

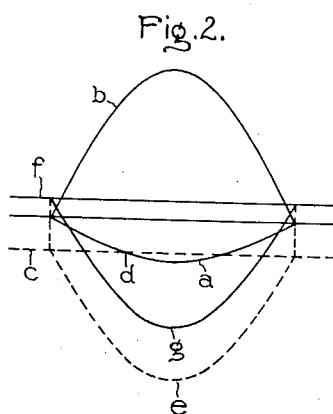
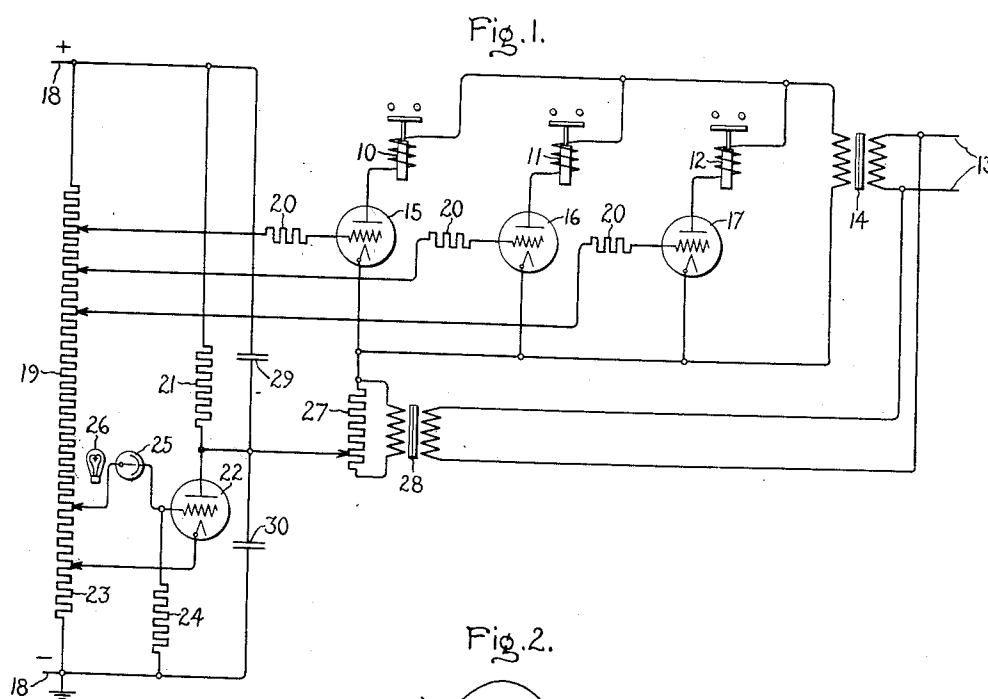
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ELECTRIC TRANSLATING CIRCUIT

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ELECTRIC TRANSLATING CIRCUIT

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10 Claims. (Cl. 250—41.5)

My invention relates to electric translating circuits, and more particularly to such circuits including electric valves for sequentially operating a plurality of electro-responsive devices.

5 Heretofore there have been proposed numerous translating circuits including electric valves operating as relays to energize electro-responsive devices. The present invention relates to translating circuits of this type in which a plurality of
10 electro-responsive devices may be operated in a predetermined sequence in response to a single controlling effect. My invention relates further to a particular grid excitation circuit for an electric valve of the discontinuous control type which
15 is of general application but which is particularly suitable for use in my improved electric translating circuit.

It is an object of my invention, therefore, to provide an improved electric translating circuit
20 including a plurality of electric valves and a plurality of electro-responsive devices in which the electro-responsive devices may be energized in a predetermined sequence in response to a single controlling effect.

25 It is another object of my invention to provide an improved grid excitation circuit for a discontinuous control electric valve included in a periodic current circuit which will insure that the valve is rendered conductive only at the initial
30 point in the positive portions of the anode potential.

