

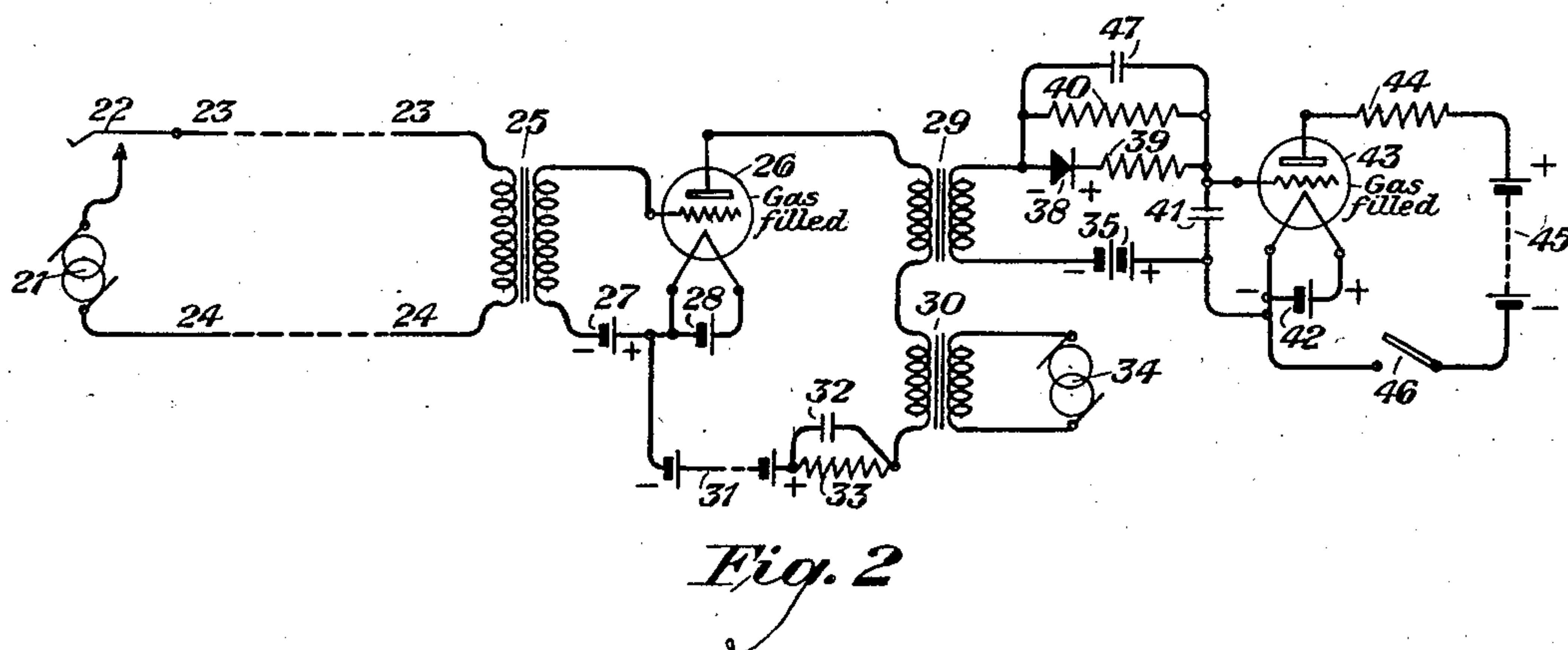
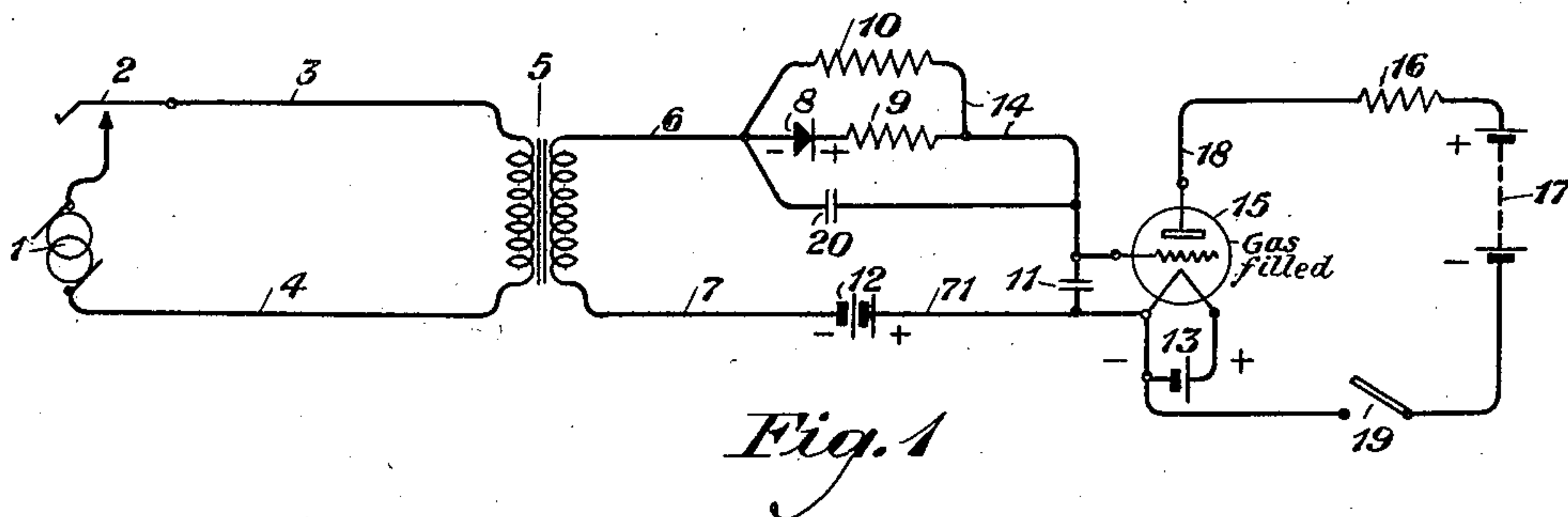
April 24, 1934.

