

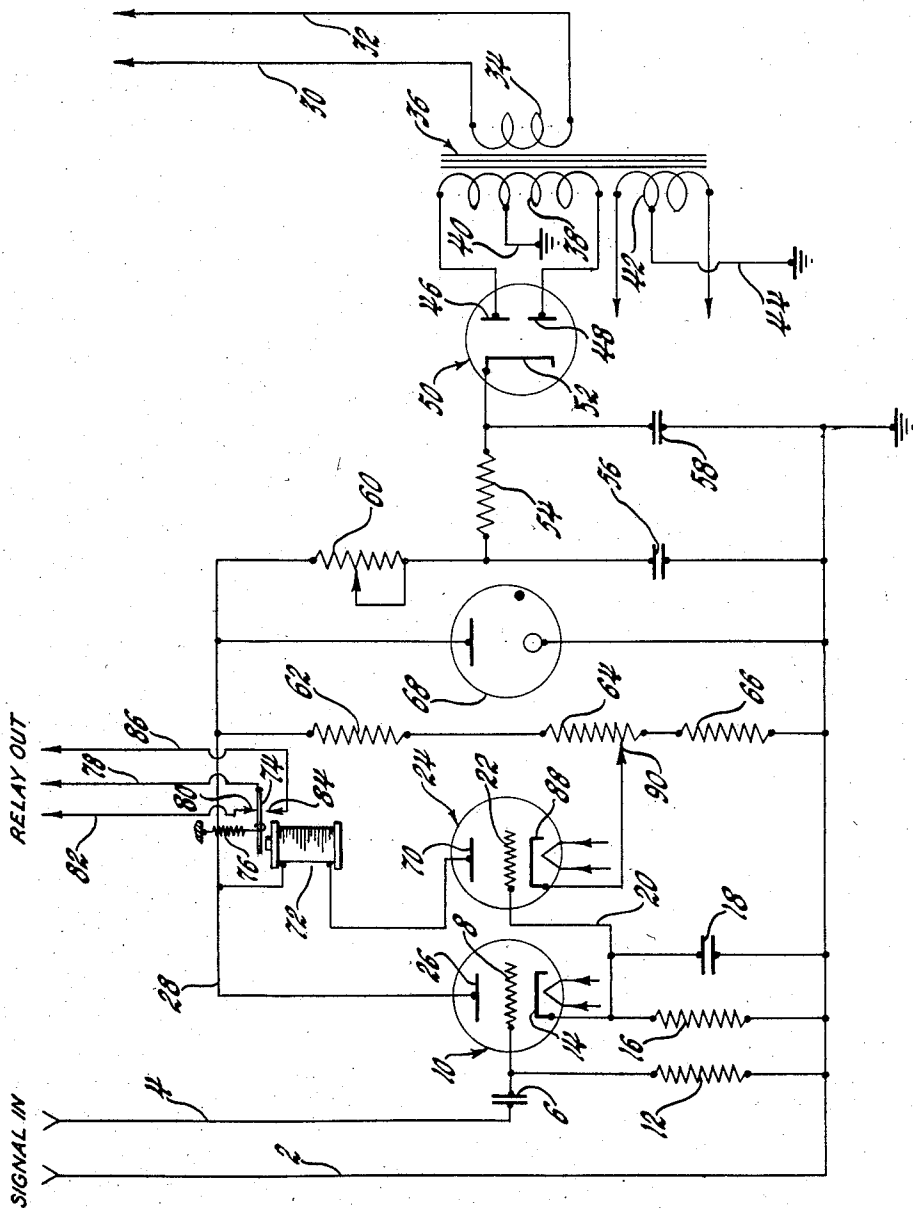
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ELECTRONIC RELAY

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1

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ELECTRONIC RELAY

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This invention relates to relay switching means and more particularly to relay switching means operated by alternating current or pulses of current.

There are many instances in which it is desired to operate switching means upon a variation in amplitude of an alternating current supply source, by application of an alternating current signal, or by the arrival of a series of pulses at a given input point.

It is an object in making this invention to provide a simple alternating current operated relay.

It is a further object in making the invention to provide an alternating current relay which will be actuated upon a change in amplitude of the signal voltage.

It is a further object in making this invention to provide an electronic alternating current relay having time delay in either or both energizing or deenergizing phases of its operation.

It is a still further object in making this invention to provide an alternating current relay having high input impedance.

