

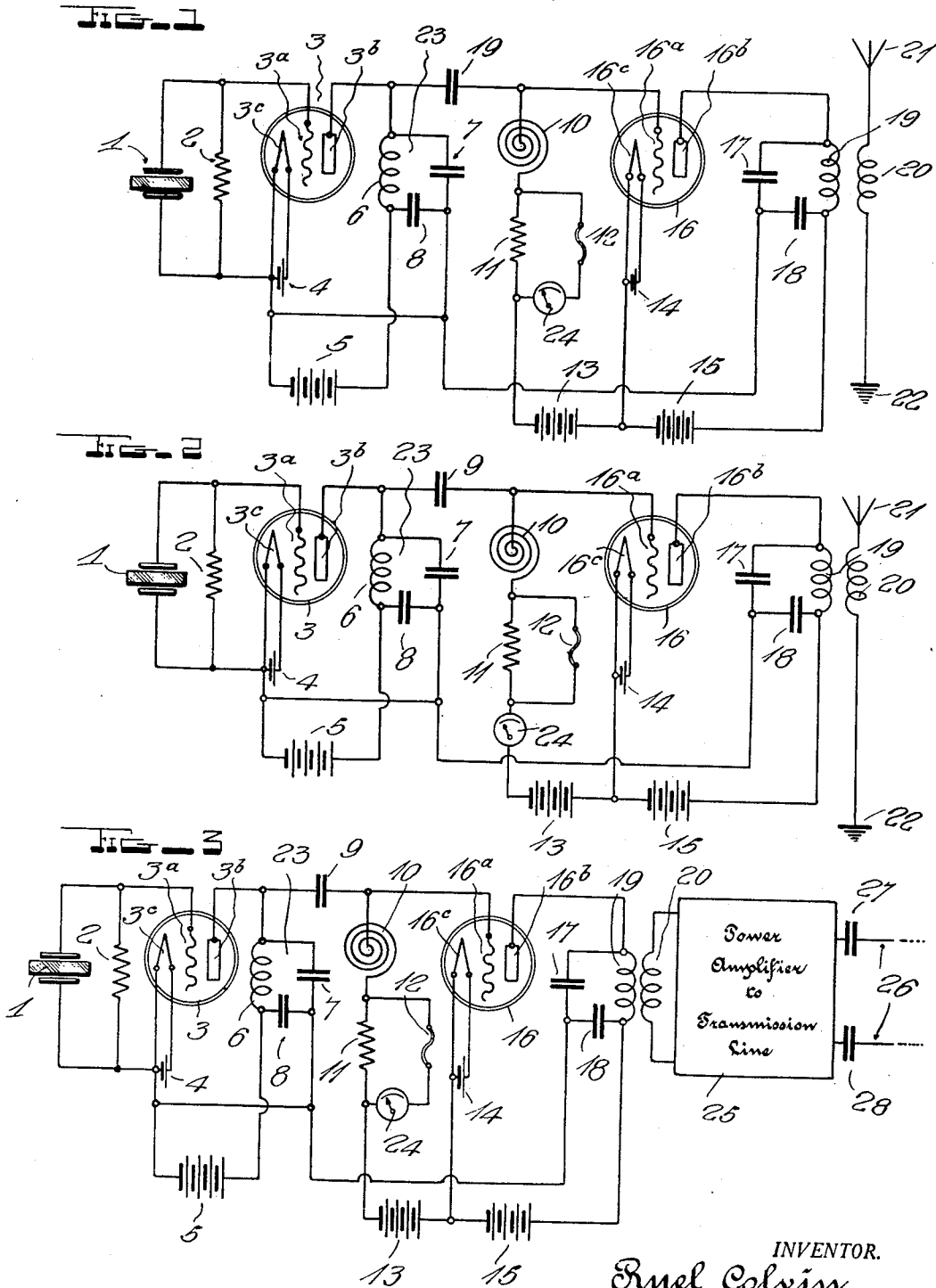
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HIGH FREQUENCY AMPLIFIER SYSTEM

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HIGH FREQUENCY AMPLIFIER SYSTEM

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14 Claims. (Cl. 179—171)

My invention relates broadly to high frequency signaling systems and more particularly to a protective circuit for high frequency amplifier systems.

