No. 662,206. Patented Nov. 20, 1900.

J. E. THORNYCROFT.

MOTOR VEHICLE.

(Application filed Oct. 16, 1899.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.

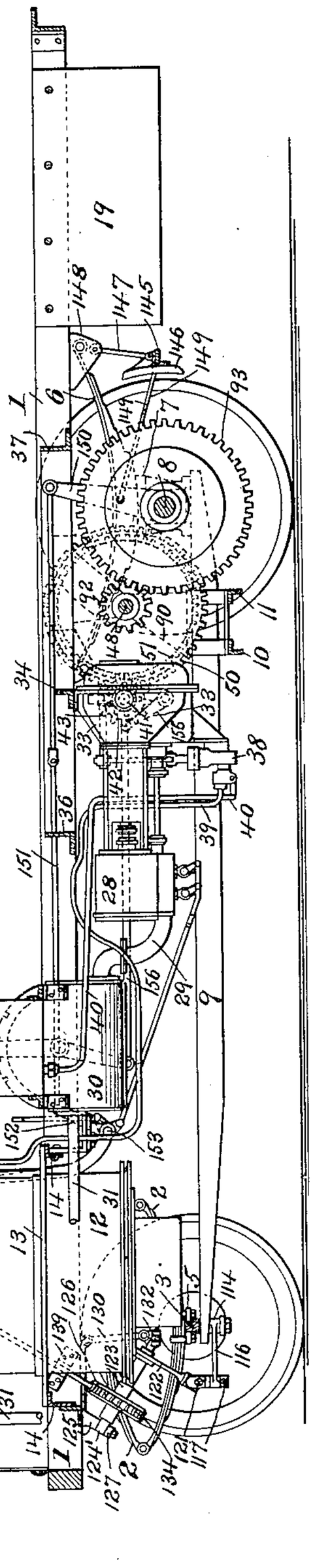
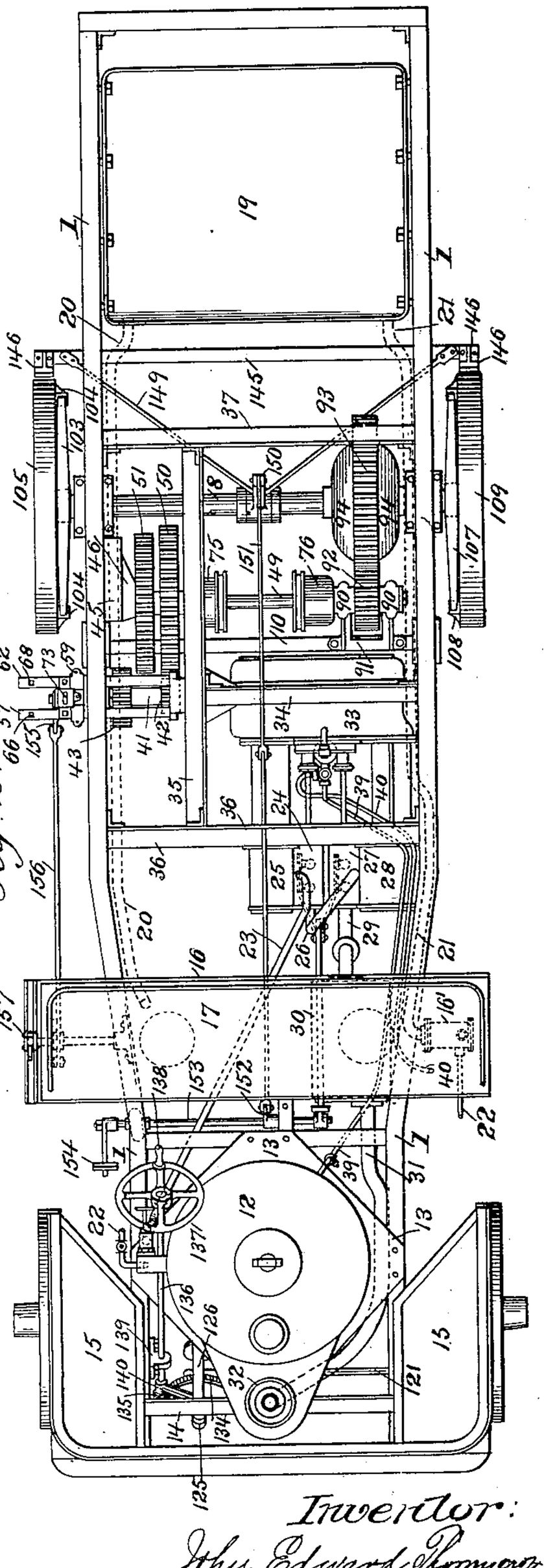


Fig. 2.



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(No Model.) 5 Sheets—Sheet 2.

Fig. 3.

