M. M. OSNOS.

PROCESS AND APPARATUS FOR PRODUCING DIRECT CURRENTS HAVING LIMITED STRENGTH.

APPLICATION FILED OCT. 29, 1907.

931,336.

Patented Aug. 17, 1909.

2 SHEETS—SHEET 1.

Fig. 1

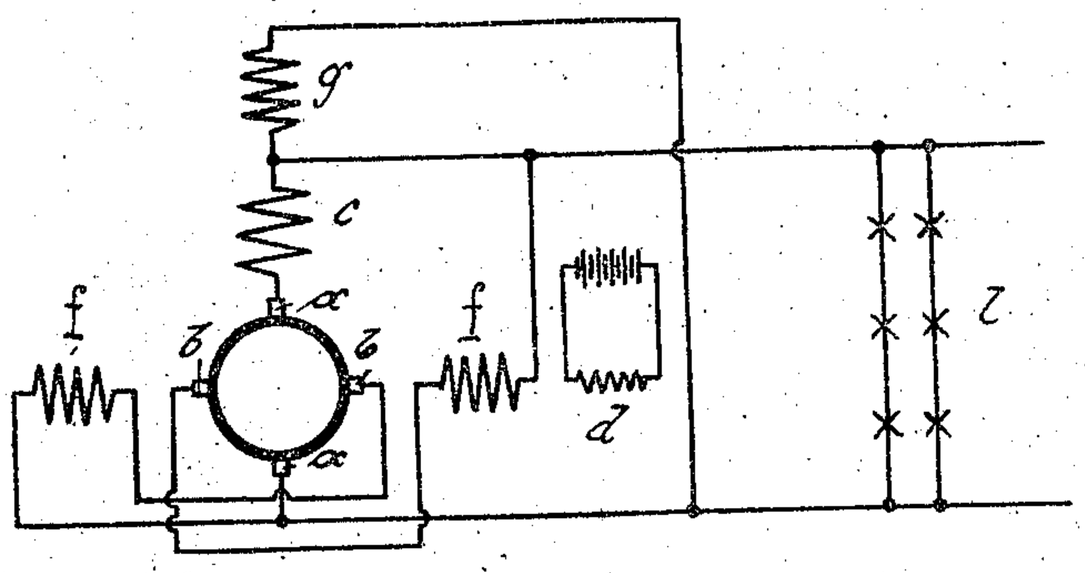
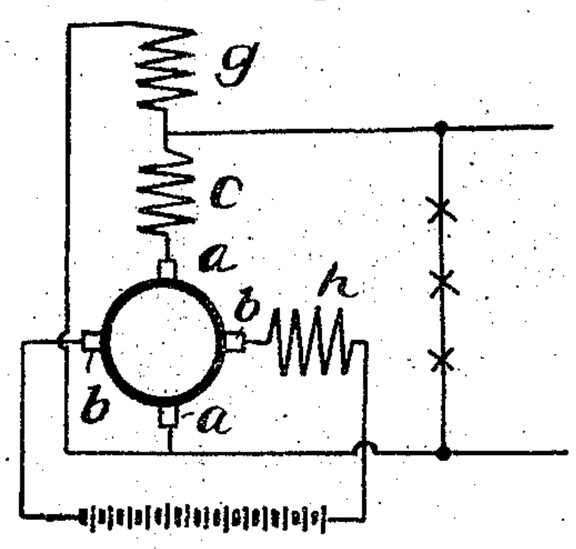


Fig. 2.

