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COAXIAL CABLE CONNECTOR

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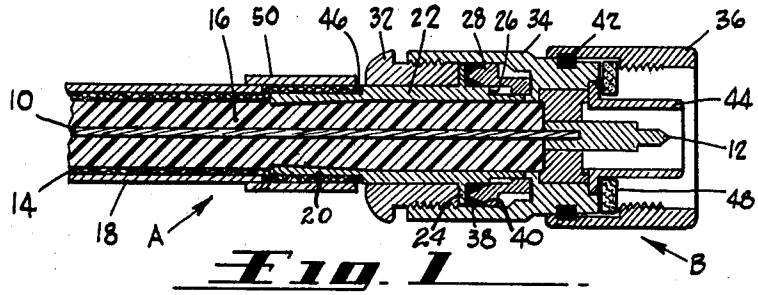

Fig. 1

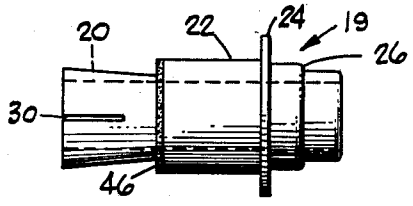

Fig. 2

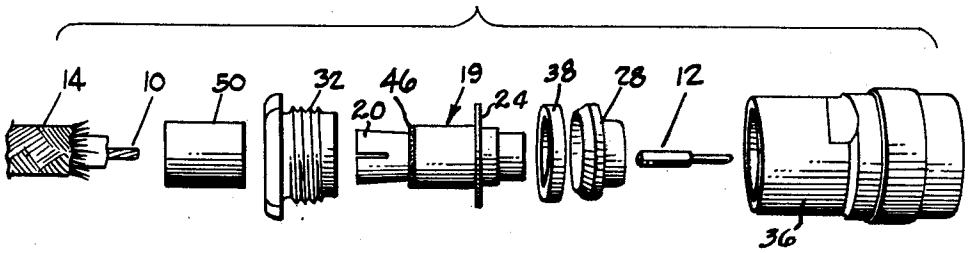

Fig. 3

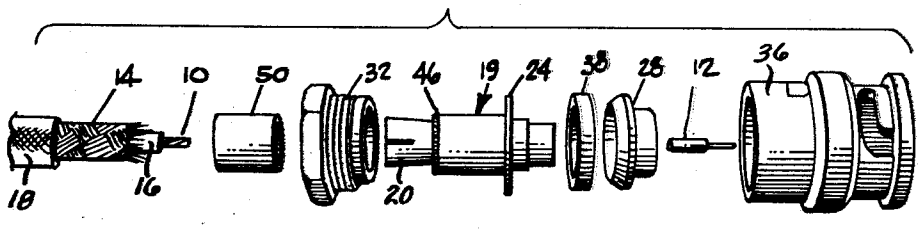

Fig. 4

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COAXIAL CABLE CONNECTOR

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Continuation of application Ser. No. 34,800, June 8, 1960. This application Aug. 5, 1963, Ser. No. 303,465
4 Claims. (Cl. 339—103)

This is a continuation of co-pending application Serial Number 34,800, filed June 8, 1960, now abandoned. This invention relates to coaxial cables and is particularly concerned with their terminal portions or junctions where they are connected to other circuits or instrumentalities.

Subject invention may be referred to as an adapter-connector for use with many types and sizes of conventional coaxial cables in connection with their terminals to other circuitry or to instruments. It is not restricted to use with a socket or as a plug-in element. It may be utilized with any subsistent "UG" connector or socket either when the latter is rigidly mounted or is of the pendant-plug type; or as an independent cable terminating device.