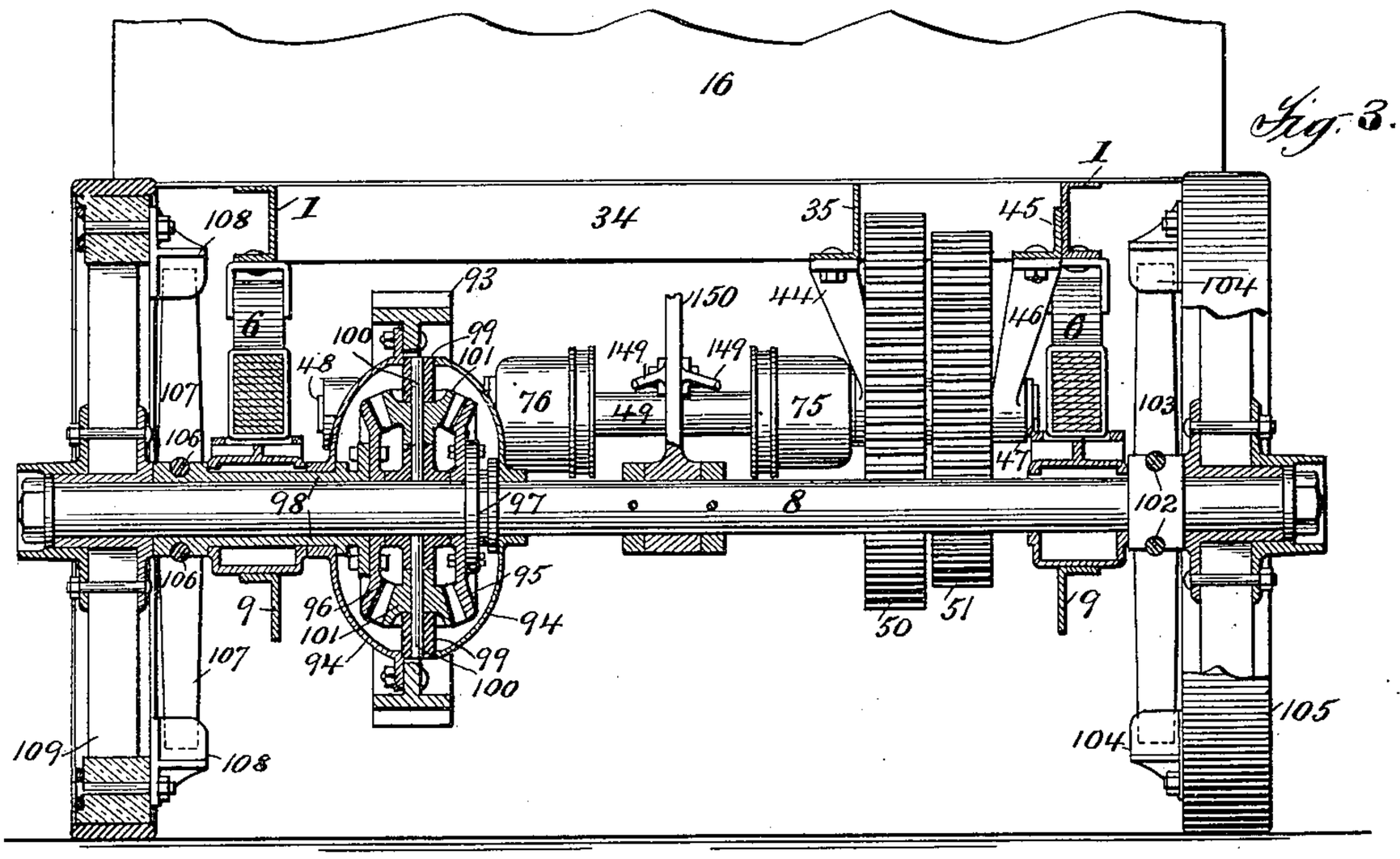


Fig. 4.

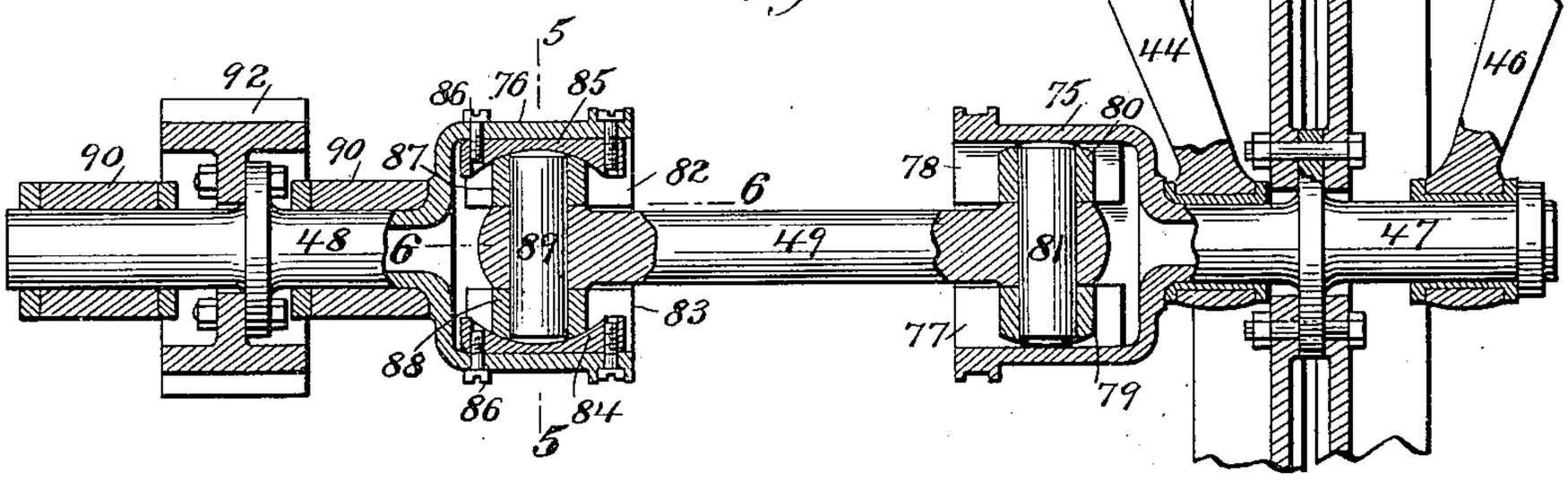


Fig. 5.

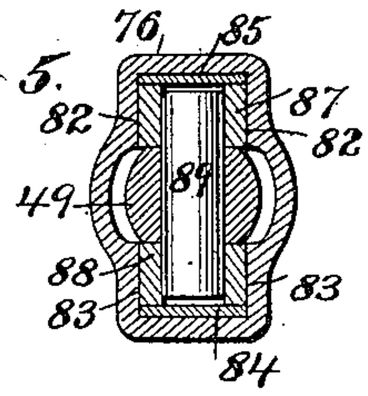


Fig. 6.

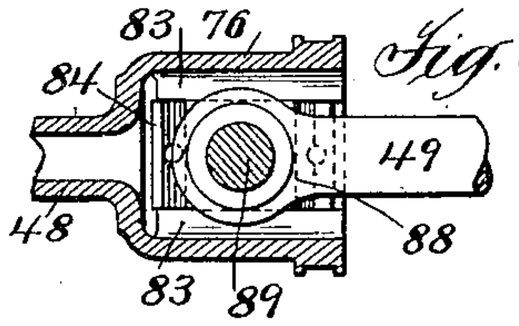
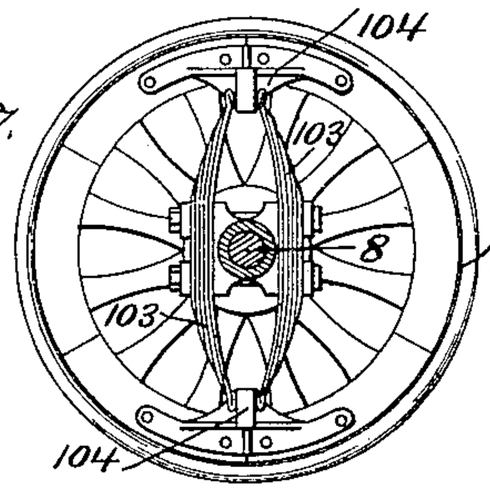


Fig. 7.



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(No Model.) 5 Sheets—Sheet 3.