In accordance with one embodiment of my invention, a plurality of electro-responsive devices are connected in parallel across a source of alternating current through a plurality of electric
35 valves. There is also provided a source of unidirectional control potential across which is connected a voltage divider. The control grids of the several electric valves are adapted to be energized from electrically spaced terminals of the
40 voltage divider, while the common cathode connection of the several electric valves is connected to an intermediate point of the control source, variable in potential. By varying the potential
45 of the terminal to which the common cathode connection is made, the several electric valves may be rendered conductive in any predetermined sequence. In certain instances it may be desirable to include in the several grid circuits a
50 source of alternating potential substantially in phase opposition to the anode potential of the several electric valves to insure that each electric valve is made conductive only at the initial
55 point of the positive half cycles of anode potential. In case this latter feature is incorporated,

it may be desirable also to include a capacitor between the terminal of variable potential and each outer terminal of the source of control potential to eliminate substantially the effect of the source of alternating potential upon the potential
5 of this point.

For a better understanding of my invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing
10 and its scope will be pointed out in the appended claims. Referring now to the drawing, Fig. 1 represents an embodiment of my invention for successively energizing a plurality of electro-responsive devices in response to the variation of a
15 single unidirectional control potential, while Fig. 2 is a diagram to aid in understanding a feature of my invention.

Referring more particularly to Fig. 1 of the drawing, there is illustrated an arrangement for
20 energizing a plurality of electro-responsive devices illustrated as the relays 10, 11 and 12, from a source of alternating current 13 through a transformer 14, and electric valves 15, 16 and 17,
25 respectively. The electric valves 15, 16 and 17 are each provided with an anode, a cathode and a control grid and may be of any of the several types well known in the art, although I prefer to use discontinuous control electric valves, such
30 for example as valves of the vapor electric discharge type. By the term "discontinuous control electric valves" I refer to valves of the type in which the starting of current in the valve may be controlled by the potential on its control
35 grid, but in which generally the current in the valve may be interrupted only by reducing the anode potential below its critical value. In order to control the conductivities of the valves 15, 16 and 17, there is provided a source of unidirectional control potential 18, across which is
40 connected a voltage divider 19, and the grids of the several electric valves are connected to electrically spaced terminals of this voltage divider through current limiting resistors 20. There is
45 also provided a second voltage divider connected across the circuit 18 comprising a resistor 21, a variable impedance, such for example as an electric valve 22, and a portion 23 of the voltage divider 19, and the common cathode connection of
50 the valves 15, 16 and 17 is connected to the junction between the resistor 21 and valve 22. The valve 22 is provided with an anode, a cathode, and a control grid and may be of any of the several types well known in the art, although I prefer to use a high vacuum pure electron discharge
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valve. The impedance of the valve 22 may be controlled in any well known manner, but I have illustrated by way of an example a connection between its grid and the negative terminal of the circuit 18 through a resistor 24 and to a point of the voltage divider 19 positive with respect to its cathode connection through a photo-responsive device 25 adapted to be illuminated by a lamp 26. The grid circuits of the several electric valves also include a component of alternating potential derived from a voltage divider 27 included in the common cathode connection, the voltage divider being energized from the circuit 13 through a transformer 28 with such a polarity that the alternating component of grid potential is substantially in phase opposition to the anode potential of the several electric valves. In case this last described feature is employed, capacitors 29 and 30 are preferably connected between the junction of resistor 21 and the valve 22 and the positive and negative sides of the direct current circuit 18, respectively, to eliminate substantially the effect of the alternating current apparatus upon the potential of this particular point.

