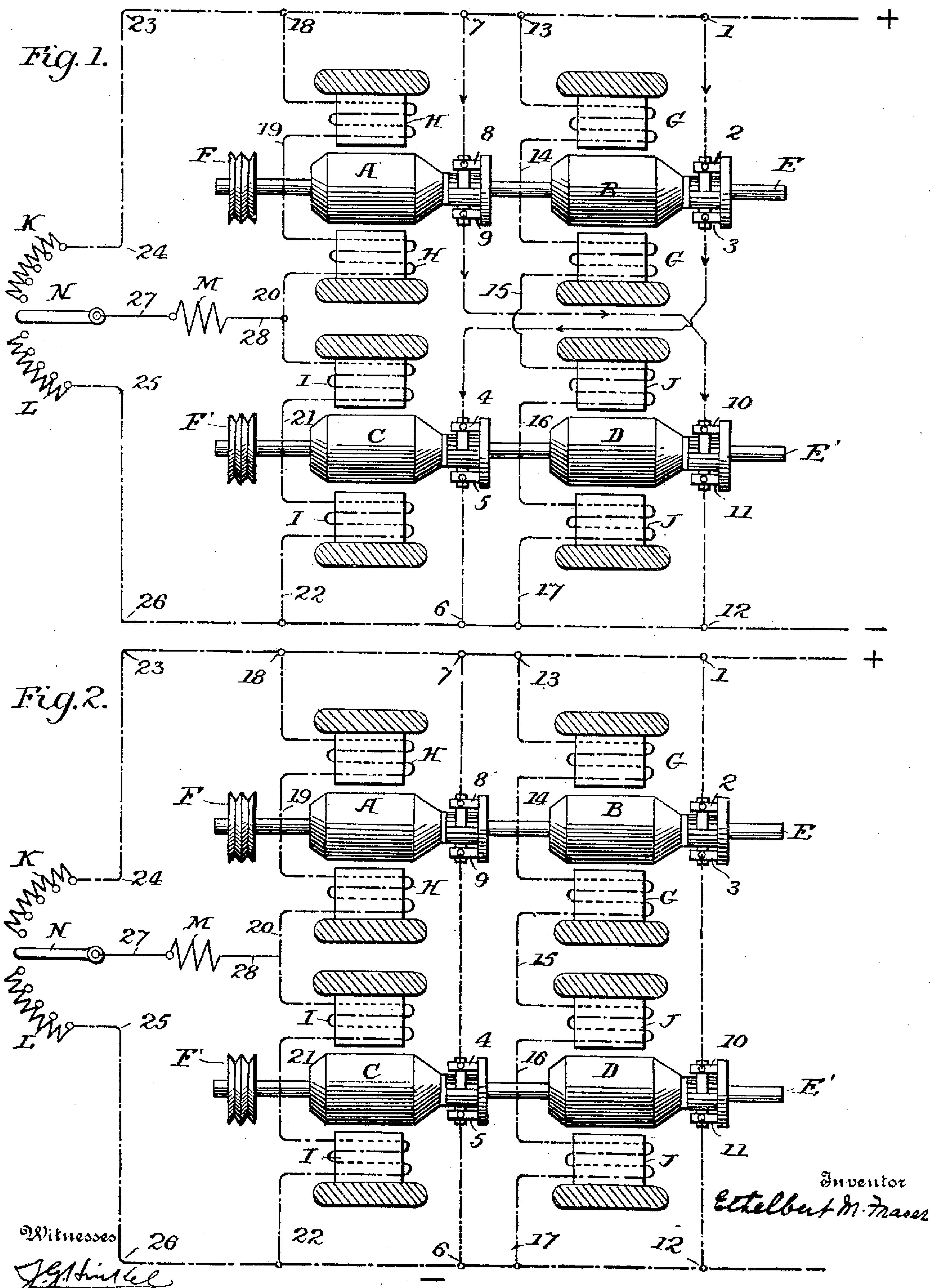
No. 697,832. Patented Apr. 15, 1902.

