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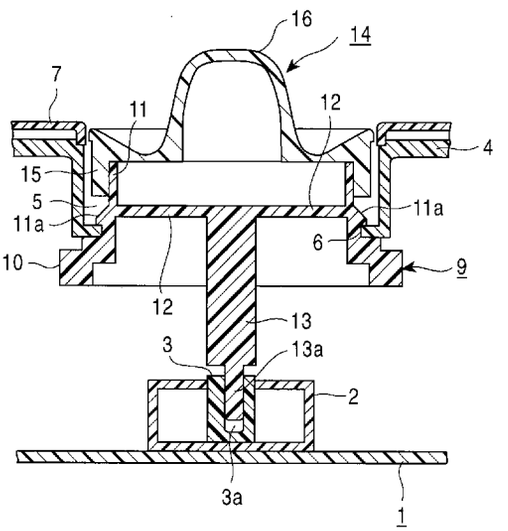
(54) Operating mechanism of rotary electric component

(57) This invention describes an operation mechanism, in which a rotary electric component is operated by rotation of an operation knob whose position is rotatably restricted by a housing. This mechanism can maintain a satisfactory operational feel of the operation knob for a user, even though the rotary electric component, which is mounted beforehand on a printed circuit board, is fixed to the housing. In the mechanism, an operation knob includes a first operation member (9) and a second operation member (14), in which there are integrally formed: a cylindrical part (11) disposed rotatably in an opening (6) of the housing (4), four flexible members (12) extending from the inner peripheral surface of the cylindrical part (11) toward the center thereof, and a connecting shaft (13) extending vertically in the downward direction from the intersection of the flexible members (12); the second operation member (14) formed of synthetic resin is attached to the cylindrical part (11) by press-fitting. Then, a printed circuit board (1), on which a rotary switch (2) is mounted beforehand, is fixed to the housing (4), and an engaging part (13a) formed at the lower end of a connecting shaft (13) is inserted into an engaging hole (3a) formed on a rotation shaft (3) of the rotary switch (2), whereby the deviation between the center of the rotation shaft (3) and that of the connecting shaft (13) caused by mounting errors which occur at this time is absorbed by swinging of the connecting shaft (13), which accompanies deformations of the flexible members (12).

FIG. 1



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Description

[0001] The present invention relates to an operating mechanism of a rotary electric component which operates by rotating a rotation knob employed in rotary electric components such as a rotary switch or a rotary volume control.

[0002] A rotary electric component is mounted on a printed circuit board when it is incorporated in an apparatus. Conventionally, such a rotary electric component has a rotation shaft carrying an operation knob. For example, an air-conditioner mounted in a vehicle adopts the following mechanism: a rotary electric component inside the apparatus is manually operated by a user turning an operation knob, which is exposed on a housing (an exterior panel) covering the printed circuit board; the operation knob rotates in a circular opening provided in the housing, and the torque is transmitted to the rotation shaft of the rotary electric component through a connecting shaft arranged at the center of the operation knob.

[0003] Recently, there has been a tendency to minimize the clearance defined between the opening of the housing and the operation knob in order to improve the appearance of the housing, which users are concerned about. However, such minimization causes the movement of the operation knob in the radial direction to be restricted by the inner peripheral surface of the opening. As a result, it leads to a problem: if the relative positions between the rotary electric component mounted on the printed circuit board and the operation knob positionally restricted by the housing are deviated due to an occurrence of errors between their mounted positions when the printed circuit board is fixed to the housing, the operation knob is leaned in the deviating direction to come into press contact with the inner peripheral surface of the opening; eventually, this causes the operational feel to seem much worse to the user when the operation knob is used. Thus, there has been adopted a conventional method, in which the printed circuit board is fixed to the housing with the terminal of the rotary electric component being inserted into the terminal insertion hole of the printed circuit board; the connecting shaft of the operation knob is attached to the rotation shaft of the rotary electric component by utilizing the clearance between the terminal insertion hole and the terminal; and, then, the terminal protruding from the terminal insertion hole is manually soldered on a land on the back of the printed circuit board. Consequently, this becomes a significant factor which degrades efficiency in assembly work.

