Bending machine 24V

Model description
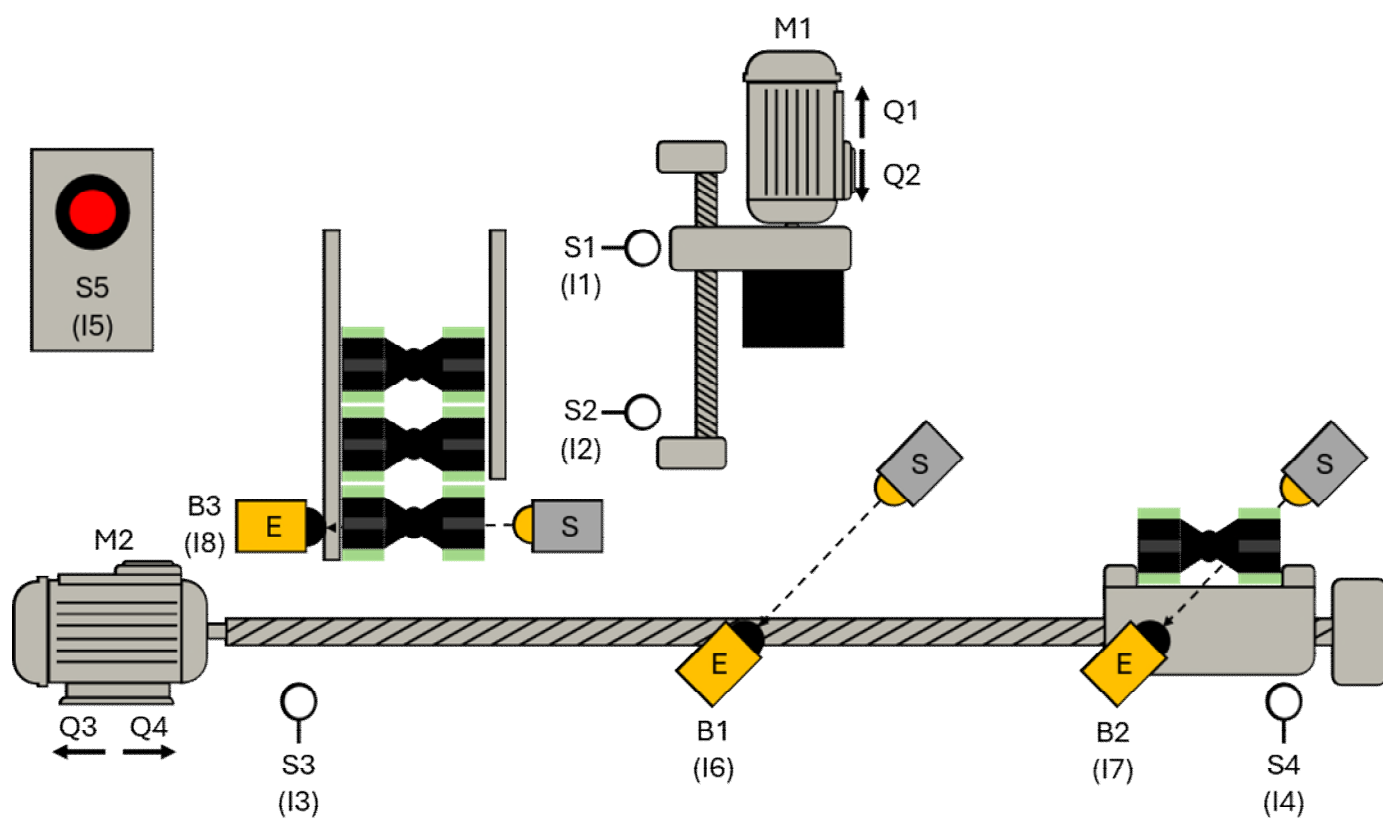
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1 Model

