New Specification

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Technology and Design

Assessment Unit AS 1

assessing

Product Design and
Systems and Control

AV111

[AV111]

WEDNESDAY 27 MAY, MORNING

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet provided and on the A3 pro forma answer page provided.
Answer **all eight** questions in Section A and both questions in **EITHER** Section B **OR** Section C.
An A3 pro forma is provided for **Question 12((b)**, **(c)**, **(d)**, and **(e))**.
At the conclusion of the examination, attach the A3 pro forma answer page securely to the Answer Booklet with the treasury tag supplied.

INFORMATION FOR CANDIDATES

The total mark for this paper is 80, including a maximum of 4 marks for quality of written communication.
Marks for quality of written communication will be awarded for questions **7(ii)**, **8(ii)**, **9(iv)**, **10(a)(ii)**, **11(a)(v)** and **12(f)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
All questions do not carry equal weighting.

Section A

Product Design and Practice

Answer **all** questions in this section.

You are advised to spend approximately **1 hour** on this section.

1 The mechanical properties of a material can greatly influence selection.

(i) Briefly explain what is meant by the term mechanical properties. [2]

(ii) Briefly explain what is meant by the terms toughness and hardness. [2]

2 Beech and ash are materials widely used for domestic products.

(i) Give **two** main reasons why beech is used for kitchen utensils. [2]

(ii) Give **two** main reasons why ash is used for garden tool handles. [2]

(iii) Stains and oils are common finishes applied to wood.
Briefly explain the main purpose of stains and the main purpose of oils. [2]

3 Cases for electric hand tools like drills, jig-saws and sanders can be manufactured using metal by the process of pressure die casting.

(i) Give **two** main reasons why pressure die casting is the most suitable process for the manufacture of these products. [2]

(ii) With the aid of an annotated sketch, describe the pressure die casting process. [3]

4 **(i)** Distinguish between thermoplastic and thermosetting plastics. [1]

(ii) Give **one** main reason why:

- Acrylic is used for illuminated signs
- Nylon is used for gear wheels
- Polyvinyl chloride (PVC) is used for drain pipes and guttering
- Polythene is used for detergent bottles. [4]

5 Riveting, and knock down fittings are used to join materials.

With the aid of annotated sketches, briefly describe how each of these is used to join materials. [4]

6 Computers are widely used in the design and manufacture of products.

(i) Briefly outline **two** main advantages associated with the use of Computer Aided Design (CAD). [2]

(ii) Briefly outline **two** main advantages associated with the use of Computer Aided Manufacture (CAM). [2]

(iii) Briefly explain what is meant by the term Computer Integrated Manufacture (CIM). [1]

7 One-off, batch and mass are terms associated with manufacturing production.

(i) Briefly compare the level of skill required by the workforce for one-off and mass production. [1]

(ii) Outline **one** main characteristic other than the skill level of the workforce associated with one-off, batch and mass. [4]

8 Proportion and colour are two aspects of aesthetics that the designer needs to consider.

(i) Briefly explain what is meant by the term proportion and give **one** main reason why it is an important consideration for the designer. [2]

(ii) Outline **three** different ways that colours may be used in products in order to improve aesthetic appeal. [4]

Section B

Electronic and Microelectronic Control Systems

Answer **both** questions in this section.

You are advised to spend approximately **1 hour** on this section.

9 The circuit shown in **Fig. 9** has been designed to indicate if a security door in a building has been opened.

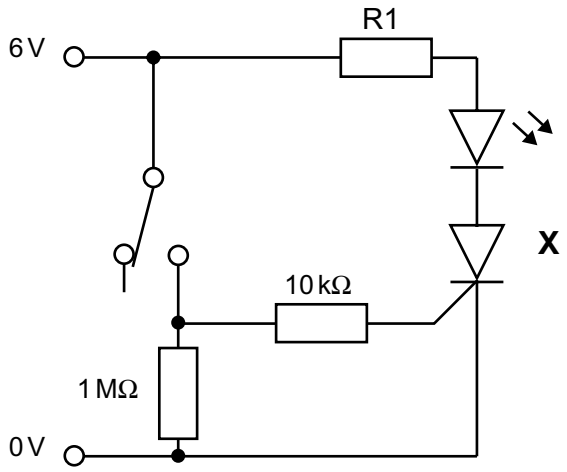

Fig. 9

(i) State **two** general safety features that can be incorporated into electronic circuits and explain how these features improve safety. [4]

(ii) Name component **X** shown in **Fig. 9**. [1]

(iii) Suggest a suitable type of switch that could be used to detect the movement of a door. [1]

(iv) The resistors shown in **Fig. 9** have been selected from the E12 series. Explain what is meant by the term E12 series. [3]

(v) Calculate the power dissipated by the resistor R1 in **Fig. 9** if the current flowing in the LED is 10 mA and the LED forward voltage is 2 V. (Assume that there is no voltage drop across component **X**). [3]

(vi) Using a labelled circuit diagram, show how the circuit in **Fig. 9** could be reset if the LED has been switched on. [2]

(vii) The circuit shown in **Fig. 9** is to be replaced by one using an SR flip flop.