[0004] Accordingly, in order to solve this problem, the present invention provides a structure in which there is arranged a connecting shaft at the center of an operation knob through the intermediation of a plurality of flexible members, the free end of the connecting shaft being engaged with a rotation shaft of the rotary electric component mounted on the printed circuit board. This arrangement offers the following advantages. For example, even if deviation occurs in the relative positions between the operation knob, the radial movement of which is restricted by the housing, and the rotary electric component mounted on the printed circuit board, this deviation is absorbed by swinging of the connecting shaft on the part where the shaft is joined to the flexible members. Accordingly, not only can this prevent the operational feel for the user from worsening when the operation knob is used, but also can contribute to the assembly work being allowed to be such that the rotary electric component is mounted on the printed circuit board in advance.

[0005] An operating mechanism of a rotary electric component according to the present invention includes a rotary electric component mounted on a printed circuit board, an operation knob for rotating a rotation shaft of the rotary electric component, and a housing for guiding the operation knob in the rotating direction, wherein a connection shaft is disposed at the center of the operation knob through the intermediation of a plurality of flexible members, the free end of the connecting shaft being engaged with the rotation shaft of the rotary electric component.

[0006] The operation knob may be an integrally formed unit. However, it is also possible for the operation knob to include a first operation member which is rotatably supported by the housing by means of a snap action or the like, and a second operation member which encloses the first operation member; provision of the flexible members and the connecting shaft on the first operation member side allows both the first and second operation members to be formed simply without using a slide core. Furthermore, the printed circuit board can be integrated with the housing in a state in which the first operation member is combined with the housing, resulting in an improvement in efficiency of assembly work.

[0007] Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view of a main part of an operating mechanism of a rotary electric component according to an embodiment of the present invention;
Fig. 2 is an exploded perspective view of a main component which is to be provided in the operating mechanism; and
Fig. 3 is an exploded perspective view of a main component, which is to be provided in the operating mechanism of a rotary electric component according to another embodiment.

[0008] A description will be given of an embodiment of the present invention referring to the drawings. Fig. 1 is a sectional view of a main part of the operating mechanism of a rotary electric component employed in the embodiment. Fig. 2 is an exploded perspective view of a main component, which is to be provided in the oper-

ating mechanism.

[0009] In these Figs. 1 and 2, numeral 1 indicates a printed circuit board, on which a flat type of rotary switch 2, or any other rotary electric component, which is not shown here, is mounted by soldering. The inner mechanism of the rotary switch 2 is not illustrated. The rotary switch 2 is a well-known type, and has a rotation shaft 3 being exposed on the top surface of a casing; operation by rotating the rotation shaft 3 allows a contact to be switched on and off. A housing 4 is positioned on an upper part of a printed circuit board 1, and the printed circuit board 1 are fixed to the housing 4 by means of screws or the like, directly or through the intermediation of an arbitrary member. In the housing 4 there is formed a cylindrical recess 5, in the bottom of which is formed a circular opening 6; and a cosmetic panel 7 is attached to the housing 4, in which there is formed a hole 8 which has an equivalent diameter to that of the opening 6.

[0010] Numeral 9 indicates a first operation member formed of synthetic resin, in which there is integrally formed a cam 10 having a plurality of click grooves 10a on the periphery thereof, a cylindrical part 11 extending in the upward direction from the cam 10, four flexible members 12 extending crosswise toward the center from the inner peripheral surface of the cylindrical part 11, and a connecting shaft 13 extending vertically in the downward direction from the intersection of the flexible members 12; the top end of the connecting shaft 13 is linked to the inner peripheral surface of the cylindrical part 11 through the intermediation of the flexible members 12. On the outer peripheral surface of the cylindrical part 11 there are formed a plurality of snap claws 11a; insertion of the cylindrical part 11 into the opening 6 through the back of the housing 4 and engagement of each of the snap claws 11a on the periphery of the opening 6 permits the first operation member 9 to be disposed rotatably in the housing 4 by using the opening 6 as a guiding portion. In this state, a click spring (not shown) is in elastic contact with the click grooves 10a of the cam 10, so that a clicking feel can be generated as the first operation member 9 rotates. On the other hand, at the lower end of the connecting shaft 13 there is formed an engaging portion 13a, which has a semi-circular formed section; the engaging portion 13a is inserted into an engaging hole 3a with a semi-circular formed section, which is formed on the rotation shaft 3 of the rotary switch 2.

