

Candidate Name	Centre Number	Candidate Number



OXFORD CAMBRIDGE AND RSA EXAMINATIONS

General Certificate of Secondary Education

**DESIGN AND TECHNOLOGY
(SYSTEMS AND CONTROL TECHNOLOGY)**

1957/6

PAPER 6: PNEUMATICS
HIGHER TIER

Specimen Paper 2003

Additional materials: Formulae Sheet OCR (Tables 2).

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the boxes above.

Answer **all** questions.

Write your answers, in blue or black ink, in the spaces provided on the question paper.

Read each question carefully and make sure you know what you have to do before starting your answer.

Show all your working out for calculations.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

Marks will be awarded for the use of correct conventions.

Dimensions are in millimetres unless stated otherwise.

Total marks for this paper is **50**.

Question Number	For Examiner's use only
1	
2	
3	
4	
5	
TOTAL	

Fig. 1 shows a skateboarder on a skateboard.



Fig. 1

- 1 Computer Aided Machines (CAM) which manufacture the skateboard components are fitted with pneumatically powered sliding doors to protect the operator. This safety devices must ensure that the machine cannot be started unless the guards are in the closed position.

Fig. 2 shows a pair of sliding door guards on a Computer Numerically controlled (CNC) lathe.

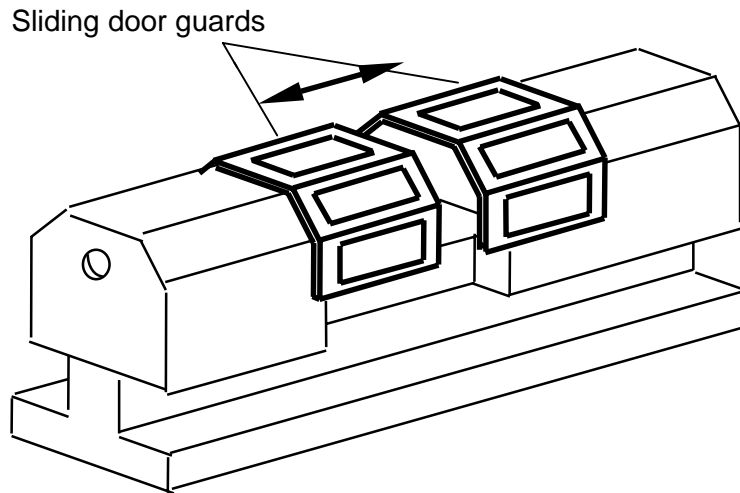


Fig.2

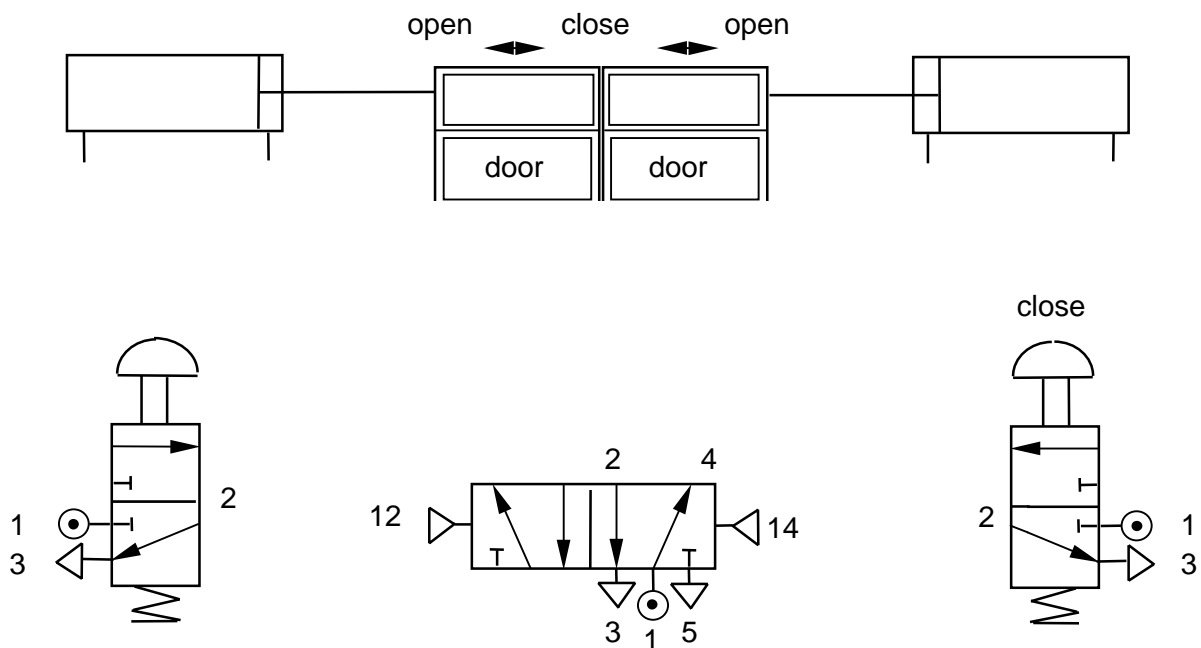


Fig. 3

- (a) Using the correct type of air lines, complete Fig. 3 to show how the circuit is to be piped up so that the “open” button will open both doors and the “close” button close both doors. Use all the components shown

