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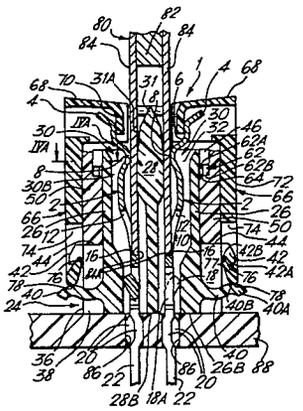
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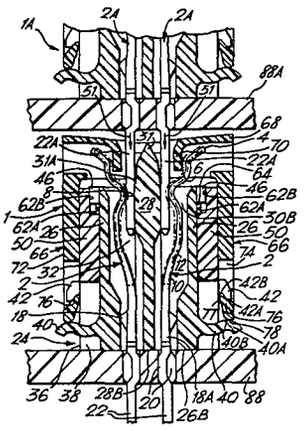
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(54) Zero insertion force electrical connector.

(57) Zero insertion force electrical connector. The connector comprises a row of electrical terminals (2) which can be moved to an open position to allow the insertion into the connector, substantially without force, of a male contact member (70) and to a closed position to engage the male member (70). The terminals (2) are moved between these positions by means of a lever (66) pivoted to a connector housing body part (24). In order to permit the forcible insertion of locking portions (20) of the terminals (2) into holes (86) in a support (88), without damage to the body part (24) and the lever (66), the terminals are provided with seats (16) for a terminal insertion tool (80). Also to this end, the lever (66) may be resiliently mounted to the body part (24).





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Zero insertion force electrical connector.

We have described in our United Kingdom Patent Specifications Nos. 1,503,824 and 1,518,869, a zero insertion force electrical connector comprising an insulating housing body part, a row of electrical terminals fixedly mounted in the housing body part and an insulating lever which is pivotable about a fulcrum on the housing body part, each terminal having an elongate resilient contact portion projecting into an opening in the housing body part, through which opening a male contact member can be introduced along an insertion path, the lever being engaged with the contact portions of the terminals in such a way that in a first angular position of the lever the contact portion of each terminal is withdrawn from the insertion path and in a second angular position of the lever, the contact portion intersects the insertion path, each terminal having a locking portion disposed externally of the housing body part and being adapted to be force fitted into a support for the connector.

The support will usually be in the form of a circuit board to printed conductors of which the terminals are soldered when the locking portions have been force fitted into the support.

Since such a connector is usually of miniature size, and the terminals are densely spaced, it is the practice to assemble the terminals to the support prior to assembling the housing to the terminals, as described, for example, in United Kingdom Patent Specification No.

1,503,824. This is because the high insertion forces that are required to drive the locking portions of the terminals into the support would tend to damage the housing of the connector, especially in the case of slight misalignment of the insertion tooling, if the housing were to be assembled to the connector prior to the assembly of the terminals to the support. Such insertion tooling is described for example in our United States Patent Specification No. 3,875,636.

The present invention proceeds from the realization that the connector should preferably be supplied to the end user in a fully assembled condition, in readiness to be mounted to its support by the end user, and that it should accordingly be ensured that the insertion forces are applied directly to the terminals, to avoid the terminals being dislodged from the connector, to avoid undue force being exerted against any plastics and inherently fragile parts of the connector, and to avoid undesired disassembly of the plastics parts. Thus, for example, the levers are fragile and are easily dislodged or damaged.

According to one aspect of the invention, therefore, a zero insertion force electrical connector as defined in the first paragraph of this specification is characterised in that each terminal is provided with a seat for a tool which can be inserted through the opening to force the locking portion of the terminal into the support.

The housing body part is preferably provided with resilient means urging the lever against the fulcrum.

According to another aspect of the invention, a zero insertion force electrical connector, comprising an insulating housing body part including first and second elongate side walls secured together in

parallel spaced relationship, and a row of elongate resilient electrical terminals between the side walls, each terminal comprising, a contact surface intermediate its ends for engaging a male contact member when such has been inserted between the side walls along an insertion path extending transversely of the row of terminals, a locking portion for forcible insertion into a support for the connector, a root portion remote from the contact surface and by means of which the terminal is fixedly located between the side walls, and a free end portion, the contact surface being positioned between the free end portion and the root portion, and the locking portion being positioned on the side of the root portion, remote from the free end portion and externally of the housing body part, there being attached to the housing body part, a shroud having a depending margin engaged about the free end portions of the terminals and a pivot member remote from the depending margin, engaging a fulcrum on the housing body part, a cam mounted between the shroud and the adjacent side wall being movable to pivot the shroud between a first angular position in which the contact surfaces are withdrawn from the insertion path and a second angular position in which the contact surfaces intersect such path; is characterised in that each terminal is provided between its root portion and its contact surface with a seat for a tool which can be inserted along the insertion path to force the locking portion of the terminal into the support, the adjacent side wall having a resilient projection extending through a support for the cam and engaging the shroud resiliently to urge a lip thereon into a recess in the fulcrum, thereby to secure the shroud to the housing body part.

As described below, it is a particular advantage

of this aspect of the invention that the effective lever length of the resilient projection is desirably long. The resilience of the mounting of the shroud to the housing body part and thus the protection of the shroud against vibration arising from the insertion forces is thereby enhanced.

Although there is disclosed in our United States Patent Specification No. 3,923,365 an electrical connector comprising elongate terminals each of which is formed with a hole intermediate its ends, these holes are not intended to provide seating for insertion tooling and would, indeed, be inaccessible to such tooling.

