Nov. 17, 1959 C. SEIFERT 2,913,679

COUPLER FOR TELEVISION SIGNAL DISTRIBUTING SYSTEMS

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FIG. 1.

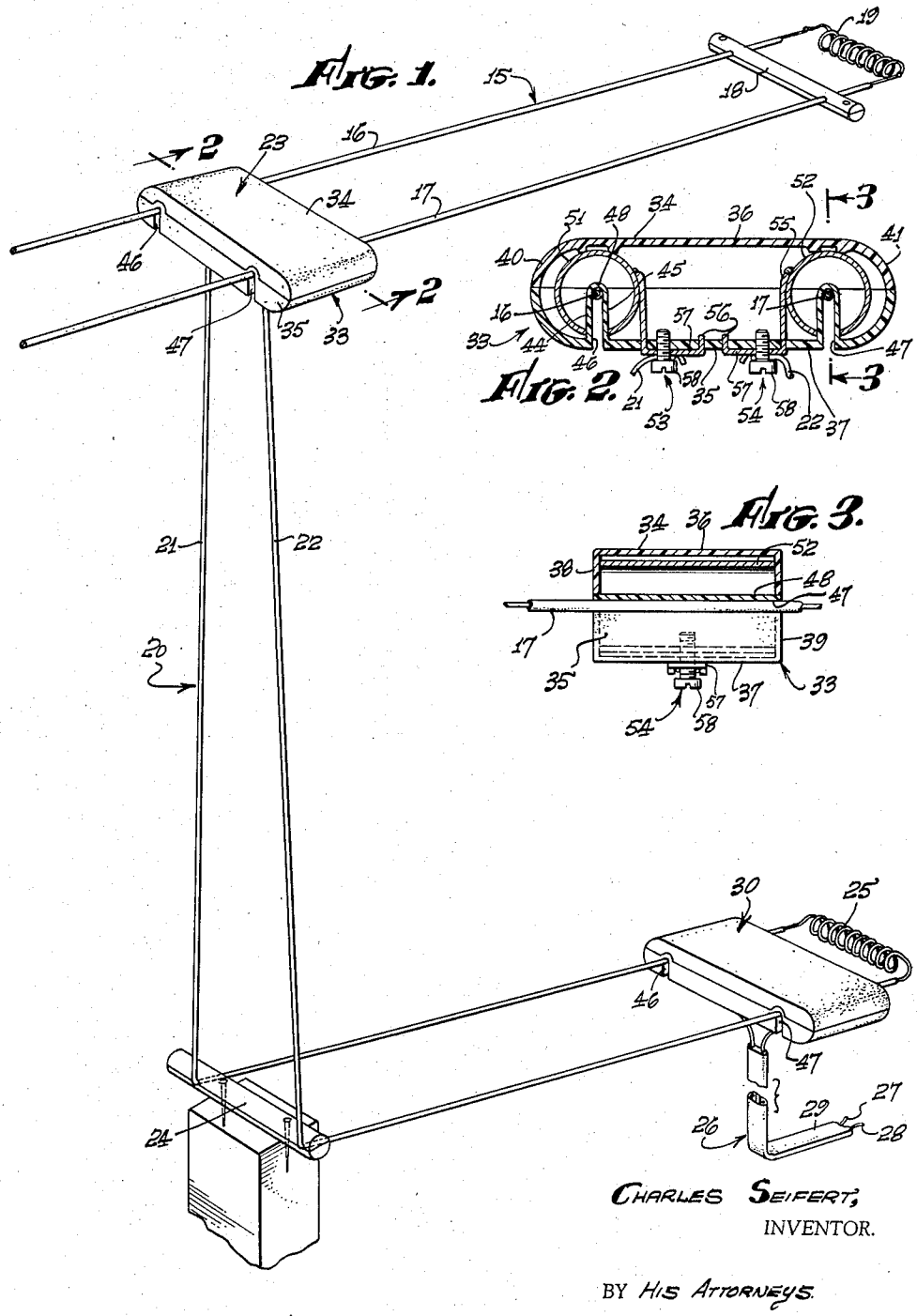


FIG. 2.

FIG. 3.

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Fig. 4.

