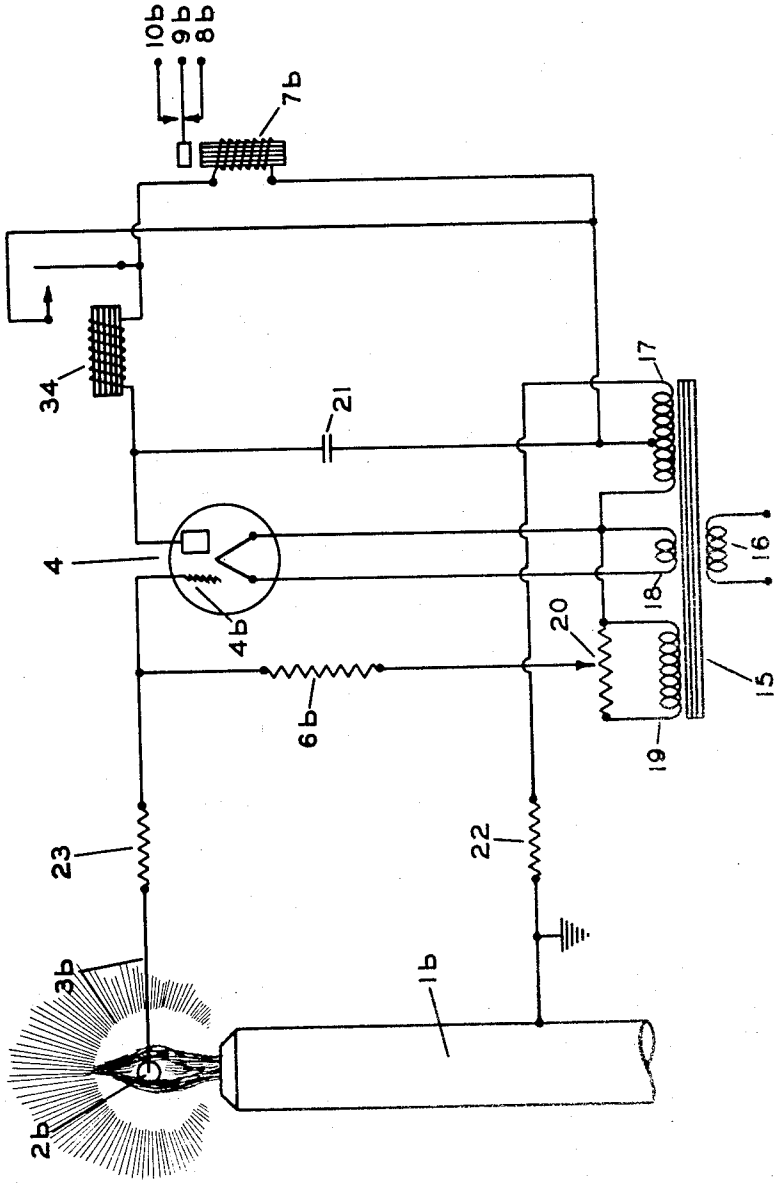
Feb. 29, 1944. T. A. COHEN 2,343,001

CONTROL APPARATUS

Filed Jan. 2, 1936



Theodore A. Cohen, INVENTOR,

BY Theodore Bel. Miller

Attorney

Patented Feb. 29, 1944 2,343,001

UNITED STATES PATENT OFFICE

2,343,001

CONTROL APPARATUS

Theodore A. Cohen, Chicago, Ill.

Application January 2, 1936, Serial No. 57,321

6 Claims. (Cl. 200—27)

This invention relates to control apparatus in general and more particularly to such an apparatus adapted to control certain functions depending upon the presence or absence of flame.

The object of this invention is to provide an improved control apparatus employing a control electrode in the input of an electronic circuit, for controlling the fuel supply to a burner in accordance with presence or absence of the burner flame in order to prevent raw fuel issuing from the burner without flame being present in general. More particularly, according to one aspect of the invention, an object of the invention is to provide such an apparatus, wherein changes in condition of an ionized path such as a burner flame, supplies an alternating current bias of different phase of potential from that of the output of the electronic circuit to the input thereof and, according to another aspect, wherein grounding or partial grounding of said electrode or input of said circuit will shut down the fuel supply.

Another object of this invention is to provide an apparatus of the above type wherein grounding or partial grounding of the electrode or input of the electronic circuit will cause to be supplied a distinct plate current level in the output thereof for shutting off the fuel supply.

