(No Model.) 3 Sheets—Sheet 1.

J. F. SHAWHAN.

ELECTRIC RAILWAY MOTOR.

No. 475,970. Patented May 31, 1892.

Fig. 1.

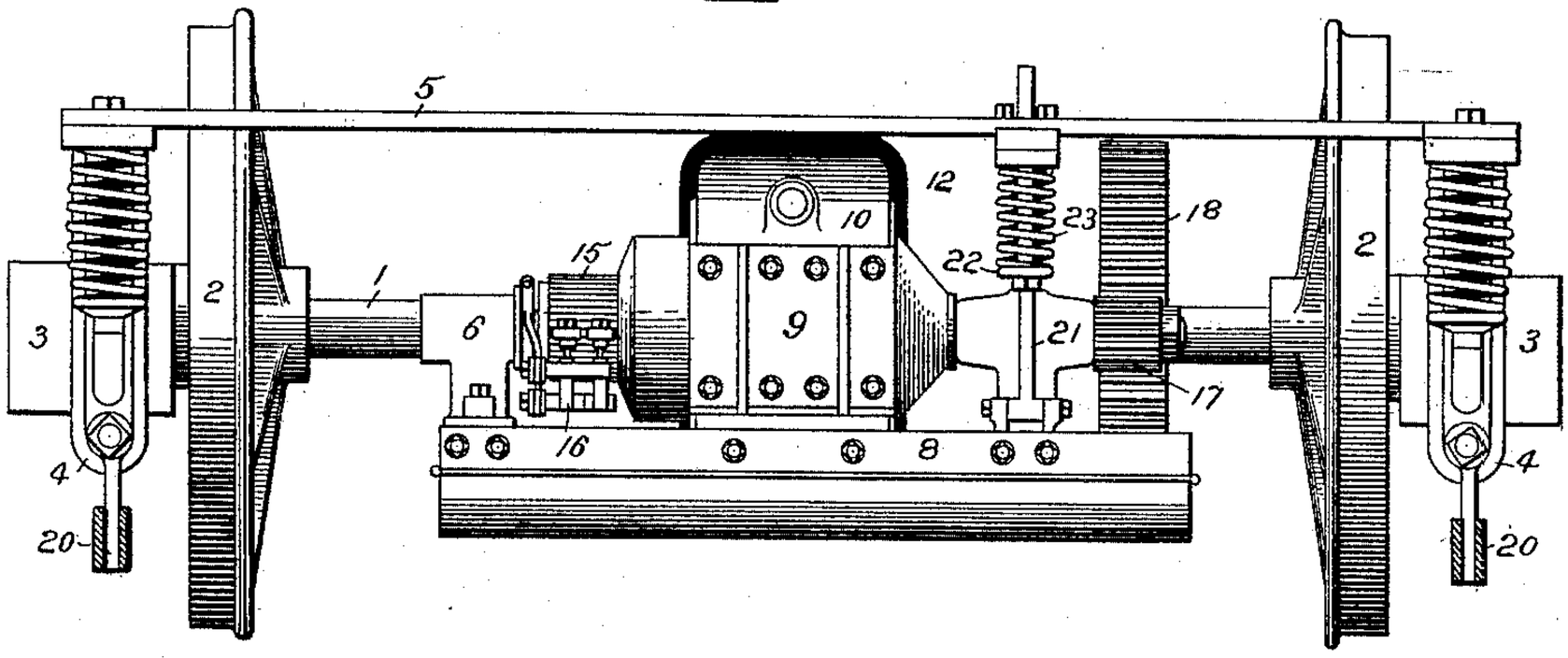
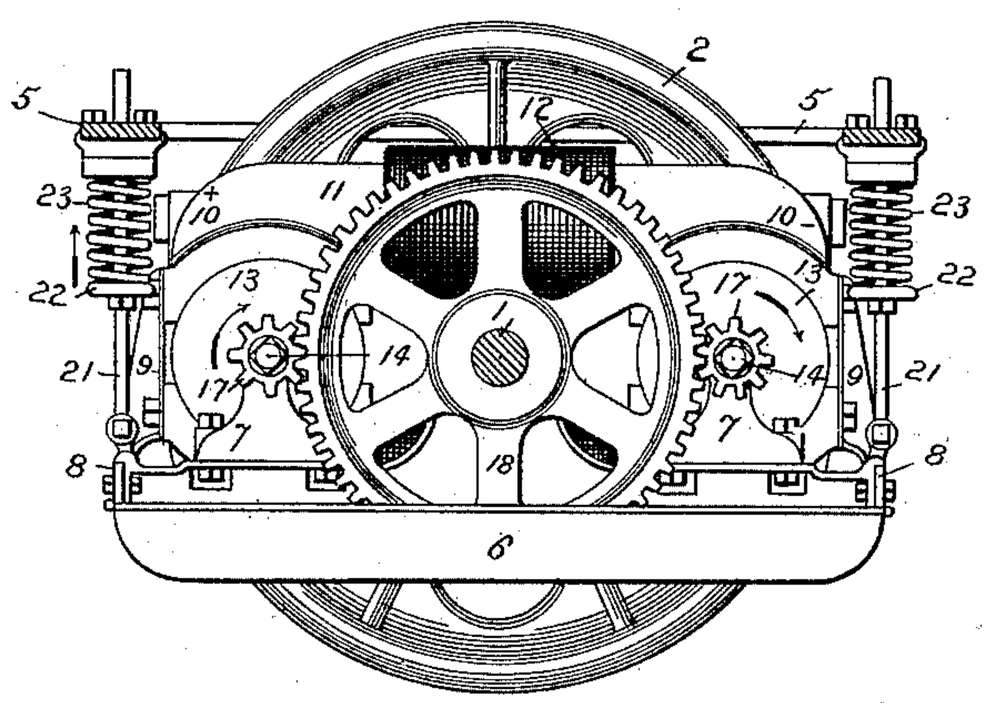


