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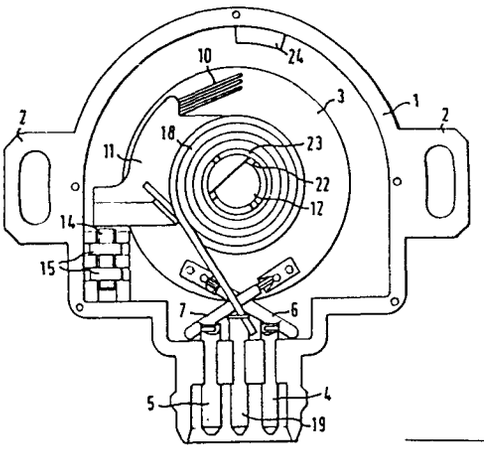
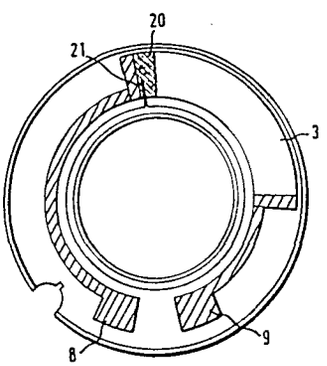
(54) Potentiometer.

(57) A rotary potentiometer is provided, particularly applicable in an internal combustion engine to follow movement of a rotatable mechanism such as a throttle or butterfly shaft in an induction manifold. The potentiometer comprises: a housing (1); an arcuate film resistance element (3) connected to terminals (4) and (5) in the housing; a wiper (10) supported on a rotatable carrier (11) and arranged to traverse the element. Adjustable stop means (14, 15) for the wiper carrier allow a position of restraint of the wiper at an end region of the element to be obtained and a helical spring (18) returns the wiper to the position of restraint from a position of rotation and electrically connects the wiper to a further terminal (19). A film (20) of electrically insulating material overlies the element at the end region where the stop means is provided and electrically insulates the wiper from the element in that position. Provision (21) is made for adjustment of the resistance of the element in the region of the insulating film.





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POTENTIOMETER

This invention relates to a rotary potentiometer that is particularly, but not exclusively, intended for mechanical connection to a rotatable mechanism to be monitored and which gives an electrical output voltage of magnitude proportional to the degree of rotation of the mechanism. A particular application of the potentiometer is to a rotatable throttle or butterfly shaft used in an internal combustion engine.

The present invention provides a rotary potentiometer comprising: a housing; an arcuate film electrical resistance element supported in said housing; electrically conductive terminals connected to opposed ends of said element for application of an electrical potential across said resistance element; a wiper of electrically conductive material supported on a rotatable carrier in said housing and arranged to traverse said

element; means to electrically connect said wiper to a further terminal in said housing so that an output voltage at said further terminal indicates the angular position of said wiper; stop means for said wiper carrier arranged whereby a predetermined position of restraint of said wiper at an end region of said arcuate element is obtained; resilient means to return said wiper to said position of restraint from a position of rotation; and a film of electrically insulating material overlying said element at the said end region thereof where said stop means is provided and such that in said region said wiper is electrically insulated from said element.

The stop means may be adjustable so that the position of restraint of said wiper relative to said resistance element can be varied and the angle through which the wiper has to be rotated from the position of restraint before it leaves said film of electrically insulating material may be preset.

The said resilient means suitably comprises a helical spring of conductive material and also electrically connects said wiper to said further terminal in said housing.

An operating spindle is preferably provided, arranged for rotation of said wiper and adapted to be secured to an external rotatable mechanism to follow rotation thereof.

Suitably said spindle is hollow and dimensioned and arranged to receive therein a matching portion of said external mechanism.

Suitably said hollow spindle has an end region of split form and is provided at said end region with a spring collar whereby said spindle is adapted to grip said external mechanism.

Fine adjustment of the electrical resistance of said element at the end thereof where said insulating film is provided may be effected by means of a narrow radial cut formed through the resistance element and extending from

an edge of said element. This adjustment may be effected either by cutting through the insulating film, or a suitable portion of the element may be left uncovered by the insulating film where said adjustment is required.

The aforementioned rotary potentiometer may be operatively connected to a microprocessor control system responsive to the voltage output of the wiper so that when the wiper is on the insulating layer the microprocessor is in a quiescent state and the microprocessor converts to its operative state on detecting the abrupt voltage change when the wiper leaves said insulating layer.

The invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 is a plan view of a rotary potentiometer according to the invention with part of the housing removed;

Figure 2 is a section through the potentiometer of Figure 1 but with the housing complete;

Figure 3 is an exploded view of wiper carrier stop means employed in the potentiometer of Figures 1 and 2;

Figure 4 is a plan view of an arcuate resistance element employed in the potentiometer of Figure 1; and

Figure 5 is a spring collar arrangement for use in securing an external mechanism in the operating spindle of the potentiometer of Figure 2.

Referring to the drawings, a rotary potentiometer has a two part housing 1 formed of a plastics material and provided with mounting flanges 2. An arcuate film electrical resistance element 3, eg. of electrically conductive polymer material, is provided on a support on the inner surface of a base part 1A (Figure 2) of the housing. Electrically conductive terminals 4 and 5 are secured in the housing and are electrically connected by leads 6 and 7 and film conductors 8 and 9 (Figure 4) to the ends of the resistance element 3. A multi-fingered wiper 10 of resilient electrically conductive material, which may be a base or precious metal, is supported on a

rotatable carrier 11, the carrier 11 having a spindle 12 which rotatably fits into a cylindrical aperture 13 in the base part 1A of the housing. As the carrier 11 is rotated in the housing, the wiper 10 is caused to traverse the arcuate resistance element 3.

An adjustable stop means is provided for the wiper carrier 11 and comprises a threaded screw 14 and nuts 15 retained by appropriately shaped regions 16 and 17 of the two-part housing. The wiper carrier 11 is arranged to come into contact with the end of the screw 14 of the stop means so that the wiper 10 is restrained in a position at an end of the resistance element 3. This position of restraint of the wiper relative to the element 3 can be precisely determined by adjusting the screw 14 by means of a small screwdriver inserted through an aperture in the housing 1.

A helical spring 18, eg. of beryllium-copper, is provided, encircling a portion of the wiper carrier 11 and electrically connected at one end to a further terminal 19 mounted in the housing. The other end of the spring is electrically connected to the wiper 10. This spring 18 serves a dual purpose. It provides the necessary electrical connection between the wiper 10 and terminal 19 in the housing. It also acts as a return spring for the wiper and carrier assembly such that when the wiper carrier 11 is rotated by application of an external influence to cause the wiper 10 to traverse the resistance element 3 to fulfil a desired potentiometric function, upon release of the external influence the wiper carrier 11 is returned to its initial position in contact with the screw 14 of the stop means.

A film 20 (Figure 4) of electrically insulating material such as an epoxy resin is applied, eg. by screen printing, on top of the resistance element 3 at an end region thereof such that when the wiper 10 is in its initial position of restraint with the carrier 11 in contact with the screw 14 of the stop means, the wiper 10

is electrically insulated from the resistance element 3 by the film 20. This arrangement effectively provides a switch incorporated in the potentiometer. If a voltage supply is connected to terminals 4 and 5 and an output voltage obtained from terminals 4 and 19, then when the wiper carrier 11 is in contact with the stop means and the wiper 10 is in contact with the insulating film 20, the wiper 10 is in an open circuit condition and no output voltage will appear between terminals 4 and 19. If the wiper and carrier assembly is rotated, then at the point where the wiper leaves the insulating film 20 and contacts the resistance element 3 an output voltage is obtained between terminals 4 and 19. As the wiper and carrier assembly 10, 11 is continued to be rotated, the output voltage increases up to a maximum value. If an electrical resistor of appropriately high value (eg. 50,000 ohms) is connected between the wiper terminal 19 and the voltage supply, then when the wiper is in its initial position in contact with the insulating film, an output voltage corresponding to the maximum value is obtained between terminals 4 and 19. As the wiper and carrier assembly is rotated, the output voltage switches to a low level as the wiper leaves the insulating film 20 and contacts the resistance element 3. The output voltage then continues to rise, up to a maximum value, as the wiper and carrier assembly is further rotated.

The angle through which the wiper and carrier assembly is rotated before the wiper leaves the insulating film 20, can be precisely determined using the adjustable stop means 14, 15.

Fine adjustment of the electrical output obtained from the potentiometer at the point where the wiper leaves the insulating film and contacts the resistance element can readily be effected by selective removal or abrasion of a portion of the resistance element underlying the insulating film in Figure 4. To achieve this, a narrow radial cut 21 is suitably formed through the insulating

film 20 and underlying resistance element 3 and extending from an edge of the element for a distance sufficient to provide the desired adjustment of the resistance value of the portion of the element underlying the insulating film.

