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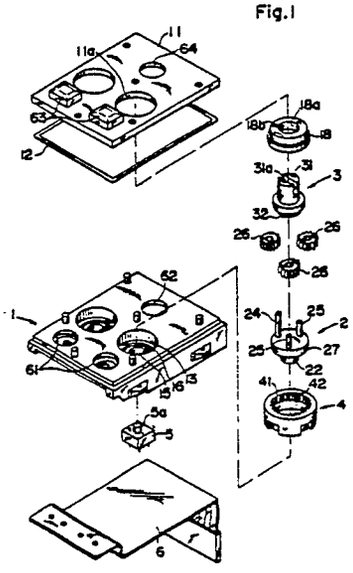
(54) Rotation operating device of variable resistor.

(57) A rotation operating device of a variable resistor comprises; a knob (3, 31) to apply a ratating force from the outside; intermediate gears (26) to transfer the rotating force of the knob to a sliding contact of a variable resistor 5); a ring member (4); an intermediate rotating body (2); and a supporting body (1) to support them. A circular supporting concave portion (13) is formed on the supporting member. An annular groove (16) having both ends is formed on the bottom surface of the supporting concave portion. The both ends of the annular groove serves as stoppers (17). The knob has a gear (32) in its lower portion. The ring member is rotatably supported into the supporting concave portion and has a gear (41) formed on its upper inner peripheral surface and has a lower inner peripheral surface (42). The intermediate rotating body has on its upper surface a position indicating portion (24) which can be seen from the outside and has shafts (24, 25) to rotatably support the intermediate gear so as to be come into engagement with the gear of the knob and with the gear of the ring member. Further, an outer peripheral surface (27) of the intermediate rotating body is come into frictional contact with a lower inner peripheral surface (42) of the ring member. A projecting portion (23) adapted to be movably fitted into the annular groove is formed on the lower surface of the rotating body. The intermediate rotating body is in engagement with the sliding contact of the variable resistor at the center of the lower surface.

Fig.1



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ROTATION OPERATING DEVICE OF VARIABLE RESISTOR

BACKGROUND OF THE INVENTION

The present invention relates to a rotation operating device to transfer the rotation of a knob to a sliding contact in a variable resistor in which the sliding contact is moved by rotating the knob to thereby continuously adjust or change a resistance value.

Such a kind of variable resistor is used as one of component parts such as various kinds of circuits, devices, and the like and is used to adjust their gains, sensitivities, or the like.

The rotation operating device of the variable resistor is mainly classified into a single rotating type and a multi rotating type. In the single rotating type, the resistance value is changed from the minimum value to the maximum value by rotating once the knob (strictly speaking, one rotation or less, that is, 360° or less). On the other hand, according to the multi rotating type, the knob is rotated once or more to change the resistance value from the minimum value to the maximum value.

In the rotation operating device of the single rotating type, the knob is merely come into engagement with the rotating portion of the sliding contact of the variable resistor. Therefore, when the knob is rotated to a position over a rotatable range, there is a fear such that the variable resistor and the rotation operating device are damaged. In addition, since the rotatable range of the knob is set to one rotation or less, it is difficult to finely adjust the resistance value.

According to the rotation operating device of the multi rotating type, a first gear is formed on the knob. On the other hand, a second gear larger than the first gear is provided for the rotating portion of the sliding contact of the variable resistor. The first and second gears are come into engagement with each other. The rotating speed of the knob is determined by the gear ratio of the first and second gears. In the multi rotating type, although the resistance value can be finely adjusted, the first and second gears must be arranged laterally, so that there is a disadvantage such that the structure increases in size. On the other hand, the knob is rotated a plurality of times and the rotation angle position of the knob does not coincide with the angle position of the sliding contact. Thus, there is a drawback such that it is difficult to know the position at which the sliding contact exists from the angle position of the knob.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a rotation operating device of the multi rotating type in which the device can be miniaturized, an angle position of a sliding contact can be clearly known, and even if a knob is rotated to a position over its limit range, it is hardly broken.

