(No Model.) 3 Sheets—Sheet 1.

A. I. AMBLER.

ELECTRIC LOCOMOTIVE.

No. 504,484. Patented Sept. 5, 1893.

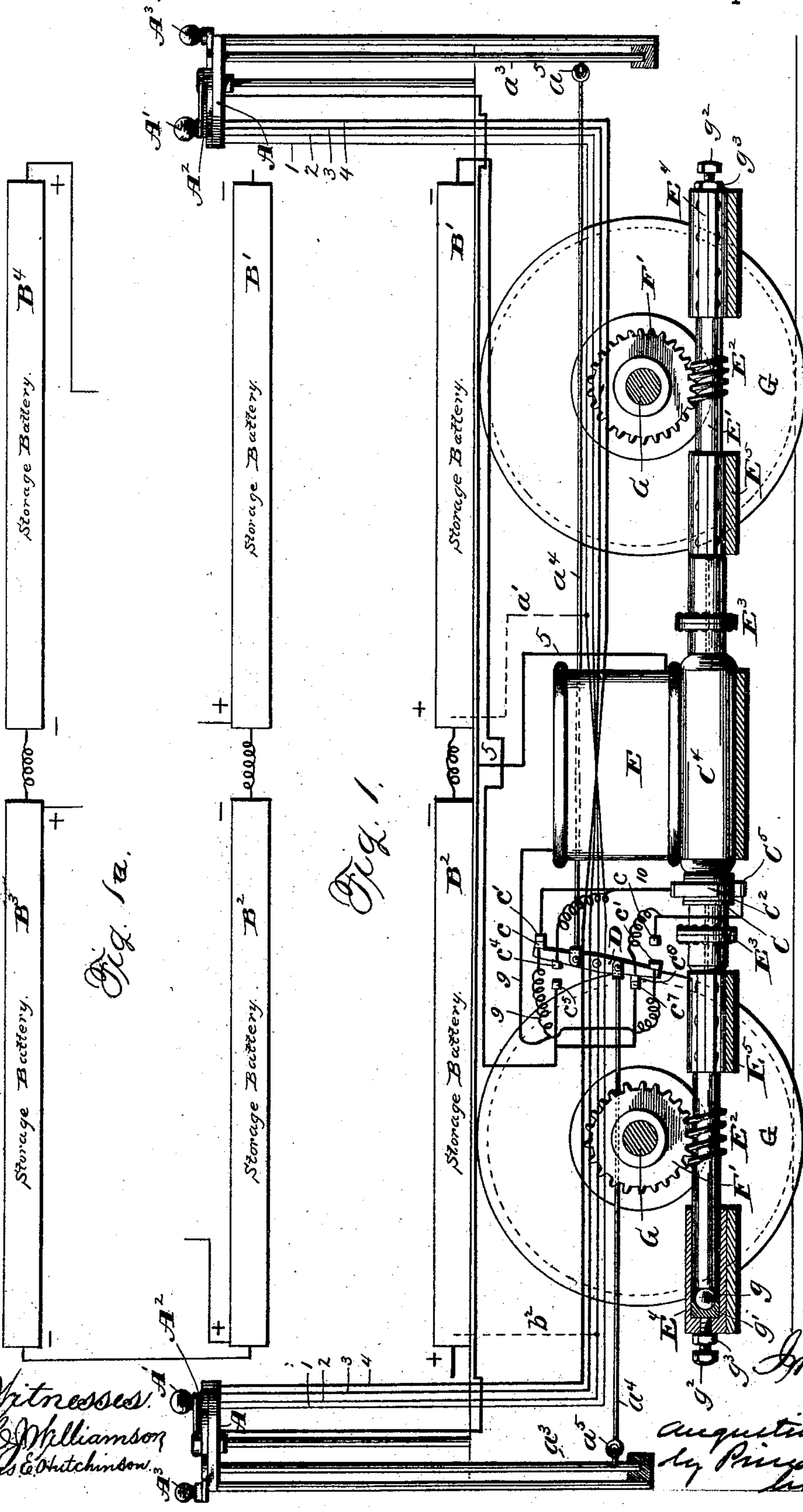

Fig. 1a.

