United States Patent

[11] 3,622,940

[72] Inventor **Reinhold Illies**
Wurselen, Germany

[21] Appl. No. **887,111**
[22] Filed **Dec. 22, 1969**
[45] Patented **Nov. 23, 1971**
[73] Assignee **Firma Neidecker & Co.**
Basel, Switzerland
[32] Priority **Dec. 21, 1968**
[33] **Germany**
[31] **P 18 16 467.5**

[54] **CONNECTOR ASSEMBLY FOR ELECTRICAL APPARATUS**
8 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **339/94 R**
[51] **Int. Cl.** **H01r 13/52**
[50] **Field of Search** 339/59–61, 92, 94, 143, 177

[56] **References Cited**

UNITED STATES PATENTS

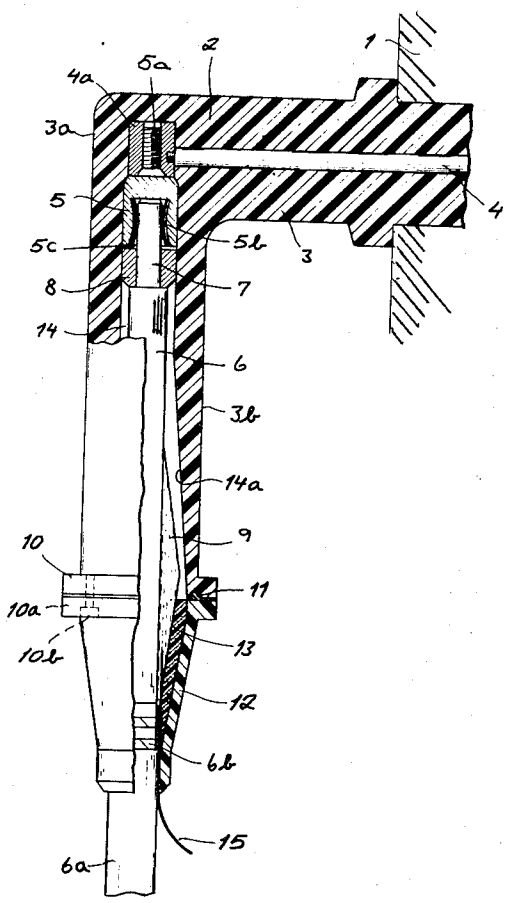
2,273,538	2/1942	Rogers	339/143
3,146,301	8/1964	Logan	339/143 S
3,466,593	9/1969	Arndt et al.	339/61 R
3,474,386	10/1969	Link	339/60 R

FOREIGN PATENTS

900,277	7/1962	Great Britain	339/177 R

Primary Examiner—Joseph H. McGlynn
Attorney—Karl F. Ross

ABSTRACT: An angle connector for high-voltage rotary-field (three-phase) transformers in which a cast synthetic resin jack body is received in the transformer housing and forms at its end remote therefrom a socket extending at right angles to a bolt, pin or rod to which the socket is affixed, both socket and rod being imbedded in the insulating composition. A plug is fitted into the socket and is potted in a frustoconical sleeve which is flanged to a sleeve of the jack body.



