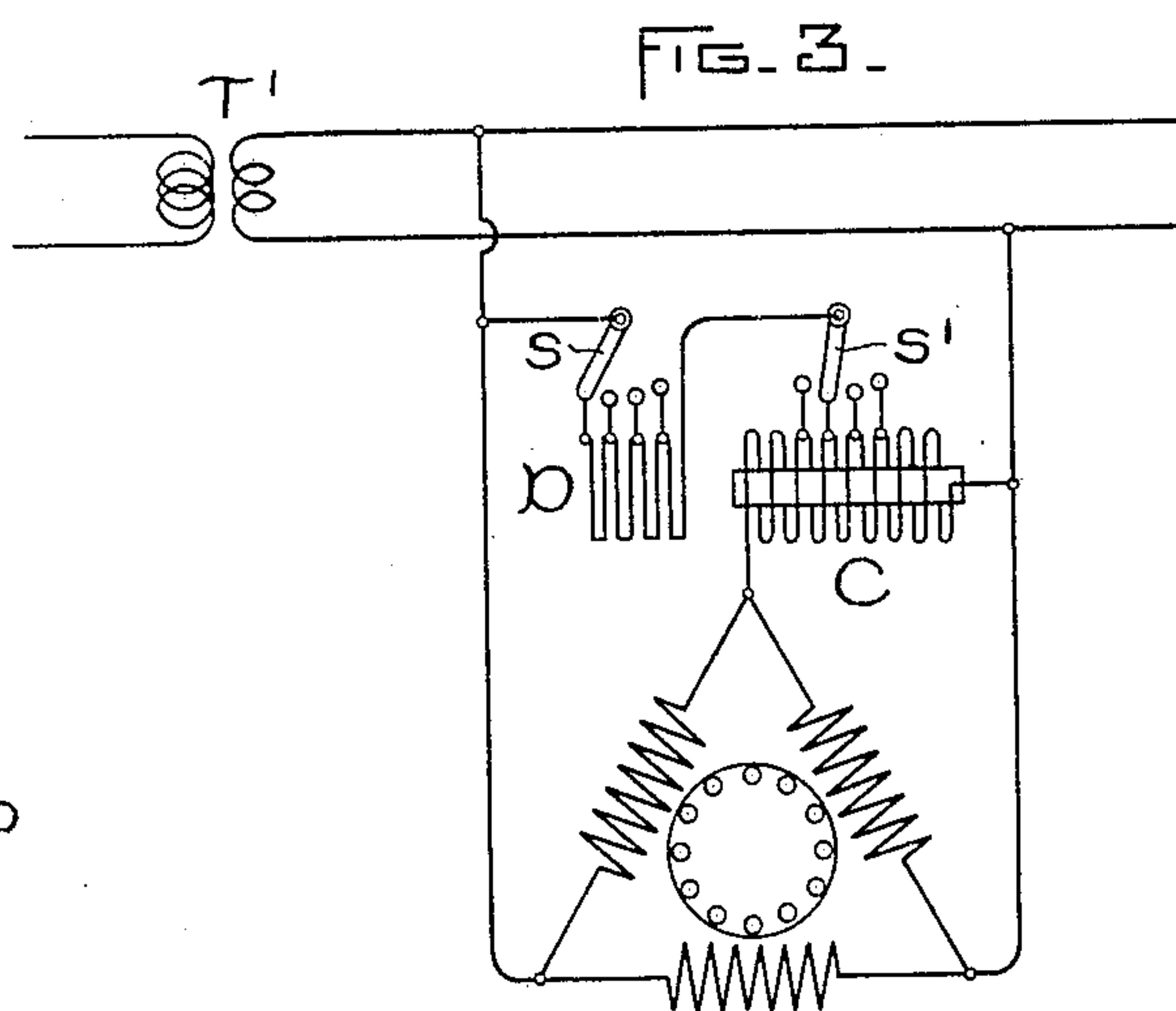
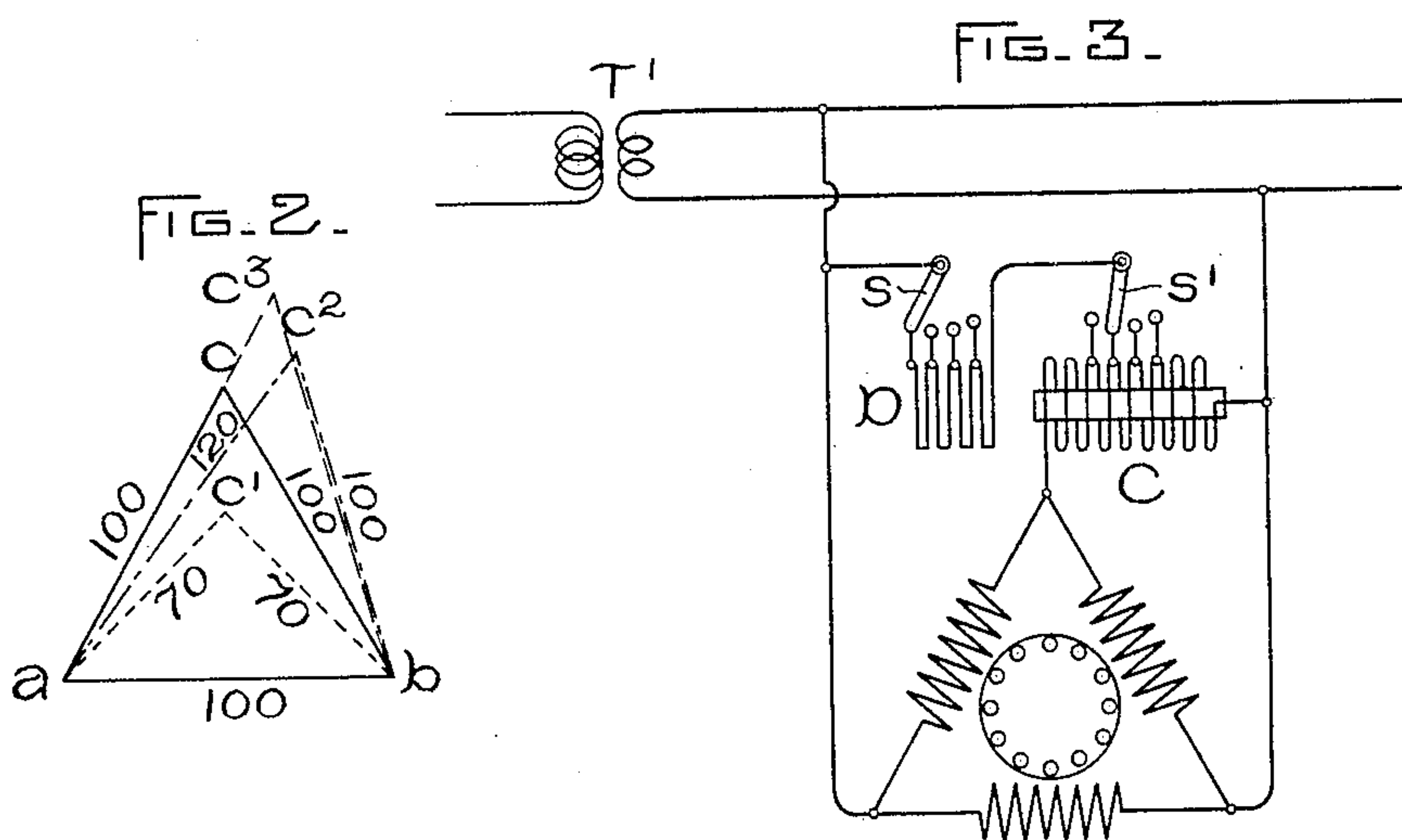