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

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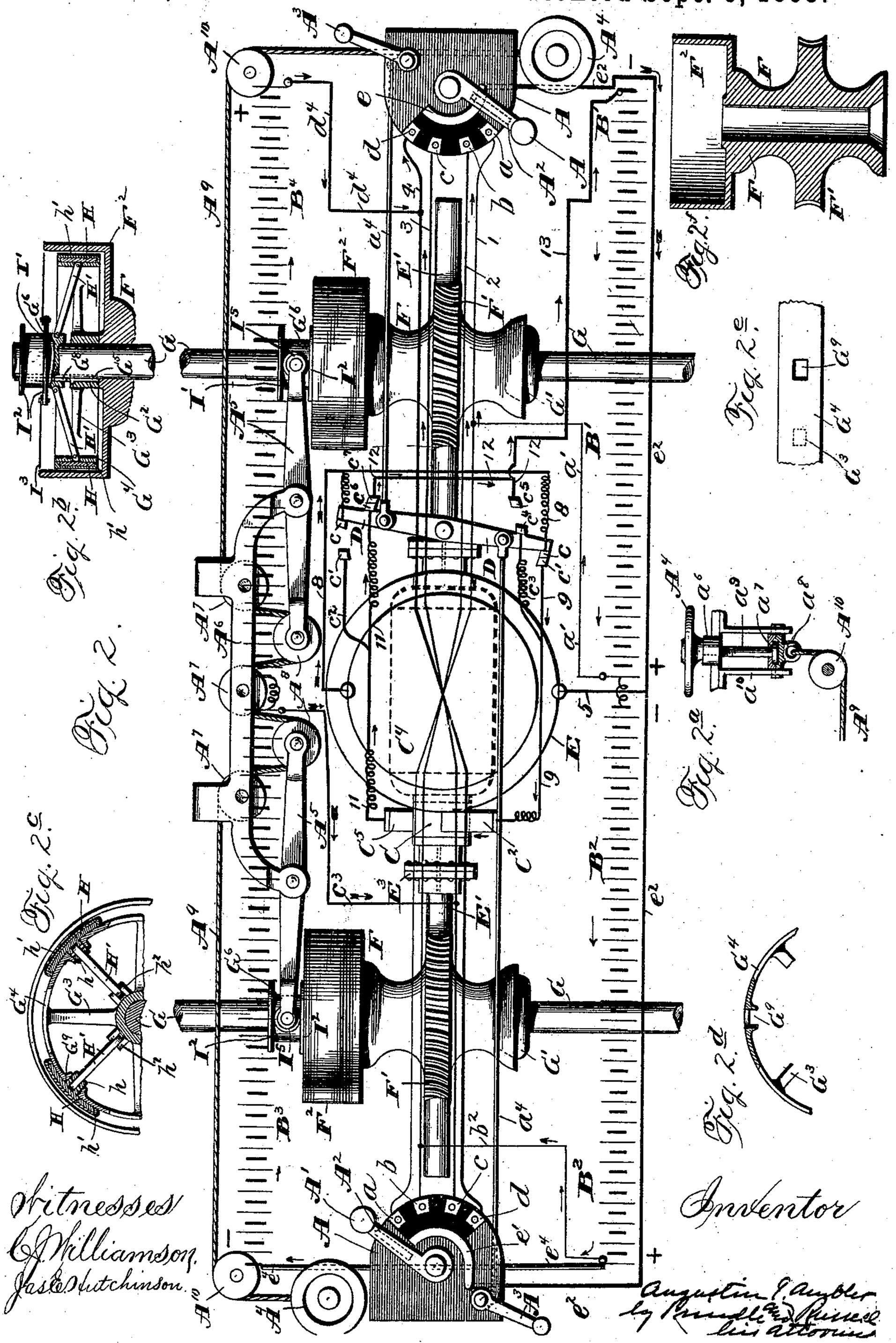

Fig. 2.

Fig. 2b.

Fig. 2c.

Fig. 2d.

Fig. 2e.

Fig. 2a.

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(No Model.) 3 Sheets—Sheet 3.

