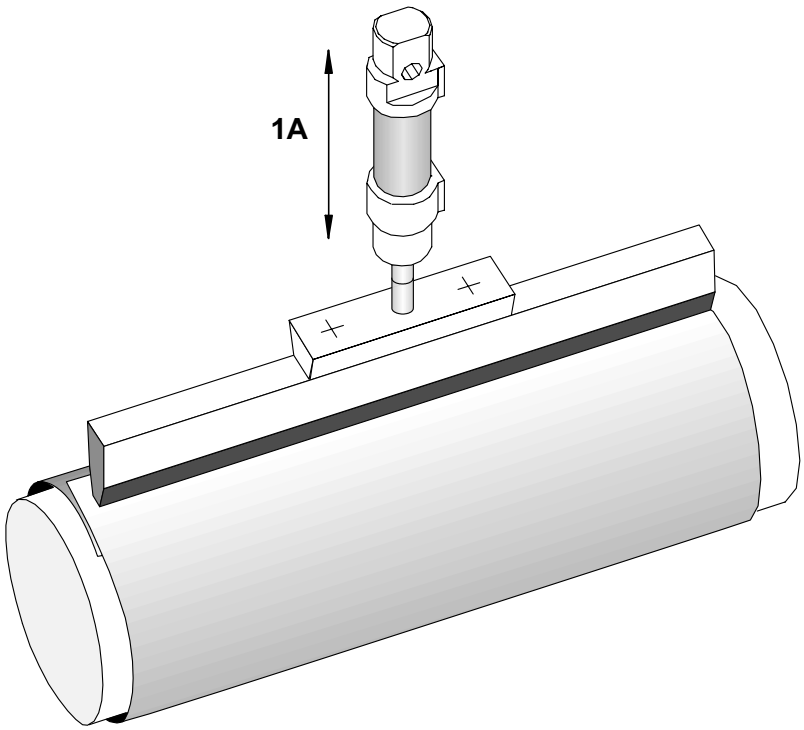
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a hot pressing die, packing material is to be sealed by application of heat and pressure.

By pressing a pushbutton switch the heating rail is advanced and the packaging material is heated along the adhesive strip. After the adhesion pressure has been reached, the heating rail is returned to its start position.

Fig. 19/1: Positional sketch



Electropneumatics — *Subject*

Transfer station — *Title*

- Co-ordinated motion control with auxiliary conditions — *Training aim*

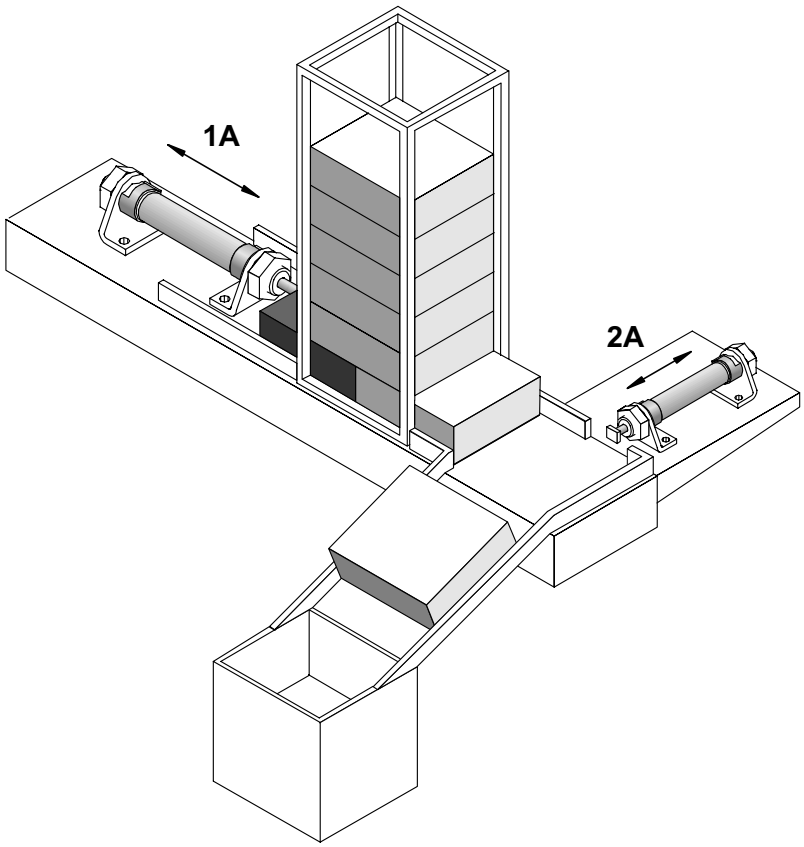
- Drawing the displacement-step diagram — *Problem*
- Drawing the pneumatic and electric circuit diagram
- Carrying out the pneumatic and electric circuit construction
- Checking the sequence of the circuit

Problem description

Using a transfer station blocks are to be transferred from a magazine to a processing station.

The blocks are pushed out of the magazine by cylinder 1A and transferred to the processing station by cylinder 2A. The piston rod of cylinder 2A may only return when the piston rod of cylinder 1A has reached the retracted end position. The magazine is monitored by means of a limit switch. If there are no more blocks in the magazine, it is not possible to start the cycle. This is indicated by means of an audible signal. The control is to be operated in single cycle.

Fig. 20/1: Positional sketch



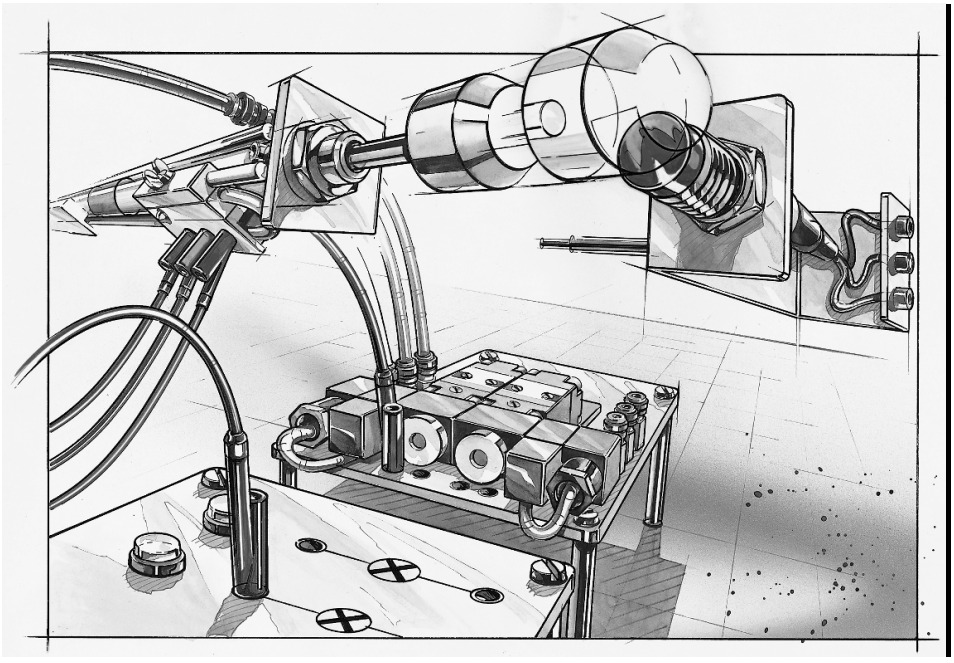
Part B – Fundamentals

The theoretical fundamentals for the training package Electropneumatics are described in the textbook

Learning System for Automation and Technology

Electropneumatics

Basic Level TP201



FESTO

Part C – Solutions

Solution 1:	Sorting device	C-3
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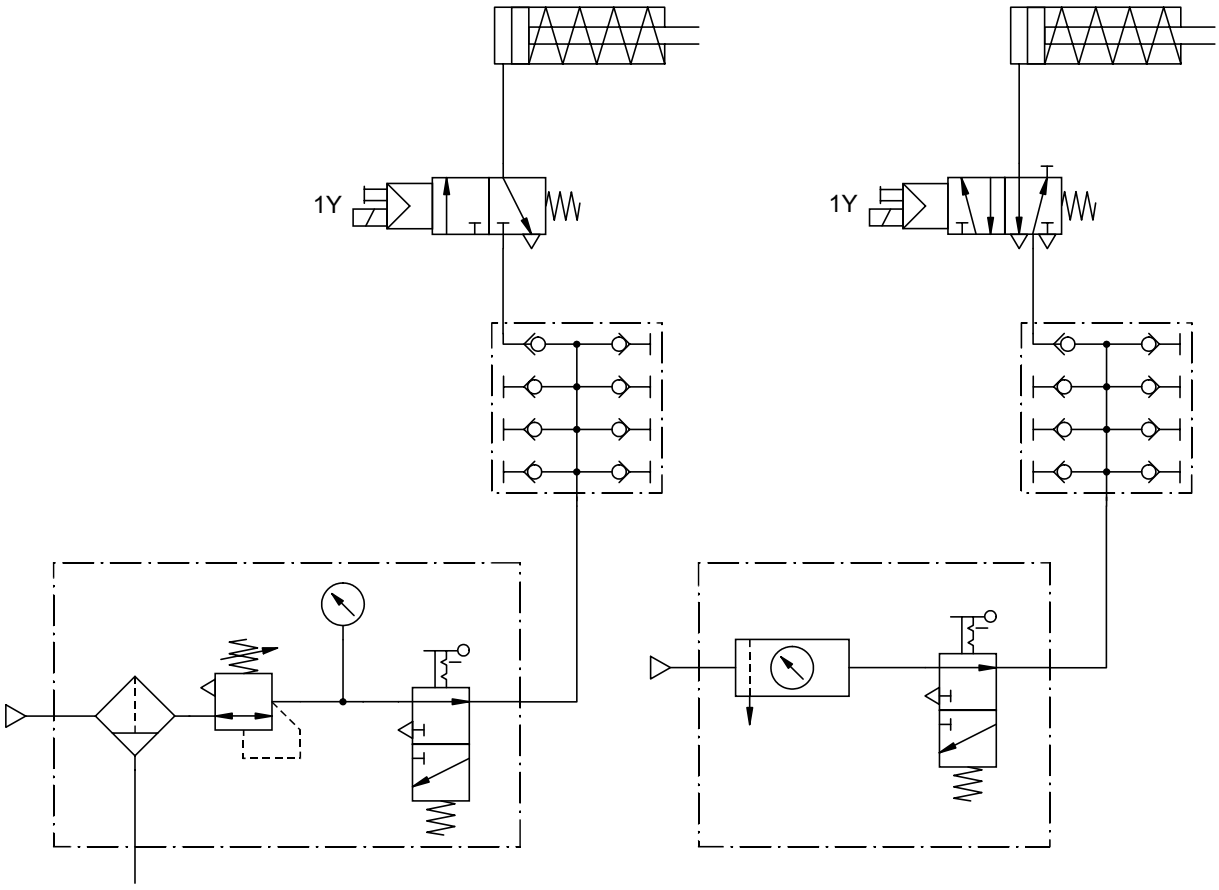
Sorting Device

Fig. 1/2:
Circuit diagram ,pneumatic

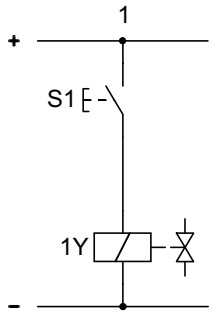


– Detailed representation of service unit with on-off valve
– Actuation of the single-acting cylinder with a 3/2-way single solenoid valve, normally closed

– Simplified representation of service unit with on-off valve
– Actuation of the single-acting cylinder with a 5/2-way single solenoid valve

Solution 1

Fig. 1/3:
Circuit diagram electrical

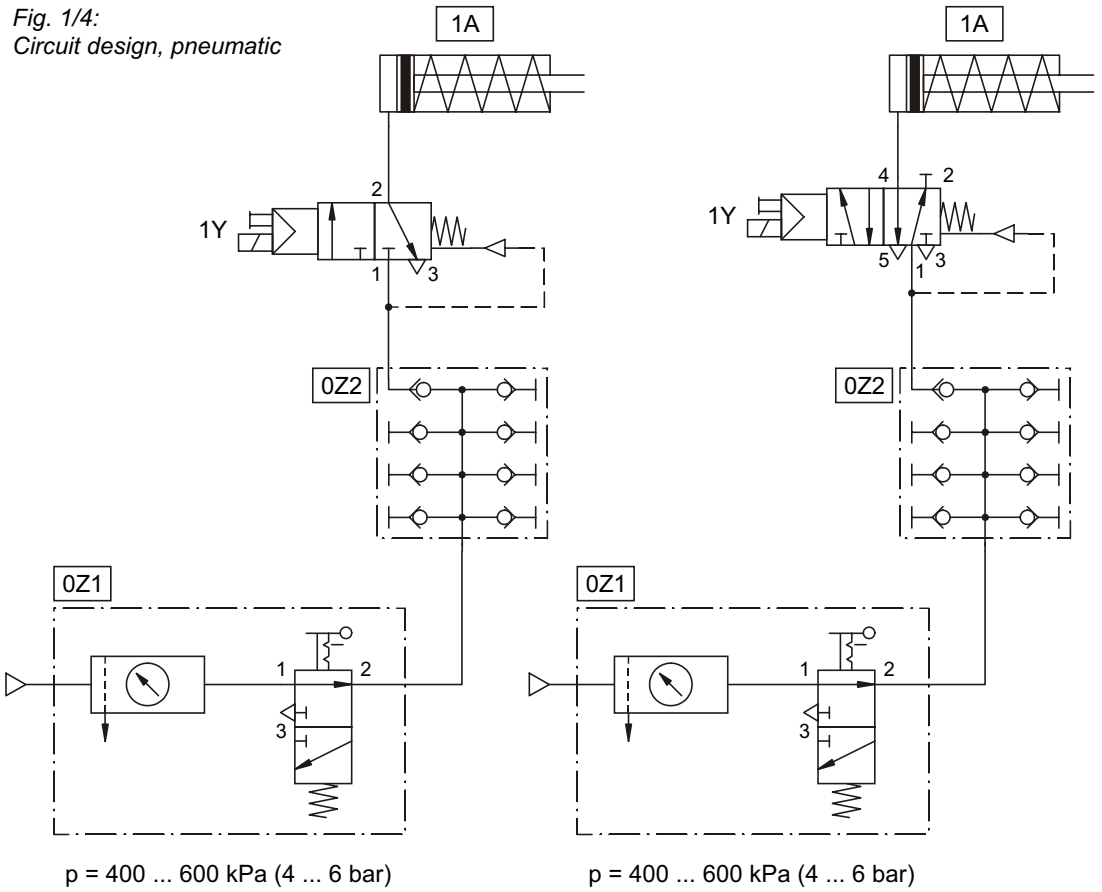


Solution description

By pressing the pushbutton switch S1, the electric circuit for the solenoid coil 1Y is closed and the 3/2- (5/2-) way solenoid valve is actuated. The piston rod of the single-acting cylinder advances to the forward end position.

After releasing the pushbutton switch S1, the electric circuit for the solenoid coil 1Y is opened and the 3/2- (5/2-) way solenoid valve is switched back to its initial position. The piston rod returns to its rear end position.

Fig. 1/4:
Circuit design, pneumatic



Port 2 of the 5/2-way single solenoid valve with spring return is closed.

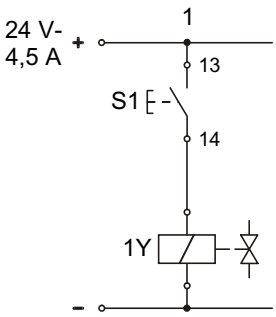
Connect the T connector (quick push-pull distributor) to the valve by means of a short tube. Link the remaining two outlets also by means of a short tube.

Components list

Quantity	*Description*
1	Single-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	3/2-way single solenoid valve, normally closed
1	5/2-way single solenoid valve

Solution 1

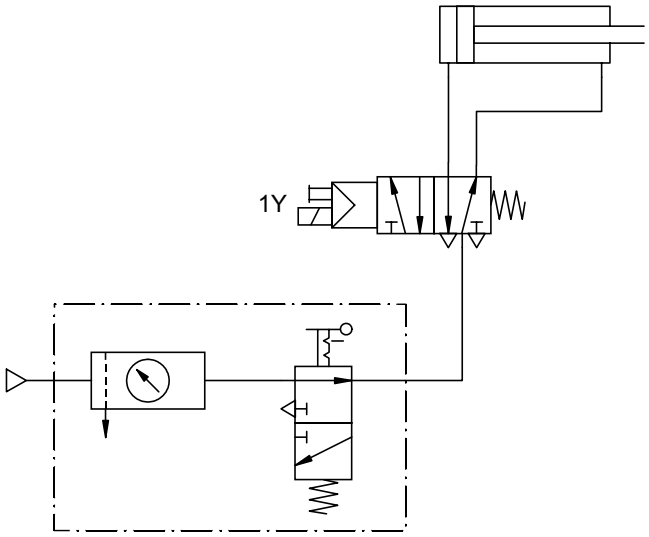
Fig. 1/5:
Circuit design, electrical



Components list

Quantity	*Description*
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Opening and closing device



Representation without manifold

Fig. 2/2:
Circuit diagram, pneumatic

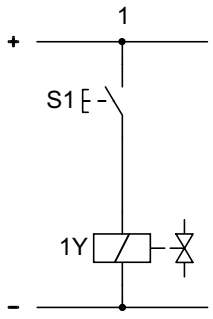


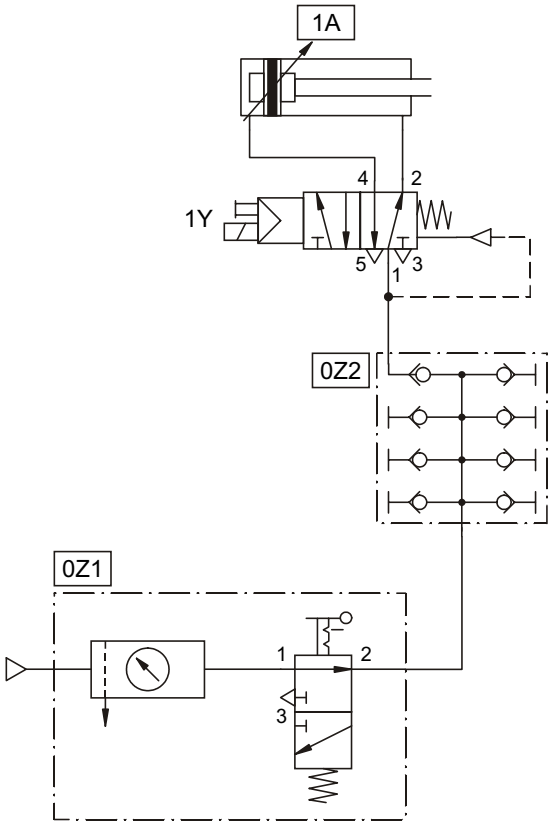
Fig. 2/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 the electric circuit for the solenoid coil 1Y is closed and the 5/2-way solenoid valve is actuated. The piston rod of the double-acting cylinder advances to the forward end position.

After releasing the pushbutton switch S1 the electric circuit for the solenoid coil 1Y is opened and the 5/2-way solenoid valve is switched back to its initial position. The piston rod returns to its retracted end position.

Fig. 2/4:
Circuit design, pneumatic



p = 400 ... 600 kPa (4 ... 6 bar)

Quantity	Description
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way single solenoid valve

Components list

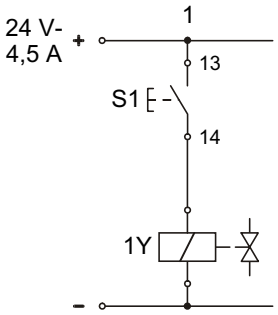


Fig. 2/5:
Circuit design, electrical

Quantity	Description
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

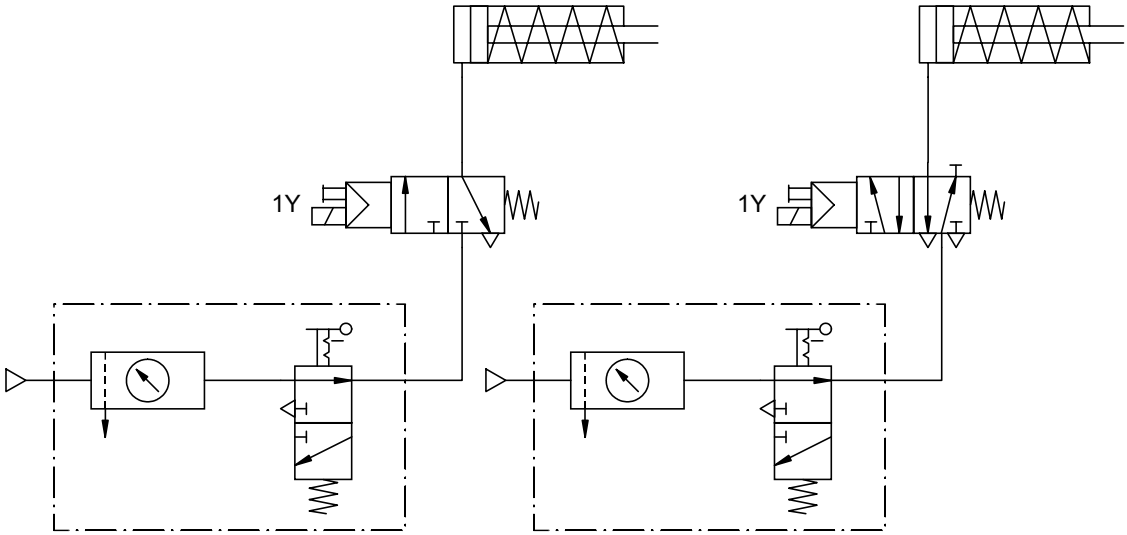
Components list

C-10

Solution 2

Turning device

Fig. 3/2:
Circuit diagram, pneumatic



Representation without manifold

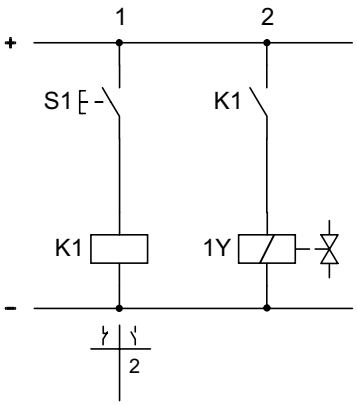


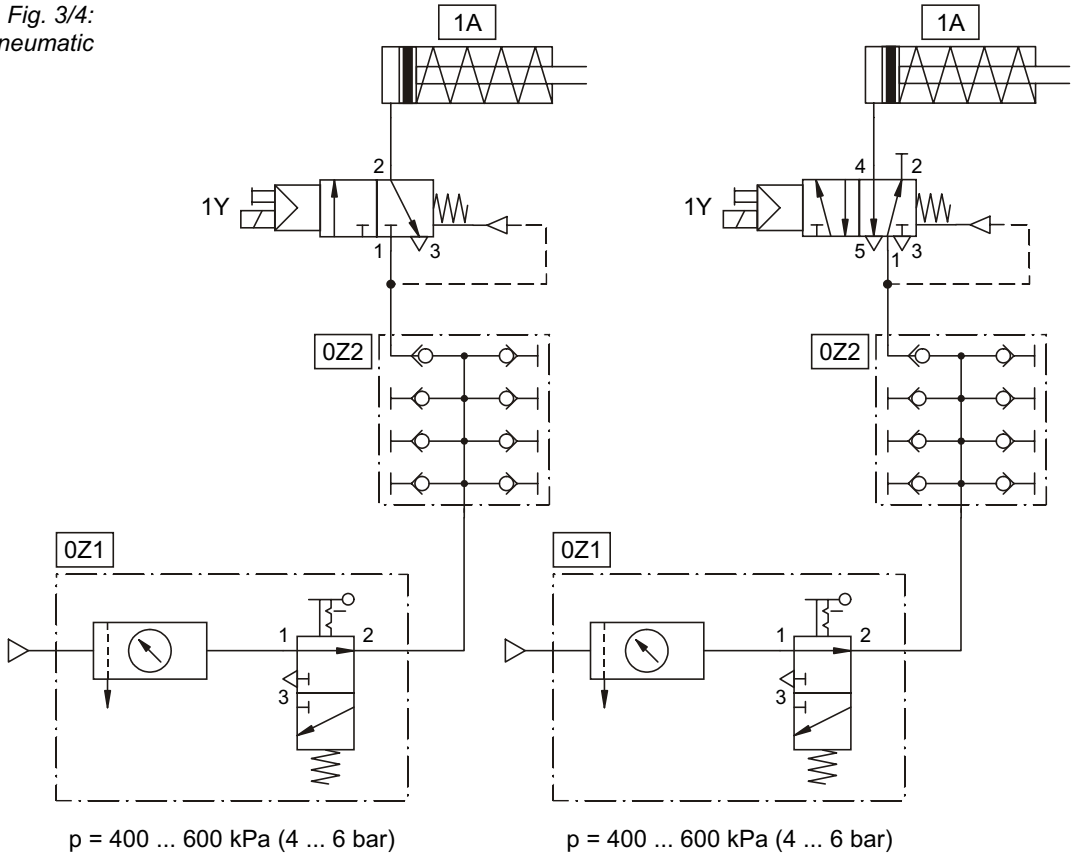
Fig. 3/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 the electric circuit for the relay K1 is closed and the contact K1 is made. The electric circuit for solenoid coil 1Y is closed and the 3/2- (5/2-) way solenoid valve is actuated. The piston rod of the single-acting cylinder advances to the forward end position.

