Dec. 12, 1933. S. R. DURAND 1,939,340

TRANSMITTER PROTECTIVE SYSTEM

Filed June 19, 1930 2 Sheets-Sheet 1

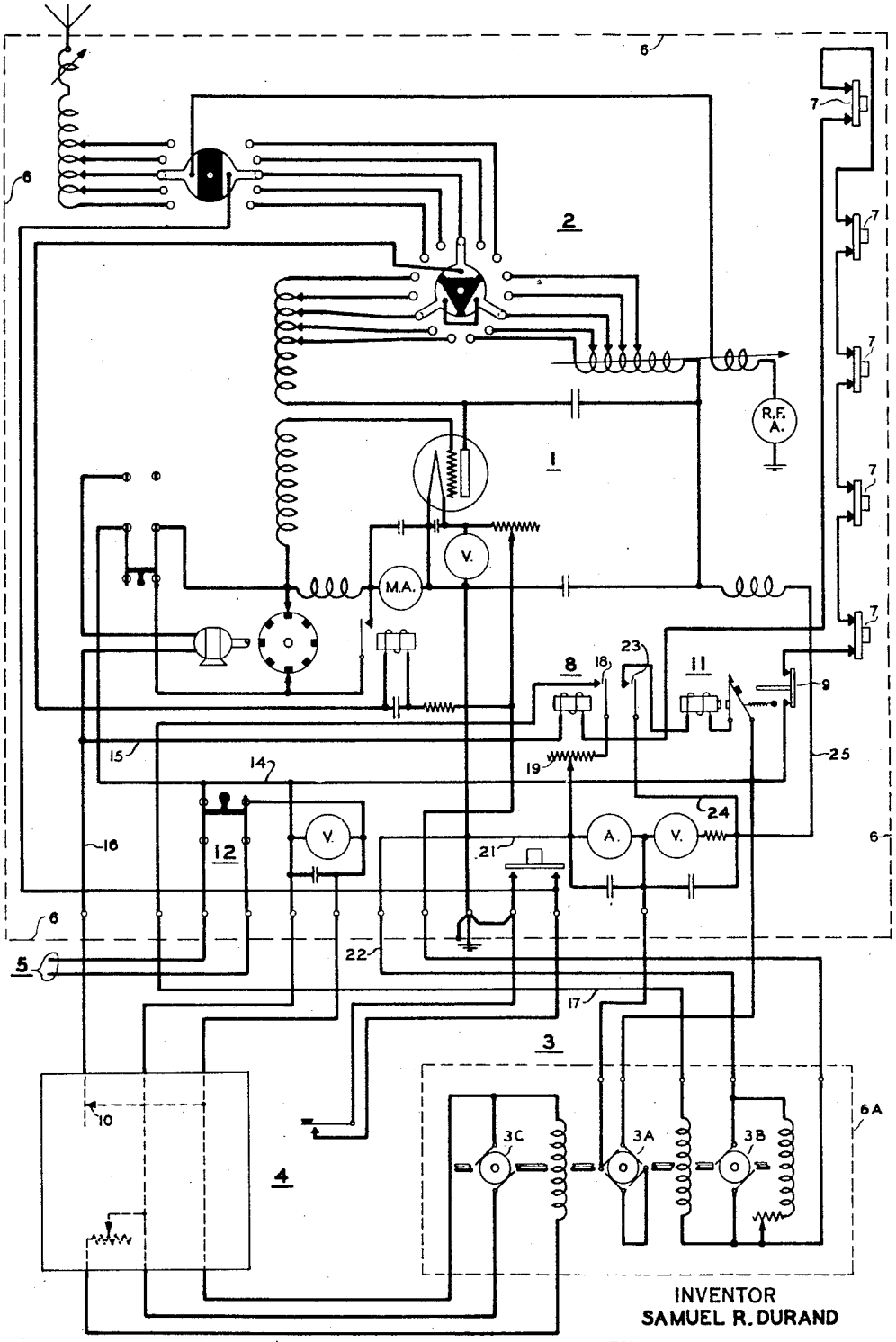


FIG. 1

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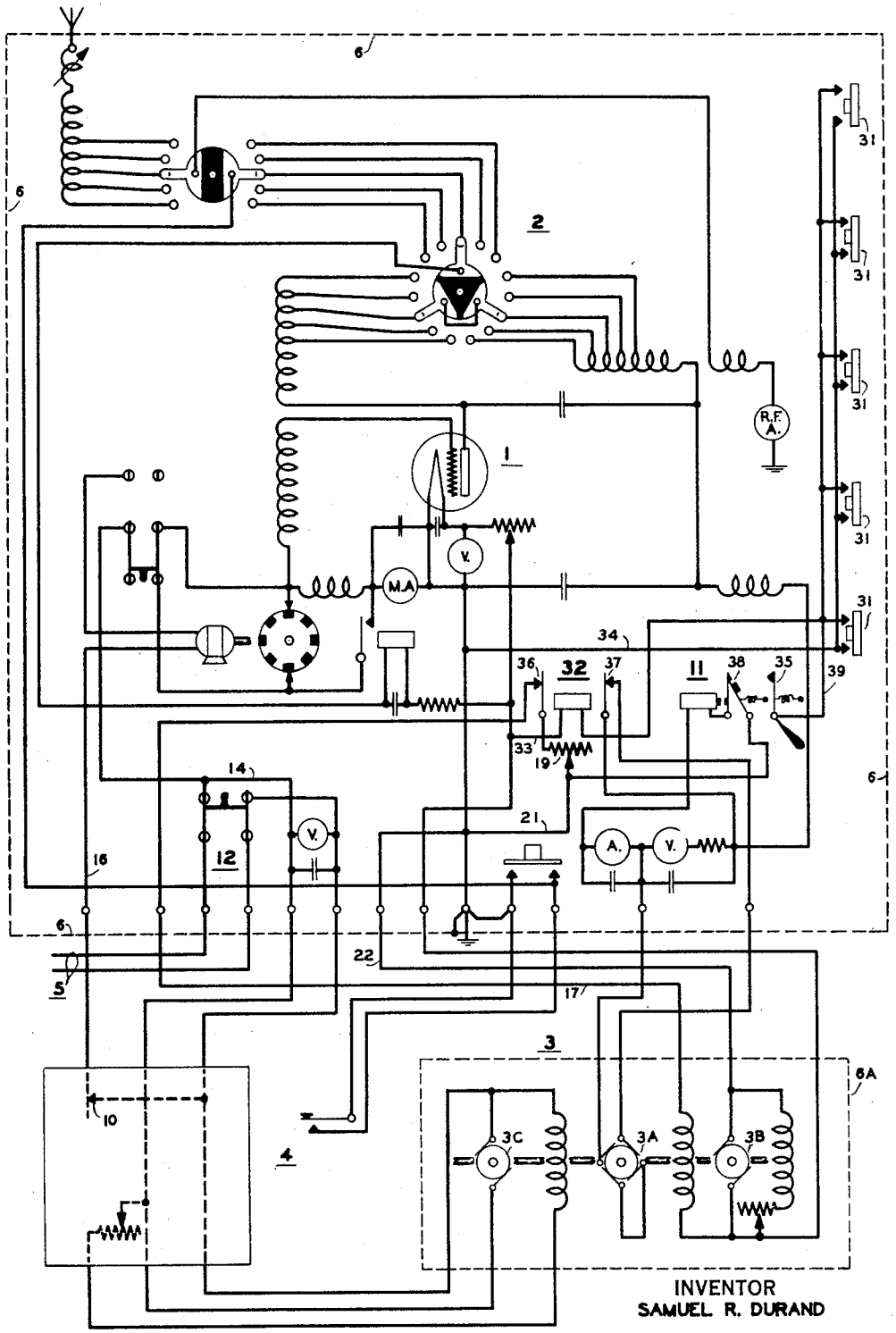


FIG. 2

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UNITED STATES PATENT OFFICE

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TRANSMITTER PROTECTIVE SYSTEM

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5 Claims. (Cl. 250—17)

My invention relates to radio transmitter devices and particularly to protective systems incorporated therein, including means for the protection of operators against injury from contact with highly charged conductors, and for the protection of the apparatus against current overloads and other dangerous conditions.

My invention has for an object the production of a simple, convenient and certain means for protecting the operator of the transmitter device against the risk of harm from the highly charged circuits which are necessary elements of high powered radio transmitters, and at the same time provides for convenient access to the various transmitter elements for maintenance and adjustment thereof, etc.

My invention has for further objects, the provision of a simple and effective means for preventing damage to the apparatus in case of over-load or short circuit, and the utilization of a minimum number of members for obtaining these desirable results.

