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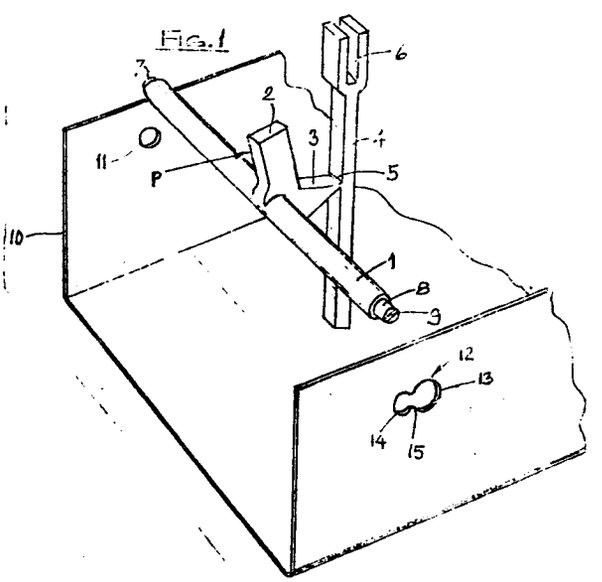
(54) Motion transmitting lever-device comprising a plastic hinge.

(57) A combined bellcrank lever and plunger moulded integrally in plastics material has one arm (2) which engages a setting cam and another arm (3) connected to a displaceable member such as a switch operating plunger (4) through an integral ligament hinge (5). Also formed integrally with the lever and plunger is a shaft (1) by means of which the device is pivotally engaged in a support (10) by snap engagement.

The ligament hinge (5) may have self-resilience enabling it to exert a biassing moment on the lever or the plunger when the device is installed.



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MOTION TRANSMITTING DEVICE

This invention relates to a motion transmitting device.

The invention has particular, but not exclusive, application to the transmission of switch-operating movement to an electrical switch from a switch control or setting member.

An object of the invention is to provide a motion transmitting device capable of transmitting movement from a control or setting member to a driven member, such as a switch operating member, movable in a direction which is at an angle to the direction of movement of the control or setting member. A further object of the invention is to provide such a motion transmitting device which is of simple one-piece construction.

According to the present invention there is provided a motion transmitting device comprising a lever having an arm engageable by a control or setting member and a plunger pivotally connected to the lever and engageable with a driven member to effect displacement thereof upon pivotal movement of the lever by means of the control member, characterised in that the lever and the plunger are formed of one piece of plastics material, the pivotal connection between the lever and the plunger being afforded by a flexible portion of the same plastics material integral with the lever and the plunger.

The motion transmitting device may be adapted to transmit movement from a control or setting member to a driven member movable in a direction substantially perpendicular to the direction of movement of the control or setting member. For example, the control or setting member may comprise a switch operating cam engaging an arm of the lever, while the driven member may comprise a switch operating member such as a tongue

of a snap acting switch blade, movable in a direction substantially perpendicular to the direction of movement of the cam.

Plastics material from which the device is made should have sufficient tensile strength to permit the transmission of linear displacement to the plunger upon pivotal movement of the lever, while having sufficient flexibility in the portion forming the pivotal connection to permit rocking movement of the lever relative to the plunger. Examples of suitable plastics material for the device are polypropylene and nylon.

Preferably the lever is fixed to a pivot shaft which is also formed integrally with the lever and the plunger in the same plastics material as the latter. The pivotal connection may comprise a ligament hinge permitting flexing of the lever relative to the plunger about an axis parallel to the axis of the pivot shaft.

Preferably the lever is a bellcrank lever one arm of which is engageable with the control or setting member and the other arm of which is pivotally connected to the plunger.

The flexible portion affording the pivotal connection between the lever and the plunger is preferably resilient so that it biases the plunger towards a predetermined angular position relative to the lever. The degree of resilience of the pivotal connection or hinge can be predetermined by suitably selecting the thickness of the plastics material forming the pivotal connection. Constructed in this way the one-piece plastics device of the present invention is mechanically equivalent to a mechanism consisting of a lever, a pivot snaft, a plunger pivotally connected to the lever, and a spring biasing the

plunger towards a predetermined angular position relative to the lever. The one-piece plastics device of the invention can therefore lead to a considerable economy of construction and component parts in many practical applications.

In a preferred embodiment of the invention the pivotal connection between the lever and the plunger is intermediate the ends of the plunger, one end of the plunger being adapted for engagement with guide means which, upon rocking movement of the lever, cause the plunger to effect substantially linear displacement in the direction of its longitudinal axis.

