(No Model.) 4 Sheets—Sheet 1.

W. E. ALLINGTON.

ELECTRIC LOCOMOTIVE.

No. 486,068. Patented Nov. 15, 1892.

Fig. 2.

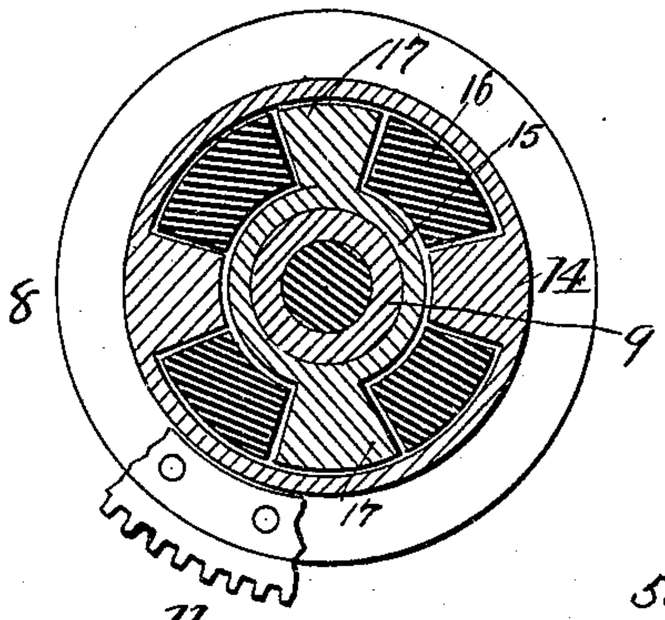
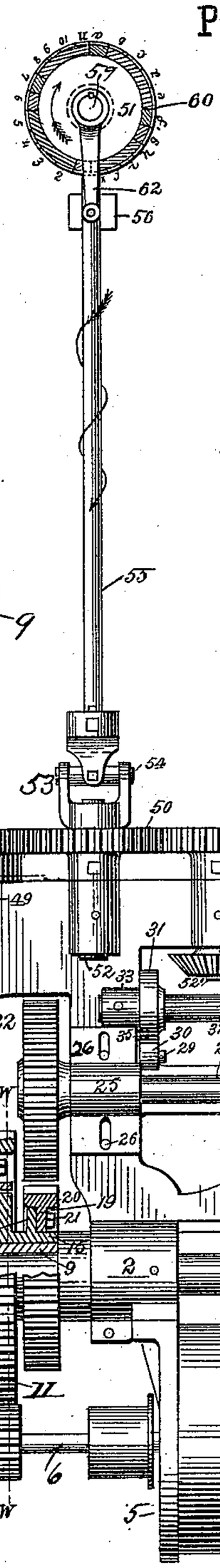


Fig. 1.



Witnesses:
T. R. Stuart
R. H. Paul

Inventor.
W. E. Allington.
By Marble, Macon & Canfield,
Attorneys.

(No Model.) 4 Sheets—Sheet 2.

W. E. ALLINGTON.

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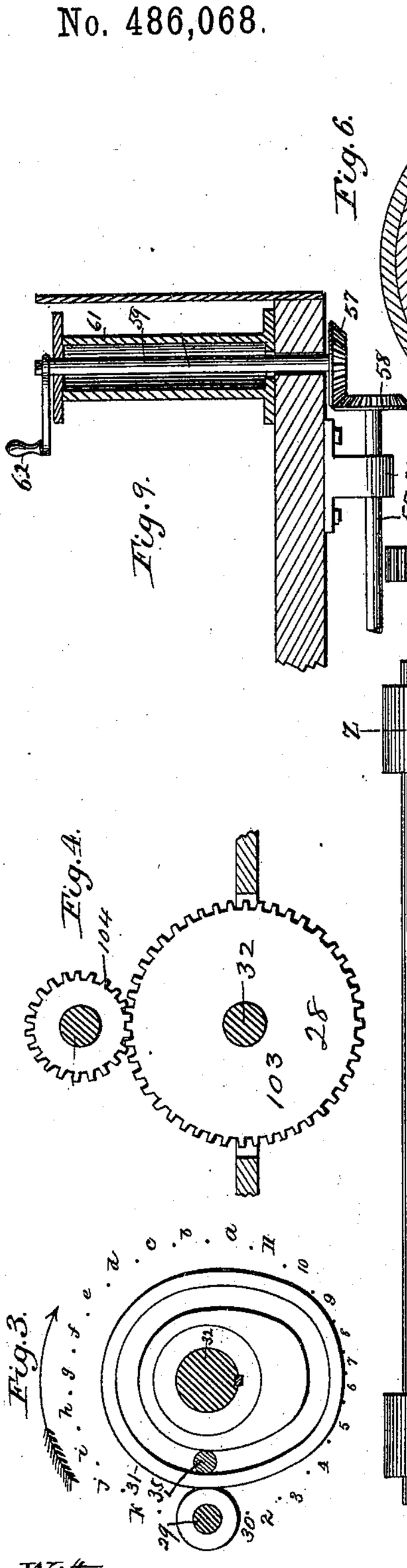