My invention has for still other objects the provision of an improved circuit breaker system, including means for dividing the arc incident to operation of the circuit breaker; means for facilitating the replacement of the vacuum tube member, without danger to the operator, and the facilitation of the adjustment of tuning contacts without danger, as well as other objects which will later become apparent.

Vacuum tube radio transmitters customarily require power sources for energizing the plate circuit at potentials ranging from 1,000 volts up to many thousand volts, direct current. Such voltages are extremely dangerous to an operator, for if he touches live parts, they usually act to produce fatal results.

It is accordingly desirable to make provision for protection of the operators from such voltages, especially during such operations as changing tubes, tuning, etc. In addition, it has been found extremely difficult to operate over-load circuit breakers on these voltages, because of the persistent character of the arc at such voltages, and the very great distance over which it will jump when once started. Accordingly, it has been found difficult to protect the current supply systems of vacuum tube devices from the shock and injury due to over-load or short circuits in the apparatus.

My invention thus provides a simple means for protecting the apparatus and the operators of such systems against danger of injury from the high voltage, without preventing convenient access to the various elements of the system; and simultaneously provides a simple, certain and convenient means for preventing damage to the power sources, in the event of over-load or short circuit, and to the transmitter apparatus under such conditions.

Other objects and structural details of my invention will be apparent from the following description when read in connection with the accompanying drawings, wherein:

Fig. 1 is a diagrammatic representation of an embodiment of my invention utilizing circuit opening principles, and

Fig. 2 is a diagrammatic representation of a circuit closing embodiment of my invention.

Referring to the Fig. 1, the vacuum tube 1 is associated with an oscillatory system 2 including a tuned circuit, an aerial circuit and a grid circuit as shown. Appropriate power supply and control units are provided as indicated. The unit 3 may desirably be a motor generator set containing a generator 3B for the filament power supply and a generator 3A for the plate power supply, driven by a motor 3C under the control of circuits from the motor starting box 4 and supplied with power through the mains 5, with switches, meters and etc., as shown.

The vacuum tube, the resonant oscillatory circuits and the various control elements are enclosed in a metal cabinet or case 6. Suitable openings and doors are provided in the case 6, for access to the various circuit elements, and each door is provided with a circuit inter-lock button 7 which is preferably designed to be held closed by latching the door closed in the access openings. A similar enclosure 6A with access doors and inter-lock contacts may be provided about the motor generator unit 3, if such is desired, although it is not so indicated in the drawings.

As shown, the door inter-locks 7 are wired in series, and, also in series in the inter-lock circuit, is included a relay 8 having two separate pairs of circuit closing contacts. Similarly in series with the contacts 7 and coil of the relay 8 is provided a contact 9 adapted to be operated by an element of the plate-circuit overload-breaker 11. The inter-lock circuit, which is the circuit as a whole including the winding of the relay 8 and contact buttons 7 and 9, is energized from any convenient current source, which may be the filament supply circuit, or in the embodiment disclosed is shown as the main power supply. In this embodiment current is obtained from the switch 12, through the conductor 14, leading to the circuit breaker contact 9, the

several door inter-lock contacts 7, the coil of relay 8, and back by way of leads 15 and 16 to the motor starter box 4, in which may desirably be provided a contact 10 as indicated which closes the inter-lock circuit when the motor starter is actuated to start the motor generator unit 3.

In the embodiment shown, the field coil of the high voltage generator 3A in the unit 3 is excited from the low voltage filament generator 3B, one terminal of the field winding being connected to the filament generator directly at the motor generator set 3, and the other led through conductor 17 to contacts 18 of the relay 8, through the field rheostat 19 and conductors 21 and 22 to the other terminal of the filament generator.

The negative terminal of the high voltage generator 3A may be connected directly to the filament circuit as indicated, and the positive terminal connected to the movable contact of circuit breaker 11, the circuit being further continued through the fixed contact, the breaker coil, contacts 23 of the relay 8, and the leads 24 and 25 to the oscillatory circuits of the vacuum tube 1.

In the operation of my device, the main switch 12 may be closed, after which the motor starter 4 may be operated, to bring the motor generator set up to speed. Simultaneously, the contacts 10 in the starter 4 close the interlock circuit, whereupon, if all of the access doors are closed and by them the inter-lock contacts 7, current will flow through the relay 8, and the contacts 18 and 23 are thereby closed, permitting the energization of the high voltage field circuits and the supplying of current to the triode 1 in the usual way. If however, any of the door inter-lock contacts 7 are open, relay 8 is not energized, contacts 18 are not closed, and no high voltage is generated since the field circuit of the generator is open. As a further protection, the high voltage plate circuit is opened at the contacts 23 of relay 8 preventing the application of any voltage which might be developed by residual magnetism in the high voltage generator field. Thus, if the access door is open, as may be the case if the operator has made any adjustments or changes before the motor is started, no generator voltage can be developed or applied to the various transmitter members.

