

July 16, 1946.

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2,404,085

COAXIAL LINE

Filed April 24, 1942

Fig. 1.

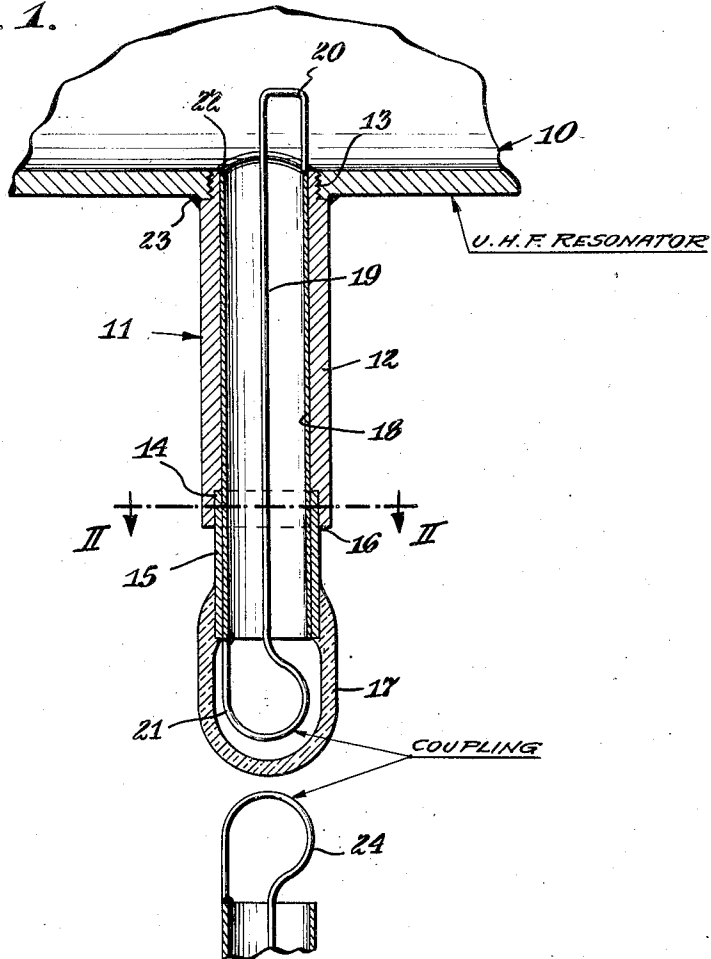
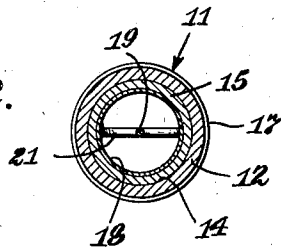


Fig. 2.



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2,404,085

COAXIAL LINE

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Application April 24, 1942, Serial No. 440,274

5 Claims. (Cl. 178-44)

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This invention relates to coaxial lines and is intended as an improvement upon the construction shown in co-pending application Serial No. 435,504 filed March 20, 1942, in the names of Ilia E. Mourontseff and George M. Dinnick, assigned to the same assignee as the present invention. The present-day utilization of coaxial lines is in the transmitting of wave energy and with the trend toward employment of so-called micro-waves, the perfection of coaxial lines to effectively function therewith becomes increasingly important.

In certain uses of the coaxial line, it is necessary to have at least one end of the inner line member or rod within an instrumentality, such as a wave generator, the nature of which necessitates the said instrumentality to be evacuated. It is, therefore, most convenient to have the outer or tubular portion of the coaxial line opening into the evacuated part of said instrumentality, as a result of which it becomes necessary to provide an appropriate vacuum-tight seal for the said tubular portion at a convenient part thereof outwardly away from said instrumentality. For convenience, the tubular conductive portion, rod and loops will be referred to herein as a unit as the coaxial body. Physical separation except at their extreme ends, and electrical conductivity of the tubular and rod portions of the coaxial line are essential, the transmission efficiency being directly dependent thereon. However, to make a vacuum-tight seal, either featheredged copper seals or "Kovar" seals are usually employed. ("Kovar" is a certain brand of alloy of nickel, cobalt and iron, and the alloy is one having substantially the same coefficient of expansion as borosilicate glass, identified specifically as "Corning" glass #704.) "Kovar" seals are far stronger than featheredged seals and in that respect are in more general favor and use. However, the resistivity and permeability characteristics of "Kovar" are serious disadvantages in applications involving the micro-wave region of wave propagation. It, therefore, becomes essential to avoid the requirement for the "Kovar" to constitute a necessary current conducting path.

An object of the present invention is to provide a coaxial line wherein "Kovar" or its equivalent may be employed for effecting a seal, and yet avoid use of the "Kovar" as a conductor.

Another object of the invention is to provide for maximum conductivity.

A further object of the invention is to provide for easy, effective assembly of the character specified.