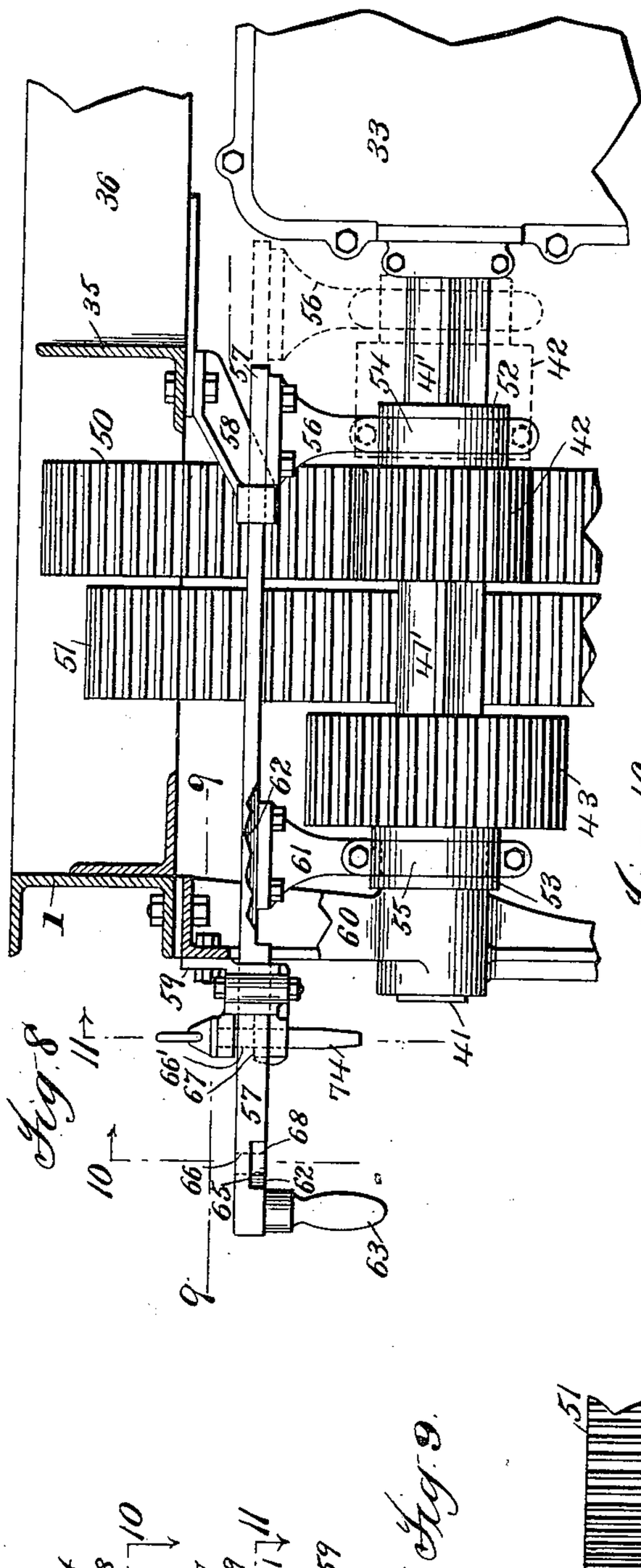

Fig. 8.

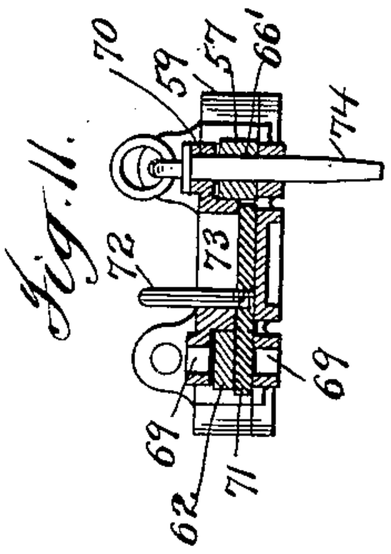

Fig. 11.

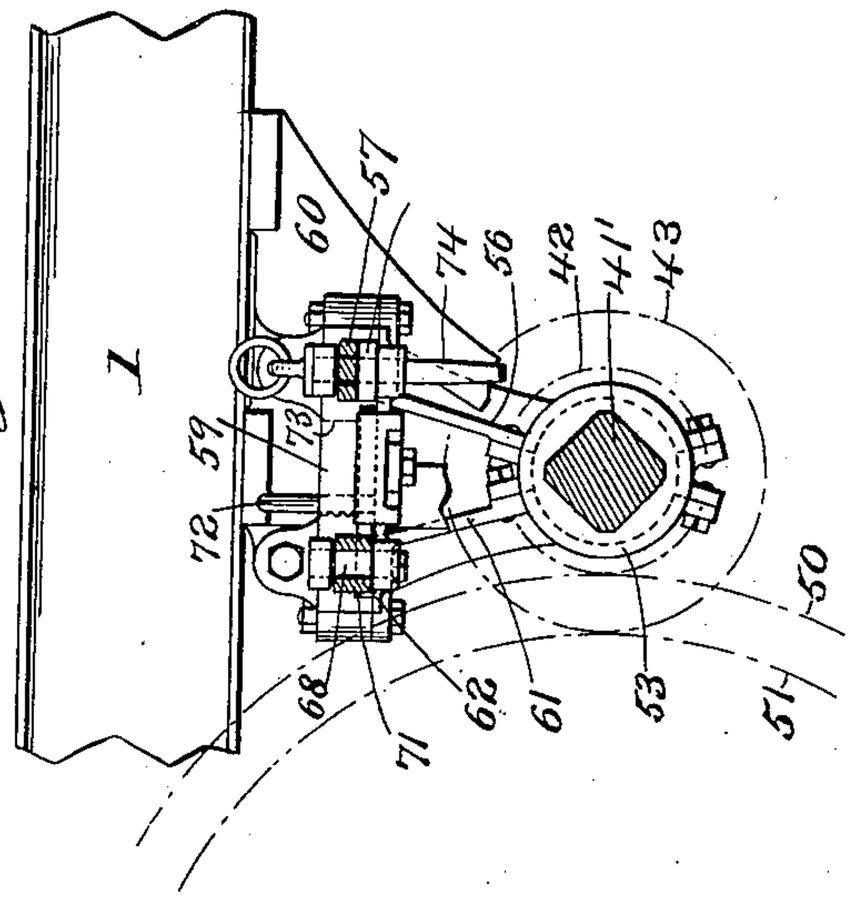

Fig. 10.

