(No Model.) 3 Sheets—Sheet 1.

T. P. MILLIGAN.

ELECTRIC MOTOR SYSTEM AND TRACTION DEVICE.

No. 549,522. Patented Nov. 12, 1895.

Fig. 1.

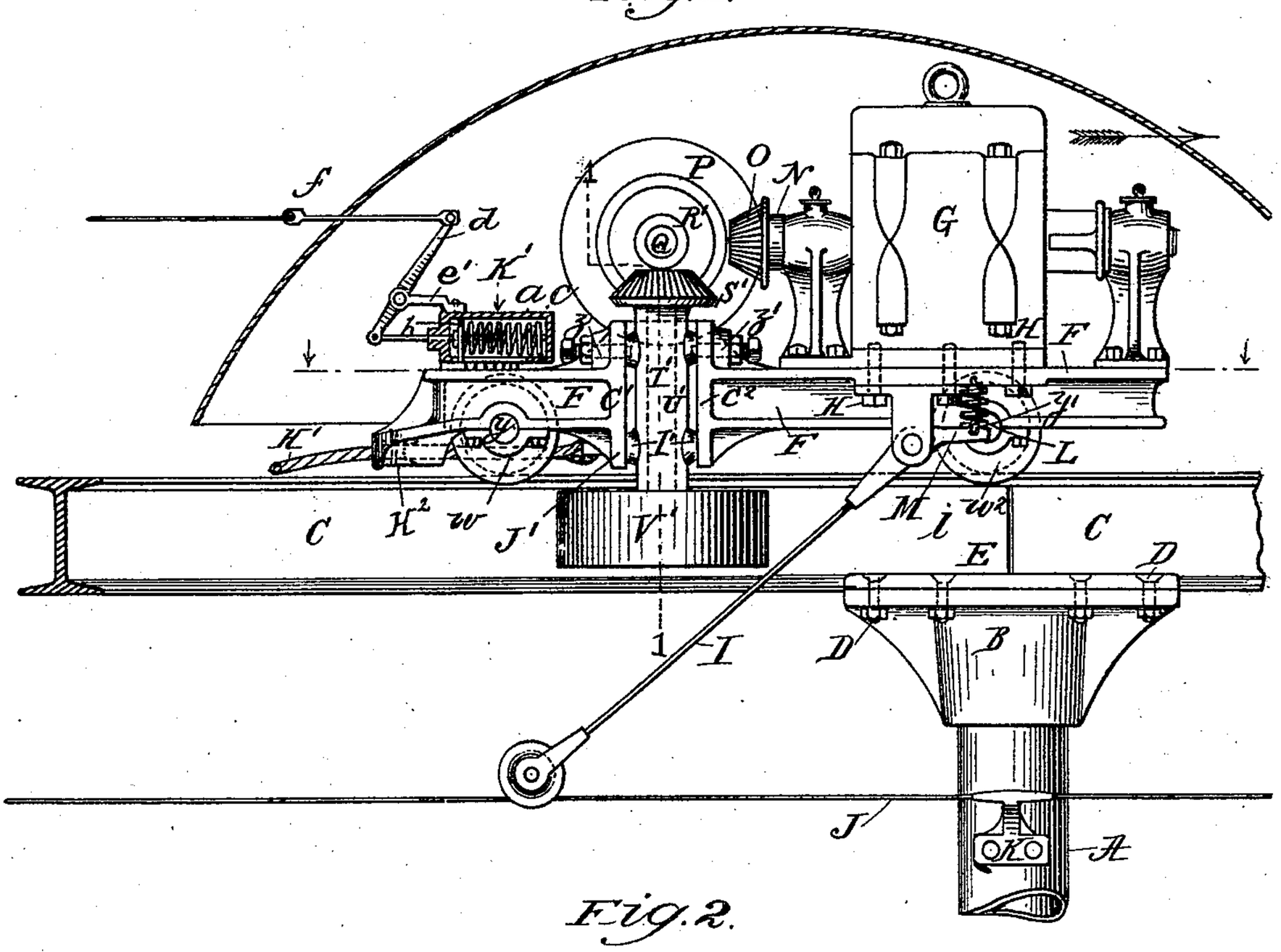

Fig. 2.

