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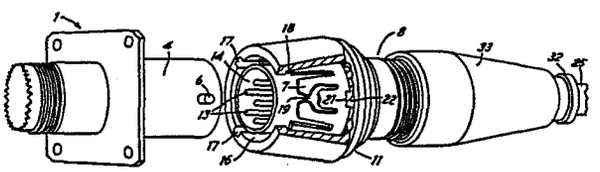
(54) Plug-and-socket connector with a resilient coupling strip.

(57) A connector member 8 for use with a mating member 1 provided with radial bayonet studs 6 has a body part 11 of a moulded plastics material enclosing a number of contacts 13. The body part has a number of entry slots 17 for the bayonet studs and retention means with a snatch safety feature are provided by a slotted resilient strip 7 located in an annular recess 18. The body part 11 has an internal region of substantially solid cross section having axially directed holes in which the contacts are a sliding fit and a thickened region in each contact is supported between the solid central region and a plastic insert 29 (not shown) which is held in place by a clamp nut 33.



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IMPROVEMENTS IN OR RELATING TO ELECTRICAL CONNECTORS

This invention is concerned with electrical connectors for multi-core cables and, particularly, with cylindrical connector members for coupling to mating members having a plurality of radial bayonet studs. Such connector members commonly include a substantially tubular shaped metal shell surrounding an insulating insert which firmly supports a number of contacts, each contact being joined within the shell to a core of a multi-core cable. A cylindrical mating member supporting a corresponding number of mating contacts enters the shell when connection is made, a plurality of external radial bayonet studs on the mating member entering corresponding entry slots in the connector member to engage retention means which may include a snatch safety feature such that when a cable is pulled with excessive force, the connector and mating members will separate. British Patent Specification No. 1403093 and European Patent Application No. 0082320, for example, each disclose connector members in which resilient elements are inserted into recesses lying to either side of each entry slot, while UK Patent Application No. GB 2063587A discloses a connector member in which the bayonet studs engage a spring

loaded rotary latch.

It is essential when assembling such connector members to ensure that the contacts are firmly supported in insulating material within the shell and that they will axially align with the mating contacts when the bayonet studs engage the retention means. Presently used methods of assembly commonly involve the steps of firmly bonding the contacts in the insert, which has been firmly fixed to the shell, and securing by, for example, soldering or crimping the cable core ends to the contacts before the securing of accessories. Such operations may be time consuming in requiring that the contacts are supported in correct angular relationship with the retention means while ensuring that no cores become broken or disconnected, particularly when fine cored cables such as audio wires are to be connected. Furthermore, the provision of slots and recesses in a metal shell to ensure that the retention means are precisely located is likely to require costly machining operations.

It is an object of the present invention to provide an improved connector member for use with a mating member provided with radial bayonet studs.

According to the invention there is provided a substantially cylindrical connector member for coupling to a mating member, said mating member supporting a first plurality of contacts and having a plurality of external bayonet studs, said connector member including an integral body part of an insulating material, said body part including a first region of substantially solid cross section adjacent to a second region which has a substantially cylindrical open ended cavity extending to the front of said connector member, said first region having a plurality of axially directed through-holes which support a second plurality of contacts, said contacts extending into said cavity, said body part including an annular recess surrounding said cavity, said annular recess enclosing retention means which engage said bayonet studs and said first

plurality of contacts mating with said second plurality of contacts when said connector member is coupled to said mating member.

An embodiment of the invention will now be described, by way of example, and with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a connector member according to one example of the invention shown partially cut away and an associated standard bayonet receptor member;

Figure 2 is a perspective view of the connector member assembled to the associated bayonet receptor member;

Figure 3 is a front end view of the bayonet receptor member;

Figure 4 is a diametric section of the connector member;

Figure 5 is a plan view of a resilient strip prior to forming a circular retaining member;

Figure 6 is a front end view of a circular retaining member formed from said resilient strip;

Figure 7 is a front end view of a first insert.

Figure 8 is a front end view of a second insert through which a multi-core cable and a retaining clip are threaded.

