

[54] **PUSH-BUTTON CONTROL MEMBER WITH
PUSH-THROUGH COUPLING**

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[56] **References Cited**

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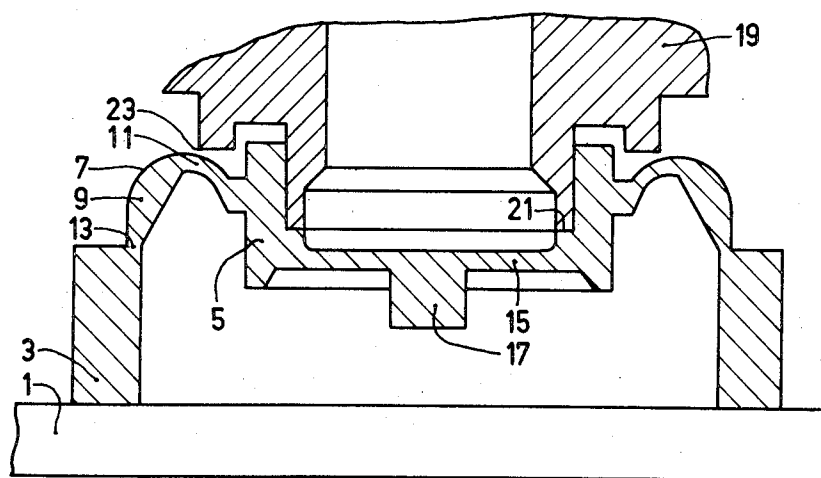
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[57] **ABSTRACT**

A control member for a contact device, comprising a first stationary cylinder of elastically compressible material, in which a second cylinder of the same material is coaxially arranged for movement with respect to this first cylinder by means of an elastically compressible annular coupling. The two cylinders and the coupling are constructed to form one integral unit. The coupling comprises a comparatively rigid centre portion which is connected by comparatively flexible portions to the cylinder, and cooperates with a pressure edge provided on the inner cylinder.