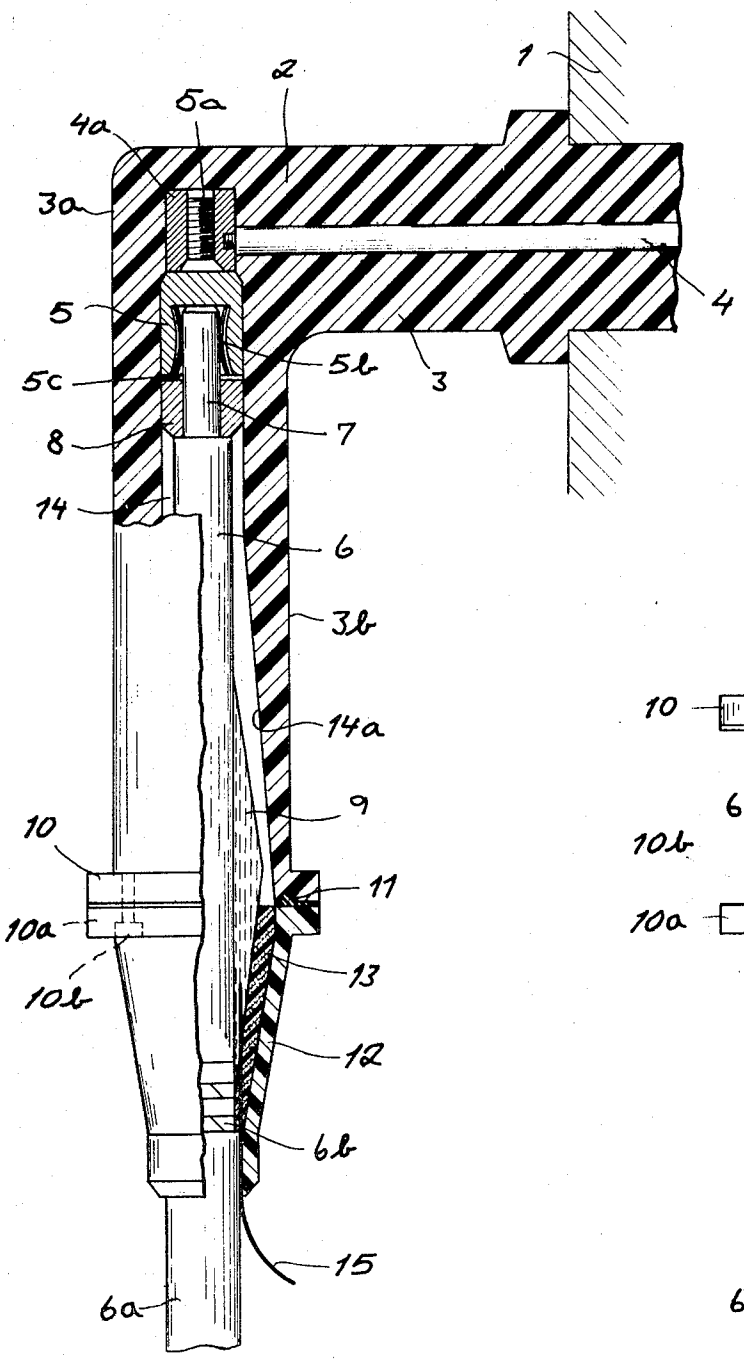


FIG. 1

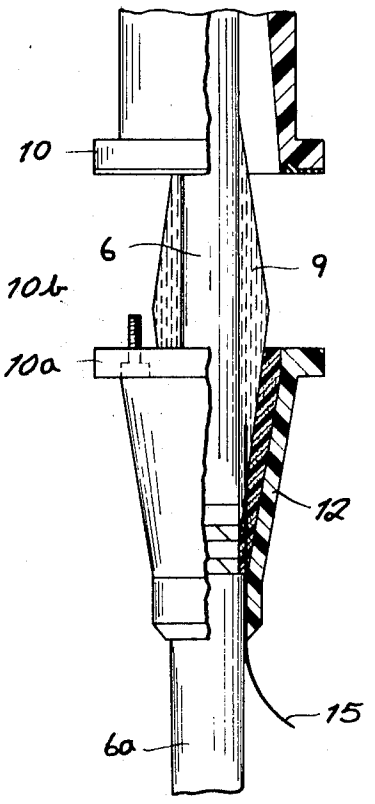


FIG. 1A

INVENTOR:
Reinhold Illies

BY

Karl G. Ross
Attorney

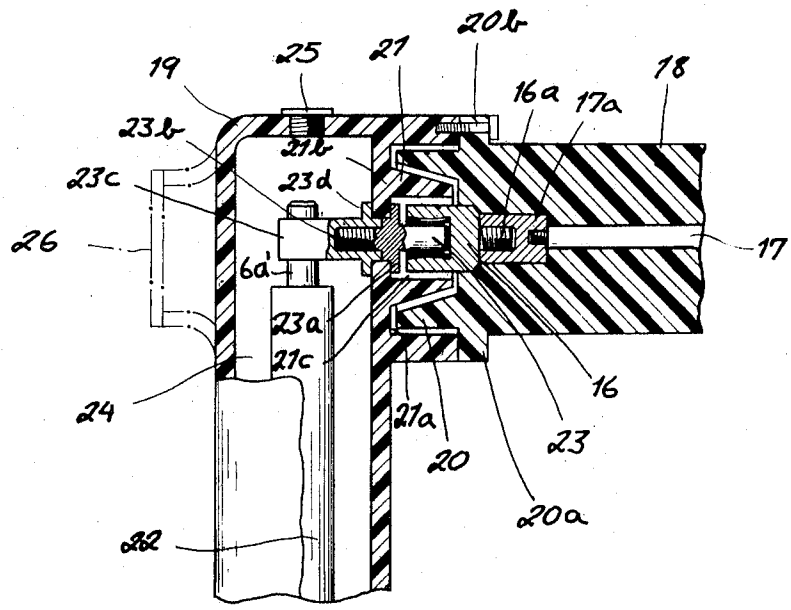


FIG. 2

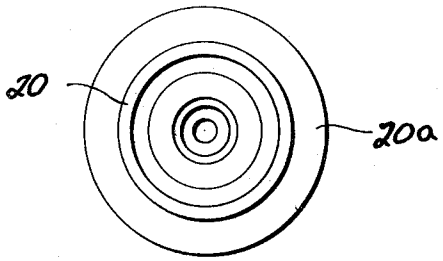


FIG. 2A

Reinhold Illies
INVENTOR.

BY

Karl F. Ross
Attorney.

CONNECTOR ASSEMBLY FOR ELECTRICAL APPARATUS

FIELD OF THE INVENTION

The present invention relates to electrical connectors and, more particularly, to plug-and-jack connectors for high-voltage electrical equipment, especially high-voltage rotary-field 3 phase transformers.

BACKGROUND OF THE INVENTION

While a wide variety of plug-and-jack connectors is known for electrical systems, the field of high-voltage connectors is more or less limited to rather massive insulated structures capable of withstanding the severe electrical and mechanical stress to which such connectors are subjected. In fact, it is not common practice to provide plug-and-jack connectors for high-voltage transformers and the like because of the inability of prior art connectors of this type to withstand the tendency toward breakdown at elevated electrical potentials, attack by the insulating media (transformer oils and chlorinated aromatic carbons), and thermal stresses arising as a result of heat generated at the connection or within the apparatus.

It has also been proposed to provide plug-and-jack connectors for rotary-field high-voltage transformer and in which the jack body has a right-angle or L-shaped configuration affording an inner chamber and/or passage through which air can flow. The plug member of this type forms a junction with the end of the electrical conductor or cable and the space around the cable plug and the inserted cable end is filled with a liquid insulating material, e.g., transformer oil or the chlorinated aromatic hydrocarbons commonly used to insulate electrical apparatus subject to high-voltage breakdown.