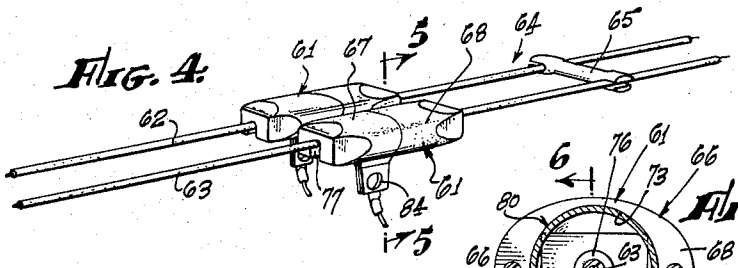


Fig. 5.

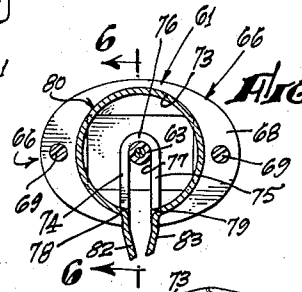


Fig. 7.

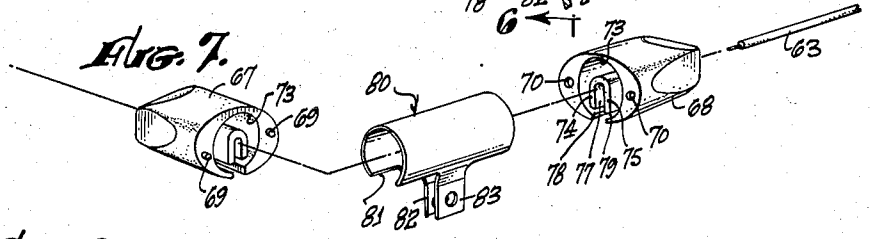


Fig. 8.

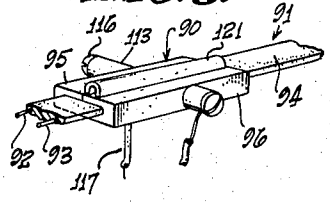


Fig. 6.

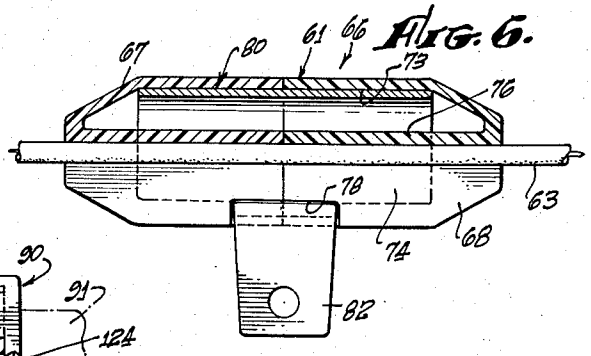


Fig. 9.

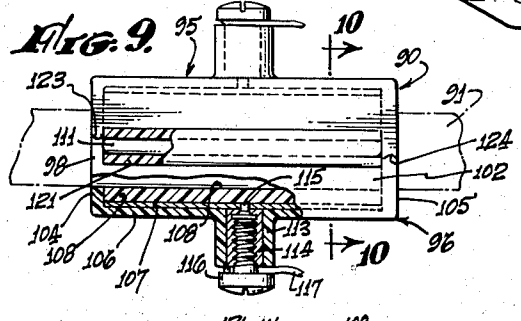
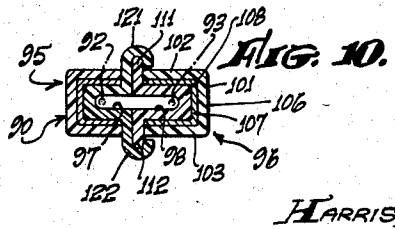


Fig. 10.



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2,913,679

COUPLER FOR TELEVISION SIGNAL DISTRIBUTING SYSTEMS

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Application December 23, 1957, Serial No. 704,826

10 Claims. (Cl. 333—24)

This invention relates to a coupler for transferring energy in the radio frequency range between two open or spaced wire transmission lines. The invention is particularly adapted to coupling a plurality of television receivers to a single antenna without interference or cross coupling between the individual receivers.

This application is a continuation-in-part of my copending application entitled "Coupler for Television Distributing Systems," Serial No. 470,376, filed November 22, 1954.

It is an object of the invention to provide a transmission line coupler which may be used with a plurality of similar couplers to feed a plurality of loads from a single transmission line without introducing additional interference between the loads while having very small line losses. A further object of the invention is to provide a coupler which can be attached to and removed from a transmission line at will and which can be moved to any position along the line as desired.

