No. 706,609. Patented Aug. 12, 1902.

C. P. STEINMETZ.

SYSTEM OF ELECTRICAL DISTRIBUTION.

(Application filed Jan. 2, 1901.)

(No Model.)

Fig. 1.

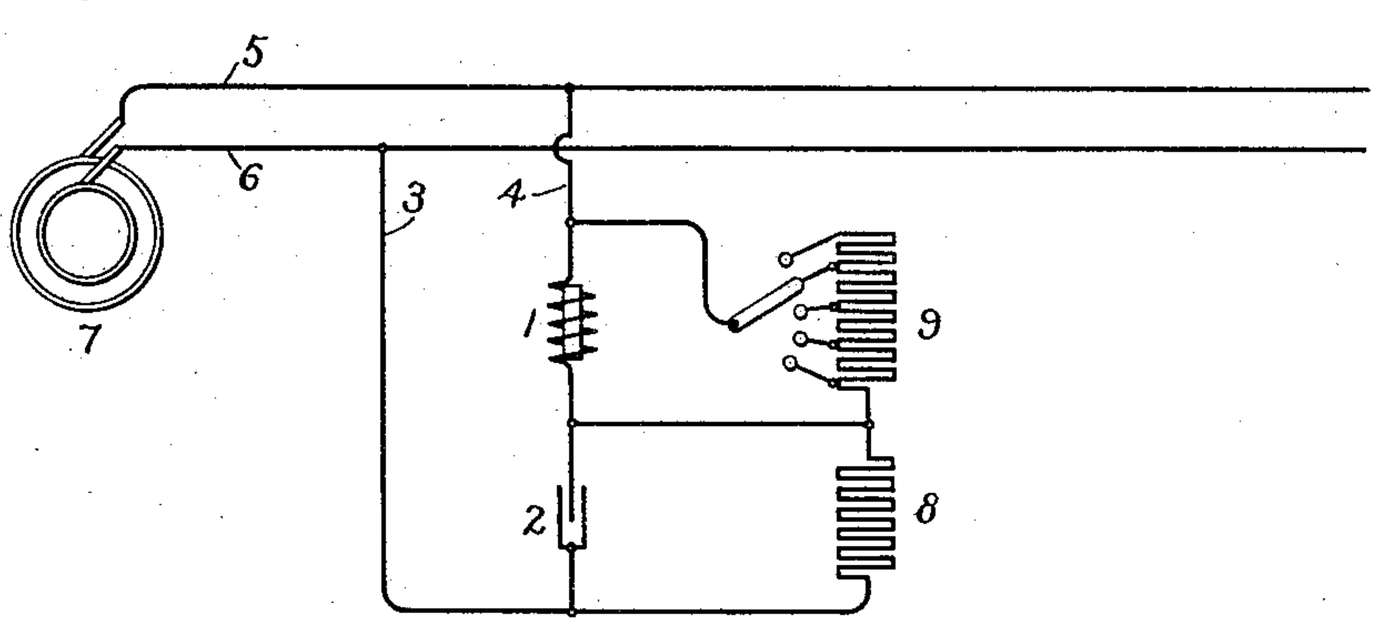
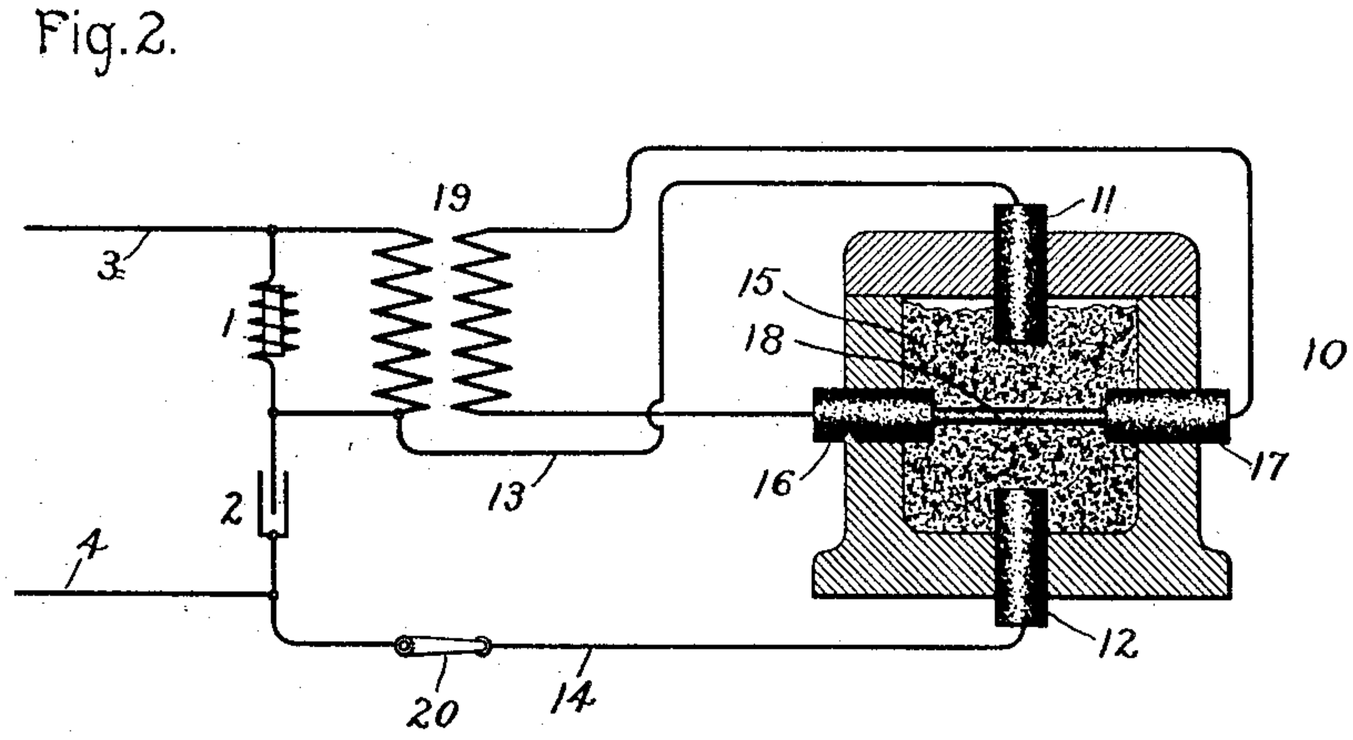


