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TAP-OFF COUPLER WITH FIXED ATTENUATION FOR COAXIAL LINES

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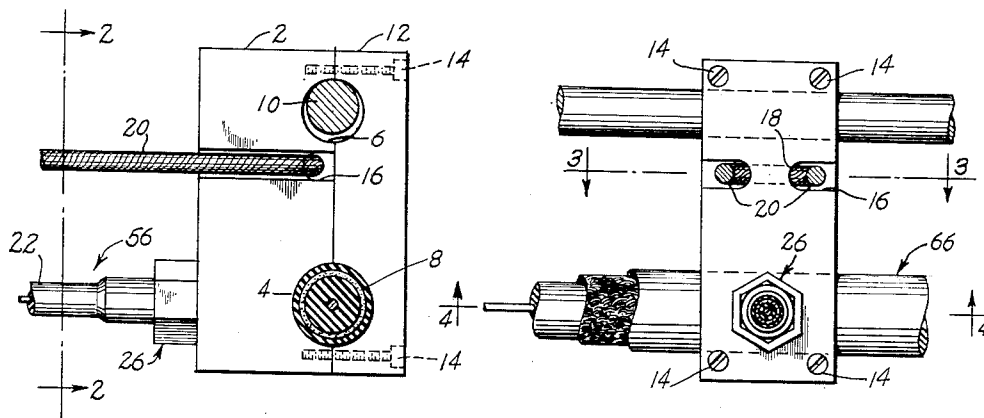


Fig. 1

Fig. 2

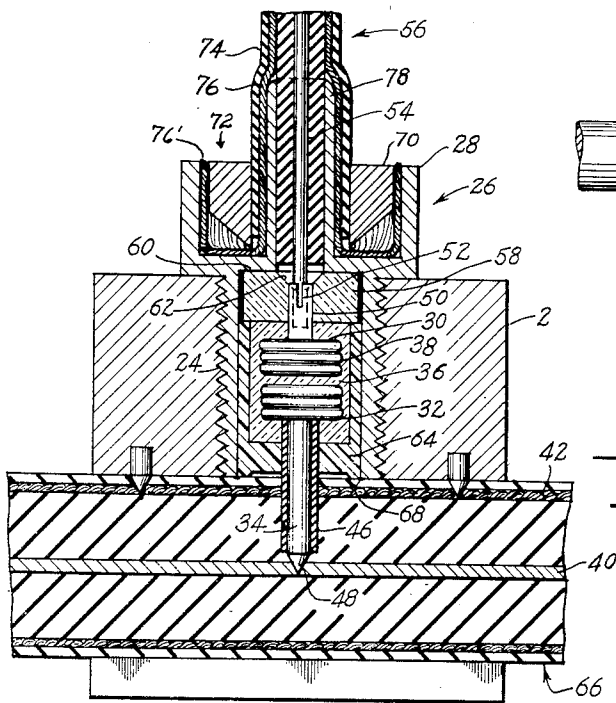


Fig. 3

Fig. 4

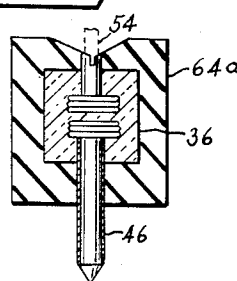


Fig. 5

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1

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TAP-OFF COUPLER WITH FIXED ATTENUATION FOR COAXIAL LINES

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9 Claims. (Cl. 333—6)

This invention relates to tap-off couplers for coaxial cables having a central inner conductor and a concentric braided outer conductor, the two being separated by suitable insulation, and is an improvement of our earlier filed U. S. patent application, Serial Number 338,104, filed February 20, 1953.

The objects and advantages of the present invention include the objects and advantages of the above identified earlier filed application, and include further the provision of an improved piercing pin for engaging the central conductor of a coaxial cable which is being tapped. Another object is to improve the construction of the attenuating capacitor or resistor, or combination of both which is provided as part of the tap-off structure. A further object is to improve the construction of the cable-engaging block which engages the main coaxial cable and provides a support for the piercing pin and connector to the tap-off cable. Still another object is the provision of an improved mechanical and electrical connection between a tap-off cable and a connector.

