

COAXIAL PLUG-IN CONNECTION

The invention relates to a coaxial plug-in connection.

When terminating a coaxial cable an inner conductor is connected
5 to an inner conductor contact element of a plug-in connector, and an
outer conductor, including a cable jacket, ends in a plug housing of
electrically conductive material in which it is mechanically clamped
and with which it makes electrically contact by means of a screw ring.
Injection moulded plastics may sealingly enclose the end of the cable,
10 the screw ring, and a part of the plug housing.

A plug-in connector of this kind has been previously proposed on
a manufactured coaxial connector cable connector of a given length
formed with a coaxial plug at each of its ends. The injection moulded
plastics performs a certain sealing function, and at the same time
15 protects against knocks. However, this coaxial plug-in connector is
not suitable for use in outdoor locations because it is not watertight.
Despite every attempt, it has not yet been possible to produce an
internal connection between the cable jacket and the injection moulded
plastics in such a way that the corresponding gap is sealed, at least
20 to spray water. Another similar problem is the gap between the plug
housing and the injection moulded plastics at the level of the front
edge. Despite the fact that no mechanical claims are made in this
region, such as are unavoidable at the cable end on the injection
moulded plastics when the cable is bent, if the plug-in connector were
25 used in an outdoor location, water could seep around the injection
moulded plastics. The water would gradually penetrate as far as the
screw connection, and thence into the inside of the plug. Whilst this
problem could be combatted by using a sealed screw connection, no
useable solution has yet been found which prevents the penetration of
30 water into the plug at the cable end.

Patent Specification DE-22 38 308 B2 discloses a coaxial plug-in
connector, wherein an annular gap which is open towards the cable end
is disposed between the outer jacket of the cable and the screw member,
this annular gap being delimited at the plug end by a sealing ring and
35 being injection moulded with plastics material at the cable end. The
plastics material used is a self-hardening casting resin which is
primarily used form-lockingly to anchor the outer conductor in the
plug-in connector housing. At the plug end of the annular sealing, an

annular space is formed which is filled with an elastic plastics material which has been injected through a radial bore in the plug housing. However, the disc-like annular sealing which is thus embedded form-lockingly on all sides is very unsatisfactory in carrying out its
5 sealing function with this design, for the reasons mentioned hereinafter.

Patent Specification US-A-46 26 055 discloses a method of forming the end faces of inter-engaging plug-in connector members in complementary fashion using the groove and spring principle, of giving
10 the grooves a profile which tapers towards the base of the groove and of arranging sealing means in the grooves which are elastically deformed by the engaging projections of the other connector member in the direction of the air gap which remains between it and the respective bottom of the groove.

15 According to the invention there is provided a coaxial plug-in connection comprising a plug at the end of a cable having an inner conductor and an outer conductor, the inner conductor is connected to an inner conductor of the plug, the outer conductor is covered by a cable jacket, terminates in a housing of the plug, and is mechanically
20 clamped therein by a screw ring and makes electrical contact with the housing, and injection moulded plastics sealingly encloses the end of the cable and a part of the housing, in which the cable end of the screw ring has a conical transition region to an approximately cylindrical region of larger inner diameter, a sealing ring is provided
25 within the region of larger inner diameter, the thickness of the sealing ring between an inner peripheral face and an outer peripheral face thereof is approximately equal to the width of the gap between the cable jacket and the inner wall of the region of larger diameter, and a remaining gap at the cable end is filled with the injection moulded
30 plastics.

It has been appreciated that it is in no way sufficient merely to provide the cable end region of the screw ring, with a sealing ring, eg an O-ring. Instead, the sealing ring only carries out its sealing function if the transitional region is conical from a region of smaller
35 inner diameter of the screw ring to the region thereof of larger inner diameter. Thus behind the sealing ring, bordering the surface of the sealing ring which faces the plug end, an annular air gap remains. When the injection moulded plastics is manufactured, the plastics

material which is injected hot at a not inconsiderable pressure and which penetrates the gap which remains at the cable end between the inner wall of the screw ring and the cable jacket, exerts a mainly axial force upon the sealing ring. This force presses the sealing ring
5 in the direction of the conical transitional region and simultaneously elastically deforms it according to the afore-mentioned air gap. Only when this elastic deformation of the cross-sectional area of the sealing ring has taken place, which would not occur if the sealing ring were simply embedded in a groove of approximately equal cross-sectional
10 size, for example, does the desired sealing result, since the elastic return forces ensure that the sealing ring is pressed firmly against both the cable jacket and also against the inner wall of the screw ring.