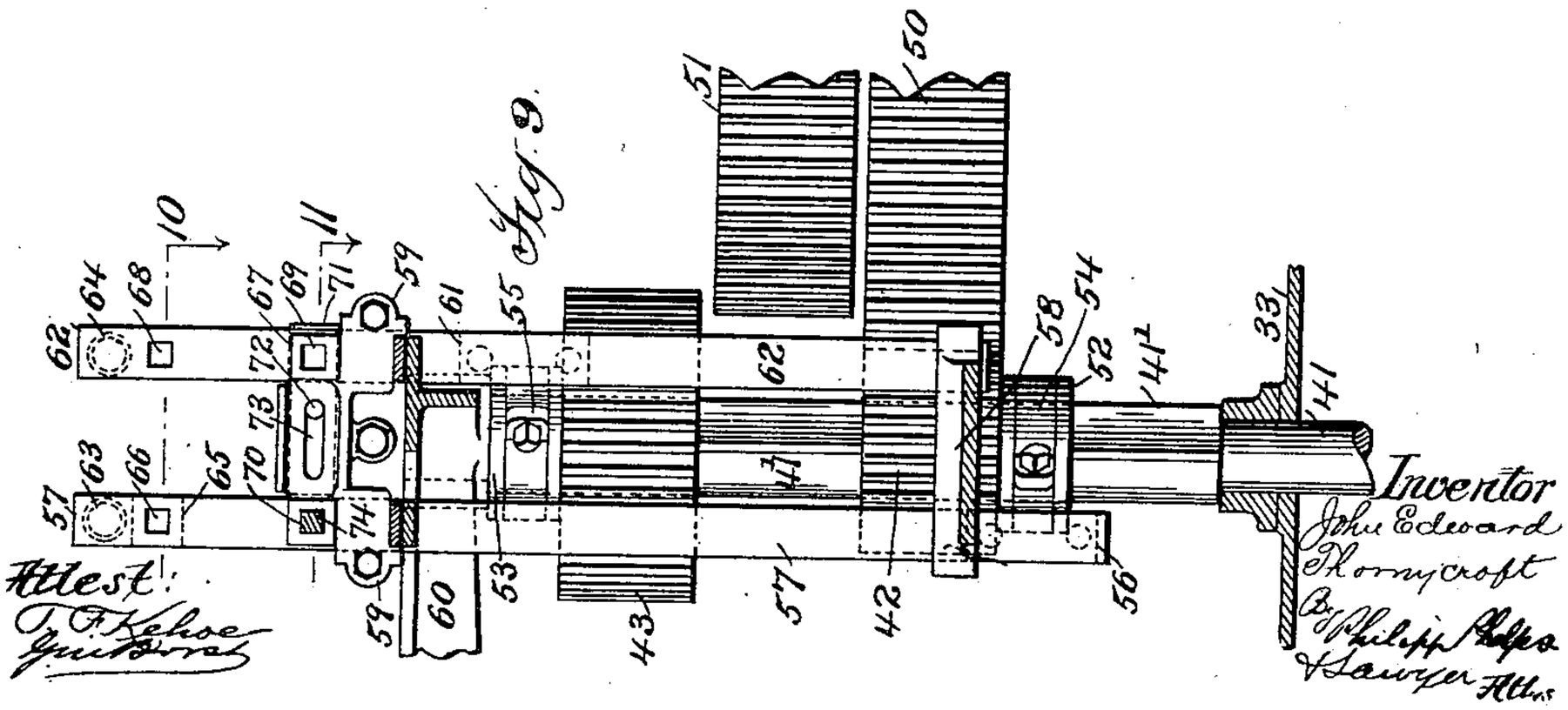

Fig. 9.

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MOTOR VEHICLE.

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(No Model.) 5 Sheets—Sheet 4.

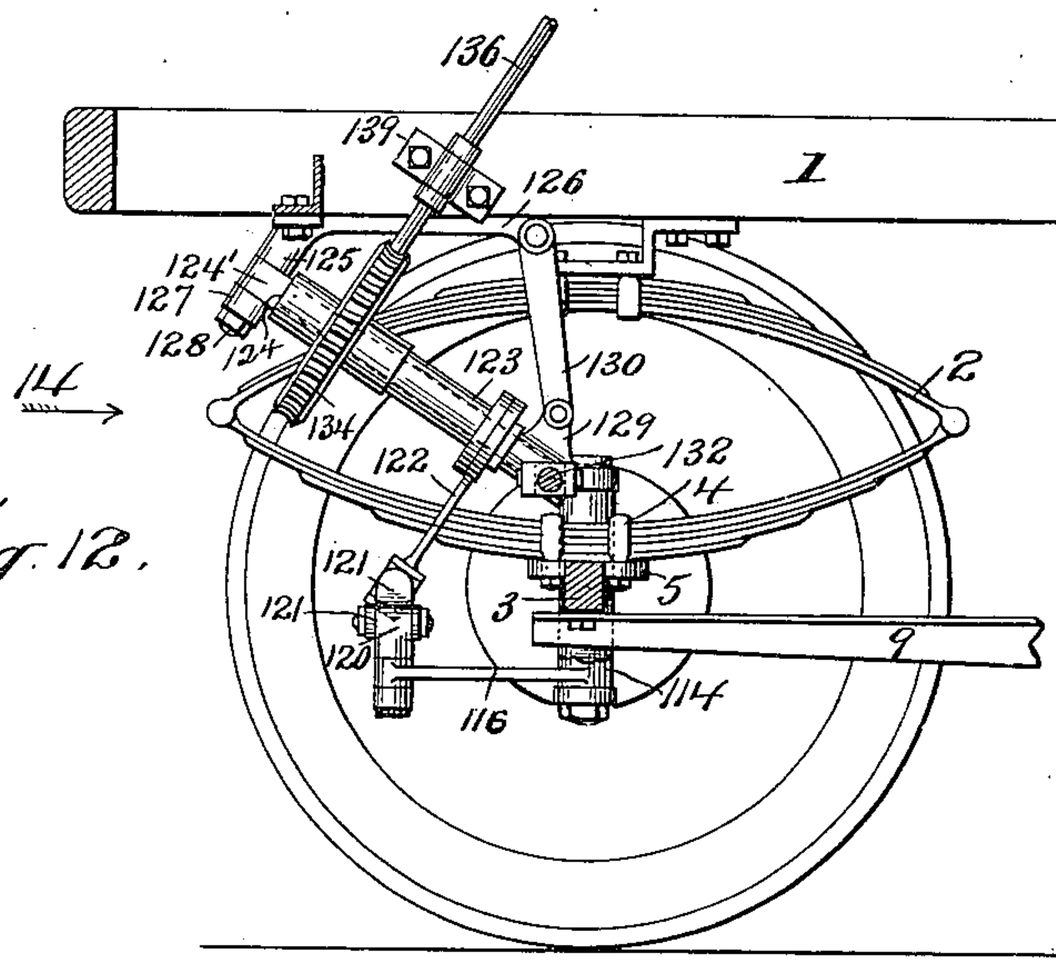

Fig. 12.