E. M. FRASER.

ELECTRIC TRANSMISSION OF POWER.

(Application filed Nov. 6, 1900.)

(No Model.) 2 Sheets—Sheet I.



Witnesses
J. G. Hinkel
H. M. Gillman, Jr.

Inventor
Ethelbert M. Fraser

By Foster Freeman Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 697,832. Patented Apr. 15, 1902.

E. M. FRASER.

ELECTRIC TRANSMISSION OF POWER.

(Application filed Nov. 6, 1900.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 3.

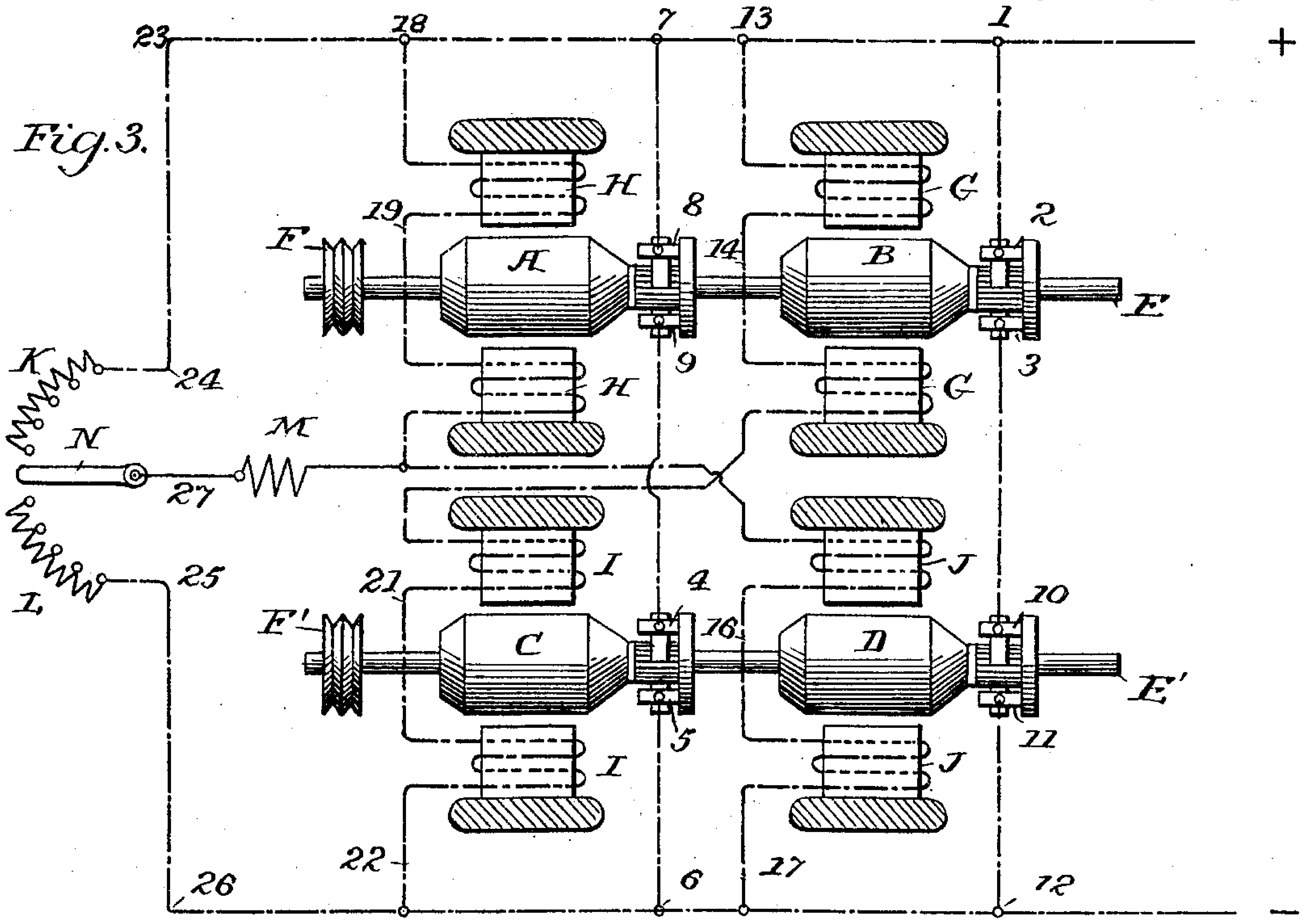
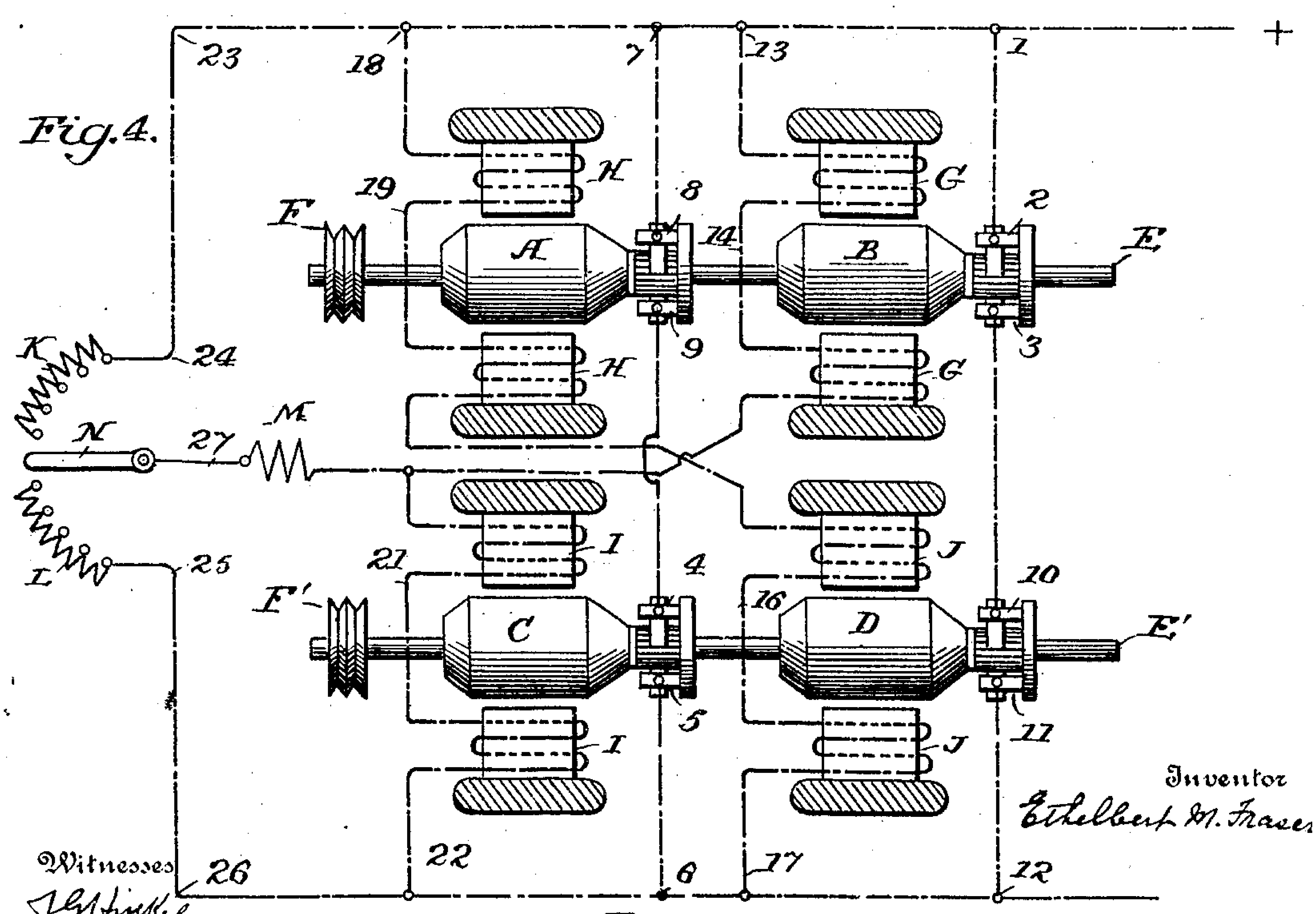


Fig. 4.