After releasing the pushbutton switch S1 the electric circuit for the relay K1 is opened and the contact K1 is brought to its normal position. The electric circuit for the solenoid coil 1Y is opened and the 3/2- (5/2-) way solenoid valve is switched back to its initial position. The piston rod returns to the retracted end position.

Fig. 3/4:
Circuit design, pneumatic



Quantity	Description
1	Single-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	3/2-way single solenoid valve, normally closed
1	5/2-way single solenoid valve

Components list

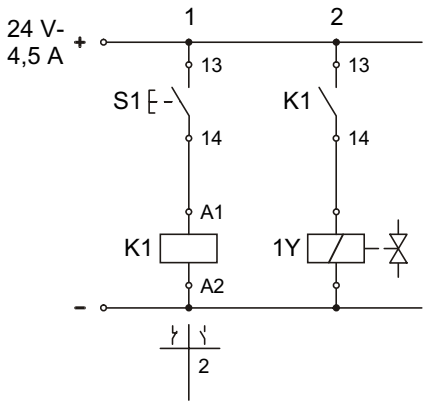


Fig. 3/5:
Circuit design, electrical

Quantity	Description
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Kabelsatz.mit.Sicherheitsstecker
1	Electrical power supply unit, 24 V

Components list

C-14

Solution 3

Lid fitting device

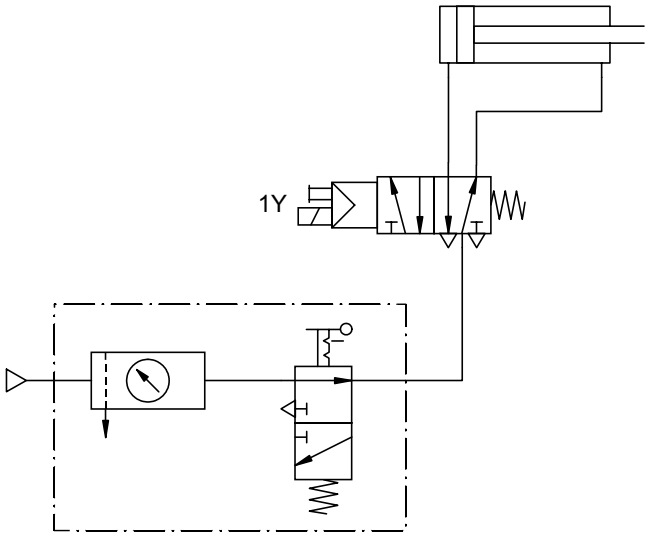


Fig. 4/2:
Circuit diagram, pneumatic

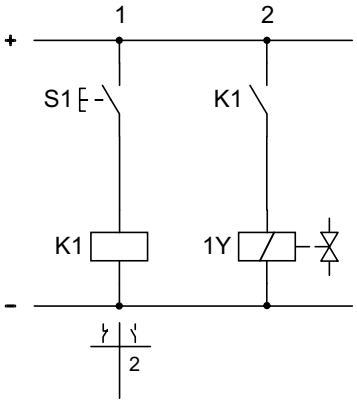


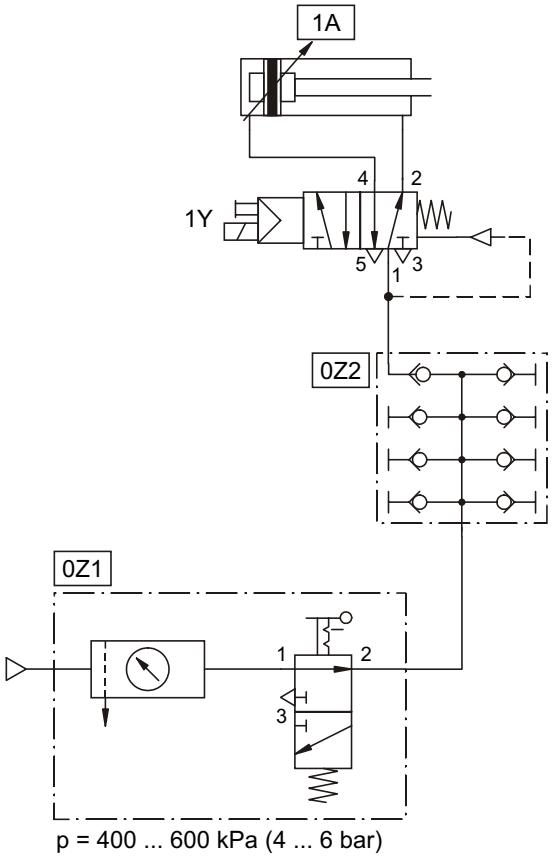
Fig. 4/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 the electric circuit for the relay K1 is closed and the contact K1 is made. The electric circuit for the solenoid coil 1Y is closed and the 5/2-way solenoid valve is reversed. The piston rod of the double-acting cylinder advances to the forward end position.

After releasing the pushbutton switch S1 the electric circuit for the relay K1 is opened and the contact K1 is returned to the normal position. The electric circuit for solenoid coil 1Y is opened and the 5/2-way solenoid valve is switched back to its initial position. The piston rod returns to the retracted end position.

Fig. 4/4:
Circuit design, pneumatic



Quantity	Description
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way single solenoid valve

Components list

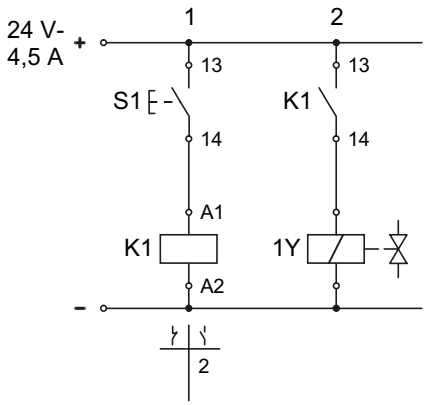


Fig. 4/5:
Circuit design,electrical

Quantity	Description
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

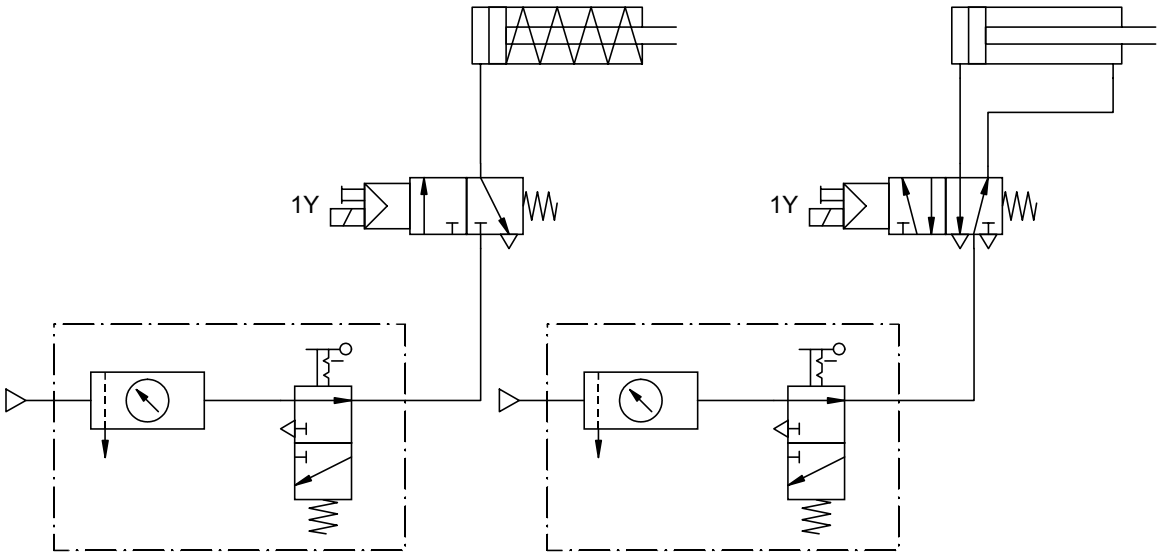
Components list

C-18

Solution 4

Assembly station

Fig. 5/2:
Circuit diagram, pneumatic



Representation without manifold

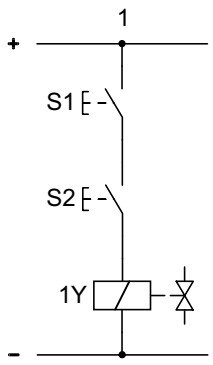


Fig. 5/3:
Circuit diagram, electrical

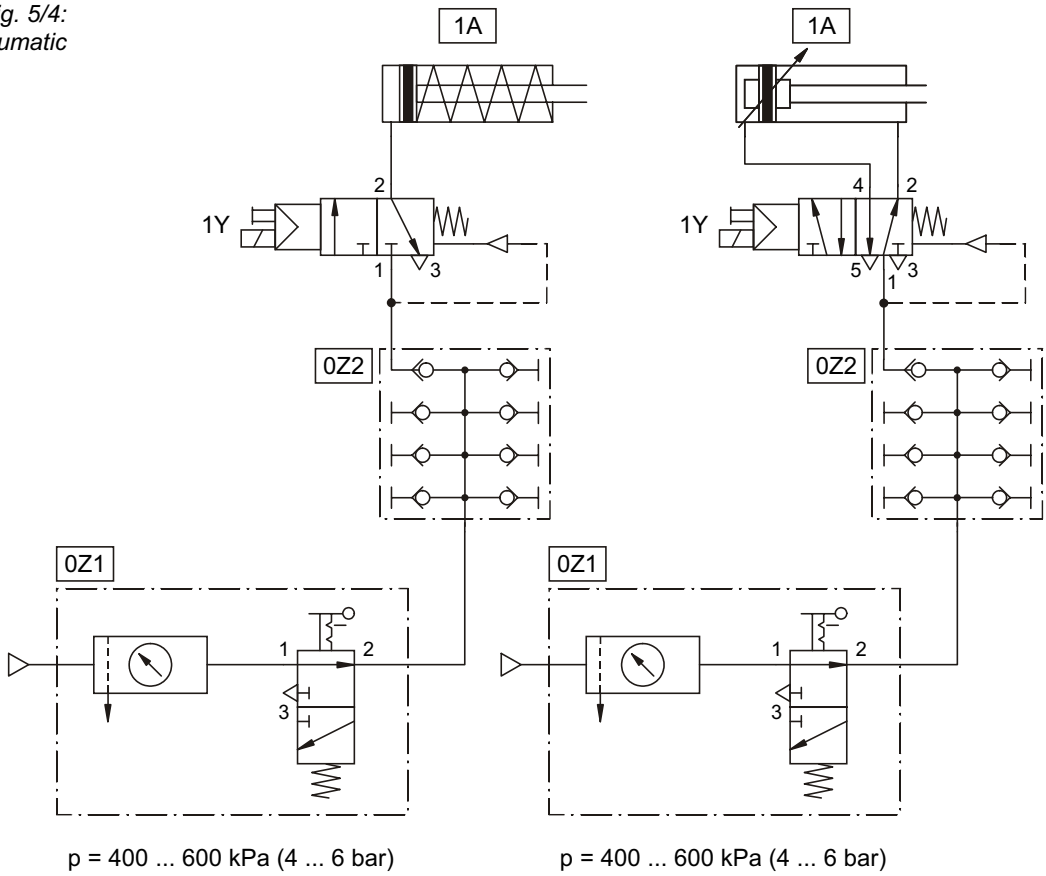
Solution description

By pressing the pushbutton switches S1 **and** S2, the electric circuit for the solenoid coil 1Y is closed 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.

After releasing the pushbutton switches S1 and S2 the electric circuit for the solenoid coil 1Y is opened and the 3/2- (5/2-) way solenoid valve is switched back to its initial position by a reset spring. The piston rod of the single-acting (double-acting) cylinder returns to the retracted end position.

*It should be pointed out that the solution shown above is a simple AND-function and **not** a two-hand safety control.*

Fig. 5/4:
Circuit design, pneumatic



Quantity	Description
1	Single-acting cylinder
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	3/2-way single solenoid valve, normally closed
1	5/2-way single solenoid valve

Components list

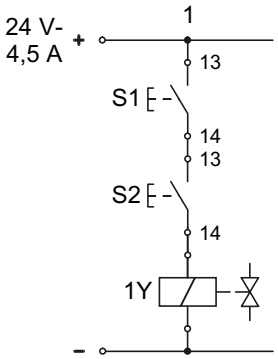


Fig. 5/5:
Circuit design, electrical

Quantity	Description
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

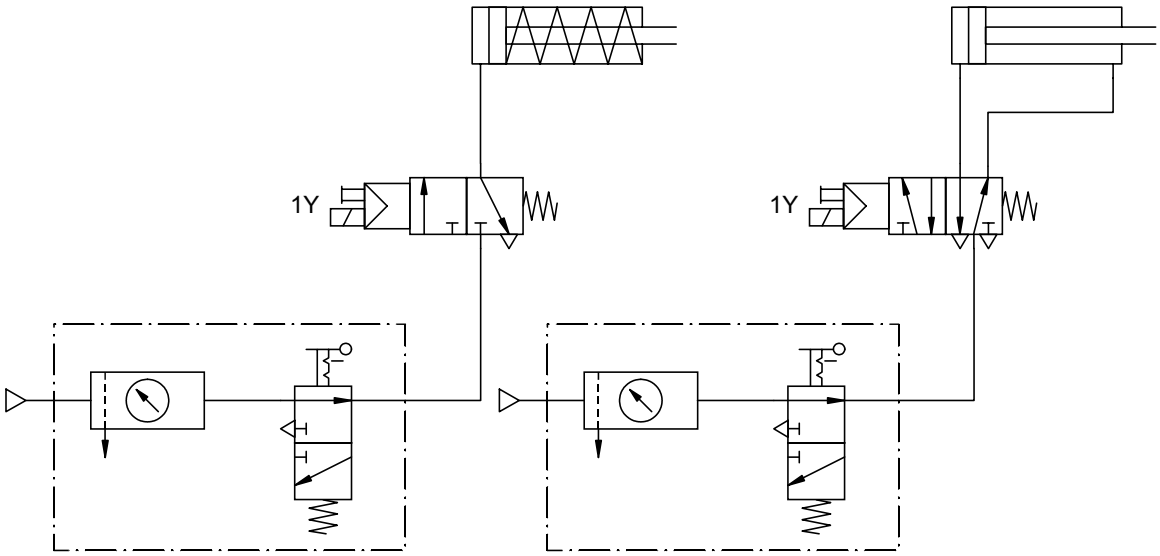
Components list

C-22

Solution 5

Cutting Device

Fig. 6/2:
Circuit diagram, pneumatic



Representation without manifold

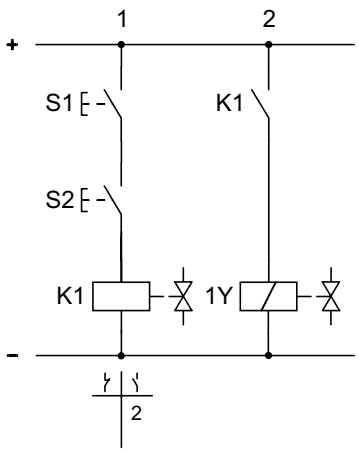


Fig. 6/3:
Circuit diagram, electrical

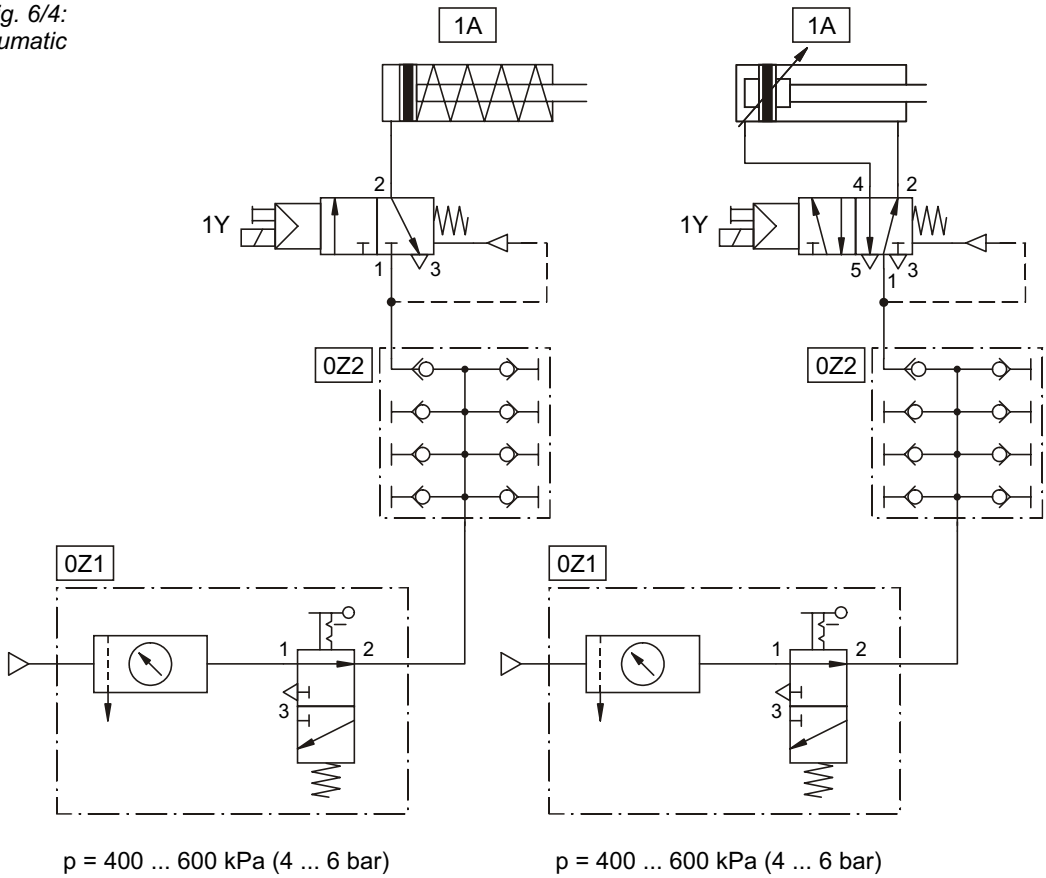
Solution description

By pressing the pushbutton switch S1 **and** S2 the electric circuit for the relay K1 is closed and the contact K1 is made. The electric circuit for the solenoid coil 1Y is closed 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.

After releasing the pushbutton switch S1 or S2 the electric circuit for the relay K1 is opened and the contact K1 is brought into the normal position. The electric circuit for the solenoid coil 1Y 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.