According to the present invention, there is provided a rotation operating device of a variable resistor, comprising: a knob to give a rotating force from the outside; intermediate gears to transfer the rotating force of the knob to a sliding contact of a variable resistor; a ring member; an intermediate rotating body: and a supporting member to support those components.

A circular supporting concave portion is formed on the supporting member. An annular groove having both ends is formed on the bottom surface of the supporting concave portion. The both ends of the annular groove are used as stoppers.

The knob has a gear in its lower portion.

The ring member is rotatably supported into the supporting concave portion and has a gear formed on its upper inner peripheral surface and has a lower inner peripheral surface.

A position indicating portion which can be seen from the outside is provided on the upper surface of the intermediate rotating body. The intermediate rotating body has shafts for rotatably supporting the intermediate gears so as to be come into engagement with the gear of the knob and with the gear of the ring member. Further, the outer peripheral surface of the intermediate rotating body is come into frictional contact with the lower inner peripheral surface of the ring member. A projecting portion adapted to be movably fitted into the annular groove is formed on the lower surface of the intermediate rotating body. At the center of the lower surface, the intermediate rotating body is in engagement with the sliding contact of the variable resistor.

According to the invention, the gear is formed on the inner peripheral surface of the ring member and the gear of the knob is in engagement with the gear of the ring member through the intermediate gears. Further, the lower inner peripheral surface of the ring member is come into contact with the outer peripheral surface of the intermediate rotating body in a state in which a frictional force can be generated. The sliding contact of the variable resistor is moved by the rotation of the intermediate rotating body. Therefore, the knob, intermediate rotating body, and variable resistor can be vertically arranged and the device can be miniaturized.

Since the rotation operating device is of the multi rotating type, even if the rotation angle of the

knob is large, a change in resistance value is relatively small and the resistance value can be finely adjusted.

Further, the rotation angle of the rotating portion of the sliding contact of the variable resistor certainly coincides with the rotation angle of the intermediate rotating body. The rotation angle position of the intermediate rotating body is indicated by the position of the position indicating portion. The position indicating portion can be seen by the eyes from the outside. Therefore, the position of the sliding contact of the variable resistor, that is, the resistance value can be clearly known.

The rotatable range of the knob is determined by the positions of the stoppers at both ends of the annular groove formed on the supporting concave portion of the holder. In other words, the positions at which the projecting portion which is movably fitted into the annular groove of the intermediate rotating body is come into contact with the stoppers correspond to the maximum and minimum values of the resistance value. The rotating force of the knob is transferred to the ring member through the intermediate gears. The rotating force of the ring member is transferred to the intermediate rotating body by the contact frictional force between the lower inner peripheral surface of the ring member and the outer peripheral surface of the intermediate rotating body. Therefore, when the knob reaches the limit angle position at which the projecting portion of the intermediate rotating body abuts on the stopper, even if the operator tries to further rotate the knob, a sliding state occurs between the ring member and the intermediate rotating body. The knob, intermediate gears, and ring member race, so that the intermediate rotating body does not rotate. Therefore, a breakage of the variable resistor or the like can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view showing a rotation operating device of the multi rotating type of a variable resistor according to an embodiment of the present invention;

Fig. 2 is an enlarged cross sectional view of the main section in the multi rotating type rotation operating device; and

Fig. 3 is an enlarged plan view showing a supporting concave portion of a casing.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Fig. 1 is an exploded perspective view showing a practical embodiment of a rotation operating device of a multi rotating type of a variable resistor according to the present invention.

Fig. 2 is an enlarged cross sectional view of the main section of the rotation operating device of the multi rotating type.

A variable resistor 5 is fixed to a printed circuit board 6 and is connected as a device for gain control or the like of an electric circuit, for instance, an amplifier assembled on the printed circuit board 6. The variable resistor 5 is of the type in which when its sliding contact (not shown) circularly moves (or rotates), a resistance value between the sliding contact and one terminal continuously changes. The variable resistor 5 has a rotating portion 5a to rotatably support the sliding contact.