(a) Draw a circuit diagram of an SR flip flop. [2]

(b) Add components to the SR flip flop and explain how it could be used to indicate if the security door was last opened from the inside or outside. [4]

10 (a) **Fig. 10(a)** shows part of a light sensing circuit.

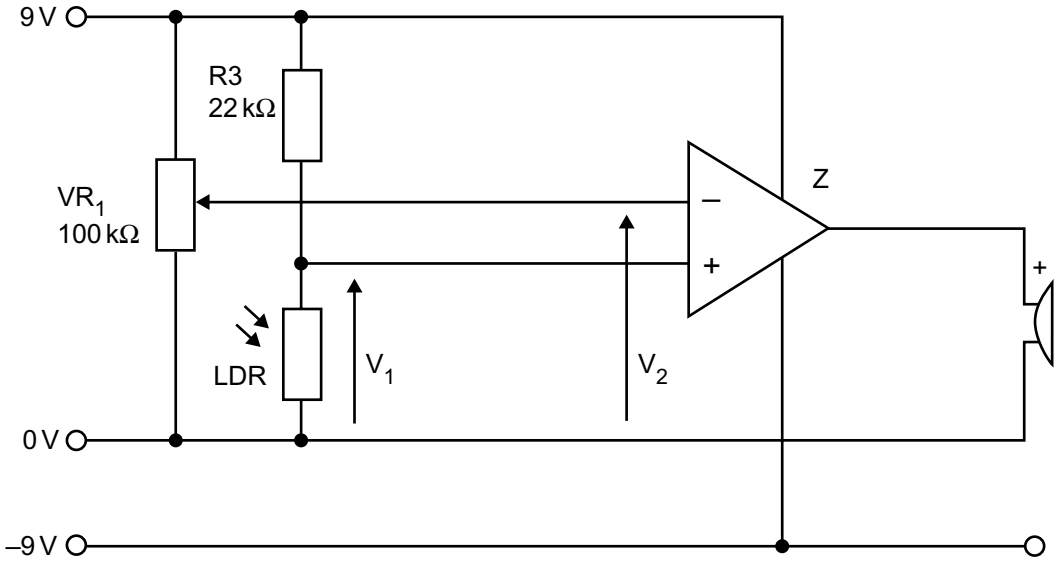

Fig. 10(a)

(i) Calculate the voltage V_2 when the variable resistor VR_1 on **Fig. 10(a)** is adjusted to its mid position. [2]

(ii) Explain the function of component **Z** in the circuit shown in **Fig. 10(a)**. [3]

(iii) The resistance of the LDR in **Fig. 10(a)** varies between 100 kΩ in a low light level and 10 kΩ in a high light level. Calculate the voltage range of V_1 between low and high light levels. [4]

(iv) State whether the buzzer in **Fig. 10(a)** will be turned on or off when the light level is high and justify your answer. Assume VR_1 is adjusted to its mid position. [3]

(b) The following two modifications have been suggested for a basic temperature alarm circuit shown in **Fig. 10(b)**.

- Replacing **TR1** with a darlington pair
- Providing a latching action when the alarm is activated.

