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TIME-DELAY SWITCH OPERATING SYSTEM

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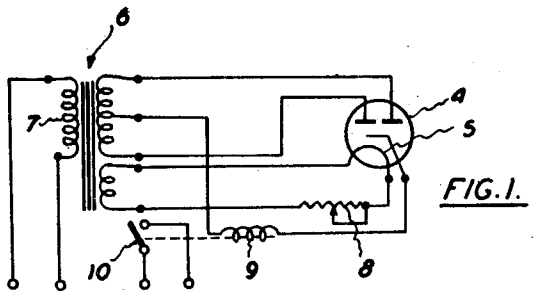


FIG. 1.

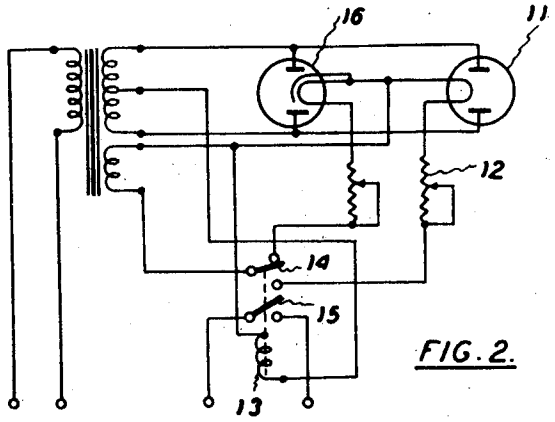


FIG. 2.

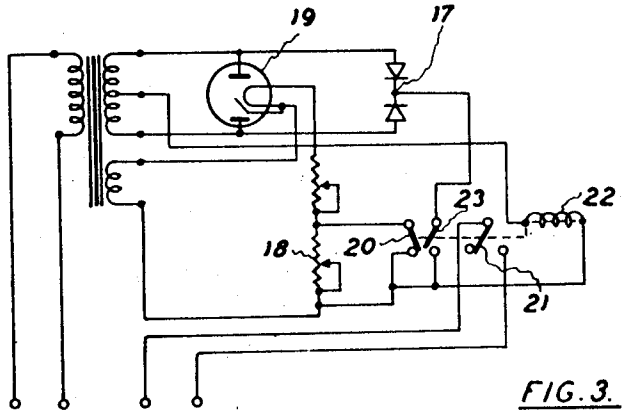


FIG. 3.

INVENTORS
DAVID JOHN ABERCROMBIE
EDWARD ANTHONY BRETTINGHAM-MOORE
WINSTON THOMAS MUSCIO
BY Robert J. Berry
AGENT

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TIME-DELAY SWITCH OPERATING SYSTEM

David John Abercrombie, Edward Anthony Brettingham-Moore, and Winston Thomas Muscio, Alexandria, near Sydney, New South Wales, Australia, assignors to International Standard Electric Corporation, New York, N. Y., a corporation of Delaware

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3 Claims. (Cl. 175—320)

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This invention has reference to switches which are required to close a circuit at some selected time after closure of an energizing circuit associated therewith. The switch operating system subject hereof is usable in a general way for the purpose indicated, but is particularly intended for use as a protective device in radio transmission systems.

In radio transmitting systems employing high power vacuum tubes, it is necessary, in order to avoid damaging the tubes, for the several supply voltages to be applied in correct sequence and at such intervals, as will enable proper adaptation of the tube to the conditions being imposed thereon. For example, in a common triode vacuum tube, the filament circuit must be closed first, and the grid polarising potential and the anode or plate potential then applied in the order stated. Further, before the plate potential is applied the filament must have reached a temperature sufficient for active electron emission, also the grid polarising potential must have become steady if the tube is to remain undamaged.

Conversely, on shutting down the transmitter, the filament potential and the grid polarising potential must not be removed from the tube, or substantially reduced in value, before the anode potential is removed. Also, in case of failure of either the filament or grid polarising potentials or a serious reduction of either of these potentials, the anode potential must be immediately shut off.

Electro-mechanical time-delay systems have been proposed, whereby the desired operations are effected more-or-less automatically, and in such manner that wrong action on the part of an operative will not endanger the equipment. These prior systems are functionally efficient, but they are expensive, and they require considerable attention to ensure continued satisfactory operation.

In the specification of our prior Commonwealth of Australia Patent No. 104,800, there is described a time-delay system incorporating a neon tube with a condenser. This prior arrangement largely overcomes the defects of time-delay mechanical relays; but, with such an arrangement, in the event of momentary or sustained power supply failure, restarting of the transmitter involves the same delay as is necessary when starting from cold.

The main object of this invention is the provision of a simple and reliable time-delay switch system which avoids the disabilities cited herein. A further object of the invention is to provide a time-delay switch system which in the event

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of the energising circuit being broken (for example, as a result of power supply failure) momentarily or for a short period of not more than a few seconds, is able automatically to effect a reclosure of the controlled circuit within a period which is (or may be varied to be) shorter than the initial time-delay period normal to the system when first switched on at the end of an intentional and prolonged rest period.

