

1,059,076.

Patented Apr. 15, 1913.
2 SHEETS—SHEET 1.

Fig. 1.

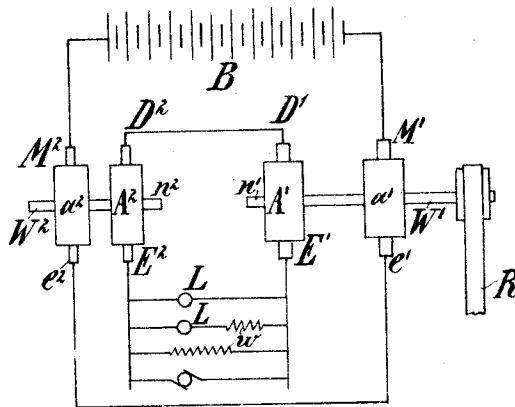


Fig. 2.

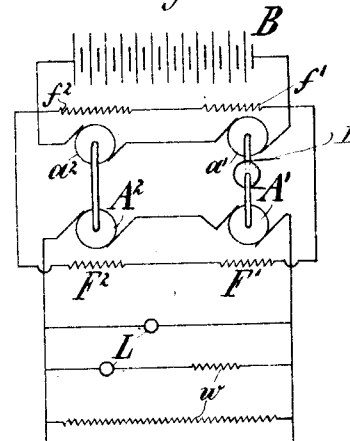


Fig. 9.

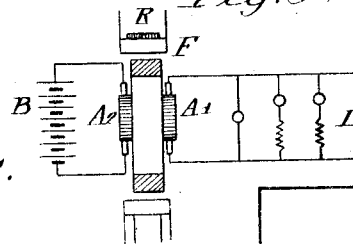


Fig. 4.

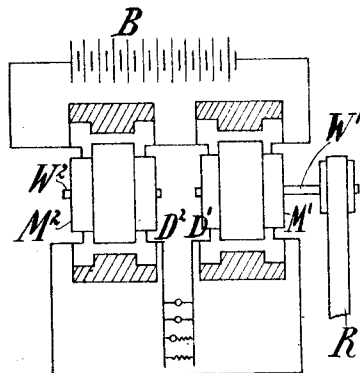


Fig. 5.

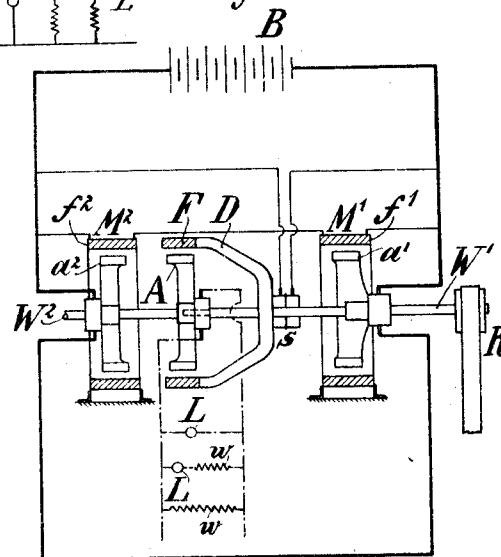
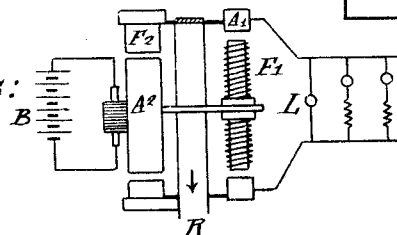


Fig. 8.



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2 SHEETS—SHEET 2.

Fig. 3.

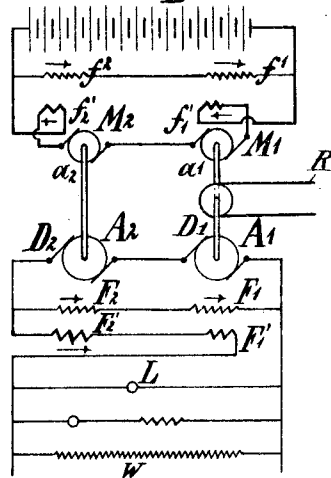


Fig. 6.