Referring to Figures 1, 2 and 3, a standard bayonet receptacle member 1 has a plurality of female contacts 2, each of which is mounted into an axially directed bore in an insulating part 3 of circular cross section. An outer tubular part 4, which may be metallic, surrounds the insulating part 3 with an annular gap 5 between the members 3 and 4. The female contact connectors are joined to an associated multi-core cable or a number of electrical leads (not shown) in known manner. A plurality, commonly three, of radial studs 6 are provided on the exterior surface of the tubular member 4 to engage with retaining means 7 in the associated connector member 8. One or more axially directed keyways 9 are provided on the interior of the tubular member 4 to engage with one or more alignment splines 10 in the associated connector member to ensure correct rotational alignment of members 1 and 8.

A connector member 8 according to one example of the invention is shown in Figures 1, 2 and 4. An integral body part 11 is formed from an insulating material, preferably a moulded plastics material, for example glass filled nylon. The body part 11 has cylindrical recesses at each ends and an inner region 15 of substantially solid cross section. Axially directed through holes 12 in the region 15 support a number of male contacts 13 with a sliding fit, the contacts 13 extending at each end into the respective cylindrical recesses. An annular cavity 16 in the front region of the body part 11 surrounds the front cylindrical recess 14 such that, when the connector member is joined to a receptor member, the part 3 enters the recess 14 and the part 4 enters the cavity 16, permitting the male contacts 13 to engage with the female contacts 2, one or more alignment splines 10 being provided in the connector body part 11 to engage with mating keyways 9 in the receptor member or vice-versa. Entry slots 17 for the bayonet studs 6 are provided at the front of the body part 11.

The annular cavity 16 has a recessed portion 18 into which a circular resilient retaining member 7 is inserted. The retaining member is a strip of resilient material which may be metallic, for example, spring steel or berillium copper, and may be initially formed as a slotted flat strip, as shown in Figure 5, and then formed to a tubular shape as shown in Figure 6. A number of substantially Y-shaped slots 19 are provided in the strip which align with the entry slots 17. The slots 19 have a tapered entry such that the dimension "A" of Figure 5 is greater than the diameter of a bayonet stud and the dimension "B" is less than the diameter of a bayonet stud. Additional slots 20 are provided to either side of each slot 19 such that their presence, associated with the resilience of the retaining strip material, permits the bayonet studs to pass through the narrow portions B, enabling the connector and receptacle members to be retained with a rapid axial pushing action. Furthermore, the retaining strip may be designed such that the connector and

receptacle members can be parted with an axial pulling force of greater than a pre-determined strength, thereby providing a snatch safety feature. This pre-determined minimum parting force may readily be chosen to be sufficiently large to prevent accidental disconnection during normal usage, while being sufficiently small to permit disconnection rather than damage and possible exposure of live conductors should a cable be accidentally snatched or pulled. The retaining member 7 has one or more keyways 21 which engage with mating protrusions 22 in the body part 11 to ensure that the slots 19 align with the entry slots 17 and the retaining member is prevented from rotation. The dimensions of the body member 11 and of the retaining member 7 are such that, when the connector member and the receptor member are connected, the holes 12 axially align with the female contacts 2, thereby ensuring alignment of the male contacts 13 with the female contacts 2. It will be apparent that the resilient strip 7 and the front member 11 may be mass produced to fine dimensional tolerances at low cost, and the assembly of these two components provide entry guidance and retention means for the bayonet studs while ensuring the alignment of male and female contact members.

Each of the male contacts 13 has a thickened portion 23 which rests in a counterbore in each of the through-holes 12. The male contact portions to the front of the thickened portions are of solid section and are a sliding fit in the bores 12. The contact portions behind the thickened portions are hollow and permit the entry and crimping of bared ends of the cores 24 of a multi-core cable 25. The hollow portions 26 of the male contacts extend into the rear cylindrical recess 27 in the body part 11 and are a sliding fit in through-holes 28 in a first insert 29, the holes 28 aligning with the holes 12 in the front member 11. The first insert 29 is of an insulating material, preferably a moulded plastics material for example a glass filled nylon, and is substantially cup shaped. A second substantially cup shaped insert 30 surrounds the cable 25 and

