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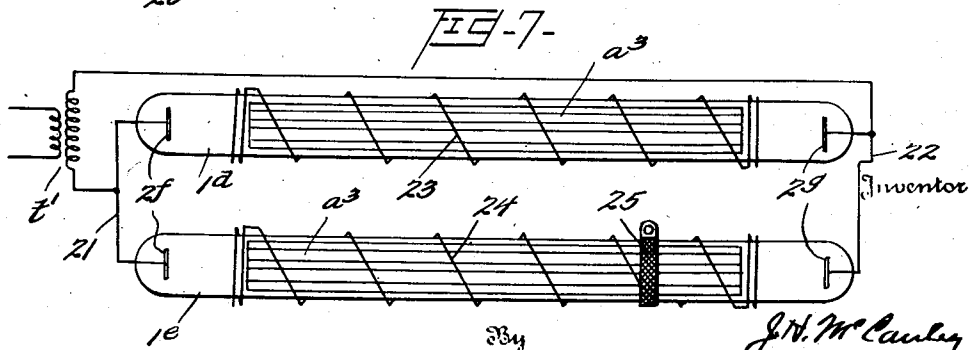
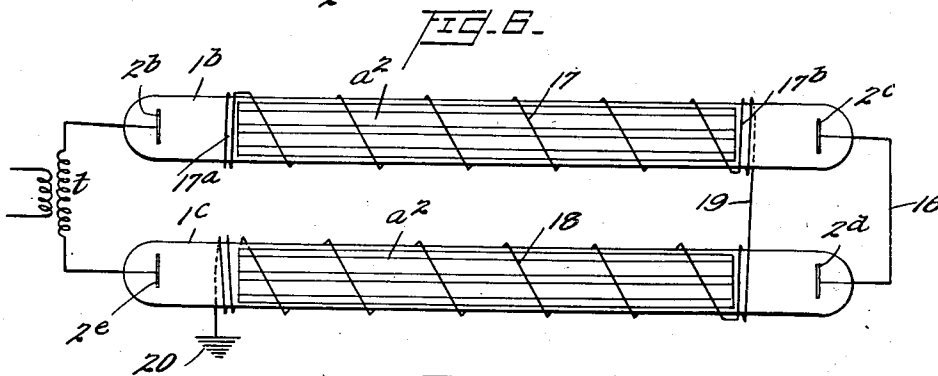
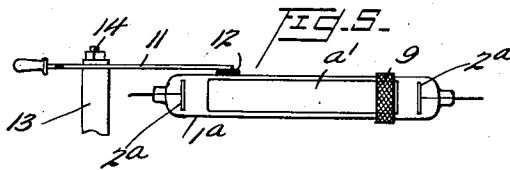
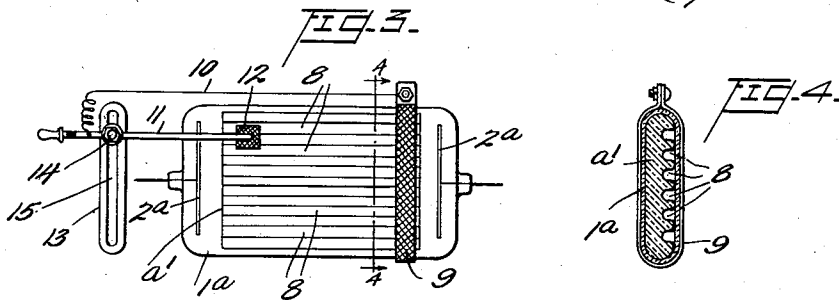
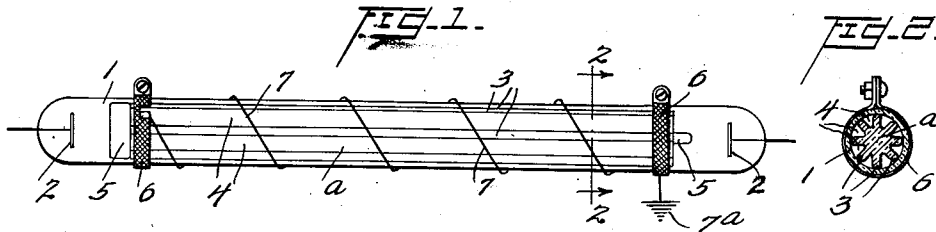
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2,133,206