[5]

- 1 (b) The control board which monitors the CNC lathe must receive a signal which tells it that the doors are closed before the lathe can start.

One way to generate this signal could be by using a single acting spring return cylinder which is instroked by the action of the doors closing. The resulting pulse of air is converted into an electrical signal to the control board.

Fig. 4 shows a cylinder and part of the safety guards.

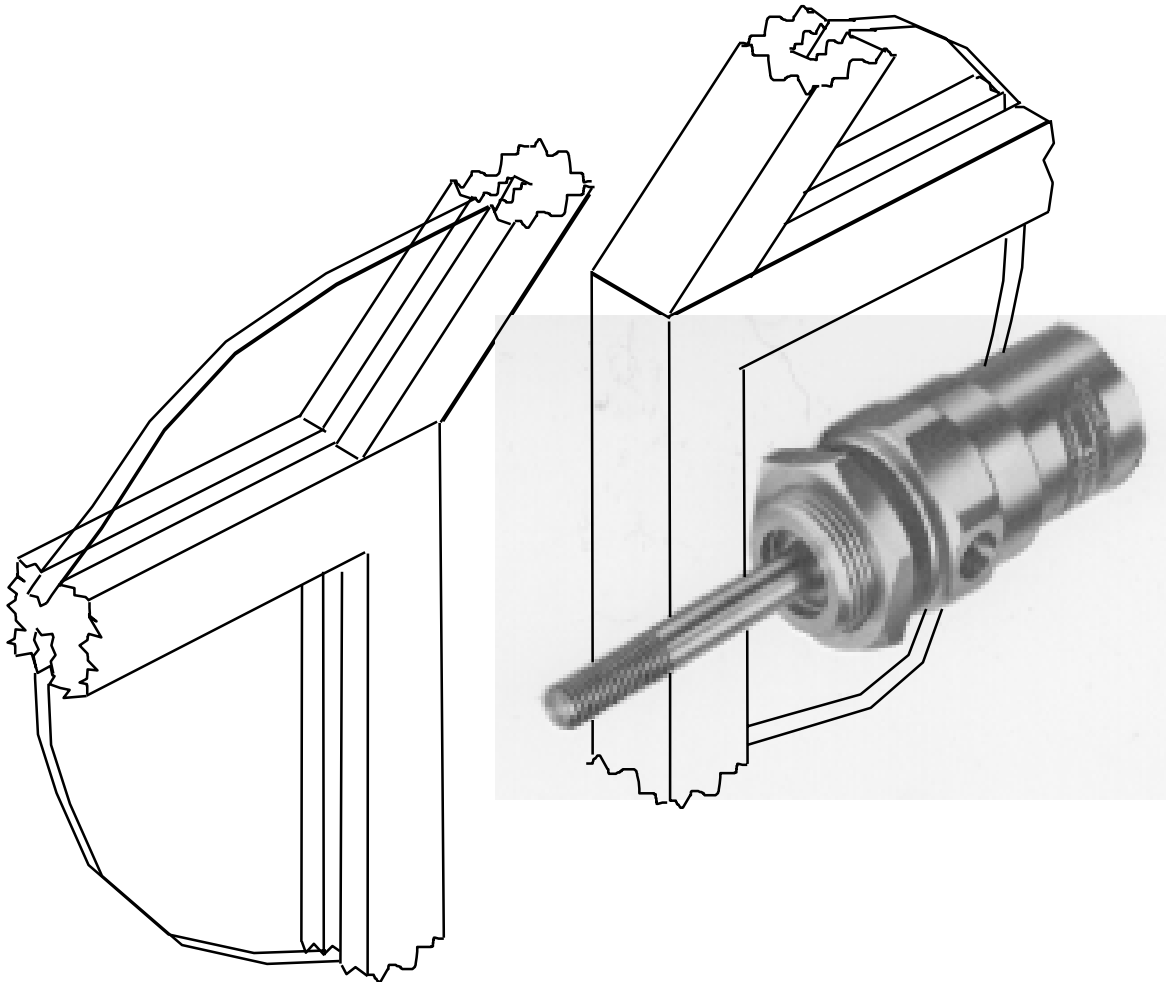


Fig. 4

Use sketches and notes on Fig. 4 to show a method of holding the cylinder body securely to the frame of the door guards at A.