Witnesses
J. G. Hinkel
H. M. Gillman, Jr.

Inventor
Ethelbert M. Fraser

By Foster Freeman Attorneys

UNITED STATES PATENT OFFICE.

ETHELBERT M. FRASER, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF EAST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTRIC TRANSMISSION OF POWER.

SPECIFICATION forming part of Letters Patent No. 697,832, dated April 15, 1902.

Application filed November 6, 1900. Serial No. 35,644. (No model.)

To all whom it may concern:

Be it known that I, ETHELBERT M. FRASER, a citizen of the Dominion of Canada, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in the Electrical Transmission of Power, of which the following is a specification.

My invention relates to the electrical transmission of power; and it has for its object to provide improved means whereby an efficient and economical distribution of power can be made; and to these ends it consists in the various combinations and arrangements of translating devices and circuits having the general mode of operation substantially as hereinafter more particularly pointed out.

Referring to the accompanying drawings, Figure 1 is a diagrammatic representation of various motors or translating devices and circuits whereby the advantages of my invention may be attained. Figs. 2, 3, and 4 are similar views showing the general arrangement of circuits for accomplishing the same general purpose in the same general way.

While, as above stated, my invention relates generally to the electrical transmission and distribution of power, and while the invention may be utilized in many and various ways and conditions for specific purposes, and the arrangement of translating devices and circuits can be adapted by those skilled in the art to accomplish the specific results desired, my invention is more particularly intended to be used in the operation of electric elevators and similar devices, and I shall therefore describe its embodiment for this purpose, but without the intention of limiting myself to this particular use, as it is equally applicable to many and various uses, which will be apparent to those skilled in the art.

Generally speaking, my invention is more especially adapted for use in connection with what are usually known as "duplex-motor-operating" devices—that is, where there are two motors or two means of exerting mechanical power connected to the motors, each means being capable of being operated at different speeds and to do different amounts of work or the same amount of work under different conditions.

In the operation of duplex motors as applied to electric elevators, on application for which I have received various Letters Patent, I provide two motors normally running at uniform speeds and both preferably connected to the elevator-operating devices and so arranged that when the motors are running at uniform speeds the elevator is at rest. When, however, there is a change in the relative speeds of the two motors, as when one motor is caused to run above its normal speed while the other remains at its normal speed, or when one motor is caused to run below its normal speed while the other remains at its normal speed, or when one motor is caused to run above its normal speed and the other below its normal speed, or, in fact, whenever there is a difference in speed between the running of two motors, the elevator is moved up or down in accordance with the difference of speed. For instance, while one of the motors, which is commonly designated the "top" motor, runs faster than the other motor, which is commonly designated the "bottom" motor, the car ascends, and, vice versa, when the bottom motor runs faster than the top motor the car descends.

In the previous constructions it has been common to use two motors, a "top" and a "bottom" motor, so called, and one of the disadvantages of this arrangement lies in the fact that the motor running at the higher speed does most of the work, and it is well known that in running a motor at a high speed the strength of the field-magnets is reduced, and this reduction of the strength of the field-magnets reduces the torque, and my present invention, among other things, overcomes this disadvantage. As the speed of the car is governed entirely by the difference in speed between the two motors, it is manifest that the slower the slower-running motor is run the faster-running motor can be run proportionately slower and still maintain the same difference in speed. So, too, it is manifest that the slower the faster-running motor is run without changing the relative speeds between it and the slower-running motor the stronger will be the field of said faster-running motor, the greater will be the torque, and the heavier will be the load which can be raised by the same-sized motor. Carrying these relations to their extremes, it will be seen that if one motor runs very slowly, or, indeed, is entirely stopped, the faster-running motor could maintain the proper difference of speed and would give the greatest efficiency, as the strength of the field-magnets would be nearer maximum, and the faster-running motor would be running under the best possible conditions. By my arrangement of motors this result can be attained, and at the same time I can retain all the advantages of the so-called "duplex-motor" system.