The essence of the invention may be said to reside in a time-delay switch operating system comprising a double diode valve having an indirectly heated cathode, means for applying a potential difference across the electrodes of said valve and for supplying of current to the heater of said valve, a resistance included in the circuit for said heater, a relay coil in circuit with said electrodes, and a switch in the circuit under control which is in operative association with said relay coil.

In the accompanying drawings, Figs. 1, 2 and 3 are respectively diagrammatic representations of three embodiments of the invention.

Referring to Fig. 1 an indirectly heated double diode valve 4 has its heater 5 supplied with current from a transformer 6 whereby the primary 7 is part of the energising circuit. An adjustable resistance 8 is serially included in this heater circuit. By adjusting the amount of resistance in circuit, the voltage applied to the heater may be selectively varied and hence the period of cathode warm-up may be correspondingly varied. When the cathode arrives at normal emissive temperature, the valve becomes conductive and thus functions as a full wave rectifier (the cathode being connected to a centre tapping in a secondary winding of the transformer, whereof the ends are respectively connected to the twin anodes of the valve as shown). The D. C. output is applied to a relay coil 9 which on energisation closes, and holds closed, a switch 10 in the circuit under control.

It may be noted that since the cathode operates at a high temperature, the time-delay period is practically unaffected by changes in ambient temperature.

When the system is required to effect automatic speedy reclosure of the controlled circuit, following a momentary or short-duration failure of power supply in the energising circuit, (referring to Fig. 2), a directly heated double diode 11 and an adjustable resistance 12 are incorporated with the embodiment shown in Fig. 1; also, the relay coil (13) armature is employed to operate a second switch 14 in addition to

the control circuit switch 15. The arrangement is such that when no current is flowing in the relay coil, the second switch is positioned to close the heater circuit for the indirectly heated diode 16, and when the relay coil is energised the second switch 14 is then positioned to close the heater circuit for the directly heated diode 11. In operation, the control circuit switch 15 closes at the end of the initial time-delay period, through the agency of the indirectly heated diode 16 energising the relay coil 13. This energisation also operates the second switch 14 so that the heater supply is cut off from the indirectly heated diode and applied to the directly heated diode 11. The filament-cathode of this second diode heats up almost instantaneously and thus maintains the D. C. supply through the relay coil. In the event of an energising circuit failure, the relay coil becomes de-energised and therefore the control circuit switch 15 opens, and the second switch 14 opens the heater circuit of the second diode and in so doing closes the heater circuit of the first diode. If the supply is interrupted momentarily or for only a few seconds, re-closure of the energising circuit finds the filament-cathode of the second directly heated diode 11 still warm enough for emissivity, and consequently the second diode is still conductive. This being so, the relay coil is immediately reenergised and the control circuit reclosed without necessity for elapse of a period equal to the initial time-delay. If the energising circuit is opened for a sufficiently long period to allow the second diode to become non-conductive, it is, of course, necessary for the normal time-delay period to run out before the control circuit is re-closed.

In a modified arrangement of the system just previously described and as shown in Fig. 3, the second diode is replaced by a non-thermionic rectifier 17 and an additional resistance 18 is included in the heater circuit of the first diode 19. This additional resistance is adapted to be short-circuited through a third switch 20, opening of which occurs by and as a result of energisation of the relay coil.

In the operation of this modified arrangement, the control circuit switch 21 closes at the end of the initial time-delay period in the same manner as that already described. The relay coil (22) energisation responsible for this closure, also effects closure of a second switch 23 whereby the relay circuit is maintained through the mentioned rectifier, and as well opens the mentioned third switch 20, thereby rendering the resistance 18 effective in the first diode heater

circuit. The additional resistance (18) thus imposed reduces the cathode temperature to a degree which renders it non-conductive, but maintains it at a temperature which is only just short of substantial emissivity. If the energising circuit is now interrupted the additional resistance is short-circuited (due to de-energisation of the relay coil) and upon rapid re-closure of the energising circuit the cathode being still relatively warm quickly arrives at emissivity and thus re-establishes the relay circuit and hence the control circuit without necessity for elapse of a period equal to the initial time-delay.

What we claim is:

1. A time delay switch operating system comprising an indirectly heated double diode valve including cathode and anode electrodes, said cathode having a heater, a directly heated double diode valve, said valves circuited in parallel, means for applying a potential difference across the electrodes of said valves and for supplying current to the heaters of said valves, a pair of resistances, each respectively included in the heater circuits of said valves, a relay coil between said cathode and said means for applying a potential difference, a pair of switches in operative association with said relay coil, a first of said switches in the circuit under control, and the second of said switches operating to close the heater circuit of either of said valves.

2. A time delay switch operating system as claimed in claim 1 wherein said resistances are variable whereby the period of cathode heating may be set to a predetermined value.

3. A time delay switch operating system as claimed in claim 1 wherein said second switch is of a double-throw type, said switch completing the heater circuit of said indirectly heated valve when said coil is unenergized and completing the heater circuit of said directly heated valve when said coil is energized.

DAVID JOHN ABERCROMBIE.
EDWARD ANTHONY BRETTINGHAM-MOORE.
WINSTON THOMAS MUSCIO.

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