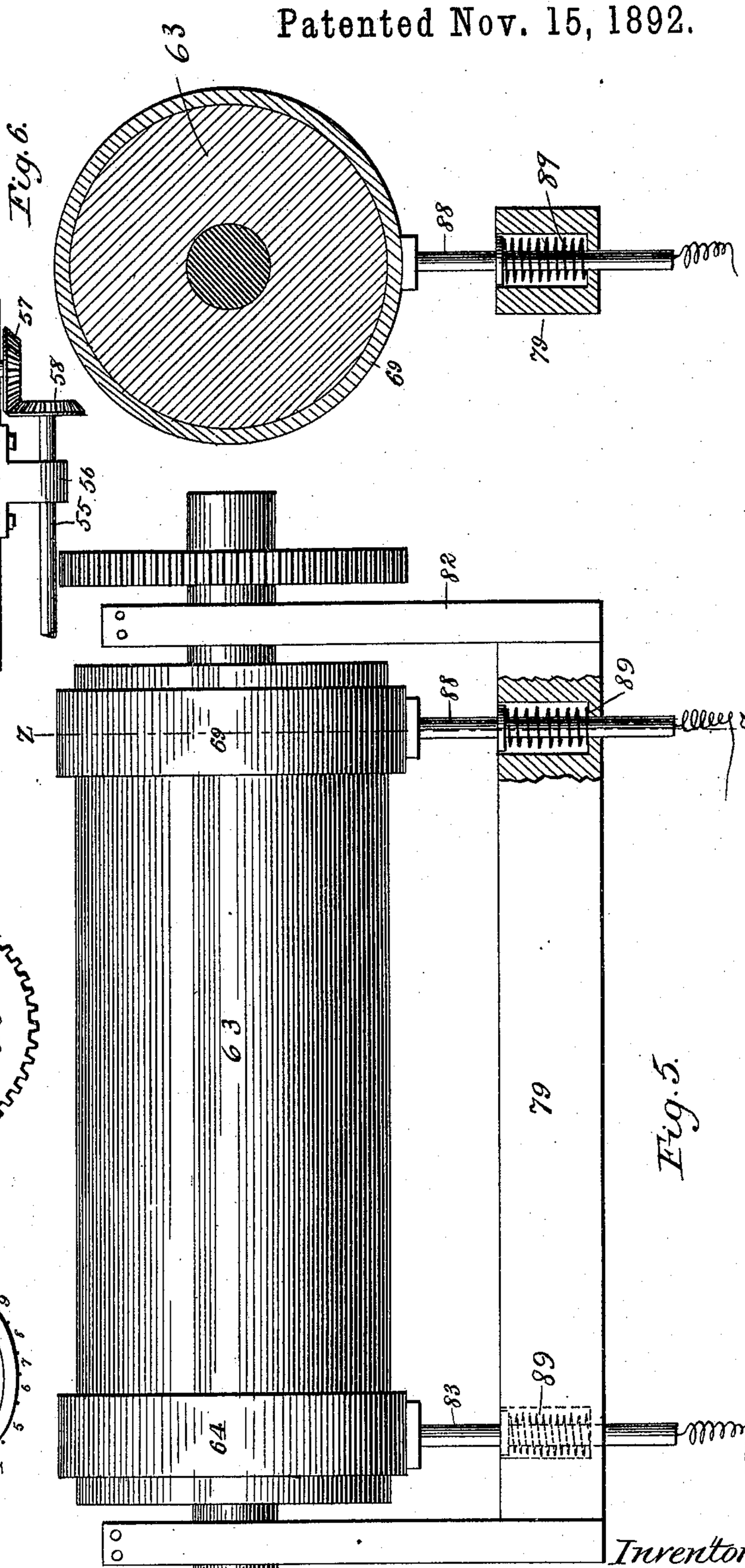

Fig. 5.

Witnesses:
T. R. Stuart.
R. H. L. Paul

Inventor:
W. E. Allington
By Marble, Mason & Langfield,
Attorneys.

