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GASEOUS TUBE AND CIRCUIT

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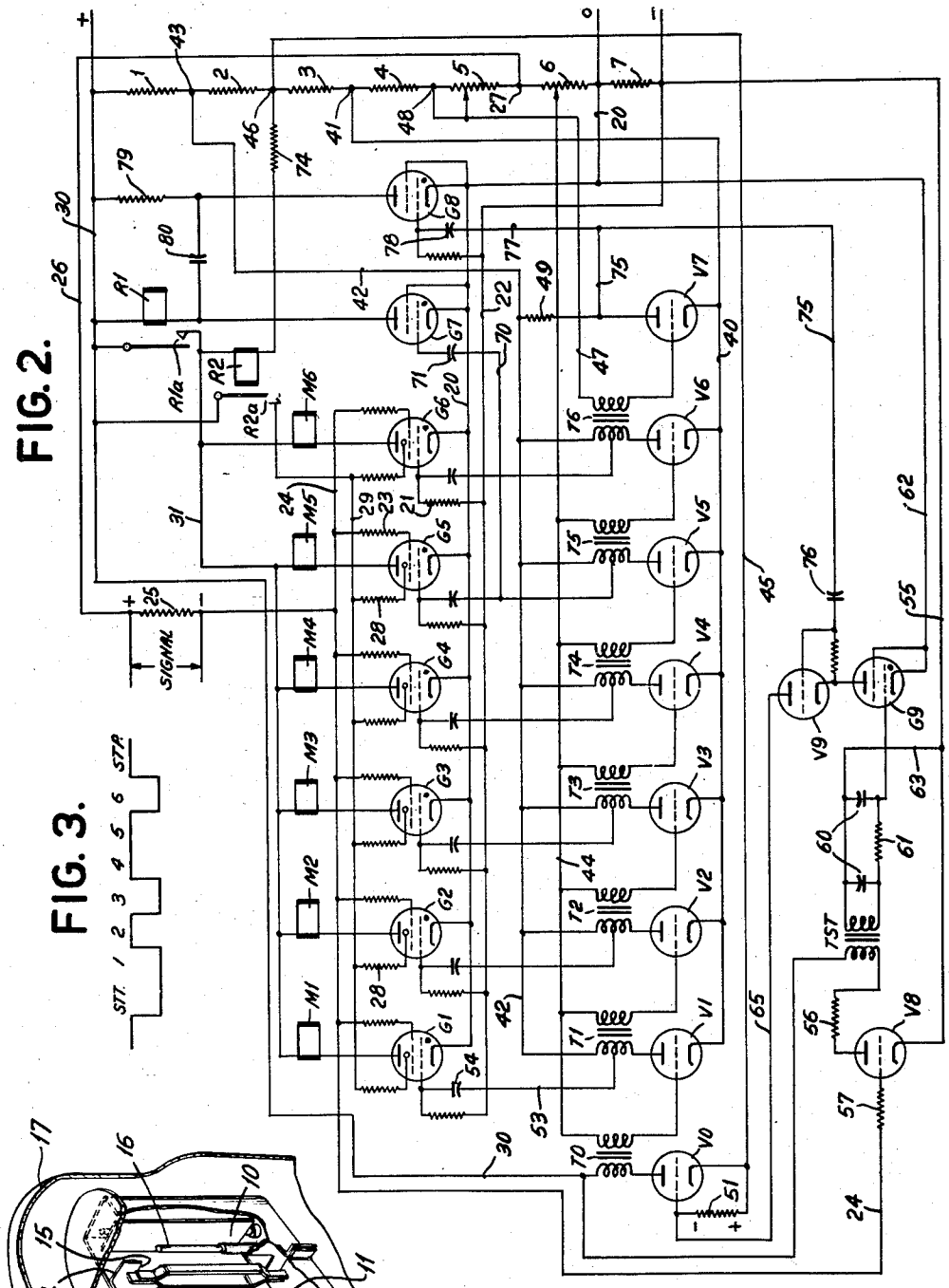

FIG. 2.

FIG. 3.

FIG. 1.

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GASEOUS TUBE AND CIRCUIT

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Application November 27, 1945, Serial No. 631,095

1 Claim. (Cl. 315—324)

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This invention relates to an electronic tube and to a circuit in which the tube is employed.

One object of the invention is to provide a gaseous trigger tube in which the arc can be picked up without drawing current through the load circuit and then transferred to the load circuit at a later time.

Another object is to provide a gaseous trigger tube so constructed that a number of tubes can be inserted in parallel load circuits and individually ignited at different times.

