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(54) **Electrical connectors**

(57) A cordless electrical connector part comprises at least one annular slot 6 for receiving an annular contact member 28 and an electrical contact 18 disposed in said slot for making electrical connection with the an-

nular contact member 28. A portion of said annular slot 6 in the vicinity of said contact 18 is provided with restrictions 10 so as to make that portion of the slot 6 locally narrower than the rest of the slot 6.

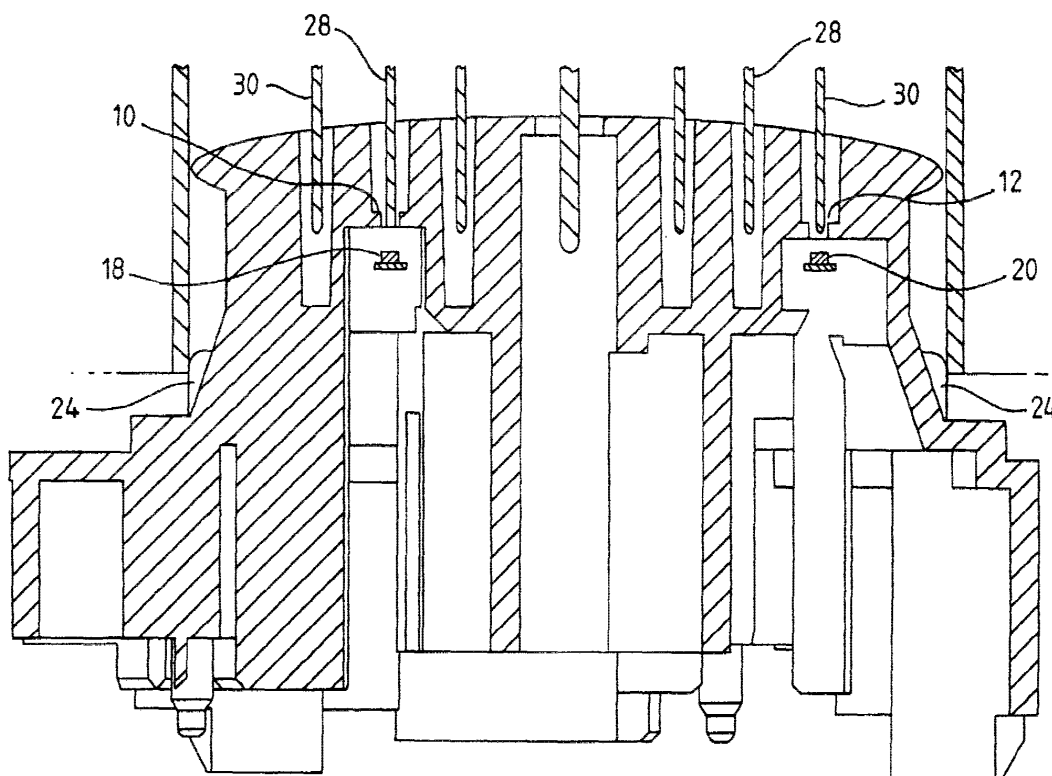


FIG. 6

Description

[0001] This invention relates to electrical connectors, more particularly those of the sort which may be engaged regardless or substantially regardless of their relative angular orientation. It applies particularly, but not exclusively, to such connectors for use in liquid heating vessels.

[0002] So-called 360° connectors have now become well known in kettles and jugs to those skilled in the art. In the most popular form of such connectors, the Strix P72, the cordless appliance has, on its underside, a central line pin and two concentric annular conductors. The smaller diameter conductor is for the neutral component of the mains supply, whilst the outermost one is an earth connection. The corresponding base part of the connector has a central aperture for the line pin surrounded by an annular slot for receiving the neutral ring. Electrical connection is made via sprung contacts inside the base connector part below the aperture and a portion of the annular slot respectively, which are biased against the line pin and neutral ring respectively. The base connector part fits within the outermost earth ring of the appliance connector part and has an outwardly sprung contact on one side for making connection to the inner face of the earth ring. Further details of these connectors is given in WO 95/08204.

[0003] Clearly for such a connection system to be safe, it must not be possible for a user to gain casual access to the live electrical contacts. In the connectors described above this is achieved by making the aperture and annular slot sufficiently narrow to prevent access by even a small child's finger. An international standard accordingly prescribes a maximum width which standard is easily met by the above-mentioned connectors. Although not necessary to meet the safety standards, a further safety criterion is applied to the P72 cordless connector - namely that it should not be possible to insert any item of ordinary household cutlery such as the tip of a knife or the handle of a teaspoon into the aperture or slot to gain access to the contacts. The narrow width and curvature of the annular apertures in the P72 ensure this.

