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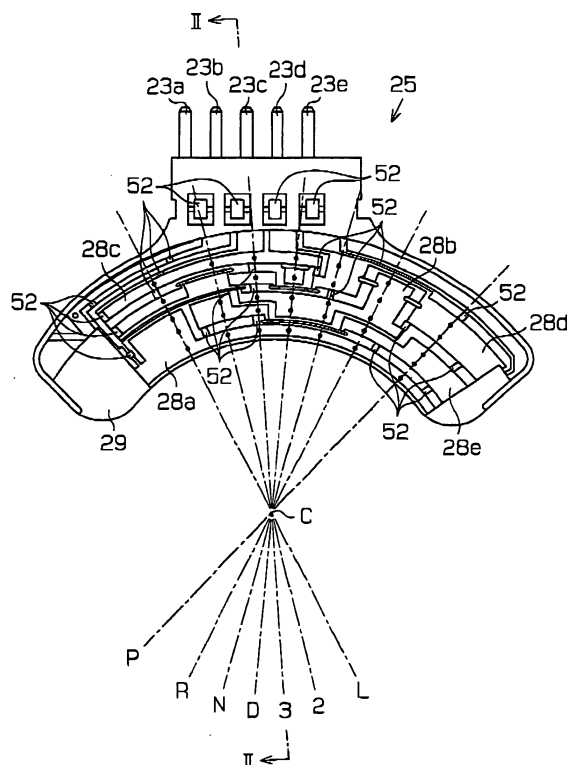
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(54) **Substrate and manufacturing method thereof**

(57) The slide switch (15) includes five fixed contact points (28a to 28e) and five movable contact points (32a). The movable contact points (32a) slide along the fixed contact points (28a to 28e) to switch the connection state with the fixed contact points (28a to 28e). A substrate (25) for the slide switch (15) has the fixed contact points (28a to 28e) and terminals (23a to 23e), each of which is electrically connected to one of the fixed contact points (28a to 28e). Each fixed contact point (28a to 28e) and the corresponding terminal (23a to 23e) are integrally formed. According to the substrate (25), a process to connect each fixed contact point (28a to 28e) to the corresponding terminal (23a to 23e) is omitted. Therefore, the number of manufacturing processes for the substrate (25) is reduced.

Fig.1



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a substrate and a method for manufacturing the substrate. More specifically, the present invention pertains to a substrate for a slide switch that has fixed contact points and movable contact points, which slide along the fixed contact points to switch the connection state with the fixed contact points, and to a method for manufacturing the substrate.

[0002] A slide switch is used as, for example, a shift position switch for detecting the position of a shift lever. Fig. 8 shows a conventional substrate for a shift position switch, which is a printed circuit board (PCB) 80. The PCB 80 has a substantially arcuate insulated substrate 86. Five fixed contact points 82, which are made of copper foil, are located on the surface of the insulated substrate 86. As shown in Fig. 9, each fixed contact point 82 projects from the surface of the insulated substrate 86. In this example, the thickness of each fixed contact point 82 is 35 μ m. Five connecting portions 81 are located at the center of the outer circumference of the insulated substrate 86. Each connecting portion 81 is electrically connected to one of the fixed contact points 82. As shown in Fig. 10, a terminal 85 is connected to each connecting portion 81 by soldering. The terminals 85 are connected to a controller (not shown), which controls an automatic transmission and an indicator. The terminals 85 are supported by a housing 84, which accommodates the PCB 80.

[0003] When the shift lever is manipulated to shift the transmission to a predetermined connection state, leaf springs, which are five movable contact points 83 (see Fig. 8), are rotated about the center C while sliding along the surface of the PCB 80. The movable contact points 83 contact all or some of the fixed contact points 82 in accordance with the position of the shift lever. The shift position switch sends signals corresponding to the fixed contact points 82 to which the movable contact points 83 contact to the controller via the terminals 85. The controller controls the operation of the automatic transmission and the indicator by determining the position of the shift lever based on the output signals.

[0004] However, since each fixed contact point 82 needs to be secured to one of the terminals 85 at the corresponding connecting portion 81 by soldering, the processes for manufacturing the PCB 80 are increased.

[0005] Also, the fixed contact points 82 are easily worn out. This is because since the fixed contact points 82 project from the surface of the insulated substrate 86, the movable contact points 83 hit the edges Y of the fixed contact points 82 when sliding along the surface of the PCB 80. Wear of the fixed contact points 82 causes improper contact between the fixed contact points 82 and the movable contact points 83 such as chattering. In addition, as shown in Fig. 9, when each movable con-

tact point 83 moves from the insulated substrate 86 to one of the fixed contact points 82, a portion of the movable contact point 83 other than the actual contact point X contacts the edge Y of the fixed contact point 82. Therefore, the distance S between the actual contact point X of the movable contact point 83 and the edge Y of the fixed contact point 82 needs to be always taken into consideration when designing the PCB 80. To solve these problems, the edges Y of the fixed contact points 82 may be chamfered by a buffed finish. However, this increases the manufacturing cost and is thus impractical.

