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(54) Electrical connector.

(57) The connector comprises a housing (110) having an infeed opening (112) for an electrically-insulated wire. The housing (110) accommodates a fixed contact (114), a pivotally mounted pressure lever (116) acted upon by a compression spring (134) and a pivotally mounted operating member (118) having a cam surface (132) engageable with the pressure lever. The fixed contact (114) and the pressure lever (116) both have co-operating, longitudinally-offset, insulation-penetrating parts (120 and 126). Pivotable movement of the operating member (118) from a first to a second position moves the pressure lever (116) against the action of the spring (134) into a position (as shown in the Figure) in which the penetrating parts (120 and 126) cut into the insulation of a wire extending through the infeed opening (112) and grip the wire in a manner which electrically connects the conductor of the wire to the fixed contact (114). Preferably the pressure lever (116) is mounted so that it can automatically compensate for different wire conductor diameters.

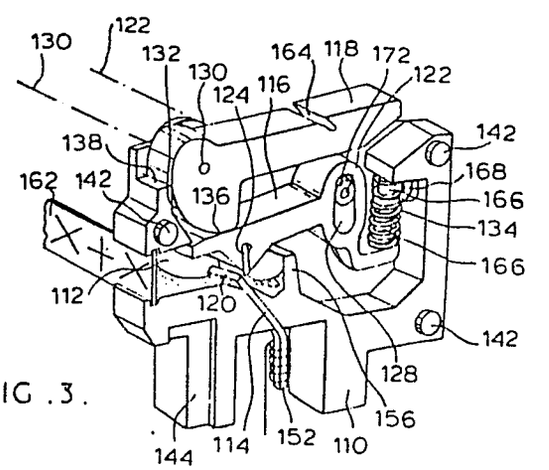

FIG. 3.

EP 0 196 925 A2

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"ELECTRICAL CONNECTOR"

This invention relates to an electrical connector and particularly but not exclusively to an electrical connector which can be used in a terminal block of a telecommunications system to connect customer's drop wires to distribution cables.

According to one aspect of the invention there is provided an electrical connector comprising a body having an infeed opening for an electrically-insulated wire, a fixed contact mounted on the body, a pressure member movably mounted on the body, the fixed contact and/or the pressure member having an insulating-penetrating part, and an operating member movably mounted on the body and having a surface engageable with the pressure member such that movement of the operating member from a first to a second position moves the pressure member into a position in which the insulating-penetrating part(s) penetrate the insulation of a wire extending through the infeed opening, and grip the wire in a manner which electrically connects the conductor of the wire to the fixed contact, the arrangement of the operating member and of the pressure member being such that the force applied to the

insulating-penetrating part(s) is substantially greater than the operating force applied to the operating member.

According to a second aspect of the invention, there is provided an electrical connector comprising a housing having an infeed opening for an electrically-insulated wire, a fixed contact mounted in the housing, a pressure lever member pivotally mounted in the housing and acted upon by resilient means, the fixed contact and/or the pressure member having an insulation-penetrating part, and an operating member pivotally mounted in the housing and having a cam surface engageable with the pressure member such that pivotal movement of the operating member from a first to a second position moves the pressure member against the action of the resilient means into a position in which the insulation-penetrating part(s) penetrate the insulation of a wire extending through the infeed opening, and grip the wire in a manner which electrically connects the conductor of the wire to the fixed contact.

Preferred and/or optional features of the invention are set forth in Claims 2 to 5 and 7 to 12. The invention extends to a terminal block comprising a casing and a plurality of connectors of the invention.

The feature of Claim 11, namely the application of the shear action, is considered an invention in its own right and is useable without the other features in Claims 1 or 6.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a sectional view of one embodiment of an electrical connector according to the invention;

Figure 2 is an end view showing a housing for five of the connectors shown in Figure 1, on a smaller scale;

Figure 3 is an isometric view of a second embodiment of an electrical connector according to the invention;

Figure 4 is a schematic isometric view of part of a terminal block including a number of the connectors shown in Figure 3, on a smaller scale;

Figure 5 is an elevation of the connector shown in Figure 3; and

Figure 6 is a front end view of the connector shown in Figure 3 (looking in the direction of the arrow VI in Figure 5).