It has, however, been found that considerable difficulty is encountered in such systems because of the problem of sealing the liquid insulating material in the connector. As a result, it has often been necessary to introduce the cable from above and this effort to prevent leakage of the insulating liquid has often proved ineffective and certainly has limited the ability to use the prior art plug-and-jack connector.

OBJECTS OF THE INVENTION

It is, therefore, the principal object of the present invention to provide an improved plug-and-jack connector for electrical apparatus wherein the aforedescribed disadvantages can be obviated.

It is another object of the invention to provide an improved angle connector for electrical apparatus which is capable of withstanding electrical, mechanical and thermal stress and which may be used with liquid insulation systems, operating with transformer oil or the like, without unwanted leakage.

Still another object of the invention is the provision of an improved but simplified and relatively inexpensive electrical connector for right-angle junctions between an electrical cable and a high-voltage rotary-field transformer

SUMMARY OF THE INVENTION

These objects, and others which will become apparent hereinafter, are attained in a plug-and-jack connector for high-voltage rotary-field transformers, which comprises a jack or socket member fitted into a wall of the transformer and cast of a low mass (massless or low density) electrically insulating synthetic resin, the jack member preferably extending through the wall of the rotary field transformer in accordance with the practice customary heretofore with such connectors; a longitudinally extending bolt, pin or rod of metal extends through and is imbedded in the body of synthetic resin material and anchors at the free end of the rod remote from the interior of the transformer, a socket member which is also imbedded in the synthetic resin material and is open away from its junction with the rod. This socket may be of the multicontact type described in the commonly owned U.S. Pats. No. 3,453,587, No. 3,296,575 or No. 3,214,721 and lies at an angle, preferably a right angle, to this socket.

