

Sept. 18, 1951

E. VROOM
SIGNALING SYSTEM

2,568,177

Filed June 9, 1950

2 Sheets-Sheet 1

FIG. 1

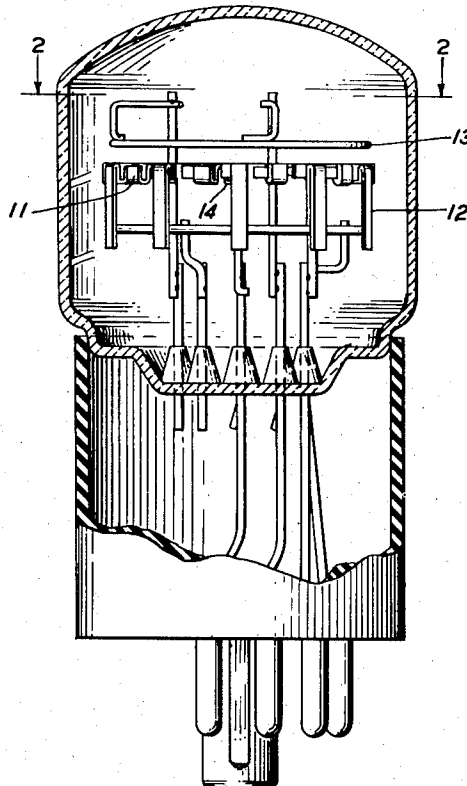
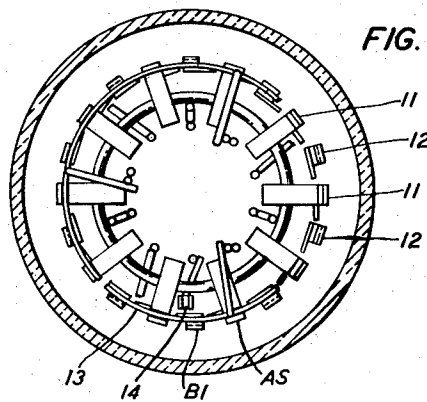


FIG. 2



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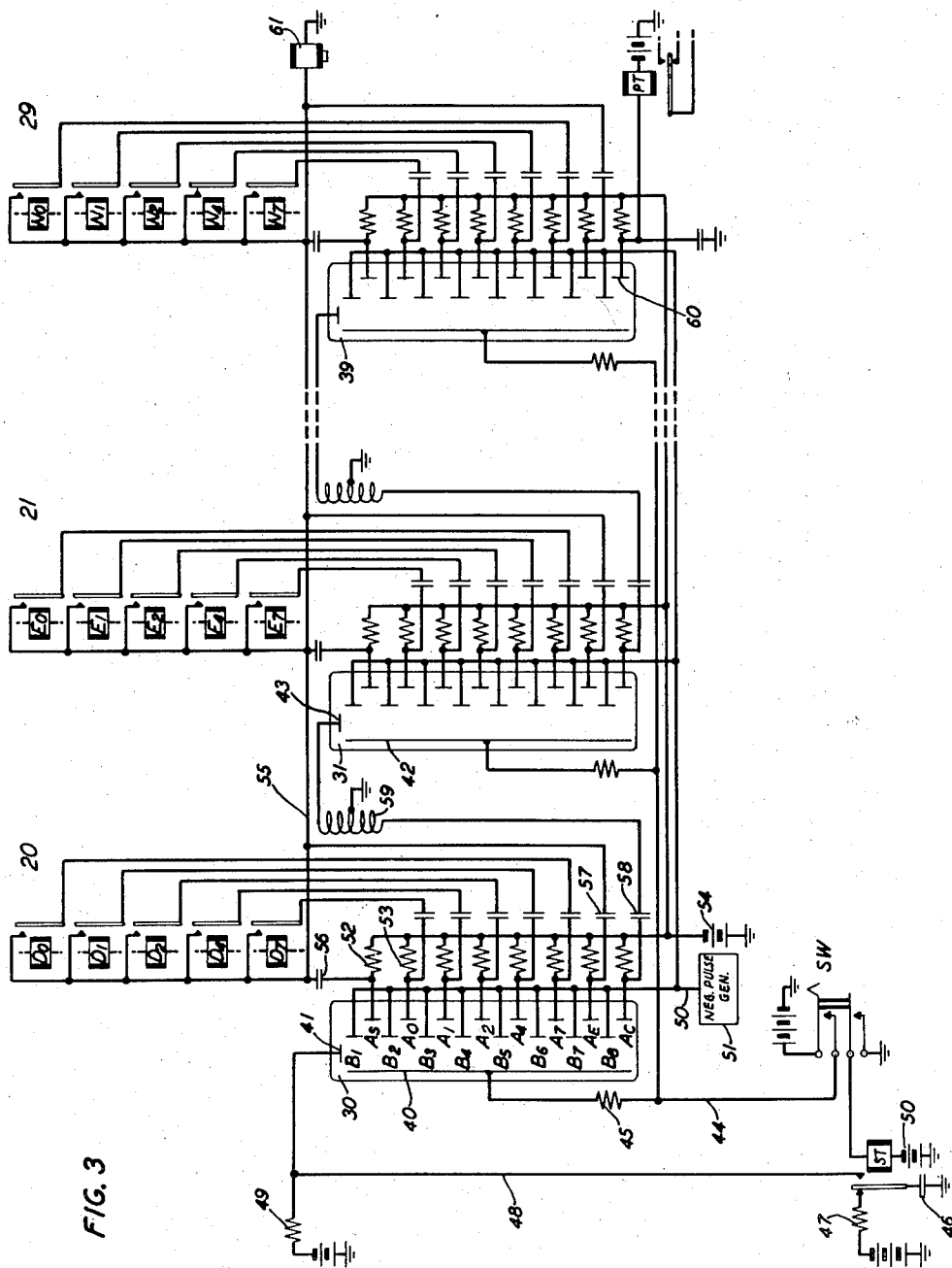