SUMMARY OF THE INVENTION

[0006] Accordingly, it is an objective of the present invention to provide a substrate that reduces the number of manufacturing processes and a method for manufacturing the substrate.

[0007] To achieve the above objective, the present invention provides a substrate for a slide switch. The slide switch has a plurality of fixed contact points and a movable contact point, which slides along the fixed contact points to switch the connection state with the fixed contact points. The substrate includes the fixed contact points and a plurality of terminals, each of which is electrically connected to one of the fixed contact points. The substrate is characterized in that each of the fixed contact points and the corresponding terminal are integrally formed.

[0008] The present invention also provides a method for manufacturing the substrate according to claim 1. The method includes: forming a lead frame by pressing a metal plate, wherein the lead frame includes a plurality of lead pieces and a plurality of tie bars, which connect the lead pieces with each other, and wherein each lead piece includes a portion corresponding to the fixed contact points and a portion corresponding to the terminals; insert molding a molded body by filling a mold, in which the lead frame is set, with nonconductive resin; and cutting the tie bars by forming through holes at portions of the molded body corresponding to the tie bars.

[0009] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a plan view illustrating a substrate according to one embodiment of the present invention;

Fig. 2 is a cross-sectional view taken along line II-II in Fig. 1;

Fig. 3 is an exploded perspective view illustrating a shift position switch on which the substrate shown in Fig. 1 is mounted;

Fig. 4 is a schematic view illustrating a shift apparatus, which has the shift position switch shown in Fig. 3, and devices connected to the shift position switch;

Figs. 5(a) and 5(b) are partial cross-sectional views illustrating the substrate shown in Fig. 1;

Fig. 6 is a plan view illustrating a lead frame used for manufacturing the substrate shown in Fig. 1;

Fig. 7 is a plan view illustrating the lead frame shown in Fig. 6 partially sealed with resin;

Fig. 8 is a plan view illustrating a prior art substrate for a shift position switch; and

Figs. 9 and 10 are partial cross-sectional views illustrating the substrate shown in Fig. 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] A substrate 25 according to a preferred embodiment of the present invention will now be described with reference to Figs. 1 to 7. The substrate 25 is used for a shift position switch 15.

[0012] As shown in Fig. 4, the shift position switch 15 is arranged in a shift apparatus 11, which is located on a floor console of a vehicle. The shift apparatus 11 includes a shift lever 12, a housing 13, a lid 14, and the shift position switch 15. The top of the housing 13 is open and is closed by the lid 14. The lid 14 has a shift gate 14a, which extends straight. The shift lever 12 projects upward from the shift gate 14a and is shifted along the shift gate 14a. Indications representing the shift position of the shift lever 12 are shown next to the shift gate 14a. The indications include a parking (P) range, a reverse (R) range, a neutral (N) range, a drive (D) range, a third (3rd) range, a second (2nd) range, and a low (L) range.

[0013] A rotary shaft 17 is supported by the proximal end of the shift lever 12. The rotary shaft 17 extends in a direction perpendicular to the axis of the shift lever 12 and to the longitudinal direction of the shift gate 14a. When the shift lever 12 is shifted along the shift gate 14a, the rotary shaft 17 is rotated about its own axis.

[0014] The shift position switch 15 is supported by one end of the rotary shaft 17 and the inner wall of the housing 13. A controller 18 is electrically connected to the shift position switch 15. The controller 18 controls the operations of a transmission 19 and an indicator 20 based on output signals from the shift position switch 15. The indicator is located on, for example, an instrument panel inside the vehicle compartment and indicates the currently selected shift range.

[0015] The shift position switch 15 will be described below. As shown in Fig. 3, the shift position switch 15

includes a stator 21 and a rotor 22.

[0016] The stator 21 is substantially sectorial and is secured to the inner wall of the housing 13. A recess 21a having substantially the same sectorial shape as the stator 21 is formed in the stator 21. The substrate 25 is accommodated at the upper portion of the recess 21a. First connector terminals 23a to 23e extend from the substrate 25. The first connector terminals 23a to 23e are collected in an accommodating portion 24 located at the upper portion of the stator 21. Terminals 27 are located at a portion of the recess 21a lower than the substrate 25. Four second connector terminals 23f to 23i extend from the terminal 27. The second connector terminals 23f to 23i are also collected in the accommodating portion 24. An insert hole 21b is formed at the lower portion of the stator 21.

[0017] The rotor 22 is coupled to the rotary shaft 17 to rotate integrally with the rotary shaft 17. The rotor 22 has a shaft 31, which is coaxial with the rotary shaft 17 and has a first end 31a and a second end 31b. The outer circumferential surface of the first end 31a is threaded. The second end 31b is rotatably inserted in the insert hole 21b. The rotor 22 has five leaf springs 32 (only four is shown in Fig. 3), which are located in a direction perpendicular to the axis of the shaft 31. The distal end of each leaf spring 32 is branched into two and curved to describe an arc (see Figs. 5(a) and 5(b)). In the preferred embodiment, the distal end of each leaf spring 32 serves as a movable contact point 32a. The movable contact points 32a slide along the surface of the substrate 25 when the rotor 22 is rotated.

