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SHORTING PLUG AND WRENCH

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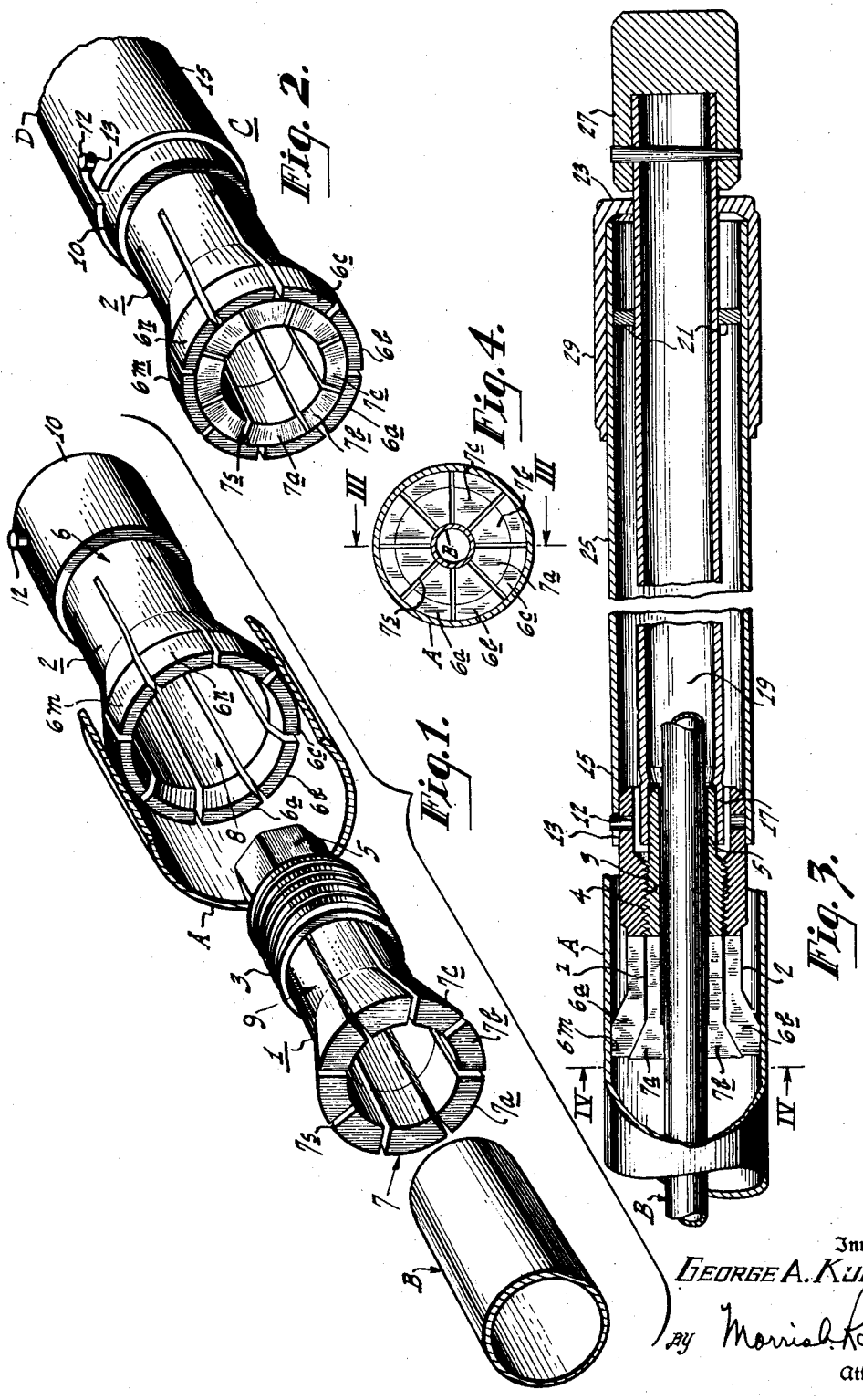


Fig. 1.

Fig. 2.

Fig. 4.

Fig. 3.

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SHORTING PLUG AND WRENCH

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This invention relates to an improved shorting-plug and wrench assembly for altering the effective mechanical length and hence the electrical tuning of a transmission line of the type comprising concentrically spaced inner and outer conductors.

