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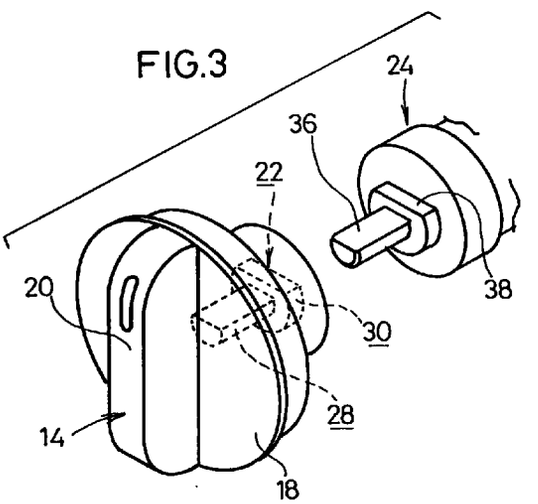
(54) Interfitting structure for control knob and shaft

(57) A shaft (24) of synthetic resin has a first fitting member (36) having a noncircular cross-sectional shape and a second fitting member (38) disposed substantially coaxially with the first fitting member (36), having a noncircular cross-sectional shape, and being larger in diameter than the first fitting member (36). A control knob (14) has a bottomed hole (22) including a fitting hole (28) receiving and complementary in shape to the first fitting member (36) and an annular step (30) receiving and complementary in shape to the second fitting member (38).

FIG.3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention:

The present invention relates to an interfitting structure for a control knob for operating a control device and a shaft that is connected to the control knob.

Description of the Related Art:

Control sections of various machines and apparatus have a plurality of control knobs for making selections, settings, and adjustments. One conventional interfitting structure for a control knob and a shaft connected thereto is illustrated in FIG. 5 of the accompanying drawings.

As shown in FIG. 5, a circular control knob 1 has a grip 2 on an end surface thereof which can be gripped by fingers of the user to turn the control knob 1 in a desired direction about its own axis. The control knob 1 also has a bottomed hole 3 defined centrally in an end surface thereof remote from the grip 2. A shaft 5 which extends from a control panel 4 has an end 6 fitted in the bottomed hole 3. The end 6 has a D-shaped cross section, and the bottomed hole 3 also has a D-shaped cross section complementary to the end 6 such that the shaft 5 can angularly be moved about its own axis in unison with the control knob 1.

When the user grips the grip 2 and turns the control knob 1 in a desired direction, the angular movement of the control knob 1 is transmitted through the end 6 to the shaft 5, which perform a desired operation through a gear mechanism or the like that engages the shaft 5.

Various control knobs 1 used in control sections of various machines and apparatus are coupled to respective shafts 5. These shafts 5 may be made of any of various different materials including metal, synthetic resin, etc., and may have different diameters depending on the mechanism strengths thereof which are governed by their materials.

Specifically, if the shaft 5 is made of metal, then since the mechanism strength thereof is relatively large, the end 6 of the shaft 5 which is inserted in the bottomed hole 3 may be of a relatively small diameter. If the shaft 5 is made of synthetic resin, then since the mechanism strength thereof is relatively small, the end 6 of the shaft 5 which is inserted in the bottomed hole 3 needs to be of a relatively large diameter.

For this reason, there have heretofore been available a variety of control knobs 1 which have substantially the same outer profile, but bottomed holes 3 having different diameters depending on the materials of shafts 5.

However, when only one type of control knobs 1 whose bottomed holes 3 have the same diameter is used, a shaft 5 of metal combined with one of the control knobs 1 may need to have an unduly increased diameter, and a shaft 5 of synthetic resin combined with another one of the control knobs 1 may be required to be made partly of another stronger material for stiffening itself.

Other problems are that it is necessary to keep an inventory of selected control knobs 1 whose bottomed holes 3 have respective different diameters depending on the materials of shafts 5, and a plurality of molds are required to molding such control knobs 1. Therefore, the cost of manufacturing those control knobs 1 has been high.