The rotation operating device to circularly move (or rotate) the sliding contact through the rotating portion 5a of the variable resistor 5 includes: a casing 1; a knob 3; intermediate small gears 26; an intermediate rotating body 2; and a ring member 4.

A supporting concave portion 13 whose plan view has a circular shape is formed on the upper surface portion of the casing 1. A through hole 15 communicating with the inside of the casing 1 is opened at the center of a bottom surface 14 of the concave portion 13. As shown in a plan view of Fig. 3, an annular groove 16 is formed on the bottom surface 14 of the concave portion 13 at the outer periphery of the through hole 15. The annular groove 16 is not formed around a whole circle (360°) but has both ends. The both ends of the groove 16 are used as stair-like stoppers 17. The upper half portion of the through hole 15 has a circular cross sectional shape and a lower half portion 15a is formed in a square shape. The whole body of the variable resistor 5 is unrotatably enclosed and fixed into the lower half portion 15a.

The ring member 4 is rotatably enclosed in the supporting concave portion 13. Further, the intermediate rotating body 2 is rotatably fitted into the ring member 4. A shaft portion 22 which downwardly projects is formed at the center of the lower surface of the intermediate rotating body 2. The shaft portion 22 is rotatably fitted into the through hole 15 and is come into engagement with the rotating portion 5a of the variable resistor 5 at the lower portion of the shaft portion 22. Therefore, the rotating portion 5a of the variable resistor 5 rotates together with the intermediate rotating body 2. Due to this, the sliding contact of the variable resistor 5 circularly moves (or rotates) and the resistance value of the variable resistor 5 changes.

A shaft 23 which is loosely and movably fitted into the annular groove 16 is projected at a proper

position on the lower surface of the intermediate rotating body 2. Further, a shaft 24 to indicate the position of the sliding contact is also formed on the upper surface of the rotating body 2 at the same position as the shaft 23. Further, two gear shafts 25 are projectingly formed at angle positions which are away from the position indicating shaft 24 by 120°, respectively. The same small gears 26 are rotatably supported to the three shafts 24 and 25. The position indicating shaft 24 is formed so as to be longer than the other two shafts 25 and is projected to the outside of a through hole 18b of a cap 18 and can be seen by the eyes from the outside of the casing 1.

The upper portion of the shaft of the knob 3 is formed as an operating knob portion 31. A small gear 32 is provided for the lower portion of the shaft of the knob 3. The knob 3 is arranged at the center of the upper surface of the intermediate rotating body 2, that is, among the three small gears 26. The small gear 32 locating at the center is come into engagement with the three small gears (planet gears) 26. An edge portion of the operating knob portion 31 is projected to the outside from a through hole 18a of the cap 18. A rotation operating groove 31a is formed on the upper surface of the knob portion 31. The knob 3 is rotated by inserting the tip of a driver or the like into the groove 31a and rotating the knob portion 31.

A cover 11 is attached onto the casing 1 through a packing 12. A window hole lla is formed in the cover 11. The cap 18 is projected to the outside from the window hole lla. Therefore, both of the operating knob portion 31 of the knob 3 and the upper portion of the position indicating shaft 24 are also projected to the outside.

The ring member 4 has an inner diameter which substantially corresponds to the outer diameter of the intermediate rotating body 2. A gear 41 which circulates the peripheral surface is formed in the upper portion of the inner peripheral surface. A smooth surface 42 having a diameter which is fairly smaller than a diameter of gear 41 is formed in the lower portion of the inner peripheral surface of the ring member 4. In a state in which the rotating body 2 is fitted into the ring member 4, the smooth surface 42 of the lower portion of the inner peripheral surface is come into close contact with a peripheral surface 27 of the rotating body 2, that is, in a manner such that the rotating body 2 is rotatable to a certain degree due to the friction by the rotation of the ring member 4. The gear 41 of the upper portion of the inner peripheral surface of the ring member 4 is come into engagement with each of the small gears 26. A multi rotating mechanism is constructed by the gear 42 and the small gears 26.