[0004] It has recently been proposed by the applicant, in PCT/GB00/03901, unpublished at the date of this application, to provide a 360° connector with additional annular slots (and corresponding additional annular conductors on the appliance part of the connector) to provide additional poles - e.g. for connecting a pair of thermal sensors in the appliance to an electronic temperature control in the base part. Since the original annular slot is the same diameter as before, the two additional outermost slots are necessarily larger. Their consequently shallower curvature means that although the slots are still sufficiently narrow to satisfy international safety standards, there is a greater chance that they would not pass the additional test outlined above, albeit that the contacts in the outer slots are not at dangerous

mains potential.

[0005] Moreover other examples can be envisaged where it would be desirable to have a similar connection system with larger and thus less curved, annular slots.

[0006] This disadvantage of larger diameter slots could be offset by correspondingly reducing the width of the slot. However this would make it more difficult to mate the two halves of the connector and may increase the chance that the annular conductors in the appliance part are damaged by improper mating.

[0007] The present invention aims to provide such an arrangement with improved resistance to insertion of foreign objects and when viewed from a first aspect provides a cordless electrical connector part comprising at least one annular slot for receiving an annular contact member and an electrical contact disposed in said slot for making electrical connection with said annular contact member in use, wherein a portion of said annular slot in the vicinity of said contact is locally narrower than the rest of the slot.

[0008] It will be seen by those skilled in the art that by narrowing the slot locally in the vicinity of the contact, insertion of a foreign body into the slot such that it may touch the electrical contact therein is made more difficult.

[0009] The narrowing of the slot could be effected at any point along the depth thereof, or could even be throughout the depth of the slot. Preferably however the narrowing is limited in depth and most preferably is set in from the mouth of the slot. This gives the benefit of ensuring that the narrowing does not interfere with the most critical initial mating between the connector parts during use.

[0010] The narrowed portion could take various forms. For example it could be a smooth reduction in the width or a step change. The profile of the narrowed portion could be in the form of a continuous lip. More preferably however it comprises a series of discrete projections e.g. in a castellated arrangement. This is beneficial in that it helps to prevent liquid collecting on the connector by allowing it to drain through. It might even, in some embodiments, give the projections sufficient give to allow a mould tool to be withdrawn past them to facilitate a one-piece moulding. In the preferred embodiment however the projections are formed at the split line between the two halves of the mould tool.

[0011] As mentioned above, the invention is particularly applicable to annular slots of a larger diameter than that presently used for the neutral ring in the P72. However it is not restricted to larger diameter slots. It could also be used for example to allow the width of a smaller slot to be increased where standards permit whilst maintaining the same degree of resistance to penetration by a foreign object in the vicinity of the contact.

[0012] The applicants have further realised that with a connector of increased diameter, percentage manufacturing tolerances will give rise to potentially increased lateral play between the two connector parts, and has

therefore devised means at least partially to alleviate this problem. According to a preferred embodiment therefore, the connector part comprises means on the outer housing thereof for properly laterally locating the corresponding connector part when the two are fully engaged.

[0013] Thus it will be seen that in accordance with this preferred embodiment, freer lateral engagement can be achieved prior to full engagement to assist in the engaging of the two parts, but when they are fully engaged the locating means will serve properly to locate the two connector parts relative to one another by preventing any significant unwanted lateral movement. This is important, *inter alia*, to ensure that the electrical contacts in one connector part maintain good electrical contact with the annular conductors or pins. This is particularly so where the contact is made against the end of the conductors since the contact area will tend to be relatively small.

[0014] In preferred embodiments such location means also acts to provide alignment of the annular conductor on the appliance connector before it encounters the narrowed portion of the annular slot. This is clearly applicable where, as is preferred, the narrowed portion is set in from the mouth of the slot.

[0015] This feature is believed to be novel and inventive in its own right and thus when viewed from a second aspect the invention provides a first cordless electrical connector part for engagement with a corresponding second cordless connector part, said first part comprising means on the outer housing thereof for properly laterally locating the second connector part when the two are fully engaged.

[0016] Preferably the first connector part is provided on the cordless base and the second connector part on the cordless appliance. Preferably the connector parts are of the type which permit engagement irrespective of their relative angular orientation.

[0017] The location means could provide some degree of location from when the two connector parts begin to engage, but preferably it provides location only in the final stages of engagement. An example of a suitable such means is a lip extending around the base of the connector (and therefore which will come into contact with the other connector part only as the two parts are brought into full engagement). Preferably however a plurality of circumferentially spaced protrusions, most preferably four, is provided. This will give a slight saving in material costs.

[0018] The locating means preferably has an outer engagement surface substantially parallel to the axis of the connector, i.e. the direction in which the two connector parts are brought together for engagement, but a slight taper is preferred, e.g. 1-2°, so that the thickness of the locating means at the very bottom can be chosen to give a tight location between the connector parts at the fully engaged position, without hampering the final stage of engagement which could otherwise tend to re-

sult in a user failing to engage the parts fully.

[0019] As before, this aspect of the invention is particularly applicable to larger diameter annular cordless connectors but may be applied equally to those of conventional size or even non-360° connectors e.g. having a rectangular shape.