(No Model.) 4 Sheets—Sheet 3.

W. E. ALLINGTON.

ELECTRIC LOCOMOTIVE.

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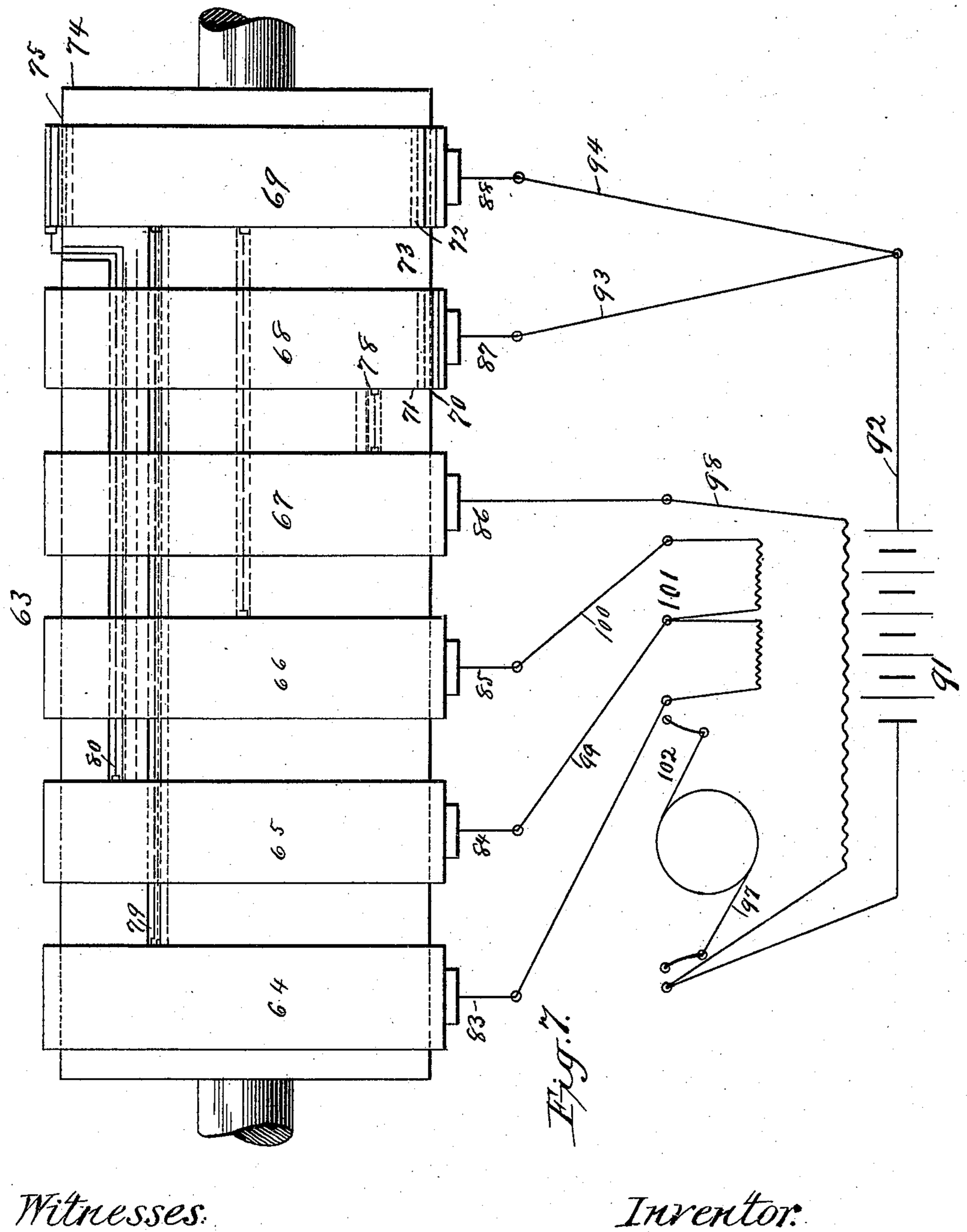