Fig. 2.



Witnesses.
John Ellis Glenn
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UNITED STATES PATENT OFFICE.

CHARLES P. STEINMETZ, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 706,609, dated August 12, 1902.

Application filed January 2, 1901. Serial No. 41,807. (No model.)

To all whom it may concern:

Be it known that I, CHARLES P. STEINMETZ, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Systems of Electrical Distribution, (Case No. 1,670,) of which the following is a specification.

The invention hereinafter described and claimed provides an automatic means for maintaining a constant or practically constant consumption of power in consumption-circuits, the aggregate resistance of which is variable.

Various applications of the invention may be made in practice—as, for example, in connection with electric furnaces, in which it is desirable that the energy consumed should be uniform throughout normal operation. Since the resistance of the electric furnace varies with the temperature, it has heretofore been found necessary to vary the voltage impressed upon the furnace by some system of hand regulation. My present invention enables this result to be accomplished automatically.

In the drawings, Figure 1 is a diagram explanatory in a general way of the nature of the invention, and Fig. 2 is a diagram representing the invention as applied to an electric furnace.

In carrying out the invention I make use of reactances of opposite sign—as, for example, an inductance-coil and a condenser—connected in series across supply-mains which receive power from some suitable source. In Fig. 1 the inductance-coil and the condenser are indicated, respectively, at 1 and 2, power being supplied to the terminals through mains 3 and 4, connected through suitable distributing-conductors 5 and 6 with a source of alternating current, (indicated conventionally at 7.) The inductance-coil and the condenser are so proportioned that their respective reactances at normal frequency of the generating source 7 are equal and opposite, this proportioning of parts corresponding to resonance relation, as will readily be understood by those skilled in the art. Across one of these reactance devices—as, for example, the condenser 2—I shunt a constant resistance 8, having a value in ohms equal to the reactance of the condenser expressed in ohms. Across the remaining reactance—to wit, the inductance-coil 1—I shunt another resistance 9, which may vary between any desired limits. With the construction thus described the power expended in the constant resistance 8 added to the power expended in the variable resistance 9 is a constant quantity. When the power consumed in one of the circuits or resistances decreases, that in the other increases, the sum of the powers expended in both circuits or resistances, however, remaining constant.