Where the device is formed with an integral pivot shaft, the shaft itself may be formed with trunnion elements at opposite ends which, upon mounting of the device, engage in bearing holes to form a pivotal mounting for the shaft. Preferably one trunnion element is slotted to permit its resilient engagement in a suitably sized aperture in a support or mounting.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying purely diagrammatic drawing, in which:

Figure 1 is a perspective view of a motion transmitting device according to one embodiment of the invention showing part of a mounting structure into which it fits;

Figure 2 is a diagrammatic side view illustrating an equivalent prior art device corresponding to that of Figure 1, and

Figure 3 is a diagrammatic side elevation, partly in section, illustrating one practical application of the device of Figure 1 for the transmission of switch operating movement in an electrical switch unit.

Referring to the drawings, the motion transmitting device shown in Figure 1 is mounted in a single piece of plastics material, for example polypropylene, and has a pivot shaft 1 provided centrally with two projecting lever arms 2, 3 arranged substantially perpendicular to each other and together constituting a bellcrank lever. The lever arm 2 is adapted to be engaged by a control or setting member, while the other lever arm, 3, tapers in width towards an elongate plunger 4, moulded integrally with the lever arm 3, and connected to the latter by way of an integral ligament hinge portion 5 which is resiliently flexible to permit rocking movement of the lever arm 3 relative to the plunger 4. The ligament hinge portion 5 defines a hinge axis which is substantially parallel to the axis of the pivot shaft 1, while the longitudinal axis of the plunger 4 is perpendicular to the axis of the pivot shaft 1.

The plunger 4 is moulded with a bifurcated end portion defining a rectangular longitudinally extending slot 6 for engagement by a fixed guide member which, upon rocking movement of the bellcrank lever 2, 3, guides the plunger to cause the latter to effect substantially linear displacement in the direction of its longitudinal axis.

The pivot shaft 1 is moulded at opposite ends with reduced diameter cylindrical trunnion elements 7,8 engageable in circular holes of a mounting structure to define the pivot axis of the shaft 1. One of the trunnion elements, 8, is formed with a slot 9 extending longitudinally from its free end and imparting sufficient resilience to this trunnion element 8 to permit its snap engagement in an appropriately sized aperture in a support or mounting.

The construction of the device shown in Figure 1 is such that if a force indicated generally by the arrow P is applied to the lever arm 2 with the pivot shaft 1 mounted for rotation about its axis by means of the trunnion elements 7, 8, the bellcrank lever 2, 3 is rocked about the axis of the shaft 1, and causes linear displacement of the plunger 4, such displacement being transmitted to the plunger 4 by means of the ligament hinge portion 5, which also permits flexing of the lever arm 3 relative to the plunger 4.

Figure 2 shows a typical prior art motion transmitting mechanism adapted to perform the same functions as the device of Figure 1. This mechanism comprises a shaft S, a bellcrank lever L and the rod R. In addition, to bias the lever L angularly relative to the rod R, a tension spring T is interposed between one arm of the bellcrank lever L and the rod R. The device according to the present invention illustrated in Figure 1 combines the functions of all the components S, L, H, R and T of the prior art mechanism of Figure 2 in a single plastics moulded device, resulting in a considerable economy of construction. In particular, it should be noted that the resilient ligament hinge portion 5 acts both as a pivotal connection between the bellcrank lever arm 3 and the plunger 4 and as a spring biassing the lever arm 3 angularly relative to the plunger 4. The biassing moment created about the hinge portion 5 will be determined by the relative angular positions in which the arm 3, the plunger 4 and the ligament hinge portion 5 are moulded, in relation to their intended positions of use, and will also be determined by the thickness of the ligament hinge portion 5 itself.

An example of one practical application of the device shown in Figure 1 is illustrated diagrammatically in Figure 3, in which the device transmits operating movement to an electrical switch. The pivot shaft 1 of the device is rotatably supported in a casing or mounting structure 10 of the switch, part of which is shown in Figures 1 and 2, the trunnion element 7 fitting closely in a circular hole 11 in one side wall of the switch casing, and the other, slotted trunnion element 8 fitting into a keyhole shaped aperture 12 in an opposite side wall of the switch casing. The keyhole shaped aperture 12 is formed by a first part-circular hole 13 into which the trunnion element 8 may be inserted, and a smaller diameter second circular hole 14 into which the trunnion element 8 can be forced by squeezing together of the two halves of the trunnion element 8 formed by the slot 9. The hole 14 communicates with the larger hole 13 by way of a throat 15 of narrower width than the diameter of the smaller hole 14, so that the movement of the trunnion element 8 into the hole 14 takes place with a snap action.