ELECTRICAL DISCHARGE DEVICE

Filed Dec. 31, 1936

2 Sheets-Sheet 1



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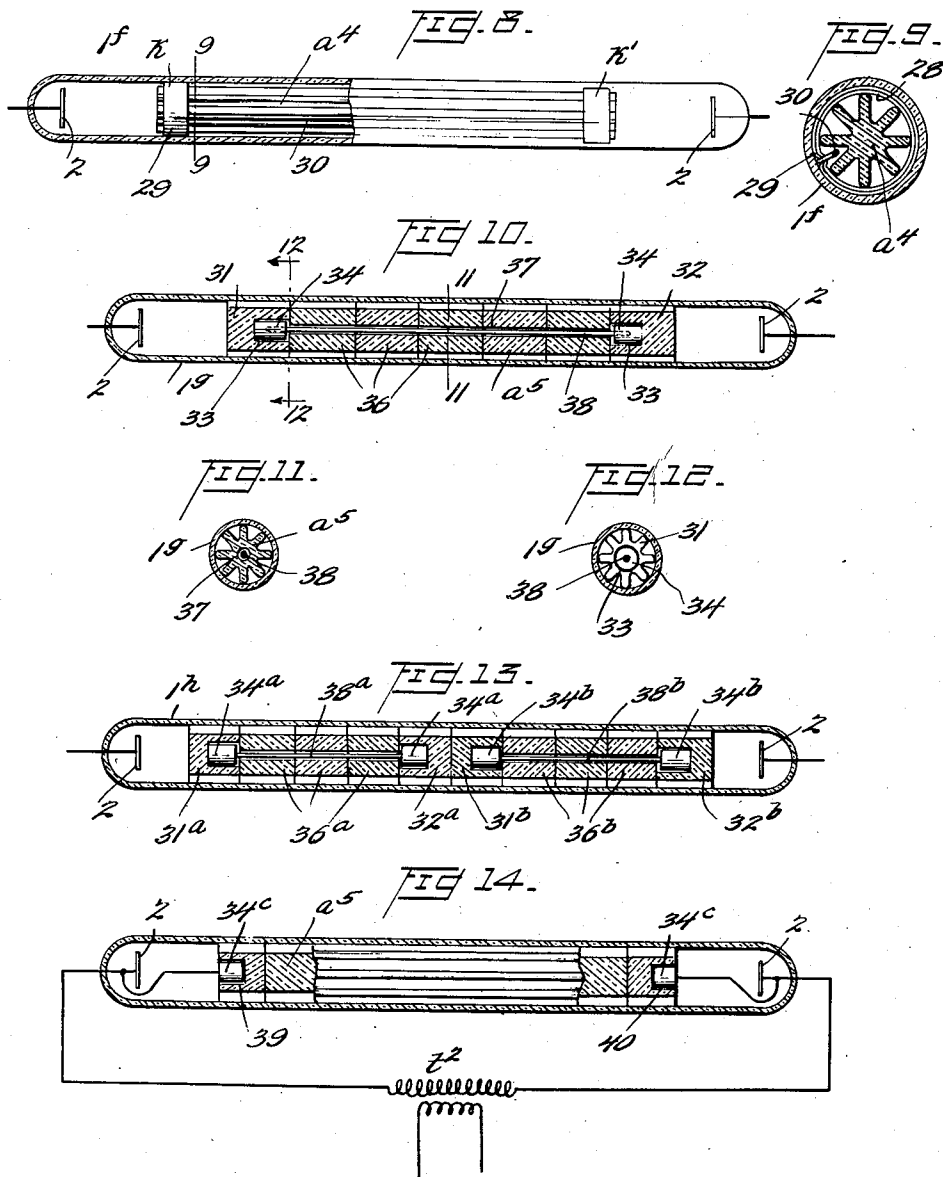
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2,133,206