meets the insert 29 to form a cavity 31 which contains the cable cores 24. The cable is threaded through a bush 32 of for example a rubber or resilient plastics material which is surrounded by a clamp nut 33. The second insert and the clamp nut are again preferably of a moulded plastics material, for example a glass filled nylon. The rear portion of the body part 11 is externally threaded. A resilient washer 34 is positioned inside the clamp nut 33 and behind a widened front portion of the resilient bush such that the clamp nut may be screwed on to the threads of member 11 and when fully tightened, the two inserts and the front portion of the resilient bush are firmly supported within the rear cylindrical recess 27 and the male contacts are firmly supported with first insert 29 pressing against their widened portions. A retaining clip 35 for example a crimped metal clip, is secured around the cable such that the cable is prevented from withdrawing from the bush 32, and the individual cores 24 leading to male contacts are contained within the cavity 31. Provision is made, if required, for a strain cord 36 to be secured to the retaining clip at one end and for a knot or nipple 37 at its other end to be retained in a recess 38 in the first insert, the strain cord passing through a slot, shown at 43 in Figure 7, in to the cavity 31. A strain cord may be used to provide additional protection against strain when using cables with fine cores. Figures 7 and 8 show front end views of the first and second inserts respectively, Figure 8 also showing the cable 25 with retaining clip 35 and strain cord 36. The inserts 29 and 30 each have one or more exterior alignment grooves, 39A, 39B, 40A and 40B, and the mating faces of the inserts have one or more location studs or protrusions 41A, 42A to locate with mating recesses 41B, 42B. The mating faces of the bush 32 and of the second insert 30 are conically tapered to ensure their axial alignment. One or more studs or protrusions (not shown) are provided on the inner surface of the rear cylindrical portion of the body part 11 to provide loosely fitting guidance for the

grooves 39A, 39B, 40A, 40B when the inserts are inserted into the recess 27.

It will be apparent that the component parts of the connector member may be manufactured at low cost by well known production methods. It will also be apparent that the connector member is constructed such that the internal conductors are well protected against strain and substantially shielded from moisture or other hazardous environments. Furthermore, the construction is such that the component parts may be rapidly assembled together in a self-aligning manner, involving the following sequence of operations:

(a) The circular retaining member 7 is inserted into the annular cavity of the front part 11.

(b) The end of the cable 25 is prepared such that the individual cores 24 are suitable exposed with bared ends.

(c) The end of the cable, so prepared, is threaded in sequence through the coupling nut 33, the thrust washer 34, the resilient bush 32 and the retaining clip 35.

(d) The retaining clip is secured to the cable, thereby preventing the cable from withdrawing through the resilient bush. A strain cord 36 is secured to the clip at this time if required.

(e) The cable end is threaded through the second insert 30 and each bared core end 24 is threaded through the appropriate bore 28 in the first insert 11 and into the hollow end of a contact 13.

(f) The core ends 24 are crimped to the male contacts 13.

(g) Contacts 13 are fully pushed into the bores 28 such that their crimped ends are contained within the bores 28. If a strain cord is fitted, the cord is threaded into the slot

42 in the first insert 11 and a knot or nipple 37 in the strain cord is placed in the recess 38.

(h) The first and second inserts are mated together, with studs 40A and 41A entering recesses 40B and 41B respectivly, the two inserts forming a ganged cylindrical assembly into which the cable enters at its rear end and from which male contacts 13 protrude at the front end.

(i) The ganged assembly is inserted into the rear recess 27 of the front part 11 whose internal protrusions loosely enter the slots 39A, 39B, 40A, 40B to approximately align the male contacts 13 with the bores 12 in the front part 11. The inserts are then lightly eased forward until the contacts 13 enter the bores 12.

(j) The clamp nut is screwed to the rear of the front part 11 and tightened. When the clamp nut is fully tightened, the thickened portions 23 of the contacts 13 have entered the counterbores of the bores 12 and the contacts 13 are firmly supported.

It will be apparent that the above sequence of operations may be performed rapidly and requires less manual skill than prior art constructions, since the ganged assembly is self aligning and mechanically protects the cable cores while being inserted.

The above embodiment of the invention has been disclosed by way of example, and alternative embodiments will be apparent to those skilled in the art.