Referring to Figures 1 and 2 of the drawings, the connector shown therein comprises a moulded body or housing 10 of electrically insulating material, e.g. an acetyl resin such as "Delrin". The housing 10 has an infeed opening 12 for the end of an insulated wire (not shown) and accommodates a fixed contact 14, a pressure member or lever 16, and an operating member in the form of a cam lever 18.

The fixed contact 14 is for example of phosphor bronze, berylium copper or precipitation-hardened copper and is fastened to the bottom wall of the housing 10 by a crimp rivet 15. The fixed contact 14 is upwardly inclined at one end, where it is rigidly supported by a raised portion of the bottom wall of the housing 10, to provide a first insulation-penetrating part 20 in the form of a knife edge.

The pressure lever 16 is pivotably mounted in the housing 10 about a sleeved pin 22. The lever 16 is of electrically insulating material, e.g. "Delrin", a polycarbonate such as "Noryl" or a glass-reinforced plastic such as polyester or polyether sulphone, and has intermediate its ends a metal insert 24, e.g. of the same material as the contact 14, to provide a second insulation-penetrating part 26 in opposition to the first insulation-penetrating part 20.

The pivot region of the pressure lever 16 is able to shift to compensate automatically for different wire conductor sizes. This ability to shift is provided by an elongate aperture 28 in the lever 16 and through which the sleeved pin 22 extends.

The cam lever 18 is of electrically insulating material, e.g. of the same material as the pressure lever 16, and is pivotably mounted in the housing about a pin 30. The lever 18 has a cam surface 32 against which the free upper end of the pressure lever 16 is urged by a tension spring 34 connected between the pressure lever 16 and the fixed contact 14. The cam surface 32 is designed to provide a toggle action for a purpose which will become apparent later but for the moment suffice it to say that the crest 36 of the cam, i.e. that part of the cam surface furthest from the pivot axis of the cam lever 18, is shown in Figure 1 in contact with the pressure lever 16.

In order to connect an insulated wire to the connector, the cam lever 18 is moved angularly in an anti-clockwise direction, as considered in Figure 1, until the lever 18 abuts against stop 38 which is a part of housing 10. When the cam lever 18 is in this position the pressure lever 16 is urged clockwise, as considered in Figure 1, by the tension spring 34 so that

the insulation-penetrating parts 20 and 26 are separated. The insulated wire is then fed through the infeed opening 12 and between the insulation-penetrating parts 20 and 26. The cam lever 18 is then moved angularly against the action of the spring 34, in a clockwise direction to the position shown in Figure 1. During the course of this movement the cam surface bearing against the pressure lever 16 pivots the latter anti-clockwise and the knife edge part 20 cuts through the insulation and makes contact with the metal conductor of the wire. The force applied to the part 20 is substantially greater than the operating force applied manually to the cam lever 18; there is considerable leverage at the cam surface 32 and there is also a camming effect. The part 26 also invariably penetrates the insulation, in which case it also makes contact with the metal conductor of the wire. Even if it does not fully penetrate the insulation, it holds the portion 20 in contact with the conductor of the wire.

The cam lever 18 is in fact moved angularly beyond the position shown in Figure 1 so that the lever 18 is entirely or almost entirely contained within the housing 10. This ensures that a part of the cam surface 32 just beyond the crest 36 contacts the upper surface of the pressure arm 16 so as to provide a toggle action and prevent unintentional release of the connector. In this

latter position at least, the portion 20 of the contact 14 is still electrically connected to the conductor of the wire and the wire is firmly gripped between the portions 20 and 26 so that it will withstand the application of a certain tensile load without pulling out.

Different conductor diameters are compensated for by the ability of the pivot region of the pressure lever 16 to shift as aforesaid.

The connector described above is therefore able to connect and retain wires having conductors of various sizes, e.g. in a range of between 0.5mm and 1.14mm diameter, and does not require pre-stripping of the insulation nor the use of any special tool.

It has particular application in telecommunications, such as in a terminal block for connecting customer's drop wires to distribution cables. In this case one or more modules of say five such connectors (see Figure 2) can be mounted in a terminal block casing (not shown) provided with a factory fitted tail, for exchange side cable connection, terminated in a compartment at the rear of the casing, individual wires of the tail being soldered to the terminal rivets 15 and encapsulated in jelly.

Referring to Figures 3 to 6 of the drawings, the same reference numerals are used as for Figures 1 and 2, but increased in value by 100; for components or parts which perform the same function, though they are not necessarily identical. Such components or parts may not be described specifically in relation to Figure 3 to 6, in which case the description of Figures 1 and 2 can be referred to.