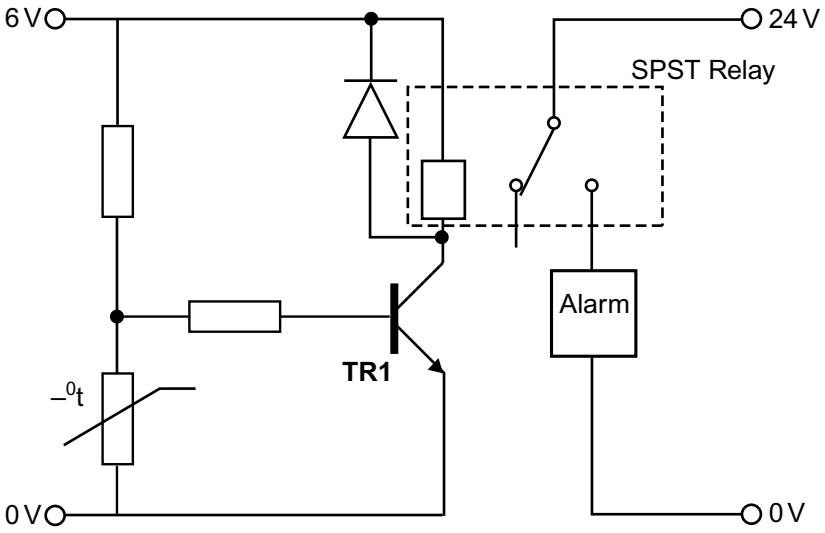

Fig. 10(b)

(i) State **one** reason why darlington pairs are used. [1]

(ii) Show with the aid of a diagram how transistors are arranged in a darlington pair. [3]

(iii) Explain with the aid of a diagram how a latching action can be achieved using a double pole double throw (DPDT) relay. [4]

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Section C

Mechanical and Pneumatic Control Systems

Answer **both** questions in this section.

You are advised to spend approximately **1 hour** on this section.

11 (a) **Fig. 11(a)** opposite shows part of a moving belt and attached gear/pulley system as used in industry.

(i) Vee, round and flat belts are commonly used with pulleys. Name **one** other common belt type. [1]

(ii) State the direction of rotation of pulley **G** if gear **A** rotates in a clockwise direction. [1]

(iii) Calculate the velocity ratio between gear **A** and pulley **G**. [3]

(iv) Calculate the distance moved by block **P** each second if pulley **D** rotates at 10 rev/min. Roller **H** has a diameter of 50 mm and assume $\pi = 3.14$. [3]

(v) Shaft **Z** is to be connected to a crank and slider. Using an annotated sketch, draw a typical crank and slider mechanism and explain how it would be attached to shaft **Z**. [4]