It is a further object of the invention to provide a coupler which does not require direct contact between the conductors of the two transmission lines, eliminating all soldering, splicing and cutting, so that the coupler may be removed leaving no evidence of its presence on the transmission line. Another object is to provide such a transmission line coupler which may be readily applied to the line by merely positioning the coupler astride the conductors of the line whereby radio frequency coupling is effected without the use of clamps or tools.

It is a further object of the invention to provide a transmission line coupler embodying a pair of conductive tubes or cylinders having slots therein and adapted to be individually positioned around each conductor of a line whereby the tubes may be readily disposed and securely held in coaxial spaced relation to the conductors. Another object of the invention is to provide a coupler suitable for television distributing systems embodying a longitudinally slotted conductive tube for positioning around the conductors of a transmission line in which means are provided for supporting the tube coaxially of the line out of physical contact therewith and in spaced relation thereto and whereby the coupler may be applied to the line by merely disposing its supporting means astride the line in frictional engagement therewith.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. The drawings merely show and the description merely describes preferred embodiments of the invention which are given by way of illustration or example.

In the drawings:

Fig. 1 is a perspective view showing the coupler of the invention as used in coupling a plurality of transmission lines;

Fig. 2 is an enlarged sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is a perspective view of an alternative embodiment of the invention;

Fig. 5 is an enlarged sectional view taken along the line 5—5 of Fig. 4;

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 5;

Fig. 7 is an exploded view of the coupler of Fig. 4;

Fig. 8 is a perspective view of another alternative embodiment of the invention;

Fig. 9 is an enlarged partial sectional view of the embodiment of Figure. 8; and

Fig. 10 is a sectional view taken along the line 10—10 of Fig. 9.

In Fig. 1, a first transmission line 15 consisting of conductors 16, 17 is supported by a plurality of insulating spacers 18, only one being shown, and is terminated in a load resistor 19, the magnitude of the resistor preferably being equal to the characteristic impedance of the line. A second transmission line 20 comprising conductors 21, 22, is coupled to the first transmission line 15 by a coupler 23. The second transmission line is supported by an insulating spacer 24 and is terminated in a load resistor 25 which is also preferably equal to the characteristic impedance of the line. A third transmission line 26 comprising conductors 27, 28 supported by a solid dielectric 29, is coupled to the second line 20 by a coupler 30.

The left end of the line 15 may be connected to an antenna or other source of radio frequency energy and the right end of line 26 may be connected to a television receiver or other load. Additional lines similar to the lines 20 and 26 may be coupled to the line 15 and additional lines may be coupled to the line 20 in the manner shown herein. When desired, the line 20 may be omitted and the line 26 coupled to the line 15 or the line 26 may be omitted and the television receiver or other load substituted for the load resistor 25.

The couplers 23 and 30 are identical and are shown in detail in Figs. 2 and 3. A hollow housing 33 of insulating material such as molded plastic or the like is formed with upper and lower half sections 34, 35. The half sections are joined together by suitable means such as by cementing, providing flat top and bottom walls 36, 37, flat side walls 38, 39, and rounded end walls 40, 41 for the housing 33.

Spaced upstanding or inwardly projecting pairs of parallel or nearly parallel walls 44, 45 extend laterally of the lower section and form a pair of transverse spaced parallel open ended slots 46, 47 in the lower section. The upper ends of the walls 44, 45 are joined together by an arcuate end wall 48 which extends mediate the top and bottom walls 36, 37 so as to lie on a plane at or near the horizontal center of the housing.

Cylinders or tubes 51, 52 of an electrical conducting material such as aluminum, are split longitudinally and positioned astride the upstanding pairs of walls 44, 45 in gripping engagement therewith. The cylinders are preferably of lengths coextensive with lengths of the walls 44, 45 and accordingly have their ends abutting the inner faces of the side walls 38, 39. The diameters of the cylinders preferably are such that the cylinders will snugly fit between the walls 36, 37, the cylinders thus being firmly seated in the housing 33 and securely held against movement relative to the housing.

The walls 44, 45, 48 which define each of the slots 46, 47 are preferably positioned so that the arcuate wall 48 will be concentric with the axis of the cylinder positioned thereabout so that when a conductor is positioned in the

slot in engagement with the wall 48 the conductor will extend substantially coaxial with the cylinder.