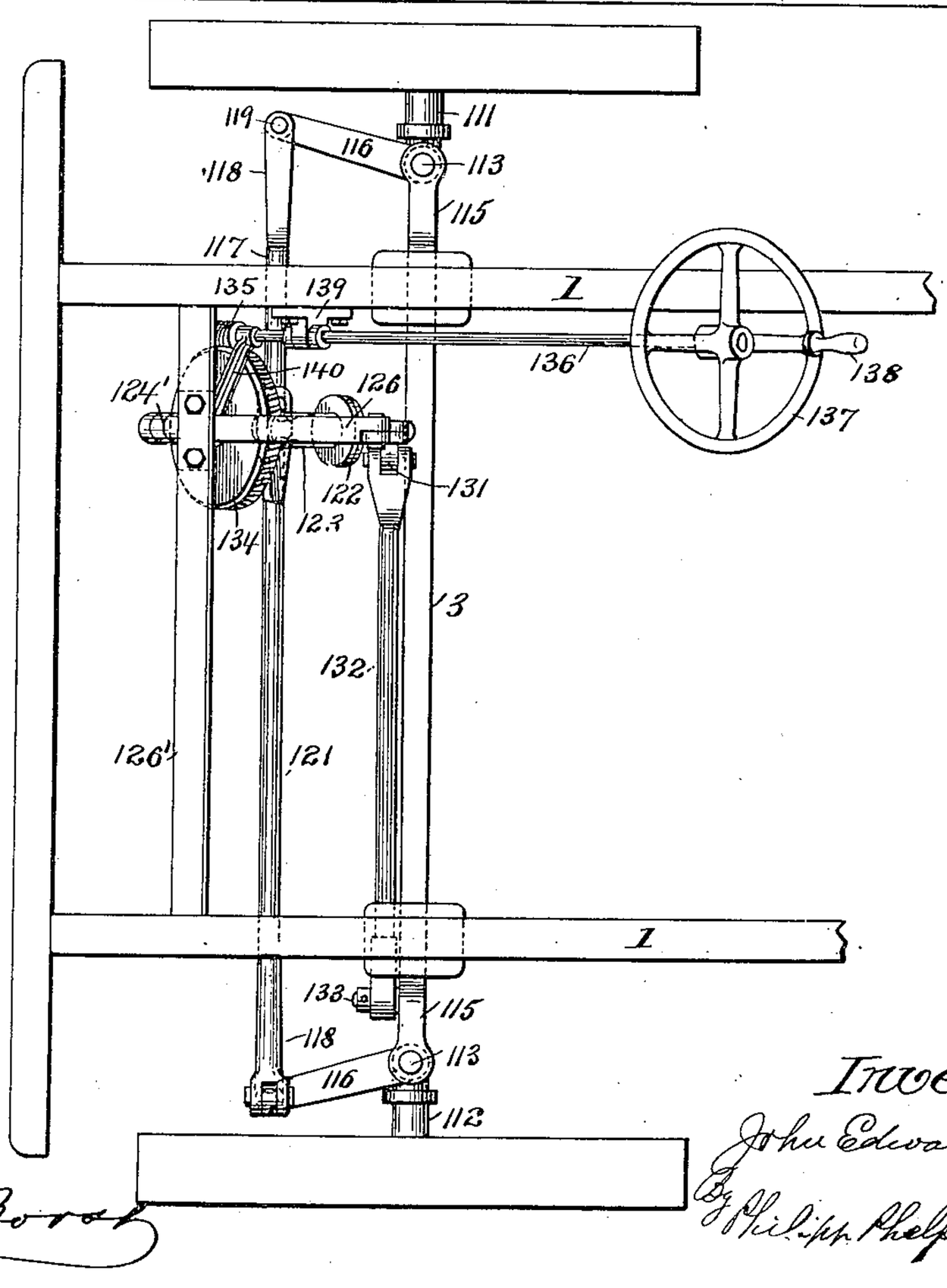

Fig. 13

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MOTOR VEHICLE.

(Application filed Oct. 16, 1899.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 14.

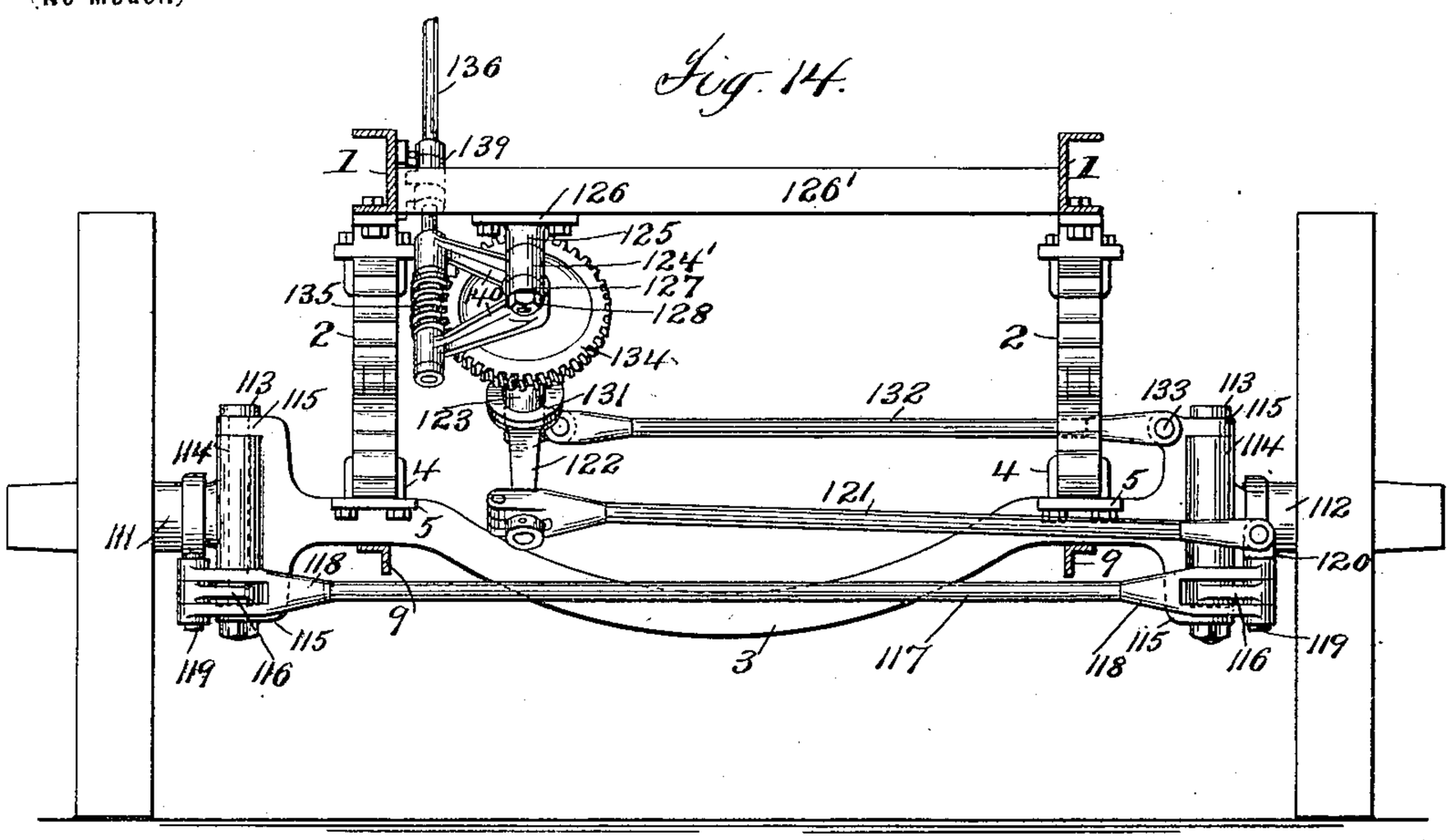
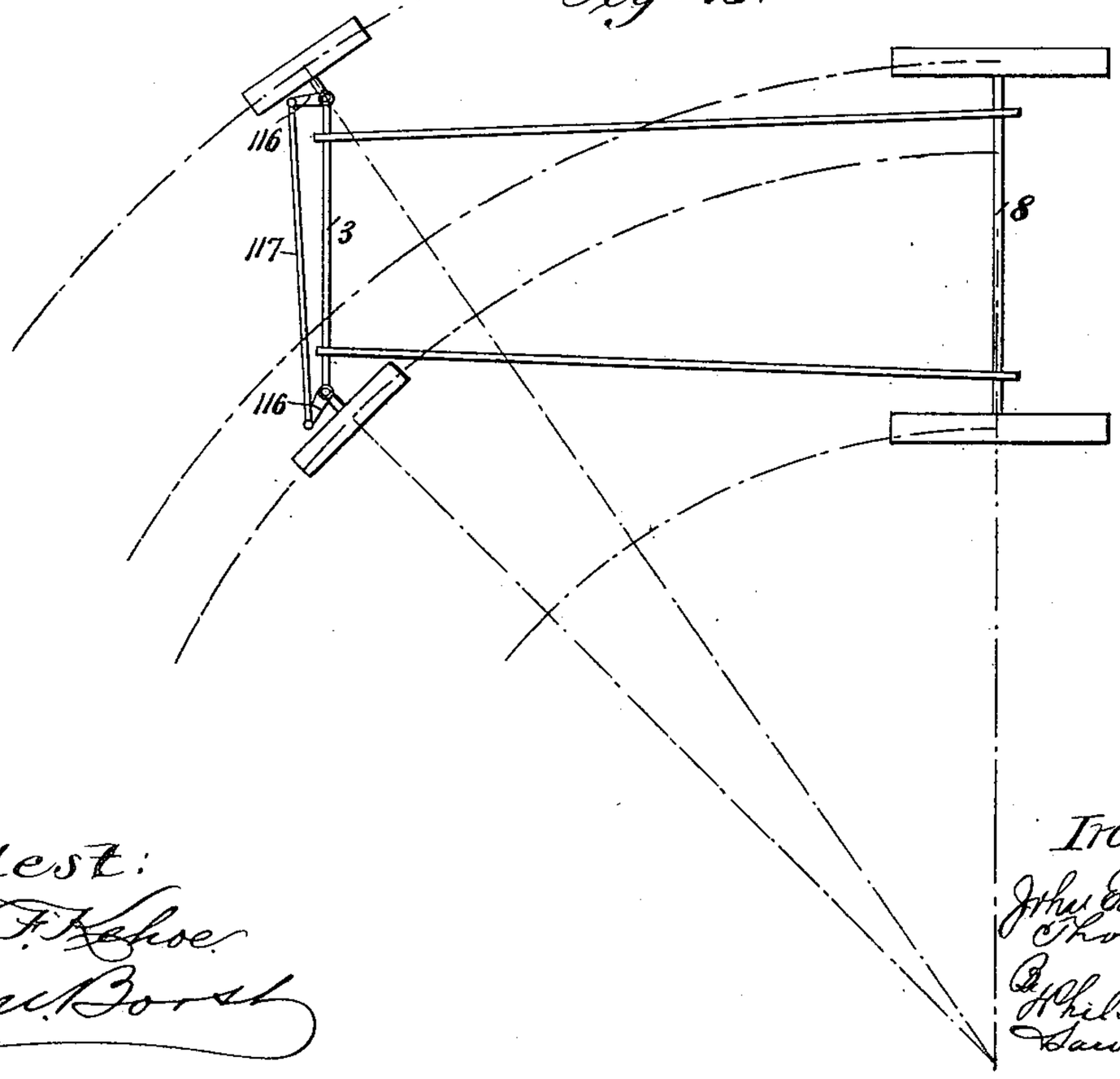