6 Claims, 4 Drawing Figures



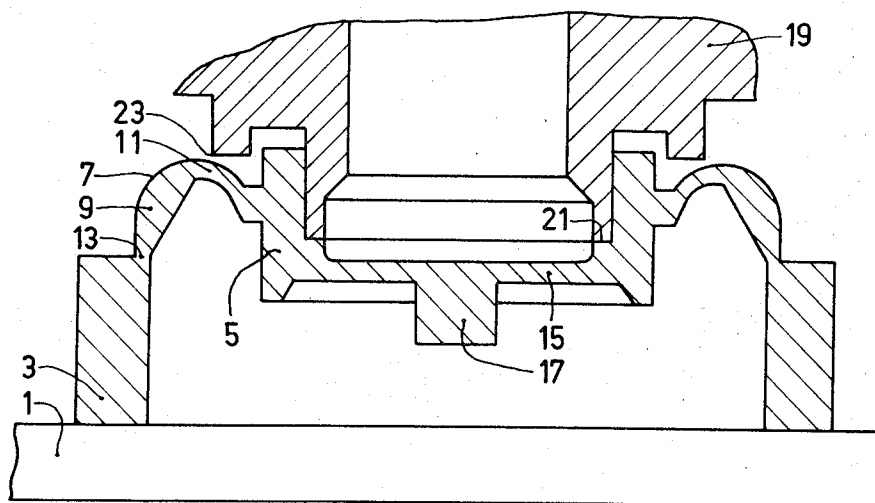


Fig.1

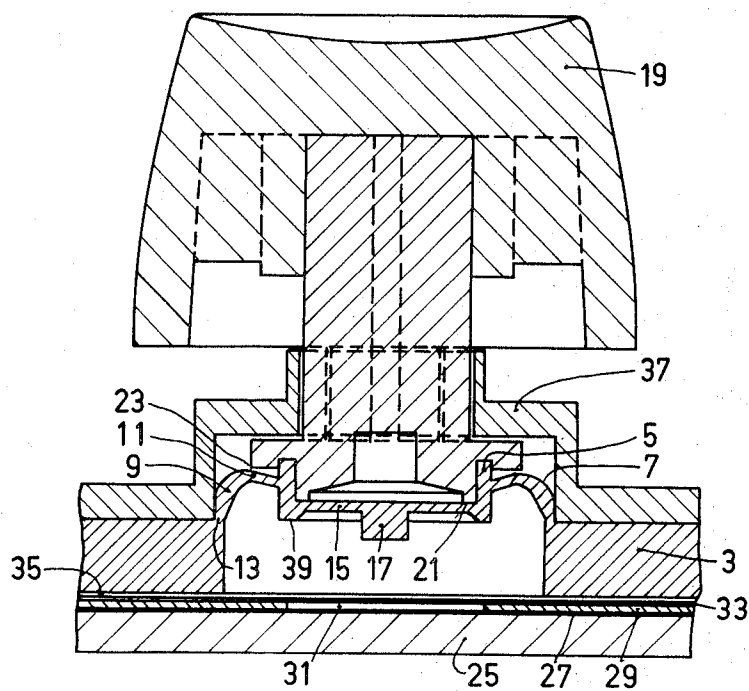


Fig.2

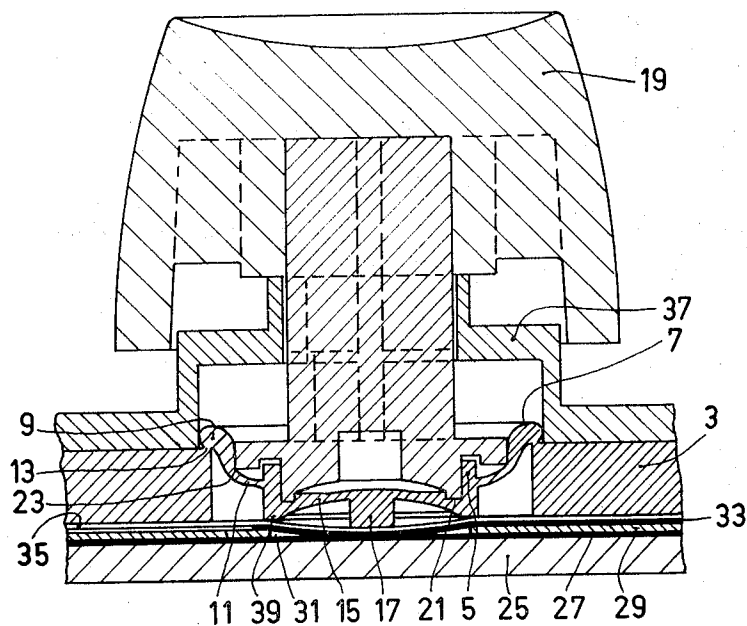


Fig. 3

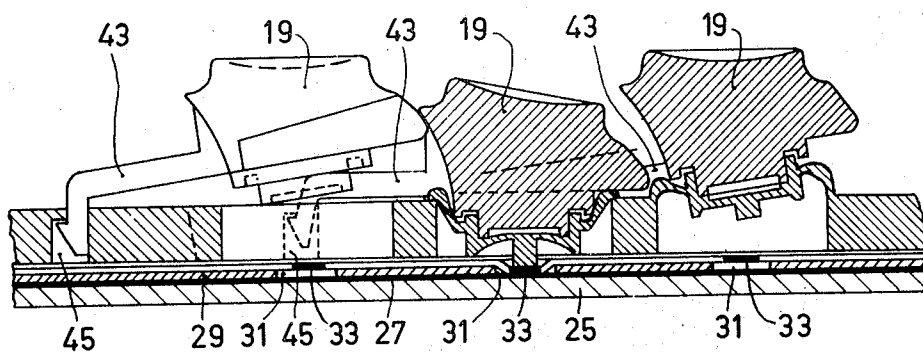


Fig. 4

PUSH-BUTTON CONTROL MEMBER WITH PUSH-THROUGH COUPLING

The invention relates to a control member for a contact device, comprising a hollow, comparatively rigid first portion of elastic compressible material with respect to which a second portion of elastic compressible material, connected to the first portion by means of a compressible coupling, is displaceable. The said second portion is provided with a pressure member, the two portions, arranged to be coaxial, and the compressible coupling being constructed to form one integral unit.

