(No Model.)

M. HUTIN & M. LEBLANC.

ALTERNATING CURRENT MACHINE.

No. 551,863. Patented Dec. 24, 1895.

Fig. 1.

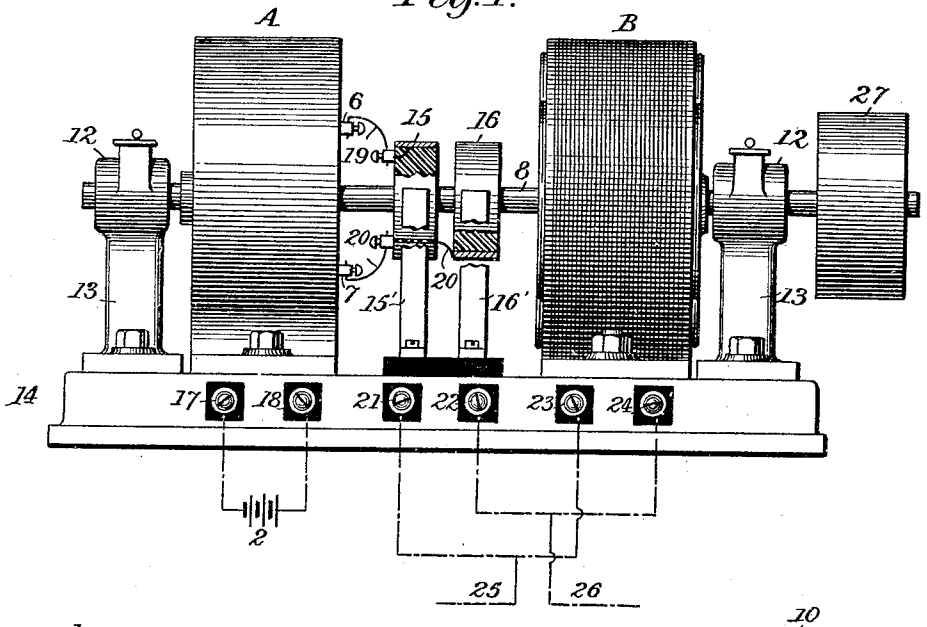


Fig. 2.

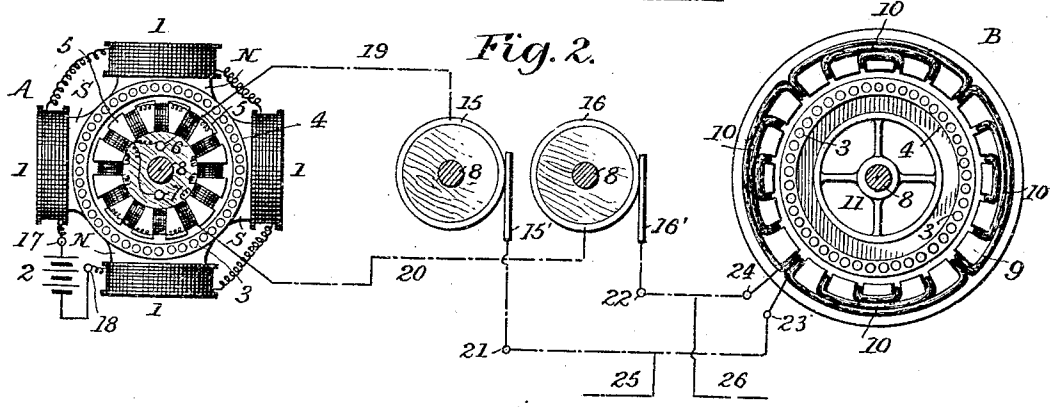
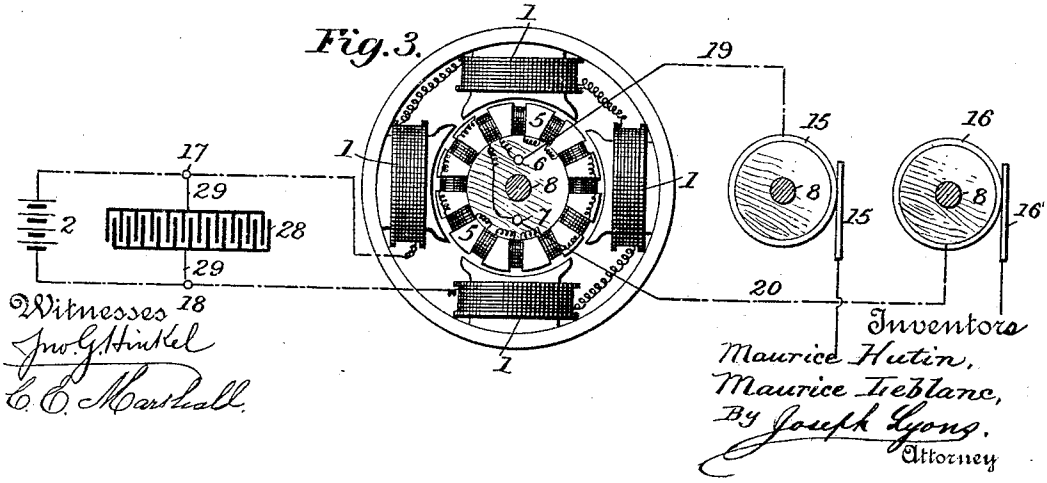


