To all whom it may concern:

Be it known that I, Oscar Güttinger, a citizen of the Swiss Republic, residing at No. 4 Rütistrasse, Baden, Switzerland, have invented certain new and useful Improvements in Direct-Current-Voltage Transformers with Series Excitation, of which the following is a specification.

This invention has for its object to provide an improved direct current voltage transformer consisting of a motor and a dynamo, which shall combine maximum simplicity of electrical connections and construction with absolute reliability in working both for normal working and for extraordinary conditions such as starting with a sudden connection to full potential. The improved transformer has also the advantage that the dynamo voltage remains practically unaltered even under large variations of load.

In the drawings:
Figure 1 illustrates the application of the improved transformer to railroad working,

Figure 2 illustrates a modified form of the invention and

Figure 3 illustrates a further modification.

The essential feature of the improved transformer consists in that both the motor and the dynamo are excited mainly by the main current of the motor. The resulting simplicity of the electrical connections will be clearly perceived from Fig. 1 of the accompanying drawings. The scheme of connections shown in this figure illustrates the application of the improved transformer to railroad working.

From the trolley line L the current passes through the trolley into the exciting winding Σm of the motor M, and thence through the motor armature whence it passes through the exciting winding Σe of the dynamo G to earth. The armature of the motor M is connected mechanically to the armature of the dynamo G, and the effective current flows from the dynamo armature to the current consuming devices V.

The magnetic dimensions of the two machines are such that simply the no-load current of the group is sufficient for the complete excitation of the two machines.

This circumstance is also a guarantee that the consequential high inductive resistance will completely exclude an impermissible increase of the starting current if the apparatus is placed in circuit suddenly under full voltage. This fact thus goes a way with the risk of the group burning out when there is no-load. The occurrence of the same risk when the circuit is interrupted at any point of the windings, is likewise rendered impossible by the very nature of the electrical connections.

For the purpose of preventing such a drop in the voltage at the terminals of the dynamo G, as would otherwise happen in consequence of the increase in the load under the influence of the drop in the number of revolutions and of the ohmic losses, the magnetic dimensions of the two machines are also so chosen that one and the same alteration in the exciting amperes turns will produce a greater alteration in the number of the lines of force in the dynamo than in the number of the lines of force in the motor. This result which is due to the selection of the magnetic dimensions of the two machines may be further intensified and amplified by means of a compensating auxiliary transformer K (Fig. 2) which is imposed upon the exciting field of the dynamo G and carries the effective current.

Instead of completely separating the electrical circuits of the two machines from each other as shown in Fig. 1, they may be connected together. Such an arrangement which is illustrated in Fig. 2, has also the advantage of the well-known differential connection.

The use of this differential connection for the purposes of the improved voltage transformer, is particularly suitable when the ratio between the primary and secondary voltages of the transformer is not very great.

The same references are employed to indicate corresponding parts in the two Figs. 1 and 2.

The illustrated embodiment of this invention relates to a transformer group having separate armatures for motor and dynamo. In some cases, however, and more especially where the load on the group does not vary within wide limits, a single-armature transformer may be employed for the purposes of this invention.

When it is desired to run the group at a speed which shall vary as little as possible, this may be effected by adding to the exci-
ing winding $S_m$ of the motor an additional counter-compound winding $H$ carrying the effective current of the dynamo $G$. Such an arrangement is illustrated in Fig. 3, where the current passes from the trolley line $L$ first through the armature of the motor $M$, then through the exciting winding $S_y$ of the dynamo $G$, then through the exciting winding $S_m$ of the motor $M$, and thence through the counter-compound winding $H$ to earth.

When the dynamo $G$ is loaded by the current-consuming devices $V$, a current flows through the counter-compound winding $H$ in opposition to the current that flows through the latter from the trolley line $L$ on starting, and the first-mentioned current weakens the field of the motor more and more as the load increases, so that the drop in the speed of the motor due to the increase in the load is thereby obviated. In this manner the aggregate or group is caused to run at practically undiminished speed and can be utilized for motive purposes.

What I claim is:

1. In a direct current voltage transformer, the combination of a motor, a dynamo mechanically coupled to said motor, and means for energizing the motor and dynamo to produce the normal no-load voltage of the dynamo solely by the motor current.

2. In a direct current voltage transformer, the combination of a motor, a dynamo mechanically coupled to said motor, and means whereby said motor and said dynamo are both excited solely in accordance with the current of said motor, wherein the magnetic dimensions of the two machines are such that the no-load current of the group is sufficient to excite completely the said two machines.

3. In a direct current voltage transformer, the combination of a motor, a dynamo mechanically coupled to said motor, and means whereby said motor and said dynamo are both excited solely in accordance with the current of said motor, wherein the magnetic dimensions of the two machines are such that one and the same alteration in the number of exciting ampere turns produces a greater alteration in the number of lines of force in said dynamo than in said motor, whereby the effects of the speed drop and of the ohmic voltage drops are counter-balanced by a proportionately larger alteration in the number of lines of force in said dynamo.

4. In a direct current voltage transformer, the combination of a motor, a dynamo mechanically coupled to said motor, means whereby said motor and said dynamo are both excited solely in accordance with the current of said motor, and an additional winding for the magnetic field of said motor, carrying current from said dynamo, said additional winding being arranged to oppose the action of the exciting winding of said motor, and weaken the field of said motor proportionately to the load current of said dynamo, whereby the speed of the transformer is maintained as near as possible to the high no-load speed, so that the constructional dimensions of said dynamo may be made smaller in correspondence to said high speed.

In testimony whereof I have signed my name to this specification.

OSCAR GÜTTINGER.

Witnesses:
-CARL GÜTLER,
OLGA AUBIG.