5 One of the objects of my invention is to provide a circuit arrangement for a high frequency amplifier having means for protecting the elements of the amplifier circuit against destructive effects of excess current.

10 Another object of my invention is to provide a circuit arrangement for a high frequency amplifier having means for limiting the plate current of the operation of the amplifier system in the event of excessive rise of current in the amplifying circuit.

15 A further object of my invention is to provide a circuit arrangement for a high frequency power amplifier having means for increasing the negative potential of the grid with respect to the cathode of the amplifier under conditions of excessive rise of current in the amplifier circuit for thereby limiting the flow of plate current and preventing destruction of elements connected in the amplifier circuit.

20 A still further object of my invention is to provide a protective circuit for a meter which may be connected in a high frequency amplifier system by which the current flow through the meter is limited to a safe value under conditions of abnormal operation of the amplifying circuit.

25 Still another object of my invention is to provide a circuit arrangement for a high frequency amplifier in which the output transformer is protected from breakdown due to severe input shocks or self-oscillation in the output of the amplifier by automatic control of the potential of the grid in the amplifier under conditions of excessive rise of current in the amplifier circuit.

30 Other and further objects of my invention reside in the circuit arrangement for a high frequency amplifier system as set forth more fully in the specification hereinafter following by reference to the accompanying drawing in which:

35 Figure 1 illustrates one circuit arrangement embodying the principles of my invention; Fig. 2 illustrates a modified arrangement of the circuit of my invention; and Fig. 3 shows the circuit arrangement of my invention as applied to a wired radio transmission system.

40 In all transmitters employing radio frequency amplifiers, it is desired to meter the direct grid current. If, however, there should be spark-over between plate and grid, or if parasitics occur which cause excessive grid currents to flow, the meters invariably burn out due to these exces-

sive currents. In order to protect the meters as well as the electron tubes in case the negative bias should for any reason become short-circuited, an arrangement has been devised whereby a resistance is automatically thrown in the circuit after the current surges have caused a fuse to burn out. This resistance, which is of high ohmic value, causes the grid to become highly negative with respect to the filament, thereby limiting the flow of plate current and preventing the meter from burning out. The protective system of my invention is also applicable for protecting the output transformers from breakdown due to severe input shocks or self-oscillation in the output amplifier. The inclusion of the protective device of my invention in the grid circuit of the power amplifier is particularly important in wired radio systems in which the grid potential of the power amplifier may be automatically controlled upon excessive rise of current in the amplifier circuit for preventing increase in current above a safe value.

Referring to the drawing, reference character 1 represents a mechanically vibratile element, 2 a resistance between the grid 30 of electron tube 3 and cathode 3b thereof to prevent a high negative static potential building up on the grid 3a. The cathode 3c of electron tube 3 is heated from battery 4.

The battery 5 supplies direct current through a series feed to the plate 3b of electron tube 3 through the elements 6—7 of a tuned radio frequency circuit 23. A by-pass condenser 8 is arranged in the circuit 23. A coupling condenser 9 is arranged between the plate circuit of tube 3 and the grid circuit of tube 16.

In the grid circuit of electron tube 16, the grid bias potential is obtained from battery 13 from the circuit leading through a fuse 12 and meter 24 shunted by resistor 11, thence through a radio frequency choke 10 to grid 16a. The meter for measuring input current is shown in Fig. 1 by reference character 24 as disposed in series with the fuse 12. The meter 24 and fuse 12 are disposed in series around the resistor 11. The opening of fuse 12 serves to cut off the meter 24 and also to place resistor 11 in the grid circuit enabling the grid to become highly negative with respect to the cathode and limiting the flow of plate current. The cathode 16c of tube 16 is heated from battery 14. Battery 15 supplies plate current through tuned circuit 17 and 19 to the plate 16b of tube 16. Radio frequency energy is by-passed by condenser 18. Coupling between antenna 21 and ground 22 and the plate circuit

of tube 16 is accomplished by means of inductance 20.