Fig. 2.



Witnesses
Jno. J. Hinkel.
H. S. McArthur

Inventor
Jabez F. Shawhan
By his Attorneys
Foster Freeman

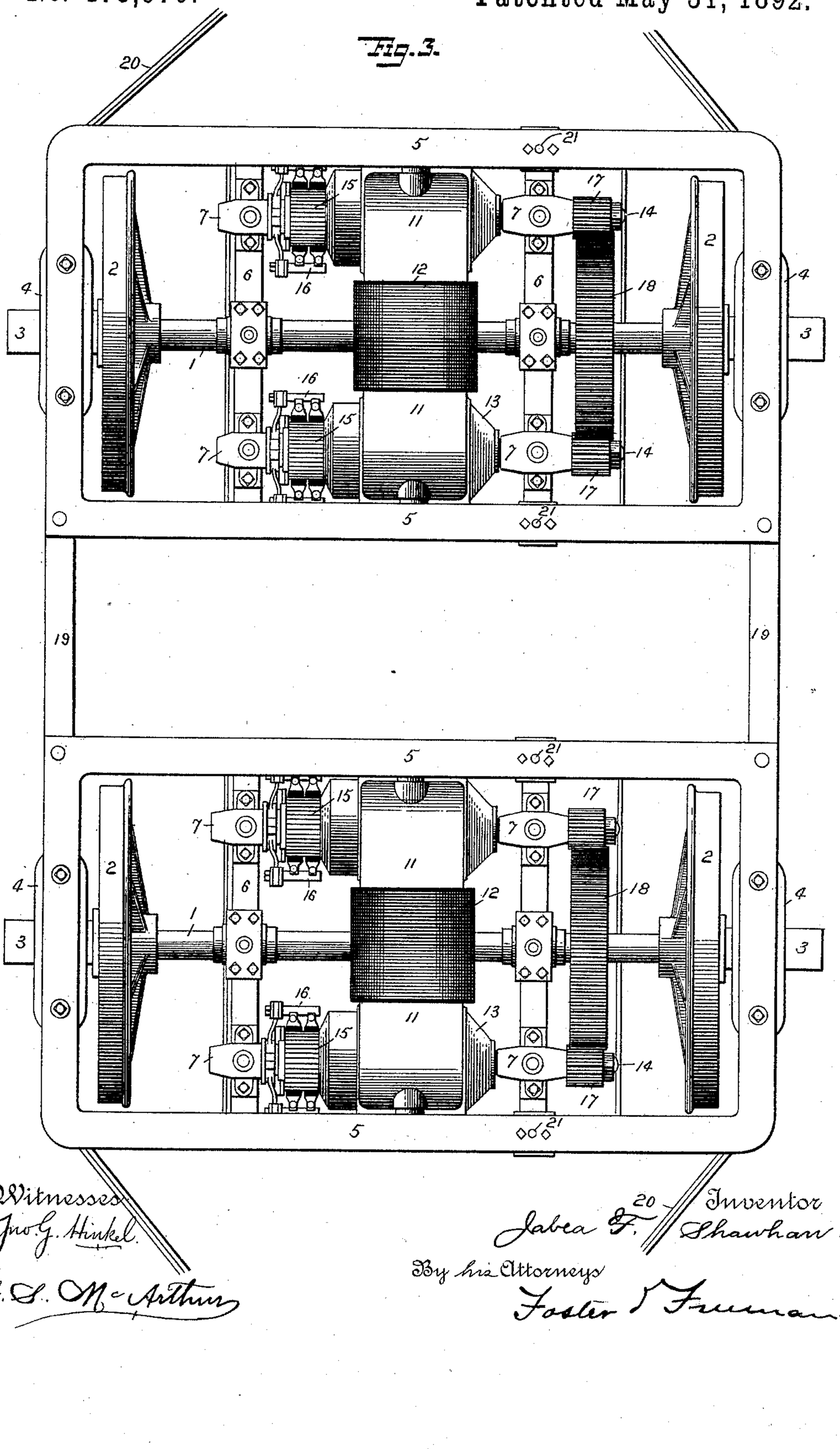
(No Model.) 3 Sheets—Sheet 2.

