Sept. 28, 1948. G. C. DEVOL 2,449,983

COAXIAL LINE COUPLING

Filed Feb. 4, 1943 2 Sheets-Sheet 1

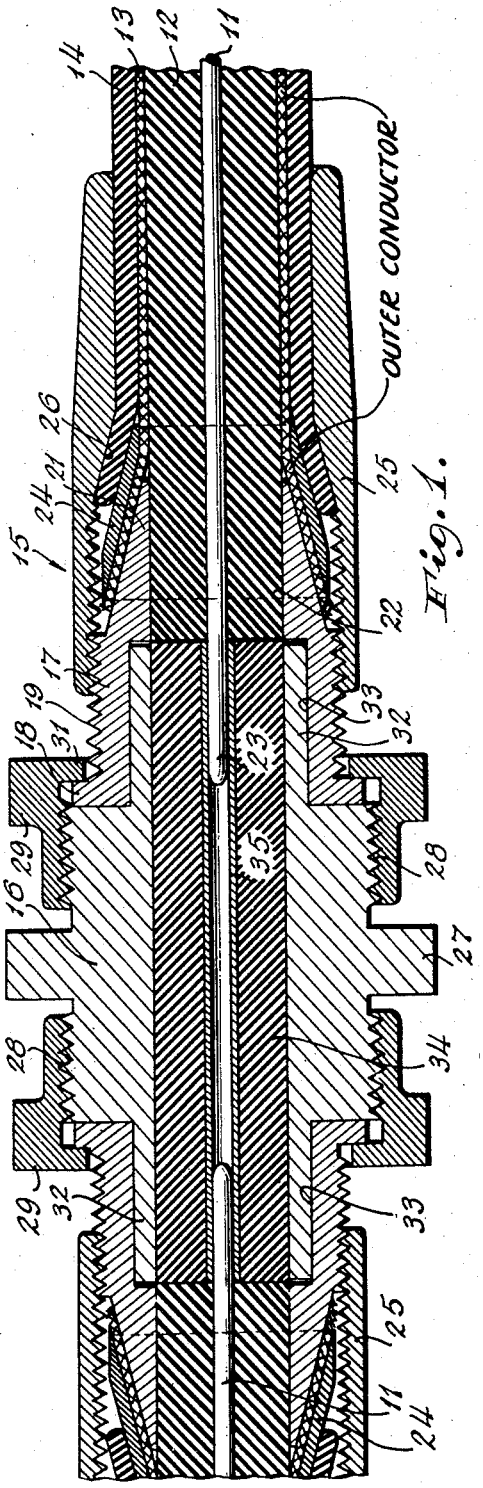

Fig. 1.

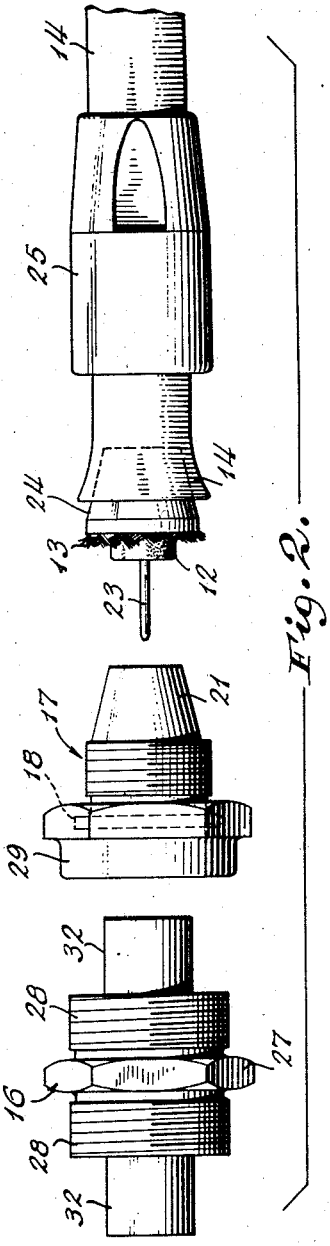

Fig. 2.