1.1 Description

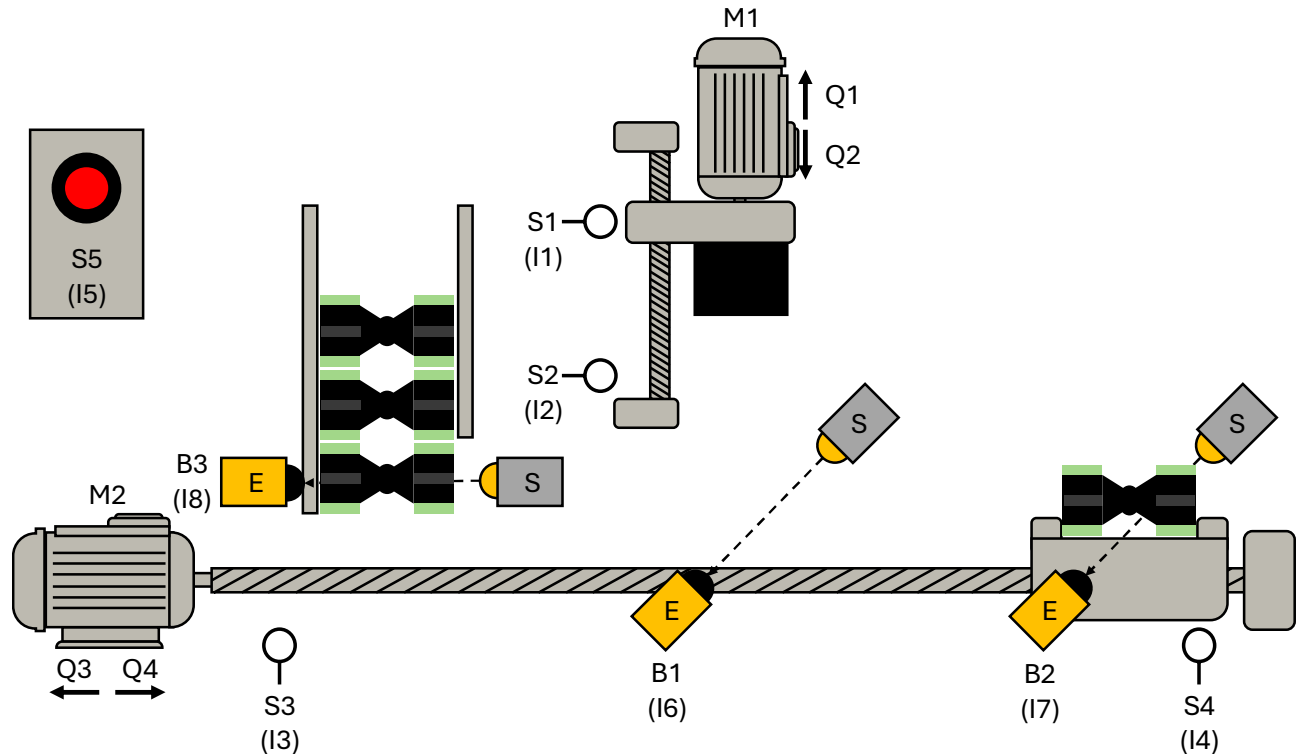The "Bending machine 24V" model consists of a transport section, the press and a storage magazine.

Figure 1 System diagram

Transport route

The transport carriage is moved by the motor M2. The forward movement of the carriage is controlled by Q4, while output Q3 is responsible for the backward movement. The end positions of the transport carriage are monitored by switches S3 (rear end position) and S4 (front end position).

In the removal position, when the carriage is in the front end position, switch S4 is actuated. A light barrier (B2) at this position detects whether a workpiece is on the transport carriage.
If the carriage with the workpiece is below the press, this is detected by light barrier B1.
A new workpiece is picked up when the carriage moves under the magazine. This position is signaled by the limit switch S3.

Press

The movement of the press brake is realized by the motor M1. The upward movement of the press brake is controlled by Q1, while Q2 is responsible for the downward movement. The end positions of the press brake are monitored by switches S1 (upper end position) and S2 (lower end position).

Storage magazine

There can be up to 4 workpieces in the magazine. As long as the magazine contains workpieces, this is indicated by an interrupted light barrier B3.

ⓘ Ensure that only flat workpieces are inserted into the magazine. If the workpieces are still bent open, they may twist when they are transferred to the transport carriage, causing the press to block.
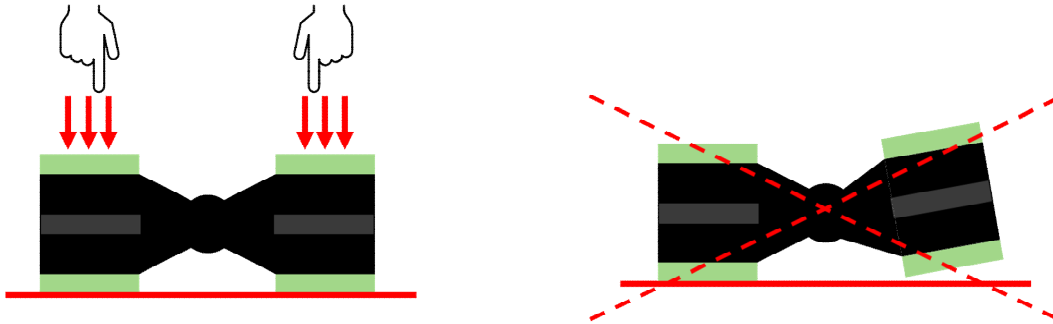