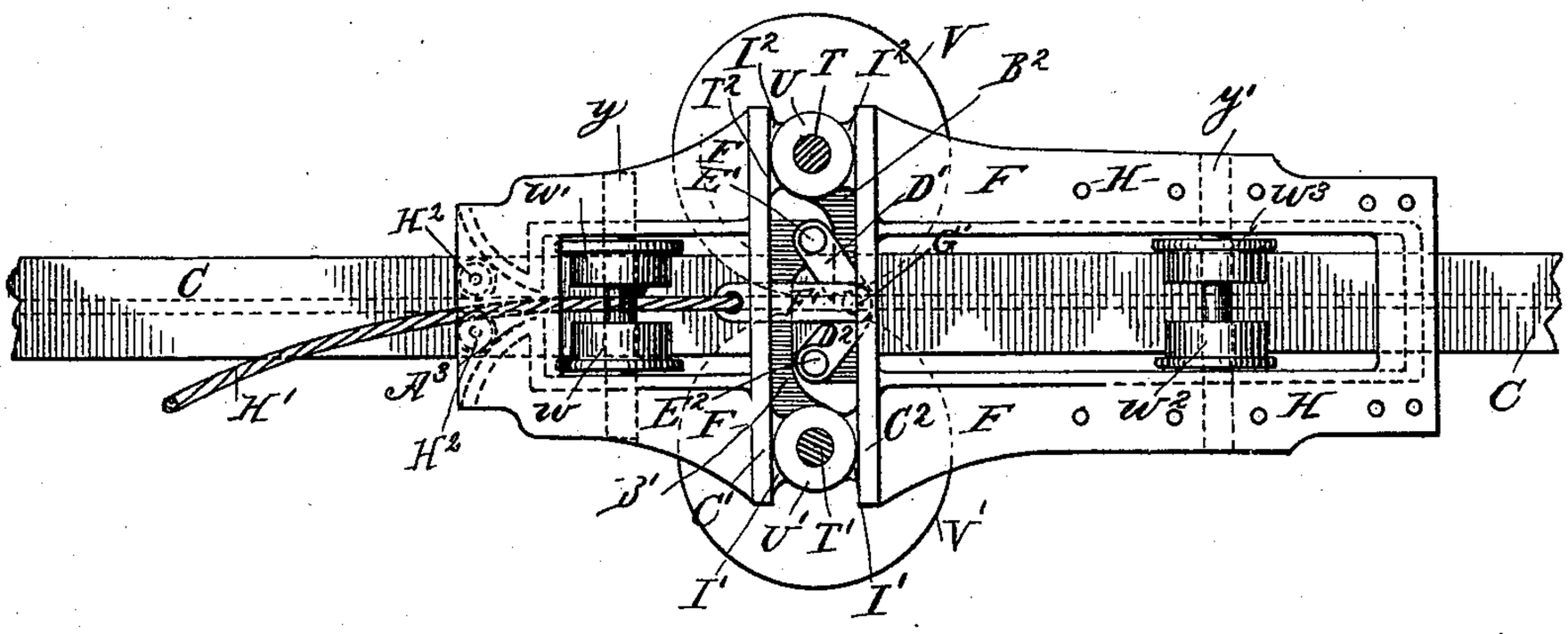

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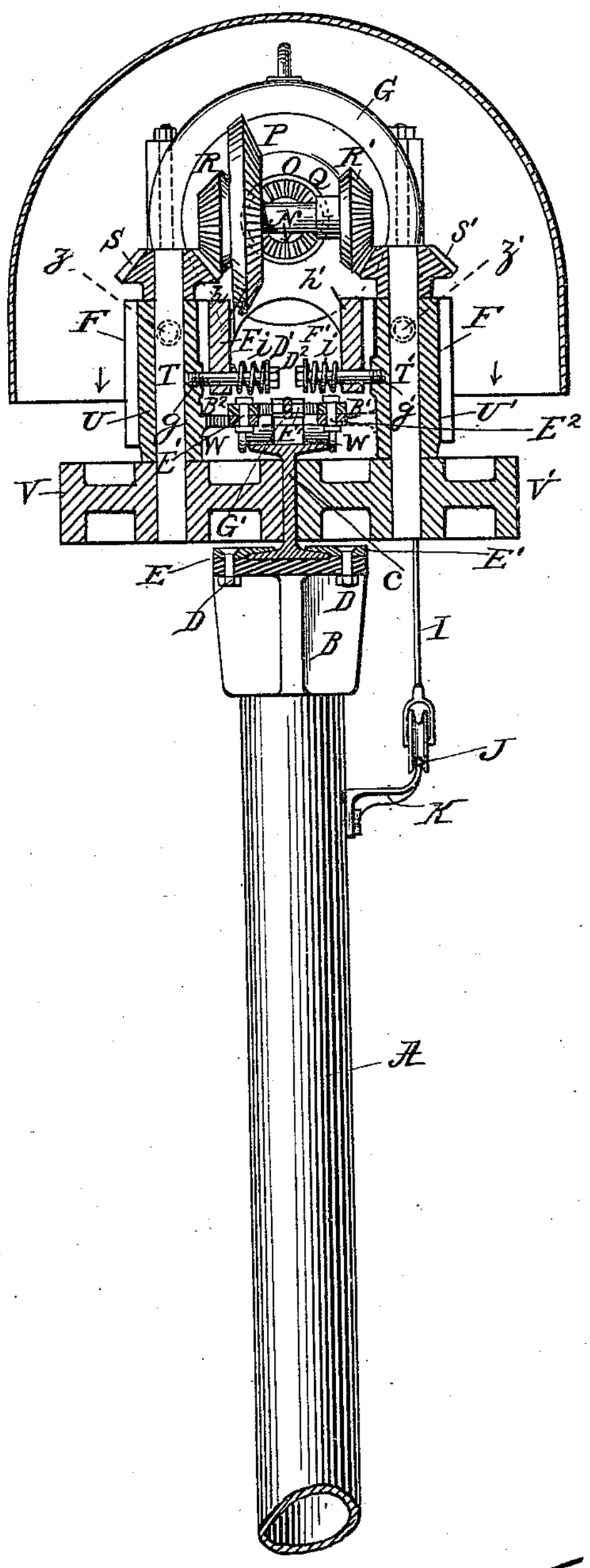
Fig. 3.