For a better understanding of the invention two embodiments thereof will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 is an enlarged perspective view, showing part broken away, of a stackable, zero insertion force electrical plug receptacle connector according to a first embodiment of the invention, in a closed, plug contacting position;

Figure 1A is a fragmentary perspective view of a detail of the connector of Figure 1, drawn to a reduced scale;

Figure 2 is an enlarged cross-sectional view of the connector of Figure 1 when mounted on a printed circuit board and showing part of a tool in use in the insertion of terminals of the connector into holes in the printed circuit board;

Figure 3 is a similar view to that of Figure 2, but in which the tool is not shown, the connector being shown in stacked relationship with a further and similar connector (only part of which is shown) which is also mounted on a printed circuit board;

Figure 4 is a similar view to that of Figure 2 but in which the tool is not shown and in which the connector is shown in an open, plug receiving position;

Figure 4A is a fragmentary sectional view taken on the lines IVA - IVA of Figure 2;

Figure 4B is a fragmentary sectional view taken on the lines IVB - IVB of Figure 4;

Figure 5 is a fragmentary cross-sectional view illustrating the assembly of a part thereof to the connector;

Figure 5A is a fragmentary sectional view taken on the lines VA - VA of Figure 5;

Figure 6 is an enlarged perspective view of a terminal of the connector; and

Figure 7 is a view similar to that of Figure 4 but illustrating a second embodiment of the connector in association with an edge portion of a printed circuit board which the connector is adapted to receive.

Reference will now be made to Figures 1 to 6.

A stackable, zero insertion force electrical plug receptacle connector 1, comprises an insulating housing containing two rows of terminals 2. Only one terminal of each row is shown (Figures 2, 3 and 4).

Each terminal 2 comprises, as best seen in Figure 6, an elongate, resilient contact part consisting of a free end portion 4 having a bight defining a depression 6, a bowed portion defining a convex contact surface 8, and a shank 9. The shank 9 is connected to a bight 14 of a widened, tool-receiving, portion 10 having a central longitudinal blind slot 12, one rounded end 13 of which extends into the bight 14. The other end 16 of the slot 12, which end is also rounded, provides a tool seat, as described below. The end part 18a of the portion 10, remote from the shank 9, has, struck out therefrom, a retaining

tongue 18 disposed between the end 16 of the slot 12 and a locking portion 20 of the terminal. The portion 20 is bifurcated, to provide a pair of oppositely bowed legs which are resiliently deformable towards one another, these being connected at one end to the part 18a and at the other to a male contact member in the form of a rectilinear plug 22 of the terminal.

The connector 1 has an insulating housing which includes a one piece, moulded, elongate body part 24 having a pair of upstanding, parallel side walls 26 which are spaced from one another in the transverse direction of the part 24 in substantially parallel relationship, and a longitudinal barrier wall 28 having a chamfered tip 31 and being disposed midway between the side walls 26. The wall 28 is connected to the walls 26 at either end by respective blocks 29 and 29' (Figures 1, 4 and 5). A series of longitudinally spaced, transverse webs 32 formed integrally with the walls 26 and 28, define a row of cavities 30 on either side of the barrier wall 28, as best seen in Figure 1, these cavities extending vertically (as seen in Figures 2 to 4) completely through the body part 24 of the housing. The wall 28 has opposed abutment faces 31A in a widened, receptacle portion 30B of each cavity 30.

As shown in Figures 5 and 5A each web 32 has a lower (as seen in Figure 5) thickened portion 34 having opposed recesses 34A (Figure 5A). Reduced width portions 30A of the cavities 30 extend between adjacent portions 34. Each barrier wall 28 has a vertical (as seen in Figure 5) groove 28A communicating with the adjacent cavity portion 30A. A thickened wall portion 36 extends along the bottom part of each side wall 26 and is provided with a vertical slot 38

opposite to each cavity 30. Formed integrally with each wall 26 is a thin, stiffly resilient finger 40 which projects laterally therefrom and extends through the adjacent slot 38 and beyond the wall portion 36. Each finger 40 is of substantially S-shape as seen in longitudinal section, having near its free end, a bight 40A having an upwardly (as seen in Figures 2, 3, 4 and 5) directed crest 40B. Each wall portion 36 has, as best seen in Figure 1, projecting laterally therefrom, on either side of each of its slots 38, a pair of longitudinally extending fulcra in the form of hook-like projections 42, the free ends 42A of which extend towards the fingers 40. Each projection 42 is undercut to provide a recess 42B. The upper (as seen in Figures 1, 4 and 5) end of each wall portion 36 defines a series of planar shelves 44, above each of which protrudes laterally from the side wall 26, a rectangular projection 46.

The wall 26 has a flat lower face 26B, the wall 28 having a flat lower face 28B, the faces 26B and 28B being coplanar.

In order to assemble the terminals 2 to the body part 24, each terminal 2 is inserted, with its plug 22 leading, into one of the cavities 30, from that end of the cavity 30 which is adjacent to the tip 31 of the wall 28, towards the lower face 28B thereof. As best seen in Figure 5A, the widened portion 10 of the terminal 2 slides during the insertion of the terminal 2, into the recesses 34A of the thickened portions 34 of an adjacent pair of the webs 32, the tongue 18 of the terminal 2 wedgingly engaging the adjacent wall 26, in the cavity portion 30A to restrain the terminal 2 against withdrawal from cavity 30. The terminal 2 is accordingly fixedly

located in the housing, with the contact surface 8 of the terminal disposed opposite to one of the abutment faces 31A of the wall 28 and the free end portion 4 of the terminal 2 projecting beyond the adjacent side wall 26 so as to be substantially level with the tip 31 of the wall 28. The locking portion 20 and thus the plug 22 of the terminal 2, then lie outside the housing beyond the faces 26B and 28B, of the walls 26 and 28.

