Dec. 10, 1957 R. S. BRADEN 2,816,272

TRANSMIT-RECEIVE AND SHUTTER DEVICE ELECTRODE STRUCTURE

Filed Oct. 25, 1955 2 Sheets-Sheet 1

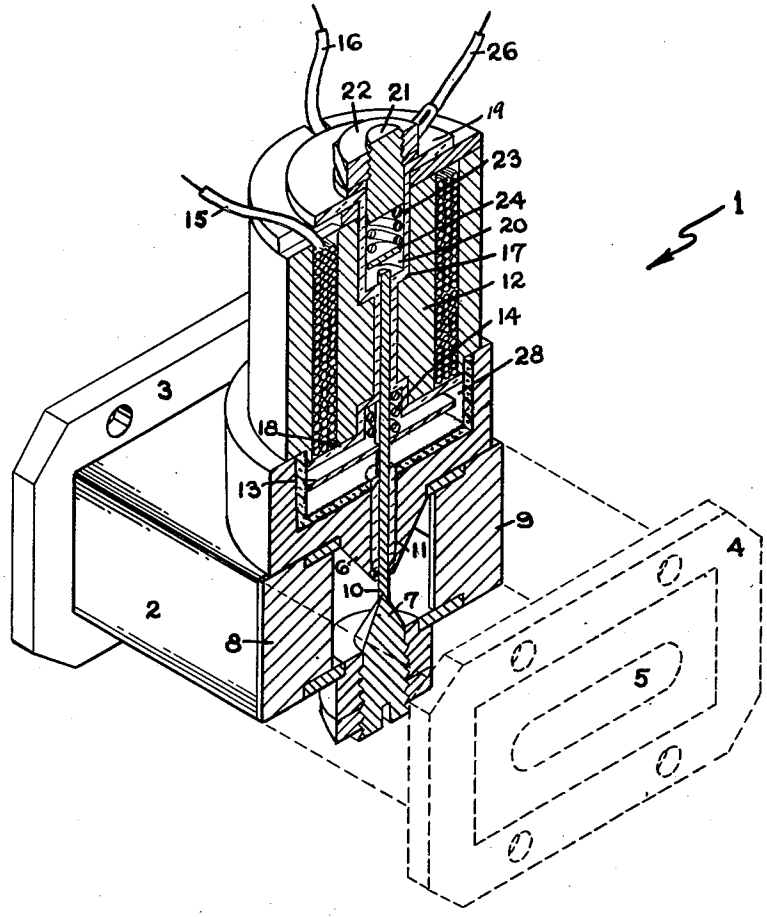


FIG. 1

INVENTOR.
RAY S. BRADEN
BY Edgar O. Rost
ATTORNEY

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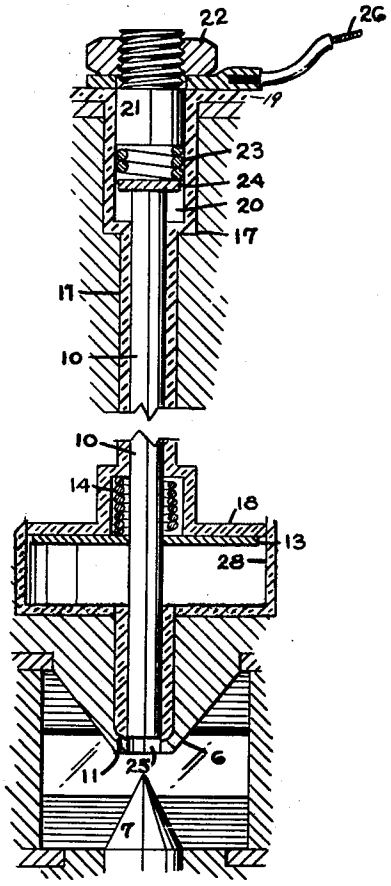


FIG. 2

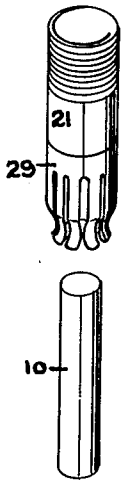


FIG. 3

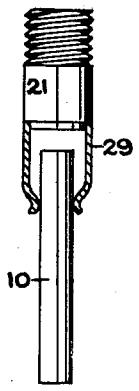


FIG. 4

INVENTOR.
RAY S. BRADEN
BY Edgar O. Rost
ATTORNEY

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TRANSMIT-RECEIVE AND SHUTTER DEVICE ELECTRODE STRUCTURE

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

Application October 25, 1955, Serial No. 542,728

2 Claims. (Cl. 333—13)

The present invention relates to combination transmit-receive gaseous discharge switching tubes with a protective shutter device and more particularly to a novel mechanical and electrical structure providing both shutter action and means for partial ionization of a gaseous atmosphere in a unitary member.