CLAIMS

1. A substantially cylindrical connector member (8) for coupling to a mating member (1), said mating member supporting a first plurality of contacts and having a plurality of external bayonet studs (6), said connector member including an integral body part (11) of an insulating material, said body part including a first region (15) of substantially solid cross section adjacent to a second region which has a substantially cylindrical open ended cavity (14) extending to the front of said connector member, said first region having a plurality of axially directed through-holes which support a second plurality of contacts (13), said contacts extending into said cavity, said body part including an annular recess (16) surrounding said cavity, characterised in that said annular recess encloses retention means (7) which engage said bayonet studs and said first plurality of contacts mate with said second plurality of contacts when said connector member is coupled to said mating member.

2. A connector member according to Claim 1 in which said first plurality comprises a plurality of female contacts and said second plurality comprises a plurality of male contacts.

3. A connector member according to Claims 1 or 2 in which said retention means comprise an integral strip of a resilient material which is formed to fit inside said annular recess, said resilient strip having a number of slots (19) facing the front of said connector member, said slots being positioned such that they will align with said bayonet studs and said mating contacts will align with said contacts when said connector member is coupled to said mating member, each of said slots having a first region of width less than the diameter of its associated bayonet stud in front of a second region of width equal to or greater than said diameter such that the resilience of said material permits said bayonet studs to be pushed through said first regions of said slots into said second regions of said slots,

thereby retaining said connector member and said mating member in a coupled condition such that said members may only be separated by an axial pulling force exceeding a predetermined value.

4. A connector member according to Claim 3 in which said resilient material comprises either spring steel or berillium copper.

5. A connector member according to Claims 3 or 4 in which said slots are substantially Y-shaped.

6. A connector member according to Claim 5 in which each substantially Y-shaped slot lies between two substantially straight slots (20).

7. A connector member according to any preceding claim in which said integral body part includes a third region (27) which is substantially tubular shaped extending to the rear of said connector member, said contacts extending into said third region such that their ends may be joined to the cores (24) of a multi-core cable (25) within said third region.

8. A connector member according to Claim 7 in which said third region of said body part encloses an insert (29) of insulating material having a plurality of axially directed through holes (28) which align with said through holes in said first region of said body part, said contacts having a first portion forwardly extending with a sliding fit into said through holes in said body part and a second portion (26) rearwardly extending with a sliding fit into said through holes in said insert, said contacts having a thickened third position (23) between said first and second portions such that when said insert is fully pushed forward within said third region, said contacts are prevented from axial movement.

9. A connector member according to Claim 8 in which said insert is a substantially cup shaped first insert, said insert facing a second substantially cup shaped insert (30) to form a hollow substantially cylindrical body, said second insert having an axial hole through which said multi-core cable may be

threaded such that in the assembled connector member the core leads (24) are contained within said hollow body.

10. A connector member according to Claim 9 in which said inserts have mating faces provided with one or more location studs (41A, 42A) and recesses (41B, 42B) and external surfaces having one or more longitudinal grooves (39A, 30B, 40A, 40B) which align with one or more internal protrusions provided on the inner surface of said third region (27) of said body part such that said connector member may be assembled in a sequence of steps which include preparing a multi-core cable with exposed core ends, threading said cable through said second insert, threading said core ends through holes in said first insert, joining each of said core ends to a contact, drawing back each of said core ends with the second portion (26) of its associated contact into its associated through hole, mating together said first and second inserts to form a ganged assembly, and easing said ganged assembly into said body member such that said internal protrusions engage said longitudinal grooves and the first portions of said contacts enter said through holes in said body member.

11. A connector member according to Claims 9 or 10 including clamp nut (33) encircling said cable, said clamp nut screwing on to an external screw thread on said third portion of said body part, said clamp nut having an internal face which bears on a resilient member (34), said resilient member transmitting a forward pressure on said second and first inserts as said clamp nut is tightened.

12. A connector member according to Claim 11 including a resilient bush (32) encircling said cable between said cable and said clamp nut, said resilient bush having a widened portion located inside said third region of said body part, said widened portion lying between said second insert and said internal face of said clamp nut such that said widened portion is compressed as said clamp nut is tightened.

13. A connector member according to Claim 12 in which

adjacent faces of said second insert and of said widened portion are both conically tapered.

