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MICROWAVE SHUTTER DEVICE

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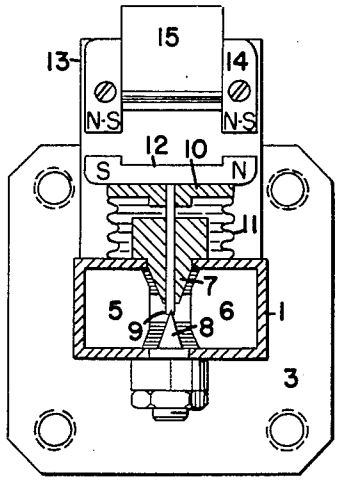


FIG. 2

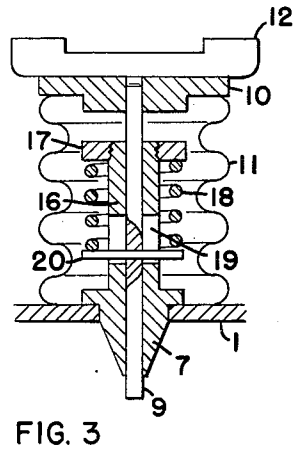


FIG. 3

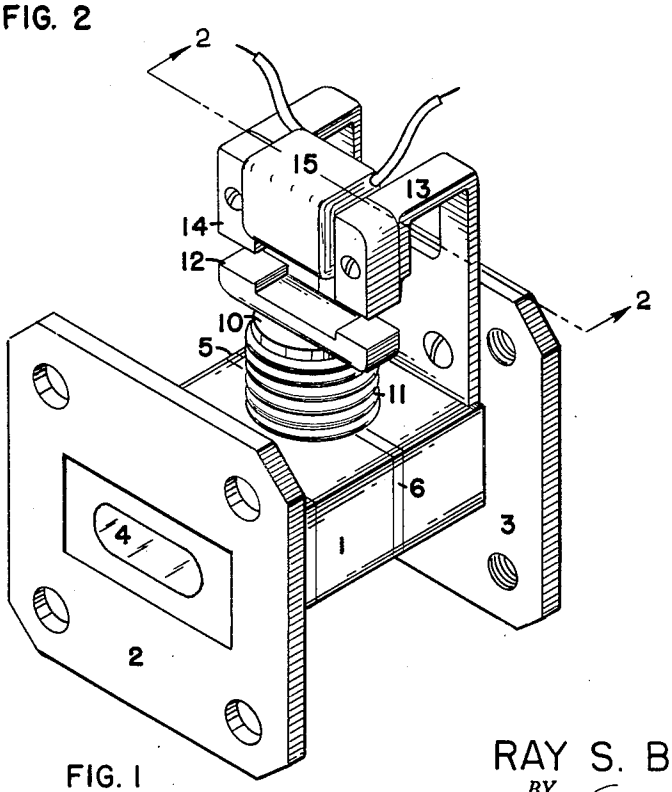


FIG. 1

INVENTOR.

RAY S. BRADEN

BY Edgar O. Root

ATTORNEY

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MICROWAVE SHUTTER DEVICE

Ray S. Braden, Melrose, Mass., assignor to Bomac Laboratories Inc., Beverly, Mass., a corporation of Massachusetts

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3 Claims. (Cl. 333—13)

The present invention relates generally to microwave frequency attenuating devices for radio direction and ranging systems and more particularly to a novel mechanism for inserting and removing an attenuator-shutter member incorporated in a transmit-receive transmission device.

Copending applications Serial No. 355,128, filed May 14, 1953, now U. S. Patent 2,734,174 and Serial No. 407,707, filed February 2, 1954, now U. S. Patent 2,734,171 disclose a novel device for protection of sensitive radar receivers during stand-by periods when the system is inoperative. Since spurious radio frequency signals may damage the detector crystals, a high degree of attenuation is necessary in the branch of the wave guide structure leading from the antenna to the receiver. By providing a metallic shutter member across the discharge gap structure within a resonant cavity member, full protection is achieved. The aforementioned disclosures provide solenoid means for rapid removal of the shutter member when the system is operative. Such removal means, however, necessitate the designing of a power source with holding power requirements to retain the shutter in an open position when normal system operation is resumed. Certain mechanical locking structures may also be provided to protect against any failures of the voltage supply.

It is, therefore, an object of the present invention to provide in a microwave frequency transmission device, having a shutter structure, improved means for removal of said shutter.

A further object is to provide an improved shutter mechanism requiring only power to open and close with zero power consumption when said shutter is retained in either the closed or open position.

A still further object is to provide an improved shutter mechanism which will fail-safe in the event of failure of the electrical system.

The objects enumerated are attained briefly by providing the combination of a shutter member adapted to short circuit a resonant discharge electrode gap and a permanent horseshoe type magnet secured at one end thereof. A soft-iron magnet having an induction coil wound thereon is spaced a short distance from the permanent magnet and by controlling the polarity of the current in the induction coil, the opposing permanent magnet may be attracted or repelled thereby opening or closing the shutter member. The magnetic forces may be employed to retain the shutter mechanism in the open position and thereby permit de-energizing of the electromagnet with no power necessary to maintain this position. Conversely, reversal of polarity will be found to maintain a closed shutter position with similar zero power consumption.