J. F. SHAWHAN.

ELECTRIC RAILWAY MOTOR.

No. 475,970. Patented May 31, 1892.

Fig. 3.



Witnesses
Jno. J. Hinkel.
H. S. McArthur

Inventor
20
Jabez F. Shawhan.

By his Attorneys
Foster & Freeman.

(No Model.) 3 Sheets—Sheet 3.

J. F. SHAWHAN.

ELECTRIC RAILWAY MOTOR.

No. 475,970. Patented May 31, 1892.

Fig. 5.

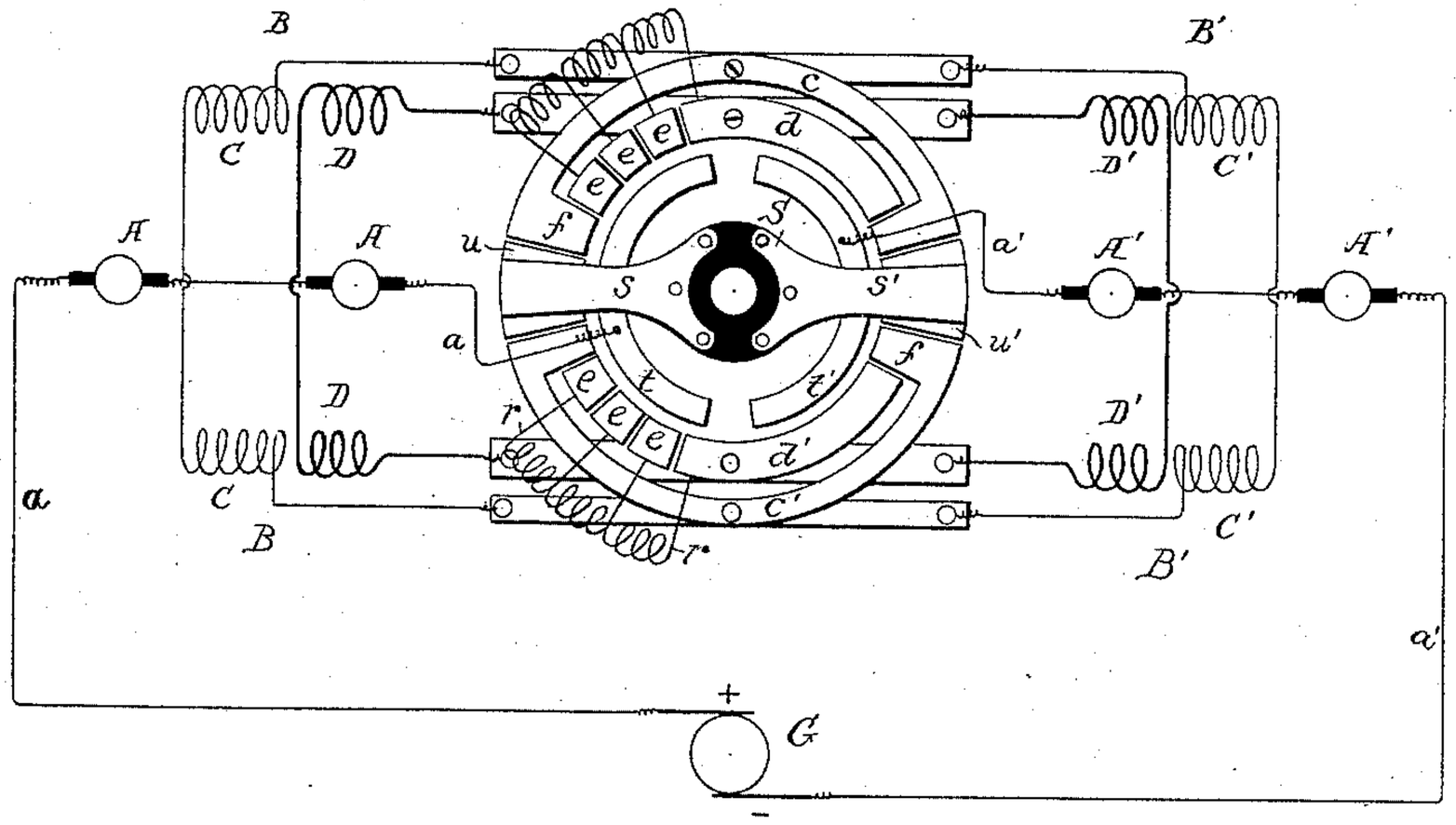
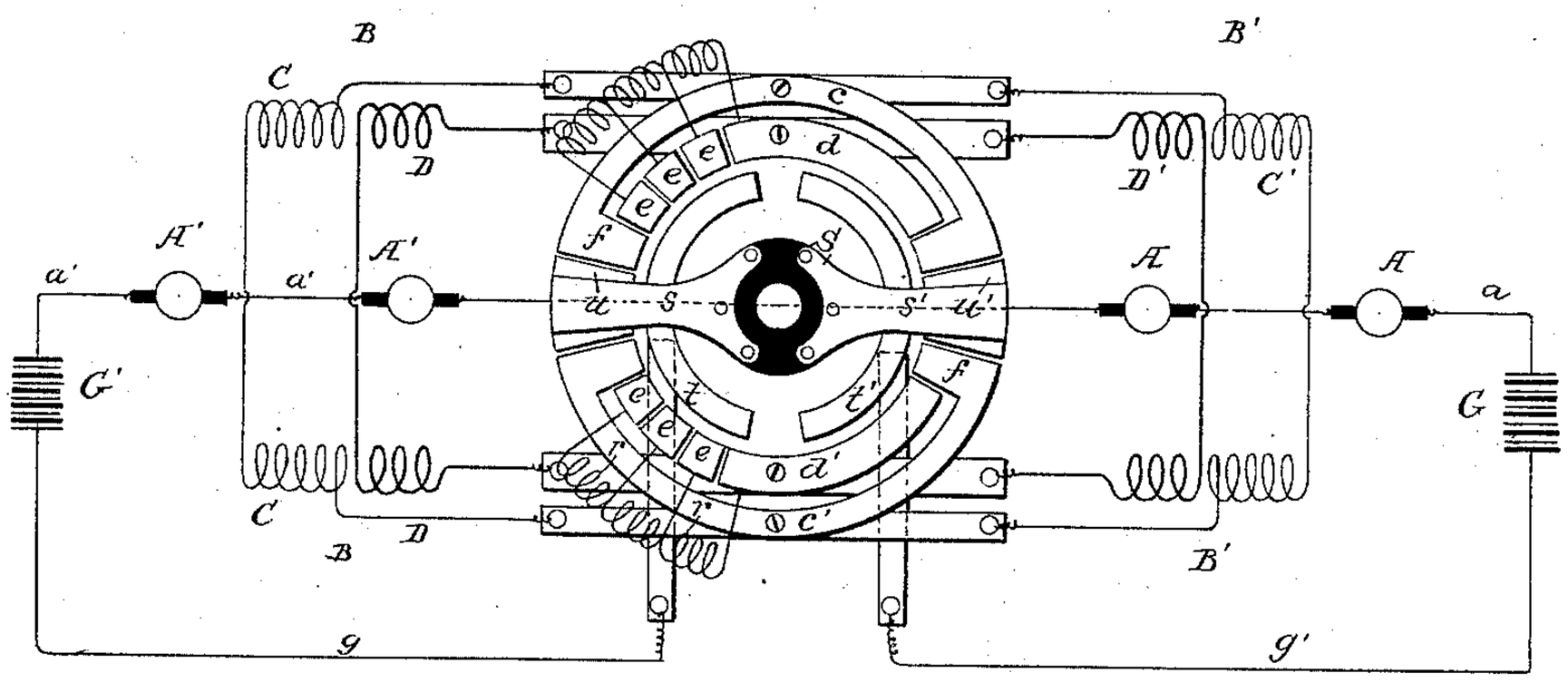