One of the outstanding heretofore unsolved problems in this art has resided in the fact that the center conductor, over which a dielectric is usually extruded unitedly, usually moves, undesirably along with the dielectric when the connection is being established or under thermal contraction or pressural cold-flow of the dielectric or when the cable is loaded in tension. Therefore, any axial dielectric movement is transferred thru the center conductor of the coaxial cable to the center pin of the connector, this pin being a circuit continuation of the center conductor and being seated or socketed in the device to which the cable is to be connected. The net result is that this movement can, in addition to changing the radio-frequency characteristics of the connection, also disconnect the center pin of the coaxial cable from its contact in the mating connector or socket. This movement and disconnection may occur even with the cable termination and the socket seemingly, when viewed from the exterior, firmly connected. This disconnection may be attributable to accumulative cold flow of the plastic dielectric linearly away from the junction portion at the inner-end or portion of the cable; to thermal contraction of the dielectric; to both influences; or even to ordinary slippage of the dielectric within the outer braid.

The present invention, broadly solves these, and other, troublesome problems, by providing a coaxial cable termination which is so constructed as to enable a crimping technique, and a crimpable collet chuck, to be incorporated in coaxial cable terminations. The construction is such that the "creep" of the dielectric, united to the center conductor, is nullified by this collet action so far as its effect on the jointure of the center pin and the connector, or socket, is concerned. The invention may be incorporated in conventional RG coaxial cable terminals as well as in standard UG coaxial cable connections, and other conventional or unconventional connections.

Briefly, the coaxial cable connector comprising the present invention includes a first sleeve adapted to fit over the core of dielectric material surrounding a center conductor of a cable. This sleeve has slots of predetermined width extending longitudinally from the outer end of the sleeve. As an inward compressive force is exerted, the slots close and the slot edges abut to limit the inward force exerted against the dielectric material. The outer surface of the sleeve flares outwardly before a deformation of the sleeve is made. The cross-sectional thickness of the material of the sleeve increases toward the outer

end of the sleeve. An outer or second sleeve fits over the outer conductor. This sleeve also is of a deformable material which, when crimped beyond its elastic limit, inwardly depresses the first sleeve into gripping relationship with the dielectric material to captivate the core.

Certain other concepts, advantages and usages pertaining to the present advances in this art are either set forth in the disclosure which follows or will become self-evident therefrom.

The now-preferred embodiment of the invention's concepts is depicted in the accompanying drawings, but only by way of example, the essence of the invention being defined in the annexed claims. It is therefore to be understood that these drawings and the following detailed description by no means constitute the invention itself. On the contrary, the invention is as constituted by, and lies within, the scope of the subjoined claims.

In the drawings:

FIG. 1 is a longitudinal, substantially central section of one of the present coaxial cable terminations and its complementary connector, or socket, with the recessed washer not set up fully against the elastomeric seal, the view having been taken to emphasize the improved relationship between the central conductor, the contact pin, and the cold-flowable, or "creeping," dielectric encasing the central conductor;

FIG. 2 is a side view of one of the novel elements provided by this invention;

FIG. 3 is an expanded view of the configuration that corresponds, regarding the inner-end portion of the coaxial cable and the socket, or other instrumentality, to which said cable is to be connected in a novel manner, to the parts of FIG. 1, and

FIG. 4 is a view similar to that of FIG. 3 but illustrating the fact that the improved coaxial cable termination can as well be employed with other types of sockets than that shown to the right in FIG. 3.

Referring now in detail to the exemplary embodiments shown in the drawings, FIG. 1 illustrates a basally conventional UG 21 D/U connector, or socket, unit B, and an improved coaxial cable termination, A. Unit A includes an inner, central conductor path 10 outwardly longitudinally terminated by a plug-in pin 12. The outer, or peripheral, conductor path 14 of the coaxial cable is concentric with 10 and consists of a stripped, braided wire sheath, which, as hereinafter detailed, establishes a flow path and connection to the coaxial outer wall-portions of unit B.

A dielectric jacket 16 is interposed between 14 and 10 is bonded to the central conductor, and is preferably, but not exclusively, composed of an elastomeric material, either synthetic or natural. However, in any case it is subject to accumulative creep due to cold flow, axial stressing and thermal contraction and expansion. An outer insulative jacket 18, composed of conventional dielectric material, envelopes a portion of the length of the braided-sheath conductor path 14.