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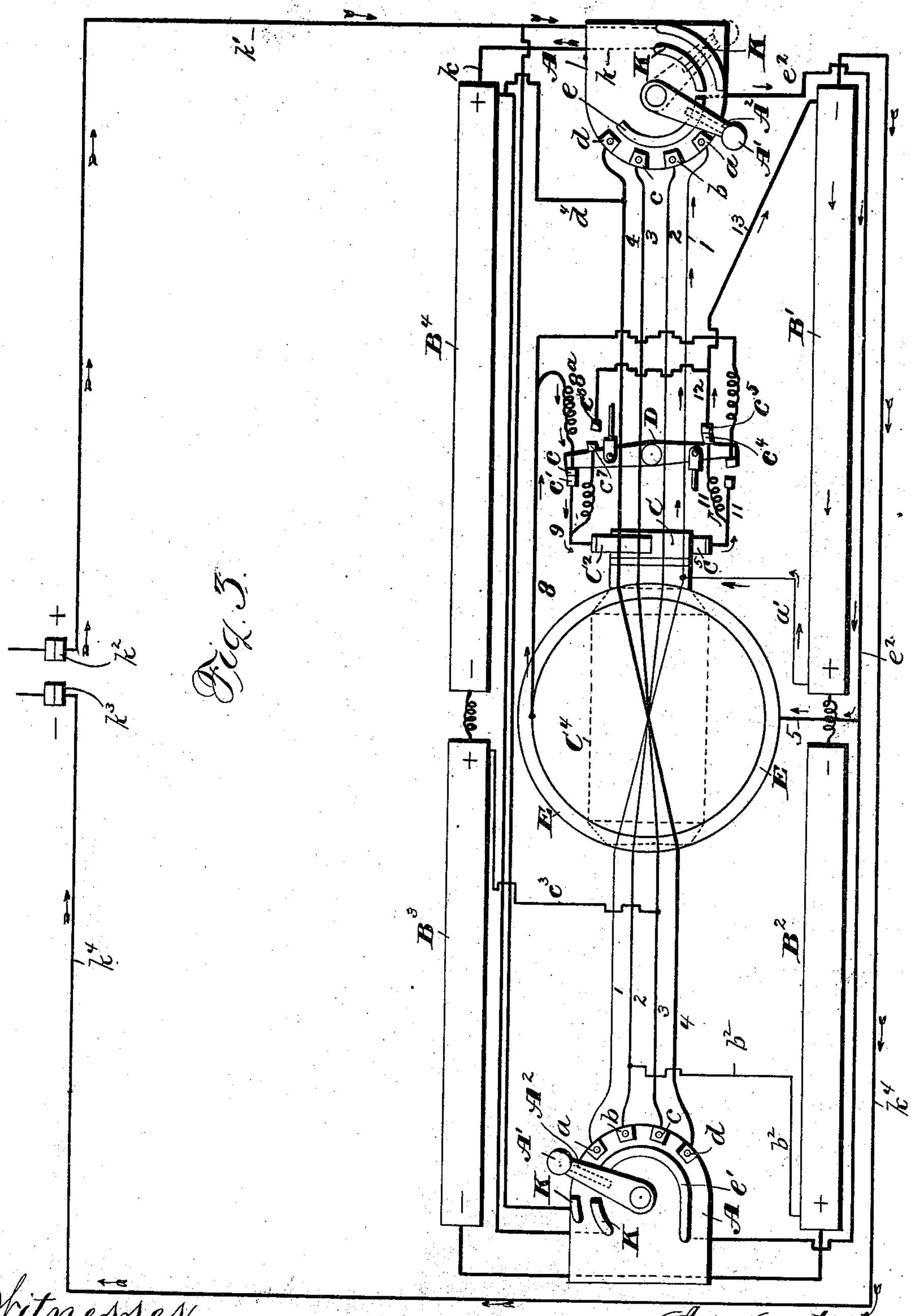

Fig. 3.

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UNITED STATES PATENT OFFICE.

AUGUSTIN I. AMBLER, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO ROSELINE N. AMBLER, OF SAME PLACE.

ELECTRIC LOCOMOTIVE.

SPECIFICATION forming part of Letters Patent No. 504,484, dated September 5, 1893.

Application filed September 16, 1892. Serial No. 446,103. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTIN I. AMBLER, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Mechanism for Driving Street or Tram Cars by Electricity; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 is a view showing, partly in side elevation and partly in longitudinal section, my improved driving mechanism, with its parts arranged as applied to a street or tram car, the frame of the car being removed; Fig. 1ª, a diagrammatic view showing, in plan, the arrangement of the divisions of the battery connected up in series; Fig. 2, a plan view of my mechanism, as arranged for application to a car, the battery being shown in a conventional way, the frame and supporting wheels of the car being removed, and the armature of the motor and the worm gears being on a larger scale than in Fig. 1; Fig. 2ª, a detail view showing the construction of the hand wheel device, for applying power to the clutch levers operating rope or cord; Figs. 2ᵇ and 2ᶜ, detail views showing, respectively, a longitudinal and transverse section of one of the friction clutches; Figs. 2ᵈ, and 2ᵉ, detail views showing, in side elevation and plan, respectively, a portion of the rim of the friction shoe bearing part of the clutch; Fig. 2ᶠ, a detail view showing, in longitudinal section, the casting containing the friction rim or flange of the clutch, and the worm wheel, both in one piece, and Fig. 3, a diagrammatic view showing the manner of making the connections between the parts of the battery and the motor, and between the battery and a trolley wire, or other conductor, from which the battery is to be charged.

Letters and numerals of like name and kind refer to like parts in each of the figures.

The object of my invention has been to provide improved mechanism for driving street or tram cars by electricity, and to this end my invention consists in the mechanism and in the parts thereof, constructed, arranged and combined as hereinafter specified.

The special purpose which I have had in view, in making the present invention, has been to provide an improved driving mechanism of the kind taking its operating current from a storage battery carried on the car; but, while my invention relates particularly to that kind of mechanism, I desire it to be understood that some parts of it are applicable, also, to advantage, for use with car motors using other sources of supply of electricity.

In the drawings, from which the car frame has been omitted, so that the operative parts can be shown more clearly, the electro-motor is represented as located centrally between the two supporting wheel axles. It can be of any of the well known constructions, without departure from my invention, which does not have to do with the construction of the motor proper. It is, therefore, represented only in a conventional way, its field magnet being designated by E, its revolving armature, placed longitudinally with reference to the car frame, by C^4, its commutator by C, and its two commutator brushes by C^2 and C^5, respectively.

Supported from the car frame by suitable bearings E^4, E^5, are the two longitudinal shafts E′, E′, one for each of the supporting wheel axles G, G, such shafts being axially in line with each other, and both having their inner ends coupled to the shaft of the armature C^4, as shown, by means of couplings E^3, each consisting, as indicated in the drawings, of two flanged sleeves keyed or splined, respectively, on the abutting ends of one of the shafts E′ and the armature shaft, and having their flanges bolted or otherwise secured together.