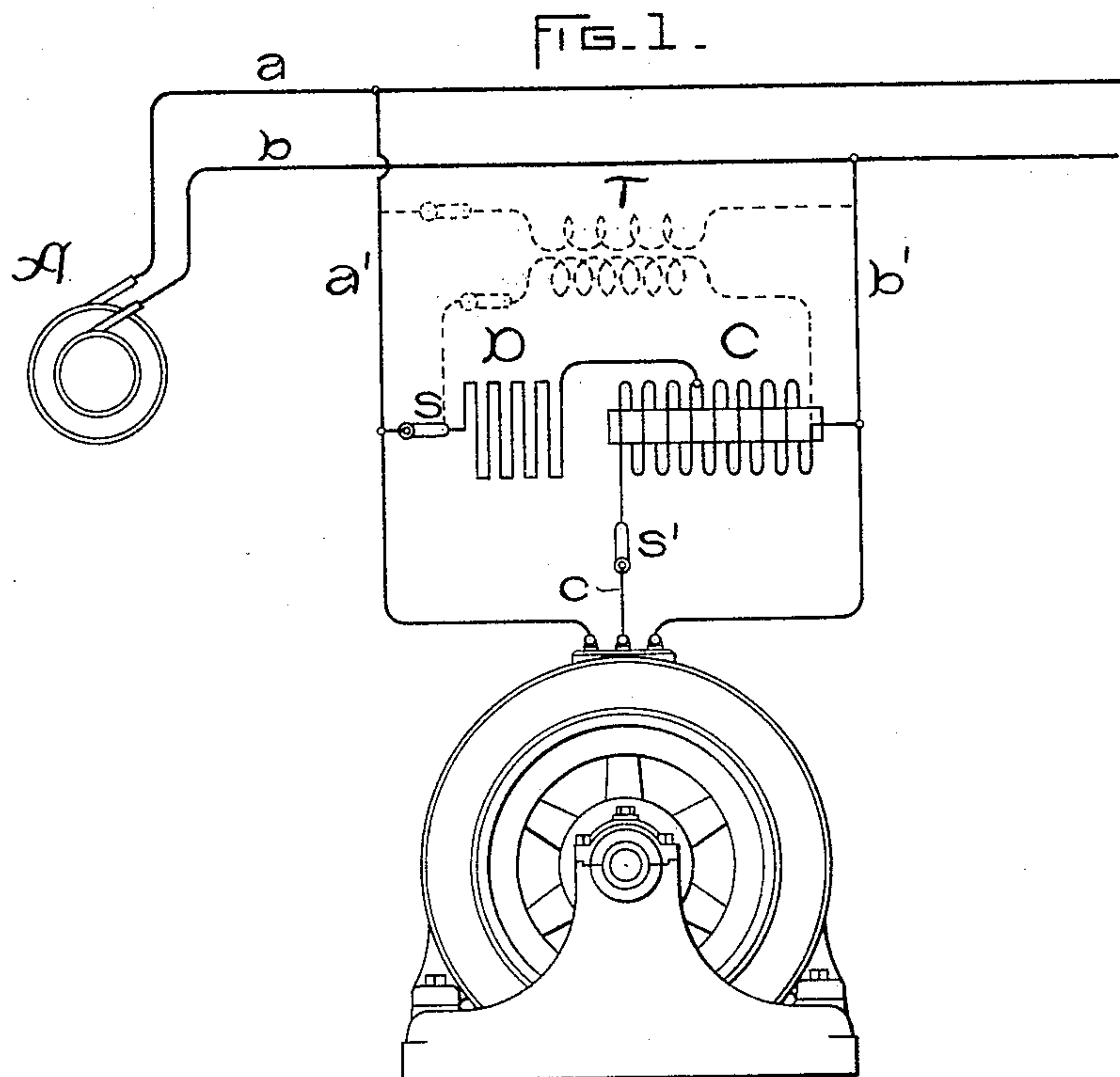