[0018] As shown in Fig. 1, the substrate 25 has a substantially arcuate shape. The substrate 25 has five fixed contact points 28a to 28e, which are electrically connected to the first connector terminals 23a to 23e, respectively. The fixed contact points 28a to 28e are adhered to the insulated substrate 29 made of polyamide. Portions of the fixed contact points 28a to 28e where the movable contact points 32a contact are flush with portions of the insulated substrate 29 where the movable contact points 32a moves along. As shown in Fig. 2, the fixed contact points 28a to 28e are thinner than the first connector terminals 23a to 23e. In the preferred embodiment, the thicknesses of the first connector terminals 23a to 23e are approximately 0.64mm and the thicknesses of the fixed contact points 28a to 28e are approximately 0.3mm. A projection 29a is located at the rear of the substrate 25 and fits in a hollow (not shown) formed in the recess 21a.

[0019] Fig. 6 shows a lead frame 40 used for manufacturing the substrate 25. The lead frame 40 includes five lead pieces 41. Each lead piece 41 includes an inner lead portion 41a, which corresponds to one of the fixed contact points 28a to 28e, and an outer lead portion 41b, which corresponds to one of the first connector terminals 23a to 23e. Each outer lead portion 41b extends from the end of the corresponding inner lead portion 41a. The lead pieces 41 are connected to each other by

first tie bars 42. The lead pieces 41 are connected to the frame 43, which surrounds the lead pieces 41 by second tie bars 44.

[0020] To manufacture the substrate 25, a metal plate is pressed to form the lead frame 40. The metal plate has a portion that corresponds to the inner lead portions 41a and a portion that corresponds to the outer lead portion 41b. The portion of the metal plate that corresponds to the inner lead portions 41a is thinner than the portion of the metal plate that corresponds to the outer lead portions 41b.

[0021] A molded body 50 as shown in Fig. 7 is formed by an insert molding. More specifically, the lead frame 40 is set in a mold, which is not shown, and molten polyamide is filled in the mold. The mold is opened after the polyamide is hardened to obtain the molded body 50, which has the lead frame 40 partially sealed by a hardened polyamide 51. When the molded body 50 is insert molded, parts of the molded body 50 corresponding to the paths of the movable contact points 32a are made flat.

[0022] Subsequently, through holes 52 are formed at portions of the molded body 50 corresponding to the first tie bars 42 to cut the first tie bars 42. The second tie bars 44 are also cut to remove the frame 43. As a result, the substrate 25 as shown in Fig. 1 is obtained.

[0023] When the shift lever 12 is shifted along the shift gate 14a to bring the transmission 19 into a predetermined connection state, the rotor 22 is rotated about the axis of the rotary shaft 17. At this time, the movable contact points 32a are rotated about the center C while sliding along the surface of the substrate 25 (see Fig. 1). As a result, the movable contact points 32a contact all or some of the fixed contact points 28a to 28e in accordance with the shift position of the shift lever 12.

[0024] As shown in Fig. 1, when the shift lever 12 is shifted to the P range, the movable contact points 32a contact the fixed contact points 28a, 28e, and 28d. When the shift lever 12 is shifted to the R range, the movable contact points 32a contact the fixed contact points 28a, 28b, and 28e. When the shift lever 12 is shifted to the N range, the movable contact points 32a contact the fixed contact points 28a, 28b, and 28d. When the shift lever 12 is shifted to the D range, the movable contact points 32a contact the fixed contact points 28a, 28b, and 28c. When the shift lever 12 is shifted to the 3rd range, the movable contact points 32a contact the fixed contact points 28a to 28e. When the shift lever 12 is shifted to the 2nd range, the movable contact points 32a contact the fixed contact points 28a, 28c, and 28e. When the shift lever 12 is shifted to the L range, the movable contact points 32a contact the fixed contact points 28a, 28c, and 28d.

[0025] The shift position switch 15 sends signals corresponding to the fixed contact points 28a to 28e to which the movable contact points 32a contact to the controller 18 via the first connector terminals 23a to 23e. The controller 18 controls the operations of the trans-

mission 19 and the indicator 20 by determining the shift position of the shift lever 12 based on the output signals.

[0026] The advantages of the preferred embodiment will now be described.

[0027] The inner lead portions 41a, which correspond to the fixed contact points 28a to 28e, and the outer lead portions 41b, which correspond to the first connector terminals 23a to 23e, are manufactured using the lead frame 40, which is integrally formed in advance. Therefore, processes to connect each one of the fixed contact points 28a to 28e to the corresponding one of the first connector terminals 23a to 23e are unnecessary. This reduces the number of manufacturing processes of the substrate 25.