*It should be pointed out that the solution shown above is a simple AND-function and **not** a two-hand safety control.*

Fig. 6/4:
Circuit design, pneumatic



Quantity	Description
1	Single-acting cylinder
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	3/2-way single solenoid valve, normally closed
1	5/2-way single solenoid valve

Components list

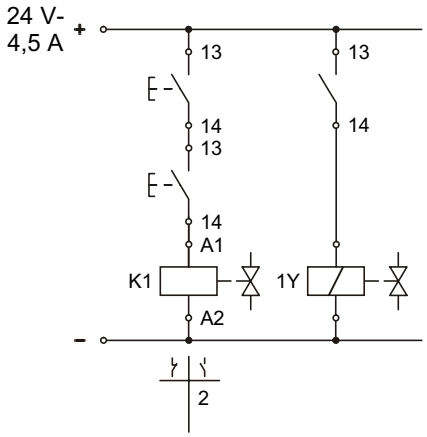


Fig. 6/5:
Circuit design, electrical

Quantity	Description
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

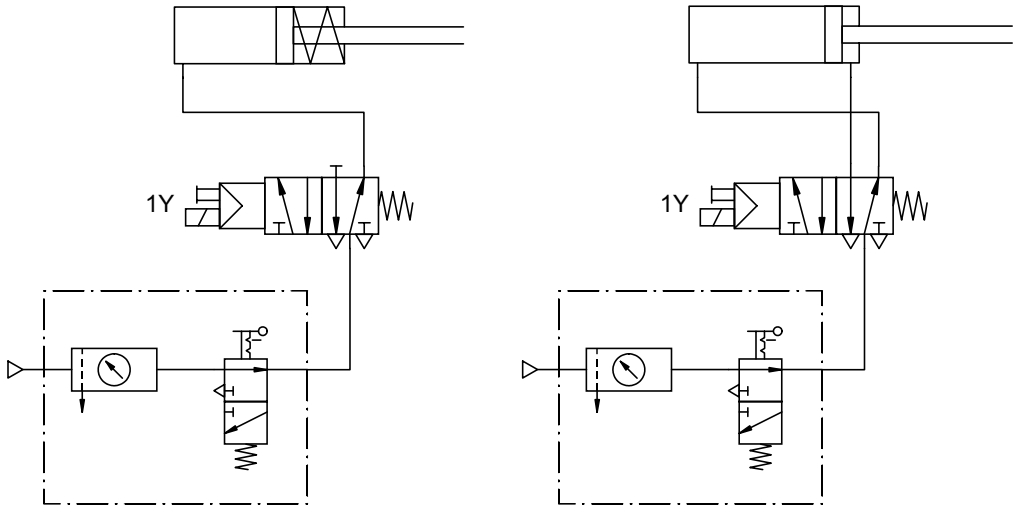
Components list

C-26

Solution 6

Flap control

Fig. 7/2:
Circuit diagram, pneumatic



Representation without manifold

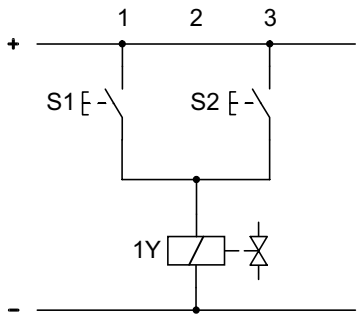


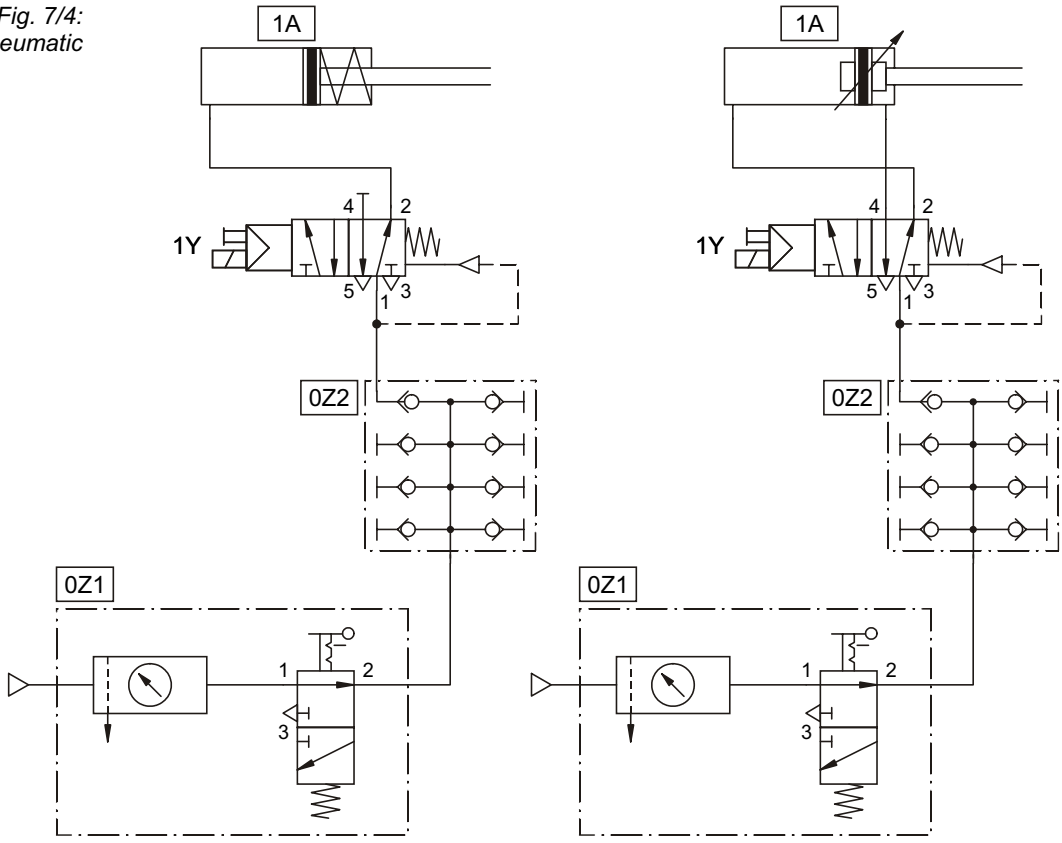
Fig. 7/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 **or** S2 the electric circuit for the solenoid coil 1Y1 is closed and the 5/2-way solenoid valve is reversed. The piston rod of the single-acting (double-acting) cylinder returns to the retracted end position.

After releasing the pushbutton switch S1 and S2 the electric circuit for the solenoid coil 1Y1 is opened and the 5/2-way solenoid valve is switched back by a reset spring to its initial position. The piston rod of the single-acting (double-acting) cylinder advances to the forward end position.

Fig. 7/4:
Circuit design, pneumatic



Components list

Quantity	*Description*
1	Single-acting cylinder
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way single solenoid valve

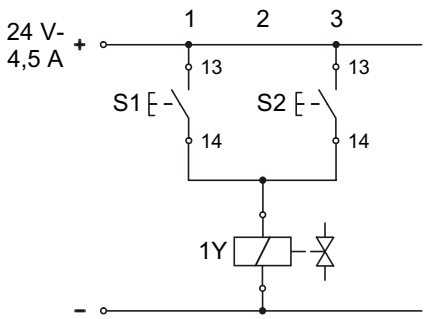


Fig. 7/5:
Circuit design, electrical

Components list

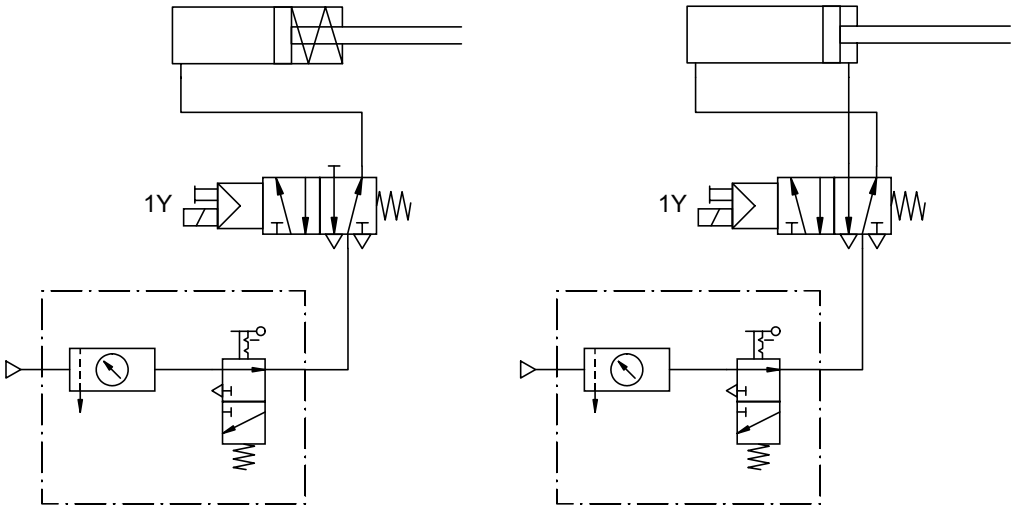
Quantity	*Description*
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

C-30

Solution 7

Tipping device

Fig. 8/2:
Circuit diagram, pneumatic



Representation without manifold

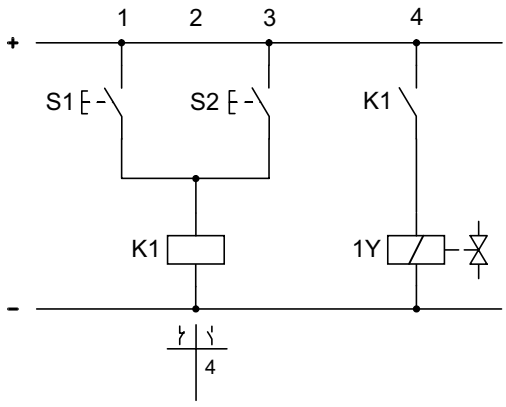


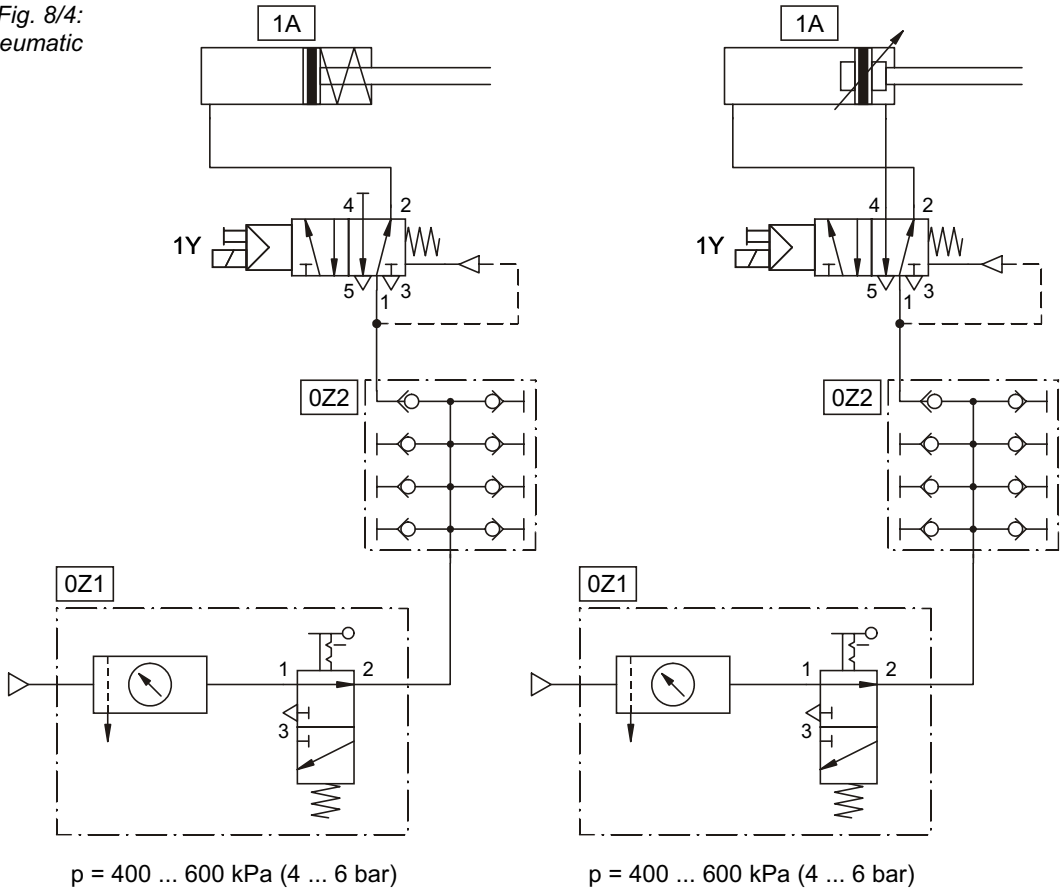
Fig. 8/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 **or** S2 the electric circuit for the solenoid coil 1Y is closed and the 5/2-way solenoid valve is reversed. The piston rod of the single-acting (double-acting) cylinder returns to the retracted end position.

After releasing the pushbutton switch S1 **and** S2 the electric circuit for the solenoid coil 1Y is opened and the 5/2-way solenoid valve is switched back to its initial position by means of the reset spring. The piston rod of the single-acting (double-acting) cylinder advances to the forward end position.

Fig. 8/4:
Circuit design, pneumatic



Quantity	Description
1	Single-acting cylinder
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way single solenoid valve

Components list

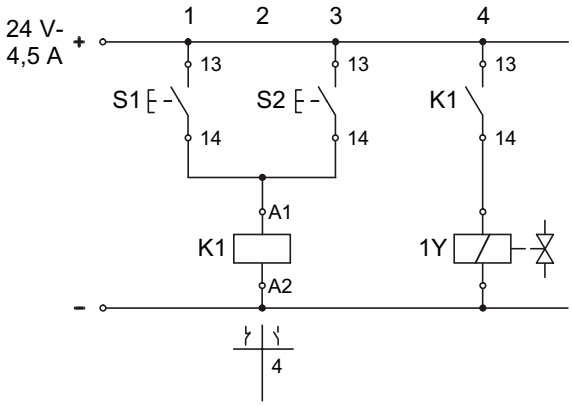


Fig. 8/5:
Circuit design, electrical

Quantity	Description
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

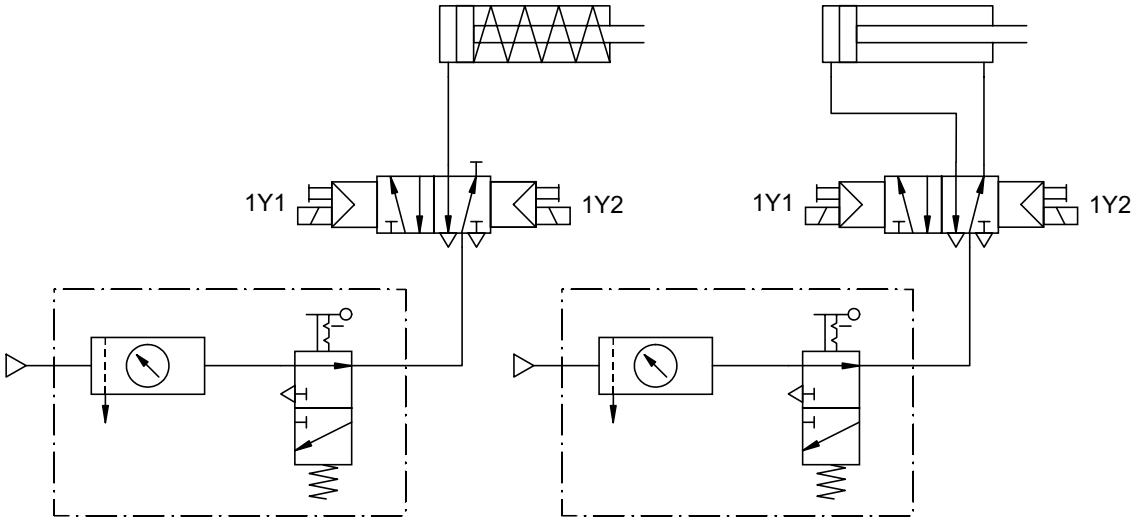
Components list

C-34

Solution 8

Diverting device

Fig. 9/2:
Circuit diagram, pneumatic



Representation without manifold

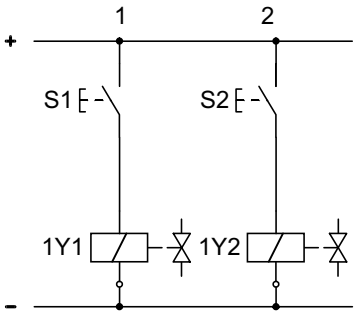


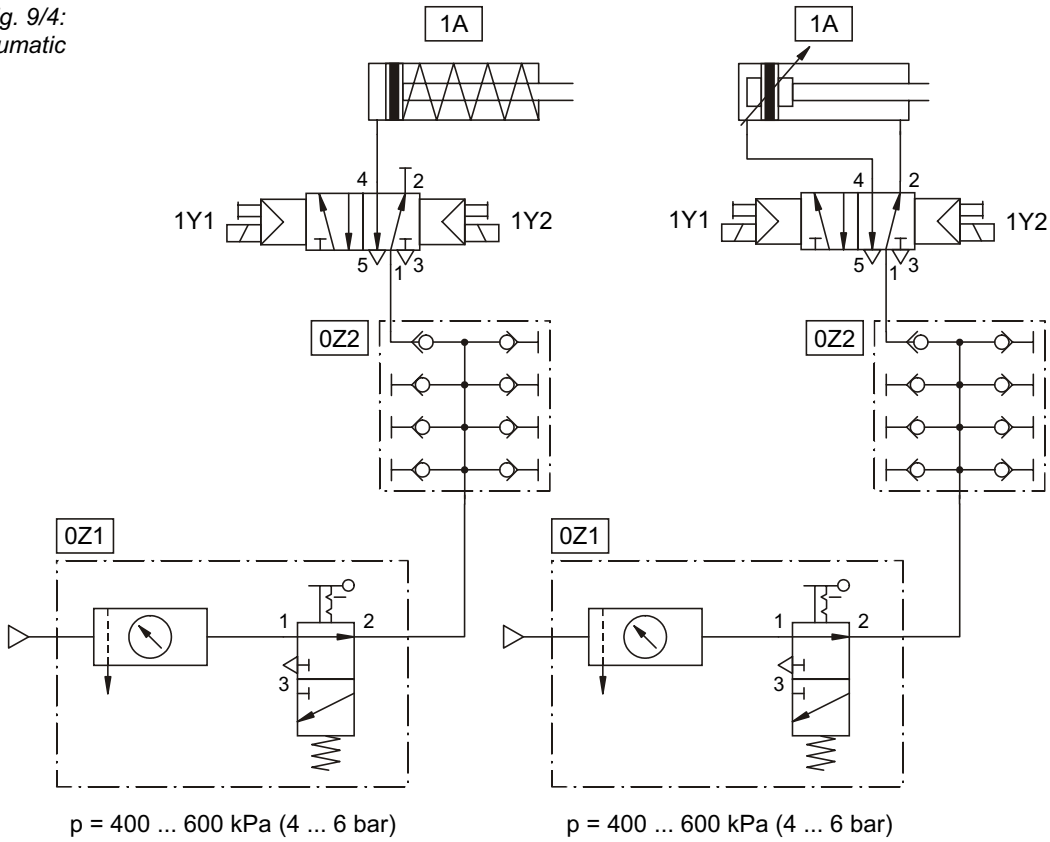
Fig. 9/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 the electric circuit for the solenoid coil 1Y1is closed and the 5/2-way double solenoid valve is reversed. The piston rod of the single-acting (double-acting) cylinder advances to its forward end position. When the pushbutton switch S1 is released the electric circuit for the solenoid coil 1Y1 is opened.

By pressing the pushbutton switch S2 the electric circuit for the solenoid coil 1Y2 is closed and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod of the single-acting (double-acting) cylinder returns to its retracted end position. After releasing pushbutton switch S2 the electric circuit for the solenoid coil 1Y2 is opened.

Fig. 9/4:
Circuit design, pneumatic



Quantity	Description
1	Single-acting cylinder
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way double solenoid valve

Components list

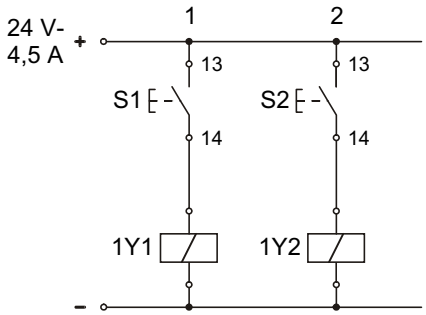


Fig. 9/5:
Circuit design, electrical

Quantity	Description
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

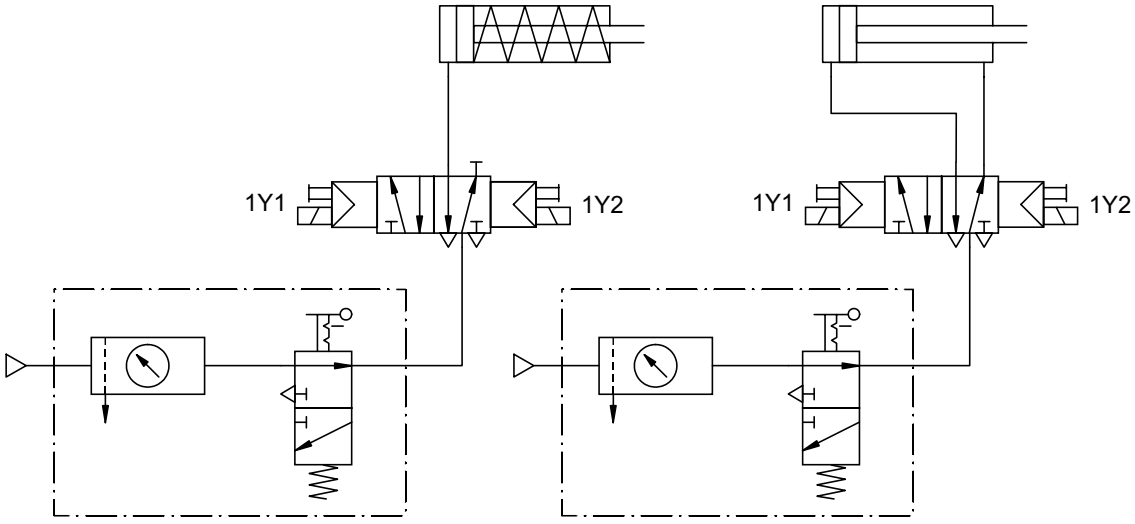
Components list

C-38

Solution 9

Hopper control

Fig. 10/2:
Circuit diagram, pneumatic



Representation without manifold

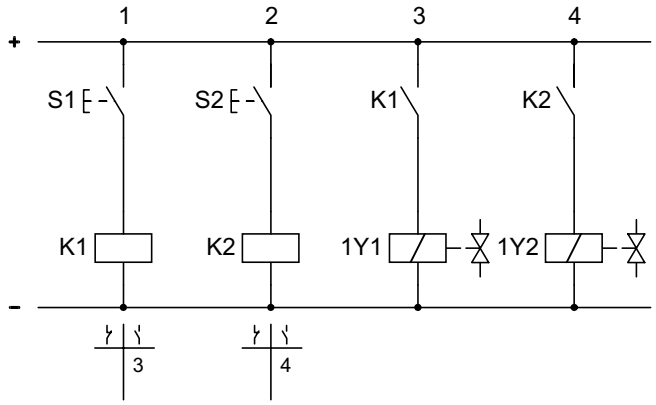


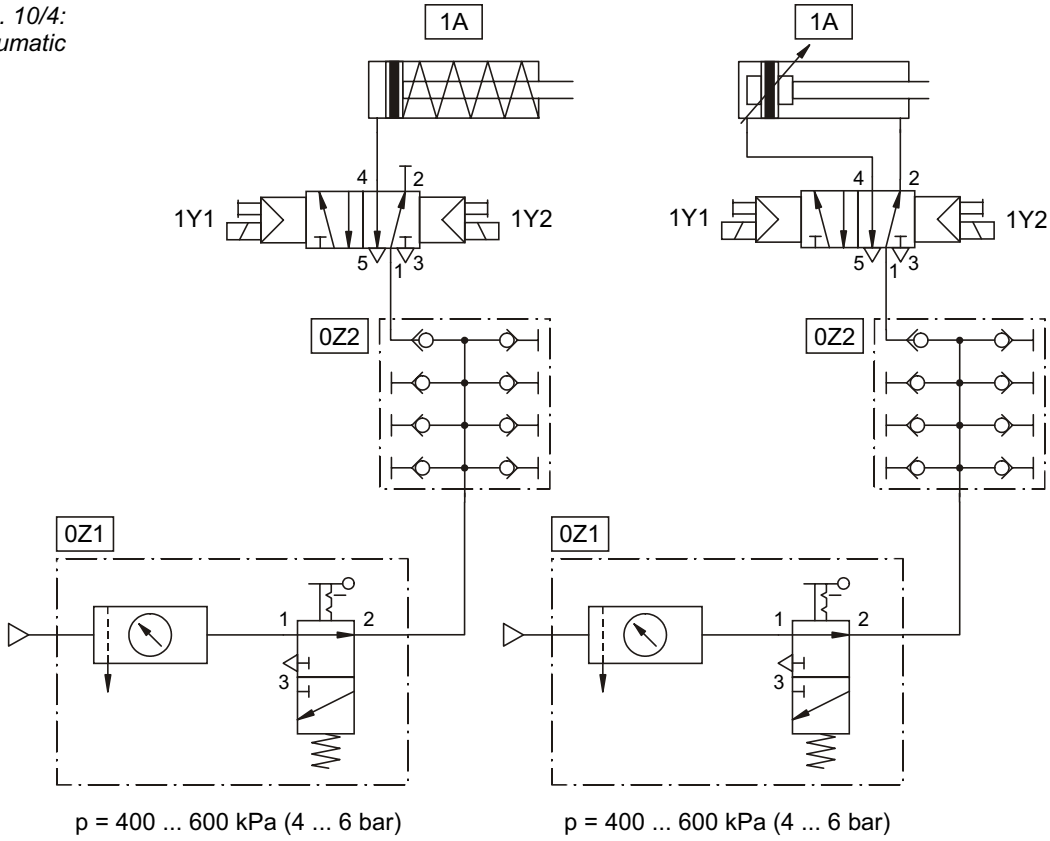
Fig. 10/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 the electric circuit for the relay K1 is closed and the contact K1 is made. The electric circuit for the solenoid coil 1Y1 is closed and the 5/2-way double solenoid valve is reversed. The piston rod of the single-acting (double-acting) cylinder advances to the forward end position. After releasing pushbutton switch S1 the electric circuit for the relay K1 is opened and the contact K1 is brought into the normal position thereby opening the electric circuit for the solenoid coil 1Y1.