In the ordinary duplex-motor system two separate motors are used, each motor having a separate armature connected to a suitable pulley or other means for transmitting mechanical power. In my present invention I utilize four electric motors, and each motor may be half the size or have half the power of the motors when two are used. In other words, I practically cut the two motors usually employed into two parts, making four electric motors, with their proper field-magnets, armatures, commutators, and circuits; but I provide for each two or pair of motors a single shaft, to which the two armatures of the pairs of motors are positively connected, and there is a pulley or other suitable means for transmitting power on each shaft. These four electric motors may be arranged in circuit in various ways between the line-terminals, and, generally speaking, the field-magnet coils of the motors and the armatures thereof are connected in circuit in pairs in series with one another between the line-terminals—that is to say, the field-magnet coils of one of the motors on one of the shafts are connected in series with the field-magnet coils of one of the motors on the other shaft, and the armature of one of the motors on one of the shafts is connected in series with the armature of one of the motors on the other shaft. It is manifest that various combinations of such connections can be made with the four motors between the main-line terminals, and I shall illustrate some of them herein.

Some means are provided whereby the current passing from the field-magnet coils of one of the motors may be shunted around said field-magnet coils, and preferably there is provided some means for increasing or decreasing the resistance in the circuit of the field-magnet coils whereby the circuit may be controlled and the maximum and minimum relative speeds of the motors can be changed.