[0028] The portions of the fixed contact points 28a to 28e to which the movable contact points 32a contact are flush with the portions of the insulated substrate 29 that correspond to the paths of the movable contact points 32a. This reduces wear of the fixed contact points 28a to 28e caused when the movable contact points 32a slide between the position where the movable contact points 32a contact the insulated substrate 29 (see Fig. 5(a)) and the position where the movable contact points 32a contact the fixed contact points 28a to 28e (see Fig. 5(b)). Thus, improper contact between the movable contact points 32a and the fixed contact points 28a to 28e due to wear of the fixed contact points 28a to 28e is reduced. Also, it is not required to take into consideration that portions of the movable contact points 32a other than the actual contact points X contact the fixed contact points 28a to 28e when designing the substrate 25.

[0029] The fixed contact points 28a to 28e are thinner than the first connector terminals 23a to 23e. Therefore, the cost is reduced as compared to a case in which the fixed contact points 28a to 28e have the same thicknesses as the first connector terminals 23a to 23e.

[0030] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the invention may be embodied in the following forms.

[0031] In the first embodiment, the shift position switch 15 is located inside the shift apparatus 11. However, the shift position switch 15 may be located at other position of the vehicle such as the transmission 19.

[0032] The number of the fixed contact points 28a to 28e may be four or less, or six or more. The number of the first connector terminals 23a to 23e may also be four or less, or six or more. The number of the movable contact points 32a may also be four or less, or six or more.

[0033] The insulated substrate 29 may be formed of nonconductive material other than polyamide such as polybutylene terephthalate.

[0034] The shift apparatus 11 need not be located on the floor console. The shift apparatus 11 may be located on an instrument panel or a steering column.

[0035] The substrate 25 may be used for slide switch-

es other than the shift position switch 15.

[0036] Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

Claims

1. A substrate for a slide switch (15), wherein the slide (15) switch has a plurality of fixed contact points (28a to 28e) and a movable contact point (32a), which slides along the fixed contact points (28a to 28e) to switch the connection state with the fixed contact points (28a to 28e), and wherein the substrate includes the fixed contact points (28a to 28e) and a plurality of terminals (23a to 23e), each of which is electrically connected to one of the fixed contact points (28a to 28e), the substrate being **characterized in that**,
each of the fixed contact points (28a to 28e) and the corresponding terminal (23a to 23e) are integrally formed.
2. The substrate according to claim 1, **characterized in that** the thickness of each fixed contact point (28a to 28e) differs from the thickness of the corresponding terminal (23a to 23e).
3. The substrate according to claim 2, **characterized in that** each fixed contact point (28a to 28e) is thinner than the corresponding terminal (23a to 23e).
4. The substrate according to any one of claims 1 to 3, **characterized by** an insulated substrate (29) to which the fixed contact points (28a to 28e) are adhered,
wherein a portion of each fixed contact point (28a to 28e) where the movable contact point (32a) contact is flush with a portion of the insulated substrate (29) that corresponds to a path of the movable contact point (32a).
5. A method for manufacturing the substrate according to claim 1, the method being **characterized by**:
forming a lead frame (40) by pressing a metal plate,
wherein the lead frame (40) includes a plurality of lead pieces (41) and a plurality of tie bars (42), which connect the lead pieces (41) with each other, and wherein each lead piece (41) includes a portion (41a) corresponding to the fixed contact points (28a to 28e) and a portion (41b) corresponding to the terminals (23a to 23e);
insert molding a molded body (50) by filling a

mold, in which the lead frame (40) is set, with non-conductive resin; and

cutting the tie bars (42) by forming through holes (52) at portions of the molded body (50) corresponding to the tie bars (42).

6. The method according to claim 5, **characterized in that** the lead frame (40) is formed such that the thickness of the portion (41a) of each lead piece (41) corresponding to one of the fixed contact points (28a to 28e) differs from the thickness of the portion (41b) of each lead piece (41) corresponding to one of the terminals (23a to 23e).
7. The method according to claim 6, **characterized in that** the lead frame (40) is formed such that the portion (41a) of each lead piece (41) corresponding to one of the fixed contact points (28a to 28e) is thinner than the portion (41b) of the lead piece (41) corresponding to one of the terminals (23a to 23e).
8. The method according to any one of claims 5 to 7, **characterized in that** the molded body (50) is insert molded such that a portion of the molded body (50) corresponding to a path of the movable contact point (32a) is flat.