For correct alignment, the body or housing 110 has keying projections 142 and corresponding recesses 144 on the other side (not visible); a keying recess 144 is visible in Figures 3 and 5, there being a corresponding keying projection 142 on the other side. The pins 122 and 130 are in the form of long rods which pass from one end of the terminal block assembly to the other. In the block assembly the individual connectors are grouped, each group has an end plate 146 (Figure 4), and the groups are held in the casing 148 of the terminal block assembly by clamping strips 150.

The insulation-penetrating parts 120, 126 are not in strict opposition but are displaced relative to one another longitudinally of the wire, to apply a shear action to the wire; in other words, there is a controlled overlap at the contact face. This avoids the tendency to cut small wires, and also reduces the

closing force when stripping the insulation from thick wires. It is found that the insulation is stretched back and cut, and also torn, and contact is made with the conductor. In addition, the cut is also sealed in the sense that the insulation tends to move back against the portions 120, 126.

The fixed contact 114 is of generally inverted L-shaped (shown partly dashed in Figure 6), and can either be moulded in position or slid in from the right-hand side (as seen looking in Figure 6). It has a square tail or tang 152 which protrudes through the base of the housing 110; this enables a conductor to be attached by wire-wrapping, soldering, blading or crimping. The upper metal insert 124, which may be termed a bridge piece, has a small bent-out sprag 154 which holds the insert 124 in place and avoids mis-assembly. The insert 124 may be slid in from the near side (at seen looking at Figure 3), or may be moulded in place.

A shield 156 is provided. This has a dual function: it prevents the wire being pushed too far into the housing 110, ensuring that just the right length of wire is pushed in (and for instance ensuring that an overlong piece of wire is not pushed up into the spring 134 or interferes with the action of the pressure

lever 116); in addition, the shield 156 confines a sealant or contact lubricant 158 (see Figure 5). At the front of the housing 110, opposed keyways 160 hold in place a thin strip 162 which extends over a number of the connectors and acts as grommet to close the infeed opening 112, providing a cable entry window. The strip 162 can be made of any suitable material, e.g. moulded from thin nylon in tape-like form, and punched or cut through for instance by a roller cutter, with alternate x and + shapes. The strip 162 is just a push fit from one end of the group of connectors to the other, being retained in place at one end by the end plate 146. The strip 162 allows the wire to enter without permitting dust or dirt to contaminate the sealant 158, or permitting the sealant 158 to escape e.g. during storage or when the wire is withdrawn. The sealant 158 may be a non-slump silicone grease or similar, or a contact jelly. The materials chosen for the other components, particularly for the pressure lever 16, should be sufficiently resistant to the sealant 158.

The cam lever 118 has a small slot 164 for the insertion of a screw-driver or coin when the cam lever 118 has been pushed right down into the housing 110, for release of the wire, though it is also possible to pick the cam lever 118 out with a fingernail.

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In the embodiment of Figures 3 to 6, the spring 134 is a helical compression spring carried between two moulded studs 166 on the housing 110 and on the pressure lever 116. In order to be able to mould the upper stud 166, a small window 168 is provided in the housing 110; when the terminal block assembly is formed, this window 168 is closed by a projecting ear 170 on the clamping strip 150 (see Figure 4). The use of the compression spring 134 speeds assembly, and the spring is less vulnerable to corrosion.

The pins 122 are each sleeved by a collar 172 which is integral with the moulding of the housing 110.

It will be seen from Figure 4 that the housings 110 can be considered in pairs, tail-to-tail. It would be feasible to mould such a pair of housings as one moulding. Instead of the front of the housing 110 protruding around the infeed opening 112, it may be planar.

Once the connectors have been fitted into the terminal block assembly, the tangs 152 of the fixed contact 114 and the connected conductor ends are encapsulated by filling resin into the space 172 (Figure 4). This can be done by back-filling or pouring, but is preferably done by injecting a predetermined amount of

resin through the underside of the casing 148 at a sufficiently slow rate to allow air to escape.