Fig. 3.



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UNITED STATES PATENT OFFICE.

MAURICE HUTIN AND MAURICE LEBLANC, OF PARIS, FRANCE, ASSIGNORS TO THE SOCIÉTÉ ANONYME POUR LA TRANSMISSION DE LA FORCE PAR L'ÉLECTRICITÉ, OF SAME PLACE.

ALTERNATING-CURRENT MACHINE.

SPECIFICATION forming part of Letters Patent No. 551,863, dated December 24, 1895.

Application filed May 1, 1895. Serial No. 547,754. (No model.) Patented in France June 11, 1892, No. 222,287.

To all whom it may concern:

Be it known that we, MAURICE HUTIN and MAURICE LEBLANC, citizens of the Republic of France, and residents of Paris, in the Department of the Seine, in the Republic of France, have invented certain new and useful Improvements in Alternating-Current Machines, (for which we received Letters Patent of France by certificate of addition, dated September 29, 1894, to French Patent No. 222,287, dated June 11, 1892,) of which the following is a specification.

This invention has reference to improvements in alternating-current machines, having for its object to maintain the speed of synchronism in alternating-current motors, and the same is in the nature of an improvement upon a like invention for which Letters Patent No. 529,272 were granted to us on November 13, 1894.

In the said patent we have described and shown the method of and apparatus for maintaining the speed of synchronism in machines of the character above referred to by counterbalancing the deviations from synchronism by a couple or couples of forces operating upon the rotating element of the machine in opposition to the said deviations, and which counterbalancing or deadening couples are produced by independent currents generated by and in accordance with said variations. This result we obtained as set forth in the said patent by providing a field magnet or magnets having constant polarity and an armature charged with alternating currents from an extraneous source and an independent closed circuit or circuits of low resistance in the path of the magnetic flux of the machine. These independent and closed electric circuits we have called "deadening-circuits" and we have located the greater portion of them within the body of the polar extension of the field-magnets.

We have found that in many cases it is of advantage to disassociate the two functions of the machines—namely, that of producing the rotation of the armature-shaft and that of maintaining a synchronism of that rotation—so that these functions may be performed severally by two distinct machines, and the main object of our present invention is to obtain this result. We have also found the function of the deadening-circuit can be assigned to the field-magnet coils themselves, and the arrangement by which this is effected constitutes another part of our invention.

All this will more fully appear from the following detailed description with references to the accompanying drawings, in which—

Figure 1 represents a front elevation, partly in section, of the combination of a synchronous motor and an asynchronous motor constituting together the synchronizing-motor embodying our invention. Fig. 2 is a diagram illustrating the circuit connections of our synchronizing apparatus with its parts developed, and Fig. 3 is a like view of a motor with the field-coils constituting at the same time the deadening-circuit.

Like numerals and letters of reference indicate like parts.

The machine A, represented on the left-hand sides of Figs. 1 and 2, is to all appearances the same as our synchronizing-motor shown in our aforesaid patent, although as will presently appear its function in the connection in which it is here used is more limited, owing to the low resistance and low self-induction, which in this case is given to the armature.