(No Model.)

J. P. STONE & S. E. DOANE.
STARTING DEVICE.

No. 603,778.

Patented May 10, 1898.



WITNESSES.

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UNITED STATES PATENT OFFICE.

JOSEPH P. STONE, OF SCHENECTADY, NEW YORK, AND SAMUEL EVERETT DOANE, OF MARLBOROUGH, MASSACHUSETTS, ASSIGNORS TO THE GENERAL ELECTRIC COMPANY, OF NEW YORK.

STARTING DEVICE.

SPECIFICATION forming part of Letters Patent No. 603,778, dated May 10, 1898.

Application filed October 22, 1897. Serial No. 656,080. (No model.)

To all whom it may concern:

Be it known that we, JOSEPH P. STONE, residing at Schenectady, in the county of Schenectady, State of New York, and SAMUEL EVERETT DOANE, residing at Marlborough, in the county of Middlesex, State of Massachusetts, citizens of the United States, have invented certain new and useful Improvements in Starting Devices, (Case No. 582,) of which the following is a specification.

Our invention relates to apparatus for starting single-phase alternating-current motors, and has for its object to provide a device which shall be more efficient than those in common use.

Various forms of starters have been devised which depend upon supplying the motor with electromotive force of phase displaced from that across the main lines, these devices being used to bring the motor up to speed and being in general cut out when their object has been attained. One of the forms of this apparatus with which we are familiar consists of a resistance and an inductance in series across the lines of the main circuit, connection being taken from a point between the resistance and inductance to a third terminal of the motor. This device gives an unsymmetrical three-phase relation. With it the switch leading to the starting device should be opened before the motor has acquired full speed to avoid the possibility of voltage induced in the motor rising above that supplied to it by the phase-displacing devices, and thus tending to feed current back into them. Our invention obviates the necessity for thus opening the switch. By it we provide a voltage at the third terminal of the motor, which may be anything desired, either a symmetrical three-phase relation or one which shall between the third terminal and either main rise above the voltage across the lines. The effect of coupling in the motor is to bring down the voltage at the third terminal. By our device we may so proportion the voltage supplied to the motor that when it is connected and starts up the displaced electromotive force will be reduced, so that a symmetrical three-phase relation is established.