The terminal block assembly made using the connectors of the invention can be relatively small and unobstrusive and inconspicuous; it can therefore be placed in a great variety of positions. No tools are required for making the connections with the wires, and the connections can be made very speedily; furthermore, for testing, a wire can be released by releasing the operating member 18,118 and inserting a test terminal - this is very quickly done, and the wire can very quickly be reinserted. In addition, the length of wire required for the connection is very short, say 3 or 4 mm; this is of particular importance if the wire end is damaged, say corroded - the same wire can be used for another attempt.

It is to be appreciated that many modifications to the above described embodiment may be made by persons skilled in the art without departing from the scope of the invention defined by the appended claims.

CLAIMS:-

1. An electrical connector comprising a body having an infeed opening for an electrically-insulated wire, a fixed contact mounted on the body, a pressure member movably mounted on the body, the fixed contact and/or the pressure member having an insulating-penetrating part, and an operating member movably mounted on the body and having a surface engageable with the pressure member such that movement of the operating member from a first to a second position moves the pressure member into a position in which the insulating-penetrating part(s) penetrate the insulation of a wire extending through the infeed opening, and grip the wire in a manner which electrically connects the conductor of the wire to the fixed contact, the arrangement of the operating member and of the pressure member being such that the force applied to the insulating-penetrating part(s) is substantially greater than the operating force applied to the operating member.

2. The connector of Claim 1, and comprising resilient means acting on the pressure member such that the movement of the operating member from the first to the second position moves the pressure member against the action of the resilient means.

3. The connector of Claim 1 or 2, wherein the pressure member has a lever action and is pivotally mounted in the housing.

4. The connector of any of the preceding Claims, wherein the said surface of the operating member is a cam surface, the operating member having a camming action on the pressure member.

5. The connector of any of the preceding Claims, wherein the operating member has a lever action and is pivotally mounted on the body.

6. An electrical connector comprising a housing having an infeed opening for an electrically-insulated wire, a fixed contact mounted in the housing, a pressure lever member pivotally mounted in the housing and acted upon by resilient means, the fixed contact and/or the pressure member having an insulation-penetrating part, and an operating member pivotally mounted in the housing and having a cam surface engageable with the pressure member such that pivotal movement of the operating member from a first to a second position moves the pressure member against the action of the resilient means into a position in which the insulation-penetrating part(s) penetrate the insulation of a wire extending through the infeed opening, and grip the wire

in a manner which electrically connects the conductor of the wire to the fixed contact.

7. The connector of Claim 3 or 6, wherein the pressure member is pivotally mounted on or in the body or housing in a manner in which its pivot region can shift to compensate for different sizes of wire conductor.

8. The connector of Claim 7, wherein the pressure member has a wire-engaging part which is between the pivot and the part of the pressure member which is engaged by the operating member, the pivot being displaceable in a direction generally at right angles to the axis of the pressure member, and spring means being provided biasing the pivot in the direction opposite to that of the moment applied by the operating member and the wire-engaging part.

9. The connector of Claim 5 or 6 or of Claim 7 or 8 when read as appendant to Claim 5 or 6, wherein the operating member is a lever which extends out from the body or housing in its first position and is entirely contained or substantially entirely contained within the body or housing in its second position.

10. The connector of any of the preceding Claims, wherein the fixed contact and the pressure member have

cooperating insulation-penentrating parts which, when in use, both penetrate the insulation of a wire disposed therebetween.

11. The connector of any of the preceding Claims, wherein the insulation-penetrating part and the respective opposed part are not in strict opposition but are displaced with respect to each other longitudinally of the wire, to apply a shear action to the wire.

12. The connector of any of the preceding Claims, wherein the operating member has a toggle action.

13. An electrical connector substantially as here described with reference to, and as shown in, Figure 1 or Figures 3, 5 and 6, of the accompanying drawings.

