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(54) Connector having flat stamped contact terminals.

(57) Multi contact electrical connector (2) comprises a housing (10) having cavities (16) extending therethrough and flat stamped contact terminals (18) in the cavities. Each terminal has an enlarged mounting portion (28). The mounting portion is supported in a rear portion (56) of the cavity between opposed cavity endwalls (62). The endwalls have V-notches (66) that receive the edges (34, 36) of the mounting portion (28). The contact arms (48) of the terminal are twisted relative to the mounting portion (28) and has a thickness which is substantially greater than the thickness of the mounting portion.

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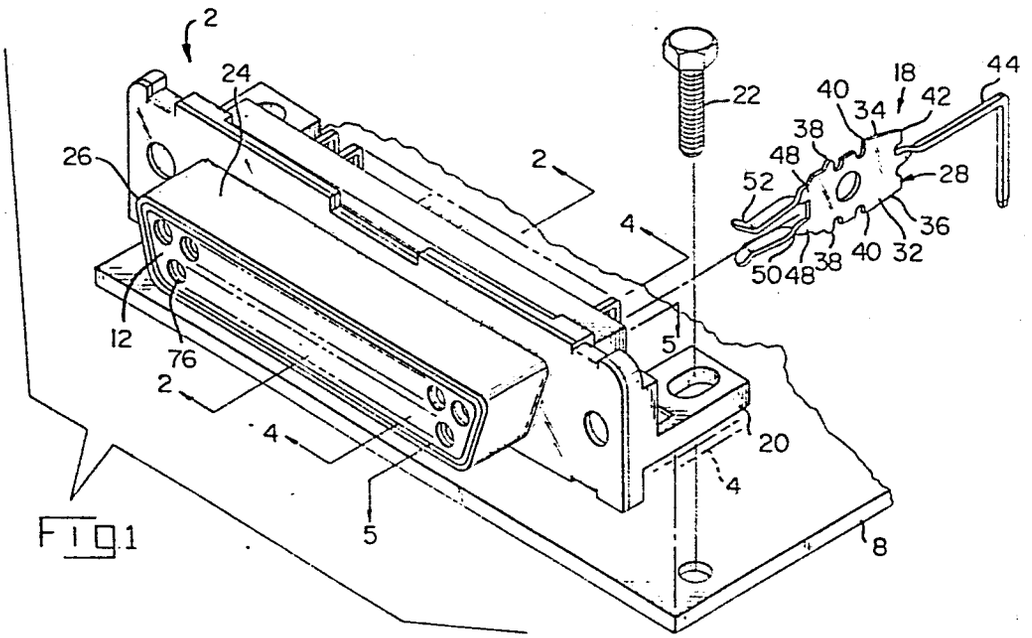
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Fig.1

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CONNECTOR HAVING FLAT STAMPED CONTACT TERMINALS

This invention relates to multi-contact electrical connectors and particularly to connectors having receptacle contacts which are of flat stamped sheet metal.

High quality multi-contact electrical connectors are usually provided with cylindrical receptacle contacts in the receptacle portion and cylindrical pins in the plug portion. The pins and sockets may be either solid screw machine parts or they may be stampings which have been formed into hollow cylinders as receptacles or pins.

Electrical contacts can be produced as flat stampings at considerably lower cost than can cylindrical contacts however, flat stamped contacts are used to only a limited extent and they are not ordinarily used for high quality connectors of the pin and socket type where good electrical performance and a high degree of reliability are required. The present invention is directed to the achievement of a multi-contact electrical connector having flat stamped contacts therein which is capable of electrical and mechanical performance which is comparable to that of a high quality pin and socket type connector of the type currently being used.

An electrical connector in accordance with the invention comprises an insulating housing having a mating face, a rear face, and a contact-receiving cavity extending therethrough from the rear face to the mating face. A contact terminal is provided in the cavity, the contact terminal having a mounting portion which is proximate to the rear face and a contact arm which is proximate to the mating face. The connector is characterized in that the contact terminal is a flat stamped sheet metal member having oppositely facing major rolled surfaces and having sheared edges. The contact arm is twisted with respect to the mounting portion, through an angle of 90° so that the major surfaces of the arm define planes which extend normally of the planes defined by the major surfaces of the mounting portion, the contact arm having side edges which extend along its length

and having a width, as measured between its side edges, which is substantially greater than the thickness of the contact terminal as measured between the major surfaces thereof. The cavity has a rear portion which extends inwardly from the rear face and a forward portion which extends inwardly from the mating face, the mounting portion of the terminal being in the rear portion and the contact arm being in the forward portion. The cavity has opposed sidewalls and opposed endwalls, the major surfaces of the mounting portion being substantially parallel to the sidewalls, the distance between the sidewa" being greater than the width of the contact arm. The endwalls have edge-receiving grooves extending fr face towards the forward portion of the cavity edges of the mounting portion have an interf grooves.

