

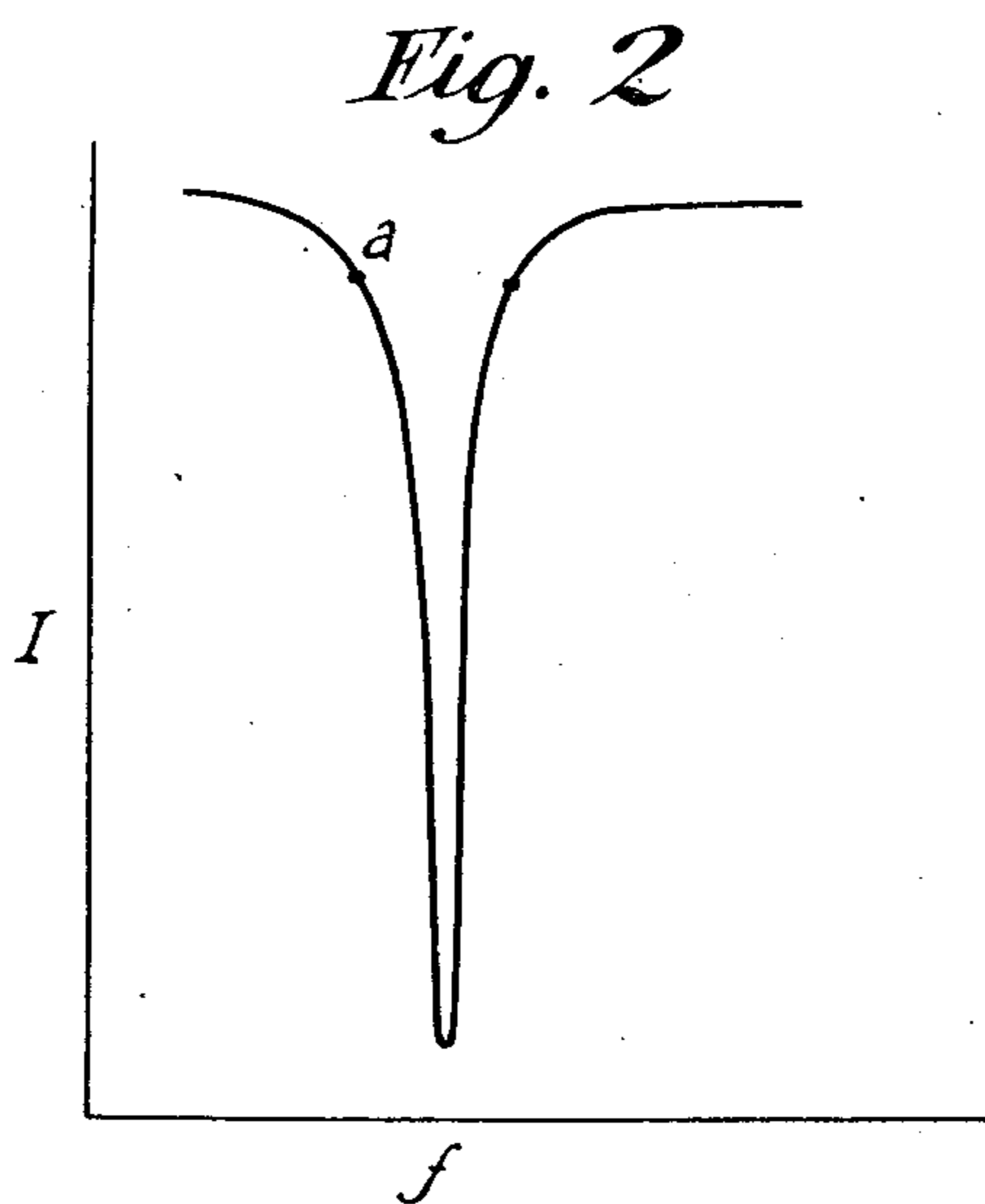
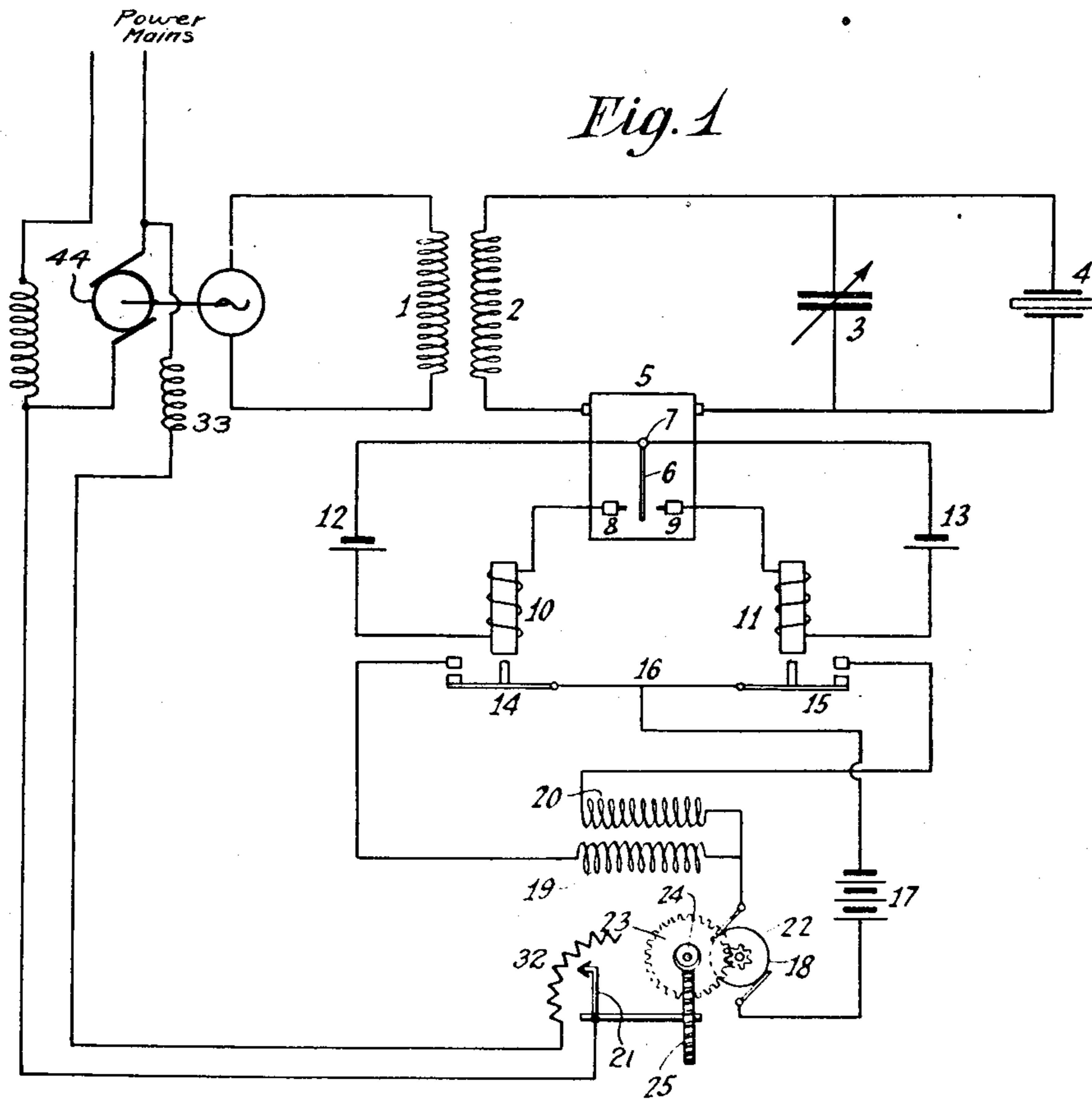
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MEANS FOR REGULATING THE FREQUENCY OF ALTERNATING CURRENT GENERATORS