By pressing the pushbutton switch S2 the electric circuit for the relay K2 is closed and the contact K2 is made. The electric circuit for the solenoid coil 1Y2 is closed and the 5/2-way double 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. After releasing the pushbutton switch S2 the electric circuit for the relay K2 is opened and the contact K2 is brought into the normal position opening the electric circuit for the solenoid coil 1Y2

Fig. 10/4:
Circuit design, pneumatic



Quantity	Description
1	Single-acting cylinder
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way double solenoid valve

Components list

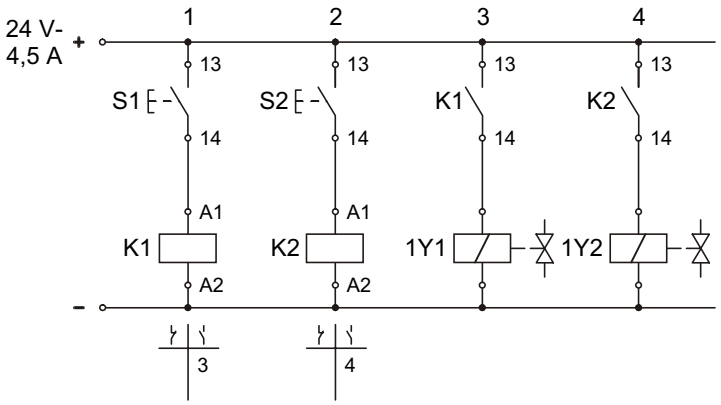


Fig. 10/5:
Circuit design, electrical

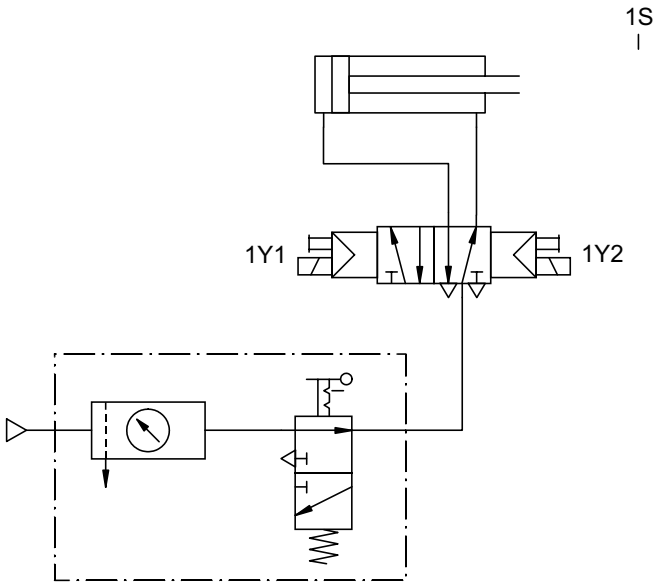
Quantity	Description
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Components list

C-42

Solution 10

Gravity feed magazine



Representation without manifold

Fig. 11/2:
Circuit diagram, pneumatic

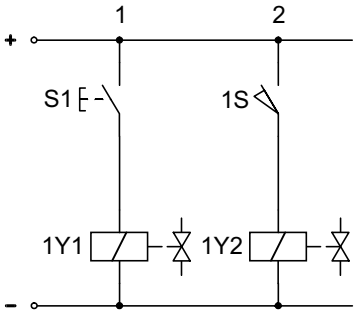


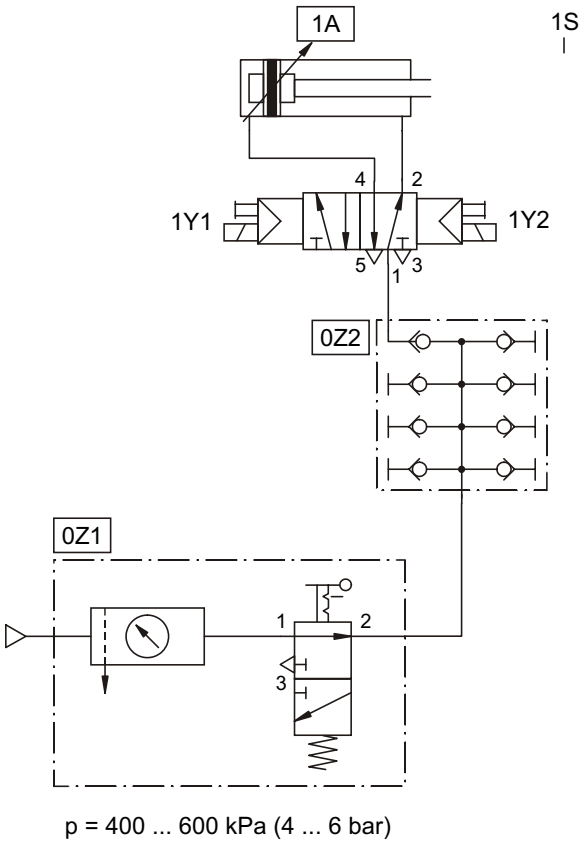
Fig. 11/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 the electric circuit for the solenoid coil 1Y1 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. When the pushbutton switch S1 is released the electric circuit for the solenoid coil 1Y1 is opened.

The piston rod of the double-acting cylinder advances to the forward end position and actuates limit switch 1S. The electric circuit for the solenoid coil 1Y2 is closed and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod of the double-acting cylinder returns to its rear end position. When the limit switch 1S is released the electric circuit for the solenoid coil 1Y2 is opened.

Fig. 11/4: Circuit design, pneumatic



Quantity	Description
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way double solenoid valve

Components list

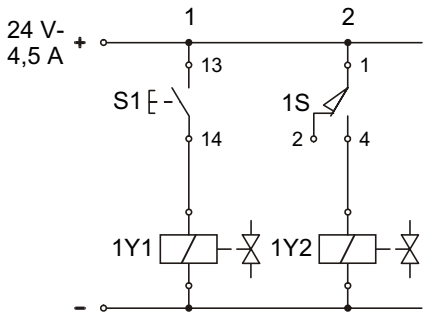


Fig. 11/5:
Circuit design, electrical

Quantity	Description
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Limit switch, electrical, actuated from the left
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Components list

C-46

Solution 11

Multi-track gravity feed magazine

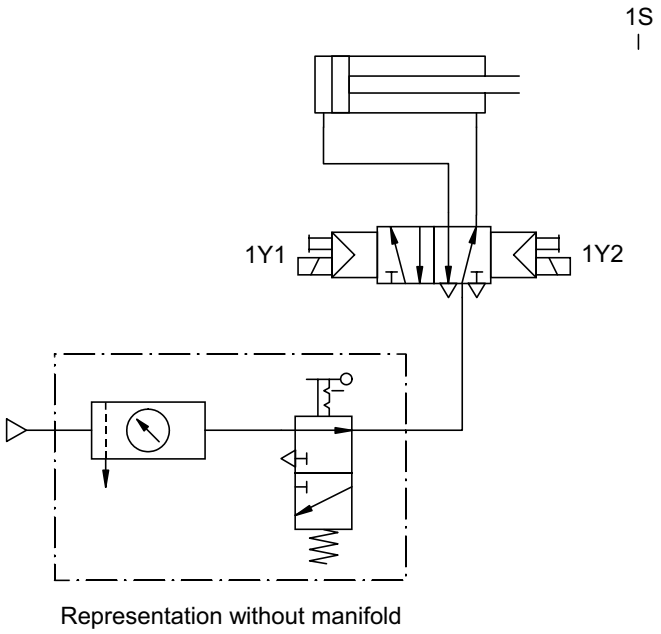


Fig. 12/2:
Circuit diagram, pneumatic

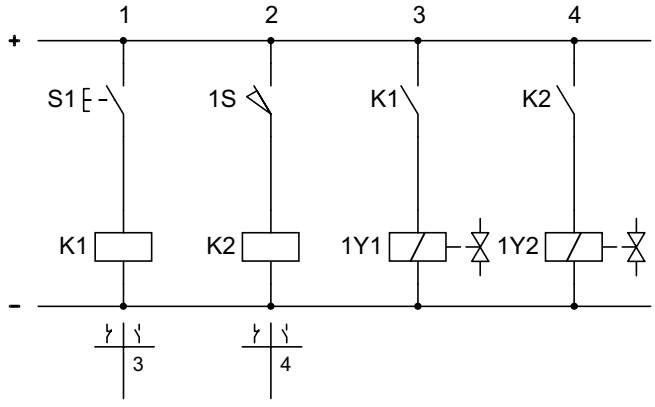


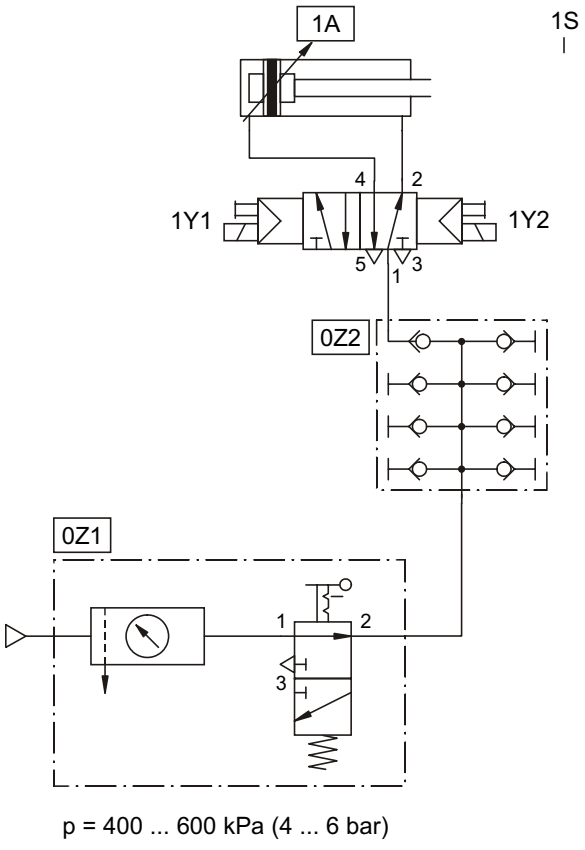
Fig. 12/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 the electric circuit for the relay K1 is closed and the contact K1 is made. The electric circuit for the solenoid coil 1Y1 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. When the pushbutton switch S1 is released the electric circuit for the relay K1 is opened and the contact K1 is brought to the normal position. The electric circuit for the solenoid coil 1Y1 is opened.

The piston rod of the double-acting cylinder advances to the forward end position and actuates limit switch 1S. The electric circuit for the relay K2 is closed and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod of the double-acting cylinder returns to its rear end position. The electric circuit for the relay K2 is opened and the contact K2 is brought into the normal position. The electric circuit for the solenoid coil 1Y2 is opened.

Fig. 12/4:
Circuit design, pneumatic



Quantity	Description
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way double solenoid valve

Components list

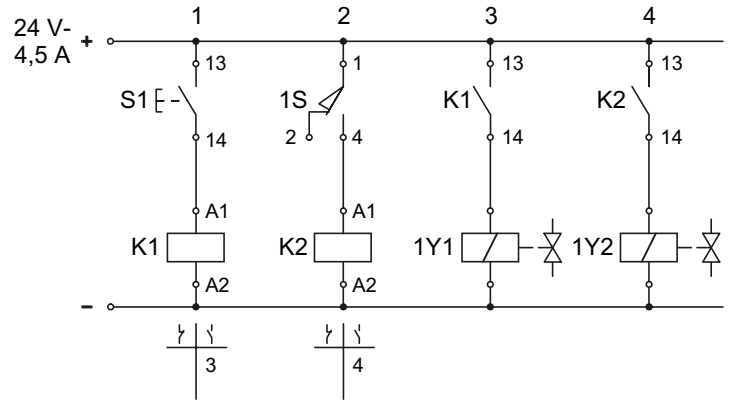


Fig. 12/5:
Circuit design, electrical

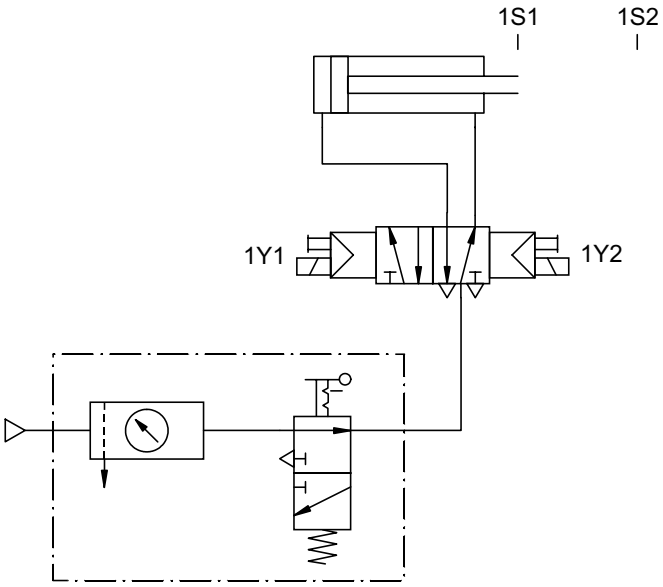
Quantity	Description
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Limit switch, electrical, actuated from the left
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Components list

C-50

Solution 12

Conveyor belt control



Representation without manifold

Fig. 13/2:
Circuit diagram, pneumatic

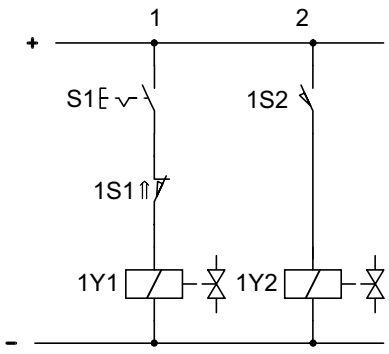


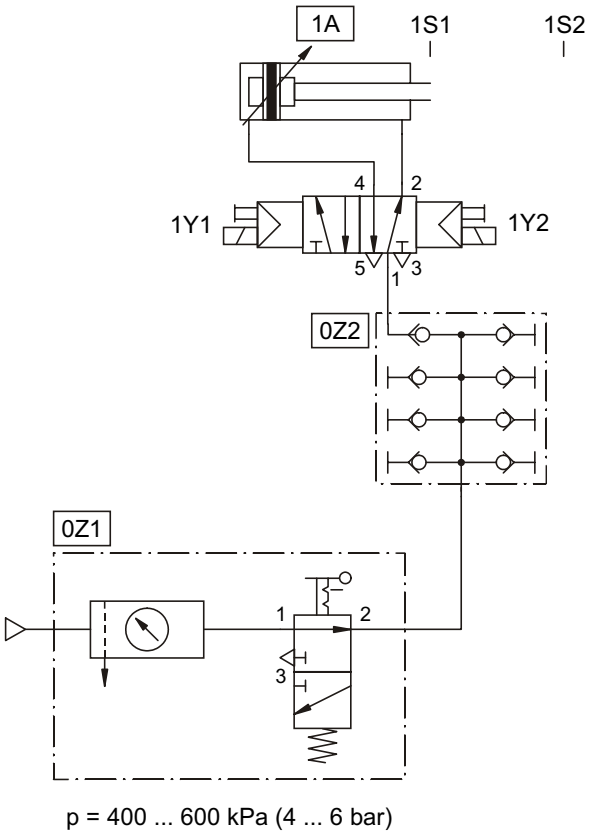
Fig. 13/3:
Circuit diagram, electrical

Solution description

When latching pushbutton switch S1 is pressed the electric circuit for the solenoid coil 1Y1 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 and switches limit switch 1S2. After leaving the rear end position, the electric circuit for the solenoid coil 1Y1 is opened via limit switch 1S1.

The electric circuit for the solenoid coil 1Y2 is closed via limit switch 1S2 and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod of the double-acting cylinder returns to its retracted end position and switches limit switch 1S1. After leaving the forward end position, the electric circuit for the solenoid coil 1Y1 is closed by means of limit switch 1S1 via the actuated latching pushbutton switch S1. The piston rod of the double-acting cylinder advances again to the forward end position.

Fig. 13/4:
Circuit design, pneumatic



Quantity	Description
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way double solenoid valve

Components list

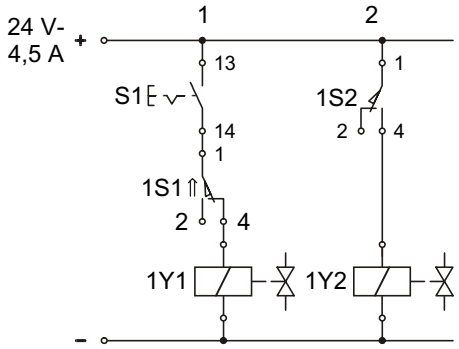


Fig. 13/5:
Circuit design, electrical

Quantity	Description
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Limit switch, electrical, actuated from the left
1	Limit switch, electrical, actuated from the right
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Components list

Solution 13

Rotary indexing table

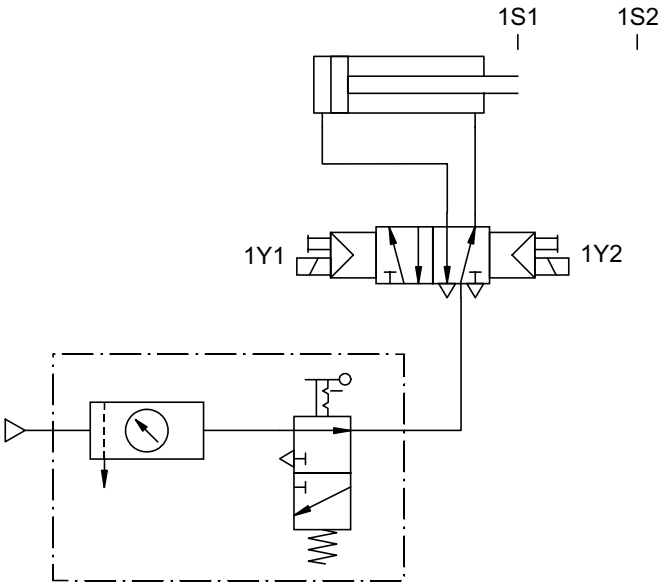


Fig. 14/2:
Circuit diagram, pneumatic

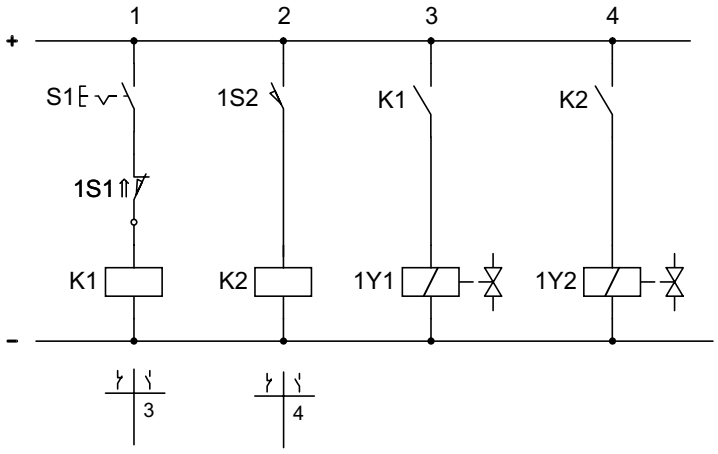


Fig. 14/3:
Circuit diagram, electrical

Solution description

By pressing the latching pushbutton switch S1 the electric circuit for the relay K1 is closed and the contact K1 is made. The electric circuit for the solenoid coil 1Y1 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 and switches limit switch 1S2. After leaving the retracted end position, the electric circuit for the relay K1 is opened via limit switch 1S1 and the contact K1 is brought into the normal position.

The electric circuit for the relay K2 is closed by means of limit switch 1S2 and the contact K2 is made. The electric circuit for the solenoid coil 1Y2 is closed and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod of the double-acting cylinder returns to the retracted end position and switches limit switch 1S1. After leaving the forward end position the electric circuit for the solenoid coil 1Y2 is opened by means of limit switch 1S2.

The electric circuit for the relay K1 is again closed via the limit switch 1S1 by means of the **latched** pushbutton switch S1 and the contact K1 is made. The electric circuit for the solenoid coil 1Y1 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.