Terminals 53, 54 are provided on the exterior of the housing 33 for making direct electrical connection to each of the cylinders 51, 52. Each terminal comprises a conductor 55 with one end fixed to the corresponding cylinder by suitable means such as by soldering, a tang 56 at the other end positioned in an opening in the housing, and an intermediate plate portion 57 disposed against the exterior of the housing, the plate portion having a threaded opening therein for receiving a screw 58.

In use, the coupler is positioned astride a transmission line with a conductor in each of the slots 46, 47, as seen in Figs. 2 and 3, thus positioning the conductors substantially at the centers of the corresponding cylinders. The slots 46, 47 are formed of a width such that the conductors therein will be firmly gripped by the walls 44, 45 and frictionally engaged therewith so that the housing 33 will be held securely in place on the pair of conductors without the use of extraneous fastenings. The coupler is removed from the line merely by applying sufficient manual force to overcome the frictional grip of the side walls of the conductors.

After the coupler has been placed on the transmission line, the coupler may be moved back and forth along the line until a maximum or optimum signal is achieved. Additional couplers may be placed at intervals along the line, with each being adjusted for an optimum or maximum signal.

An alternative embodiment of the invention is shown in Figs. 4, 5, 6, and 7, wherein the two conducting tubes or cylinders are carried in separate housings so that the coupler may be used with lines having various spacings between conductors. Referring to Fig. 4, two couplers 61 are positioned on conductors 62, 63 of a transmission line 64, the conductors being supported by an insulating spacer 65. One of the couplers 61 is shown in detail in Figs. 5, 6, and 7. A housing 66 of an insulating material such as a molded plastic is formed of two shells 67, 68 which are identical with the exception of bosses 69 on the shell 67 which engage openings 70 in the shell 68 for aligning the shells when they are joined to form the housing. A chamber 73, which may be cylindrical in shape, is formed within the shell. Substantially parallel side walls 74, 75 project into the chamber 73, the interior edges of the side walls being joined by a top wall 76 with the walls defining a longitudinal slot 77 through the shell.

The slot 77 is dimensioned so that the conductor 63 may be positioned therein with the walls 74, 75 frictionally gripping the conductor and with the conductor substantially coaxial with the longitudinal axis of the chamber 73 when the conductor engages the top wall 76.

A tube 80 of electrical conducting material and preferably having the same form as the chamber 73 is positioned in the chamber 73, the tube having a slot 81 therein for alignment with the slot 77 of the housing. In the particular embodiment illustrated herein, the tube 80 is formed from a piece of flat material and is provided with integral, apertured tabs or terminals 82, 83 at the respective edges of the slot. Openings 78, 79 are provided in the walls 74, 75, respectively, adjacent the outer shell for passage of the tabs 82, 83.

The shells 67, 68 are butted together with the tube 80 positioned therein, substantially as shown in Fig. 6, and the two shells are fixed together by suitable means such as by cementing. The coupler may then be placed on a transmission line with a conductor in the slot. Then a screw 84 is positioned in the openings in the terminals 82, 83 and a lead or conductor 85 is fixed to the screw by a nut, not shown, for making the electrical connection to the tube (Fig. 4). Another coupler is similarly placed on the other conductor of the transmission line and the two units may be moved along the line to function in the same manner as the single unit of the embodiment of Figs. 1, 2, and 3.

Another alternative embodiment of the invention which is particularly suited for use with transmission lines in which the conductors are spaced by a continuous solid dielectric is shown in Figs. 8, 9, and 10. Of course, the structure of this embodiment is not limited in use to a line with a solid dielectric but may also be used with lines of the type shown in Fig. 4. In Fig. 8, a coupler 90 is positioned about a transmission line 91, the latter comprising conductors 92, 93 carried in a solid dielectric 94. The coupler 90 is formed of two housing units 95, 96 having corresponding longitudinal slots 97, 98, respectively therein, the two units being positionable on opposite sides of the transmission line for joining to each other with the slots aligned to enclose the transmission line therein.