[0020] A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a plan view of the base part of a 360° cordless electrical connector in accordance with the invention;

Fig. 2 is a view of the underside of the connector part of Fig. 1;

Fig. 3 is a cross-section on the line A-A of Fig. 2;

Fig. 4 is a side view of the connector part of Figs. 1 to 3;

Fig. 5 is a cross-section on an axis through two diametrically opposed locators; and

Fig. 6 is a view similar to Fig. 3 showing two connector parts being engaged.

[0021] Turning to Figure 1, there is shown a plan view of the base part of a 360° cordless connector in accordance with the invention. This allows a cordless appliance to be supplied with electrical power regardless of its relative angular orientation. The basic principles of this arrangement are set out in WO 95/08204.

[0022] In common with the connection system disclosed in WO 95/08204, to which reference should be made for further details, the base connector part shown in Fig. 1 has a central aperture 2 to receive the line pin of the corresponding appliance connector part. Although not visible in the accompanying drawings, an earth tab is also provided, projecting from the periphery of the connector part to engage on the inner surface of the outermost earth ring of the appliance connector in exactly the same way as is described in WO 95/08204.

[0023] Outwardly of the central aperture 2 is an annular slot 4 for receiving an annular conductor of the appliance connector part. Two further concentric annular slots 6, 8 are designed to receive two corresponding further annular conductors of the appliance part of the connector (see conductors 28, 30 in Fig. 6).

[0024] Leaf spring contacts provided within the connector part (not shown) make electrical contact in use with the ends of the line pin and the annular conductors respectively (see e.g. contacts 19, 20 in Figs. 3 and 6).

[0025] In the depicted embodiment the outermost annular slot 8 provides connection to the mains neutral pole. This means that it is as spaced as possible from the line aperture 2 which further enhances safety.

[0026] The two additional poles 4, 6 of the connector may, for example, provide electrical connection to a pair of thermal sensors on a thick film heating element in the appliance from an electronic control circuit in the base.

[0027] The two additional annular slots 6, 8 are pro-

vided outwardly of the first annular slot 4 and are therefore greater in diameter with correspondingly lower curvatures. In order to make it more difficult to insert foreign objects into the two outer slots 6, 8 in view of their lower curvature, two series of circumferentially spaced restrictions 10, 12 respectively are provided in the slots 6, 8. This arrangement enhances drainage of spilt water through the connector.

[0028] When viewed from the orientation of Fig. 1, the restrictions 12 provided in the outermost slot 8 are substantially at the top of the slot, whilst the restrictions 10 in the next slot in 6, are at the bottom of the slot. The reason for these locations is that they are the portions of the respective slots 6, 8 in which the leaf spring contacts are provided.

[0029] Although the leaf springs have been omitted from the underside view in Fig. 2 the mounting location 14 for the outermost slot contact and the mounting location 16 for the contact for next most outward slot 6 may be clearly seen. These mounting locations 14, 16 are positioned so that, when installed, the leaf spring contacts will be beneath the respective restrictions 10, 12 in the slots 6, 8.

[0030] This arrangement is shown more clearly in the cross-section of Fig. 3. From this the ends of the leaf spring contacts 18, 20 may clearly be seen in the two outermost annular slots 6, 8 respectively. Furthermore restrictions 10, 12 are provided in the annular slots 6, 8 in the region of these contacts. Thus additional protection against insertion of foreign objects is provided where it is required most - i.e. to prevent the foreign object from being able to touch the electrical contacts 18, 20.

[0031] It will be seen from Fig. 3 that even when the intended annular conductors are inserted into the annular slots 6, 8, when the ends of the conductors reach the restrictions 10, 12 there will only be a small range of angles from the vertical that will allow the conductors to be inserted past the restrictions 10, 12.

[0032] In order to prevent any problems with the ends of annular conductors in the appliance connector part catching or sticking on the restrictions 10, 12, a series of four circumferentially locators 22 is provided around the base of the upwardly projecting portion 24 of the connector part. This may be seen in the side and cross-sectional views respectively of Figs. 4 and 5. The locators 22 take the form of projections both horizontally and vertically from the sloping surface of the base of the upwardly projecting portion 24 of the connector part. As may be seen most clearly from Fig. 5, the outward facing surfaces 22a of the locators 22 are in fact inclined by an angle of approximately 1-2° from the vertical towards the central axis of the connector part. It can also be seen that the horizontal edges of the locators 22 are rounded.

[0033] In use the appliance connector part, comprising an outer earth skirt within which are three concentric annular conductor and a central pin, is brought towards the base connector part shown in the drawings. First

contact is made between the two connector parts when the outer earth skirt contacts the rounded upper edge 26 of the base connector part. The shape of the edge 26 allows the appliance connector to be 'rolled' into proper alignment with the base connector part. The annular conductors and central pin of the appliance connector then begin to enter the corresponding apertures 2 to 8 in the base part.