Fig. 4.



Witnesses
Jno. J. Hinkel.
H. S. McArthur

Inventor
Jabez F. Shawhan.
By his Attorneys
Foster & Freeman

UNITED STATES PATENT OFFICE.

JABEA F. SHAWHAN, OF DETROIT, MICHIGAN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO FREEMAN B. DICKERSON, OF SAME PLACE.

ELECTRIC-RAILWAY MOTOR.

SPECIFICATION forming part of Letters Patent No. 475,970, dated May 31, 1892.

Application filed May 10, 1890. Serial No. 351,338. (No model.)

To all whom it may concern:

Be it known that I, JABEA F. SHAWHAN, a citizen of the United States, residing at Detroit, Wayne county, State of Michigan, have invented certain new and useful Improvements in Electric-Railway Motors, of which the following is a specification.

My invention relates to electric-railway motors; and it has for its object to provide an electric motor specially applicable for electric railways, which shall be simple, compact, and effective, and which shall be so mounted and connected with the wheels or their axles as to produce the greatest effect in the action of starting and propelling the car and its total energy be most directly applied for these purposes.

To these ends my invention consists in an electric-railway motor constructed, mounted, and carried substantially as hereinafter set forth and mounted in connection with the axles and the car and operated by means of circuits and connections in the manner hereinafter explained.

Referring to the accompanying drawings, forming a part of this specification, Figure 1 is an end view of so much of a motor as is necessary to show my invention. Fig. 2 is a side view of the same, the one wheel being removed. Fig. 3 is a plan view of a truck for a car provided with a pair of motors, and Figs. 4 and 5 are diagrammatic representations of the preferred arrangements of circuits and connections for controlling the electric current supplied to the motor.

In the application of electric motors for railway purposes it is very desirable to have a simple, compact, and yet powerful motor that can be readily applied in such a manner as to transmit its power to the axles or wheels of the car in the most advantageous manner. In accomplishing this purpose I provide a motor having all these advantages to an eminent degree which may be applied to one or more sets of the wheels of the car, the preferred arrangement being substantially such as shown in the drawings, which I will now describe.

The axle 1 is rigidly connected to the wheels 2, and the extensions of the axles run in journal-boxes 3, connected by suitable hangers or pedestals 4 to the frame 5 of the truck. Mounted upon the axle are the hangers 6, having lateral extensions upon which are mounted the bearings 7 of the armature-shafts of the motor. These hangers are connected at their ends in any suitable way, as by bars 8, upon which are supported plates 9 of non-magnetic material, which are attached to and support the pole-pieces 10 of the field-magnets clear of the truck, the axle of which passes freely between the two field-magnets.

