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DEVICE FOR REGULATING ELECTRICAL DISCHARGE

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Fig 1

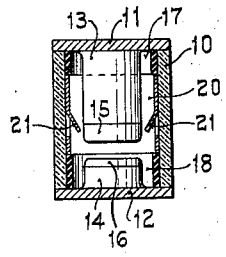
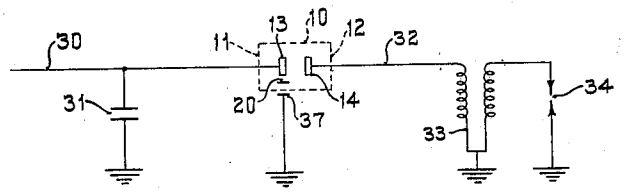


Fig 2



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DEVICE FOR REGULATING ELECTRICAL DISCHARGE

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8 Claims. (Cl. 315—58)

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This invention relates to a device for regulating electrical discharge. The problem of securing a uniform electrical discharge, for instance across an air gap, is quite difficult, particularly when the air gap is subjected to rapid and great variations in air pressure. Various attempts have been made to combat this problem, but none has been uniformly satisfactory.

The use of cold or hot tubes for regulating a discharge, the discharge depending upon the ionization of gas within the tube, is known, but such tubes are relatively complex in construction and generally require an auxiliary energizing circuit for operation.

It is an object of this invention to control an electrical discharge by means which are independent of variations in air pressure. Another object of the invention is to construct a cell capable of controlling an electrical discharge by means involving the ionization of a gas, all the circuits of which are fed from a single electrode, and the controlling action of which is inherent and not dependent upon the functioning of external devices.

The objects of the invention are accomplished generally speaking by a sealed cell containing major electrodes designed, after ionization of the gap between them, to carry the main discharge, and teaser electrodes comprising a condenser element adapted to control the ionization of the gas. Particular objects of the invention are attained by the novel construction of the cell.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention, reference for this later purpose being had primarily to the appended claims.

In the drawing, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a vertical section through a cell constructed in accordance with the preferred principles of this invention; and

Fig. 2 is a wiring diagram of a spark plug circuit in which the cell is employed to regulate the discharge across the spark gap.

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Referring to Fig. 1 of the drawing, 10 represents a cylinder of gas-impermeable dielectric material such as a dielectric plastic. Phenol formaldehyde plastics and hard rubber may be employed and are exemplary of the useful materials, but in the preferred form of the invention, the tube 10 is made of glass because of particular advantages that arise from its use.

The ends of the glass tube 10 are sealed by metal plates 11 and 12 which are preferably made of material having a coefficient of expansion close to that of the glass tube, for example steel, "Kovar" nickel alloy, or nickel. These metal plates are applied to the ends of the glass and become sealed thereto when the glass is at red heat. It is advisable to put the parts under slight pressure while the fusing takes place in order to insure the production of a tight joint. The plates 11 and 12 carry stud electrodes 13 and 14 which may be integral with the plate or attached thereto by electrically conducting means. For example, an electrode 13 of nickel may be welded, or silver soldered, to the plate. These electrodes are spaced from the sides of the tube 10. They are preferably fitted with caps 15, 16 of tungsten or other hard and erosion resistant metal, the function of which is to prevent the swift disintegration of the electrodes and to prevent the growth of deposits which tend to interfere with the proper functioning of the cell. The electrodes 13 and 14 are spaced from each other a distance which is calculated in connection with the gas pressure and the imposed voltage to permit firing only when a definite potential is attained in the anode.

Spacing sleeves 17, 18 of insulating material such as glass, ceramic or the like are provided within the cell and hold between them a metal cylinder 20 which has a similar coefficient of expansion and may also be fused to the glass in the same way as the metal pieces at the end. This cylinder has teaser electrodes 21 which may be formed as segments partially cut from the wall and pressed inward as prongs. These electrodes are brought closer to the anode 13 than the cathode 14, so that as the potential of the anode increases current will flow to the teaser electrode first, ionize the gas within the cell and

facilitate the main discharge, which occurs between electrodes 13 and 14.

The cylinder 20, 21 is one element of a condenser, the other element 37 of which is provided outside the glass tube 10, as shown in Fig. 2, and is grounded. This outer element need not have any particular shape or function so long as it is grounded and performs as a condenser element with the element 20. In the case of a spark plug it may well be the grounded metallic shell.

The gas within the tube must be of ionizable character such as nitrogen, argon, hydrogen, helium, these being merely exemplary of suitably ionizable gases. The gas is employed at a pressure calculated in relation to the gaps and the voltage employed to give discharge at a selected potential. For instance, a pressure of one atmosphere may be employed with a voltage of 3,000 to 4,000, a main gap of .040 inch and a teaser gap of .010 to .015 inch. This is merely illustrative and will be varied according to the circumstances of use and the nature of the construction. The larger the surface of the tube the greater will be the capacity of the condenser element 20. The better the contact of the condenser element with the glass the less will be the surface of the tube required.