Witnesses:
T. R. Stuart.
R. H. Paul

Inventor:
W. E. Allington.
Marble, Mason & Caulfield,
Attorneys.

(No Model.)

4 Sheets—Sheet 4.

W. E. ALLINGTON.

ELECTRIC LOCOMOTIVE.

No. 486,068. Patented Nov. 15, 1892.

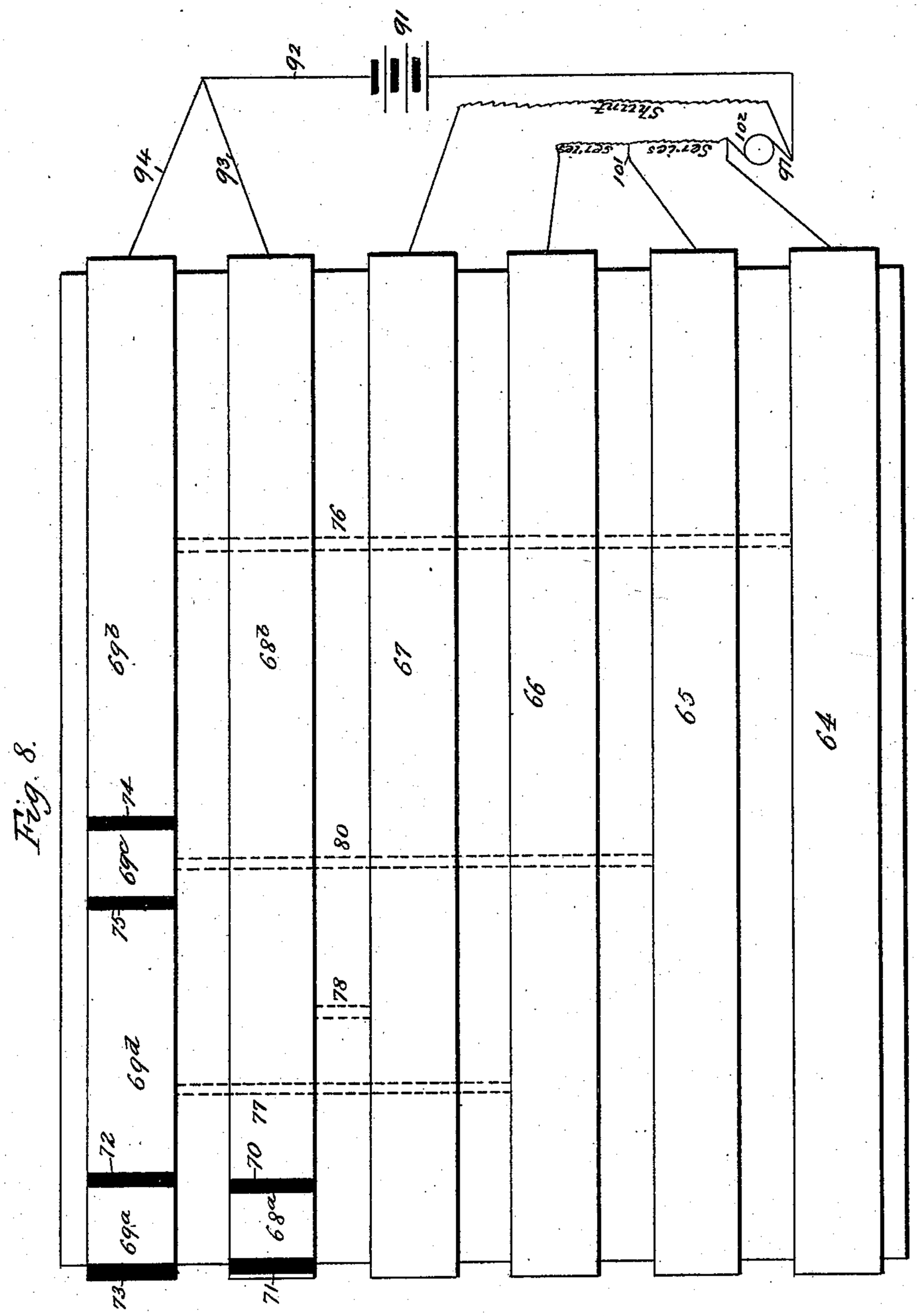

Fig. 8.

Witnesses:
F. G. Stuart.
H. M. Marble.

Inventor:
Wm. E. Allington.
By Marble, Mason & Caulfield
his Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM E. ALLINGTON, OF EAST SAGINAW, MICHIGAN.

ELECTRIC LOCOMOTIVE.

SPECIFICATION forming part of Letters Patent No. 486,068, dated November 15, 1892.

Application filed June 9, 1891. Serial No. 395,634. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. ALLINGTON, a citizen of the United States, residing at East Saginaw, in the county of Saginaw and State of Michigan, have invented certain new and useful Improvements in Electromotors for Street-Cars; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to motors electrically operated for the propulsion of street-cars or other vehicles, and it is especially useful where the current is supplied to the motor by storage or secondary batteries; and it consists in the novel construction and arrangement of the parts constituting my motor, as is more fully hereinafter described.

The objects of my invention are, first, to provide means for varying the ratio of speed of motor to speed of the driving-axle, thereby permitting the motor to work under the greatest advantage when the car is starting; second, to so connect the mechanism for operating the motor-gearing with the circuit-controller, switch, or rheostat of the motor that both are operated by the same means at the same time; third, to so construct and arrange the parts that broken or injured members may be easily and quickly replaced, and, fourth, to so construct and arrange the various parts that the mechanism may be compact, strong, simple in construction, easily managed, comparatively cheap, and easy of repair. These objects are attained in the mechanism herein described, and illustrated in the drawings which accompany and form part of this application, in which the same reference-numerals indicate the same or corresponding parts, and in which—