In a similar fashion, if the apparatus has been energized and in use, and the operator attempts to make adjustments without stopping the motor generator set, the act of opening the access door automatically opens one of the contact interlocks 7, thereby deenergizing the relay 8 and opening both the field circuit of the high voltage generator and the armature circuit to the triode plate. The operator can then proceed with such changes as are desirable upon the transmitter units without danger of injury.

It is particularly desirable that the operation of changing or replacing the vacuum tube in a tube transmitter be conveniently and safely performed, and for this purpose it is desirable that a door be provided in the case or cabinet at a point conveniently close to the tube socket. But the operation of changing tubes requires a series of operations in a neighborhood near to the high voltage leads to the tube which are extremely dangerous as the circuits are energized by high voltage. This is particularly the case where air cooled tubes with a top contact for the plate supply are utilized, since the operation of changing this tube requires a manual removal of the plate lead from the tube contact, thus involving direct bodily contact by the operator with the plate circuit. The danger otherwise inherent in this operation is removed by the device of my invention by the automatic removal of all voltage from the plate circuit in the transmitter when any of the access doors are opened. Similarly, the operation of adjustment of the leads to the inductances for setting the various inductances for a given oscillation frequency involves direct bodily contact in the handling by the operator of the metal members directly connected to the plate circuit, and thus accordingly may be a hazardous operation. But by the device of my invention, the hazard is removed from this operation as well, by the necessary opening of an access door and deenergization of the plate circuits thereby.

If by any mischance an over-load or short circuit occurs in the transmitter, the excess current in the coil of the circuit breaker 11 causes the release of the circuit opening contacts, and the movable contact strikes the interlock contact 9, causing the inter-lock circuit to be opened and the coil of relay 8 deenergized, thereby releasing the contacts 18 and 23 which in turn open both the field circuit and the armature circuit of the high voltage generator. This sequence of acts very greatly reduces the severity of the duty imposed upon the circuit breaker 11 since the voltage of the generator is automatically reduced by the opening of the field circuit, and a second break in the circuit is made between the contacts 23 of relay 8 dividing the circuit breaker arc into two portions which are much more promptly and easily extinguished.

The above described embodiment utilizes a system in which an opening of the access doors or tripping of the circuit breaker opens a protective circuit. Alternatively, the embodiment may be modified so that opening the access doors closes a protective circuit.

This embodiment, with other advantageous features, is shown in Fig. 2, in which figure the same numbers as are applied to Fig. 1, represent similar parts. Thus, a vacuum tube member 1 is provided, associated with a resonant circuit system 2 and a power supply system 3 which may desirably be a motor generator unit, including a high voltage generator 3A for plate power, a low voltage generator 3B for filament power, and a driving motor 3C, supplied through a motor starting device 4, with power obtained from the power supply mains 5. As described for the first mentioned embodiment, a case member 6 having appropriate access doors is provided within which the tube and circuit members may be positioned and similarly if desired a case member 6A may be provided around the motor generator set 3, also with appropriate access doors. Likewise, contactor buttons 31 may be provided cooperating with the access doors in the case 6 in a manner similar to that in which the buttons 7 of the first described embodiment function. The buttons 31 are, however, adapted to close the circuit when the access doors are opened.

In this embodiment, the door inter-lock contactor-buttons 31 are connected in parallel, instead of in series as in the previous embodiment, and the group of contacts is connected to the coil of relay 32. This relay and interlock button circuit is desirably connected to the filament supply circuit by leads 33 and 34 as shown, although it may of course be connected to the main power supply leads 5, as in the previous embodiment. An over-load circuit breaker 11 is provided as before but connected in the negative lead from

the generator, as distinguished from the position indicated in the first embodiment in which it was connected in the positive lead. The circuit breaker 11 is provided with a metallic re-set member 35, against which the movable contact member 38 of the circuit breaker is adapted to contact.

The relay 32 is provided with contacts 36 and 37, the pair of contacts 36 being connected in series with the resistance 19 in the field circuit of the high voltage generator 3A, so that the field circuit is opened upon opening of the contacts 36. The contacts 37 are connected in the positive lead of the generator 3A and adapted to open the circuit from the generator to the plate of the vacuum tube 1.