[4]

- (c) CAD/CAM systems are widely used in the production of pneumatic components.

Give one reason for this.

[1]

2 Fig. 5 shows a special type of clevis attached to the threaded end of the piston rod.

This is used with a spigot fixed to the sliding door to operate the standard single acting cylinder.

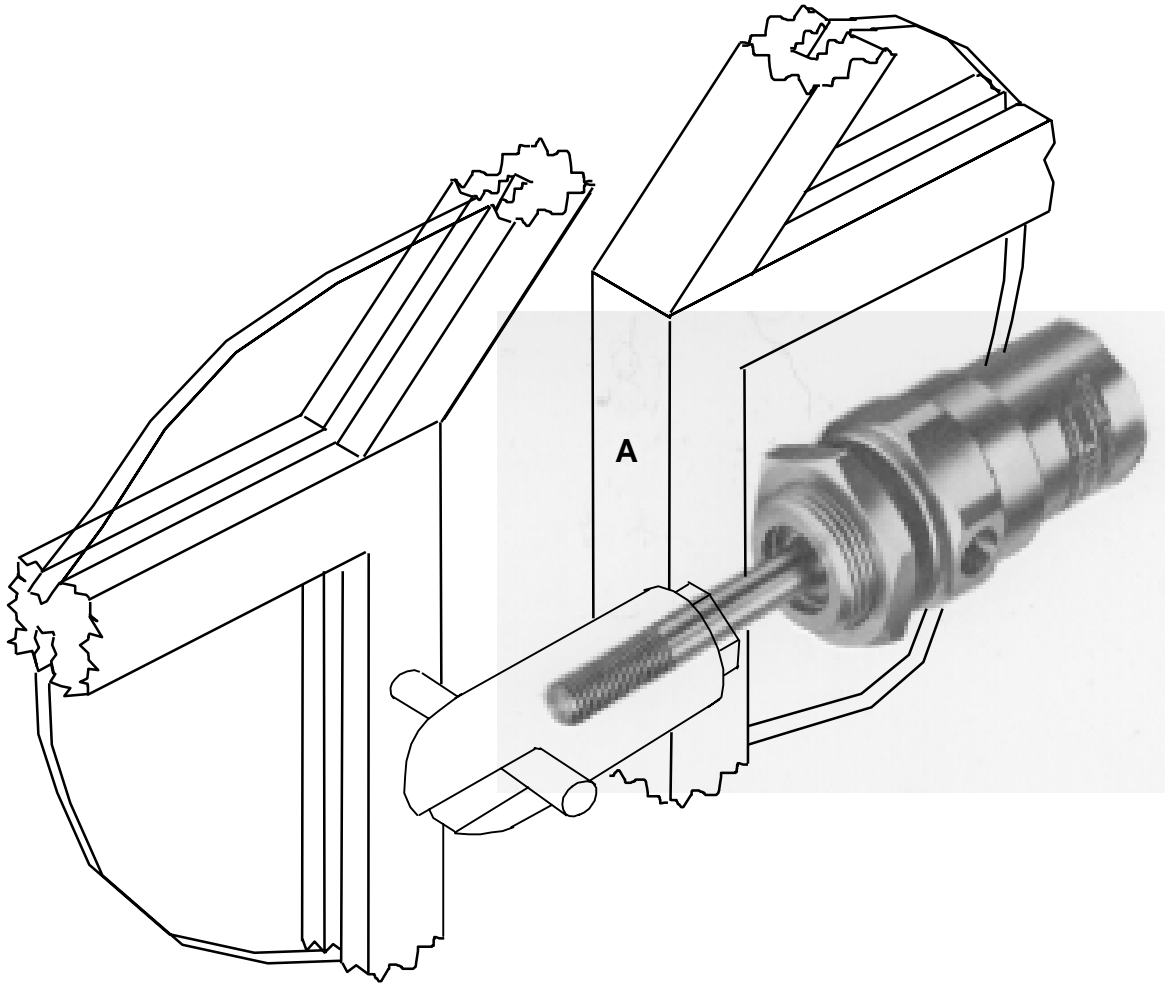


Fig.5

(a) Evaluate the effectiveness of this special clevis in this situation.

When the doors are fully open the spigot and clevis are disengaged.

[6]

- 2 (b) Using annotated sketches show how the clevis arrangement can be redesigned to perform the function more reliably.