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3 Sheets—Sheet 3.

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Fig. 4.

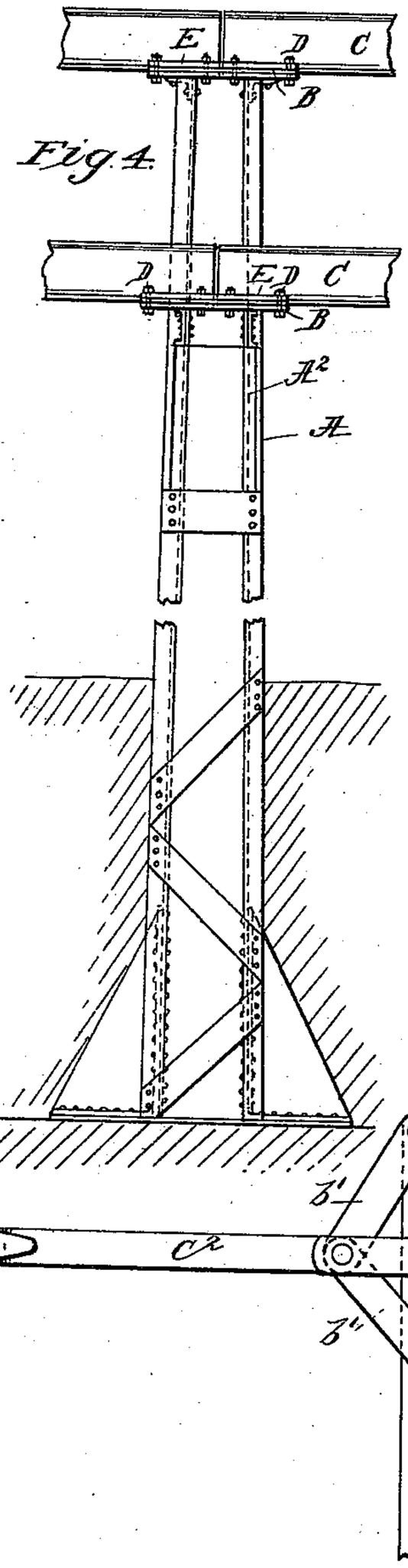

Fig. 6.