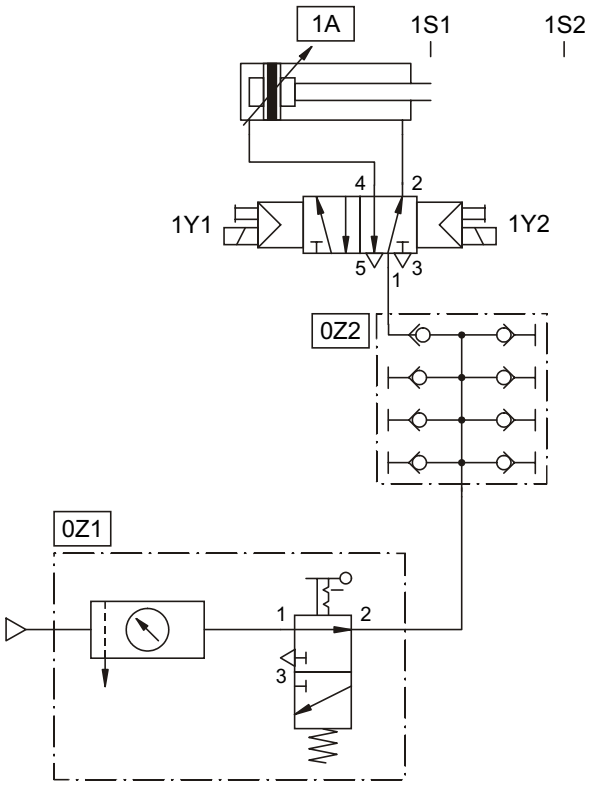
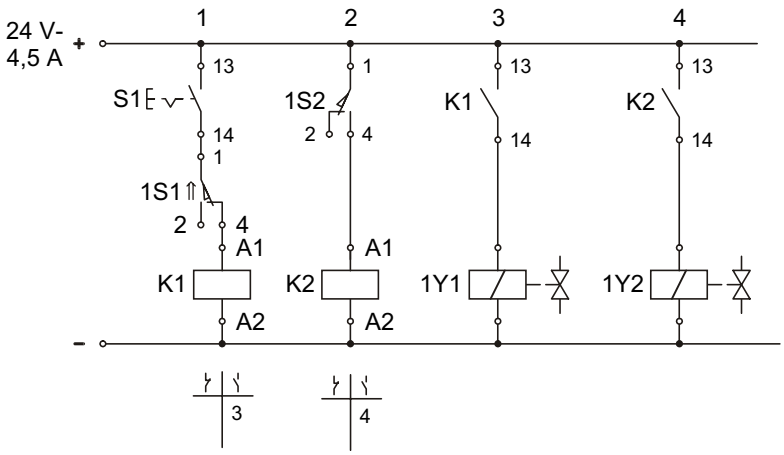


Fig. 14/4:
Circuit design, pneumatic

Components list

Quantity	*Description*
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way double solenoid valve

Fig. 14/5:
Circuit design, electrical

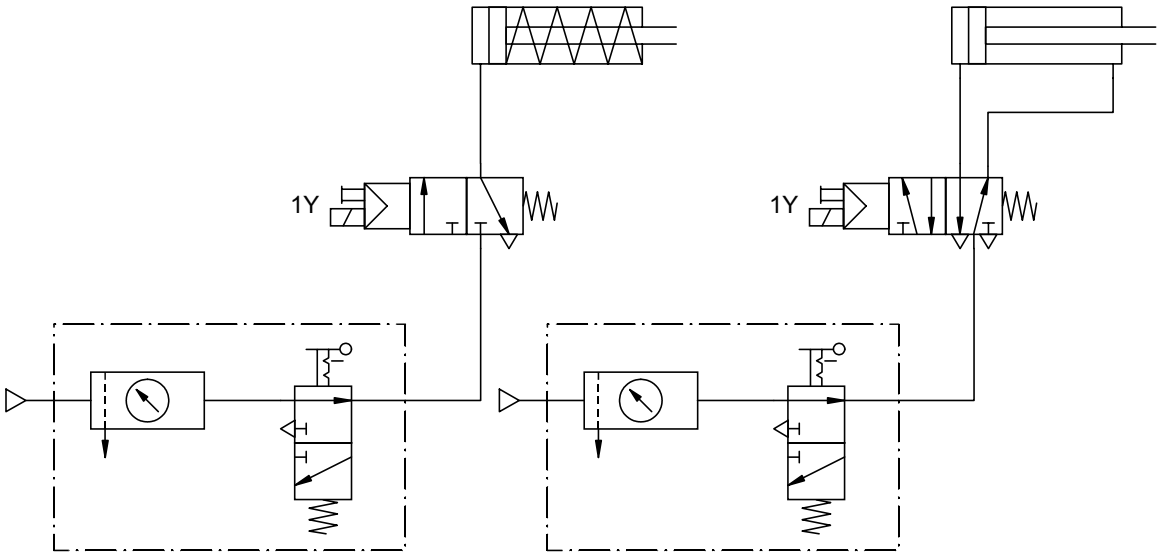


Components list

Quantity	*Description*
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Limit switch, electrical, actuated from the left
1	Limit switch, electrical, actuated from the right
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Sliding table

Fig. 15/2:
Circuit diagram, pneumatic



Representation without manifold

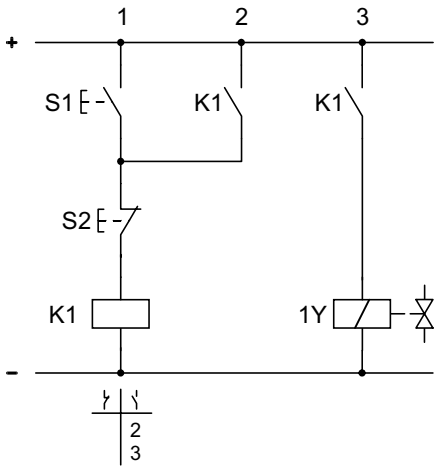


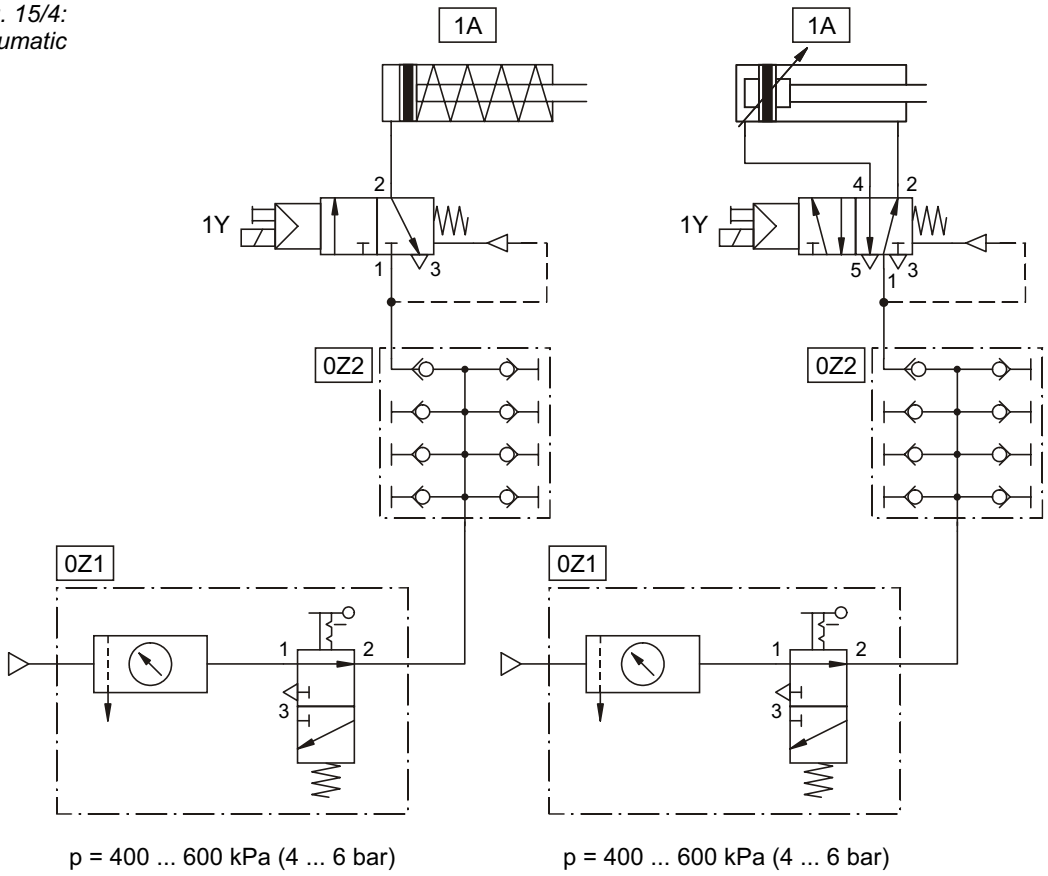
Fig. 15/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switch S1 (ON) the electric circuit for the relay K1 is closed via the **unactuated** pushbutton switch S2 (OFF) and the bank of contacts is made. The latching circuit with contact K1 (13, 14) 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 1Y is closed with 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 to the normal position. The electric circuit for the solenoid coil 1Y is opened and the 3/2- (5/2-) way solenoid valve is reversed. The piston rod of the single-acting (double-acting) cylinder returns to the retracted end position.

Fig. 15/4:
Circuit design, pneumatic



Quantity	Description
1	Single-acting cylinder
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	3/2-way single solenoid valve, normally closed
1	5/2-way single solenoid valve

Components list

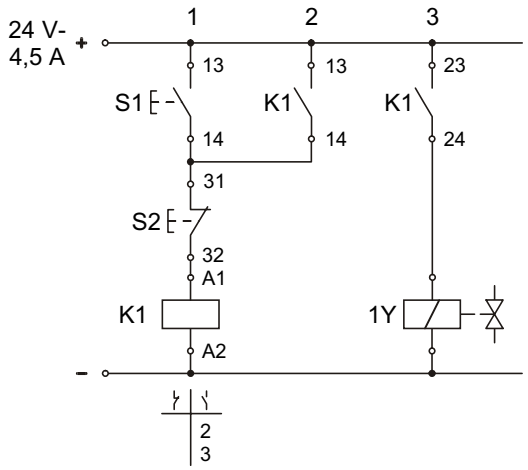


Fig. 15/5:
Circuit design, electrical

Quantity	Description
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

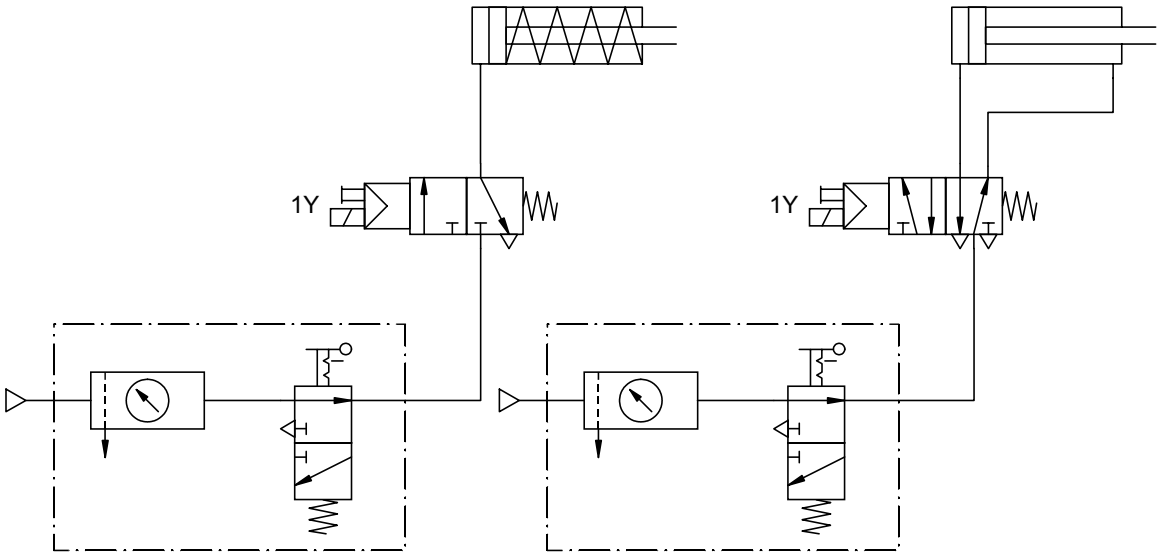
Components list

C-62

Solution 15

Clamping device

Fig. 16/2:
Circuit diagram, pneumatic



Representation without manifold

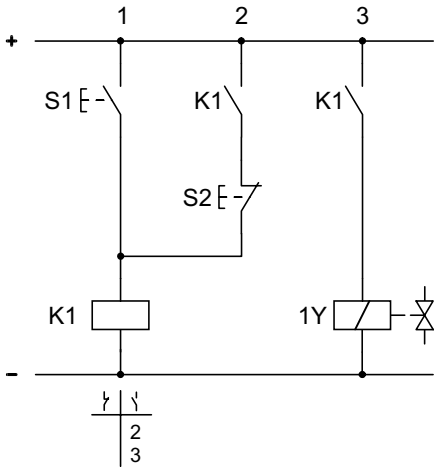


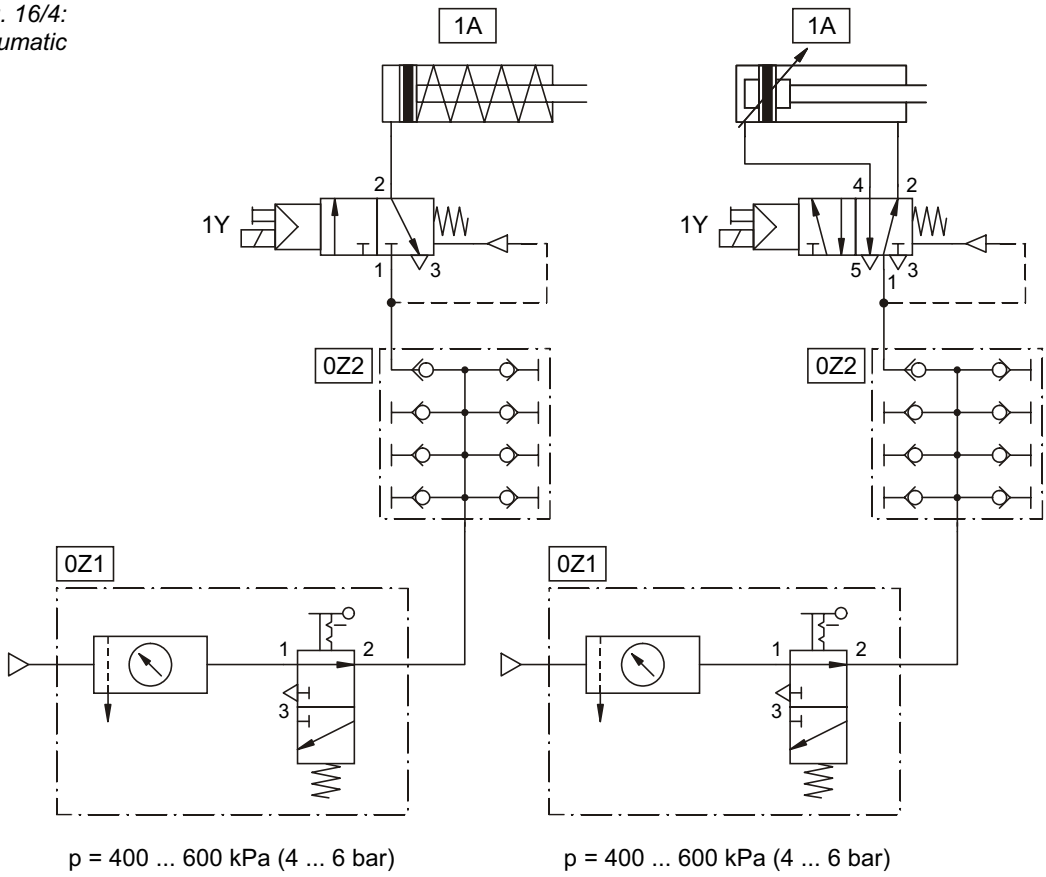
Fig. 16/3:
Circuit diagram, electrical

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 1Y 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 normal position. The electric circuit for the solenoid coil 1Y 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.

Fig. 16/4:
Circuit design, pneumatic



Quantity	Description
1	Single-acting cylinder
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	3/2-way single solenoid valve, normally closed
1	5/2-way single solenoid valve

Components list

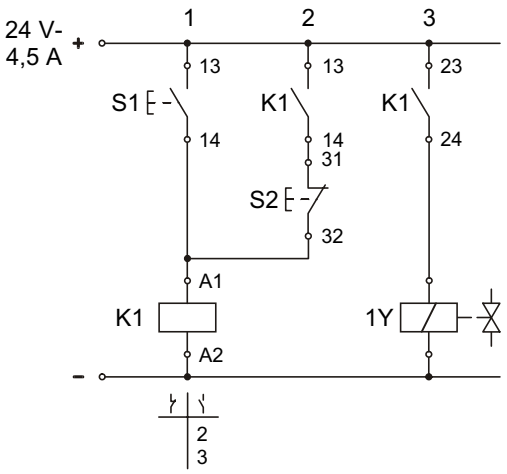


Fig. 16/5:
Circuit design, electrical

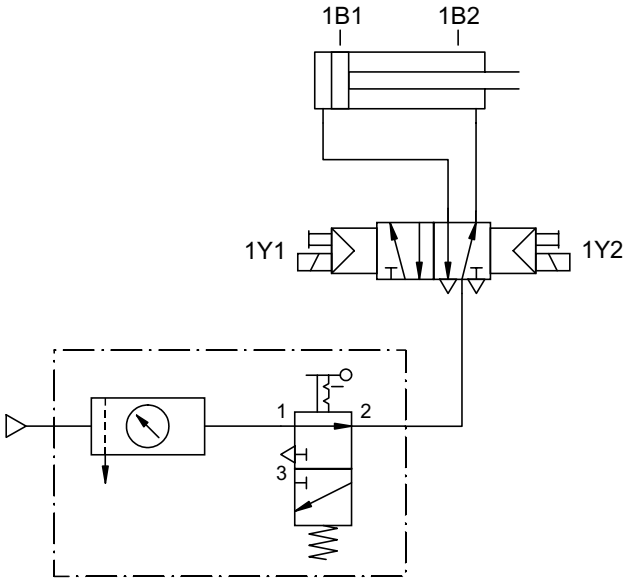
Quantity	Description
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Components list

C-66

Solution 16

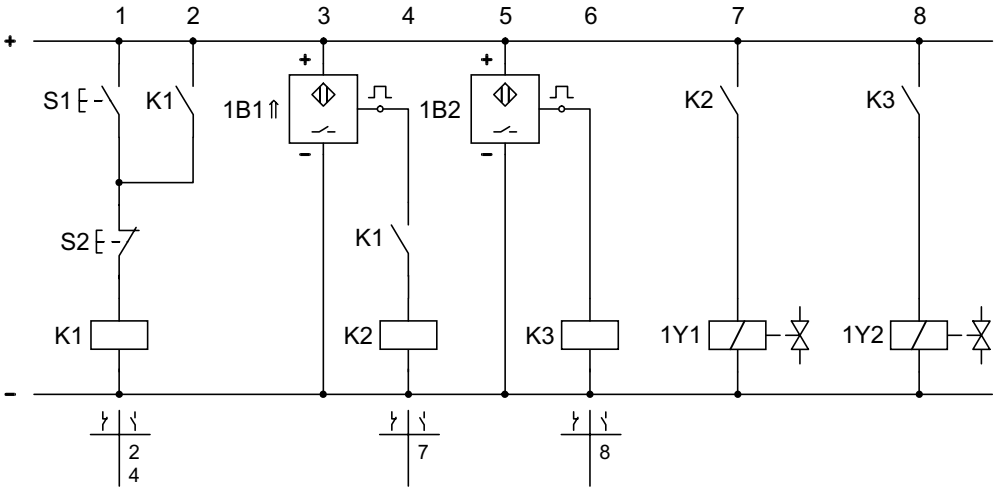
Diverting device



Representation without manifold

Fig. 17/2:
Circuit diagram, pneumatic

Fig. 17/3:
Circuit diagram, electrical



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 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 1Y1 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 1B2. After leaving the rear end position, the electric circuit for the relay K2 is opened via sensor 1B1 and the contact K2 is brought to the normal position.

The electric circuit for the relay K3 is closed via sensor 1B2 and the contact K3 is made. The electric circuit for the solenoid coil 1Y2 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 1B1. After leaving the forward end position the electric circuit for relay K3 is opened via sensor 1B2 and the contact K3 is brought to the normal position.

1The electric circuit for the relay K2 is closed via sensor 1B1 and the contact K2 is made. The electric circuit for the solenoid coil 1Y1 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.

