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(54) Zero insertion force connector for cable to board applications.

(57) In electrical connector (2) is shown having an insulative housing (4) with a plurality of terminal receiving passages (24), the passageways extending from a lower surface (34) to a position proximate to an upper face (16). A plurality of electrical terminals (70) are disposed within the passageways (24) where posts (86) extend from the lower face (34) for contacting printed circuit board traces. The upper face (16) of the housing (4) includes a plurality of conductor receiving passageways (20) which are in alignment with conductor receiving sections (78), (82) of the electrical terminals (70). An actuator member (50) is moveable relative to the housing and relative to the upper face (16), the movement of the actuator member (50) opening the cable receiving sections (78), (82) of the electrical terminals (70), while release of the actuator member (50) causes the conductor receiving section (78), (82) to engage the exposed conductor of the multiconductor cable for electrical connection thereto.

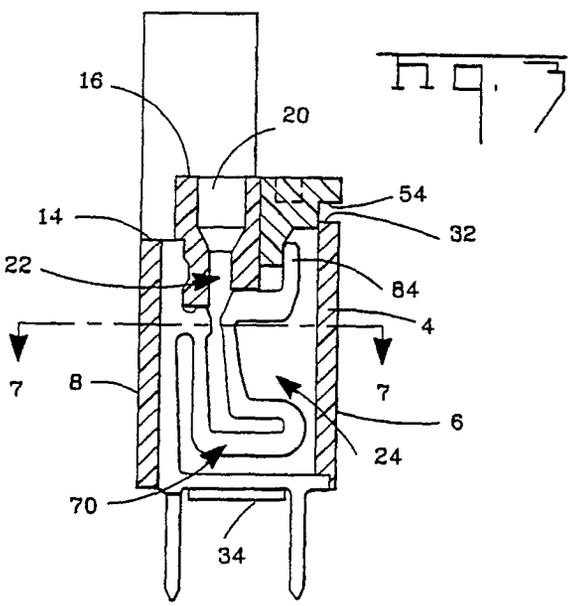

Fig. 7

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ZERO INSERTION FORCE CONNECTOR FOR CABLE TO BOARD APPLICATIONS

This invention relates to an electrical connector for the interconnection of individual conductors of an electrical cable to a printed circuit board.

Electrical connectors exist in the electronics industry having the capability of interconnecting individual conductors of a multi-conductor flat cable to circuit traces of printed circuit boards. These connectors are mounted to the board having electrical terminals exposed at a lower edge thereof which make electrical contact with the traces on the printed circuit board. The electrical connectors also have electrical terminals which accept the conductors in an electrically conducting manner.

One electrical connector in particular, includes an electrical terminal housing having through passageways for electrical terminals. The housing has a lower face which mounts proximate to the printed circuit board and an upper face which accepts the multi-conductor cable. The terminals are placed in respective passageways within the connector housing, with printed circuit board posts extending beyond the lower face, and cable receiving portions of the terminals disposed proximate to the upper face. The housing also includes a camming member which is moveable to open the cable receiving portion of the terminal, to accept the wire in a zero insertion force fashion. Release of the camming member returns the spring to an undeflected position and into contact with the wire.

A disadvantage of the above mentioned connector is that the upper face, which includes the conductor receiving openings, is an integral part of the moveable camming member. Thus, to make the electrical connection, the cable is stripped to expose the conductors, and the cam is actuated to open the conductor receiving portions of the terminals. The actuation of the camming member also moves the upper face and the conductor receiving openings, as the conductor receiving openings are integral with the camming member. When the conductors are inserted within the openings, and the camming member released, the spring force actually forces the camming member, including the upper face and openings, upwardly which drives the cable and conductors upwardly also. This reverse spring force could take the conductors out of contact with the terminals when the upper face is moved.

In the present invention, the electrical connector is characterized in that the upper face of the housing has a plurality of conductor receiving openings therein, the upper face of the housing and the openings being fixedly rigid relative to the camming member. The camming member is moveable relative to the housing and the upper face, whereby, when the camming member is moved to actuate and release the conductor receiving portions of the terminals, the upper face remains fixed relative to the camming member.

A further object of the instant invention is to design an electrical connector which can accomodate a range of wire sizes.

The further object has been accomplished by designing an electrical connector of the type for interconnecting a plurality of electrical conductors to further conductive elements. The connector has an insulating housing retaining a plurality of electrical terminals with terminal passageways of the housing, the connector housing having conductor receiving openings therein which are in alignment with conductor receiving sections of the terminals. The connector is characterized in that the conductor receiving openings comprise axially extending passageways comprising arcuate sections contiguous with further surfaces which extend inwardly of the radius of curvature of the arcuate sections, whereby the conductors are aligned towards the center of the passageway by the further surfaces.

The preferred embodiment of the electrical connector will now be described with relation to the drawings, where:

Figure 1 is a front plan view of the connector of the subject invention;

Figure 2 is a top plan view of the connector shown in Figure 1;

Figure 3 is a cross-sectional view through lines 3-3 of Figure 2;

Figure 4 is a side plan view of the electrical terminal shown in Figure 3;

Figure 5 is similar to the cross-sectional view of Figure 3, absent the electrical terminal;

Figure 6 is an end view of the electrical connector;

Figure 7 is a cross-sectional view through lines 7-7 of Figure 3 showing a large diameter wire terminated; and

Figure 8 is a cross-sectional view similar to that of Figure 6 showing an optional smaller diameter wire terminated to the same electrical connector.

Figure 9 is a cross-sectional view showing an alternate embodiment of the present invention.

