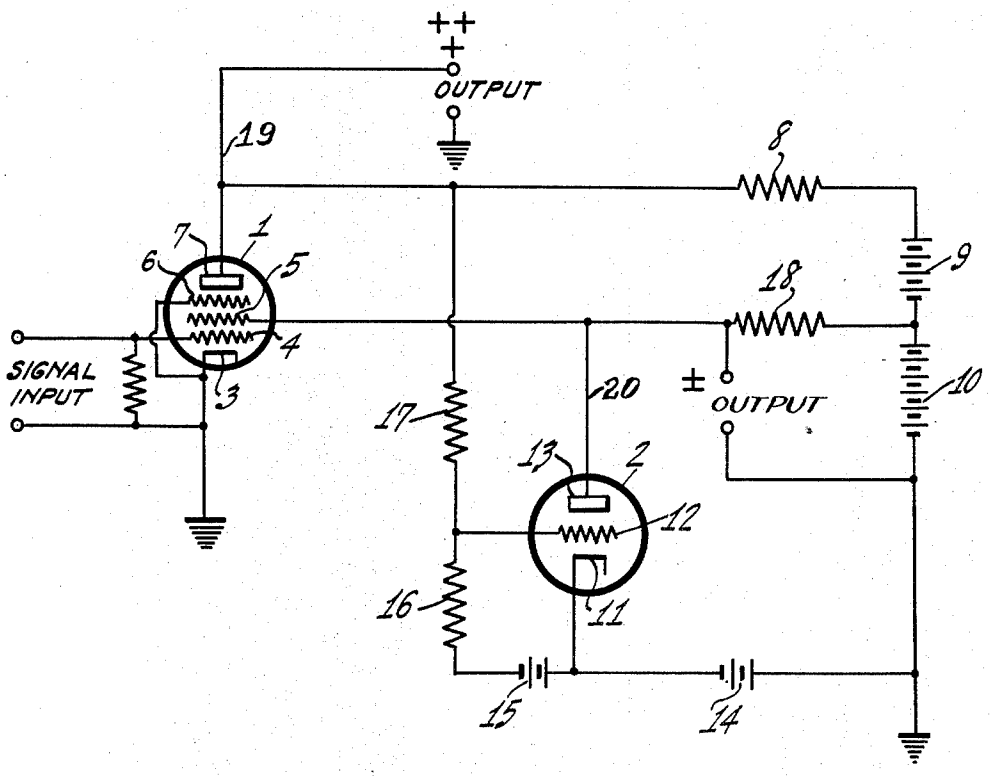
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POLAR LOCKING CIRCUIT

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POLAR LOCKING CIRCUIT

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This invention relates to locking circuits. More particularly my invention relates to a circuit arrangement of the type which employs a triode discharge tube and a pentode discharge tube suitably interconnected so that the triode tube may be held conducting or non-conducting by varying its grid voltage while the pentode tube is controlled by varying its screen grid voltage between positive and negative values. The controlling input signal is preferably applied to the control grid of the pentode tube, either directly or through a suitable condenser.

Locking circuits as heretofore known commonly employ two voltage dividers, one connected from the anode of a first tube to a point of potential below the cathode of the second tube, a tap being taken off of this voltage divider and connected to the control grid in the second tube. The second voltage divider is like the first except that it is connected between the anode of the second tube and a potential below that of the cathode in the first tube. A tap on this second voltage divider is connected to the control grid of the first tube. In such an arrangement the ohmic values of the resistors involved in the voltage dividers must be held within a close percentage of the prescribed values if the proper circuit operation is to be obtained. This fact, therefore, necessitates the anticipation of any temperature changes to be encountered under operating conditions.

In the conventional locking circuit both anodes vary between two potentials by the same amount and these potentials are usually above a common ground or reference potential.

In order to overcome the difficulties heretofore encountered as indicated in the foregoing paragraphs, I have found it possible to design a locking circuit having only one voltage divider, the respective values of its sections being less critical for proper operation of the circuit than was heretofore considered necessary.

I also have found it possible to obtain two sets of outputs from the anodes, one set of which varies between potentials which are above and below the common ground potential.

It is, therefore, an object of my invention to provide a simply designed locking circuit having features which relieve it from the necessity for critical adjustment of its components.

It is also an object to obtain an output which varies from a point above to a point below the common ground potential.

It is another object of my invention to provide a dependable polar locking circuit for use in signaling and in other applications.

My invention will now be described in more detail, reference being made to the accompanying drawing the sole figure of which represents illustratively a preferred circuit arrangement

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wherein a pentode tube and a triode tube are used in combination with suitable circuit components for carrying out the invention.

Referring to the drawing, I show therein a pentode discharge tube 1 and a triode discharge tube 2. In the pentode tube I show a cathode 3 connected to ground, a control grid 4 to which signal input voltages may be applied, a screen grid 5 and a suppressor grid 6, the latter being connected directly to the cathode 3.

The anode 7 of the tube 1 is connected through an anode resistor 8 to the positive terminal of a direct current source, one section of which is indicated at 9. Another section of this source 10 is in series with section 9 and has its negative terminal connected to ground.

In the tube 2, I show a cathode 11, a control grid 12 and an anode 13. The cathode 11 is maintained at a negative potential with respect to ground, the bias voltage being supplied by a direct current source 14. Another biasing source 15 is connected between the cathode 11 and the control grid 12, a resistor 16 being interposed between the negative terminal of the source 15 and the grid 12. The grid 12 is also connected to the anode 7 in tube 1 through a resistor 17. The two resistors 16 and 17 constitute a voltage divider which provides interaction between the pentode tube and the triode tube.