Fig.1

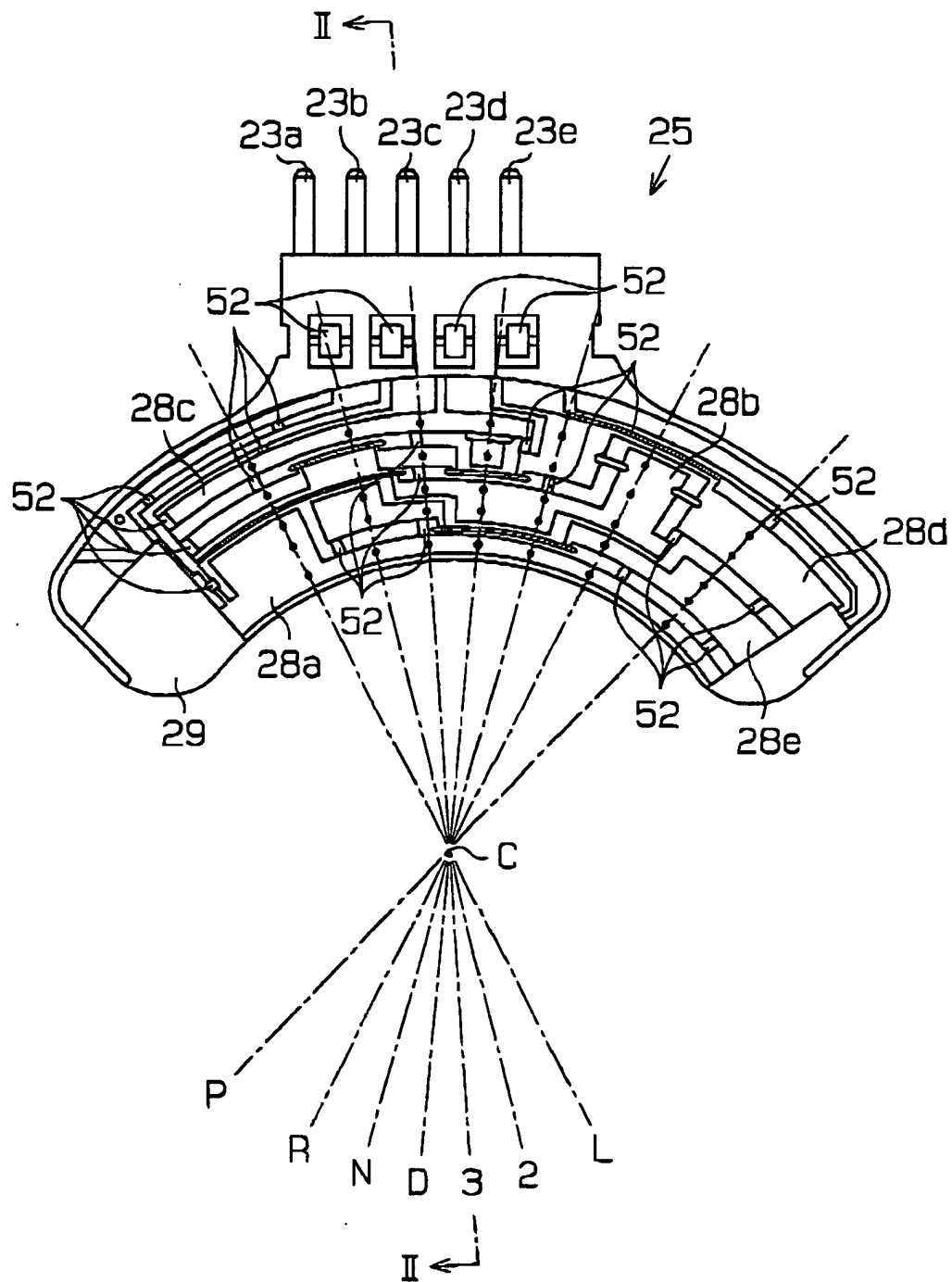


Fig. 2

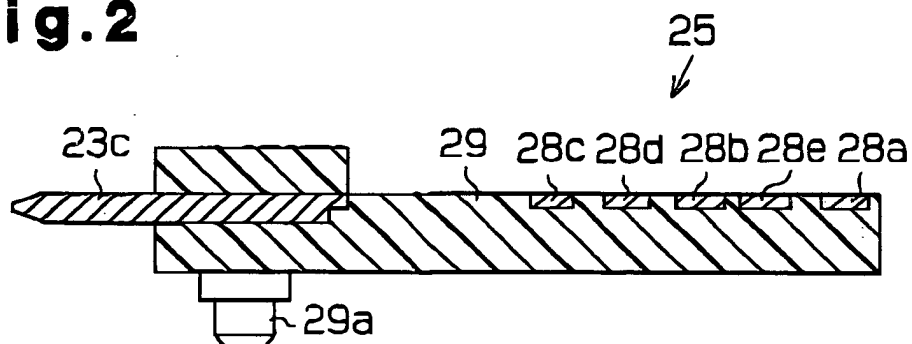


Fig. 3

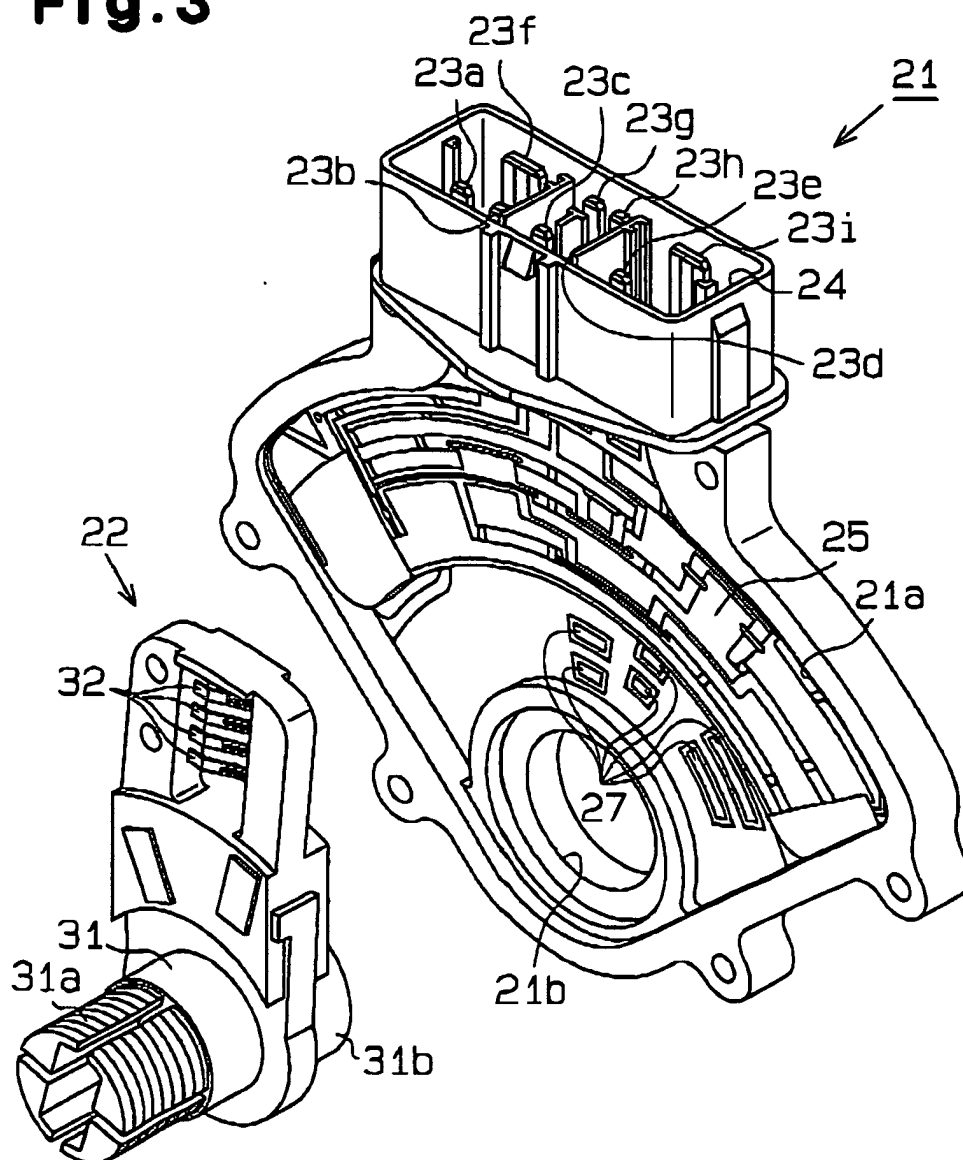