INVENTOR
GEORGE C. DEVOL
BY Paul B. Hunter.
ATTORNEY

Sept. 28, 1948. G. C. DEVOL 2,449,983

COAXIAL LINE COUPLING

Filed Feb. 4, 1943 2 Sheets-Sheet 2

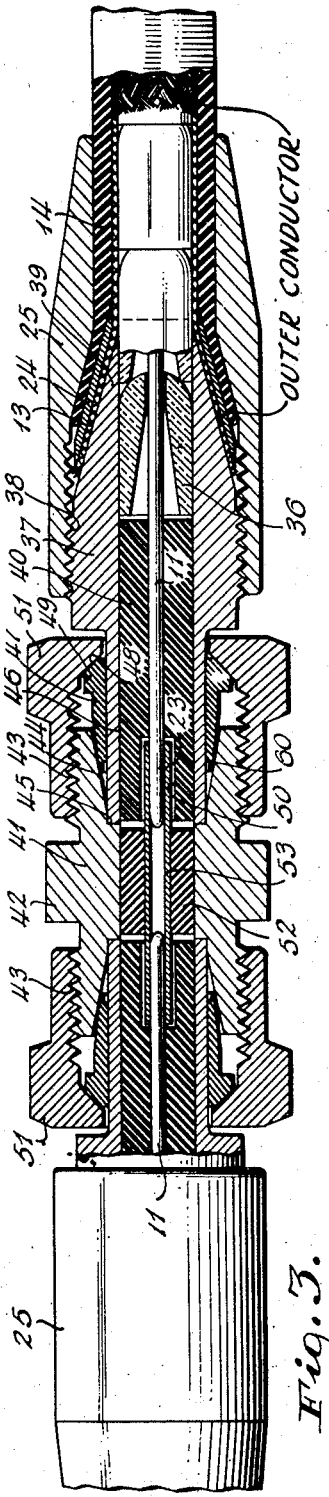

Fig. 3.

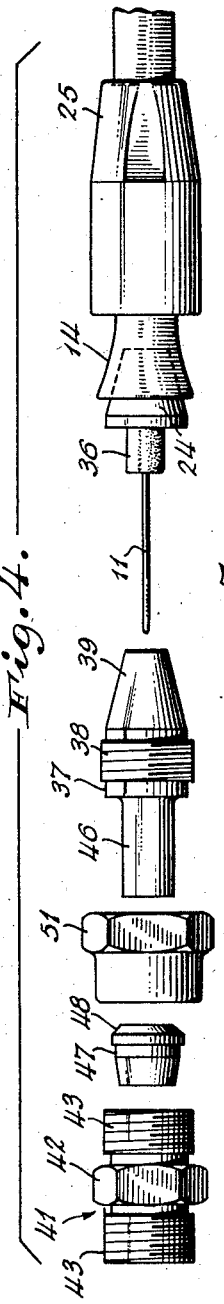

Fig. 4.

