

July 2, 1935.

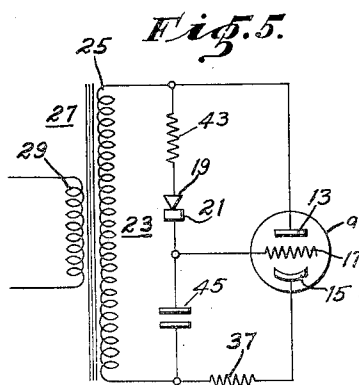
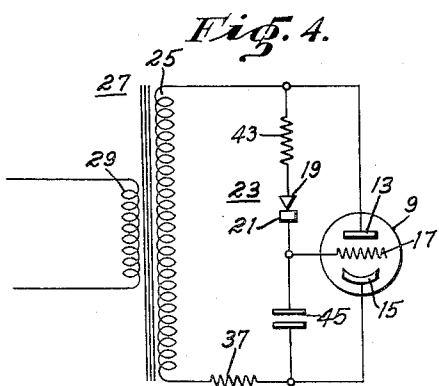
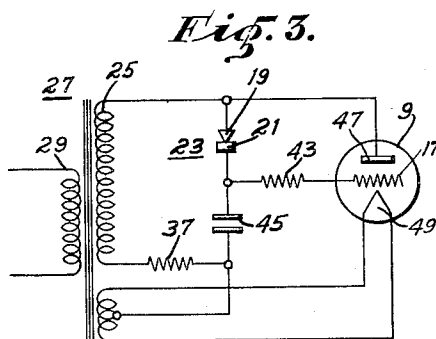
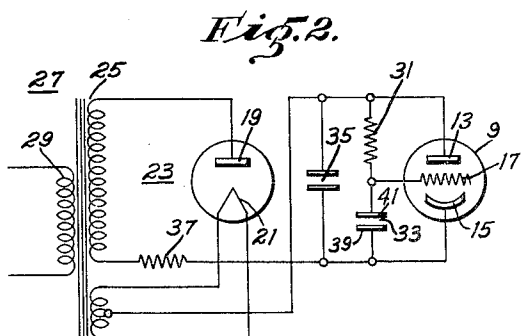
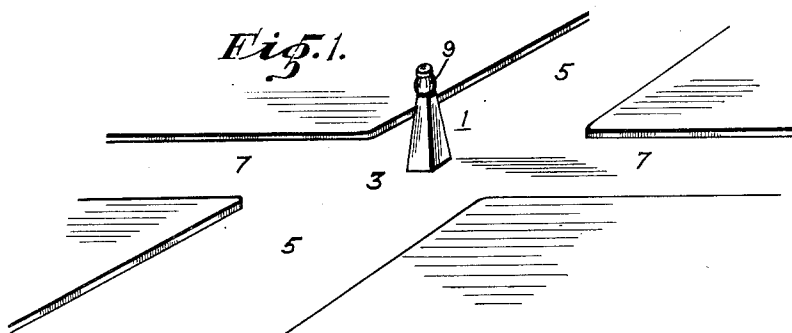
R. K. GESSFORD

2,006,737

FLASHING APPARATUS

Filed March 24, 1931

2 Sheets-Sheet 1



WITNESSES
T. L. Williams
Hymen Diamond

INVENTOR
Ross K. Gessford
 BY
Wesley S. Carr
 ATTORNEY

July 2, 1935.