Copending application Serial No. 407,707 filed by Harold Heins, dated February 2, 1954, now Patent No. 2,734,171, issued February 7, 1956 and assigned to the same assignee as the present application, illustrates a combination transmit-receive switching tube having a shutter device for protection of a sensitive radio receiver during periods when a radio direction and ranging system is inoperative. To allow for normal transmit-receive action during transmission of high power pulse magnetron energy, such devices are provided with a side-arm ignitor electrode to supply a continuous source of electrons in the discharge gap to facilitate ionization of the gaseous atmosphere at a predetermined voltage level. Since such side-arm electrode structure employs an outer support member of a dielectric material, such as glass, it may be readily damaged during installation or handling.

It is an object of the present invention to provide in a transmit-receive gaseous discharge tube a novel shutter arrangement which incorporates an enclosed coaxial ignitor electrode structure.

A further object is to provide in a transmit-receive tube a novel shutter device which provides complete protection in the full attenuating position and serves as an ignitor electrode structure when normal tube operation is resumed.

A still further object is to provide a novel combination of a shutter-attenuator to short-circuit a discharge gap in a transmit-receive tube and a coaxial ignitor electrode within a unitary structure thereby improving overall construction and performance characteristics.

To accomplish the objects enumerated herein, I have discovered that the attenuating member of the shutter protective device positioned coaxially within the discharge gap electrode structure may be employed as an ignitor electrode when the attenuator is withdrawn from the short-circuit position. In this position, the attenuating member which is electrically insulated from the electromagnet and tube envelope contacts electrically conductive means to impress a desired ignitor electrode voltage thereon. The tip of the attenuating member will then be positioned in close proximity to the apex of the conical discharge gap electrode at approximately the same critical distance as a common ignitor electrode in a transmit-receive tube. It will thus be evident that a source of electrons will be introduced into the discharge gap region when the attenuating member is conductive to thereby partially ionize the gaseous atmosphere.

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

Fig. 1 is a perspective view partly in section of the illustrative embodiment with dotted lines indicating the overall configuration;

Fig. 2 is an enlarged longitudinal cross-sectional view of the illustrative embodiment in the non-attenuating position;

Fig. 3 is a perspective view of an alternative embodiment; and

Fig. 4 is a longitudinal cross-sectional view of the alternative embodiment.

Referring to the drawings the combination transmit-receive and shutter device is shown generally at **1** and comprises a length of rectangular waveguide **2** having secured at the ends thereof connecting flanges **3** and **4**, each having a resonant window element **5**, to provide a hermetically sealed envelope. The device is filled with an ionizable atmosphere comprising a mixture of an inert gas such as hydrogen, argon, or nitrogen, and a small percentage of water vapor at a total pressure of approximately 5 to 10 millimeters of mercury. Resonant discharge gap electrodes **6** and **7** are mounted within waveguide **2** to define therebetween a discharge gap in the manner described in United States Patent 2,680,207 and the aforementioned application. Inductive metallic partition members **8** and **9** are also disposed within said waveguide to provide a resonant iris in a manner well known in the art.

The shutter-attenuator member **10** of the embodiment is slidably disposed within a hollow passageway in gap electrode **6** and is formed of a conductive metal. To isolate the attenuator member **10** from the envelope, a sleeve **11** of a non-conductive insulating material is positioned in the passageway of electrode **6**. In the attenuating position, attenuator member **10** extends across the discharge gap to contact the opposed electrode **7**.

Structure for retraction of attenuator member **10** is similar to that described in the aforementioned application and comprises an electromagnet **12** mounted on the envelope with an armature **13** attached to member **10**. Spring **14** urges said armature downwardly to return the member to its attenuating position when the electromagnet is de-energized. Leads **15** and **16** are provided for connection of the electromagnet to a suitable energizing circuit of approximately 15–30 volts either direct or alternating current. Inasmuch as the core of the electromagnet is provided with a passageway to receive the upper portion of member **10**, I next insulate said member from the electromagnet circuit and the envelope by a liner **17** in the passageway and washers **18** and **19** all of a suitable insulating material.