Other objects, features and advantages will be apparent after consideration of the following detailed specification and appended drawings, in which

Fig. 1 is a perspective view of the illustrative embodiment;

Fig. 2 is a cross sectional view along the line 2—2 in Fig. 1; and

Fig. 3 is an enlarged view of the shutter and electrode assembly incorporating a modification of the invention.

Referring now to Fig. 1, the illustrative embodiment of a broad band transmit-receive device comprises a length of rectangular wave guide **1** having secured at the ends thereof flanges **2** and **3**. Each flange is provided with a centrally positioned hermetically sealed resonant window **4** to provide a vacuum tight envelope. To provide for a gaseous discharge when high level radio frequency energy is transmitted, an ionizable atmosphere is introduced into the envelope after suitable evacuation.

Internally, metallic partition or iris members **5** and **6** extend transversely across the wave guide **1** at intervals of approximately a quarter of a wavelength in the manner well-known in the art. Discharge gap conical electrode structure is positioned between said iris members and comprises electrodes **7** and **8** with electrode **7** having an axial passage therethrough.

The shutter mechanism of my invention includes a plunger or rod **9** extending into the hollow electrode **7**. In full attenuating position the tip of said rod **9** contacts the apex of opposed electrode **8** thereby effectively short circuiting the resonant gap and blocking any transmission through the device.

My improved structure for inserting or removing the shutter rod comprises a bellows top plate **10** secured by brazing, soldering, or welding to the end of rod **9**. A bellows **11** of a resilient metal, such as beryllium copper is sealed to the tube body **1** and top plate **10** to make a vacuum tight unit. Permanent horseshoe type magnet **12** secured to top plate **10** provides for axial movement of shutter rod **9** when external magnetic forces are applied to magnet **12**. To illustrate the operation of the illustrative embodiment, the polarity of magnet **12** has been indicated by standard symbols N and S.

Bracket **13** secured to flange **3** supports an inverted soft-iron horseshoe magnet **14** having an induction coil **15** wound thereon in spaced opposed relationship to magnet **12**. If desired bracket **13** may be attached directly to the top wall of wave guide **1**. By controlling the polarity of the current in coil **15** the polarity of magnet **14** may be determined to be either similar to or opposed to that of the magnet **12**. Hence by well-known magnetic laws, the rod **9** can be retracted or repelled to thereby permit complete attenuation of microwave energy or full transmission. When the permanent magnet **12** is lifted up to contact the pole faces of electromagnet **14**, the coil **15** may be de-energized and the shutter rod **9** will be held in open position without any additional energy being required. By reversing the polarity the shutter rod will be moved to a short circuit position bridging the discharge gap between electrodes **7** and **8**. In this position an air gap is developed between the pole faces and the pull of the permanent magnet **12** through the air gap will not be sufficient to overcome the atmospheric pressure on the bellows **10**. Hence a "fail-safe" mechanism is available which permits either complete protection with the shutter is full attenuating position or complete transmission with the shutter open.

An alternative embodiment of the shutter rod mechanism is shown in Fig. 3. Electrode **7** is provided with a tubular extension **16** secured to the wide wall thereof. Top plate **17** may be threaded on the extension as an upper retaining member for a compressible spring **18**. A longitudinal slot **19** at an intermediate point on extension **16** limits the axial movement of a transverse pin **20** extending through rod **9**. The other end of spring **18** rests against pin **20** thereby urging the rod **9** downward when the spring is compressed. It is, of course,

necessary to provide a suitable spring tension which will not hinder upward movement of the shutter member when electromagnet **14** is energized.

My improved shutter mechanism disclosed herein not only eliminates the requirement of power for holding the shutter member in open position but also eliminates any mechanical retaining means which will be subject to wear and possible failure.

While an illustrative embodiment has been described herein various modifications or alterations will be evident to persons skilled in the art. It is my intention to include in the appended claims all such modifications or alterations as fall within the spirit and scope of the invention.

What is claimed is:

1. In a microwave transmission device having an evacuated metallic envelope, opposed discharge gap electrode structure positioned therein with at least one of said electrodes having a hollow passageway therethrough and a shutter member extending within said passageway to contact the opposed electrode, magnetic means for axially moving said shutter member comprising a permanent type magnet secured at one end of said shutter member, an electromagnet in register with and spaced from said permanent magnet to attract or repel said permanent magnet by control of the polarity of said electromagnet to thereby alter the transmission characteristics of said device.

2. In a microwave transmission device according to claim 1 wherein said electromagnet is supported by an L-shaped bracket extending vertically from said envelope.

3. In a microwave transmission device according to claim 1 wherein said electromagnet may be de-energized when said shutter member is in a closed or open position.

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