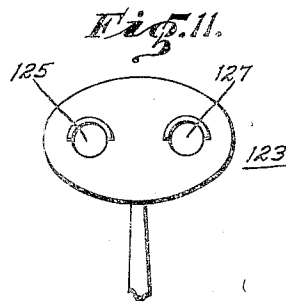
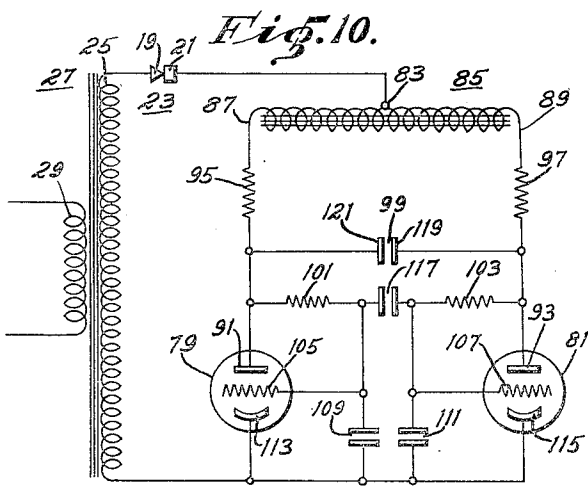
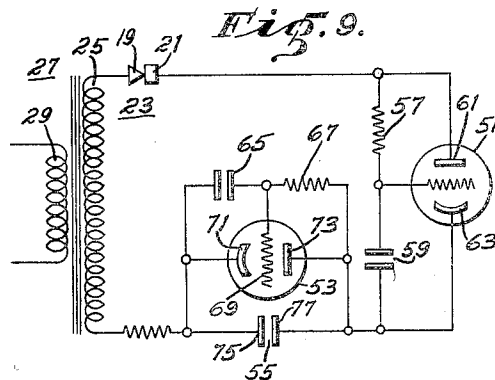
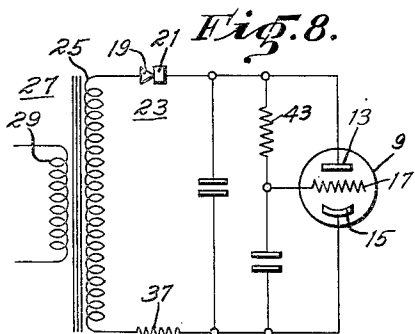
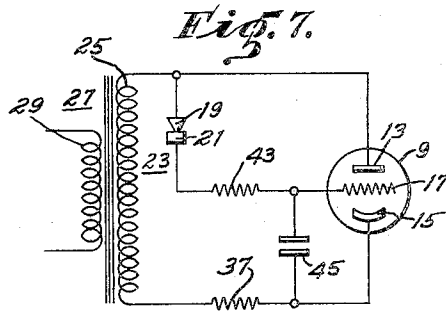
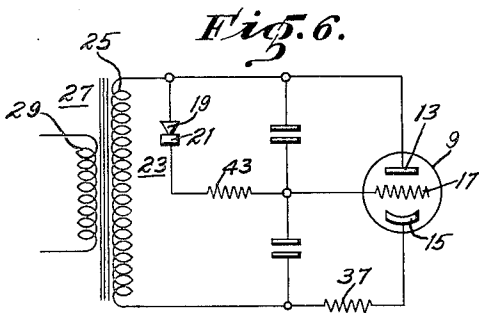
R. K. GESSFORD

2,006,737

FLASHING APPARATUS

Filed March 24, 1931

2 Sheets-Sheet 2



WITNESSES
R. S. Williams
Hymen Diamond

INVENTOR
Ross K. Gessford
BY
Chester A. Carr
ATTORNEY

UNITED STATES PATENT OFFICE

2,006,737

FLASHING APPARATUS

Ross K. Gessford, Wilkinsburg, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, a corporation of Pennsylvania

Application March 24, 1931, Serial No. 524,801

8 Claims. (Cl. 177—346)

My invention relates to signalling apparatus and has particular relation to traffic-signalling apparatus.

In traffic-signalling apparatus constructed and operated according to the teaching of the prior art, with which I am familiar, the signal ordinarily comprises a plurality of sources of light that are intermittently or sequentially ignited. The sources of light are disposed in containers of such structure that, when they are ignited in a predetermined sequence, the conventional signals are displayed to the drivers of vehicles.

