No. 847,079. PATENTED MAR. 12, 1907.

M. JOHANNET.

ELECTROMAGNETIC TRANSMITTING DEVICE.

APPLICATION FILED NOV. 27, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

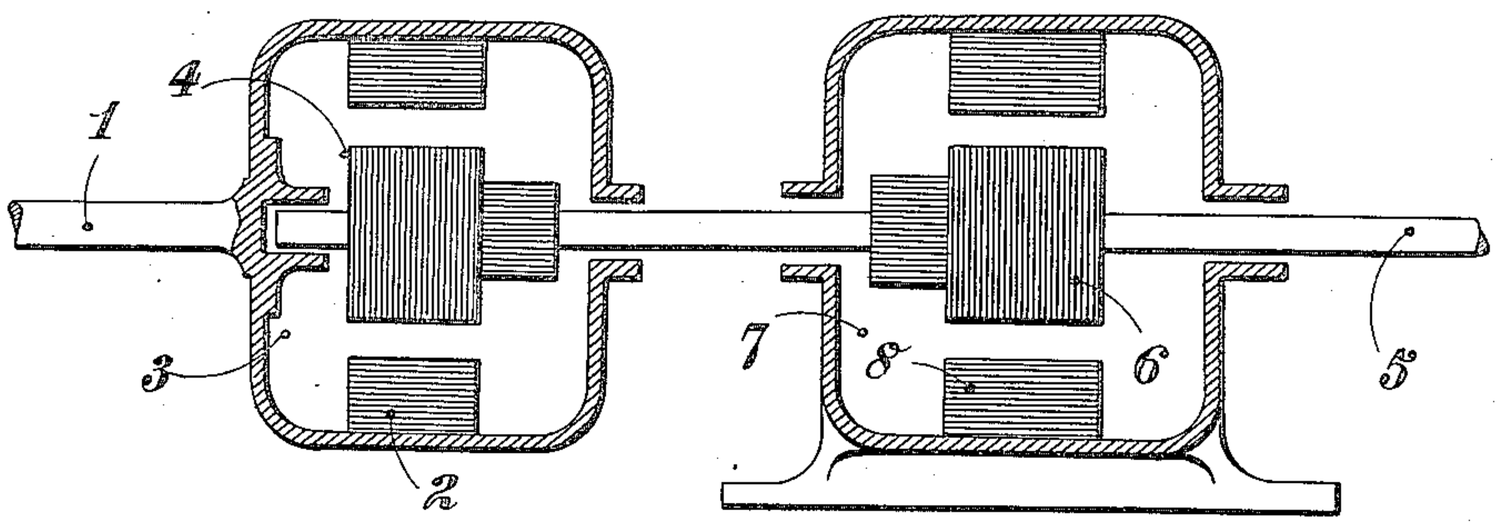
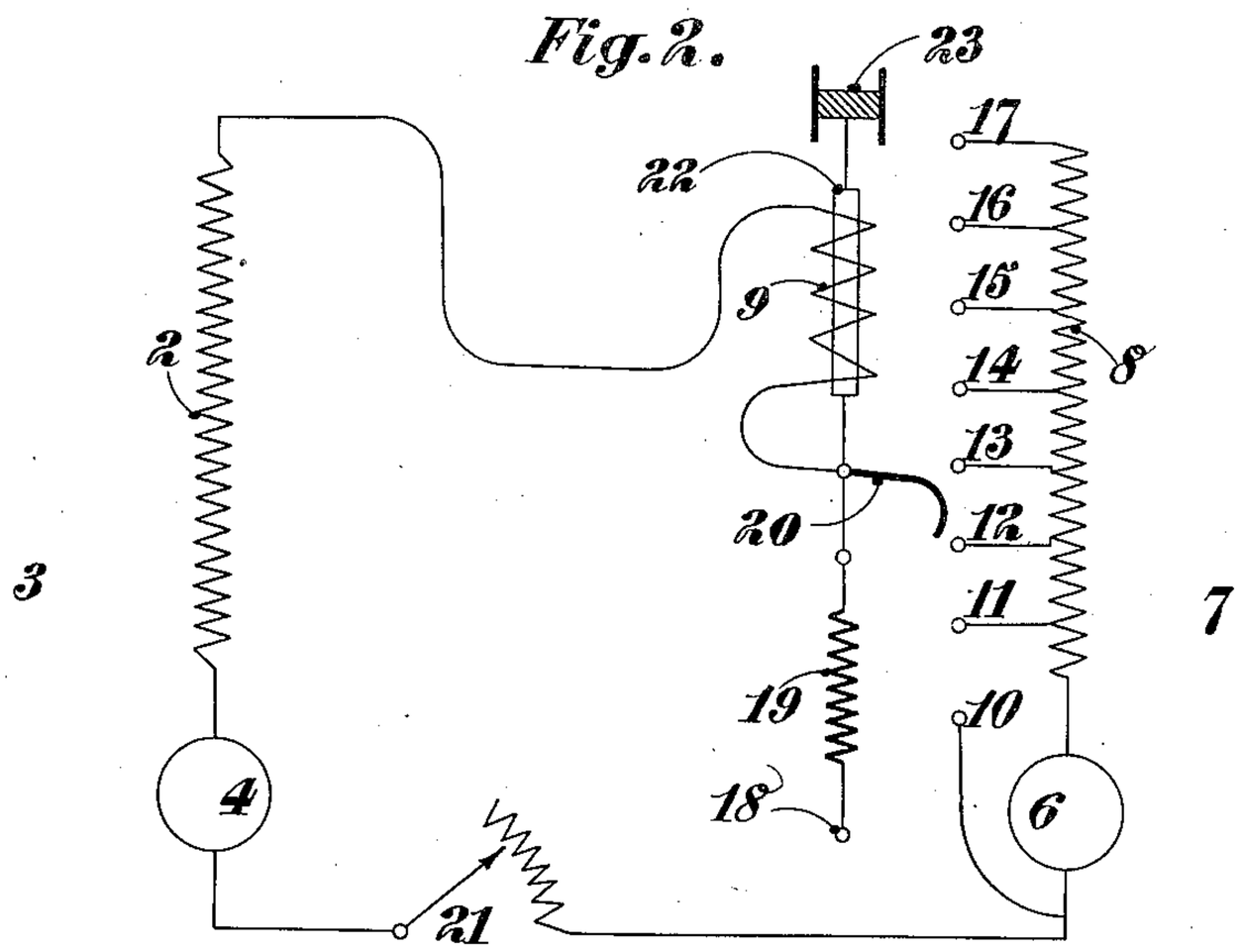