An element 19 constituting a part of the essence of the invention, is longitudinally interposed between the inner end of 14 and unit B.

As indicated in FIG. 2, this element 19, designated generally as a cable-grip sleeve, broadly consists of an elongate, hollow generally tubular metallic member having an inwardly longitudinally tapered or frusto-conical, or flared portion 20, receiving and anchoring the dielectric and the braid end by a novel radial crimping means and action that also extends peripherally and longitudinally in part 20.

Portion 20 is followed, longitudinally to the right in FIG. 2, by a hollow cylindric portion 22, this portion being terminated, geometrically, at its farther end by an

annular flange 24, adapted to serve as a seal-abutment, and later detailed as such.

Longitudinally rightwardly beyond 24 the element 19 bears a hollow cylindric, smaller portion terminated by an annular shoulder 26. The rule of probability would most likely cause the right hand inner end of the smallest portion of 19 to bear or fit against the inner face of the inner end of 28, which is a recessed washer. Shoulder 26 does not, however, constitute the actual grounding-means. Compression joints at this point would not serve the purpose intended. The U.G. type is chosen for illustrative purposes, merely, and is not limitative.

It is important to notice that the tapered section, 20, is longitudinally slotted, for a pre-controllable distance both as to slot-width and slot-length, by means of slots 30, here shown as being arranged at quadrantal points of 20. By these and other means later described, portion 20 thus constitutes a species of collet-chuck, directly acting upon the normally cold-flowable, creeping or by cold-flow or plastic creep axially outwardly away from the connector thermally contractile, dielectric 16. The relative widths, lengths and circumferential spacings of slots 20 are exemplary, only, since their parameters and the composition of 20 are to be varied in such manner that upon radial crimping of the cable-grip unit and sleeve in this region, the edges of the slots are mutually urged together, peripherally, despite the various diameters of dielectric, etc. Thereby it not only positively obviates "creep" of 16, but concurrently, in conjunction with a sleeve element later described, eliminates the undesirable creep or longitudinal movement of the inner end portion of the braided outer conductor 14 that occurs when it is clamped in the conventional manner, that is, of that portion of braided conductor 14 that lies between the sleeve 50 and flared portion 20. Also, it so deforms and permanently "sets" this portion that said resilient, spring-away braid has no tendency to spring away from its seat, either radially outwardly or longitudinally and deforms the braid-terminal into full and complete cylindric contact with member 20. The outer and inner surfaces of 20 are preferably quite rough, and the thickness of 20 tapers from the outer end of 20 to the opposite end.

By these means, among others, the maximum holding strength per unit area or volume is conferred upon the connection.

It is essential, however, to note that the opposite sides of each slot, at least near the end 30 and inwardly a substantial distance, must be peripherally brought into full mutual contact, with no gap therebetween. For otherwise, the spring-apart tendency thereof would remain and the collet-chuck gripping action of 20 on the creepable dielectric would fall short of the essential completeness thereof that is mandatory to stabilize and maintain the connection of member 12 with the socket or other associated instrumentality to which it is intended to connect it. Also, if the "leaves" between the slots in the collet had not deformed radially inwardly to mutually meet by being crimped together circumferentially, subsequent dielectric cold flow would permit further inward movement of the leaves thus loosening the grip on the braid exerted by chuck-like sleeve 20 and of sleeve 50, and detracting from the strength of the grip-joint between the parts concerned.

To facilitate union of coaxial cable terminus A with conventional unit B, the invention provides a mating connector or clamp nut 32, which is unitary with the unit B and is externally threaded so as to engage with internal threads on the inner end of a union-like member 34. 34 is conductive; and at its outer end, engages the similarly conductive sleeve, or the like, 36. 36 constitutes a mechanical coupling member, part 44 serving for completing the connection of the outer one of the necessary two coaxial conductor paths.

A seal 38 that is a rubber annulus with an annular, triangular-section recess 40 on that face which is nearer

the contact pin, is interposed between the annular abutment 24 and the recessed washer 28, the latter having an arcuate, annular inner face to seat in the recess in the seal and further to establish metal-to-metal contact with flange 24, upon the washer being seated.