14. A connector member according to either of Claims 12 or 13 in which said resilient bush is comprised of a moulded rubber or of a resilient plastics material.

15. A connector member according to any one of Claims 12 to 14 in which a retaining clip (35) is fastened to said cable within said connector such that said cable may not be readily withdrawn through said resilient bush.

16. A connector member according to Claim 15 which includes a strain cord (36), said strain cord being joined at one end to said retaining clip, said strain cord having a nipple or a knot (37) at its other end, said nipple or knot being located in a recess (38) in said first insert.

17. A connector member according to any preceding claim in which said insulating material is a moulded plastics material.

18. A connector member according to Claim 17 in which said plastics material is glass filled nylon.

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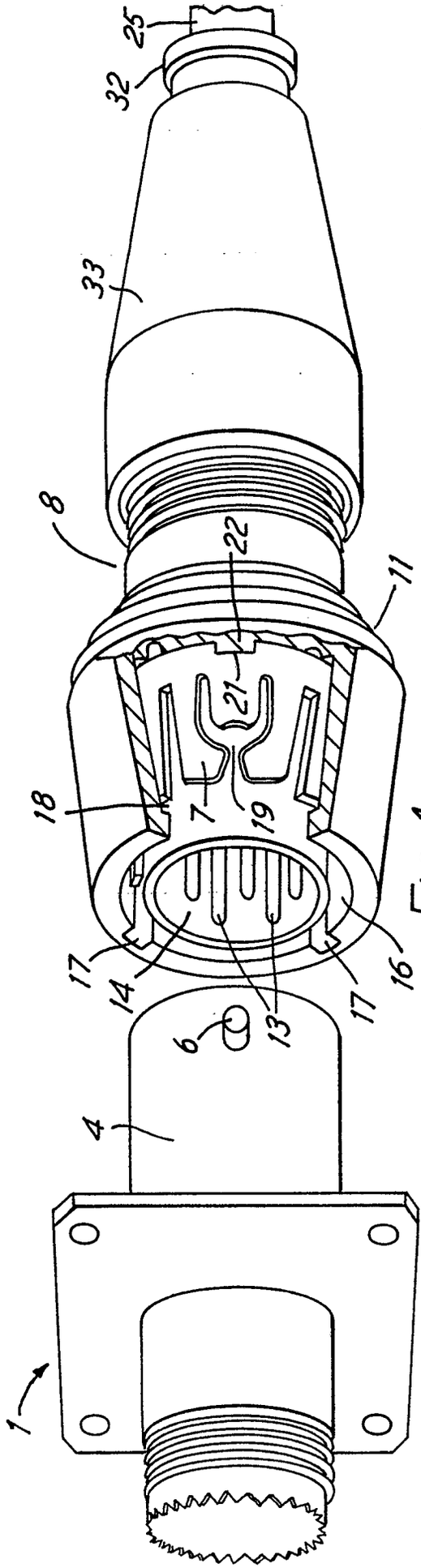

