

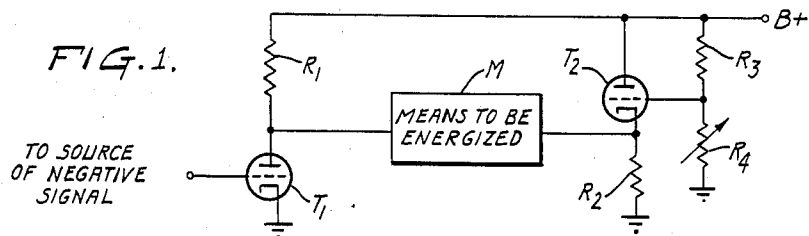
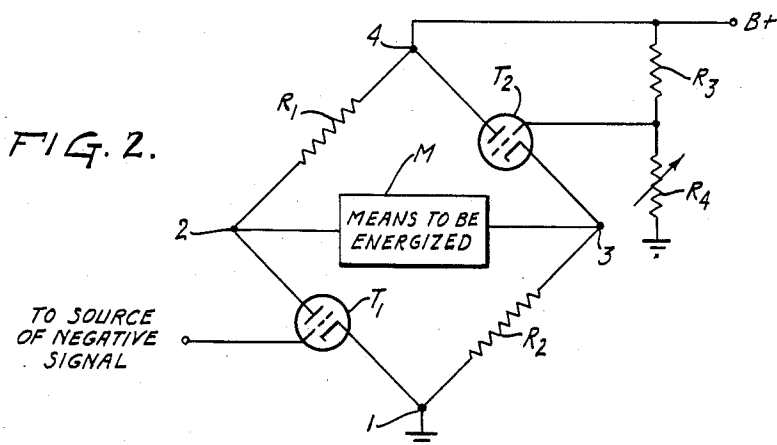
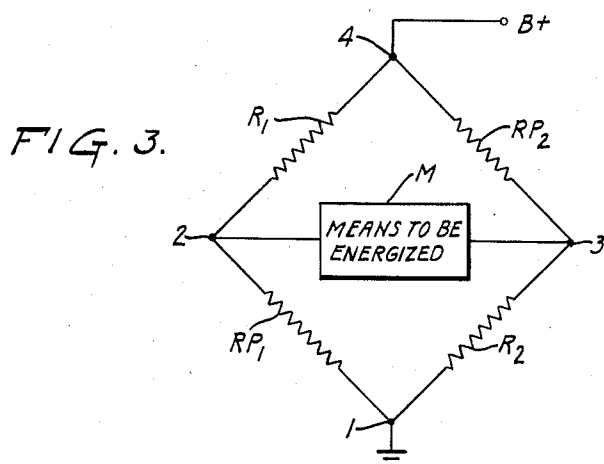
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SIGNAL-RESPONSIVE CIRCUIT

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1

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SIGNAL-RESPONSIVE CIRCUIT

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3 Claims. (Cl. 323-75)

This invention relates to signal responsive circuits or devices, and more particularly to circuits or devices which are responsive to changes in an input signal to produce corresponding changes in an output signal.

There are numerous instances in which it may be desirable, in response to relatively small changes in an input signal, to produce substantially larger changes in an output signal. For example, it is frequently desired, in response to a small change in magnitude of an input signal voltage or current, to produce a relatively large change in current to actuate a relay.

While numerous arrangements have been proposed for this purpose, in general they have suffered from various defects including insufficient sensitivity, complexity, and instability under variations in circuit parameters and power supply.

Accordingly, it is an object of this invention to provide an improved circuit which is responsive to variations in an input signal to produce substantially larger variations in an output signal, and which is simple, inexpensive, stable and highly effective.

Another object of the invention is to provide an improved circuit for actuating a relay in response to relatively small variations in an actuating signal.

A further object of the invention is to provide an improved relay-actuating circuit of the bridge type.

Other objects and features of the invention will be apparent from the description to follow.