Fig. 4

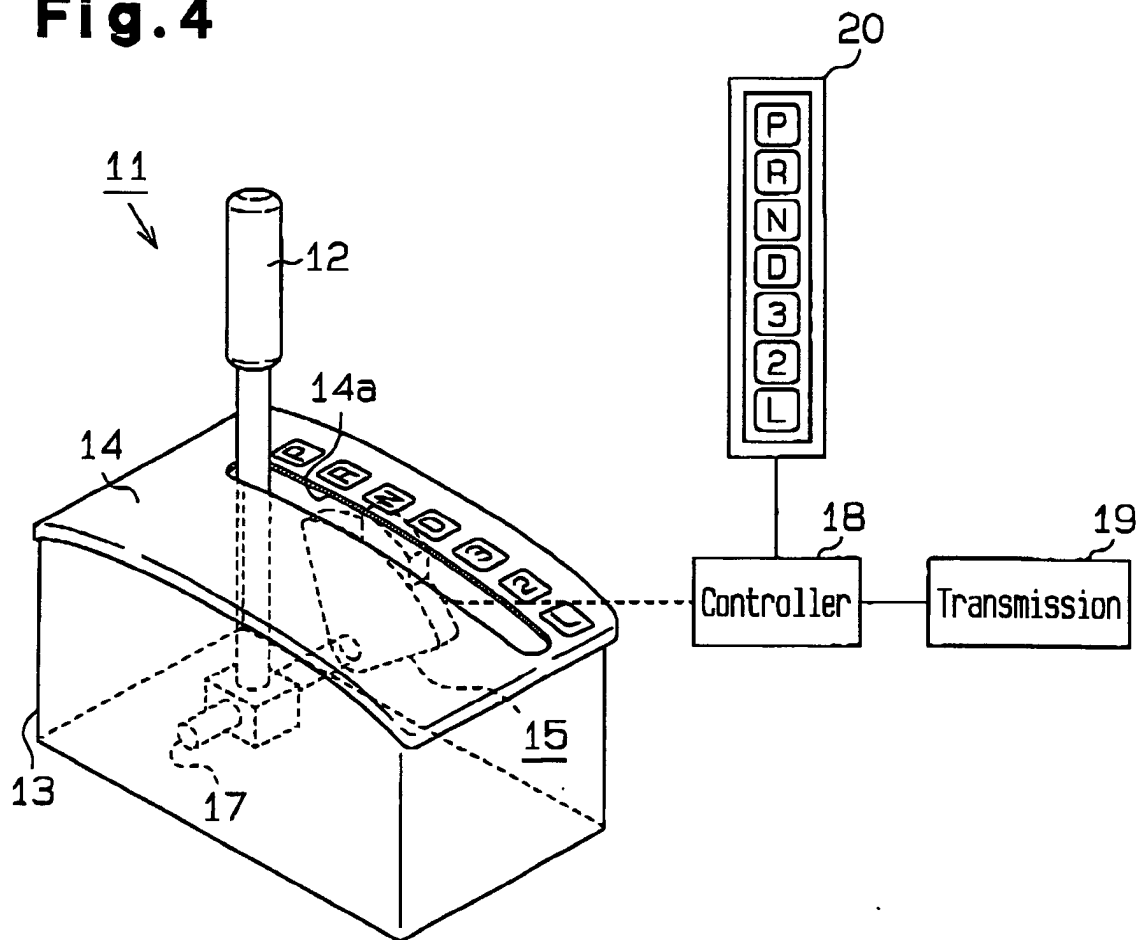


Fig. 5 (a)

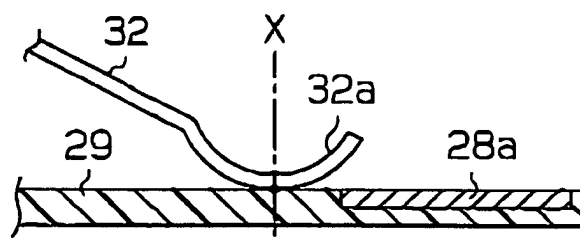


Fig. 5 (b)

