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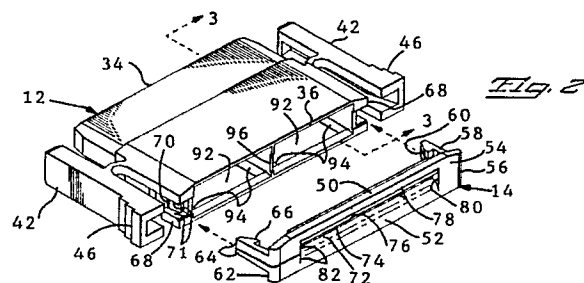
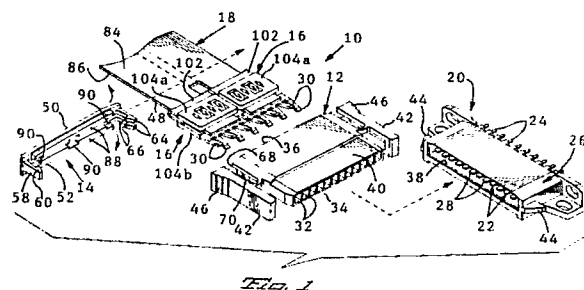
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(54) **Housing for flat power cable connector.**

(57) A housing for a termination of a pair of terminals (16) onto an end of flat power cable (18) has a pair of wide cavities (92) to receive the terminated cable end from rearwardly thereof, for contact sections (30) of the terminals (16) to extend forwardly from or be exposed along the forward housing mating face (34). A strain relief member (14) is then securable to the rearward end (36) of the housing (12) such as by latching thereto, to secure the terminals (16) within the cavities (92) and define a cable exit (72) spaced rearwardly of the terminations of the terminals (16). The strain relief member (14) can be bifurcated having upper and lower struts (50,52) joined at one lateral end (56) thereof to be inserted over the flat cable (18) from one side (48), and a latch arm (58) extends forwardly from the joined end (54) and a pair of adjacent latch arms (64) extend forwardly from the unjoined ends (62) of the struts (50,52), for latching to the housing (12), and the adjacent latch arms (64) after latching act as a single latch arm.



HOUSING FOR FLAT POWER CABLE CONNECTOR

The present invention relates to the field of electrical connectors and more particularly to terminating flat power cables.

Flat power cable is entering commercial use for transmitting electrical power of for example 75 amperes nominal, and includes a flat conductor one inch wide and about 0.020 inches thick with an extruded insulated coating of about 0.004 to 0.008 inches thick over each surface with the cable having a total thickness averaging about 0.034 inches. Also entering commercial acceptance is a dual conductor flat cable, wherein a pair of parallel spaced coplanar flat conductor strips having insulation extruded therearound define power and return paths for electrical power transmission. It is desired to provide housing means for a connector having terminals terminated to single or dual conductor flat power cable.

It is also desired to provide a means for cable strain relief included by the connector.

It is further desirable for the connector housing to provide means for limiting axial and vertical movement of the terminals within the housing.

The present invention comprises a housing means for a pair of transition adapter terminals terminated adjacent each other to an end of flat power cable, to define an electrical connector. The pair of terminals and the housing therefor may be used with single conductor flat power cable but are especially suitable for terminating dual conductor flat power cable. The terminals include contact sections extending forwardly from the cable end and extending forwardly from or otherwise exposed along the mating face of the housing for electrical connection with corresponding contact means of another electrical article such as another cable connector, a header mounted on a printed circuit board, terminal posts of a power supply, or a bus bar.

Each terminal is of the type having a pair of opposed plate sections transversely across each of which are an array of shearing wave shapes alternating with relief recesses, so that when the pair of plate sections disposed against major surfaces of the flat cable at an end thereof are pressed together and against the cable therebetween, the arrays of shearing wave shapes cooperate to shear the conductor of the flat cable into a plurality of strips which remain integral with the cable. The wave shapes also extrude the newly sheared conductor strips into the opposing relief recesses so that newly sheared conductor edges are moved adjacent electrical engagement surfaces defined by the vertical side edges of the adjacent shearing wave shapes forming electrical connections of the

adapter terminals with the flat cable conductors.

The pair of plate sections of each terminal both extend forwardly from a rearward cable-receiving terminal end where they coextend forwardly at a slight angle from a pair of bight sections spaced laterally apart defining a cable-receiving slot therebetween of known transverse width. Tab-shaped portions are formed on the end section of the cable and are inserted through the cable-receiving slots of the terminals and are disposed between upper and lower plate sections of each terminal. The upper and lower plate sections of each pair are pressed respectively together by being rotated about the bight sections which act as integral hinges, so that the shearing wave shapes shear and extrude strips of the conductor (or conductors) of the cable forming a termination of the terminals to the cable.

The two tab-shaped cable portions fit through the terminal slots with no more than a slight clearance with the inside edges of the pair of bight sections of each terminal. More importantly, the exposed axial conductor edges are formed precisely to be adjacent outwardly facing edges of the inner ones of the bight sections of the respective terminals. When the terminal plate sections are pressed together terminating the cable, the inner bight section already at least adjacent the conductor edge along the cable slot is deformed slightly against the conductor edge thereby biting into the metal, while the outer bight section is deformed slightly against and into the insulative coating along the adjacent lateral outer edge of the cable, thus gripping the tab-shaped cable portions after termination to act as stop mechanisms against axial movement of the terminals with respect to the cable and relieving stress on the terminations.

The terminals terminated to the tab-shaped cable portions are insertable into respective openings at the rearward end of a housing member until the terminals are disposed within respective cavities and the contact sections are disposed appropriately along the housing mating face. The housing member of the connector of the present invention is preferably molded as an integral member to precisely define upper and lower pairs of terminal-proximate ledges of precisely fixed spacing. The pairs of ledges maintain each of the terminals closely positioned vertically within their respective cavities to assist in minimizing detrimental effects of vibration on the terminations and are assisted in that function by a central rib between the cavities joining the upper and lower housing cover portions. A strain relief member is then securable to the rearward housing end to define a cable exit, and

includes rearward stop surfaces to maintain the terminals properly positioned axially within the housing, maintaining the contact sections in position axially to enhance wear resistance of the contact surfaces by minimizing axial movement thereof.

The cable strain relief member of the connector of the present invention is preferably integrally molded of plastic and bifurcated having upper and lower transverse struts joined at one lateral end, to be inserted over the flat cable from one side thereof after termination by the terminals. The member has a pair of latch arms each extending forwardly from a respective lateral end, which latchingly engage the housing when moved forwardly along the cable and against the rearward end of the housing. One of the latch arms is an integral member at the integrally joined lateral end while the other is split horizontally comprising upper and lower arm sections respectively extending forwardly from the lateral ends of the upper and lower struts at the split lateral end. When latched upper and lower arm sections are firmly held together vertically by the latching recess of the housing, and the strain relief member then closely fits against the flat cable disposed between the upper and lower struts, with curved cable-proximate edges to maintain the integrity of the cable insulation during handling and in the event the cable is bent or stressed vertically into a perpendicular orientation.