In accordance with this invention, a circuit is provided comprising two electron tubes (or sections of a single tube) connected to a source of operating voltage, one tube serving as a control tube and having a control electrode to current of said tube, means effective upon change of anode current of said control tube to change the anode current of the second tube, and means to be controlled connected to be subjected to an output variation upon change of the anode current of the first tube and to be subjected to a further output variation upon change of anode current of the second tube. In the preferred form of the circuit, the elements form a bridge which is normally balanced but becomes unbalanced in response to variation in an applied signal.

Reference is now made to the accompanying drawing wherein;

Fig. 1 is a diagrammatic illustration of a preferred embodiment of the invention;

Fig. 2 shows the circuit more clearly in bridge form; and

Fig. 3 shows the equivalent circuit of the bridge.

Referring first to Fig. 1, there is shown a first electron tube T_1 having a control grid to be connected to a source of negative signal as indicated, this tube preferably being a triode. The cathode of tube T_1 is grounded, while the anode is connected through a resistor R_1 to a source $B+$ of operating voltage. A second tube T_2 has its cathode connected through a resistor R_2 to ground, and has its anode connected directly to the source $B+$. A

2

means to be energized, designated by the rectangle M , is connected between the anode of tube T_1 and the cathode of tube T_2 . Such means is representative of any device to be energized in response to variation in an input signal.

For example, where it is desired to effect operation of a relay in response to variation in the input signal, the means M may be the relay coil.

Tube T_2 is also preferably a triode, and its control grid is connected to the junction between resistors R_3 and R_4 which are serially connected between the source $B+$ and ground. These two resistors constitute a voltage divider, by means of which a biasing voltage is applied to the grid of tube T_2 . Resistor R_4 is variable in order that the grid bias may be adjusted to give a relatively low current or zero current through the energizable means M in the absence of effective variation of an input signal.

Fig. 2 illustrates more clearly the bridge form of the circuit. It will be seen that the circuit components and connections form a bridge having four arms and four junction points, the junction points being designated for convenience by reference numerals 1 to 4. The first electron tube T_1 has its cathode and anode connected respectively to the first and second junction points 1 and 2, so that the tube is included in one arm of the bridge. The second electron tube T_2 has its cathode and anode connected respectively to the third and fourth junction points 3 and 4, so that this tube is included in a second arm of the bridge opposite the first-mentioned arm. Resistor R_2 is connected between the first and third junction points 1 and 3 so as to be included in a third arm of the bridge, while resistor R_1 is connected between the second and fourth junction points 2 and 4 so as to be included in the fourth arm of the bridge. The source $B+$ establishes the junction point 4 at a positive potential relative to the first junction point 1 which is at ground potential. The energizable means M is connected between the second and third junction points 2 and 3.

Considering the operation of the circuit, in the absence of an input signal plate current flows in both of the tubes, but little or no current flows through the energizable means M , due to the fact that the bridge is substantially balanced and there is little or no voltage between points 2 and 3. When a negative signal is applied to the grid of tube T_1 the anode current of that tube is decreased, and consequently, there is less voltage drop across resistor R_1 and the anode voltage rises. This causes current flow, or increased current flow, through the energizable means M and through resistor R_2 , with the result that increased positive bias is applied to the cathode of tube T_2 , thus decreasing the anode current of that tube. Consequently, the current through the energizable means M is further increased. Thus in operation of the circuit, the energizable means M receives increased current in response to decrease of anode current of the first tube T_1 , and receives further increased current in response to decrease of the anode current of the second tube T_2 . The end result, therefore, is the production of a relatively large output current.

In the preferred form of the circuit as illustrated, in which the cathode of tube T_1 is grounded, the applied negative signal drives the tube T_1 to cutoff, thus effecting maximum rise of the anode voltage. The consequent increased current flow through resistor R_2 produces an increased bias which tends to cut off tube T_2 . If desired, the selection of values of the circuit components may be such as to cause cutoff of tube T_2 in response to the increased current flow through resistor R_2 , in which case the further increased current through the energizable means M will be a maximum.