ELECTRICAL DISCHARGE DEVICE

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2 Sheets-Sheet 2



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2,133,206

ELECTRICAL DISCHARGE DEVICE

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Application December 31, 1936, Serial No. 118,647

6 Claims. (Cl. 176-122)

This invention relates to improvements in what I call animated luminous electrical discharge devices. Such a device comprises a closed glass envelope containing a rare gas, such as neon, argon, helium, or mixtures of such gases, and spaced electrodes and a filler in that part of the envelope which lies between the electrodes, the filler being composed of insulating material and providing a plurality of passageways for the electrical discharge, whereby the discharge takes a course which changes at frequent intervals, causing changing luminous lines to appear in the tube or envelope. Such devices, with various forms of filler, are shown in my co-pending applications Serial Number 691,551, filed September 29, 1933, Serial Number 60,496, filed January 23, 1936, and Serial Number 96,879, filed August 19, 1936. In application Serial Number 60,496, above mentioned, I have shown capacity circuits by which the course of the discharge is influenced and the rate at which its course is changed is controlled, the capacity circuits there described being external to the envelope. In the present invention, I have shown both internal and external capacity circuits for the same purpose in conjunction with various forms of filler, some of which are also shown in my application Serial Number 96,879, above mentioned.

In the accompanying drawings,
Fig. 1 is a side view of an electrical discharge tube having a filler with a plurality of channels or passageways for the electrical discharge and having an external capacity circuit adapted to control the shifting of the discharge through the passageways;

Fig. 2 is a section on the line 2-2 of Fig. 1;

Fig. 3 is a plan view of a relatively flat discharge tube having a filler with a plurality of channels and having an external capacity circuit including a member of conductive material which is movable transversely of the channels for controlling the current flow therethrough;

Fig. 4 is a section on the line 4-4 of Fig. 3;

Fig. 5 is a side elevation of the device shown in Fig. 3;

Fig. 6 is a view showing two discharge tubes connected in series in the transformer circuit and each having an external capacity circuit;

Fig. 7 is a view showing two electrical discharge tubes connected in parallel in the transformer circuit, each tube having an external capacity circuit, and one of said tubes having an adjustable member for modifying the internal resistance of one of the tubes so that the tubes may be operated in parallel;

Fig. 8 is a side view, partly in section, of a discharge tube having an internal capacity circuit and a filler having a plurality of passageways, the terminals of the capacity circuit being mounted on the ends of the filler;

Fig. 9 is a section on the line 9-9 of Fig. 8;

Fig. 10 is a longitudinal section through a discharge tube having an internal capacity circuit, the terminals of the capacity circuit being arranged within the end portions of the filler;

Fig. 11 is a section on the line 11-11 of Fig. 10;

Fig. 12 is a section on the line 12-12 of Fig. 10;

Fig. 13 is a longitudinal section through a discharge tube having two internal capacity circuits with terminals arranged within sections of the filler as in Fig. 10, and,

Fig. 14 is a longitudinal section through a discharge tube having a capacity circuit with internal terminals at the ends of the filler, these terminals being connected together outside of the tube through the secondary of the transformer circuit.