To carry out the purposes of this invention, we employ a resistance, as in the device already mentioned; but instead of an ordinary inductance we employ a transformer or compensator or auto-transformer, and we so proportion the windings and the connections of the motor that the voltages may be in any proportion desired.

Our invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram of the connections; Fig. 2, a diagram of the electromotive forces, and Fig. 3 a modified form showing that the devices may be made adjustable.

In Fig. 1, A is the alternator supplying the single-phase mains $a b$, from which leads $a' b'$ go directly to the motor-terminals. Between these two leads the resistance D and the inductance, in the form of a compensator C, are connected in series, suitable switches $s s'$ being provided to disconnect the starting devices from the circuit. A lead c passes from the third terminal of the motor to one end of the compensator, the other end of which is connected to the lead b' , while the connection from the resistance D is to an intermediate point of the compensator-coil. In Fig. 3 the same arrangement of devices is shown, except that in this instance the resistance D is made adjustable, the switch s being provided with a number of contacts leading to different points in the resistance, and a similar adjusting-switch s' is adjusted to different points in the compensator-coil. By changing the proportions of the resistance and inductance the exact displacement of phase may be effected to suit the required conditions.

In Fig. 2 we show a diagram illustrative of our present understanding of the electromotive forces in our invention. In the triangle $a b c$, $a b$ represents the electromotive force across the mains, which for the purpose of illustration may be taken as a hundred volts. With the former devices which we have named in our statement of invention the potential at c' , as shown by the dotted lines, only differs from that of each main by about seventy volts. By our invention, however, the potential being stepped up by the compensator or transformer C, this displaced voltage is

raised to a degree illustrated by the point c , being the usual equilateral arrangement illustrating three-phase electromotive forces. This is, however, the condition which is preferred after the motor has started. To obtain it, the compensator is so wound as to raise the voltage a little more than would normally be desired, or to the point c^2 , which gives an unsymmetrical three-phase relation where the split-phase electromotive force is higher upon one side of the circuit than the other, so that the difference between it and the outside mains would be, for example, one hundred and twenty volts on one side and approximately one hundred volts on the other. When the added inductance of the motor is brought into circuit, the relation of phase is as shown in the black-line triangle abc . The compensator is for several reasons the preferred form of the device, but an ordinary transformer might be used without departing from our invention, and such a variation or other ordinary engineering variations we aim to include in our claims. The inductive connection to the mains is also within our invention. A diagrammatic indication of such a connection is shown in Fig. 3, the transformer T' having its primary in the generator-circuit, and the motor being connected to the secondary.

In Fig. 1 we show in dotted lines that the phase-displacing devices may be themselves included in the circuit of a step-up transformer T , the effect of which would be to raise the potential difference between the middle terminal of the motor and the mains, so that the point c of the triangle in Fig. 2, representing the split-phase electromotive force,

would be, for instance, at c^3 , thus giving a greater starting torque.

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

1. A starting device for a single-phase alternating-current motor, comprising two phase-displacing devices in series across the mains, and in shunt to the motor, one of the phase-displacing devices consisting of a step-up transforming device designed to deliver from a point between the phase-displacing devices to a third terminal of the motor a higher than normal voltage.

2. In combination, a motor having three terminals, two of which are connected to a source of single-phase current directly or inductively, and the third terminal of which is connected to the mains through phase-displacing devices consisting of a resistance and step-up transformer in series across the mains, the third terminal of the motor being connected between the phase-displacing devices.

3. As a means of starting a single-phase alternating-current motor, a resistance and a compensator in series across the main circuit, the resistance being connected at one end to one side of the main circuit and at the other end to an intermediate point of the compensator, the latter being connected at one end to the other side of the circuit and at the other end to the third terminal of the motor.

In witness whereof we have hereunto set our hands this 19th day of October, 1897.

JOSEPH P. STONE.

SAMUEL EVERETT DOANE.

Witnesses:

B. B. HULL,

HARRY BOTTOMLEY.