The device is arranged in the embodiment of Figure 3 so that the lever arm 2 of the bellcrank lever is engaged by an edge of a cam 16 mounted on an operating shaft 17 the axis of which is generally perpendicular to the pivot axis of the lever 2, 3.

The slot 6 at one end of the plunger 4 is engaged in a guide member 18 which may be formed by upsetting a portion of one wall of the switch casing. In an alternative embodiment (not shown) the plunger 4 may have in place of the slot 6 a male extension piece which engages in a guide slot or guide hole in the switch casing to guide the displacement of the plunger 4.

The end of the plunger 4 opposite the slot 6 engages a flexible operating tongue 19 of a snap action switch blade 20 carrying a switch contact 21 which can be moved into and out of engagement with a fixed contact 22. In the illustrated embodiment the switch contacts 21, 22 are normally closed and are opened with a snap movement by movement of the switch operating plunger 4 downwardly as viewed in Figure 2.

The resilience of the flexible ligament hinge portion 5 between the bellcrank lever arm 3 and the plunger 4 is such that the lever arm 3 is biassed into a normal position in which it is inclined to the longitudinal axle of the plunger 4. In the example illustrated, the lever arm 3 adopts a position inclined at 82° to the longitudinal axis of the plunger 4. The resilience of the hinged portion 5 tends to return the plunger to a position in which it is inclined at this angle to the lever arm 3, and accordingly the ligament hinge portion 5 is equivalent, as stated earlier, to a tension spring interposed between the plunger 4 and the lever arm 3, as shown diagrammatically by the broken outline ghost spring 23 shown in Figure 3.

In a typical practical embodiment of the invention the motion transmitting device would be moulded in polypropylene, the hinge portion 5 consisting of a ligament having a thickness of 0.5 millimetres.

It will be appreciated that the device according to the invention is applicable to the transmission of motion between relatively movable parts in general, being illustrated by way of example in its practical application as a switch operating device. In this latter application the device has the further practical advantage that, being of plastics material, it is

electrically insulating, so that it can be employed for the transmission of movement from a switch control or setting member such as the cam 16 shown in Figure 3 to a switch blade 20 which, when the switch is closed, may be electrically live.

In the arrangement illustrated in Figure 3 the device would normally be installed in the switch casing by engagement of the guide member 18 in the slot 6 at the end of the plunger 4 in such a way that when so engaged the angle between the lever arm 3 and the plunger 5 is greater than the angle between these parts in the normal relaxed condition of the device, so that the ligament hinge portion 5 is prestressed, eliminating any play between the guide slot 6 and the guide member 18.

CLAIMS:

1. A motion transmitting device comprising a lever having an arm (2) engageable by a control or setting member (16) and a plunger (4) pivotally connected to the lever and engageable with a driven member (18) to effect displacement thereof upon pivotal movement of the lever by means of the control member (16), characterised in that the lever (2,3) and the plunger (4) are formed of one piece of plastics material, the pivotal connection between the lever and the plunger (4) being afforded by a flexible portion (5) of the same plastics material integral with the lever and the plunger.

2. A device according to Claim 1, in which the lever (2,3) is fixed to a pivot shaft (1) which is formed integrally with the lever and the plunger (4).

3. A device according to Claim 2, in which the pivotal connection comprises a ligament hinge (5) permitting flexing of the lever (2,3) relative to the plunger (4) about an axis parallel to the axis of the pivot shaft (1).

4. A device according to Claim 1, Claim 2 or Claim 3, in which the lever is a bellcrank lever one arm (2) of which is engageable with the control or setting member and the other arm (3) of which is pivotally connected to the plunger (4).

5. A device according to any one of the preceding Claims, in which the flexible portion (5) affording the pivotal connection between the lever (2,3) and the plunger (4) is resilient and biases the plunger towards a predetermined angular position relative to the lever.

6. A device according to any one of the preceding Claims, in which the pivotal connection between the lever (2,3) and the

plunger (4) is located intermediate the ends of the plunger (4), one end (6) of the plunger being adapted for engagement with guide means (17), which, upon rocking movement of the lever, cause the plunger (4) to effect substantially linear displacement in the direction of its longitudinal axis.

