(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 339 968 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **13.04.94**

(51) Int. Cl.5: **H01C 17/00**, H01C 17/22, H01C 10/32

(21) Application number: **89304156.6**

(22) Date of filing: **26.04.89**

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

(30) Priority: **29.04.88 GB 8810323**

(43) Date of publication of application:
02.11.89 Bulletin 89/44

(45) Publication of the grant of the patent:
13.04.94 Bulletin 94/15

(84) Designated Contracting States:
DE FR GB IT SE

(56) References cited:
EP-A- 0 096 948
EP-A- 0 099 821
EP-A- 0 229 446
GB-A- 1 320 762
LU-A- 42 896

(73) Proprietor: **CRYSTALATE ELECTRONICS LIMITED**
Wharf House
Medway Wharf Road
Tonbridge Kent TN9 1RE(GB)

(72) Inventor: **Swindell, Harold Victor**
10 Hawksway
Basildon Essex SS16 5JO(GB)
Inventor: **Norburn, David William**
7 Church View
Upminster Essex RM14 2OX(GB)

(74) Representative: **Gallafent, Richard John**
GALLAFENT & CO.
8 Staple Inn
London WCIV 7OH (GB)

Rank Xerox (UK) Business Services
(3.10/3.09/3.3.3)

Description

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. Our EP-A-0 229 446 discloses a rotary potentiometer in which the angular position of an arcuate resistance track is adjustable through a limited angle relative to a rotary actuating lever before both are secured together. In the present invention, a two-part spindle is used giving much-greater freedom of relative movement during initial calibration.

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

(a) providing the spindle 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 the wiper (15) is secured, the first and second parts being mutually engageable such that one part is rotatable relatively to the other;

(b) locating the mutually-engaged first and second parts of the spindle in the housing;

(c) applying a voltage across the terminals connected to the ends of the track;

(d) measuring the output voltage at the terminal connected to the wiper while rotating the two parts of the spindle relatively to each other, and

(e) securing together the two parts of the spindle against further relative rotation when a desired output voltage is obtained at a predetermined position of rotation of the first part of the spindle relative to the housing.

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; a spindle (10, 11) supported for rotation in the housing and adapted to be rotated by means external to the housing; an electrically-conductive wiper (15) secured to the spindle and adapted to traverse the resistance track when the spindle is rotated; electrically conductive terminals (7, 8) supported in the housing and electrically connected to the ends of the resistance track and to the wiper; the process comprising :

(a) providing the spindle 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 the wiper (15) is secured, the first and second parts being mutually engageable such that one part is rotatable relatively to the other;

(b) locating the mutually-engaged first and second parts of the spindle in the housing;

(c) applying a voltage across the terminals connected to the ends of the track;

(d) measuring the output voltage at the terminal connected to the wiper while rotating the two parts of the spindle relatively to each other, and

(e) securing together the two parts of the spindle against further relative rotation when a desired output voltage is obtained at a predetermined position of rotation of the first part of the spindle relative to the housing.

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 of a thermoplastics material and are to be secured together by ultrasonic 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 in two parts (1A, 1B) to facilitate assembly.

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

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

8. A process according to Claim 7, characterised in that the third part is secured by means similar to those 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 wipers (15A, 15B) are provided, and in that the second part of the spindle comprises two relatively-rotatable sections (11C, 11D), each section having a wiper secured thereto, the two sections being rotatable relative to one another and to the first part of the spindle, when the mutually-engaged first and second parts are located in the housing, until both wipers 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, which they constitute, is secured to the first part of the spindle.

Patentansprüche

1. Verfahren zur Herstellung eines elektrischen Drehpotentiometers mit: einem Gehäuse (1A, 1B), einer gebogenen elektrischen Widerstandsbahn (2), die in dem Gehäuse gelagert ist; einer Welle (10, 11), die in dem Gehäuse drehbar gelagert und durch außerhalb des Gehäuses liegende Mittel drehbar ist; einem elektrisch leitenden Schleifer (15), der an der Welle befestigt ist und auf der Widerstandsbahn entlanggleitet, wenn die Welle gedreht wird; elektrisch leitenden Anschlüssen (7, 8), die in dem Gehäuse gelagert und mit den Enden der Widerstandsbahn und dem Schleifer verbunden sind; wobei das Verfahren umfaßt:

a) die Ausbildung der Spindel in Form eines ersten Teils (10), der durch die außerhalb des Gehäuses liegenden Mittel drehbar ist, und eines zweiten Teils (11), an dem der Schleifer (15) befestigt ist, wobei der erste und der zweite Teil derart gegenseitig in Eingriff bringbar sind, daß der eine Teil relativ zu dem anderen drehbar ist;

b) das Anordnen der gegenseitig in Eingriff gebrachten beiden Teile der Spindel in dem Gehäuse;

c) das Anlegen einer Spannung an den mit den Enden der Widerstandsbahn verbundenen Anschlüssen;

d) das Messen der Ausgangsspannung an dem mit dem Schleifer verbundenen Anschluß, während die beiden Teile der Welle relativ zueinander gedreht werden, und

e) das Verbinden der beiden Teile der Spindel derart, daß sie nicht mehr relativ zueinander verdrehbar sind, wenn eine gewünschte Ausgangsspannung in einer vorbestimmten Drehwinkelstellung des ersten Teils der Welle relativ zu dem Gehäuse erreicht ist.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der erste und zweite Teil der Spindel jeweils mit einem zylindrischen Teil (10B, 11A) versehen werden, wobei die zylindrischen Teile derart miteinander in Eingriff bringbar sind, daß der eine passend im anderen sitzt.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der erste und zweite Teil der Welle aus thermoplastischem Material bestehen und durch Ultraschallschweißung oder Heißverkleben fest miteinander verbunden werden.

4. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der erste und zweite Teil der Welle durch Klebstoff oder ein oder mehrere Schrauben fest verbunden werden.

5. Verfahren nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß das Gehäuse in zwei Teilen (1A, 1B) ausgebildet wird, um den Zusammenbau zu erleichtern.

6. Verfahren nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß eine Feder (16) zwischen dem Gehäuse und der Welle vorgesehen und so ausgebildet und angeordnet wird, daß sie den Schleifer in eine vorbestimmte Ruhelage zurückdrehen kann, wenn die Welle freigegeben wird, nachdem sie gedreht worden ist.

7. Verfahren nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Welle einen dritten Teil (20) aufweist, der mit dem ersten und zweiten Teil kombiniert werden kann und relativ zu dem einen oder beiden Teilen während des Zusammenbaus drehbar ist, wobei der dritte Teil, nachdem er in eine vorbestimmte Lage gebracht worden ist, relativ zu dem ersten und/oder zweiten Teil unbeweglich befestigt und so ausgebildet wird, daß er mit dem Gehäuse zusammenwirkt, um einen Endanschlag für den Schleifer relativ zu der Widerstandsbahn zu bilden.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß der dritte Teil durch Mittel befestigt wird, die denen ähnlich sind, die zum festen Verbinden des ersten und zweiten Teils

der Welle verwendet werden.

9. Verfahren nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß zwei Widerstandsbahnen und zwei zugehörige Schleifer (15A, 15B) vorgesehen werden und daß der zweite Teil der Welle zwei relativ zueinander drehbare Abschnitte (11C, 11D) aufweist, an denen jeweils ein Schleifer befestigt wird, wobei die beiden Abschnitte relativ zueinander und zu dem ersten Teil der Welle drehbar sind, wenn der erste und zweite Teil, nachdem sie gegenseitig in Eingriff gebracht worden sind, in dem Gehäuse angeordnet sind, bis beide Schleifer die gewünschten Stellungen relativ zu ihrer zugeordneten Widerstandsbahn einnehmen, wonach die beiden Abschnitte gegen eine weitere relative Drehung fest verbunden werden und der zweite Teil der Welle, den sie bilden, an dem ersten Teil der Welle befestigt wird.

Revendications

1. Un procédé de production d'un potentiomètre électrique rotatif comprenant: un boîtier (1A, 1B); une piste incurvée de résistance électrique (2) supportée dans le boîtier; une broche (10, 11) supportée à rotation dans le boîtier et apte à être tournée par un moyen externe au boîtier; un frotteur électriquement conducteur (15) fixé à la broche et apte à balayer la piste de résistance lorsque la broche est tournée; des bornes électriquement conductrices (7, 8) supportées dans le boîtier et reliées électriquement aux extrémités de la piste de résistance et au frotteur; le procédé comprenant les étapes consistant à:

   (a) réaliser la broche sous la forme d'un premier élément (10) qui est apte à être tournée par le moyen externe de boîtier, et une deuxième partie (11) à laquelle le frotteur (15) est fixé, la première et la deuxième parties pouvant venir en prise entre elles d'une manière telle qu'une partie puisse tourner l'une par rapport à l'autre;

   (b) positionner dans le boîtier les première et deuxième parties, en prise entre elles, de la broche;

   (c) appliquer une tension aux bornes des broches reliées aux extrémités de la piste;

   (d) mesurer la tension de sortie à la borne reliée au frotteur tout en faisant tourner les deux parties de la broche l'une par rapport à l'autre, et

   (e) fixer entre elles les deux parties de la broche pour s'opposer à une poursuite d'une rotation relative lorsqu'une tension de sortie souhaitée est obtenue à une position prédéterminée de rotation de la première partie de la broche par rapport au boîtier.

2. Un procédé selon la revendication 1, caractérisé en ce que la première et la deuxième parties de la broche comportent chacune une partie cylindrique (10B, 11A), les parties cylindriques pouvant venir en prise entre elles d'une manière telle que l'une s'ajuste à l'intérieur de l'autre.

3. Un procédé selon la revendication 1 ou 2, caractérisé en ce que la première et la deuxième parties de la broche sont en matière thermoplastique et doivent être fixées entre elles par soudage ultrasonique ou par scellement à chaud.

4. Un procédé selon la revendication 1 ou 2, caractérisé en ce que la première et la deuxième parties de la broche sont fixées entre elles au moyen d'un adhésif ou par une ou plusieurs vis.

5. Un procédé selon l'une des revendications précédentes quelconque, caractérisé en ce que le boîtier est disposé en deux parties (1A, 1B) afin de faciliter le montage.

6. Un procédé selon une revendication précédente quelconque, caractérisé en ce qu'un ressort (16) est disposé entre le boîtier et la broche et est adapté et agencé de façon à ramener le frotteur à une position de repos prédéterminée lorsque la broche est libérée après avoir été tournée.

7. Un procédé selon une revendication précédente quelconque, caractérisé en ce que la broche incorpore une troisième partie (20) qui est apte à être combinée avec la première et la deuxième parties, et qui peut tourner au cours du montage par rapport à l'une des parties ou par rapport à l'une et l'autre, la troisième partie (20) étant ensuite fixée pour empêcher une poursuite d'un mouvement relatif vis-à-vis de la première et/ou de la deuxième parties lorsqu'elle a été positionnée à une position souhaitée, et étant agencée pour coopérer avec le boîtier de façon à constituer un arrêt final du frotteur vis-à-vis de la piste de résistance.

8. Un procédé selon la revendication 7, caractérisé en ce que la troisième partie est fixée par un moyen semblable à ceux qui sont utilisés pour fixer l'une à l'autre la première et la deuxième parties de la broche.

9. Un procédé selon une revendication précédente quelconque, caractérisé en ce que deux pistes de résistance et deux frotteurs associés (15A, 15B) sont prévus, et en ce que la deuxième partie de la broche comprend deux sections qui peuvent tourner l'une par rapport à l'autre (11C, 11D), un frotteur étant fixé à chacune des sections, les deux sections pouvant tourner l'une par rapport à l'autre et par rapport à la première partie de la broche, lorsque la première et la deuxième parties en prise entre elles sont positionnées dans le boîtier, jusqu'à ce que les deux frotteurs soient dans les positions nécessaires vis-à-vis de leurs pistes associées de résistance, les deux sections étant ensuite fixées pour empêcher une poursuite d'une rotation relative, et la deuxième partie de la broche, qu'elles constituent, est fixée à la première partie de la broche.