[0034] As the two connector parts are brought closer into engagement, the outer earth skirt will engage the outer facing surfaces 26a of the four locators 26. This is shown in Fig. 6. The locators substantially reduce any lateral play between the two connector parts and ensure that the two outermost annular conductors 28, 30 are able to pass cleanly through the restrictions 10, 12 in the annular slots 6, 8 to make contact with the spring leaf contacts 18, 20. The slight bevel on the locators 26 allows the finally engaged position to be tight whilst avoiding catching during engagement.

[0035] Apart from any benefit in guiding the annular conductors through the restrictions in the annular slots, the four locators 22 ensure that, when fully engaged, the two connector parts are a tight fit. This is despite the fact that their relatively larger size could otherwise mean relatively more lateral play due to manufacturing tolerances.

[0036] Thus it will be seen that the described embodiment provides a multi-pole 360° connector which allows easy initial engagement and a firm positive final engagement. Furthermore, access to the electrical contacts within the base connector by a foreign object - e.g. the handle of a teaspoon - is prevented: by the tight curvature of the inner apertures 2, 4; and by a combination of curvature and width restrictions 10, 12 in the outer slots 6, 8.

Claims

1. A cordless electrical connector part comprising at least one annular slot for receiving an annular contact member and an electrical contact disposed in said slot for making electrical connection with said annular contact member in use, wherein a portion of said annular slot in the vicinity of said contact is locally narrower than the rest of the slot.
2. A connector part as claimed in claim 1 wherein the narrowing of the slot is limited in depth.
3. A connector part as claimed in claim 2 wherein said narrowing is set in from the mouth of the slot.
4. A connector part as claimed in claim 1, 2 or 3 wherein the narrower portion of the slot comprises a series of discrete projections.
5. A connector part as claimed in any preceding claim

comprising means on the outer housing thereof for properly laterally locating the corresponding connector part when the two are fully engaged.

6. A connector part as claimed in claim 5 wherein said location means also acts to provide alignment of the annular conductor on the appliance connector before it encounters the narrowed portion of the annular slot. 5
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7. A first cordless electrical connector part for engagement with a corresponding second cordless connector part, said first part comprising means on the outer housing thereof for properly laterally locating the second connector part when the two are fully engaged. 15
8. A connector part as claimed in claim 7 wherein the first connector part is provided on the cordless base and the second connector part is provided on a cordless appliance. 20
9. A connector part as claimed in claim 7 or 8 wherein the connector parts are of the type which permit engagement irrespective of their relative angular orientation. 25
10. A connector part as claimed in any of claims 5 to 9 wherein said location means provides location only in the final stages of engagement. 30
11. A connector part as claimed in any of claims 5 to 10 wherein said location means comprises a plurality of circumferentially spaced protrusions. 35
12. A connector part as claimed in any of claims 5 to 11 wherein said locating means has an substantially parallel to the axis of the connector. 40
13. A connector part as claimed in claim 12 wherein said outer engagement surface has a slight taper such that the thickness of the locating means at the very bottom is chosen to give a tight location between the connector parts at the fully engaged position, without hampering the final stage of engagement. 45

