

C. E. GREEN AND J. H. CLOUGH.
ELECTRICAL DISCHARGE TUBE.
APPLICATION FILED JULY 11, 1916.

1,334,150.

Patented Mar. 16, 1920.

Fig. 1.

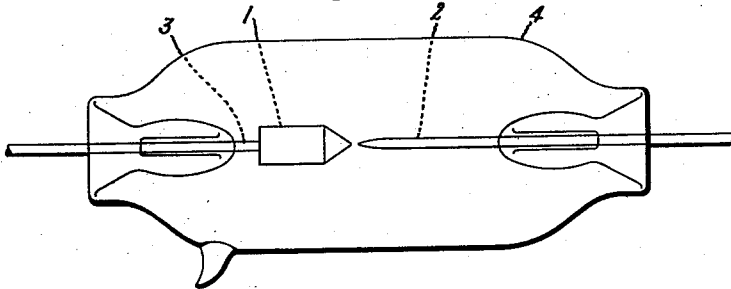


Fig. 2.

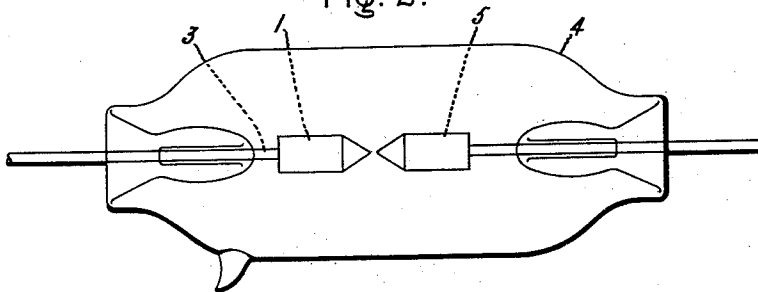
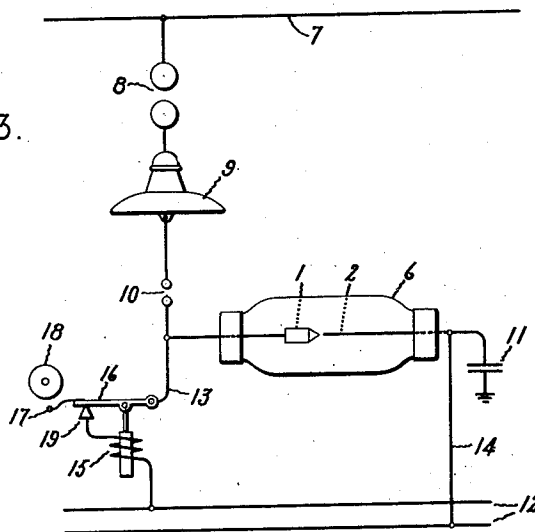


Fig. 3.



Inventors:
Charles E. Green,
John H. Clough,
by *Alfred S. Davis*
Their Attorney.

UNITED STATES PATENT OFFICE.

CHARLES E. GREEN AND JOHN H. CLOUGH, OF SCHENECTADY, NEW YORK, ASSIGNORS
TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRICAL DISCHARGE-TUBE.

1,334,150.

Specification of Letters Patent. Patented Mar. 16, 1920.

Application filed July 11, 1916. Serial No. 108,693.

To all whom it may concern:

Be it known that we, CHARLES E. GREEN and JOHN H. CLOUGH, citizens of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electrical Discharge-Tubes, of which the following is a specification.

The present invention relates to electrical discharge devices and comprises particularly a spark discharge or trigger device whereby a feeble electric discharge may be utilized to prime the tube for a heavier discharge. While our new device is of general application, it is of special utility as a surge indicator.

It is desirable to provide some means at a power station to indicate when a surge occurs on the transmission lines, and our present device enables a minute high potential current, to initiate the passage of a local current of sufficient power to operate a signal, or make a record of the surge.

We have devised a spark gap tube containing a gas, for example, argon, or other suitable rare gas, and electrodes separated by a short gap, which is readily made conducting by the high voltage spark, chemical means being provided for purifying and maintaining pure the gaseous filling. Conveniently the chemical purifier constitutes the cathode which consists for this purpose of magnesium, or calcium.

The various novel features of our invention are pointed out with particularity in the appended claims.

The accompanying drawing illustrates in Figures 1 and 2 two alternative forms of discharge tubes embodying our invention, and Fig. 3 shows a system of connections in which a device embodying our invention may be used.

