March 10, 1931. A. NYMAN 1,796,254

ELECTRICAL TRANSFORMER

Filed June 1, 1925 2 Sheets-Sheet 1

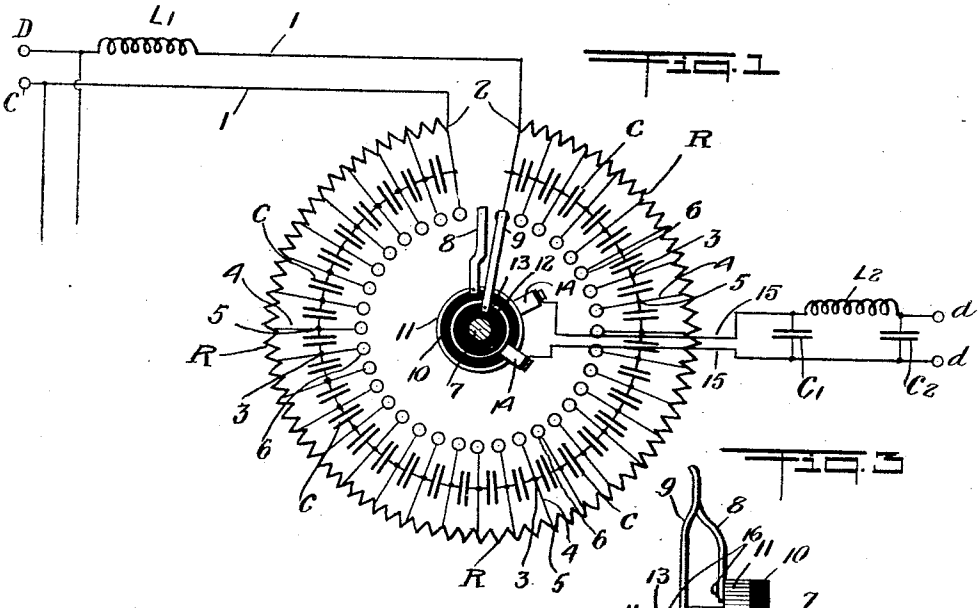



Fig. 1

Fig. 3

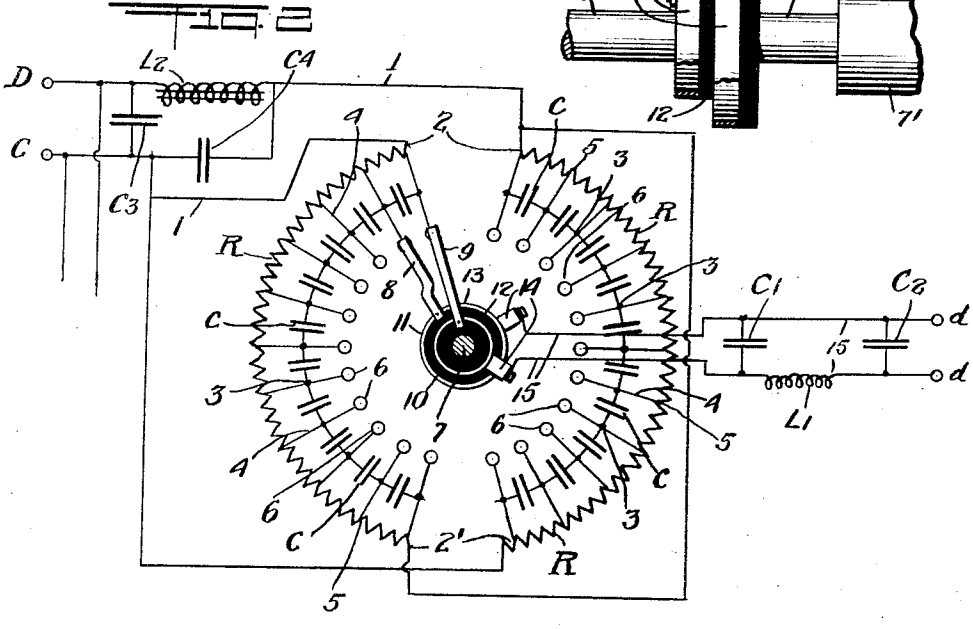



Fig. 2

INVENTOR
ALEXANDER NYMAN
BY
Van Deventer & Nickel