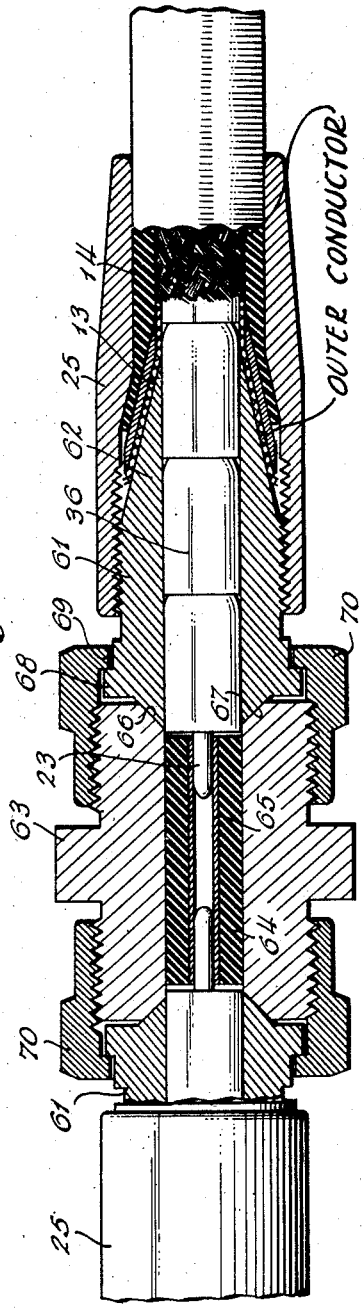

Fig. 5.

INVENTOR
GEORGE C. DEVOL
BY Paul B. Hunter
ATTORNEY

Patented Sept. 28, 1948

2,449,983

UNITED STATES PATENT OFFICE

2,449,983

COAXIAL LINE COUPLING

George C. Devol, Greenwich, Conn., assignor to The Sperry Corporation, a corporation of Delaware

Application February 4, 1943, Serial No. 474,740

15 Claims. (Cl. 174—88)

1

This invention relates to couplings for electrical transmission lines and is more particularly concerned with couplings for flexible transmission lines of the coaxial conductor type.

The major object of this invention is to provide a coupling for a flexible transmission line of the coaxial conductor type wherein the coaxial conductors are reliably and securely attached in a novel manner to the coupling.

A further object of the invention is to provide novel rigid coupling construction for a flexible transmission line of the coaxial conductor type.

It is a further object of the invention to provide a coupling structure for a flexible coaxial conductor transmission line wherein novel clamp arrangements are provided between the outer conductor and the coupling.

A further object of the invention is to provide a novel coaxial conductor transmission line coupling wherein the end of such a flexible line is rigidly wedged between suitable relatively adjustable inclined surfaced coupling members.

A further object of the invention is to provide a coaxial conductor transmission line coupling having novel arrangements for connection to the inner and outer line conductors.

Further objects of the invention will presently appear as the description proceeds in connection with the appended claims and the annexed drawings wherein:

Fig. 1 is an axial section through a coaxial transmission line provided with a coupling according to the invention;

Fig. 2 is an exploded view illustrating various elements of the coupling and the mode of assembly of the coupling with the flexible line in Fig. 1.

Fig. 3 is an axial section through a coaxial transmission line provided with a coupling of somewhat different structure than Fig. 1, but embodying the invention;

Fig. 4 is an exploded view illustrating various elements and the mode of assembly of the line of Fig. 3; and

Fig. 5 is an axial section through a coaxial transmission line illustrating a still further embodiment of the invention.

Referring to Fig. 1, a coupling for interconnecting adjacent ends of two flexible coaxial conductor ultra high frequency electrical transmission lines is illustrated. Each flexible line is of conventional construction, comprising a flexible solid wire inner conductor 11, a continuous insulator sleeve 12 of a material which is suitably flexible and has sufficiently high dielectric properties for the use desired, an outer conductor 13 which is usually of braided copper to permit desired expansibility and flexibility, and an external insulator covering 14 of rubber or saturated fabric of any known design.

2

The coupling consists primarily of line terminal sections indicated at 15 and a body member 16. Each line terminal section comprises a tubular fitting 17 having a radially projecting flange 18 at one end, an intermediate threaded section 19, and a tapered or substantially frusto-conical section 21 at the other end. As shown in Fig. 1, section 21 projects at least partly within the open end of the transmission line. Since the tapered face of section 21 is of increasingly larger outer diameter than conductor 13, the latter is outwardly flared at its end.

Internally, fitting 17 is formed with a cylindrical bore 22 into which extends the line insulator sleeve 12 as illustrated. A section of the sleeve is cut away to bare inner conductor 11 in a tip 23, which is preferably rounded off for coupling purposes.