Of the two bearings for each shaft E′, the outer one E^4, has within it a ball *g*, engaging the outer ends of the shaft a follower *g′*, to hold the ball against the shaft, a screw g^2, engaging the follower, to adjust the same, and a jam nut g^3 on the screw, to lock it from turning. A thrust bearing is thus formed which offers very little frictional resistance to the shaft's rotation, can be readily adjusted to take up wear, and has a removable bearing piece, the ball, which can be made of hardened steel, to best resist wear, and can be readily removed and replaced by another, should it become worn by long use.

Between its outer and inner bearings, each

shaft E′ is provided with a worm E^2, which meshes with and drives a worm gear wheel F′, journaled on one of the two shafts G, G, to which the supporting wheels G′, G′, are attached.

Attached to and, preferably, cast in one piece with each worm wheel F′, so that there can be no play or lost motion between them, is the hub F, carrying a disk provided with an annular flange F^2, concentric with the respective shaft G.

On the side of the worm wheel, away from the flange carrying disk, there is a projecting hub, having at the outer end of its bore a conical enlargement, adapted to engage the conical face of collar G′ fixed upon the shaft, so that end thrust of the hub and wheel F′, in that direction, will be prevented; while the wheel is free to rotate on the shaft.

Inside the circle of flange F^2, is a wheel shaped piece having the hub G^2, keyed to the shaft G by the headed key G^5, engaging key ways in hub and shaft, so that said piece has to rotate with the latter, and having its head or lug engaging a suitable recess in the hub, so as to prevent outward longitudinal movement of the piece along the shaft.

From the hub G^2, radiate the spokes G^3 carrying, on their outer ends, the rim G^4 concentric with flange F^2, but made standing at some distance from the latter; so that the friction shoes H, H, can be placed between them, and be capable of some movement toward and from the inner face of the flange. Each shoe, having its outer side preferably faced with copper, as indicated at *h′*, so as to have the best kind of frictional contact with the flange F^2, when the shoe is forced outward, as hereinafter described, has, on its inner side, an inwardly projecting lug *h*, fitted and guided in a non cylindrical or angular radial passage G^9 in the rim G^4, and having its inner end forked, or provided with ears.

Upon the shaft G beyond the outer end of hub C^2, is the sliding sleeve G^6, which is connected with the shaft, so as to rotate therewith, by a key G^8 fixed in the shaft groove, so as to engage, at opposite ends, the headed end of key G^5 and the outer end of the groove, and so prevent any longitudinal outward movement of key G^5. Its part projecting beyond the periphery of the shaft, engages a groove on the inner side of the sleeve, so as to cause the latter to revolve with the shaft, while leaving it free to be reciprocated along the latter toward and from the hub of the friction shoe carrying piece.

Links H′, H′, one for each shoe, are pivotally connected, at their inner and outer ends, respectively, with the sleeve and the respective friction shoe lugs *h*, *h*. These links are, as shown, made longer than the radial distance between the planes in which the pivotal connections with the hub, and those with the friction shoe lugs stand, when the shoes are jammed against the inner face of flange F^2, and extend from the sleeve inward, at an angle to the plane of the spokes of the shoe carrying piece. Upon the outer part of the sleeve, are two annular flanges I^2, I^2, to be engaged by the fork of the shifting lever A^5 to be described.

To the inner flange I^2, the plate or disk I^3 is attached, which, extending out so as to substantially fill the opening within the flange F^2, is adapted to keep dust and dirt from the operative parts of the clutch, already described. If desired, such plate could have on its edge a gasket, of any suitable kind, to effectually close even the slight space between such edge, and the inner face of the flange.

The manner of assembling the parts of the above described friction clutch mechanism, the special construction of such parts, and their operation, need not be set forth at length herein, as they are fully described in another pending application for United States patent, Serial No. 446,104, filed by me, to cover the clutch by itself, as a device capable of advantageous use in connection with other mechanisms than those set forth in the present case. As fully explained in said other application, movement of the sleeve G^6 inward toward the shoe carrying piece, so as to carry the inner ends of the links H′, H′, toward the hub G^2, causes the outer ends of said links to force the friction shoes out against the frictional surface on inner side of flange F^2, more or less closely, according to the amount of movement of the sleeve, and the force applied to the latter, when the shoes have been brought into frictional contact with said flange. Frictional connection between the shaft G and the part carrying the flange and worm wheel can, with the construction shown, be produced or removed, at any time, by a short movement of the sleeve G^6 toward or from the hub G^2 of the shoe carrying piece. The amount of friction between the shoes and the flange F^2, can be adjusted, as desired, from a very slight degree up to a point where the shoes and flange will be locked together; so that any amount of power, applied to the worm gear by the worm on the shaft E^2, will be positively transmitted to the respective wheel shaft G.