Figure 2 Workpieces

1.2 Sensors / actuators

The following components are installed in the model:

Mini motor

The transport carriage and the press are driven by a mini motor. This compact motor is a permanently excited DC machine that can be used together with a plug-in U-gear. The rated voltage of the motor is 24 V and the maximum current consumption is 400 mA. This results in a maximum torque of 6.92 mNm and an idling speed of 10,910 rpm. The U-gear has a ratio of 64.8:1 and a lateral output.
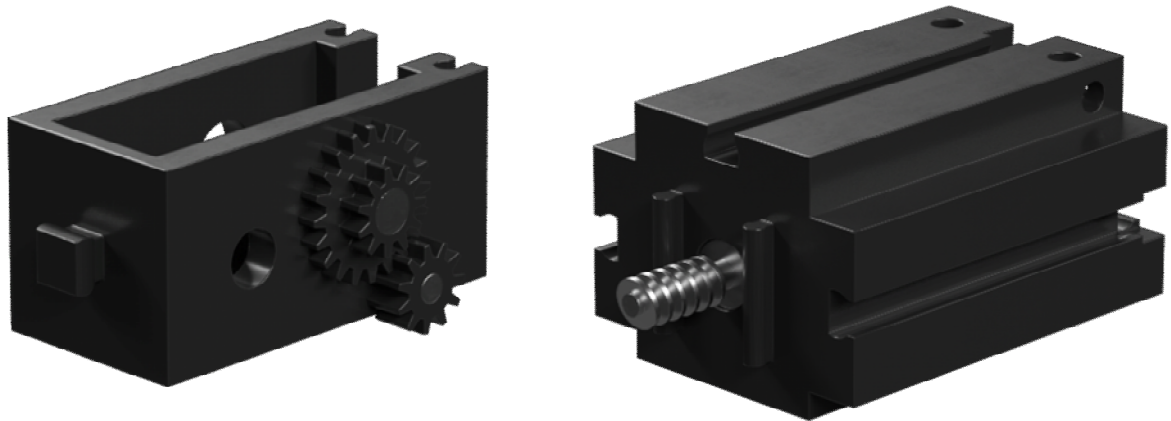

Figure 3 U-gearbox and mini motor

Mini push-button

Mini push-buttons are used as reference switches. In a point-to-point movement, for example the stroke of the bending machine, they are used to determine the end position. The mini push-button used here is equipped with a changeover contact and can be used both as a normally closed contact and as a normally open contact.

When the button is pressed, there is a conductive connection between contact 1 and contact 3 (normally open contact), while the connection between contact 1 and contact 2 is disconnected (normally closed contact).
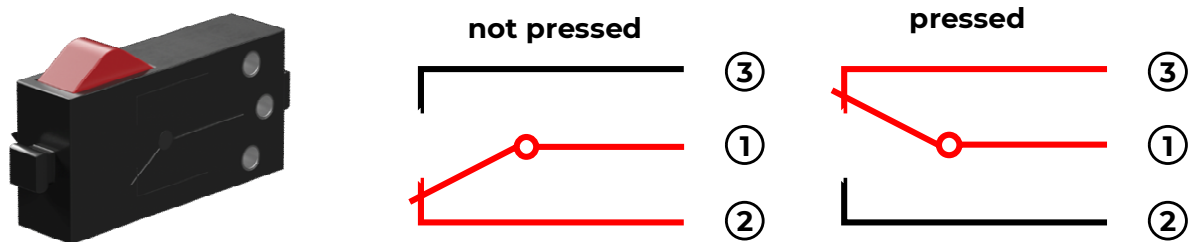

Figure 4 Mini push-button and circuit diagram

LED

The LED is an electronic component that converts electrical energy into light. The abbreviation LED is derived from the English "Light Emitting Diode". In this model, LEDs are used to generate light for the light barriers.

The building block can be recognized by the imprint "+" and "L". Another feature is the glass body. This has a beam focus so that the light rays are not scattered but hit the phototransistor in parallel.