It is an objective of the present invention to provide a housing for terminals terminated onto an end of flat power cable.

It is also an objective for such a housing to accommodate a system of terminals simultaneously for either single or dual conductor flat power cable.

It is a further objective to provide a housing which is adapted to secure the terminals substantially against vertical movement therewithin and to secure the terminals substantially against axial movement therewithin.

It is yet a further objective to provide a strain relief member securable to the rearward end of an integral housing after the terminated cable end is received into the housing from rearwardly thereof.

It is still further an objective to provide such a strain relief member which is an integral member latchable to the housing and which snugly fits about the flat cable.

Embodiments of the housing and strain relief members will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective view of the connector of the present invention, and a connector matable therewith, with the terminated flat cable exploded from the housing and a strain relief mem-

ber exploded from the connector;

FIGURE 2 is a perspective view of the housing and strain relief member of Figure 1 from rearwardly thereof;

FIGURE 3 is a longitudinal section view through the housing taken along lines 3-3 of Figure 2;

FIGURE 4 is a perspective view of the terminals about to receive the prepared cable end for termination thereto, and showing an alternate type of contact section on the terminals;

FIGURES 5A and 5B illustrate placing terminals on the cable end prior to termination, with insert members of the terminals not shown, and where the flat cable is a single conductor type and the terminals being integral across the contact sections;

FIGURES 6 and 7 illustrate the terminals of Figure 1 being terminated to the cable end;

FIGURES 8 and 9 are section views taken along lines 8-8 and 9-9 of Figures 6 and 7 respectively, showing the terminals gripping the side edges of the cable end upon termination;

FIGURES 10 through 12 are plan section views of the mating connectors of Figure 1 prior to securing the respective terminals in the housings, after terminal securing, and after connector mating, respectively;

FIGURES 13 and 14 are elevation section views of the connectors of Figures 11 and 12 taken along lines 13-13 and 14-14 respectively thereof, unmated and mated; and

FIGURES 15 and 16 illustrate separate terminals and individual housings and strain relief members for terminating dual conductor flat cable for relative axial spacing of the connectors, before and after insertion of the terminals into the respective housings.

Connector 10 of Figure 1 includes a housing member 12 and rearward cable exit or strain relief member 14, adapted to house a pair of terminals 16 terminated onto flat power cable 18. Connector 20 is matable with connector 10 and is adapted to house a corresponding pair of terminals 22 which are shown to include post sections 24 extending rearwardly from housing 26 for insertion into corresponding plated through-holes of a printed circuit board (not shown). Terminals 22 also are shown having spring arm contact sections 28 at forward ends thereof matable with splines 30 at forward ends of terminals 16, when connectors 10 and 20 are mated. Housing 12 includes a plurality of forward passageways 32 in communication with mating face 34 within each of which is disposed a spline 30 after terminals 16 are inserted into housing member 12 from rearward end 36. Housing 26 of connector 20 includes a large cavity 38 within which are disposed spring arms 28, and large

cavity 38 is adapted to receive thereinto forward section 40 of housing 12 of connector 10 upon mating, with spring arms 28 received within passageways 32 to electrically engage respective splines 30. Housing 12 is shown having a pair of latch arms 42 along sides thereof which ride over and latchingly engage a pair of corresponding latching projections 44 of housing 26 to secure the connectors together. Latch arms 42 are shown having rearward gripping portions 46 deflectable inwardly to facilitate delatching from projections 44 upon connector unmating.

Referring to Figures 1 and 2, after terminals 16 on cable 18 are inserted into rearward housing end 36, strain relief member 14 is insertable across flat cable 18 from lateral edge 48 and then movable forwardly therealong to latch securely to housing member 12 along rearward end 36. Strain relief member 14 includes upper and lower struts 50,52 extending laterally from integral section 54 spaced slightly apart for cable 18 eventually to be disposed therebetween. At lateral end 56 including integral section 54, first latch arm 58 extends forwardly to inwardly directed latching projection 60. At lateral end 62 a pair of second latch arms 64 extend forwardly from ends of upper and lower struts 50,52 to inwardly directed latching projections 66 which will cooperate as a single latch arm during latching to connector housing 12. Housing member 12 includes near rearward end 36 and along outer surfaces 68 a pair of latching recesses 70 in channels defined between upper and lower channel wall surfaces 71, for receiving thereinto latching projections 60,66,66 when strain relief member 14 is secured to housing member 12.

Upon assembly to housing member 12 cable strain relief member 14 defines a cable exit or slot 72 between facing surfaces 74,76 of upper and lower struts 50,52 with rounded rearward corners 78 and between side walls 80,82,82 near lateral ends 56,62 respectively. The distance between side walls 80,82,82 is preferably selected to be slightly less than the nominal width of cable 18 to generate a slight interference fit width wise after connector assembly. Further it is preferred that after connector assembly facing surfaces 74,76 of upper and lower struts 50,52 clamp against upper and lower major surfaces 84,86 of cable 18. Forwardly facing surfaces 88 of struts 50,52 shown in Figure 1 will act as rearward limits or stops engageable by terminals 16 after connector assembly; rounded recesses 90 in surfaces 88 are shown within which rearwardmost portions of terminals 16 are received (Figures 13 and 14).

Referring to Figures 2 and 3, a pair of large cavities 92 extend forwardly from rearward housing end 36 to rearwardly facing stop surfaces 93, to receive terminals 16 inserted thereinto. Pairs of

upper and lower ledges 94 are defined axially along both sides of each cavity 92 between which terminals 16 will be disposed, with the distance between the facing ledge surfaces precisely selected so that after connector assembly terminals 16 will be allowed little vertical movement, if any, but allowing for some tolerance in the eventual height of terminals 16 which are terminated to cable 18 (Figures 13 and 14). Housing member 12 being integrally molded allows the distance between facing ledge surfaces to be precisely controlled. Vertical barrier wall 96 between cavities 92 disallows upper and lower cover sections 98,100 of housing 12 from slight spreading and thus maintains the distance between facing ledge surfaces of the inner pairs thereof.

Terminals 16 include stamped and formed adapter members 102 disposed immediately against cable surfaces 84,86, and also preferably include insert members 104 secured along cable-remote surfaces of adapter members 102 and being of high copper content which establish gas-tight electrical engagement with sheared edges of the cable conductors after termination. Figure 4 illustrates a pair of adapter members 106 having blade-like contact sections 108 of the type suitable for termination to terminal posts of a power supply; it is preferred that the terminals include insert members but such inserts are not shown in order to assist in illustrating the method of termination. Cable 18 includes two parallel spaced coplanar flat conductor members 110 therein coated by an insulative covering which also defines a medial portion 112 between the conductors 110. As shown cable 18 is prepared by cutting an axial slot 114 rearwardly from the cable end along the cable centerline, slot 114 having a selected width, thereby defining a pair of tab-shaped cable portions 116. Rearward ends 118 of adapter members 106 include a pair of bight sections 120,122 which join upper and lower plate sections 124,126 of adapter members 106.