[0011] Numeral 14 indicates a second operation member formed of synthetic resin, in which a cylindrical coupling part 15 and a knob 16 extending upwardly from the top surface of the coupling part 15 are integrally formed with each other; fixing the coupling part 15 to the cylindrical part 11 by means of press fitting, snap action, or the like, permits the first operation member 9 and the second operation member 14 to be formed integrally so as to make an operation knob.

[0012] The following description refers to an assembly work of the above embodiment. In this case, the rotary switch 2 is beforehand soldered in a predetermined position on the printed circuit board 1, while the first operation member 9 is rotatably disposed in the opening 6 of the housing 4. Then, in this state, the printed circuit board 1 is fixed to the housing 4 by using an appropriate means so as to insert the engaging portion 13a of the first operation member 9 into the engaging hole 3a of the rotary switch 2. At this time, even if the center of the rotation shaft 3 deviates from the center of the connecting shaft 13 due to mounting errors or the like, the connecting shaft 13 joined to the flexible members 12 with little rigidity is formed in such a manner that it can swing using the top end side thereof as a fulcrum, so that the deviation between the centers can be absorbed by the swinging of the connecting shaft 13. Then, the coupling part 15 is fitted onto the cylindrical part 11 exposed in the opening 6 so as to integrate the first operation member 9 with the second operation member 14; and the cosmetic panel 7 is attached to the housing 4 to complete the assembly as shown in Fig. 1.

[0013] In the use of the mechanism, when a user manipulates the knob 16 of the second operation member 14 by a rotating operation, the first operation member 9 which is integrated with the second operation member 14 rotates by using the opening 6 of the housing 4 as a guiding portion; the torque is transmitted to the rotation shaft 13 through the flexible members 12 and the connecting shaft 13, so that the contact of the rotary switch 2 is switched on and off as the rotation shaft 3 rotates. In this case, as mentioned above, since the deviation between the center of the connecting shaft 13 and that of the rotation shaft 3 is absorbed by deformation of the flexible members 12, the first operation member 9 smoothly rotates in the opening 6, with the result that a satisfactory operational feel (of the first operation member 9 and the second operation member 14) is maintained for the user who manipulates the operation knob.

[0014] In an embodiment of Fig. 3, the top end of the connecting shaft 13 is linked to the inner peripheral surface of the cylindrical part 11 through the intermediation of flexible members 12, which are formed in a corrugated configuration, wherein the substantial spring span of each of the flexible members 12 is made long enough to permit an easy deformation.

[0015] The above embodiment employs a flat type rotary switch as an example of a rotary electric component. This invention, however, is applicable to other types of rotary electric components such as a rotary volume control, a rotary encoder, and even to a type of rotary electric component with a rotation shaft protruding from the top surface of a casing.

[0016] Furthermore, while in the above embodiment the cylindrical part 11 of the first operation member 9 and the connecting shaft 13 are linked to the four flexible members 12, the number and shape of the flexible members 12, however, are not to be limited to those of the case described above, and can be changed as required.

[0017] The present invention is implemented as de-

scribed above and gives the following advantages.

