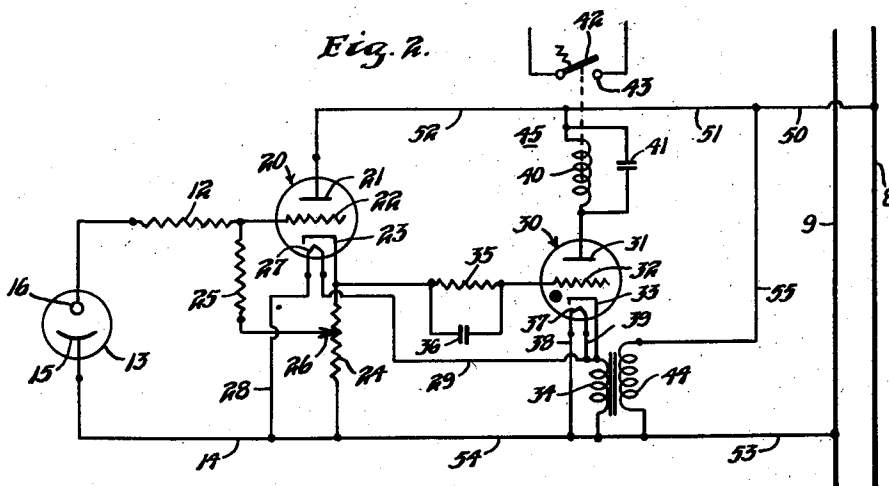
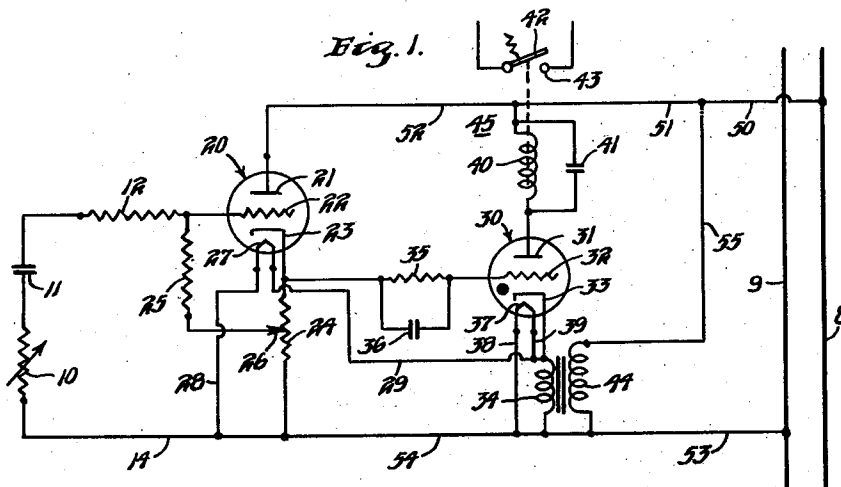


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ELECTRONIC AMPLIFIER

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This invention relates to electronic amplifiers and particularly to thyatron amplifiers. It is therefore an object of the invention to provide a new and improved type of thyatron amplifier.

Another object of the invention is to provide an improved type of thyatron amplifier in which the plate supply voltage may be taken directly from a voltage supply line of commercial frequency and amplitude.

Another object of the invention is to provide an improved type of thyatron amplifier wherein the thyatron input is derived from a cathode follower circuit.

An advantage derived from this type of amplifier construction is that the electron flow between the control grid and cathode of the thyatron is greatly reduced. The internal cathode to control grid impedance of the thyatron is in parallel with the cathode resistance of the preceding stage and because the impedance through the thyatron is so large in comparison with the cathode follower resistance there will be almost no electron flow from the control grid of the thyatron.

Another advantage is that the "hash" produced will not back up through the amplifier because of the comparatively low impedance to ground through the cathode follower resistance. This is of particular importance in this circuit due to the amount of noise produced by the thyatron.

