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D. F. WHITING

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CURRENT SUPPLY CIRCUITS

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Fig. 1

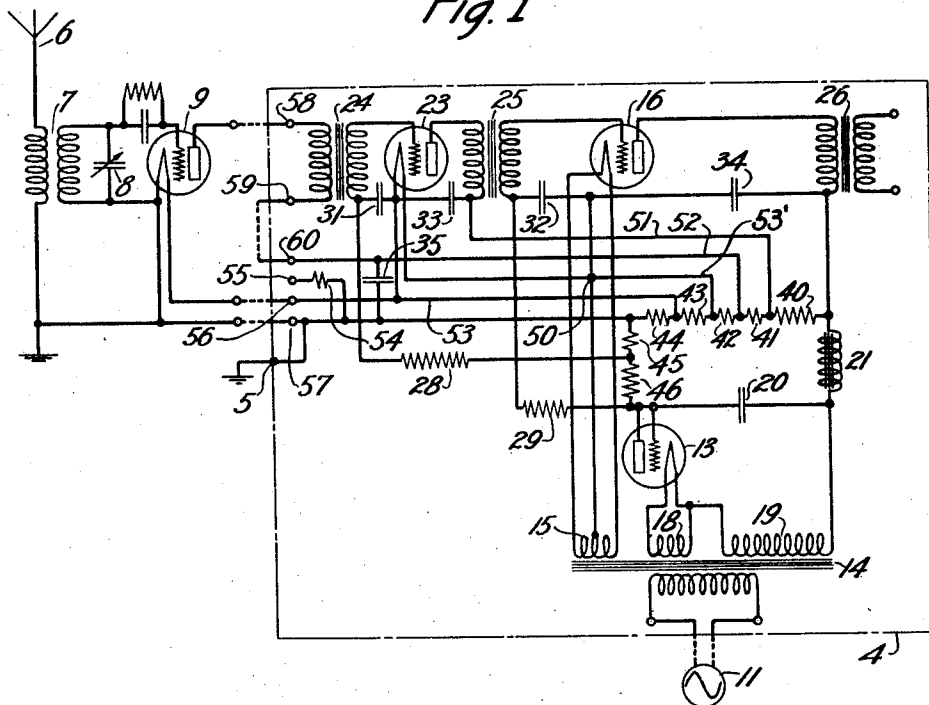
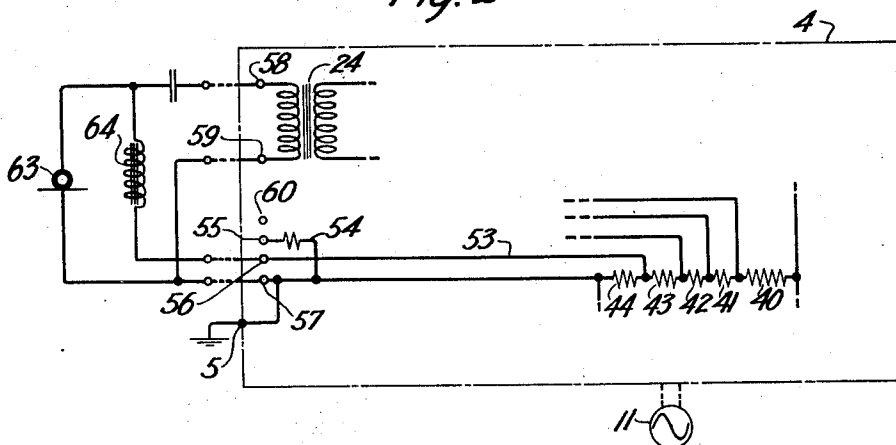


Fig. 2



Inventor:
Donald F. Whiting
by J. E. Roberts Att'y.

UNITED STATES PATENT OFFICE

DONALD F. WHITING, OF PORT WASHINGTON, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

CURRENT SUPPLY CIRCUITS

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This invention relates to current supply systems and particularly to those employing rectified alternating currents.

An object of the invention is to supply relatively high and low uni-directional potentials from the same rectifying system. The rectifying system may employ any suitable type of rectifier, such as a vacuum tube, chemical or mechanical rectifier.

A further object of the invention is to insure that the low potential rectified current supply, which may be utilized for any desired purpose provides a voltage always less than a prescribed maximum above ground under the various contingencies of operation of the system.