A hollow substantially frusto-conical metal collar 24, preferably internally of the same taper as section 21, is disposed at least partly between outer conductor 13 and insulator covering 14 at the open end of the line. This flares covering 14 outwardly as illustrated. Finally, an external holding member 25, internally threaded at one end to be rotatably adjustably mounted on section 19 of fitting 17, extends over the joint and is formed with an internal substantially frusto-conical surface 26 preferably of the same taper as the outer surface of collar 24. Beyond surface 26, the bore of holding member 25 fits relatively snugly about the transmission line.

When holding member 25 and fitting 17 are relatively rotated to draw them together, the flared end of insulator covering 14 is tightly compressed between surface 26 and collar 24, and simultaneously the outer conductor is tightly gripped between collar 24 and fitting 17. As is shown in Fig. 1, a relatively large annular area of insulator covering 14 is clamped in the coupling. Similarly, a relatively large annular area of outer conductor 13 is clamped between collar 24 and the tapered metal face at 21 on fitting 17, thereby insuring an excellent conductive connection between conductor 13 and fitting 17. These large clamping areas afford strength against longitudinal pull on the transmission line.

Body member 16 comprises a tubular metal part serving as a continuation of the outer con-

ductor of the transmission line. An enlarged central flange 27 is formed to be gripped by a wrench or the like and flanked by external threaded portions 28 for mounting nuts 29. Each nut 29 is formed with a radially inwardly projecting flange 31 for engaging flange 18 on the adjacent fitting 17, so that when either nut 29 is drawn tight, the adjacent fitting 17 is secured tightly to body member 16.

Body member 16 is formed at opposite ends with rigid, preferably integral, longitudinally projecting cylindrical collars 32 each of which extends with friction fit into a suitable shouldered region 33 of fitting bore 22. This provides a telescoping connection between the fitting and body member, promoting ease of assembly.

Internally, body 16 contains an insulator sleeve 34, which may be of solid or flexible dielectric material as desired, and a central hollow metal tube 35 which is preferably fixed to the sleeve 34. Sleeve 34 is of such length as to extend entirely through the body member and collars 32, and preferably a short distance beyond collars 32 as illustrated.

Tip 23 fits frictionally within the female fitting provided by open ended tube 35, thereby providing a good electrical connection to inner conductor 11. The parts are furthermore so dimensioned that, in the assembly illustrated, the adjacent ends of insulator sleeves 34 and 12 are closely adjacent and preferably abutting.

As shown in Fig. 1, the left side of the coupling is identical with that above described if a flexible line is to be attached thereto. If, however, the coupling is for attaching a flexible line to a rigid transmission line, the coupling may be altered to suit at the left side.

The manner of assembling the coupling is shown best in Fig. 2. Holding member 25 is first slipped over the cable end, which is suitably cut to expose conductor 11 and remove the necessary sections of sleeve 12, outer conductor 13 and covering 14. Collar 24 is then inserted strongly between covering 14 and the outer conductor 13. Whereby covering 14 is rubber, it stretches easily to permit this operation. Then fitting 17, which has nut 29 slipped thereover as shown in Fig. 2, is advanced so that section 21 is inserted between the outer conductor 13 and sleeve 12, sleeve 12 simultaneously advancing within bore 22. Holding member 25 is then moved up into threaded engagement with fitting 17 and the two are drawn tight, thereby clamping the flexible line to fitting 17 as above described. The length of tip 23 is so chosen as to terminate adjacent the open end of fitting 17 as illustrated.

Fitting 17 is then rigidly attached to body member 16 by first telescoping collar 32 into shoulder 33 and then drawing nut 29 up tight. During this operation, tip 23 enters tube 35, and the insulator sleeves 12 and 34 are drawn into substantially abutting relation.

In Fig. 3, the illustrated flexible line is of the type having the inner conductor 11 supported by successive, individually rigid, universally coupled insulator beads 36 of polystyrene or the like. Fitting 37 is mainly similar to fitting 17. Fitting 37 has an externally threaded section 38 for mounting holding member 25, and a frusto-conical end portion 39 projecting within outer conductor 13. When holding member 25 is drawn tightly, the flexible line is clamped to fitting 37 as in Fig. 1.

