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(54) **Process for the production of a potentiometer.**

(57) In a process for the production of a rotary electrical potentiometer, a spindle means is provided initially in the form of a first part (10), which is adapted to be rotated by means external to a housing (1A, 1B), and a second part (11) to which is secured a wiper (15) which traverses a resistance track (2). The first and second parts (10, 11) of the spindle are mutually engageable such that one part is rotatable about the other. Relative rotation is effected between the parts (10, 11) such that with the first part (10) in a predetermined position of rotation relative to the housing (1A, 1B), the wiper (15) secured to the second part is arranged to be in a required position with respect to the resistance track (2). The two parts (10, 11), which suitably comprise a thermoplastics material are then secured together against further mutual rotation, e.g. using ultrasonic welding or heat sealing techniques.

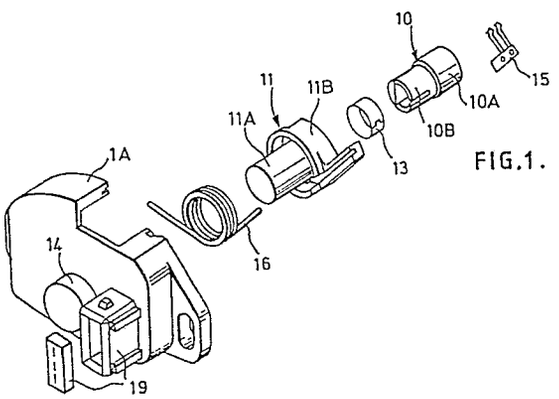

FIG.1.

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Description

PROCESS FOR THE PRODUCTION OF A POTENTIOMETER

This invention relates to rotary electrical potentiometers and more particularly to a process for the production of a rotary potentiometer in which an accurately predetermined output voltage may be achieved in relation to a specified angular position of an actuating spindle.

The invention finds particular, but not exclusive, application to potentiometers for use as engine throttle position sensors in automotive vehicles.

Potentiometers are finding increasing application in automotive electronics as engine throttle position sensors. In such sensors it is required for an accurately predetermined voltage output to be provided when the throttle is in a particular angular position. Normal production tolerances in potentiometer manufacture make it difficult to achieve the required accuracy and some means is required to pre-set each individual potentiometer during manufacture. Various methods have already been proposed for this. These have included adjusting the position of an external actuating lever relative to a rotatable spindle which carries the wiper which traverses the resistance track in the potentiometer. Alternatively, the position of a substrate carrying the resistance track has been adjusted in the housing to give the required output at a particular position of rotation of the wiper operating spindle.

It is an object of the present invention to provide an improved process for the production of a potentiometer which enables a precisely required electrical output for a potentiometer to be achieved at a specified angle of rotation of an operating spindle.

The present invention provides a process for the production of a rotary electrical potentiometer comprising: a housing; an arcuate electrical resistance track supported in the housing; spindle means supported for rotation in the housing and adapted to be rotated by means external to the housing; electrically conductive wiper means secured to the spindle means and adapted to traverse the resistance track when the spindle is rotated; electrically conductive terminal means supported in the housing and electrically connected to ends of the resistance track and to the wiper; said process being characterised by:

(a) providing the spindle means in the form of a first part which is adapted to be rotated by the means external to the housing, and a second part to which is secured the wiper means, the first and second parts being mutually engageable such that one part is rotatable about the other;

(b) locating the mutually engaged first and second parts of the spindle in the housing and effecting relative rotation between the parts such that, with the first part in a predetermined position of rotation relative to the housing, the wiper means secured to the second part is arranged to be in a required position with respect to the resistance track;

(c) securing together the first and second parts against further mutual rotation.

Suitably the first and second parts of the spindle are each provided with a cylindrical portion, the cylindrical portions being mutually engageable such that one fits inside the other.

The first and second parts of the spindle may be secured together by any suitable means, e.g., by ultrasonic welding or heat sealing, when the parts are provided of appropriate thermoplastics material, or by means of an adhesive or by one or more screws.

The housing is conveniently provided as two parts to facilitate assembly.

If desired a spring means may be provided, cooperating between the housing and the spindle means and adapted and arranged to return the wiper means to a predetermined rest position when the spindle means is released after being rotated.

If desired, the spindle means may incorporate a third part which is adapted to be combined with the first and second parts and relatively rotatable with one or both thereof during assembly, the third part being subsequently secured against further movement relative to the first and/or second parts after being set to a desired position and arranged to cooperate with the housing to provide an end stop for the wiper means relative to the resistance track. The third part is conveniently secured by the same means as is used to secure together the first and second parts of the spindle.