Fig. 3



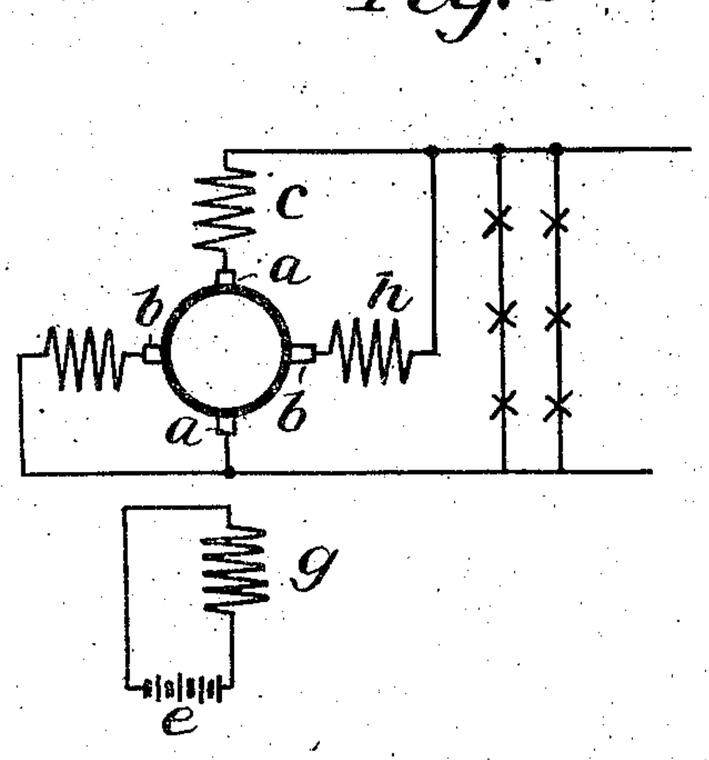
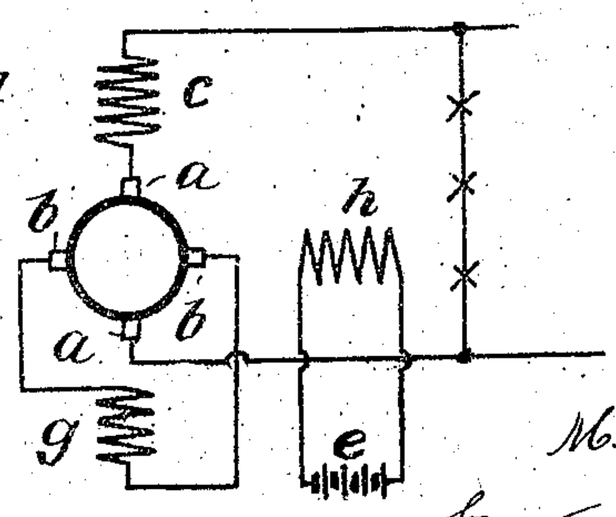


Fig. 4



Witnesses:
C. H. Taylor.
B. H. Smith

Inventor:
Menahem M. Osnos,
by Foster Freeman, Watson & Coit,
Attorneys.

M. M. OSNOS.

PROCESS AND APPARATUS FOR PRODUCING DIRECT CURRENTS HAVING LIMITED STRENGTH.

APPLICATION FILED OCT. 29, 1907.

931,336.

Patented Aug. 17, 1909.

2 SHEETS—SHEET 2

Fig. 5.

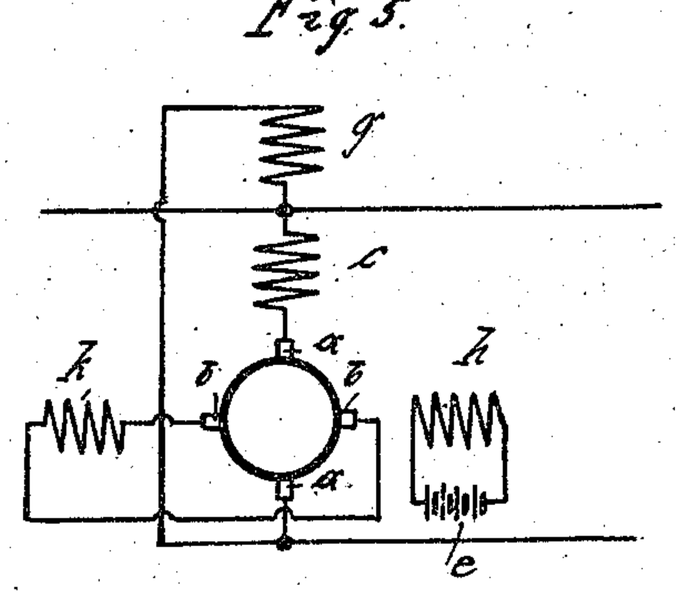


Fig. 6.