ATTORNEYS

March 10, 1931. A. NYMAN 1,796,254

ELECTRICAL TRANSFORMER

Filed June 1, 1925 2 Sheets-Sheet 2

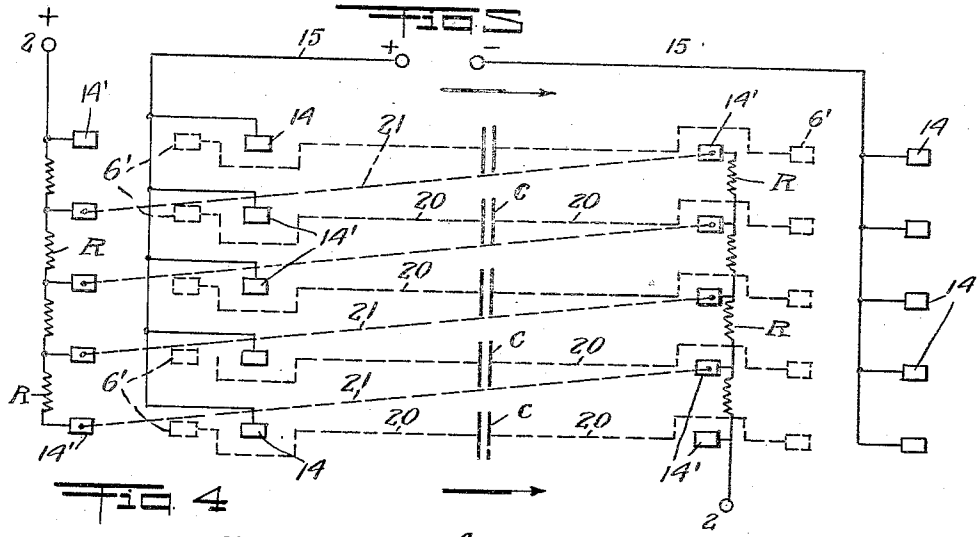


Fig. 4

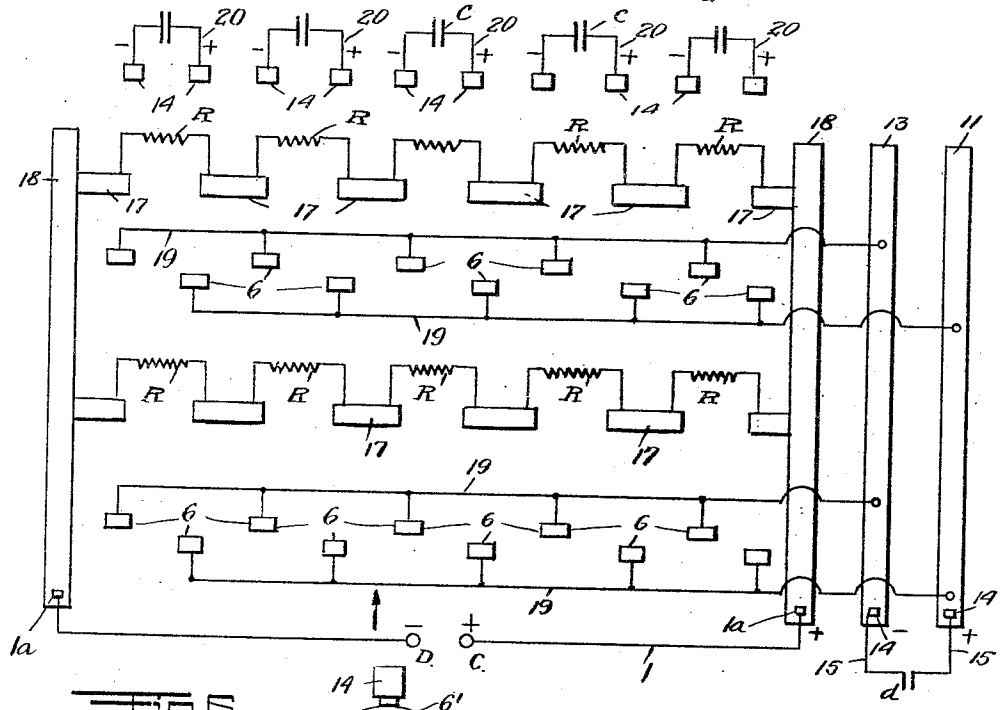
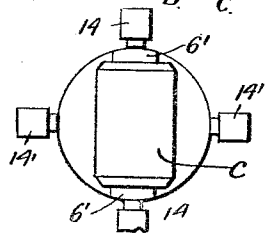