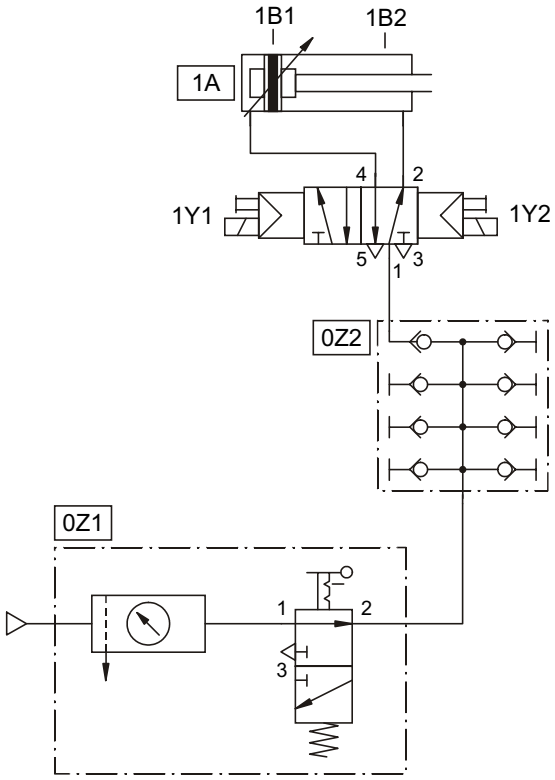
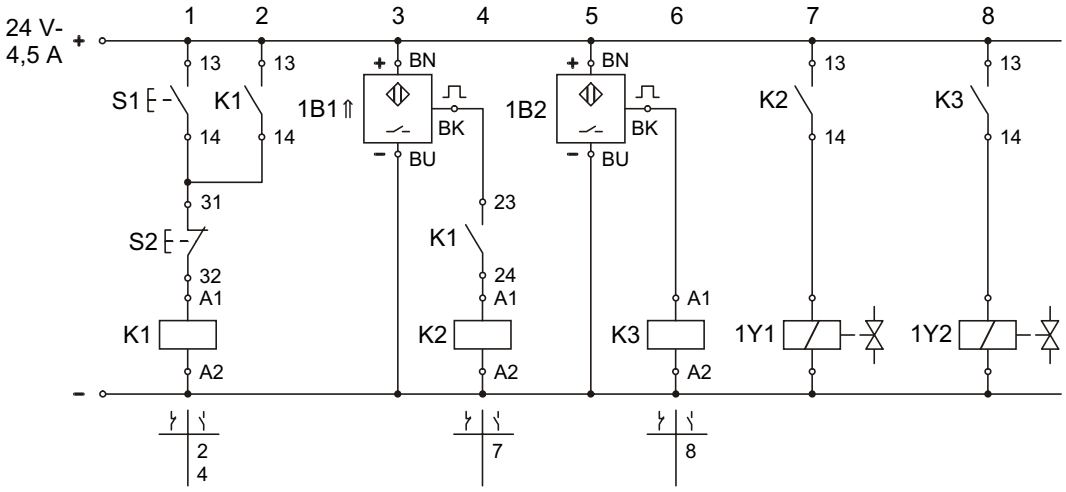


Fig. 17/4:
Circuit design, pneumatic

Components list

Quantity	*Description*
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way double solenoid valve

Fig. 17/5:
Circuit design, electrical



Components list

Quantity	*Description*
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
2	Proximity switch with cylinder mouting
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Stamping device

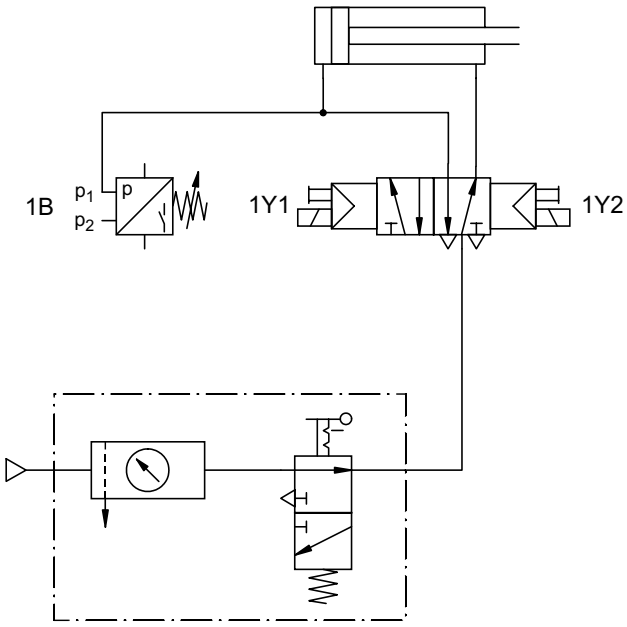


Fig. 18/2:
Circuit diagram, pneumatic

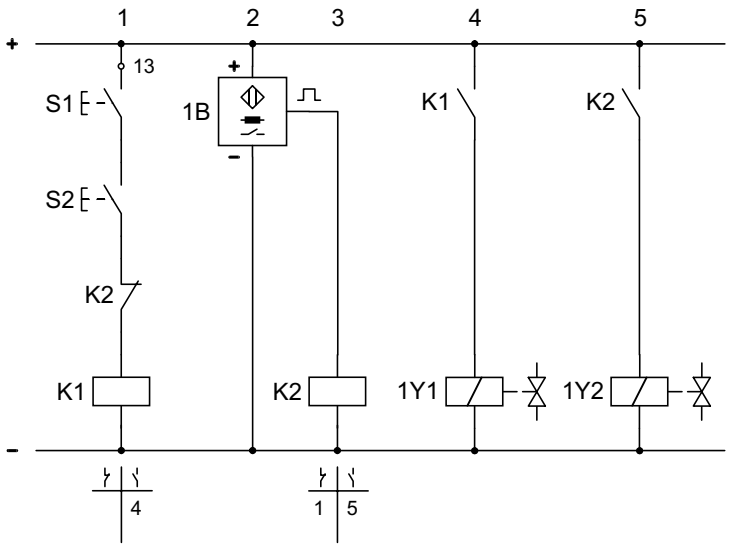


Fig. 18/3:
Circuit diagram, electrical

Solution description

By pressing the pushbutton switches S1 **and** S2 the electric circuit for the relay K1 is closed and the bank of contacts is made. The electric circuit for the solenoid coil 1Y1 is closed with contact K1 (13, 14) and the 5/2-way double solenoid valve is reversed. The piston rod of the double-acting cylinder advances to the forward end position.

When the pre-set switching pressure has been achieved in the supply line of the double-acting cylinder, the pressure switch 1B is actuated. The electric circuit for the relay K2 is closed and the bank of contacts is actuated. The electric circuit for the relay K1 is opened with contact K2 (41, 42) and the bank of contacts is brought to the normal position. The electric circuit for the solenoid coil 1Y1 is opened. At the same time the electric circuit for the solenoid coil1 Y2 is closed with contact K2 (13, 14) and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod of the double-acting cylinder returns to the retracted end position.

When the switching pressure has dropped the pressure switch 1B is returned to its initial position by means of a reset spring. The electric circuit for the relay K2 is opened and the bank of contacts is brought to the normal position. The electric circuit for the solenoid coil 1Y2 is opened.

*The solution shown above is an AND-function, **not** a two-hand safety control..*

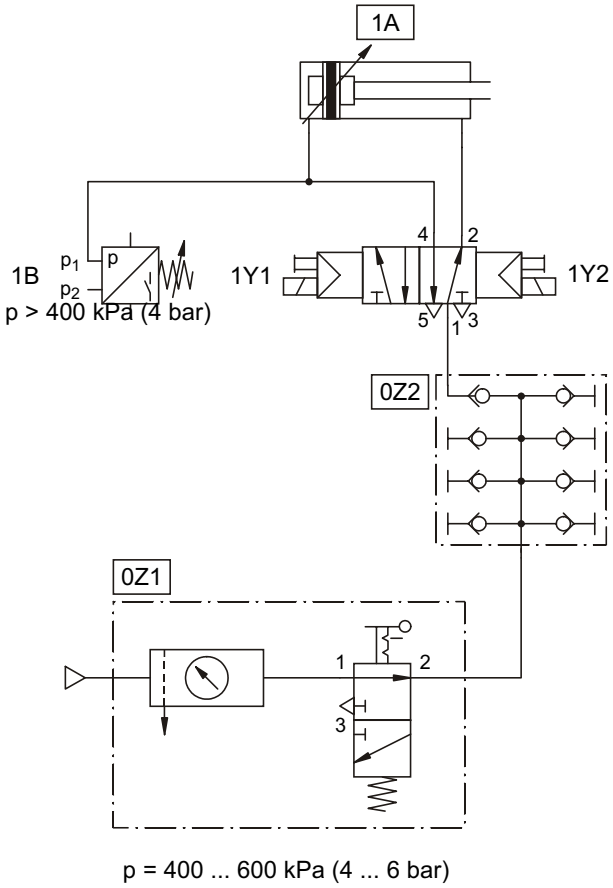
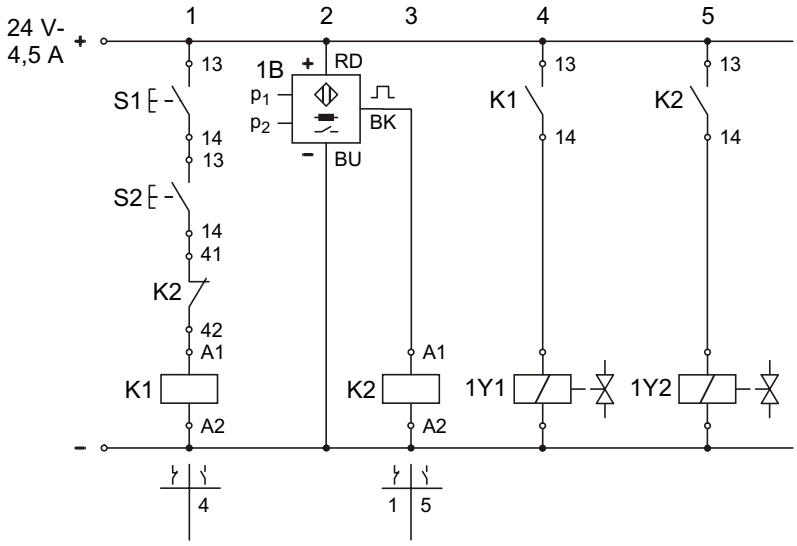


Fig. 18/4:
Circuit design, pneumatic

Components list

Quantity	*Description*
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	Pneumatic-electrical converter
1	5/2-way double solenoid valve

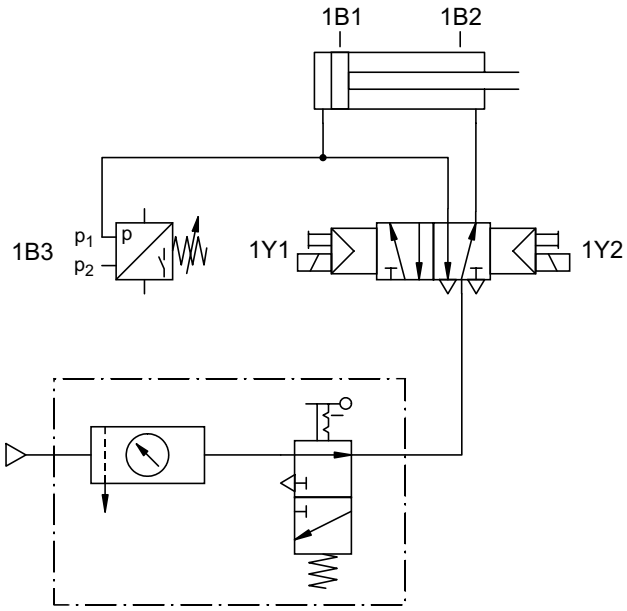
Fig. 18/5:
Circuit design, electrical



Components list

Quantity	*Description*
1	Relay, 3-off
1	Signal input plate, electrical
1	Indicator and distributor plate, electrical
1	Cabel set, universal
1	Electrical power supply unit, 24 V

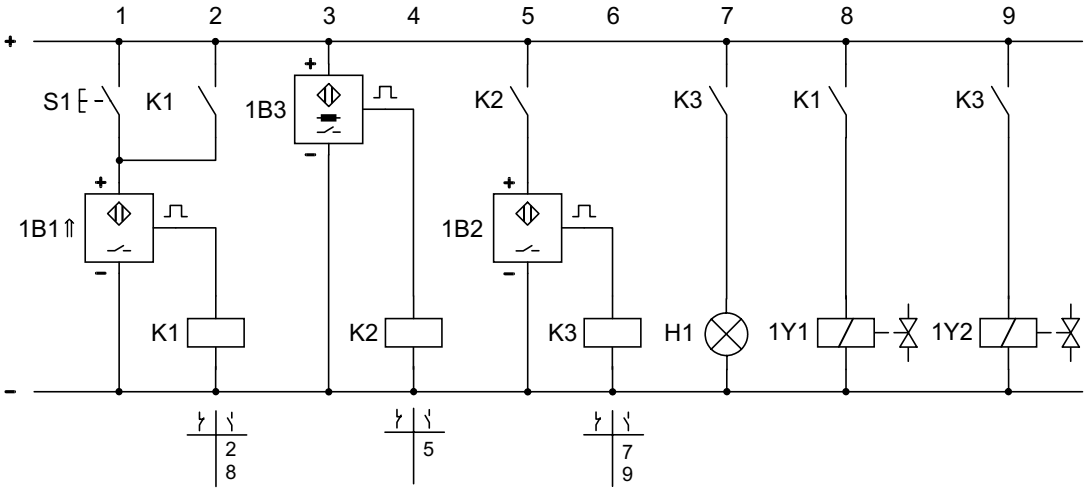
Heat sealing device



Representation without manifold

Fig. 19/2:
Circuit diagram, pneumatic

Fig. 19/3:
Circuit diagram, electrical



Solution description

By pressing the pushbutton switch S1 the electric circuit for the relay K1 is closed and the bank of contacts is made. After releasing the pushbutton switch S1 the electric circuit for the relay K1 remains closed via the latching circuit with contact K1 (13, 14). The electric circuit for the solenoid coil 1Y1 is closed with contact K1 (23, 24) and the 5/2-way double solenoid valve is reversed. The piston rod of the double-acting cylinder advances to the forward end position and actuates sensor 1B2. As long as sensor1 B2 is in the forward end position and not energised no signal is supplied.

After leaving the rear end position, the sensor 1B1 opens the electric circuit for the relay K1 and the bank of contacts is brought into the normal position. The electric circuit for the solenoid 1Y1 is opened.

When the pre-set switching pressure has been reached in the supply line of the double-acting cylinder, the pressure switch 1B3 is actuated. The electric circuit for the relay K2 is closed and the bank of contacts is made. 1B2 can now also supply a signal. The electric circuit for the relay K3 is closed and the bank of contacts is made. The electric circuit for the indicating lamp H1 is closed via contact K3 (13, 14). At the same time the electric circuit for the solenoid coil 1Y2 is closed with contact K3 (23, 24) and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod of the double-acting cylinder returns to the retracted end position and actuates sensor 1B1.

After leaving the forward end position, the electric circuit for the relay K3 is opened via sensor 1B2 and the bank of contacts is brought into the normal position. The electric circuits for the indicating lamp H1 and the solenoid coil 1Y2 are opened. After the switching pressure has been reduced, the pressure switch 1B3 is brought into its initial position by means of a reset spring.

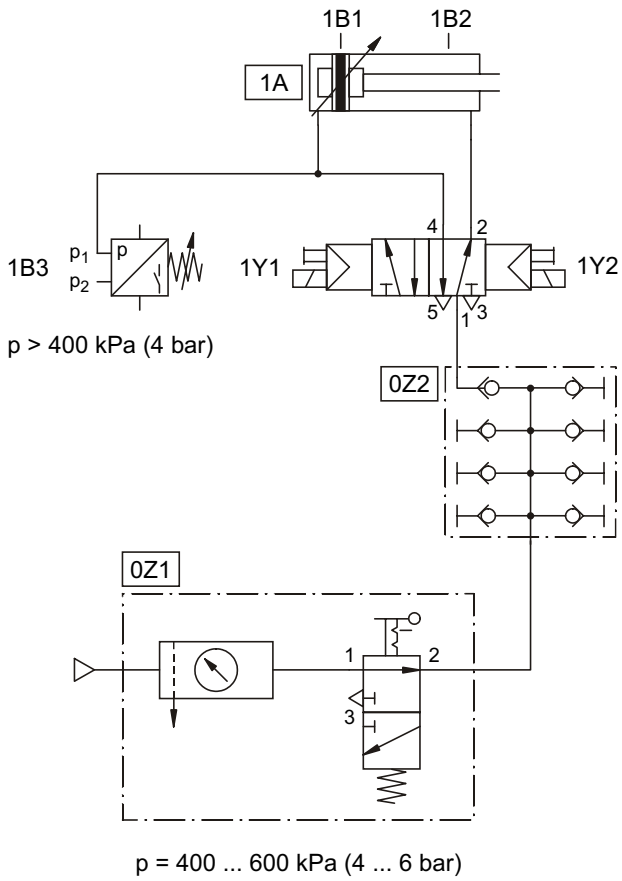
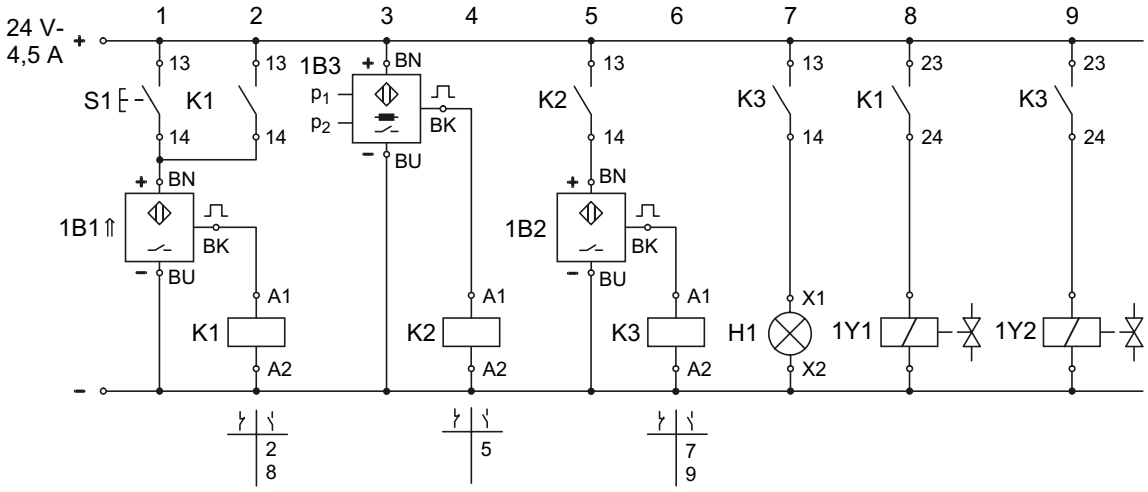


Fig. 19/4:
Circuit design, pneumatic

Quantity	*Description*
1	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	Pneumatic-electrical converter
1	5/2-way double solenoid valve

Components list

Fig. 19/5:
Circuit design, electrical



Components list

Quantity	*Description*
1	Relay, 3-off
1	Signal input plate, electrical
2	Indicator and distributor plate, electrical
2	Proximity switch with cylinder mouting
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Transfer station

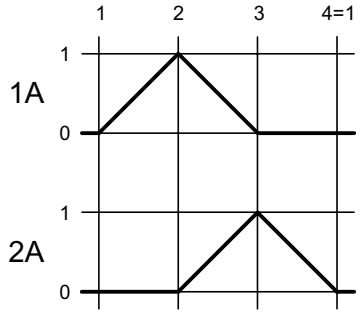
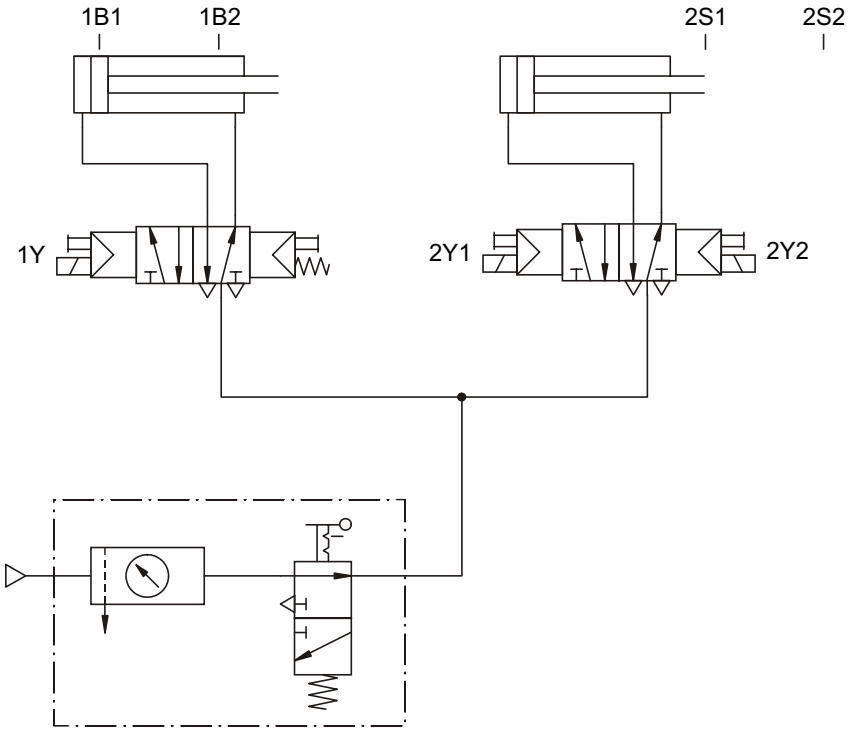


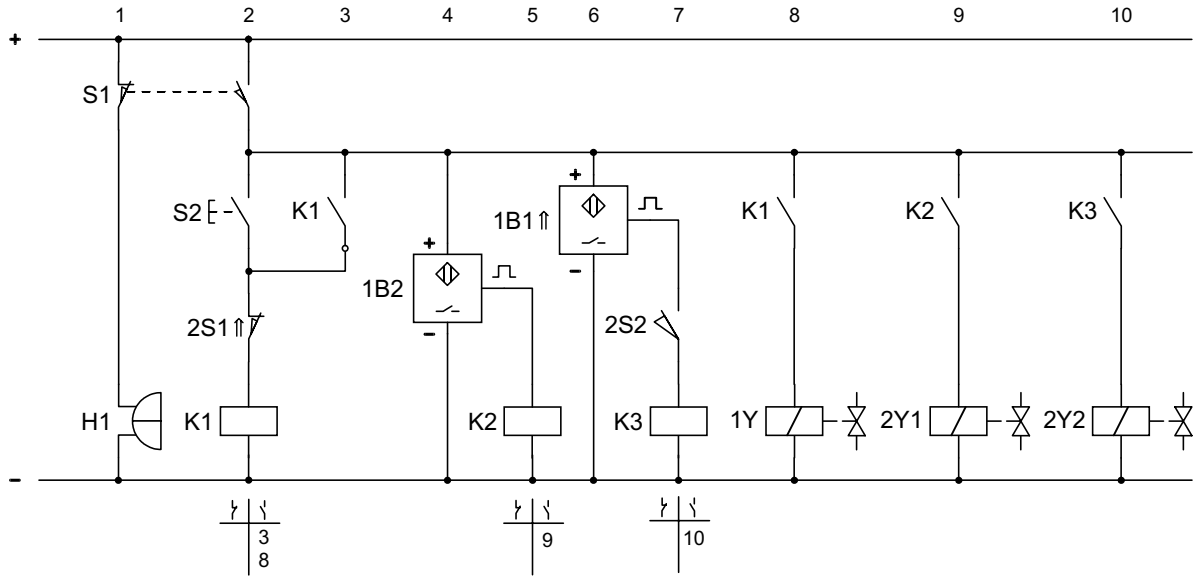
Fig. 20/2:
Displacement-step diagram



Representation without manifold

Fig. 20/3:
Circuit diagram, pneumatic

Fig. 20/4:
Circuit diagram, electrical



Solution description

When carrying out the practical circuit construction, the limit switch S1 is replaced by the latching pushbutton switch on the electrical signal input plate.

Empty magazine
When the latching pushbutton switch S1 is **unactuated** the electric circuit for the audible indicator H1 is closed via contact S1 (31, 32). The electric current supply for the main circuit is switched off via contact S1 (13, 14).