In the modified circuit arrangement illustrated in Fig. 2, meter 24 is shown in series with the fuse 12 and the resistor 11. Fuse 12 is constructed so that the fuse will open upon excessive rise in current and at a point which is below a safe operating current for meter 24. Meter 24 is thereby protected against current of dangerous proportions. The elements of the amplifier circuit are protected by the inclusion of resistor 11 in the input circuit and the increasing of the negative potential on the grid 16a for limiting the plate current of the operation of the amplifier circuit.

In Fig. 3 I have illustrated the protective system of my invention applied to the power amplifier of a wired radio transmission system. The output transformer is illustrated at 19. The secondary winding 20 may connect to the output amplifier 25 which leads to the transmission lines 26 through capacity coupling elements 27 and 28. The fusible link 12 in the input circuit of the power amplifier stage constituted by electron tube 16 is opened under conditions of severe input shocks or self oscillation in the output amplifier 25 and applies a highly negative potential to grid 16a thereby limiting the plate current of the operation of the amplifier and protecting the elements of the amplifier circuit against excessive rise of current pending the repair of the amplifier system.

In operation, the grid meter may be in the position shown in Figs. 1 and 3 or in the position shown in Fig. 2. Should the battery 13 become short-circuited or should sparking take place between the plate and grid of tube 16 resulting in either case in a flow of grid current of dangerous value, fuse 12 will burn out with the immediate result that high resistance 11 is placed in the circuit causing the grid to become highly negative with respect to the cathode and thereby limiting the flow of plate current and protecting the tube and all of the elements of the grid circuit. The value of the resistance constituted by the fuse 12 in shunt with the resistor 11 is such that the combined conductivity of the two members 11 and 12 permits normal biasing potential to be applied to the grid 16a of the amplifier 16. However, upon rupture of fusible link 12 due to shock excitation, parasitics, short-circuit by shunting of the plate and grid or for other reasons, the resistance path is increased. This results in an increase of negative potential on grid 16a for the power amplifier tube for limiting the flow of plate current thus protecting the tube and all the elements of the grid circuit.

After a protective operation as herein described has been effected, the fusible link must be restored in order to correct the bias on the power amplifier tube for again restoring the transmitter to normal operation. While I have shown batteries for providing the cathode heating potential at 4 and 14 and providing the plate potential at 5 and 15 and the negative biasing potential at 13, it will be understood that generators may be employed in lieu of batteries and that the showing of batteries in the system is provided merely for illustrative purposes only.

While I have described my invention in certain preferred embodiments, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In a high frequency amplifier system, an electron tube including a grid circuit and a plate circuit, biasing means disposed in said grid circuit, a high resistance element connected in series in said grid circuit, a measuring instrument, a fusible member, and a series connected path including said measuring instrument and said fusible member in series, said path being connected in shunt with said high resistance element.

2. In a high frequency amplifier system, an electron tube including a grid circuit and a plate circuit, sources of potential for energizing said circuits, a high resistance element disposed in series with said grid circuit, and a fusible member connected in shunt with said resistance element.

3. In a high frequency amplifier system, an electron tube including a control grid in an input circuit and other electrodes in an output circuit, sources of potential for energizing each of said circuits, and means for modifying the bias potential applied to said control grid comprising a resistance and a shunt-connected fusible member disposed in series in said input circuit whereby all the circuits of said amplifier system are protected against the flow of destructive currents.

4. In a high frequency amplifier system, an electron tube including an input circuit and an output circuit, sources of potential for energizing each of said circuits, a resistance element connected in series with said input circuit, a meter for measuring the current in said input circuit, and means for protecting said circuits and said meter comprising a fusible member, said fusible member being disposed in series with said meter and forming a path through said meter connected in shunt across said resistance element.