Referring to Fig. 1, + and − represent the main-line terminals of a circuit supplying a current of constant electromotive force or voltage. A and B represent two armatures mounted on a single shaft E, having a driving-pulley F or similar means for transmitting mechanical power. H H are the fields for the armature A, and G G are the fields for the armature B. C and D are two armatures mounted on a single shaft E′, having a driving-pulley F′ or similar device, and I I represent the fields for the armature C, and J J the fields for the armature D. The armature B is connected to the + line and is in series in this instance with the armature C, which is connected to the − line, the circuits being from the + line at 1 to the brush-holder 2, through the armature B to the brush-holder 3, thence to brush-holder 4 of armature C, through armature C to brush-holder 5, thence to the − line at 6. The armature A is connected to the + line and in this instance is connected in series with the armature D, which is connected to the − line, the direction of flow of the current being from the + line at 7 to the brush-holder 8, through the armature A to the brush-holder 9, thence to the brush-holder 10 of armature D, through armature D to brush-holder 11, thence to the − line at 12. The fields G G and J J are in this instance in series with each other and are connected in a straight line across the feed-terminals. Thus the current flows from the + line at 13 through one field-coil G, by the conductor 14 through the second field-coil G, thence by conductor 15 to one of the field-coils J, by conductor 16 to the other field-coil J, and by conductor 17 to the − line. The fields H H and I I are also in this instance connected in series with each other and in a straight line across the feed-wires, and the current flows from the + main line at the point 18 through one of the fields H, by the conductor 19 to the other field H, by the conductor 20 to the field I, thence by conductor 21 to the other field I, and thence to the − line by conductor 22. There is a shunt around the fields, and the current can flow from the + line at the point 23 to the point 24 through the resistance K, lever N, conductor 27, resistance M, and conductor 28 to the conductor 20, thus shunting part of the current from the fields H H, or the current from the fields I I can be shunted by moving the lever N to the resistance L, completing the shunt through the point 25 and conductor leading therefrom to the point 26 on the − main line. Suitable starting and stopping devices of course must be used, so that the motors may run continuously or be stopped, as deemed expedient; but these form no part of my present invention, and hence are not shown, as the present invention applies only to the manner of controlling the motors while they are running or in suitable connection to run. With this arrangement of circuits one pair of armatures can be slowed or even stopped, while the other pair can be speeded up to the desired degree, and the relative difference between the speeds of the two pairs of motors can be maintained whatever may be the actual speed of the motors. For instance, the pair of motors having the armatures C and D can be slowed down to any desired degree and even brought to a state of rest while maintaining the relative speeds between this pair of motors and the motors having the armatures A and B, and, as before intimated, it is manifest that this is theoretically the most economical and effective relation between the running of the two pairs of motors, and I will now explain how this can be accomplished. Under normal conditions it is assumed that both pairs of motors are running at their normal speeds and at a uniform speed, so that the pulleys F F′ are rotating at the same speed, and it is assumed that it is desired to slow down or stop the armatures C D and speed up the armatures A B, so as to obtain the proper difference in speed between the two shafts E and E′, and it is supposed that the permanent resistance M has been properly adjusted for this purpose. To do this, the rheostat-lever N is moved so as to make contact with and gradually cut out the resistance K, and thus shunt a portion of the current flowing through the field-coils H H, and this of course will weaken these coils, and the armature A will increase its speed. This increase of speed of the armature A causes several changes in the circuits of the motors and in their operations to follow one another. Thus, as the armatures A and B are on the same shaft E, when the armature A increases its speed the armature B is driven at a speed higher than its normal, and this would cause the armature B to act as a generator and generate a current to supply the line; but the armature C is in series with the armature B, and as each when running normally would divide equally the line-voltage when the armature B generates a higher voltage by being speeded up, the strength of the field remaining the same, the armature C will have less counter electromotive force to generate, and consequently it will run at a much slower speed. The armature C is connected directly to armature D by the shaft E′, and the armature D consequently must run at the same slow speed as the armature C, and as the armatures A and D are in series with each other and when running at their normal speeds equally divide the line-voltage, and as armature D now runs slower than its normal speed, it must necessarily generate less counter electromotive force, and so to maintain the line-voltage the armature A will have to be speeded up enough to generate this difference. When the armature A speeds up, it intensifies this action, and the armatures A and B continue to speed up and the armatures C and D continue to slow down until the armatures C and D stop rotating and also cease to generate any counter electromotive force, and the armatures A and B will then be running on the total line-voltage and running in the most efficient manner. The speed of the armatures A and B cannot be increased after the armatures C and D are stopped without causing the armature B to generate current to supply the line, and they thus become self-regulating and self-controlling and work in the most effective manner. When, however, the rheostat-lever N is moved to its normal position, the currents will adjust themselves so that all the armatures will run at the same speed as under normal conditions. Of course the same general effect results if the lever N is moved onto and over the resistance L, and the fields I I are weakened, except that the speed of the armatures C and D will be increased and the speed of the armatures A and B slowed down and finally stopped. In actual practice it is necessary only to weaken the fields H H or the fields I I to a slight degree to cause the respective pairs of armatures to slow down and stop or to run at their maximum speed, and thus this adjustment can be accomplished with a practically sparkless operation. In Fig. 2 I have shown the same arrangement of motors except that the electric connections are different. In this case the armatures A and C are in series and the armatures B and D in series, while the fields remain as in Fig. 1. In Fig. 3 the same arrangement of motors is shown, and the armatures are shown in the same circuits as in Fig. 2; but the fields H H and J J are in series, and the fields G G and I I, and the rheostat is arranged so as to vary the current in the fields H H and J J. In Fig. 4 the armatures are connected the same as in Fig. 3, and the fields G G and I I are in series, as in Fig. 3; but the circuits are such that the current is varied in the fields G G and I I. In all of these arrangements of circuits the ultimate results are substantially the same as in the arrangement shown and described in connection with Fig. 1, and it is not deemed necessary to trace the circuits and explain the resulting conditions in all of these modifications, as they will be readily understood by those skilled in the art. It will thus be seen that I provide two sets of motors in the present instance, each set comprising two motors, although the number may be extended, and the armatures of each set are mechanically connected, while the armature of a motor of each set is electrically connected in series with an armature of a motor of the other set, and each field of a motor of one set is connected with a field of a motor of the other set, and there are means for varying the field of one of the motors of one set, and connections between the armatures and fields and the supply-circuits whereby when the field of one of the motors of one set is varied one set of motors will be speeded up and the other set of motors be speeded down automatically until even one set of motors may be stopped entirely and the other set of motors be running at its normal speed, thereby utilizing the current to the best advantage. Furthermore, it will be seen that between the leading line-wires there is a series of parallel circuits and each circuit includes two fields or two armatures in series, or, in other words, two motor elements, one for each set of motors.