[0018] The present invention provides an operating mechanism, comprising a rotary electric component mounted on a printed circuit board, an operation knob for rotating a rotation shaft of the rotary electric component, and a housing for housing the operation knob in the rotating direction, wherein a connecting shaft is arranged at the center of the operation knob through the intermediation of a plurality of flexible members, the free-end side of the connecting shaft being engaged in the rotation shaft of the rotary electric component, whereby, even if a deviation is produced in the relative positions between the operation knob, whose radial movement is restricted by the housing, and the rotary electric component mounted on the printed circuit board, the deviation is absorbed by such means that the connecting shaft swings by using a contact of the shaft with the flexible members as a fulcrum. Accordingly, this enables the operational feel for the user who rotates the knob to be prevented from worsening. Furthermore, an assembly can be performed in a state in which the rotary electric component is mounted beforehand on the printed circuit board.

[0019] Also, by an arrangement in which the operation knob is composed of a first operation member rotatably supported by the housing by means of snap action or the like, and a second operation member enclosing the first operation member, the flexible members and the connecting shaft being disposed on the first operation member side, a simple formation of the first operation member and the second operation member without using a slide core is feasible. Moreover, since the printed circuit board is formed integrally with the housing in a state in which the first operation member is combined with the housing, more enhanced assembly efficiency is obtainable.

Claims

1. An operating mechanism of a rotary electric component, comprising a rotary electric component (2) mounted on a printed circuit board (1), an operation knob for rotatably operating a rotation shaft (3) of the rotary electric component (2), and a housing (4) for guiding the operation knob in the rotating direction, characterized in that a connecting shaft (13) is disposed through the intermediation of a plurality of flexible members (12) at the center of the operation knob, the free end of the connecting shaft (13) being engaged with the rotation shaft (3) of the rotary electric component (2).

2. An operating mechanism of a rotary electric component according to Claim 1, characterized in that the operation knob includes a first operation member (9) which is rotatably supported by the housing (4), and a second operation member (14) which encloses the first operation member (9), the flexible members (12) and the connecting shaft (13) being disposed in the first operation member (9).

3. An operating mechanism of a rotary electric component according to Claim 1, characterized in that the flexible members (12) are formed in a straight-line configuration to link the connecting shaft (13) with the operation knob.

4. An operating mechanism of a rotary electric component according to Claim 1, characterized in that the flexible members (12) are formed in a corrugated configuration to link the connecting shaft (13) with the operation knob.

5. An operating mechanism of a rotary electric component according to Claim 3 or Claim 4, characterized in that the flexible members (12) include four pieces.

6. An operating mechanism of a rotary electric component according to Claim 2, characterized in that the first operation member (9) has snap claws (11a) for rotatably fixing by snapping it to the housing (4).

7. An operating mechanism of a rotary electric component according to Claim 2, characterized in that click grooves (10a), which are in elastic contact with a click spring, are arranged around the peripheral edge of the first operation member (9).