Referring now to Figures 5A and 5B, an alternate embodiment of adapter member 128 is shown having two adapter sections 130 each having a cable-receiving slot between pairs of bight sections 132,134. Adapter member 128 is integral across contact section 136 containing splines 138 and is suitable for terminating single conductor cable 140 which has been prepared similarly to cable 18 of Figure 4 to have a pair of tab-shaped cable portions 142. Tab-shaped cable portions 142 are inserted into and through the cable-receiving slots until cable portions 142 are disposed between pairs of upper and lower plate sections 144,146. Defined transversely across upper and lower plate sections 144,146 are arrays of alternating shearing wave shapes 148 and relief recesses 150, with

wave shapes 148 extending toward upper and lower major surfaces of the flat cable.

In Figures 6 and 7 a representative terminal 16 is shown having an adapter member 102 and upper and lower insert members 104a,104b, with a tab-shaped cable portion 152 extending through cable-receiving slot 154 and disposed between upper and lower plate sections 156,158 of adapter member 102. Crests 160,162 of shearing wave shapes 164,166 of upper and lower plate sections 156,158 are shown against cable surfaces 84,86 prior to termination in Figure 6; in Figure 7, wave shapes 164,166 have sheared the conductor of cable 18 and have extruded the thus-sheared conductor strips 168 into the opposing relief recesses 170,172 to define alternating and interlocking upper and lower wave joints 174,176 disposed in respective apertures 178 of insert members 104. In Figure 7 sheared conductor edges are disposed adjacent and in electrical engagement with the vertical wall surfaces simultaneously defining the sides of wave shapes 180 and longitudinal side walls of apertures 178 adjacent and alternating with wave shapes 180 transversely across upper and lower insert members 104a,104b. The wave joints may preferably be split by staking, and the insert members also staked along outwardly facing surfaces of wave shapes 180 to enhance the gas-tight nature of the electrical connections between the insert members and the sheared conductor edges by imparting stored energy in the wave joints.

In Figures 8 and 9 can be seen the gripping of lateral edges of the tab-shaped conductor portions before and after termination of terminals 16 thereto. Inner and outer bight sections 182,184 define cable-receiving slot 154 between facing edges 186,188 thereof. Cable 18 has been prepared as in Figure 4 by cutting a slot 190 along the cable centerline, thereby shearing conductor 192 forming a sheared edge 194. Cable insulation 196 extends along lateral cable edge 198 and also defines medial strip 200 between the pair of conductors. When upper and lower plate sections of the adapter member are pressed together as in Figure 7, the metal of the bight sections 182,184 is deformed slightly and protrudes simultaneously against the conductor edge 194 and lateral cable edge 198 thereby biting into the metal of conductor 192 at 202 and compressing the insulation material 196 at 204 to grip the tab-shaped cable portion 152 and comprise an axial stop for terminal 16 along cable 18.

Figures 10 to 12 illustrate the assembly of connectors 10 and 20. Terminals 16 have been terminated to tab-shaped cable portions 152 including splitting the wave joints as indicated at 206 and staking the inserts between the wave joints as indicated at 208. Cable strain relief member 14 has

been inserted over cable 18 from lateral edge 48 in Figure 10. In Figure 11 terminals 16 have been inserted into cavities 92 of housing member 12 with splines 30 within passageways 32, and strain relief member 14 has been latched to housing member 12 by latching projections 66 in latching recesses 70; terminals 22 have been secured in housing member 26 of connector 20 with contact sections 28 arrayed across cavity 38 and post sections 24 extending outwardly from housing member 26. In Figure 12 connectors 10 and 20 are shown latched and mated together, with latching surfaces 210,212 of latch arms 42 and projections 44 having a slight reverse angle for vibration resistance; forward section 40 of housing member 12 has been received within cavity 38 of housing member 26 and with spring arm contact sections 28 of terminals 22 electrically engaged with splines 30 of terminals 16, alternating upwardly and downwardly across the terminals.

Figures 13 and 14 show connectors 10 and 20 being mated, with a downwardly angled spline 30a and an upwardly deflectable spring contact arm 28a electrically engageable together. Cable strain relief member 14 is shown latched in place defining the cable exit with cable 18 clamped between facing surfaces 74,76 of upper and lower struts 50,52 and a bight section 184 of terminal 16 disposed in a recess 90.

In Figures 15 and 16 are shown an alternate arrangement wherein terminals 250,252 are terminated to ends of respective cable portions 254,256 containing individual conductors of a dual conductor cable 258. Individual housing members 260 are shown for terminals 250,252, with individual cable strain relief members 262 shown to be placed and latched to rearward ends of housing members 260. The arrangement shown accommodates the desire to space the connectors 264,266 apart for the power and return paths established by the individual conductors of the cable.

Claims

1. A housing assembly for housing terminations of terminals (16) onto an end of flat power cable (18), having a housing member (12) having cavities (92) in which the terminals (16) are to be disposed with contact sections (30) of the terminals (16) exposed along the mating face (34) for mating with corresponding contact sections (28) of another electrical article (20), characterized in that:

the housing member is an integral member (12) with respective cavities (92) in communication with the rearward end (36) of the housing (12) for receiving the terminals (16) insertably therein after the terminals have been terminated onto the end of

the flat cable (18), and having rearwardly facing stop surfaces (93) providing forward stops for the terminals, and further including forward passageways (32) through which the contact sections (30) extend to the mating face (34); and a rearward member (14) is securable onto the rearward housing end (36) after insertion of the terminals (16) into the housing cavities (92), the rearward member (14) having a slot (72) between upper and lower strut members (50,52), the slot (72) having a width about equal to the width of the flat cable (18) and having a height about equal to the thickness of the flat cable (18) after being secured to the rearward housing end (36), and the rearward member (14) defining forwardly facing stop surfaces (88) corresponding to rearwardly facing stop surfaces of the terminals (16) whereby the rearward member (14) retains the terminals (16) within the housing cavities (92), with the flat cable (18) extending through the slot (72) of the rearward member (14), and provides dielectric material closing the rearward housing end (36) rearwardly from the terminations of the terminals (16) to the flat cable (18), thereby protecting the terminations from cable torque relative to the housing member (12).