Referring to Figs. 1 and 2 of the drawings, I indicate a closed glass tube or envelope containing a rare gas, and in the ends of the tube are arranged the electrodes 2 adapted to be connected to the secondary circuit of a high tension transformer. Within the tube is arranged a filler 3 composed of insulating material, preferably a material white in color and having passageways for the electrical discharge passing between the electrodes. The filler may be of various forms which provide a plurality of passageways for the electrical discharge, that shown in the drawings for the purpose of illustration consisting of a bar having longitudinal ribs 3 and grooves 4 alternately arranged on its periphery. This filler bar fits closely within the tube and is held against movement within the tube by pieces of mica 5, wedged tightly within the tube. The grooves or channels 4, enclosed by the wall of the tube, form passageways for the electrical discharge. The several passageways in the filler shown have approximately the same dimensions and contain columns of the rare gas having approximately the same resistance. When the discharge takes place through one passageway, heating the gas therein and increasing its resistance, the discharge shifts to another passageway where the gas is cooler and its resistance is lower, and then to other passageways, the discharge forming luminous lines in the channels.

The shifting movement of the luminous lines in a discharge tube containing a filler with a plurality of passageways for the discharge can be modified or controlled by providing what might be termed a capacity circuit on or in connection with the tube. In my co-pending application, Serial Number 60,496, filed January 23, 1936, several types of such circuits are shown. In the present application, other arrangements of capacity circuits are illustrated. In Fig. 1 of the drawings, metal bands 6 are shown on the tube 60

surrounding the ends of the filler. These are shown as made of wire mesh, but they may be of bare or insulated wire. Each band serves as one element of a condenser, the electrified gas serving as another element, and the glass tube being the dielectric. These bands alone, properly positioned, have the effect of accelerating the shifting movement of the discharge through the various channels. Connecting the bands by a conductor 7 greatly improves this result. This conductor, which may be a bare or insulated wire, is a part of the capacity circuit and it may be a straight wire or, as shown, coiled spirally about the tube. With the conductor so arranged and extended to the ends of the filler, the bands may be dispensed with, but I prefer to use them because of increased efficiency. The capacity circuit may be connected to ground as shown at 7^a and this has the effect of reducing radio interference.

In Figs. 3, 4 and 5, I have shown a flattened discharge tube or envelope 1^a containing a flat filler *a'* formed with channels 8 on one side, which channels extend longitudinally of the tube, and an external capacity circuit consisting of a conducting band 9 extending around the tube at one end of the filler and a conductor 10 extending from the band to an adjustable metal rod 11 which has at one end a relatively small metal terminal 12 which rests upon the tube adjacent the opposite end of the filler. This rod is adjustable cross-wise of the filler over the channels or passageways therein. The rod is conventionally shown mounted on a suitable support 13 to which it is slidably attached by a bolt 14 movable in a slot 15 in the support. The movable terminal 12 is approximately as wide as one of the channels, although it may be made somewhat wider or narrower. The electrodes 2^a extend parallel with the ends of the filler and lie opposite all of the channels. When the current is applied to the tube, the discharge will take place through the passageway over which the terminal 12 may be placed. If the terminal extends equally over two passageways, the discharge may take place through either, shifting from one to the other, or if it extends over only one passageway, the discharge will follow that passageway. The arm which carries the terminal 12 may be moved to set it over any one of the passageways. If desired, a clock mechanism or motor may be arranged to move the arm alternately back and forth which would cause shifting of the discharge from channel to channel, following the movement or adjustment of the terminal 12. It would appear from this that the condenser action reduces the resistance of the column of gas in the channel or channels over which the terminal 12 extends, but I do not confine myself to any particular theory concerning the action, which can be observed by the production of luminous lines in the particular channels. This method of controlling the discharge by causing it to flow through any one of a number of particular passageways has a commercial value aside from the luminous effects as it may be used for switching or controlling other circuits external to the tube.