14. A terminal block comprising a casing and a plurality of connectors of any of the preceding Claims.

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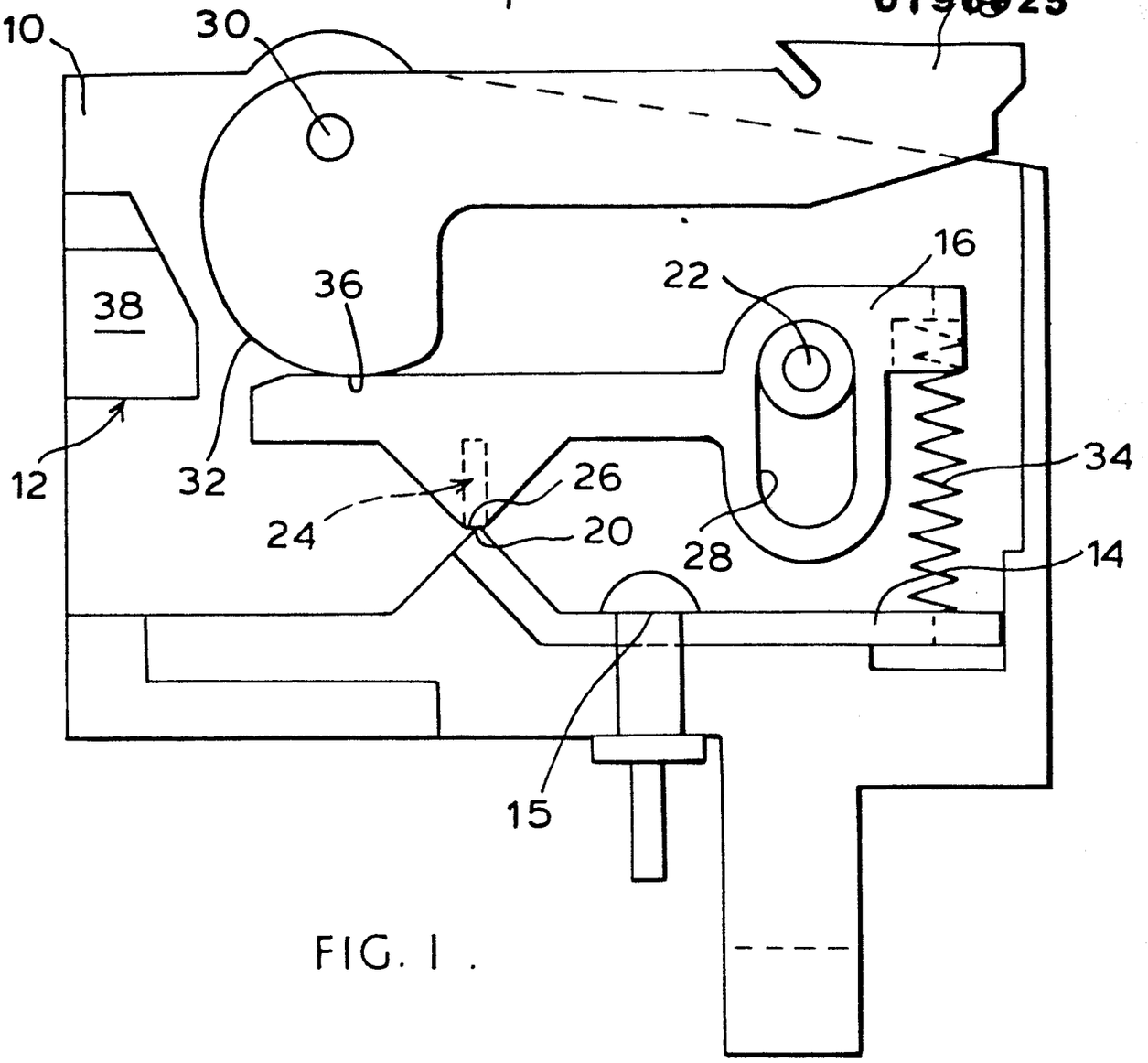

FIG. 1 .

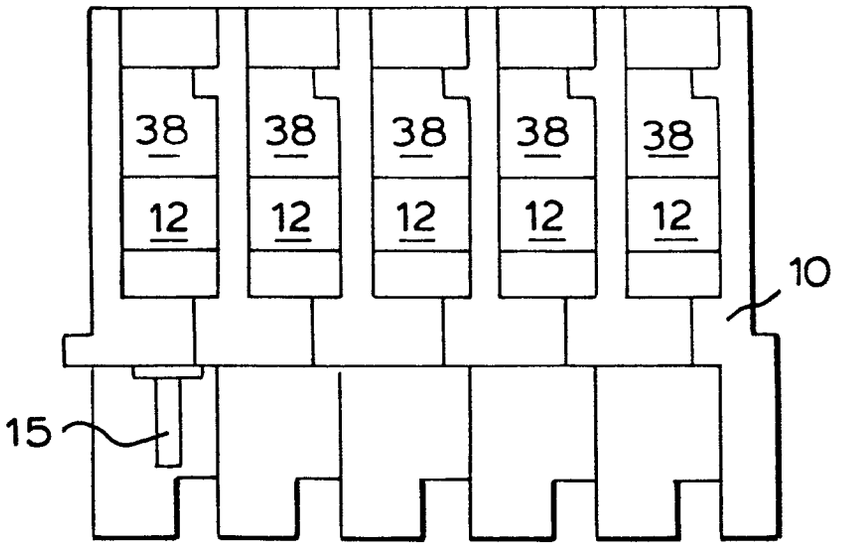

FIG. 2 .

