

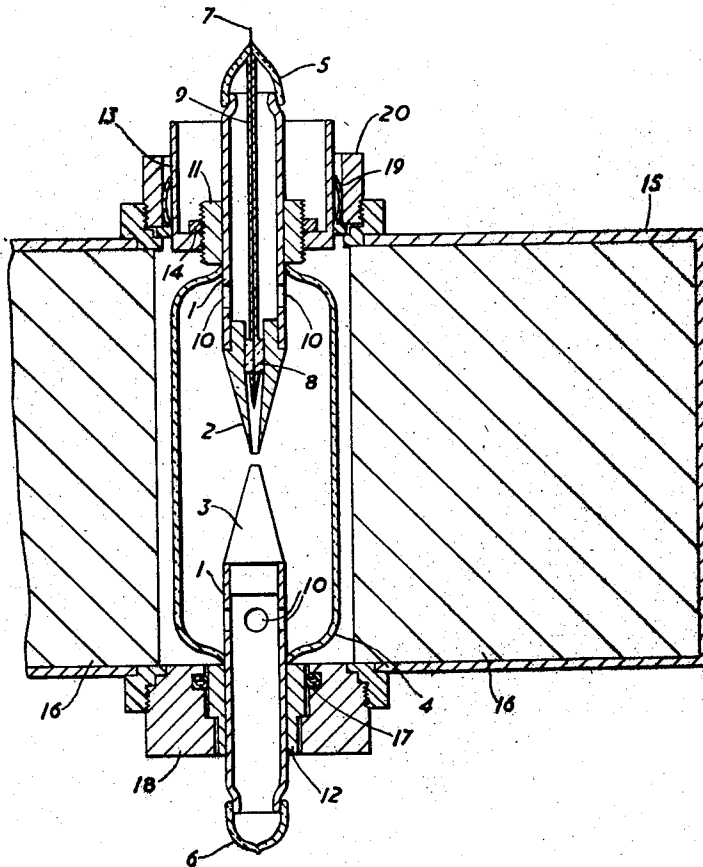
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TRANSMIT-RECEIVE CELLS

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TRANSMIT-RECEIVE CELLS

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This invention relates to so-called transmit-receive cells, hereinafter referred to by their customary designation of TR cells, such as are commonly employed for example in the wave guides of radar system to protect the receiver portion of the system against powerful energy direct from the associated transmitter portion.

The invention has for its object to provide highly efficient and relatively simple TR cells which can be "plugged in" to a wave guide and which can be tuned accurately after the completion of vacuum processing and, indeed, even after the cell is in position in the guide in which it is to be used. Common present day practice with respect to TR cells is either to make them broad-band or to incorporate them in and as part of resonant cavities, the combination being carefully manufactured to close limits of dimension so as to be, as it were, "fixed tuned" in manufacture. In the broad band type of cell the dimensions and shapes of the parts have to be determined to close tolerances before vacuum processing and in manufacture generally and this is very costly. Moreover, known broad band cells, though soon removable and replaceable, are such that removal and replacement cannot be effected without breaking the run of the wave guide and, so far as the present applicants are aware, there is none which can be simply plugged into a holder in the wave guide (much as a valve can be plugged into a valve holder) so that removal and replacement can be effected without mechanically disturbing the wave guide at all. The known cavity-cell arrangement not only has the defects of being large, expensive and in general requiring what may be termed laboratory technique in manufacture in order that the correct predetermined operating frequency may be achieved but also the defect of being utilizable only for its own narrow frequency range.

The main object of this invention is to avoid the above defects and difficulties and to provide improved cells which can be simply plugged in to a guide; which can be relatively cheaply manufactured; and in which accurate tuning is a matter of relatively simple adjustment after vacuum processing.

Another important object of the invention is to provide simple and relatively cheap removable TR cells of the type having at least one "keep alive" electrode wherein the operating voltage of the keep alive electrode may be accurately predetermined and will remain close to the predetermined value even after considerable periods of ordinary use. This object is achieved by adopting a construction in which the position of the keep alive electrode is accurately and permanently determined and maintained.