In order to avoid having to cut through the insulating film, a portion of the resistance element in the region where the cut 21 is to be made may be arranged to be left uncovered by the insulating film when the latter is applied. Adjustment of the resistance element will be effected in a region with which the wiper will not come into contact.

A further stop 24 is provided with which the carrier 11 comes into contact when the wiper 10 reaches the opposite end of the resistance element to that where the insulating film 20 is provided.

For mechanical connection of the potentiometer to a rotatable external mechanism (not shown) whose rotation is to be followed and monitored by the potentiometer, the spindle 12 of the potentiometer is suitably of hollow construction and shaped to receive a shaft or spindle (eg. of D shaped section) of the external mechanism. One or more slots 22 are provided in the spindle 12 and a spring collar 23 (Figure 5) is provided to encircle the slotted end of the spindle 12. When the shaft or spindle of the external mechanism is fitted into the hollow spindle 12, the presence of the spring collar 23 ensures that the spindle 12 securely grips the received shaft or spindle.

In one particular application, the external mechanism comprises a throttle or butterfly shaft in an internal combustion engine.

The aforementioned potentiometer may form part of a microprocessor controlled engine management system. The microprocessor is in a quiescent state when the engine is running at tickover speed and a triggering or switching-on signal is required for the microprocessor when the throttle is opened. Furthemore, the microprocessor must begin its operation virtually at the instant when a driver

applies his foot to the accelerator pedal. The required triggering is achieved by arranging for a fast rate of change of output voltage from the potentiometer to occur as the wiper 10 leaves the insulating layer 20 and contacts the resistance element 3. At this point the output voltage drops rapidly from the maximum level to a low level (which may typically be about 11% of the maximum). Thereafter, the microprocessor controlled electronics utilises the level of output voltage from the potentiometer as an indication of the position of rotation of the throttle.

CLAIMS:

1. A rotary potentiometer comprising a housing (1), an arcuate film electrical resistance element (3) supported in said housing (1), a wiper (10) of electrically conductive material supported on a rotatable carrier (11) in said housing and arranged to traverse said resistance element (3), means to connect said wiper (10) to a first terminal (19) in said housing (1), stop means (14, 15) for said wiper carrier (11) arranged to define a predetermined position of restraint of said wiper (10) at an end region of said resistance element (3), and resilient means (18) to return said wiper (10) from a position of rotation to said position of restraint characterised in that second and third electrically conductive terminals (4, 5) are connected to opposed ends of the resistance element (3) for application of an electrical potential across the resistance element (3) so that an output voltage at the first terminal (19) indicates the angular position of the wiper (10) and a film of electrically insulating material (20) overlies the resistance element (3) at a region thereof corresponding to the position of restraint of the wiper (10) so that in said region the wiper (10) is insulated from the resistance element (3).

2. A potentiometer according to claim 1, wherein said stop means (14, 15) is adjustable so that the position of restraint of said wiper (10) relative to said resistance element (3) can be varied and the angle through which the wiper (10) has to be rotated from the position of restraint before it leaves said film (20) of electrically insulating material may be preset.

3. A potentiometer according to claim 1 or 2, wherein the said resilient means (18) is a helical spring of conductive material that also electrically connects said wiper (10) to said first terminal (19).

4. A potentiometer according to any preceding claim, wherein an operating spindle (12) is provided, arranged for rotation of said wiper carrier (11) and adapted to be secured to an external rotatable mechanism to follow rotation thereof.

5. A potentiometer according to claim 4, wherein said spindle (12) is hollow and dimensioned and arranged to receive therein a matching portion of said external mechanism.

6. A potentiometer according to claim 5, wherein said hollow spindle (12) has an end region of split form (22) and is provided at said end region with a spring collar (23) whereby said spindle (12) is adapted to grip said external mechanism.

7. A potentiometer according to any preceding claim, wherein fine adjustment of the electrical resistance of said element (3) at the end thereof where said insulating film (20) is provided is effected by means of a narrow radial cut (21) formed through the resistance element (3) and extending from an edge of said element (3).

8. A potentiometer according to claim 7, wherein said adjustment is effected by cutting through said insulating film (20).