Figure 1 is a plan view of the motor-truck, showing the position of the electric motor, the gears, and the dial-plate and regulating-handle. Fig. 2 is a sectional view on the line *w w* of the speed-gear wheel. Fig. 3 is a sectional view on the line *x x* of Fig. 1, showing the construction and form of the cams 31. Fig. 4 is a sectional view on the line *y y* of Fig. 1, showing the method of gearing the switch to the operating mechanism. Fig. 5 is a plan view of the switch and electrical connections. Fig. 6 is a cross-section taken on the line *z z* of Fig. 5. Fig. 7 is a diagram of the switch-barrel and electrical connections. Fig. 8 is a development of the surface of the switch-barrel, showing more clearly the conducting-rings, the insulating-strips and "dead-spaces," and the conductors; and Fig. 9 is a longitudinal section of a portion of the platform of the car, showing the regulating-handle, dial-plate, and the rods and gears for operating the switch and motor gearing.

In the drawings, 1 indicates the frame of the motor-truck, and has cast in it bearings for the axles of the car and for the shafts 48, 52, 52′, and 32, and two projecting arms cast on or secured to it carry bearings for the armature-shaft 6 of the electric motor 6′. Attached to and supported from this frame are also the journal-boxes 25 of the supplemental shaft 23. The electric motor shown in Fig. 1 is a special type of compound-wound motors; but any motor may be used, either series, shunt, or compound wound, the only change necessary being in the switch. I prefer, however, a compound motor having two series and one shunt coil, and the switch, as described, is adapted to that form of motor. The armature-shaft 6 has keyed to it the pinion 7, intermeshing with the speed-gear wheel 8, mounted on the driving-axle 3, but free to revolve about it. Projecting from the inner face of this gear-wheel 8 is a flange 13, which has on opposite sides lugs 14, projecting toward the center. The hub 9 of the wheel 8 is also elongated into a sleeve, and on this sleeve is loosely mounted the gear-wheel 15, which has projecting from its hub radial lugs 17, which engage with the lugs 14, before mentioned. Between these engaging lugs, however, are placed the cushions 16, which are of rubber or some other elastic material and which serve to deaden the shock which occurs when the motor is thrown into gear.