2. A housing as set forth in claim 1 further characterized in that said rearward member (14) is bifurcated with said upper and lower struts (50,52) being integrally joined at a joint (54) at a first lateral end (56) and separated at a second lateral end (62), whereby the rearward member (14) is adapted to be inserted over the flat cable (18) from a lateral edge (48) thereof with said upper and lower struts (50,52) passing over and under upper and lower major surfaces (84,86) of the flat cable (18) rearwardly of the terminals (16) terminated to an end of the flat cable (18).

3. A housing as set forth in claim 2 further characterized in that said rearward member (14) includes a first latch arm (58) extending forwardly from said first lateral end (56) and including first latching means (60) at a forward end of said first latch arm (58), and further includes second latch arms (64) coextending forwardly from said upper and lower struts (50,52) at said second lateral end (62) and having second latch means (66) at respective forward ends thereof, said second latch arms (64) comprising a cooperable latch arm pair opposed from said first latch arm (58), and said housing member (12) including corresponding latching means (70) along side walls (68) thereof proximate said rearward end (36) adapted to establish latching engagement with said first and second latching means (60,66) of said first latch arm (58) and cooperable latch arm pair (64) respectively when said rearward member (14) is urged axially forwardly along the flat cable (18) and against said rearward housing end (36), securing said rearward

member (14) to said housing member (12) and retaining said terminals (16) in said housing member (12).

4. A housing as set forth in claim 3 further characterized in that one of said corresponding latching means (70) is adapted to hold said second latch arms (64) of said cooperable latch arm pair after latching against movement relatively apart.

5. A housing as set forth in claim 3 further characterized in that said first and second latching means (60,66) comprise latching projections (60,66) extending relatively toward each other and define rearwardly facing latching surfaces, and said corresponding latching means (70) comprise laterally outwardly facing latching recesses (70) adapted to receive said latching projections (60,66) thereinto upon latching and defining forwardly facing latching surfaces corresponding to said rearwardly facing latching surfaces to latchingly secure said rearward member (14) to said housing member (12).

6. A housing as set forth in claim 5 further characterized in that said rearwardly facing latching surfaces are slightly angled outwardly and said forwardly facing latching surfaces are slightly angled inwardly, whereby the latching system defined by the rearward member (14) and the housing member (12) is adapted to hold the latch arms (58,64,64) relatively toward the side surfaces (68) and to thereby resist unlatching upon stress applied by the terminated flat cable urging said rearward member (14) rearwardly from said housing member (12).

7. A housing as set forth in claim 2 further characterized in that said cable exit (72) is defined by facing surfaces (74,76) of said upper and lower struts (50,52) spaced to abut the upper and lower major surfaces (84,86) of the flat cable (18) after assembly, and by inwardly facing surfaces (80) defined on said integral joint (54) at said first lateral end (56) and on respective second lateral ends (82) of said upper and lower struts (50,52) after said rearward member (14) is secured to said housing member (12), which are spaced to abut the lateral edges of the flat cable (18) after assembly.

8. A housing as set forth in claim 7 further characterized in that rearward edges (78) of said facing surfaces (74,76) of said upper and lower struts (50,52) are rounded.

9. A housing as set forth in claim 1 for said terminals comprising a pair of separate terminal members (16) terminated onto respective tab-shaped portions (152) of the flat cable, further characterized in that said cavities (92) comprise a pair of cavities (92) for respective ones of said pair of separate terminal members (16), said housing member (12) including a central barrier wall (96) between said pair of cavities (92) establishing in-

ulative material between the separate terminals (16) after insertion thereof into said pair of cavities (92) and joining said upper and lower cover sections (98,100) of said housing member (12) midway thereof transversely, whereby the upper and lower cover sections (98,100) are held a fixed spacing apart transversely thereacross along said rearward end (36).

10. A housing as set forth in claim 9 further characterized in that pairs of upper and lower ledges (94) are defined axially along inner surfaces of said upper and lower cover sections (98,100) defining said pair of cavities (92) and adjacent upper and lower surfaces of the terminals (16) after insertion thereof into said cavities (92), said ledge pairs (94) being disposed at both lateral ends of each of said pair of cavities (92), upper and lower ones of each of said pair of ledges (94) having facing surfaces spaced apart a precise distance approximately corresponding to the nominal vertical height of each of the terminals (16) of said pair, whereby the housing member (12) maintains an assured effective vertical height to the respective cavities (92) and vertical movement of the separate terminals (16) is thereby closely limited.