Metallic pin 12 conductively engages the central conductor 10, or may be integral therewith, and is adaptable to plug into many existent types of coaxial cable connectors, including UG-88 C/U, UG-21D/U, and other connectors in the BNC, N, C, and HN etc. classes.

The union type coupling nut 34 is fitted and adapted to socket element 36 by means of a metallic washer 42, in order to transfer the mechanical load. It also enables rotation of that element with respect to the assembly when necessary.

In the socket B is an element 44 which constitutes a portion of the connection for receiving the connected-instrumentality and is also a part of the outer one of the coaxial circuit completing elements. Pin 12 is the inner circuit completing element. The outer element 36 is internally threaded for reception and engagement of apparatus components entering the right-hand end of the unit.

To adapt the foregoing construction for use in environments demanding even better moisture-proofing than afforded by the basal elements, a member 46, in the form, preferably, of an elastomeric torus, or rubber band, is seated sealingly around part 20. Alternatively a cold setting sealing compound may be flowed in place.

In assembling the device, braid-conductor 14 is slid over 20 until it abuts 46. The outer crimp sleeve 50, is slid over the braid portion and also over 46. It is to be noted that the collet-chuck unit 20 is first positioned over dielectric jacket 16 and squeezed down thereon, as described hereinabove. After applying crimping action to the sleeve 50, which incidentally, overlaps a portion of outer insulating jacket 18, the cable jacket and the braid are under high radial compression, among other advantages effectively barring moisture from the region between braid 14 and dielectric 16 and the crimping of 50 effectuates closing of the slots 30.

It is noted that the four slots 30 in element 20 are to be calibrated in width commensurately with the particular design and degree of taper of part 20. Thus, upon crimping, the diameter of section 20 will be so reduced as to flatten the taper to a regular cylindric surface for properly and fully seating the braid. It is to be remembered that element 19 also serves as a collet-chuck, as it were, immobilizing the otherwise cold-flowable and creeping dielectric 16, so as to entirely obviate the defects in this respect of all known previous such coaxial cable junctions.

Thus, these means concurrently serve as a creep-preventer and a braid-end anchorage means.

The present coaxial cable-runs connector is also conceived of as taking care of situations where the cable and connector are employed at the critical and hard-to-handle microwave frequencies, and to this end the invention concerns itself with the effect and action of the internal surface of the hollow member 19, among other things. The invention contemplates pre-controlling the shape, diameter, length, etc. of this internal surface such that it, in turn, maintains constant or pre-controllable, the length and diameter of braid 14, where it is interposed between 20 and 50, thus to retain constant the ratio of the inner conductor extent to the outer conductor extent. Thereby, the impedance in this region is also, and effectively, maintained constant.

Further to this end, the invention conceives of controlling the efficacy of the "ground-point" on the outer coaxial conductor path by means of a novel tight fit between that end of element 19 which lies longitudinally opposite to the collet portion 20 and the inner surface of 34, which can thus be a conventional UG-type component.

It should be mentioned that element 20 can be, by

virtue of the present internal configuration, crimped so tightly over dielectric **16** that passage of moisture in this particular region is reduced materially. Compression together of the sides of slots **30** at their distal ends, as above, may leave a small gap. To prevent the entry of moisture, seal **46** serves very well.

FIG. 4 is presented chiefly to demonstrate the range of utility of the invention, showing that the element B can well be a specific BNC type connector socket-unit, rather than a generic UG type. No alteration in the configuration of unit A is required in these instances, and A and B are employed in substantially the same manner as hereinabove to achieve the same objectives.

It has now been made manifest that among the advances provided by the invention, it has enabled the utilization in coaxial cables of a dependable crimp-technique for anchoring purposes. The combination of this technique with the equally reliable collet chuck component totally eliminates creep of the entire cable core, **16** and **10**; in fact, there can be no relative motion between the core-unit and the braid in the initial region of the associated members. In cases where the cable cannot be rotated around its longitudinal axis to facilitate making the connection as in bulkhead connectors, the invention nonetheless still enables non-rotatable coaxial cable ends to be properly connected to connectors, or sockets without necessitating rotation thereof.