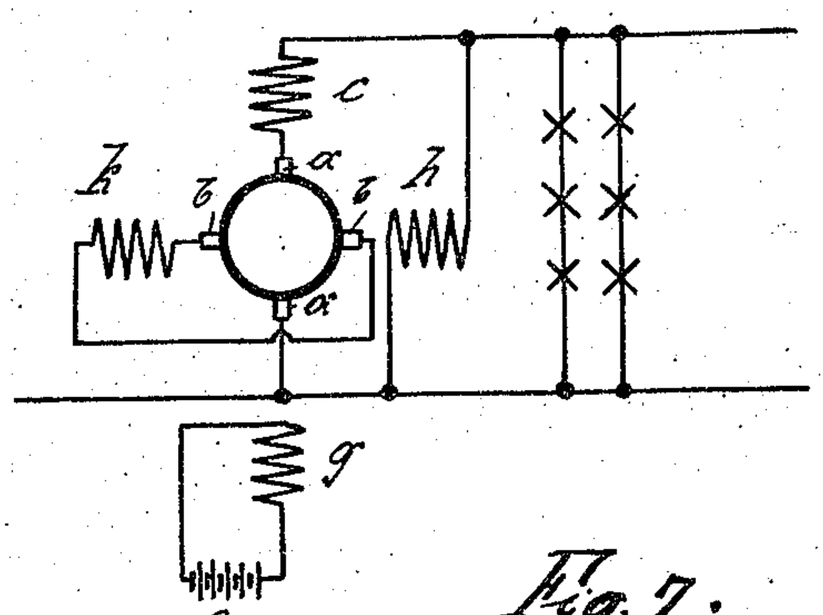
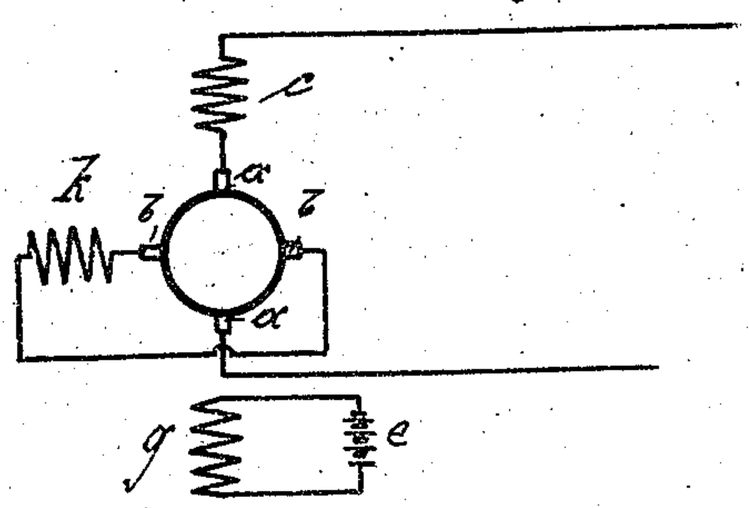


Fig. 7.



Witnesses
C. F. Taylor
B. M. Smith

Inventor:
Menahem M. Osnos,
by Foster, Freeman, Watson & Coit,
Attorneys.

UNITED STATES PATENT OFFICE.