5. In a high frequency amplifier system, an electron tube having input and output circuits, means for energizing each of said circuits, an impedance element disposed in said input circuit, a meter for measuring the current in said input circuit, a fusible member, a series path including said meter and said fusible member, said series path being disposed in shunt with said impedance element.

6. In a high frequency amplifier system, an electron tube having input and output circuits, sources of potential for energizing said circuits, an impedance element in said input circuit, a fusible member connected in shunt with said impedance element, and having such value that said fusible member is ruptured under conditions of excess current in said input circuit.

7. In a high frequency amplifier system, an electron tube having input and output circuits, sources of potential for energizing said circuits, an impedance element in said input circuit, a fusible member connected in shunt with said impedance element, a meter connected in said input circuit and disposed in series with said impedance element, said fusible member having such value that said element is ruptured under conditions of excess current in said input circuit for increasing the resistance in the path through said meter.

8. In a high frequency amplifier system, an electron tube having input and output circuits, sources of potential in each of said circuits, a resonant circuit connected with said output cir-

cuit, an impedance path in said input circuit and a thermally responsive device connected in shunt with the impedance path in said input circuit for automatically changing the effective impedance in said input circuit under conditions of excessive current in said circuits.

9. In a high frequency amplifier system, an electron tube having input and output circuits, a resonant circuit connected with said output circuit, a high impedance path connected with said input circuit and means including a circuit-breaker electrically connected in shunt with said high impedance path for changing the effective value of said high impedance path under condition of excessive current in said circuits.

10. In a high frequency amplifier system, an electron tube having grid, cathode and plate electrodes, input and output circuits interconnecting said electrodes, a source of potential in said output circuit, a source of biasing potential in said input circuit, a resistance in said input circuit in series with said source of biasing potential for applying a predetermined normal bias on the grid electrode, and means including a circuit-breaker connected in shunt with said resistance element for changing the potential drop thereacross and modifying the potential applied to said grid under conditions of excessive current in said circuits.

11. In a high frequency amplifier system, an electron tube having grid, cathode and plate electrodes, input and output circuits interconnecting said electrodes, a source of potential in said output circuit, a source of biasing potential in said input circuit, a resistance in said input circuit in series with said source of biasing potential for applying a predetermined normal bias on the grid electrode, and a thermally responsive element connected in shunt with said resistance element and subject to rupture under conditions of excessive current in said circuits for modifying the potential applied to said grid.

12. In a high frequency amplifier system, an

electron tube having grid, cathode and plate electrodes, input and output circuits interconnecting said electrodes, a source of potential in said output circuit, a source of biasing potential in said input circuit, a resistance in said input circuit in series with said source of biasing potential for applying a predetermined normal bias on the grid electrode, and a fusible member connected in shunt with said resistance element and subject to rupture under conditions of excessive current in said circuits for increasing the biasing potential upon said grid.

13. In a high frequency amplifier system, an electron tube having grid, cathode and plate electrodes, input and output circuits interconnecting said electrodes, a source of potential in said output circuit, a source of biasing potential in said input circuit, a resistance in said input circuit in series with said source of biasing potential for applying a predetermined normal bias on the grid electrode, a fusible member connected in circuit with said resistance element and subject to rupture under conditions of excessive current in said circuits for effecting a change in biasing potential applied to said grid from one negative value to a greater negative value.

14. In a high frequency amplifier system, an electron tube having a grid, filament and plate electrodes, input and output circuits interconnecting said electrodes, a source of potential in each of said circuits, a resistance element disposed in said input circuit in series with the source of potential therein, a fusible member electrically connected with said resistance element, said fusible member having such value as compared to said resistance element that under conditions of excessive current in said circuits said fusible member is ruptured for changing the effective resistance of said resistance element and modifying the potential applied to said grid.

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