April 16, 1935. I. J. KAAR 1,998,321

POWER SUPPLY SYSTEM

Original Filed June 18, 1932

Fig. 1.

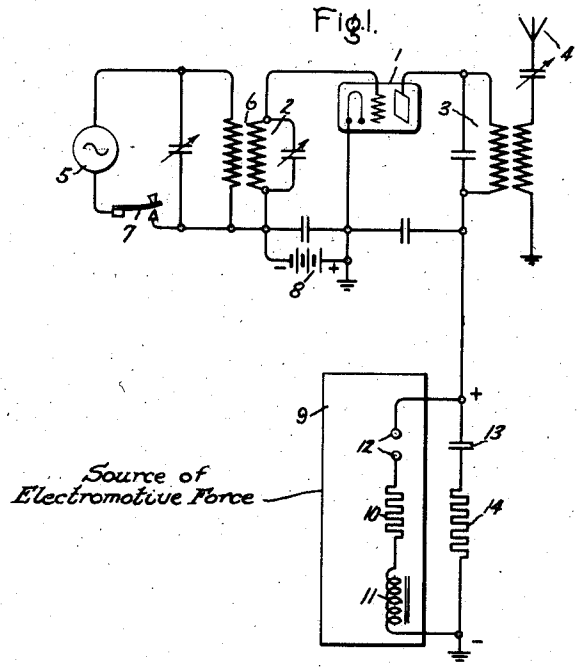


Fig. 2.

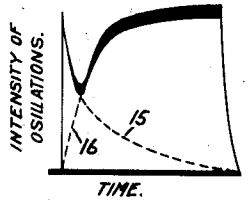
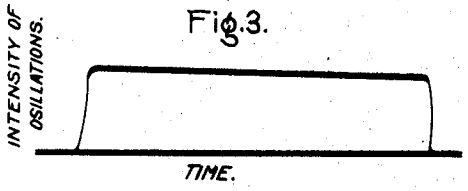


Fig. 3.



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1,998,321

POWER SUPPLY SYSTEM

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7 Claims. (Cl. 250—17)

My invention relates to power supply systems and particularly to such supply systems for use in connection with electron discharge devices.

In radio telegraphy, for example, where the supply of high frequency oscillations to the grid of one or more electron discharge devices is controlled in accordance with desired signals, the anode impedance of the discharge device is varied over a wide range with the telegraphic interruption in the transmitted signals, that is, when oscillations are present upon the grid the anode impedance of the device is relatively low whereas when the oscillations are interrupted the anode impedance is high. The anode voltage for these discharge devices is commonly supplied from a dynamo-electric machine, or other type of power source having a certain amount of resistance and inductance. Also commonly a condenser is connected across the terminals of the power source for current smoothing purposes, as to smooth out commutator ripple, etc.

It has been found that with this type of power source the character of the transmitted impulses is affected by transient conditions in the power supply. It is accordingly one of the objects of my invention to provide a power source which is free from these transient effects.

A further object of my invention is to provide a power source which, while it has a certain amount of inherent inductance, or capacity, operates with respect to the load circuit as though its internal impedance were pure resistance and in the nature of a dry cell, or storage battery.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 represents an embodiment of my invention; and Figs. 2 and 3 indicate certain characteristics with reference to its operation.

In Fig. 1 of the drawing, I have shown therein for purposes of illustration, a radio telegraph transmitter of a conventional type, this transmitter comprising an electron discharge amplifier 1, having a tuned grid circuit 2 and a tuned anode circuit 3, the latter of which is coupled to a suitable radiating system 4. A source of high frequency oscillations 5 is coupled by means of transformer 6 to the input circuit of the amplifier 1. The supply of oscillations from this source is arranged to be interrupted in accordance with telegraphic signals by means of key 7, or its equivalent.

The amplifier 1 is provided with a source of grid biasing potential indicated at 8 and with a source of anode supply potential indicated by the rectangle at 9. This source of anode supply potential may, for example, comprise the armature of a dynamo-electric machine. The armature possesses a certain amount of internal resistance which is indicated in the drawing at 10, and internal inductance which is indicated at 11. The electromotive force generated in the armature may be considered as being induced between the terminals 12 connected in series with the resistance 10 and inductance 11. Frequently a condenser indicated at 13 is connection in shunt with the armature of the dynamo-electric machine for current smoothing and other purposes. I have shown a resistance 14 connected in series with the condenser 13 the purpose of which will be explained hereinafter.

Considering the type of system hereinbefore described but in which the resistance 14 is omitted, the operation may be indicated by the characteristic shown in Fig. 2. This characteristic indicates the variation in intensity of oscillations supplied to the antenna with respect to time during the interval of a telegraphic dot or dash. Thus in this figure the intensity of the high frequency oscillations is plotted as ordinates and time as abscissas. Thus, for example, if I assume that the key 7 is closed at a time corresponding to the extreme left hand portion of the curve represented in this figure, it will be seen that in this portion of the curve the intensity of the high frequency oscillations supplied to the antenna is large and is comparable with that which is supplied late in the telegraphic interval, but that the intensity first rapidly diminishes and then increases to a fairly steady value later in the telegraphic interval. This form of the curve is due to the fact that at the time the key 7 is first closed the condenser 13 is fully charged and potential is supplied to the anode of the discharge device equal to the normal no-load voltage of the source 9. However, after the key 7 is closed, the impedance of the discharge device 1 is immediately reduced with the result that the condenser 3 discharges through the low impedance of the discharge device for an interval at the left hand portion of the curve of Fig. 2 while current is building up through the inductance of the source 9. Thus, for example, if it were assumed that the source 9 was disconnected from the condenser 13 simultaneously with the closing of the switch 7, the condenser 13 would continue to discharge along the logarithmic curve indicated by the dotted line 15 in Fig. 2. However, as the current