FIG. 3

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SIGNALING SYSTEM

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14 Claims. (Cl. 177—380)

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This invention relates to a signaling system and more particularly to a system for scanning and transmitting stored information.

An object of this invention is the accurate transmission of signals at a high rate of speed.

Another object of this invention is the rapid scanning of a series of digit registers to ascertain and transmit the data stored in those registers.

In general, a system arranged in accordance with the invention utilizes cold cathode gaseous discharge devices each having a plurality of cathodes. The tubes are arranged to operate in response to pulses applied thereto to advance the conductive path therein step by step from cathode to cathode. The output paths of certain of the cathodes in each tube are connected to individual digit registers whereby those registers are scanned as each tube steps through its cycle. Means are provided successively to render the stepping tubes operative to provide a successive scanning of the several digit registers.

The invention may be more fully understood from the following detailed description of a preferred embodiment thereof when read with reference to the accompanying drawings in which:

Fig. 1 is an elevational view of a multicathode glow discharge device illustrative of one type of tube suitable for use in the present system;

Fig. 2 is a sectional view taken along 2—2 of Fig. 1 illustrating the arrangement of the several cathodes and the cooperative relation thereof with the anode, a portion of the anode being broken away to show certain of the cathodes more clearly; and

Fig. 3 is a circuit diagram representing a preferred embodiment of the invention.

The multicathode stepping tubes which are employed in the present system may be of any suitable type. A tube operable in a suitable manner is disclosed, for example, in the United States patent application of W. A. Townsend, Serial No. 101,322, filed June 25, 1949, the disclosure of which is incorporated herein by reference. A representation of that tube is presented in Figs. 1 and 2 of the present disclosure.

In general the disclosed gaseous discharge device comprises an anode and a plurality of cold cathodes in cooperative relationship with the anode, the cathodes being mounted in a row which may be rectilinear, circular or of other geometrical form. The cathodes, or certain of them, are electrically grouped and are so constructed and arranged that the discharge between one cathode and the anode may be stepped

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or shifted selectively to a path between the anode and another cathode in response to signal pulses, the discharge shifting or advancing one position for each pulse.

Referring now to Figs. 1 and 2 of the drawings, the tube of the exemplary type comprises a plurality of cathodes 11, hereinafter referred to as "A" cathodes, and a second plurality of cathodes 12, hereinafter designated as "B" cathodes, all of the cathodes being mounted in a circular array with each A cathode 11 between two B cathodes 12. The main anode 13 may be and is shown to be ring-shaped, and is supported in spaced relation with the A and B cathodes. An auxiliary, start, reset or "normalizing" electrode 14 is also provided.