Fig. 15.



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UNITED STATES PATENT OFFICE.

JOHN EDWARD THORNYCROFT, OF LONDON, ENGLAND.

MOTOR-VEHICLE.

SPECIFICATION forming part of Letters Patent No. 662,206, dated November 20, 1900.

Application filed October 16, 1899. Serial No. 733,735. (No model.)

To all whom it may concern:

Be it known that I, JOHN EDWARD THORNYCROFT, a subject of the Queen of Great Britain and Ireland, residing at Chiswick, London, county of Middlesex, England, have invented certain new and useful Improvements in Motor-Vehicles, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to certain improvements in motor-propelled road-vehicles, and more particularly to that class of vehicles known as "trucks," in which it is desired to obtain a large carrying capacity for freight.

One object of the invention is to construct an improved motor-propelled vehicle of the type referred to in which all the driving mechanism for the vehicle shall be located below the top of the underframe of the vehicle, thus producing a vehicle in which the greatest possible carrying-space is secured and one in which any style or kind of carrying-body—such as a frame, tank, or carrier of other description—may be secured to the vehicle or underframe and in which a change from one type of carrier to another may be quickly and effectively made when desired.

A further object of the invention is to construct an improved vehicle of the character described in which the wheels and the parts by which the power is directly transmitted to them shall be connected to a rigid frame and the motor and parts immediately connected therewith shall be carried by a spring-mounted frame, suitable connections being interposed between the motor and the mechanism for directly driving the wheels, thereby producing a vehicle in which the shocks and strains incident to rapidly driving the vehicle over ordinary rough roads shall not be transmitted to the motor, thereby avoiding the danger of breakage.

A further object of the invention is to locate the boiler, main water-tank, and coal-bunkers or other fuel-containers of a motor-truck at the forward end of the vehicle, where they are in full view and easy reach of the driver, and to do this in such a way that they shall not interfere with the carrying capacity of the frame, the fuel-containers being preferably so arranged that they shall act as a protection to the boiler in case of accident to the vehicle from collision or other analogous causes.

A further object of the invention is to mount the boiler, water-tanks, and engine of a steam-propelled motor-vehicle and the piping connecting the same on a spring-mounted frame, so as to avoid the necessity for flexible joints in the piping and also to relieve the boiler and engine from the shocks incident to use on ordinary roads.

A further object of the invention is to so construct the vehicle that a sufficient water-supply may be carried thereby in such a manner that the carrying-space of the vehicle shall not be reduced and at the same time providing that the weight of the water shall be properly distributed on the carrying-springs of the vehicle.

A further object of the invention is to support the engine on the spring-mounted carrying-frame so that any twisting or winding of the wheel-carrying frame will not throw the strain upon the engine.

A further object of the invention is to so construct the power-transmitting gearing that the power may be transmitted from the motor to the wheels by intermeshing gears, thus avoiding the use of chain transmitting-gearing and the disadvantages incident thereto.

A further object of the invention is to provide an improved mechanism for connecting the driving mechanism to the road-wheels, so as to relieve the strains on the driving mechanism incident to starting and stopping and to inequalities in the road.