Figure 5 LED of the light barrier

Phototransistor

The phototransistor is an electronic component that reacts to the incidence of light. Phototransistors usually only have two leads - the collector and the emitter. The base is replaced by the incident light. If the light from the LED hits the phototransistor, it switches the current flow. This behavior can be evaluated by programming.
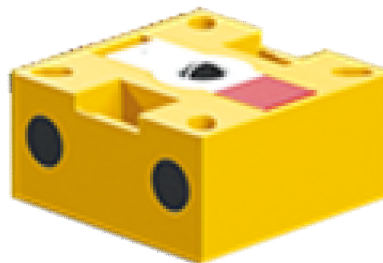

Figure 6 Photo transistor of the light barrier

Connection

- The limit switches (S1 - S4) are wired as normally closed contacts and provide a wire-breakage-proof 1 signal when not actuated.
- The start button (S5) is wired as a normally open contact.
- The light barriers (B1 - B3) provide a 0 signal when a workpiece interrupts the light beam.
- It is important to ensure that the movements of the motors (M1 and M2) are only controlled until the corresponding limit switch is reached, as otherwise they may run to block and be overloaded.
   The control should therefore be a continuous action with a condition.
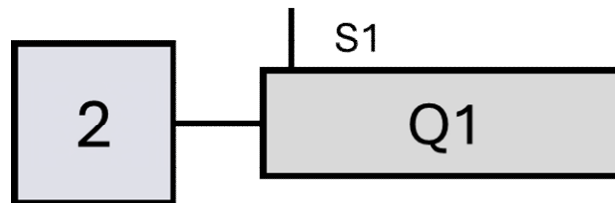

Fig. 7 Example of press movement on

The model's sensors and actuators are connected to the ST1 and ST2 terminals on the circuit board using ribbon cables.
 Terminal strip X1 is available as an interface between the model and the control unit.
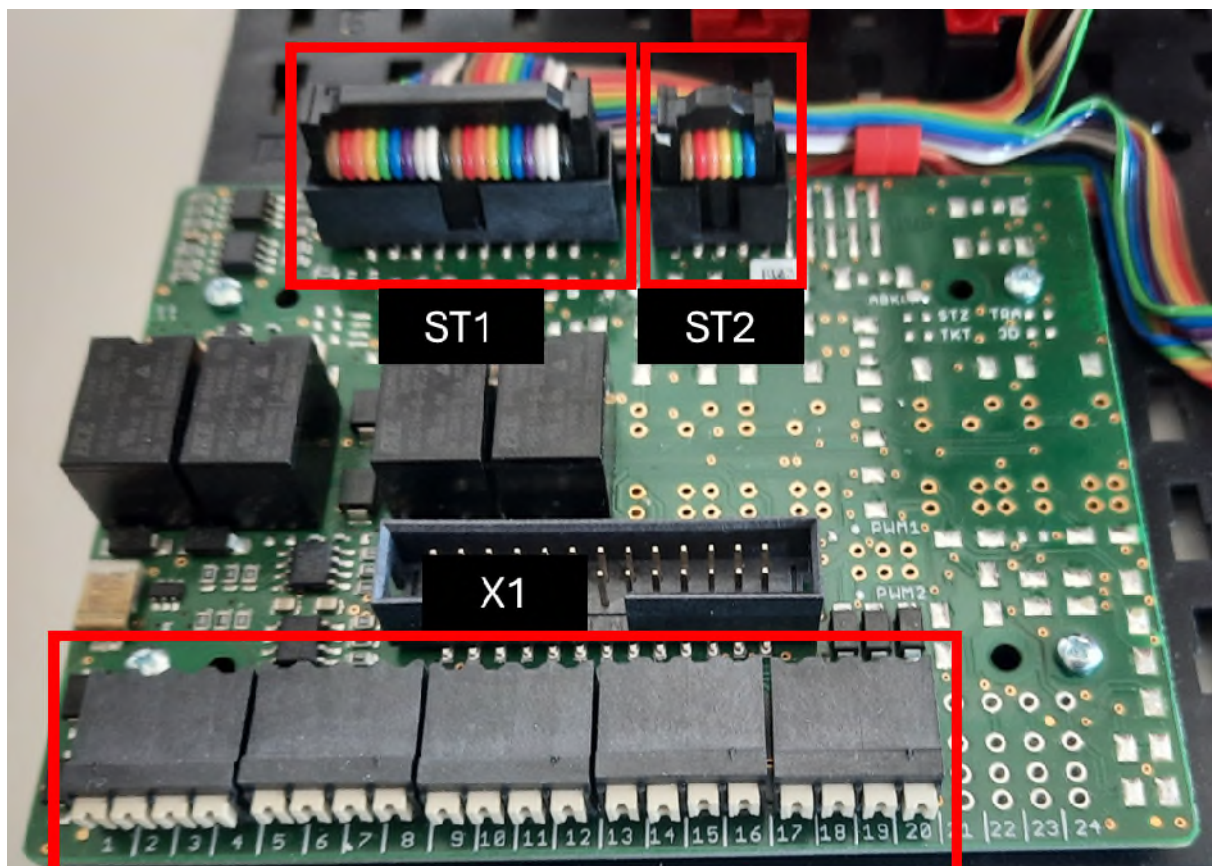