The manner of attaching fitting 37 to body member 41 is somewhat different from Fig. 1.

Body 41 is formed with a wrench-fitting flange 42 and externally threaded end sections 43. At each end, body member 41 is formed with an inwardly tapering throat 44 which terminates in a cylindrical shoulder 45. An elongated cylindrical collar 46, rigid and preferably integral with fitting 37, projects within the body member 41 and has its end seated in shoulder 45. A preferably rigid insulator sleeve 40 is supported by fitting 37 wherein it terminates well short of the flexible line end as shown and extends through collar 46. Sleeve 40 is internally shouldered at 50 for a reason which will appear. A slidable locking sleeve 47 is mounted on collar 46. Sleeve 47 is formed with an outwardly tapered, preferably conical, face 48 adapted to be engaged by a similarly shaped internal face 49 on a nut 51 threadedly mounted on section 43 of the body member.

Within body member 41 is a rigid insulator block 52 carrying a hollow metal tube 53 which projects therefrom at opposite ends and serves as an inner line conductor extension in the assembly.

For assembly, as shown in Fig. 4, a much longer section of inner conductor 11 is bared than in Fig. 2. This is because conductor 11 must extend through insulator sleeve 40. Preferably enough beads 36 are left on conductor 11 to insure substantial abutment with sleeve 40 within fitting 37, as shown in Fig. 4.

Sleeve 47 and nut 51 are placed on collar 46, which is then inserted into body member 41. As nut 51 is drawn up tight, sleeve 47 is slidably advanced by contact of faces 48 and 49 and wedged into tapered bore 44. If desired, the end of sleeve 47 may be weakened at 60 to facilitate this action and help strengthen the wedged connection between the fitting and body member. During this operation also, the projecting end of tube 53 extends into shoulder 50, while tip 23 of the inner conductor slips frictionally into tube 53. The end of sleeve 40 is drawn closely adjacent the associated end of block 52.

The left side of Fig. 3 is preferably substantialy identical, as illustrated.

The assembly of Fig. 5 is similar to that of Fig. 3 in the manner in which the flexible line is attached to fitting member 61, as illustrated, conical section 62 being clamped to the outer conductor when holding member 25 is tight. Here, however, sufficient beads 36 are retained on conductor 11 to extend entirely through hollow fitting 61, so that tip 23 projects from the fitting.

Body member 63 is externally similar to body 41 in Fig. 3 and contains a rigid insulator sleeve 64 to which is fixed a hollow tube 65. Sleeve 64 extends almost entirely through the bore of body 63, which bore is formed at each end with conical locating recess 66 for receiving correspondingly formed projection 67 on the fitting. Fitting 61 is provided with a radial end flange 68 for engagement with a similar flange 69 on a nut 70.

When nut 70 is drawn tight, fitting 61 and body member 63 are drawn tight, surfaces 66 and 67 insuring coaxial alignment, and tip 23 enters tube 65. As illustrated, the left side of Fig. 5 may be identical with the right side.

I have thus provided couplings for flexible coaxial type transmission lines which are mechanically strong and electrically reliable. The inner conductor of the line is joined to the inner conductor of the coupling with very little change in diameter through the fitting to prevent sudden or large changes in characteristic impedance in the coupling. The outer conductor is held by

pressure contact, without solder, through the coupling, thereby providing strength against axial pull. In each instance the dielectric in the line, between outer and inner conductors, is butted under compression to the corresponding dielectric in the coupling, for retaining electrical characteristics of the line in the coupling. The insulator sleeve in the line, solid or beaded, is guided into the associated coupling member during assembly. The inner conductor tip 23 is protected against bending by termination short of the far end of the clamp fitting into which the line extends.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a coupling adapted for straight through extension of a flexible transmission line having an inner conductor, a substantially coaxial outer conductor and an insulator covering about said outer conductor; the combination comprising a coupling member having a clamping face adapted to extend within said outer conductor, a clamp collar adapted to be inserted between said outer conductor and said covering, a holding member adjustably connected to said coupling member for tightly securing said outer conductor between said clamping face and said clamp collar and for securing said insulator covering between said holding member and said clamp collar, and conducting means coaxially supported within said coupling member and adapted to telescopically receive said inner conductor.