In accordance with a further embodiment a stabilizing projections extend laterally of the axis of at a location adjacent to the contact arm and a second stabilizing projections extend laterally of the axis at a loc spaced from the contact arm. The second pair of project extend laterally a greater distance than the first pair of projections whereby during insertion of the terminal into the cavity, the first pair of projections gouge into the grooves and enlarge the grooves, and the second pair of projections also gouge into the grooves, and when the terminal is fully inserted, the mounting portion will be held in the cavity by the projections of both pairs.

Figure 1 is a perspective view of a connector in accordance with the invention exploded from the surface of a circuit board and showing a contact terminal exploded from the connector.

Figure 2 is a cross sectional view taken along the lines 1-1 of Figure 1 but showing the connector assembled to the circuit board.

Figure 3 is a plan view of a short section of contact terminals in accordance with the invention.

Figure 4 is a view taken along the lines 4-4 of Figure 1.

Figure 5 is a view taken along the lines 5-5 of Figure 4.

Figure 6 is a view looking in the direction of the arrows 6-6 of Figure 2.

Figure 7 is a view similar to Figure 6 which illustrates the self-centering of a contact terminal during insertion into a cavity.

Figure 8 is a perspective view of a core pin used in the molding of a cavity housing in accordance with the invention.

Figures 1 and 2 show a connector 2 in accordance with the invention which serves to connect compact pins in a complimentary connector to conductors 4 on the lower surface 7 of a circuit board 8. The connector 2 comprises an insulating housing 10 having a mating face 12, a rear face 14, and cavities 16 which extend through the housing from the mating face to the rear face. The housing is of molded insulating material, preferably a thermoplastic which can be deformed slightly when the terminals are inserted in the cavities as will be described below.

The housing has integral ears 20 by means of which it is secured to the surface of the circuit board 8, fasteners 22 being provided for this purpose as indicated. The forward portion of the housing has a trapezoidal projection 24 and the mating face 12 is the face of this projection. The connector shown also has sheet metal shielding 26 surrounding the forward portions of the housing.

The contact terminals 18 are produced in continuous strip form with each of the terminals being connected to a carrier strip 27, see Figure 3. The terminals are produced as flat stampings having an enlarged central mounting portion 28, an integral solder post portion, and at least one contact arm. The enlarged mounting portion 28 has oppositely facing major surfaces 30, 32 (Figure 6) which were the rolled surfaces of the strip stock metal from which the terminal was stamped. The

mounting portion has upper and lower side edges 34, 36 which are sheared edges and which have a width equal to the thickness of the stock metal.

The first pair of retaining projections 38 are provided on the mounting portion adjacent to the left-hand end of this portion of the terminal and these projections 38 extend slightly beyond the adjacent edge portions. A second pair of projections 40 are provided rightwardly of the projections 38 as viewed in Figure 3 and the projections 40 extend slightly beyond the projections 38. These projections assist in retaining the terminal in the cavity as will be explained below.

The mounting portion has a rearward edge 42 and a centrally extending post 44 which is twisted as shown in Figure 1 when the terminal is inserted into the housing and the housing is assembled to the circuit board as shown in Figure 2. The post may be soldered to the conductor as shown at 46.

A pair of contact arms 48 extend from the left-hand end, as viewed in the drawing, of the mounting portion 28 and these arms are twisted in opposite directions through an angle of substantially 90° as shown at 50 at a location adjacent to the mounting portion. The arms thus have opposed rolled surfaces and a contact zone as shown at 51 is provided on each arm by bending the end portion of the arm as shown at 52. The width of the contact zone is the distance between the side edges 49 of the arms as shown in Figure 3. Advantageously, the contact zones 51 are plated with a contact metal, such as gold, and this plating operation can be carried out when the terminals are in strip form. The gold plating can therefore be provided only in the contact zone of the contact arms thereby reducing the plating costs for the terminal.