The sleeve shifting levers A^5, A^5, having forks to engage the flanges on the respective sleeves, as indicated hereinbefore, preferably, have their fork arms each provided with an antifriction roller or wheel I^5, to prevent friction between the fork and the flanges on the sleeve, as the latter rotates. These levers are pivoted in a bracket or frame A^6, which is to be supported from the car frame or bottom, in any desired way. In order that they may be moved at the same time, and have equal power applied to them both, as they are moved to throw the clutches into operation, I provide each one of them with a pulley A^8, journal three other pulleys A^7, A^7, A^7, in the frame A^6, and use a lever actuating wire cord or rope A^9, which, passing over one of the pulleys A^7, at the end of the series, runs thence

inward and around the pulley A^8 on one of the levers, then outward around the middle one of pulleys A^7, then inward to and around the pulley A^8 on the other lever, and out around the other end pulley A^7. With this construction, any power applied to the cord or rope, tending to draw the pulley bearing end of one of the sleeve shifting levers outward, will be equally applied to the other lever. The pulleys allow any travel or self adjustment of the cord necessary to bring the same power to bear upon both levers.

As it is desirable that the clutch mechanism be capable of being operated from either end of the car, I connect the opposite ends of the rope or cord A^9 with actuating devices, at opposite ends of the car within reach from the end platforms thereof. Each of such devices, as shown, consists of a hand wheel A^4 attached to a threaded shaft a^9, tapped through a fixed nut or threaded sleeve a^6, so that turning of the hand wheel, in one direction or the other, will raise or lower the shaft, a piece a^8, having a head a^7, on the lower end of shaft a^9, swiveled in it, and a loop or eye to which the respective end of cable or cord a^9 is attached. To prevent this piece from turning, while leaving it free to be moved vertically, as the head a^7 is raised or lowered, such piece has two or more guide holes or notches engaging the guides a^{10} fixed to the same support as the nut or threaded sleeve a^6. Pulleys A^{10}, A^{10}, are used merely to change the direction and guide the cord or rope between its actuating devices and the levers A^5, A^5. With the construction described, as either hand wheel A^4 is turned to screw up the respective threaded shaft a^9, the cord or cable will be pulled along to an amount and with a force depending upon the number of turns of the wheel and the power applied to cause the turning. If there is any slack or difference in tension at any parts of the cord or rope, the lever and other pulleys will allow longitudinal travel of the latter, so that all parts will be under equal tension, and the levers A^5, A^5, will have exactly the same power applied to them, to cause them to force the friction shoes of the respective clutches with the same power against the engaging flanges F^2 F^2; so that both of the worm gears driven from the shafts E′ will be frictionally connected, in the same manner and to the same degree, with their respective wheel axles G.

The storage battery, which I use for supplying the electric current for driving the electro-motor described, is divided into several divisions of any desired size, which are to be connected together in series. As indicated in the drawings, there are four of these battery divisions, but there can, of course, be a greater or less number of them, as desired, without departure from my invention.

The special object which I have had in view, in dividing the battery into divisions connected in series, and in devising the connections between such divisions and the motor, so that the number of the divisions supplying electricity to the motor can be increased or diminished quickly at any time, as hereinafter described, has been to have the battery so available, that the strength of the current used can be regulated, increased, or diminished, at any time, as more or less power is needed, under varying conditions of load on the car, or grade of the road, without the use of any rheostat.

At opposite ends of the car, I place the two similarly constructed switch boards A. A., having contact pieces *a*, *b*, *c*, *d*, equal in number to the divisions of the battery, and the segmental contact strips *e*. Contacts *a*, *b*, *c* and *d*, are arranged on the two switch boards, so as to be in the same relative order, reading from right to left, as one faces from the car outward. This arrangement is to make the operation of the switches, at the opposite ends of the car, precisely the same, to produce a given result in connecting the batteries with the motor. The corresponding contacts on the two boards are connected with the same conductors. Of the latter, the one designated by 1, connects contacts *a*, *a*; while conductor 2 connects with contacts *b*, *b*; conductor 3 with contacts *c*, *c*; and conductor 4 with contacts *d*, *d*, the wires forming the conductors, being crossed past each other, as indicated in the drawings, Figs. 2 and 3. Such wires I prefer to make of different sizes, according as they are to transmit the current of different numbers of the divisions of the battery, the one designated 4 being the largest, as it is the one used, when all four battery divisions are connected with the motor. Another wire e^2, e^2, runs from the segmental contact strip *e*, of one switch board, to that of the other, and is connected by wire 5 with the field magnet of the motor, from the other side or pole of which runs the wire 8, connected by the spiral expansible and contractible portions, with contact pieces *c*, *c*, on opposite arms of a switch lever D, which is to be pivoted to or supported from the car frame or bottom, in any suitable way. The said spiral portions are simply to allow the arms of the lever to be moved freely back and forth, in the manner and for the purpose to be hereinafter described, without danger of breaking or injuring the connection of wire 8, with the said contact pieces. Two stationary contacts *c*′, *c*′, are so placed, that they will be engaged alternately by those on the lever, as the latter is swung in one direction, and the other. On the opposite sides of the lever arms from pieces *c*, *c*, are the other contact pieces c^6 and c^4, respectively. Wire c^2, from the one stationary contact *c*′, is connected with wire 11, which runs to the commutator brush C^5, and is also connected with the contact piece c^6 on the back of the lever arm which carries the contact piece for connecting wire 8 with wire 11. From the other commutator brush C^2, a conductor 9, runs to the contact piece *c*′, and is connected, by branch wire c^3, with the con-

tact piece c^4 on the back of the lever arm carrying the piece c which is to connect wire 8 with wire 9, as hereinbefore indicated.