C. S. DEMAREST

1,955,874

MEANS FOR CONTROLLING GAS FILLED DISCHARGE TUBES

Filed Aug. 18, 1932



INVENTOR
C. S. Demarest
BY *J. F. York*
ATTORNEY

UNITED STATES PATENT OFFICE

1,955,874

MEANS FOR CONTROLLING GAS FILLED
DISCHARGE TUBES

Charles S. Demarest, Ridgewood, N. J., assignor
to American Telephone and Telegraph Com-
pany, a corporation of New York

Application August 18, 1932, Serial No. 629,383

5 Claims. (Cl. 175—320)

This invention relates to electrical circuits and more particularly to improved means for controlling the starting of an arc discharge in gas filled discharge tubes, of the grid controlled type.

5 These tubes are useful in many diverse circuit applications as a substitute for electromagnetically operated relays and possess many advantages over these devices. In many circuit applications it is desired, to provide a relay having
10 slow operate features, that is to say, when the conditions for operation have been set up, a predetermined time must elapse before the relay contacts actually close. This has heretofore been a difficult problem, when utilizing the ordi-
15 nary type of electromagnetic relay, and it has been necessary to resort to complicated and unsatisfactory mechanical or electrical arrangements, such as dash pots, thermal operation, or the like. The arrangements of this invention
20 provide a means for introducing a definite and predetermined delay in starting an arc in a gas filled discharge tube. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

25 The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1 and 2 of which the invention is illustrated. Figure 1 shows the invention in its simplest form, while in
30 Fig. 2 a modified arrangement, including an impulse repeating tube, is shown, in which the delay will not be affected by the magnitude of the applied impulses.

Figure 1 shows a source of alternating current
35 1, connected through a signaling key 2 over conductors 3 and 4 to the primary of transformer 5. Conductor 7 connects from one side of the secondary of transformer 5 to the negative pole of grid battery 12, from the positive pole of which
40 conductor 71 connects to the negative side of the cathode of gas filled thermionic tube 15. This tube may be filled with a gas such, for example, as neon. Battery 13 heats the cathode to an electron emitting temperature by passing current
45 therethrough. The cathode shown is of the filamentary type. The other terminal of the secondary of transformer 5 connects to conductor 6, which connects to the negative side of rectifier element 8 and resistance 10. The positive side of
50 rectifier 8 connects to resistance 9. The other terminal of resistance 9 is connected to conductor 14, which also is connected to resistance 10, capacity 11 and the grid of gas filled tube 15. The other terminal of capacity 11 is connected
55 to conductor 71 and thus to the cathode of tube

15. The anode of this tube connects over conductor 18 through resistance 16 to the positive pole of battery 17. The negative pole of battery 17 is connected to the cathode of tube 15 through switch 19. Condenser 20 is provided connected
60 in parallel with resistance 10, between conductors 6 and 14 for purposes to be pointed out hereinafter.