With these and other objects in view, the invention consists in certain parts, improvements, and combinations, as will be hereinafter described and more particularly pointed out in the claims hereunto appended.

In the accompanying drawings, which form a part of this specification, and in which like characters of reference indicate the same parts, Figure 1 is a side elevation, partly in section, of a steam-propelled motor-vehicle embodying the invention. Fig. 2 is a plan view of the construction shown in Fig. 1. Fig. 3 is a sectional view on the line 3 3 of Fig. 1, certain parts being broken away. Fig. 4 is a detail view of the connection between the parts of the frame counter-shaft.

Fig. 5 is a detail sectional view on the line 5 5 of Fig. 4. Fig. 6 is a detail sectional view on the line 6 6 of Fig. 4. Fig. 7 is a detail view, partly in section, of the driving connection between the axle and the wheels. Fig. 8 is a sectional view on the line 8 8 of Fig. 1, illustrating the change-gearing by which the changes in speed are attained. Fig. 9 is a sectional detail plan view of the construction shown in Fig. 8, the plane of section being indicated by the line 9 9 of said figure. Fig. 10 is a vertical sectional view on the line 10 of Fig. 8. Fig. 11 is a similar view on the line 11 of Fig. 8. Fig. 12 is a detail sectional elevation showing the manner of mounting the front end of the main frame and the steering connections. Fig. 13 is a plan view of the construction shown in Fig. 12. Fig. 14 is a front view of the construction shown in Fig. 12, the view being taken in the direction indicated by the arrow in said figure. Fig. 15 is a diagrammatic view illustrating the operation of the steering apparatus.

Referring to the drawings, which illustrate a preferred form of the construction embodying the invention, 1 indicates the general supporting-frame for the driving mechanism of a motor-truck. This frame may also serve to support the carrying-body of the truck, and will be hereinafter referred to as the "underframe." This underframe may be constructed of wood, iron, or any other suitable material of any suitable form, but will preferably be constructed of angle-irons and will be preferably supported on springs, which may be variously arranged. In the construction shown the forward end of the frame 1 is supported on a pair of double-bow leaf-springs 2, these springs being secured to the forward axle 3 in any suitable manner, as by means of clevis-bolts, which pass through eyes 5, formed on or secured to the main axle. The rear part of the underframe 1 is preferably supported on a pair of springs 6, which may be single-bow leaf-springs, said springs being preferably supported on the axle-boxes 7 of the rear axle 8.

The front and rear axles are preferably rigidly connected by a frame, which is hereinafter referred to as the "perch-frame," the purpose of this frame being to steady and stiffen the vehicle and also to afford a support for some of the parts to be hereinafter described. To this end the longitudinal sides 9 of the perch-frame are connected at their front ends to the front axle 3 and at their rear ends to the rear-axle boxes 7. The two longitudinal sides 9 of the perch-frame are connected at their rear ends by a pair of cross-bars 10 and 11, these bars being suitably tied together.

While many features of the invention may be used in connection with vehicles propelled by any suitable form of motor, the invention is shown, and will be preferably used, in connection with vehicles which are steam-propelled. In the form of the invention which is shown in the accompanying drawings the boiler 12 is preferably located at substantially the extreme forward end of the underframe 1 and over the supporting-springs therefor. It does not, therefore, interfere with or reduce the carrying capacity of the vehicle, and at the same time any shocks or jars due to unevenness in the road are taken up by the springs, and thus do not tend to strain the parts of the boiler. The boiler is preferably supported on a plate 13, which rests on the longitudinal sides of the underframe 1 and also on suitable cross-strips 14, which are connected to the sides of the underframe. The fuel-container will preferably be arranged to contain solid fuel, such as coal or coke, though it may be arranged to contain other forms of fuel, if desired, and will be arranged at the forward end of the main frame. Preferably this container will consist of a two-part coal-bunker, and in the prefered construction the two parts 15 of the bunker will be arranged, as shown, to flank the boiler. They thus serve as protection for the boiler in case of accident. It will be seen that by locating the boiler and bunkers at the extreme forward end of the frame in the manner described the driver has them constantly in view, and this without in any way disturbing his view ahead. He can therefore exercise a constant supervision over the boiler and at the same time easy access may be had thereto for firing, boiler-feeding, engine-regulating, and other purposes.

The main water-tank 16 is located rearwardly of the boiler, but also at the forward end of the carrying-frame, said tank preferably carrying a driver's seat 17. The main water-tank 16 may be filled from any suitable source of supply and in any desired manner. Preferably, however, this tank will be filled by means of a water-lifter, such as an ordinary injector, though any other suitable device may be used. The water-lifter 16′ is indicated in dotted lines in Fig. 2. The connection between the water-lifter and the main tank 16 may be made in any suitable way, as by means of a rubber hose.

In order to provide a sufficient water-supply where opportunities for replenishing are infrequent and also to avoid the necessity of frequent stops to obtain water, there may and preferably will be provided a supplemental water-tank 19, which is or may be located at the extreme rear end of the underframe 1, but beneath the top thereof. By so locating this supplemental tank it does not interfere with the carrying capacity of the vehicle, and the weight of the water is distributed, so that it is not borne entirely by one set of springs. This water-tank 19 is connected with the main tank 16 by means of an overflow-pipe 20, and there is also preferably provided a pipe 21, leading from the tank 19 to the water-lifter 16′. By this construction it will be seen that the water-lifter operates either to fill the main

tank from the supplemental tank or the main tank may be supplied from any suitable way-side source of supply, the supplemental tank being filled by overflow from the main tank. The water-lifter may be supplied with steam in any suitable manner. A pipe 22 is, however, shown in Fig. 2, by which steam may be led from the boiler to the water-lifter. The main portion of this pipe is shown as broken away in Fig. 2 in order to avoid obscuring the other connections, but the two ends are indicated.

Any suitable or desired type of engine may be used with the vehicle. The engine will, however, be so located with respect to the underframe as not to obstruct carrying-space above said frame and will be supported thereby. The engine is thus spring-supported through the springs of the frame and is thus relieved from the shocks due to irregularities in the road and from the strains due to the winding or twisting of the wheel-supporting or perch frame. The engine indicated in the drawings is a compound engine of the ordinary type, the engine being connected to the boiler by means of a pipe 23, which leads to the steam-chest 24 of the high-pressure cylinder 25. A pipe 26 leads to the steam-chest 27 of the low-pressure cylinder 28, through which the exhaust from the high-pressure cylinder passes to the low-pressure cylinder, as is common. An exhaust-pipe 29 is provided, which leads to a silencing-box 30, the purpose of which is to deaden the sound of the escaping steam and also to entrap any suspended water in the steam. This silencing-box may be of any suitable construction—as, for instance, an ordinary box containing a series of baffle-plates. A surface condenser operating to condense the exhaust-steam might be used instead of it. Preferably, however, the silencing-box will be used and a pipe 31 will be provided, said pipe leading to the chimney 32 of the boiler 12, the exhaust-steam being thus utilized for the purpose of assisting the draft.