Stationary contact pieces c^5, c^7, so placed as to act in conjunction with contacts c^4 and c^6, respectively so as to make and break contact alternately, are both connected with wires 12 and 13, which latter runs to the one pole of division B′ of the battery. As indicated, this is the negative pole, though, of course, not necessarily so. The positive poles of the battery divisions B′, B^2, B^3 and B^4, are connected, respectively, with the wires 1, 2, 3, and 4 running to the contact pieces on the switch boards, as described, the connections between such poles, and the respective wires being for division B′, conductor a', a', for division B^2 conductor b^2, b^2, for division B^3, conductor c^3 c^3, and for division B^4 conductor d^4, d^4.

Each switch board A, is provided with a swinging switch arm A′, which has on its under side a conducting contact piece A^2, adapted to connect the segmental strip e with any one of the pieces a, b, c, and d, as the arm is swung over the board. For swinging the lever D, the movement of which is to reverse the passage of the current through the motor armature and so cause a reversing of the rotation of the latter, I provide, at or near each switch board A, a reversing switch arm A^3, which is attached to a rotary vertical shaft a^3, to be suitably journaled in bearings on the car frame. On such shaft is an arm a^5, as shown, in the shape of a loop or eye, to which is connected one end of a rod a^4, the other end of which is pivoted to one arm of the lever D. In order that the same motion of the lever D may be secured by the same movement of each switch arm A^3, the rods a^4, a^4, from opposite ends of the car, are attached to the lever on opposite sides of its pivot. If, with the parts in position as shown in Fig. 2, either switch lever A′ be moved to connect the contact piece a with the strip e, the circuit of the current will be, starting from the strip, through wire e^2 to wire 5, to the field magnet of the motor, from that, through wires 8 and 9, to commutator brush C^2, from the other brush C^5, through wires 11, 12, and 13, to the negative pole of division B′ of the battery, from the other pole of such division, through wires a' and 1, to contact piece a, and from the latter, through piece A^2, on the switch arm A′, to the contact strip e. If the switch arm be moved over contact piece b, the current will be the same as before, except that division B^2 of the battery will be included, in series, with B′, and the current will reach the contact b through wires b^2 and 2. If contact piece c be connected with the strip e by the switch arm A′, the current will be from the three battery divisions B′, B^2, B^3, joined in series, and will pass from division B^3, through wires c^3, 3, to said contact c.

When all the divisions of the battery are to be used at once, the switch arm is moved over contact piece d, and the whole current of the battery will be passed through the motor, the connection between one pole of the division B′ and contact strip e, being, as before, and the opposite pole of division B^4 being connected with contact piece d, through wires d^4, 4. With the construction and arrangement shown and described, I am then enabled, by a movement of switch arm A′, bringing it over contact piece a, b, c, or d, to use the current from battery division B′ alone, or to throw two, three, or all four divisions, connected in series, into use to drive the motor. While either one or more of the battery divisions are being employed, the motor, which is, of course, of the reversible kind, can be reversed at once, by a turning of one of the arms A^3, to swing the lever D, so that its contact piece c, which before engaged piece c', connected with wire 9, will be disengaged therefrom, and its other piece c will be brought to the contact c', which is connected with wire c^2. This motion of the lever separates contacts c^6 and c^7, and brings together the other pair of contacts c^4, c^5, to connect the wire c^3 with wire 12. The course of the current leaving the field magnet by wire 8, will then be along wire 8, to wires c^2 and 11, thence through commutator brush C^5, from brush C^2 to wire 9, and from the latter, through contacts c^4, c^5, and wires 12 and 13, to the pole of battery division B′. It will thus be seen that the current passing through the armature, is reversed. Its direction can be changed back again at once, when desired, by swinging the arm A^3 back, so as to return lever D to its first position.

To provide for the charging of the battery, from a trolley wire or other conductor, at any time, without the necessity of removing the battery divisions, I place on each of the switch boards A, the two contact strips K, K, which the contact piece A^2 can be made to connect, as the arm A′ is swung to the position indicated by dotted lines in Fig. 3. One of these strips is connected by wire k, with a pole of one of the battery divisions B^4, while the other one is connected with conductor k', which runs to one of the contact devices k^2, which is to be on a suitable supporting arm, not shown, whereby it can be brought into contact with a trolley wire or other conductor, from which the battery is to be charged. From the other contact device k^3, the wire k^4 runs to the outer or negative pole of battery division B′.