MENAHEM MENDEL OSNOS, OF FRANKFORT-ON-THE-MAIN, GERMANY, ASSIGNOR TO FIRM OF FELTEN & GUILLEAUME-LAHMEYERWERKE ACTIEN-GESELLSCHAFT, OF FRANKFORT-ON-THE-MAIN, GERMANY.

PROCESS AND APPARATUS FOR PRODUCING DIRECT CURRENTS HAVING LIMITED STRENGTH.

No. 931,336. Specification of Letters Patent. Patented Aug. 17, 1909.

Application filed October 29, 1907. Serial No. 399,684.

To all whom it may concern:

Be it known that I, MENAHEM MENDEL OSNOS, a subject of the Czar of all the Russias, and a resident of Frankfort-on-the-Main, Germany, have invented certain new and useful Improvements in a Process of and Apparatus for Producing Direct Currents Having a Limited Strength, of which the following is a specification.

My invention relates to improvements in systems for controlling the strength of the current supplied by direct current dynamos, and the object of the improvements is to provide a system, whereby the current is held within certain limits, though the resistance or the counter electromotive force of the circuit is considerably varied.

The system is particularly useful in dynamos supplying current to circuits which include apparatus consuming direct current, the strength of which varies within large limits, or to circuits the resistance of which, or the counter-electromotive forces of which vary within large limits, or are intentionally varied. For example, search lights are operated in such a way as to start the arc lamps of the same by separating the carbons, while they are cut out by bringing the said carbons in contact with each other. Now, if in such cases each arc lamp is provided with a dynamo of its own, as is usual, the said dynamo will be short-circuited when switching out the lamp. Therefore, a dynamo designed for such purposes must be constructed in such a way, as to permit a considerable decrease of the resistance of the circuit, or a short-circuiting. For this purpose, it has been suggested to counter-compound the dynamo by means of a field electromagnet energized by the working current, which means, however, have not proved sufficient to meet practical requirements. By the said means the current can be held below a certain limit in case of a short-circuit. But the strength of the current in case of a short-circuit is about double the maximum current supplied by the machine under normal conditions. If therefore the machine is normally operated at its full load, it would be overloaded in case of a short-circuit. If however the machine is operated in such a way as to have its maximum current in case of a short-circuit, it would not be operated at its full capacity under normal conditions.

Now, my invention consists in providing means, whereby the dynamo may be operated at its full capacity and at the same time avoiding an excessive increase of the current in case of a short-circuit.

For this purpose my invention consists in preventing an increase of the current, in case of a decrease of the resistance of the circuit, by causing the working current to produce a magnetic field and by generating by means of said field, an electromotive force which operates to weaken the main field of the machine, when the current of the machine is increased. The said weakening effect can take place by energizing, by means of the current due to said electromotive force, a field magnet located in line with the main field, or by including the said electromotive force in the energizing circuit of the main field magnet.

For the purpose of explaining the invention, I have shown several examples of systems embodying the same in the accompanying drawings, in which the same letters of reference have been used in all the figures to indicate corresponding parts.

In the said drawings, Figure 1 is a diagrammatic view of a system embodying the invention, and Figs. 2 to 7 are diagrammatic views of various systems embodying modifications of the system shown in Fig. 1, the various figures showing means for connecting the electro-magnets in different ways.

In the example shown in Fig. 1, a shunt wound dynamo is illustrated which comprises two field magnets *f*, *f*, and working or main brushes *a*, *a*, arranged in a line substantially at right angles to the axis of the main field magnets *f*, *f*. By means of an overcompensating coil *c*, the field set up in the armature in the direction of the brushes *a*, *a*, is more than balanced, so that a field is produced in the direction of the brushes *a*, *a*, which increases upon an increase of the working current. Between the coils of the field magnets *f*, *f*, I provide subsidiary brushes *b*, *b*, coöperating with the field set up in the direction of the main brushes, to generate an electromotive force by the rotation of the armature in the overcompensating field which counteracts the energizing current of the coils *f*, *f*.