In Fig. 2 the tube 10 is shown employed in connection with a circuit having a power line 30, a condenser 31 connected between the line and ground on the high side of the tube, and a condenser element 37 outside the tube cooperating with the cylinder 20 within it. The electrode 14 is connected by a line 32 to a transformer 33 and a spark gap 34 operated thereby.

The construction of the cell can be carried out in a chamber filled with the inert gas at appropriate pressure, but under normal circumstances it is easier to provide one of the end pieces 11, 12 with a small hole through which the cell can be evacuated, filled with the selected inert gas at the selected pressure, and sealed by appropriate means such as welding, soldering, or by the employment of a suitable plastic.

The tubes as thus constructed are durable and are efficient and uniform in operation and when inserted in a spark plug circuit as described in a copending application Ser. No. 627,474, filed November 8, 1945, secure uniform operation of the plugs without respect to variations in atmospheric pressure and without regard to pressure variations within the cylinders of an aircraft engine. The cell itself is of simple construction and is adapted to mass production methods.

The cell has the particular advantage that only one circuit is required for its charging, in that only the main electrode need be connected to a source of power. Once the potential of that electrode attains a selected value, a discharge will commence across the air gap to the teaser electrode, which is itself a condenser element. That discharge produces an ionization sufficient for the current to strike across the main gap to the electrode 14. Another advantage of the invention is in the method of constructing the cell, particularly in the method of joining the plates to the glass body of the cell. Other advantages lie in the manifold uses of the cell in controlling discharge in various types of circuits, only one of which has been disclosed herein as a non-limitative example.

Although only one embodiment of the invention has herein been illustrated and described, it is to be expressly understood that the same is not limited thereto. Various changes may be made in the design and arrangement of the parts without departing from the spirit and scope of the invention, as will now be clear to those skilled in the art. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. A device for regulating electrical discharge comprising a cell containing ionizable gas, spaced electrodes in said cell, and means comprising a condenser connected to ground having an element within the cell in closer relation to the anode than to the cathode, and nearer to the anode than the anode is to the cathode, for ionizing the gas within the cell to initiate the discharge thereof.

2. A device for regulating electrical discharge comprising an impermeable dielectric tube, metal plates fixed in sealing relation to the ends of the tube, electrodes on the plates within and spaced from the wall of the tube, a metal condenser element within the tube in closer spaced relation to one said electrode than the other said electrode, and an ionizable gas in said tube.

3. A device for regulating electrical discharge comprising a glass tube, metal plates fixed in sealing relation to the ends of the tube, stud electrodes on the plates within and spaced from the wall of the tube, a metal cylinder comprising a condenser element within the tube fixed to the wall thereof in closer spaced relation to one said electrode than the other said electrode, and an ionizable gas in said tube.

4. A device for regulating electrical discharge comprising a glass tube, metal plates fixed in sealing relation to the ends of the tube, stud electrodes on the plates within and spaced from the wall of the tube and having durable tips spaced from each other, a metal cylinder within the tube fixed to the wall thereof having teaser electrodes in proximity to a said electrode, and an ionizable gas in said tube.

5. A device for regulating electrical discharge comprising an impermeable dielectric tube, conducting plates fixed in sealing relation to the ends of the tube, electrodes on the plates within and spaced from the wall of the tube, a metal condenser element within the tube in such relation to the electrodes that current tends to flow to said element through gas in said tube prior to the flow thereof from electrode to electrode, and an ionizable gas in said tube.

6. In a spark plug circuit having a plug, a high tension transformer, and a source of low tension current adapted to feed the transformer, a device interposed between the said source and the transformer comprising a sealed dielectric tube having metal ends with inwardly directed spaced electrodes having broad and flat tips of tungsten, an ionizable gas in said tube, a metal sleeve on the tube wall surrounding the anode, and a flexible projection extending from the sleeve in proximity to the anode.

7. In a spark plug circuit having a plug, a high tension transformer, and a source of low tension current adapted to feed the transformer, a device interposed between the said source and the transformer comprising a sealed dielectric tube having metal ends with inwardly directed spaced electrodes, an ionizable gas in said tube, a metal sleeve on the tube wall surrounding the anode but not the cathode, and a flexible projection extending from the sleeve in proximity to the anode.

8. In a spark plug circuit having a plug, a high

tension transformer, and a source of low tension current adapted to feed the transformer, a device interposed between the said source and the transformer comprising a sealed dielectric tube having metal ends with inwardly directed spaced electrodes, an ionizable gas in said tube, and a metal sleeve on the tube wall surrounding the anode but not the cathode, and being in closer relation to the anode than to the cathode and than the anode is to the cathode, and constituting a condenser to ground.

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