Each of the cavities 16 has a rear portion 56 which receives the mounting portion 28 of the terminal and a forward portion 58 which receives the contact arms of the terminal. Each cavity has opposed sidewalls 60 which extend from the rear face 14 substantially to the inner end 72 of the cavity which is adjacent

face 12. These sidewalls are substantially parallel but are tapered very slightly towards each other in accordance with good molding practice. Inclined lead in surfaces 61 are provided on the sidewalls adjacent to the rear face 14 to guide the terminals into the cavities.

Each cavity has opposed end walls, the endwalls having rearward portions 62 and forward portions 70, see Figure 5. In the rearward portion 62 of the cavity, the endwalls 62 have convergent surfaces 64 which extend from the sidewalls obliquely towards each other and which intersect to form a groove in the form of a V-notch 66. This V-notch extends to a triangular ramp 68 in each of the endwalls and the endwalls in the forward portion of the cavity are again substantially parallel to each other as shown at 70 in Figure 2. A circular opening 74 is provided in the inner end 72 of the cavity which extends to the mating face 12, this opening merging with a conical surface 76 which serves as a guide surface when a pin is inserted into the opening. The terminals 18 are inserted into the cavities from the rear face 14 (the contact receiving face). This operation is carried out with a contact terminal insertion machine.

The twisting of the contact arms provides a flat rolled surface for the contact surfaces 51 of the arms rather than a sheared edge surface as noted above. Also, the contact arms can be relatively wide, significantly wider than the thickness of the metal stock from which the terminal was stamped.

Because of the width of the contact arms 48, as measured between their side edges, the cavity 16 must be of sufficient width as measured between the sidewalls 60, in its rearward portion to permit insertion of the arms therethrough until the terminal is fully inserted. This means that the relatively thin mounting portion 28 must be supported in the relatively wide rearward portion of the cavity. Good support for the terminal is obtained by virtue of the provision of the V-notches 66 and the projections 38, 40 on the mounting portion of the terminal.

As the terminal is inserted, the leading projections 38 gouge into the V-notch very slightly and form a furrow. As insertion continues, the second projections 40 gouge into the previously formed furrow by a slight additional amount and when the terminal comes to rest, the mounting portion will be held by interference fits in the vicinity of all four projections 38, 40. If the material is a thermoplastic which is capable of some flow, it will tend to flow around the surfaces 30, 32 in the vicinity of the projections 38, 40 and the terminal will be firmly held in the cavity.

A further distinct advantage of the form of cavity shown is that during insertion of a terminal into a cavity, it is impossible to align the edges 34, 36 perfectly with the V-notches 66 in the endwalls. However, during the initial stages of insertion and when the projections 38 engage the surface adjacent to the opposed V-notches, the terminal will be slightly reoriented and will find its own center line in the cavity. In other words, the form of the cavity compensates for any slight misalignment of the terminal when insertion is carried out. As a result, the terminal will be precisely located in the cavity in the completed connector. Figure 7 shows a slightly misaligned terminal at the beginning of the terminal inserting operation. As insertion proceeds, the projections will slide over the inclined surfaces 64 until they are sealed in the V-notches 66 in the endwalls.

Figure 8 shows the core pin used to produce cavities in the connector, the surfaces of the core pin being identified by the same reference numerals, differentiated by prime marks, as are used in the foregoing description of the cavity. It will be noted that the core pin has pilaster-like projections 78' centrally located on its surfaces 60'. These projections are merely provided for the purpose of strengthening the core pin and they produce the recesses 78 in the cavity shown in Figure 5.

Terminals in accordance with the invention can be produced in any desired size and in fact can be manufactured in sizes which are comparable to the sizes of the smallest conventional

pin and socket terminals. For example, one embodiment of a terminal in accordance with the invention has an overall length from the tip of the contact arms to the right-hand edge of the mounting portion of the 9.76 mm. The arms have a width of 0.62 mm which is substantially twice the thickness of the mounting portion which is 0.32 mm.

Connectors in accordance with the invention can be used in place of connectors having conventional cylindrical sockets which are more expensive to manufacture than the flat stamped terminals 18. The terminals 18 can be inserted into the cavities by an automatic insertion machine at a very fast rate and the terminals will be properly located by virtue of the self-aligning feature illustrated in Figures 7 and 6.