As best seen in Figures 1, 1A and 5, the housing of the connector 1 also includes a one piece, insulating, cam member 48 comprising a pair of elongate cam plates 50 connected together at their left hand (as seen in Figure 1) ends by a web 52 from which extends a platform 54 provided with an operating handle 56 joined to the web 52.

As shown in Figure 1, the platform 54 has a channel-like track 58 slidably receiving a rail 60 formed integrally with, and projecting axially from, the end wall 29 of the housing part 24. Each cam plate 50 is, as shown in Figure 1A, 4A and 4B, provided with a series of ramps 62 extending, and being spaced from one another, longitudinally of the plate 50. A stop wall 64 is provided at the thicker end 62A of each ramp 62.

The cam member 48 is assembled to the housing part 24 with the cam plates 50 slidably received therein so as to rest on the shelves 44 and to seat against the side walls 26.

The housing of the connector 1 also includes one piece cam follower levers in the form of a pair of insulating shrouds 66. Each shroud has a top (as seen in Figures 1, 2, 3, 4 and 5) wall 68 having a depending longitudinal margin 70, which, when the shrouds 66 have been assembled to the body portion 24,

engages over, i.e. is hooked over, the free end portions 4 of the terminals 2 of one of the rows thereof, with the free end portion of the margin 7 in the depression 6 of the terminal 2. Connected to, and extending perpendicularly from, the top wall 68 of each shroud 66 is a side wall 72 having a row of apertures 74 extending lengthwise of the connector 1. There projects from the lower edge of each aperture 74, a pivot member in the form of a lip 76 which is inclined inwardly of the housing and has a rounded tip 77. The end 78 of the wall 72, remote from the top wall 68 is also rounded.

In order to assemble each shroud 66 to the housing part 24, the margin 70 thereof is first hooked over the free ends of the terminals 2 (as shown in Figure 5), of the corresponding row and the shroud 66 is then pivoted about the bottoms of the depressions 6 of these terminals to cause the end 78 of the wall 72 of the shroud 66 to engage the crests 40B of the fingers 40 of the adjacent wall 26, resiliently to deflect these fingers away from the projections 42, there above, so that these projections enter the apertures 74, and the rounded tip 77 of the lip 76 enters the recesses 42B of the projections 42, being retained therein by the resilient action of the fingers 40 against the end 78 of the wall 72. The free end portions 4 of the terminals 2 are also deflected resiliently to allow the projections 42 to enter the apertures 74, and therefore assist the action of the fingers 40 in retaining the tip 77 in the recesses 42B.

Each shroud 66 can readily be released from the housing part 24 by prying the end 78 of the shroud 66 to cause the lip 76 to snap out from between the fingers 40 and the projections 42.

Since the fingers 40 are formed on the walls

26 themselves rather than on the wall portions 36, these fingers are of suitably long lever length.

Each terminal 2 can be withdrawn from the housing part 24 by engaging a hooked tool end (not shown) in the slot 12 of the terminal 2 and then withdrawing the tool.

As will be apparent from Figure 2, the plugs 22 of the terminals 2 of the fully assembled connector can be simultaneously locked into holes 86 in a printed circuit board 88 positioned beneath the connector 1, by means of an insertion tool 80. The tool 80 is of elongate (in the longitudinal direction of the connector 1), rectangular shape and comprises an anvil block 82 from opposite sides of which depend rectilinear, terminal insertion blades 84, the total number of these blades being equal to that of the cavities 30 of the housing part 24.

The plugs 22 of the terminals 2 are first inserted into the holes 86 until the locking portions 20 rest against the upper (as seen in Figure 2) face of the board 88. Each blade 84 is then inserted into a cavity 30 so as to pass between the contact surface 8 of the terminal 2 therein, and the adjacent surface 31A of the wall 28 (as shown in Figure 2), so that the tip 84A of the blade 84 enters the slot 12 of the terminal, and seats against its end 16. The tip 84A is arcuate so as to correspond to the curvature of the end 16. The block 82 is now depressed, for example by means of a power driven ram (not shown), to force each locking portion 20 into a hole 86 there beneath, whereby the legs of the portion 20 (which is initially substantially over sized with respect to the hole 86) are resiliently forced towards one another so that the portion 20 is securely locked in its hole 86.

Although high insertion forces are required to

insert the portions 20 into the holes 86, the connector is protected from damage, since the insertion forces are applied directly to the terminals and not to the housing and the blades 84 are supported against the abutment surfaces 31A of the central barrier wall 28 to restrain the blades from buckling, the terminals 2 serving to urge the blades 84 against the surfaces 31A. The blades 84 are flexible enough to allow them to be deflected slightly, initially to align them with the ends 16 of the slots 12.

By virtue of the secure and resilient engagement of the tips 77 of the lips 76 in the recesses 42B of the projections 42, additional assurance is provided that the shrouds 66 are not dislodged from the housing part 24, or damaged, as a result of the vibration arising from the application of the high insertion forces.

