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(54) Title: PROBE		
(57) Abstract		
A probe for use in a co-ordinate measuring machine comprising a probe stylus (7) movably mounted in a housing (2) so as to project beyond said housing, a switch activating member (13) for activating switch means, and transmission means (10, 11) for transmitting movement of the probe stylus into movement, preferably linear movement, of the switch activating member.		

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PROBE

This invention relates to a probe for use, for example, in conjunction with a co-ordinate measuring machine for determining the dimensions of an object and to co-ordinate measuring machines incorporating such a probe.

5 It is an object of the present invention to provide an improved probe of the type referred to.

According to one aspect of the present invention there is provided a probe for use in a co-ordinate measuring machine, comprising a probe stylus movably mounted in a housing so as to
10 project beyond said housing, a switch activating member for activating switch means, and transmission means for transmitting movement of the probe stylus into movement, preferably linear movement, of the switch activating member.

Preferably, the probe stylus is mounted for
15 multidirectional movement relative to the housing.

Conveniently, the transmission means comprises a first transmission member attached to the end of the probe stylus remote from the end thereof projecting from the housing and a second transmission member attached to one end of the switch
20 activating member, said first and second transmission members being in contact with each other by virtue of the switch activating member being biased towards the probe stylus by biasing means such as spring means.

Advantageously, a first of the two transmission members
25 includes a seat, which is most preferably substantially conical in shape, and a second of the two transmission members includes a ball bearing which is capable of riding on the inclined surfaces of the conical seat. The arrangement of transmission members is usually such that, when the probe stylus is not in
30 use, the biasing means serves to bias the transmission member attached to the switch activating members so that the ball bearing seats in the apex region of the conical seat which corresponds to a reference position in which the probe stylus is centralised.

35 Generally it is preferred that the first transmission member is attached to the probe stylus and the second



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transmission member is attached to the switch activating member.

- The internal apex angle subtended by the inclined surfaces of the conically shaped seat should not be so large that the ball bearing will not return to the "zero" position despite the biasing means, nor should it be so small that the switch activating shaft is stressed to such a degree when the probe stylus moves to its maximum deflection that the shaft cannot return to its normal slidable mounting within the casing.
- Looking at the conical seat in diametric cross-section, the angle subtended to the horizontal by the line along the inclined internal surface thereof which extends from the apex of the conical seat to the edge of the conical seat is preferably up to 45° , more preferably 15° to 30° and most preferably substantially $20 - 25^{\circ}$.

- The probe is intended for use with a co-ordinate measuring machine which may be driven manually or under computer control. The position of the probe stylus may be determined by a readout/counter which provides a visual display, and also may be capable of having data accessed from itself and through an interface presented to a computer. This facility enables the computer to drive the system to any given position and monitor its progress on the way. Once the probe has arrived at a preset reference position, the measuring operation can commence.

- The co-ordinate measuring machine may then be driven either manually or under computer control, until the probe stylus comes into contact with the part to be measured. At this instant the probe generates a signal via the switch which causes the relative data of the measuring machine's position to be presented to the computer, and the main drive system of the measuring machine to stop, reverse direction, and back the probe stylus away from the part, to the preset position, before the next operation is commanded from the computer.

- The more the probe stylus is displaced from its "reference" position, the greater will be the movement of the switch activating member and differing amounts of movement can



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be sensed. For example the switch means can be an infra-red type switch means with which different amounts of movement of the switch activating member cause different amounts of interference in the infra-red field of the switch. The amount of interference caused in such an arrangement can be interpreted by the computer to give a read out showing the movement of the actual probe stylus itself. Contours may, for example, be measured in this way.

Reference is now made to the accompanying drawings, in which:

Figure 1 is a side view, partially in cross-section of one form of the probe according to the invention;

Figure 2 is a schematic illustration showing how the probe may be mounted in a machine;

Figure 3 is a circuit diagram illustrating one way of using the probe; and

Figure 4 is a circuit diagram illustrating another way of using the probe.

The probe 1 has a two part housing 2, 3, the first part 2 and the second part 3 being secured together by means of a screw thread 4. The first part 2 includes an internal annular ring 5, for example of a plastics material, which receives a substantially spherical portion 6 integral with the probe stylus 7. The probe stylus 7 projects through the end wall 8 of the part 2 which is so shaped to allow a angular movement of the stylus 7 in any radial direction.

A conical seat 10 is provided at the end of the probe stylus 7 remote from the tip 9 so that movement of the tip 9 causes the seat 10 to move in the opposite direction as the probe stylus 7 pivots about the ball 6. A ball 11 disposed in the conical seat 10 constitutes the transmission means.