CLAIMS:

1. An electrical connector (2) of the type comprising an insulating housing (10) having a mating face (12), a rear face (14), and a contact-receiving cavity (16) extending therethrough from the rear face to the mating face, a contact terminal (18) in the cavity, the contact terminal having a mounting portion which is proximate to the rear face and a contact arm which is proximate to the mating face, the connector being characterized in that:

the contact terminal (18) is a flat stamped sheet metal member having oppositely facing major rolled surfaces (30, 32) and having sheared edges (34, 36),

the contact arm (48) being twisted (50), with respect to the mounting portion, through an angle of 90° so that the major surfaces of the arm define planes which extend normally of the planes defined by the major surfaces (30, 32) of the mounting portion (28), the contact arm (48) having side edges (49) which extend along its length and having a width, as measured between its side edges (49), which is substantially greater than the thickness of the contact terminal as measured between the major surfaces (30, 32) thereof,

the cavity (16) having a rear portion (56) which extends inwardly from the rear face (14) and a forward portion (58) which extends inwardly from the mating face (12), the mounting portion (28) of the terminal being in the rear portion (56) and the contact arm (48) being in the forward portion (58), the cavity having opposed sidewalls (60) and opposed endwalls (62), the major surfaces (30, 32) of the mounting portion (28) being substantially parallel to the sidewalls (60), the distance between the sidewalls (60) being greater than the width of the contact arm,

the opposed endwalls (62) having edge-receiving grooves (64) extending from the rear face (14) towards the forward portion (58) of the cavity, the sheared edges (34, 36) of the mounting portion (28) having an interference fit in the grooves (64).

2. An electrical connector as set forth in Claim 1 characterized in that the mounting portion has a first pair (38) of stabilizing projections extending laterally of the axis of terminal at a location adjacent to the contact arm (48) and a second pair (40) of stabilizing projections extending laterally of the axis at a location spaced from the contact arm (48), the second pair (40) of projections extending laterally a greater distance than the first pair (38) of projections whereby during insertion of the terminal into the cavity, the first pair (38) of projections gouge into the grooves (64) and enlarge the grooves, and the second pair (40) of projections also gouge into the grooves, and when the terminal is fully inserted, the mounting portion (28) will be held in the cavity by the projections of both pairs.

3. An electrical connector as set forth in Claim 2 characterized in that the contact terminal (18) has two arms (48) extending from the mounting portion (28).

4. An electrical connector as set forth in Claim 3 characterized in that the terminal (18) has an integral solder post (44) which extends from the mounting portion (28) at the rear face.

5. An electrical connector as set forth in 3 characterized in that each of the arms (48) has a contact portion (51), the contact portions being opposed to each other and being electroplated with a conductive metal which was plated onto the contact portions prior to twisting of the arms.

6. An electrical connector as set forth in Claim 5 characterized in that the opposed endwalls (62) each have converging surfaces extending from the sidewalls and

intersecting and forming a V-notch (66), the V-notch constituting edge-receiving grooves (64).

7. An electrical connector as set forth in Claim 1 characterized in that the terminal has two contact arms (48) extending from the mounting portion (28), the contact arms having contact portions (51) which are opposed to each other and which are plated with a contact metal, the contact portions having been plated prior to twisting of the contact arms.

8. An electrical connector (2) of the type comprising an insulating housing (10) having a contact-receiving face (14), a contact-receiving cavity (16) extending into the housing from the contact-receiving face (14), and a contact terminal (18) in the cavity, the connector being characterized in that:

the contact terminal (18) is a flat stamped sheet metal member having oppositely facing major rolled surfaces (30, 32) and oppositely facing side edges (34, 36),

the cavity (16) having opposed sidewalls (60) and opposed endwalls (62), the oppositely facing major surfaces (30, 32) of the terminal (18) being parallel to the sidewalls (60), the opposed endwalls (62) each have converging surfaces (64) which intersect to form a V-notch (66) which extends inwardly from the contact receiving face (14), the side edges (34, 36) of the contact terminal (18) being centered in the roots of the V-notches (66).

9. An electrical connector as set forth in Claim 8 characterized in that the oppositely facing side edges (34, 36) of the contact terminal each has first (38) and second (40) stabilizing projections, the second stabilizing projections (40) being adjacent to the contact receiving face (14), the first stabilizing projections (38) being spaced inwardly in the cavity from the contact-receiving face (14), the second stabilizing projections (40) projecting laterally by an amount which is greater than the amount by which the first stabilizing projections (38)

project, all of the stabilizing projections being embedded in the housing (10) and serving to support and retain the terminal in the housing.