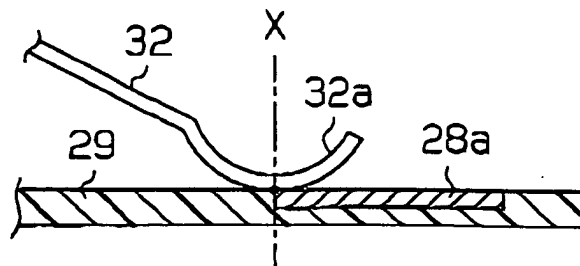


Fig.6

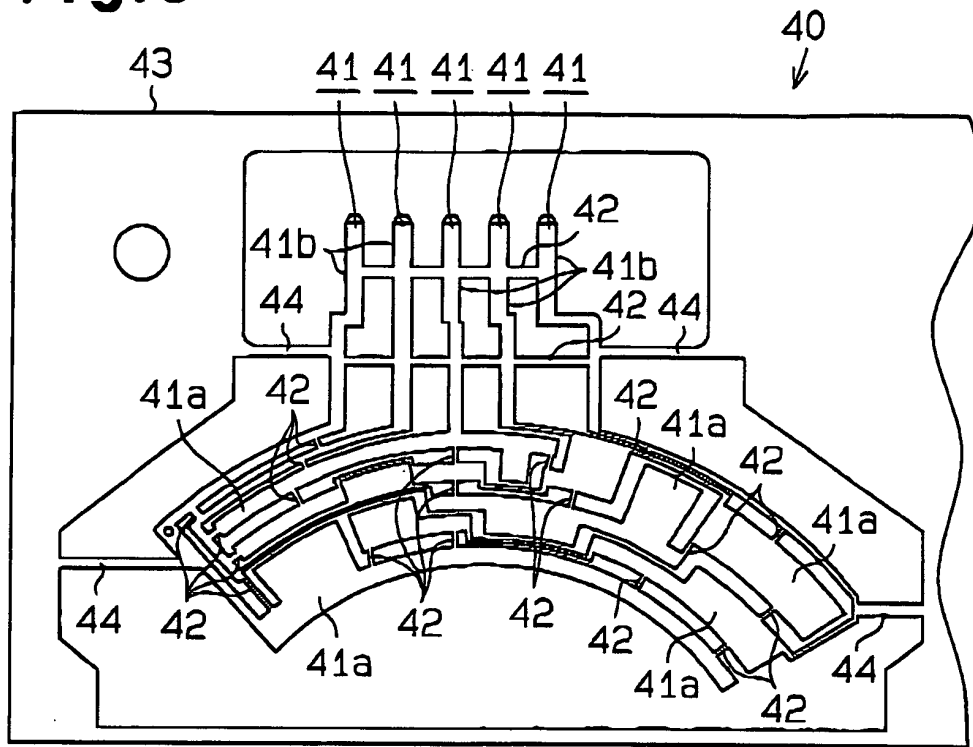


Fig.7

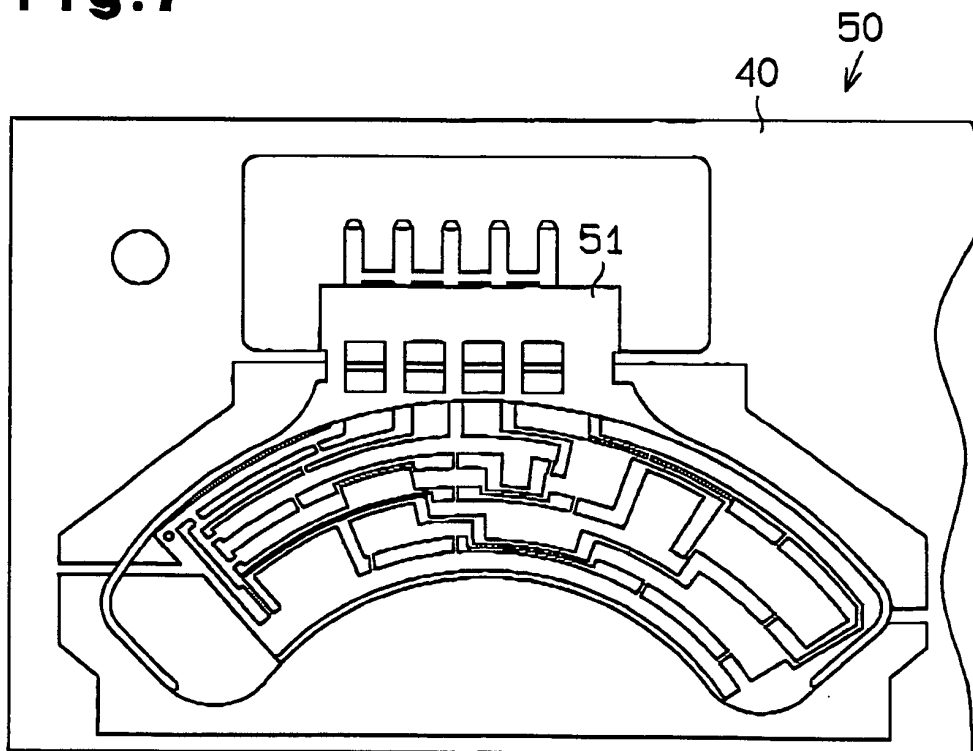