In a known control member of the kind set forth (French Pat. specification No. 1,216,717) the coupling consists of a ring of compressible material which has substantially the same resistance against bending over its entire section. The stroke performed in the said control member during the contact movement is proportioned such that a maximum pressure energy accumulated in the coupling (pressure point) is not passed. The drawback of a control member of this kind is that the operator does not receive a clear indication whether or not proper electrical contact has been made, unless it is accepted that a comparatively large force must always be exerted so as to obtain this certainty. However, this will readily lead to damage or premature wear of the contacts. Even in the case where said control member would require such a large stroke that the pressure energy accumulated in the coupling reaches a maximum value, this maximum will not be so large that the operator obtains a clear indication. This is due to the fact that the deformation energy which is applied to the known coupling consists for a comparatively large part of bending energy and for a comparatively small part of pressure energy. The degree of compression of the coupling is decisive for the occurrence of a well-defined pressure point as a result of the accompanying high spring rigidity.

The invention has for its object to provide a control member with a compressible coupling by means of which the described drawback is eliminated.

To this end, the invention is characterized in that the compressible coupling comprises a comparatively rigid portion which is connected on one side, by a comparatively flexible portion, to the one portion of elastic material and on the other side, again by a comparatively flexible portion, to the other portion of elastic material. The control member is provided with a pressure edge which is connected to the movable second portion and which compresses the comparatively rigid portion of the coupling during the contact movement.

The invention also has for its object to provide a control member whose pressure member cannot damage the contacts to be switched, not even in the case of very rough operation.

To this end, the invention is further characterized in that the movable second, comparatively rigid portion is provided with a flexible diaphragm, the said pressure member being connected thereto.

The invention will be described in detail with reference to the accompanying drawings.

FIG. 1 is a partial sectional view at an increased scale of a control member according to the invention.

FIG. 2 is a sectional view of a contact device in the neutral position comprising a control member as shown in FIG. 1.

FIG. 3 is a sectional view of the contact device shown in FIG. 2 in the switching position.

FIG. 4 is a partial plan and sectional view of a multiple contact device comprising a number of control members according to the invention.

The control member which is shown in the neutral position in FIG. 1 comprises an outer cylinder 3 of elastically compressible material, arranged on the support 1 for the sake of clarity, in which an inner cylinder 5 of the same material is suspended, coaxially with the cylinder axis, by means of an annular trough-like coupling 7. The coupling 7 can also consist of a number of bridge segments. The cylinders 3 and 5 and the coupling 7 are constructed to form one unit, preferably by pressing or moulding. The control member can be made of elastic high-polymeric materials such as, for example, a natural or synthetic rubber. As a result of their wall thickness, the cylinders 3 and 5 are comparatively rigid. The coupling 7 comprises a comparatively rigid portion 9 which is connected on one side, by a comparatively flexible portion 11, to the inner cylinder 5 and on the other side, by a comparatively flexible portion 13, to the outer cylinder 3. The inner cylinder 5 accommodates a closed disc-like diaphragm 15 on which a pressure member 17 is formed. The pressure member can also be connected to inner cylinder 5 by means of bridge segments. The thickness of the portion 9 exceeds that of the portions 11 and 13.

However, a closed diaphragm is to be preferred in order to meet severe requirements with respect to sealing against dust.