10. An electrical connector of the type comprising an insulating housing having a mating face, a rear face, and a contact-receiving cavity extending therethrough from the rear face to the mating face, a contact terminal in the cavity, the contact terminal having a mounting portion which is proximate to the rear face and a pair of contact arms which are proximate to the mating face, the connector being characterized in that:

the contact terminal is a flat stamped sheet metal member having oppositely facing major rolled surfaces and having sheared edges,

the contact arms being twisted, with respect to the mounting portion, through angles of 90° so that the major surfaces of the arms define planes which extend normally of the planes defined by the major surfaces of the mounting portion, each of the contact arms having side edges which extend along its length and having a width, as measured between its side edges, which is substantially greater than the thickness of the contact terminal as measured between the major surfaces thereof.

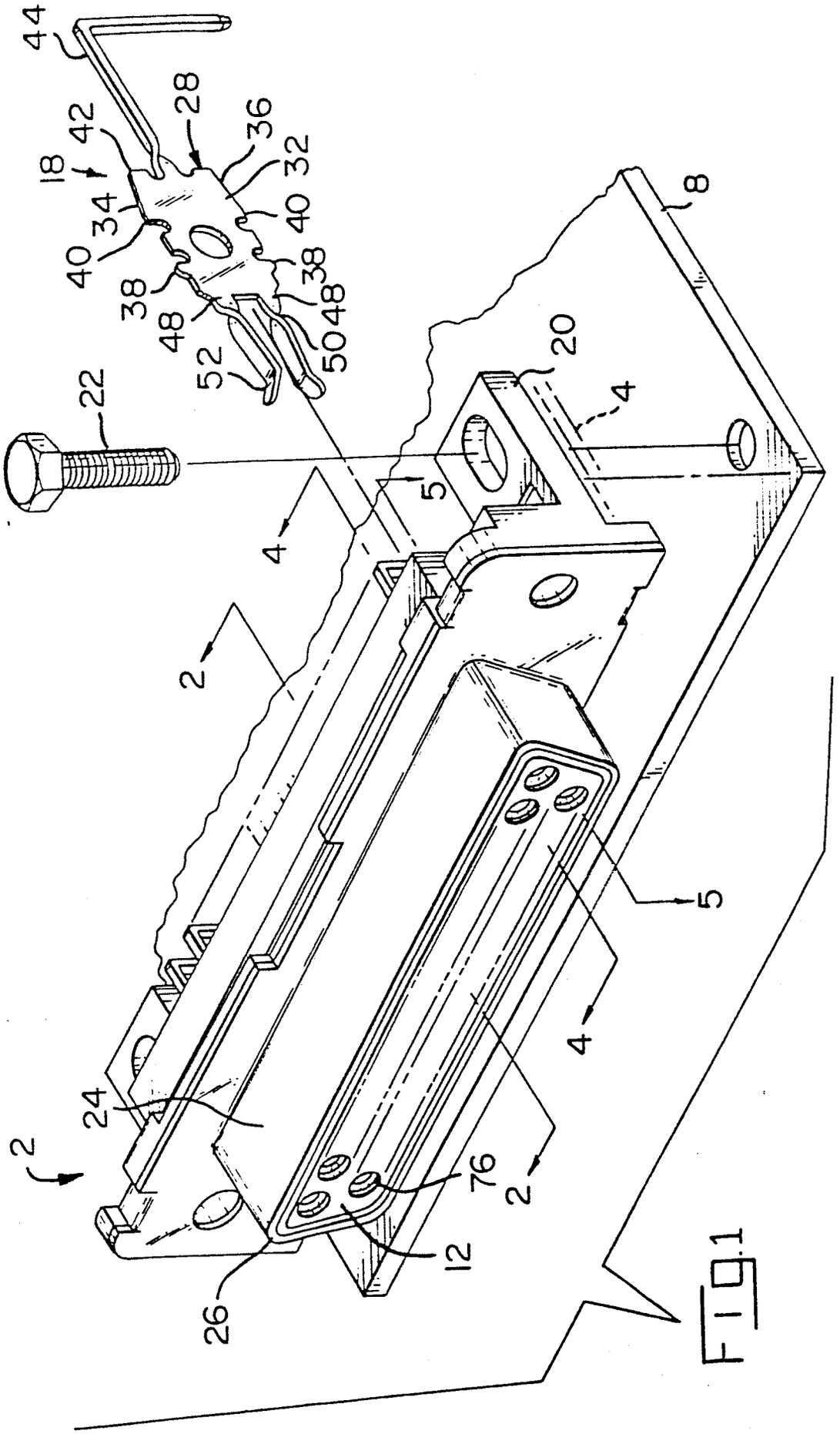
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FIG.1