Looking at the conical seat in diametric cross-section, the angle subtended to the horizontal by the line along the inclined internal surface thereof which extends from the apex of the conical seat to the edge of the conical seat is preferably up to 45° , and is most preferably $22.1/2^{\circ}$.

The ball 11 mounted in a bearing 12 which carries an



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annular flange 12a. The bearing 12 is mounted on a shaft 13 which has an axially extending projection 13a which serves as the switch actuating member. This shaft 13 is slidably mounted in a linear bearing 15 within the housing part 3, the bearing

5 15 including ball bearings 14. The shaft 13 is biased towards the seat 10 by means of a coil spring 16, the opposite ends of which abut the flange 12a and the bottom of the casing 15.

Biassing of the shaft 13 in this way causes the ball 11 to be biased towards the apex of the conical seat 10.

10 When the probe 1 is in use and the tip 9 is deflected from the normal position shown in the drawing, the whole assembly of parts 6, 7, 9 and 10 also moves, the sphere 6 acting as a pivot. Movement of the seat 10, causes the ball 11 to ride up the conical surface to move the shaft 13. When the deflecting

15 force on the tip 9 is removed, the probe 1 will return to the position shown in the drawing due to the action of the spring 16 or other biassing means.

One way of mounting the probe is illustrated in Figure 2 of the drawings. The probe 1 is mounted on a lower body 20

20 which is connected to an upper body 21 by means of an insulating gasket 22. The upper body 21 is carried by a shank 23 which is received in the measuring machine. The electronic control circuitry may be located in the lower body 20.

One form of electronic circuit is shown in Figure 3 of the

25 drawings. This is an opto-electronic device with associated control circuitry. The opto-electronic device is located relative to the switch actuating member 13a so that the switch actuating member enters a light field between an anode and a cathode thereby causes a change in the electronic state of the

30 device.

In Figure 3 the opto-electronic device is indicated as SW1 and output indicated by O/P.

An alternative electronic circuit for use with the probe is shown in Figure 4 of the accompanying drawings. In this

35 method the work piece is held at one potential, such as earth potential, and the probe is maintained at a different potential for example 5 volts DC. In the circuit shown this voltage is



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applied to the stylus by means of an internal connection within the probe body. When the probe comes into contact with the workpiece, the input signal condition of TRL is changed and this is converted into an output pulse.

5 In both the above described methods the output electronic pulse can have many uses, depending upon the application of the probe. It may, for example, be used for gaining a data transfer from a suitable digital readout.

10 It will be appreciated that for different types of measuring function, tips other than the sphere 9 shown in the drawings may be used. For example, if it is desired to measure the thickness of a plate in the vicinity of a hole therethrough, the tip conveniently comprises a disc, the centre of which is attached to the shaft of the probe stylus, and a
15 ball bearing is set near the periphery of the disc.

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CLAIMS

1. A probe for use in a co-ordinate measuring machine comprising a probe stylus movably mounted in a housing so as to project beyond said housing, a switch activating member for activating switch means and transmission means for transmitting
5 movement of the probe stylus into movement, preferably linear movement, of the switch activating member.
2. A probe according to Claim 1 in which the probe stylus is mounted for multidirectional movement relative to the housing.
10
3. A probe according to Claim 1 or 2 in which the transmission means comprises a first transmission member attached to the end of the probe stylus remote from the end thereof projecting from the housing and a second transmission
15 member attached to one end of the switch activating member, said first and second transmission members being in contact with each other by virtue of the switch activating member being biased towards the probe stylus.
- 20 4. A probe according to Claim 3 in which the biasing means is spring means.
5. A probe according to Claim 3 or 4 in which the first of the two transmission members includes a seat, which is most
25 preferably substantially conical in shape, and a second of the two transmission members includes a ball bearing which is capable of riding on the inclined surfaces of the conical seat.
6. A probe according to Claim 3, 4 or 5 in which the
30 arrangement is such that, when the probe stylus is not in use, the biasing means serves to bias the transmission member attached to the switch activating members so that the ball bearing seats in the apex region of the conical seat which corresponds to a reference position in which the probe stylus
35 is centralised.



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7. A probe according to any of Claims 3 to 6 in which the first transmission member is attached to the probe stylus and the second transmission member is attached to the switch activating member.

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8. A probe according to any of Claims 1 to 7 in which the internal apex angle subtended by the inclined surfaces of the conically shaped seat to the horizontal is up to 45° .

10 9. A probe according to Claim 8 in which the angle is 15 to 30° .

10. A probe according to Claim 8 in which the angle is substantially 20° - 25° .

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11. A co-ordinate measuring machine provided with a probe as claimed in any of Claims 1 to 10.