In one method of operating the stepping tube, a suitable positive potential is supplied to the main anode 13 and a potential negative with respect to the main anode potential is applied to the auxiliary electrode 14 which, therefore, serves as a start cathode. A discharge will occur between these two electrodes. If a negative pulse then be applied to the B cathodes 12, the discharge will transfer initially so as to exist between the main anode and the first one of the B cathodes 12. This first B cathode is designated B₁ in Fig. 2. At the cessation of the pulse, the discharge will transfer so as to exist between the main anode and the first one of the A cathodes 11, which is supplied with a suitable voltage through an impedance. This first A cathode is designated A₁ in Fig. 2. In a similar manner, successive pulses applied to the B cathodes 12 will cause the conduction to transfer so as to exist between the main anode 13 and the successive A cathodes 11, in a counter-clockwise direction in the structure as shown in Fig. 2. The directivity of the stepping is accomplished by the construction of the cathodes, in the manner fully set forth in the above-cited patent application or in any other suitable manner.

As the conductive path progresses step by step from position to position in the tube, the conduction is limited to one path at a time. When the conductive path is transferred to a B cathode, the conduction between the main anode and the previous A cathode 11 is extinguished. This may be accomplished by utilizing a suitable impedance in series with the main anode of the device whereby the increased voltage drop across this impedance, resulting from the transfer of conduction to a B cathode 12, is sufficient to cause the voltage between the main anode 13 and

the A cathode 11 to fall below the sustaining value.

Referring now to Fig. 3 of the drawings, a plurality of settable digit registers 20 to 29 are provided. Only three such registers have been shown, but any number thereof may be employed. Each digit register has been shown as comprising five relays D₀—D₇, E₀—E₇, N₀—N₇ whereby any digit may be recorded in any of the registers on the conventional two-out-of-five code basis. The manner in which the information is supplied to the digit registers has not been shown inasmuch as this may be accomplished in any of a variety of ways such as by keys, counting chains, pulsing relays, etc.

Individual to each of the digit registers 20 to 29 is a multicathode stepping tube 30 to 39. As aforesaid, these tubes may be of the type shown in Figs. 1 and 2 in which event the A cathodes 11 in Figs. 1 and 2 are labeled A_s, A_o, A₁, A₂, A₄, A₇, A₈ and A_c in tube 30 of Fig. 3, the B cathodes 12 in Figs. 1 and 2 are labeled B₁—B₈ in tube 30 of Fig. 3, the anode 13 in Figs. 1 and 2 is labeled 40 in tube 30 of Fig. 3, and the starter or "normalizing" electrode 14 in Fig. 2 is labeled 41 in tube 30 of Fig. 3.

The circuit of Fig. 3 may be placed in operation by the closure of key SW. Upon the operation of key SW, positive battery, which may supply, for example, 130 volts, will be connected to conductor 44, resistor 45 and to the anode 40 of tube 30. Similarly, this positive voltage is supplied via conductor 44 and through other individual resistors to the anodes of the other multicathode stepping tubes 31 to 39. The operation of key SW also operates relay ST over an obvious circuit.

Prior to the operation of relay ST, the lower electrode of capacitor 46 is connected to ground and the upper electrode of capacitor 46 is connected to negative battery, which may supply, for example, 130 volts, through resistor 47 and a back contact of relay ST. Upon the operation of relay ST, the upper electrode of capacitor 46 is connected via conductor 48 to the start electrode 41 of stepping tube 30 and through resistor 49 to negative battery which may supply, for example, 50 volts. Therefore, upon the operation of relay ST, capacitor 46 is discharged to cause a negative pulse to be applied to the start electrode 41 of the first stepping tube 30.

With a suitable positive potential applied to the anode 40, the application of a pulse of suitable amplitude and polarity to the start electrode 41 will cause tube 30 to undergo a discharge between these two electrodes. After the pulse subsides, conduction continues across this gap through resistor 49 and to negative battery.

The B cathodes in the several stepping tubes are all multiplied via conductor 50 to a negative pulse generator 51. Generator 51, which may be of any suitable type, is arranged, in the preferred embodiment of the invention, continuously to supply negative pulses of suitable amplitude. It may be noted that the stepping tubes constructed in accordance with the representations of Figs. 1 and 2 will operate properly with generator 51 supplying pulses at a rate up to and exceeding 1500 pulses per second.

After a discharge has been initiated between the start electrode 41 and the anode 40 of tube 30 as above described, the first pulse applied by generator 51 to lead 50 will appear at all of the B cathodes including the first B cathode B₁ of tube 30. The discharge in tube 30 will then transfer so as to exist between the anode 40 and the

cathode B₁. At the termination of this pulse, the discharge will again transfer so as to exist between the anode 40 and the first A cathode A_s which is connected to negative battery 54 through an individual resistor 52. At the next pulse, the conduction in tube 30 again transfers so as to exist between the anode 40 and the next B cathode B₂ and at the termination of that pulse, the discharge will again transfer so as to exist between the anode 40 and to the next A cathode A_o, which is supplied with negative battery through resistor 53. The tube continues to step in this fashion. As hereinbefore noted, when a pulse is applied to the B cathodes to cause conduction to exist between the anode 40 and the B cathode which is adjacent (in the stepping direction) the then conducting A cathode, the conductive path between the anode 40 and the previously conducting A cathode is extinguished due to the increased voltage drop across the anode impedance 45.