2. In a coupling for a flexible transmission line having a solid inner conductor, a substantially coaxial outer conductor and an insulator covering about said outer conductor; the combination comprising a tubular coupling member having a generally frusto-conical face adapted to be inserted into the open end of said line interiorly of said outer conductor, said coupling member also having a bore equal to the inner diameter of said outer conductor and forming a smooth extension thereof, a substantially frusto-conical clamp collar adapted to be inserted into the open end of said line between said outer conductor and said covering, a holding member adjustably connected to said coupling member, said tubular coupling member, said clamping collar, and said holding member having clamping surfaces at least partly coextensive with one another and conducting means coaxially supported within said tubular coupling member and adapted to telescopically receive said inner conductor, whereby smooth continuations of said inner and outer conductors are provided.

3. The coupling defined in claim 2, wherein said holding member is provided with an internal substantially frusto-conical face adapted to engage said covering exteriorly and opposite said collar.

4. In a coupling for a flexible transmission line having a solid inner conductor, a substantially coaxial outer conductor, an insulator sleeve between said conductors and an insulator covering about said outer conductor; the combination comprising a tubular fitting having a substantially frusto-conical face adapted to project within the open end of said line between said insulator sleeve and said outer conductor so that outer conductor is flared at its end, said fitting being hollow to receive a substantial length of the end section of said insulator sleeve, a substantially frusto-conical movable clamp collar adapted to be inserted into the open end of said line between the outer conductor and said covering so that said covering is flared at its end, and a solid external holding member adjustably connected to said fitting having an internal face adapted to bear against said covering, said tubular fitting, said clamp collar, and said holding member having clamping surfaces at least partly coextensive with one another so that said outer conductor and covering may be securely clamped in said coupling upon adjustment of said holding member and conducting means coaxially supported within said fitting and adapted to telescopically receive said inner conductor.

5. In a coupling for an ultra high frequency electrical transmission line having a solid inner conductor, a substantially coaxial outer conductor, an insulator means between said conductors, and an insulator covering about said outer conductor; a tubular fitting, movable gripping means within said coupling for clamping said outer conductor and said insulator covering securely to said fitting, said fitting being centrally apertured to receive the extended end of said insulator means, a coupling body member containing an insulator sleeve and a fixed center conductor therein having a female end, and means for securing said fitting and body member together for electrically continuing said outer conductor, with the end of the insulator sleeve of said body member closely adjacent the associated end of the insulator means of said line, and with said inner line conductor inserted within the female end of said center conductor of said body member.

6. The coupling defined in claim 5, wherein the insulator sleeve of said body member extends a substantial distance into the interior of said fitting.

7. The coupling defined in claim 5, wherein said body member and fitting are telescopically joined.

8. The coupling defined in claim 5, wherein said body member projects into said fitting oppositely from said line.

9. The coupling defined in claim 5, wherein said body member is externally threaded at opposite ends and said securing means comprises threaded connector collars enclosing the joint between said fitting and body member.

10. In a coupling for interconnecting two flexible transmission lines of the coaxial type, a rigid body member, clamp fittings by which the outer conductors and insulation covering, respectively, of said lines are adapted to be separately gripped said fittings connecting substantially telescopingly with said body member, a center conductor within said body member in alignment with the inner conductors of said lines and having female ends for receiving the associated ends of the respective inner conductors of said lines, and means securing said fitting and body member together to provide smooth electrical continuity of the outer and inner conductors of said lines.