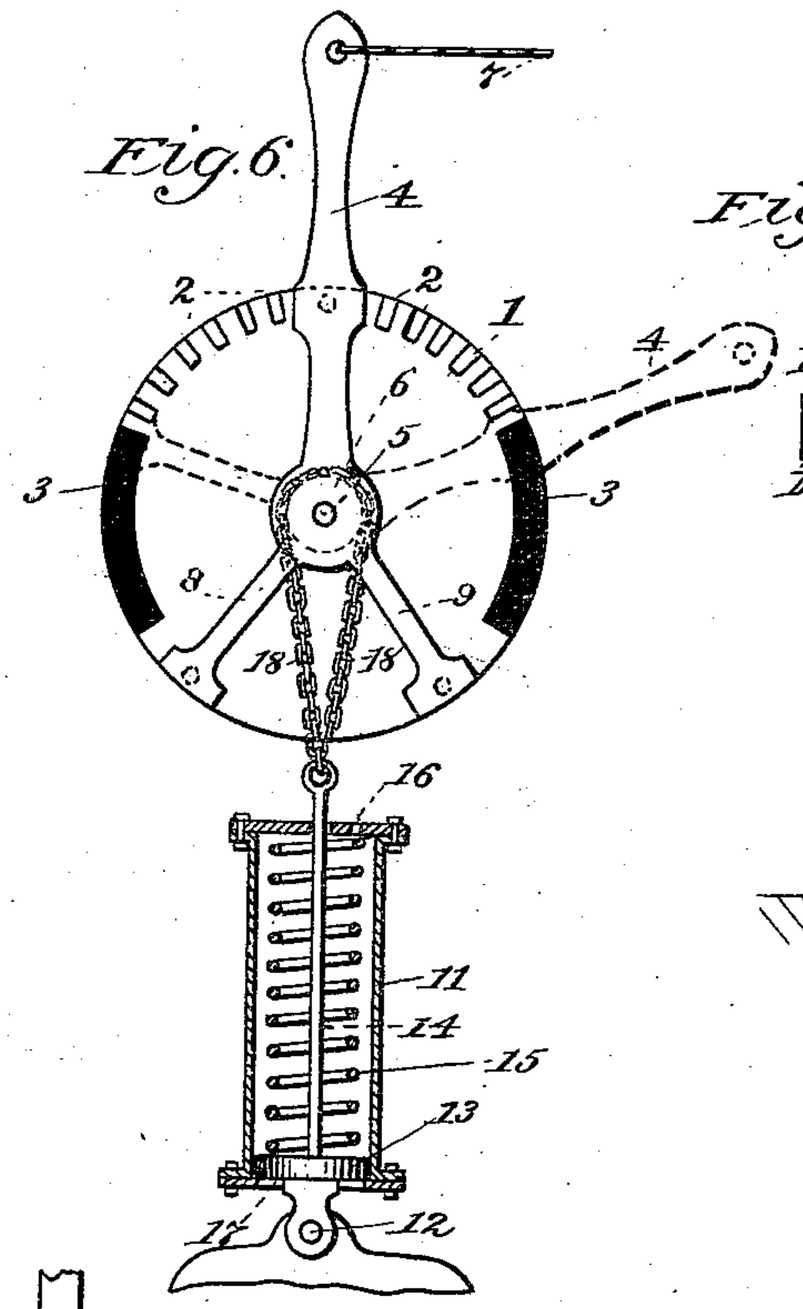

Fig. 5.

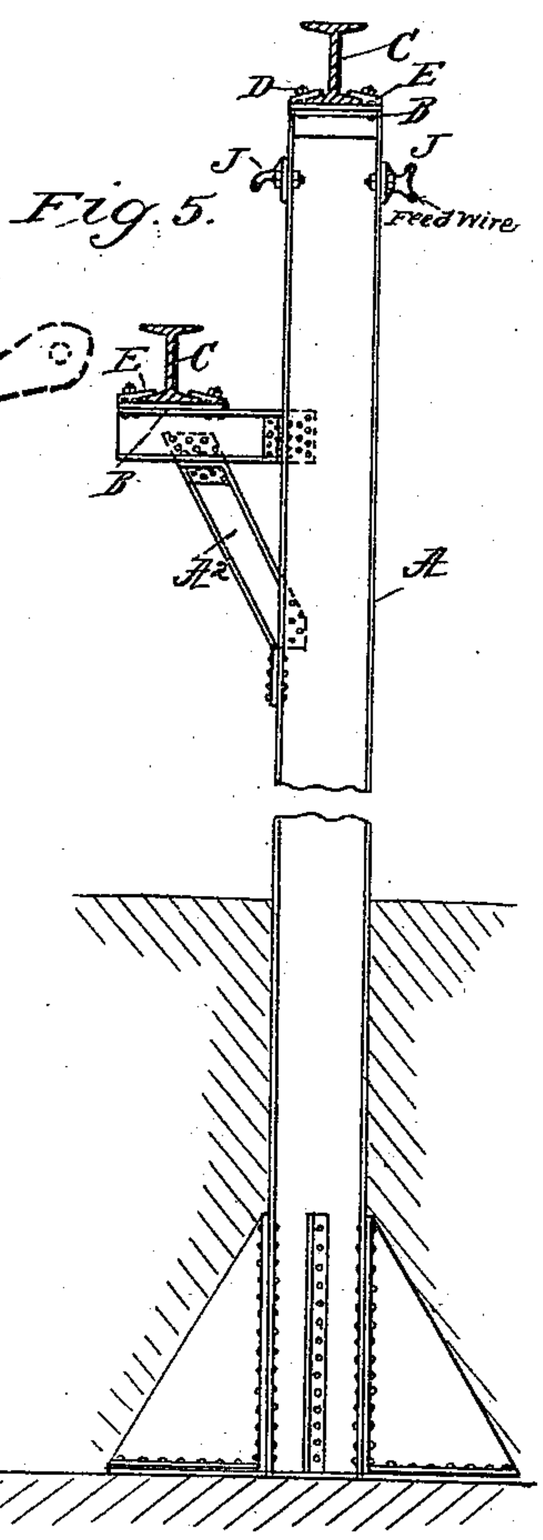

Fig. 7.