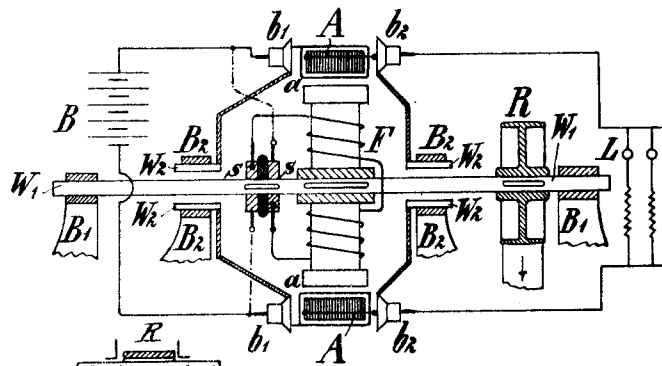
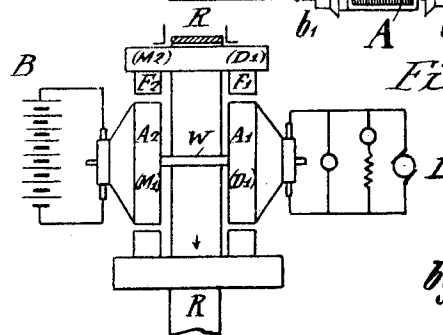


Fig. 7.



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UNITED STATES PATENT OFFICE.

OTTO SCHALLER, OF STEGLITZ, NEAR BERLIN, GERMANY.

ELECTRIC PLANT.

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Specification of Letters Patent.

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Application filed August 7, 1907. Serial No. 387,531.

To all whom it may concern:

Be it known that I, OTTO SCHALLER, a citizen of the German Empire, and residing at Steglitz, near Berlin, Germany, have invented new and useful Improvements in Electric Plants, of which the following is a full, clear, and exact description.

In systems of electric car lighting wherein the car axle is used to drive the dynamo furnishing the current for the lighting system, the speed of the car axle of necessity varies considerably because of variations in the speed of the car or train, and therefore the terminal voltage of the dynamo will vary within wide limits.

The object of the present invention is to obtain an approximately constant potential at the terminals of the working circuit irrespective of great variations in speed of the mechanically driven power shaft. To this end there is provided a second shaft and electrical means, consisting of one or more auxiliary dynamos, for driving such second shaft, whereby the sum of the speeds of the main and auxiliary dynamos, or the relative speed of parts of the main dynamo rotating one in opposition to the other, and therefore the voltage of the working circuit will remain approximately constant.

The invention will be best understood from a consideration of the following detailed description with reference to the accompanying drawings forming a part of this specification, with the understanding that the showing of the drawings is largely indicative and that the invention is susceptible of many changes and modifications without material departure from the principles of the invention.

Referring to the drawings Figure 1 is a diagram illustrating a simple embodiment of the invention; Fig. 2 is a diagram similar to that of Fig. 1, but showing the field connections; Fig. 3 is a diagram showing an elaboration of the system of Fig. 1; Fig. 4 is a diagram showing an embodiment of the invention in a double direct current generator and a dynamotor; Fig. 5 is a diagram showing a special type obtained by combining parts of Fig. 1 into a machine having the induced and inducing parts oppositely rotatable; Fig. 6 is a diagram showing another embodiment of the invention. Figs. 7, 8 and 9 are diagrams illustrating special types obtained by combining some parts of

the set shown in Fig. 1 into double generators.

Referring to the drawings and first to Fig. 1, there is indicated a shaft W' which may be driven in either direction or first in one direction and then after a time in the other direction, as would happen if the shaft be considered as driven from a car axle by a belt R or in any other manner. On this shaft W' are mounted the armature A' of a dynamo D' and the armature a' of a dynamo-electric machine M' , the fields of which are externally excited as shown in Figs. 2 to 4.

A second set is provided comprising a motor M^2 and a dynamo D^2 having their respective armatures A^2 and a^2 mechanically connected by a shaft W^2 , and this second set is electrically driven.

The set $D'-M'$ operates as a direct current converter, and the set D^2-M^2 as a motor-booster.

The armatures a' and a^2 are connected together in series and to a battery B which latter is preferably a storage battery. The armatures A' and A^2 are connected together in series, and to a working circuit in which are included translating devices such as lamps L , heating coils w , motors or the like.