Other and further objects of this invention will be apparent as the same becomes better understood from an examination of the specification and claims in conjunction with the accompanying drawing wherein is shown a diagrammatic sketch or view of a control apparatus embodying this invention.

Referring to the drawing particularly, reference character 1*b* designates a standard flame orifice a predetermined distance from the mouth of which is supported a metallic conductor which may be of nickel or other metal capable of withstanding high temperatures without corroding too seriously. The end 2*b* of the conductor is shown in the shape of a sphere so as to present a large area of contact surface to the flame from the orifice 1*b*. This conductor is designated by the reference character 3*b*, the end 2*b* thereof and the orifice 1*b* forming a pair of electrodes within the orifice flame, the impedance between which electrodes is dependent upon the size of the electrodes and the number of ions present in the flame, should the flame be present, the impedance between these electrodes is fairly low but should the flame go out for any of a number of reasons such as gas failure, power failure, etc., this resistance becomes infinitely high.

In the embodiment shown the various potentials and currents are supplied by a transformer 15. The primary 16 of transformer 15 is adapted to be connected to an alternating current line. The transformer 15 is provided with secondary windings 17 for the plate circuit of the vacuum tube (which is self rectifying), 18 for the filament of the vacuum tube, and 19 for the grid 4*b*. A potentiometer 20 is connected across winding 19 and to the grid leak 6*b*. A condenser 21 is connected across relay 7*b* and both are connected to winding 17 at an intermediate point thereof. Orifice 1*b* is connected to the highest point of winding 17, and grounded safety resistors 22 and 23 are used to limit the amount of grid current flow below the safe grid dissipation of the tube used. Furthermore erratic effects are sometimes noted with long cable runs between electrode and tube apparatus due to induced potentials upon such lines from nearby power sources or leakage or reactive effects to ground. These resistors 22 and 23, which may be either lumped or distributed, have a further effect of preventing such disturbances. The potentiometer 20 allows placing a desired grid potential or proper value upon the grid 4*b* through grid resistor 6*b*. This potential is so adjusted as to keep the plate current (when the flame is out) below the normal pull up value of the relay 7*b*, and the voltage terminals are so phased that this potential is 180 degrees out of phase with the potential from the winding 20, supplied to grid 4*b* through resistor 6*b* when the flame is extinguished or diminished below a predetermined point desired for safety, the relay 7*b* will be deenergized.

The circuit is provided with relay 7*b*, whose contacts 8*b*, 9*b*, and 10*b* are adapted to control a fuel supply means, in the following manner: Since it is desired that the fuel supply means be opened when flame is present, and further that such means be closed when flame is absent or upon a grounding or partial grounding of electrode 2*b*, means to that end is provided as later described.

Plate circuit of a tube 4 is supplied from tapped secondary 17 of transformer 15. This voltage is alternating and, since such tube is self rectifying, a pulsating direct current will flow through relay 7*b*. Condenser 21 stores sufficient energy during its charging cycle and, during the instant of negative maximum of

supply voltage, delivers such energy to relay to prevent chatter of such relay 7b.

A potential derived from secondary winding 19 of transformer 15, capable of being adjusted in amplitude by means of potentiometer 20, is supplied to grid 4b of tube 4 through resistor 6b. Phase of such potential with respect to applied plate potential is such as to produce a substantially low plate current, through relay 7b. The phase of this potential in practice may be 180 degrees out of phase with respect to plate potential, the phase difference being sufficient to obtain a predesired low plate current below the drop out value of relay 7b.

Upon flame being present at burner 1b, an alternating potential will be placed upon grid 4b due to the conducting properties of the flame, such potential being derived from upper end of winding 17 of transformer 15. This new alternating potential is superimposed upon the original alternating potential derived from winding 19. The new superimposed potential derived from winding 17, and applied to grid of tube through flame, causes the creation upon grid of tube, of an effective voltage which causes a rise in plate current through relay 7b and effects operation of relay contacts 8b and 9b, to maintain fuel supply control means open.

Should flame disappear the potential derived from winding 17 is removed from grid of tube reestablishing the original alternating potential derived from winding 19, with a consequent instantaneous drop in plate current through relay 7b, opening the latter to cause a closing of fuel supply (not shown).

Since in practice electrode 2b is subjected to conditions which cause a breakdown of same due to high temperatures it is vitally important in such an event, when sagging or other action, which may cause a ground or partial ground of same, occurs, to immediately close the fuel supply. The manner in the embodiment shown in which I accomplish this will now be described in detail.