In the copending application of Fitch and Eichorn, Serial No. 623,024, filed October 18, 1945, now Patent Number 2,456,825, there is described a distributor comprising storage devices for the selective storage of the signal elements of a combinational code signal. The storage devices include gaseous trigger tubes having their plates connected through respective plate resistors to the B+ voltage supply and, in parallel to said plate resistors, individual control magnets which are normally disconnected from the B+ voltage but can be connected thereto by a gang of relay contacts. On receiving a signal, the trigger tubes are selectively ignited and their arcs held through the plate resistors and finally the relay contacts are closed and the plate circuits extended through the respective control magnets.

It is a particular object of the present invention to provide an improved trigger tube which can be employed in a circuit of the type shown in the copending application and which will eliminate the need for a gang of relay contacts.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a perspective cut-away view of an improved trigger tube constructed in accordance with the invention.

Fig. 2 is a diagram of a circuit employing six trigger tubes of the type shown in Fig. 1.

Fig. 3 is a diagram of a combinational code signal to which the circuit is designed to respond.

The trigger tube, as shown in Fig. 1, is similar to a thyratron of the type known as a 2050. It has an anode 10, a cathode 11, a control grid 12 and a shield grid 13, all of standard construction. The shield grid is a box-like structure enclosing the other electrodes and having a partition 14 between the anode and control grid with a window 15, providing passage for electrons flowing from the cathode to the anode.

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In accordance with the invention, an auxiliary anode 16 is inserted in the compartment containing the main anode 10 and is shown in the drawing as a small round rod located between the partition 14 and the anode 10. The electrode structure is enclosed in an envelope 17 which contains a gas, such as mercury vapor, or one of the inert gases, at a low pressure.

The circuit shown in Fig. 2 is designed for the reception of signals of the kind shown in Fig. 3, consisting of a start signal STT, six code elements 1–6, and a stop signal STP. The signal shown in Fig. 3 is the combination 245. The stop signal and the code elements 2, 4 and 5 are represented by marking conditions while the signal elements 1, 3 and 6 and the start signal are represented by spacing conditions.

The circuit comprises six gaseous trigger tubes G1–G6 of the kind shown in Fig. 1. The cathodes of these tubes are connected by a wire 20 to the negative end of a voltage divider comprising resistances 1–6. The voltage divider is connected across a suitable D. C. voltage supply represented by +0. There is also a bias voltage supply across a resistance 7, represented by 0—. The control grids of the tubes G1–G6 are connected through respective grid resistors 21 and a wire 22 to the negative end of the resistance 7. The shield grids are connected through grid resistors 23, a wire 24, a resistance 25, and a wire 26 to a point 27 on the voltage divider 1–6. The auxiliary anodes are connected through anode resistors 28, wire 29, normally closed contacts R2*a* of relay R2, and wire 30 to the positive end of the voltage divider 1–6. The main anodes are connected through the respective control magnets M1–M6 to a wire 31 leading to a normally open contact R1*a* of the relay R1. When the contact R1*a* is closed, the wire 31 is connected to the wire 30 and thence to the positive end of the voltage divider 1–6.

It will be seen from the connections described that the control grids of the trigger tubes G1–G6 normally have a negative bias and this bias is sufficient to prevent an ignition of these tubes, even if a positive bias is applied to the shield grids. In the normal condition of the circuit, the shield grids have a positive bias, the point 27 to which they are connected being at a higher potential than the negative end of the resistor 1–6 to which the cathodes are connected. The signal potential is applied across the resistor 25. A spacing signal condition causes a potential

drop in the resistance 25 of the polarity indicated, while a marking signal condition causes no potential drop in the resistance. When a spacing signal condition is applied across the resistance 25, the bottom end of this resistance is driven to a potential which is sufficiently negative with respect to the cathode potential of the tubes G1–G6 to prevent these tubes from being ignited even when a positive potential is applied to their control grids.

Provision is made for unlocking the gas tubes G1–G6 in succession, in time with the respective code signal elements. If at the time the tube G2 is unlocked there is no potential drop in the resistance 25, due to a marking signal condition, the tube G2 will be ignited, the arc extending only to the auxiliary anode. If at the time the tube G3 is unlocked there is a voltage drop across the resistance 25, due to a spacing signal condition, the potential on the shield grid of the tube G3 will be low and no arc will be struck in this tube.