In one type of traffic-signalling apparatus, a signalling device, commonly known as a blinker, is utilized. In a signalling device of this type, the activity of a source of light is ordinarily regulated from mechanically movable apparatus, such as a motor or a system of relays.

In the traffic signals that are utilized for regulating the passage of traffic along a plurality of intersecting highways, a plurality of sources of light are incorporated. These sources are ignited and extinguished in a predetermined sequence from a system of relays and from a program control motor. The difficulties inherent in mechanically moving parts when utilized for purposes of operating a traffic system, or any other system of signals, for that matter, are manifest and need hardly be specified.

It is, accordingly, an object of my invention to provide a traffic-control system wherein the operation of the signalling lights shall be regulated electrically.

Another object of my invention is to provide a traffic-signalling system wherein the activity of the signalling lights shall not be regulated from a system of mechanical relays.

A further object of my invention is to provide signalling apparatus which shall incorporate combined signalling lights and relays.

A still further object of my invention is to provide a traffic-control system which shall incorporate only electroionic relays.

A more specific object of my invention is to provide a traffic blinker which shall include a signalling source to be periodically ignited solely by the operation of electrical elements.

An incidental object of my invention is to provide an electronic time-delay relay.

More concisely stated, it is an object of my invention to provide, for traffic-control apparatus, a traffic signal of simple structure, the periodicity of the illumination of which shall be dependent upon the constants of the circuit in which it is incorporated and shall not depend upon the oper-

ation of electro-mechanical or electromagnet-
ic elements.

According to my invention, I provide a traffic-control system which incorporates signalling lights comprising electric-discharge devices having control electrodes and a plurality of principal electrodes. A circuit, including principally a capacitor and a resistor, is associated with the control electrode of the electric-discharge device in such manner that the potential of the control electrode is periodically varied and, in turn, causes the electric-discharge device to periodically break down. When the electronic device breaks down, an intense glow is produced between its electrodes, and such a glow is utilized for signalling purposes, in a manner similar to the light from an ordinary signalling lamp.

The duration of the glow and the period of time that passes between two successive glowing periods are dependent upon the constants of the circuit associated with the control electrode, and both of these characteristics may vary from a small fraction of a second to as long as several minutes. The color of the glow is dependent upon the particular gas that is contained in the electrical-discharge device and may be regulated at will.

The intensity of the glow may be regulated by including an additional impedance in the circuit of the principal electrodes of the electronic device. The magnitude and the character of this impedance is such that it shifts the phase of the potential impressed between the principal electrodes relative to the phase of the potential impressed between one principal electrode and the control electrode. It is apparent that, if the relative phases of the two potentials are such that the control electrode attains the requisite potential for break down near the start of a positive half cycle of potential impressed between the principal electrodes, the glow has its maximum intensity. On the other hand, if the phase relation is such that the control electrode attains the requisite potential for discharge near the end of the positive half cycle of potential impressed between the principal electrodes, the discharge is comparatively weak and may be entirely absent.

The intensity of the discharge is, moreover, regulated by the character of the tube that is utilized for a light source. If a comparatively brilliant source is desired, a tube carrying a comparatively heavy current is utilized. For localities where sources of smaller intensity are required, a tube carrying a current of only a few milliamperes may be utilized.

The circuit associated with the control electrode and provided for regulating the time characteristic of the signal may assume numerous forms. Certain of the modifications that may be given to it will be described hereinafter. However, it is apparent that the number of possible combinations that can be made with several modifications of an electroionic tube having a plurality of electrodes and a number of electrical elements is extremely large and cannot be completely represented or described in the space and time allowed for an ordinary specification. However, as the essential features of the invention may be completely illustrated by a few principal embodiments of my invention, these embodiments have been incorporated in the present application.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention, itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which

Figure 1 is a view, in perspective, showing a traffic-control system wherein my apparatus is embodied.

Fig. 2 is a diagram illustrating the principal features of the control circuit of the embodiment of my invention illustrated in Fig. 1.