builds up in the source 9 the condenser again becomes charged to a voltage corresponding to the full load voltage of the source 9 and in a time depending upon the rate of current increment through the inductance 11. The rate of increment is shown by line 16. The voltage on the discharge device 1 is then increased in accordance with the heavy line curve of the figure.

To avoid this undesirable character of the transmitted impulse, in accordance with my invention the aforementioned resistance 14 is connected in circuit with the condenser 13, this resistance having a value equal to the internal resistance 10 of the source 9 and equal to the square root of the ratio of the inductance 11 of the source 9 to the capacitance of the condenser 13. With these constants so adjusted it has been found that the impulses supplied to the antenna 4 are then of the character shown in Fig. 3, the transient condition which appears at the left hand portion of Fig. 2 being entirely eliminated.

It is well known in the theory of parallel resonance that when the resistance of the inductive branch of a parallel circuit is equal to the resistance of the capacitive branch of this parallel circuit, and each of these resistances is equal to the square root of the ratio of the inductance of the inductive branch to the capacitance of the capacitive branch, then the circuit becomes aperiodic, the reactance of the circuit is zero for all frequencies, and the resistance is constant for all frequencies. This phenomenon is explained in the "Principles of Radio Communication" by J. H. Morecroft, second edition, page 93.

Thus the effect of resistance 14 adjusted to the value above specified is to render the network 10, 11, 13, 14 of zero effective reactance at all frequencies. Accordingly an electromotive force may be induced in this circuit at any point and varied as desired without setting up transient effects due to reactance, either capacitive or inductive. Further, any variation of current through the system, or due to variation in load, for example, is not accompanied by transient effects due to reactance in the system. Since the system is one which presents pure resistance to the anode circuit of the discharge device it acts in the same way as a dry cell or storage battery.

It will be apparent that my invention is not limited to use in connection with dynamo electric machine or to systems in which the electromotive force is induced in the inductive branch of the system but that it is applicable independently of the point in the system at which the electromotive force is produced.

While I have shown but a single application of my invention, it will be understood that I do not wish to be limited thereto since its utility may extend to any system in which it is desired that variations in load or in the applied electromotive force, may take place without transients being produced due to the inherent reactance of the system. I therefore contemplate by the appended claims to cover any modifications of the system which fall within the true spirit and scope of my invention.

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

1. In combination, a source of electromotive force having internal resistance and reactance, and a shunt to said source having resistance substantially equal to said first resistance and reactance of opposite sign to that of said first reactance, the square root of the ratio between said reactances being substantially equal to either of said equal resistances.

2. In combination, a network including a source of electromotive force having internal resistance and reactance, a variable load connected across said source, said network further including a shunt across said source having resistance and reactance, said last resistance and reactance having such values with respect to said first resistance and reactance that said network comprising said source and said shunt is aperiodic.

3. In combination, a source of voltage having internal resistance and reactance, and a shunt to said source having reactance of opposite sign to that of the reactance of said source and resistance substantially equal to the resistance of said source and to the square root of the ratio of said reactances.

4. In combination, a network including a source of electromotive force having internal reactance and resistance, said network further including a shunt to said source having resistance and having reactance of opposite sign to said first-named reactance and resistance, said last-named reactance and resistance having such values relative to the values of said first-named reactance and resistance that the reactance of said network is substantially zero for all frequencies.

5. In combination, a network including a dynamo-electric machine and a condenser connected in shunt to said machine and a resistance in series with said condenser, said resistance having such value that said network comprising said dynamo-electric machine and said condenser and resistance is aperiodic.

6. The combination, in a high frequency transmitter, of an electron discharge device having an anode, a cathode and a grid, an output circuit connected to said anode, means to supply high frequency impulses to said grid in accordance with desired signals whereby said signals are repeated to said load circuit, a source of anode voltage having reactance and resistance, said reactance being sufficient to retard substantially the rise to normal value of each of said impulses as repeated to said load circuit, and means to eliminate the effect of said reactance upon said impulses whereby said impulses are faithfully repeated to said load circuit, said means comprising a capacitance and resistance in shunt to said source.

7. The combination, in a high frequency transmitter, of an electron discharge device having an anode, a cathode and a grid, an output circuit connected to said anode, means to supply high frequency impulses to said grid in accordance with desired signals whereby said signals are repeated to said load circuit, a source of anode voltage comprising a dynamo-electric machine connected between said anode and cathode and a condenser connected in shunt to said dynamo-electric machine, the reactances of said machine and of said condenser being sufficient to cause the value of each of said impulses first to be relatively large, then to diminish rapidly to a value substantially less than normal and finally to increase gradually to normal, and means to eliminate the effect of said reactances upon said impulses whereby said impulses are faithfully repeated to said load circuit, said means comprising a resistance in series with said condenser.

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