SUMMARY OF THE INVENTION

It is a general object of the present invention to provide an interfitting structure for a control knob and a shaft coupled thereto, which allows any of shafts of various materials to be fitted in one type of control knobs, but still permits control forces to be smoothly transmitted from the control knob to the shaft fitted therein.

A major object of the present invention is to provide an interfitting structure for a control knob and a shaft coupled thereto, which allows one type of control knobs to be shared by shafts of various materials, so that the control knobs can be manufactured inexpensively.

The above and other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawings in which preferred embodiments of the present invention are shown by way of illustrative example.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of a control panel assembly of an air-conditioning unit for motor vehicles, which incorporates an interfitting structure for a control knob and a shaft coupled thereto according to the present invention;

FIG. 2 is a vertical cross-sectional view taken along line II - II of FIG. 1;

FIG. 3 is an exploded perspective view of the interfitting structure according to the present invention;

FIG. 4 is a an exploded perspective view of a modified interfitting structure; and

FIG. 5 is an exploded perspective view of a conventional interfitting structure for a control knob and a shaft coupled thereto.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. 1, a control panel assembly 10 of an air-conditioning unit for motor vehicles, which incorporates an interfitting structure for a control knob and a shaft coupled thereto according to the present invention, has a circular mode selection control knob 12, a circular temperature setting control knob 14, and a cir-

cular fan selection control knob 16 which comprise manual control knobs and are positioned at spaced intervals in a horizontal linear array. Since these control knobs 12, 14, 16 are identical in structure with each other, only the temperature setting control knob 14 will be described in detail below.

As shown in FIG. 3, the temperature setting control knob 14 has a circular block 18, a grip 2 on an end surface of the circular block 18 and projecting therefrom so that it can be gripped by fingers of the user to turn the control knob 1 in a desired direction about its own axis, and a bottomed hole 22 defined centrally in an end surface of the circular block 18 remote from the grip 20. The bottomed hole 22 has a fitting hole (first fitting hole) 28 in which an end of a shaft 24 made of synthetic resin is fitted, and an annular step (second fitting hole) 30 contiguous coaxially to and larger in diameter than the fitting hole 28. The annular step 30 is open at the end of the circular block 18 away from the grip 20. Each of the fitting hole 28 and the annular step 30 has a D-shaped cross section.

The end of the shaft 24 which is fitted in the bottomed hole 22 comprises a first fitting member 36 angularly movable supported by a bearing 34 mounted in a hole defined in a control panel 32, and a second fitting member 38 disposed coaxially on the first fitting member 36 and spaced from a tip end of the first fitting member 36.

The first fitting member 36 and the second fitting member 38 are preferably integrally molded of synthetic resin as the shaft 24. Alternatively, the second fitting member 38 may be formed separately from the first fitting member 36 and subsequently securely joined to the first fitting member 36, providing the shaft 24. Each of the first fitting member 36 and the second fitting member 38 has a D-shaped cross section.

The fitting hole 28 and the first fitting member 36 are complementary in shape to each other, and the annular step 30 and the second fitting member 38 are complementary in shape to each other. The first fitting member 36 is fitted in the fitting hole 28, whereas the second fitting member 38 is fitted in the annular step 30.

A pinion gear 40 is defined on an outer circumferential surface of an end portion of the shaft 24 remote from the knob 14 and held in mesh with a rack gear 42 connected to a control cable (not shown). When the grip 20 is turned, the shaft 24 is turned, causing the pinion gear 40 and the rack gear 42 in mesh therewith to displace the control cable for opening or closing a temperature adjustment damper (not shown) of an air-conditioning unit to make temperature adjustments.