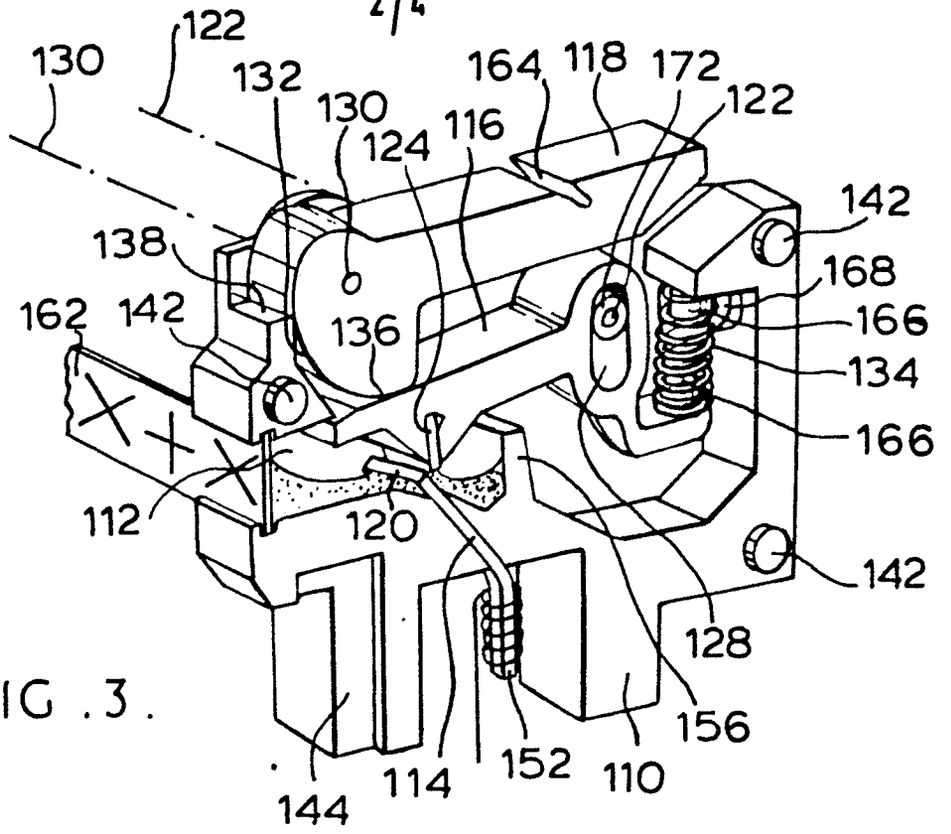
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FIG . 3 .

