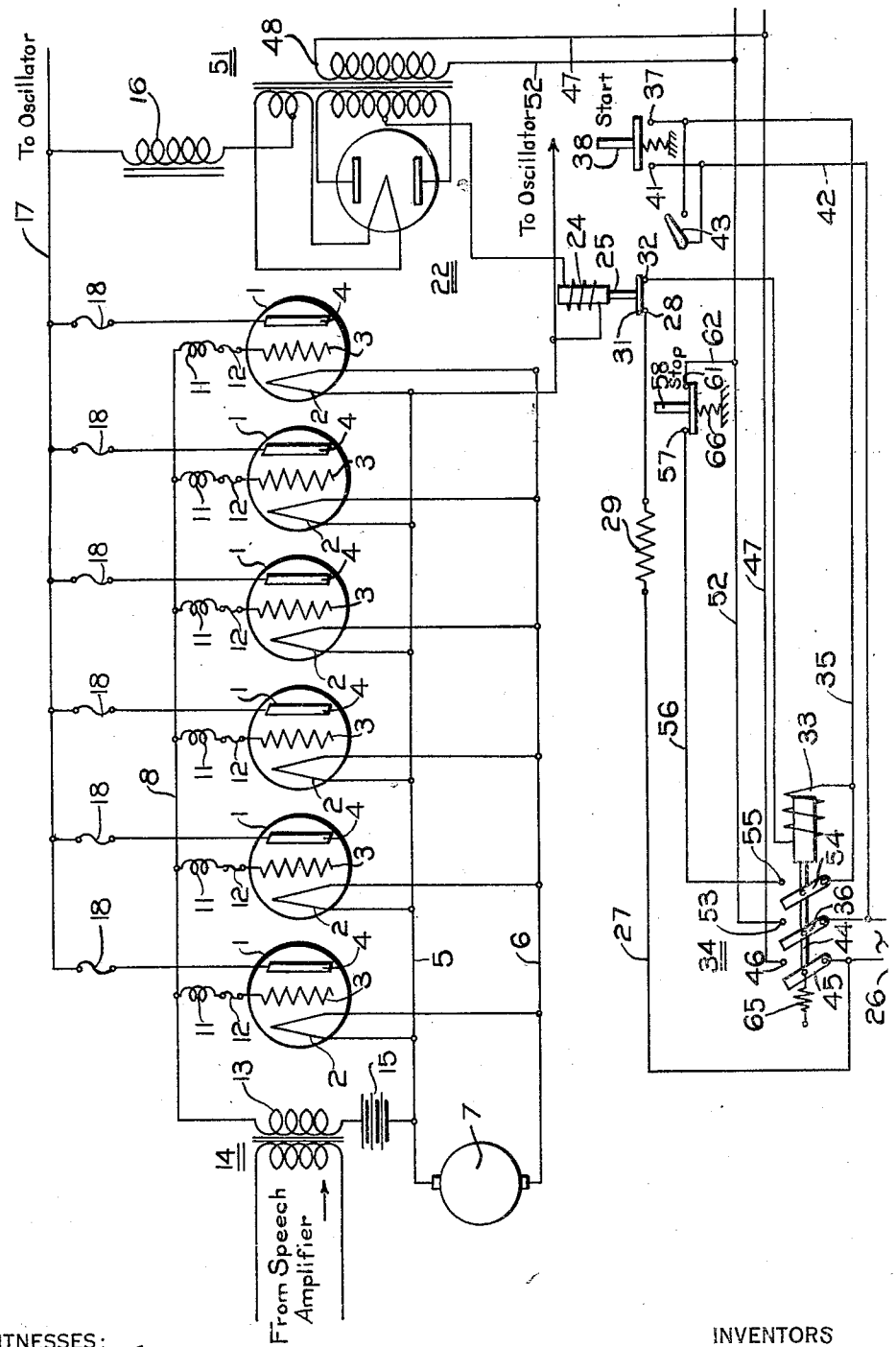
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RADIO TRANSMITTING SYSTEM

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RADIO TRANSMITTING SYSTEM

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Our invention relates to radio transmitting systems, and it has particular relation to such systems in which a plurality of thermionic devices are connected in parallel in order to give a large power output.