In explaining the operation of the above described apparatus, it will be assumed that, initially, the intensity of the light supplied by the lamp 26 to the photo-responsive device 25 is so low that none of the electric valves 15, 16 or 17 is rendered conducting. It will be seen that the device 25 and the resistor 24 comprise a voltage divider connected across a portion of the main voltage divider 19 so that the resultant grid potential of the valve 22 will be dependent upon the impedance of the device 25. As the intensity of the illumination of the lamp 26 increases, the resistance of the device 25 will be decreased and the grid potential of the valve 22 will increase positively, thus decreasing its impedance, as is well understood by those skilled in the art. As the impedance of the valve 22 is decreased, the potential of the common cathode connection to this voltage divider comprising the resistor 21 and the valve 22 decreases, approaching the potential of the point of connection to the main voltage divider 19. The result is that the bias potentials included in the grid circuits of the valves 15, 16 and 17 are positively increased equally and simultaneously. It will be understood that with a predetermined increase in the intensity of illumination of the device 25 the electric valve with the most positive bias potential, that is, electric valve 15, will be first rendered conductive, and that upon successive increases of illumination, electric valves 16 and 17 will successively become conductive to energize their respective relays 10, 11 and 12. Due to the fact that an alternating potential is impressed upon the anodes of electric valves 15, 16 and 17, a subsequent decrease in the illumination supplied by the lamp 26 will cause these valves to be rendered non-conductive in an inverse order whenever their grid bias voltages have been reduced below the critical value.

The usual critical grid voltage characteristic of a valve of the discontinuous control type when supplied with a sinusoidal anode potential is illustrated by the curve *a* of Fig. 2, in which the curve *b* represents a positive half cycle of the sinusoidal alternating potential of one of the electric valves, for example valve 15. In case a negative bias potential of the value indicated by the dotted line *c* should be applied to the grid of this valve, it will be seen that the valve would become conductive at the point *d* in each half

cycle, which would effect an energization of the relay 10 something less than normal, and this energization would decrease with decreasing bias potential until the line *c* became tangent to the curve *a*. Such partial energization of the relays 10, 11 and 12, may, under certain circumstances, tend to cause uncertainty of operation and, in order to eliminate this effect, an alternating component of grid potential substantially in phase opposition to the anode potential of each valve, is furnished to the several grid circuits. For example, if an alternating potential of a magnitude illustrated by the curve *e* be supplied from the voltage divider 27, it will be seen that the resultant grid potential at no time intersects the critical grid voltage characteristic of the valve with the result that it remains completely non-conductive. When, however, the bias on the grid of the valve 15 increases to some positive value *f*, the resultant grid potential is represented by the curve *g* and it will be seen that the grid is positive at the initial point of the positive half cycle of anode potential; that is, it is above the critical grid potential at this instant, and the electric valve will be conductive for the complete half cycle. In this way it is insured that each electric valve will be conductive during complete half cycles of positive anode potential or completely non-conductive, thus increasing the certainty and reliability of operation. In case the capacity of the various alternating current circuits to ground is sufficient to effect an appreciable variation of the potential of certain points in the unidirectional potential control circuit, these effects may be substantially eliminated by connecting capacitors 29 and 30 between the junction of resistor 21 and the valve 22, and the positive and negative sides of the direct current circuit 18, respectively, thus substantially absorbing any alternating component of potential appearing at this point.

While I have described my invention as embodied in an arrangement in which a plurality of electro-responsive devices are energized in a predetermined sequence in response to variations in the intensity of the illumination of a device, it will be apparent that the photo-responsive device 25 and the lamp 26 or the valve 22 and these devices may be replaced by any impedance varied either manually or automatically in response to any desired condition.

While I have described what I at present consider the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric translating circuit comprising a source of current, a plurality of electro-responsive devices energized from said source, an electric valve in circuit with each device for controlling the energization thereof, each of said valves being provided with a control grid, a source of unidirectional bias potential, a grid circuit for each of said valves, each of said grid circuits having a connection to include a portion of said bias potential of a different magnitude, a voltage divider energized from said bias potential and including an impedance common to all of said grid circuits, and means for varying said

impedance to control the conductivities of said valves in a predetermined sequence.

2. An electric translating circuit comprising a source of current, a plurality of electro-responsive devices energized from said source, an electric valve in circuit with each device for controlling the energization thereof, each of said valves being provided with an anode, a cathode, and a control grid, a source of unidirectional control potential, a voltage divider energized from said source of control potential, circuits interconnecting said grid to different points of said voltage divider, and a common connection from said cathode to another point of said voltage divider including an impedance device, and means for varying the impedance of said device to control the conductivities of said valves in a predetermined sequence.