FIG. 1

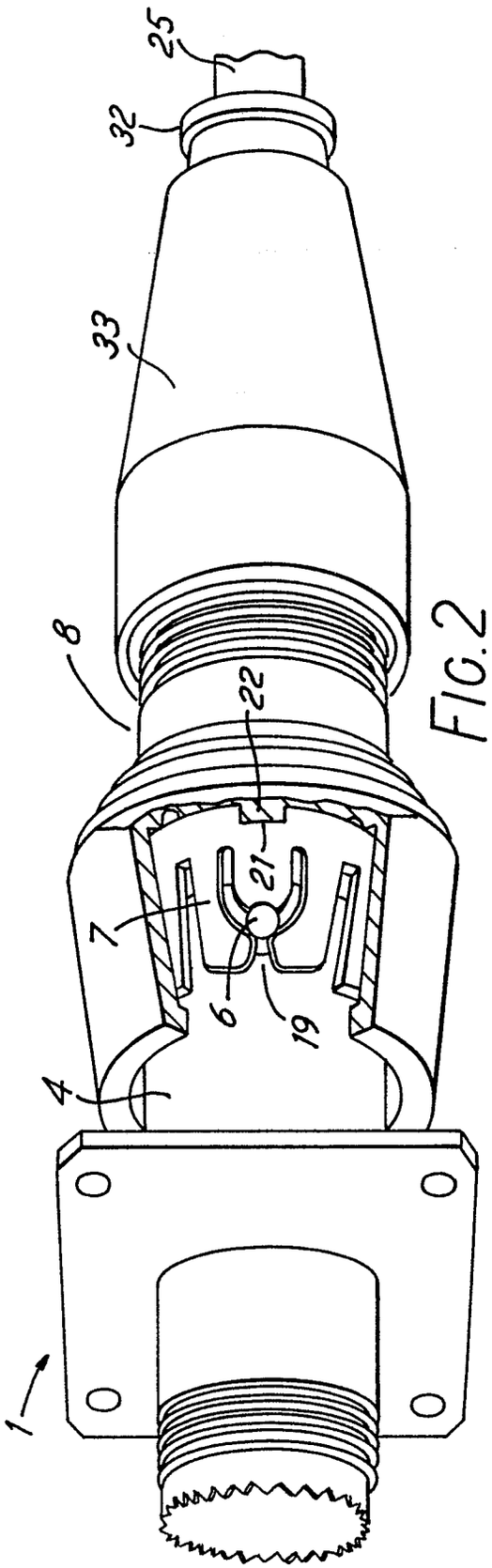

FIG. 2

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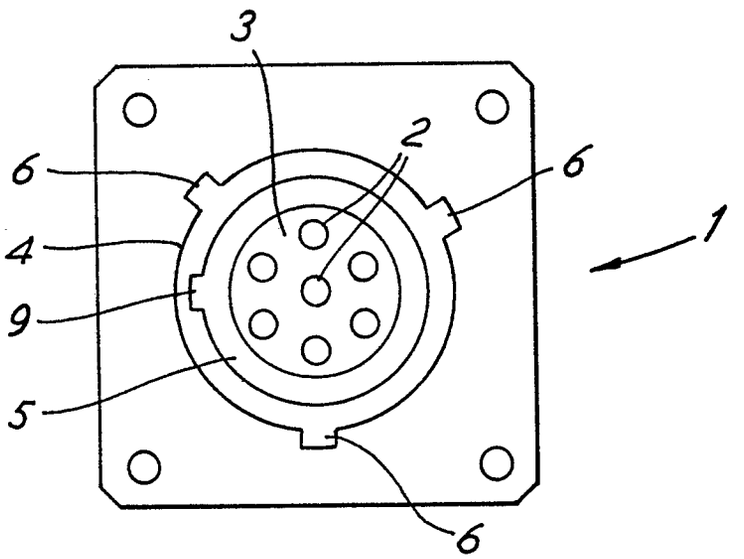