In the fully inserted position of the portions 20, the faces 26B and 28B engage the upper surface of the board 88.

The connector 1 can be placed in an open, plug receiving condition (Figure 4) by sliding the cam member 48 (from its Figures 1 and 4A position) along the rail 60 in the direction of the arrow 90 in Figure 1, to cause the cam plates 50 to be withdrawn from the housing part 24 so that the thicker ends 62A of the ramps 62 engage the projections 46 (Figure 4B), to force the shrouds 66 angularly away from one another, and thus away from the walls 26, the shrouds 66 swinging about the pivotal axis provided by the tips 77 and the floors of the recesses 42B. The depending margins 70 of the wall 68 thus pull the terminals away from the barrier wall 28 as shown in Figure 4, to allow a plug to be inserted between the wall 28 and the contact portion 8 of each terminal, substantially

without insertion force. The outward movement of the cam member 48 is limited by the abutment of the stop walls 64 of the plates 50 against the projections 46.

The contact portions 8 of the terminals can be made operatively to engage the inserted plugs by returning the cam member 48 to its initial position so as to return the shrouds 66 to their initial positions. The connector is then in a closed plug contacting position.

As shown in Figure 3, the connector 1 described above may be mated in stacked relationship with a further and similar connector 1A, mounted on a printed circuit board 88A, the plugs 22A of the terminals 2A of the connector 1A being inserted along insertion paths, in the directions of the arrows 51 in Figure 4, into the cavities 30 of the connector 1 when in its open, plug receiving position (Figure 4) and the connector 1 there after being placed in its closed plug contacting position (Figure 3).

According to the embodiment of Figure 7, a zero insertion force connector 1X is adapted to receive a male contact member in the form of a printed circuit board 92, instead of electrical plugs as in the case of the first embodiment. To this end, the barrier wall 28X terminates at a position well below the contact surfaces 8 of the terminals 2 and has an upper (as seen in Figure 7) surface 90, a single central opening 30X being formed in each web 32X joining the side walls 26 to the barrier wall 28X. In the open position of the connector 1X, the printed circuit board 92 is inserted into the openings 30X along an insertion path, in the direction of the arrow 93 in Figure 7 until the leading end of the board 92 seats upon the surface 90. The connector 1X is then placed in its closed position so that the

contact portions 8 of the terminals 2 engage printed conductors 94 on either side of the board 92. The connector 1X is otherwise constructed and operates in the same way as the connector 1 described above. Parts of the connector 1X which are the same as corresponding parts of the connector 1, bear the same reference numerals.

Since the barrier wall 28X does not extend between the contact portions 8, a shim block (not shown) should be inserted between the two rows of terminals 2 prior to using the tool 80 to insert the portions 20 of the terminals 2 into the holes in the printed circuit board 88.

The fingers 40 on either side of the housing could be replaced by single resilient member serving the same purpose.

The connector 1 may if desired have only a single row of terminals 2, the wall 28 acting as an external side wall of the housing and only one shroud 66 being provided. Similarly, in the connector 1X, the webs 32X on one side of the cavity 30X may be replaced by an external side wall of the housing.

Claims:

1. A zero insertion force electrical connector (1 or 1X) comprising an insulating housing body part (24), a row of electrical terminals (2) fixedly mounted in the housing body part (24) and an insulating lever (66) which is pivotable about a fulcrum (42) on the housing body part (24), each terminal (2) having an elongate resilient contact portion (4, 8, 10) projecting into an opening (30 or 30X) in the housing body part (24), through which opening (30 or 30X) a male contact member (22 or 92) can be introduced along an insertion path (51 or 93), the lever (66) being engaged with the contact portions (4, 8, 10) of the terminals (2) in such a way that in a first angular position of the lever (66) the contact portion (4, 8, 10) of each terminal (2) is withdrawn from the insertion path (51 or 93) and in a second angular position of the lever (66), the contact portion (4, 8, 10) intersects the insertion path (51 or 93), each terminal (2) having a locking portion (20) disposed externally of the housing body part (24) and being adapted to be force fitted into a support (88) for the connector (1 or 1X); characterised in that each terminal (2) is provided with a seat (16) for a tool (80) which can be inserted through the opening (30 or 30X) to force the locking portion (20) of the terminal (2) into the support (88).

2. A connector according to Claim 1, characterised in that the housing body part (24) is provided with resilient means (40) urging the lever (66) against the fulcrum (42).

3. A connector according to Claim 2, characterised in that the lever (66) has a lip (76) engaging in a recess (42B) in the fulcrum (42), a resilient finger (40) extending from the housing

body part (24) engaging an end (78) of the lever (66) to urge the lip (76) into the recess (42B).

4. A connector according to Claim 3, characterised in that the finger (40) is substantially S-shaped, as seen in cross-section through the housing body (24), a crest (40A) of the finger (40) engaging the lip (76).

5. A connector according to any one of the preceding claims, characterised in that the lever (66) has a depending marginal portion (70) engaged over free end portions (4) of the terminals (2) so as to lift the lever (66), thereby to assist the action of the resilient means (40) in urging the lever against the fulcrum (42).

6. A connector according to any one of the preceding claims, characterised in that the seat is constituted by the bottom (16) of a longitudinal slot (12), in the contact portion (4, 8, 10) of the terminal (2), the slot (12) being positioned to receive a rectilinear, terminal insertion blade (84) of the tool (80).