The fields of the several machines are excited in any suitable manner, and while not shown in Fig. 1, may be excited by the battery B , as in Fig. 2, where the field coils F' , F^2 , f' , f^2 are shown as fed by the battery B .

The connections are such that the sum of the speeds of the mechanically driven variable speed shaft W' and the freely running electrically driven shaft W^2 is substantially constant.

If the speed of the shaft W' increases to n' , then dynamo D' may generate a voltage E' and the voltage at the terminals of the dynamo-electric machine M' may be e' .

If b be the voltage of the battery B , the motor M^2 will have $e^2 = b - e'$ volts and its speed at the excitation to which its field f^2 is adjusted may assume the value n^2 corresponding to the counter electromotive force e^2 .

Considering the booster D^2 so dimensioned that at a speed n^2 with the field F^2 , it will supply a voltage of E^2 , then the speeds $n' + n^2 = n$ and the voltages $E' + E^2 = E$,

which value may be equal to or greater or smaller than b .

If the speed of the shaft W' decreases, say, to one-half, the voltages of D' and M' would be

$$\frac{E'}{2} \text{ and } \frac{e'}{2};$$

the counter electromotive force of M^2 would be

$$b - \frac{e'}{2} = e^2 + \frac{e'}{2},$$

the speed of the shaft W^2 would be

$$n^2 + \frac{n'}{2},$$

and the electromotive force of the booster would be

$$E^2 + \frac{E'}{2},$$

so that again the speeds $n' + n^2 = n$, and the voltages $E' + E^2 = E$ without having altered the fields at all.

Should the shaft W' stop, the set $M^2 D^2$ will still run, and the armatures A' and a' will consume only the small voltage corresponding to their resistances. If, however, the shaft W' is running in the reverse direction, then the shaft W^2 will increase in speed to such an extent that $n^2 - n' = n$, but if this be undesirable, former conditions may be established by reversing the current in the armatures or fields in the well known manner.

In the foregoing the fields F' , F^2 , f' and f^2 are assumed to be excited constantly without regulation, but it is obvious that special regulations of speed may be brought about by utilizing the varying voltages at the brushes of the different machines for reinforcing or weakening the magnetic fields.

With variable load the excitation may be altered by additional or subtractional main or shunt windings to either or both sets of fields f' , f^2 , F' and F^2 . In Fig. 3 subtractional series windings f'_1 and f'_2 are provided for the machines M' , M^2 , and additional series windings F'_1 and F'_2 for the machines D' , D^2 .

Other means for influencing or regulating the speed are obvious to those skilled in the art and require no special illustration or description.

The armatures A' and a' of the main set and A^2 , a^2 of the auxiliary set of rotating electrical machinery may be arranged in a common field, thus forming a double direct current generator M' , D' , and a dynamotor M^2 , D^2 , as shown in the diagram of Fig. 4.

A saving of space may be attained if, instead of employing the booster D^2 , the main dynamo D , Fig. 5, is so arranged that its field F and its armature A may both be re-

involved either in the same or the opposite sense, the former by means of the auxiliary dynamo M^1 and the shaft W^1 , the latter by the motor M^2 and the shaft W^2 . It is evident that the reverse arrangement is possible, in which case W^1 would drive the armature and W^2 the field. In Fig. 5 slip rings are necessary to feed exciting current to the rotating field F .

It is also considered unnecessary to illustrate or describe at length known means of regulating, such as counter main current windings, through which the main current from B passes into a_1 , a_2 (Fig. 3) weakening the fields f^1 , f^2 and thus influencing the regulation, while the main working current from A_1 , A_2 compounds through F^1 , F^2 . With the aid of these known arrangements, the voltage of the working circuit, for instance with a variable load, may increase, remain constant, or decrease. This is especially the case by altering the voltage b of the auxiliary current source, which latter is illustrated here as a battery.