Preferably the cable jacket is set back from the front edge, at
15 the plug end, of the outer conductor, and the plug is provided with at least one bore which opens into a space occupied by bare cable outer conductor. Thus, the plastics material penetrates, at the plug end, from the sealing ring into the inside of the plug, to be more exact, into the space remaining between the outer conductor of the cable and
20 the inner wall of the screw ring. The additional form-locking connection made thereby between the outer jacket of the cable and the screw ring and thus the plug as a whole improves the resistance of the cable to being pulled out, especially if the cable is of the type which has a corrugated steel outer conductor.

25 However, with such an embodiment, plastics material which partially seeps through the cable jacket cannot be completely prevented from penetrating into the gap between the cable jacket and inner wall of the screw ring. This would result in the sealing ring which is disposed there being embedded on both sides in the plastics material
30 and thereby being incapable of performing its sealing function.

Advantageously, therefore, the inner wall of the screw ring between the bore and the conical transitional region to the larger inner diameter region has an annular groove in which a further sealing ring is received, the inner peripheral face of the further sealing ring
35 resting on the cable jacket. The cross-sections of the further sealing ring and those of the annular groove receiving it must be measured for the reasons stated and in such a way that any plastics material

penetrating this region results in an elastic change of shape to the other sealing ring.

Reference was made in the introduction to the fact that when a plug-in connection of the kind in question is used outdoors, where it is likely to be in contact with water, there is also a risk that the water will seep around the injection moulded plastics from the plug end, and penetrate through the screw connection into the plug. Advantageously, therefore, the plug housing has an annular groove on the outside, the depth of which groove is greater than the thickness of a third sealing ring inserted into the annular groove, the injection moulded plastics of the plug fills the rest of the depth of the annular groove, and the bottom of the groove and/or the third sealing ring has a cross-section such that an air gap remains between the third sealing ring and the bottom of the groove. The third sealing ring, using the same principle as the first and second sealing rings, can produce reliable sealing between the transitional region or gap between the metal plug housing and the front peripheral edge of the injection moulded plastics.

The invention is diagrammatically illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a cross-sectional view through a first embodiment of a coaxial plug connection according to the invention;

Figure 2 is a view similar to Figure 1 of a second embodiment; and

Figure 3 is a view similar to Figure 1 of a third embodiment.

In all the embodiments shown, the plug-in connection comprises a coaxial plug of any design, a coaxial cable connected to the plug, of any kind, but here by way of example having a corrugated steel outer conductor, and a common injection moulded plastics which acts as a sealing means, protects against knocks and also forms the plug dielectric.

The coaxial cable shown comprises an inner conductor 1, a conventional dielectric 2, here in the form of a foam dielectric, an outer conductor 3 and a cable jacket 4.

The plug comprises a plug inner conductor 11 which is shown at the plug end as a pin, but which could also be in the form of a sleeve, a plug dielectric 12, a plug housing 13, a screw ring 15 which

cooperates with a pressure ring 14 and usually a metal roughcast bush, not shown here.

Most of the plug housing 13, the screw ring 15 and part of the cable protruding therefrom are embedded in an injection moulded plastics material 16. This injection moulded plastics fills the inside of the plug housing 13 through at least one bore 13a in the plug housing 13 and acts as the plug dielectric 12. Between the plug dielectric 12 and the pressure ring 14 is a disc 17 of insulating material.

The three embodiments which are shown and which all include the above described components differ from one another in that they have different sealing features. However, with all three embodiments the way in which the cable entry into the plug is sealed is the same. The screw ring 15 has an inner diameter which has several steps. The inner diameter of the screw ring 15 which is dependent on the diameter of the cable, including the cable jacket 4, expands in the direction of the cable end of the screw ring to attain a cylindrical end region 15a of increased inner diameter.