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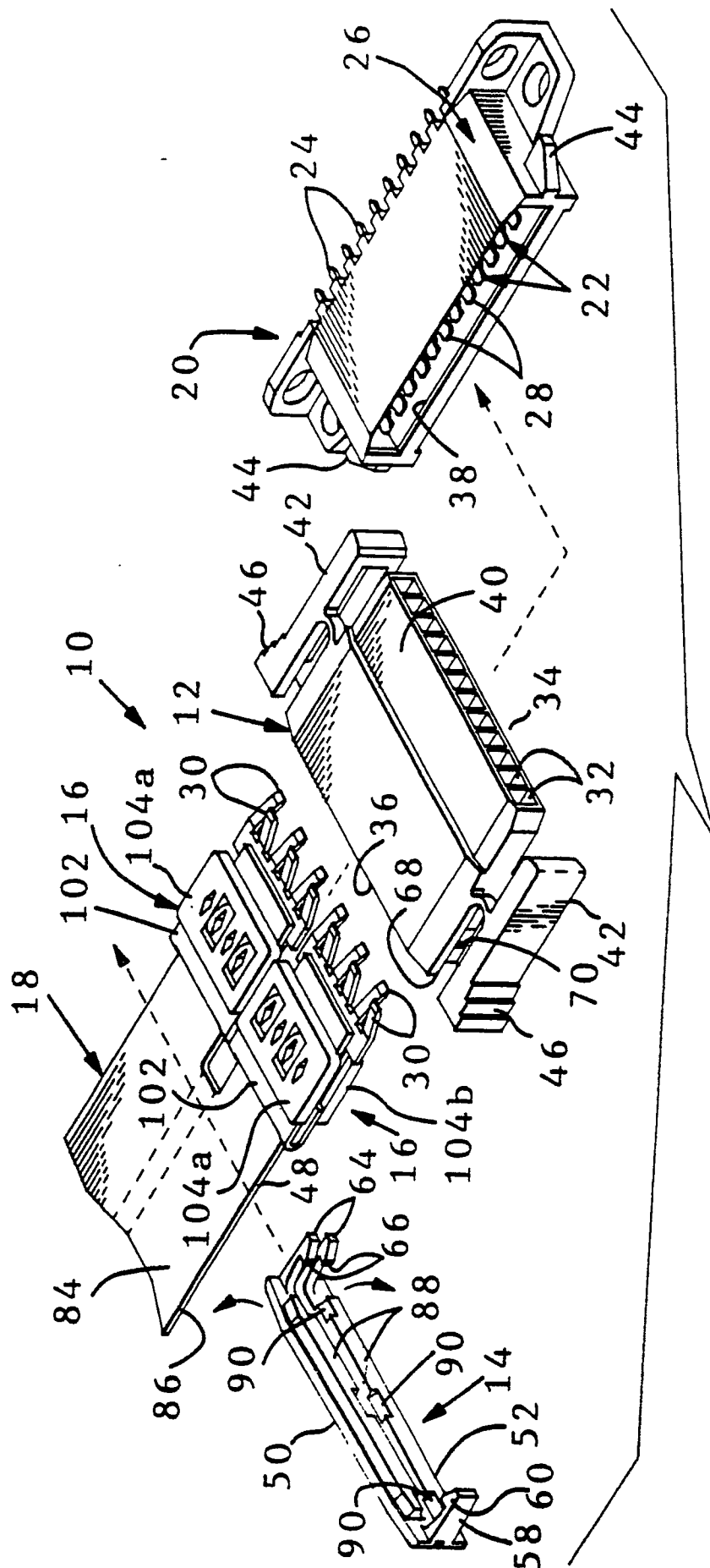
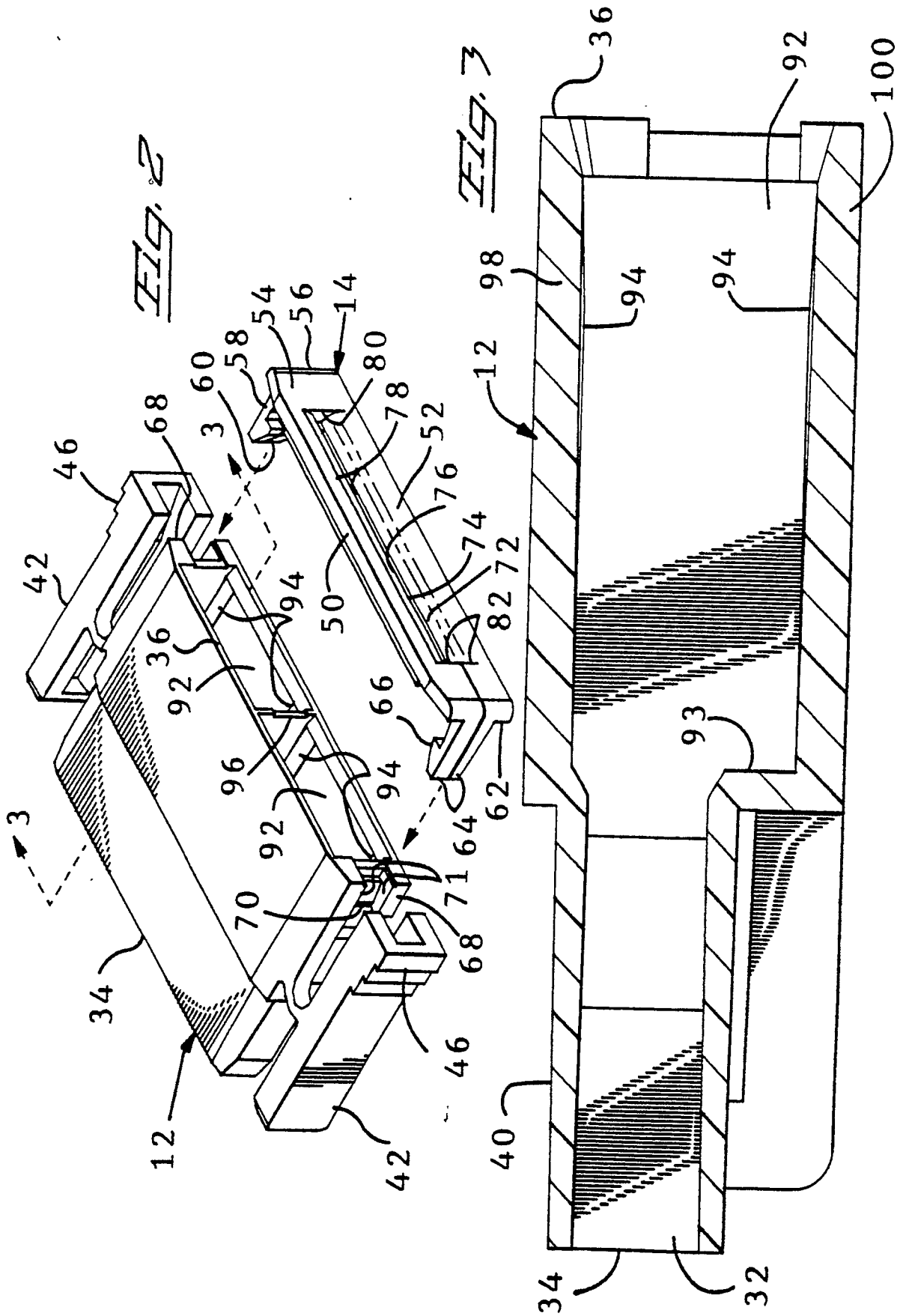