Fig. 8

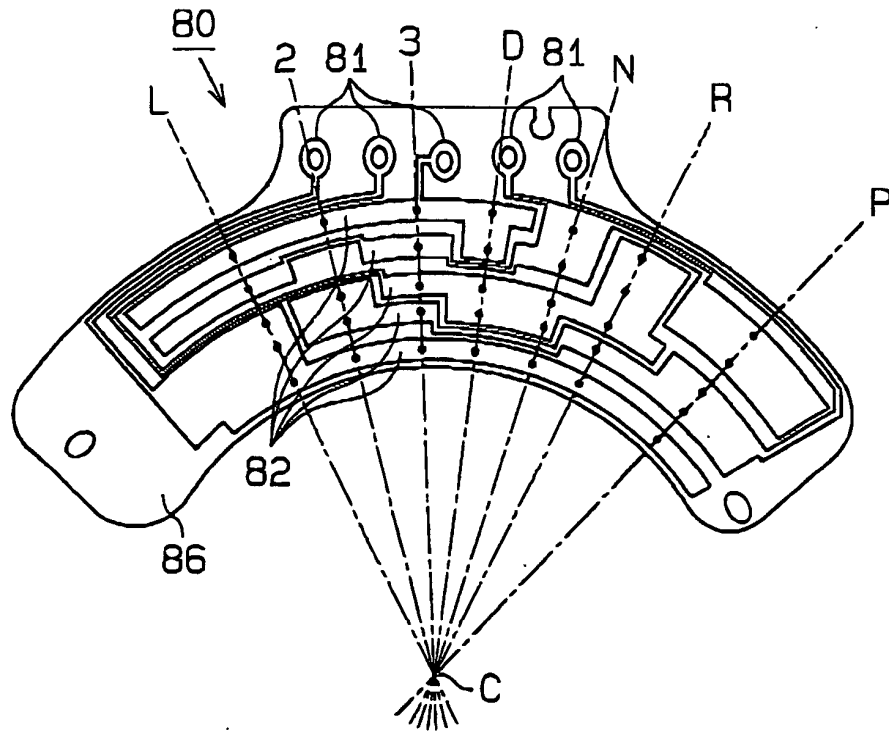


Fig. 9

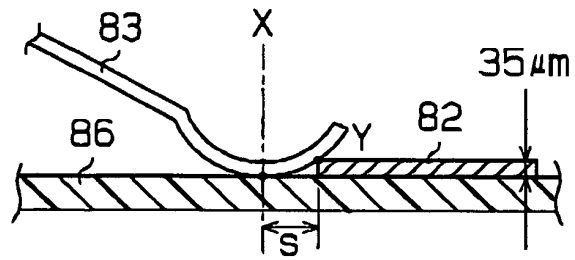


Fig. 10