Figs. 3 to 8, inclusive, are diagrams showing modifications of the apparatus illustrated in Fig. 2.

Fig. 9 is a diagram showing the principal elements of a system constructed according to my invention and including two signalling lamps that are ignited simultaneously.

Fig. 10 is a diagram showing the principal elements of a signalling system constructed according to my invention, wherein a plurality of signalling sources to be operated in timed sequence, is incorporated and

Fig. 11 is a view, in front elevation, showing a signalling device wherein the control circuit constructed according to Fig. 10 may be incorporated.

The system shown in Fig. 1 comprises a signalling device 1 disposed at the intersection 3 of a plurality of highways 5 and 7. The signalling device 1 is equipped with a glow device 9 connected in circuit as illustrated in Figs. 2 to 8, as will be described hereinafter, and is thus rendered capable of emitting flashes of light with a predetermined periodicity.

As illustrated in Fig. 2, the signalling system comprises the glow device 9 which includes a plurality of cold principal electrodes 13 and 15 and a control electrode 17. The principal electrodes 13 and 15 are connected in series with the electrodes 19 and 21 of a rectifier 23 of any well known type. The rectifier 23 is fed from the secondary 25 of a transformer 27, the primary 29 of which is connected to an appropriate source of power.

It will be recognized that the electric-discharge device 9 should be preferably of the grid-glow-tube type, although it may be a grid-controlled electroionic or electronic device of any other type well known in the art, such, for example, as a grid-controlled mercury-vapor discharge device or a thermionic tube. The control electrode 17 of the device is connected to the anode 13 through a resistor 31, and to the cathode 15 through a capacitor 33. A second capacitor 35 is also connected between the principal electrodes 13 and 15

of the device. A current-limiting resistor 37 is included in the principal circuit of the glow device.

When power is applied to the system, the capacitor 33, associated with the control electrode 17, is charged from the secondary 25 of the power transformer 27, and one of its plates 41 is raised to the same potential as the control electrode. The remaining plate 41 accumulates a charge of opposite polarity and is raised to a potential of corresponding polarity. The control electrode 17 is connected to the same electrical point as the plate 41 and it attains the same potential as the plate.

When the difference of potential thus impressed between the control-electrode 17 and the cathode 15 attains a predetermined value, the device 9 breaks down, and a heavy current flows, between its principal electrodes 13 and 15, through the rectifier 23 and partly through the circuit including the resistor 31 and the capacitor 33. The capacitor 33 is, therefore, discharged, and the control electrode 17 of the electric-discharge device 9 again assumes a potential substantially equivalent to the potential of the cathode 15.

Moreover, it will be noted that the rectifier utilized in the system is of the half-wave type. During substantial periods of time, the potential between the principal electrodes 13 and 15 of the electric-discharge tube 9 is, therefore, substantially zero. When one of these periods coincides with the period of zero potential difference between the control electrode 17 and the cathode 15, the discharge in the tube 9 is interrupted, and one complete period, during which the tube flashed and became dark, is at an end.

The function of the capacitor 35, connected between the principal electrodes 13 and 15 of the tube 9, is principally to regulate the intensity of the discharge. It will be seen that, by varying the magnitude of the capacitor, the phase of the potential impressed between the principal electrodes of the tube may be varied relative to the phase impressed between a principal electrode of the tube and the control electrode 17. The total current passing between the principal electrodes 13 and 15 of the tube 9 is thus regulated, and, hence, the intensity of the illumination emitted by the tube is controlled.

The periodic characteristics of the tube 9 depend upon its structure, in a general way, but, in particular, they depend upon the time constants of the circuit associated with its control electrode. In practice, the resistor 31 and the capacitors 33 and 35, utilized in the system, may be of the variable type and, consequently, the characteristics of the discharge in the tube 9 may be regulated with great facility by the person servicing the apparatus.