In Fig. 6, two discharge tubes 1^b and 1^c are shown with their electrodes connected in series in the secondary circuit of a transformer. Thus the electrode 2^b of tube 1^b is shown connected to one terminal of the secondary coil of transformer *t* and the electrode 2^c of tube 1^c is connected to the opposite terminal of said coil, and the electrodes 2^c and 2^d of the tubes are con-

nected together by conductor 16 so that the current will flow through the tubes in series. The fillers *a*² are shown the same as the filler *a* in Fig. 1. The tube 1^b has a capacity circuit consisting of a wire 17 coiled about that part of the tube containing the filler. Instead of connecting the ends of the coil to bands as shown in Fig. 1, the end turns 17^a and 17^b of the coil are wrapped about the tube short distances beyond the ends of the filler, serving the same purpose as the bands. Each tube shown in Fig. 6 may have a capacity circuit independent of the other, but, if desired, the circuit 17 on the tube 1^b may be connected in series with a corresponding capacity circuit 18 on the tube 1^c by conductor 19, and one of these circuits may be grounded, as shown at 20, if desired, to reduce radio interference. The action in each tube is the same as that described in connection with Fig. 1, the shifting of the discharge through the channels being controlled by the capacity circuit on the tube.

In Fig. 7, the discharge tubes 1^d and 1^e are connected in parallel in the secondary circuit of the transformer *t'*. Thus the electrodes 2^d of both tubes are connected together and to one terminal of the transformer by a conductor 21, and the electrodes 2^e of both tubes are connected together and to the other terminal of the transformer by a conductor 22. Ordinarily the operation of discharge tubes connected in multiple is not successful, because the discharge will take its course through one tube where the resistance is low and not through the other where the resistance may be higher, leaving the latter tube unlighted. But, with my improvements, the resistance through one tube can be adjusted with respect to that in the other tube so that the discharge will take place through both tubes. In Fig. 7, the capacity circuits 23 and 24 on tubes 1^d and 1^e, respectively, are shown the same as in Fig. 6, except that they are not connected together. On one of the tubes, the tube 1^e in this instance, I provide a conducting member 25, preferably in the form of a ring or band of wire mesh, which extends around the tube in contact with the conductor 24, near one of its ends. When the current is turned on, if the discharge takes place through one tube only, an adjustment of the band 25 along the tube 1^e has the apparent effect of modifying the conductivity of the gas in the channels of the filler, and by careful adjustment a point will be found where the conductivity of the gas in the two tubes will be balanced and the discharge will take place through the channels in both tubes, and at the same time the rate of shifting of the discharges in the channels of each tube will be controlled by the capacity circuit. The fillers *a*³ in these tubes are shown the same as in Fig. 1. If no filler is used, both tubes will glow if the member 25 is adjusted to the right position.

The channels in the filler are proportioned so as to provide ample gas spaces with consequent low resistance of the gas between the electrodes. This is desirable in order that the length of animated tubing which can be efficiently operated with a given transformer voltage may be as great as possible. These channels may be so large that practically no shifting of the discharge will take place if the capacity circuit be omitted, because of the low resistance of the columns of gas in the channels; but when the capacity circuit is applied to the tube very active shifting of the course of the discharge takes

place and the discharge has the appearance of broad shifting lines of light.

Figures 8 to 14, inclusive, show discharge tubes having fillers and internal capacity circuits.

In Fig. 8, the tube 1^f has a filler α^4 , and within the tube and surrounding the end portions of the filler are condenser members k, k' , each, as shown in Fig. 9, consisting of a band of mica 28 mounted upon and extending around the filler, and a band of metal foil 29 on the outer side of the mica band. Instead of metal foil, a coating of conducting material, such as metallic paint, applied to the outer side of the mica band, may be used. In this case, the metal foil or conducting paint is one element of a condenser, the mica is the dielectric and the electrified gas in the channels is another element of the condenser. The presence of these condenser members in the tube causes active shifting of the discharge and the luminous lines, and by connecting these members by a small insulated or bare wire 30, extending through one of the channels in the filler, the shifting action of the discharge is increased.