FIG.3

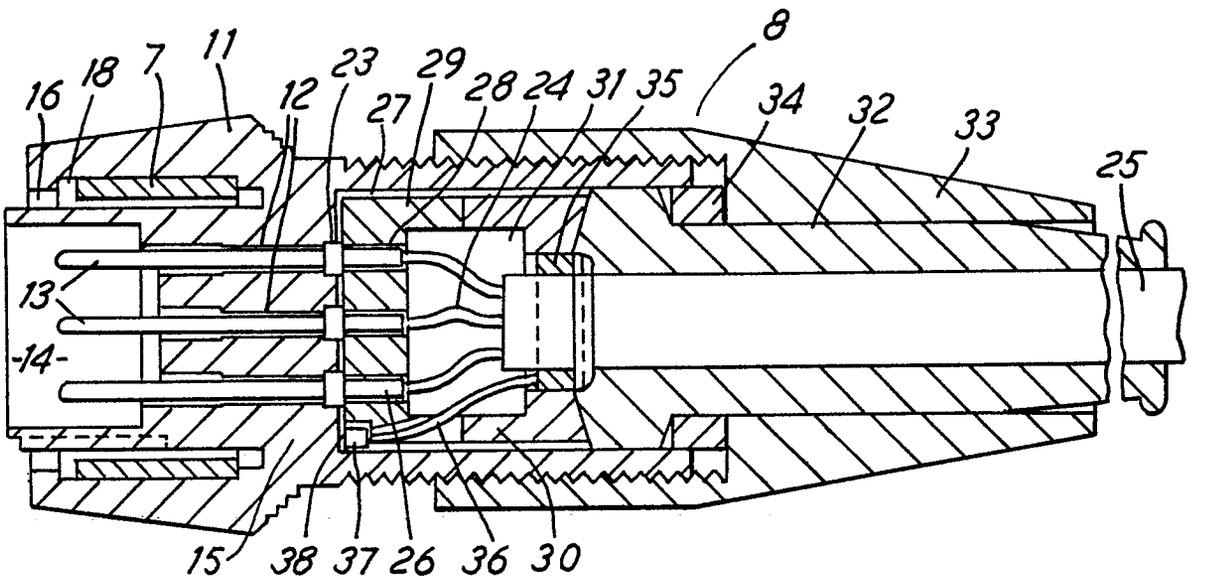

FIG.4

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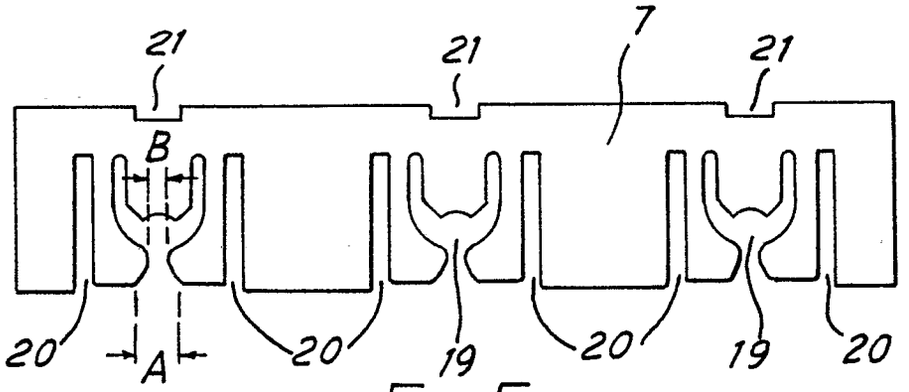

FIG.5

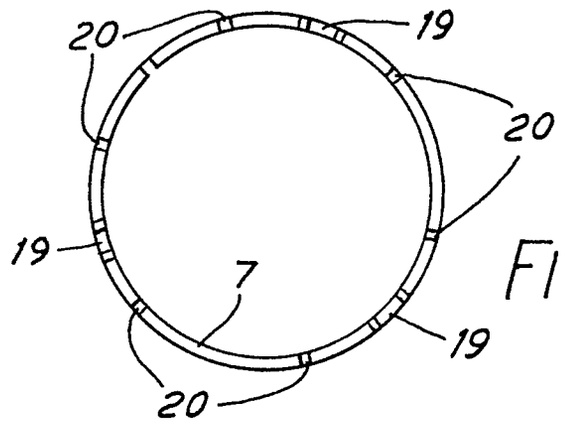

FIG.6

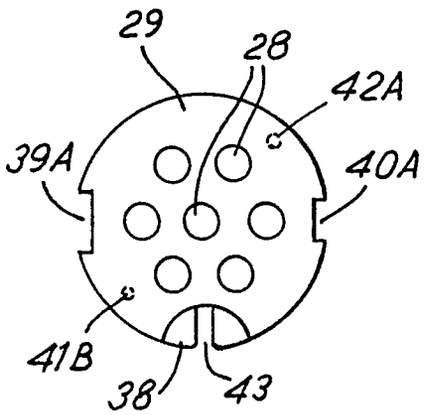

FIG.7

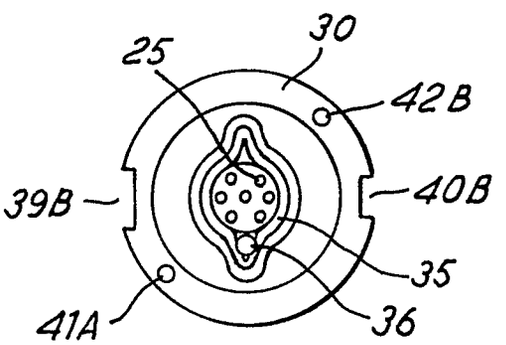

FIG.8