7. A connector according to Claim 6, characterised in that the housing body part (24) is provided with a wall (28) extending alongside the contact portions (4, 8, 10) of the terminals and serving to restrain buckling of the insertion blade (80) during the forcing of the locking portions (20) of the terminals (2) in the support (88).

8. A connector according to Claim 6, characterised in that the opening (30X) is adapted to receive an edge portion of a printed circuit board (92) for engagement with the contact portions (4, 8, 10) of all the terminals (2) of the row, a shim block having been inserted into the opening (30X) to lie between the contact portions (4, 8, 10)

and the insertion blade (84) to restrain buckling thereof during the forcing of the locking portions (20) of the terminals (2) into the support (88).

9. A connector according to any one of the preceding claims, characterised in that a free end portion (4) of each terminal (2) has a depression (6) adapted to receive an edge portion (70) of the lever (66) to allow the lever (66) to be swung about such edge portion (70) during assembly of the lever (66) to the housing body part (24).

10. A zero insertion force electrical connector (1 or 1X), comprising an insulating housing body part (24) including first and second elongate side walls (26) secured together in parallel spaced relationship, and a row of elongate resilient electrical terminals (2) between the side walls, each terminal (2) comprising, a contact surface (8) intermediate its ends (4 and 22) for engaging a male contact member (22 or 92) when such has been inserted between the side walls (26) along an insertion path (51 or 93) extending transversely of the row of terminals (2), a locking portion (20) for forcible insertion into a support (88) for the connector (1 or 1X), a root portion (18, 18A) remote from the contact surface (8) and by means of which the terminal (2) is fixedly located between the side walls (26), and a free end portion (4), the contact surface (8) being positioned between the free end portion (4) and the root portion (18, 18A), and the locking portion (20) being positioned on the side of the root portion, remote from the free end portion (4) and externally of the housing body part (24), there being attached to the housing body part (24), a shroud (66) having a depending margin (70) engaged about the free end portions (4) of the terminals (2) and a pivot member

(76) remote from the depending margin (70), engaging a fulcrum (42) on the housing body part (24), a cam (50) mounted between the shroud (66) and the adjacent side wall (26) being movable to pivot the shroud (66) between a first angular position in which the contact surfaces (8) are withdrawn from the insertion path (51 or 93) and a second angular position in which the contact surfaces intersect such path;
characterised in that each terminal (2) is provided between its root portion (18, 18A) and its contact surface (8) with a seat (16) for a tool (80) which can be inserted along the insertion path (51 or 93) to force the locking portion (20) of each terminal (2) into the support (88), the adjacent side wall (26) having a resilient projection (40) extending through a support (36) for the cam (50) and engaging the shroud (66) resiliently to urge a lip (76) thereon into a recess (42b) in the fulcrum (42), thereby to secure the shroud (66) to the housing body part (24).

FIG.1A.

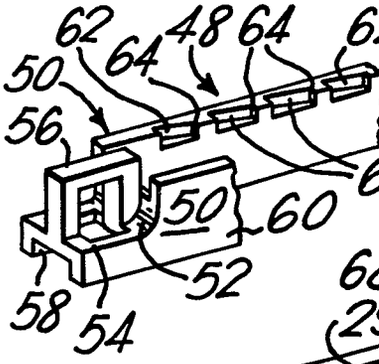


FIG.1.

FIG.4.

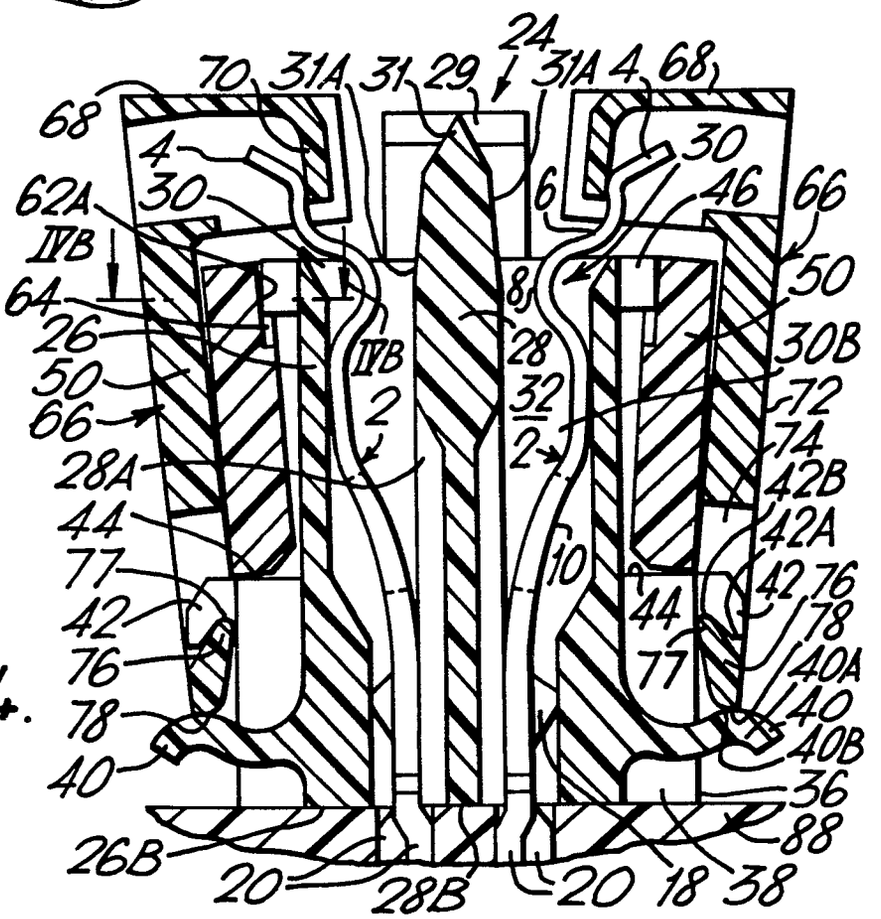


FIG.2.