It is well to note that, in view of the fact that the grid-controlled electric-discharge device, incorporated as a light source in apparatus constructed as illustrated in Fig. 2, is of the cold-electrode type, no heating current need be supplied to the cathode 15 of the tube 9 and there is, consequently, a considerable saving in the expense of operation. Where extremely large intensities of light are not required, a tube of this type has been found to be highly useful for signalling. In apparatus of the type wherein the cold-cathode tube 9 is utilized, it is advantageous to incorporate a rectifier of the cold-electrode type, such as a copper-oxide rectifier. It should be borne in mind that the rectifier illus-

trated in Fig. 2 as of the hot-cathode type is to be regarded only as symbolical and as representative of a copper-oxide rectifier as it is of a hot-cathode rectifier.

5 In apparatus of the type illustrated in Fig. 3, the resistor 43 of the timing circuit is connected between the control electrode 17 of the electric-discharge device and the capacitor 45 of the timing circuit. The principal electrodes 47 and 10 49 of the electric-discharge device 9 are directly connected across the terminals of the secondary 25 of the power-supply transformers 27. It will be noted that, in apparatus of this type, the potential between the principal electrodes 47 and 15 49 of the electric-discharge device 9 become periodically reversed in polarity when the device is ignited. Consequently, the interruption of the discharge between the principal electrodes of the electric-discharge device is of a considerably 20 more positive nature than it is in apparatus of the type illustrated in Fig. 2.

Finally, the tube 9, utilized with the apparatus illustrated in Fig. 3 is of the hot-cathode type. Since, tubes of this type carry considerably more 25 current than those of the cold-cathode type, the apparatus illustrated in the view is particularly usable in localities where a comparatively intense light source is desirable.

The re-arrangement of the parts illustrated in 30 Figs. 4 to 8 will be readily understood by one who examines the views. The modification of my invention, shown in these drawings, may be utilized for the same purposes as the modifications discussed hereinabove. They represent signalling 35 devices having predetermined characteristics dependent upon the character of the electric-discharge device and of the remaining electrical elements incorporated therewith. Essentially, however, the character of the discharge and its period 40 is regulated by the electrical co-action of a resistor and a plurality of capacitors arranged in a manner identical with, or similar to, that shown in the drawings.

The apparatus, shown in Fig. 9, includes a plurality of signalling sources 51 and 53 of the electric-discharge type. One electric-discharge device 51 is connected in a manner similar to the electric-discharge device 9 of the apparatus described hereinabove. The remaining device 53 50 is connected across a capacitor 55 that is, in turn, connected in series with the timing resistor 57 and the timing capacitor 59 and with the principal electrodes 61 and 63 of the first electric-discharge device 51.

55 A timing circuit, comprising a capacitor 65 and a resistor 67, is connected between the control electrode 69 and the respective principal electrodes 71 and 73 of the electric-discharge device 53. The capacitor 55, associated with the electric-discharge device 53, is of such character that the timing capacitor 59, associated with the electric-discharge device 51, is prevented from becoming discharged when a potential is impressed 60 between the plates 75 and 77 thereof. The capacitor 59 can only become discharged after the electric-discharge device 53 has broken down and has discharged the capacitor 55. The electric-discharge device 53, therefore, breaks down during the period when the glow device 51 is ignited. 70 The timing circuits for both of the devices 51 and 53 may be so regulated that they flash simultaneously and for equal periods of time.

The apparatus shown in Fig. 10 comprises a plurality of electric-discharge devices 79 and 81 75 utilized for signalling sources and connected in

such manner as to flash in alternating sequence. The negative terminal 21 of the rectifier 23 is connected to the mid tap 83 of an inductor 85, the terminals 87 and 89 of which are connected to the anodes 91 and 93 of the electric-discharge 5 device 79 or the device 81 through current-limiting resistors 95 and 97. A capacitor 99 is connected across the terminals 87 and 89 of the inductor 85, and a plurality of resistors 101 and 103 are connected between the anodes 91 and 93 10 of the electric-discharge devices 79 and 81 and the control electrodes 105 and 107 thereof. A plurality of capacitors 109 and 111 are connected between the cathodes 113 and 115 and the control electrodes 105 and 107 of electric-discharge 15 devices 79 and 81. An additional capacitor 117 is also connected between the control electrodes 105 and 107 of the electric-discharge devices.