Removably connectable with the insulating body thereof or integral with this body, there is provided, in accordance with this invention, a sleeve or duct member into which the forwardly projecting end of a plug assembly may be seated with clearance, the tip of the plug assembly being formed with a plug member, complementary to and receivable in the socket member to establish electrical connection. The plug assembly also comprises, in accordance with the invention, a frustoconical sleeve having at its forward end an annular transverse flange which is sealingly bolted to the annular transverse flange at the free end of the aforementioned sleeve, whereby the interior of the latter and the space therein surrounding the cable, is closed. There is also provided an annular compartment converging away from the socket member, between the inner wall of the frustoconical sleeve and the outer wall of the cable, which is filled with an electrically insulating composition which, upon setting, forms a seal for the interior of the connector, thereby permitting the latter to receive transformer oil or some other insulating liquid.

The plug-and-jack connector for electrical apparatus of the present invention thus comprises a jack body which is cast or molded of a synthetic resin having high-voltage breakdown characteristics, suited to the particular installation, and serving to fix a socket member which is imbedded in a head portion of the jack body. Unitarily and monolithically formed with the head of the jack body, is a solid shank portion which is received in and traverses a wall of the electrical apparatus with which the connector is used. A rod passes centrally through this cylindrical shank portion and serves as a terminal for the connector.

In addition, the jack body is provided with a sleeve member which s hollow and likewise is formed of a synthetic resin with high-voltage breakdown characteristics, the sleeve portion being closed at its end proximal to the head portion of the jack body but open at its free end remote therefrom.

The sleeve portion, moreover, is of cylindrical configuration and has its axis extending perpendicularly to the axis of the shank portion, and may be monolithically unitarily with the head portion and removably affixed thereto. In the former case, the socket member which is embedded in the jack body, may open axially along the sleeve portion through which the elongated extension of the plug is designed to lie when the plug member, at the end of the extension, is inserted into the socket member. An open airspace is provided between the extension of the plug, which may be a potted portion of the cable to increase its rigidity.

At the free end of the sleeve portion, moreover, there is provided a closure portion in the form of a frustoconical sleeve which converges away from the open end of the sleeve portion but is connected thereto at a pair of confronting flanges formed respectively on the frustoconical sleeve and upon the free end of the sleeve portion of the jack body. A sealant of the castable type, e.g., a foamed elastomeric cellular polyurethane composition, may be cast in the space between the inner wall of the frustoconical member and the portion of the cable and/or plug assembly received in this frustoconical sleeve.

The external surfaces of the jack the and the sleeve portion are advantageously metallized and, when the sleeve portion is removably received in the heat portion of the jack body, there are provided mating coaxial formations, preferably surrounding the socket member and converging in the direction of insertion of the plug, to center the assembly. In this case the plug member may be formed in the wall of the sleeve portion which is to be fixed to the head of the jack body.

The aforedescribed system, according to the invention, makes use of a lightweight, low-mass solid body of cast synthetic resin and a relatively dense but small socket member and connecting rod. It has the important advantage that the connector may be used at practically any angle (i.e., with the plug extending in substantially any direction from the axis of the shank) since the shank is anchored in the wall of the transformer and the orientation is not material. Moreover, the connector may be disposed substantially anywhere on the trans-

former housing and may be made without expensive apparatus to the desired shank lengths depending upon the wall thickness. Moreover, it has been found to the advantageous to constitute the plug assembly as standardized or fixed-configuration members, regardless of the configuration of the jack body with which the plug assembly is to be used. It is only significant that the socket member embedded in the jack body be standardized to correspond to the plug members. Furthermore, with relatively simple mold arrangements, the jack body may be cast in place on the wall of the transformer.

The jack body, according to this invention, may be provided with an opening in the direction of the axis of its shank portion to accommodate a preformed or standard plug inserted in the axial direction or plug members specially designed or adapted to fit the socket member at the open end of the head of the jack body. In this case, the socket member has its mouth open along the axis of the shank portion, perpendicular to the wall in which the jack body is mounted.