The cross-sectional shape of each of the first fitting member 36 and the second fitting member 38 and the cross-sectional shape of each of the fitting hole 28 and the annular step 30 are not limited to the D shape, but may be a noncircular shape insofar as the first and second fitting members 36, 38 fitted respectively in the fitting hole 28 and the annular step 30 cause the control knob 14 and the shaft 24 to rotate in unison with each other.

Shafts fitted in the control knobs 12, 14, 16 are made of different materials. For example, a shaft 44 (see FIG. 4) made of metal is fitted in the fan selection control knob 16, and shafts 24 made of synthetic resin are fitted respectively in the mode selection control knob 12 and the temperature adjustment control knob 14.

Operation and advantages of the control panel assembly 10 will be described below.

The user grips the grip 20 with fingers, and turns the control knob 14 in a desired direction about the shaft 24. The angular movement of the control knob 14 is transmitted through the first fitting member 36, which provides an axis about which the control knob 14 is turned, and the second fitting member 38, which acts as a torque carrier, to the shaft 24, causing the rack gear 42 meshing with the pinion gear 40 to operate the control cable. The second fitting member 38 to which the angular movement of the control knob 14 is applied is of a sufficient mechanical strength against loads (torque) imposed by the angular movement of the control knob 14.

While the angular movement of the control knob 14 is applied to both the first fitting member 36 and the second fitting member 38, since the second fitting member 38 is much larger in diameter than the first fitting member 36, most of the torque from the control knob 14 is carried by the second fitting member 38, and no appreciable torque is carried by the first fitting member 36.

Specifically, with the conventional structure shown in FIG. 5, the torque transmitted from the control knob 1 is applied to the end 6 of the shaft 5 which provides an axis about which the control knob 1 is turned. According to the present invention, the first fitting member 36 that provides an axis about which the control knob 14 is turned and the second fitting member 38 that serves as a torque carrier for receiving the torque from the control knob 14 are positionally and structurally different from each other. Therefore, no undue torque or shearing forces will be applied to the first fitting member 36, while at the same time the angular movement or torque from the control knob 14 can smoothly and safely be transmitted to the shaft 24 even if the shaft 24 is made of synthetic resin. As a result, it is possible to use the shaft 24 of synthetic resin which may have substantially the same diameter as the shaft 24 of metal.

According to a modified interfitting structure shown in FIG. 4, the fan selection control knob 16, which is identical in shape to the temperature adjustment control knob 14, is fitted over a shaft 44 of metal for selecting fans of an air-conditioning unit. The shaft 44 of metal is of the same structure as the conventional shaft, and will not be described in detail.

Therefore, it is possible to use one type of the control knobs 12, 14, 16 whose bottomed holes 22 have the same diameter in combination with shafts of different

materials.

As a consequence, since only one mold is required for molding the control knobs 12, 14, 16 of synthetic resin, the cost of the process for molding the control knobs 12, 14, 16 may be reduced. The cost of manufacturing the control panel assembly 10 may also be lowered because it is not necessary to keep an inventory of control knobs of different kinds.

Although certain preferred embodiments of the present invention has been shown and described in detail, it should be understood that various changes and modifications may be made therein without departing from the scope of the appended claims.

A shaft (24) of synthetic resin has a first fitting member (36) having a noncircular cross-sectional shape and a second fitting member (38) disposed substantially coaxially with the first fitting member (36), having a noncircular cross-sectional shape, and being larger in diameter than the first fitting member (36). A control knob (14) has a bottomed hole (22) including a fitting hole (28) receiving and complementary in shape to the first fitting member (36) and an annular step (30) receiving and complementary in shape to the second fitting member (38).

Claims

1. An interfitting structure comprising:

   a control knob (12, 14, 16) having a bottomed hole (22); and
   a shaft (24, 44) having an end fitted in said bottomed hole (22) for receiving an angular movement of said control knob (12, 14, 16);
   said shaft (24) having a first fitting member (36) providing as an axis about which said control knob (12, 14, 16) is angularly movable, and a second fitting member (38) serving to carry a load due to the angular movement of said control knob (12, 14, 16);
   said bottomed hole (22) having a first fitting hole (28) receiving and complementary in shape to said first fitting member (36) and a second fitting hole (30) receiving and complementary in shape to said second fitting member (38).