There are shown four field-magnets 1 1, &c., the energizing-coils of which are wound alternately in opposite directions, so that a continuous current coming from any source 2 and passing through these coils, which are connected in series, will produce the alternate magnetic poles N S, &c. We have here shown four magnets, but any other even number may be used. The deadening-circuits are in the shape of a squirrel-cage and are composed of copper rods 3 3 3 3 passing through the polar extensions and in the spaces between them and riveted at their ends to bronze or copper rings 4.

The armature 5, which in this case is shown as of the Pacinotti type, but which may be differently constructed, has four sets of coils, alternately wound, and all in series with each other, so that an alternating current admitted by the binding-posts 6 7 will produce in the

core of the Pacinotti ring four alternate poles.

The machine thus far described is substantially like that set forth in our aforesaid patent, and it is a true synchronizing alternating-current motor. An analysis of this machine shows that if the deadening-circuit were removed the machine would at once become an ordinary alternating-current motor, tending to synchronism and generally spoken of as a "synchronous motor." It would be a true synchronous motor if the mechanical load upon the armature-shaft were small and constant and if the current supplied to the armature were also constant. On the other hand, if the field-magnets were removed, the armature combined with the deadening-circuit would constitute an asynchronous motor, in which the former deadening-circuit would be the field-magnet with circuits closed upon themselves. Thus it appears that the machine A, or, which is the same thing, the machine shown in our aforesaid patent, combines in one structure two machines, one being a synchronous motor and the other an asynchronous motor, and the two together constitute what may properly be called a "synchronizing motor." Now it is well known that a synchronous motor will run the more nearly in synchronism with the current the lower the resistance and the self-induction of its armature and the stronger the field, while an asynchronous motor in order to work promptly and with good efficiency should have considerable resistance and self-induction. It will be seen from this that when the two functions of the synchronous and the asynchronous motor are assigned to a single machine the construction required for the performance of one function conflicts with the construction required for the performance of the other function, so that it is difficult to construct a single machine that will develop the highest attainable synchronizing effort.

With our present invention this difficulty is overcome in that we separate the synchronous motor from the asynchronous motor—that is to say, we use two motors, structurally independent of each other, but combined for joint action upon the same shaft.

In accordance with our invention, therefore, we join upon the same shaft 8 a synchronous motor A and an asynchronous motor B. We may therefore, dispense in the construction of the motor A with the deadening-circuit; but we have found that while not absolutely necessary it is preferable to employ the deadening-circuit, but otherwise we construct the motor as if it had to perform the function of a synchronous motor alone—that is to say, the armature is wound with very few turns of heavy wire, so that the resistance and the self-induction of the armature is made as low as practicable.

The asynchronous motor B has a stationary armature 9, having four sets of winding 10 10, &c., alternating in direction but connected in series, as indicated, so as to produce four alternate poles. This stationary armature is wound with a considerable amount of wire, whereby its resistance and self-induction are made rather high. Upon the shaft 8 and in inductive relation to the stationary armature 9 is mounted the field-magnet 11, which consists of a laminated hollow cylinder through which the squirrel-cage rods 3 3 3 pass, which at each end are electrically connected to copper or bronze cheeks 4, substantially in the manner of our deadening-circuit hereinbefore repeatedly referred to. Any other form of asynchronous motor may be used, as also any other form of synchronous motor may be employed; but by preference we use in connection with the synchronous motor a deadening-circuit, since we have found that this improves the working of the apparatus. We are, however, not obliged to use the deadening-circuit as an adjunct to the synchronous motor.