With reference first to Figure 1, the electrical connector of the instant invention is designed for applications where the electrical connector is mounted to through holes in a printed circuit board for electrical connection with a plurality of circuit traces on a printed circuit board. The electrical connector provides easy installation of a multi-conductor flat cable by stripping an end of the

insulation which covers the conductors of the cable, and the stripped ends of the cable can be inserted into the wire receiving openings of the electrical connector.

The subject connector shown generally as 2 in Figure 1 includes an insulating housing 4 having side walls 6 and 8 (Figure 3) and end walls 10 and 12. The electrical connector 2 further comprises an actuator 50 (Figure 2) which is moveable in a downward direction to open the electrical contacts for insertion of the cable conductors. The electrical connector 2 further includes a plurality of electrical terminals 70 (Figure 3) having portions which extend below the lower surface 34 of connector for interconnection with printed circuit boards.

With reference first to Figure 5, the housing 4 will be described in greater detail. Figure 5 is a cross-sectional view through lines 3-3 of Figure 2 excluding the electrical terminal 70. The housing 4 includes a plurality of wire receiving openings 20 which extend from the upper wire receiving face 16 and extend into the terminal receiving cavities 24. Also shown in Figure 5 is the fact that the conductor receiving opening 20 merges with a conductor aligning channel 22.

With reference now to Figure 7, the detail of the terminal receiving cavity 24 and the wire aligning channel 22 are described in greater detail, remembering that Figure 7 is a cross-sectional view through lines 7-7 of Figure 3. The terminal receiving channel is defined generally by opposed surfaces 24a and 24b while the wire receiving passage is defined by arcs 22b and planar surfaces 22a. It should be noted that the planar surfaces 22a are inside of the radius of curvature which is formed by the arcuate surfaces 22b.

With reference now to Figure 4, the electrical terminal includes a horizontal base section 72 which is continuous with a vertical base section 74. Extending from the vertical base portion 74 is a first leg 76 which forms an upper contact portion 78. The leg portion 76 is continuous, through a bight section 77, with a second leg section 80 which extends upwardly to form an opposed and second contact portion 82. Extending from the second leg portion 80 is a lever section 84. Extending from the horizontal base section 72 is a printed circuit board post 86.

Finally, with reference to Figures 5 and 6, the actuator includes a horizontal section 52 and arm sections 62 which extend downwardly from the horizontal section 52. An aperture 58 extends from the upper surface 52 of the actuator and extends downwardly to form a stop surface 64 (Figure 6). With reference to Figure 1, the housing end surfaces 10 and 12 each include a recessed section 36 having a downwardly facing latch 38 along a vertical centerline of the recessed section 36. The latches 64 and 38 cooperate to form an upper stop position of the actuator member 50. The lower surface 54 of the actuator in combination with the upper edge 32 of the housing (Figure 5) provide a maximum deflection for the contacts which prevents overstressing the contacts.

To assemble the connector of the instant invention, the plurality of terminals are positioned within the housing 4 being inserted through the terminal receiving cavities 24 from the lower surface to the connector housing. The actuator 50 can then be assembled to the connector housing with the arms 62 being inserted into the recesses 36 on each end wall 10 and 12 until the stop surface 64 rides up over the latch to abut the downwardly facing shoulder of the ramp 38. It should be noted that when in this position, the cam surface 56 (Figure 5) is proximate to the lever portion 84 (Figure 3) such that downward movement of the actuator 50 causes an outward deflection of the lever portion 84 on the cam surface 56, thereby spreading the opposed contact portions 78 and 82 for insertion of the stripped conductors.

It should be noted that the actuator 50 moves relative to the housing and relative to the wire receiving openings 20. Said differently, the wire receiving openings are not integrated with the actuator such that the wire receiving openings move upwardly and downwardly with the actuator. In some prior art connectors, the wire receiving openings are integrated with the actuator and when the actuator is deflected downwardly and the cable is inserted into the wire receiving openings, the release of the actuator tends to push the cable back out of contact with the electrical contacts.

The present invention has also been designed to accommodate a range of wire sizes, the wire receiving channels 22 are profiled to receive and align conductors of various diameters, as shown in Figures 7 and 8. This has been accomplished by providing a wire receiving channel 22 extending vertically within the side walls 24a, 24b of the terminal receiving cavity 22 as shown in Figures 5 and 7. The wire receiving channel 22 first includes radiused sections 22b which are continuous with planar surfaces 22a. As shown in Figure 7, the worst condition of termination is shown where the electrical terminal 70 is right justified within the terminal receiving cavity 24 whereas the conductor C_1 is left justified within the conductor receiving channel 22. However, the planar surface 22a positions the conductor by providing a tangent surface to the conductor C_1 to prevent the conductor C_1 from moving further to the left. Furthermore, the planar surfaces 22a provide tangent surfaces which are within the radius of curvature of the path formed by arcs 22b. As shown in Figure 7, even with the worst case condition, the electrical terminal

continues to have an overlap from the edge of the terminal to the center of the conductor, of a distance L_1. Since there is an offset L_1, the conductor C_1 is mainly gripped between the two opposed contacts 82, 78; rather than relying on the plastic of the housing for a contact force. The planar surfaces 22a are only used for alignment.

As shown in Figure 8, a small conductor C_2 having a diameter D_2 can also be terminated within the connector again with the surface 22a positioning the conductor within the wire receiving channel 22 with the overlap of the edge of the terminal and the center of the conductor of a distance L_2.