The circuit of Fig. 1 provides a slow operate feature in the following manner:

65 With no input applied, the condenser 11 will be charged to the voltage of battery 12. When an alternating current input of sufficient magnitude is applied to the primary winding of transformer 5, an alternating voltage will appear
70 across the secondary windings thereof and being rectified in rectifier 8 will tend to reverse the charge on condenser 11. Resistance 10 is relatively large in comparison with resistance 9, while both are large compared to the resistance of
75 rectifier 8 in the pass or conducting direction, when current flows in at the negative and out at the positive terminal as indicated on the drawing. The resistance of the rectifier element in the non-pass direction is very large in comparison
80 with either resistances 9 or 10.

As a result, the current flow into condenser 11 on positive half cycles of the input voltage will be that resulting from the positive peak value of the alternating E. M. F. less the value
85 of the voltage of battery 12, acting through resistances 9 and 10 in parallel, while on the negative half cycles this current flow will be that due to the sum of the negative peak value of the alternating current and the voltage of battery
90 12, acting through resistance 10 alone. Since 10 is very high, the charging current in the positive direction will be the larger, until condenser 11 is charged to such a value that its voltage due to this charge will overcome the normally
95 negative charge thereon due to battery 12 and thus render the grid of tube 15 sufficiently positive to cause it to discharge. This condition of charge of condenser 11 will require several cycles to be established, due to the limited rate of charging resulting from the presence of resistance 9
100 in the circuit. Evidently variation of resistance 9 will enable this charging rate and therefore the time required to be varied. When condenser 11 has charged up sufficiently, the grid of tube
105 15 will no longer be sufficiently negative with respect to the cathode to prevent an arc from being established, and the arc will therefore strike between anode and cathode of tube 15 as soon as the charge delivered to condenser 11 has been
110

sufficient. It is thus apparent that there will be a delay in operation of tube 15, the arc only being established after a signal has been applied to transformer 5 for a predetermined period.

Condenser 20 is not required for the delayed operation thus far discussed. It may be utilized, however, to permit signal frequencies higher than the normal value to produce instantaneous operation, or to permit large input amplitudes to operate tube 15 substantially without delay. If neither of these features is desired, condenser 20 may be omitted.

It will be apparent from the preceding discussion that the amplitude of the incoming signal voltage applied to the primary of transformer 5 will have a large effect on the time delay introduced. For amplitudes below a definite minimum, no operation will result, as the charge due to rectification in rectifier 8 will leak off through resistance 10 between positive half cycles, while for sufficiently great inputs, the condenser 11 may be charged to the voltage permitting an arc to form in less than one-half cycle. While for certain purposes, such as the operation of overload devices, inverse time element operation in this manner is desired, such a feature may be a serious disadvantage in other applications. Accordingly, the arrangements of Fig. 2 have been provided to overcome any disadvantages due to variations in amplitude of source 1, as in Fig. 1.

The circuit arrangement shown in Figure 2 of the drawing illustrates a second form of the invention, in which a signal repeating tube 26 is interposed between the input transformer 25 and the slow-operating tube 43. The operation of this circuit is as follows: Signaling impulses from generator 21 are sent over conductors 23 and 24 under control of key 22. It is assumed that these conductors are of considerable length and that, owing to variation in attenuation in the circuit formed by conductors 23 and 24, or variations in the voltage of generator 21, or both, the signaling impulses applied to transformer 25 will not be of uniform amplitude, but that these impulses of signaling voltage, after being stepped up in transformer 25, will be of sufficient magnitude to cause an arc to strike in tube 26. Battery 27 furnishes grid bias to the grid of tube 26, and battery 28 heats the cathode. The anode circuit of this tube contains the primaries of transformers 29 and 30, in series and resistance 33, shunted by condenser 32. This resistance limits the anode current due to battery 31 to a safe value, when an arc is established in tube 26.