The general arrangement and combination of all parts of our synchronizing apparatus, as well as the circuit connections, are delineated in Figs. 1 and 2. The common shaft 8 is mounted in bearings 12 12 in standards 13, mounted upon the base-plate 14. The field-magnets of the synchronous motor A and the fixed armature of the asynchronous motor B are also mounted upon the same base-plate between the two standards 13 13. The armature of the synchronous motor and the field-magnet of the asynchronous motor are both keyed to the shaft 8, and between the two motors, also mounted on the common shaft 8, are the two collector-rings 15 16. Brushes 15′ 16′ bear upon these collector-rings, and the circuit connections are made as follows: From the source 2 of continuous current connections are made with the binding-posts 17 18, to which the terminals of the field-winding of the synchronous motor A are connected. One terminal 6 of the armature-winding of the machine A is connected with the collector-ring 15, while the other terminal 7 is connected with the collector-ring 16. These connections are made by stiff conductors 19 20, one of which, 20, passes through the insulating-support of the collector-ring 15, as is indicated in Fig. 1. The brush 15′ is connected with a binding-post 21 and the brush 16′ is connected with a binding-post 22. The binding-post 21 is connected with the terminal binding-post 23 of the field-magnet winding of the asynchronous motor B and the binding-post 22 is connected with the other terminal binding-post 24. The connecting-conductors are tapped between 21 and 23 by the line-conductor 25 and between 22 and 24 by the line-conductor 26. If now alternating currents are admitted by the line-conductors 25 26, it will be seen that they pass in two multiple-arc branches through the coils of the armature of the synchronous motor and through the winding of the fixed armature of the asynchronous motor, respectively. Each

motor then performs its own function and the two co-operate to maintain the speed of synchronism of both and of any machine that may be driven by the pulley 27 fixed to the shaft 8.

As hereinbefore explained, the synchronous motor is preferably provided with a deadening-circuit, and if it were necessary to make that deadening-circuit in the manner shown in our Patent No. 529,272, and here indicated in Fig. 2, the ordinary synchronous motors which are found in the market could not be used for our synchronizing apparatus; but it is not necessary that the deadening-circuit be constructed in that manner, since the function of the deadening-circuit can be assigned to the field-magnet coils of an ordinary synchronous motor. This we have indicated in Fig. 3 and it constitutes one of our improvements. With reference to Fig. 3 it will be seen that the squirrel-cage deadening-circuit has been omitted from the synchronous motor there represented. In place of the same we use a condenser 28 of large capacity in a shunt 29 between the terminals 17 18 of the field-circuit. It will now be seen that the continuous currents from the source 2 will pass to and through the field-coils as before, since these currents cannot cross the condenser. On the other hand any alternating currents generated in the field-coils by varying magnetic fluxes will pass unobstructedly through the condenser as a path of least resistance, but will not pass through the continuous-current generator 2. The conditions therefore are the same as if there were two sets of field-coils, one of which closed upon the continuous-current generator and the other closed upon itself, and in the latter the alternating currents produced by the varying fluxes due to the desynchronizing effects to which the machine is subjected can circulate. In this manner any ordinary synchronous motor may be adapted for use as a part of our synchronizing apparatus by the simple addition of a condenser of suitable capacity without changing the structure of the motor.

The apparatus herein shown and described may be variously modified without departing from the principles of our invention, and we are therefore not limited to the identical details of construction or dispositions of parts set forth. The types of synchronous and asynchronous motors may be different from those which we have exemplified and the two motors may be coupled mechanically in any suitable manner. So also may the circuit connection be variously changed, as will readily be understood by those skilled in the art.

Having now fully described our invention, we claim and desire to secure by Letters Patent—

1. An apparatus for producing and maintaining synchronous rotation, comprising a synchronous alternating current motor of low resistance and self induction and having a constant field of force, and an asynchronous alternating current motor of comparatively high self induction, both simultaneously fed from the same alternating source and having their rotating elements mechanically coupled, substantially as described.

2. A synchronizing apparatus, consisting of a synchronous alternating current motor of low resistance and self induction, having a constant field of force, and an asynchronous alternating current motor of comparatively high self induction, the two arranged in constantly closed parallel branches of the same alternating current line, and the rotating element of both mechanically coupled, substantially as described.

3. A synchronizing apparatus, consisting of a synchronous alternating current motor of low resistance and self induction, having a constant field of force and provided with a deadening circuit, and an asynchronous alternating current motor of comparatively high self induction, both fed by the same alternating current line and having their rotating element mechanically coupled, substantially as described.

4. A synchronous alternating current motor having its field magnets excited by a constant current, and a condenser of suitable capacity in a shunt across the terminals of the field magnet windings, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

MAURICE HUTIN.
MAURICE LEBLANC.

Witnesses:
CLYDE SHROPSHIRE,
PAUL BOUR.