[4]

- 3 The action of the doors closing on the lathe causes the single acting piston to send a pulse of air to a diaphragm operated valve as shown in Fig. 6.

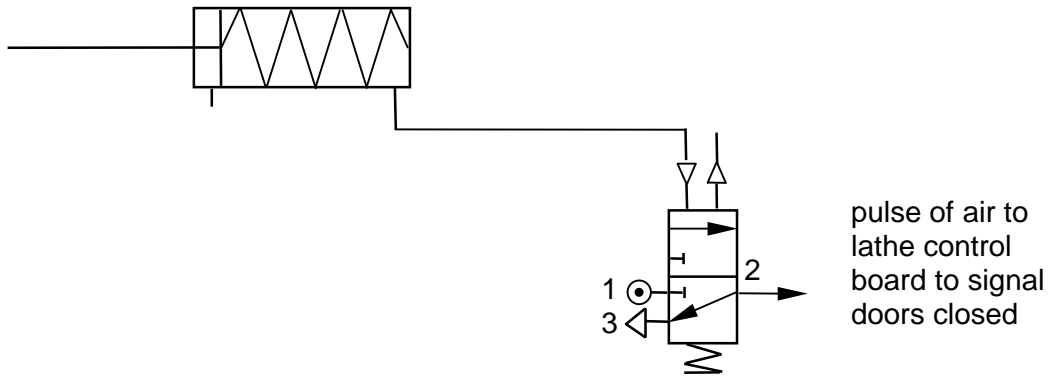


Fig. 6

- (a) Explain how the action of the doors closing on the single acting cylinder as shown in Fig. 6 will send a pulse of main air to the control board.

[4]

- (b) Suggest why a diaphragm valve is used in this application.

[3]

3 (c) Explain why it was possible to start the lathe before the doors were fully closed.

[3]

- 4 The flow chart in Fig. 7 shows one cycle of the operation of the CNC lathe in producing one component.

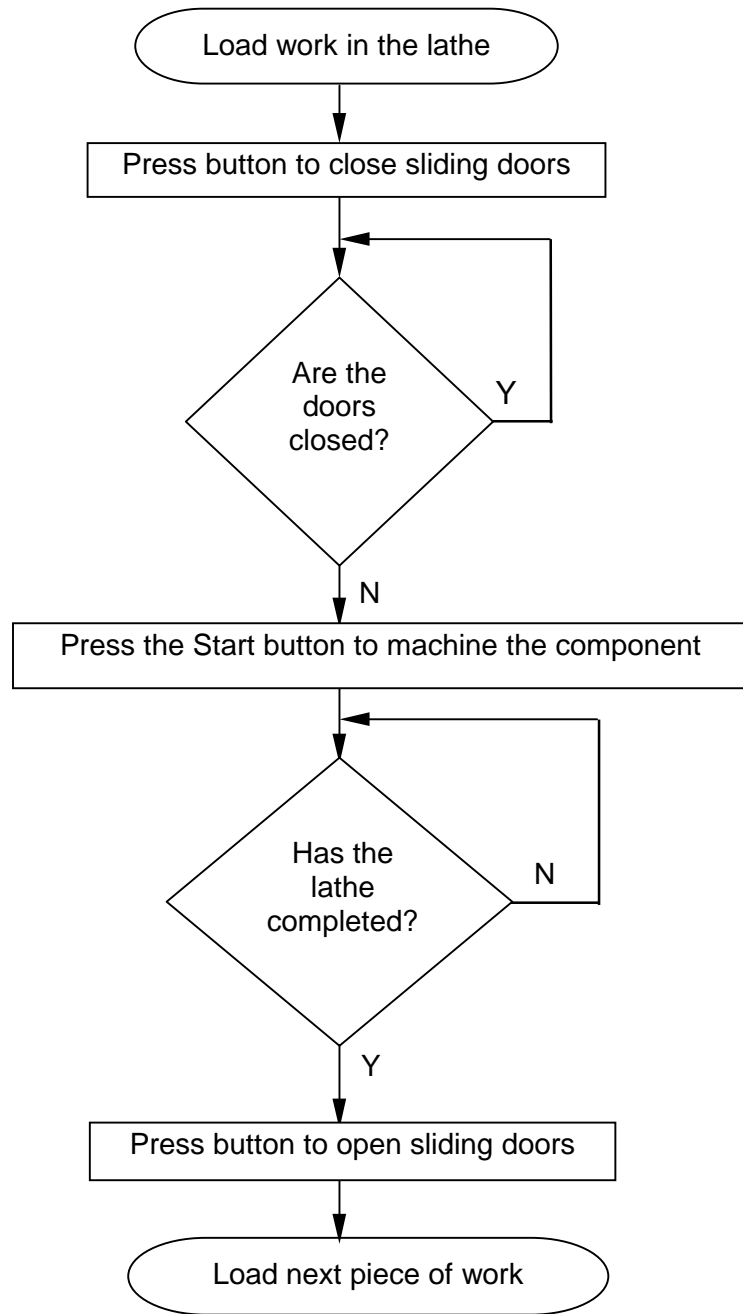


Fig. 7

- (a) Explain what would happen if the flow chart of Fig. 7 was put into operation.