Another advantage is the stabilization of the control point of the thyatron because of the low impedance input thereto.

Another object is to provide a cathode follower circuit wherein a voltage to energize a preceding circuit is obtained from that potential across the cathode follower resistance.

Another object of the invention is to provide a cathode follower circuit utilizing regenerative feedback by means of a connection from the cathode follower resistor to the grid of the tube in the cathode follower stage.

These and other objects and advantages may become more apparent from the following, more detailed, description taken in conjunction with the drawings in which:

Figure 1 shows a circuit embodying the preferred modification of the invention;

Figure 2 shows a modification of the invention employing a different means of controlling the input voltage.

In the circuit shown in Figure 1, the magnitude of the input voltage is controlled by a relative humidity responsive resistance element 10. This element may be any one of various, well-known

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types in which the resistance of the element varies with the relative humidity of the surrounding medium.

The element 10 controls the input voltage applied to an electron discharge device in the form of a tube 20. The tube 20 comprises an anode 21, a control grid 22, a cathode 23 and a filament 27. One terminal of the element 10 is connected in series with a condenser 11 and grid current limiting resistor 12 to the grid 22. The other terminal of element 10 is connected through conductor 14 and a resistor 24 to the cathode 23. The resistor 24 has a slider 26 cooperating therewith to form a potentiometer, the slider 26 being connected through a resistor 25 to the grid terminal of the grid limiting resistor 12.

Power for the operation of the amplifier is supplied by two power lines 8 and 9 leading to any suitable source of power (not shown). Line 8 is connected by conductors 50, 51 and 52 to anode 21 while line 9 is connected by conductors 53 and 54 and resistor 24 to cathode 23.

The tube 20 together with the elements directly associated therewith form the cathode follower stage of the amplifier. This stage is connected to the output stage which employs a gas filled electronic discharge device in the form of a thyatron tube 30. The tube 30 comprises an anode 31, a control grid 32, a cathode 33 and a heater filament 37. A filament transformer having a primary 44 and a secondary 34 has its secondary winding connected to the cathode 33 of the thyatron.

A relay 45 having a winding 40 is connected in the output circuit of the thyatron tube. The relay winding 40 has a condenser 41 in parallel therewith. When the relay winding 40 is energized the two contacts 42 and 43 of relay 45 are closed. As shown in the drawing, when the relay is in deenergized position the contacts 42 and 43 are separated by means of a spring bias.

A phase shifting network consisting of a resistor 35 and a condenser 36 in parallel therewith is connected into the input circuit of the thyatron 30.

Power lines 8 and 9 also supply the power necessary for the operation of the thyatron tube 30. Line 8 is connected by conductors 50 and 51 and relay winding 40 to anode 31 while line 9 is connected by conductor 53 and transformer secondary 34 to cathode 33.

Transformer primary 44 is connected across power leads 8 and 9 by means of conductors 50 and 55 to one terminal of the transformer primary and by conductor 53 to the other terminal.

The humidity responsive resistance 10, condenser 11, grid current limiting resistor 12 and resistance 25 are placed across that portion of resistance 24 between the slider 26 and conductor 54 and receives a potential therefrom.

Operation

When the humidity responsive resistance element is at that resistance value indicating a satisfactory humidity condition the current flow through the vacuum tube 20 will be such that the potential placed on grid 32 of the thyatron tube 30 will prevent the thyatron from firing and thus prevent energization of the relay coil 40. This is because the resistance of the relative humidity responsive resistance element 10 is of sufficiently low resistance value so that the current flow which travels through the humidity responsive resistance element 10, capacitor 11, grid current limiting resistor 12 and resistance 25 causes a large voltage drop across the resistance 25. As a result the potential on grid 22 is sufficiently negative with respect to the potential on cathode 23 to cause a very small electron flow through the tube 20 which results in a low potential across cathode resistance 24. This low potential across the cathode resistance 24 will operate to place a small potential on the grid 32 of thyatron 30. The bias placed on cathode 33 by transformer secondary 34 tends to oppose the potential placed on grid 32 and the result is that the potential on the grid 32 is sufficiently negative with respect to the potential on cathode 33 to deenergize relay 45.