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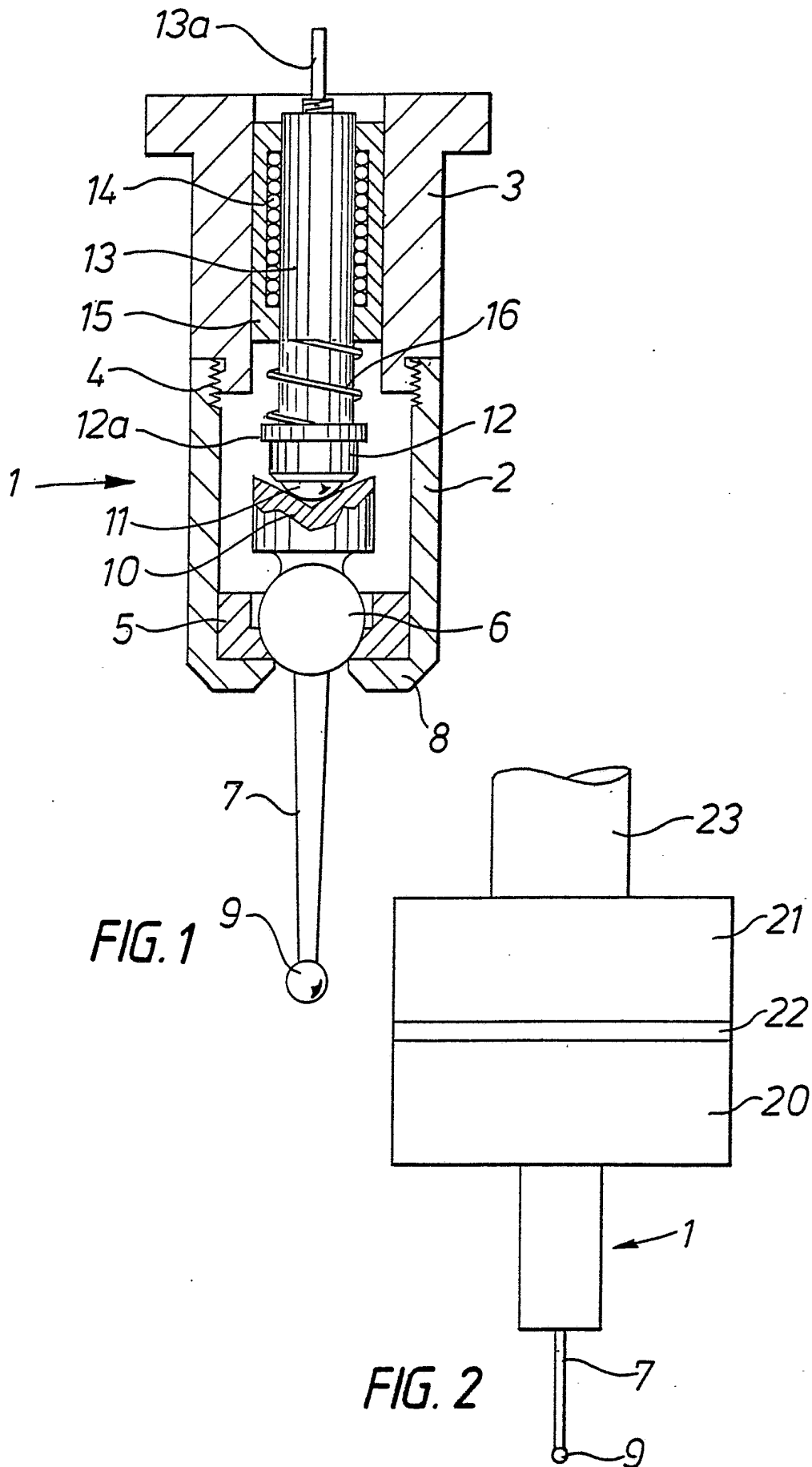
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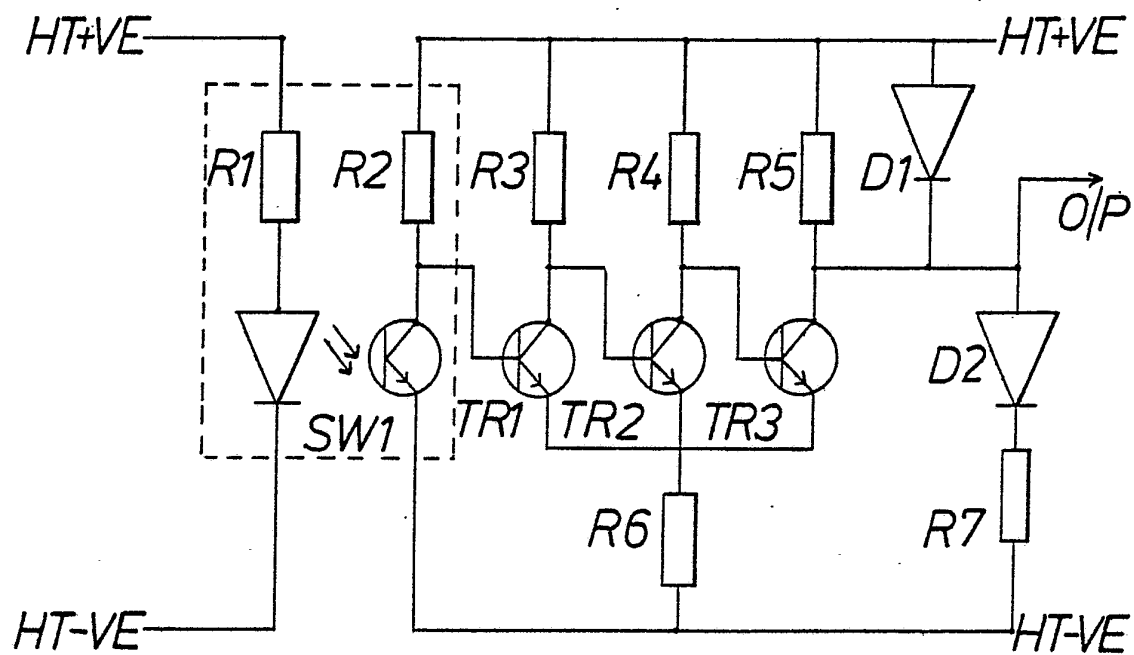