In Figs. 10, 11 and 12, the tube 1^g has a sectional filler α^5 , the sections of which have channels for the discharge the same as in the previously described figures. The end sections 31 and 32 are alike, each having an axial socket 33 within which is arranged a part 34 of any conducting material, such as metal or carbon. Each of the intermediate sections 36 has a central perforation 37, and a conductor 38, which may be a bare or insulated wire, extends through these perforations and engages the parts 34 in the sockets. The sections fit closely together and enclose the conducting parts. In Fig. 10, the part 34 in each socket is one element of a condenser, the wall of the socket is the dielectric and the electrified gas in the channels is the other element of the condenser. The presence of the conducting parts in the sockets causes acceleration of the shifting of the electrical discharge from channel to channel and the connecting wire between these parts causes more active shifting of the discharge.

In Fig. 13, the structure is the same as in Fig. 10, except that two capacity circuits are arranged in the same tube 1^h. In one part of the tube, filler sections 31^a and 32^a, the same as sections 31 and 32 in Fig. 10, have sockets within which conductive parts 34^a are arranged and these parts are connected by a conductor 38^a passing through intermediate filler sections 36^a. In another part of the tube are shown socketed end sections 31^b and 32^b of filler in which are electrically conductive parts 34^b, and these are connected by conductor 38^b which extends through perforations in intermediate filler sections 36^b. The sections 32^a and 31^b are shown abutting, but they may be spaced apart any desired distance. The action of these capacity circuits is the same as that described in connection with Fig. 10.

In Fig. 14, a modification is shown in which the conductive condenser elements at the ends of the filler are within the tube, but they are connected together through the transformer circuit outside of the tube. Here the filler α^5 is the same as the filler shown in Fig. 1, except that it has axial sockets 39, 40 in its ends within which are arranged metal parts 34^c which are connected by conductors to the leading-in wires of the secondary circuit of the transformer 1². Here, as in Figs. 10-13, there is a condenser ac-

tion between the conductive parts 34^c and the electrified gas in the gas channels, through the walls of the sockets which are the dielectric elements.

What I claim is:

1. A luminous electrical discharge device comprising a closed glass envelope containing a rare gas and spaced electrodes of solid material and a filler of insulating material within that part of the envelope which lies between said electrodes, said filler affording a plurality of paths for the electric discharge, and electrically conductive material extending spirally about that portion of the envelope containing the filler.

2. A luminous electrical discharge device comprising a closed glass envelope containing a rare gas and spaced electrodes of solid material and a filler of insulating material within that part of the envelope which lies between said electrodes, said filler affording a plurality of paths for the electric discharge, and a wire extending spirally about that portion of the envelope containing the filler.

3. A luminous electrical discharge device comprising a closed glass envelope containing a rare gas and spaced electrodes of solid material and a filler of insulating material within that part of the envelope which lies between said electrodes, said filler fitting closely within the envelope and having, throughout its length, a plurality of substantially continuous passageways for the electrical discharge, and electrically conductive material associated with the device, for inductively influencing the course of the discharge.

4. A luminous electrical discharge device comprising a closed glass envelope containing a rare gas and spaced electrodes of solid material and a filler of insulating material within that part of the envelope which lies between said electrodes, said filler fitting closely within the envelope and having, throughout its length, a plurality of substantially continuous marginal channels for the electrical discharge, and electrically conductive material associated with the device, for inductively influencing the course of the discharge.

5. A luminous electrical discharge device comprising a closed glass envelope containing a rare gas and spaced electrodes of solid material and a filler of insulating material within that part of the envelope which lies between said electrodes, said filler fitting closely within the envelope and having, throughout its length, a plurality of substantially continuous marginal channels of substantially equal cross-sectional area for the electrical discharge, and electrically conductive material associated with the device, for inductively influencing the course of the discharge.

6. A luminous electrical discharge device comprising a closed glass envelope containing a rare gas and spaced electrodes of solid material and a filler of insulating material within that part of the envelope which lies between said electrodes, said filler fitting closely within the envelope and having, throughout its length, a plurality of substantially continuous marginal channels of substantially equal cross-sectional area and length for the electrical discharge, and electrically conductive material associated with the device, for inductively influencing the course of the discharge.

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