23 is a supplemental shaft supported by the journal-boxes 25 and having keyed to it a gear-wheel 22, arranged to mesh with the gear-wheel 15, and a pinion 27, arranged to mesh with a gear-wheel 28, keyed to the driving-axle 3. The journal-boxes 25 are secured to the motor-frame by bolts which pass through slots in said journal-boxes, which may therefore

have a slight backward-and-forward movement sufficient to engage or disengage the gears on the shaft 23 with the corresponding gears on the driving-axle 3. It will be seen that when the supplemental shaft and its gears are in gear the armature-shaft 6 is connected through gears to the driving-axle 3. This then constitutes the power-gear, which is thrown into or out of gear by the backward or forward movement of the supplemental shaft 23. The means by which this motion is obtained is as follows: Projecting from the journal-boxes 25 are pins 29, carrying friction-rollers 30, which bear against the cams 31, (better shown in Fig. 3,) which are mounted on and keyed to the shaft 32. These cams are grooved, as shown in Fig. 3, and in these grooves work pins 35, projecting from the journal-boxes 25. Keyed to the shaft 32 is a bevel-gear 36, engaging with another similar bevel-gear 37, which is keyed to the shaft 52′. On the other end of this shaft is keyed a gear-wheel 51, meshing with another similar gear-wheel 50, keyed to the shaft 52. The shaft 52 has also attached to it one yoke of the universal joint 53, the other yoke of which is attached to the rod 55, which has at its other end the bevel-gear 58, engaging with the similar bevel-gear 57, keyed to the operating-shaft 59. This shaft 59 passes up through the case 61, which has at its upper end the dial-plate 60, and to it is attached the regulating-handle 62, by which the movement of the car is controlled. The rod 55 is supported at its forward end by the hanger 56, which is placed as near the gear 58 as practicable and fits the rod 55 loosely. This is necessitated by the fact that when the car is rounding curves the truck has a swinging motion relative to the floor of the car, and the rod 55 must be left free to follow this motion.

The speed-gear of the motor is constructed as follows: On the driving-axle 3 of the car is mounted the wheel 39, keyed to the axle by the key or feather 41. Though thus forced to revolve with the axle it is free to move transversely along the same. On its inner face are two lugs 40, corresponding to two lugs 38 on the outer face of the speed-gear wheel 8, and when the wheel 39 is moved transversely inward along the axle 3 these lugs engage, and the armature is by this means geared to the axle 3. This constitutes the speed-gear of the motor. It is thrown into and out of gear by the following means: The hub of the wheel 39 has in it a groove 42, and in this groove fits the forked end of the lever 43, which is pivoted to the truck-frame at 44 and has an extension beyond the pivot, carrying a friction-roller which works in a groove of the cam 46, which cam is of a similar form to the cams 31, before mentioned. The cam 46 has fastened to it the gear-wheel 47, which engages with the gear-wheel 50, before mentioned. The three gears 47, 50, and 51 are all of the same size. It will thus be seen that both the speed and power gears are thrown into and out of gear by the same means—viz., the rotation of the regulating-handle 62. The cams 31 and 46 are, however, placed oppositely on their respective shafts, and their forms are such that the power-gear is completely out of gear before the speed-gear is thrown into gear, and vice versa, so that no conflict can ensue. In the drawings both gears are shown out of gear and the regulating-handle at the starting-point on the dial-plate. Moving the regulating-handle in the direction shown by the arrow the gears 47, 50, and 51 are revolved and the cams 31, pressing against the friction-rollers 30, move the supplemental shaft and gears back into engagement with the gears on the driving-axle. A further movement of the regulating-handle will cause the surface of the cams to recede from the friction-rollers, and then the pins 35 draw the supplemental shaft and gears back out of engagement. A further movement of the regulating-handle causes the cam 46 to press out the friction-roller mounted on the lever 43, forcing the wheel 39 inward and throwing it into gear with the speed-gear wheel 8. A further movement of the regulating-handle throws the speed-gear out of gear again and returns the parts to the position from which they started, the handle having made one complete revolution. The gear-wheels 8 and 15, as shown in the drawings, are "built-up" gears, having the teeth cast in segments of circles, which are then secured to the rim of the wheel by bolts or otherwise. There may be two or more of these segments to each wheel. The advantage of this construction is that when teeth are broken or worn they may be removed and others substituted easily and quickly without removing the wheel from its position on the axle and without fitting a new wheel.