For purpose of explanation, it is assumed that one electric-discharge device 79 is excited, and 20 a heavy current is flowing between its electrodes 91 and 113. The capacitor 99, connected across the inductor 85, therefore, immediately becomes charged in such manner that its plate 119, associated with the anode 93 of the unexcited electric-discharge device 81, becomes positive, while the 25 plate 121, associated with the anode 91 of the excited electric-discharge device 79, becomes negative.

The capacitor 117, connected between the control 30 electrodes 105 and 107 of the two devices 79 and 81, also assumes potentials of the same corresponding polarity as the capacitor 99 connected across the inductors 85, but its rate of charging is dependent upon the resistors 101 and 103 35 in series therewith and, consequently, a considerable time is required for its charging period.

After the capacitor 117 has been charged to a predetermined polarity it attains such potential 40 distribution that the control-electrode 105 of the originally excited tube 79 becomes highly negative, while the control electrode 107 of the tube 81 becomes correspondingly positive. The discharge in the excited tube 79 is, therefore, interrupted at the following period of inactivity of the 45 rectifier 23, and the activity of the tube 81 is initiated during the same period of activity of the rectifier 23.

It will be apparent that the period of discharge, the period between the successive discharges of 50 a single tube and the period between the successive discharges of two tubes may be regulated at will by giving the capacitors and the resistors, associated with the tubes, appropriate values. The intensity of the discharge may be regulated 55 by adjusting, in a requisite manner, the magnitude of the inductor 85 and of the capacitor 99 connected across its terminals.

In Fig. 11, a signalling device 123, particularly adapted to be utilized with the system of the type 60 illustrated in Fig. 10, is shown. One of the tubes 79 is disposed at one eye 125 of the signalling device 123, and the other tube 81 is disposed at the other eye 127, thereof. As the tubes 79 and 81 are excited in alternating sequence, the signalling 65 device assumes the appearance of a reciprocating signal.

In connection with the apparatus of the type illustrated in Figs. 10 and 11, it should be kept 70 in mind that the duration of the signals displayed by the tubes 79 and 81 need not necessarily be equal. One tube may have a comparatively long period of ignition, and the other tube may have a comparatively short period, depending upon the relative magnitude of the con- 75

stants incorporated in the circuit of the tubes.

In experimenting with the systems of the type illustrated in Fig. 10, I have found that the time of flash of the tubes may be varied over a wide range. In a specific system of the type wherein each tube flashes for a period of $7\frac{1}{2}$ seconds and is extinguished for $7\frac{1}{2}$ seconds, the tubes 79 and 81 are of the hot-cathode type and an electromotive-force of 110 volts and commercial frequency is impressed between their principal electrodes. The capacitors 99 and 111 are 4 microfarads each; the capacitors 109 and 111 are .01 microfarad each; the resistors 101 and 103 are 4 megohms each, and the resistors 95 and 97 are 250 ohms each. The tubes carry a current of 360 milliamperes. If the resistors 101 and 103 are reduced to .1 megohm, the period of flash is reduced to one second.

In the above-described embodiments of my invention, electrical-discharge devices having the form of ordinary electrical-discharge tubes are illustrated. It is well to keep in mind that my invention may be equally as well applied to a signal having a particular configuration such, for example, as the word "Stop". In apparatus of this type, the electric-discharge device 9 is given the form of the word or design to be displayed, and its principal electrodes are disposed at the extreme terminals of the letter. When a glow is produced in this tube, the display corresponds to the particular configuration which has been given the device.