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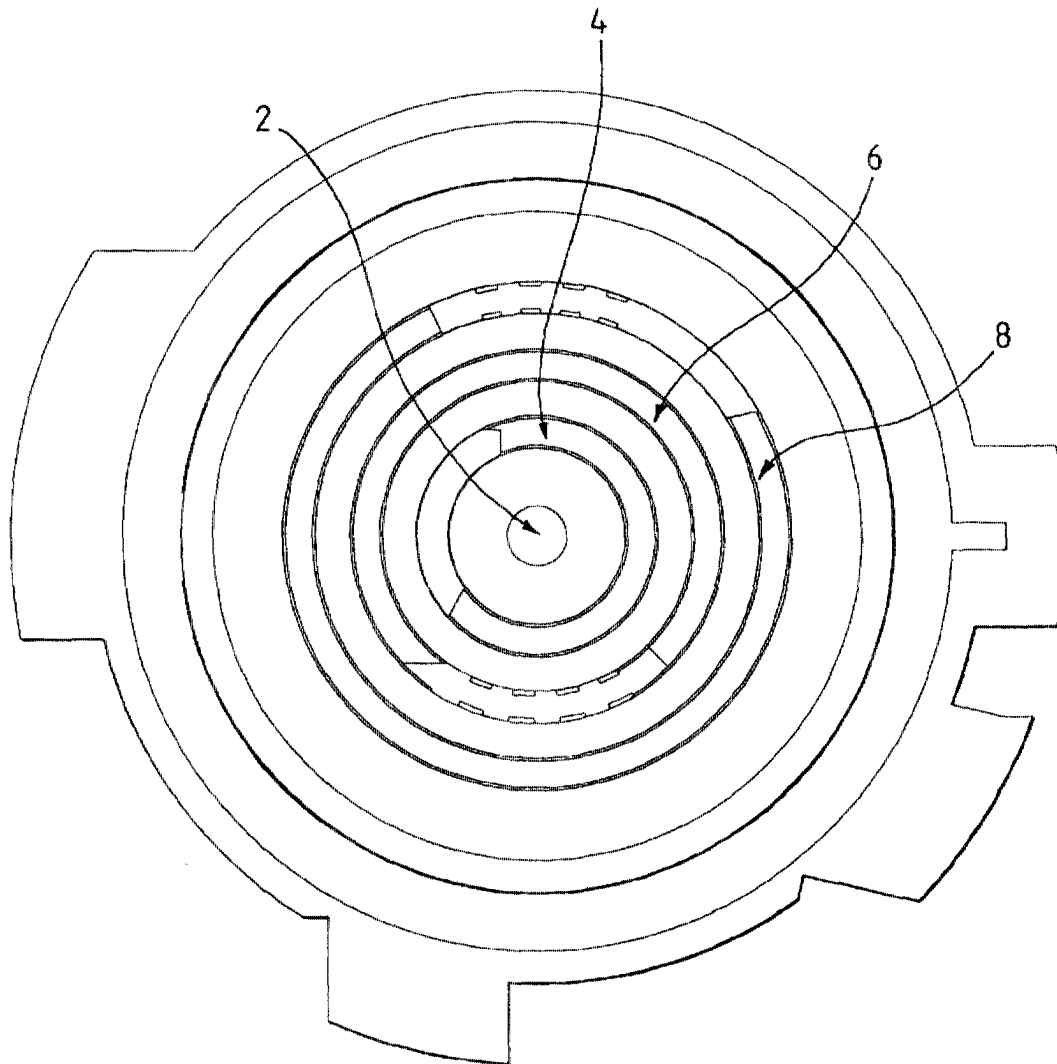