7. A device according to Claim 2 or Claim 3, in which the pivot shaft (1) is formed with trunnion elements (7,8) at opposite ends, one trunnion element (8) being slotted (9) to permit its resilient engagement in a suitably sized and shaped aperture (12) in a support or mounting.

FIG.1

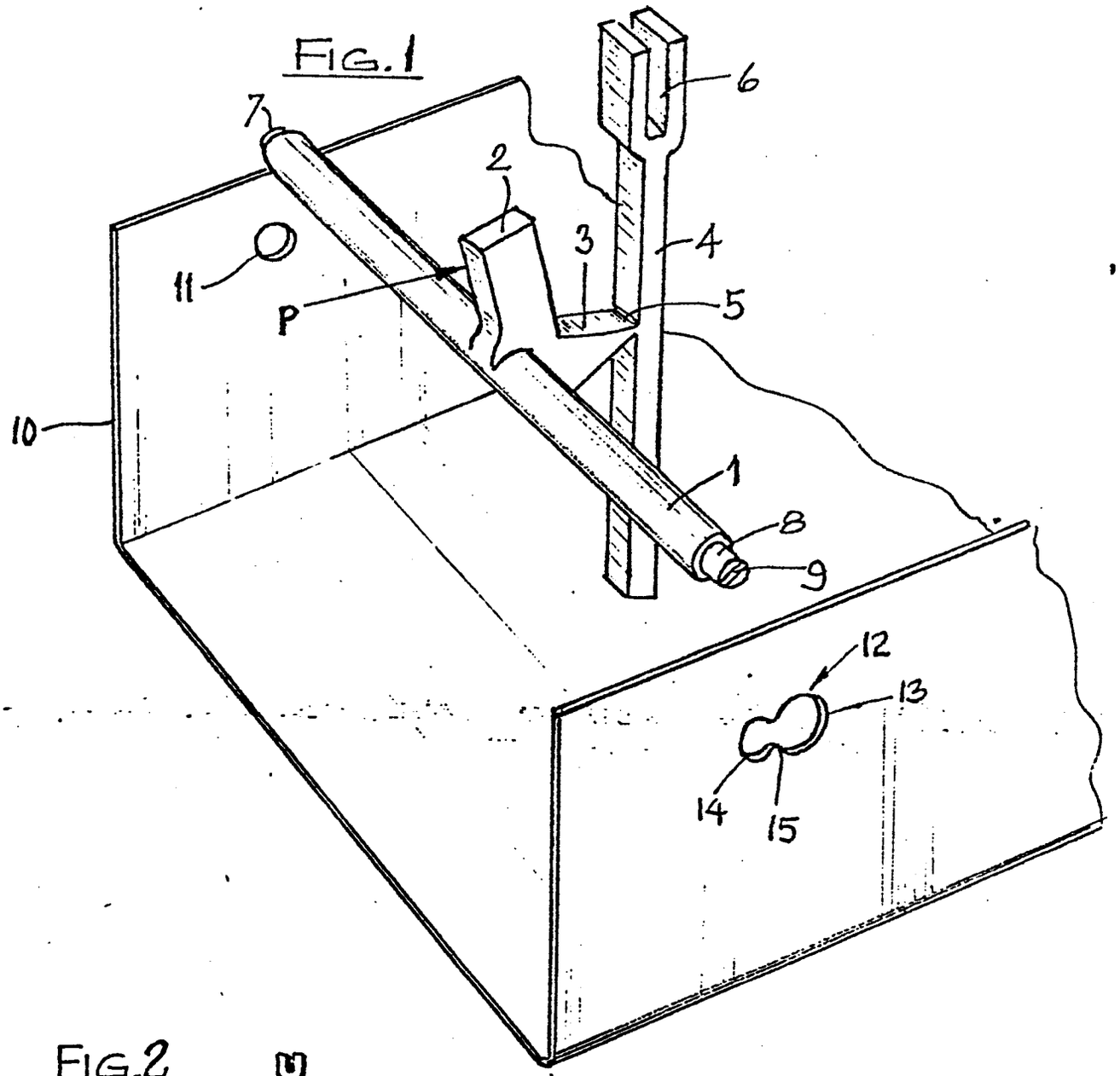


FIG.2

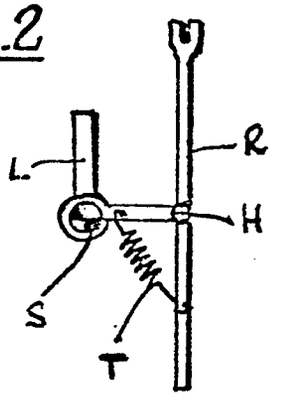
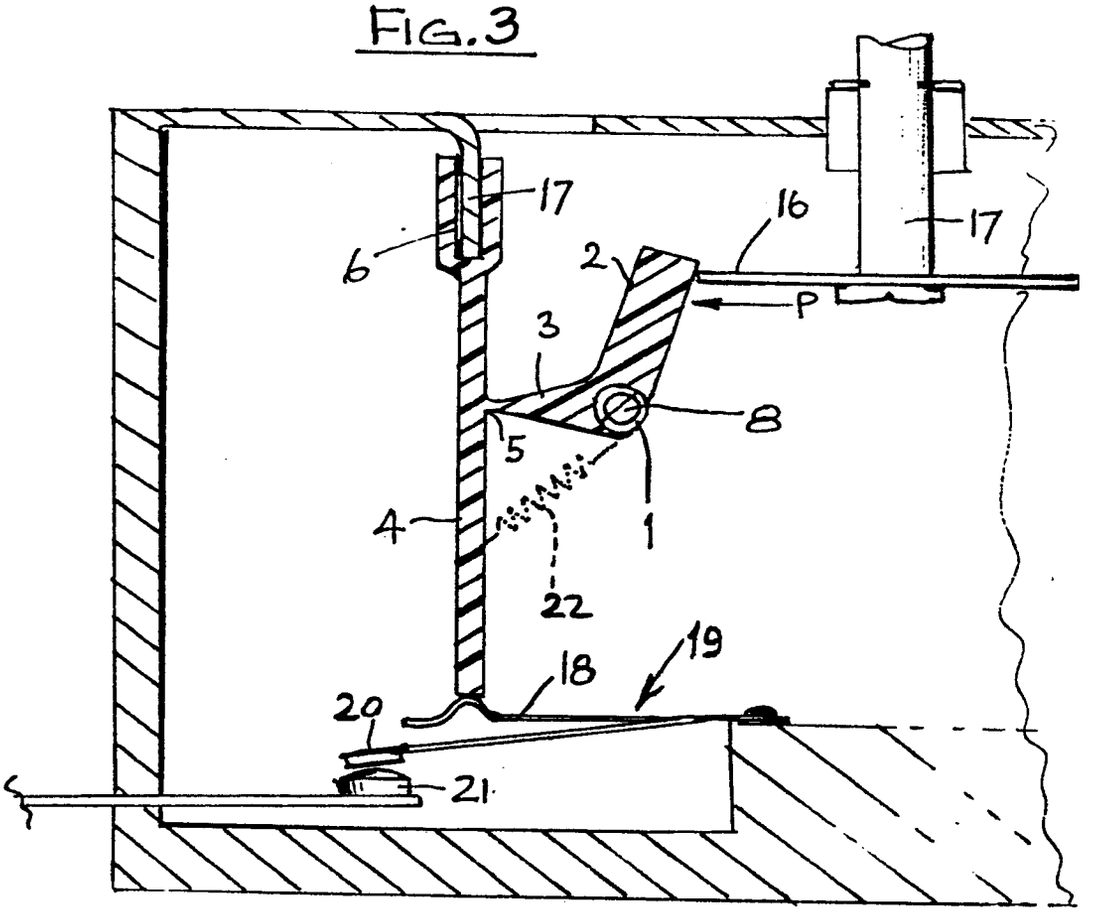


FIG.3



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EUROPEAN SEARCH REPORT

Application number
EP 78 30 0147

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	DE - B - 1 268 922 (PHILIPS PATENTVERWALTUNG GmbH) * Claim 1; column 1, lines 11-35; column 2, lines 39-41; figures 1-3 *	1-3
X	US - A - 3 322 924 (M.I.SHEPS) * Column 1; colomn 2, lines 1-45; column 3, lines 15-45; column 4, lines 5-41; claims 2,4,5 *	1-6
A	DE - U - 1 966 267 (RAMSTETTER) * Page 2, lines 6-24; figure 2 *	
A	US - A - 3 258 548 (R.J.CARTIER) * Column 2, lines 1-12, 45-67; column 3, lines 1-12 *	1,6

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

H 01 H 3/46
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TECHNICAL FIELDS SEARCHED (Int.Cl.³)

H 01 H 3/46
H 01 H 3/32
H 01 H 3/00
H 01 H 21/84
F 16 H 21/00
F 16 H 25/08

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	09-10-1978	RUPPERT

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