Other advantages of the above mentioned design should be readily apparent. For example, this electrical connector can terminate electrical conductors having diameters which are larger than the thickness of the electrical terminals (t), which allows for a very dense connection system on very close centerlines. Also, since the contacts are edge stamped, as opposed to stamped and formed, the contacts can also be placed on very close centerlines. Since the contacts are edge stamped, the normal force is much higher than a comparably sized stamped and formed terminal.

Another advantage of this design of electrical connector is that the conductor receiving openings can be alternately formed as shown in Figure 9 such that every other opening is a mirror of the previous one. This places adjacent planar surfaces 22a in a parallel manner which allows for a thin web of material to interconnect the two adjacent openings thereby allowing for very close side-by-side spacing.

Claims

1. An electrical connector (2) for interconnecting conductors (C) of a multi-conductor cable to a printed circuit board comprises an electrical terminal housing (4) and a plurality of electrical terminals (70); the housing (4) has through passageways (24) for the electrical terminals (70), and has a lower face (34) which mounts proximate to the printed circuit board and an upper face (16) which accepts the multi-conductor cable; the terminals (70) are placed in respective passageways (24) within the connector housing (4), with printed circuit board posts (86) extending beyond the lower face (34), and conductor receiving portions (78,82) of the terminals (70) disposed proximate to the upper face (16); the housing (4) also includes a camming member (50) which is moveable relative to the housing (4) to open the conductor receiving portions (78,82) of the terminals (70), the electrical connector (2) being characterized in that:
the upper face (16) of the housing (4) is rigidly fixed relative to the camming member (50), and has a plurality of discrete conductor receiving openings (20) formed within the periphery of the upper face (16) of the fixed housing (4), the conductor receiving openings (20) being in communication with the conductor receiving portions (78,82) of the terminals (70), the camming member (50) being spaced from the openings (20) and moveable relative to the housing (4) and the upper face (16), whereby, when the camming member (50) is moved to actuate and release the conductor receiving portions (78,82) of the terminals (70), the upper face (16) remains fixed relative to the camming member (50).

2. The electrical connector of claim 1, characterized in that the terminals (70) are edge stamped from a strip of metal.

3. The electrical connector of claim 2, characterized in that the terminals (70) comprise opposed contact sections (78,82) defined by sheared edges of the contacts, the opposed contact sections (78,82) being aligned with the discrete conductor receiving openings (20).

4. The electrical connector (2) of claim 3, characterized in that one of the opposed contact sections is a fixed contact section (78) and the other of the opposed contact sections is a moveable contact section (82).

5. The electrical connector of claim 4, characterized in that the moveable contact section (82) is attached to a moveable arm (80) and has at its upper portion a lever section (84) which is disposed proximate to the upper face (16).

6. The electrical connector (2) of any of claims 1-5 characterized in that each terminal passageway (24) comprises a channel (24a) to receive the individual moveable arms (80), the channels (24a) having an upper surface (27) which is lower than the lever sections (84), which disposes the lever sections (84) into an open channel (25) in the housing (4).

7. The electrical connector of claim 6 characterized in that the camming member (50) is disposed within the open channel (25), each lever section (84) having a dedicated camming surface (56) in contact therewith, the individual camming surfaces (56) being separated by a plurality of side-by-side walls (30) to isolate the lever sections (84).

8. An electrical connector of the type for interconnecting a plurality of electrical conductors (C) to further conductive elements, the connector (2) having an insulating housing (4) retaining a plurality of electrical terminals (70) within terminal passageways (24) of the housing (4), the connector housing (4) having conductor receiving openings (20) therein which are in alignment with conductor receiving sections (78,82) of the terminals (70), the connector

(2) being characterized in that the conductor receiving openings (20) comprise axially extending passageways comprising arcuate sections (22b) contiguous with further surfaces (22a) which extend inwardly of the radius of curvature of the arcuate sections (22b), whereby the conductors (C) are aligned towards the center of the passageway by the further surfaces (22a).

9. The electrical connector (2) of claim 8, characterized in that the further surfaces (22a) are defined by planar surfaces (22a).