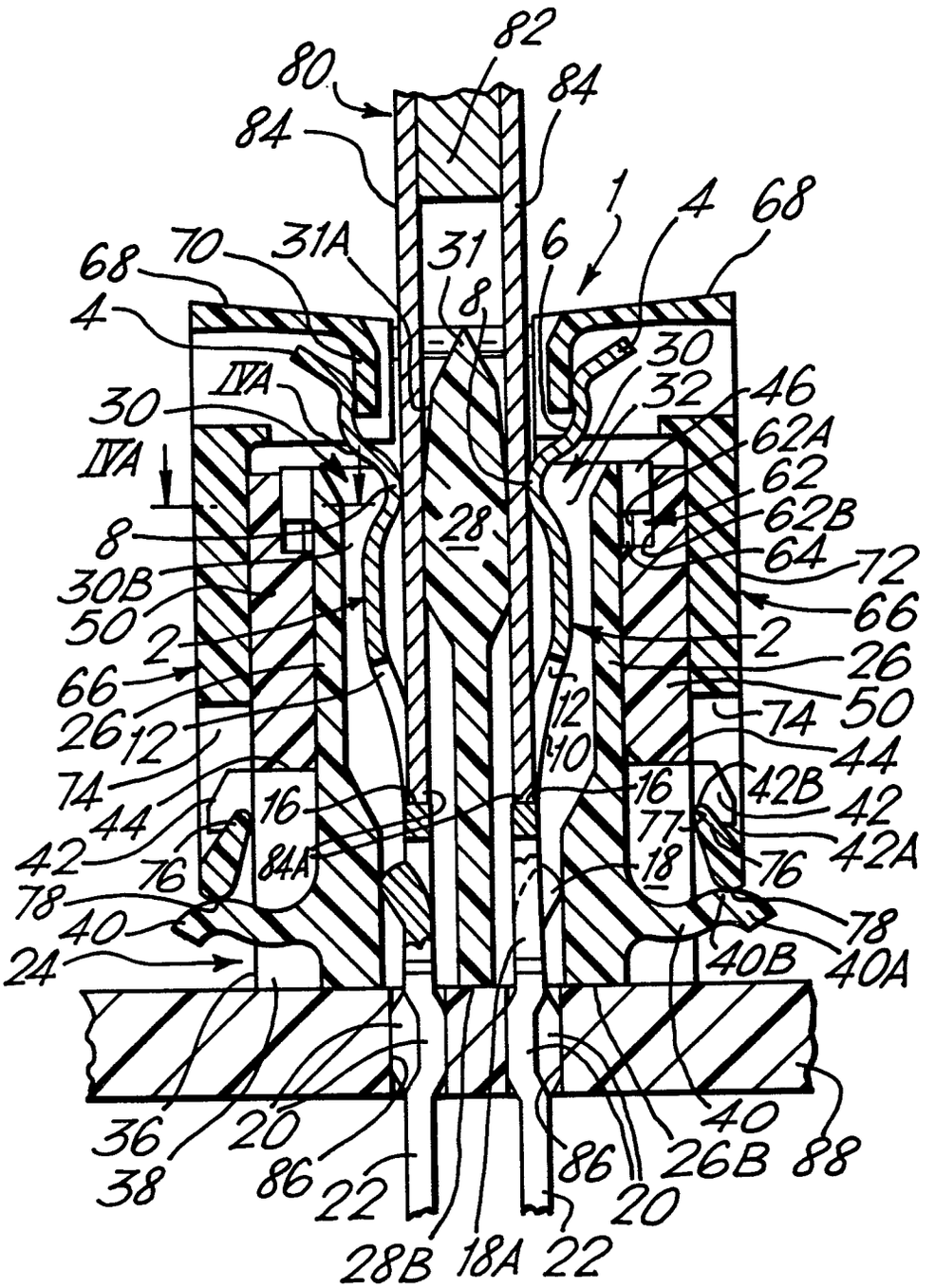

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FIG.3.