While I have not shown the arm for carrying the contact pieces k^2, k^3, or the manner in which they are arranged to be brought into or out of contact with the trolley wires or current supplying conductors, but have only indicated, in a conventional way, the connections between such pieces and the battery on the car, the arrangement and construction of my charging device will, with the description and drawings given, be readily understood by those familiar with the manner and means

of connecting the motor of a trolley system car with the trolley wire or wires. By my device, the current from the wire or wires is to be directed around through the battery divisions, connected in series, just as it is sent through the armature of the motor of a trolley car, and can be shut off from the battery by swinging the switch arm A′, to disconnect the contact strips K, K.

The operation of my mechanism, which will be understood from the foregoing description, is briefly as follows: With the parts in position, as indicated in Figs. 2, 2^a, and 2^b, the battery being disconnected from the motor, and the friction clutch shoes being drawn inward away from the clutch rim or flange F^2, to start the car, the switch A′ is swung to connect the contact strip *e* with contact piece *a*, *b*, *c*, or *d*, according to the amount of resistance due to load on the car, or inclination of the road which is to be overcome. Either one division of the battery, or several of the divisions, connected in series, can thus be thrown into use, at will, to drive the motor, and, by a proper movement of the switch A′, the number of divisions employed at any time can be most quickly changed to suit varying circumstances of load on the car or grade of the track. With the friction clutches out of operation, the motor can be quickly speeded up as desired, for it has no resistance to overcome except the inertia of the two shafts E, and the pieces carrying the flanges F^2, and the worm gears driven by the worms on the respective shafts. One of the hand wheels A^4 is then turned to cause the wire cord or rope A^9 to draw the outer ends of the two levers A^5, A^5, outward, which, for the reason hereinbefore fully described, it does with precisely the same power applied to both levers. The forked ends of the latter then force the two sleeves G^7, G^7, inward, toward the respective friction shoe carrying pieces attached to the wheel axles G, G, and cause the links H′ to press the friction shoes against the respective flanges F^2 F^2, with a closeness and power which will vary according to the amount of turning of the hand wheel, and the power applied to the latter. In starting the car from a state of rest the wheel A^4 is turned to apply the friction shoes lightly at first, so that the friction between the shoes and the respective flanges F^2, F^2, will be just enough to transmit, from the worm gears and shafts driven by the motor, the power needed to drive the car. With the car thus started, the friction between said shoes and flanges of the clutches can be increased, so as to drive the wheel axles G, G, more and more rapidly, and, finally, lock the shoe carrying pieces, revolving with such axles, to the flanges F^2 F^2. As the closeness of the frictional contact between shoes and flanges is increased, the amount of power which can be transmitted from the motor driven shafts will also be increased. With my clutch mechanism, described and shown, the amount of transmitted power can be varied from nothing, to the full strength of the motor, without any shock or jar, even when the clutching of the axles to the worm gears takes place with the motor already speeded up, and the car is at rest. With the cord or rope connected with the clutch levers, as shown and described, both clutches are necessarily operated alike, so that there will always be an equal power applied to both wheel axles. To disconnect the latter from the motor, all that is necessary is to turn back the hand wheel A^4, so as to loosen the rope or cord A^9 and release the levers A^5, A^5. The car can then be stopped by any suitable brake, without involving the stopping and restarting of the motor, which can be kept rotating, ready to apply its greatest power to drive the wheel axles when the friction clutches are thrown into operation again. The direction of rotation of the motor armature, and, consequently, of the travel of the car, can be changed by a turning of either arm A^3, to shift the switch lever D, and change the contacts; so as to direct the current in the opposite direction through the commutator brushes and armature, such change being capable of being made without any shutting off of the current from the battery. With my mechanism, as shown and described, I am enabled to do away with the necessity of any brake; for I can employ the power of the motor itself to check the motion of the car and to make the stopping action a most powerful and quick one, if desired, in case of emergency, or, as slow and gradual as can be desired. When thus operating without brakes, if the car is to be stopped or its motion checked, the friction clutches are thrown out of operation, and the lever D is shifted by a swinging of one of the arms A^3 to reverse the motor which, as it is disconnected from everything but the shafts E′, E′, and the pieces carrying the worm gears, is capable of being reversed very quickly and speeded up in the opposite direction sufficiently for the best securing of power therefrom. The friction clutches are then thrown into action again, the degree of pressure of the friction shoes against the respective flanges F^2, F^2, depending upon the amount of movement of levers A^5, A^5, and the power applied to them through cord or rope A^9 from the hand wheel device A^4. Power from the motor, which is rotating the pieces carrying the flanges F^2, F^2, in a direction opposite to that of the rotation of axles G, G, is thus applied in such way as to oppose the turning of the latter, the amount of such power used being dependent upon the closeness of the frictional contact between said shoes and flanges, and, therefore, being capable of being controlled by the one turning wheel A^4; so that the stoppage of the car can be made as quick or gradual as desired. Having been thus stopped, the car can be caused to run back by the continued application of the friction clutches; or the latter can

be thrown out of operation again, and the lever D can be shifted to cause the motor to turn forward so as to start and drive the car once more in its original direction, when the clutches are again thrown into action.