Fig. 5



INVENTOR
ALEXANDER NYMAN
BY
Van Deventer & Nickel
ATTORNEYS

Patented Mar. 10, 1931

1,796,254

# UNITED STATES PATENT OFFICE

ALEXANDER NYMAN, OF NEW YORK, N. Y., ASSIGNOR TO DUBILIER CONDENSER CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

## ELECTRICAL TRANSFORMER

Application filed June 1, 1925. Serial No. 34,014.

My invention relates to electrical transformers, and more particularly to a transformer of direct current into a current of altered voltage.

An object of my invention is to provide a transformer of direct current, comprising electrical condensers for lowering the voltage of the supply current to the extent required.

Another object of my invention is to provide such a transformer having means to discharge successively the electrical condensers after they have been charged.

Yet another object of my invention is to provide devices whereby the condensers are charged in series and discharged singly and in succession, or together in multiple to a suitable work circuit.

A further object of my invention is to provide a mechanical direct current transformer which is easily constructed and consists of but few parts which are not liable to get out of order even after long and continued use.

With these and other objects in view, which may be incident to my improvements, the invention consists in the parts and combinations to be hereinafter set forth with the understanding that the several necessary elements comprised in my invention, may be varied in construction, proportions and arrangement, without departing from the spirit and scope of the appended claims.

In order to make my invention more clearly understood, I have shown in the accompanying drawings means for carrying the same into effect, without limiting the improvements in practice to the particular constructions, which for the purpose of explanation, have been made the subject of illustration.

In the drawings:

Figure 1 is a diagrammatic view of a transformer with circuit, according to my invention;

Fig. 2 is a diagrammatic view showing a modification of such a transformer;

Fig. 3 is a side elevation of rotating contact members embraced in my invention;

Fig. 4 is a diagrammatic or developed view showing another form of my invention;

Fig. 5 is a diagrammatic or developed view showing a further modification of the transformer of Fig. 4; and

Fig. 6 is a front elevation of the transformer device using the circuit shown in Fig. 5.

Referring to the drawings, and more particularly to Fig. 1, I have shown my transformer as comprising a plurality of storage condensers $c$ having equalizing resistances R connected between the condensers. The resistances are connected to a direct current supply source D C through a self-induction coil $L^1$ and the leads 1 which are connected to the resistances and condensers $c$ at the points 2.

Suitable transverse connectors 4 are provided to connect the terminals of the condensers and the equalizing resistances at the points 3 and 5, respectively. The connectors 4 terminate in the contacts or terminals 6. Mounted upon a shaft 7 are two contact means or arms 8 and 9. The arm 8 is mounted upon the shaft by means of an insulating disk 10, to which is attached a slip ring 11. The arm 9 is also mounted upon an insulating ring or disk 12, which is concentric with the disk 10 and also has a slip ring 13 mounted on its periphery.

As shown in Fig. 1, the condensers $c$ and resistances R are arranged in a circle, all the condensers being in series and all the resistances in series, but each condenser and each resistance are joined in parallel by the adjacent conductors 3 and 5. The contacts 6 are also arranged in a circle inside the condensers and resistances.

Contact with each of the slip rings 11 and 13 is made by means of the brushes 14 which are connected through the leads 15 to a suitable filtering circuit having condensers $C^1$, $C^2$, and induction coils $L^2$ which lead to terminals $d$ connected with a work circuit. When a direct current is applied to the terminals D and C, the condensers $c$ are charged, the contact members 8 and 9 are rotated on the shaft 7, which is connected to a suitable motor, and the members 8 and 9 make con-

tact with each pair of terminals or contacts 6 at the extremities of each condenser *c* in turn, thereby discharging the condensers successively. The charge from each condenser is then carried through the leads 15 to the filters and thence to the terminals *d* to which is attached a work circuit. To avoid short-circuiting the leads 1 to the leads 15, the contacts 6 connected to the points 2 are placed relatively far apart.

By this device, the voltage of the supply is decreased and a continuous relatively large current is delivered to the work circuit at the terminal *d*.