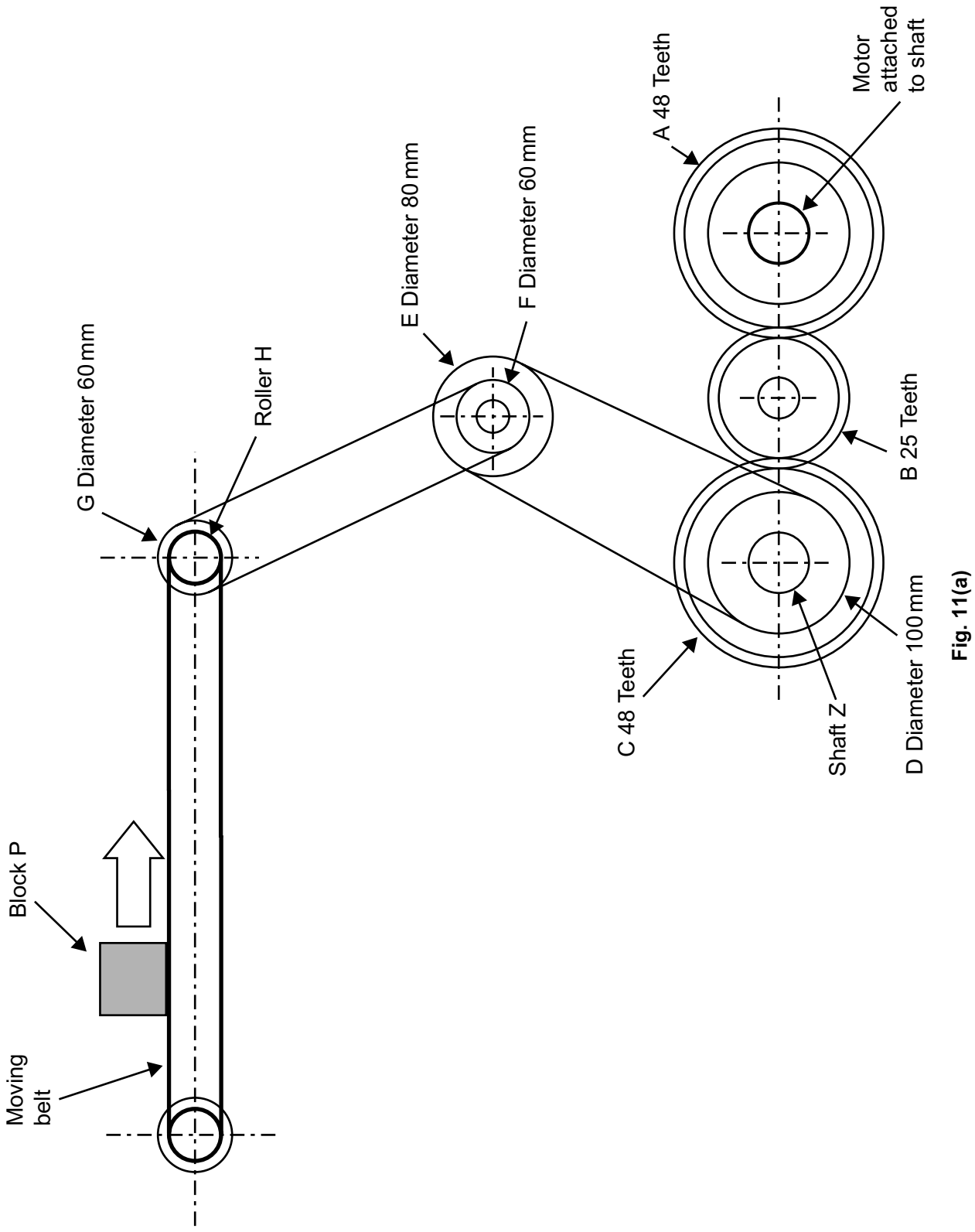

Fig. 11(a)

(b) **Fig. 11(b)** shows part of a prototype lifting system used to move heavy industrial components.

(i) Calculate the effort required of the lifting system if the load is 200 N and the mechanical advantage is 1.25. [2]

(ii) The velocity ratio is 3:2 and the effort moves 1.2 m. Calculate the distance moved by the load. [3]

(iii) Calculate the efficiency of the simple lifting system. [3]

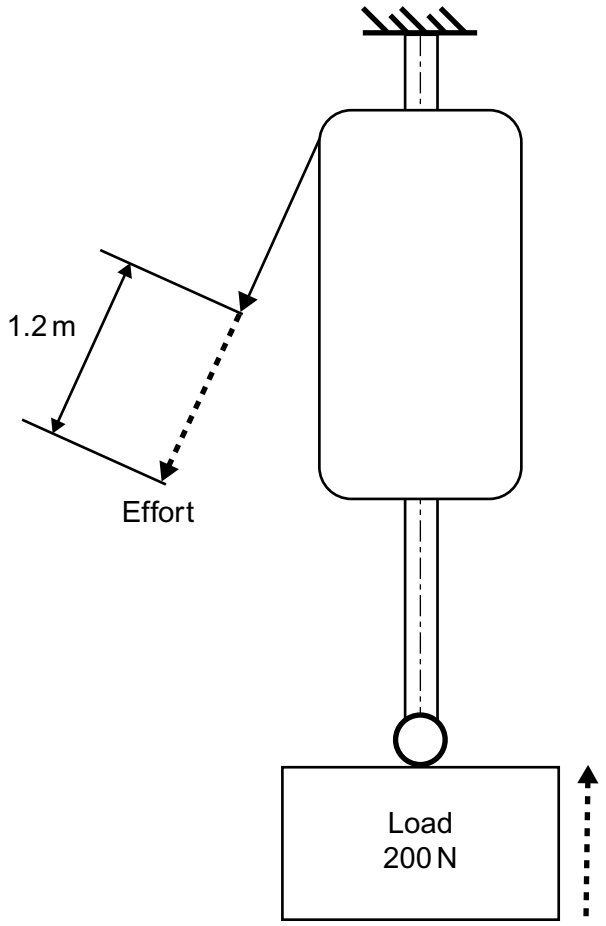

Fig. 11(b)

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12 **Fig. 12** opposite shows part of an incomplete pneumatic system.

(a) **(i)** Name the activation method at **C**. [1]

(ii) Name the activation method at **X**. [1]

(b) On the pro forma provided (answer number **12(b)**, **(c)**, **(d)** + **(e)**), complete the circuit enabling the double acting cylinder **D1** to go negative following a delay in time after **A** is activated. [3]

(c) On the pro forma provided (answer number **12(b)**, **(c)**, **(d)** + **(e)**), complete the circuit enabling a combined activation at **B and C or D** to outstroke the double acting cylinder **D1**. [5]

(d) As a safety measure it is intended that a **NOT** logic function is to be incorporated to prevent the double acting cylinders outstroking or instroking unnecessarily. On the pro forma provided (answer number **12(b)**, **(c)**, **(d)** + **(e)**), complete the circuit to include the safety measure. [3]