Fig. 2.



Witnesses:

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Inventor

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2 SHEETS—SHEET 2.

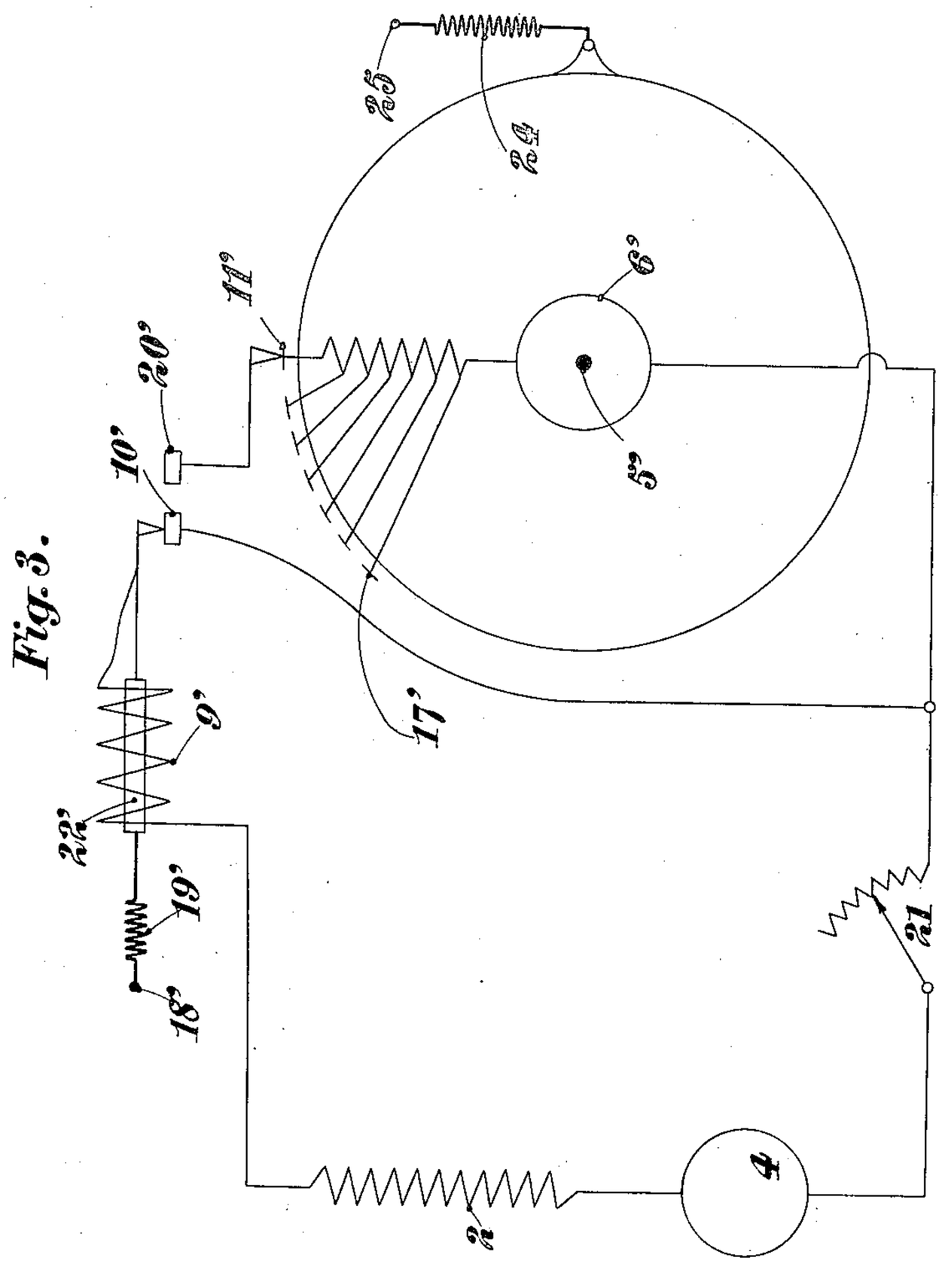

Fig. 3.

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ELECTROMAGNETIC TRANSMITTING DEVICE.

No. 847,079. Specification of Letters Patent. Patented March 12, 1907.

Application filed November 27, 1906. Serial No. 345,341.

To all whom it may concern:

Be it known that I, MAX JOHANNET, engineer, a citizen of the French Republic, residing at Paris, department of the Seine, France, and whose post-office address is 138 Avenue de Wagram, in the said city, have invented certain new and useful Improvements in Electromagnetic Transmitting Devices, of which the following is a specification.

This invention has for its object a means of transmission comprising an electromagnetic clutch serving to transmit the movement of a motor-shaft to a driven shaft arranged in line with it by means of two dynamos, one acting as generator and the other as receiver.

The accompanying drawing illustrates the manner of carrying this arrangement into practice diagrammatically.

Figure 1 shows an arrangement of the motor-shaft in line with the driven shaft. Fig. 2 shows a method of connection intended for progressively throwing the driven dynamo into circuit. Fig. 3 illustrates a modification of this device.

A shaft 1, driven by a motor of any suitable kind, drives the field-magnets 2 of a generator 3, the field-magnets replacing the fly-wheel of the motor, if desired. The armature 4 of this generator is keyed upon the driven shaft 5, as is also the armature 6 of a receiving-machine 7, the field-magnets 8 of which may be fixed, as is the case in Fig. 1.