One object of our invention is to provide means whereby the failure of one or more of a plurality of thermionic devices connected in parallel will not seriously interfere with the continuity of a program being transmitted.

Another object of our invention is to provide means for automatically removing a defective tube from a circuit before a destructive arc has had an opportunity to form therein.

Another object of our invention is to provide means for automatically disconnecting a defective tube from a transmitting circuit, for stopping the transmission of the signal during the small interval of time required to disconnect the defective tube, and for automatically restarting the transmission after the defective tube has been disconnected.

In modern transmitting systems handling large amounts of power it is customary to connect groups of power-tubes in parallel in order that a sufficient output may be obtained. If, for any reason, one of the tubes of any one group starts drawing more than its proportionate share of plate current, by reason of ionization, internal short-circuits, or arcs, the functioning of the group is disturbed, and it is necessary that the defective tube be at once disconnected.

It is of course possible to discontinue the transmission while the defective tube is being removed by hand from the circuit, but this entails a very considerable break in the program, which is undesirable.

The apparently obvious solution of the problem, by using a fuse in series in the plate circuit of each tube, is impracticable. In general, plate potentials of the order of 10,000 volts are now being used on power tubes, and in order to break the arc in a 10,000 volt direct current circuit it would be necessary to use a fuse well over three feet in length. Such fuse lengths are obviously out of the question, and I have accordingly provided an instantaneous-trip over-load relay in the primary side of the transformer which is utilized to feed the rectifiers supplying plate potential, and have inserted the actuating coil of this relay in series with the negative lead from the rectifier itself. In addition, we have provided means whereby the entire transmitter is momentarily shut down during the time it takes one of the fuses to open the circuit, and additional means for automatically restoring the transmitter to the operative state.

The novel features which are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing.

The single figure of the drawing is a diagrammatic view of a group of modulator tubes arranged according to a preferred embodiment of my invention.

Referring specifically to the drawing, a plurality of modulator tubes 1, each having a filament 2, a grid 3 and a plate 4 are so arranged that filament potential therefor is supplied to the tubes through conductors 5 and 6 in parallel from a source 7. The grids 3 are connected in parallel to a conductor 8, and interposed between the conductor and each of the grids is a radio frequency choke coil 11 and a fuse 12. The conductor 8 is connected to one end of the secondary winding 13 of an audio frequency transformer 14, the other end of which is connected through a source 15 of grid biasing potential to the filament power supply conductor 5. The primary winding 16 of the transformer 14 forms the output circuit of a speech amplifier (not shown).

The plates 4 of the tubes are connected in parallel to a conductor 17 which is also connected to the plates of the oscillator tubes (not shown). Interposed between the conductor 17 and each of the plates is a fuse 18 of such a value that it will open the circuit when the current therethrough reaches two or three times the normal current for the tube

associated therewith. Plate potential for the tubes is supplied through a modulator choke coil 16 connected in the usual manner to a rectifier 22 which, in general, will comprise a plurality of individual rectifiers, arranged for single or polyphase excitation. The negative terminal of the rectifier is connected through the actuating winding 24 of an instantaneous-trip over-load switch 25 to the negative terminal of the filament potential source 7 which terminal may also be connected to the filament terminals of the oscillator tubes (not shown). In actual practice it may be necessary to add a dash-pot, or equivalent means, to the overload switch, in order to delay the resetting thereof sufficiently for the circuit through the defective tube to be entirely broken. It is also feasible to equip the switch with a latching device to retain it open after extraordinary over-loads, caused by other than tube failures.

A source 26 of alternating potential is connected through a conductor 27 to a fixed contact element 28 associated with the movable element 31 of the overload switch, with which is also associated another fixed contact element 32.

An actuating coil 33 of a switching device 34 is connected in circuit between the contact element 32 and a conductor 35, which conductor is in turn connected to a movable arm 54, and to a fixed contact element 37 associated with a starting button 38. A second contact element 41 is associated with the starting button 38, from which element a conductor 42 leads to the opposite side of the alternating potential source 26.

A manually operable short-circuiting switch 43 is connected across the starting button contact elements.

