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ELECTRICAL BREAKDOWN DEVICE

Robert V. Pound, Cambridge, Mass., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Application May 25, 1944, Serial No. 537,315

4 Claims. (Cl. 178—44)

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This invention relates to radio transmitting and receiving systems in which a transmitter and receiver are operated on a single antenna in combination with an electrical breakdown discharge switch, such as that disclosed in the James L. Lawson application entitled "Protection of receivers against overload," S. N. 479,662, filed March 18, 1943, and more particularly to a means for assuring maximum protection to the receiver against high powered inputs.

The protection afforded to the receiver of radio echo detection systems where such an electrical breakdown discharge switch is most commonly used is not complete, since during the period that the radio echo transmitter is turned off and for a short period after it is turned on the discharge switch will not break down, for reasons hereinafter advanced, thus rendering it incapable of protecting the receiver during these periods from pulses received from both nearby radio echo detection systems and the local transmitter itself.

It is thus an object of this invention to provide a manually operable means for improving the protection afforded receivers by an electrical breakdown discharge switch of the foregoing type.

Other objects and features of the present invention will become apparent upon a careful consideration of the following detailed description when taken together with the accompanying drawings the figures of which represent a typical embodiment of the invention and are not to be construed as a definition of the limits of the invention. Reference for the latter purpose is to be had to the appended claims.

Fig. 1 is a cross-sectional view taken through the axis of a typical breakdown discharge switch, showing a typical structural arrangement of the invention, and Fig. 2 is a portion of Fig. 1 broken away therefrom and illustrating the additional protective effect lent to the receiver by the operation of the invention.

In order to facilitate an understanding of the function of the present invention, the operation of an electrical breakdown discharge switch of the type disclosed in the above mentioned application of James L. Lawson will be here briefly reviewed. In the structural assembly, a toroidal or cylindrical cavity shown at 10 is provided, so dimensioned as to resonate at the frequency of operation. Disposed within the cavity at diametrically opposite points are input and output coupling loops, illustrated respectively at 22 and 11 whereas at the central axis of the cavity is a spark gap 23 formed by a close approach of the

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upper and lower walls 12 and 13 of the cavity 10. Also provided is a "keep alive" electrode 24 which is held in close proximity to the spark gap at a potential negative with respect to the gap electrodes so as to produce a supply of ions around the gap thereby facilitating breakdown thereof whenever a surge of power appears across the gap electrodes. The region surrounding the gap 23 is preferably maintained at a reduced pressure by the sealed glass chamber 25. In practice, the breakdown switch is interposed between the receiver and its junction to the main transmission line which connects the transmitter to the antenna, preferably at a point a ¼ wavelength from the receiver junction. Thus when the transmitter pulses, the energy of the system breaks down the spark gap thereby shorting the receiver line at the switch thus reflecting a high impedance at the junction and hence inhibiting the transfer of excessive energy to the receiver. If, however, the spark gap fails to ignite due to a momentary inoperativeness of the keep alive electrode, for example, a large quantity of energy will be forced upon the detector of the receiver (usually a crystal) causing great damage thereto. As previously mentioned this damage is most likely to occur during the period that the transmitter is turned off and for a short period after the inception of operation thereof. It is for this reason that the retractable shorting plunger 14 is provided, suitably adapted to short the coupling loop 11 to the wall 12 of the cavity, thereby causing equal and opposite currents *a* and *b* to be induced in the upper and lower loops. These currents will cancel at the center conductor 15. Unfortunately the currents are not actually equal, but substantially so, so that attenuation up to 100 db. will result. The amount of attenuation is an inverse function of the amount of resistance between the shorting plunger 14 and the adjacent surfaces of the wall 12. That is, the smaller the resistance the greater the tendency to equalize currents *a* and *b* and hence the greater the attenuation. It is for this reason that the cylindrical choke type resonator 16 is provided, having at one end a constricted portion 17 adapted to open into the cavity 10, and an inwardly extending tubular flange member 18 at the other end, into which the shorting plunger 14 is adapted to extend. The cavity 19 formed by the plunger 14 and the cylindrical member 16 is of such a dimension (preferably a ½ wavelength) that regardless of the degree of electrical contact effected between the plunger 14 and the flange 18 at point 20, there

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