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ULTRAHIGH-FREQUENCY SWITCH TUBE

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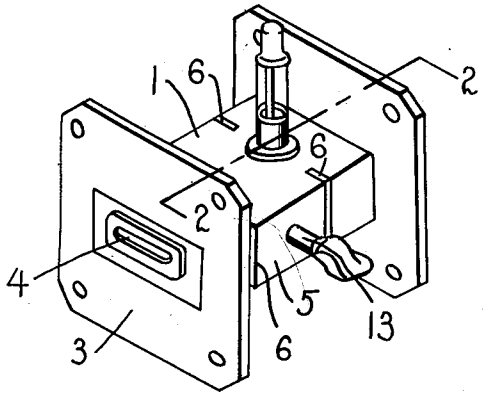


Fig. 1

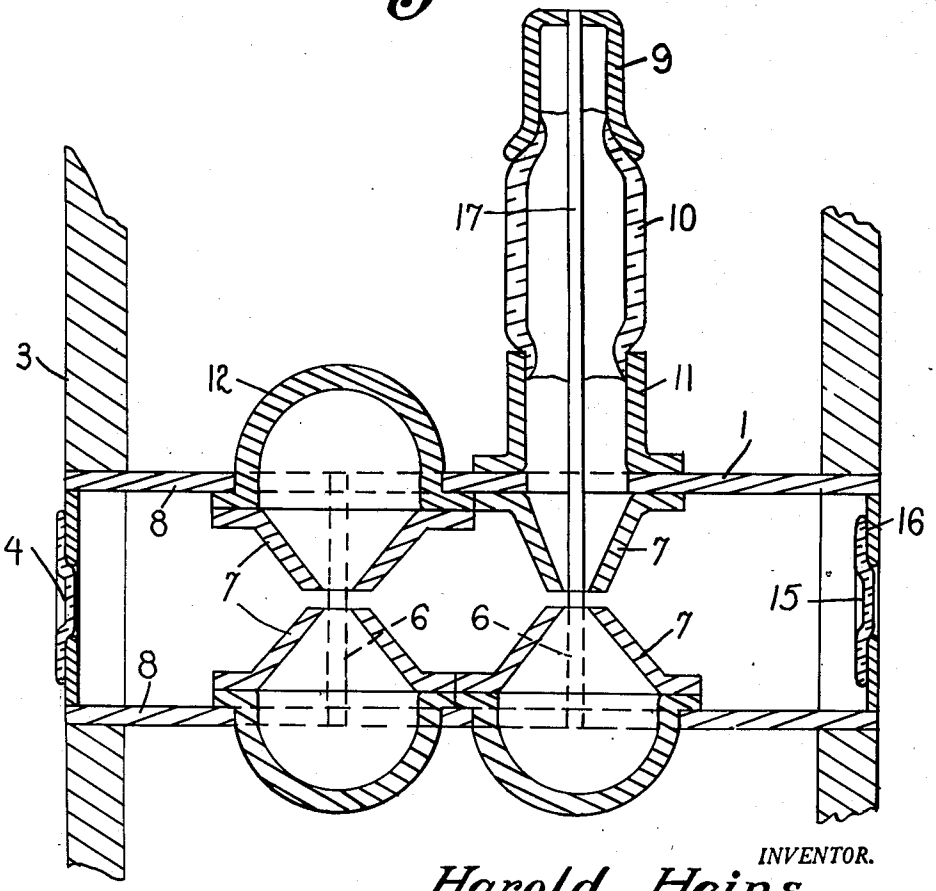


Fig. 2

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ULTRAHIGH-FREQUENCY SWITCH TUBE

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5 Claims. (Cl. 315—35)

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This invention relates to windowed apertures in wave-guides and the like, and particularly to such apertures in transmit-receiving tubes and similar devices, such as are generally used in radar and other ultra high frequency electromagnetic wave transmission tubes for protecting the receiving apparatus while the transmitting pulse occurs. Such tubes are generally gas filled and have one or more resonant circuits with a gap in at least one of them between which a discharge may flash for operation of the tube, for example, when a wave pulse from the transmitter goes out along the wave guide. Considerable trouble is experienced with such tubes when used at high instantaneous power levels. The characteristics of the tube change and the insulating material of the window deteriorates or reduces the life of the tube.

I have found that this is due to flash-over occurring across the outside of the window, and that this occurs despite the length of gap inside the tube being very much less than the leakage path across the window. The advancing wave front of the pulse reaches the window before reaching the interior gap, and a high voltage builds up at the window before there is any voltage at the gap.

I find that this may be prevented or inhibited by extending the glass of the window to a considerable distance away from the aperture itself and on the outside of the tube. In some cases, the glass of the window may be extended over the metal support to the walls of the waveguide, although that is not generally necessary. In certain types of prior tubes the glass was sealed in such a way that it extended away from the aperture on the inside of the tube, and with such tubes a reversal of the window is sufficient to achieve the result.

Other objects, features and advantages will be apparent from the following specification, taken in connection with the accompanying drawing in which:

Fig. 1 is a perspective view of a device according to my invention;

Fig. 2 is a longitudinal section through a device according to my invention.