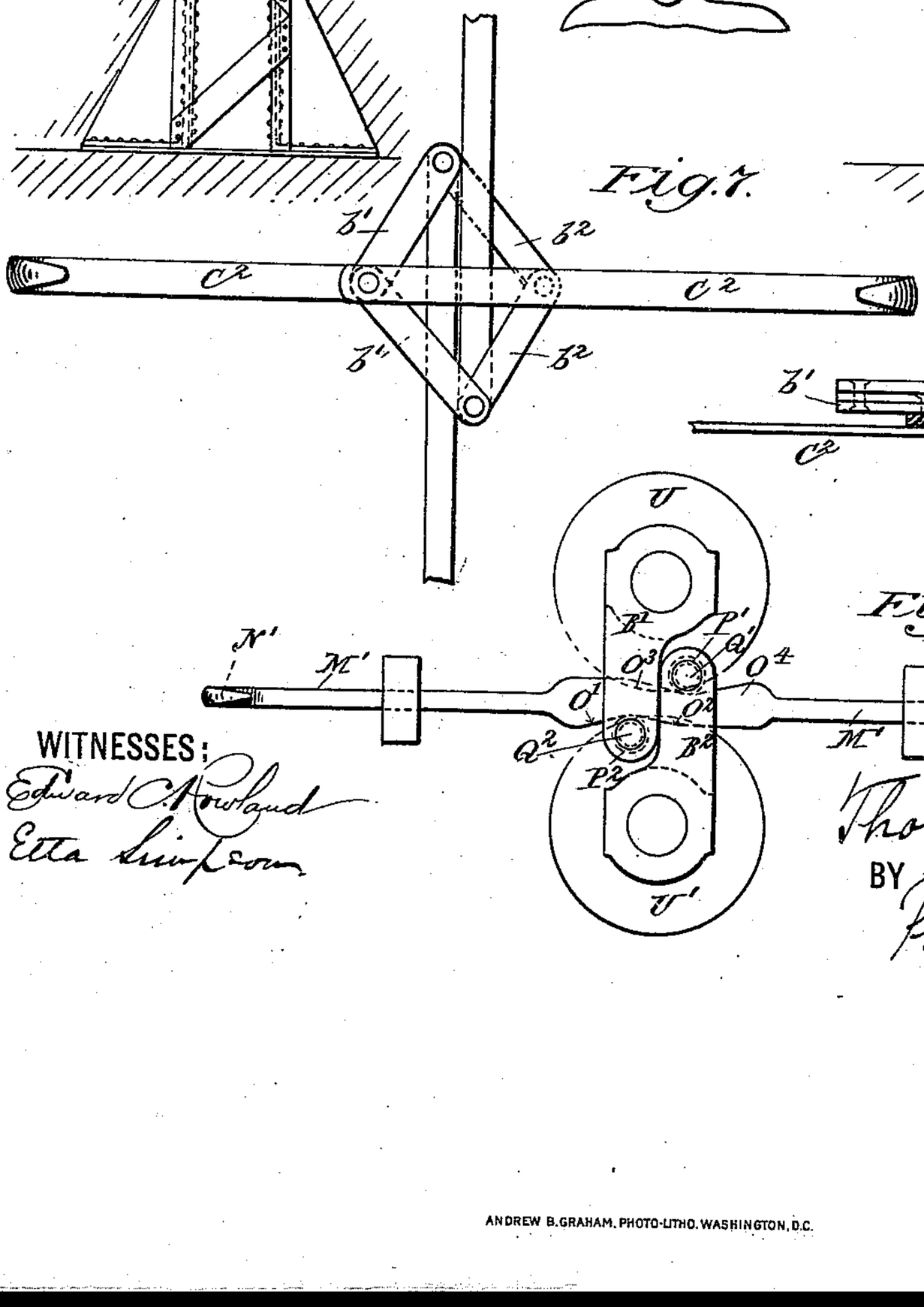

Fig. 8.

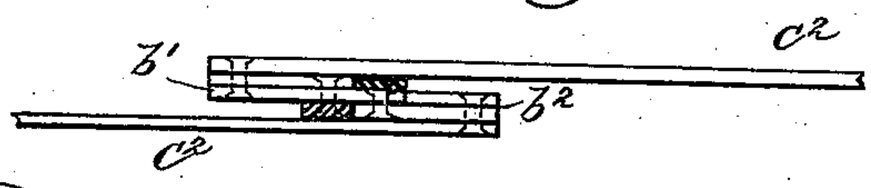

Fig. 9.

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UNITED STATES PATENT OFFICE.

THOMAS P. MILLIGAN, OF SOUTH ORANGE, NEW JERSEY.

ELECTRIC-MOTOR SYSTEM AND TRACTION DEVICE.

SPECIFICATION forming part of Letters Patent No. 549,522, dated November 12, 1895.

Application filed January 26, 1895. Serial No. 536,299. (No model.)