9. A potentiometer according to claim 7, in which a suitable portion of said element (3) is left uncovered by the insulating film (20) in the region where said adjustment is required.

10. An internal combustion engine including a throttle or butterfly shaft fitted with a potentiometer according to any one of the preceding claims.

11. A rotary potentiometer as claimed in any of claims 1 to 9 connected to a microprocessor control system responsive to the voltage output of the wiper (10) so that when the wiper (10) is on the insulating layer (20) the microprocessor is in a quiescent state and the microprocessor converts to its operative state on detecting the abrupt voltage change when the wiper (10) leaves said insulating layer (20).

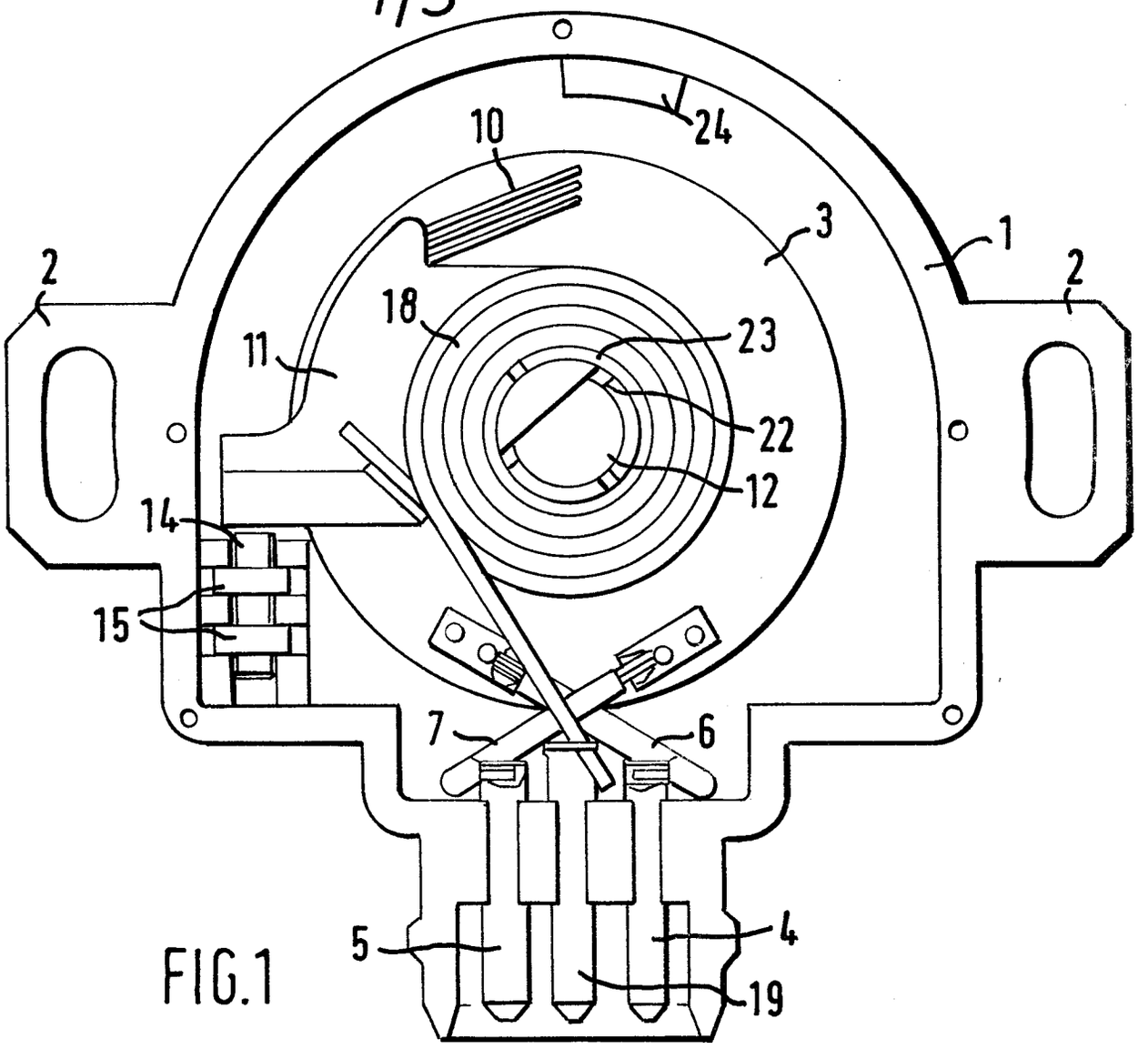

FIG.1

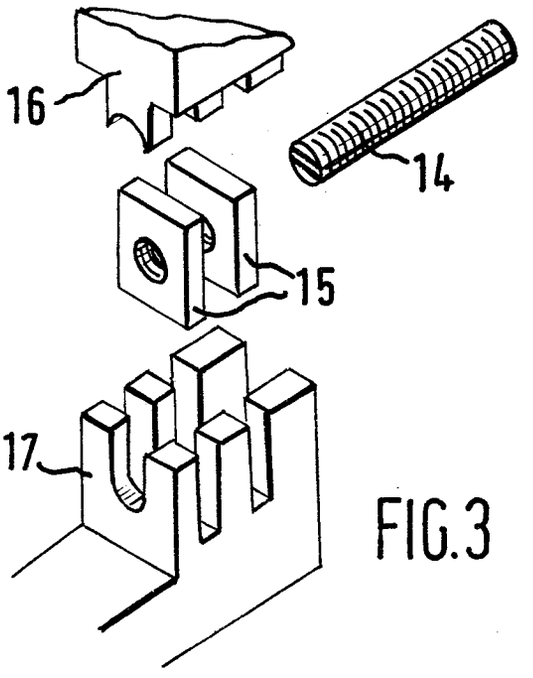

FIG.3

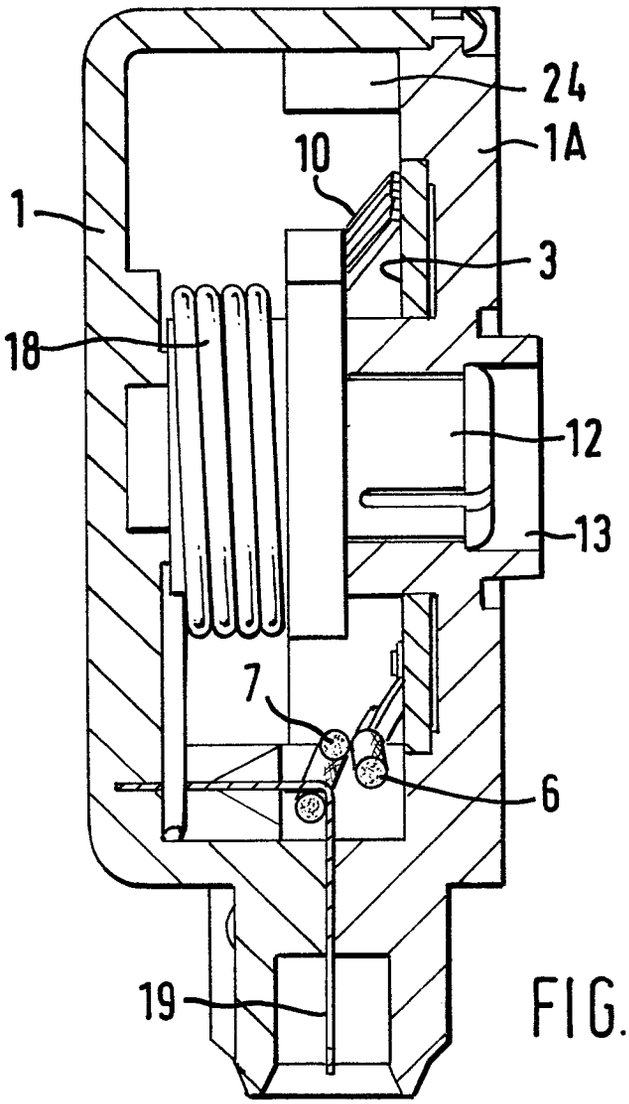

FIG.2

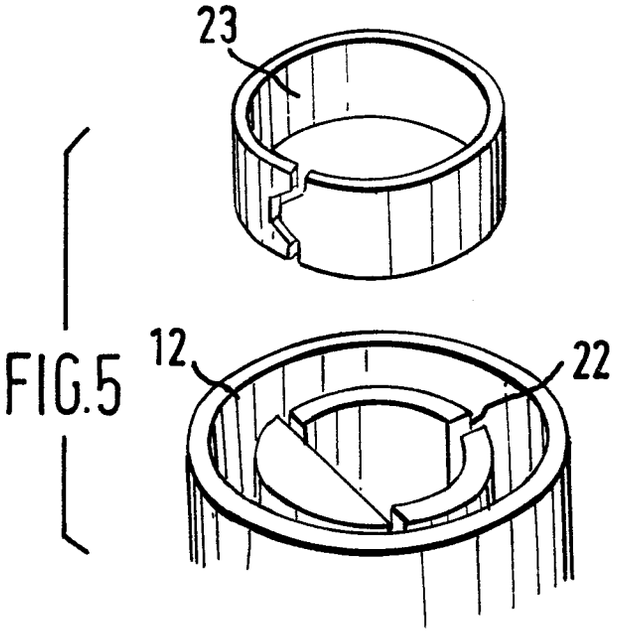

FIG.5

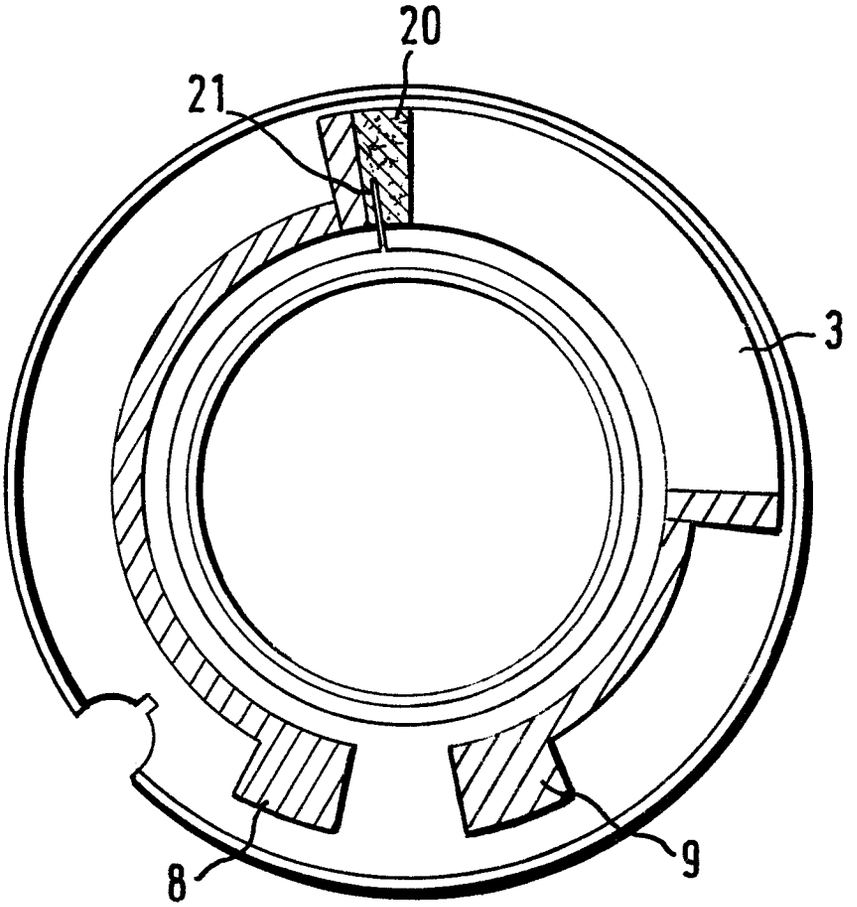

FIG.4

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EUROPEAN SEARCH REPORT

0096948
Application number

EP 83 30 0883

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Y	DE-A-2 265 331 (ROBERT BOSCH GmbH.) * Claim 1; page 5, paragraph 2 - page 6, paragraph 3; figures 1,3,4 *	1,3,4, 10,11	H 01 C 10/36 F 02 D 5/00
Y	GB-A- 832 547 (MORGANITE RESISTORS LTD.) * Claim 1; page 1, lines 48-60; figure 1 *	1	
A	US-A-2 769 883 (F.M. ECKERT et al.) * Claim 1; column 1, lines 21-36; column 2, line 5 - column 3, line 37; figures 1-4 *	1,3,4	
A	US-A-2 958 838 (G.O. PUERNER et al.) * Column 3, line 71 - column 4, line 3 *	4-6	TECHNICAL FIELDS SEARCHED (Int. Cl. 3) H 01 C
A	US-A-4 032 881 (D.L. SINGLETON) * Claim 1; column 3, line 63 - column 5, line 13; figures 5,6 *	7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-09-1983	DECANNIERE L.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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