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Another object is to avoid soldering operations in proximity to the glass portion or seal for the coaxial line.

Again, an object of the invention is to enable and facilitate use of hard solder in assembly of the coaxial line parts and in assembly of the coaxial line unit in the instrumentality where finally applied.

Yet another object of the invention is to provide a coaxial line embodying all of the features of adequate vacuum seal, conductivity and strength.

Still further objects of the invention will appear to those skilled in the art as the description progresses, both by direct statement thereof and by implication from the context.

Referring to the accompanying drawing in which like numerals of reference indicate similar parts in both views;

Figure 1 is a longitudinal sectional view of a concentric line construction embodying our invention, and

Figure 2 is a cross-section thereof on line II-II.

In the specific embodiment of the invention illustrated in said drawing, the reference numeral 10 designates an instrumentality, such as an ultra high frequency resonator, magnetron or other wave generator, characteristics of which of interest to the present invention are that it is an evacuated envelope and of metal such as steel, copper or alloy and responsive to wave propagation. The present invention provides means for receiving wave propagation from or introducing wave propagation into some such evacuated instrumentality, said means having the general nomenclature herein employed of coaxial line unit referring to the complete assembly, and coaxial body when referring to the sub-assembly of tubular portion and rod portion of which the rod portion provides loops at its ends or is otherwise formed for energy transfer.

The present invention is directed primarily to the fabrication of the coaxial line unit and body, of the housing therefor, and of their assembly, a feature being a construction wherein the coaxial line body may be separately formed and thereafter included within an enclosing elongated housing, said housing and coaxial line body thereby constituting a unit 11 and the unit thereafter being applied to a resonator or other instrumentality.

As shown, said housing comprises a suitably strong outer tubular encasement 12 extending a considerable portion of the length of the unit and threaded, at 13, next its inner end for attachment

to the resonator in an appropriate threaded hole in the wall thereof. Where magnetic properties are not detrimental to the effective operation of the instrumentality with which said unit is employed, said encasement 12 may be of steel or the like, whereas copper or other non-magnetic material of adequate thickness and strength should be used under conditions involving presence or influence of magnetic fields. The outer end of the encasement 12 is counter bored or otherwise provided with an enlarged interior concentric socket 14. Seated in said socket in surface engagement therewith is the inner end of a collar 15 of the aforementioned alloy of nickel, cobalt and iron sold under the trade name of "Kovar" the constituency whereof is more fully described in U. S. patent to Scott, No. 2,062,335 of Dec. 1, 1936. The inner wall surface of the said collar is preferably a continuation of the inner wall surface of the passage through the encasement, both being indicated in the drawing as cylindrical and of the same diameter, although it is to be understood that other geometric cross-sectional shapes may be employed. The encasement and collar are unified by suitable means, such as by a peripheral weld 16 where the collar projects from the encasement, thereby rendering the joint vacuum tight.

On the outer surface of the protruding portion of the collar 15 is sealed the rim portion of a glass or other ceramic cap 17, completing the vacuum-tight enclosure formed by said housing of which said cap is a part. It is preferred to employ borosilicate glass, such as Corning glass #704, as the material constituting said cap, to take advantage of its ability to adhere securely to the "Kovar" and not readily crack or form crevices from changes in temperature in view of such glass and "Kovar" having substantially the same coefficient of expansion. The glass is permeable to radio wave propagation so it is not necessary to pass the inner conductor or rod therethrough. The encasement 12, collar 15 and cap 17 assembled constitute the entity herein referred to as the housing of the complete unit 11.

In the assembled unit, extending from the innermost end of the encasement 12 entirely through said encasement to the outermost end of the "Kovar" collar, therefore also extending entirely through that part, is a highly conductive lining 18, preferably of copper. This lining, which constitutes a part of the aforementioned coaxial body, is in surface contact with the encasement and collar but does not have to maintain any vacuum seal nor be of any great strength since those requirements are fulfilled by the encasement and collar. But since "Kovar" is a relatively poor electrical conductor its employment as a necessary part of the electrical conducting path is to be avoided if possible, and this desideratum is accomplished in the present invention by the provision of the said conductive lining 18. Thus is accomplished an important feature of the invention of utilizing the desired strength of steel, or other encasement material, and "Kovar" with strong union therebetween and between the "Kovar" and glass, and at the same time obtaining the benefit of the conductivity of copper. The utilization of this lining has the further beneficial effect of avoiding physical joints and electrical gradients, thus obtaining uniform and minimum resistance and maximum conductivity.