The number of rotations of the knob portion 31 which is necessary to change the resistance value of the variable resistor 5 from the maximum value to the minimum value is determined by the gear ratios among the gears 32, 26, and 41. That is, the gear ratios are decided such that when the knob 3 is rotated more than once, the resistance value changes within its adjustable range. On the other hand, the gear ratios are set in a manner such that when the resistance value becomes the maximum value, the shaft 23 abuts on one of the stoppers 17 and when the resistance value becomes the minimum value, the shaft 23 is come into contact with the other stopper 17.

In Fig. 1, the foregoing variable resistor and its rotation operating device are provided at two positions. On the other hand, a hole 61 to enclose an indicator lamp (light emitting diode or the like) and a hole 62 to enclose a switch and the like are formed in the casing 1. In correspondence to the holes 61 and 62, an indicator lamp cover 63 and a hole 64 are provided for the cover 11.

When the resistance value of the variable resistor is adjusted by using the multi rotating type rotation operating device havig the foregoing construction, the operating knob portion 31 of the knob 3 is (forwardly) rotated. Thus, the three small gears (planet gears) 26 on the rotating body 2 which is come into engagement with the small gear 32 of the knob 3 are rotated. At the same time, the ring member 4 in which the gear portion 41 which is come into engagement with the three small gears 26 is provided in the upper portion of the inner peripheral surface is rotated in accordance with the gear ratios. The lower portion of the inner peripheral surface of the ring member 4 (the smooth surface 42 having no gear portion) is tightly fitted to the peripheral surface 27 of the rotating body 2. Therefore, when the ring member 4 rotates, the rotating body 2 rotates due to the contact frictional pressure. The rotating portion 5a of the variable resistor 5 communicating with the rotating body 2 rotates, so that the resistance value is finely adjusted. The position indicating shaft 24 on the rotating body 2 also circulates by the rotation of the ring member 4. Since the tip of the position indicating shaft 24 is projected from the casing 1 (cap 18), the rotating position of the sliding contact of the variable resistor 5 (that is, the adjustment position of the resistance value) can be seen from the outside. Now, assuming that the knob 3 was forwardly rotated a few rotation times and the rotating body 2 has rotated to the maximum resistance value point, the shaft 23 which moves in the annular groove 16 in association with the rotation of the rotating body 2 abuts on the edge of the groove 16, that is, the stopper 17. Thus, the subsequent forward rotation of the rotating body 2 is

blocked. Now, assuming that the knob 3 is further forwardly rotated against the stopper 17, the ring member 4 whose inner peripheral surface lower portion (smooth surface portion 42) is held in the contact relation with the peripheral surface 27 of the rotating body 2 which is in the fixed state by the stopper 17 is rotated in a slightly loaded state. That is, when the knob 3 is rotated to a position over a limit range, the rotating body 2 is not rotated and the knob 3, small gears 26, and ring member 4 race, so that the breakage of the variable resistor 5 is prevented.

On the contrary, when the knob 3 is reversely rotated in this state, the rotating body 2 is again reversely rotated toward the minimum resistance side by the frictional contact pressure between the ring member 4 and the rotating body 2 due to the engagement among the gear 41 of the ring member 4, the small gears 26 and the gear 32 of the knob 3. After the knob 3 reached the minimum resistance value point, the further rotation of the rotating body 2 is blocked by the stopper 17 on the other end of the annular groove 16 in a manner similar to the above. After that, the ring member 4 races.

Since the present invention has been constructed as mentioned above, the knob, engaging shaft portion of the rotating body, and variable resistor are vertically arranged, so that the device can be miniaturized as compared with the conventional multi rotating type rotation operating device. On the other hand, since the position indicating shaft which rotates together with the rotation of the rotating body can be seen from the outside through the casing, the adjusting position state of the resistance value can be clearly known. Further, when the knob was rotated to a position over the limit point of the resistance value, since the knob and the ring member race, the variable resistor is not broken. As mentioned above, the excellent advantages which can accomplish the object of the present invention are obtained.