To all whom it may concern:

Be it known that I, THOMAS P. MILLIGAN, a citizen of the United States, and a resident of South Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Electric-Motor Systems and Traction Devices, of which the following is a specification.

My invention relates to a new and useful electric-motor system and traction device especially intended for hauling canal-boats, although adapted to other uses.

Generally stated, the invention consists in a track supported on posts or otherwise, and an electric motor held to the rail by its own rolling-gear and driving-wheels, and a system of levers whereby the traction or grip of the driving-wheels on the rail is automatically adjusted to the resistance of the canal-boat or other object to be moved. The motor is controlled from the boat.

In the drawings hereof, Figure 1 illustrates a sidewise elevation of the invention, the hood being sectioned longitudinally. Fig. 2 illustrates a plan view, the hood, the motor-gearing, &c., being removed, the better to show the construction and operation of the toggle-arm mechanism, which automatically adjusts the traction to the resistance. Fig. 3 illustrates a transverse vertical section on the line I I of Fig. 1. Figs. 4 and 5 illustrate a modification showing two tracks on the same line of posts. Fig. 6 illustrates a switch mechanism whereby the motor may be reversed and made to run backwardly. Figs. 7 and 8 illustrate a modified construction of the toggle devices whereby the motor may be run in either direction. Fig. 9 illustrates a modified construction of the draw-bar and coacting parts.

Referring first to Figs. 1, 2, and 3, A illustrates one of a line of posts, metal or wood, as preferred. They support the track-rail, and are of such length above ground as preferred. They may be varied in length to compensate for irregularities in the surface of the ground, so as to secure as much uniformity in the grade of the track-rail as may be. When, however, the invention is used for canal-boat propulsion, the posts will be set on the back edge of the tow-path, and consequently levels will most always be suitable.

B are castings fastened to the tops of the posts.

C are the rails which constitute the track. They are shown, ordinarily, as shallow trusses or wrought-iron **I**-beams, and are fastened upon the top of the castings B by bolts D and anchor-plates E. No fish-plates are required.

F is the frame of the motor. It is, preferably, a casting.

G is the electric motor proper. It may be of any preferred form and will not be particularly illustrated or described, since they are now well known in various forms. The motor is bolted to the frame F by bolts H or in any other suitable manner.

I is the trolley device, which engages with the conductors J in any preferred manner.

I show the conductor in Figs. 1 and 3 as supported upon brackets K on the posts A, and a spring L (see Fig. 1) between the heel of the trolley-pole hub M and the frame of the motor keeps the trolley in contact with the trolley-wire in aid of gravity. The spring will not always be required.

N is the main shaft of the motor. Upon its rear end is a beveled pinion O, which gears into a reducing-gear P, set on a counter-shaft Q, upon which are two beveled pinions R and R′, which mesh, respectively, into two other beveled gears S S′, which are keyed to the upper ends of two vertical shafts or axles T T′, which are journaled, respectively, in sleeve-bearings U U′, and on the lower ends of the shafts T T′, respectively, are keyed the main driving-wheels V V′. These drivers are of such diameter and width on their faces as will adapt them to rest against the vertical web of the **I**-beams C.

w, w', w^2, and w^3 are four wheels, arranged in pairs, running on axles Y and Y′, which are journaled on the main frame. These wheels are flanged on their outer edges, and they run upon the top member of the **I**-beam C, their flanges embracing the edges of that member. Thus the motor and its frame are sustained by and move upon the track-rail, and the flanges on the wheels w w' w^2 w^3, plus the bearing of the drivers on the web of the rail, prevent the motor from leaving or being pulled away from the track.

The sleeve-bearings U U′ are pivoted to the

main frame on pins or center z z', respectively, and at the lower part of each sleeve there is attached a horizontally-extending plate B′ B². (See Fig. 2.) These plates cross each other, and are guided by and slide on transverse plates C′ C² of the main frame.

D′ D² are a pair of toggle-levers. They are pivoted, respectively, to the horizontal sliding plates B′ B² at E′ E², and are pivoted to each other and to the draw-bar F′ at G′.

The draw-bar passes through and is supported by a slot made in the rear plate C′ of the main frame, and the rope or cable H′, which extends away to the canal-boat, is fastened to it and passes through an opening A³ made in the rearmost part of the frame.

I prefer that there should be a short section of wire cable, say, a foot or two in length, attached to the draw-bar and projecting rearwardly from the frame a sufficient distance, so that all wear against the sides of the opening A³ will come upon the wire cable, and I place antifriction-rollers H² H² in the frame to relieve the cable of wear. I also prefer to have a hook on the end of the section of cable, over which a ring on the end of the tow-line may be slipped when lifted by the boatman on the end of a suitable pole or crotch provided for the purpose.