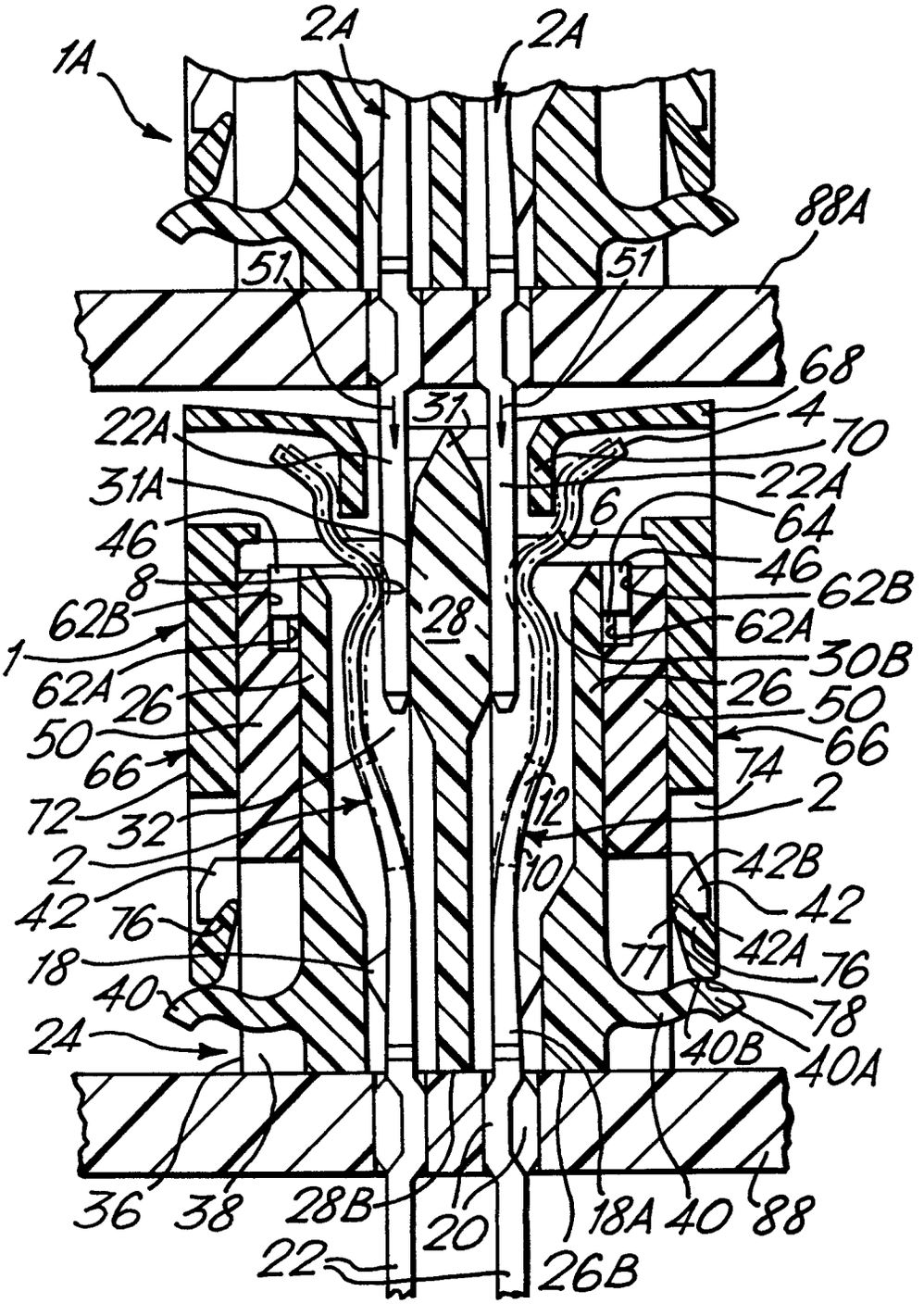

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FIG.4A.

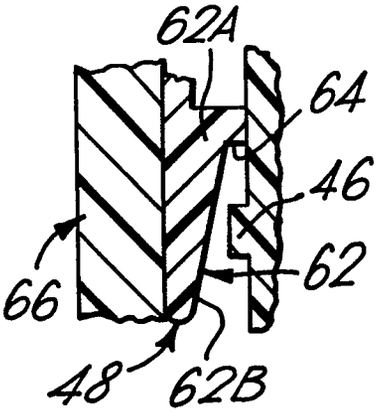


FIG.4B.

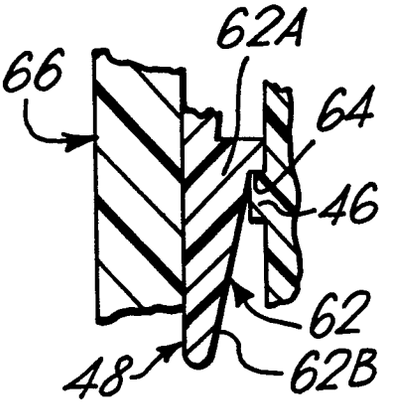
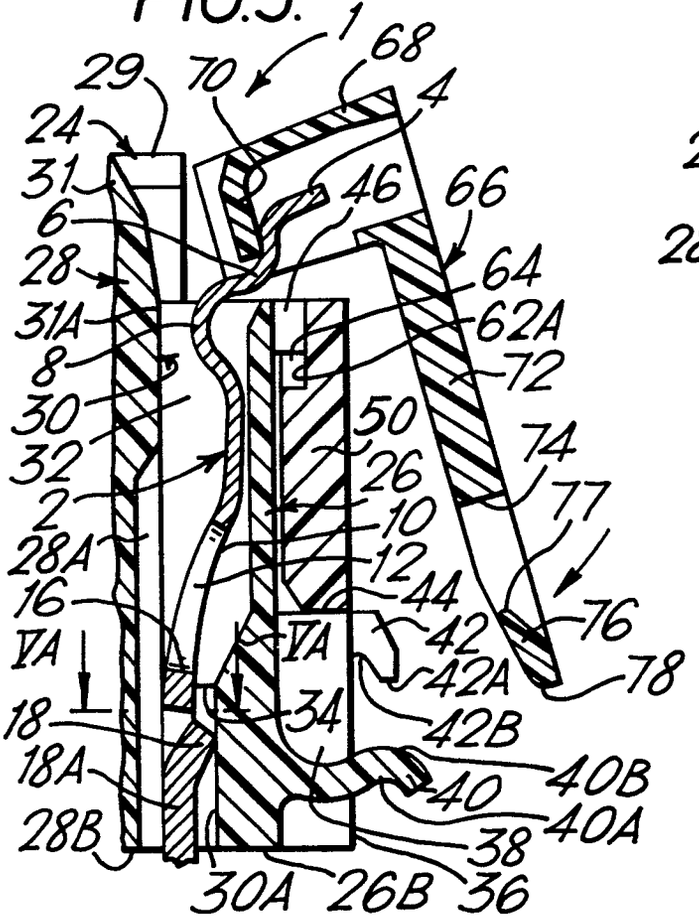


FIG.5.