Fig. 3 shows the equivalent circuit of the bridge. As shown in this figure the plate resistances RP_1 and RP_2

of tubes T_1 and T_2 actually constitute resistance arms of the bridge. The effect of an input signal is first to increase RP_1 to cause current flow through M , and second to increase RP_2 to cause greater current flow through M .

It will be seen from the foregoing description, that this invention provides a novel circuit which is capable of producing a large output signal variation in response to a small input signal variation.

Another advantage of this circuit is that in its balanced condition it is unaffected by changes of the operating voltage $B+$; that is to say, such changes will not cause false operation of the circuit. Thus, if the voltage $B+$ rises, the voltage at each of points 2 and 3 will rise, and the increased positive bias on the cathode of tube T_2 will be counteracted by the increase of positive bias on the grid of that tube. Conversely, if the voltage $B+$ drops, the voltage at each of points 2 and 3 will drop, and the decreased positive bias on the cathode of tube T_2 will be counteracted by the decrease of positive bias on the grid of that tube. Therefore, a change of the voltage $B+$ will not produce any significant difference of voltage between points 2 and 3.

A further advantage of the circuit is that where the input signal contains an A.-C. ripple component, as where the D.-C. signal is derived by rectification of an A.-C. signal, the circuit is substantially unaffected by such A.-C. component, and therefore, there is little chance of appreciable A.-C. hum reaching the energizable means M to cause buzz or chatter of a device such as the relay. Since the control tube T_1 is operated at zero cathode bias, positive swings of any A.-C. component tend to be limited or clipped by grid conduction, and as the D.-C. component quickly drives the grid below cut-off, negative swings of the A.-C. component are ineffective. With the grid maintained below cut-off, of course there is no output.

By way of example only, in one physical embodiment of the invention, a twin triode tube (type 12AV7) is used to provide the two triodes T_1 and T_2 , with a source $B+$ of 175 volts. Resistors R_1 and R_2 have values of 12,000 and 10,000 ohms, respectively. The energizable means M is a D.-C. relay whose operating coil has a resistance of 1,500 ohms. The voltage divider R_3 — R_4 provides a normal voltage of about 50 volts at the grid of triode T_2 .

Since, as indicated by the above example, it is possible to use a twin triode tube instead of two separate triodes, the term "electron tube" employed in the appended claims is intended to designate either an individual tube or a tube section.

While a single preferred embodiment of the invention has been illustrated and described, it will be understood that the invention is not limited to such embodiment, it being contemplated that modifications and further embodiments may be resorted to without departure from the spirit and scope of the invention.

I claim:

1. In a system for effecting controlled energization of a device in response to a control signal, a source of unidirectional electrical energy, a device to be energized from said source, a first electron tube having at least triode elements, a first fixed resistor, means serially connecting said tube and said resistor across said source with said resistor connected between the anode of said tube and the positive terminal of said source, a second electron tube, a second fixed resistor, means serially connecting said second tube and said second resistor across said source with the anode of said second tube connected directly to the positive terminal of said source and with said second resistor connected between the cathode of said second tube and the other terminal of said source, means connecting said device between the junction point of said first tube and said first resistor and the junction point of said second tube and said second resistor, said tubes and said resistors being elements of a Wheatstone bridge which normally is substantially balanced so that there is substantially no current flow through said device, and means for supplying a negative signal to the control grid of said first tube, whereby the current conduction in said first tube decreases and this in turn causes decrease of the current conduction in said second tube, with the result that substantial current is caused to flow through said device.

2. In a system according to claim 1, said second tube having a control grid, and adjustable means for supplying a biasing potential to the control grid of said second tube, thereby to enable balancing adjustment of the circuit.

3. A system according to claim 2, wherein the means for supplying a biasing potential to the control grid of said second tube comprises a fixed resistor and an adjustable resistor serially connected across said source, and means connecting the control grid of said second tube to the junction point of said series-connected resistors.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,885,630

May 5, 1959

Deril T. Webb

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 47, after "trode to" insert -- which an input signal may be supplied to change the anode --.

Signed and sealed this 10th day of January 1961.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

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