The principal object of the present invention is to provide a shorting-plug having the minimum number of parts required to effect an adjustable connection of low impedance between the spaced apart conductors of a coaxial cable, or the like, and one which may be easily adjusted by a removable wrench of simple construction.

The invention will be described in connection with the accompanying drawing wherein:

Fig. 1 is an exploded view of an open-end portion of a coaxial cable containing a bi-part shorting-plug which is constructed in accordance with the principle of the invention.

Fig. 2 is a view in perspective of the bi-part shorting-plug of Fig. 1 with its two parts assembled and showing the end of a wrench for effecting relative movement of the said parts,

Fig. 3 is a longitudinal sectional view taken on the line III—III of Fig. 4 of a coaxial transmission line with the plug of the invention arranged therein and with the wrench in position to adjust the plug at a selected point in the line and

Fig. 4 is a sectional view taken on the line IV—IV of Fig. 3.

In the drawing, A designates the outer conductor and B the inner conductor of a coaxial cable, side-band filter, or analogous device capable of handling radio waves of a frequency determined, at least in part, by the effective length of the said conductors. The shorting plug of the invention, shown generally at C, is movable in the space between the inner and outer conductors and normally constitutes a conductive connection between the said conductors A and B. As will hereinafter more fully appear the force required to move the plug to a desired point within the cable, and the relative movement of the parts required to secure the plug at that point, are applied by means of a removable socket type wrench D.

As previously indicated the shorting plug C of the invention consists of but two separable parts. These parts comprise a hollow spring fingered chuck 1 for gripping the inner conductor B and a spring fingered collet 2, surrounding the chuck and adapted to bear against the inner surface of the outer conductor A when the collet is screwed-up over the chuck on complementary threads 3 and 4 on the said parts.

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It will be observed upon inspection of Fig. 1 that the chuck 1 comprises a hollow sleeve which terminates at its inner end in a hexagonal nut portion 5 and, at its outer end, in an expanded frusto-conical portion 7 which is divided into a number (in this case, eight) of spring-fingers 7*a*, 7*b*, 7*c* by slits 7*s* which extend from the annular end or base of the cone into the cylindrical central body portion 9 of the sleeve. The threads 3 upon which the outer collet rides are contained on the central body portion 9 of the chuck adjacent to the hexagonal end 5 thereof.

The outer member or collet 2 of the shorting-plug C, has a central cylindrical body portion 6 and, like the chuck 1, has an expanded frusto-conical end portion 8. Here, however, the outer surface of the ends of the spring fingers 6*a*, 6*b* etc. which comprise the said frusto-conical portion 8 terminate in short cylindrical surfaces 6*m*, 6*n* etc. which provide an enlarged area of contact between the said fingers and the inner surface of the outer conductor A. As shown in Fig. 3 the threads 4 which engage the external threads 3 on the chuck 1 are contained on the inner surface of the cylindrical portion 6 of the collet. The collet is also provided, on its inner end, with an integral cylindrical collar portion 10 having a radially extending bayonet pin 12 thereon which is adapted to be engaged by a complementary bayonet slot 13 on the socket end 15 of the wrench D. It should be noted that the outer diameter of the collar portion 10 of the collet 2 is small enough to permit the slot 13 on the end of the wrench D to be fitted on the pin 12 when the entire "plug" (C) is within the cable A—B. It will also be observed upon inspection of Fig. 3 that the inner diameter of the collar portion 10 of the collet 2 is sufficiently large to accommodate an inner hexagonal socket portion 17 of the wrench which fits over the hexagonal nut portion 5 of the chuck 1.

As shown in Fig. 4 the wrench D comprises an inner cylindrical member 19 which is supported for rotation, as on one or more insulating spacers or bearings 21 and 23, within an outer cylindrical member 25. The free end of the inner cylinder 19 extends beyond the corresponding end of the outer cylinder 25 and the end of each is provided with an insulating handle 27 and 29, respectively, for holding the one part while turning the other. As previously indicated, the leading end of the inner cylinder 19 terminates in a socket portion 17 for receiving the hexagonal (or other non-circular) nut 5 of the chuck 1, and the corresponding end of the outer cylinder or sleeve 25 is

provided with a slot 13 within which the pin 12 on the collet fits.