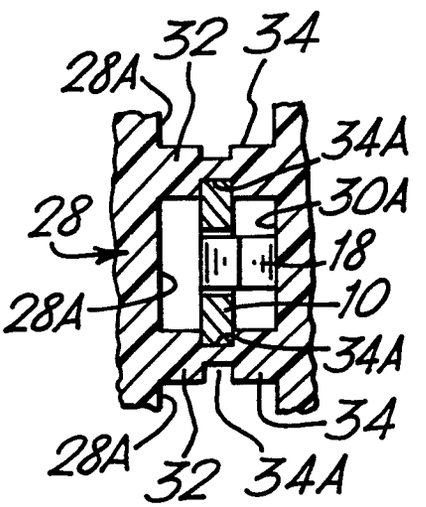


FIG.5A.

FIG.6.

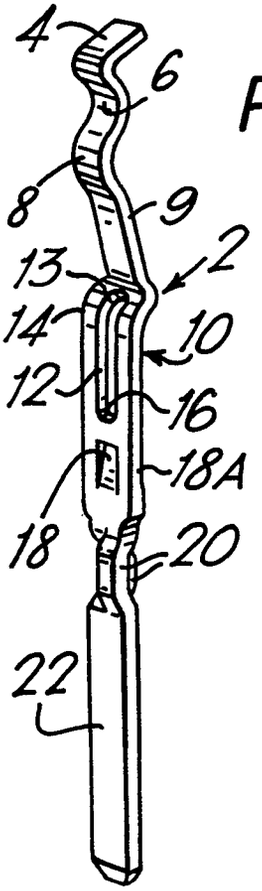
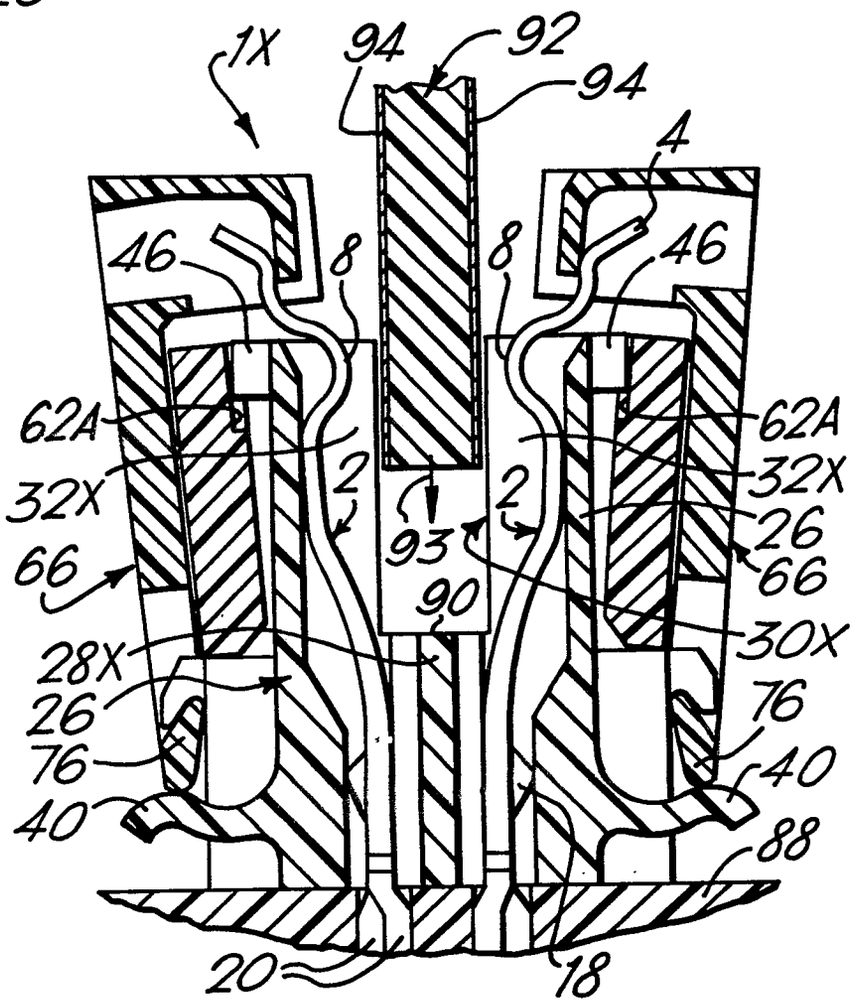

4
6
8
9
13
2
14
10
12
16
18A
18
20
22

FIG.7.


1X
94
92
94
4
46
8
8
46
62A
62A
32X
32X
2
2
26
93
66
66
90
30X
28X
26
76
76
40
40
88
20
18