All of the A cathodes are connected to negative battery 54 through individual resistors. When the conductive path in the stepping tube includes any one of those A cathodes, the voltage at that cathode will rise due to the potential drop across its individual resistor. This rise in cathode potential is utilized to transmit "start" and "end" signals and to sense the state of the digit registers. Thus, the first A cathode A_s is connected to the output conductor 55 through a capacitor 56 whereby when the conductive path in tube 30 includes cathode A_s, a "start" pulse will be transmitted over conductor 55.

Each of the intermediate A cathodes A_o to A₇ is connected through an individual capacitor to the front contact of one of the relays in digit register 20. With a digit having been recorded in that register, two of the five relays D₀ to D₇ will be operated. As a result, when the conductive path in the stepping tube 30 includes an A cathode which is associated with an operated one of the digit-register relays D₀ to D₇, a pulse will be transmitted through the closed relay contacts to output conductor 55. Therefore, pulses will be transmitted over conductor 55 on a time basis, the temporal relation between the two pulses and the start pulse being indicative of the digit recorded in the first digit register 20.

When the conductive path in tube 30 includes cathode A_o, a pulse is transmitted through capacitor 57 to output conductor 55 and this pulse is indicative of the end or termination of the transmission of the representation of the first digit.

Cathode A_c of tube 30 is coupled to the start electrode 43 of the second stepping tube 31 by capacitor 58 and transformer 59, the center tap of which is grounded. When the conductive path in tube 30 is stepped to B cathode B₈ and then to the last A cathode A_c, tube 30 will have effectively completed its cycle. The resulting rise in potential of cathode A_c will cause capacitor 58 to apply a pulse to transformer 59 whereby a negative pulse will be applied to the start electrode 43 to initiate a discharge in tube 31.

In the manner above described in relation to tube 30, the conductive path in tube 31 will then successively move step by step from position to position to sense the state of the second digit register 21, applying pulses indicative of the state of that digit register to the output conductor 55. In a similar manner, the several stepping tubes successively scan the other provided digit registers.

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The battery supply to the last A cathode 80 of the last stepping tube 39 includes the winding of relay PT. Therefore, when the last tube 39 has completed its cycle, relay PT will be operated and may be employed to indicate to various control circuits that the subject system has completed the scanning and transmitting operation.

The output conductor 55 may be connected to any suitable output means. As an exemplary arrangement, output conductor 55 is connected to the winding of the recording head 61 of a magnetic recorder whereby the information recorded in the digit registers 20 to 29 may be stored.

If desired, the present system may be employed always to transmit preset intelligence. This may be accomplished by maintaining two of the five relays in each register operated, or by directly connecting the outputs of the selected two A cathodes in each stepping tube to the output conductor 55, thereby dispensing with the digit registers. The system, as so arranged, may then be employed, for example, to cause a telephone subscriber's station or a mobile radio station to transmit its own code designation for identification or verification purposes.

It is to be understood that the above-described arrangements are but illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a plurality of distinct conduction positions and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step from position to position, output means responsive to conduction in each of said devices when the conductive path in each of said devices is in selected ones of the distinct conduction positions, and means rendering said devices successively conducting.

2. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a plurality of distinct conduction positions and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step from position to position, output means, and means for connecting the conductive path in each of said devices to said output means when the said conductive path in each of said devices is in selected ones of its distinct conduction positions.

3. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a plurality of distinct conduction positions and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step from position to position, output means, means for connecting the conductive path in each of said devices to said output means when the said conductive path in each of said devices is in selected ones of its distinct conduction positions, and means rendering said devices successively conducting.

4. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a plurality of distinct conduction positions and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step from position to position, output means, means for connecting the conductive path in each of said devices to said out-

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put means when the said conductive path in each of said devices is in selected ones of its distinct conduction positions, and means coupling the last of the conductive positions in each of said devices to the next succeeding ones of said devices whereby said devices are successively rendered conductive.

5. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a first electrode and a plurality of other electrodes and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step so that said path exists between said first electrode and successive ones of said other electrodes, output means, means for connecting said output means to selected ones of said other electrodes in each of said devices, and means rendering said devices successively conducting.

6. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a first electrode and a plurality of other electrodes and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step so that said path exists between said first electrode and successive ones of said other electrodes, output means, means for connecting said output means to selected ones of said other electrodes in each of said devices, and means coupling one of said other electrodes in each of said devices to the next succeeding ones of said devices whereby said devices are rendered successively conductive.

7. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a first electrode, a second electrode and a plurality of other electrodes and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step so that said path exists between said first electrode and successive ones of said other electrodes, output means, and means coupling one of said other electrodes in each of said devices to the said second electrode in the next succeeding ones of said devices whereby said devices are rendered successively conductive.

8. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a first electrode and a plurality of other electrodes and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step so that said path exists between said first electrode and successive ones of said other electrodes, output means, and a digit register individual to each of said devices and operative to connect said output means to selected ones of said other electrodes in the associated one of said devices in accordance with the digit registered in said digit register.

9. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a first electrode and a plurality of other electrodes and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step so that said path exists between said first electrode and successive ones of said other electrodes, output means, a digit register individual to each of said devices and operative to connect said output means to selected ones of said other electrodes in the associated one of said devices in accordance with the digit registered in said digit register, and means rendering said devices successively conducting.

10. In a signaling system, a pulse source, a plu-

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ality of gaseous conduction devices each having a first electrode and a plurality of other electrodes and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step so that said path exists between said first electrode and successive ones of said other electrodes, output means, a digit register individual to each of said devices and operative to connect said output means to selected ones of said other electrodes in the associated one of said devices in accordance with the digit registered in said digit register, and means coupling one of said other electrodes in each of said devices to the next succeeding ones of said devices whereby said devices are rendered successively conductive.

11. In a signaling system, a pulse source, a plurality of gaseous conduction devices each having a first electrode, a second electrode and a plurality of other electrodes and each responsive to pulses transmitted from said pulse source to advance the conductive path therethrough step by step so that said path exists between said first electrode and successive ones of said other electrodes, output means, a digit register individual to each of said devices and operative to connect said output means to selected ones of said other electrodes in the associated one of said devices in accordance with the digit registered in said digit register, and means coupling one of said other electrodes in each of said devices to the said second electrode in the next succeeding ones of said devices whereby said devices are rendered successively conductive.

12. In a signaling system, a plurality of gaseous conduction devices each having an anode, a first plurality of cathodes and a second plurality of cathodes, a pulse source connected to said first plurality of cathodes in each of said devices, each of said devices being responsive to pulses applied to said first plurality of cathodes therein by said pulse source to advance the conductive path therein step by step so that said path exists between said anode and successive ones of said second plurality of cathodes, output means, a digit register individual to each of said devices and operative to connect said output means to selected ones of said second plurality of cathodes in the associated one of said devices in accordance with the digit registered in said digit register, and means rendering said devices successively conducting.

13. In a signaling system, a plurality of gaseous conduction devices each having an anode, a first plurality of cathodes, a second plurality of cath-

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odes and a start electrode, means for applying a discharge initiating potential to the start electrode of the first one of said devices, a pulse source connected to said first plurality of cathodes in each of said devices, each of said devices being responsive to pulses applied to said first plurality of cathodes therein by said pulse source to advance the conductive path therein step by step so that said path exists between said anode and successive ones of said second plurality of cathodes, output means, a digit register individual to each of said devices and operative to connect said output means to selected ones of said second plurality of cathodes in the associated one of said devices in accordance with the digit registered in said digit register, and means coupling one of said second plurality of cathodes in each of devices to the starter electrode in the next succeeding ones of said devices whereby said devices are rendering successively conductive.

14. In a signaling system, a plurality of gaseous conduction devices each having an anode, a first plurality of cathodes, a second plurality of cathodes and a start electrode, means for applying a discharge initiating potential to the start electrode of the first one of said devices, a pulse source connected to said first plurality of cathodes in each of said devices, each of said devices being responsive to pulses applied to said first plurality of cathodes therein by said pulse source to advance the conductive path therein step by step so that said path exists between said anode and successive ones of said second plurality of cathodes, output means, a digit register individual to each of said devices and operative to connect said output means to selected ones of said second plurality of cathodes in the associated one of said devices in accordance with the digit registered in said digit register, and means including a capacitor and a transformer coupling one of said second plurality of cathodes in each of devices to the starter electrode in the next succeeding ones of said devices whereby said devices are rendering successively conductive.

EDWARD VROOM.

REFERENCES CITED

The following references are of record in the file of this patent:

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