10. The electrical connector (2) of any of claims 1 to 7 characterized by features of claim 8 or 9.

Fig. 1

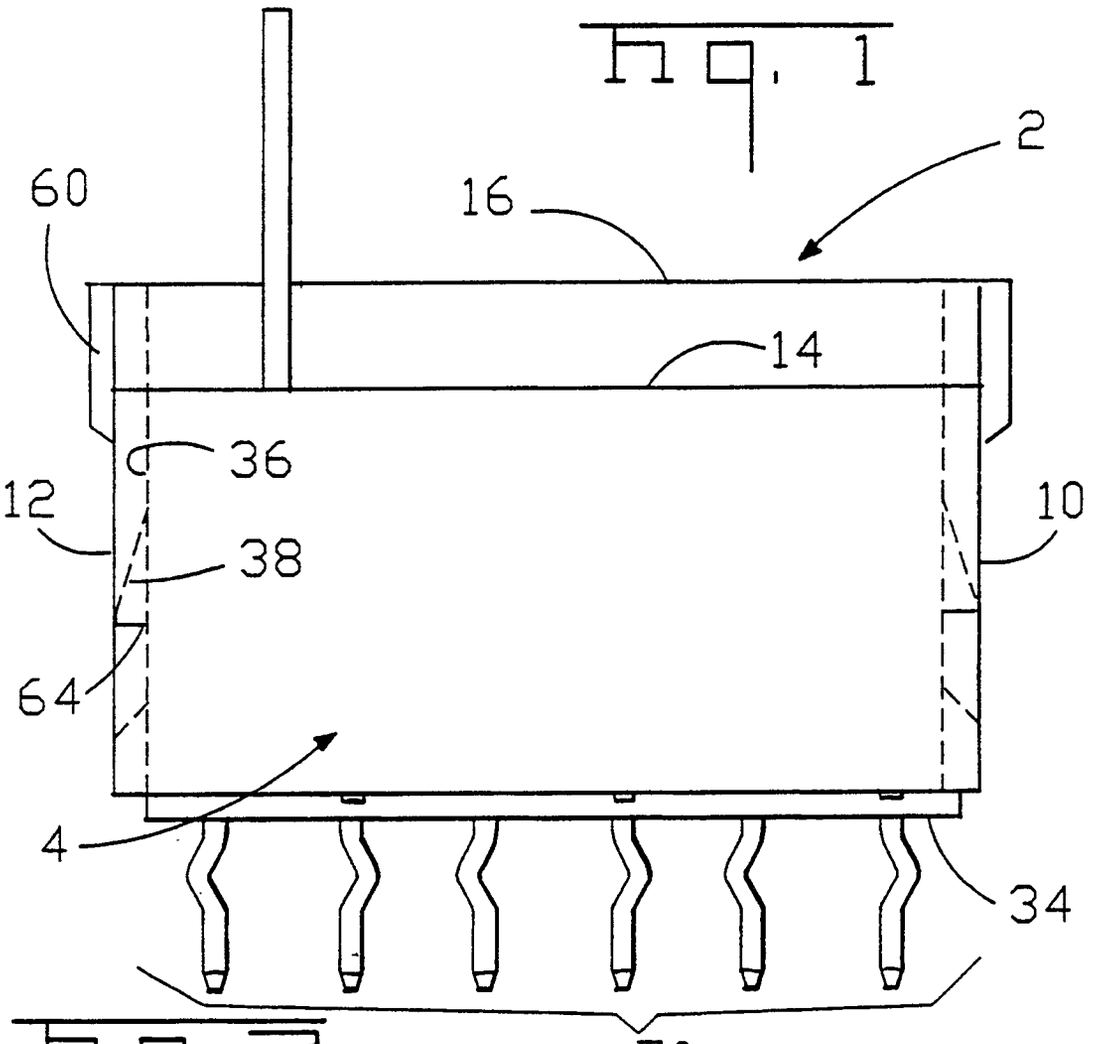
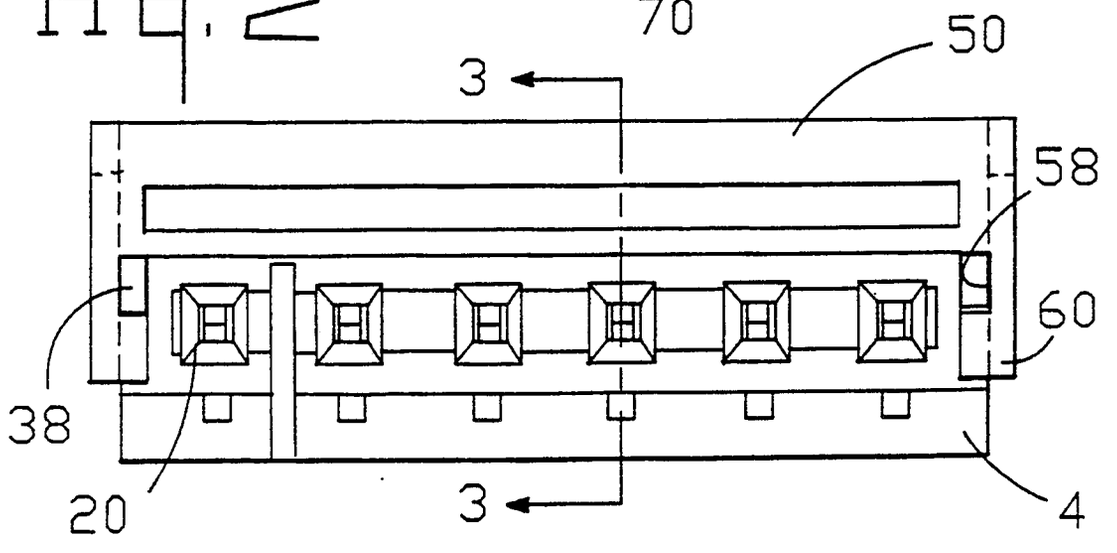