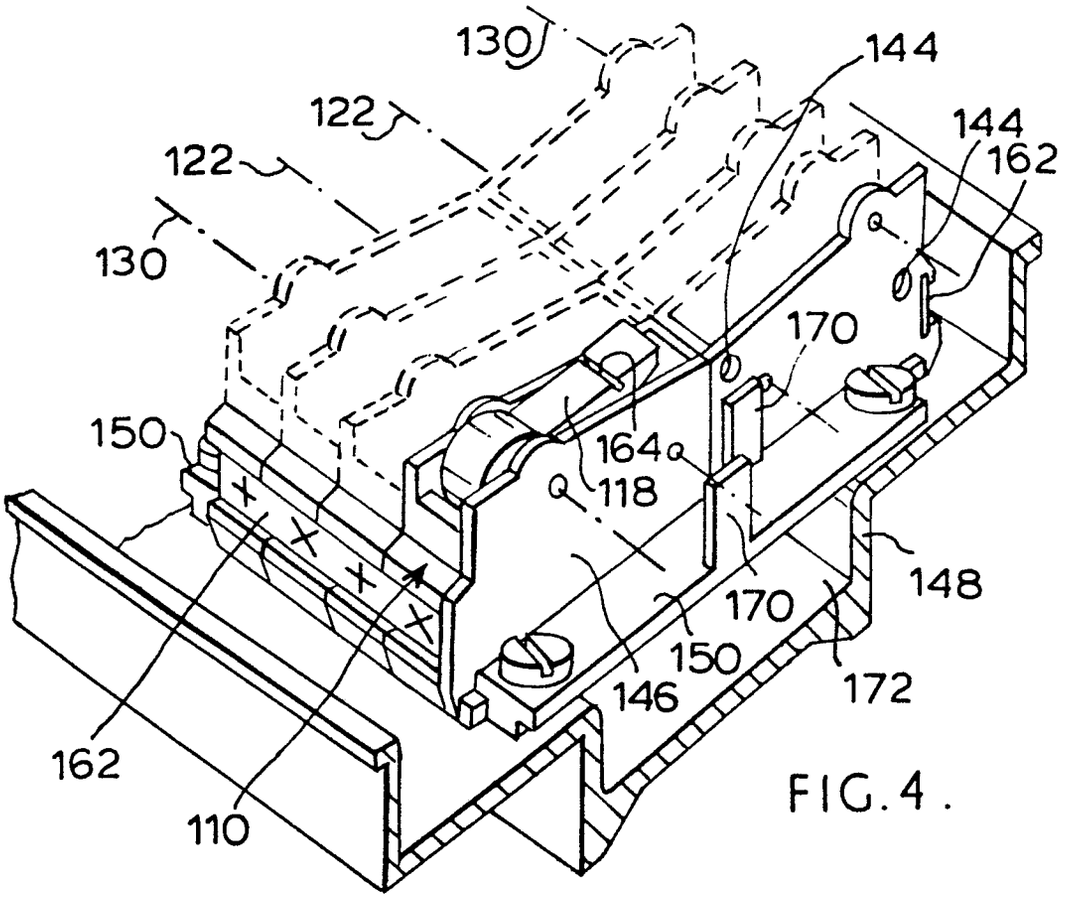
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FIG. 4 .

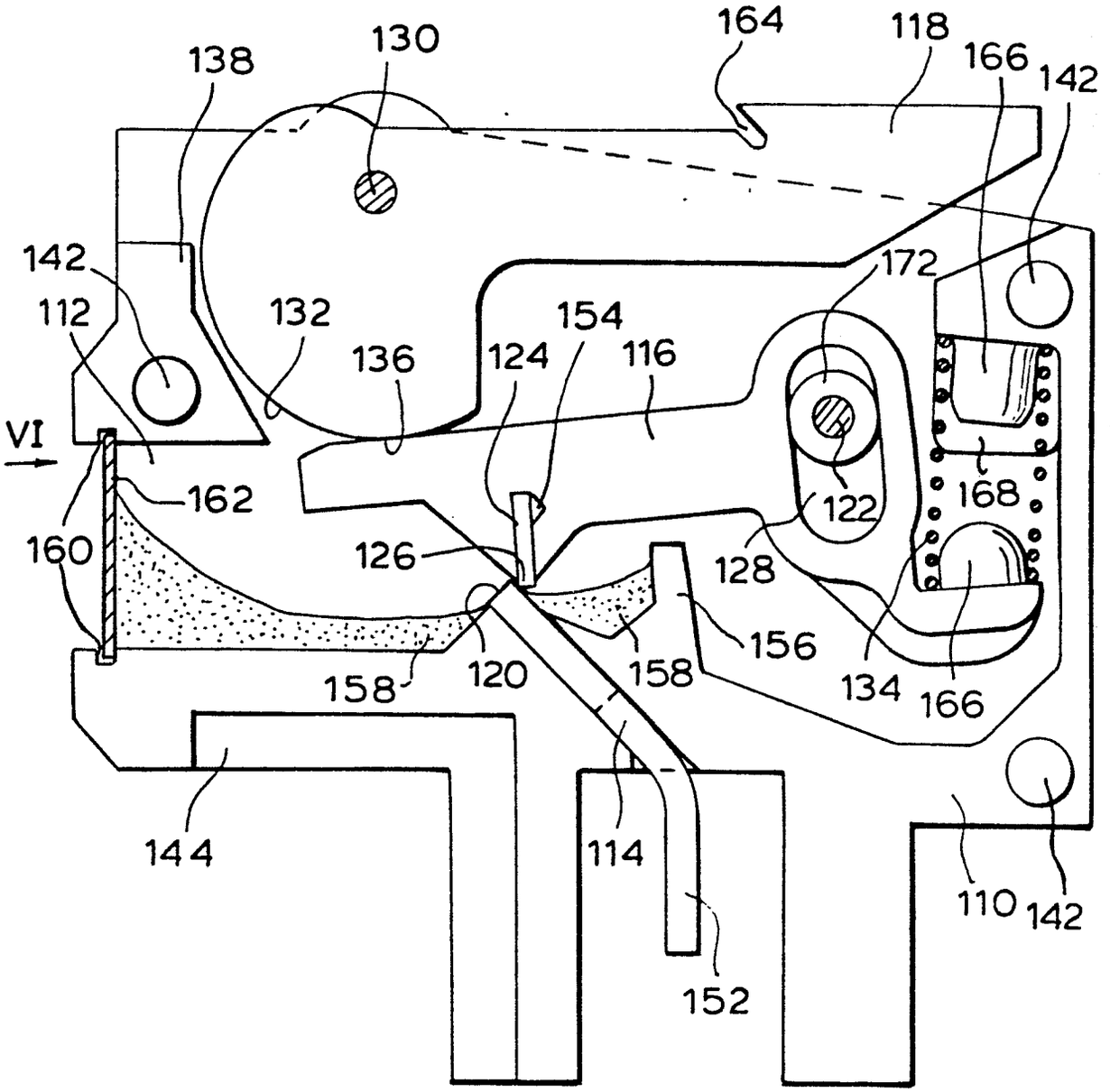
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FIG. 5.