Fig. 2 illustrates the electrical connections. The same numerals of reference represent the same parts; but in addition it will be seen that the field-magnets of the machine 7 are divided in such a manner that an automatic-regulator electromagnet 9 causes the current of the generating-machine to pass into a greater or less number of field-magnet coils of the receiving-machine 7, consequently increasing its magnetic field to a greater or less extent. Finally, a starting-rheostat with interrupter 21 completes the circuit. The dynamos are both wound in series in such a manner that the total current traverses all the appliances or else traverses none of them, according to the action of the automatic-regulator electromagnet. This automatic regulator comprises a solenoid 9, attracting a core 22, which carries the movable current-conducting finger 20. A spring 19, attached to a fixed point 18, tends to move the core 22 in the opposite direction to that of the action of the solenoid 9. This spring 19 is given such an initial tension that it balances the attraction of the solenoid 9 when this latter is traversed by a current of given value i. It is also sufficiently sensitive in order that a slight increase of the current will cause the finger 20 to move toward the contact 17, and for this the current will be i', differing but little from i. Let us consider an intensity of circulation I comprised between these two extreme values i and i'. It will be seen that an increase of I will cause the movement of the finger 20 toward the contact 17, introducing into the circuit a larger number of field-magnet coils of the receiving-machine, while a diminution of the intensity of circulation I will cause the finger 20 to move toward the contact 10, cutting out of the circuit a larger or smaller number of these coils of the receiving-machine, or even cutting this latter entirely out of circuit. To sum up, an increase of the intensity of circulation will produce an increase of the field of the receiving-machine, while a diminution of the intensity of circulation will produce a diminution of the field of the receiving-machine, or in the extreme case will cut it out of circuit. In order to damp the excessively rapid oscillations of the apparatus, a damping-air piston 23, adjustable at will, may be arranged on the core 22.

The operation may be described as follows: On the stoppage of the system the spring 19 maintains the finger 20 on the contact 10. The shaft 5 is stopped and likewise the two armatures 4 and 6. The motor-shaft 1 is placed in movement. The starting-rheostat 21 is closed. At this moment the generating-machine is closed upon the solenoid 9 and becomes energized in proportion to the rotation of its field-magnets 2 around its armature 4.

First case.—The circulation-current is much lower than the special value I, or, more particularly, than the value i. The attraction of the solenoid 9 on the core 22 is less than that of the counter-spring 19, and the finger 20 remains upon the contact 10. The receiving-machine is out of circuit. In proportion as the intensity increases the mechanical couple furnished by the motor-shaft 1 increases, and with it the electromagnetic couple, which is substantially equal to it, and which the armature 4, attracted by the field-magnets 2, transmits to the shaft 5. The electromotive force of the generating-machine is at first very large when the shaft 5 is

at rest, thus giving rise to very great intensity, and then starting takes place. As the resistant couple diminishes owing to this fact, the intensity will diminish, and consequently the magnetic field will diminish also. On the other hand, as the armature begins to rotate in the same direction as the field-magnets the speed of operation of the generating-machine diminishes. For these two reasons—diminution of the speed of operation and diminution of the magnetic field—the electromotive force of the generating-machine decreases. Subsequently any variation of the resistant couple will produce a variation in the inverse direction of the speed of the shaft 5, and for the reasons which have just been given this variation causes contrary variations—that is to say, in the same sense as that of the resistant couple—for the speed of operation of the generator, for the intensity of circulation, for the electromotive force, and for the motor-couple.

Second case.—The circulation-current attains the special value I, or, more particularly, is comprised between i and i'. The attraction of the solenoid 9 is then counterbalanced by the spring 19 in such a manner that a variation of intensity produces a variation in the same sense for the field of the receiving-machine. In this case the shaft 5 is driven both by the action exerted by the field-magnets 2 upon their armature 4 and by the ordinary action of the magnetic field 8 of the receiving-machine 7 upon its armature 6. The resistant couple is then greater than the motor-couple by the whole value of the couple of the receiving-machine, except the output in the dynamos of the electromagnetic couples relatively to the mechanical couples. Assuming an increase of the resistant couple, its immediate action translates itself into a diminution of the speed of the shaft 5, and consequently by an increase of the speed of operation of the generating-machine, of its electromotive force, and of its intensity, which increases have for their consequence increases of the field and of the intensity of the receiving-machine, which in their turn result in increasing the couple of the receiving-machine. In the same manner a diminution of the resistant couple results in a diminution of the couple of the receiving-machine. Any variation of the resistant couple is therefore borne wholly by a variation in the same sense of the couple of the receiving-machine and does not exert any appreciable action upon the motor-couple, which remains constant, since the intensity I of the generating-machine, and consequently its electromagnetic couple, remains substantially constant, owing to the automatic regulator. The exactitude of this result will be greater according as the spring 19 is more sensitive to the small variations of the intensity I or as i and i' are closed together.