[4]

4 (b) With reference to Fig. 7 explain the term “feedback”.

[2]

(c) The interface between the buttons controlling the pneumatics and the electronics controlling the lathe tool movements could be a reed switch cylinder.

With the aid of sketches describe how the action of a reed switch cylinder could signal the electronic control board.

[4]

- 5 The skate board manufacturer wishes to develop a pneumatic system which automatically positions and presses the wheel bearings into the tyres.

Fig. 8 shows the layout of the system.

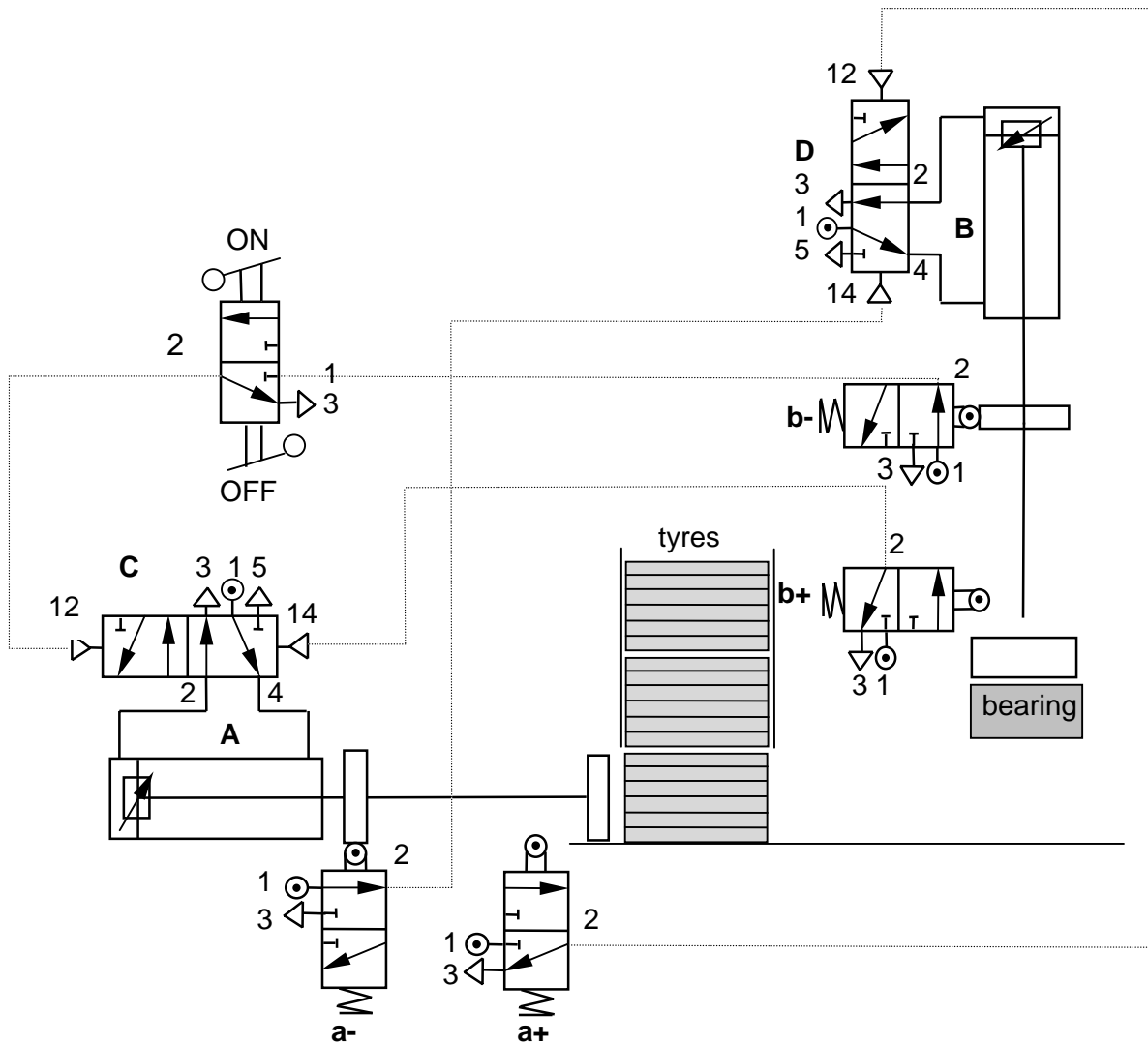


Fig. 8

- 5 (a) Explain in brief sentences how the circuit operates after the ON switch is pressed, the first sentence has been completed.