Another modification of my invention, to which apparatus of the type illustrated in Fig. 10 has particular application, relates, in particular, to traffic signals of the type utilized to regulate the traffic along a plurality of intersecting highways. In traffic-signalling systems of this type, a signalling device for displaying a stop signal along one highway and a go signal along the remaining highway is provided.

In this particular embodiment of my invention, a plurality of electric-discharge devices, connected as are the tubes of Fig. 10, are utilized for light sources and are suitably disposed in the signalling device.

However, since the stop signal is ordinarily indicated by the color red, while the go signal is ordinarily indicated by the color green, the glow in the electric-discharge device should have a bright yellow color. Consequently, in electric-discharge devices utilized with apparatus of this type, a gas capable of yielding a bright yellow color should be incorporated. I have found, in particular, that the vapor from a small particle of sodium, deposited within the container of the electrodes of the electronic device, is highly suitable for yielding the particular color desired.

It should also be noted that apparatus of a type similar to the apparatus illustrated in Figs. 9 or 10 may be provided wherein more than two glow devices are utilized. The mode of practicing my invention in this connection will be apparent to one skilled in the art.

It may be noted that it may be desirable for some uses, to omit the electrodes 13 of Figs. 2, 4, 5, 6, 7, 8 and 47 of Fig. 3 and that such arrangements are within the purviews of my invention.

Finally, I have found that inductors may also be utilized in the timing circuits and in a phase-shifting circuit for producing the proper characteristics of the signalling system. Modifications of the apparatus wherein inductors are in-

corporated in the circuits lie within the scope of my invention.

Although, I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted, except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In a traffic signal an illumination unit comprising an electric discharge device of the type that emits visible radiations when it is energized said device having a control electrode and a plurality of principal electrodes, a source of periodic potential for energizing said device, the amplitudes of the output of said source being of such magnitude that said discharge device if energized will be deenergized with the periodicity of the source, a circuit including a capacitor connected between said control electrode and one of said principal electrodes and a resistor connected between said control electrode and another of said principal electrodes, said circuit cooperating with said energizing means to impress a periodic variation on the control electrode of said device thereby to so vary the state of excitation of said device that it periodically emits visible radiations and a capacitor connected between the principal electrodes of said device and cooperating with said energizing means to vary the luminosity of said radiations.

2. In a traffic signal an illumination unit comprising an electric discharge device of the type that emits visible radiations when it is energized said device having a control electrode and a plurality of principal electrodes, a source of periodic potential for energizing said device, the amplitude of the output of said source being of such magnitude that said discharge device if energized will be deenergized with the periodicity of the source, a circuit including a capacitor connected between said control electrode and one of said principal electrodes and a resistor connected between said control electrode and another of said principal electrodes, said circuit cooperating with said energizing means to impress a periodic variation on the control electrode of said device thereby to so vary the state of excitation of said device that it periodically emits visible radiations and phase shifting means coupled between the principal electrodes of said device and cooperating with said energizing means to vary the luminosity of said radiations.

3. In a traffic signal an illumination unit comprising two electric discharge devices of the type that emit visible radiations when they are energized, each of said devices having a control electrode and a plurality of principal electrodes, means for energizing said devices, a capacitor connected between the control electrode and a principal electrode of one of said devices, a capacitor connected between the principal electrodes of said second device, means for connecting the network comprising the control and principal electrodes of said first-named device and the capacitor connected therebetween to the network comprising the principal electrodes of said second-named device and the capacitor connected therebetween, so that said capacitor of said last-named network cooperates with said energizing means and said second-named device to control the electromotive force impressed on the capacitor of said first-named device, and a capacitor connected between the control electrode and one principal electrode of said second-named device and cooperating

with said energizing means to vary the state of excitation of said device and in consequence of said variation to vary the potential impressed on the capacitor connected between the principal electrodes of said device and the potential impressed on the capacitor connected between the control and principal electrodes of said first-named device thereby to produce the emission of visible radiations from said first-named device and from said second-named device.