11. In a coupling for a flexible transmission line of the type having coaxial inner and outer conductors spaced by insulating means and having an insulator covering about said outer conductor, the combination comprising a coupling member having a clamping face adapted to extend within said outer conductor and having a central recess adapted to receive said insulating

means, a holding member adjustably connected to said coupling member for securing said outer conductor and said insulator covering between said holding member and said coupling member, a hollow body member forming the outer conductor in said coupling, an insulator sleeve extending entirely through said body member, and a tubular inner conducting member fixed within said insulator sleeve, said insulating means extending into said coupling member a sufficient distance to abut said insulator sleeve, and said tubular inner conducting member sliding over the ends of the inner conductors of said transmission line.

12. In a coupling between a first transmission line and a second transmission line, said two lines having respective inner conductors and hollow outer conductors of substantially the same inner diameter respectively concentrically disposed about said inner conductors; the combination comprising coupling means adapted to be inserted into the open end of said first line and extending between said first and said second lines, and a holding member adjustably connected to said coupling means for clamping said first line to said coupling means, said coupling means having a continuous inner bore completely therethrough of the same diameter as the bore of said outer conductors and providing smooth electrical continuity therebetween.

13. In a coupling for a flexible transmission line having an inner conductor, a coaxial outer conductor, and an insulator covering about said outer conductor, the ratio of the inner diameter of said outer conductor to the outer diameter of said inner conductor being of a fixed predetermined value; the combination comprising a coupling member adapted to contact said outer conductor, a holding member adjustably connected to said coupling member and adapted to contact said insulator covering, and clamping means formed in said coupling and having a continuous inner bore completely therethrough of the same diameter as that of said outer conductor, thereby providing an effective extension of said outer conductor and maintaining said diametral ratio substantially constant, said clamping means being operable to secure said outer conductor and said insulator covering to said coupling.

14. In a coupling for a flexible transmission line having an inner conductor, a coaxial outer conductor, and an insulator covering about said outer conductor; the combination comprising a pair of adjustably interconnected tubular coupling members having clamping faces between which said line is adapted to be introduced, one of said coupling members being telescopingly insertable within said transmission line between said inner and outer conductors, the other of said coupling members being disposed exteriorly of said insulator covering, an axially displaceable adapter interposed between said outer conductor and said insulator covering and operable upon adjustment of said coupling members to separately grip said outer conductor and said insulator covering and to bind them securely to said coupling members, and a conducting member coaxially supported within one of said coupling members and adapted to contact said inner conductor and to provide an extension thereof.

15. In a coupling for a flexible transmission line having an inner conductor, a substantially coaxial outer conductor, and an insulating cover surrounding said outer conductor; the combination comprising a coupling member having a substantially conical clamping face insertable within said transmission line in contact with said outer conductor, a holding member adjustably connected to said coupling member and having a clamping face adapted to contact said insulating cover, axially movable gripping means in said coupling having clamping faces adapted to oppositely engage said outer conductor and said insulating cover, said clamping faces being operable to separately grip said outer conductor and said insulating cover upon adjustment of said holding member relative to said coupling member and a conducting member coaxially supported within said coupling member and adapted to contact said inner conductor and to provide an extension thereof.

GEORGE C. DEVOL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
477,951	Mezger	June 28, 1892
1,060,600	Jamieson	May 6, 1913
1,246,964	Lowe	Nov. 20, 1917
1,497,002	Sanderson	June 10, 1924
1,718,817	Greene	June 25, 1929
1,896,444	Fossati	Feb. 7, 1933
2,007,357	Anderson et al.	July 9, 1935
2,093,403	Sertillange	Sept. 21, 1937
2,118,103	Oeding	May 24, 1938
2,173,643	Moser	Sept. 19, 1939
2,275,762	Horton	Mar. 10, 1942
2,296,766	Bruno	Sept. 22, 1942
2,328,111	Thornbery	Aug. 31, 1943

FOREIGN PATENTS

Number	Country	Date
112,951	Great Britain	Feb. 7, 1918
304,007	Great Britain	Jan. 17, 1929
489,510	Great Britain	July 28, 1938
560,808	France	July 19, 1923