3. An electric translating circuit comprising a source of current, a plurality of electro-responsive devices energized from said source, an electric valve in circuit with each device for controlling the energization thereof, each of said valves being provided with a control grid, a source of unidirectional control potential, a pair of voltage dividers energized from said control potential, a grid circuit for each of said valves, said grid circuits including different connections to one of said voltage dividers and a common connection to the other, and a variable impedance included in one of said voltage dividers for simultaneously varying the grid potentials of the several valves to control their conductivities in a predetermined sequence.

4. An electric translating circuit comprising a source of current, a plurality of electro-responsive devices energized from said source, an electric valve in circuit with each device for controlling the energization thereof, each of said valves being provided with an anode, a cathode, and a control grid, a source of unidirectional control potential, a voltage divider connected across said latter source, connections from said grids to electrically spaced terminals of said voltage divider, a second voltage divider connected across said source and including a variable impedance device, a common connection from said cathodes to said second voltage divider, and means for varying the impedance of said impedance device to energize said electro-responsive devices in a predetermined sequence.

5. An electric translating circuit comprising a source of current, a plurality of electro-responsive devices energized from said source, an electric valve in circuit with each device for controlling the energization thereof, each of said valves being provided with an anode, a cathode, and a control grid, a source of unidirectional control potential, a voltage divider connected across said source, connections from said grids to electrically spaced terminals of said voltage divider, a common connection for said cathodes to one side of said control source including an impedance device, a common connection for said cathodes to the other side of said control source including an electric valve provided with a control grid, and photo-electric means for controlling the grid potential of said last mentioned valve to energize said electro-responsive devices in a predetermined sequence.

6. An electric translating circuit including a discontinuous control electric valve provided with an anode, a cathode, and a control grid, a source of periodic anode potential, and a grid circuit for said valve including a source of uni-

directional potential variable in magnitude to control the conductivity of said valve and a source of periodic potential substantially in phase opposition to said anode potential to insure that said valve is rendered conductive only at the initial point of the positive portion of each cycle of anode potential.

7. An electric translating circuit including a discontinuous control electric valve provided with an anode, a cathode, and a control grid, a source of alternating anode potential, a source of unidirectional control potential connections from said grid and said cathode to said potential source, means for varying the potential applied to said electrodes to control the conductivity of said valve, a source of alternating potential substantially in phase opposition to said anode potential and included in circuit with said grid, and a capacitor connected between said source of alternating potential and each side of said control source to eliminate substantially the effect of said sources of alternating potential on the potential of said variable potential terminal.

8. An electric translating circuit comprising a source of alternating current, a plurality of electro-responsive devices energized from said source, a discontinuous control electric valve in circuit with each device for controlling the energization thereof, each of said valves being provided with an anode, a cathode, and a control grid, a source of unidirectional control potential, a grid circuit for each of said valves including a portion of said control potential of a different magnitude and a common point and a source of alternating potential substantially in phase opposition to its respective anode potential, means for varying the magnitudes of the control potentials of said grid circuits to render said valves conductive in a predetermined sequence, and a capacitor connected between said alternating potential source and each side of said control source to eliminate substantially the effect of said source of alternating potential on said source of control potential.

9. An electric translating circuit including a discontinuous control electric valve provided with an anode, a cathode, and a control electrode, a source of alternating anode potential, a control electrode circuit including a source of unidirectional control potential, photo-electric means interconnecting said cathode with said control potential for varying the potential applied to said control electrode to control the conductivity of said valve, and a source of alternating potential connected in said control electrode circuit, said alternating potential being substantially in phase opposition to said anode potential to insure that said valve is rendered conductive only at the initial point of the positive portion of each cycle of anode potential.

10. An electric translating circuit comprising a source of current, a plurality of electro-responsive devices energized from said source, an electric valve in circuit with each device for controlling the energization thereof, each valve being provided with a control electrode and a control circuit therefor, a source of unidirectional bias potential, each of said control circuits having a different connection to said bias potential to provide a bias potential of different magnitude, a common cathode circuit for said electric valve, and photo-electric means for determining the effective point of connection of said common cathode circuit to said source of bias potential.

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