Claims

1. A rotation operating device of a variable resistor comprising:
a knob (3, 31) to apply a rotating force from the outside;
intermediate gears (26) to transfer the rotating force of said knob to a sliding contact of a variable resistor (5);
a ring member (4);
an intermediate rotating body (2); and
a supporting member (1) for supporting said ring member and said intermediate rotating body,
wherein a circular supporting concave portion (13) is formed on said supporting member, an annular groove (16) having both ends (16) is formed on a bottom surface of said supporting concave portion, the both ends of said annular groove serve as stoppers (17).
said knob has a gear (32) in its lower portion,
said ring member is rotatably supported in said supporting concave portion and has a gear (41) formed on its upper inner peripheral surface and has a lower inner peripheral surface (42),
said intermediate rotating body has on its upper surface a position indicating portion (24) which can be seen from the outside and has shafts (24, 25) for rotatably supporting said intermediate gears so as to be come into engagement with the gear of the knob and with the gear of the ring member, an outer peripheral surface (27) of the intermediate rotating body is come into frictional contact with a lower inner peripheral surface (42) of the ring member, a projecting portion (23) adapted to be movably fitted into said annular groove is formed on a lower surface of the intermediate rotating body, and the intermediate rotating body is in engagement with the sliding contact of the variable resistor at the center of the lower surface thereof.

2. A device according to claim 1, wherein the position indicating portion of said intermediate rotating body is a shaft (24) to rotatably support one of the intermediate gears.

3. A device according to claim 2, wherein a cap (18) is rotatably fitted into said knob and the shaft (24) serving as the position indicating portion is projected through a hole (18b) of said cap.

Fig.1

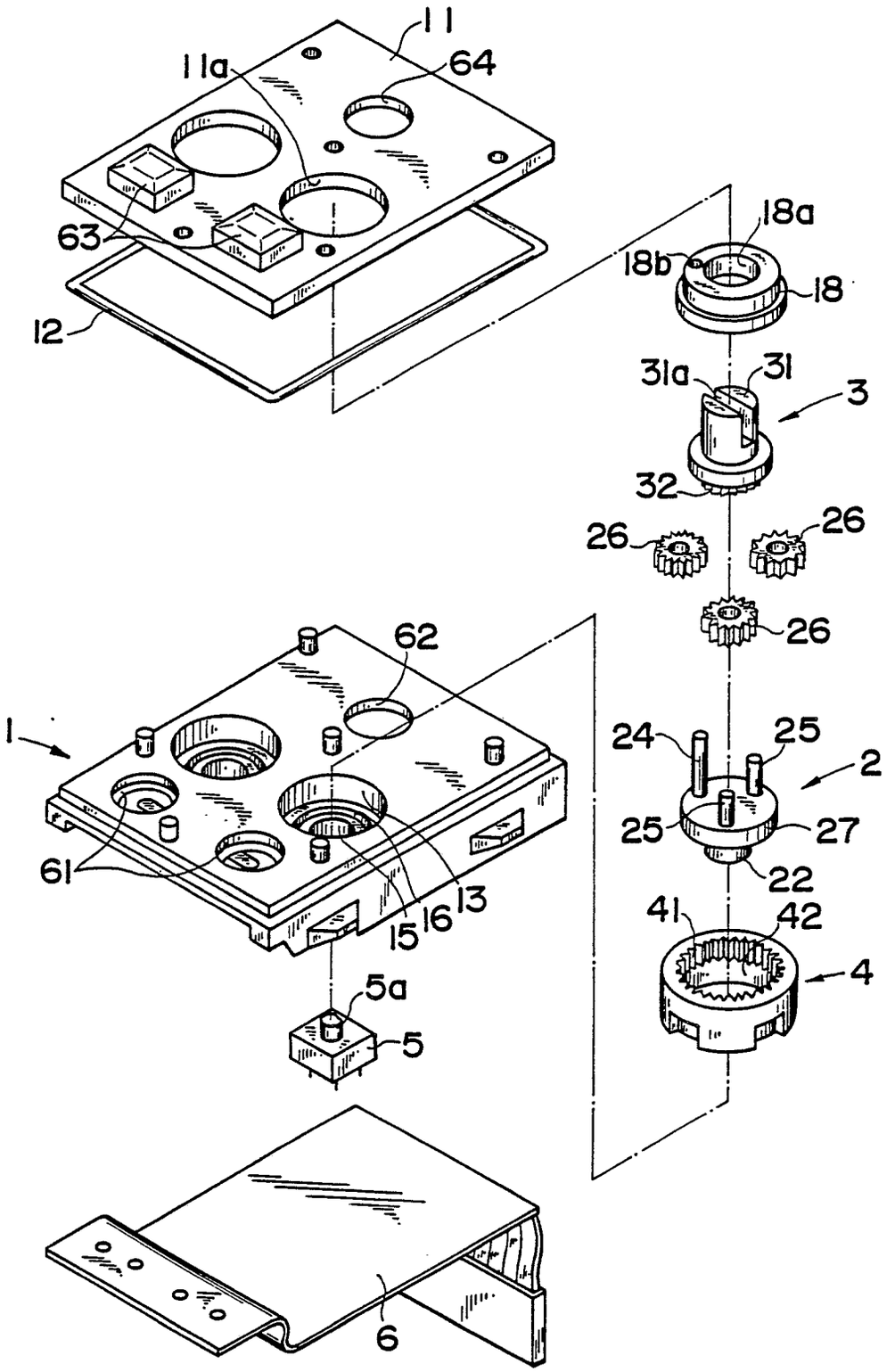
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Fig.2