Figs. 5, 6, 7, and 8 are drawings of the switch and the parts connected therewith. In the drawings, 63, known as the "switch cylinder" or "barrel," is a cylinder of some non-conducting material mounted on a shaft parallel to and directly above the shaft 32 and geared thereto by the gears 103 and 104, (shown in Fig. 4,) which are in the ratio of two to one, the switch-barrel making two revolutions for one of the shaft 32 and regulating-handle. On the switch-barrel are six bands 64, 65, 66, 67, 68, and 69 of some conducting material, as brass. Suitably supported by the side of this switch-barrel is the bar 79, of some non-conducting material, which has in it six recesses corresponding to the six conducting-bands of the switch-barrel 63. (In Fig. 5 but two ef these rings and recesses are shown.) Working in these recesses are pins or "brushes" 83, 84, 85, 86, 87, and 88, which are pressed out against the conducting-rings by springs 89, bearing against the bar 79. To these brushes are connected wires leading to various points, to be hereinafter mentioned. A portion 68^a of the band 68 is insulated from the rest of the band—viz., 68^b—by the insulating-strips 70 and 71.

The band 69 has a corresponding insulated portion or dead-space 69^a, insulated by the strips 72 and 73. The strips 72 and 73 are placed somewhat farther apart than the strips 70 and 71, and the space 69^a is also placed somewhat behind 68^a, so that the brush 87 makes contact with the portion 68^b of the strip 68 before the brush 88 makes contact with the main portion of the band 69. This is because in order to avoid danger of burning out the armature when starting the motor it is desirable to energize the magnets before current is passed through the armature, and this end is accomplished by arranging the insulating-strips as I have described. The band 69 has also another insulated space 69^c, insulated by the strips 74 and 75. The band 69 is therefore divided into four segments 69^a, 69^b, 69^c, and 69^d. 69^b and the band 64 are connected by the conductor 76, 69^c with the band 65 by the conductor 80. 69^d and the band 66 are connected by the conductor 77, and bands 67 and 68^b are connected by the conductor 78.

91 indicates the battery or other means for supplying current to the motor. One pole is connected with the conductor 92, which has branches 93 and 94 connected with the brushes 87 and 88, and hence with the bands 68 and 69. The other pole of the battery is connected with the brush 97 of the electric motor. The band 67 is connected through the brush 86 with the shunt-coil of the motor, and hence with the motor-brush 97. The two series coils of the motor are connected up in series and band 66 connects through both of them with the brush 102, while band 65 connects with only one of them. Band 64 is connected direct to the motor-brush 102.