Instead of a formed-on pressure chamber 17, for example, a pressed-in pin can alternatively be used. The diaphragm 15 has a thickness such that when a forced is exerted on the pressure member 17, it starts to bend through a distance which will be discussed hereinafter. Inside the inner cylinder 5 a button 19 is provided which bears on a ridge 21 which is formed on the inner wall of the cylinder. The button 19 can be clamped in the inner cylinder 5 or be glued thereto. It is alternatively possible to press the button 19 to form one assembly with the cylinders 3 and 5 and the coupling 7. However, in that case the shape of the button will deviate slightly from that shown in FIG. 1. The button 19 is provided with a circular pressure edge 23 which cooperates with the coupling 7 during the contact movement. In the neutral position of the control member, the pressure edge 23 can either be situated at some distance above the coupling 7 or be in contact with the coupling 7. FIGS. 2 and 3 show a contact device, in the neutral position and the switching position, respectively, which is provided with a control member according to the invention. As will yet be explained, a control member according to the invention is particularly suitable for contact devices as shown in the FIGS. 2 and 3. A contact device of this kind comprises an electrically insulating substrate 25 on which a metal contact strip 27 is provided. The contact strip can be provided, for example, according to known printed wiring techniques. Provided on the contact strip 27 is an insulating substrate 29 which leaves the contact strip 27 locally exposed through an opening 31. Provided on the substrate 29 is a flexible metal contact strip 33 which bridges the opening 31. Through a flexible, electrically insulating foil 35, a control member according to the invention is connected to the assembly of the said substrates and strips. The button 19 is guided in a

plate 37 which is provided on the outer cylinder 3 of the control member. The operation of a control member according to the invention will be described herein after with reference to the FIGS. 1, 2 and 3.

In the embodiment shown in the FIGS. 1 and 2, in which the pressure edge 23 is situated at a small distance above the coupling 7 in the neutral position, the transition between portion 11 and portion 9 of the coupling 7 is initially displaced over a smaller distance than the pressure member 17 or the inner cylinder 5 when the button 19 is depressed. As a result, the pressure edge 23 contacts the coupling 7 only after the depression has progressed somewhat. The comparatively rigid portion 9 of the coupling 7 is then somewhat bent through as if it were hinged about the comparatively flexible portion 13 of the coupling. At the instant at which the pressure edge 23 makes contact, the position of portion 9 is such that the better part of the energy applied to the button 19 is taken up for the compression of portion 9, whilst only a small part is taken up for the bending of part 9. A small part of the energy is also taken up to deform the comparatively flexible portions 11 and 13 of the coupling 7 which act as an elastic hinge. It will be obvious that when button 19 is further depressed, the portion 9 is compressed between portion 13 and the pressure edge 23 until the instant at which portion 9 folds over as if it were about the portion 13 which acts as an elastic hinge. As a result, portion 9 will assume a state of much lower energy, which can be clearly felt by the operator. The best defined pressure point occurs when the pressure edge 23 engages near the transition between portion 9 and portion 11 of the coupling 7. During the depression of the button 19, the pressure member 17 has come into contact with the flexible foil 35 so that the flexible contact strip 33 is pressed against the contact strip 27 upon further depression, with the result that the contact strips 27 and 33 are electrically interconnected. The outer diameter of button 19 is proportioned such that the button 19 always returns to the neutral position. If the diameter were too large, the friction between the coupling 7 and the pressure edge 23 would prevent the return to the neutral position. In a special embodiment of a control member according to the invention, the inner cylinder 5 has a length such that it has on its lower side an edge 39 which acts as an abutment. The distance between this edge 39 and the free end face of the pressure member 17 determines, in conjunction with the rigidity of diaphragms 15, the maximum contact pressure which can occur between the contact strips 27 and 33, and also the maximum bending of the diaphragm 15 to which the pressure member 17 is connected. Particularly in the case of contact devices having an extremely vulnerable flexible contact strip, the limitation of the contact pressure is important. This is because it is quite possible that the pressure-point action of the coupling 7 itself is not sufficient to ensure careful operation when it is not accepted or experienced as an indication of established contact. It is to be noted that control members according to the invention can also be used in combination with contacts where two comparatively robust contact reeds have to be pressed against each other. Such contacts always require a contact pressure limitation. In those cases the pressure member 17 can be formed by a projection which is rigidly connected to a solid inner cylinder 5. The abutment is then formed by the stationary contact reed. Alternatively, when a

contact limitation is omitted in the control member, the resilient contact reed can be made to abut in known manner on a fixed abutment.