A signal changes the state of valve C _____

[7]

- (b) Explain with the aid of diagrams how the output from the computer could signal 5/2 valves to operate the reed switch cylinders as required.

[3]

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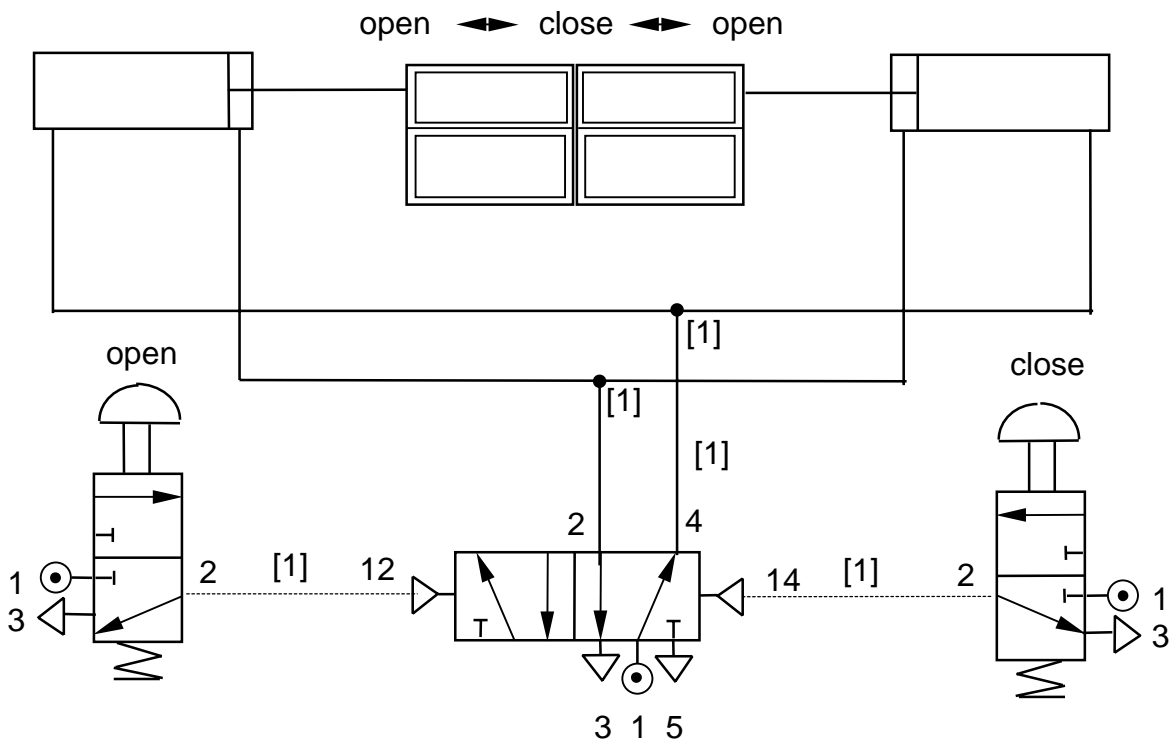
PAPER 6: PNEUMATICS OPTION

HIGHER TIER

MARK SCHEME

Specimen Paper 2003

1 (a)



[5]

(b)