Preferably, however, the jack portion is used with a sleeve portion of the aforedescribed type wherein, at its closed end, the sleeve portion carrying a plug which is received in the socket member and interfits with the head of the jack body so as to constitute a right-angle extension thereof. The first type of connection is most common when the cable is a synthetic resin-covered cable and is relatively flexible, whereas the second type may be used when the cable is less flexible and is a paper-composition impregnated insulation cable. Such cables are sensitive to dislocation by bending and are anchored to the fixedly positioned plug at the end of the sleeve portion and may be anchored to the open end of the latter as well by the closure member previously described.

DESCRIPTION OF THE DRAWING

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. **1** is a fragmentary vertical section, partly in elevation, of an electrical connector embodying the invention;

FIG. **1A** is a view similar to FIG. **1** of a detail, showing the plug assembly partly removed;

FIG. **2** is a view similar to FIG. **1** of a portion of another embodiment of the invention; and

FIG. **2A** is an end view of the jack body after removal of the sleeve portion thereof.

SPECIFIC DESCRIPTION

In FIG. **1**, there is shown the wall **1** of a transformer of the rotary-field or three-phase type which is filled with transformer or insulating oil and is provided with the connecting assembly of the present invention. It will be understood that three connectors of the type illustrated in FIG. **1** are commonly used.

The connector comprises a jack body **2** monolithically cast from an epoxy resin having high-voltage breakdown characteristics and comprising a cylindrical shank portion **3** in which the connecting rod **4** is embedded axially. The rod terminates at the head **3***a* of the jack body in an internally threaded sleeve **4***a* into which the threaded projection **5***a* of a socket member **5** is screwed. The socket member **5** is likewise embedded in the synthetic resin material of the jack body. The inner cavity **5***b* of the socket member, whose outwardly flared mouth **5***c* opens along the plug axis perpendicular to the axis of the rod **4**, is formed with spring layers or elements of the multicontact type described and claimed in the above-identified patents.

The head **3***a* of the jack body is located externally of the transformer and the socket member **5** is spaced outwardly of the wall thereof. The body **2**, **3**, **3***a* may, of course, be cast in place of preformed to correspond to the requirements of the particular transformer and thus may vary from transformer to transformer according to the physical and electrical requirements. However, the multicontact socket member **5** may be a standardized unit as illustrated also in FIG, **2**, and will accommodate standardized plugs or adapters provided with standard fittings cooperating with the socket member.

From the head **3***a*, a sleeve portion **3***b* extends at right angles to the rod **4** and terminates in an annular transverse flange **10** at the open end of this sleeve portion. It has been found to be desirable to design the sleeve portion **3***b* so as to provide a cylindrical annular space **14** around the plug **6** close to the socket member **5**, the chamber widening outwardly at **14***a* away from this cylindrical portion. The plug assembly is shown to comprise a cable **6***a* which is clamped at **6***b* in the plug member **6**, the tip **7** of which is receivable in the Multicontact socket member **5**. A centering member is provided at **8** to guide the plug, while a cone **9**(e.g. of sintered iron) surrounds the plug **6** to control the electrical field in the usual manner. A ground lead **15** is shown to emerge from the assembly.

A sealing ring **11** is clamped between the flange **10** and the confronting flange **10***a* of a frustoconical closure **12** which converges away from the socket and has the space between the jack and the inner wall of this closure filled with a cast synthetic resin material which, upon the setting, seals the closure member **12** to the plug and enables the closure member and plug to be removed together. Screws **10***b* secure the closure member to the sleeve portion **3***b*. The sealing mass is preferably an elastomeric cellular synthetic resin such as a foamed polyurethane. It will be understood that the connector illustrated in FIGS. **1** and **1A** is independent of orientation of structure so that it may be positioned in any direction upon the outer wall of the apparatus. Consequently, the dimensions of the connector can be selected in accordance with optimum positioning and orientation requirements.

Whereas the system illustrated in FIGS. **1** and **1A** is designed primarily for so-called plastic insulated cables, the system of FIGS. **2** and **2A** is primarily designed for use with impregnated-insulation cables which are much more sensitive to bending and distortion.

In this embodiment the shank portion **18** the jack body is cast of an epoxy resin having a high-voltage breakdown characteristic and embed the connector rod **17** and the internally threaded sleeve **17***a* which is affixed thereto.