In energy supply sets, such as those furnishing operating current to vacuum tube amplifiers and the like, voltages amounting to several hundred volts are often encountered. Frequently, the system in which the high voltage apparatus is used, requires also relatively low voltages and it is economical and convenient to obtain all such potentials from the same supply set. In order to guard against dangers from the high operating voltages, it is customary to include in one casing all of the apparatus utilizing the high voltages. However, if a low potential supply is to be derived from the supply set, it is often desirable to bring out leads, and it then becomes important to insure that the voltages of these exposed leads can never rise above the predetermined maximum in order that the safety of the operator and apparatus may not be endangered.

The invention provides low voltage connections to a high voltage supply, which insures that the potential on the supply leads will not rise higher than the predetermined maximum above ground.

In one embodiment of the invention a resistance element is placed in the path of the rectified current supplied by the rectifier. The low voltage supply leads are bridged across this resistance element, one terminal of which is grounded or is maintained at a low potential with respect to ground, furnishing a direct current supply, the voltage of which is determined by the values of the recti-

fied currents flowing through the resistance element and the resistance of the external circuit bridged across it. A definite maximum voltage between the external wires can be easily predetermined from the value of the current which flows when the external circuit is opened, and the value of the internal resistance element. If one terminal of this resistance element is grounded, the potential between the external lead connected to the opposite terminal and ground is never higher than the drop of potential across this resistance. If one terminal of the resistance is maintained at a low potential with respect to ground, the highest potential above ground which the other wire can assume is the algebraic sum of the potential of the first wire and the difference of potential between the wires.

One of the systems which has been chosen to illustrate the operation of the invention is a radio receiving set comprising a rectifier-amplifier unit and a separate detector unit, the detector unit being supplied with low voltage from the rectifier for the plate and filament of the detector tube. The other system is a speech amplifier system, such as a public address set comprising the same rectifier-amplifier unit as in the radio receiving set with the addition of a microphone which is supplied with operating current from the rectifier system in accordance with this invention.

Referring to the drawings, Fig. 1 is a schematic drawing of the radio receiving system referred to above as an illustrative example, and

Fig. 2 is a partial schematic drawing showing the speech amplifier set referred to.

In Fig. 1 the rectifier-amplifier unit is shown inclosed in any suitable container such as a metal casing 4 with input and output terminals. The system is shown connected to the metal case and grounded at point 5. To this unit is connected (shown by the dotted lines) any well known type of radio intercepting and detecting system, the one shown comprising an aerial 6, a coupling coil 7, a variable tuning condenser 8 and a vacuum tube 9.

The rectifier-amplifier unit inclosed in the

metal case 4 comprises a transformer 14 equipped with terminals on its primary winding to which an external source of alternating current 11 may be connected. The transformer 14 has a secondary winding 15 supplying filament heating current to an amplifier tube 16, a secondary winding 18 supplying filament current to the rectifier tube 13, and a secondary winding 19 supplying the high operating voltages for the system. A filter arrangement for the purpose of smoothing out the ripples in the rectified current may be composed of a condenser 20 and a retardation coil 21 or it may consist of several such condensers and retardation coils, only those mentioned being shown in the sketch for the purpose of simplification.

Signals to be amplified are impressed on a tube 23 comprising the first stage of audio frequency amplification through an input transformer 24 and on a second stage of audio frequency amplification including tube 16 through a transformer 25. The output energy of this unit is available and is supplied through an output transformer 26 to a receiver or other load device. Resistances 28 and 29 of approximately 100,000 and 50,000 ohms respectively, acting in conjunction with condensers 31 and 32 respectively, aid in providing the necessary grid bias for the tubes 23 and 16, without disturbance caused by their connection to the rectified circuit or to the plate supply system. Condensers 33 and 34 serve to reduce the disturbing effects in the plate circuits of tubes 23 and 16, respectively, caused by their connection to the rectified circuit, while also serving as by-pass condensers for the higher frequency waves which pass through the amplifying tubes. A condenser 35 likewise provides an additional filter element to the circuit furnishing the plate voltage to the detector tube and acts as a return circuit for the alternating current flowing in the detector plate circuit.