The anode 13 is connected through a resistor 18 to the junction between the two direct current source sections 9 and 10. The anode 13 is also directly connected to the screen grid 5 in tube 1.

Shown also are output terminals 19 and 20. Terminal 19 varies between two potentials above ground while terminal 20 varies between two potentials, one of which is above and the other below ground.

Before proceeding with an explanation of how the circuit operates, it should be pointed out that one of the well known characteristics of pentode tubes is that even with a negative screen voltage the tube may still be rendered conductive, provided the control grid is driven sufficiently positive with respect to the cathode. The anode, of course, must be maintained at a positive potential in order to produce a conductive state.

I will now show why it is unnecessary to fix the values of the respective elements 16 and 17 with great exactitude in order to maintain suitable operating conditions for the circuit. The different kinds of outputs from the two anodes will also be explained.

Assume first that tube 1 is normally conductive in the absence of a signal potential. The voltage drop through the voltage divider 17, 16 is such as to maintain a negative voltage on grid 12 in the triode tube 2 so that this tube is biased to cut-off, especially since a negative grid bias is afforded by the C-battery 15. The anode 13 and

the screen grid 5, being interconnected, are both maintained at a relatively high positive potential. The conductive state in tube 1 and the non-conductive state in tube 2 may, therefore, be said to be relatively stable.

This condition makes available two different anode voltages. One from anode 7 is the direct current source 10+9 minus the I_pR_9 drop in 9 where I_p is the pentode tube current. Subtracted from 10+9 is also I_dR_8 where I_d is the current flowing through the divider 16, 17. The other output from anode 13 is the direct current source 10 minus I_sR_{18} where I_s is the pentode screen current. Both of these outputs are at a potential above ground.

Now assume that a signal potential is applied in sufficient magnitude and negatively to the control grid 4 with respect to the grounded cathode 3. The pulse so applied need be of only momentary duration in order to reverse the conductive states in the two tubes. Tube 1 being now blocked, its anode voltage rises substantially to the voltage at the positive terminal of the source 9. A positive increment of voltage is, therefore, applied to the control grid 12 in the triode tube 2 which is sufficient to render the grid 12 more positive than the cathode 11. This drives the tube 2 conductive and at the same time lowers the screen grid voltage 5 in tube 1. In this state the potential of the anode 13 and of the screen grid 5 is so far reduced that it is negative with respect to ground. This negative screen potential prevents tube 1 from conducting.

In this condition the outputs are as follows: Terminal 19 is at a potential equal to the direct current sources 9+10 minus the I_dR_8 drop in resistor 8, and the terminal 20 is at a potential equal to the direct current source 10 minus the I_2R_{18} drop, where I_2 is the triode plate current. This output potential is actually more negative than ground while the output at terminal 19 is above ground.

The locking circuit as herein shown and described therefore fulfills the following conditions: The potential of the anode 7 in tube 1 is shifted between two positive values with respect to a certain reference potential, while the anode 13 in tube 2 is shifted from positive to negative values with respect to such a reference potential.

It should be understood that the input control signal could be applied to the grid 12 in the triode tube 2 if so desired. In fact, controlling signals of the same polarity could be applied alternately to grids 4 and 12 in the pentode and triode tubes respectively.

My invention is capable of modification in various ways, as will be well understood by those skilled in the art.

I claim:

1. In a locking circuit, two electron discharge tubes at least one being of the multi-grid type with a screen grid and both having a control grid, a cathode and an anode, a first direct current potential source connected between the anode and cathode of said multi-grid tube, an impeder in said connection between the anode of the multi-grid tube and said source, a second direct current potential source of less positive value connected between the anode and cathode of the other tube, an impeder in said connection between the anode of the other tube and said second source, a connection between the cathode of said multi-grid tube and a point on said second source which is positive with respect to the cathode of said other tube, whereby the anode and cathode of said multi-grid tube are normally more positive respectively than the anode and cathode of said other tube, a direct current potential divider including at least two impeders in shunt to said first direct current source, a connection between a point on said potential divider between said two last-named impeders and the control grid of said other tube, a direct connection between the anode of the other tube and the screen grid of the multi-grid tube, means for applying signals to the control grid of one tube, and means for deriving output from the anode of one or the other tube.

2. In a locking circuit, two electron discharge tubes each having a cathode, an anode and a control grid, one of said tubes also having a screen grid, means for causing said one tube to be conductive while causing the other tube to be cut-off, said means including a source of direct current potential connected between the anode and cathode of said one tube with its positive terminal toward the anode of said one tube, a resistor in the connection between said source and the anode of said one tube, a resistor connecting a positive point on said source to the anode of the other tube, connections to said source for maintaining the cathode of the other tube negative relative to the cathode of the first tube, a direct current potential divider including series resistances connected indirectly across said source, a connection between a point on said divider between said series resistances and the control grid of the other tube such that a reduction of direct current potential on the anode of said one tube applies a more negative bias to the control grid of the other tube, means including a direct current connection between the screen grid of the said one tube and the anode of the other tube for holding said screen grid at a relatively high positive direct current potential when said one tube is conductive and said other tube is non-conductive and for materially reducing the potential on said screen grid when said other tube is conductive and said one tube is non-conductive, and means for applying signal pulses to the control grid of said one tube, the arrangement being such that the potential on the anode of said screen grid tube varies with respect to a positive value and the potential on the anode of said other tube varies plus and minus with respect to a base value as said locking circuit is tripped.

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