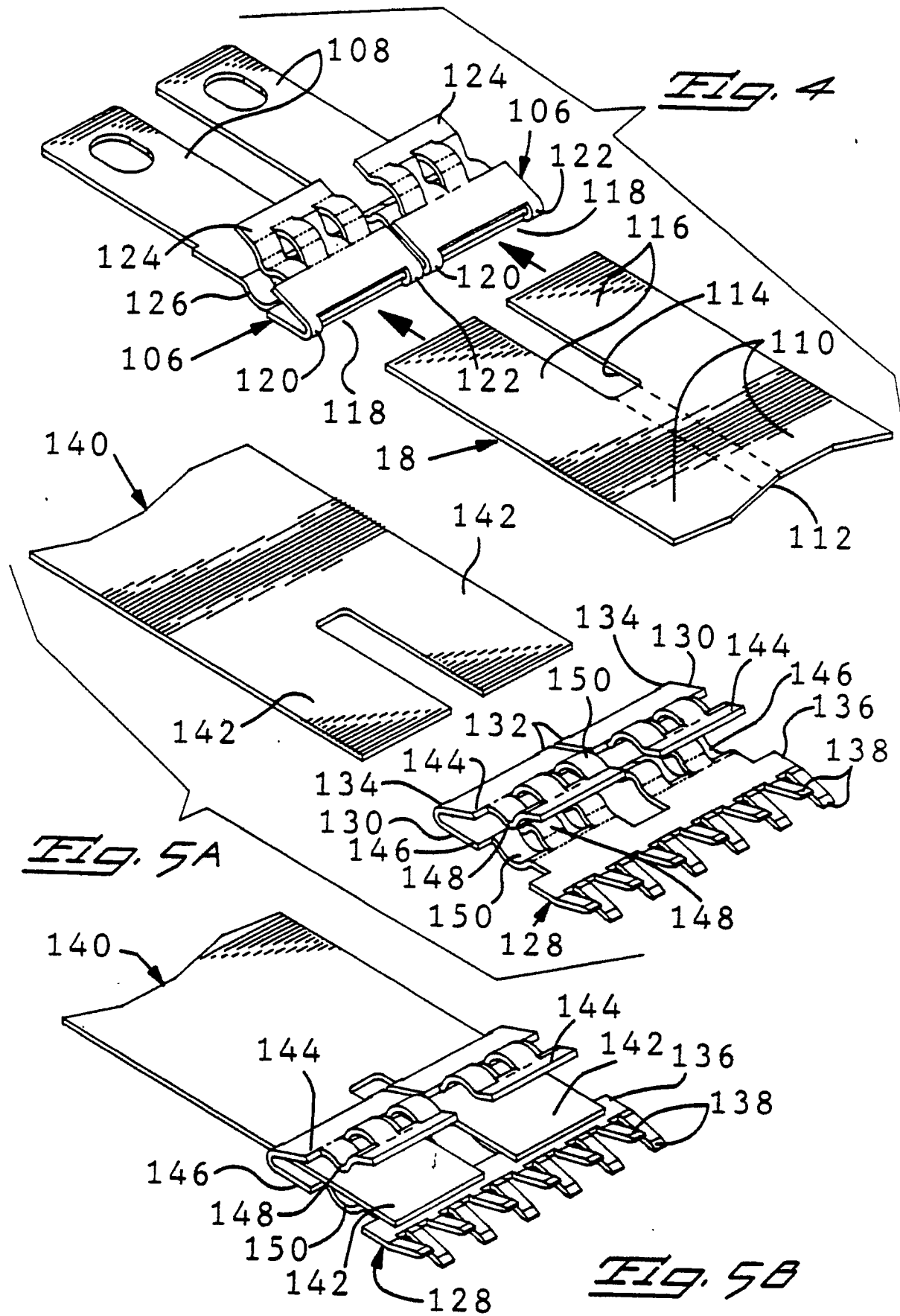
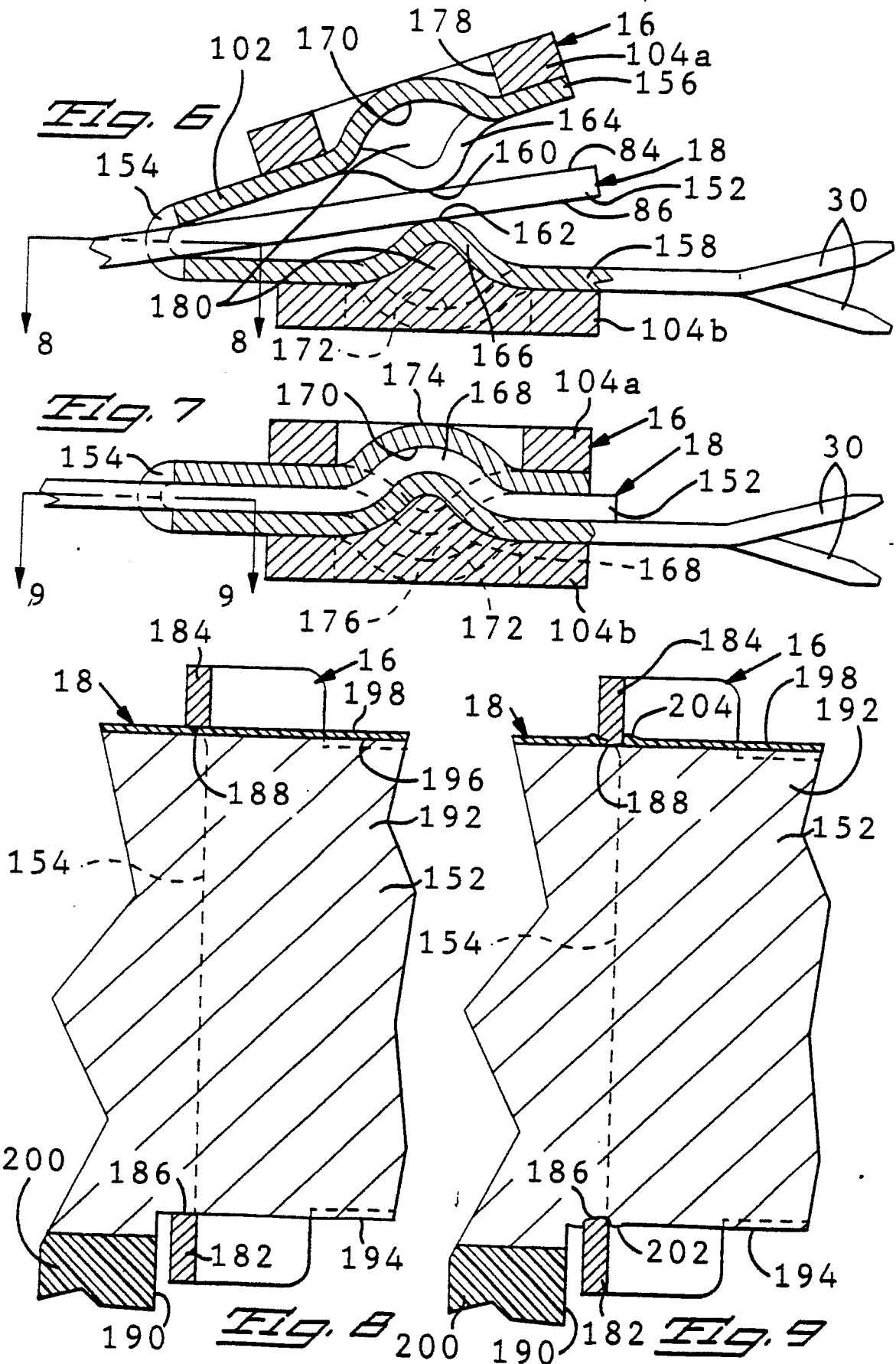
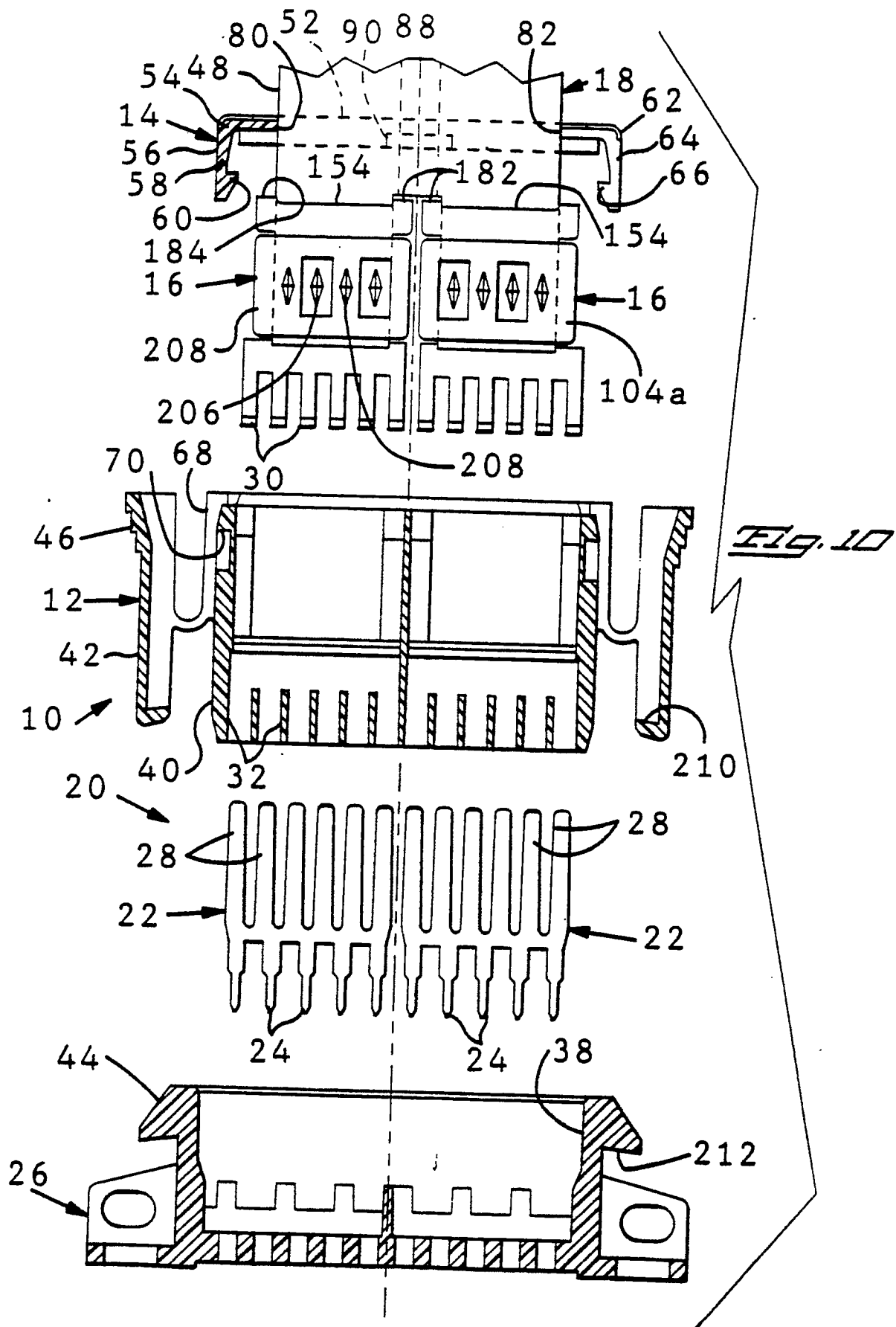