The field-magnets 11 are wound at or near their center with the coils 12 in such a way that the poles 10 of each field-magnet are respectively north and south, and the opposite poles of the two field-magnets are arranged adjacent to each other, so that the machine is a motor having two separate and independent armatures operating in one complete magnetic circuit. This construction has several advantages, some of which are apparent and need not be specified; but particularly in the application of electric motors to railway-cars is it advantageous in that it results in a very compact motor, occupying comparatively little space under the car, and, which is more important, enables the power of the motor to be applied on both sides of the axle. This arrangement prevents any tendency to distort the axle or the frame of the truck, and also furnishes simple means of applying the power of the motor directly to the axle. In the arrangement shown each armature 13 is mounted upon its own independent shaft 14, mounted in its own bearings 7 and carrying its own commutator 15 and brush arrangement 16, which is mounted, as usual, on the bearings 7; also, mounted upon each armature-shaft is a pinion 17, meshing in opposite sides of the gear-wheel 18, rigidly mounted on the axle 1. It will thus be seen that with this arrangement of the two armatures, one on each side of the gear-wheel, the power is applied to said wheel equally on both sides and in the most direct manner. It will further be seen that the axle is provided with a motor and is complete in itself; but when it is applied to the car of course it is necessary to have two axles, one or both of which may be supplied with a motor; but in either event each axle can be mounted in its own separate frame, and they

can be connected together or to the car-body in any suitable way, so that each axle can move independently of the other to a certain extent to accommodate itself to unevenness in the track.

It is well understood that it requires much greater power to start a car from the point of rest than it does to propel the car after it is once in motion. The same is true in starting a motor itself, and after the armature of the motor has commenced to rotate the same strength of current passing through the coils of the motor exerts a much greater force. I take advantage of this in the application of the motor to the car-axle and connect the motor to bear directly upward against the frame of the truck through the medium of springs or other elastic connections. Thus in the arrangement shown in the drawings I attach to the end of hangers 6 or bars 8 pivoted rod 21, which extends up through the frame 5 of the truck, and carries adjusting heads or nuts 22, between which and the frame are interposed springs or cushions 23. This construction permits the hangers and the motor carried thereon to rock to some extent, and as the end rocks toward the frame it is opposed by the spring or cushion 23, which is compressed in proportion to the power or force transmitted. When the end of the hanger rocks downward away from the frame, the rod 21 moves freely. Thus it will be seen on reference to Fig. 2 that there is a spring on each side of the hanger, and when the hanger rocks, so as to put one of the springs under compression, the rod at the other end of the hanger moves freely away from the spring. This construction provides for the difficulties before mentioned, for it will be seen that, supposing the car to be propelled in the direction of the arrow, Fig. 2, the gear-wheel 18 will be rotated toward the left and the armatures and armature-shafts will both be rotated in the opposite direction, as indicated by the arrows thereon. If the motor was free to move, it is manifest that the armature on the left-hand side would tend to move upward on the gear-wheel 18, and the armature on the right-hand side would tend to move downward below the central line. By the interposition of the spring 23 this tendency is overcome by a yielding force, and as soon as the armatures commence to rotate the action is first to compress the spring 23 and thereby to press upward against the weight of the frame until the resistance of the spring is sufficient to overcome the inertia of the car when it commences to move when the pressure stored up in the spring becomes active. In this way it may be said that the weight of the car and pressure of the spring 1 is utilized to assist in rotating the axle, as it is caused to bear on the gear-wheel 18 tangentially or out of the horizontal plane of the axle. Not only is this result effected, but it will be seen that it does not require as much power or force to start the armatures into rotation as it does to start the car into motion, and not until the pressure on the spring 23 is equal to the inertia of the car is the full force requisite. This permits the armatures to commence rotation under less than a full load, and I can thus take advantage of the fact before stated, that the armature exerts a greater pull in proportion to the current passing through it after it has commenced rotation than starting from the dead-point. It will be understood, of course, that if the car is to be propelled in the opposite direction the same results will be attained.

In both cases it will be seen that the tendency of both armatures is to move around the gear-wheel 18 in the same direction, and that they co-operate with each other in this action. It will thus be seen that the motor is carried bodily on the axle and is free to oscillate, and is carried directly with the axle whenever it goes, and no cramping strain is thrown on the gear, no matter how uneven be the track, and it will further be seen that the springs do not support the motor, but prevent it from rotating bodily with the axle.