The present invention comprises a connecting block, constructed to closely engage and firmly grip a main coaxial cable, and provided with piercing points for insuring good electrical engagement with the outer braided conductor of an engaged coaxial cable. A threaded aperture is provided for receiving a tap-off coaxial cable connector having an insulated piercing point adapted to penetrate the outer braided conductor and to electrically contact the inner conductor of the main coaxial cable when threaded into said aperture. An attenuator, preferably in the form of a small capacitor, is provided in said connector structure between the piercing pin and the connection to a tap-off cable.

The main connector block according to the present invention includes as part thereof unitary means for engaging a messenger wire such as is commonly employed to support the main coaxial cable. Further unitary means are provided in the block for convenient attachment of a strain relief line. By this construction, a simple and unitary coupler is provided having all of the necessary features for enabling a quick, efficient, and fool-proof tap-off connection to be made to a main coaxial cable.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawing, in which:

Fig. 1 is a side elevation of a tap-off connector embodying the invention;

Fig. 2 is a view taken on line 2—2 of Fig. 1;

Fig. 3 is a view taken on line 3—3 of Fig. 2;

Fig. 4 is a view taken on line 4—4 of Fig. 2; and

Fig. 5 is a diagrammatic view of a modified form of capacitor-pin block.

Referring to the figures, a metal block 2 is provided with two semi-circular grooves 4 and 6 of diameters corresponding respectively to that of the cable 8 which is to be tapped, and to that of a messenger cable 10 which supports cable 8 in known fashion. A closure block 12 is provided with corresponding semi-circular grooves thereby, when the two blocks are fastened together, as by means of screws 14, the assembly is rigidly fastened to both the coaxial cable 8 and the messenger cable 10. Block 2 is provided with a curved cut as shown at 16 so as to leave a smoothly curved portion 18 for supporting a strain relief line 20 as best shown in Fig. 3. The strain

2

relief line is attached in conventional fashion (not shown) to tap-off coaxial line 22 so that the mechanical strain is taken entirely by messenger cable 10, block 2, 12, and strain line 20. Block 2 is provided with a threaded aperture 24 (Fig. 4) for threadedly receiving tap-off connector shell 26. Both block 2 and shell 26 are, of course, made of good conducting material. Shell 26 is suitably externally shaped at its central portion to form a nut 28. The lower portion of the shell is externally threaded to fit the correspondingly threaded aperture 24 in block 2, and is internally bored to receive a combined piercing member and attenuating condenser, A, the construction of which differs materially from that disclosed in our earlier filed application.

According to the present invention, the capacitor member is formed of two plates 30 and 32 imbedded in a small block 36 of suitable insulating dielectric material. Although any suitable insulating material may be employed, a preferred material is that material used in manufacturing the GA and QC capacitors available from Stackpole Carbon Co. and Quality Component Inc., both of St. Mary's, Pennsylvania. The entire unit is molded under heat and pressure to form a unitary condenser having a definite, fixed capacity of unchanging value. Block 36 is composed of a high-efficiency, high-dielectric material whereby a reasonably large value of capacitance may be obtained in a small volume. Plate 32 may be formed by suitably heading wire 34 by means of a cold-forming operation, and plate 34 may, of course, be similarly formed. The lateral edges of the plates may be grooved as shown at 38 to ensure better engagement with the dielectric material 36.

For some applications instead of a capacitor, it will be preferred to have a resistor. This can be accomplished in essentially the same construction by making block 36 of suitable resistance material. For other applications, the combination of a resistor and capacitor may be desired. This, too, can be accomplished by making the block 36 of sufficiently high resistance material so that some current leakage occurs, but not enough to overshadow the capacitive effect, whereby any desired proportion of capacitance to leakage resistance may be obtained.