The standardized Multicontact socket **16** has its shank **16***a* threaded into the sleeve **15***a* and is also embedded in the lightweight mass **18** of insulating, hardenable casting material. The flange of the head of the jack body is formed by an annular flange **20***a* at the base of an externally cylindrical, but inwardly frustoconical formation **20** which converges in the direction of the axis of the jack body in the direction in which the plug member **23** is inserted. The mating formations of the sleeve portion **19** are illustrated at **21** and **21***a* and consist, respectively of a frustoconical boss **21** rising from the wall **21***b* of the sleeve portion **19**, and a frustoconical recess **21***a* complementary to the formation **20**. A bayonet coupling or screw arrangement may be provided to connect the sleeve portion to the cast body **18** as shown at **20***b*.

In the recess **21***c* enclosing the projecting end of the socket member **16**, there is provided a plug **23** whose flange **23***a* is seated against the right-hand side of the wall **21***b* and is threaded at **23***b* into a lug **23***c* having a flange **23***d* resting against the inner surface of the wall **21***b*. The conductor **6***a'* of the cable is received in **18** lug **23***c* and may be cast or soldered in place. An characteristic is provided at the upper end of the sleeve **19** and is closed by a plug **25** to enable the space **24** surrounding the electrical plug **22** to be filled with an elastomeric synthetic resin such as the polyurethane used to bond the closure sleeve to the lower portion of the plug as previously described in connection with FIG. **1**. The lower end of the sleeve **19** is provided with a flange and a seal arrangement as illustrated at **10** and **11** in FIG. **1** while the closure configuration may be that shown at **12** in this Figure.

The interfitting formations **20**, **21** form a labyrinth seal at the junction of the plug **23** with the socket member **16**, thereby increasing any conductive path between the exterior and the exposed conductive members and limiting accidental

short-circuiting or leakage from the junction. In place of a synthetic resin mass, the filler for the space **24** can be a breakdown-resistant fluid such as chlorinated aromatic hydrocarbons or transformer oil as used in the transformer. The plug is here represented at **22**. In broken lines at **26**, there is represented a so-called compensating or adapter dome for use when a horizontal plug is to be inserted directly in the socket member **16**.

The system illustrated in FIG. **2** and **2A** has the significant advantage that a relatively short plugging distance is provided, this not being achievable with conventional connectors. After assembly, of course, the members **18** and **19** may be fixed by the screws **20***b*.

I claim:

1. A plug-and-jack connector for electrical apparatus, comprising:

a jack body of electrically insulating material having a shank portion receivable in a wall of said apparatus and a head portion lying externally thereof, said jack body being formed with a socket member embedded in said head portion of said body and a rod connected to said socket member and extending through said shank portion while being embedded in said body; and

a plug body formed with a plug member removably receivable in said socket member and connectable to said jack body, said plug body being formed with an electrical cable connected with said plug member, said head portion being formed with an elongated sleeve portion extending at an angle to said shank portion and defining an internal cavity terminating in the region of said socket member, said plug body including an elongated extension receivable with clearance in said socket member and carrying said plug member, and a closure portion sealingly and removably attachable to said sleeve portion remote from said head portion, said closure portion being an annular housing receiving said cable with clearance, the clearance between said housing and said cable being filled at least partially with a sealing material.

2. The connector defined in claim **1** wherein said material is a cellular electrically insulating elastic synthetic resin.

3. The connector defined in claim **1** wherein said sleeve portion and said jack body have metallized surfaces.

4. The connector defined in claim **1** wherein said jack body and sleeve portion are composed of a cast synthetic resin having high breakdown voltage.

5. The connector defined in claim **1** wherein said head portion is formed with an elongated sleeve portion extending at an angle to said shank portion and defining an internal cavity terminating in the region of said socket member, said plug body including an elongated extension receivable with clearance in said socket member and carrying said plug member.

6. The connector defined in claim **5** wherein said sleeve portion is detachably mounted upon said head portion substantially level with said socket member, said head portion and said sleeve portion being provided with mating rotationally symmetrical formations coaxial with said socket member.

7. The connector defined in claim **6** wherein said sleeve portion is provided with a wall confronting said socket member, said plug member extending through and being entered in said wall of said sleeve portion, said cable entered in said wall of said sleeve portion, said cable extending through said sleeve portion and being anchored to said plug member in the region of said wall of said sleeve member.

8. The connector defined in claim **7** wherein said formations are frustoconical and converge axially in the direction of insertion of said plug member in said socket member.

* * * * *