To transform the attenuator member **10** into a coaxial ignitor electrode, which is one of the principal advantages of the invention, electrically conductive contact means are contained within electromagnet **12** of the illustrative embodiment. The passageway within the electromagnet **12** is enlarged at its upper end as **20** with a threaded plug **21** enclosing the end thereof. A vacuum seal between the walls of insulating liner **17** and plug **21**, which may be of a conductive metal such as copper or brass is achieved by metallizing the inner wall of liner **17** in the area of contact and then brazing the pieces together in a manner well-known in the art. An electrical connector **26** may then be fastened around the threaded shank of plug **21** and retained in position by nut **22**. To the underside of metallic plug **21**, I affix a spring **23** and a contact plate **24** which is in turn affixed to the spring.

In the non-attenuating position as shown in Figure 2, with the electromagnet energized, armature **13** will move upwards until it rests against insulator washer **18**. This in turn moves attenuator member **10** to a position within hollow electrode **6** with a critically short distance **25** between the tip of attenuator member **10** and the apex of hollow electrode **6**. The upward movement further re-

sults in the upper end of attenuator member **10** contacting plate **24** which in turn compresses spring **23**. By connecting the lead **26** to a suitable ignitor electrode direct current voltage supply of approximately 500–800 volts, a current of 100–200 microamperes may be achieved with suitable resistance in the circuit. This current is customary for ignitor electrodes in the transmit-receive tube art and will result in partial ionization of the gaseous atmosphere to supply a source of electrons in the discharge gap prior to transmission of high power magnetron pulses. It will thus be evident that the attenuator-shutter member **10** can be employed to serve in an additional capacity as an ignitor electrode when it is in the non-attenuating position. The eliminates the need for any auxiliary electrode structure now commonly employed in the TR art.

Inasmuch as the attenuator member is conductive in the ignitor position, it is desirable to insulate armature **13** from the upper inside walls of electrode **6** to prevent any arc-over. For this purpose, I provide a dielectric cup member **28** within this portion of electrode **6**. Alternatively, a coating of an insulating material may be provided on the exposed wall surfaces.

Alternative contact means are shown in Figures 3 and 4. In this embodiment end plug **21** may be fabricated with a plurality of preformed fingers **29** of a material such as beryllium copper extending from the under side thereof. When member **10** is moved upwardly the fingers will firmly engage the shank as shown in Figure 4. The pressure of the fingers should be adjusted so that the member **10** may be quickly returned to the attenuating position by the spring **14** which is compressed when the member **10** is in the electrode or upward position.

Other modifications or alterations may occur to those skilled in the art. It is, therefore, my intention to cover in the appended claims such modifications or alterations as fall within the spirit and scope of the invention.

What is claimed is:

1. A microwave shutter and transmit-receive switching device comprising a hermetically sealed envelope containing a gaseous atmosphere, spaced opposed electrode structure defining a resonant discharge gap mounted within said envelope with at least one of said electrodes having a hollow passageway therethrough, a metallic rod element slidably disposed within said hollow passageway and extending across said discharge gap to contact the opposed electrode when in full attenuating position, electromechanical means mounted on said envelope to retract said rod element to a position within said hollow electrode, means positioned within said electromechanical means to contact the upper end of said rod element in its retracted position, said contact means including a spring-biased plate member electrically connected to a direct current voltage source to thereby transform said rod element into an auxiliary ignitor electrode with a voltage potential impressed thereon sufficient to partially ionize said gaseous atmosphere.

2. A microwave shutter and transmit-receive switching device comprising a hermetically sealed envelope containing a gaseous atmosphere, spaced opposed electrode structure defining a resonant discharge gap mounted within said envelope with at least one of said electrodes having a hollow passageway therethrough, a metallic rod element slidably disposed within said hollow passageway and extending across said discharge gap to contact the opposed electrode when in full attenuating position, electromechanical means mounted on said envelope to retract said rod element to a position within said hollow electrode, said electromechanical means having an axial passageway therethrough with a contact member disposed at the upper end thereof, said contact member being electrically connected to a direct current voltage source of between 500 to 800 volts to thereby transform said rod element into an auxiliary ignitor electrode when in its retracted position, a liner of an insulating material within said electromechanical means passageway and hollow electrode to prevent leakage of current when said rod element is in contiguous relationship with the electrically conductive contact member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,499,777	Pound	Mar. 7, 1950
2,520,604	Linder	Aug. 29, 1950
2,524,268	McCarthy	Oct. 3, 1950
2,734,171	Heins	Feb. 7, 1956