The two housing units 95, 96 are substantially identical with the exception of the particular means for fastening them together. The unit 96 includes an outer shell 101 having sides 102, 103, ends 104, 105, and a top 106, the slot 98 extending through the ends. A U-shaped plate or slotted tube 107 of electrical conducting material is positioned within the shell 101 and a U-shaped inner shell 108 of insulating material is positioned inside the plate 107, the open center of the U serving to define the slot 98. The inner shell 108 includes longitudinal ribs 111, 112, which project outward beyond the outer shell 101 on opposite sides of the unit transverse to the slot 98. A hollow boss 113 projects outward from the top 106 of the outer shell and a threaded metal plug 114 is positioned within the boss 113, the plug being fixed to the plate 107 by suitable means such as by a rivet 115. A screw 116 is threaded into the plug 114 serving as a terminal for connecting a conductor 117 to the plate 107.

The housing unit 95 is similar to the housing unit 96 except for the ribs of the inner shell, the ribs being provided with curved end sections 121, 122 providing grooves for slidingly receiving the ribs 111, 112, respectively.

The end 104 of the outer shell of a housing unit preferably extends slightly beyond the center line of the slot, being terminated in a concave section 123 (Fig. 9) while the end 105 does not extend to the center line of the slot and is terminated in a convex section 124. The coupler is mounted on a transmission line by placing the two housing units on opposite sides of the line with the units displaced from each other along the longitudinal axis of the line with the unit 95 to the right as viewed in Fig. 9. Then the units are moved toward each other along the line to slidingly engage the ribs of one unit in the corresponding grooves of the other unit to bring the units to the position shown in Fig. 9 with the transmission line frictionally gripped therebetween. The mating concave and convex sections of the ends of the outer shells engage each other to provide a snap action for holding the two units together.

Thus this embodiment of the coupler of the invention may also be placed on and removed from a transmission line as desired and may be moved to any position along the line without requiring any physical connections to the line such as splicing, taping, cutting and the like.

The most obvious method of coupling one open two-wire transmission line to another or a balanced twin feeder line to an open two-wire transmission line, would be to solder, tape, or otherwise establish direct electrical connection between the appropriate conductors of the two lines. Such a method of direct electrical connection would cause impedance mismatch, with a resultant large standing wave ratio, voltage reflections, deterioration of the quality of the radio frequency signals being transmitted over the transmission lines, and severe reduction of signal strength in the transmission lines. It is commonly known that if a pair of wires carrying an alternating current be placed in close parallel proximity to another pair of wires, then there will be an electrical interaction between the two pairs of wires. A coupler

could, therefore, in this application, consist merely of parallelism between the appropriate conductors of two open two-wire lines. Such an arrangement, however, while feasible in certain applications, has the inherent disadvantage that, in order to obtain sufficiently good coupling, the length of parallelism required may approach a quarter wave length of the radio frequencies being transmitted. This, in turn, has a deleterious effect upon the transmission of the radio frequency signals, and upon their quality. Thus, essentially, this method of transfer of energy is limited either as to the amount of coupling possible, or as to the bandwidth possible. Furthermore, the placing of the conductors of one line in close juxtaposition to the conductors of another, has an effect upon the characteristic impedance of the latter, and this effect is increased with length of parallelism. Thus, again mismatch is caused, with its attendant undesirable effects upon the radio frequency signals being transmitted. The present invention achieves closer coupling than is possible with parallelism, so that the limitations, particularly as to bandwidth, are considerably less, so that the invention is, in practice, able to be used satisfactorily over the entire VHF television frequency spectrum. An important feature of the coupler of the invention is its small size. For example, the particular embodiments shown herein are being used with present day television systems including 450 ohm and 300 ohm transmission lines with the conducting sleeve or tube being in the order of one to one and one half inches in length and one quarter to one half inch in width.

Although exemplary embodiments of the invention have been disclosed and discussed, it will be understood that other applications of the invention are possible and that the embodiments disclosed may be subjected to various changes, modifications and substitutions without necessarily departing from the spirit of the invention.

I claim as my invention:

1. In a coupler for an open wire transmission line, the combination of: a pair of metallic, axially slotted tubes; housing means for frictionally engaging the wires of the line, said housing means including means for supporting said tubes thereon for positioning a tube coaxial with a wire when said housing means is frictionally engaged with the wire, with said housing means spacing said tube from the wire; and means for connecting an electrical conductor to each of said tubes.