Third case.—The circulation-current is much larger than the special value I, or, more exactly, than the special value i'. In this case the attraction of the solenoid 9 is constantly greater than that of the spring 19, and the finger 20 is constantly in contact with the contact-piece 17, corresponding to the maximum number of field-magnet coils of the receiving-machine. In this case the shaft 5 is driven, as in the foregoing, both by the action of the generator and by that of the receiving-machine. The variations of the resistant couple lead to the same variations of the operative parts as in the foregoing case—that is to say, in the inverse sense for the speed of the shaft 5, but in the same sense for the speed of operation of the generator, its electromotive force, and its intensity, and also for the field, the intensity, and the couple of the receiving-machine; but in this case the variations of the resistant couple can only be obtained by means of appreciable variations of the intensity. These latter necessitate variations of the electromagnetic couple of the generator, which can only result from variations of the motor-couple. In this case, as in the first case, the motor-couple varies when the resistant couple varies; but the two cases are differentiated, owing to the fact that in the third case a smaller variation of the motor-couple corresponds to the same variations of the resistant couple than in the first case, owing to the action of the receiving-machine, which is operative contrary to what occurred in the first case.

To sum up, it may therefore be stated, first case, the variations of the resistant couple cause variations of the same value of the motor-couple; second case, the variations of the resistant couple may take place without variations of the motor-couple; third case, the variations of the resistant couple cause variations of the motor-couple in the same sense, but of less value. They will be one-half, and the two dynamos have the same electromagnetic couple.

The normal operation of the apparatus of course corresponds to the second case. There is therefore the advantage of automatically transforming the two power factors of a given motor in such a manner that the couple and the speed of the driven shaft will vary automatically in the inverse senses one to the other without appreciable variations of the motor work. The first and the third cases correspond to the extreme cases of operation, for which a momentary variation of normal running conditions is admissible. It will therefore be seen that means are provided for utilizing under the best conditions as regards operation and efficiency any kind of motor which may be connected to the shaft 1.

The transmission may be defined by a self-energizing electromagnetic clutch, in which any loss of work occasioned by slip is recuperated apart from internal losses in the receiving-machine, which is itself of variable field arrangement, in such a manner as to maintain the motor work constant.

Variations of speed.—When it is desired to cause the speeds of operation of the driven shaft to vary, all that is necessary is to diminish the available motor work by the means appropriate to the motor employed. The result of the variations of the motor work is the variations of speed of the driven shaft if the resistant couple has remained the same. The starting-rheostat may also be introduced more or less into the circuit. The electromotive force of the generating-machine being intended to balance the contra-electromotive force of the receiving-machine and the losses of charge in the circuit, the introduction of the rheostat increases the total resistances of the circuit, and as the resistant-couple has remained the same the intensity should remain constant, and consequently the contra-electromotive force of the receiving-machine diminishes, which entails the diminution of its speed, and consequently that of the driven shaft. In cases in which the rotation of the field-magnets of the receiving-machine are not utilized for increasing the couple the electroregulator may be replaced by a simple switch which places the receiving-machine in the circuit of the generating-machine or out of this circuit. In this case, Fig. 3, the solenoid 9′, provided with a counter-spring 19′, attracts a core 22′, which can only establish a contact at 10′ or at 20′.

The divided field-magnets 11′ to 17′ of the receiving-machine are arranged in such a manner that they are able to rock around the armature-shaft 5′; but their movement is limited by a spring 24, attached to a fixed point 25. The whole thus constitutes an actual electrodynamometer in such a manner that the increase of intensity resulting from the operation, as described above, introduces a more or less considerable number of induction-coils into the circuit.

The apparatus is applicable to motor-vehicles, lifting appliances, punches, machine-tools, or any machine in which the work varies.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

An electromechanical transmission from a motor-shaft to a driven shaft, comprising two dynamos, one of which constitutes a generator and the other a receiver, said dynamos having the armatures thereof keyed upon the driven shaft, the generating-dynamo having its field-magnets integrally connected to the motor-shaft, and the receiving-machine having its field-magnets subdivided into sections, and an electromagnetic regulator for placing in circuit a variable number of the sections of the field-magnets of the receiving-dynamo and operating automatically in proportion to the intensity of the current developed in the generating-machine, for the purpose of varying the field of the receiving-machine, and consequently causing the variation in the inverse sense of the two factors (couple and speed) of the constant power available on the driven shaft.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

MAX JOHANNET.

Witnesses:

MAX DE RIVAUD,

EMILE KLOTZ.