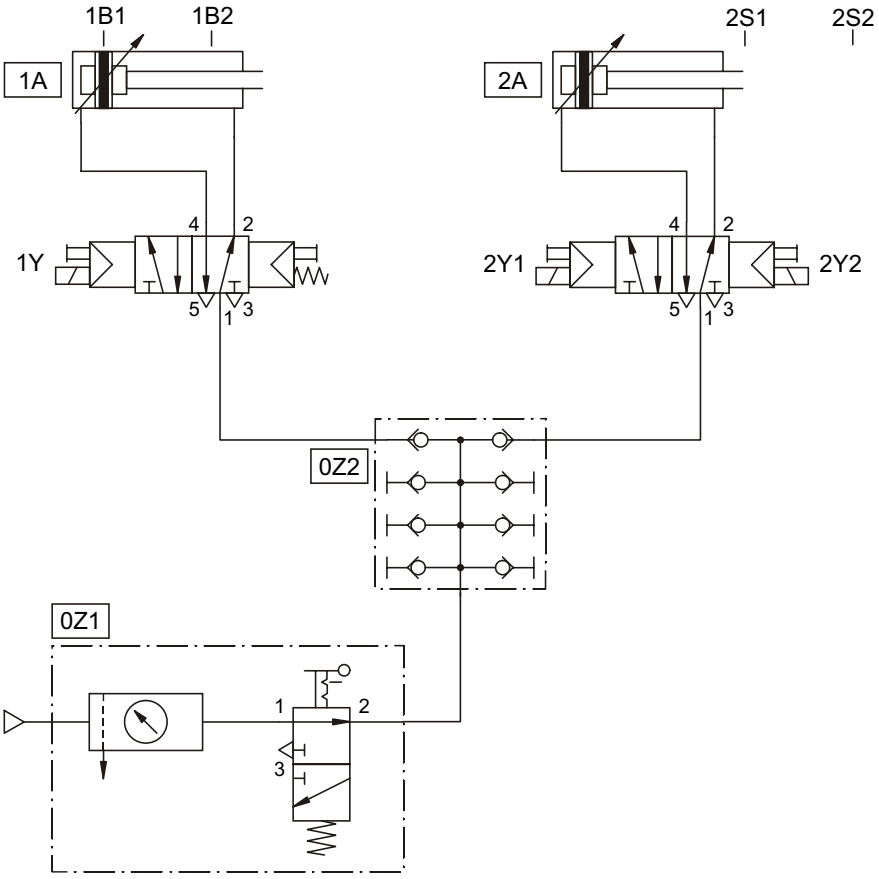
Full magazine
When the latching pushbutton switch S1 is **actuated** the electric circuit for the audible indicator H1 is opened via contact S1 (31, 32). The electric current supply for the main circuit is switched on via contact S1 (13, 14).

Step 1
By pressing the pushbutton switch S2 the electric circuit for the relay K1 is closed and the bank of contacts made. When the pushbutton switch S2 is released, the electric circuit for the relay K1 remains closed via the latching circuit with K1 (13, 14). The electric circuit for the solenoid coil 1Y1 is closed with contact K1 (23, 24) and the 5/2-way solenoid valve is reversed. The piston rod of cylinder 1A advances to the forward end position and actuates sensor 1B2.

Step 2
The electric circuit for the relay K2 is closed and the contact K2 is made. The electric circuit for the solenoid coil 2Y1 is closed and the 5/2-way double solenoid valve is reversed. The piston rod of cylinder 2A advances to the forward end position and actuates limit switch 2S2. After leaving the retracted end position the electric circuit for the relay K1 is opened via limit switch 2S1 and the bank of contacts is brought into the normal position. The electric circuit for the solenoid coil 1Y1 is opened and the 5/2-way solenoid valve is switched back to its initial position. The piston rod of cylinder 1A returns to the retracted end position and actuates sensor 1B1.

Step 3
After leaving the forward end position the electric circuit for the relay K2 is opened via sensor 1B2, and the contact K2 is brought into the normal position. The electric circuit for the solenoid coil 2Y1 is opened. The electric circuit for the relay K3 is closed and the contact K3 is made. The electric circuit for the solenoid coil 2Y2 is closed and the 5/2-way double solenoid valve is switched back to its initial position. The piston rod of cylinder 2A returns to the retracted end position. The electric circuit for the relay K3 is opened via limit switch S2 and the contact K3 is brought into the normal position. The electric circuit for the solenoid coil 2Y2 is opened.

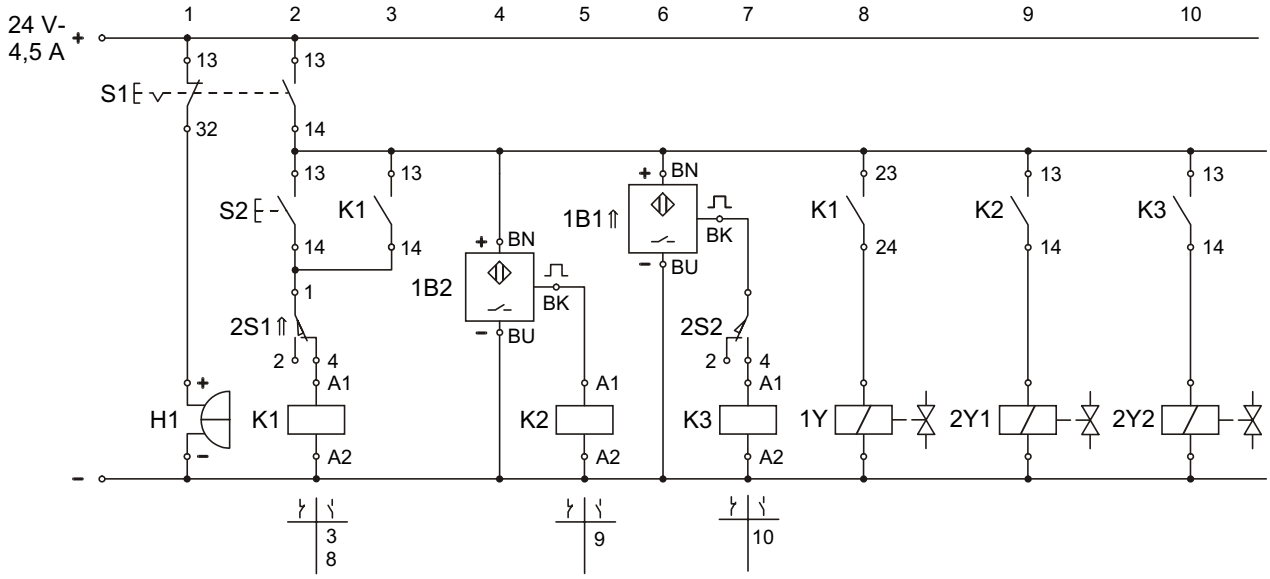
Fig. 20/5:
Circuit design, pneumatic



Components list

Quantity	*Description*
2	Double-acting cylinder
1	Service unit with on-off valve
1	Manifold
1	5/2-way single solenoid valve
1	5/2-way double solenoid valve

Fig. 20/6:
Circuit design, electrical



Quantity	*Description*
1	Relay, 3-off
1	Signal input plate, electrical
2	Indicator and distributor plate, electrical
2	Proximity switch with cylinder mouting
1	Limit switch, electrical, actuated from the left
1	Limit switch, electrical, actuated from the right
1	Cabel set, universal
1	Electrical power supply unit, 24 V

Components list

C-84

Solution 20

Part D – Appendix

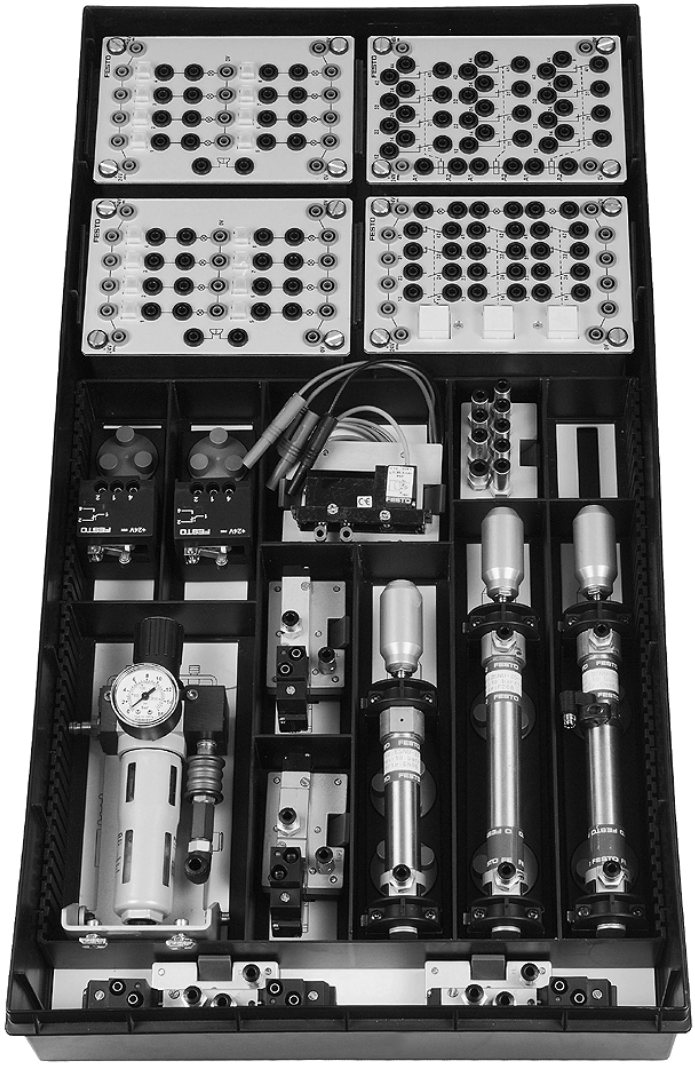
Storage tray	D-2
Mounting technology	D-3
Plastic tubing	D-4

Data sheets

Single-acting cylinder	152887
Double-acting cylinder	152888
Service unit with on-off valve	152894
Manifold	152896
Relay, 3-off	162241
Signal input plate, electrical	162242
Indicator and distributor plate, electrical	162244
Proximity switch with cylinder mounting	167060
3/2-way single solenoid valve, closed in normal position	167073
5/2-Wege-Magnetventil	167074
5/2-Wege-Magnet-Impulsventil	167076
Pneumatisch-elektrischer Wandler	177459
Limit switch, electrical, actuated from the left	183322
Limit switch, electrical, actuated from the right	183345

Storage tray

Equipment set TP201 in storage tray



All the components of the equipment set for technology package TP201 are stored in a storage tray.

This storage tray serves both as a means of packaging for despatch purposes and as a drawer insert for the Didactic furniture rage.

Mounting technology

The components of the equipment set are mounted on the Festo Didactic profile plate. The profile plate has 14 parallel T-grooves equally spaced 50 mm apart.

There are four alternatives for mounting the components on the profile plate:

Alternative A Detent system (also referred to as snap-lock system),
without additional facilities,
clamping mechanism with lever and spring,
which can be moved in the direction of the groove,
for light, non load-bearing components

Alternative B: Rotational system, without additional facilities,
triple grip nut with locking disc and T-head bolt,
vertical or horizontal alignment,
for medium-weight load-bearing components

Alternative C: Screw-in system, with additional facilities,
cheese head screw with T-head nut,
vertical and horizontal alignment,
for heavy load-bearing components or
components which are rarely removed from the profile plate

Alternative D: Plug-in system, with adapter
Components on plug-in assembly board with locating pins,
movable in the direction of the groove,
for light, non load-bearing components

The signal input, indicator and relay plates can also be mounted to the holding frame for ER units.

With **alternative A**, a slide engages in the T-groove of the profile plate. This slide is pre-tensioned by a spring. By pressing the blue lever, the slide is retracted and the component can either be removed from or attached to the profile plate. The components are aligned with the groove and can be moved in the direction of the groove.

With **alternative B**, the component is secured to the profile plate by means of a T-head bolt and a blue triple grip nut. A locking disc is used for positional attachment, which can be attached in all four 90° directions. In this way, the components can be secured on the profile plate either parallel or across the groove.

When the locking disc has been adjusted to the required setting, the component is positioned on the profile plate. By turning the triple grip nut clockwise, the T-head nut is rotated by 90° in the T-groove by means of thread friction. Further turning of the triple grip nut clamps the component against the profile plate.

Alternative C is used for heavy components or components which are screwed on to the profile plate only once or seldom removed. Such components are secured by means of cheese head screws with hexagon socket and T-head nuts.

With **alternative D**, the tried and tested ER-units for plug-in assembly boards which have locating pins on a 50 mm grid, can be attached to the profile plate by means of adapters. One black, plastic adapter is required for each locating pin. The adapters are inserted in the T-groove, positioned at intervals of 50 mm and secured by a rotation of 90°. The locating pins of the ER-unit are inserted in the adapter holes.

Plastic tubing

The polyurethane tubing provided is particularly flexible and fracture-resistant.

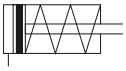
Technical data

Colour	silver metallic
External diameter	4 mm
Internal diameter	2.5 mm
Minimum bending radius within temperature range of -35 bis +60 °C	17 mm
Maximum operating pressure within	
temperature range of -35 to +30°C	1000 kPA (10 bar)
temperature range of +30 to +40°C	900 kPA (9 bar)
temperature range of -40 to +60°C	700 kPA (7 bar)

Subject to alterations.

152887

Single-acting cylinder



Design

The single-acting cylinder with trip cam and push-in fitting is mounted on a plastic retainer. The unit is mounted on the profile plate via quick release detent system with two blue trip grip nuts (mounting alternative "B").

Function

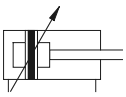
The piston rod of the single-acting cylinder moves into the forward end position through the supply of compressed air. When the compressed air is switched off, the piston is returned to the retracted end position via a return spring.
The magnetic field of a permanent magnet, which is attached to the cylinder piston, actuates the proximity switches.

Technical data

Pneumatic	
Medium	Compressed air, filtered (lubricated or unlubricated)
Design	Piston cylinder
Operating pressure max.	1000 kPa (10 bar)
Max. stroke length	50 mm
Thrust at 600 kPa (6 bar)	150 N
Spring return force min.	13.5 N
Connection	QS-G1/8-4 fittings for plastic tubing PUN 4 x 0.75

152888

Double-acting cylinder



Design

The double-acting cylinder with trip cam and push-in fittings is mounted on a plastic retainer. The unit is mounted on the profile plate via a quick release detent system with two triple grip nuts (mounting alternative "B").

Function

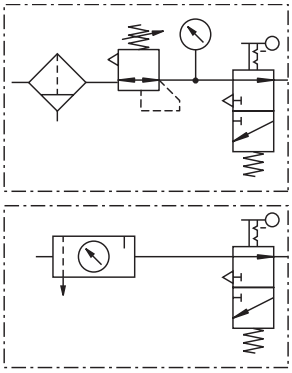
The piston rod of the double-acting cylinder is reversed by means of alternating supply of compressed air. End position cushioning at both ends prevents a sudden impact of the piston on the cylinder housing. The end position cushioning can be adjusted by means of two regulating screws.
The magnetic field of a permanent magnet attached to the cylinder piston actuates the proximity switches.

Technical data

Pneumatic	
Medium	Compressed air, filtered (lubricated or unlubricated)
Design	Piston cylinder
Operating pressure max.	1000 kPa (10 bar)
Max. stroke length	100 mm
Thrust at 600 kPa (6 bar)	165 N
Return force at 600 kPa (6 bar)	140 N
Connection	QS-G1/8-4 fittings for plastic tubing PUN 4 x 0.75

152894

Service unit with on/off valve



Design	The filter regulator with pressure gauge, on/off valve, push-in fitting and quick coupling plug is mounted on a swivelling retainer. The filter bowl is fitted with a metal bowl guard. The unit is mounted on the profile plate by means of cheese head screws and T-head nuts (mounting alternative “C”). Attached is a quick coupling socket with threaded bush and connector nut for plastic tubing PUN 6 x 1.
Function	The filter with water separator cleans the compressed air of dirt, pipe scale, rust and condensate. The pressure regulator adjusts the compressed air supplied to the set operating pressure and compensates for pressure fluctuations. An arrow on the housing indicates the direction of flow. The filter bowl is fitted with a filter drain screw. The pressure gauge shows the preset pressure. The on/off valve exhausts the entire control. The 3/2-way valve is actuated via the blue sliding sleeve.
Note	When constructing a circuit, please ensure that the filter regulator is installed in the vertical position. The pressure regulator is fitted with an adjusting knob, which can be turned to set the required pressure. By sliding the adjusting knob towards the housing, the setting can be locked.

152894

Service unit with on/off valve

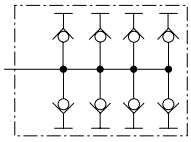
Technical data

Pneumatic	
Medium	Compressed air
Design	Sintered filter with water separator, diaphragm control valve
Assembly position	Vertical ±5°
Standard nominal flow rate *	750 l/min
Upstream pressure max.	1600 kPa (16 bar)
Operating pressure max.	1200 kPa (12 bar)
Connection	Coupling plug fore coupling socket G 1/8 QS-plug fitting for plastic tubing PUN 6 x 1

* Upstream pressure: 1000 kPa (10 bar), Operating pressure: 600 kPa (6 bar), Differential pressure: 100 kPa (1 bar).

152896

Manifold



Design

The manifold with eight self-sealing push-in fittings is screwed on to a universal plate. The unit is mounted on the profile plate via a quick release detent system with blue lever (mounting alternative "A").

Function

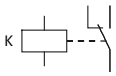
The manifold with a common P-supply enables a control system to be supplied with compressed air eight individual connections.

Technical data

Pneumatic	
Connection	1 QS-1/8-6 for plastic tubing PUN 6 x 1 8 QSK-1/8-4 for plastic tubing PUN 4 x 0.75

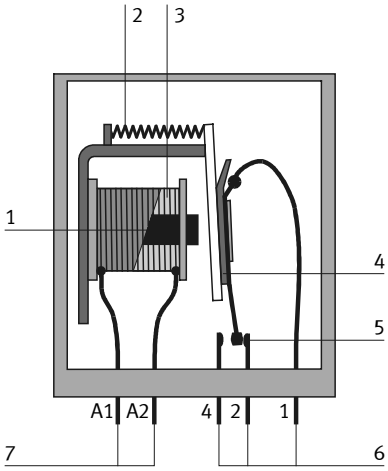
162241

Relay, 3-off



Design

This component consists of three relays with connections and two bus-bars for the power supply. All electrical connections are in the form of 4 mm sockets. The unit can be mounted in a mounting frame or on the profile plate using four plug-in adapters.

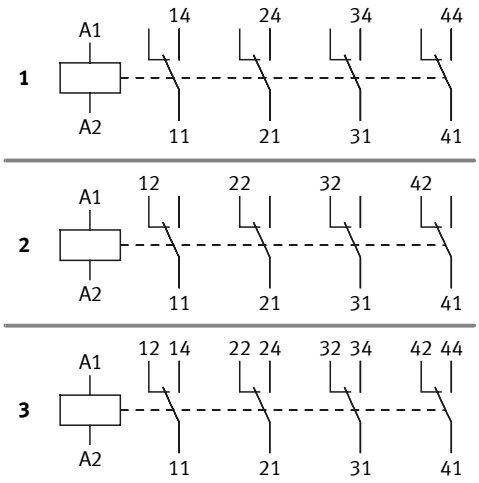


Function

The relay consists of a coil with a core (1) and winding (3) with connection lugs (7), an armature (4), a return spring (2) and a contact assembly with four changeover contacts (5) and connection lugs (6). When power is applied to the coil connections, current flows through the winding, creating a magnetic field. The armature is pulled onto the coil core and the contact assembly is actuated. Electrical circuits are opened or closed via this assembly.
When the electrical current is removed, the magnetic field collapses and the armature and contact assembly are returned to their original position by a return spring.

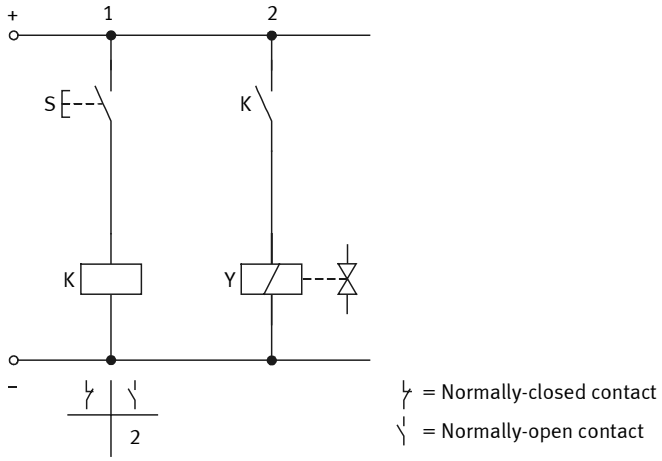
162241

Relay, 3-off



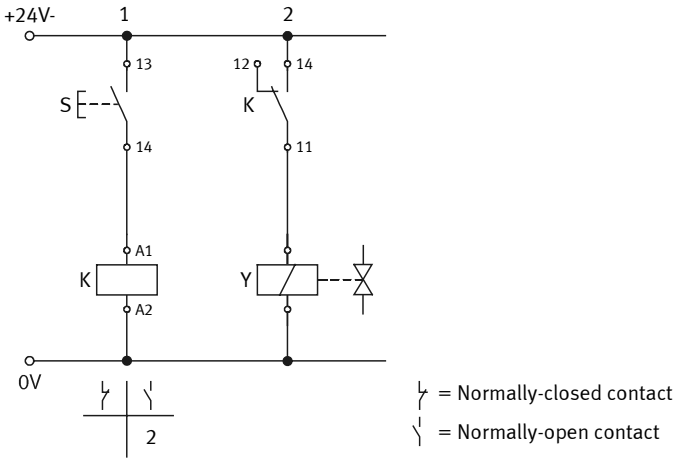
Note

The switching status of the relays is indicated by LEDs, which are protected against incorrect polarity.
The four changeover contacts of the contact assembly can be used as normally-open contacts (1), normally-closed contacts (2) or changeover contacts (3).



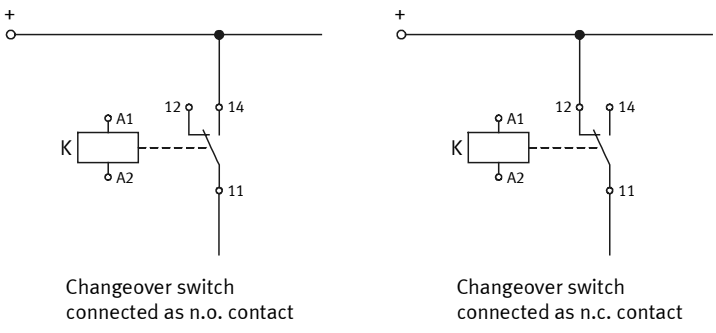
S = START push-button

Example of application: Circuit diagram, electrical



S = START push-button

Example of application: Practical assembly, electrical



Normally-open contacts, normally-closed contacts: Allocation of contacts on relay plate

162241

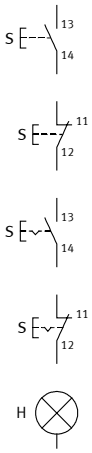
Relay, 3-off

Technical data

Electrical	
Voltage	24 V DC
Contact assembly	4 changeover contacts
Contact rating	Max. 5 A
Contact interrupt rating	Max. 90 W
Pichup time	10 ms
Drop-off time	8 ms
Connections	For 4 mm safety connector plug
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1

162242

Signal input plate,electrical



Design

This component consists of two illuminated pushbuttons in the form of momentary-contact switches and one illuminated pushbutton in the form of a detented switch. All electrical connections are in the form of 4 mm safety connectors. The unit can be mounted in a mounting frame or on the profile plate using four plug-in adapters.