2. In a coupler for television distributing systems embodying a pair of radio frequency conductors, the combination of: an insulating housing formed with a pair of spaced transverse slots on its underside for reception of conductors; a pair of upstanding side walls carried within said housing and bordering opposite sides of each of said slots; a conductive, axially split cylinder positioned astride each pair of said walls within said housing; an end wall connecting each pair of said side walls and adapted to seat on a conductor leading therebeneath, said walls being arranged to position the conductor in the slot bordered thereby coaxially with the associated cylinder in spaced relation thereto; and a conductor leading from each of said cylinders.

3. A device for transmitting radio frequency between pairs of radio frequency transmission lines comprising: a pair of spaced, parallel, axially split conductive cylinders; an insulating housing carrying said cylinders having pairs of spaced upstanding walls interiorly thereof astride of which said cylinders are mounted, each of the spaces between each pair of walls being adapted to receive one conductor of a transmission line; means for positioning lines in said spaces in coaxial spaced relation to said cylinders; conductors leading from said cylinders; and binding posts connected to said conductors.

4. The structure called for in claim 3 in which the pairs of spaced walls frictionally grip a line interposed therebetween.

5. A device for transmitting radio frequency between pairs of radio frequency transmission lines comprising: an insulating housing having a top wall, a bottom wall, side walls and end walls, said bottom wall being formed with spaced pairs of upstanding spaced walls leading transversely thereof and bordering line receiving slots which open through said bottom and side walls; interior top walls connecting the upper ends of each of said pairs of upstanding walls; a hollow, axially split, open ended, conductive cylinder positioned astride each of said pairs of upstanding walls in engagement with the lower portions thereof with said interior top walls concentric with said cylinders; and a conductor leading from each of said cylinders.

6. In a coupler for a two wire transmission line, the combination of: first and second members of insulating material having longitudinal slots therein and means for joining said members together with said slots aligned to provide a substantially rectangular passage through said joined members for receiving said two-wire transmission line with one wire in each slot; a first axially slotted tube of electrical conducting material carried on said first member and positioned about the slot therein; a second axially slotted tube of electrical conducting material carried on said second member and positioned about the slot therein; and means for connecting conductors to each of said tubes.

7. A coupler for a two wire transmission line comprising two elongated channel-shaped units with means for joining the open sides of the units to define a passage for said two transmission line wires therethrough with one wire in each unit, each of said units including an outer member of insulating material, a central member of conducting material, an inner member of insulating material positioned within said central members for spacing said central members from the transmission line, said inner members defining the inner faces of said channels, and means for connecting a conductor to said central member.

8. In a coupler for a transmission line, the combination of: a first housing of insulating material having a longitudinal slot therein for gripping one conductor of the line and having opposed longitudinal ribs projecting outward therefrom; a first axially slotted metallic tube mounted in said first housing for positioning around the conductor in the slot; means for connecting a conductor to said first tube; a second housing of insulating material having a longitudinal slot therein for gripping the other conductor of the line and having opposed longitudinal grooves for longitudinal sliding engagement with said ribs of said first housing to join said housings about the transmission line; a second axially slotted metallic tube mounted in said second housing for positioning around the other conductor in the slot of said second housing; and means for connecting a lead to said second tube.

9. A coupler for mounting on a transmission line having two conductors spaced by a solid dielectric, with the coupler slidable along the line to any desired location, the coupler comprising: a housing with two separable members having aligned slots therein providing a substantially rectangular passage for the transmission line with one conductor in each of said slots, the housing having means for joining said members together to grip the transmission line therebetween; an axially split metallic tube carried in each of said members with the tube encompassing the slot; and means for connecting a lead to each of said tubes to couple said lead to the transmission line.

10. In a device for coupling a first transmission line to a second transmission line, the combination of: a hollow housing section of nonconducting material having a circumscribing peripheral wall and end walls, a portion of said peripheral wall being of generally U-shape and extending into said housing to define an outwardly facing open channel; slots in said end walls in alignment with the ends of said channel whereby said housing may

be removably placed on said first transmission line with said first transmisison line extending along the bottom of said channel; a generally U-shaped conducting element in said housing embracing said generally U-shaped peripheral wall portion and extending between said end walls with the bottom of said channel extending substantially along the longitudinal axis of said U-shaped conducting element whereby said element is coupled to said first transmission line; and conducting terminal means extending from said conducting element to the exterior of said housing.

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