FIG. 1

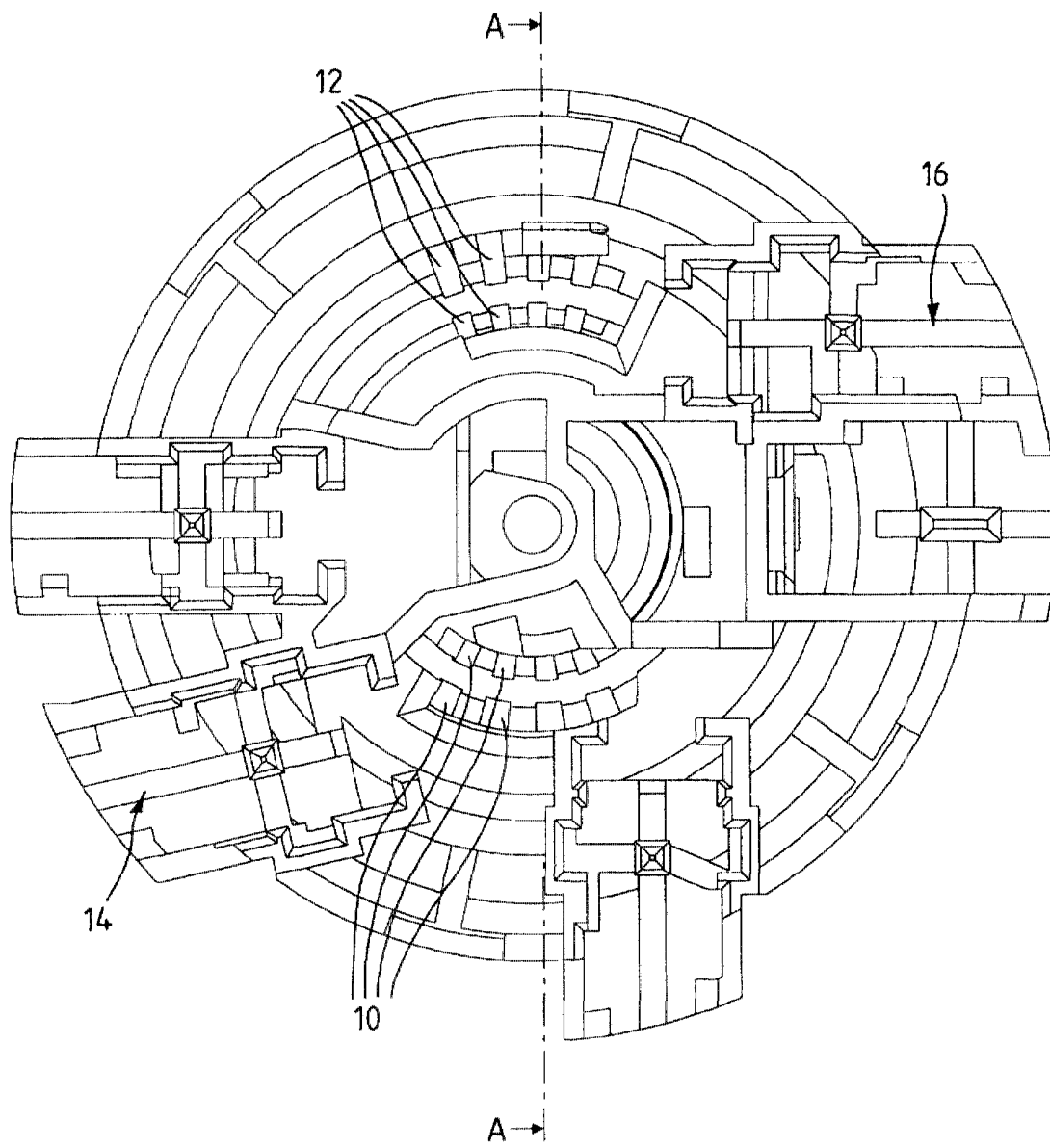


FIG. 2

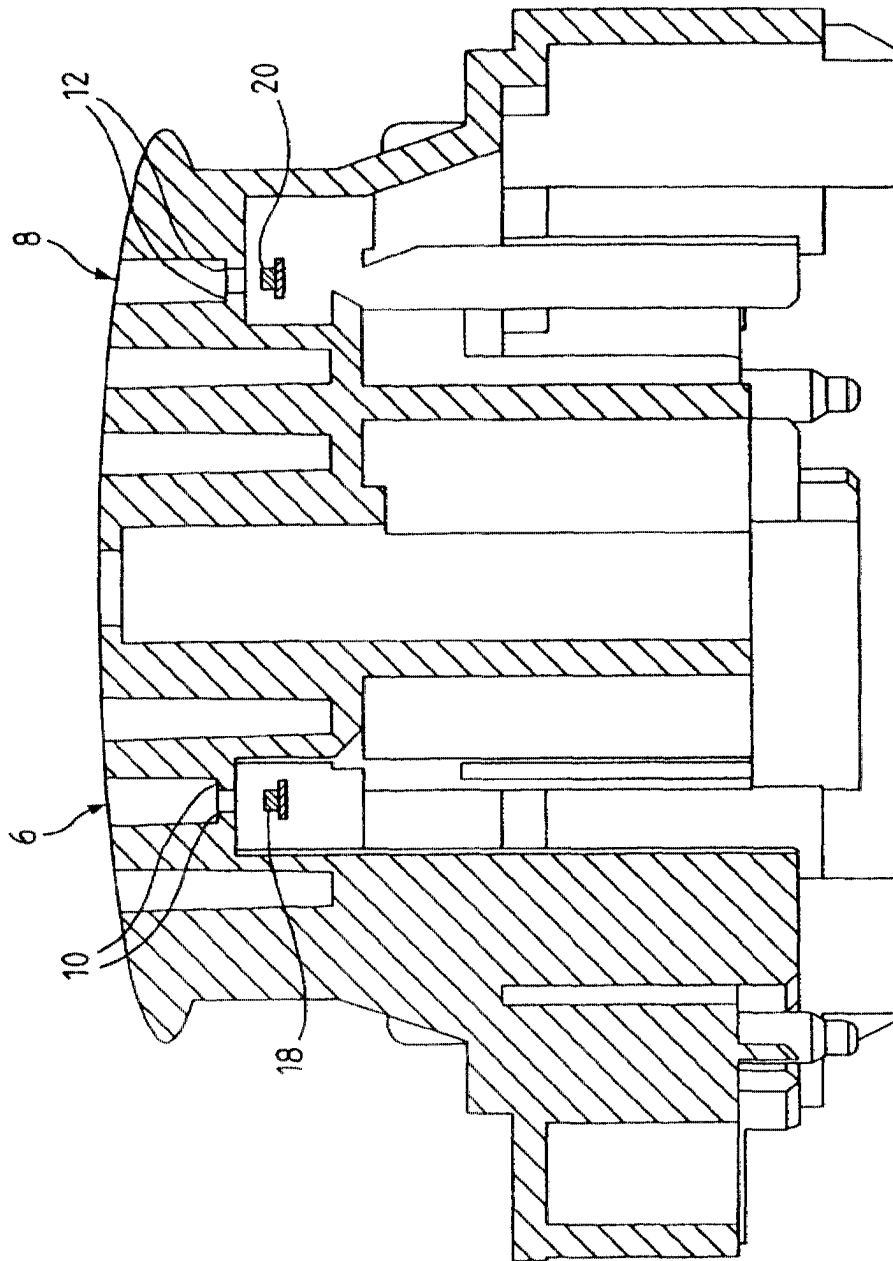