Having thus described my invention, what I claim is—

1. In combination with the motor, and the two axles to be driven therefrom, the two friction clutches each interposed in the connections between one of the axles and the motor, the two levers for operating the respective clutches to bring their coacting frictional parts together, and means for actuating such levers connected with both of them so as to operate them both with the same power, to move the movable parts of the two clutches simultaneously, into and out of engagement with the corresponding fixed parts substantially as and for the purpose described.

2. In combination with the motor, and the two axles to be driven therefrom, the two friction clutches each interposed in the connections between one of the axles and the motor, the two levers for operating the respective clutches to bring their coacting frictional parts together, pulleys on the outer ends of the levers, a cord or rope passing around such pulleys and out over others beyond the lever ends, and means for pulling upon such cord or rope to shorten the bends therein between the outer pulleys and those on the respective lever ends, substantially as and for the purpose described.

3. In combination with the motor and the two axles to be driven therefrom, the two friction clutches each interposed in the connections between the motor and one of the axles, the two levers for operating the respective clutches so as to bring their coacting frictional parts together, pulleys on the outer arms of the levers, three pulleys journaled on a suitable support beyond the lever ends, a rope or cord passed over one of these pulleys inward to and around one of the lower pulleys, then outward around the middle one of the three pulleys, then inward around the other lever pulley, and outward around the remaining one of the outer pulleys, and means for applying power to draw upon the rope, so as to tend to straighten it out where it bends around the several pulleys, substantially as and for the purpose described.

4. In combination with the motor and the two axles to be driven therefrom, the two friction clutches, each interposed in the connections between the motor and one of the axles, the two levers for operating the respective clutches to bring their coacting frictional parts together, pulleys on the outer arms of the clutch levers, three pulleys journaled on a suitable support, a rope or cord having one end attached to any suitable support, and passing thence over the latter pulleys, and on each side of the middle of the three pulleys passing inward and around the pulley on one of the clutch levers, a reciprocating piece to which the other end of the cord or rope is attached, the screw having a head swiveled in such piece, and a hand wheel by which it can be turned, and a stationary nut or threaded block through which the screw is tapped, substantially as and for the purpose described.

5. In combination with the car frame and the motor for driving the car, the two supporting wheel axles to be driven from the motor, the two friction clutches each interposed in the connections between the motor and one of the axles, the two levers for operating these clutches having pulleys on their outer arms, the three pulleys journaled on a stationary support, the cord or rope passing over each of the end pulleys of the three, inward around one of the lever pulleys, and then outward over the middle one of the three pulleys, and having its opposite ends attached to reciprocating pieces at or near opposite ends of the car, a screw for each one of such pieces, having a device whereby it can be turned, and a stationary threaded block or nut for each screw through which the latter is tapped, substantially as and for the purpose described.

6. In combination with the two supporting wheel axles of a tram or street car, and the single motor, the two shafts coupled to opposite ends of the armature shaft, and each carrying a worm, a worm gear wheel for each axle kept in mesh with the worm on the respective worm shaft and means for connecting the two worm wheels simultaneously with the respective supporting wheel axles, and disconnecting them therefrom at will, substantially as and for the purpose described.

7. The combination with the motor and the two supporting wheel axles of a tram or street car, the two shafts coupled to the opposite ends of the single motor shaft, wheels adapted to be driven by the two coupled shafts connected therewith by gearing, a friction clutch for each wheel to connect the same with one of the supporting wheel axles, and means for operating the two clutches simultaneously to cause their co-acting parts to come together with any desired amount of frictional contact, substantially as and for the purpose described.

8. In combination with the single electromotor and means for reversing the motion of the same at will, the two supporting wheel axles of a tram or street car, the two shafts coupled to the opposite ends of the motor shaft, the two wheels one being geared to and driven from each of such coupled shafts, friction clutch connection between each of such driven wheels and one of the supporting wheel axles, and means for simultaneously operating such clutch devices to cause each of the driven wheels to be connected with and drive its respective supporting wheel axle, substantially as and for the purpose described.

9. In combination with the reversible electromotor and the battery for driving the same divided up into divisions normally connected in series, by suitable conductors connecting

the opposite poles of adjoining divisions a switch board having a contact strip, a series of contact pieces one for each battery division, and a movable arm having a contact piece adapted to connect the strip electrically with any one of the series of contact pieces, upon proper movement of the arm, the conductors for conducting the current to and from the motor, one connected with the contact strip, and the other, with one end of the series of battery divisions, conductors connecting each one of the series of contact pieces of the switch board with the pole of its respective battery division, opposite to that of the first division with which the motor is connected the current-reversing switch, and means to actuate the same mounted on the switch board and adapted to be operated by hand, at will, substantially as and for the purpose specified.

In testimony that I claim the foregoing I have hereunto set my hand this 16th day of September, 1892.

AUGUSTIN I. AMBLER.

Witnesses:
HENRY C. HAZARD,
FERDINAND SCHMIDT.