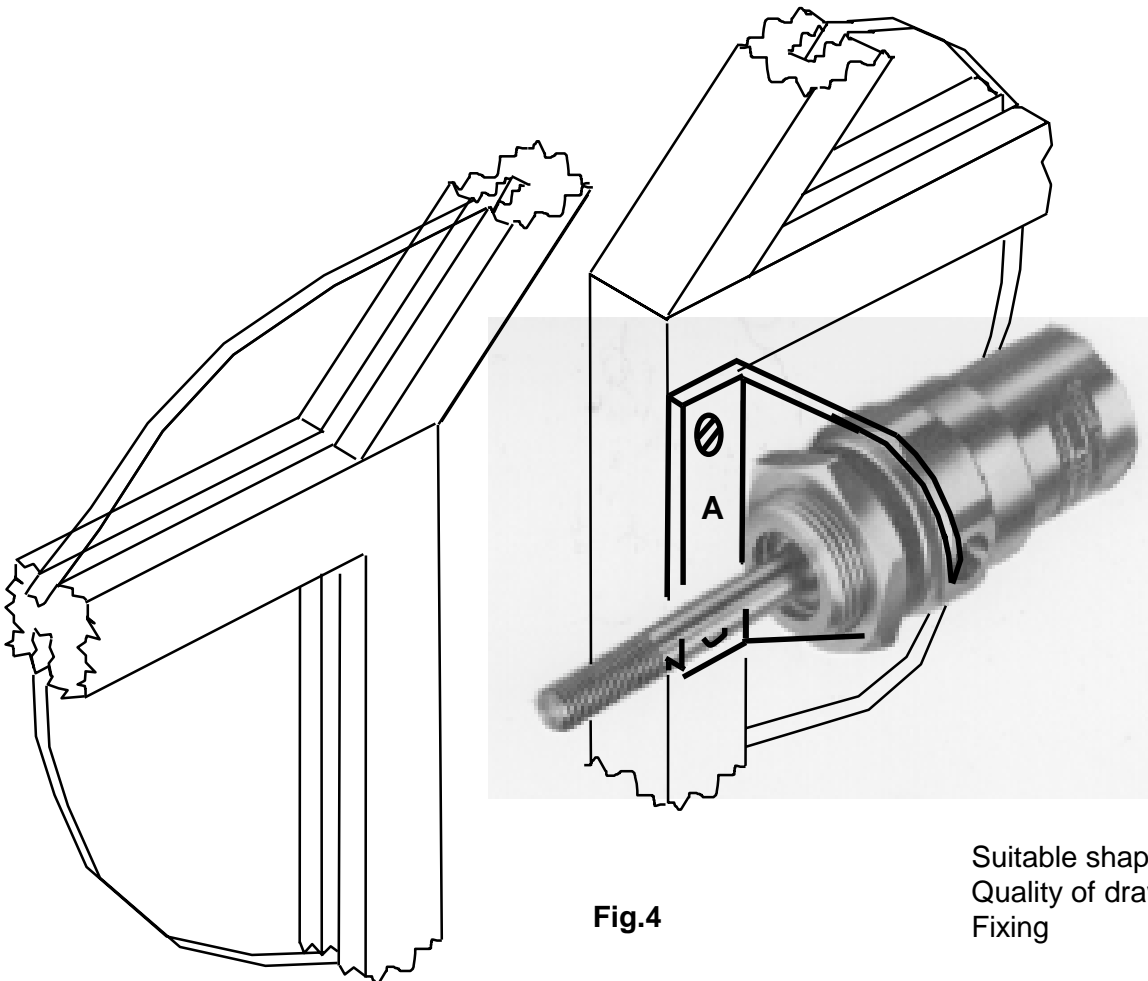


Fig.4

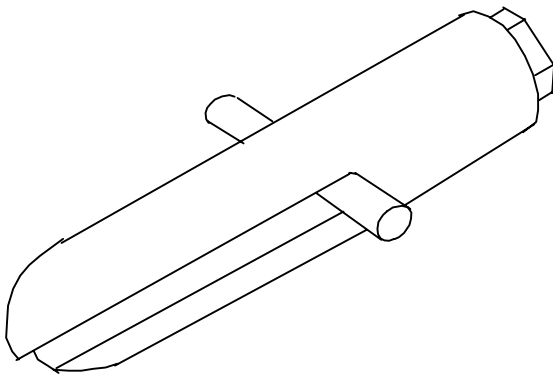
Suitable shape [2]
 Quality of drawing [1]
 Fixing [1]

- (c) CAD/CAM systems are widely used in the production of pneumatic components because they are made up of many smaller parts which are easy to mass-produce on a CAM system. CAD systems are used to design the components. [1]

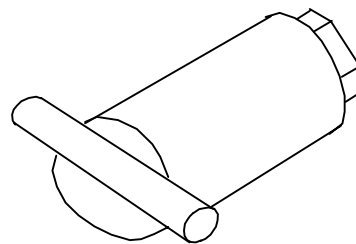
[Total: 10]

- 2 (a) The special clevis in this situation is not really suitable [1] because the piston rod in the cylinder can rotate [1] if this happens the clevis will also rotate [1] this will cause the clevis slot to miss the pin. [1] if the clevis has rotated the pin will start to push the piston rod in too soon [1] this would be dangerous. [1]

(b)



Make the clevis longer so that the pin never leaves the slot.



Make the end of the clevis flat so that the pin will always find the same position.