According to this invention, a TR cell comprises an envelope, a pair of tubular main electrodes of taper form extending towards one another from opposite ends of said envelope, and sealed through said envelope at opposite ends thereof, at least one collar member external to said envelope on one of said tubular electrodes, a movable capacity tuning member adjustable in position along

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the length of said collar, and vacuum tight sealing means at the outer ends of said main electrodes.

Preferably there is a second collar member external to the envelope on the other main electrode, said second collar member being arranged to provide one connection with a wave guide in which the cell is inserted, the tuning member being adapted to provide the second connection with said guide when the cell is in position.

Preferably a keep alive electrode is fitted axially within one of the two main electrodes and its operative end is accurately positioned with reference to said main electrode by means of a spacing insulator fixed to said keep-alive electrode near said operative end and fitted between said keep-alive electrode and the interior of said main electrode. The said spacing insulator is preferably a hollow insulating cylinder mechanically united with the customary glass tube surrounding most of the length of the keep-alive electrode and fused on to the said keep-alive electrode.

In the preferred construction the capacity tuning member is in the form of a hollow cylinder with an internal flange on one end, the internal flange being internally threaded to engage a screw thread on the collar on one of the main electrodes.

The invention is illustrated in the accompanying drawing which is an elevation, partly in cross-section showing a preferred form of TR cell in accordance with this invention inserted in position in a wave guide.

Referring to the drawing the cell therein shown, which is a so-called plug-in or removable cell, comprises two similar tubular main electrodes of tapered form each of which consists of a metal sleeve 1 of Kovar or other material having a coefficient of thermal expansion such that it may be fused in a satisfactory manner to glass, and a conical (or truncated conical) mild steel tip, 2 or 3, brazed thereto. These two main electrodes are copper-plated to reduce radio frequency losses. The two sleeves are sealed through opposite ends of a glass envelope 4, the vacuum tightness of which is completed by providing glass end sealing members 5 and 6 over the outer open ends of the sleeves. Through the sealing member 5 is fused a keep-alive electrode 7 which is accurately axially located within the tubular electrode along which it runs, by means of an insulating spacer 8. This spacer is constituted by a glass cylinder, which is fused to the keep-alive electrode and is unitary with a glass insulating tube 9, surrounding the major part of the length of the keep-alive electrode and also fused thereto. The insulator 8 is made accurately to size and its external surface is preferably ground. It fits accurately within a space provided to receive it inside the tip 2 on the end of the sleeve 1, and serves to ensure that the operating gap around the end of the keep-alive electrode will be accurate as predetermined and will be so maintained in use. Alternatively, and preferably, the glass insulating spacer 8 may be replaced by a ceramic cylinder fitting over the glass tube 9 and cemented to it. Such a ceramic cylinder need not be externally ground. The extent to which the keep-alive electrode extends down the tip is determined, in manufacture, by a jig which is not removed until the said electrode is fixed longitudinally by fusing to the sealing member 5.

In manufacture the envelope is pumped out through the two main electrodes and before sealing member 6 is sealed off. Holes 10 are provided in both main electrodes so that the entire interior space of the envelope and of the electrodes is open to the pump during evacuation. After pumping out, gas filling and sealing off, metal collars 11 and 12 are fitted externally of the envelope on to the sleeves 1. The upper collar 11 is externally screw-threaded and on it is screwed a capacity tuning member in the form of a cylinder 13 having an internal flange at one end, internally screw-threaded to screw on to the col-

lar 11. A lock-nut 14 serves to lock the position of the tuning member when adjusted in position for tuning.