Fig. 2



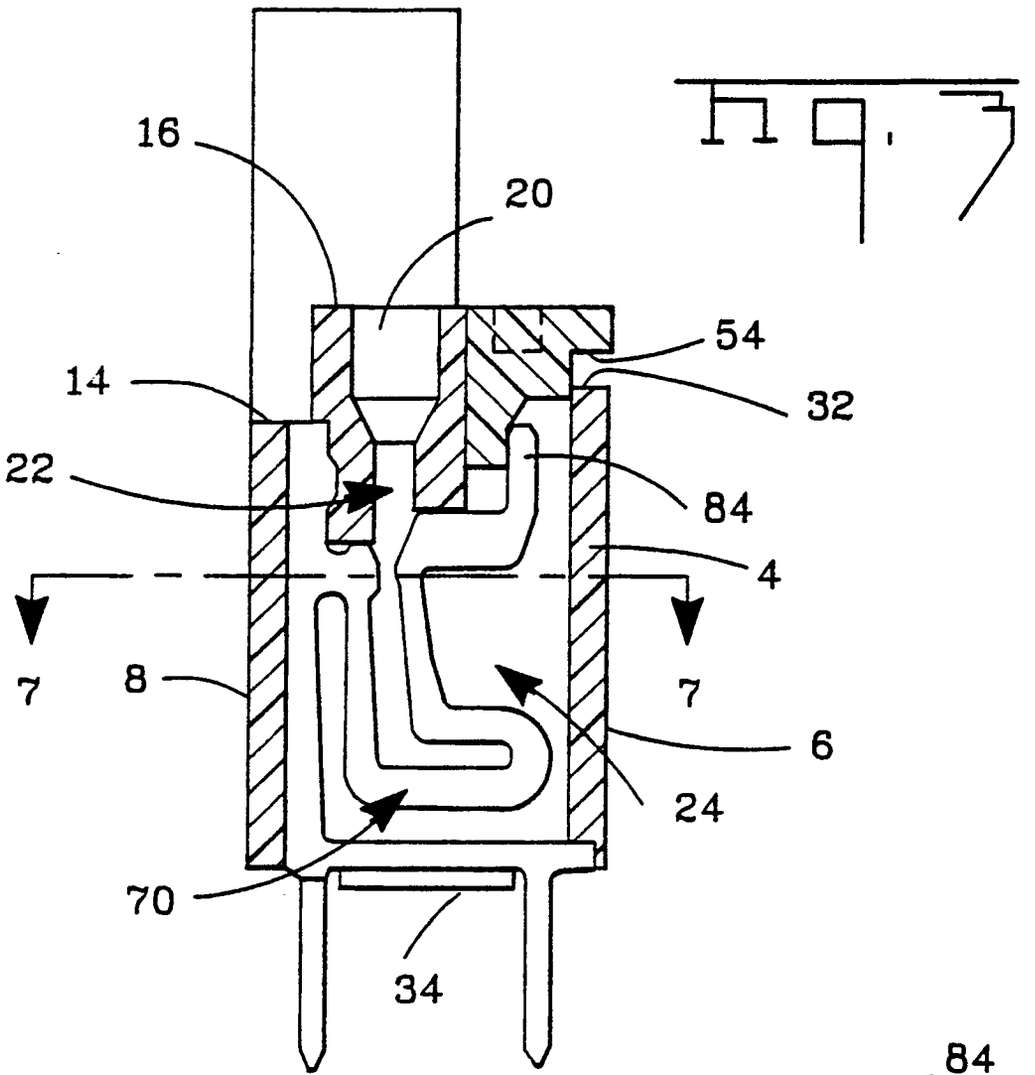


Fig. 7

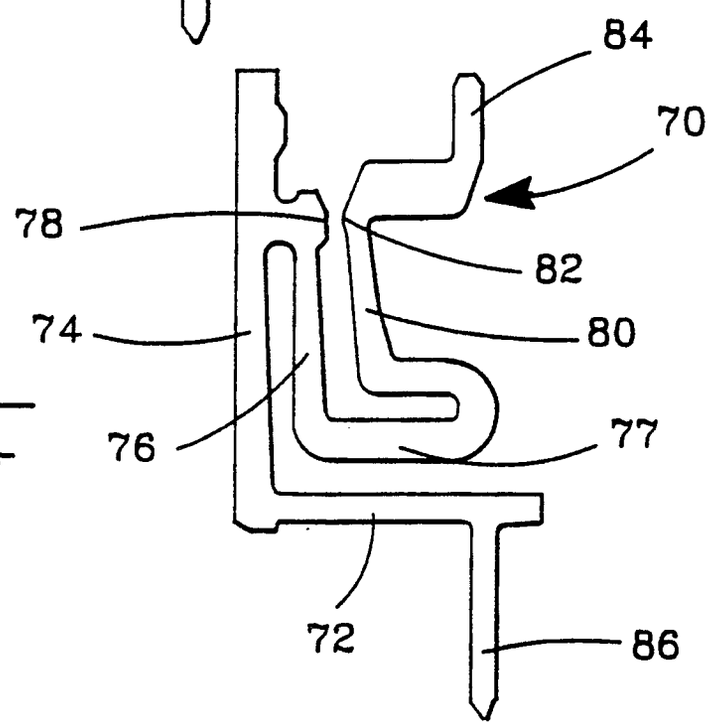


Fig. 4

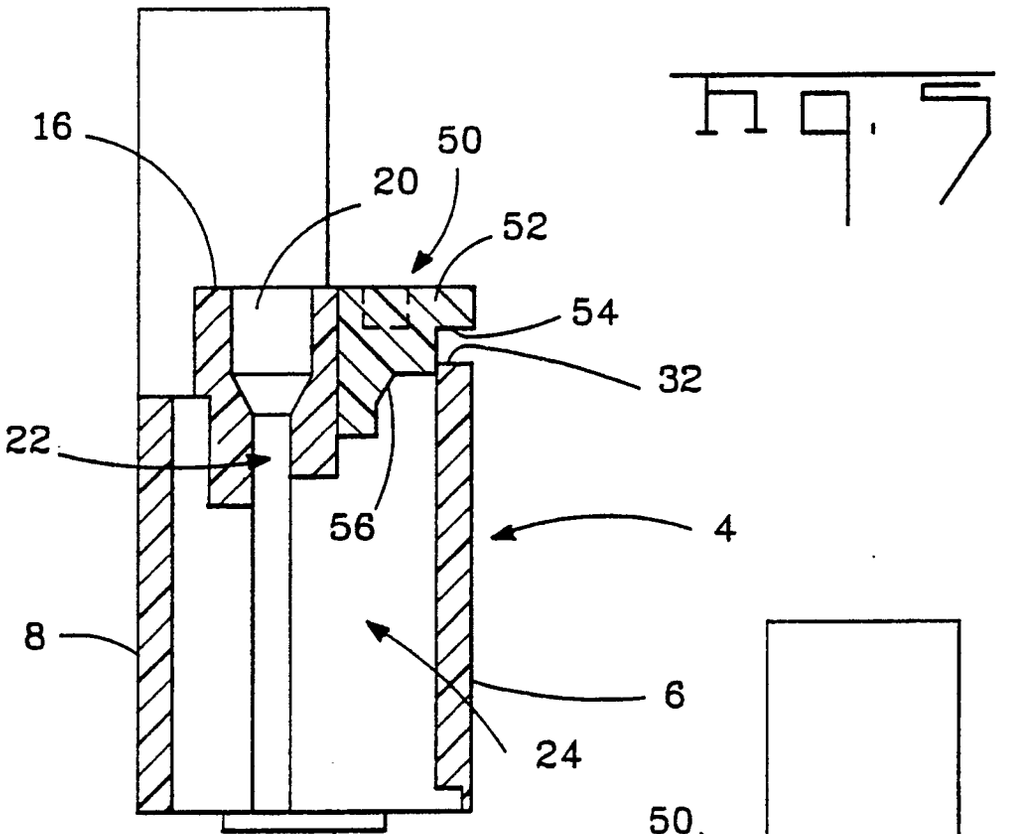


Fig. 5

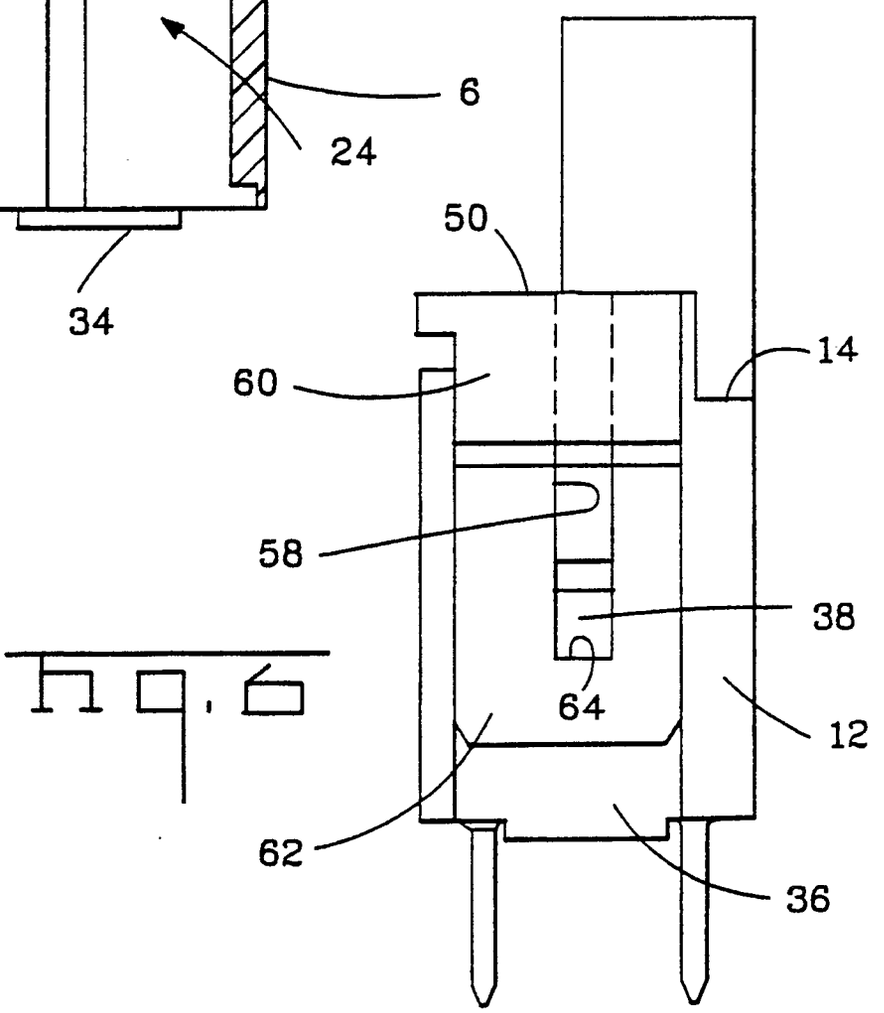


Fig. 6

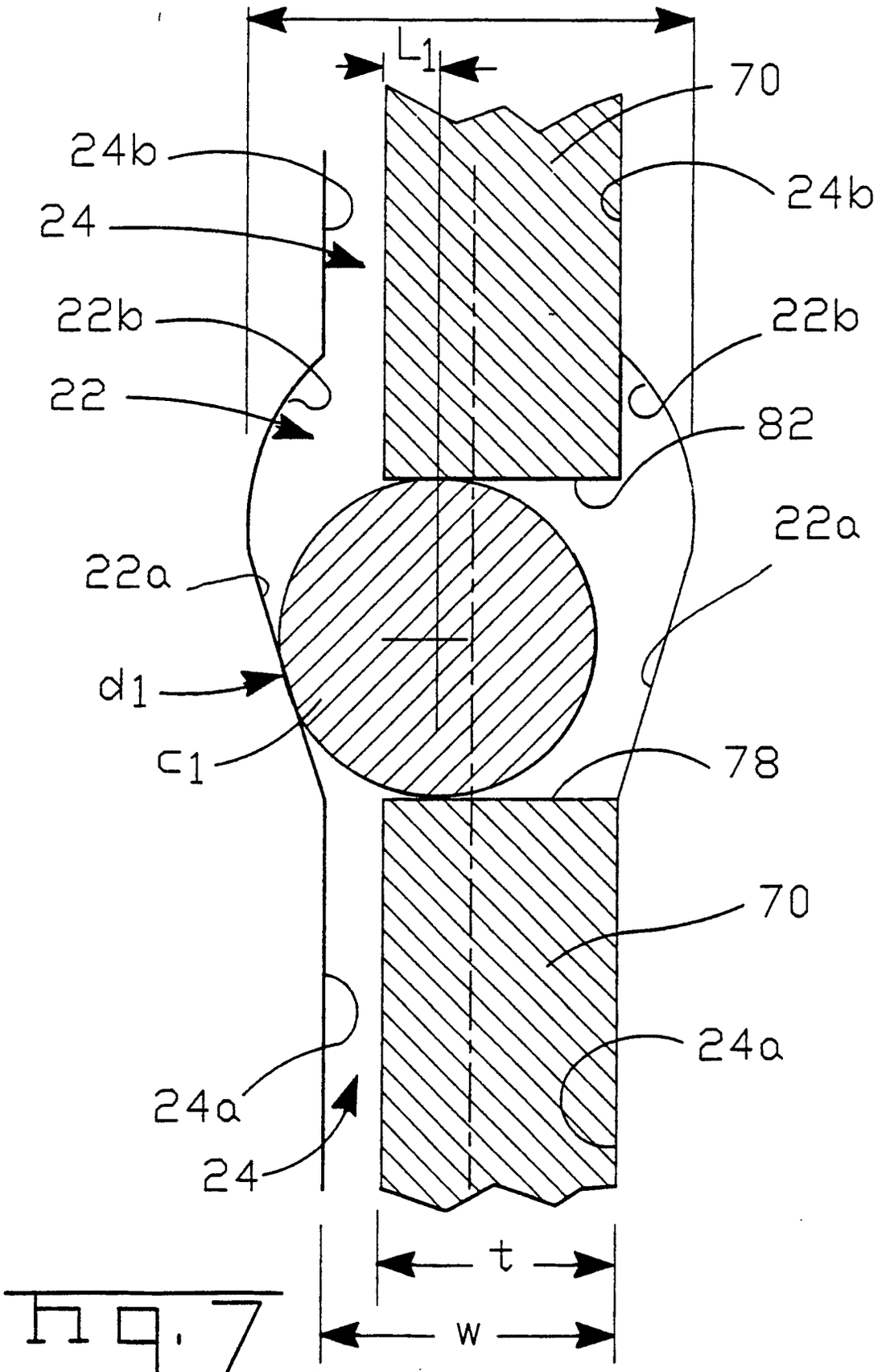


Fig. 7