When the humidity is increased the resistance of relative humidity element 10 is lessened, resulting in a larger current flow through resistance 25 and consequently the grid 22 of tube 20, and thus the grid 32 of thyatron 30 is driven more negative and relay 45 remains deenergized.

When the humidity in the medium surrounding the relative humidity responsive resistance element 10 decreases the humidity responsive element will increase in resistance value to increase the total impedance path across that portion of resistance 24 between the slider 26 and the conductor 54 and result in a lower current flow in the path composed of the relative humidity responsive resistance element 10, condenser 11, grid current limiting resistor 12, and resistance 25. This will decrease the voltage drop across resistance 25 with the result that the grid 22 of tube 20 will be driven in a positive direction with respect to its cathode 23. The greater electron flow through tube 20 will increase the potential across resistance 24 and raise the potential on grid 32 with respect to its cathode 33 until tube 30 fires. This firing of tube 30 will energize relay winding 40 and close the relay contacts 42 and 43 to place a controlling circuit into operation.

The type of relative humidity responsive resistance element used in this circuit is one utilizing a salt solution such as is described in the Dunmore Patent 2,285,421 though it is understood that other types of humidity responsive resistance elements can be used. Because a salt solution type of relative humidity responsive resistance is used it is necessary to place a condenser in series therewith to block the direct current and prevent the rapid disintegration of the salt which would otherwise occur due to electrolysis from direct current passing through the element.

The RC network composed of resistance 35 and condenser 36 in parallel therewith is a phase shifting network intended to aid in eliminating

any chattering tendency of the relay 45 in the thyatron output circuit. The reason for this is probably due to the fact that the RC network advances the phasing of the potential on the grid of the thyatron and thus causes the thyatron to fire over a larger portion of the cycle than would otherwise be the case.

A condenser 41 is placed in parallel with relay winding 40 to smooth out the current flowing through winding 40 and further aid in eliminating any tendency of the relay winding to chatter. Both transformer primary 44 and transformer secondary 34 are tied to power source lead 9. This makes it possible to energize both tubes and the filament transformer from the same source while making use of only one transformer with a single secondary winding. Filament 27 of tube 20 is connected across the transformer secondary 34 through leads 28, 54, and 29. Filament 37 of thyatron 30 is connected across transformer secondary 34 by leads 38 and 39.

Values of various components which have been found to work satisfactorily in the circuit are as follows:

Resistance 12	-----	megohms	5.0
Resistance 25	-----	megohms	5.0
Resistance 24	-----	kilohms	50
Resistance 35	-----	megohms	1.0
Condenser 36	-----	microfarads	0.05

It can be seen from the foregoing discussion of the circuit that the cathode follower resistance 24 which is comparatively small in relation to the internal cathode to control grid impedance of the thyatron and the resistance 35 in parallel therewith causes most of the current flow to pass therethrough. This prevents the thyatron from burning out because of too large a grid current. Also because of the comparatively small value of the cathode follower resistance with respect to the internal cathode to grid impedance of the tube in the cathode follower stage any undesired noise from the thyatron which might otherwise back up through the amplifier will be largely drained off and so will not affect the operation of the circuit.

Species of Figure 2

Figure 2 shows a circuit employing a different means of controlling the input voltage. The overall circuit in Figure 2 is very similar to that in Figure 1 and like numerals indicate like components in the two circuits. In Figure 2 a photocell 13 replaces the relative humidity responsive resistance element 10 and capacitance 11. Photocell 13 has a cathode 15 and an anode 16.

Briefly the operation of the circuit in Figure 2 is as follows.