4. In combination, an electric discharge device having a control electrode and a plurality of principal electrodes and being capable of transition from a deenergized to an energized condition in response to variations only of the potentials impressed between said control electrode and said principal electrodes, a periodic power source having a plurality of terminals connected to said principal electrodes the amplitudes of the output of said source being of such magnitude that said discharge device if energized will be deenergized with the periodicity of the source, a capacitor and means for connecting said capacitor between said control electrode and one of said principal electrodes, whereby the charge on said capacitor controls the potential impressed between the last said electrodes to a sufficient extent to vary the excitation of said discharge device, a resistor connected between said control electrode and another of said principal electrodes, and means to charge said capacitor through said resistor thereby to vary the excitation of said discharge device, whereby the capacitor is discharged through said device on materially increased excitation of said device.

5. In combination, an electric discharge device having a control electrode and a plurality of principal electrodes and being capable of transition from a deenergized to an energized condition in response to variations only of the potentials impressed between said control electrode and said principal electrodes, a power source of unidirectional current having a plurality of terminals connected to said principal electrodes for supplying a current between said principal electrodes, a capacitor and means for connecting said capacitor between said control electrode and one of said principal electrodes, whereby the charge on said capacitor controls the potential impressed between the last said electrodes to a sufficient extent to vary the excitation of said discharge device, a resistor connected between said control electrode and another of said principal electrodes and means to charge said capacitor through said resistor, and a capacitor connected between said principal electrodes to vary the excitation of said discharge device.

6. In traffic signalling apparatus, an illumination unit comprising a plurality of electric discharge devices of the type that emit luminous radiations when they are energized each of said devices having a plurality of principal electrodes between which a discharge is to pass and an electrode for controlling the discharge, means for energizing said devices and circuits having predetermined time constants so coupling the prin-

cipal electrodes and the control electrode of one of said devices to the principal electrodes and the control electrode of another device and so cooperating with said energizing means that when each one of said devices becomes energized it causes the other device to become de-energized for a period of time dependent on said time constant circuits, after which the last said device is energized by said energizing means so that said devices are successively and periodically energized in a predetermined timed sequence dependent on the time constants of said circuits and a flashing luminous signal is produced.

7. In a traffic signalling apparatus, an illumination unit comprising a plurality of electric discharge devices of the type that emit luminous radiations when they are energized, each of said devices having a control electrode and a plurality of principal electrodes, means for energizing said devices, a capacitor, and means to connect said capacitor to said energizing means and between a principal electrode of one of said devices and a principal electrode of another of said devices in a manner to cooperate with energizing means to interchange the polarity of the potentials applied between the electrodes of said devices when one is energized and the other is deenergized, a circuit having a predetermined time constant connected between the control electrodes of each of said devices and the principal electrode of another device, and means connecting said circuits to said energizing means thereby to impress potentials between the control electrodes and the principal electrodes of each of said devices so that they vary in accordance with the variations of the potentials impressed between the principal electrodes whereby said devices are successively and periodically energized in a predetermined time sequence and produce a predetermined luminous signal.

8. In combination, an electric discharge device having a control electrode and a plurality of principal electrodes and being capable of transition from a deenergized to an energized condition in response to variations only of the potential impressed between said control electrode and said principal electrodes, a periodic power source having a plurality of terminals connected to said principal electrodes the amplitudes of the output of said source being of such magnitude that said discharge device if energized will be deenergized with the periodicity of the source, a capacitor and means for connecting said capacitor between said control electrode and one of said principal electrodes, whereby the charge on said capacitor controls the potential impressed between the last said electrodes to a sufficient extent to vary the excitation of said discharge device, an impedance connected between said control electrode and another of said principal electrodes, and means to charge said capacitor through said impedance, thereby to vary the excitation of said discharge device, whereby the capacitor is discharged through said device on materially increased excitation of said device.

ROSS K. GESSFORD.