In the figures, the envelope may comprise for example a waveguide tube 1 of rectangular cross section and flat end plates 3 generally of larger cross section for a connection, and each having a rectangular window 4 of glass or the like on the outside of the device at the input end. Another window 15 may be placed at the output end, and this output window 15 may have the

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glass sealed to its inside portion 16. Extending inside the wave-guide 1 and from the shorter walls 5 are small rectangular metal plates 6 and the hollow metal conical pieces 7 extending toward each other from the opposite longer dimension walls between two of the metal plates 6 in a plane transverse to the axis of the wave-guide. The plates 6 and cones 7 together with their metallic connections form a resonant circuit the opposing cones affording discharge gaps, the resonant circuit and cones constituting a composite resonant circuit and discharge gap structure extending across the wave-guide. The plates 6 extend into the wave-guide 1 through slots. The plates 6 are soldered or welded to the guide 1 to form a hermetical seal.

Some trans-receive tubes may have only one such resonator or may have some other suitable form of resonator, the so-called broad band tubes generally having two of them, in addition to which the metal plate 3, with its window 4 also forms a resonator, so that in a tube such as shown in Figure 1, with a window in each end, there are four resonant circuits. The multiplicity of resonant circuits permits the tube to give good response over a broader band of wave-lengths, in the manner well-known in the art. The resonators are generally spaced one quarter wavelength apart. A keep-alive electrode extends into, but is spaced from one of the cones 7, generally at the resonator nearest the output end of the tube. Electrode 17 is joined to a terminal cap 9 carried by glass tube 10 on flanged metal sleeve 11 that is in turn sealed to wave-guide 1.

The tube may be exhausted through the tubulation 13 extending through one of the walls and sealed hermetically at its outer end. The tube is filled with gas which generally includes a quenching gas, such as water vapor to speed up deionization. The tube may be filled for example with 5 mm. of argon and 3½ mm. of water vapor. This pressure is not critical, and is expressed in the usual manner in millimeters of mercury pressure.

A material such as sodium hydroxide may be used to increase the life of the tube in the manner shown in co-pending application Serial 35,905 filed June 29, 1948 by Ezio Thomas Casellini.

My invention is particularly useful as a transmit-receive tube in balanced duplexers and ring-type duplexers, as shown for example in Chapter 8 of the book "Microwave Duplexers" of the Radiation Laboratory Series, by L. D. Smullin and C. G. Montgomery, and published by the

McGraw-Hill Book Company, New York, N. Y. The voltage across the tube window in such circuits reaches very high values.

What I claim is:

1. A high frequency electric discharge tube adapted for mounting in a wave guide structure, said tube being of the type characteristically employing a resonant window, said tube having a gas-filled envelope including a length of hermetically sealed wave guide and a resonant window hermetically sealed to said one end of said length of wave guide, said window having a metal plate in which is provided a central resonant aperture and a hermetically sealed covering of insulating material across said aperture and extending a substantial distance away from said aperture and over the face of said plate on the side thereof away from said length of wave guide and occupying a major part of the difference between the area of the aperture and the cross-sectional area of the wave guide.

2. A high frequency electric discharge tube of the type characteristically employing a resonant window, said tube having a gas-filled envelope including a length of hermetically sealed rectangular wave guide and a resonant window hermetically sealed across one end of said length of wave guide, said window having a metal plate in which is provided a central resonant aperture and a hermetically sealed covering of insulating material across said aperture and extending over the face of said plate on the side thereof away from said length of wave guide and occupying a major part of the difference in width between said wave guide and said aperture.

3. A high frequency electric discharge tube adapted for mounting in a wave guide structure, said tube being of the type characteristically employing a resonant window, including a gas-filled length of hermetically sealed wave guide, a composite resonant circuit and discharge gap structure extending across said wave guide and spaced one-quarter wave-length away from one end of said length of wave guide, and a resonant window hermetically sealed across said one end of said length of wave guide, said window having a metal plate in which is provided a central resonant aperture and a hermetically sealed covering of insulating material across said aperture and extending a substantial distance away from said aperture over the face of said plate on the side thereof away from said length of wave guide and occupying a major part of the area difference between the area of the aperture and the cross-sectional area of the wave guide.

4. A high frequency electric discharge tube of the type characteristically employing a resonant window, said tube having a gas-filled envelope including a length of hermetically sealed rectangular wave guide and a resonant window hermetically sealed across one end of said length of wave guide, said window having a metal plate in which is provided a central resonant aperture and a hermetically sealed covering of insulating material across said aperture and extending over the face of said plate on the side thereof away from said length of wave guide and occupying a major part of the difference in width between said wave guide and said aperture, and multiple composite resonant circuit and discharge gap structures mutually spaced apart by one-quarter wave-lengths, said window being spaced from the nearest composite resonant circuit and discharge gap structure by a quarter wave-length.

5. A transmit-receive tube adapted for mounting in a wave guide structure, said tube being of the type characteristically employing resonant windows, said tube having a gas-filled envelope including a length of hermetically sealed rectangular wave guide and resonant windows sealed across the ends of said length of wave guide, and plural composite resonant circuit and discharge gap structures extending across said length of wave guide and spaced apart one-quarter wave-length, said windows being spaced one-quarter wave-length from the respective nearest composite resonant circuit and discharge gap structure, one of said composite resonant circuit and discharge gap structures including a keep-alive electrode, one of said windows at the output end of the transmit-receive tube having a metal plate provided with a central aperture and a hermetically sealed covering of insulation material across the aperture and extending over the face of said plate on the inside of the envelope and the other of said windows having a metal plate provided with a central aperture and having a hermetically sealed covering of insulating material across its aperture and extending over the face of its plate on the outside of the envelope facing away from said length of wave guide and occupying a major part of the difference in width between the width of the aperture and the width of the rectangular wave guide.

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