The rod 19 of the coaxial line body has its end portions formed into loops 20, 21, with the extreme ends thereof brazed, hard soldered or other-

wise secured to the respective extreme ends of the tubular lining 18. This presents a continuity of electric path without any sudden changes in the course of flow of current. Preferably, and as a feature of the present invention, said rod portion 19 and tubular or lining portion 18 of the coaxial line body are fabricated independent of the instrumentality in which used, so that the loops are formed and brazed or otherwise secured to the tubular portion before introduction into the housing. This method of manufacture lends itself to greater security and continuity both physically and electrically between the parts of the coaxial line body since joints are not made in the proximity of glass or under other conditions where soft solder need be used or where difficult operations are involved. Likewise, the housing, comprising encasement 12, collar 15 and cap 17, is fabricated in whole or in part before assembly with the coaxial line body aforementioned. In constructions where coupling loop 21 is small enough to permit its entry through the housing, the assembled coaxial line body may be slid into the housing from the inner opening thereof after the cap has been applied and closed. Otherwise, and in any case, if desired, the cap may be applied as a tube to the collar, and while still open at its outer end then affords an opening through which the assembled coaxial line body may be slid to place, after which the glass is closed at its outer extremity to form the completed cap shown. Following insertion and proper positioning of the coaxial line body in the housing a line of solder 22 is applied at the substantially contiguous ends away from the cap. This soldering is preferably made flush so the assembled parts present an even or level extremity. Since the soldering is remote from the glass, a hard or high-melting point solder may be used.

After the fabrication of the unit 11 is thus completed, it may be screwed home in the resonator or other instrumentality 10 and the encasement peripherally welded, as at 23, at the joint with the resonator wall. At such time, namely, after fabrication of the unit and assembly with the resonator, one loop 20 or other coupling means, is situated within the resonator hollow body and the other loop 21 is exterior thereof but within the influence of the same vacuum as said resonator. Wave impulse or energy passes between this outer loop 21 and an external loop 24 in proximity thereto as part of any desired external circuit. The loops are one type of coupling, and are preferred, as there is efficient transfer of energy without need of passing conductors out of the vacuum enclosure.

The invention thus described presents a conductive, strongly unified and independently fabricated coaxial line body, as well as a separately formed housing of desired strength without any needed compromise for obtaining conductivity and which therefore enables employment of "Kovar" to glass seal for full benefit thereof. The invention likewise presents desired convenient assembly of housing and coaxial line body and permits high temperature or hard-solder attachment of those parts at a place remote from the energy-permeable glass portion so as to accomplish such attachment without injury to the glass or vacuum seal established thereby. Also the invention presents the advantageous construction of a coaxial line unit comprising the said housing and coaxial line body, which may be completely fabricated independent of the instrumentality with which it is to be used, and applied

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as a unit, when desired, to said instrumentality.

Since the various details of construction, as well as the precise relation and functioning of parts are subject to variation and change without departing from the inventive concept or scope of the invention, it is intended that all matter contained in the specification or illustrated in the drawing, shall be interpreted as exemplary and not in a limiting sense. The present disclosure is accordingly directed to all of the generic and specific features of the invention herein shown and described and to all statements of the scope of the invention herein set forth which, as a matter of language, might be said to fall therebetween.

We claim:

1. An electrical wave conducting means comprising a hollow encasement of metal characterized by its strength irrespective of its electrical conductivity, means of less conductivity electrically constituting an extension of said encasement, and means within both the encasement and the said extension coextensive with and at the inner surfaces thereof and having greater electrical conductivity than either said encasement or said extension.

2. An electrical wave conducting means comprising a hollow steel encasement having an open end, a collar of electrically less conductive material protruding from said open end of the encasement, a glass cap on said collar, said cap and collar having substantially the same coefficients of expansion, and an electrically conductive lining electrically bridging the said collar lengthwise.

3. A coaxial line for conducting electrical wave energy, comprising a central conductor having an end loop, a hollow encasement around said con-

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ductor having an open end toward the loop and with the loop outside said encasement, and electrically conductive means of different material from and at the inner surface of said encasement bridging the length thereof and having connection with the end of said loop.

4. A coaxial line for conducting electrical wave energy, comprising a central conductor having an end loop, a hollow encasement around said conductor having an open end toward said loop, a collar sealed with respect to and constituting an extension of said encasement at the said open end and with said central conductor therein and with said loop beyond the collar, means enclosing said loop and closing the end of said collar from which the loop projects, and electrically conductive means electrically bridging the collar and encasement over the combined length of said collar and encasement and said loop connected at its end to the end of said conductive means.

5. A coaxial line for conducting electrical wave energy, comprising a central conductor having an end loop, a hollow encasement around said conductor having an open end toward said loop, a collar sealed with respect to and constituting an extension of said encasement at the said open end and with said central conductor therein and with said loop beyond the collar, means enclosing said loop and closing the end of said collar from which the loop projects, and an electrically conductive lining coextensive with and at the inner surfaces of said encasement and collar and having greater electrical conductivity than said collar, said loop being connected at its end to an end of said lining.

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