The drawing shows the device mounted in a wave guide 15. When so mounted the cell is tuned (by adjusting the tuning cylinder 13) to resonance, the required inductance for resonance being obtained in manner known per se by a pair of plates 16 (sometimes called irises) positioned centrally in the guide and having their adjacent edges at a predetermined spacing from the inserted cell and from one another as shown. Contact between the cell and one wall of the guide is made via the collar 12 through a spring contact member 17 in the form of a helical spring bent round into a circle and fitted into a groove in a member 18 screwed into the guide. As will be seen, the collar 12 is stepped as also is the member 18 so as to govern the degree of insertion of the one into the other and the helical spring 17 and the parts are so dimensioned that when the collar 12 is inserted into the member 18 the spring 17 is deformed or flattened so that it bites into the collar and into the member 18 to give good electrical contact. At the other end of the cell, contact is made with the tuning cylinder 13 by means of a spring 19 in the form of a ring of spring fingers, the said spring fingers being pressed against the tuning cylinder 13 by the action of a screwed ring 20 arranged as shown to screw into a member 21, and which will obviously, when screwed down, press the spring fingers firmly against the tuning cylinder 13.

It will readily be seen that the construction illustrated, though providing all the advantages of a tuned TR cell of the resonant cavity type, is much simpler constructionally than such a known type of cavity-cell arrangement, consists of only a few relatively easily manufactured parts of robust mechanical construction and can be removed and replaced by a simple plug-in operation without disturbing the run of the wave guide to which it is fitted. The cell is easily adjusted for tuning when in position. The construction is also strong against thermal shock since the vacuum-preserving glass seals are all so-called "matched" seals, i.e. they are seals between glass and metal of the same, or substantially the same coefficient of thermal expansion. Due to the nature of the construction in which metal parts are brazed to one another (in this connection it may be noted that all the metal parts which have to be fixed to one another are fixed by brazing) the cell may be pumped out at high temperature and a pure gas filling may be used. Furthermore, the position of the keep-alive electrode is accurately determined and maintained so that design performance as regards this electrode will be ensured over a substantial working life.

In practice, the gap between the adjacent ends of the tips 2 and 3 is accurately predetermined in manufacture so that the range of tuning required is not great.

If desired, a second keep-alive electrode similar to and arranged in manner similar to the keep-alive electrode shown may be fitted into the other tubular electrode 1, 3 in order to guard against glow-arc transitions if required.

We claim:

1. A transmit-receive cell including an envelope, a pair of axially disposed sleeves sealed in opposite ends of said envelope, main electrodes of taper form mounted in said

sleeves and extending towards one another from opposite ends of said envelope, at least one of said electrodes having an axial bore extending therethrough, glass sealing members extending over the outer open ends of said sleeves, a keep-alive electrode, said keep-alive electrode being fitted axially within the axial bore in one of the two main electrodes and having its operative end recessed within said main electrode, first and second collar members, said collar members being mounted externally to the envelope on said sleeves, a waveguide into which said cell is inserted, said first collar member forming one connection between said waveguide and one of said main electrodes and said second collar member being arranged to provide another connection with said waveguide, and a movable capacity member, said movable capacity member being adjustable in position along the length of said second collar member and forming the second connection within said waveguide when the cell is in position.

2. A transmit-receiver cell as set forth in claim 1 wherein said first collar member is connected with said waveguide through a fixedly mounted spring contact member and wherein said second collar member is externally screw-threaded and wherein said movable capacity member is internally screw-threaded and adjustably engages the external screw-threads on said second collar member.

3. A transmit-receive cell as set forth in claim 1 in which said keep-alive electrode is provided with a cylindrical insulator that is insulatingly fitted within the axial bore in said one of said main electrodes and is electrically connected to a terminal extending through the sealed end of one of said sleeves and insulated from the said sleeve.

4. A transmit-receive cell as set forth in claim 1 in which said first collar member is annularly stepped and wherein a coating annularly stepped support is mounted in one side of the waveguide for receiving said stepped collar member and spring means interposed between said first collar member and said stepped support.

5. A transmit-receive cell as set forth in claim 1 in which said movable capacity member is a hollow tuning cylinder having an internal end flange on one end, said flange being internally screw-threaded and wherein said second collar member is externally screw-threaded to receive the internal screw-threads of said internal end flange and wherein said waveguide includes a cylindrical fitting within which said tuning cylinder is axially adjustable and spring means interposed between said cylindrical fitting and said tuning cylinder for stabilizing the movement of said tuning cylinder into and out of said waveguide.

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