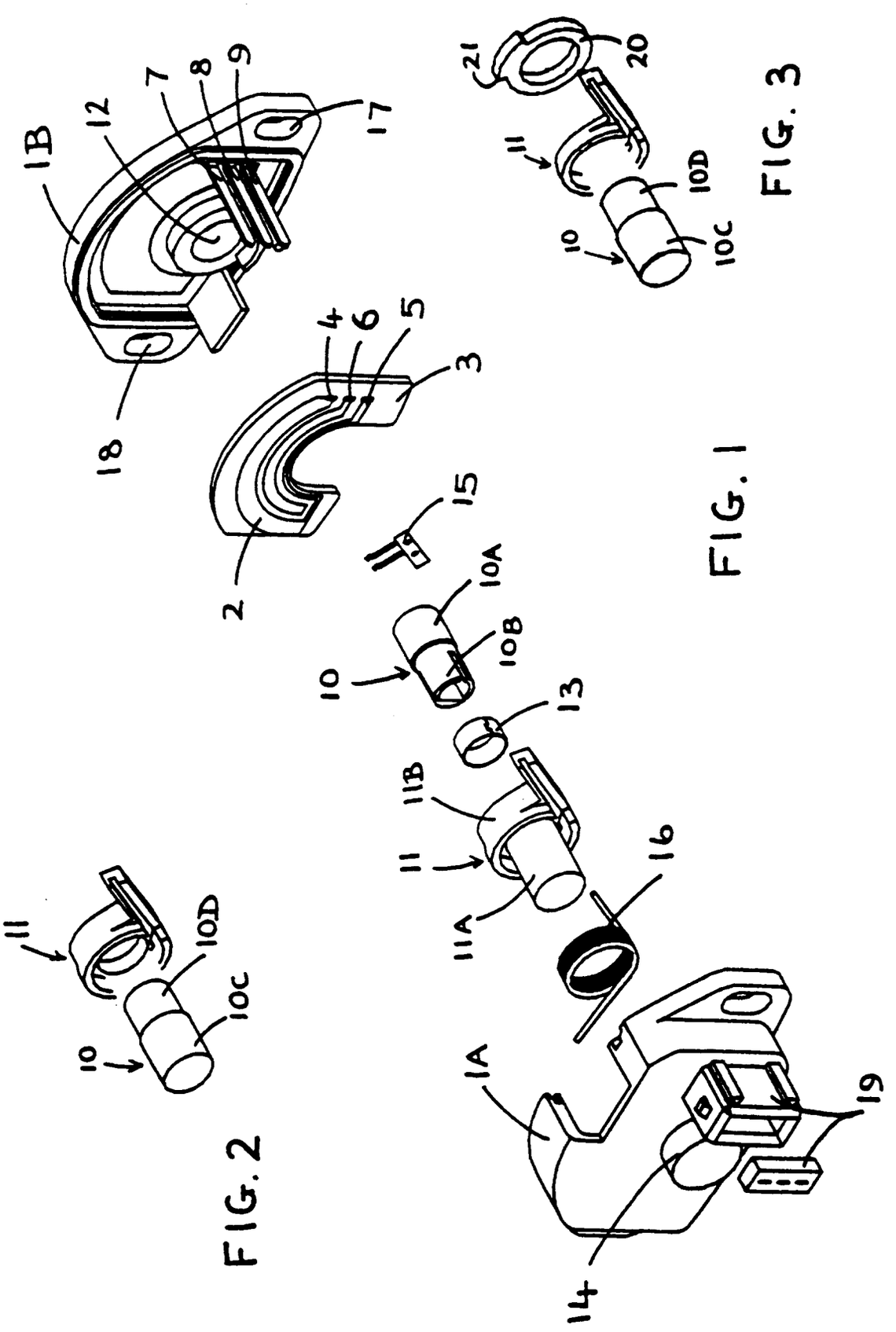

FIG. 1

FIG. 2

FIG. 3

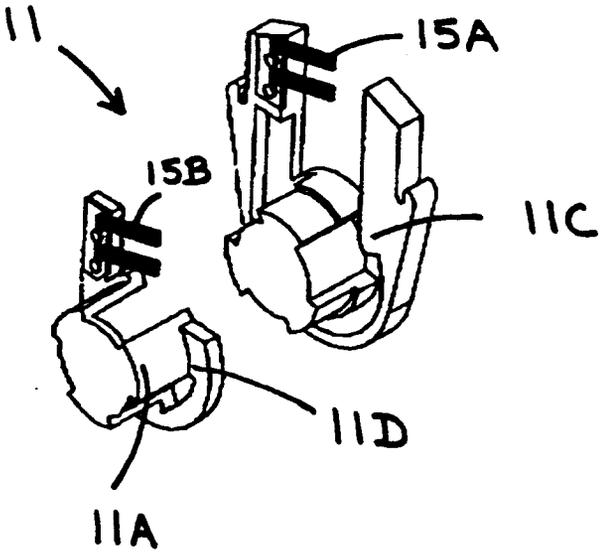

FIG. 4