From the foregoing it will be understood

that the machine may be said to consist of two systems, that is of a system which comprises the field winding *f*, *f* and the brushes *a*, *a*, and a second system which comprises the winding *c* and the brushes *b*, *b*. Evidently the field of the first system, which is produced by the windings *f*, *f*, does not produce, in a practical sense, an electromotive force at the brushes *b*, *b* of the second system, because the brushes *b*, *b* are located in the neutral zone of the field *f*, *f*. In the same way the field produced by the winding *c* cannot directly produce an electromotive force at the brushes *a*, *a*.

If the working current taken from the brushes *a*, *a*, is increased by a decrease in the resistance of the line, as by cutting out a lamp, thereby strengthening the field *c*, the electromotive force between the brushes *b*, *b*, is increased, and the voltage of the working current which, in the example shown, includes arc lamps is decreased. This decrease of the voltage, however, causes a decrease of the field energizing voltage, and thereby also a weakening of the current exciting the main field, and the increasing electromotive force between the brushes *b*, *b* counteracting said energizing voltage produces a further decrease of the energizing current, so that the main field coöperating with the brushes *a*, *a*, is weakened; and therefore the current taken from the brushes *a*, *a*, remains substantially constant.

To produce a sufficient effect on the machine an overcompensation of the field in the direction of the main brushes amounting to 10% will be sufficient.

Under certain circumstances, for the purpose of adjusting the automatic regulation of the machine the field operating in the direction of the brushes *a* may be influenced by a shunt coil *g*, operating in the direction of the field set up in the armature and opposite to the field produced by the compensating coil *c*. Instead of providing a special coil *g* the brushes *a*, *a*, may be displaced from the axis vertical to the axis of the main field of the machine, which displacement, however, must take place in a direction opposite to the usual displacement of the brushes of dynamos, that is, in a direction opposite to that of the revolution of the machine. As it is known in the art, by properly displacing the brushes of a direct current dynamo, the armature field can be compensated to a greater or less degree.

If required, the machine may be provided with a special field coil apart from the shunt coil *f*, a coil *d* being shown in the example illustrated in Fig. 1. By means of the said coil the machine receives a certain constant pressure, whereby any considerable decrease of the current below the normal is avoided. Where only a shunt coil is provided, the current may fall to zero, if the resistance of the circuit is very small. If on the contrary, the field is produced merely by means of a separately energized coil, the current in case of a short-circuit, is too large. But when using the modification just described, under any circumstances a practically constant current is obtained with a practically constant speed of the machine.

In the system so far described a comparatively large series compensating coil *c* is required, because the latter must at least compensate the armature field set up in the direction of the brushes *a*, *a*. In order to decrease the size of the coil *c* and thereby the losses of energy caused thereby, I prefer to so construct the coil *c*, that a part only of the armature field is compensated by the same. In this case, in addition to the coil *c*, the coil *g* is so arranged as to act in the opposite direction to that previously described, that is, in the same direction as *c* and its dimension is such, that under normal conditions, the sum of the fields produced by the coil *c* and by the coil *g* are stronger than the armature field produced in the direction of the brushes *a*, *a*. If now the current is increased a certain amount, on account of a decrease of the outer resistance of the working circuit, the difference between the field of the coil *c*, depending upon the load of the machine, and the field of the coil *g*, is increased. Thereby the main field in the direction of the line *b*, *b*, is weakened, so that the voltage and the excitation of the shunt coil are decreased.

To illustrate the invention more clearly, an example illustrating the effect of the various coils will now be given. If the dimension of, and the current passing through the coil *g* correspond to 100 ampere turns, and the overcompensating field produced by the difference between the field set up in the armature and the field set up the coil *c* corresponds to −90 ampere turns, the sum of both is 10 ampere turns, whereby the field is strengthened. If now the overcompensating field be increased 5% that is to −94.5 ampere turns, the sum of the fields is 5.5 ampere turns. The field is, therefore, weakened, but its direction is not altered.