Figure 8 Model connection board

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The equipment is laid out according to the following allocation plan:

Clamp	Function	BMK	Address	Icon
1	Power supply (+) - Actuators	24V DC		
2	Power supply (+) - Sensors	24V DC		
3	Power supply (-)	0V		
4	Power supply (-)	0V		
5	Press up limit switch	S1 (I1)		
6	Press down limit switch	S2 (I2)		
7	End position switch rear transport carriage	S3 (I3)		
8	End position switch front transport carriage	S4 (I4)		
9	Start button	S5 (I5)		
10	Light barrier press	B1 (I6)		
11	Light barrier acceptance	B2 (I7)		
12	Light barrier magazine	B3 (I8)		
13				
14				
15	Press high	Q1		
16	Press from	Q2		
17	Transport carriage back	Q3		
18	Transport carriage in front	Q4		
19				
20				

Table 1 Terminal strip assignment diagram X1

ℹ️ For quick and easy assignment, the absolute and symbolic addresses of the variables from the automation system can be entered in the "Address" and "Symbol" columns.

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Clamp	Function	BMK	Color
1	Motor Press	Q1 / Q2	Brown
2			Red
3	24V	S1 (I1)	Orange
4	Press up limit switch		Yellow
5	24V	S2 (I2)	Green
6	Press down limit switch		Blue
7	Motorized transport sled	Q3 / Q4	Violet
8			Gray
9	24V	S3 (I3)	White
10	End position switch rear transport carriage		Black
11	24V	S4 (I4)	Brown
12	End position switch front transport carriage		Red
13	24V	LED light barriers	Orange
14	GND		Yellow
15	24V	B2 (I7)	Green
16	Light barrier acceptance		Blue
17			Violet
18			Gray
19	24V	S5 (I5)	White
20	Start button		Black

Table 2 Terminal strip assignment diagram ST1

Clamp	Function	BMK	Color
1			Brown
2			Red
3	24V	B3 (I8)	Orange
4	Light barrier magazine		Yellow
5	24V	B1 (I6)	Green
6	Light barrier press		Blue

Table 3 Terminal strip assignment diagram ST2

1.3 Functional description

1.3.1 Home position

The home position represents the initial situation for the operating cycle. It is defined by the following states:
- The press is in its upper end position, which is signaled by the actuated end position switch S1.
- The transport carriage is in its front end position, which is indicated by the actuated end position switch S4.
- The transport carriage is empty, which is indicated by the light barrier B2 not being interrupted.
- There is material in the supply magazine. This is indicated by activating the corresponding light barrier B3.

1.3.2 System start

The automatic sequence of the system can be started by a positive edge on push-button S5.
At the start of the automatic sequence, the system is first moved to the home position. These steps are also carried out if the system is already in the home position:
1. The press moves to the upper end position (S1 actuated).
2. The transport carriage moves to the front end position (S4 actuated) and must be empty (B2 not interrupted).

1.3.3 Automatic sequence

After starting the sequence, the transport carriage moves back until it has reached the position of the supply magazine (S3 actuated).
After a workpiece has been picked up in this position, the carriage transports it forwards until it has reached the position of the press (light barrier B1 interrupted).
The press moves to the lower end position (S2 actuated) and back to the starting position (S1 actuated) after forming.
The formed workpiece is then transported to the removal position (S4 actuated). Once the finished workpiece has been removed (B2 no longer interrupted), the process can be restarted by pressing the start button (S5).

The start button (S5) should also assume the function of a "reset":
If the start button is pressed and the step chain is not in the initial step, the initial step is set and all other steps are reset.
Set actions must also be reset.