In Figs. 4 and 5 I have illustrated, diagrammatically, the preferred ways of connecting the armature and field-circuits when running the motor with secondary batteries and with a current from a mechanical generator. In these figures A A and A′ A′ represent, respectively, the armatures of two motors, and B B B′ B′ the field-magnets for the motors. S is a switch controlling the circuits. Each field-magnet is wound with circuit-coils C D, the former being of many turns of wire with sufficient resistance to allow a definite amount of current to flow through them to magnetize their cores and the latter of low resistance with fewer turns. The terminals of the coils C C′ are each connected to two plates *c c′*, and the terminals of the coils D D′ are connected to the plates *d d′*. The switch is provided with an arm, which may be turned in any suitable way, having two insulated plates *s s′*, normally bearing upon the segmental plates *t t′*, and when the machine is at rest their free ends bear upon the insulated plates *u u′*. The plates *c c′* have sectors *f*, arranged adjacent the insulated blocks *u* on each side thereof, and the plates *d d′* are divided into a number of insulated portions *e*, connected by resistance-coils *r*. The secondary batteries are divided into two sections G G′, and one of the terminals of each section is connected by a conductor *g g′* to the plates *t t′*. The other terminals of each section are connected by the wires *a a′* to the armature, all the armatures being arranged in series. Of course in the position shown no current can pass. When, however, the switch is moved so that the arms *s s′* are in contact with two of the sectors *f*, the circuit is closed. Passing from the section of the battery G through the wire *a* it goes through the armature-coils A A, thence through the armature-coils A′ A′, all in series, by the wire *a′* to the other section of the battery G′, thence by the wire *g*

to the segment-ring *t*, through the arm *s'*, the sector *f*, to the plate *c*, where it divides, passing through the coils C of the magnet B in one branch and the similar coils C' of the magnet B' in the other branch, meeting again at the plate *c'*, thence by the sector *f* to the arm *s'*, segment *t'*, conductor *g'* to the sectional battery G. It will thus be seen under these conditions that all the armatures are in series with each other and with the sections of the battery and the coils on the field-magnets in multiple circuit, but in series with the armatures and sections of the battery. Under these conditions the field-magnets will become energized, but there will not be sufficient current flowing through the armature to operate the motor to move the car; but the armature would rotate if free from the load or car. The switch is then turned so that the arm *s* contacts with the sectors *e* in succession, sending the currents through all of the resistance, coils at first, and gradually cutting them out of circuit until the switch-arms are nearly at right angles to the position shown in the drawings. The circuit is through the plate *d*, the coils D of the magnet B in one branch, and the coils D' of the magnet B' in the other branch, meeting again at the plate *d'*, and thence through the arm *s'*, segment *t'*, to the batteries, as before. Under these conditions it will be seen that the armatures remain in series with the sections of the battery, as before, while both the coils of the field-magnets are in multiple, but all in series with the armatures and the sections of the battery. Of course under these conditions the current will flow through fine-wire coils C C' in proportion to $\frac{E}{R}=C$; but most of it will flow through the low-resistance coils D D', the relative proportions of the current depending upon the amount of resistance *r* included in the circuit of the low-resistance coils or work done by the motor, and this will be varied according to the load or work to be done in propelling the car.

In Fig. 5 substantially the same arrangement is shown for the mechanical generator. Starting from the plus brush of the generator G the current flows through the conductor *a* to the armatures A A, thence to the segmental plate *t* and by arms *s* to the sector *f* and plate *c* through the high-resistance coils C C' in multiple arc, united again at the plate *c'*. Thence it flows through the arm *s'* to the segmental plate *t'* by the conductor *a'* to the armature A' A' to the other minus pole of the generator. In this arrangement it will be seen that the armatures are in series, with the high-resistance coils of the magnets in multiple between the armatures of each motor; but when the switch-arm is moved farther, so as to include the plates *d d'*, the low-resistance coils D D D' D' are included in this branch circuit in multiple between the armatures of each motor. It will thus be seen that in this arrangement also the armatures are in series with the field-magnet coils, they being in multiple-arc circuit to themselves. By this arrangement I am enabled to arrange the working parts in practical series with each other, for while the field-magnet coils are in multiple to themselves they are in series with the armature and generator, the amount of current flowing through the branches of the multiple field series being regulated by a switch device. In this way, in thus making use of the high ampère winding on the fields to magnetize them, and by then including the low ampère winding the requisite amount of current can be passed through the armatures and fields to propel the car, and this amount can be regulated and adjusted by the switch device in accordance with the load. This arrangement also prevents all danger of sparking, which is liable to burn out the switch or coils of the motor. I have found by actual practice that I can obtain sufficient power from the current that passes through the fine-wire coils to rotate the armature, and then by adjusting the resistances in the large wire coils can increase this power and regulate it in order to propel the car.