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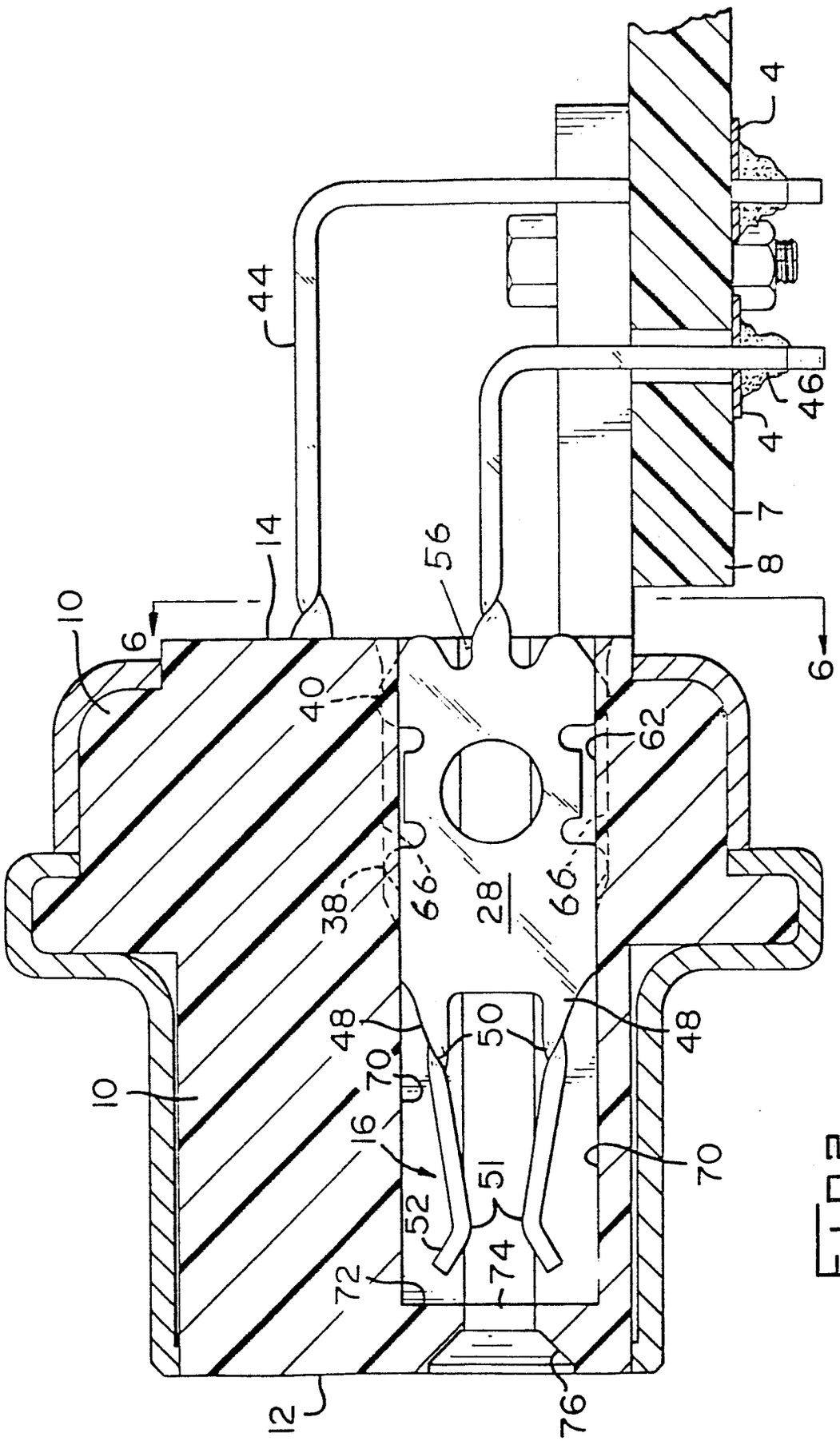