Function

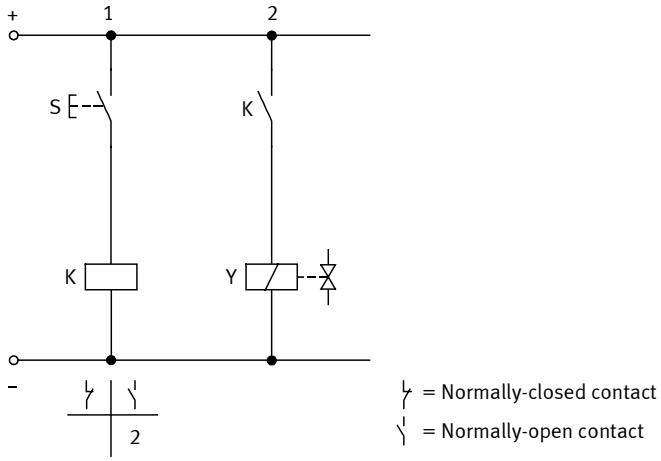
The **illuminated pushbutton** in the form of a detented switch consists of a contact assembly with two normally-open contacts and two normally-closed contacts, together with a colourless transparent pushbutton cap with a miniature lamp. The contact assembly is actuated by pressing this cap. Electrical circuits are opened or closed via the contact assembly. When the cap is released, the switching status is maintained. The contact assembly is returned to its initial position by pressing the pushbutton a second time.
The **illuminated pushbuttons** in the form of momentary-contact switches consist of a contact assembly with two normally-open contacts and two normally-closed contacts, together with a colourless transparent pushbutton cap with a miniature lamp. The contact assembly is actuated by pressing this cap. Electrical circuits are opened or closed via the contact assembly. When the cap is released, the contact assembly returns to its initial position.

Note

When power is applied to the connections of the visual indicator, the switching status is displayed by the built-in miniature lamp in the pushbuttons.

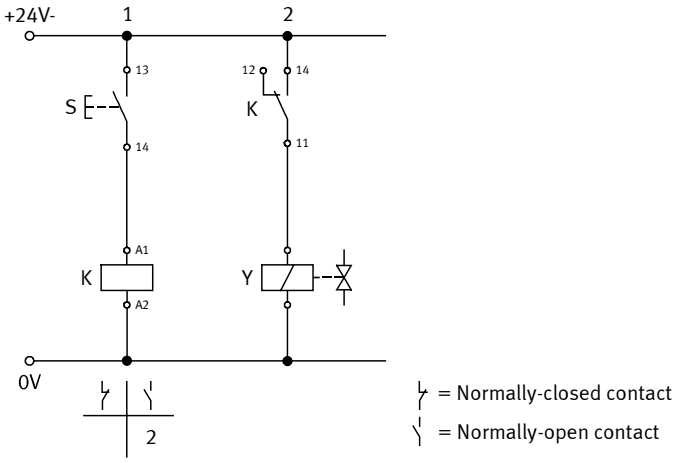
162242

Signal input plate,electrical



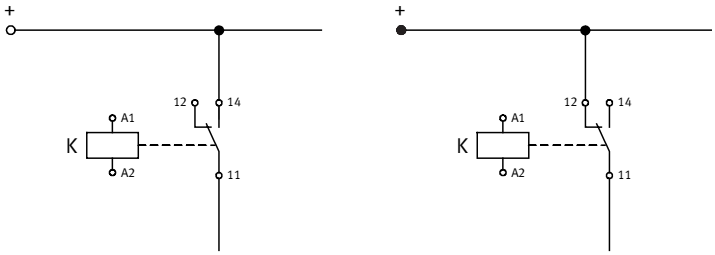
S = START push-button

Example of application: Circuit diagram, electrical



S = START push-button

Example of application: Practical assembly, electrical



Changeover switch
connected as n.o. contact

Changeover switch
connected as n.c. contact

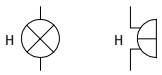
Normally-open contacts, normally-closed contacts: Allocation of contacts on relay plate

Technical data

Electrical	
Voltage	24 V DC
Contact assembly	2 normally-open contacts, 2 normally-closed contacts
Contact rating	Max. 1 A
Power consumption (miniature lamp)	0.48 W
Connections	For 4 mm safety connector plug
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1

162244

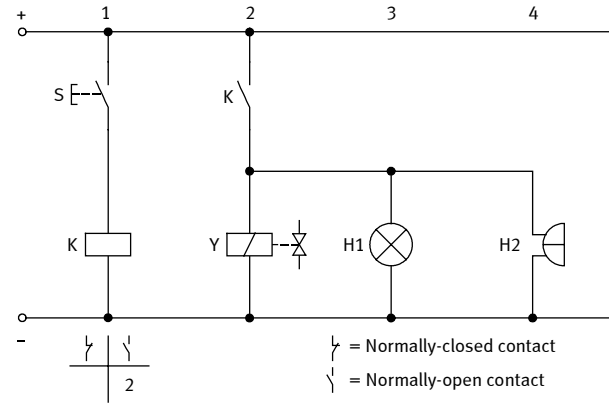
Indicator and distributor plate, electrical



Design	This component consists of an acoustic indicator and four visual indicators with connections and three busbars for the power supply. All electrical connections are in the form of 4 mm safety connectors. The unit can be mounted in a mounting frame or on the profile plate using four plug-in adapters.
Function	The **acoustic indicator** outputs a buzzing tone when power is applied to its connections. The **visual indicator** consists of a housing and a colourless transparent cap with a miniature lamp. When power is applied to its connections, its operating status is indicated by the built-in miniature lamp. A bridged pair of sockets is provided for each lamp, allowing the component to be used also as a distributor.
Note	To ensure that the **acoustic indicator** operates correctly, check the polarity of the power supply.

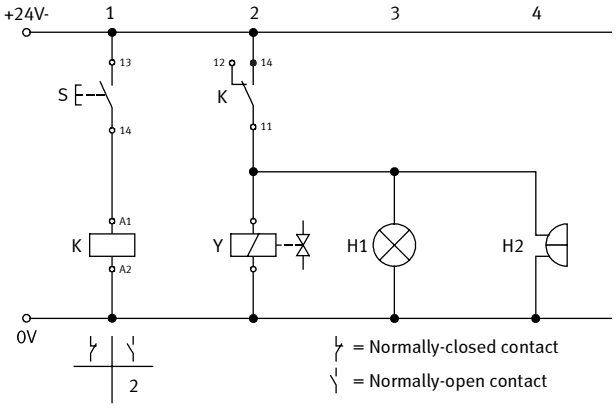
162244

Indicator and distributor plate, electrical



S = START push-button

Example of application: Circuit diagram, electrical



S = START push-button

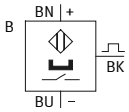
Example of application: Practical assembly, electrical

Technical data

Electrical	
Voltage	24 V DC
Power consumption (acoustic indicator)	0.04 W
Visual indicator	1.2 W
Frequency (acoustic indicator)	420 Hz
Connection	For 4 mm safety connector plug
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1

167060

Proximity switch with cylinder mounting

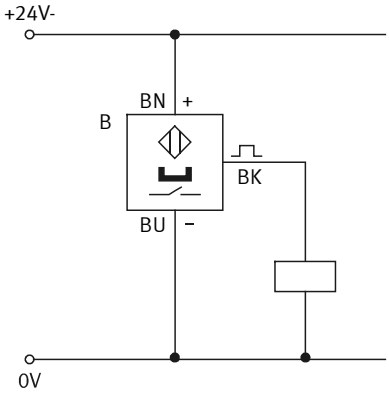


Design

This proximity switch consists of a sensor, a mounting kit and a cable. The cable is fitted with a plug socket and three safety connector plugs.

Function

The proximity switch outputs an electrical signal when it enters a magnetic field (e.g. the field of the permanent magnet fitted to the piston of the cylinder). The electrical connections are moulded into the switch. The switching status is shown by an LED. This yellow LED lights when the switch is actuated.



Note

In order to obtain correct switch operation, ensure that the polarity of the voltages applied to the switch is correct. The cores of the socket cable are colour-coded: blue (BU) for negative, red (BN) for positive and black (BK) for the signal output. The load (relay) is connected to this and to the negative terminal. **The switch is protected against incorrect polarity, however not against short-circuiting.**

167060

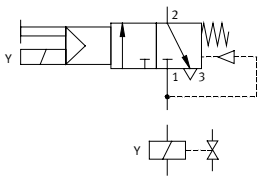
Proximity switch with cylinder mounting

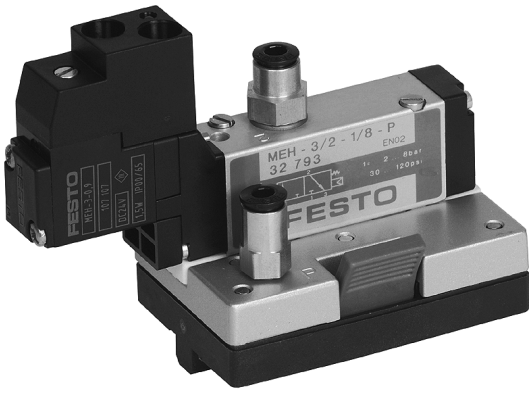
Technical data

Electrical	
Switching voltage	10 – 30 V DC
Switching current	Max. 200 mA
Switching precision	±0.1 mm
Connection	Plug for socket with cable
Cable	with 4 mm safety connector plug
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1

167073

3/2-way single solenoid valve, normally closed





Design	This 3/2-way single solenoid valve with push-in fittings is attached to a function plate which is equipped with a P port and silencer. The two electrical connections are equipped with safety connectors. The unit is mounted on the profile plate using a quick release detent system with a blue lever (mounting alternative "A").
Function	The solenoid valve is reversed when voltage is applied to the solenoid coil (1 → 2) and brought back into its initial position (1 → 0) by a return spring when the signal is removed. The switching status is displayed via an LED in the terminal housing. The valve is equipped with a manual override.
Note	The solenoid coil is characterised by very low power consumption and low heat generation. The electrical connection incorporates protection against incorrect polarity for the LED and a protective circuit.

167073

3/2-way single solenoid valve, normally closed

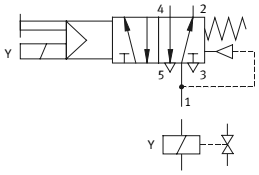
Technical data

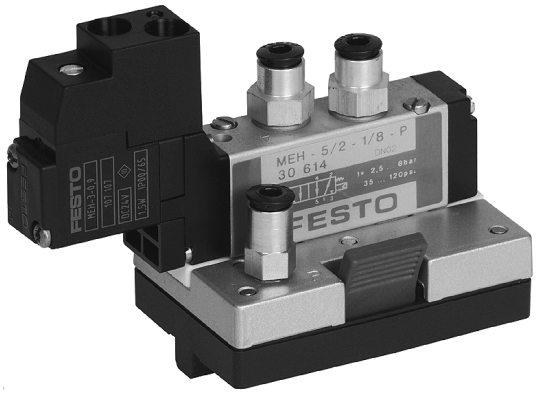
Pneumatic	
Medium	Compressed air, filtered (lubricated or unlubricated)
Design	Spool valve, pilot-actuated, with return spring
Pressure range	250 – 800 kPa (2.5 – 8 bar)
Switching time at 600 kPa (6 bar)	On: 20 ms, Off: 30 ms
Standard nominal flow rate	500 l/min
Connection	QS 3 for plastic tubing PUN 4 x 0.75

Electrical	
Voltage	24 V DC
Power consumption	1.5 W
Duty cycle	100 %
Connection	For 4 mm safety connector plug

167074

5/2-way single solenoid valve





Design	This 5/2-way single solenoid valve with push-in fittings is bolted onto a function plate which is equipped with a P port and silencer. The two electrical connections are equipped with safety connectors. The unit is mounted on the profile plate using a snap-lock system with a blue lever (mounting variant "A").
Function	The solenoid valve is reversed when voltage is applied to the solenoid coil (1 →4) and brought back into its initial position (1 → 2) by a return spring when the signal is removed. The switching status is shown by an LED in the terminal housing. The valve is equipped with a manual override.
Note	The solenoid coil is characterised by very low power consumption and low heat generation. The electrical connection incorporates protection against incorrect polarity for the LED and a protective circuit.

167074

5/2-way single solenoid valve

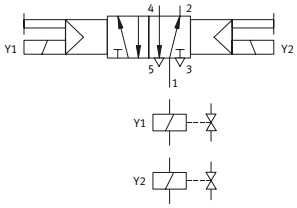
Technical data

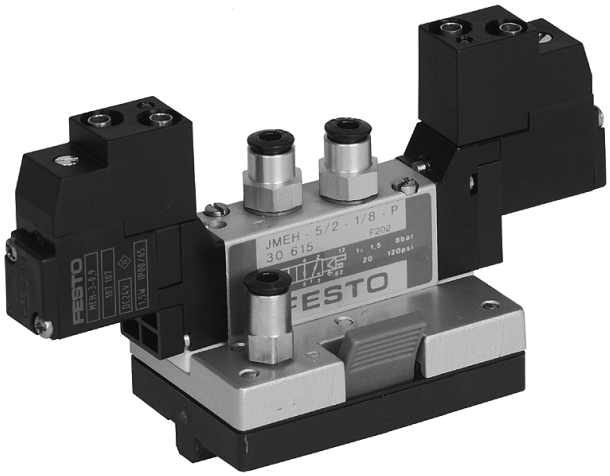
Pneumatic	
Medium	Compressed air, filtered (lubricated or unlubricated)
Design	Spool valve, pilot-actuated, with return spring
Pressure range	250 – 800 kPa (2.5 – 8 bar)
Switching time at 600 kPa (6 bar)	On: 20 ms Off: 30 ms
Standard nominal flow rate	500 l/min
Connection	QS-1/8-4-I fittings for plastic tubing PUN 4 x 0.75

Electrical	
Voltage	24 V DC
Power consumption	1.5 W
Duty cycle	100 %
Connection	For 4 mm safety connector plug

167076

5/2-way double solenoid valve





Design	This 5/2-way double solenoid valve with push-in fitting is bolted onto a function plate which is equipped with a P port and silencer. The four electrical connections are equipped with safety connectors. The unit is mounted on the profile plate using a snap-lock system with a blue lever (mounting variant "A").
Function	The double solenoid valve is reversed when voltage is applied to a solenoid coil and remains in this switching position after the signal is removed until an opposed signal is applied. The presence of switching signals is shown by the LEDs in the terminal housings. The valve is equipped with a manual override.
Note	The solenoid coil is characterised by very low power consumption and low heat generation. The electrical connections incorporate protection against incorrect polarity for the LEDs and protective circuits.

167076

5/2-way double solenoid valve

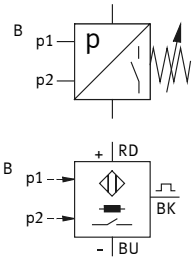
Technical data

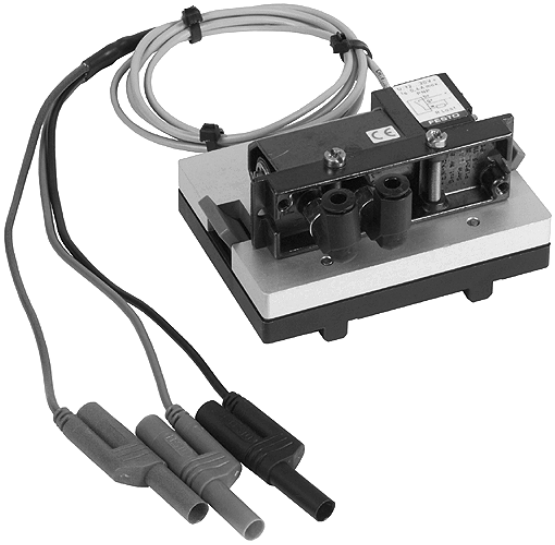
Pneumatic	
Medium	Compressed air, filtered (lubricated or unlubricated)
Design	Spool valve, pilot-actuated
Pressure range	150 – 800 kPa (1.5 – 8 bar)
Switching time at 600 kPa (6 bar)	10 ms
Standard nominal flow rate	500 l/min
Connection	QS-1/8-4-I fittings for plastic tubing PUN 4 x 0.75

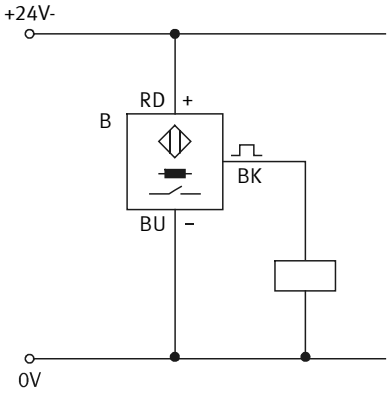
Electrical	
Voltage	24 V DC
Power consumption	1.5 W
Duty cycle	100 %
Connection	For 4 mm safety connector plug and 2-way jack plug

177459

Pneumatic/electrical converter







Design

This pneumatic/electrical converter with L fittings is mounted on a function plate. The electrical connection is effected via a cable with three safety connector plugs. The unit is mounted on the profile plate using a snap-lock system with a blue lever (mounting variant "A").

Function

The adjusting screw is used to vary the initial tension of the spring which presses the metal bellows against the stop face. In this state, the metal bellows is in the active area of the proximity switch. If the metal bellows is now moved away by a pneumatic signal, this is detected by the proximity switch, which generates an output signal which can be used to switch loads requiring currents of up to 400 mA.

177459

Pneumatic/electrical converter

Note

The pneumatic/electronic converter can provide three functions:
pressure switch, vacuum switch and differential pressure switch.
The plug of the cable are colour-coded as follows:

Red (RD)	24 V
Blue (BU)	0 V
Black (BK)	Switching output

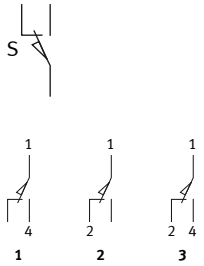
Technical data

Pneumatic	
Medium	Compressed air, filtered (lubricated or unlubricated)
Design	Pre-tensioned metal bellows and proximity switch
Pressure ranges: Pressure switch Port P1 Vacuum switch Port P2	 Adjustable for pressures from 25 – 800 kPa (0.25 – 8 bar) Adjustable for vacuum from -20 – -80 kPa (-0.2 – -0.8 bar)
Differential pressure switch Port P1...P2	Adjustable for differential pressures from -95 – 800 kPa (0.95 – 8 bar)
Hysteresis	Max. 25 kPa (0.25 bar)
Connection	For plastic tubing PUN 4 x 0.75

Electrical	
Voltage	24 V DC
Switching current	400 mA
Connection	For 4 mm safety connectors
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1

183322

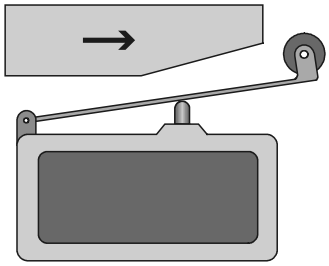
Limit switch, electrical, actuated from the left



The two electrical limit switches, order no. 183322 for actuation from the left and order no. 183345 for actuation from the right, have the same symbol in the circuit diagram.

Design

A microswitch with roller lever and electrical connections is installed in a plastic housing. The electrical connection is effected by means of safety connectors or via a 3-pin plug socket. The component is mounted on the profile plate using the rotary system by means of two blue grip nuts (mounting variant “B”).



Function

This electrical limit switch consists of a mechanically-actuated microswitch. It is actuated when the roller lever is pressed, for example by the trip cam of a cylinder. The switch contacts are used to open or close a circuit. The microswitch returns to its original position when the roller lever is released.

Note

The microswitch can be connected up to act as a normally-open contact (1), normally-closed contact (2) or changeover contact (3). In cases where piston speeds are high, the limit switch should be actuated by the trip cam of a cylinder only in the specified direction. The limit switch must not be actuated from the front.

183322

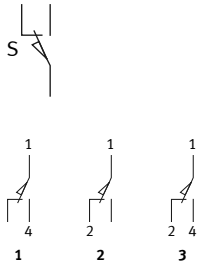
Limit switch, electrical, actuated from the left

Technical data

Electrical	
Design	Mechanically-actuated electrical microswitch in limit-switch housing
Voltage	24 V DC
Contact rating	Max. 5 A
Switching frequency	Max. 200 Hz
Reproducible switching accuracy	0.2 mm
Switch travel	2.7 mm
Actuation force	5 N
Connection	For 4 mm safety connector plug or 3-pin plug socket
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1

183345

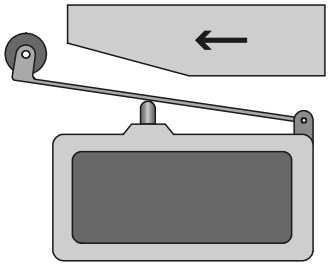
Limit switch, electrical, actuated from the right



The two electrical limit switches, order no. 183322 for actuation from the left and order no. 183345 for actuation from the right, have the same symbol in the circuit diagram.

Design

A microswitch with roller lever and electrical connections is installed in a plastic housing. The electrical connection is effected by means of safety connectors or via a 3-pin plug socket. The component is mounted on the profile plate using the rotary system by means of two blue grip nuts (mounting variant “B”).



Function

This electrical limit switch consists of a mechanically-actuated microswitch. It is actuated when the roller lever is pressed, for example by the trip cam of a cylinder. The switch contacts are used to open or close a circuit. The microswitch returns to its original position when the roller lever is released.

Note

The microswitch can be connected up to act as a normally-open contact (1), normally-closed contact (2) or changeover contact (3). In cases where piston speeds are high, the limit switch should be actuated by the trip cam of a cylinder only in the specified direction. The limit switch must not be actuated from the front.

183345

Limit switch, electrical, actuated from the right

Technical data

Electrical	
Design	Mechanically-actuated electrical microswitch in limit-switch housing
Voltage	24 V DC
Contact rating	Max. 5 A
Switching frequency	Max. 200 Hz
Reproducible switching accuracy	0.2 mm
Switch travel	2.7 mm
Actuation force	5 N
Connection	For 4 mm safety connector plug or 3-pin plug socket
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1