Referring to Fig. 3, I have shown a method of mounting the contact members 8 and 9. The insulated disk 10 is provided with a slip ring 11 on its periphery. The contact arm 8 is attached to the disk in contact with the ring 11 by suitable fastening means 16. The disk 12, which is concentric with the larger disk 20, has a slip ring 13 mounted on its periphery, and the contact member 9 is attached to the disk in contact with the ring 13 by suitable fastening means 16.

Referring to Fig. 2, I have shown my transformer having connections which permit a longer time to charge the condensers than the circuit shown in Fig. 1. The supply source is connected through a suitable filtering circuit comprising condensers $C^3$, $C^4$ and a self-induction coil $L^2$. The leads 1 connect the filtering circuit to the equalizing resistances R at the points 2 and 2′. In this arrangement, as the arms revolve with the shaft 7, they make contact with the connectors 6 and cause each condenser to discharge to the work circuit attached to the terminals *d*.

In Fig. 2, the condensers with their parallel resistances are arranged in two opposing semi-circular rows, with their ends too far apart for the source to be connected directly to the conductors 15, and the contacts 6 as before on the inside. Each semi-circular row is connected at its ends across the two conductors 1, and thus the two rows are in parallel with each other.

Referring to Fig. 4, I have shown my transformer comprising separate fixed or stationary condensers *c* connected with fixed brushes 14 through the leads 20. Suitably mounted upon a rotary commutator or controller means and adapted to rotate therewith, are commutator contacts 17 connected in series with the resistance R to the slip rings 18. Interposed between the two rows of commutator contacts are placed two rows of contacts 6, the corresponding alternate contacts of each row being connected through the leads 19 to the slip ring 11 and the remaining ones of the two rows by similar leads 19 to the ring 13.

When the controller is rotated, the condensers *c* are charged in series from the source by means of the commutator segments 17 which are across the two slip rings 18. After the condensers have been charged, they are then discharged in multiple through the contacts 6 and the leads 19 to the slip rings 11 and 13, which are connected to a suitable work circuit at the terminals *d*. The supply current arrives at the rings 18 by means of conductors 1 and brushes 1*a* engaging the slip rings, and brushes 14 connect the wires 15 to the rings 11 and 13. Of course it is understood that Fig. 4 is a developed or plane view of the commutator or controller, which in practice will be a cylindrical body rotating on its axis with the parts 17 and 19 imbedded in it, but flush with its surface and exposed therethrough, while the resistances R and conductors 19 will be wholly imbedded and preferably not exposed at all.

For example, assume that the commutator is at rest and the condensers *c* have just been discharged, that is, the brushes 14 are bearing on the surface between the segments of the lower row of commutator contacts 17 and an upper row of the contacts 6. If the commutator is rotated, the direction being indicated by the arrow in Fig. 4, the segments 17, which are connected with the slip rings 18, next make contact with the brushes 14 and charge the condensers in series.

When the commutator is further rotated, the lower row of contacts 6 make contact with the brushes 14 and the condensers are discharged in multiple through slip rings 11 and 13 to a suitable work circuit connected to the terminals *d*.

After the condensers have been discharged, the cycle is repeated; the condensers *c* are charged in series all at once and discharged together in parallel all at once. It will be seen that in the present arrangement the condensers are charged and discharged twice per revolution by the commutator. However, the number of charges per revolution may be varied for a particular construction.

Referring to Fig. 5, I have shown my transformer comprising condensers *c*, each connected through a pair of leads 20 to two diametrically opposite moving contacts 6′. The condensers are mounted in the body of the rotating commutator or controller and the contacts 6′ are suitably mounted in spaced relation on the surface of the commutator and adapted to engage fixed brushes 14′, the leads 20 being embedded in the controller.

Figure 5, like Fig. 4, is a so-called developed view, presenting the controller as if its cylindrical surface were cut across in an axial direction and then spread out flat.

Resistances R are connected to the fixed brushes 14′. These brushes 14′ are in two axial rows, the rows being on opposite sides of the commutator and the resistances R lie between the contacts of each row. Diagonal leads 21 connect the first brush of one row, (the upper in Fig. 5) with the second brush of the other row, and so on, except that the last

brush of the first row is joined to a supply terminal 2 and the first brush of the other row to the opposite supply terminal 2. When the commutator carrying the contacts 6′ and the condensers *c* is rotated, the brushes 14′, which are thus connected to the input circuit, engage the contacts 6′ and charge the condensers in series; then the condensers are discharged in parallel by the contacts 6′ leaving the brushes 14′ and connecting with the output circuit by engaging brushes 14 joined to the leads 15 of the work circuit. The brushes 14 are also fixed, and in two axial rows, each a quarter of a revolution from the rows of brushes 14′.