While the arrangements shown in the drawings are the preferred arrangements of circuits and motors, my invention is not limited to the precise arragements shown.

What I claim is—

1. The combination with a source of electric supply, of a plurality of sets of motors, the armatures of a motor of each set being connected in series, the fields of each motor of one set being separately connected in series with the field of a motor of another set, and means for varying the field of one of the motors, substantially as described.

2. The combination with a source of electric supply, of a plurality of sets of motors, the armatures of each set being mechanically connected, the armatures of a motor of each set being connected in series, the fields of a motor of each set being connected in series, and means for varying the field of one of the motors, substantially as described.

3. The combination with a source of electric supply, of two sets of motors, the armatures of each set being connected to a single shaft, each of the armatures of one set being connected in series with an armature of the other set, each of the fields of each set being connected in series with a field of the other set, and means for varying the field of one of the motors, substantially as described.

4. The combination with the leading conductors of a source of electric supply, of parallel circuits between said leading conductors, a plurality of sets of motors, the armatures of which sets are mechanically connected, each parallel circuit including a motor element of each set in series, and means for varying the current flowing through the motors, substantially as described.

5. The combination with a source of electric supply, of two sets of motors, the armatures of each set being mechanically connected, the armatures of a motor of each set being connected in series, the fields of a motor of each set being connected in series, and a shunt around the fields of one of the motors, substantially as described.

6. The combination with a source of electric supply, of two sets of motors, the armatures of each set being mechanically connected, the armatures of a motor of each set being connected in series, the fields of a motor of each set being connected in series, a shunt around the fields of one of the motors including a variable resistance, and a permanent resistance also included in the shunt, substantially as described.

7. The combination with two sets of motors adapted to normally run at the same speed, of means for varying the field of one of the motors, and circuits and connections between the motors whereby one set of motors will speed up and the other set of motors will speed down, substantially as described.

8. The combination with two sets of motors adapted to normally run at the same speed, the armatures of each set being mechanically connected, of means for varying the field of one of the motors of one set, and circuits and connections between the motors whereby one set of armatures will speed up and the other set of armatures will speed down, substantially as described.

9. The combination with two sets of motors adapted to normally run at the same speed, the armatures of a motor of each set being connected in series, and the fields of a motor of each set being connected in series, of means for varying the current of one only of the motors, and circuits and connections whereby the rate of speed between the sets of motors will be varied, substantially as described.

10. The combination with two sets of motors adapted to normally run at the same speed, the armatures of each set of motors being mechanically connected, and the fields and armatures of one set of motors being electrically connected in series, with the fields and armatures respectively of the other set of motors, of means for varying the field of one of the motors, substantially as described.

11. The combination with a source of electric supply, of a plurality of sets of motors, and circuits and connections whereby varying the current to one motor only of one set will vary the speed of the other set of motors, substantially as described.

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

ETHELBERT M. FRASER.

Witnesses:

THOS. M. LOGAN,

W. H. WHITE, Jr.