FIG. 1

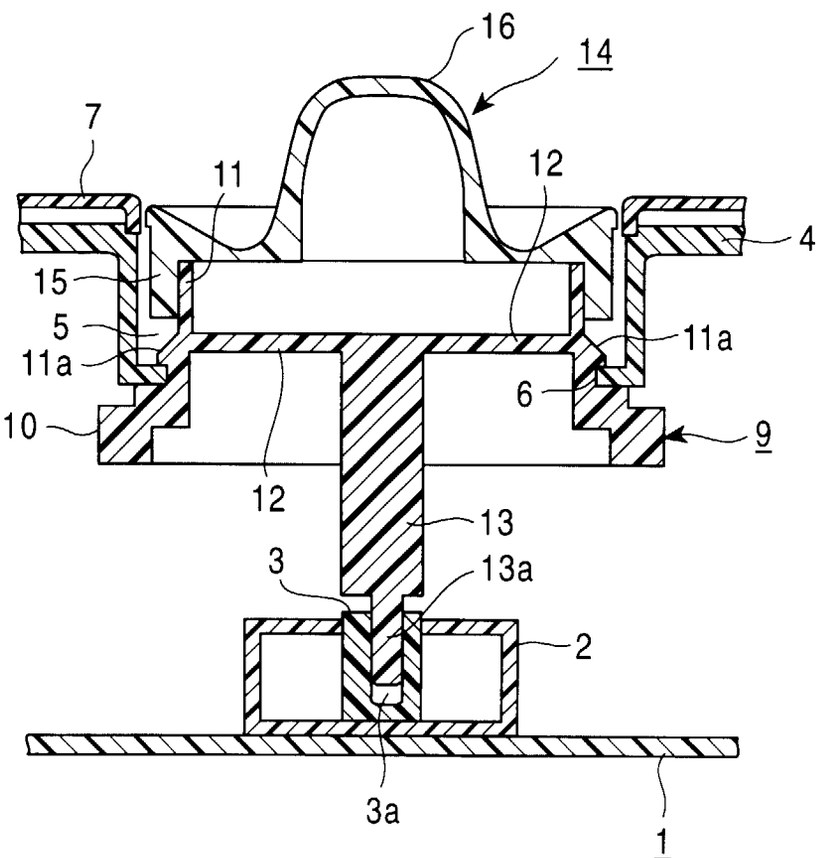

FIG. 2

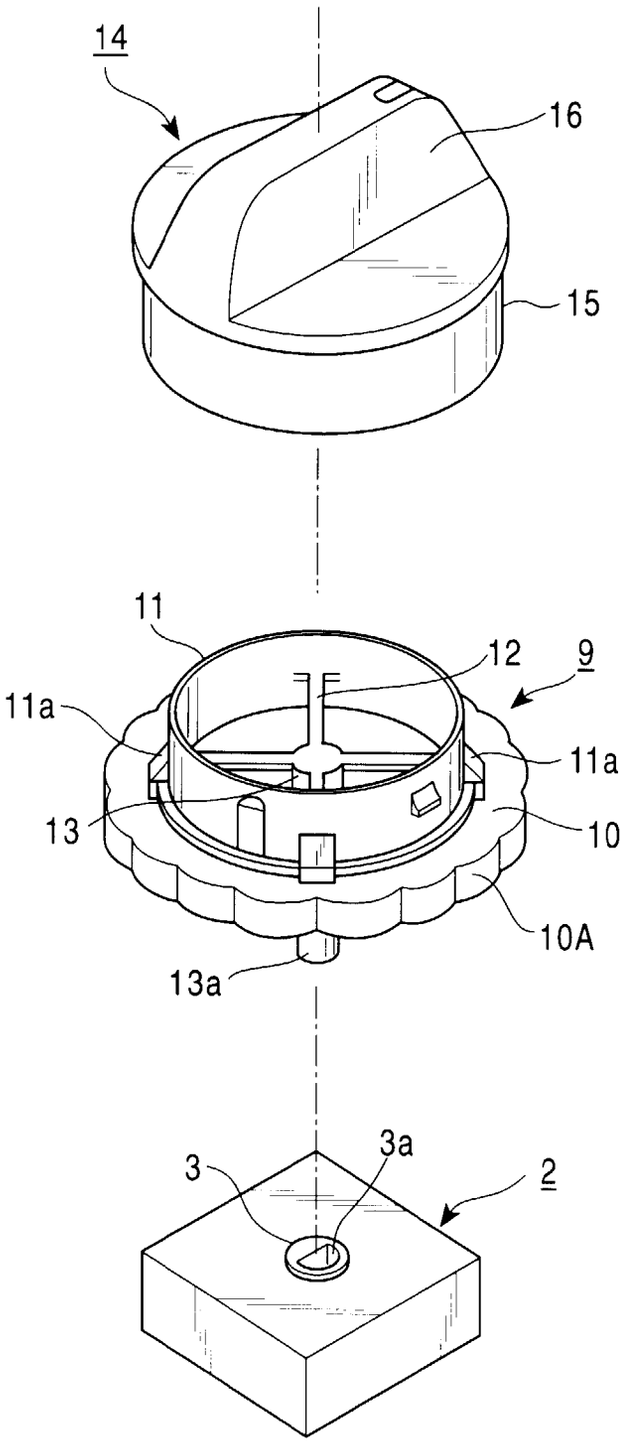

FIG. 3