FIG. 3

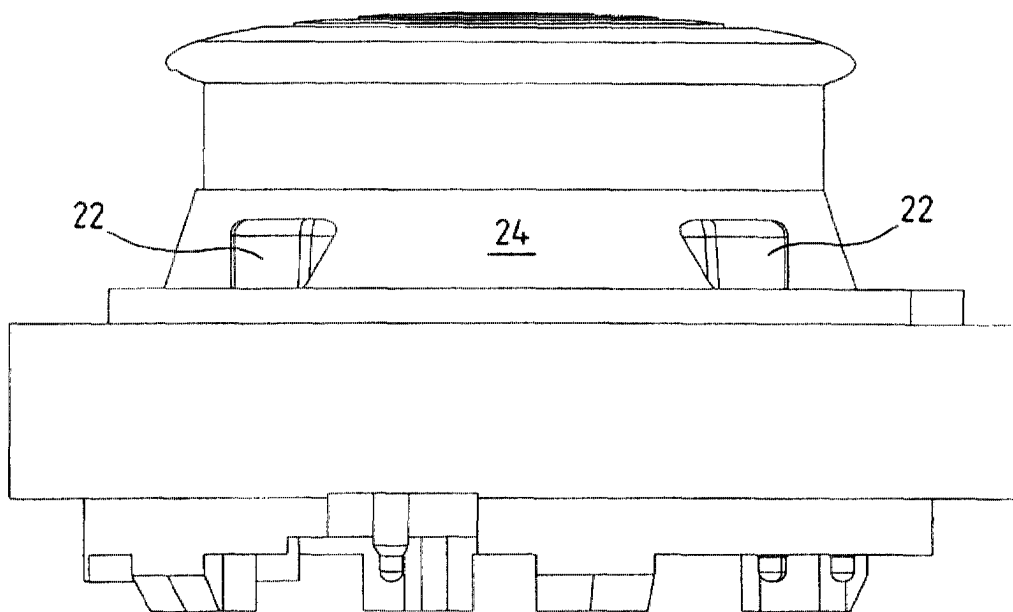


FIG. 4