In a particular embodiment, two resistance tracks and two associated wiper means may be provided and the second part of the spindle means may comprise two relatively rotatable sections, each section having a wiper means secured thereto, the two sections being rotated relative to one another and to the first part of the spindle means, when the mutually engaged first and second parts are located in the housing, until both wiper means are in required positions with respect to their associated resistance tracks, the two sections then being secured against further relative rotation and the second part of the spindle means, which they constitute, is secured together with the first part of the spindle means.

If desired, a voltage may be applied to the terminals connected to the ends of the track and an output voltage measured at the terminal connected to the wiper means while the relative rotational position of the first and second parts of the spindle is being set the two parts being secured against further rotation relative to one another when a desired output voltage is obtained at a predetermined position of rotation of the first part of the spindle relative to the housing.

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

Fig. 1 represents an exploded perspective view of one embodiment of a potentiometer

produced by the process of the invention;

Figs. 2, 3 and 4 represent exploded perspective views of alternative spindle arrangements for use in the potentiometer of Fig.1.

Referring to Fig. 1, a housing for a potentiometer is constructed of two parts 1A and 1B which are suitably moulded in a thermoplastics material. An arcuate film resistance track 2 of known form is provided on an electrically insulating substrate 3 and electrically conducting terminations 4, 5 of film form are provided connected to opposite ends of the track 2. An electricallly conducting collector track 6, also of film form, is provided on the substrate 3. The substrate 3 is located on part 1B of the housing and electrically conducting terminal pins 7, 8, 9, secured to the part 1B of the housing, pass through holes in the substrate 3 and are electrically connected, e.g. by soldering, to the terminations 4, 5 and 6 on the substrate 3.

An operating spindle for the potentiometer is provided initially of separate first and second parts 10 and 11. The first part 10 is hollow and has a cylindrical end 10A which is rotatably inserted into a hole 12 provided through the part 1B of the housing. The part 10 is suitably shaped internally, e.g., of D-shaped cross-section, to receive an external shaft (not shown) of appropriately matching cross section by means of which the potentiometer will be operated. The part 10 of the spindle has a cylindrical end 10B which is slotted and over which fits a spring collar 13. The combination of the spring collar 13 and the slots in the end 10B of the part 10 provide a means to grip an external operating shaft when the latter is inserted into the part 10 from the exterior of the potentiometer.

The second part 11 of the spindle has a hollow bore arranged to rotatably receive the end 10B of the first part 10 of the spindle. Part 11 of the spindle also has a cylindrical end portion 11A which is arranged for rotatable insertion in a cylindrical aperture 14 moulded into the second part 1A of the housing. Part 11 of the spindle also has a portion 11B to which is secured an electrically conducting wiper assembly 15 which is adapted to traverse the resistance track 2 and the collector 6.

With the end 10A of the part 10 of the spindle located in the hole 12 in the housing 1B and maintained in a precisely set position of rotation, suitably relative to mounting holes 17, 18 of the potentiometer, a voltage is applied to the terminals 7, 9 and an output voltage is monitored at terminal 8. The part 11 of the spindle is then rotated about the part 10 until a precisely required output voltage is obtained at the terminal 8. When this is achieved, the two parts 10 and 11 are secured together to prevent further relative rotation. The two parts 10 and 11 are suitably formed of thermoplastics material and are conveniently secured together by an ultrasonic welding or heat sealing process. Other techniques, such as an applied adhesive or one or more inserted screws, may be used to secure the two parts of the spindle together. Assembly of the potentiometer is then completed by applying and securing the part 1A of the housing to the part 1B of the housing, the two parts being suitably secured together by ultrasonic welding or heat sealing. The terminals 7, 8, 9 emerge through slots in a plug arrangement 19.

For some applications of the potentiometer, e.g., when used to monitor the position of an engine throttle in an automotive vehicle, a return spring 16 is provided cooperating between the part 11 of the spindle and the housing 1A, 1B and operating to return the wiper 15 to a rest position at an end of the track 2 when the spindle 10, 11 is released after being rotated by an external means.

Fig. 2 shows an alternative construction of the two parts 10, 11 of the spindle in Fig. 1. In Fig. 2, the equivalent part 10 of the spindle has a cylindrical portion 10C at one end which rotatably fits into the aperture 14 in the part 1A of the housing and has a further cylindrical portion 10D of smaller diameter at the other end which passes thrugh a cylindrical hole in the other part 11 of the spindle and into the cylindrical hole 12 in the part 1B of the housing. The two parts of the spindle are rotated relative to one another and subsequently secured together in exactly the same manner as previously described for the arrangement illustrated in Fig. 1.