At the condition where no light strikes the cathode 15 there will be no electrons emitted therefrom and as a result there will be no current flowing through the circuit composed of photocell 13, grid current limiting resistor 12, resistance 25 and across that portion of resistance 24 between the slider 26 and conductor 54. As a result there will be no voltage drop across resistance 25 and grid 22 will be sufficiently positive with respect to cathode 23 to permit tube 20 to be energized. Upon energization of tube 20, grid 32 of thyatron 30 will be sufficiently positive with respect to cathode 33 to permit thyatron 30 to fire. Firing of thyatron 30 energizes relay winding 40, closing contacts 42 and 43 to place a controlling circuit into operation.

When a light is directed onto cathode 15 of

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photocell 13 a stream of electrons will flow from cathode 15 to anode 16 and a current will flow through resistance 25 to drive the potential on grid 22 negative with respect to that potential on cathode 23. This lowering of the potential on grid 22 deenergizes tube 20 and the resulting potential placed on grid 32 will be sufficiently negative to prevent thyatron 30 from firing. When tube 30 is deenergized relay 45 is also deenergized, permitting contacts 42 and 43 to break connection and open the controlling circuit.

It might be noted that whereas in Figure 1 the condenser 11 prevents any direct current from flowing through the relative humidity element 10 to the grid 22 of tube 20 the photocell 13 in Figure 2 prevents any alternating current from flowing to the grid 22. This does not, however, change the characteristics of the circuit.

It is to be understood that the invention herein disclosed is not to be considered limited to the two modifications described but rather to be defined within the scope of the appended claims.

I claim as my invention:

1. In combination: a voltage source; a signal producing device; a first electronic stage having an electron discharge device including an anode, a control electrode and a cathode, and an impedance electrically connected to said cathode; a second electronic stage having an electron discharge device including an anode, a control electrode and a cathode; means electrically connecting said voltage source across the discharge device and impedance in said first stage; means electrically connecting said voltage source across the discharge device in said second stage; means electrically connecting said signal producing device to the control electrode and across a portion of the impedance in said first stage in such a manner that the potential across said signal producing device will be derived across a portion of said impedance; means electrically connecting said impedance between the control electrode and the cathode of the discharge device in said second stage to impress a voltage thereon and affect energization of the discharge device in said second stage; and means electrically connected to the discharge device in said second stage to utilize the output thereof.

2. In combination: an alternating voltage source; a signal producing device; a first electronic stage having an electron discharge device including an anode, a control electrode and a cathode, and an impedance electrically connected to said cathode; a second electronic stage having an electron discharge device including an anode, a control electrode and a cathode; means electrically connecting said alternating voltage source across the discharge device and impedance in said first stage; means electrically connecting said alternating voltage source across the discharge device in said second stage; means electrically connecting said signal producing device to the control electrode in said first stage in such a manner that the potential across said signal producing device will be derived across said portion of said impedance; means electrically connecting said impedance in said first stage between the control electrode and the cathode of the discharge device in said second stage to impress a voltage thereon and affect energization of the discharge device in said second stage; and means electrically connected to the discharge device in said second stage to utilize the output thereof.

3. In combination: an alternating voltage source; a signal producing device; a first elec-

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tronic stage having an electron discharge device including an anode, a control electrode and a cathode, and an impedance electrically connected to said cathode; a second electronic stage having a thyatron including an anode, a control electrode and a cathode; means electrically connecting said alternating voltage source across the discharge device and impedance in said first stage; means electrically connecting said alternating voltage source across the thyatron in said second stage; means electrically connecting said signal producing device to the control electrode in said first stage in such a manner that the potential across said signal producing device will be derived across a portion of said impedance; means electrically connecting said impedance in said first stage between the control electrode and the cathode of the thyatron in said second stage to impress a voltage thereon and affect energization of the thyatron in said second stage; and means electrically connected to the thyatron in said second stage to utilize the output thereof.