The sliding plates B′ B² are thickened or filled out where they respectively join the sleeve-bearings U U′, and are formed into bearing-surfaces I′ I², resembling hubs, which give a good broad support against the frame at J′ J² (see Figs. 1 and 2) to resist the strain of starting the boat or other load.

g g' are two bolts or rods which are respectively threaded or otherwise fastened to the sleeve-bearings U U′. They pass through plates h h', which form part of the main frame, and i i' are springs which surround the bolts and abut against their heads at one end and the said plates at their opposite ends. The function of these devices is to permanently pull the sleeve-bearing U and U′ inwardly, so that the driving-wheels shall always be in contact with the web of the rail; so that traction and consequent movement of the motor will always be secured, whether there is a resistance on the draft-cable H′ or not.

K′ (see Fig. 1) is a switch of any preferred construction whereby the current can be turned on or off from the motor. In the example shown in this figure the switch comprises a cylinder a, in which a piston b, mounted on a rod, moves. The piston engages with suitable contact-surfaces on the inside of the cylinder, which may be of any desired construction. They are not illustrated in detail because many different forms are now well known. A spring c normally thrusts the piston to the left, and a lever d, which is pivoted at e to the cylinder or other suitable part, and a pull-cord f, which extends rearwardly to the deck of the boat, give movement to the piston in the opposite direction. When there is no pull on the cord, then the spring c throws the piston to the extreme left-hand end of the cylinder onto an insulated plate or part, and then the motor is cut out. Of course suitable return-circuit wires (not shown) are provided, because it would be unsafe, ordinarily, to go to ground through the posts.

K is a metallic hood which covers and protects the whole apparatus.

The operation is obvious. When desiring to start his boat, the boatman pulls the cord f and the switch throws the current into the motor, which immediately starts. The degree of pull on the cord will determine the amount of current and speed of the motor. As soon as the strain comes on the cable H′, the toggle-levers, acting to the right and left, cause the driving-wheels to hug hard on the web of the track-rail, thus increasing the traction which they ordinarily have by reason of the springs i i'. The boatman, after the cable has become taut and the boat is under its usual headway, pulls the cord f as taut as necessary to maintain the proper current for the speed desired, and he can then, if he prefers, make the cord fast. When wishing to stop, he slacks up on the cord f and the spring e then immediately returns the switch (piston b) to the insulated part or cut-out, and then all current ceases.

Under the plan shown in Figs. 1, 2, and 3 one track only is shown, and the one going in the opposite direction should be erected on the opposite side of the canal. Sometimes this cannot be conveniently done. Consequently I show at Figs. 4 and 5 a construction in which a second track is supported on brackets A², which are bolted to the sides of the posts, so that the track is lower than the track on the ends of the posts, as shown. The construction and operation of all the parts are the same as already described, excepting that the trolley device projects upwardly from the lower motor to its conductor J instead of downwardly, as in the other case, and the vertical position of one track relative to the other is such that the tow-line from the upper motor will pass over the lower motor and its tow-line, and consequently boats going in opposite directions can pass each other. In this figure I show the trolley-wire or conductor arranged above the upper motor. This construction may be employed when only one track is used, if preferred.

In Fig. 6 I show a peculiarly-constructed switch whereby the current may be reversed and the motor run backwardly. In it 1 represents a switch provided with resistance contact-plates 2 and insulated contact-pieces 3. A lever 4 is pivoted at 5, and there is a hub 6 surrounding the pivot. This lever has one long arm, as shown, to which the pull-cord 7 is attached, and two diverging lower arms 8 and 9, respectively, which have contact-surfaces on their ends. 11 is a cylinder, pivoted at 12 to any suitable support, upon which it may rock. 13 is the piston within the cylinder, and the piston-rod 14 is surrounded

with a spiral spring 15. 16 is a small air-vent at the upper end, through which the air can be slowly ejected. The bottom of the cylinder is as open as may be, as shown at 17. 18 is a chain, the two ends of which are fastened to the upper end of the piston-rod and the bight of which is fastened by a staple or otherwise to the top of the hub 6, so that when the lever is moved in either direction one side or end of the chain will be drawn upon and the other slackened, and the piston consequently elevated, during which a slight rocking motion will be given to the cylinder 11.

The operation of this device is as follows: The boatman pulls upon the cord, throwing in more or less of the current, as he desires. When he wishes to reverse his motor, he pulls hard upon the cord, thereby rocking the lever so far as that the long arm thereof moves upon the right-hand insulating contact-surface, whereas the left-hand shorter arm 8 comes in contact with the circuit-contacts 2. The parts are shown in dotted lines as in transit, and the wiring of the device is such that when this takes place the current is reversed and the motor goes backwardly. The two halves or sides of the switch are counterparts of each other, so that the motor can run in either direction and be reversed in either direction at will, and the two chains, or, rather, the two ends of the same chain, and the pivoting of the cylinder are provided so that the motor may be run and reversed in either direction. It will be seen that the spring 15, the bottom of the cylinder being practically open, and thus allowing free exit for the air, will instantly return the current-controlling lever to its normal position, thus cutting out all current the moment the pull on the cord 7 is released; but, on the other hand, when starting the boat or other vehicle the full current cannot be thrown on instantly, which might strain, if not rupture, some of the parts, because the vent-hole 16 at the top of the cylinder is made so small that the air cannot be ejected excepting very slowly. Thus the pull by the boatman is controlled, and, however ignorant or unfamiliar he may be with the apparatus, he cannot injure it or break any part of the apparatus.