The switching device 34 carries a plurality of movable arms on an insulating actuating member 44. An arm 45 is connected to one side of the alternating source 26 and has associated with it a contact element 46 which is connected through a conductor 47 to the primary winding 48 of a transformer 51 which energizes the rectifier 22. The other end of the primary winding 48 is connected to a conductor 52 which, in turn, connects to a contact element 53 with which is associated a movable arm 36 connected to the opposite side of the alternating potential source.

A contact element 55 is associated with the movable arm 54 previously referred to, and is connected by a conductor 56 to a contact element 57 associated with a "stop" button 58. A second contact element 61, associated with the "stop" button 58, is connected, by means of a conductor 62, to the conductor 52, and, consequently, is connected to the contact element 53 associated with the movable arm 36 which is connected to the alternating potential source 26.

It will be noted that the movable member which carries the three arms is biased to an open position by a spring 65. The "stop" button 58 is biased to a closed position by a spring 66, while the "start" button 38 is biased to an open position by a spring 67. The circuit breaking or overload switch 25 is normally retained in a closed position under the influence of the force of gravity.

The operation of a system arranged according to our invention will now be explained. It is assumed that the filament-potential source 7, which preferably is a small direct-current generator, is supplying filament potential to all the tubes and that the filaments of the oscillator and speech amplifier tubes have also been energized. In order to start transmitting, the starting button 38 is momentarily depressed. A circuit can now be traced from one side of the alternating-potential source 26 through a resistor 29, the overload switch contact elements 28, 31 and 32, the winding 33, the conductor 35, the starting-button contacts 37 and 41, back to the other side of the source 26. The winding 33 of the starting switch 34 now being energized causes the movable arms 54, 36 and 45 to make contact with their respective contact members 55, 53 and 46.

The starting button is now released and a holding circuit for the starting switch may be traced from one side of the source 26 through the resistor 29, the overload switch contact elements, the winding 33, the movable arm 54, the conductor 56, the stop switch contact elements, the conductors 62 and 52, the contact element 53, the movable arm 36, to the other side of the power source 26. The power source 26 also applies potential to the primary winding 48 through movable members 36 and 45 and conductors 52 and 47. Power for the rectifier associated with the oscillator tubes, if a separate rectifier is utilized, may also be applied through the conductors 52 and 47.

If, from any cause, one of the modulator tubes becomes "soft", permitting an excess of plate current to flow therethrough, the fuse 18 associated therewith immediately opens the circuit. As explained before, however, this fuse is, of itself insufficient to interrupt the high-potential direct current which is being supplied to the tubes. As soon, however, as the current taken from the rectifier rises to a predetermined amount above normal, the overload switch 25 breaks the circuit through the holding winding 33, permitting the spring 65 to retract the element 44, thus moving all of the arms carried thereby away from their respective contacts. This action is substantially instantaneous and, inasmuch as the source 26 is not necessarily of high potential, the circuit through the primary of the rectifier power transformer is thus broken. The breaking of the primary circuit deenergizes the rectifier 22 and

stops the supply of plate potential to the modulator tubes.

The holding coil will not be again reenergized upon closing of the overload relay under the influence of gravity, inasmuch as the starting button 38 is biased to the open position.

By reason of the fact that the defective tube has been removed from the circuit by the action of the fuse associated therewith, the attendant may now restart the transmitter by again closing the starter button 38. In the interval, the defective tube may be replaced, or, if desirable, continued transmission may be carried on with the remaining tubes.

The interruption, however, to the program occasioned by the necessity of personal attention and action on the part of the attendant is, in general, much longer than is desirable. We have, therefore, supplied the short-circuiting switch 43 which may be so actuated as to supply a semi-permanent connection across the starter button. The sequence of operations which take place when this switch is closed will now be explained.

Upon first depressing the starter button, as previously described, the primary of the rectifier will be supplied with energy, and the field of the holding coil 33 established. After the transmitter has thus been placed in operation, the attendant closes the short-circuiting switch. Upon failure of any of the tubes, the overload switch functions as previously described, breaking the holding current and causing the primary power supply to the rectifier to be interposed. Upon reclosing of the overload switch under the influence of gravity, a circuit may now be traced from one side of the source 26, through the contacts of the overload switch, through the holding coil 33, the conductor 35, the short circuiting switch 43 and back to the other side of the source 26. It is thus obvious that the power supplied to the rectifier will only be interrupted for an interval of time corresponding to the opening and reclosing of the overload relay. This interval may, by proper adjustment of the relay, be so correlated to the length of time necessary for the fuse associated with the defective tube to open the circuit, that the tube is entirely disconnected from the high-potential conductor 17 before the reclosing of the overload relay.