FIG.2

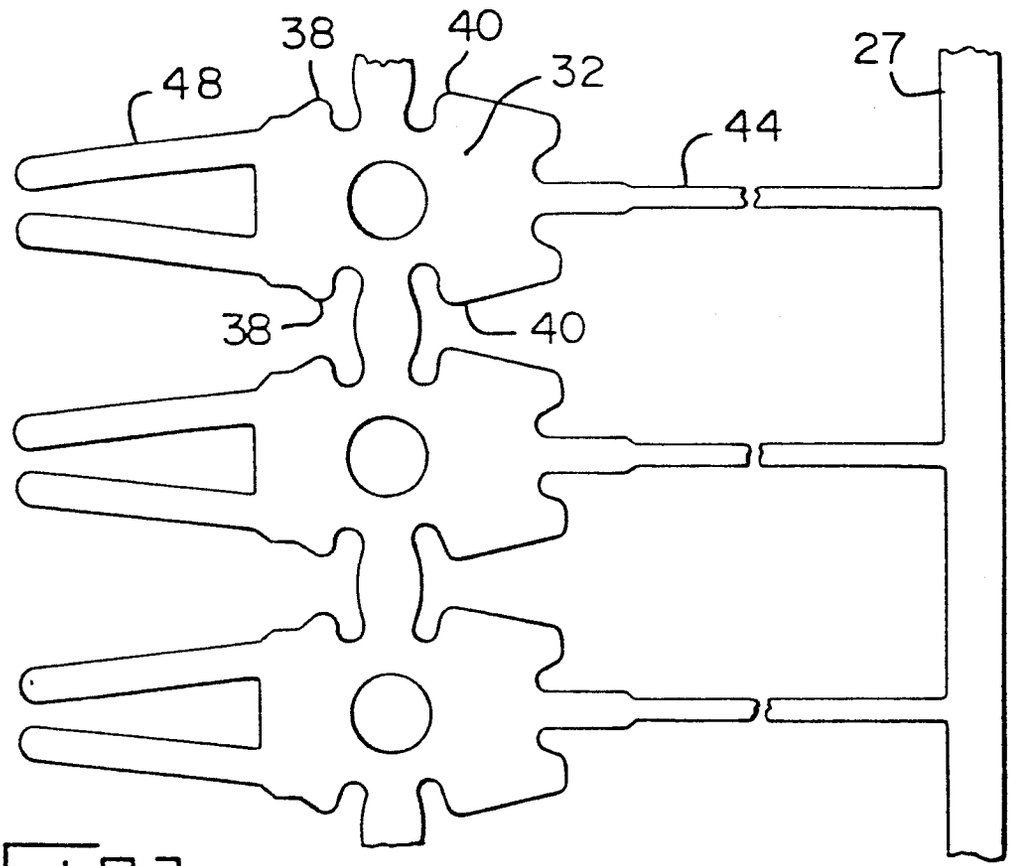

Fig.3

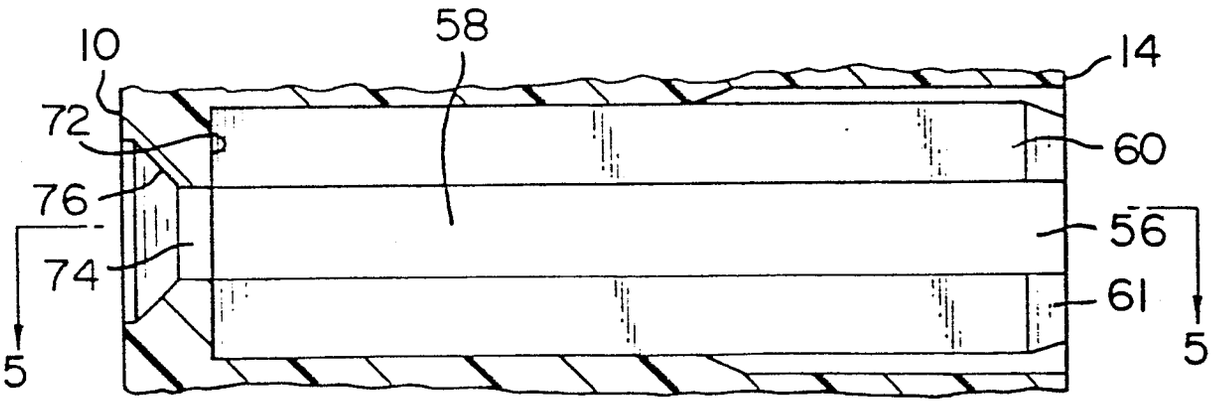

Fig.4

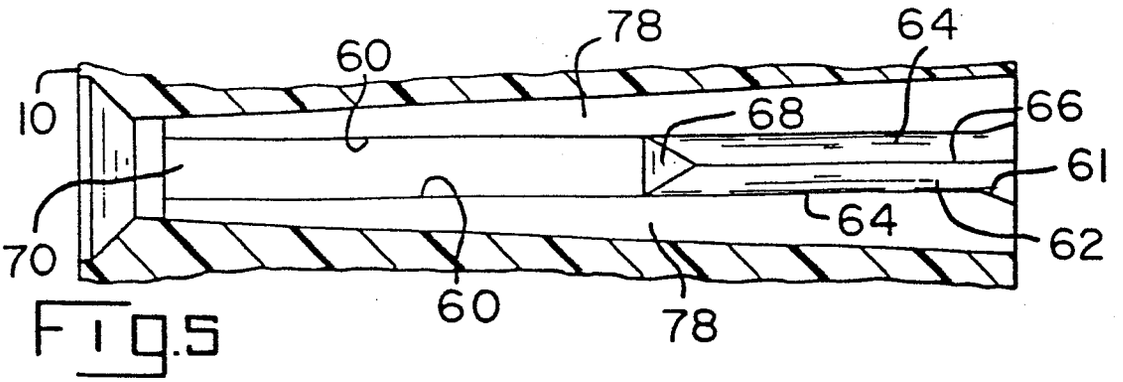

Fig.5