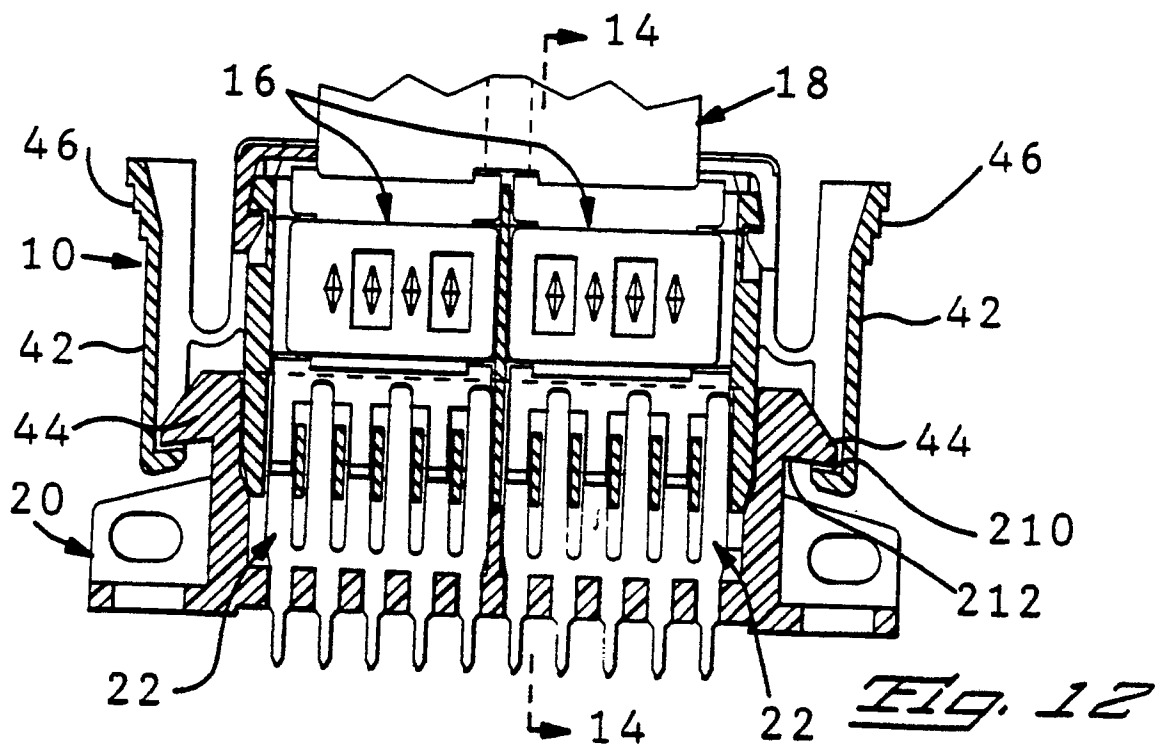
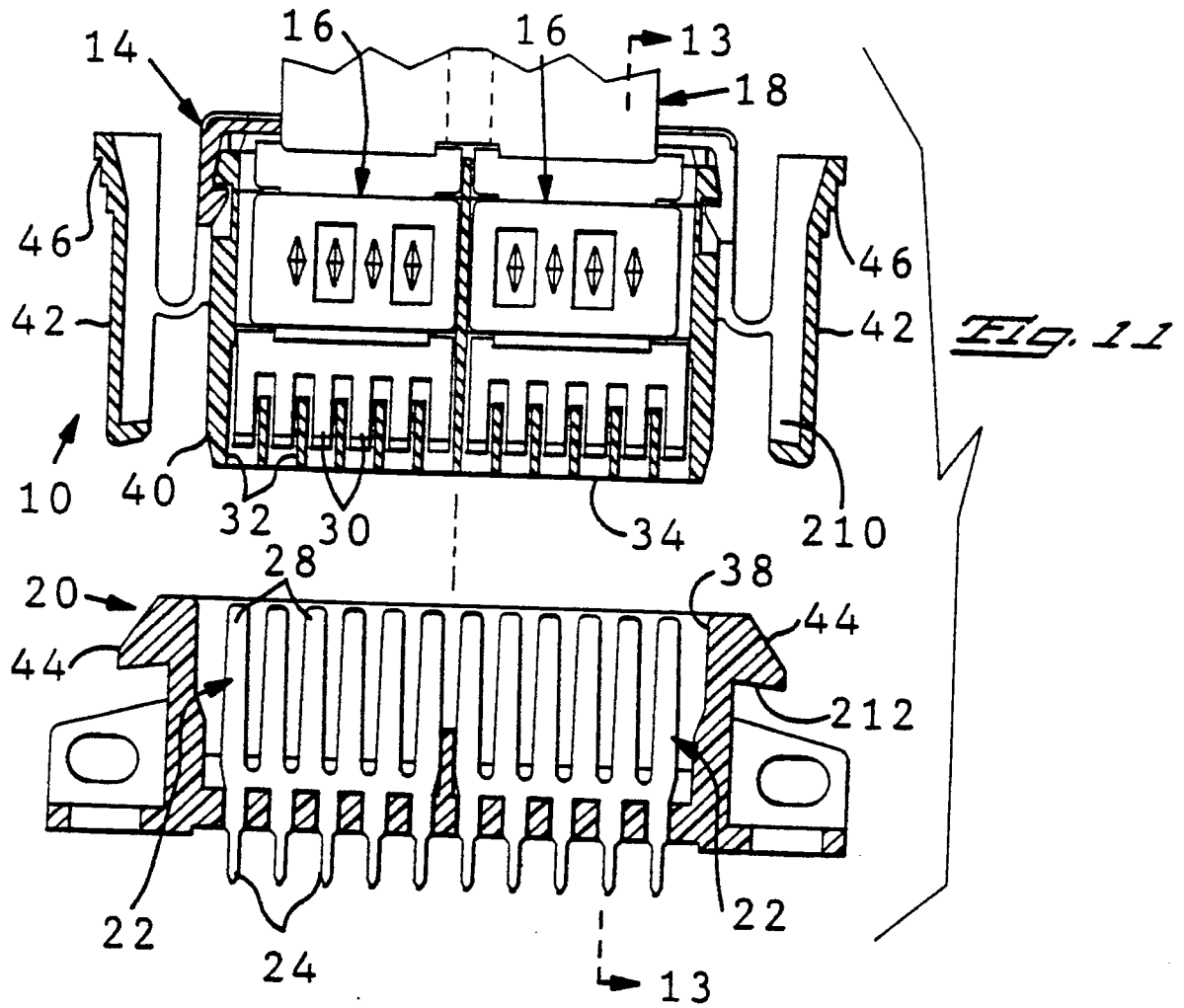
Fig. 1