The operation of the device of the invention is as follows: With the collet 2 screwed but part way on the chuck 1 the flexible fingers 6*a*, 6*b* etc., 7*a*, 7*b* etc. are free from any clamping force, hence the entire plug may be entered into the cable by fitting the inner fingers 7*a*, 7*b* etc. over the free end of the inner conductor B and pushing the plug inwardly a convenient distance prior to grasping it with the wrench D. The wrench which, if necessary, may be several feet long, is then fitted over the trailing end of the plug so that its inner socket 17 receives the hexagonal nut 5 on the chuck 1 and slot 13 on the outer cylinder 25 receives the bayonet pin 12 on the collet 2. When the plug C has been pushed inwardly to the point required to tune the line AB to a desired frequency the plug may be tightened at that point simply by holding one of the handles 27 or 29 of the wrench and turning the other handle in the direction required to cause the frusto-conical end of the chuck 1 to nest tightly within the similarly shaped end of the collet 2. This relative inward movement of the chuck exerts an expansion force upon the spring fingers 6*a*, 6*b* etc. of the collet 2 and urges the outer cylindrical surfaces 6*m*, 6*n* etc. of the said fingers into tight engagement with the inner surface of the outer conductor. The same (inward) movement of the chuck 1 compresses its spring fingers 7*a*, 7*b* etc. which are thus caused to exert a clamping force upon the inner conductor B of the transmission line. It will be apparent that without such positively applied clamping forces it is practically impossible to achieve a low impedance connection between the inner and outer conductors of the line A—B.

In order to release the clamping forces applied to the conductors A and B by the chuck 1 and collet 2 it is merely necessary partly to unscrew the chuck by turning the wrench in the reverse direction, whereupon the plug may be pushed (or pulled) along the inner conductor to any desired point in the line.

From the foregoing it will be apparent that the present invention provides an adjustable shorting plug capable of effecting a connection of extremely low impedance between the inner and outer conductors of a concentric transmission line, and one characterized by its ease of adjustment and by the simplicity and economy of its parts.

What is claimed is:

1. A device for altering the electrical length of a transmission line of the type comprising spaced inner and outer concentric conductors, said device comprising a nest of two complementary, resilient frusto-conical members concentrically mountable in the space between said conductors, said members being movable with respect to each other in relative inward and outward nesting movements, whereby said expansible members are urged into and out of engagement with said inner and outer conductors as determined by the direction of said relative nesting movement.

2. A shorting-plug for a transmission line of the type comprising spaced inner and outer concentric conductors, said plug comprising an expansible frusto-conical collet adapted to be accommodated in the space between the said inner and outer conductors, a complementary expansible chuck mounted for axial movement within said collet about the outer surface of said inner conductor, screw means for moving said chuck selectively inwardly and outwardly with respect to said collet, whereby to expand said collet and to contract said chuck into clamping engagement, respectively, with said inner and outer conductors upon said inward movement of said chuck and to contract said collet and expand said chuck out of clamping engagement with said conductors upon movement of said chuck in said outward direction.

3. A device for altering the electrical length of a transmission line of the type comprising spaced inner and outer coaxial conductors, said device comprising an inner frusto-conical member having external threads and a bore within which said inner conductor is adapted to be received, said inner member terminating at its leading end in a plurality of outwardly extending resilient fingers and at its trailing end in a non circular nut portion, and an outer frusto-conical member having complementary internal threads and a bore within which said externally threaded inner member is received, said outer member terminating at its leading end in a plurality of outwardly extending resilient fingers against which the fingers of said inner member are adapted to bear with a force determined by the relative longitudinal axial position of said members, said outer member being provided adjacent to its trailing end with a radially extending bayonet pin, and wrench means for applying torque to said inner and said outer members through said nut and bayonet pin whereby to alter said relative longitudinal axial position of said members.

4. The invention as set forth in claim 3 and wherein said wrench means comprises inner and outer tubular members supported for relative movement about a common axis and terminating respectively at their leading ends in a socket for said nut and a bayonet slot for said bayonet pin.

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