If desired, as shown in Fig. 3, the spindle 10, 11 may be provided with a third part 20 capable of relative rotation with respect to one or both of the other parts 10, 11. This third part 20 may be arranged to be secured in like manner as the parts 10 and 11 after being set to a predetermined position and has a region 21 arranged to cooperate with a portion (not shown) of the housing 1A, 1B to serve as a pre-set end stop for the wiper 15 on the track 2.

It is sometimes required to provide a potentiometer with two resistance tracks, each with its associated wiper and provide means to phase the wipers accurately with respect to one another. This can be achieved by an embodiment of the present invention in which an alternative arrangement of the second part 11 of the spindle of Figure 1 is provided, as shown in Fig. 4 and two resistance tracks are provided instead of the single track 2. With reference to Fig. 4, the second part 11 of the spindle comprises two sections 11C and 11D arranged to fit one inside the other with a degree of permitted relative rotation. Each section has a wiper 15A, 15B secured thereto for contacting its associated resistance track. The sections 11C and 11D are assembled together with the first part 10 of the spindle in the same way as shown for the embodiment of Fig. 1. With the part 10 of the spindle maintained in a precisely set position of rotation, the two sections 11C and 11D of the part 11 of the spindle are rotated relative to one another and about the part 10 of the spindle until the wipers 15A and 15B are in precisely required positions relative to one another on their associated resistance tracks.

The two sections 11C and 11D are then secured together against further relative rotation and are also secured to the part 10 of the spindle. The securing operation is again suitably carried out by means of an adhesive or an ultrasonic welding or a heat-sealing process. Part 1A of the housing is then applied and secured to part 1B of the housing.

The end portion 11A of part 11 of the spindle of Fig. 4 rotatably fits into the cylindrical aperture 14

moulded into the part 1A of the housing.

Claims

1. A process for the production of a rotary electrical potentiometer comprising: a housing (1A, 1B); an arcuate electrical resistance track (2) supported in the housing; spindle means (10, 11) supported for rotation in the housing and adapted to be rotated by means external to the housing; electrically conductive wiper means (15) secured to the spindle means and adapted to traverse the resistance track when the spindle is rotated; electrically conductive terminal means (7, 8) supported in the housing and electrically connected to ends of the resistance track and to the wiper; said process being characterised by:

(a) providing the spindle means in the form of a first part (10) which is adapted to be rotated by the means external to the housing, and a second part (11) to which is secured the wiper means (15), the first and second parts being mutually engageable such that one part is rotatable about the other;

(b) locating the mutually engaged first and second parts of the spindle in the housing and effecting relative rotation between the parts such that, with the first part in a predetermined position of rotation relative to the housing, the wiper means secured to the second part is arranged to be in a required position with respect to the resistance track;

(c) securing together the first and second parts against further mutual rotation.

2. A process according to Claim 1, characterised in that the first and second parts of the spindle are each provided with a cylindrical portion (10B, 11A), the cylindrical portions being mutually engageable such that one fits inside the other.

3. A process according to Claim 1 or 2, characterised in that the first and second parts of the spindle are provided of a thermoplastics material and are secured together by ultasonic welding or heat sealing.

4. A process according to Claim 1 or 2, characterised in that the first and second parts of the spindle are secured together by means of an adhesive or by one or more screws.

5. A process according to any preceding claim, characterised in that the housing is provided as two parts (1A, 1B) to facilitate assembly.

6. A process according to any preceding claim, characterised in that a spring means (16) is provided, cooperating between the housing and the spindle means and adapted and arranged to return the wiper means to a predetermined rest position when the spindle means is released after being rotated.

7. A process according to any preceding claim, characterised in that the spindle means incorporates a third part (20) which is adapted to be combined with the first and second parts and relatively rotatable with respect to one or both thereof during assembly, the third part (20) being subsequently secured against further movement relative to the first and/or second parts after being set to a desired position and arranged to cooperate with the housing to provide an end stop for the wiper means relative to the resistance track.

8. A process according to Claim 7, characterised in that the third part is secured by the same means as is used to secure together the first and second parts of the spindle.

9. A process according to any preceding claim, characterised in that two resistance tracks and two associated wiper means (15A, 15B) are provided and the second part of the spindle means comprises two relatively rotatable sections (11C, 11D), each section having a wiper means secured thereto, the two sections being rotated relative to one another and to the first part of the spindle means, when the mutually engaged first and second parts are located in the housing, until both wiper means are in required positions with respect to their associated resistance tracks, the two sections then being secured against further relative rotation and the second part of the spindle means, which they constitute, is secured together with the first part of the spindle means.