With these and other objects in view which will become apparent as the specification proceeds, my invention will be best understood by reference to the following specification and claims and the illustrations in the accompanying drawings, in which the figure is a circuit diagram of a relay control system embodying my invention.

Referring now more particularly to the drawing, there is shown therein a pair of input lines 2 and 4 across which the control signal is applied. Line 2 is connected directly to ground. Line 4 is connected to one side of a condenser 6, the opposite side of which is connected to the control grid 8 of an electron tube 10. A biasing resistance 12 is connected between the grid 8 and ground. The cathode 14 of the tube 10 is connected to ground through its biasing resistor 16 which has a condenser 18 connected in shunt therewith. A conductive line 20 extends from the cathode 14 to the control grid 22 of a second electron tube 24 to control the flow of current through said tube. The plate 26 of the tube 10 is connected through line 28 to the power supply, which applies the proper voltage to the plate.

The power supply in this instance may be the ordinary 110 volt, 60 cycle outlet to which are connected the two lines 30 and 32, which are connected to and feed the transformer primary 34. The transformer 36, which includes the primary 34, has a plurality of secondaries, the first, 38, being of relatively high voltage and being center tap grounded as shown at 40, and the second secondary 42 for providing lower voltage for the filament circuits of the tubes and likewise being center tap grounded as shown at 44. The actual filament circuits have been omitted in the interest of clarity, but the connections are indicated by arrows on the secondary 42 and on the filaments. This low voltage coil would supply in the neighborhood of three volts for the filament circuit of any of the tubes which require the same.

2

The outer terminals of the high voltage secondary coil 38 are connected to anodes 46 and 48 of full wave rectifier tube 50. The cathode 52 of this tube is connected directly to a filter circuit including resistance 54 in series and two condensers 56 and 58 connected from opposite ends of the resistance 54 to ground. A variable resistance 60 is connected from the remote terminal of resistance 54 to high voltage supply line 28. A potential divider consisting of three resistances 62, 64 and 66 in series is connected between line 28 and line 2, the latter being at ground potential. A voltage regulator tube 68 is also connected between line 28 and ground to regulate the main supply voltage. Thus regulated direct current voltage is supplied to line 28.

The anode 70 of the tube 24 is connected through operating coil 72 to high voltage supply line 28. The coil 72 is the actuating coil for a movable armature 74 normally spring biased in an upward position by biasing spring 76, but which can be pulled against the spring bias to a lower position when the actuating coil 72 is energized. The armature 74 is electrically connected to conductive line 78. When the armature 74 is in its upper position it engages a stationary contact 80 which is connected to conductive line 82, and when it is pulled into its lower position it is moved away from engagement with stationary contact 80 into engagement with a second spaced stationary contact 84 connected to conductive line 86. While no specific means have been shown connected to the three lines 82, 78 and 86, they merely indicate that the switch is connected to some operative mechanism which might take any form. When the relay operating coil 72 is energized, one switch formed of armature 74 and contact 80 is opened and another switch formed of armature 74 and contact 84 is closed. The cathode 88 of the tube 24 is connected to a movable contact 90 which is adjustable over resistance 64 of the potential divider, and therefore the position of this contact 90 determines the biasing voltage on the cathode.

As exemplary only of a given set of values for components utilized in such a system, the following may be cited:

Condenser 6	----- microfarads	.1
Resistance 12	----- megohms	1
Resistance 16	----- ohms	470,000
Condenser 18	----- microfarads	1
Resistance 62	----- ohms	18,000
Resistance 64	----- do	5,000
Resistance 66	----- do	22,000

Tubes 10 and 12 may be any conventional triode tube or they may consist of two halves of a double triode tube such as a 12AX7.

In the operation of the system it is desired to point out that the system is primarily designed for operation on alternating current. Basically the system operates in the following manner. An input signal of alternating current, for example, is applied to the input lines 2 and 4. On the positive half cycles the grid 8 of the tube 10 is driven sufficiently in the positive direction to cause said tube to conduct and such periods of conduction will charge condenser 18. This charge, as it builds up, increases the voltage on the line 20 which is directly connected to control grid 22 of the tube 24. This latter tube has been biased to a desired cutoff point by adjusting contact 90 on resistance 64. When the voltage on line 20 reaches high value as to cause the tube 24 to conduct a sufficient amount, the current flow through the relay operating coil 72 will cause that coil to attract its armature 74, opening switch 80—74 and closing switch 74—84 to produce a desired switching control operation. It is obvious that this system will also operate in the same manner if a series of positive pulses are

3

applied to the input lines 2 and 4 rather than an alternating current, for the tube 10 utilizes only the positive half cycles at any rate. It is also obvious that the shape of the pulses can affect the operation. The condenser 6 and resistor 12 provide an alternating current coupling of the input circuit to grid 8. Delay periods in the operation of the relay system are introduced by certain time constant resistance-capacity arrangements. A delay in the operation of the relay after a signal is applied is dependent upon the time constant of the circuit formed by condenser 18 and the resistance of the tube 10. Drop-out time of the relay is dependent upon the time constant of the circuit including condenser 18 and resistance 16.