The tube shown in Fig. 1, comprises a cathode 1, consisting of magnesium, calcium, alloys of the same or other suitable highly reactive metal capable of combining with gaseous impurities in the gas filling in the tube, and the anode 2 consists of tungsten, molybdenum, or other suitable refractory metal. The electrode tips are separated by a gap of about 0.25 to 1.0 millimeter. The cathode stem 3, and the shank of the anode are sealed into an envelop 4 of glass. In some cases the anode may also consist of magnesium, calcium, alloys of same with

other metals, or the like, as indicated at 5, Fig. 2, but in either case the anode should have a diameter substantially no greater than the cathode. As shown in Fig. 1, the anode may to advantage have a lesser diameter than the cathode when the anode consists of refractory metal. Although in the preferred embodiment of our invention the cathode consists of highly reactive metal, in some cases the anode only may consist of highly reactive metal, tungsten or the like being used as cathode.

The tube contains a gas of relatively high pressure so as to cause the primary, or ionizing discharge to be concentrated as a spark instead of a diffused glow discharge. Preferably, we use a gas in which the voltage of discharge will be relatively low, for example, argon, neon, or other rare gas, the pressure of the gas being equal to about 20 to 40 centimeters of mercury.

The juxtaposed tips of the electrodes are sharp pointed both to decrease the breakdown voltage and to localize the discharge so that the spark occurs over the same length of gap and therefore the same voltage.

Gaseous impurities, for example, nitrogen, oxygen, water vapor, or hydrogen, are given off by the electrodes and the envelop, which, if not removed, would cause the discharge potential to be variable. However, as a minute quantity of magnesium or calcium is vaporized by each discharge from the cathode and as this vapor is in a highly reactive ionized state, it combines with the gaseous impurities and maintains the gaseous filling pure. Prior to installing for service, the device should be operated a number of times with a sufficiently high potential to vaporize some of the calcium or magnesium thereby purifying the gas so as to insure that the dynamic current will follow the priming spark discharge.

Fig. 3 shows a surge indicator provided with a trigger tube constructed in accordance with our invention. The system of connections here shown, however, is not part of our present invention. The tube 6 is connected at the cathode terminal to a high potential transmission line 7, through a relatively wide spark gap 8, an insulator 9 having electrical capacity, and a second smaller spark gap 10. The large spark gap 8 is set for a spark potential above normal line voltage and the smaller spark gap 10

is set for a discharge potential sufficient to prevent the voltage induced on the lower sphere of the gap 8 due to its capacity from sparking through the tube 6. The anode terminal of the tube is connected to one terminal of a condenser 11, the opposite terminal of which is connected to ground. The cathode and anode are connected to a low potential direct current source, as represented by conductors 12, through wires 13, 14. The condenser prevents grounding of the low potential direct current circuit. The low potential source may have a voltage of, say 125 volts and capable of furnishing a current of several amperes, depending on the characteristic of the tube, and the service required of it. In circuit with the conductor 13 is a magnet 15, the armature of which is connected to a lever 16 carrying a hammer 17 of a bell 18. The lever 16 is included in the circuit 13 and, when the solenoid is energized, opens the low potential circuit at a contact 19.

When a surge occurs on the transmission line and a high enough potential is generated, an electrostatic high potential discharge jumps the spark gap 8, charging the insulator 9, and passing to ground through the spark gap 10, the discharge tube 6 and the condenser 11. A conductive path will be established by the discharge across the gap between the electrodes 1 and 2 in the spark tube. The current from the low voltage source 12 will follow the path-opening discharge, thereby energizing the magnet 15, operating the signal and immediately opening the local low potential circuit by the movement of the magnet armature. The local circuit being broken, the dynamic low potential discharge is interrupted and the tube is restored to its original high resistance condition. A tube filled with gas at relatively considerable pressure

will be activated by extremely minute currents, as low as a microampere, due largely to the concentration of the discharge into a well-defined spark instead of a glow.

What we claim as new and desire to secure by Letters Patent of the United States, is:—

1. An electrical discharge device comprising the combination of an envelop, electrodes therein one of which consists of magnesium separated by a gap of about 0.5 millimeter, and a filling of argon at a pressure of about one-half an atmosphere.

2. A spark discharge device comprising the combination of an envelop, a filling of argon therein at a pressure of about half an atmosphere, a pointed magnesium cathode, and a pointed cooperating tungsten anode of lesser diameter than said cathode, said electrodes being separated by a gap of about 0.5 millimeter.

3. An electric trigger discharge tube comprising the combination of an envelop, a pointed cathode of magnesium, a pointed anode, the points of said electrodes being separated by a gap of the order of magnitude of about 0.25 to 1.0 millimeter, and a filling of argon for said envelop at a pressure exceeding about 20 centimeters of mercury pressure.

4. An electric discharge device comprising an envelop, a rare gas therein, a cathode of magnesium, and an anode.

5. An electrical discharge device comprising the combination of an envelop, a filling of rare gas therein, and a cathode consisting of magnesium, a juxtaposed anode and a filling of rare gas having a pressure of at least about 20 centimeters of mercury.

In witness whereof, we have hereunto set our hands this 10th day of July 1916.

CHARLES E. GREEN.
JOHN H. CLOUGH.