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MEANS FOR REGULATING THE FREQUENCY OF ALTERNATING-CURRENT GENERATORS

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This invention relates to the control of the frequency of high powered alternating current generators of high frequency. In my prior Patent Serial No. 1,472,583, filed October 30, 1923 I have shown and described a system for maintaining the frequency constant in a comparatively low powered vacuum tube system.

It is an object of this invention to provide for the maintenance of a high powered alternating current generator such as the Alexanderson alternator, for example, at substantially constant frequency.

In my paper in the Proceedings of Radio Engineers for April 1922, page 101 I have shown in Fig. 6, the relation between the current and frequency in a piezo-electric resonator circuit. It will be observed that the current curve falls practically to zero at resonance, and this large change in current occurs with a comparatively small change in frequency. I make use of this principle in carrying out my invention. I couple a resonator circuit to the generator circuit and provide certain apparatus which is set to be responsive to the large change in current corresponding to a small change in frequency in the neighborhood of resonance. By means of suitable indicating means and relays I automatically operate suitable frequency correcting apparatus which is operated by the change in frequency in the generating circuit to bring the same back to its normal value, in the event that it should vary from its value indicated by the point "a" on the curve shown in Fig. 2. Obviously, some operating point other than "a" may be chosen without departing from the spirit of this invention.

The manner in which I carry out this invention will be better understood from the following description taken in connection with the following drawing in which:

Fig. 1 is a diagrammatic showing of the frequency controlling circuit, certain parts being omitted.

Fig. 2 shows the relation of the current and frequency in the resonator circuit.