It is also to be noted that this system is further capable of operating upon a variation in the amplitude of the input control signal rather than only on the application or non-application of an alternating current signal. This is a very important part of applicant's operation. The components may be so selected that with an alternating current of a given amplitude applied to lines 2 and 4 of a certain value, the charge on the condenser 18 will not be built up to raise the voltage on line 20, and thusly grid 22, to a point at which tube 24 could conduct to actuate the relay armature. The condenser 18 will charge almost to the peak of the applied voltage. Under these conditions an alternating current signal would be present on lines 2 and 4 but the relay would not operate to attract its armature. However, a slight increase in the amplitude of the alternating current would be sufficient to apply a sufficient increase in charging current to the condenser 18 to raise the voltage on the line 20 sufficiently to cause the operating coil 72 to attract the armature 74 and switch the system.

It is likewise to be noted that this electron relay system has a high input impedance which may be important, depending upon the signal to it from some other apparatus. The system is flexible in that the bias on the cathode 88 may be varied to change the operating point of the relay over a wide range.

One further advantage of this system is that there is low current consumption therein. The operation of the armature 74 has been shown as either opening or closing switching contacts upon energization of the relay operating coil. This can be fitted into any control circuit as desired, and of course there may be a plurality of contacts in either position to control as many circuits as desired. If the input signal is applied directly to the grid and condenser 6 is omitted, the circuit will function as a high impedance direct current relay.

I claim:

1. In a control system for actuating means, a source of regulated direct current power, a pair of electron tubes connected across said source, means for adjustably varying the bias across one tube, said actuating means being connected in the output circuit of said tube with the variable bias, a control electrode in each tube, a time constant circuit connected to the control electrode of the variable biased tube and to the output of the other tube, and means for applying an independent fluctuating control voltage to the control electrode of the other tube to vary the charge on the time constant circuit and thus the voltage on the control electrode of the variably biased tube.

2. In a control system for actuating means, a source of regulated direct current power, a pair of electron

4

tubes connected across said source, means for adjustably varying the bias across one tube, said actuating means being connected in the output circuit of said tube with the variable bias, a control electrode in each tube, a time constant circuit connected to the control electrode of the variable biased tube and to the output of the other tube, a condenser connected to the control electrode of the other tube and independent means for applying a fluctuating signal voltage to said condenser and thus varying the voltage on the control electrode of said other tube.

3. In a control system for actuating means, a source of regulated direct current power, a pair of electron tubes having a plate, grid and cathode, both plates being connected to said source of power, said actuating means being connected in series with one plate to control desired apparatus, adjustable means connected to the cathode of said tube for varying the bias thereon, a resistance and a condenser connected in parallel to the grid of said tube and to ground and to the cathode of the other tube to apply a control voltage to said grid which is dependent upon the output of the other tube, a second biasing resistance and a series condenser connected to the grid of the other tube to provide a coupling circuit and independent means connected to said coupling circuit to supply fluctuating control voltage thereto to actuate the actuating means as long as the fluctuating voltage has sufficient amplitude.

4. In a control system for an actuating coil, a source of electrical power, a plurality of electronic amplifying means each having a control electrode, a variable resistance, said variable resistance, actuating coil and one of the electronic amplifying means being connected in series across the source of electrical power, the flow of current through said one electronic amplifying means determining the flow through said coil, a condenser connected between the control electrode of said one of said amplifying means and ground, a further resistance connected across the condenser and having its ungrounded end connected to a further electrode of said other electronic amplifying means to develop a voltage for charging the condenser, said further resistance and said other electronic amplifying means being connected in series across said source of electrical power and independent means for applying a continuous pulsating voltage to the control electrode of said other electronic amplifying means, said other amplifying means applying a control voltage to said one electronic amplifying means so that the actuating coil will actuate desired apparatus.

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