Fig. 2 shows the invention as applied to an electric furnace, the supply-mains 3 4 and the reactances 1 and 2 corresponding to the same parts, as indicated in Fig. 1. The electric furnace is indicated conventionally at 10 and may be of any desired construction. It is, however, here shown as provided with two separate consumption-circuits. One of the circuits, which corresponds to the terminals 11 12, receives current through conductors 13 14, connected across the condenser 2, and conveys this current through the substance 15 to be heated, in which substance the ends of the terminals are inserted to suitable depth. The other set of terminals 16 and 17 are joined by a rod of conducting material 18, preferably of carbon, this rod being buried in the mass of the material 15 to be acted upon by the furnace. This latter set of terminals receives current through operative connections across the inductance-coil 1, the connections in this instance being effected by means of a transformer 19, the purpose of which is to transmit current to the terminals 16 and 17 and at the same time maintain the circuit of these terminals electrically distinct from the circuit of the terminals 11 and 12. The currents of these respective sets of terminals therefore do not interfere in their passage through the material 15, upon which the currents act. When the furnace is cold, the resistance of the material to be heated is comparatively high, and it is for this reason that I provide the carbon rod 18, which I use for the purpose of initially heating the material 15. When this operation is to be performed, the switch 20 is left open, the entire power being concentrated in the rod 18, which thereupon heats the surrounding material. As the tem-

perature of the latter rises its conductivity increases. After the initial heating has proceeded a sufficient length of time, thereby causing the conductivity of the material 15 to increase, the switch 20 may then be closed and current then is supplied jointly to the two sets of terminals 11 12 and 16 17. It should be observed that the resistance of the circuit between the terminals 16 and 17 is sufficiently near constancy as to satisfy the condition of constant resistance, the relations of which with respect to the reactance about which it is shunted were sufficiently set forth in connection with the description of Fig. 1.

It is to be observed that in Fig. 1 the constant resistance is shown as shunted about the condenser and the variable resistance about the inductance. These connections may, however, be reversed without affecting the operation of the invention and are so illustrated in Fig. 2, in which the variable resistance represented by the circuit between the terminals 11 and 12 is shunted about the condenser and the constant resistance between the terminals 16 and 17 is operatively connected in shunt to the inductance-coil 1.

Wherever herein I speak of "reactances of opposite sign," I mean to include devices which possess capacity and inductance, respectively. For the purpose of illustration I have shown a condenser as typifying a device possessing capacity and an inductance-coil as typifying a device possessing inductance; but it will be evident to those skilled in the art that other devices possessing these same qualities may be employed—such, for example, as polarization-cells, transformers with open magnetic circuits, tranformers with condensers in their secondaries, &c.

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

1. The combination of constant-potential supply-mains, energy-consuming means supplied therefrom, and means for causing the consumption of power in said energy-consuming means to remain constant regardless of variation of the aggregate resistance of said energy-consuming means.

2. The combination of supply-mains, consumption-circuits fed therefrom, and means for automatically maintaining a constant consumption of power in said circuits regardless of variation of the aggregate resistance of said circuits.

3. The combination of constant-potential mains, reactances of opposite sign in series across said mains, a non-inductive energy-consuming device operatively connected across one of said reactances, and another energy-consuming device operatively connected across another of said reactances.

4. The combination of constant-potential mains, reactances of opposite sign in series across said mains, and non-inductive resistances in shunt respectively across said reactances.

5. The combination of constant-potential mains, reactances of opposite sign in series across said mains, a circuit in shunt to one of said reactances and containing an approximately constant resistance, and a circuit in shunt to another of said reactances and containing a variable resistance.

6. The combination of constant-potential mains, reactances of opposite sign in series across said mains, a resistance arranged to receive current transmitted through a circuit in shunt to one of said reactances of the same value in ohms as the resistance, and another resistance receiving energy from a circuit in shunt to another of said reactances.

7. The combination of constant-potential mains, reactances of opposite sign in series across said mains, a resistance arranged to receive current transmitted through a circuit in shunt to one of said reactances of the same value in ohms as the resistance, and a variable resistance receiving energy from a circuit in shunt to another of said reactances.

In witness whereof I have hereunto set my hand this 29th day of December, 1900.

CHARLES P. STEINMETZ.

Witnesses:
BENJAMIN B. HULL,
MARGARET E. WOOLLEY.