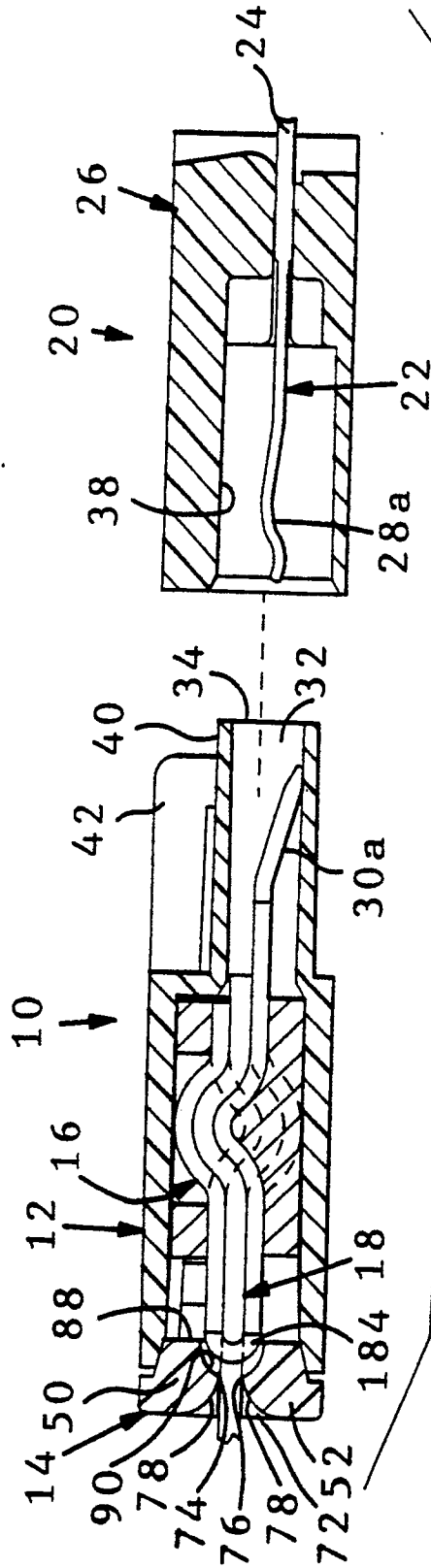


Fig. 13

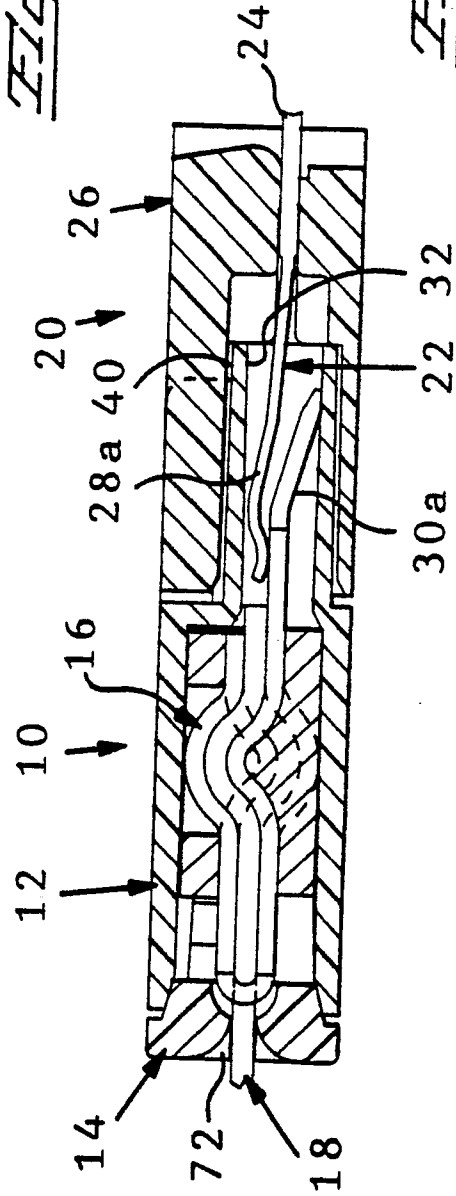


Fig. 14