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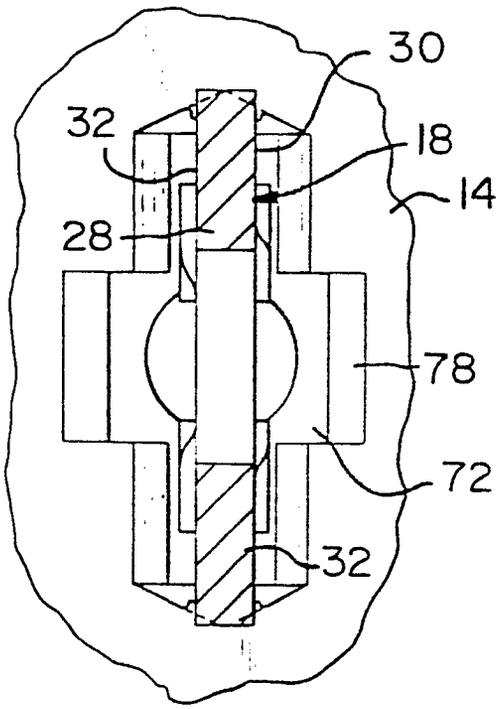

FIG.6

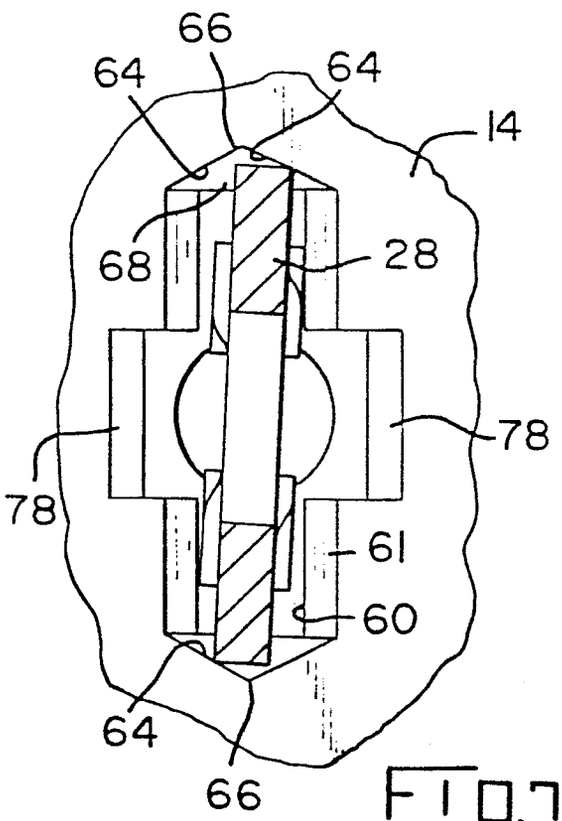

FIG.7

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