The resistance composed of elements numbered 40 to 46 inclusive, with the various connections forms a distribution network for supplying various voltages to the elements of the system. The rectifier circuit beginning at the cathode of the rectifier tube 13 is through secondary 19, retard coil 21, to the terminal of resistance element 40 where it branches, one circuit tracing through the primary winding of transformer 26 to the anode of tube 16, to the filament of tube 16, to the mid-point of secondary winding 15 and thence to the point 50; the other circuit tracing through resistance elements 40, 41 and 42 to the point 50. From point 50 the circuit passes through the filament of amplifier tube 23, to a terminal 56, through the filament of detector tube 9 to a terminal 57, through resistance units 45 and 46 to the anode of rectifier tube 13. Connected in shunt to the filaments of tubes 23 and 9 are resistance ele-

ments 43 and 44, respectively. In addition to the circuits just traced portions of the rectified current flow from the junctions of resistance units 40—41 and 40—42 through conductors 51 and 52 and the primary windings of transformers 25 and 24 to the plates of tubes 23 and 9, respectively.

In the circuits just traced in the foregoing paragraph it is seen that the resistance units 40, 41 and 42 form a shunt across the space of the amplifier tube 16, protecting condensers 20 and 34 from abnormal increases in voltage if the tube 16 should become inoperative due to its filament burning out or if it is removed from its socket. Similarly across the space path of the tube 23 are shunted resistance units 41 and 42 by leads 51 and 53' providing protection to condenser 33 if the tube 23 becomes inoperative due to its filament burning out or removal of the tube. The proper amount of plate voltage is determined by the value of the resistance units just mentioned and the respective currents through them. The resistance units 42, 43 and 44 serve the same function with respect to condenser 35 in the operation of detector tube 9. The plate circuit for this tube is from the junction point between resistance units 41 and 42 through conductor 52, terminals 60 and 59, primary winding of transformer 24, terminal 58 and thence to the plate.

The maximum open line potential between either of terminals 58, 59 or 60 and the terminal 57 may be determined by the various currents flowing through the elements 42, 43 and 44 when the circuit to the plate of tube 9 is opened. The voltage between the terminals 56 and 57 on open circuit is determined by the current through resistance unit 44 under this condition. The open circuit voltages may be thus predetermined and kept below a prescribed maximum, in accordance with the invention. The approximate values of the resistances above mentioned are as follows: unit 40, 4000 ohms; unit 41, 700 ohms; unit 42, 700 ohms; unit 43, 1500 ohms; and unit 44, 1500 ohms.

Since the filaments of tubes 9 and 23 are connected in series and have similar resistance values and since there is shunted across them the resistance units 43 and 44 of equal resistance value, as mentioned above, the four resistances form a bridge and conductor 53 connected between the junction points of the two filaments and the junction point of the two resistances 43 and 44 will normally have no current flowing in it. This conductor is of advantage, however, in limiting the voltage between terminals 56 and 57 when the radio detector or other apparatus used, which will be described hereinafter, is disconnected from the amplifier. A resistance 54, having a value equal to the filament resistance of tube 9, is connected at one end to terminal 57 and is provided at the other end

with a terminal 55 which may be strapped to terminal 56 to simulate the original filament series circuit in case of the removal of the tube 9. This connection may provide approximately the same internal operating conditions as prevailed before the detector tube was disconnected from the unit. Terminal 57 is the ground terminal and is connected to the metal case at the point 5. The terminals 58 and 59 are the terminals of the input coil 24 and terminal 60 is the voltage terminal operating at a higher potential than the terminal 56 and, in this particular circuit, it is used to supply the plate potential to detector tube 9. These terminals are the only supply connections leading from the rectifier-amplifier unit, and in this manner, several sources of relatively low voltages may be provided which may be handled without endangering life or apparatus.

The resistance elements 45 and 46 of the potentiometer-like arrangement are for the purpose of supplying proper values of negative biasing potentials for the grids of amplifier tubes 23 and 16 and may have ohmic resistances of approximately 50 and 300 ohms, respectively.