10. A process according to any preceding claim, characterised in that a voltage is applied to the terminals connected to the ends of the track and an output voltage measured at the terminal connected to the wiper means while the relative rotational position of the first and second parts of the spindle is being set, the two parts being secured against further rotation relative to one another when a desired output voltage is obtained at a predetermined position of rotation of the first part of the spindle relative to the housing.

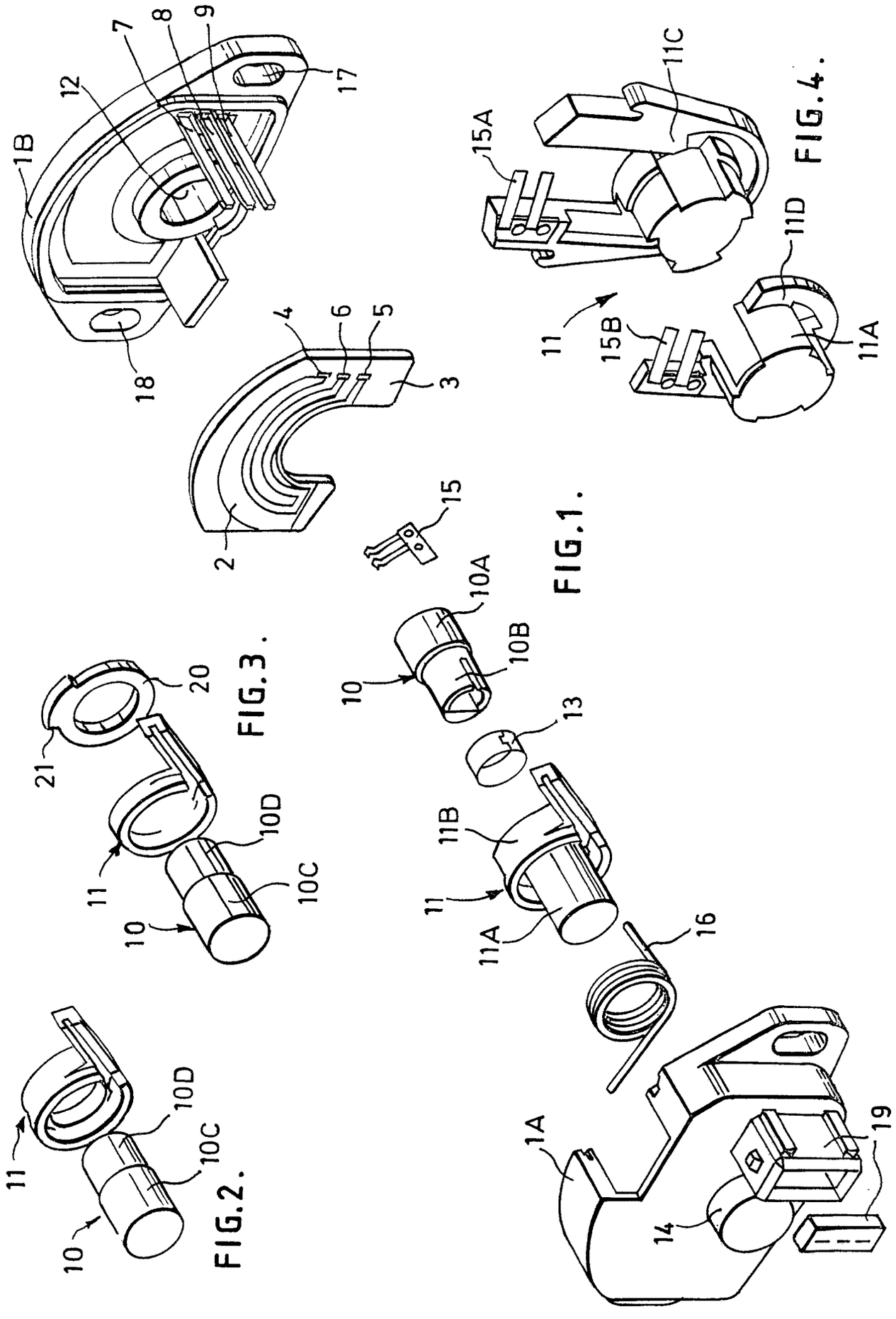

FIG.1.

FIG.2.

FIG.3.

FIG.4.