Arranged in the annular gap thus created between the cable jacket 4 and the inner wall of the screw ring 15 is a sealing ring 18. The rest of the annular gap, at the cable end, is filled with the injection moulded plastics material 16. So that the sealing ring 18 can perform its sealing function, it must be able to become elastically deformed by the pressure exerted by the molten material of the injection moulded plastics 16 which penetrates into the afore-mentioned annular gap. This is made possible by an annular air gap 19 which borders a surface of the sealing ring 18 facing the plug end. This air gap 19 is formed by a conical transitional region 15b disposed between the smaller diameter of the screw ring 15 and the region 15a thereof of larger inner diameter.

The embodiment shown in Figure 1, particularly if the cable outer conductor is a corrugated tube, can be further improved as shown in Figure 2 by the cable jacket 4 being set slightly back from the front edge of the outer conductor 3, and by at least one bore 15c, preferably a radial bore, being provided opening into the free internal space, thus created, in the screw ring 15. This causes the injection moulded plastics 16 also to fill the free space. The form-locking connection

thus made increases the resistance of the cable to being pulled out. In order to prevent the plastics material which penetrates into the free space from pushing into the unavoidable peripheral gap between the cable jacket 4 and the inner wall of the screw ring 15 as far as the air gap 19 and filling the air gap 19, thus preventing elastic deformation of the sealing ring 18, in the region disposed between the bore 15c and the conical transitional region 15b, the screw ring 15 has an annular groove to receive a second sealing ring 20. For the same reasons as in the case of the sealing ring 18, the cross-sections of the annular groove, on the one hand, and of the second sealing ring 20, on the other hand, must be of a size such that the sealing ring 20 undergoes elastic deformation to produce return spring forces which cause the sealing ring 20 to press firmly against the cable jacket 4.

In the embodiment shown in Figure 3, a front transitional region, or transitional region at the plug end, between the plug housing 13 and the injection moulded plastics 16, is water-tight, so that no water can penetrate the peripheral gap between the plug housing 13 and the injection moulded plastics 16 until it reaches the screwthreaded gap between the plug housing 13 and the screw ring 15. The plug housing 13 has an annular groove at this end on the outside, into which groove a third sealing ring 21 is inserted. So that the third sealing ring 21 can be elastically deformed by the pressure of the injection moulded plastics 16, the bottom of the groove is of a V-shaped configuration, so that a peripheral air gap 22 remains.

The sealing measures taken all involve elastic deformation of the sealing rings which are provided at the various places locations. Those skilled in the art can readily determine the particular structural manner in which the respective sealing rings are deformed elastically by the pressure of the injected plastics material.

Attention is directed to our co-pending Application 9301367.0 published under No 2 263 828 which has a similar description but different claims.

CLAIMS

1. A coaxial plug-in connection comprising a plug at the end of a
5 cable having an inner conductor and an outer conductor, the inner
conductor is connected to an inner conductor of the plug, the outer
conductor is covered by a cable jacket, terminates in a housing of the
plug, and is mechanically clamped therein by a screw ring and makes
10 electrical contact with the housing, and injection moulded plastics
sealingly encloses the end of the cable and a part of the housing, in
which the cable end of the screw ring has a conical transition region
to an approximately cylindrical region of larger inner diameter, a
sealing ring is provided within the region of larger inner diameter,
15 the thickness of the sealing ring between an inner peripheral face and
an outer peripheral face thereof is approximately equal to the width of
the gap between the cable jacket and the inner wall of the region of
larger diameter, and a remaining gap at the cable end is filled with
the injection moulded plastics.
- 20 2. A coaxial plug-in connection according to claim 1, in which the
cable jacket is set back from the front edge, at the plug end, of the
outer conductor, and the plug is provided with at least one bore which
opens into a space occupied by bare cable outer conductor.
- 25 3. A coaxial plug-in connection according to claim 2, in which the
inner wall of the screw ring between the bore and the conical
transitional region to the larger inner diameter region has an annular
groove in which a further sealing ring is received, the inner
peripheral face of the further sealing ring resting on the cable
30 jacket.
4. A coaxial plug-in connection according to claim 3, in which the
plug housing has an annular groove on the outside, the depth of which
groove is greater than the thickness of a third sealing ring inserted
35 into the annular groove, the injection moulded plastics of the plug
fills the rest of the depth of the annular groove, and the bottom of
the groove and/or the third sealing ring has a cross-section such that



an air gap remains between the third sealing ring and the bottom of the groove.

5. A coaxial plug-in connection substantially as hereinbefore described and illustrated with reference to any of the accompanying drawings.