Fig. 2 is drawn to show a similar rectifier-amplifier set enclosed in the metal case 4 as shown in Fig. 1 with a microphone unit associated therewith both units comprising a speech amplifier system. A microphone 63 is supplied with operating current through a retardation coil 64 and the lead 53, the lead being bridged across the single resistance unit 44, using terminals 56 and 57 corresponding to the same numbered terminals in Fig. 1. Assuming that the microphone 63 operates on a lower value of current than the filament of tube 9 in Fig. 1, lead 53 is utilized to return a current which is the difference between the current previously taken by the filament of tube 9 and the current now taken by the microphone 63. The alternating current output of the microphone is impressed upon the input transformer at terminals 58 and 59 similar to the arrangement described in connection with Fig. 1. The terminal 57 is grounded and connected to the metal casing 4 at the point 5 so that the voltage across the terminals 56 and 57 or ground will never be greater than the product of the current in the resistance element 44 when the microphone is disconnected from the rectifier-amplifier set and the value of the resistance element itself. For the purpose of the present disclosure and in accordance with experience a potential of 200 volts is taken as a maximum voltage on external leads from the standpoint of personal safety and fire hazards. In the circuits operated by applicant the maximum voltage of the external leads never reached 100 volts.

This invention has been described in connection with a particular single tube circuit

but is not limited to this type of rectifier or these circuits but only by the scope of the attached claims.

What is claimed is:

1. In a current supply system, a high voltage portion comprising a rectifier and apparatus utilizing rectified high voltage, a protecting casing enclosing said high voltage portion, means maintaining said casing at substantially ground potential, a resistance included in the path of the rectified current, one terminal of said resistance being connected to ground, and a lead connected to a point on said resistance, the amount of resistance included between the ground and said point of connection being of such a value that the drop of potential across it is many times smaller than the maximum operating voltage of said system, said lead extending outside of said casing for supplying direct current of less than a predetermined maximum potential.

2. In a current supply system, a source of alternating current potential, a rectifier, a main load circuit receiving current from said rectifier at a high potential, a resistance element in the path of the rectified current, a protecting casing enclosing all of said elements, connections from said resistance external to said casing for supplying direct current voltage to an auxiliary load circuit available to an operator, one terminal of said resistance being grounded, the amount of resistance included between said connections and ground being such that the voltage between either of said connections and ground is less than a prescribed maximum potential.

3. In a current supply system, a source of alternating current potential, a rectifier, a main load circuit receiving current therefrom at a potential of a higher order of magnitude than 200 volts, a resistance element in the path of the rectified current, one terminal of which is grounded, a protecting casing enclosing all of said elements, said casing being grounded, connections for shunting an auxiliary load circuit external to said supply set across said resistance element, whereby the said auxiliary work circuit receives a portion of the rectified current, the amount of resistance included between said connections being such that the potential between either of said connections and ground is always as low as 200 volts.

4. In a high voltage energy supply system, a cabinet, a rectifier, a high voltage load circuit utilizing a voltage in excess of 200 volts, a resistance in the path of the rectified current, one terminal of which is substantially at ground potential, said rectifier, load circuit and resistance being enclosed within said cabinet, said resistance having leads therefrom external to said cabinet for the purpose of supplying a low uni-directional potential many times smaller than that furnished said

load circuit internal to said cabinet, the point of connection of said ground to the circuit and the magnitude of said resistance being such that said potential will always be less than a value of approximately 200 volts.

5 5. In combination, a microphonic transmitter, an audio-frequency amplifier connected therewith, and an energizing circuit for the microphone in series with the plate circuit of the amplifier.

10 6. In combination, a microphonic transmitter, an audio-frequency amplifier connected therewith, and an energizing circuit for the microphone in series with the plate circuit of the amplifier and a substantial series resistance.

15 7. In combination, a microphonic transmitter, an audio-frequency amplifier connected therewith, and an energizing circuit for the microphone in series with the plate circuit of the amplifier and a resistance of the order of 1000 ohms.

20 8. In combination, a microphonic transmitter, an audio-frequency amplifier connected therewith, an energizing circuit for the microphone in series with the plate circuit of the amplifier and a substantial series resistance, and a resistance bridged across the terminals of the energizing circuit from the amplifier.

25 9. In combination, a microphonic transmitter, an audio-frequency amplifier connected therewith, an energizing circuit for the microphone in series with the plate circuit of the amplifier and a substantial series resistance, and a by-passing condenser for the said resistance.

30 In witness whereof, I hereunto subscribe my name this 5th day of April, A. D. 1926.
DONALD F. WHITING.

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