It will be seen that the element 32, 34 comprises a combined piercing pin and capacitor plate. As this pin in use must pierce the outer braided conductor of the coaxial cable, its outer surface must be insulated so that when its point engages the central conductor 40 as shown in Fig. 4, there will not be a short circuit between the outer braid 42 and the central conductor 40. A highly satisfactory insulating coating 46 is provided according to the invention by making pin 34 of aluminum and anodizing the surface of the pin. Point 48 is formed by grinding subsequent to the anodizing operation and is therefore, of course, uninsulated. The anodizing is performed according to the standard commercial process of Metal Finishers, Inc., of Baltimore, Maryland, known as Martin Hard Coat. We have found that this process performed on aluminum of grade 56S provides an exceedingly hard coating having excellent insulating quality; this coating is so hard that it is difficult to scratch even with a file. It is therefore excellently suited for the present purpose. Alternatively, other firmly bonded, thin, abrasion-resistant insulating coatings utilizing a chemical compound of the pin metal could be used, as many oxides have good mechanical and electrical properties for the present purpose, for example, Parkerizing in combination with a nylon, silicone, epoxy resin or varnish coating could be employed, although the anodized coating described above is preferred over any material we have used.

Pin 50 of capacitor plate 30 is bored and split at its end as shown at 52 in order to provide a well known type of connection to solid central conductor 54 of tap-off cable 56.

The piercing connector may be assembled as follows: An insulating wafer 58, preferably of Teflon, is first inserted in the bore of shell 26 so that it rests against shoulder 60 of the shell. Wafer is centrally pierced to accommodate pin 50 and is conically dished as shown at 62 so

as to readily guide central conductor 54 into engagement with slotted end 52 of pin 50. Molded block 36 with its capacitor and pin elements is next inserted as shown. If the parts are accurately made, pin 46 will now be centered in the bore of shell 26, but in any case a suitable centering jig may be used to hold pin 46 accurately centered in the bore. A suitable casting resin 64 is now poured into the central bore, the unit being, of course, held inverted from the position shown in Fig. 4 so that the casting resin will be retained by gravity. A suitable casting resin for this purpose is Scotch Kast, made by Minnesota Mining & Manufacturing Co. of St. Paul, Minnesota. This material has excellent dielectric properties and very high mechanical strength and adherence, and serves to very rigidly cement together all of the elements and also to take the major portion of the mechanical strain which occurs when piercing pin 46 is forced through main cable 66 to engage its central conductor 40. Although the engagement of resin 64 with the walls of the shell bore is probably sufficient for all practical purposes, we prefer to roll over the edge of the shell as shown at 68 (which may be done prior to adding the resin) in order to insure against the slightest possibility of the assembly loosening or coming out.

Alternatively, the piercing connector and capacitor assembly may be made up as a unit prior to insertion into the bore, any suitable resin being used as shown in Fig. 5. In this modification, a single outer casing 64a is provided which is firmly bonded at least to pin 46 so that any mechanical stress due to the piercing operation will be transmitted not to the block 36 (which is selected primarily for its electrical qualities rather than for its mechanical qualities) but to casing 64a, and thence to shoulder 60 of the shell 26.

Another alternative construction would be similar to that shown in Fig. 4 except that instead of casing 64 being poured in situ, it could be preformed externally of the shell 26 and assembled as shown, preferably with adhesive compound to form a rigid unit capable of relieving the capacitor dielectric of most of the mechanical stress. One reason for this precaution is, as previously noted, that block 36 is selected primarily for its electrical (rather than mechanical) properties.