2. An interfitting structure comprising:

   a control knob (12, 14, 16) having a bottomed hole (22); and
   a shaft (24, 44) having an end fitted in said bottomed hole (22) for receiving an angular movement of said control knob (12, 14, 16);
   said shaft (24) having a first fitting member (36) disposed on an end thereof and having a noncircular cross-sectional shape, and a second fitting member (38) disposed substantially coaxially with said first fitting member (36), having a noncircular cross-sectional shape, and being larger in diameter than said first fitting member (36);
   said bottomed hole (22) having a first fitting hole (28) receiving and complementary in shape to said first fitting member (36) and a second fitting hole (30) receiving and complementary in shape to said second fitting member (38).

3. An interfitting structure according to claim 1 or 2, wherein said first fitting member (36) and said second fitting member (38) are integrally formed with said shaft (24).

4. An interfitting structure according to claim 1 or 2, wherein said first fitting member (36) is integrally formed with said shaft (24), and said second fitting member (38) is formed separately from said shaft (24).

5. An interfitting structure according to any one of claims 1 through 4, wherein said shaft (24, 44) is made of either synthetic resin or metal.

6. An interfitting structure according to any one of claims 1 through 5, wherein said control knob (12, 14, 16) comprises a circular block (18) and a grip (20) projecting from said circular block (18), said control knob (12, 14, 16) being mounted on a control panel assembly (10) of an air-conditioning unit for a motor vehicle.

7. An interfitting structure according to any one of claims 1 through 6, wherein each of said first fitting member (36) and said second fitting member (38) of a D-shaped cross section.