The sequential unlocking of the trigger tubes is accomplished by means of a sweep circuit comprising vacuum tubes V0, V1 . . . V7. This sweep circuit is similar to one shown in the pending application of Clyde J. Fitch, Serial No. 465,604, filed November 14, 1942, now Patent Number 2,424,110. The cathodes of the tubes V1–V7 are connected by a wire 40 to a point 41 on the voltage divider 1—6. Their anodes are connected through the primary coils of respective transformers T1–T6 and a wire 42 to a point 43 on the voltage divider 1—6. The grids are connected through secondary transformer windings and a wire 44 to the arm of the potentiometer 6. The circuit or each grid extends through the secondary winding of the transformer associated with the preceding tube in the sequence, the circuit of the grid of the tube V1 extending through a secondary winding of a transformer T0 associated with the vacuum tube V0. The anode of the latter tube is connected through the primary winding of the transformer T0 and wire 30 to the positive end of the voltage divider 1—6, while its cathode is connected through a wire 45 to a point 46 on said voltage divider. The grid of the tube V7 is connected through the secondary winding of transformer T6 and the wire 47 to a point 48 on the voltage divider 1—6. The anode of this tube is connected through an anode resistor 49 to wire 42 and thereby to the point 43 of the voltage divider 1—6.

The grid of the tube V0 is connected through a resistance 51 to the cathode of this tube, the tube being therefore normally conductive, which means that plate current flows through the primary winding of the transformer T0. When the tube V0 is rendered non-conductive, in a manner to be described presently, current ceases to flow in the primary winding of the transformer T0 and the field of this transformer collapses. This induces a voltage in the secondary winding which lifts the potential of the grid of the tube V1 to a point which renders the latter tube conductive. Also, grid current flows in the tube V1 retarding the collapse of the field in the transformer T0 for a definite time. When plate current begins to flow through the primary of transformer T1, a negative voltage wave is applied to the grid of the tube V2, which is without effect. After a predetermined time the voltage on the grid of tube V1 drops to cathode potential and the grid current ceases to flow. The field of the transformer T0 then collapses suddenly and the tube V1 is cut off, terminating the flow of plate current through the primary winding of transformer T1. The field of this transformer collapses and a positive potential is applied to the grid of the tube V2. Thus, the sweep passes down through the series of tubes V1–V7, the period during which each tube remains conductive being determined for the tubes V1–V6 by the position of the arm of the potentiometer 6 and for the tube V7 by the position of the point 48 on the voltage divider 1—6. As each tube V1–V6 is cut off, a positive voltage wave is transmitted from a point on the primary winding of the related transformer T1–T6, through the wire 53 and condenser 54, to the control grid of the related tube G1–G6. These voltage waves are sharply peaked and timed to occur at the middle of each code element.

During the standby period there is no voltage drop across the resistance 25, but the tubes G1–G6 are prevented from igniting by the negative bias on their control grids. The tube V0 is in a conductive state and current is flowing in the primary winding of the transformer T0. The start of the sweep is controlled by a start tube V8, the cathode of which is connected by a wire 55 to the negative end of the resistance 7, the plate of which is connected through a resistance 56, the primary winding of transformer TST, and wire 30, to the positive end of the voltage divider 1—6, and the grid of which is connected through a grid resistor 57, wire 24, resistance 25, and wire 26 to the point 27 of the voltage divider 1—6. The tube V8 is therefore normally conductive. When the start signal arrives, a voltage drop is impressed across the resistance 25, depressing the potential on the grid of the tube V8 and cutting off the flow of current through it. The field of the transformer TST collapses and a positive voltage wave is transmitted from the secondary winding of the transformer, through a time delay circuit comprising condensers 60 and resistance 61, to the control grid of a gaseous trigger tube G9. The cathode and shield grid of this tube are connected by wire 62 to the negative end of the voltage divider 1—6, while the control grid of the tube is connected through resistance 61, the secondary of transformer TST and wires 63 and 55 to the negative end of the resistance 7. The positive voltage wave transmitted from the transformer TST removes the normal negative bias of the control grid of the tube G9, which is ignited. When this occurs current passes from the point 46 on the voltage divider 1—6 through wire 45, resistance 51, wire 65, the plate-to-cathode path of a vacuum tube V9, the plate-to-cathode path of tube G9 and wire 62 to the negative end of voltage divider 1—6. The voltage drop across resistance 51 cuts off the tube V0, starting a sweep which proceeds in the manner previously described.