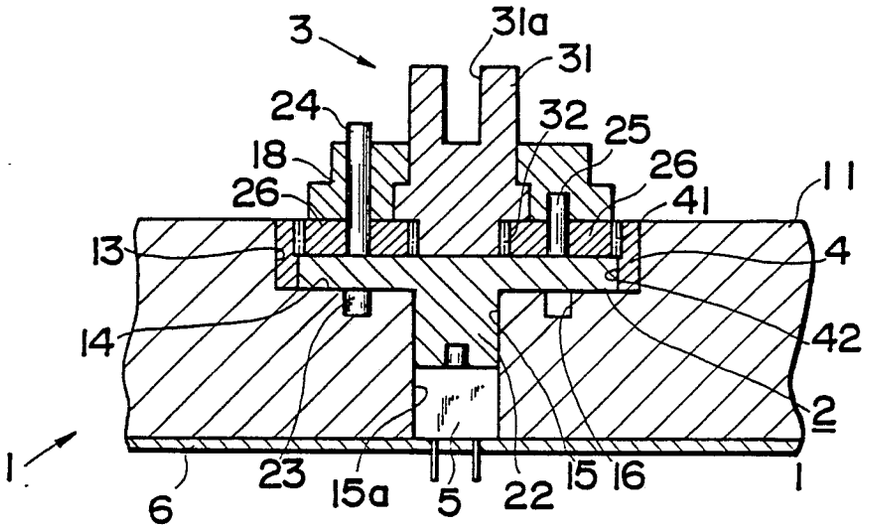
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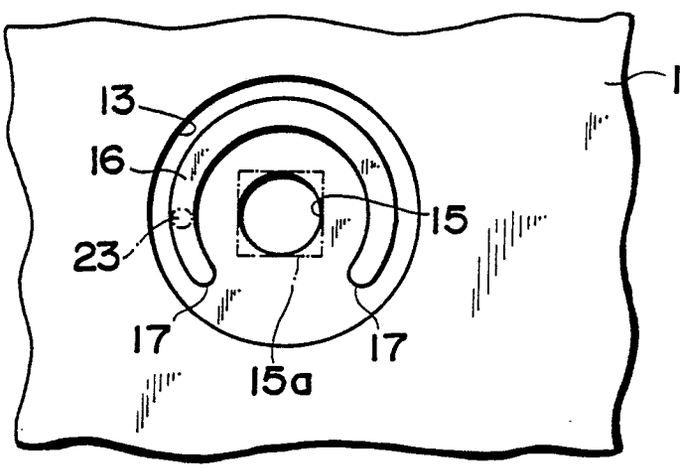
Fig.3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