Possible answers:

Idea

[2]

Quality of sketch

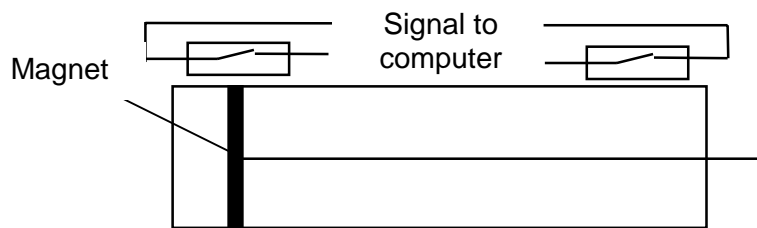
[2]

[Total: 10]

- 3 (a) As the door pushes the piston rod of the single acting cylinder in, pressure in the exhaust pipe rises [1] this is connected to the diaphragm of the 3/2 valve and a slight change of pressure will activate the valve [1]. The valve will connect ports 1 and 2 [1] this will send a higher pressure to the control board [1].
- (b) A diaphragm valve is used in this application because it will switch at a low pressure [1] due to the fact that it amplifies the signal [1] the low pressure is the exhaust from the single acting cylinder in stroking [1].
- (c) The lathe could be started before the doors were closed if the clevis had rotated [1] and caused the rod to catch the tip [1] and force air through the exhaust of the single acting cylinder. [1]

[Total: 10]

- 4 (a) If the flow chart was put into operation, after pressing the button to close the doors it would be possible to start the lathe before the doors had closed [1] alternatively if the doors did close it would not be possible to start the lathe [1]. The outputs from the decision "Are the doors closed" are inverted [1] they would need to be changed around to make it work properly [1].
- (b) Feedback is when there is a path for a signal to return back to where it originated [1] in Fig. 7 there are 2 feedback signals from the 2 decision symbols asking if the doors are closed and if the lathe has completed [1].
- (c)



[2]

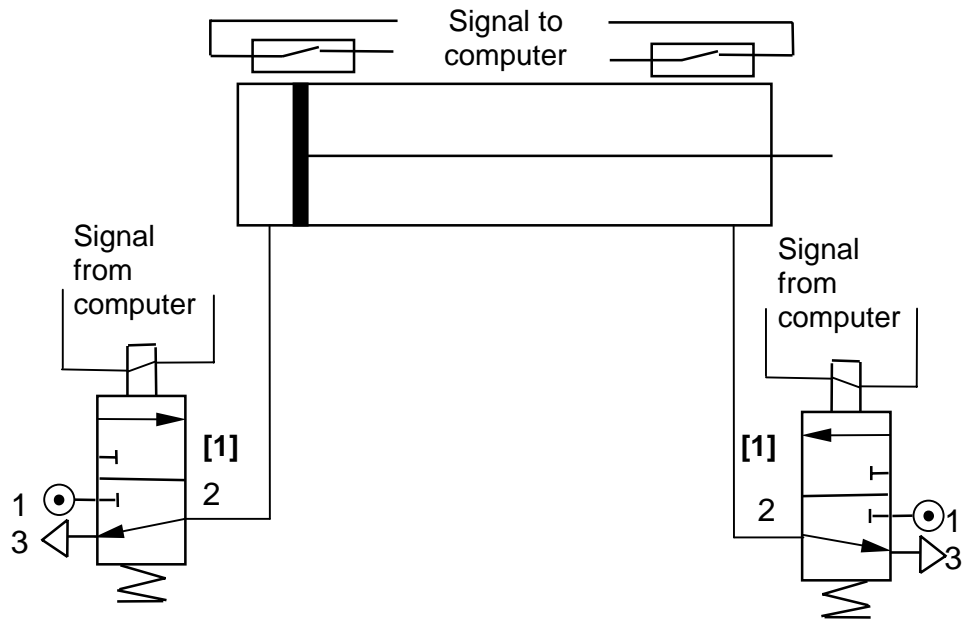
When the magnet on the piston is in line with the micro switch it closes [1] signals the control board [1].

[Total: 10]

- 5 (a) A signal changes the state of valve C. [1]
- Cylinder A will outstroke and push the tyre under the bearing and activate a+ [1]
- a+ signal changes the state of valve D. [1]
- Cylinder B will outstroke and push the bearing into the tyre and activate b+. [1]
- b+ signal changes the state of valve C. [1]
- Cylinder A will instroke and activate a-. [1]
- a- signal changes the state of valve D. [1]
- Cylinder B will instroke and activate b-. [1]
- The sequence will repeat. [1]

[max: 7]

(b)



If solenoid operated spring return 3/2 valves were used the computer could signal these to operate the reed switch cylinder.

[3]

[Total: 10]

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