Broadly, this embodiment operates in a manner similar to that described in connection with the previous embodiment, although in detail various of the minor functions are differently performed. In this embodiment the opening of any of the access doors closes the contact through one of the buttons 31, thereby energizing the coil of the relay 32, from the low voltage generator 3B, when the power supply set 3 is running, thereby attracting both of the armatures and opening the contacts 36 and the contacts 37. The opening of contacts 36 opens the field circuit of the high voltage generator, destroying its excitation, while the opening of the contacts 37 opens the plate circuit, thereby removing any voltage from the plate circuits which may be generated by residual magnetism in the generator field.

Similarly the over-load circuit breaker 11 may function when an over-load occurs thereby opening the plate supply between the generator and the filament. Simultaneously, the release of the movable member 38 permits it to make contact with the metallic re-set lever 35, which is connected as shown by a lead 39 to the coil of the relay 32. The member 38 is connected to the filament circuit, and upon contacting with the member 35, it closes a circuit through the coil of the relay 32, thereby energizing it, and opening the contacts 36 and 37 which in turn open the plate generator field circuit, and the plate generator connection to the vacuum tube plate circuit. This embodiment thus attains the objects previously mentioned in an equally simple and satisfactory manner to that of the embodiment first described and permits the utilization of several other features.

By the system of my invention, I have thus provided a simple, inexpensive and certain means for protecting the operator from danger of contact with the high voltage circuits in a radio transmitter without interfering with convenient access to and adjustment of the members of the device. The system is also adapted to provide protection against over-loads and short circuits, and to reduce the duty required upon the over-load circuit breaker.

While I have disclosed but a single embodiment of my invention in the above description, it is capable of various modifications therefrom without departure from the spirit thereof, and I desire therefore that only such limitations shall be imposed upon the appended claims as are stated therein or required by the prior art.

I claim as my invention:

1. In a transmitter device, an oscillatory circuit, a vacuum tube device, a protective enclosure therearound having access doors therein, a source of power for said tube, an over-load circuit-breaker connected therebetween and having a contact member operated by actuation thereof, contactor buttons controlled by said access doors, a relay having a coil and contacts, a circuit including said contactor buttons and said coil and connected to a power source, said contacts being in circuit with said tube power source, and adapted upon actuation to deenergize said source, said relay being operated by actuation either of any of said access door contacts, or said circuit breaker contacts, to remove power from said tube.

2. In a transmitter device, oscillatory circuits, a vacuum tube, a generator, a source of power therefor, a protective relay having a contact connected in one lead of said generator, a circuit opening over-load protective device having contacts connected in the other lead of said generator, and means associated with said circuit breaker for actuating said relay upon operation of said breaker.

3. In a radio transmitter comprising a vacuum tube having cathode, grid, and anode electrodes, an enclosure for the vacuum tube having an access door, a contactor button actuated by the door, a power supply circuit for the anode, an electromagnetic relay, an overload circuit breaker in the power supply circuit which also includes a contact of the relay, and an energizing circuit for the relay including the contacts of the contactor button and contacts controlled by the circuit breaker.

4. In a radio transmitter, the combination of a vacuum tube having a cathode, grid and anode, an enclosure for said tube having an access door, contacts actuated by said door, an electromagnetic relay having an energizing winding, a generator, a circuit over which energy is supplied from the generator to the anode and including contacts closed by energization of said relay, an overload circuit breaker included in said circuit contacts controlled by the circuit breaker and connected in circuit with said energizing winding, a source of current, a switch, and connections between said switch, said door actuated contacts, said circuit breaker contacts, said operating winding and said source of current whereby upon closure of said switch whilst said access door and said circuit breaker contacts are closed, said relay is energized.

5. In a radio transmitter, the combination of a vacuum tube having a cathode, grid and anode, an enclosure for said tube having an access door, contacts actuated by said door, an electromagnetic relay, a generator, a circuit for supplying energy from the generator to the anode and including contacts closed by energization of the relay, an overload circuit breaker included in said circuit, contacts controlled by the circuit breaker, a field circuit for the generator including contacts closed by energization of said relay, an operating circuit for the relay including the door contacts and the circuit breaker contacts, and a switch for completing said operating circuit thereby to energize said relay if said door and circuit breaker contacts are closed.

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