For the sake of clearness, the parts in Fig. 5 which are movable are in broken lines, the stationary parts being in full lines.

The operation of the device is as follows: Assume that the commutator rotates and the condensers and the diametrically opposite contacts 6′ have just been carried out of engagement with the fixed brushes 14′. The condensers are therefore charged. For the condensers to be discharged, as the commutator is rotated, the brushes 14 will next be engaged by contacts 6′, the brushes 14 being located between the brushes 14′. In Fig. 5, the direction of motion is to the right, as the arrow indicates.

Figure 6 shows the commutator or controller carrying the condensers and contacts 6′ in end elevation, with condensers discharging through brushes 14; the charging brushes 14′ lying between the brushes 14. On this view the leads 21 do not appear.

After the condensers have been charged and discharged the cycle is repeated. It will be understood that the number of charging and discharging operations per revolution of the commutator may be increased for a given work circuit.

While I have shown and described the preferred embodiment of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth, by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention, or exceeding the scope of the appended claims.

I claim:

1. A transformer device for direct current, comprising a source of direct current, a plurality of electrical condensers, and a rotating means adapted to charge said condensers in series from the direct current source, additional means to distribute the charging potential in substantially equal steps between said condensers, and said first means also serving to discharge the condensers in multiple to supply a reduced potential uni-directional current to a work circuit.

2. In combination with a source of direct current and a load circuit, of a rotating commutator, a plurality of electrical condensers mounted within the rotating commutator, and means to charge the condensers in series from the supply source and discharge them in multiple to the load circuit.

3. In combination with a source of direct current and a load circuit, of a rotating controller having a series of contacts arranged in spaced relation on its surface, and a plurality of electrical condensers mounted within the controller adapted to be charged in series from the direct current source and discharged in multiple to the load circuit.

4. The method of transforming direct current which consists in charging a plurality of storage condensers in series in such manner as to cause the same relative potential difference to be applied to the terminals of each of said condensers by the charging current regardless of the position of said condensers in the charging circuit, and subsequently discharging each of said condensers into a work circuit.

5. The method of transforming direct current which consists in charging a plurality of similar storage condensers in series in such manner as to cause the same potential difference to be impressed across the terminals of each of said condensers by the charging current regardless of its position in the charging circuit, and subsequently discharging said condensers into a work circuit.

6. A direct current transformer comprising a plurality of storage condensers, means for connecting said condensers in series with a source of charging current, means for causing the same relative potential difference to be applied to the terminals of each of said condensers by the charging current regardless of its position in the charging circuit, and means for discharging said condensers into a work circuit.

7. A direct current transformer comprising a plurality of storage condensers, means for connecting said condensers in series with a source of charging current, potential equalizing means connected to the condensers for causing the same potential to be impressed across the terminals of each of said condensers by the charging current, and means for discharging said condensers into a work circuit.

8. A direct current transformer comprising storage condensers, means for connecting the condensers in series with a source of charging current, a potential equalizing means connected to each of said condensers to cause the same charging potential to be impressed across the terminals of each of the condensers regardless of its position in the charging circuit, and means for intermittently discharging said condensers into a work circuit.

9. A transformer device for direct current comprising a plurality of storage condensers, means for connecting the condensers in series with a source of charging current, an impedance connected in multiple with each of said condensers and in series in the charging circuit, the impedances having values such that the voltage drop across each of them is the same, whereby the same charging potential is applied to each of said condensers, and means for intermittently discharging the condensers in the same direction to a work circuit to supply a lower potential uni-directional current thereto.

10. A direct current transformer comprising a plurality of storage condensers connected in series with a source of charging current, a resistance connected across the charging circuit and having taps connected in shunt with each of said condensers to form a voltage divider whereby the same charging potential is impressed upon each of said condensers, and means for disconnecting the condensers from the charging circuit and discharging the same in multiple to a work circuit.

In testimony whereof I affix my signature.

ALEXANDER NYMAN.