In Figs. 7 and 8 I show a construction of the toggles whereby the motor may run in either direction. In it the toggles are arranged in two pairs b^2 and b^3, the two pairs being presented in different directions, and each of them has its own appropriate draw-bar c^2. It will be seen that by this construction the motor may be run in either direction, and the tow-line will be made part of the one or the other of the draw-bars, depending on the direction in which the motor is going. Of course one pair of the toggles only are operative at any one time, the other pair moving idly under the power of the operative pair.

In Fig. 8 I show a form of draw-bar which is well adapted to use in both directions, and, although not so powerful as the toggle-lever mechanism, will be desirable under many circumstances and for many uses. In it some of the parts are the same as shown in the other drawings and as above described—*i. e.*, U U′ are the sleeve-bearings for the driving-wheel shafts, and B′ B^2 are the equivalents for the horizontally-extending plates B′ B^2 of Fig. 2. The other devices constitute the modification—that is to say, M′ is a longitudinally-extending rod having hooks N′ N^2 at its respective ends, which project beyond the respective ends of the motor, to which the tow-line is attached. Centrally in this rod there are bearing-surfaces O′ O^2 O^3 O^4, which, depending on the direction in which this rod is moved, impinge and crowd laterally upon sleeves or antifriction-rollers P′ P^2, set on pins Q′ Q^2 on the ends of the horizontally-sliding plates B′ B^2, whereby the sleeves U U^2 are drawn inwardly and the driving-wheels crowded against the web of the I-beams, as already explained.

I do not limit myself to the details of construction shown, since it will be obvious to those who are familiar with this art that modifications may be made therein without departing from the spirit of the invention.

I have described and illustrated the devices specially referred to in the body of this specification, because they, as I believe, originated with me, whereas the others are well known. Moreover, mine are cheaper. I wish it distinctly understood, however, that I do not disclaim the use of any means for controlling the motor from the boat in the combinations specifically referred to in the claims hereof.

I claim—

1. An electric motor system comprising a single rail, a motor for supporting wheels, which rest on the rail, driving wheels on each side of the web of the rail which are positively driven by the motor, and means to permanently and independently press each of the driving wheels against the rail, for the purposes set forth.

2. An electric motor system comprising a single rail, a motor provided with driving wheels, which are positively driven by the magnets, means to independently press the driving wheels against the rail, and means whereby the driving wheels may each independently move toward and from the rail, for the purposes set forth.

3. An electric motor system comprising a track, a motor having positively driven wheels on both sides of the track, and means connecting the driving wheels with the load, whereby the driving wheels are independently caused to grip the track, for the purposes set forth.

4. An electric motor system comprising a track, a motor, means to support the motor vertically on the track, positively driven driving wheels on both sides of the track, means whereby permanent pressure between them and the track is preserved, and means connecting the driving wheels of the load where-

by the resistance of the latter will increase the traction of the former, and cause them independently of each other to grip the track, for the purposes set forth.

5. In an electric motor, driving wheels, each independently supported upon a yielding axis and each positively driven by the motor, and means connecting the driving wheels with the load, whereby the traction of the former is automatically increased as the resistance of the motor increases, for the purposes set forth.

6. In an electric motor, driving wheels driven positively by the motor, pivoted bearings which support the driving wheels, arms or levers connected with said bearings and with the draw bar of the motor, which arms straighten as the strain increases, thus pressing the driving wheels with increasing force against the rail, for the purposes set forth.

7. In an electric motor, driving wheels positively driven by the motor and supported in pivoted bearings, springs interposed between said bearings and the frame of the motor which hold the driving wheels on both sides of the track in permanent contact with it, and arms or levers connected with said bearings and with the draw bar of the motor, which arms straighten as the strain increases, for the purposes set forth.

8. In an electric motor system, the combination of driving wheels, bearings which support the driving wheels, two pairs of arms or levers pivoted to the bearings and projecting in different directions, each pair having its own draw bar, and each pair constructed and arranged to straighten as the strain increases.

Signed at New York, in the county of New York and State of New York, this 23d day of January, A. D. 1895.

THOMAS P. MILLIGAN.

Witnesses:
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I. C. MILLIGAN.