As is illustrated in FIG. 4, provided with reference numerals corresponding to those of the other Figures, a plurality of control members according to the invention can be used in a multiple contact device which is suitable, for example, for use in pocket calculators. These control members can be manufactured both individually and simultaneously. In the latter case there are no longer individual outer cylinders 3, but an integral elastic high-polymeric layer 41 in which all control members are pressed. By shaping the buttons 19 as shown in FIG. 4, the guide plate 37 for the buttons 19 can be omitted and replaced by arms 43 which are formed on the buttons 19 and which hinge in openings 45 in the layer 41.

What is claimed is:

1. A control member for a contact device comprising a hollow relatively rigid first body of elastic compressible material, a second relatively rigid body of elastic compressible material coaxially arranged with respect to said first body, a compressible coupling connecting said first body with said second body so that said second body is axially displaceable for contact movement with respect to said first body, said first body said second body and said compressible coupling forming a single integral unit, a pressure member carried on said second body, said compressible coupling comprising a rigid portion, a first flexible portion connecting one side of said rigid portion to said first body, and a second flexible portion connecting the other side of said rigid portion to said second body, and a pressure edge connected to said displaceable second body engaging said rigid portion of said compressible coupling when said second body is axially displaced so as to compress said rigid portion of the coupling during contact moving.

2. A control member for a contact device comprising a hollow relatively rigid first body of elastic compressible material, a second relatively rigid body of elastic compressible material coaxially arranged with respect to said first body, a compressible coupling connecting said first body with said second body so that said second body is axially displaceable for contact movement with respect to said first body, said first body said second body and said compressible coupling forming a single integral unit, a flexible diaphragm carried by said second body, a pressure member carried on said flexible diaphragm, said compressible coupling comprising a rigid portion, a first flexible portion connecting one side of said rigid portion to said first body, and a second flexible portion connecting the other side of said rigid portion to said second body, and a pressure edge connected to said displaceable second body engaging said rigid portion of said compressible coupling when said second body is axially displaced so as to compress said rigid portion of the coupling during contact moving.

3. The control member according to claim 2 wherein the connection of said compressible coupling to the first and second bodies forms a circle.

4. The control member according to claim 3 wherein said compressible coupling further comprises a curved trough-like section, the curvature of said section being directed in a direction opposite to the direction of axial displacement of said second body for contact movement.

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5. The control member according to claim 2 further comprising an annular abutment provided on said second body for limiting axial displacement thereof.

6. A contact device comprising a first flexible contact strip located in a first flat plane, a second contact strip located in a second flat plane spaced from said first flat plane, a layer of electrically insulating material located between said first and second contact strips, an opening in said insulating layer, a control member for moving said flexible first contact strip into electrical contact with said second contact strip through said opening, said control member comprising a hollow relatively rigid first body of elastic compressible material connected to the contact device by an adhesive layer, a second relatively rigid body of elastic compressible material coaxially arranged with respect to said first body, a compressible coupling connecting said first body with said second body so that said second body is axially displaceable with respect to said first body for causing movement of said first contact strip into contact with

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said second contact strip, said first body, said second body and said compressible coupling forming a single integral unit, a flexible diaphragm carried by said second body, a pressure member carried by said flexible diaphragm for cooperative engagement with said first contact strip, said compressible coupling comprising a rigid portion, a first flexible portion connecting one side of said rigid portion to said first body, and a second flexible portion connecting the other side of said rigid portion to said second body, and a pressure edge connected to said displaceable second body engaging said rigid portion of said compressible coupling when said second body is axially displaced so as to compress said second rigid body of the coupling during axial movement of said second body, whereby upon axial movement of said second body said pressure member will engage said first contact strip causing movement thereof into contact with said second contact strip.

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