What I claim is—

1. The combination, with the car-axle, of a motor supported thereon, the said motor consisting, essentially, of two electro-magnets and two armatures, the armatures being connected with the axle, substantially as described.

2. The combination, with the axle, of an electro-motor mounted thereon, the said motor having two field-magnets and two armatures, a gear-wheel mounted on said axle, and pinions on the armatures connected to opposite sides of said gear-wheel, substantially as described.

3. The combination, with the axle, of the hangers supported on the axle, a motor supported on said hangers and provided with two armatures revolving in a single magnetic circuit, and a gear-wheel on the axle and pinions on the armatures engaging the opposite sides of said gear-wheel, substantially as described.

4. The combination, with the axle and gear secured thereto, of a single magnetic circuit having two armatures rotating in the same direction and provided with pinions engaging the opposite sides of said gear-wheel, substantially as described.

5. The combination, with the axle, of the hangers connected thereto having bearings for the armature-shafts and connecting-pieces between the hangers having supports for the field-magnets, substantially as described.

6. The combination, with the axle supported in pedestals mounted in the frame, of a motor supported on said shaft and provided with two armatures, connections between the armatures and the axle, and elastic connections between the motor and the frame, substantially as described.

7. The combination, with the frame and axle supported therein, of a motor supported bodily on said axle and provided with two armatures, connections between the armatures

and the axle, and elastic connections between the motor and frame, the said connections opposing the motion of the motor toward the frame but allowing it to move freely from the frame, substantially as described.

8. The combination, with the frame, of the axle supported therein, hangers supported on the axle, a motor carried by the hanger and embracing the axle, two armatures arranged at opposite sides of the axle and connected to drive the same, a rod connecting the hanger and frame, and a spring between the rod and frame, substantially as described.

9. The combination, with the frame and axle supported therein, of hangers supported on said axle and carrying the electric motor, a pivoted rod connected to the motor and extending freely through the frame, a spring surrounding the rod, and an adjusting-nut on the rod, substantially as described.

10. The combination, with the axle and gear thereon, of a motor supported upon the axle having two armatures connected on opposite sides of the gear, and elastic connections between the motor and frame, the arrangement being such that the motors can commence to operate before the gear is turned, substantially as described.

11. The combination, in a motor-truck, of two motors, each provided with two armatures, a divided source of energy for said motors, the armatures being connected in series between the two portions of the source of energy, and the field-coils being connected in multiple between the two portions, substantially as described.

12. The combination, in a motor-car, of two motors, each provided with two armatures and two field-magnets of a divided source of energy for said motors, the armatures being connected in series between the divided portions, and the field-magnet coils being connected in multiple with themselves but in series with the armatures and portions of the source of energy, substantially as described.

13. The combination, in a motor-truck, of two motors, each provided with two armatures and two field-magnets, and two sets of secondary batteries, the armatures being connected in series between the two sets, each field-magnet being provided with a high-resistance and a low-resistance coil and connected in multiple between the two sets of batteries, substantially as described.

14. The combination, in a motor-car, of two motors, each provided with two armatures and two field-magnets, each magnet being wound with two coils, one of high and one of low resistance, and a switch for closing the circuit through the high-resistance coils alone or through both the high and low resistance coils simultaneously, substantially as described.

15. The combination, with the motor-car, of a motor having two armatures and two field-magnets, the armatures being connected in series and the field-magnets being provided with two separate coils connected in multiple, substantially as described.

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

JABEA F. SHAWHAN.

Witnesses:

ALBERT BEEBE,

CYRUS JOHNSTON.