(e) On the pro forma provided (answer number **12(b)**, **(c)**, **(d)** + **(e)**), complete the circuit enabling a second double acting cylinder **D2** to be added which goes positive as **D1** goes negative. [2]

(f) The double acting cylinder is supplied with an air pressure of 0.4 N/mm^2, has a piston diameter of 80 mm and a piston rod diameter of 6 mm. Calculate the force produced by the cylinder during the instroke and explain why it would be different from the force produced during the outstroke. Please assume $\pi = 3.14$. [5]

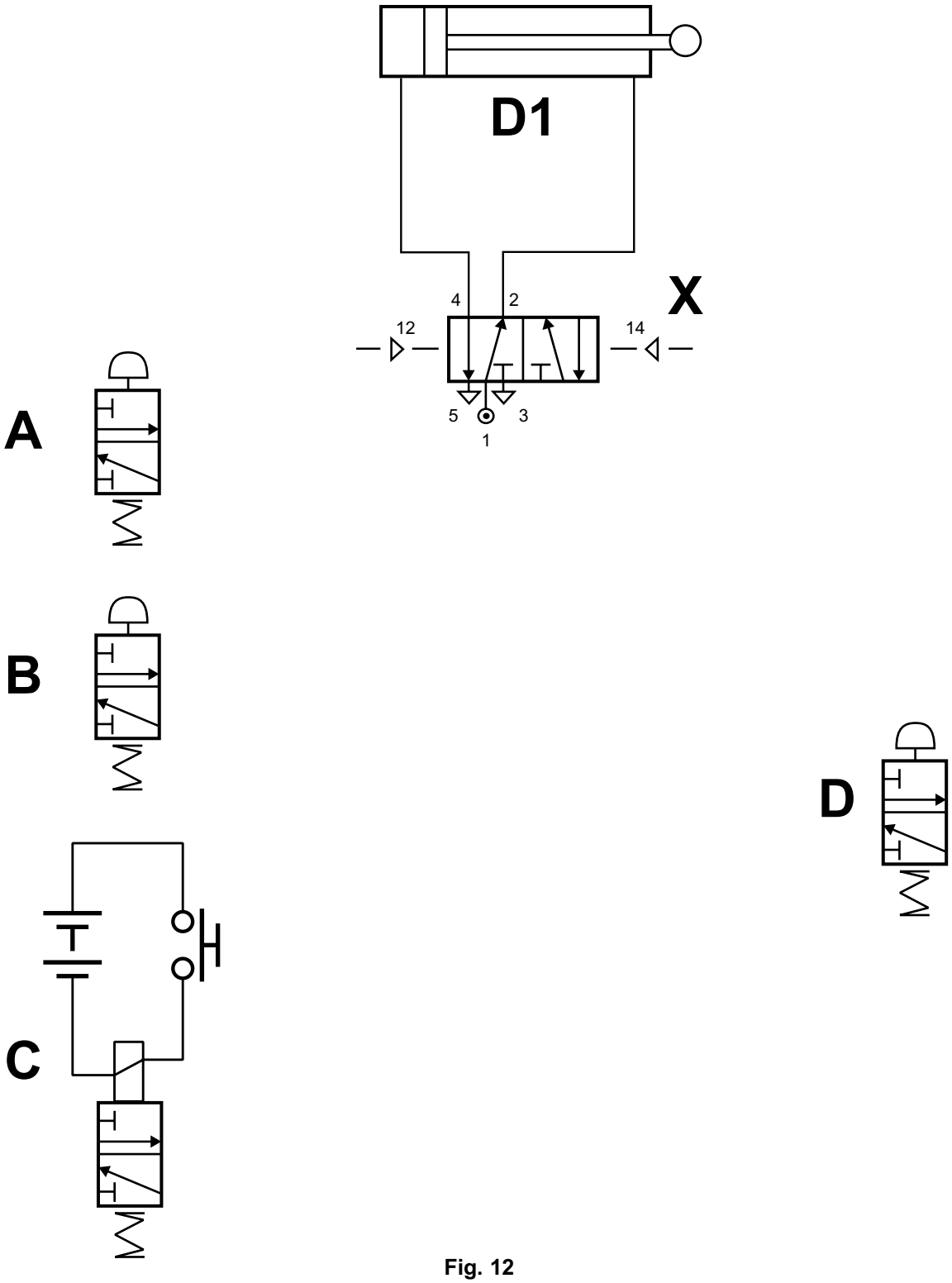

Fig. 12

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