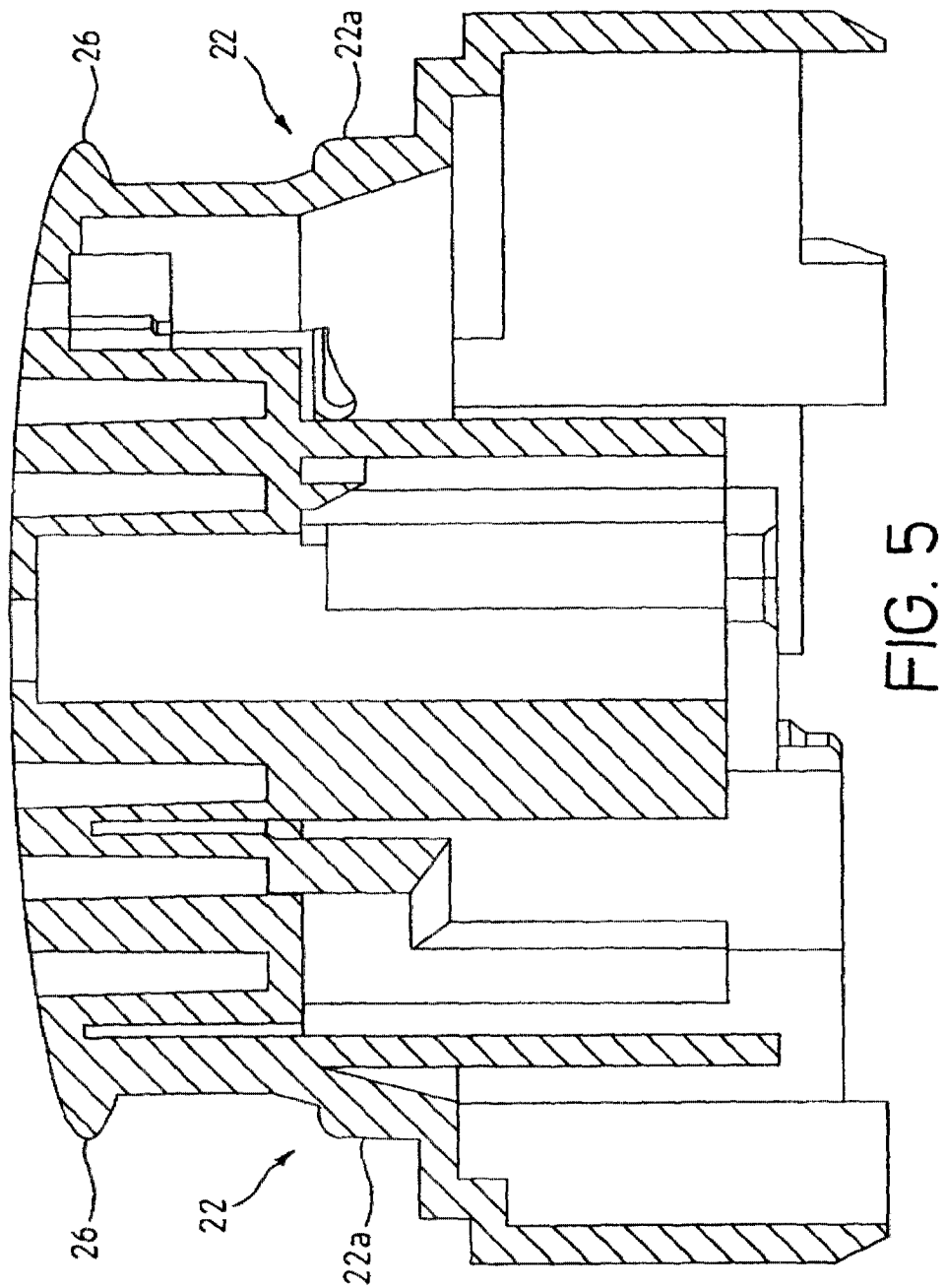


FIG. 5

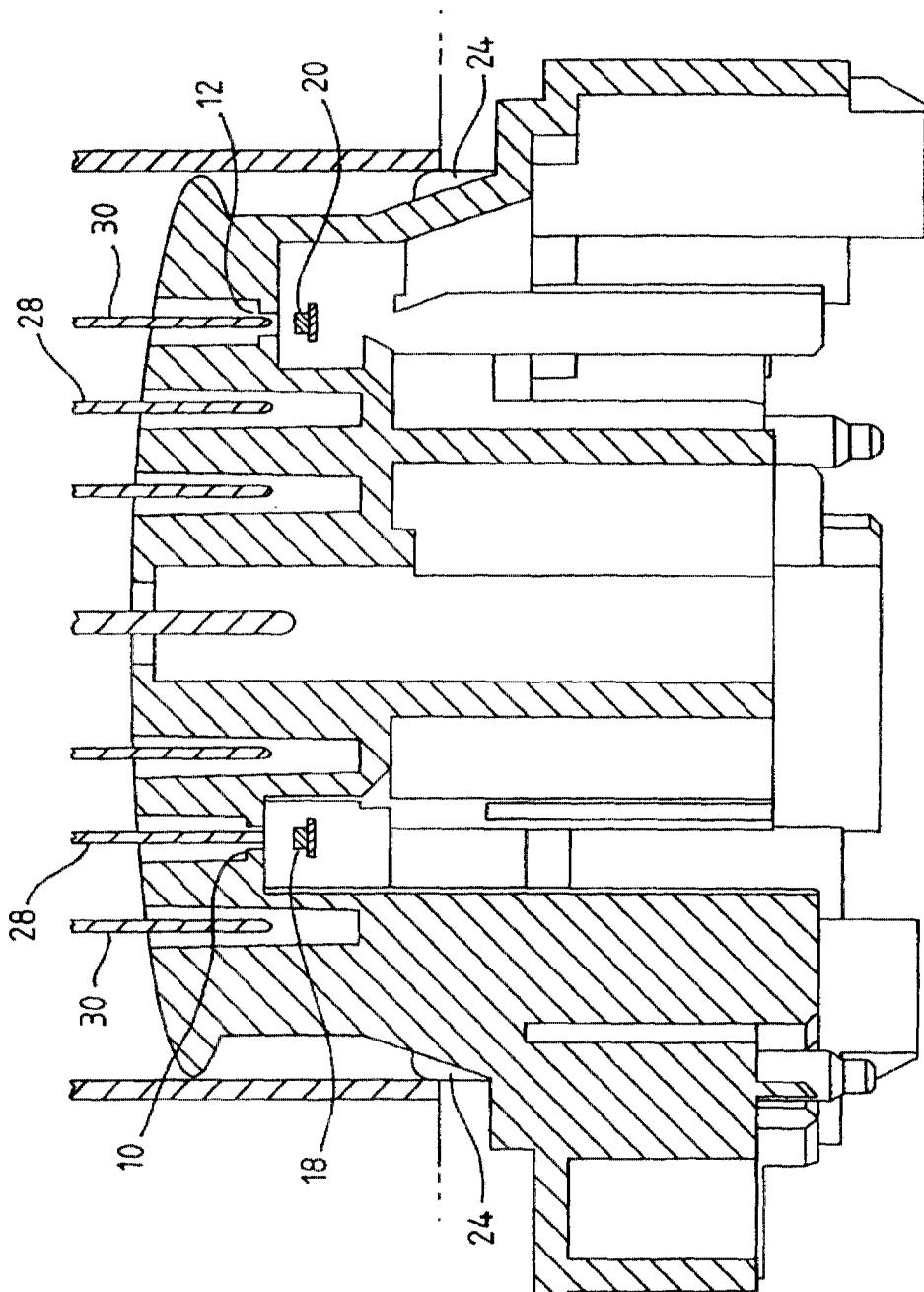


FIG. 6