In Fig. 2, the connections of the brushes *b*, *b*, to the field magnets have been changed as compared with the example shown in Fig. 1. Now, as the field of *g* is opposite to the armature field, the brushes may be displaced relatively to the coils *h* or *g* and out of the neutral zone in the usual manner, that is in the same directions as in a dynamo, while in the example shown in Fig. 1 the said displacement must be effected in the opposite direction. In this modification coils *g* and *c* act in the same direction to overcompensate the armature cross-field. The field *h* is separately excited, thereby accomplishing the same result obtained in Fig. 1 by the use of an auxiliary field *d*. The coil *g* which assists

in compensating the armature field may be energized in various ways according to convenience. In Figs. 3 to 7, I have shown several examples illustrating various means of energizing said coil, the machines illustrated being in addition provided with shunt wound field magnets, separately energized field magnets, and compensating means. In all these modifications the coils *g* and *c* together overcompensate the armature cross-fields. Furthermore, it may be advisable to provide a further additional coil *k* connected to the subsidiary brushes *b*, *b*, as shown in Fig. 5.

In the example shown in Fig. 3, the magnet *g* counteracting the armature field is energized from a battery *e*, the additional magnets *h* being connected to the working circuit. By separately exciting the field *g* by means of a battery or the like the ampere turns remain constant and therefore closer regulation may be obtained.

Fig. 4 shows an example in which the magnet *g* is energized from the subsidiary brushes *b*, *b*, the magnet *h* being separately energized from the battery *e*. When the resistance decreases, and the current in *c* increases, a strong field is set up in opposition to the field *h*.

A further example is shown in Fig. 5 in which the magnet *g* is arranged as in the example shown in Fig. 2, the electromagnet *h* being separately energized from the battery *e* and a special additional coil *k* connected to the subsidiary brushes *b*, *b*, being provided in the same axis with the coil *h*. By providing a field winding *h* which is separately excited, the same results and advantages are obtained as were obtained in the modification shown in Fig. 1 by the winding *d*.

Fig. 6 shows a modification of the arrangement shown in Fig. 3, the electromagnet *h* being connected to the working circuit, while the coil *k*, as in the example shown in Fig. 5, is connected to the subsidiary brushes.

As appears from Fig. 7 it may be preferable, under certain circumstances, to omit the shunt electromagnet *h* shown in Fig. 6. By omitting this shunt magnet *h* the regulation of the machine is dependent altogether upon the action of the auxiliary coil *k*.

In all the examples, however, which show different forms of my invention the electromotive force which acts on the main exciting field so as to decrease the same when the strength of the current is increased, is produced by the rotation of the armature; the field required in all the cases is produced by the simultaneous effect of a compensating coil energized by the working current, and of an exciting coil energized by the machine itself, or by a separate source of electricity the field of the said coils operating in the same direction.

I claim:

1. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of means for setting up a subsidiary magnetic field passing through the armature substantially in the direction of the working brushes of the dynamo and dependent upon the strength of the working current supplied by the same, means for causing the electromotive force produced in the armature by said subsidiary field to weaken the main field upon an increase of the working current and an auxiliary field for the subsidiary field, excited by a current separate from that generated by the subsidiary field.

2. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of means for setting up a subsidiary magnetic field passing through the armature substantially in the direction of the working brushes of the dynamo and dependent upon the strength of the working current supplied by the same, means for causing the electromotive force produced in the armature by said subsidiary field to reduce the electromotive force exciting the main field upon an increase of the working current and an auxiliary field for the subsidiary field, excited by a current separate from that generated by the subsidiary field.

3. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of means for setting up a subsidiary magnetic field substantially in alinement with the working brushes of the dynamo and dependent upon the strength of the working current, subsidiary brushes bearing upon the armature and connected in series with the exciting winding of the main field magnet, said brushes coöperating with the subsidiary magnetic field to produce an electromotive force acting to weaken the main field upon an increase of the working current and an auxiliary field for the subsidiary field, excited by a current separate from that generated by the subsidiary field.

4. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of means for setting up a subsidiary magnetic field, substantially in alinement with the working brushes of the dynamo and dependent upon the strength of the working current, subsidiary brushes bearing upon the armature and connected in series between two sections of the exciting winding of the main field magnets, said brushes coöperating with the subsidiary magnetic field to produce an electromotive force acting to weaken the main field upon an increase of the working current and an auxiliary field for the subsidiary field, excited by a current separate from that generated by the subsidiary field.

5. In a system for producing direct cur-

rent of limited strength, the combination with a direct current dynamo, of an overcompensating coil for said dynamo, a second coil for regulating the action of said overcompensating coil, and means whereby the electromotive force produced in the armature by said overcompensating coil opposes the flow of current in the main field upon an increase of the working current.

6. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of means for setting up a subsidiary magnetic field passing through the armature substantially in the direction of the working brushes of the dynamo and dependent upon the strength of the current supplied by the same, means for causing the electromotive force produced in the armature by said subsidiary field to weaken the main field upon an increase of the working current, and an additional field exciting coil adapted to prevent the main field from falling below a certain limit.

7. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of means for setting up a subsidiary magnetic field passing through the armature substantially in the direction of the working brushes of the dynamo and dependent upon the strength of the current supplied by the same, a separately excited field magnet acting in a direction opposite to said subsidiary field, and means for causing the electromotive force produced in the armature by the combined action of said subsidiary field and separately excited field to weaken the main field upon an increase of the working current.

8. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of means for setting up a subsidiary magnetic field along the line of the armature cross field and dependent upon the strength of the working current supplied to the same, means for causing the electromotive force produced in the armature by said subsidiary field to weaken the main field, and an auxiliary field for the subsidiary field excited by a current separate from that generated by the subsidiary field.

9. In a system of producing direct current of limited strength, the combination with a direct current dynamo, a subsidiary winding in the main circuit for setting up a subsidiary field along the line of the armature cross field and dependent upon the strength of the working current, means for causing the electromotive force produced in the armature by said subsidiary field to weaken the main field, and an auxiliary field for the subsidiary field excited by a current separate from that generated by the subsidiary field.

10. In a system for producing direct current of limited strength, the combination with a direct current dynamo, a subsidiary winding in the main circuit for setting up a subsidiary field along the line of the armature cross field and dependent upon the strength of the working current, means for causing the electromotive force produced in the armature by said subsidiary field to oppose the electromotive force applied to the main field, and a regulating winding for the subsidiary winding excited by a current separate from that generated by the subsidiary field.

11. In a system for producing direct current of limited strength, the combination with a direct current dynamo, a subsidiary winding in the main circuit, a second regulating winding connected across the main circuit, said windings having their polar axes along the line connecting the working brushes, and means for causing the electromotive force produced in the armature by said subsidiary field to oppose the electromotive force applied to the main field.

12. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of a series field winding in the main circuit, a shunt winding connected across the main circuit, said windings having their polar axes along the line connecting the working brushes, and said shunt winding being opposed to said series winding, and means for causing the electromotive force produced in the armature by said series winding to oppose the electromotive force applied to the main field.

13. In a system for producing direct current of limited strength, the combination with a direct current dynamo, of a series field winding in the main circuit, a shunt winding connected across the main circuit, said windings having their polar axes along the line connecting the working brushes, and said shunt winding being opposed to said series winding, means for causing the electromotive force produced in the armature by said series winding to oppose the electromotive force applied to the main field, and an additional field winding adapted to prevent the main field from falling below a certain limit.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MENAHEM MENDEL OSNOS.

Witnesses:
JEAN GRUND,
ERWIN DIPPEL.