Referring to the drawing, 1 indicates the high frequency generating circuit which may consist of an Alexanderson alternator or a high powered electron tube generator to which is coupled at 2 the tuned circuit containing the variable condenser 3 and the piezo-electric resonator 4 of the type disclosed in my prior Patent 1,450,246 of April 3, 1923. In order to indicate the change in current in the circuit 2—3, I provide some such instrument as a hot-wire ammeter or a thermogalvanometer 5 having the needle 6 pivoted at 7. As long as the current in 5 is at the operating point "a", Fig. 2, for example, the needle 6 lies midway between the two stops 8 and 9. If the current increases slightly, owing to a minute decrease in the frequency of the generator, then the needle 6 will come into contact with one of the stops 8, for example; and if it decreases by a like amount, it will make contact with the other stop 9. The needle 6 is electrically connected to stops 8 and 9 respectively through the relay coils 10 and 11 and the batteries 12 and 13. Hence, contact of the needle with either of the stops 8 or 9 will energize coils 10 or 11 and cause the corresponding armatures 4 or 15 to close, as the case may be. These armatures are electrically connected by conductor 16, which in turn is connected through the battery or generator 17 to a series motor 18 provided with two independent field windings 19 and 20. Relay arms 14 and 15 are connected to field windings 19 and 20 respectively. The field windings are so arranged that a current through relay 14 and coil 19 causes the motor to rotate in one direction, while a current through relay 15 and coil 20 causes it to rotate in the opposite direction. The motor is used to impart a slow movement to the rotating arm 21. This may be accomplished, for example by providing the motor shaft with a pinion gear 22. The gear 23 meshes with

gear 22 and the worm gear 24 is mounted on the shaft of 23. The gear 25 which carries the movable arm 21 mounted upon its shaft is driven by the worm 24. Thus, the arm 21 will rotate in one direction or the other, according to whether relay 14 or 15 is closed. As explained above, the direction of rotation of the arm 21 depends on whether the alternating current in the device 5 is above or below the value corresponding to this point "a" on the curve of Fig. 2.

Now, if the alternating current whose frequency it is desired to stabilize is derived from an alternator, the arm 21 may be used to vary the resistance 32 in series with the shunt field 33 of the motor 44 that drives such alternator. Or if an electron tube generator is employed as the source of alternating current, the arm 21 may by its rotation cause the capacity of a tuning condenser to be varied, and thus bring the frequency back to its normal value.

It is to be understood that the above described embodiment of the invention is merely used by way of illustration and that certain changes and modifications may readily be made by those skilled in the art without departing from the spirit of this invention. For example, in carrying out this invention it is not essential that a direct current motor be used to operate the frequency correcting means; but any other equivalent means well known in the art may be substituted. Thus, a Tirrill regulator or similar device having an intermittent contact may be employed in place of the motor. Also light sensitive relays of the well known type may be substituted for those described above. In the appended claims it is intended to cover all the novelty that the invention may possess.

Having thus described my invention, I claim:

1. The combination of an alternator and means to maintain the frequency of said alternator substantially constant, said means comprising a tuned circuit including a piezo electric resonator coupled to said alternator circuit, two separate relays connected to said tuned circuit, means in said tuned circuit responsive to a variation in current to operate said separate relays, a direct current motor having separate field windings associated with said relays, whereby said motor may be operated reversibly, a frequency correcting device, and means associated with said motor to operate said frequency correcting device.

2. The combination of an alternator and means to maintain the frequency of said alternator substantially constant, said means comprising a tuned circuit, means in said tuned circuit adapted to produce a large variation in the current flowing therein upon a small variation of the generator frequency, relays connected to said tuned circuit, means to actuate selectively said relays in accord-

ance with said variation in current, a direct current motor having separate field windings associated with said relays, whereby said motor may be operated reversibly, a frequency correcting device, and means associated with said motor to operate said frequency correcting device.

3. In combination an alternator, a tuned circuit coupled to said alternator and adapted to be traversed by a portion of the output of said alternator, a piezo electric device connected with said tuned circuit, said device being adapted to vibrate in resonance with the current flowing in said tuned circuit, said device being also adapted to produce a comparatively large change in current corresponding to a comparatively small change in frequency flowing in said tuned circuit, and two separate means selectively operated by said changes in current in the tuned circuit to compensate for said changes in frequency.

4. In combination an alternator, a tuned circuit coupled to said alternator and adapted to be traversed by a portion of the output of said alternator, a piezo electric device associated with said tuned circuit, said device being adapted to vibrate in resonance with the current flowing in said tuned circuit, said device being also adapted to produce a comparatively large change in current corresponding to a comparatively small change in frequency flowing in said tuned circuit, means operable by said change in current to increase the speed of the alternator when said current changes in one direction and means operable by said change in current to decrease the speed of the alternator when the change in current is in another direction.

5. In combination, an alternating current generator, and means to maintain the frequency of said generator substantially constant, said means comprising, a tuned circuit coupled to said generator and adapted to be traversed by an alternating current resulting from the coupling between said circuit and said generator, a piezo electric crystal having a predetermined frequency of vibration associated with said circuit, said crystal being adapted to vibrate to produce a relatively large variation in current flowing in said circuit corresponding to a relatively small variation in the frequency of said generator, a frequency correcting device, and means responsive to said variations in current constructed and arranged to actuate said frequency correcting device.

6. In a system including a generator for producing alternating current, means to maintain said alternating current at a substantially constant frequency, said means comprising, a circuit coupled to said generator and adapted to be traversed by an alternating current resulting from said coupling of the generator to the circuit, a piezo

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electric device connected with said circuit and adapted to vibrate mechanically and to react electrically to produce a relatively large variation in the current flowing in said circuit corresponding to a relatively small variation in frequency of the current produced by said generator, a frequency correcting device, and means responsive to said current variations constructed and arranged to actuate said frequency correcting device.

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