Generator 34 supplies alternating current of constant amplitude and of a frequency high in comparison to that from generator 21, to the secondary of transformer 30. An alternating voltage will appear across the primary of transformer 30 which is of constant amplitude, such that on negative half cycles the anode of tube 26 is negative with respect to the cathode; or in other words, the peak value of this alternating voltage slightly exceeds the voltage of battery 31. When no arc exists in tube 26 there is no complete circuit, but when an arc is established through the primaries of transformers 29 and 30, anode to cathode arc of tube 26, to the negative pole of battery 31, resistance 33 or condenser 32, according to whether the current being considered is alternating or direct and back to the primary of transformer 30. When this path is completed alternating current of constant amplitude will flow through the primary of transformer 29 and after

a predetermined delay will cause an arc to be established in tube 43. Battery 35 supplies the negative grid bias, corresponding to battery 12 in Figure 1, while rectifier 38, resistances 39 and 40, condensers 41 and 47 correspond in function to rectifier 8, resistances 9 and 10, condensers 11 and 20 of Figure 1.

In Fig. 1 or 2, the anode circuits of the tubes 15 or 43 contain resistances 16 or 44 to limit the anode current, batteries 17 or 45 to supply anode voltage or current, and switches 19 or 46 to interrupt the anode circuit and extinguish the arc after the tubes have operated. Switches 19 and 46 have been supposed closed in the preceding discussion. While other methods of extinguishing the arc may be used, the simple switch arrangement here shown has been used in illustrating the operation of this invention for convenience only, and the invention is not limited to any especial means of extinguishing this arc in the slow operate tube. Nor is it intended that the invention should be limited to the case of thermionic gas filled tubes, as cold electrode gas filled tubes may equally well be used, or also thermionic equipotential cathode tubes, without departing from the scope of this invention and the appended claims.

What is claimed is:

1. A signaling system comprising a gas filled discharge tube, a control circuit connected to the grid of said discharge tube, a source of direct current and a condenser so connected in said control circuit that said condenser will normally apply a negative charge to said grid, means for applying an alternating current potential to said control circuit, and means in said control circuit offering a lower impedance to the positive half cycles of said alternating potential than to the negative half cycles thereof whereby the negative charge on said condenser will be gradually reduced, said last mentioned means comprising a rectifier and resistance in series with each other connected in said control circuit and a second resistance connected in said circuit in parallel with said rectifier and resistance, said second resistance being of greater value than said first resistance.

2. A signaling system comprising a gas filled discharge tube, a control circuit connected to the grid of said discharge tube, a source of current and a condenser so connected in said control circuit that said condenser will normally apply a negative charge to said grid, and means for applying an alternating current potential to said control circuit, said control circuit being divided into branched paths, one of said paths including in series a resistance and a rectifier so poled that its positive terminal will be connected to the normally negative terminal of said condenser, the other of said branched paths including a resistance of a value larger than the resistance in said first branched path.

3. A signaling system comprising a gas filled discharge tube, a control circuit connected to the grid of said discharge tube, a source of current and a condenser so connected in said control circuit that said condenser will normally apply a negative charge to said grid, and means for applying an alternating current potential to said control circuit, said control circuit being divided into branched paths, one of said paths including in series a resistance and a rectifier so poled that its positive terminal will be connected to the normally negative terminal of said condenser,

another of said branched paths including a resistance of a value larger than the resistance in said first branched path, and another of said branched paths including a condenser.

- 5 4. A signaling system comprising a gas filled discharge tube, a control circuit connected to the grid of said discharge tube, a source of current and a condenser so connected in said control circuit that said condenser will normally apply
10 a charging potential to said grid to render said discharge tube inoperative, and means for applying an alternating current potential of constant effective value to said control circuit to change the charging potential of said condenser so as
15 to render said discharge tube operative, said last mentioned means comprising a second gas filled discharge tube, means for causing the initial discharge of said second tube, means for connecting the plate circuit of said second tube to said control circuit, and means for applying to the plate
20 circuit of said second tube an alternating current potential of constant effective value.

5. A signaling system comprising a gas filled

discharge tube, a control circuit connected to the grid of said discharge tube, a source of current and a condenser so connected in said control circuit that said condenser will normally apply
80 a charging potential to said grid to render said discharge tube inoperative, and means for applying an alternating current potential of constant effective value to said control circuit to change the charging potential of said condenser so as to render said discharge tube operative, said last
85 mentioned means comprising a second gas filled discharge tube, a source of alternating current, means for connecting said last mentioned source to the grid of said second tube to cause it to discharge, means for connecting the plate circuit
90 of said second tube with said control circuit, and means for applying to the plate circuit of said second tube an alternating potential of constant effective value and of a frequency high in comparison with the frequency of the alternating
95 current potential applied to the grid of said second discharge tube.

CHARLES S. DEMAREST.

25

100

30

105

35

110

40

115

45

120

50

125

55

130

60

135

65

140

70

145

75

150