Many other advantages and advances will become apparent from a study of the foregoing disclosure; for example, it has been made to appear that, size-for-size, etc., the present jointure has greater strength, axially and otherwise, than conventional jointure, and the assembly may be readily disassembled for inspection purposes yet reassembled thereafter in its pristine condition. It is also manifest that no sort of soldering, brazing or welding will be found to be necessary in establishing the present connection.

Although certain specific nomenclature, shapes, dimensions, etc. have been employed hereinabove in describing specific embodiments of the inventive concepts, such examples have been resorted to solely for purposes of clarity. These examples in no wise constitute the invention itself, nor limit it, except as required by the subjoined claims.

We claim:

1. A coupling for the end portion of a coaxial cable of the type having a central conductor, an outer conductor circumscribing the inner conductor and a dielectric between the conductors and tightly embracing the central conductor, said coupling comprising:

a mechanical coupling member adapted to be coupled to a mating connector and including a central contact connectible to the central conductor;

a first radially contractible sleeve adapted to be interposed between the outer conductor and the dielectric, said sleeve having a flare and a cross-section dimension of material therein increasing toward the outer end of the sleeve, said sleeve having a plurality of longitudinally extending slots therein to permit peripheral deformation upon compression thereof;

a second radially contractible sleeve for encircling the outer conductor in a region thereof diametrically opposed to the first said sleeve, said second sleeve being deformable inwardly beyond its elastic limit thereby to clamp the outer conductor between the sleeves and to concurrently clamp said first sleeve in an inwardly permanently deformed condition against the dielectric by virtue of the bodily contraction of

the second sleeve, said first sleeve exerting a captivating force on both the dielectric and the inner conductor and immobilizing them as a unit;

and means for securing the first sleeve to the mechanical coupling member whereby tension loads applied axially to the coaxial cable are transmitted to the aforesaid coupling member through the first sleeve so as to preclude the imposition of tensile loads on the central conductor at its connection to the central contact, thereby to prevent disconnection.

2. A coupling as defined in claim **1** wherein the first sleeve is provided with circumferentially spaced slots running longitudinally inwardly from one end of the sleeve, said slots rendering the first sleeve radially contractible against the dielectric all around its periphery, the width of the slots controlling the extent of the captivating and immobilizing forces exerted by the first sleeve on the unit consisting of said dielectric bonded to and encasing said inner conductor

3. A coupling as defined in claim **2** wherein the material of the first sleeve, that is, the material lying between the slots of said sleeve, flares outwardly prior to contraction of the first sleeve and the contraction of which slots renders the outer surface of the first sleeve cylindrical, the cross-sectional thickness of said material increasing toward the outer end of said slots, the inner surface of said sleeve seizing the dielectric with a force adequate to immobilize both the dielectric and the inner conductor as a unit against axial tensile forces applied thereto.

4. In a connector arrangement for the terminal portion of a coaxial cable having a core consisting of a central conductor and a dielectric surrounding the conductor, and a flexible outer conductor encompassing the dielectric, the combination comprising;

a first tubular, radially compressible sleeve to be disposed between the inner face of the inner end portion of the outer conductor and the dielectric; said sleeve comprising a split-collet-chuck having a radial flare, the cross-section dimension of the material of said sleeve increasing toward the outer end of said sleeve, and slots of a predetermined width limiting the degree of radial and peripheral deformation said first sleeve can undergo to limit the compressive force said collet-chuck can exert when fully peripherally contracted,

a second tubular radially compressable sleeve for mounting outwardly adjacent said first sleeve and substantially diametrically opposite said first sleeve with said outer conductor positioned therebetween whereby when said second sleeve is deformed radially inwardly said outer conductor is gripped between said sleeves and said outer sleeve is deformed radially inwardly beyond it elastic limit so as to grip and immobilize said dielectric and said central conductor against thermal and tensile forces tending to move them axially.

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