An improved connection between cable 56 and shell 26 is provided by means of a wedge ring 70, which is forced down into annular recess 72 so as to firmly press outer insulation 74 and conducting braid 76 against the tubular shank 78 of shell 26. A length of braided outer conductor is left extending beyond the cut end of outer insulation 74 and is turned back on itself in the recess, so that the outside surface of the wedge ring 70 engages it as shown at 76' and forces it into very tight engagement with the inner surface of the annular recess at 76'. This serves both to wedge the braid firmly into electrical contact with the shell, and also provides frictional engagement between the shell and braid so that it can withstand any strain which occurs in practical use. Moreover, the braid is caused to bite into the shell so firmly by the above-described wedging action that even rotary sliding contact cannot occur, such as sometimes happens with other types of contacts.

Ring 70 is, of course, slipped over cable 56 prior to attachment of the cable. If desired, the ring may be provided with an axial or diagonal slit to accommodate itself to slight changes in diameter of the embraced portion, although a closed ring of suitable relative dimensions approximately as shown has been found to be quite satisfactory in performance. After the end of cable 56 has been prepared and is fitted to shank 78 as shown, the wedge ring is forced into place by any suitable means.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

We claim:

1. A tap-off for a coaxial cable of the type comprising conductive clamping means for firmly engaging a coaxial cable in electrical contact with the outer conductor thereof, a piercing terminal member supported by said clamping means and insulated therefrom, having an insulated piercing conductor terminating in a point for engagement with the central conductor of an engaged coaxial cable and having also a capacitor integrally connected to said

piercing conductor, said capacitor comprising two parallel spaced conducting plate members, a block of high-dielectric insulating material molded about said plate members and completely filling the space between them, one of said plate members being integrally connected to said piercing conductor, the other of said plate members having an integral linearly extending conductor portion axially aligned with said piercing member and extending oppositely therefrom, and means for connecting the central conductor of a tap-off cable to the end of said linearly extending conductor.

2. The invention according to claim 1 including an element mechanically supported by said clamping means and having a bore opening toward and aligned with the central conductor of an engaged coaxial cable, said block and embedded conductors being retained within said bore with said piercing conductor extending out beyond the bore, and a casing of insulating material of high mechanical strength containing and supporting said block and piercing pin in said bore.

3. The invention according to claim 1, said piercing pin having a surface insulation comprising a chemically bonded layer of insulating material comprising a chemical compound of the pin material.

4. The invention according to claim 3, said chemical compound comprising an oxidation product of the pin material.

5. A tap-off for a coaxial cable of the type comprising conductive clamping means for firmly engaging a coaxial cable in electrical contact with the outer conductor thereof, a threaded aperture in said clamping means, a threaded piercing terminal member supported by said clamping means in said aperture and having an insulated central piercing conductor terminating in a point for engagement with the central conductor of an engaged coaxial cable, and a capacitor integrally connected to said piercing conductor; said capacitor comprising two parallel spaced conducting plate members, a block of high-dielectric insulating material molded about said plate members and completely filling the space between them, one of said plate members being integrally connected to said piercing conductor, the other of said plate members having an integral linearly extending conductor portion axially aligned with said piercing conductor and extending oppositely therefrom, and means for connecting the central conductor of a tap-off cable to the end of said linearly extending conductor.

6. The invention according to claim 5, and a casing of insulating material of high mechanical strength containing and supporting said block and said piercing conductor.

7. The invention according to claim 6, said casing being firmly bonded to a portion of said insulated piercing conductor, whereby mechanical stress is transmitted mainly from the piercing conductor to the casing rather than to said block.

8. The invention according to claim 5, said threaded piercing terminal member comprising an outer shell having a central bore at one end thereof accommodating said block and embedded conductors with said piercing conductor extending out beyond said bore, said bore being of substantially larger diameter than said block, and a filling of solid plastic material of high strength and mechanical adherence mechanically supporting said block and conductors and firmly bonding them to the walls of said bore.

9. The invention according to claim 8, said bore being open at one end and leading to a reduced bore at the other end, thereby forming an annular shoulder at the junction of said two bores, a loose-fitting annular wafer of high-dielectric insulating material in the first bore positioned against said shoulder and having a central aperture dimensioned to receive said linearly extending conductor.

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