The delay circuit 60, 61 is designed for a delay of one-half signal baud, so that the sweep begins at the mid-point of the start signal. Assuming the signal to be the combination 245, as shown in Fig. 3, the positive voltage wave applied from the transformer T1 to the control grid of the trigger tube G1 finds a spacing signal condition (signal element 1) across the resistance 25, which depresses the potential on the shield grids of the tubes G1–G6 and prevents the tube G1 from being ignited. The positive voltage wave from the transformer T2 to the control grid of the tube G2 finds a marking signal condition (signal element 2) which causes no voltage drop across the

resistance 25, permitting the potential on the shield grids of the tubes G1–G6 to rise. The tube G2 is accordingly ignited, the arc being held through a circuit extending from the positive end of the voltage divider 1—6, through wire 30, normally closed contact R2*a*, wire 29, anode resistor 28 of the tube G2, the auxiliary anode of this tube, across to the cathode and, by way of wire 20, to the negative end of the voltage divider 1—6.

In a similar way the tubes G3 and G6 are not ignited, while the tubes G4 and G5 are ignited.

The positive voltage wave transmitted from the transformer T5 also extends through a wire 70 and condenser 71 to the control grid of a gas tube G7. The cathode and shield grid of this tube are connected through wire 20 to the negative end of the voltage divider 1—6, while its anode is connected through the coil of relay R1 and wire 30 to the positive end of the voltage divider. The positive voltage wave transmitted to the control grid of the tube ignites the tube and the relay R1 is energized. Its contact R1*a* closes about the time the positive voltage wave is transmitted to the control grid of the tube G6, and extends a circuit to the wire 30, through said contact R1*a*, wire 31, magnets M2, M4 and M5 in parallel, the anode-to-cathode paths of the related tubes G2, G4 and G5, and wire 20 to the negative end of the voltage divider 1—6, energizing said magnets. The magnets M1, M3 and M6 are not energized because the tubes G1, G3 and G6 are not ignited. The closure of contact R1*a* also extends a circuit through the coil of relay R2 and a resistance 74, to the point 46 of the voltage divider 1—6, energizing said relay. The contact R2a opens and the B+ potential is removed from the auxiliary anodes of the tubes G1–G6.

After a predetermined time the field of the transformer T6, which was last energized, collapses and a positive potential is applied to the grid of the tube V7 which becomes conductive for a period determined by the position of the point 48 on the voltage divider 1—6. A negative voltage wave is transmitted from the plate of the tube V7, through wire 75 and condenser 76 to the grid of the tube V9, cutting off this tube and thereby deionizing the tube G9. The tube V9 becomes conductive again and the sweep circuit is restored to standby condition.

When the vacuum tube V7 ceases to conduct, a positive voltage wave is transmitted through wire 77, and condenser 78 to the control grid of a gas tube G8, which becomes ignited. Current flowing from the positive end of the voltage divider 1—6, through the resistance 79, the plate-to-cathode path of the tube G8, and wire 20, to negative end of voltage divider 1—6, causes a negative voltage wave to be transmitted through a condenser 80 to the plate of a gas tube G7, which becomes deionized. The relay R1 is deenergized and its contacts R1*a* opens, removing positive potential from the main anodes of the tubes G1–G6. The relay R2 is deenergized, its contact R2*a* closes, and B+ potential is restored to the auxiliary anodes of the tubes G1–G6, after the arcs have been extinguished in any of these tubes which were in conductive state. The coil of the relay R1, the condenser 80 and the resistance 79 form a resonant circuit in which

oscillations occur when the relay R1 is deenergized. The first negative wave of these oscillations depresses the potential on the anode of the tube G8 and extinguishes this tube, restoring the circuit to starting condition.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claim.

What is claimed is:

In a distributor, a direct current voltage source, a plurality of gaseous trigger tubes, each comprising a gas filled envelope containing a cathode, a first grid, a second grid, an auxiliary anode, and a main anode; means connecting the cathodes, the first grids, and the auxiliary anodes of said tubes to said voltage source so that each of said first grids has a negative bias sufficient to prevent its tube from ionizing, each of the auxiliary anode connections containing a resistance, a load device for each of said tubes, each load device being connected to the main anode of the related tube, means including a normally open contact for connecting all of said load devices to a positive point of said voltage source, means for raising the potential on the first grids of said tubes in succession to unlock the same at different times, means for varying the potential on the second grids of all of said tubes concurrently, between a low value which will prevent ionization of the tubes and a high value which will permit ionization of any tube having the potential on its first grid raised, said last means being timed in relation to the means for raising the potential on said first grids so that the high value potential on said second grids coincides with the raising of the potential on the first grids of selected ones of said tubes, whereby arcs are started between the cathodes and auxiliary anodes of said selected tubes, and means for closing said normally open contact to complete circuits through the main anodes of said selected tubes and the related load devices.

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Certificate of Correction

Patent No. 2,484,084 October 11, 1949

CLYDE J. FITCH ET AL

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 3, line 29, for the patent number "2,424,110" read *2,421,606*;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of March, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.