It is accordingly apparent that, by our invention, we have provided a system whereby the failure of any one of a plurality of tubes connected in parallel will not cause a serious interruption in the continuity of transmitted signals. The restarting of the transmission may be either manually controlled or may be automatic, as described. Our invention, therefore, is of very great advantage when interruptions to a radio program are undesirable or where it is of prime importance that signals of any other type be substantially continuous.

Although we have illustrated and described our invention in connection with the modulator tubes of a radio transmitting system, it is believed obvious that it is applicable to any of the other groups of parallel-connected tubes, such as are employed in the oscillator, the power amplifier or the speech amplifier. It is also obvious that many modifications of our invention will be suggested to those skilled in the art and our invention is, accordingly, not to be limited except as is necessitated by the prior art and by the spirit of the following claims.

We claim as our invention:

1. In a transmitting system, a plurality of thermionic devices, means actuated by abnormal current conditions in any of said devices for temporarily discontinuing the supply of power to all of said devices, and self-actuated means for subsequently restoring the power supply to only said devices.

2. In a transmitting system, a plurality of thermionic devices, a source of power therefor, means whereby the failure of any of said devices removes it from circuit and causes a temporary discontinuity in the power supplied to all of the devices, and self-actuated means for automatically restoring the power supply to only the remaining tubes.

3. In a transmitting system, a plurality of thermionic devices, a source of power therefor, means actuated by abnormal current conditions in any of said devices for interrupting the supply of power thereto, and additional means for removing power supply potential from said devices during the interval of time required for said interrupting means to function.

4. In a transmitting system, a plurality of thermionic devices, a common source of power therefor, a plurality of like means severally associated with said devices and respectively actuated by abnormal current conditions in the corresponding devices for interrupting the power supply thereto, and additional means, also actuated by abnormal current conditions, for de-energizing said power source.

5. In a transmitting system, a thermionic device, a source of plate potential therefor, means actuated by abnormal current conditions in said device for interrupting the supply of plate current thereto, and additional means also actuated by abnormal current conditions for de-energizing said plate potential source during the interval of time required to interrupt said plate current and for re-energizing said source automatically as soon as the defective thermionic device has been effectively removed from the circuit.

6. In a transmitting system, a thermionic device, means for deriving plate potential therefor from a primary power supply,

means comprising an actuating solenoid and a plurality of switching devices for controlling said primary power supply, and means whereby abnormal current demands upon said plate potential supply means cause said actuating solenoid to permit said switching devices to interrupt the primary power supply to said plate potential supply means.

7. In a transmitting system, a thermionic device, a source of plate potential for said device, a primary power supply for said source, means between the device and the source of plate potential for permanently breaking the circuit therethrough upon the inception of abnormal current conditions, additional means responsive to abnormal current conditions for interrupting the primary power supply, and means for at will rendering said primary power interrupting means incapable of permanently interrupting said power supply.

8. In combination, a plurality of thermionic devices, a rectifier for supplying plate potential thereto, a source of primary power for said rectifier, a fuse between the plate of each thermionic device and said rectifier, a connection including the actuating winding of an over-load switch between said rectifier and said devices, a switching device for interrupting said primary power supply, said switching device being under the control of said overload switch, whereby said primary power supply to said rectifier may be interrupted during the period of time required for a fuse to respond to abnormal current conditions in the associated tube and remove said tube from conductive connection to said rectifier.

9. In a transmitting system, a plurality of thermionic devices, a plate-potential-supply conductor common to said devices, means actuated by abnormal current conditions in any of said devices for temporarily depriving said conductor of potential, and self-actuated means for subsequently restoring plate potential to said conductor.

10. In a transmitting system, a plurality of thermionic devices, a plate-potential-supply conductor common to said devices, means whereby the failure of any of said devices causes a temporary discontinuity in the potential applied to said conductor, means for removing the defective device from circuit, and self-actuated means for automatically restoring plate-potential to said conductor.

In testimony whereof, we have hereunto subscribed our names this 31st day of December, 1926.

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