FIG. 3

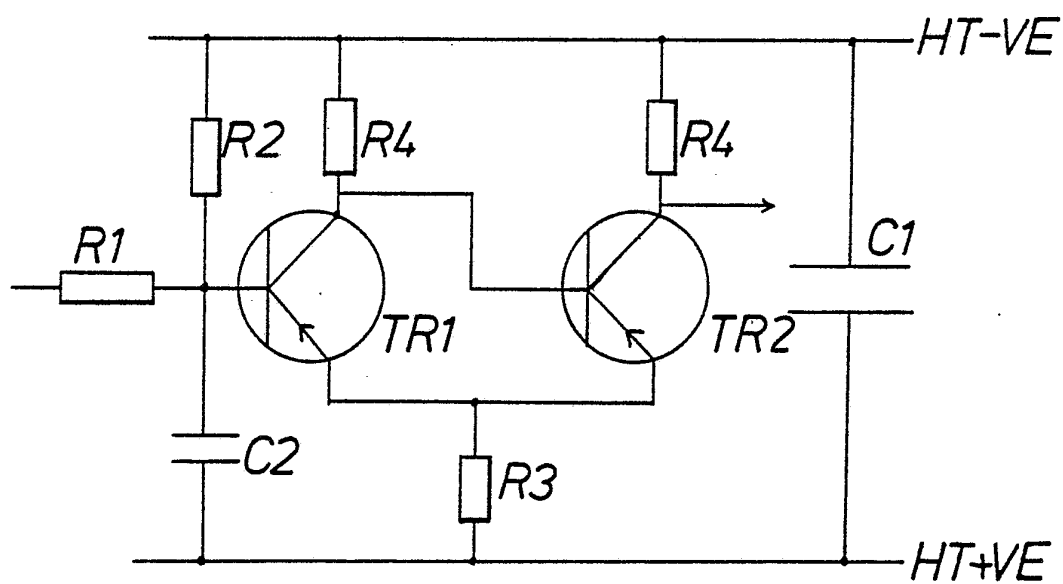


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 82/00284

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ³ : G 01 B 5/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
IPC ³	G 01 B; B 23 Q	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁸	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
X,Y	US, A, 3660906 (H.M. ZIMMERMAN) 9 May 1975 see the introduction; figures 1,2,5,5A; column 2, lines 15-62; column 3, line 36 - column 5, line 21 ---	1-9
Y	DE, A, 1513348 (MASCHINENFABRIK HEID A.G.) 22 January 1970 see figure introduction; page 5, para- graph 3 - page 6, paragraph 1 ---	1-6
X	FR, A, 2303267 (C. STIEFELMAYER KG) 1 October 1976 see figures 1,2,5,7; page 19, line 17 - page 21, line 11; page 22, line 23 - page 24, line 29; page 27, line 21 - page 29, line 31 ---	1-8,10
X	FR, A, 2011609 (LOCKHEED AIRCRAFT CORP.) 6 March 1970 see figures 1,2,3,4,5; page 2, line 11 - page 8, line 9 -----	1-8,10
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IV. CERTIFICATION		
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22nd December 1982	11 JAN 1983	
International Searching Authority ¹	Signature of Authorized Officer ²⁰	
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