The operation of my invention is as follows: Taking the parts in the positions shown in the drawings, the motor is out of gear with the driving-axle. The brushes 87 and 88 are on the dead-points 68^a and 69^a, and no current passes through the motor. The regulating-handle is at the zero position on the dial-plate. Moving the handle in the direction of the arrow, as soon as the brushes 87 and 88 touch the segments 68^b and 69^d the circuit is completed from the battery through the conductor 94, the brushes 87 and 88, the conductors 78 and 77, and the series and shunt coils of the motor back to battery again. The motor will now run light—at about two hundred revolutions above its normal speed of three hundred and fifty revolutions. When the regulating-handle has moved to "5" on the dial, the cams 31 have moved enough to throw the power-gear into gear, starting the car, though slowly. The momentum of the rapidly-moving armature-shaft and wheels connected therewith is utilized in overcoming the initial inertia of the car; but the cushions 16 tend to prevent any shock to the gear-teeth when the load is thus suddenly thrown on. The electrical connections remain the same as at first until "6" on the dial is reached, when the brush 88 is on the space 69^c, cutting out one series coil, thereby decreasing the strength of field, and, owing to a peculiarity of shunt-motors and also of compound motors in which the shunt-coils have the most influence on the strength of field, increasing the speed and power of the motor. Passing the regulating-handle to "7" on the dial cuts out the other series coil and converts the motor into a simple shunt-machine. The motor is then running at full speed and this is the best arrangement for working under the most severe conditions, such as rounding curves or climbing heavy grades. In starting the car, however, this position of the parts would usually be maintained only until the car was well under headway. Turning the regulating-handle still farther throws out the power-gear, and when the handle has reached "a" on the dial cuts off the current, and if the regulating-handle were allowed to remain there the car would come to rest. The regulating-handle and the cams have now made one half-revolution and the switch-barrel has made one complete revolution. Turning the handle still farther the same connections are made as at first and in the same order. When "e" on the dial-plate is reached, the speed-gear is thrown into gear, and by subsequent movements of the handle first one and then both of the series coils are cut out and the car runs at full speed. Further movement throws out the speed-gear and cuts off the current, and the parts are in the positions from which they first started.

It is apparent that in adapting my invention to other methods of controlling the speed and power of the motor described other switches may be substituted for that here described, and switches might be used which control the motor through the agency of a rheostat. As described, but one axle of the car has power applied to it.

Other motors may of course be used, all controlled by one operating-rod and regulating-handle and one switch. The axles may likewise be connected by sprocket wheels and chains, and the wheel 39 may have projections on its rim and be used for one of these sprocket-wheels.

Having thus completely described my invention, its construction, and operation, what I claim as new is—

1. In a motor-gearing for street-cars, the combination, with the wheel 39, having a grooved hub, of a lever 43, pivoted to the motor-truck, one end of said lever being forked and fitting into the groove 42 in said hub, the other end fitting into the groove of a grooved cam 46, and means for causing said cam to be revolved by the revolution of the regulating-handle, thereby throwing said wheel 39 in and out of gear with the speed-gear wheel, substantially as described.

2. In a motor-gearing for street-cars, the combination, with the supplemental shaft and gear-wheels mounted thereon, of a shaft

32, carrying grooved cams 31 and rotated by the revolution of the regulating-handle, the journal-boxes 25, supporting the supplemental shaft and movably secured to the frame of the motor-truck, said journal-boxes being provided with projecting pins carrying friction-rollers bearing against said cams 31 for moving the supplemental shaft backward, and other projecting pins working in the grooves of said cam 31 for drawing the supplemental shaft forward, thereby throwing the supplemental shaft into and out of gear, substantially as described.

3. In a motor-gearing for street-cars, the combination, with a motor, a speed-gear wheel mounted loosely on the driving-axle, and a pinion keyed to the armature-shaft and intermeshing with said speed-gear wheel, of a clutch mounted on the driving-axle and adapted to gear said speed-gear wheel directly to the said driving-axle, a supplemental shaft carrying a gear-wheel adapted to engage with a secondary gear-wheel driven from the speed-gear wheel, a pinion likewise keyed to said shaft and adapted to engage with a gear-wheel keyed to the driving-axle, and journal-boxes for said supplemental shaft, adapted to be slid backward and forward, thereby throwing said supplemental shaft and gearing into and out of gear with the speed-gear wheel and driving-axle, and means for throwing either said clutch or said supplemental shaft into and out of gear with the speed-gear wheel, substantially as described.

4. In a motor for street-car propulsion, the combination, with a compound-wound motor and speed and power gears for gearing said motor to the driving-axle, and a regulating-handle for throwing either the speed or power gear into gear at will, of a switch likewise operated by the motion of the regulating-handle and adapted to vary the speed and power of the motor by throwing in or out of circuit the series coil or coils of the motor, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM E. ALLINGTON.

Witnesses:
E. J. DEMOREST,
JAS. V. OXTOBY.