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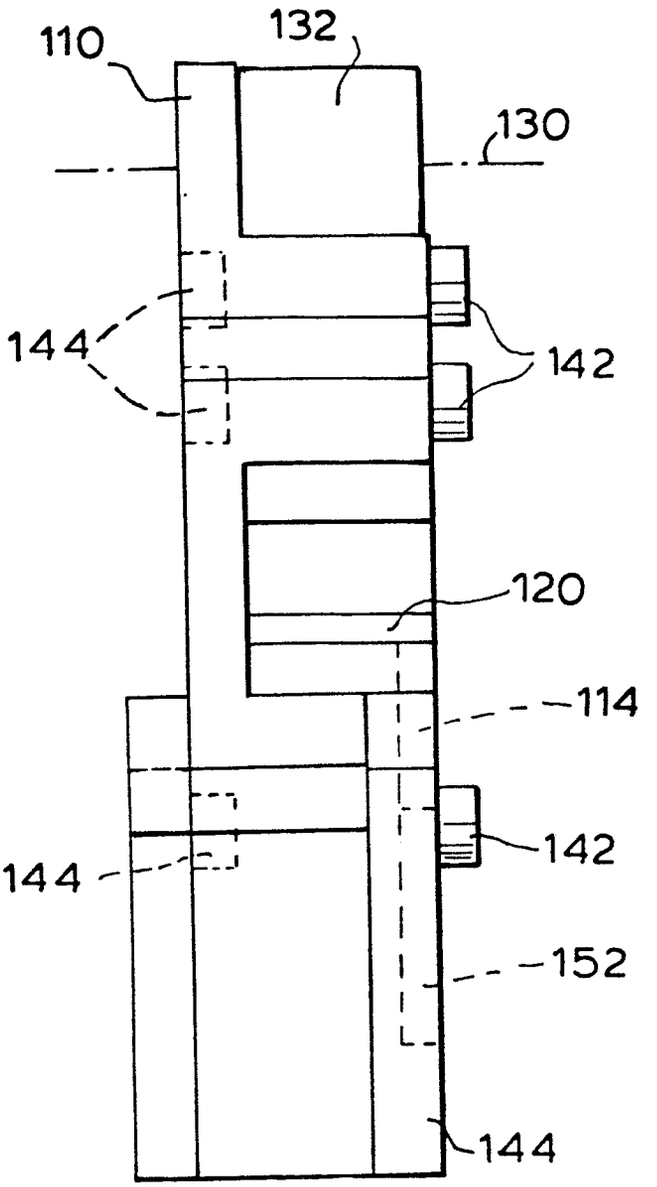

FIG . 6.