If it is desired to still further compress the arrangement shown in Fig. 5, the armatures a_1 and a_2 may be combined to form a single armature, which together with the armature A may be arranged in a single field F . The two armature windings may then be wound on the same armature iron. They are shown in Fig. 6 as a ring winding a and a drum winding A , the former being connected to the left, the latter to the right hand commutator. The brushes b_1 of the left hand commutator are fed from the battery B , those b_2 of the right hand commutator are connected to the load L in the way illustrated by the former figures. The single field F is excited from the battery B through slip rings s , and is coupled (by keys or the like) to the shaft W_1 driven by belt and pulley R . The armatures a and A form one solid body and may be bodily rotated together with their windings and commutators through a hollow shaft W_2 in the bearings B_2 . It will be readily understood that shaft W_1 may be turned within the bearings B_1 mechanically, and shaft W_2 within the bearings B_2 electrically, as shown in Fig. 8 or vice versa. Also other mechanical means may be employed for driving, for instance, a car axle, if the plant is to be used in connection with a carriage, for instance for lighting a train. All the effects previously described will be produced in this case. The arrangement of Fig. 6 is in fact only a further development of the arrangement of Fig. 3. Thus two rotary armatures a and A will be on a common shaft W^2 and two rotary fields or one common field F on a second shaft W^1 . Again, one of the two shafts, in Fig. 6 the field shaft W^1 , is driven by means of a pulley R from a mechanical source of power. One armature a is con-

needed to the auxiliary source of current B, the other A to the working circuit L. The same idea is represented in a somewhat different way in Fig. 7, a machine with exterior poles being assumed. The two fields F_1 and F_2 are both driven from R. If in this case the field F_2 attains a speed, relatively to the armature A^2 , which corresponds to the tension of the auxiliary current source B, the armature shaft W will stop and the lamps L will have their normal tension. If the speed of R falls below the normal, the auxiliary current B will rotate the armature A , *i. e.* the shaft W in the opposite direction to the field, so that the relative speed of both will be again normal, and the normal tension will again be generated in the armature A. If, on the other hand, the speed of R exceeds the normal, the auxiliary current source will have the effect of turning the shaft W in the same direction as the field, so that the relative speed of both, and also the tension of the armature A is again normal. In the latter case the armature A operates as a negative motor armature or as current generator, which may be used to charge the battery.

It is self evident that the armature of one part may be mechanically coupled to the field of the other part. This arrangement is shown in Fig. 8, in which case for instance the machine has one armature A_1 and exterior poles F^2 , and another A_2 and interior poles F^1 . The operation is the same as that described with reference to Fig. 7. If a direct current is used as working current, the current will have to be collected by brushes, from the armature A_1 , which rotate on the field F^1 . In the case of alternating current, the brushes may, of course, be stationary, the current being collected from A by means of slip rings. The brushes and slip rings are omitted in Fig. 8. If the two armatures A and A_1 are combined in the known manner to a double armature as in Fig. 9, the combination illustrated in Fig. 9 will result. The armatures in this case lie on a common magnetic field, it being immaterial whether this is composed of several single fields or not. If finally this machine is developed to one having a double armature and interior poles, the arrangement will

be as shown in Fig. 6. In this view, excitation of the field F is effected by the auxiliary current source B. Additional or substitutional exciting windings may of course also be used in this case, as in the case of Fig. 3. If alternating current is collected, slip rings with stationary brushes should be substituted for the rotary brushes b^1 . In all these cases the freely-running part will exercise but a very weak resulting torque or turning movement on the shaft driven from the mechanical source of power.

What is claimed is:—

1. In combination, a variable speed double direct current generator, and a motor-booster, each armature of the double generator being connected in series with a respective armature of the motor-booster, a current source in series with one pair of electrically connected armatures and a working circuit fed by the other pair of electrically connected armatures.

2. The combination of a variable speed drive shaft, a double direct current generator driven thereby at varying speed, a motor booster, a storage battery connected up in series to the motorpart of said motorbooster, and one armature of said double direct current generator and a working circuit having approximately constant voltage tapped from the second armature of said double generator and the booster, substantially as described.

3. In a system of electric car lighting utilizing the car axle as a driving or power means, a double direct current generator driven thereby, a second shaft, and a motor-booster coupled to it, a storage battery for energizing the motorpart of said booster and one armature of the said double direct current generator in series, a series connection between two points of said booster, and the second armature of said double generator and a working circuit tapped from the remaining two points of said last named armatures, substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses:

OTTO SCHALLER.

Witnesses:

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HENRY HASEP.