FIG.1

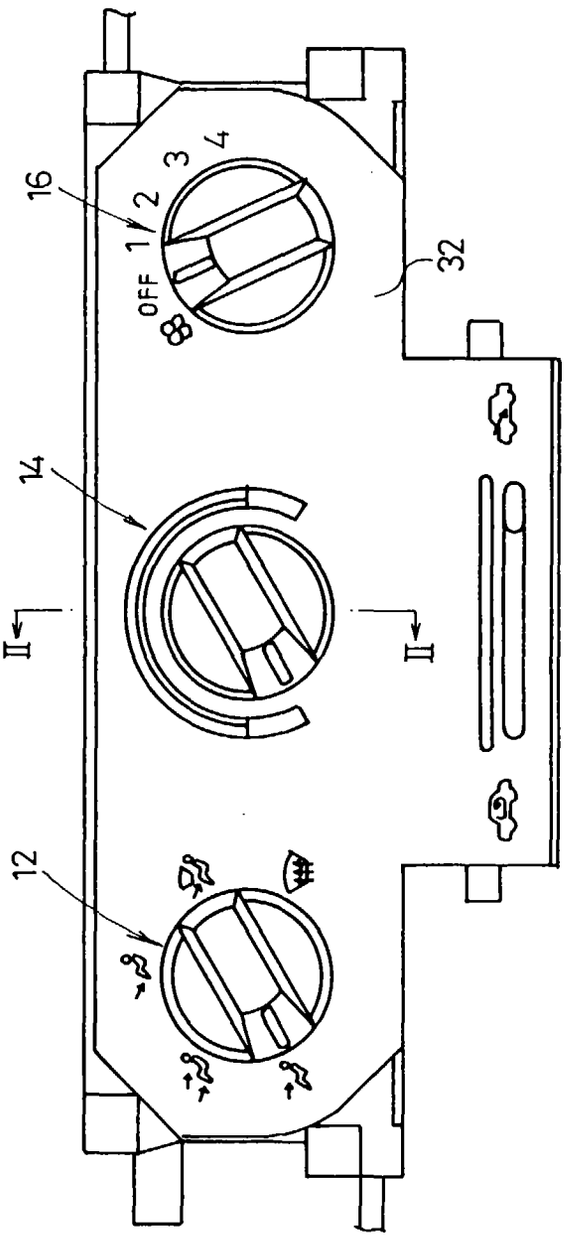


FIG. 2

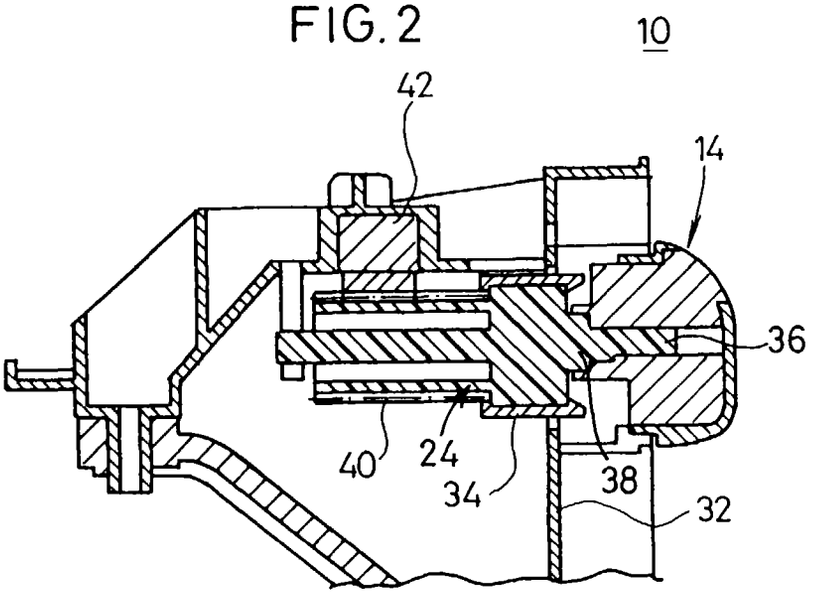


FIG.3

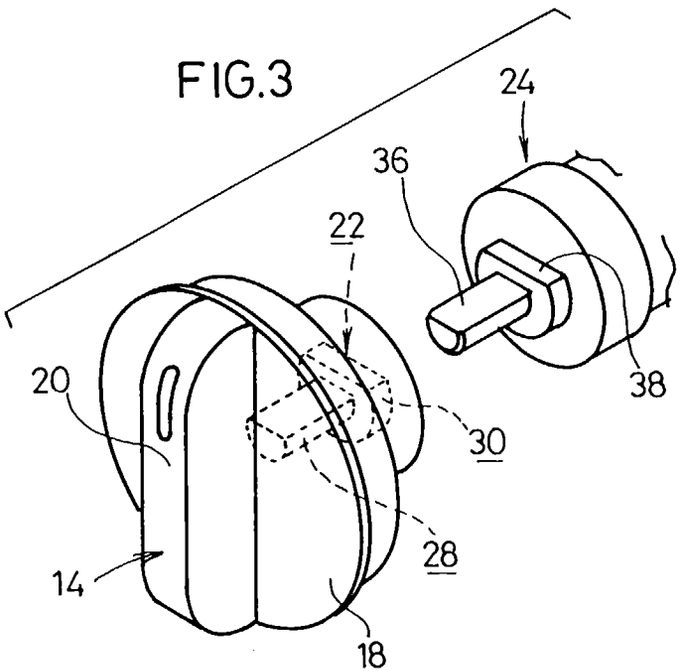


FIG.4

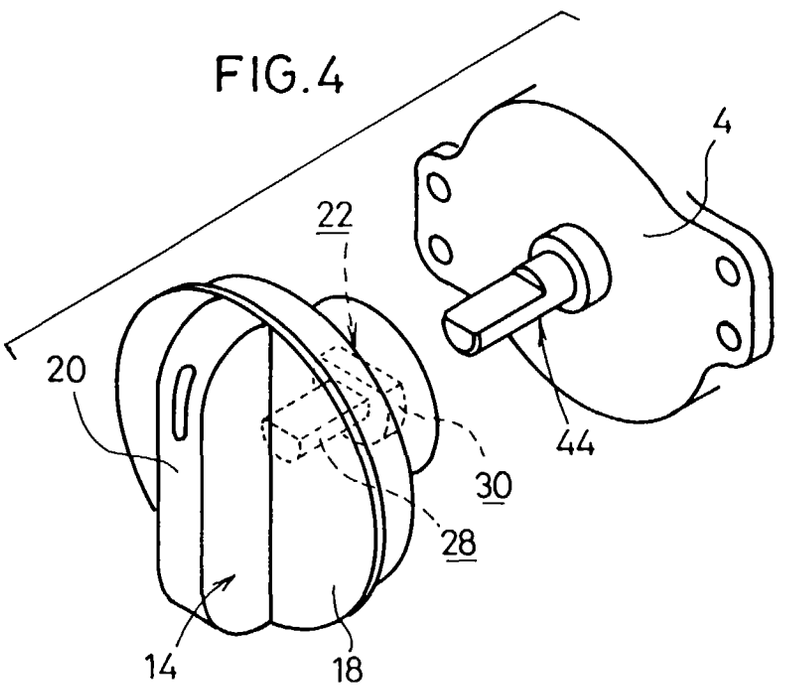
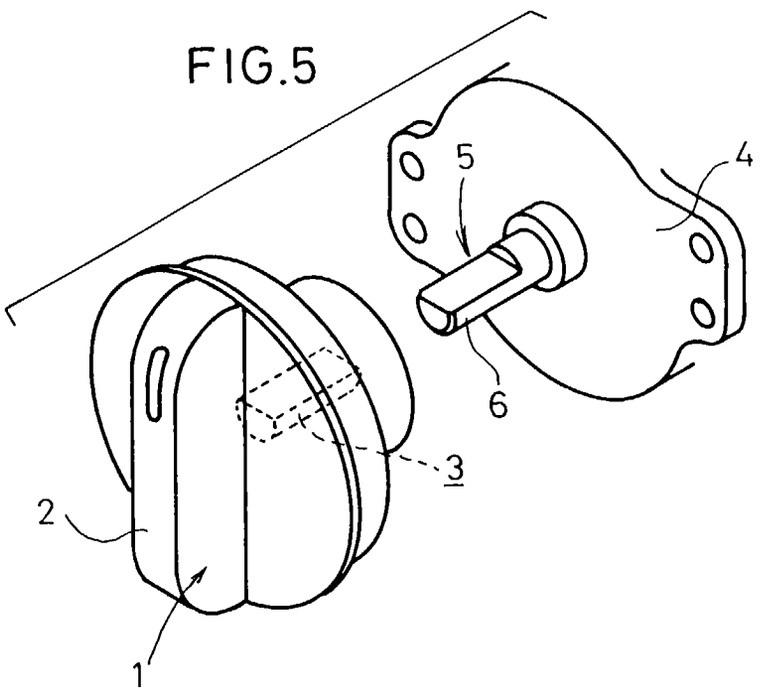


FIG.5



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EUROPEAN SEARCH REPORT

Application Number
EP 97 11 6563

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	NL 8 102 257 A (SMITT H M INSTR BV) 1 December 1982 * claims; figure 2 *	1	G05G1/12
X	GB 551 927 A (MALLORY & CO) 16 March 1943 * the whole document *	1	
X	FR 1 308 118 A (BOSCH) 15 February 1963 * the whole document *	1	
A	CH 537 049 A (CONTRAVES) 29 June 1973		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G05G
H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 January 1998	De Schepper, H

CATEGORY OF CITED DOCUMENTS

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