4. In combination: a voltage source; a signal producing device; an electronic stage having an electron discharge device including an anode, a control electrode and a cathode, and an impedance electrically connected to said cathode; means electrically connecting said voltage source across the discharge device and impedance in said stage; means electrically connecting said signal producing device to the control electrode and across a portion of the impedance in said stage in such a manner that the potential across said signal producing device will be derived across a portion of said impedance; and output circuit elements connected to said resistor at electrically spaced points.

5. In combination; a source of alternating voltage; a humidity responsive resistance; an electron discharge device having an anode, a control electrode and a cathode; a first resistance electrically connected to said cathode; a second resistance electrically connected between said control electrode and a point on said first resistance; means electrically connecting said voltage source across said discharge device and said first resistance; and means electrically connecting said humidity responsive resistance across said second resistance and that portion of said first resistance between said point and that terminal connected to said source in such a manner that the potential across said humidity responsive resistance is derived from the voltage across said portion of said first resistance.

6. In combination; a source of alternating voltage; a humidity responsive resistance; an electron discharge device having an anode, a control electrode and a cathode; a first resistance electrically connected to said cathode; a second resistance electrically connected between said control electrode and a point on said first resistance; means electrically connecting said voltage source across said discharge device and said first resistance; and means electrically connecting said humidity responsive resistance, in series with a capacitance and a current limiting resistance, across said second resistance and that portion of said first resistance between said point and that terminal connected to said source in such a manner that the potential across said humidity responsive resistance is derived from the voltage across said portion of said first resistance.

7. In combination; a source of alternating voltage; a phototube; an electron discharge device having an anode, a control electrode and a cathode; a first resistance electrically connected to

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said cathode; a second resistance electrically connected between said control electrode and a point on said first resistance; means electrically connecting said voltage source across said discharge device and said first resistance; and means electrically connecting said phototube across said second resistance and that portion of said first resistance between said point and that terminal connected to said source in such a manner that the potential across said phototube is derived from the voltage across said portion of said first resistance.

8. In combination: a source of alternating voltage; a phototube; an electron discharge device having an anode, a control electrode and a cathode; a first resistance electrically connected to said cathode; a second resistance electrically connected between said control electrode and a point on said first resistance; means electrically connecting said voltage source across said discharge device and said first resistance; and means electrically connecting said phototube, in series with a current limiting resistance, across said second resistance and that portion of said first resistance between said point and that terminal connected to said source in such a manner that the potential across said phototube is derived from the voltage across said portion of said first resistance.

9. In combination: a condition responsive device; an electron discharge device having an anode, a control element and a cathode; a first resistor electrically connected to said cathode, said resistor having a wiper arm moving thereacross; means electrically connecting an alternating voltage of line potential directly across said discharge device and said first resistor in series therewith; a second resistor electrically connected between said control element and the wiper arm associated with said first resistor; means electrically connecting said condition responsive device between said control element and the terminal of said first resistor distant from said cathode such that the voltage across said condition responsive device is derived from the

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voltage across that portion of the first resistor between the wiper arm and that terminal distant from said cathode; a gaseous discharge device having an anode, a control element and a cathode; means electrically connecting an alternating voltage of line potential across said gaseous discharge device such that the phase of the voltage between the anodes and cathodes of said discharge devices is the same; means connecting the cathode of said first discharge device to the control element of said gaseous discharge device through a phase shifter network; and a device in the output circuit of said gaseous discharge device to be energized upon energization of said gaseous discharge device.

10. In combination: a voltage source; a phototube; an electronic stage having an electron discharge device including an anode, a control electrode and a cathode, and an impedance electrically connected to said cathode; means electrically connecting said voltage source across the discharge device and impedance in said stage; means electrically connecting said phototube to the control electrode and across a portion of the impedance in said stage in such a manner that the potential across said phototube will be derived across a portion of said impedance; and output circuit elements connected to said resistor at electrically spaced points.

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