A relay 34 is placed in plate circuit and is designed to operate on a substantially different plate current level, in this instance higher, from that of relay 7b. The contacts of relay 34 upon closing shunt relay 7b which thereupon is deenergized and opens its contacts 9b—8b to close fuel supply.

As has been previously stated the alternating potential applied from winding 17, due to and through the conducting qualities of the flame, to the grid 4b of the tube is of prechosen phase displacement from that derived from winding 19, and creates an effective grid voltage capable of causing a rise in plate current, for energizing relay 7b. This plate current level is a function of flame resistance and is determined by effective instantaneous voltage on the grid with respect to applied plate potential. It is not sufficient to close relay 34. Thus the effective instantaneous voltage upon the grid determines the medium plate current for operation of relay 7b for a flame-on condition.

Upon electrode 2b contacting a ground or partial ground circuit, the flame resistance is no longer effectual in the circuit causing the superimposed voltage upon the grid derived from winding 17 to change the effective voltage upon the grid, causing a further increase in plate current which causes relay 34 to close making relay 7b inoperative and deenergizing same to cut off fuel supply.

The manner in which the new plate current is obtained is dependent upon the fact that when an alternating potential is applied to the grid of a biased tube through a resistance which in this case is the flame, a small grid current will flow the instant the grid becomes positive during the alternating cycle. Since the flame exhibits resistive properties a potential drop appears across the flame, during the instant of grid current flow through the flame. The grid current flow taking place in the circuit, grid, electrode, flame and return connection to winding 17, produces a drop across flame, such drop magnitude depending upon flame resistance and applied potential, determining the effective instantaneous voltage upon the grid which in turn determines the medium plate current required to cause operation of relay 7b.

Upon a grounding or partial grounding of electrode taking place, flame resistance disappears from the circuit with a consequent disappearance of flame potential drop. The potential from winding 17 therefore appears upon the grid of the tube and since such is of opposing phase to the voltage produced from winding 19 the effective instantaneous voltage is increased and a new high level of plate current therefore appears, causing the operation of relay 34 to deenergize relay 7b.

With flame impingement upon the electrode and with flame resistance values of one megohm to one hundred megohms the plate current through the relays varies from twenty milliamperes to ten milliamperes. With the electrode grounded to a circuit of less than one megohm the plate current through the relays reaches a value of thirty milliamperes.

Relay 34 is designed to pullup at 28 milliamperes and release at 24 milliamperes.

Relay 7b is designed to pull up at 8 milliamperes and release at 6 milliamperes.

With flame out and electrode ungrounded the plate current is at one milliampere.

The operation and advantages of the afore-described apparatus will be apparent without further detail.

I am aware that many changes may be made and details varied without departing from the principles of my invention and I therefore do not wish to be limited to the details shown or described.

I claim:

1. In an apparatus of the character described, an electronic tube circuit including an input control circuit having conducting path contacting means and an alternating current energized output circuit containing control means, and means for supplying an alternating current bias of different phase from that of the output circuit to the input circuit.

2. In an apparatus of the character described, an electronic tube circuit including an input control circuit having conducting path contacting means and an alternating current energized output circuit containing control means, means for supplying an alternating current bias of different phase from that of the output circuit to the input circuit and means for further control of said control means in event of change in conducting path resistance from a predetermined amount.

3. The combination of ionized path contacting means, electronic apparatus operable therefrom and provided with an alternating source of power of a plurality of different phases of potentials, such apparatus including control means,

and means whereby said path may control the differences in said phases to correspondingly control said control means.

4. The combination of ionized path contacting means, electronic apparatus operable therefrom and provided with an alternating current source of power having a plurality of potentials, such apparatus including control means and means whereby said path may control said potentials to correspondingly control said control means.

5. The combination of ionized path contacting means, an electronic device including a plate circuit responsive to normal presence of an ionized path to provide one predetermined current level and responsive to a diminution of said path to provide another predetermined level, said device and first means having means associated therewith for causing the plate circuit to assume a third predetermined level in response to grounding of said first means and control means in plate circuit operable in accordance with said levels.

6. The combination of ionized path contacting means, an electronic device including a plate circuit responsive to normal presence of an ionized path to provide one predetermined current level and responsive to a diminution of said path to provide another predetermined level, said device and first means having means associated therewith for causing the current in plate circuit to assume a third predetermined level in response to grounding of said first means, and control means in the plate circuit operable in one manner at the two second mentioned levels and in another opposite manner at the first mentioned level.

THEODORE A. COHEN.