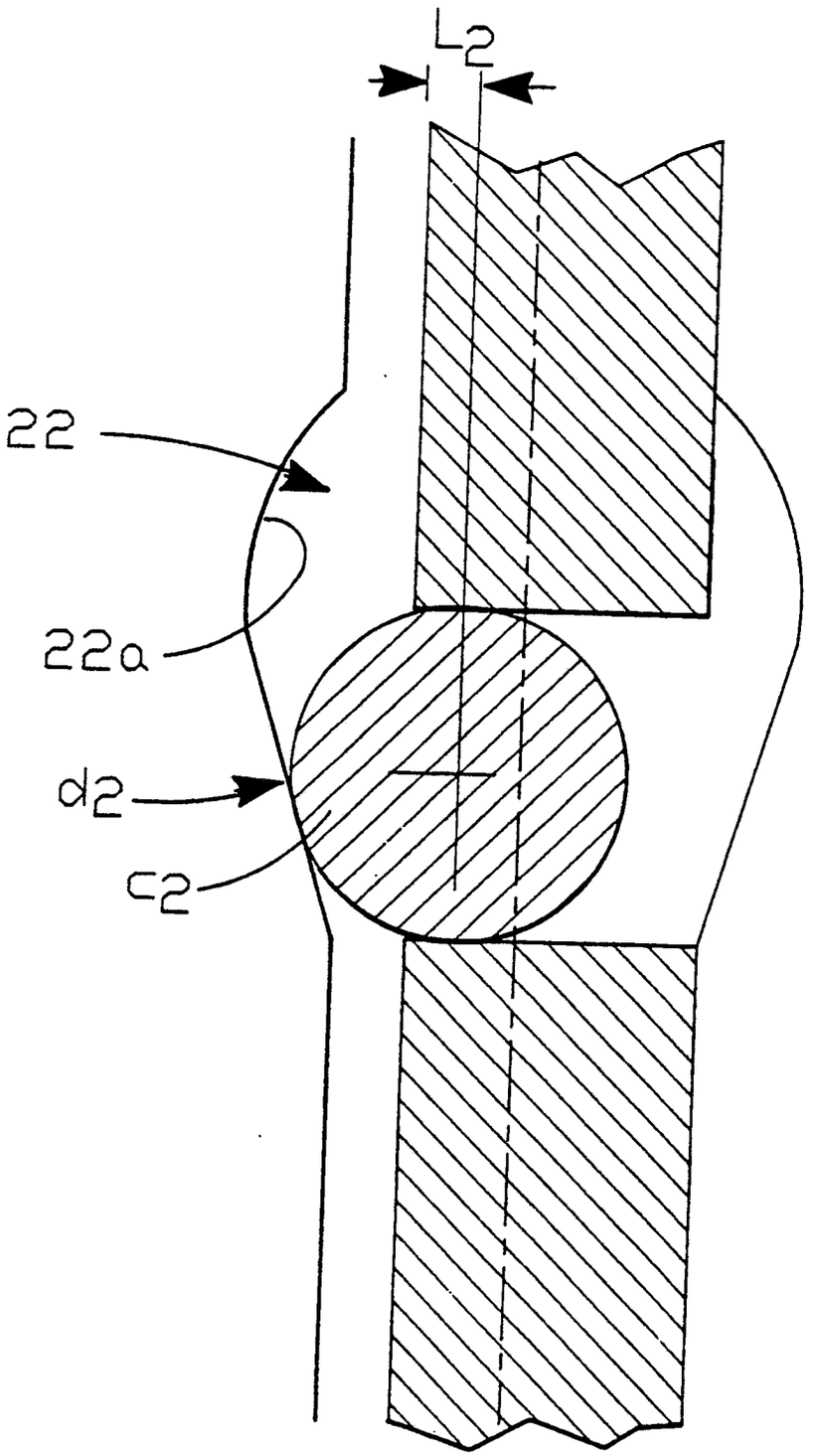


Fig. 8

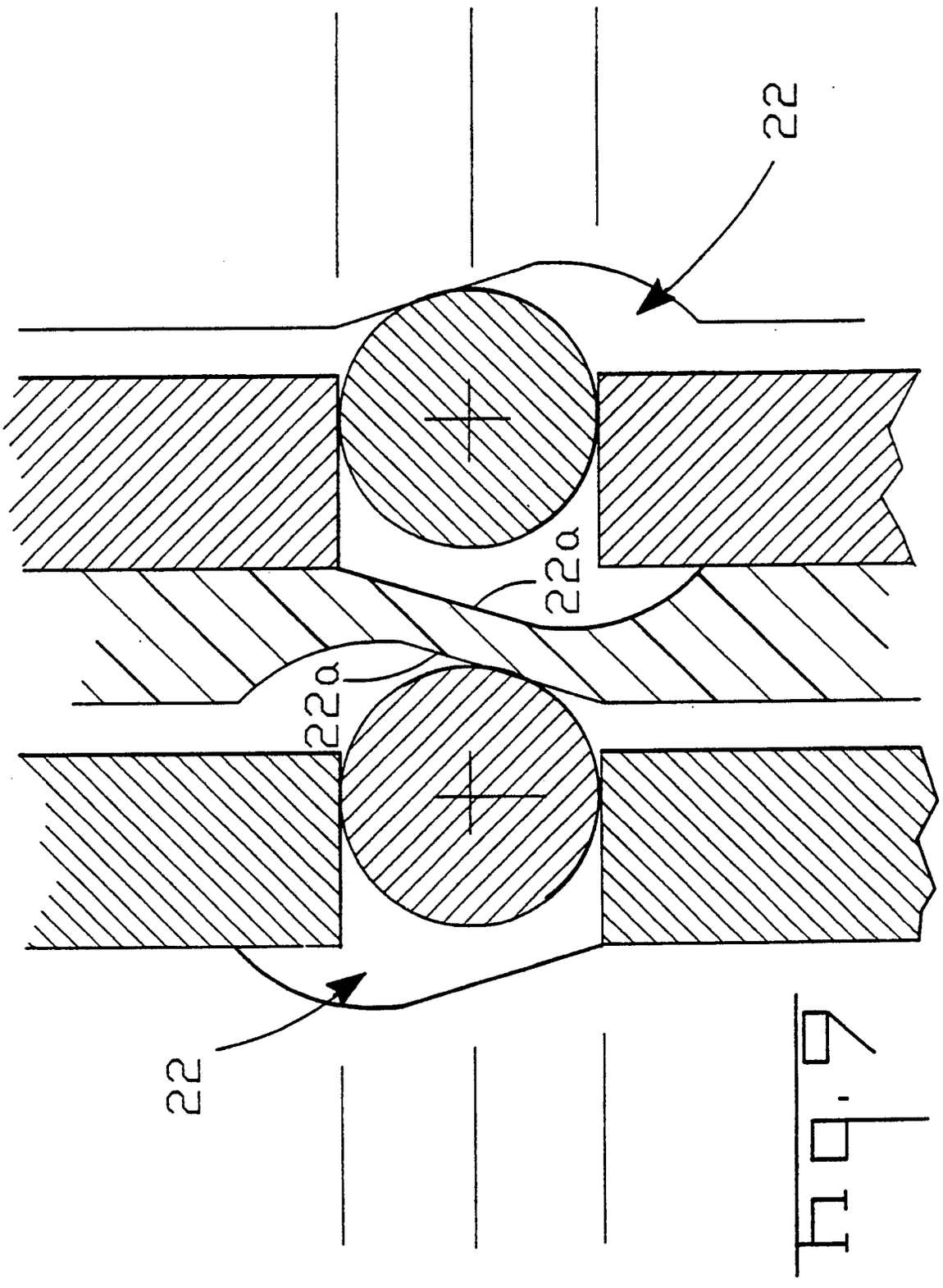


Fig. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 10 3582

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.5)
Y	US-A-4691975 (FUKUNAGA ET AL) * column 3, lines 51 - 57; claim 1; figure 3 *	1-3	H01R9/07 H01R23/68
A		8	
Y	DE-A-2707122 (JAPAN AVIATION ELECTRONICS IND. LTD.) * page 9, line 17 - page 10, line 22; figure 1 *	1-3	
A	US-A-4629271 (AWANO) * abstract; figure 2 *	1, 8	
P,X	DE-U-8816214 (LOTTER) * claims 7, 16; figure 1 *	1-3	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H01R
H05K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06 JUNE 1990	HORAK A. L.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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