The main operating parts of the engine are shown as inclosed in a casing 33, so that the same may be run in an oil-bath. The casing 33 may be connected to the underframe in any suitable manner. It is preferably supported, however, from a cross-bar 34, said bar being connected at one end to the underframe and at the other end to a short longitudinal bar 35. The short longitudinal bar 35 is supported by two cross-pieces 36 and 37, which in turn are carried by the longitudinal sides of the underframe 1. This structure forms an efficient means for not only supporting the engine proper, but also the cylinders and the parts connected therewith. Connected with the engine is a pump 38, operated directly from the engine and which delivers to the boiler through a pipe 39, said pump acting to draw water from the main tank 16 through a pipe 40.

The operating parts of the engine may be of any suitable form; but, as has been before indicated, they are preferably inclosed in a casing in order that they may be allowed to run in an oil-bath and be thus thoroughly lubricated. From the description so far given it will be seen that the boiler, the engine, the water-tanks and pumps are all spring-supported and at the same time are all mounted on the same frame. They are thus not only cushioned against shocks, jars, and strains, but the use of flexible piping, flexible joints, and all similar devices in the connections between these parts is avoided, thereby not only cheapening the construction, but also greatly improving it.

The main driving-shaft of the engine is indicated at 41. The outer end of the main driving-shaft 41 is preferably made polygonal in cross-section (see Figs. 8, 9, and 10) and carries two pinions 42 and 43, the pinion 42 having less teeth than the pinion 43. These pinions operate in connection with the parts to be hereinafter described to enable the speed of the vehicle to be changed, as desired. It will be understood of course that more than two pinions may be used, if necessary, though two, one for the high speed and one for the low speed, will usually be found sufficient.

The short longitudinal bar 35, before referred to, has depending therefrom a bracket or hanger 44, (see Fig. 3,) and the side bar of the underframe is provided with an inwardly-projecting bracket or angle-piece 45, which carries a similar hanger or support 46. The brackets 44 and 46 serve to support one part 47 of a two-part-frame counter-shaft 47 48, (see Figs. 3 and 4,) the parts of the counter-shaft being connected by a link 49, so that they may move with relation to each other, as will hereinafter appear. The part 47 of the two-part shaft carries two gears 50 51, the gear 50 being larger in diameter and having more teeth than the gear 51. The gears 50 and 51 mesh with the pinions 42 and 43, before referred to, the large gear 50 meshing with the pinion 42 and the smaller gear 51 meshing with the pinion 43. It is evident that when the gear 51 and pinion 43 are in mesh the two-part shaft will be driven at a higher speed for an equal number of revolutions of the engine-shaft than it will when the pinion 42 and gear 50 are in mesh.

In a motor-vehicle of the character described it is desirable that the construction for controlling the high and low speed pinions should be such that either pinion may be capable of being put in and out of gear, that both pinions be capable of being placed out of gear at the same time, and that it be impossible to place both pinions either partly or wholly in gear at the same time.

While various mechanisms may be used for effecting the results referred to, the pinions 42 and 43 are preferably slidably mounted on a squared portion 41′ of the engine-shaft 41, and suitable mechanism is provided, so that either of the pinions 42 43 may be in mesh with their corresponding gears 50 51, or

both of them may be out of mesh with said gears, but so that both of them may not be in mesh. The construction by which the position of the gears is thus shifted and controlled may be widely varied. Preferably, however, the pinion 42 is provided with a grooved hub 52 and the pinion 43 is provided with a grooved hub 53. These grooved hubs are surrounded by collars 54 and 55. The collar 54 is connected to an arm 56, which depends from a slide 57, the inner end of said slide being mounted in a bracket 58, secured to the bar 35. The outer end of the slide is mounted in a bracket 59, which is secured to a bracket 60, this bracket serving to support the outer end of the shaft 41. The collar 55 is connected to a depending arm 61, said arm being secured to a slide 62, the inner end of which is supported in the bracket 58, before referred to, its outer end passing through and being supported in the bracket 59. The slide 57 is provided with a handle 63, and a similar handle 64 is secured to the slide 62. The slide 57 is provided on its under side with a groove 65, which extends across the same, as is clearly shown in side view in Fig. 8 and in plan in dotted lines in Fig. 9, and also with two squared perforations 66 and 66′. The slide 62 is provided with a groove 67 and with a squared perforation 68. The bracket 59 is provided with two squared perforations 69 and 70. This bracket further carries a slide 71, which has a handle 72 extending upward through a slot 73 therein. A locking-pin 74 is used to secure the slides 57 62 to the bracket 59. When the parts are in the position shown in Fig. 9, the pinion 42 is in mesh with the gear 50. At this time the slide 57 is drawn outward, and its inner perforation 66′ is under and registers with the perforation 70 in the bracket 59. The pin 74 is dropped through the perforations 70 and 66′, and the slide is therefore securely locked in position. In this position of the parts it is necessary of course that the pinion 43 be held out of mesh with the gear 51. The slide 62, which is in its outward position, in which position its groove 67 is opposite the slide 71, is locked in this position by the slide 71, which has been slid over by its handle and entered the groove.

If it be desired to change the gearing so as to cause the gear 43 to mesh with the gear 51, thus increasing the speed at which the shaft is driven, the pin 74 is removed and the slide 57 is moved inward until its groove 66 is opposite the slide 71, thus carrying the pinion 42 out of mesh with the gear 50, and at the same time bringing the groove 66 opposite the end of the slide 71, so that the slide may be moved out of engagement with the groove in the slide 62. The slide 71 is now moved over by its handle 72, locking the slide 57 in its inward position and unlocking the slide 62, so that it is free to move. The slide 62 is now moved inward until its squared perforation 68 is under and registers with the perforation 69 in the bracket 59, by which movement the gear 43 is caused to mesh with the gear 51. The pin 74 is dropped through the perforations 68 and 69, thus locking the gear in position.

If it be desired to have both gears out of mesh, the slide 57 is moved in its inward position and the slide 62 is moved into its outward position. The slide 71 is moved over so that it engages the groove 67 in the slide 62, and the pin 74 is dropped through the perforations 66 70 in the slide 57 and the bracket 59. In this position neither of the pinions 42 43 will be in mesh with the gears 50 51, and the slides which control them will be locked.

It will be seen that when the pinion 42 is in mesh with the gear 50, the parts being then in the position shown in Fig. 9, it is impossible to move the pinion 43 so that it will engage with the gear 51 until after the slide 57 has been moved to throw the pinion 42 out of engagement with the gear 50. This is so because the slide 71 is locked in its position in the groove by abutting against the side of the slide 57, and it will remain locked until the groove 66 in the slide 57 comes opposite the end of the slide 71. When the slide 57 is moved inward, so that the pinion 42 is out of mesh with its gear 50 and it is locked by the slide 71, and the slide 62 is moved inward, so that its pinion 43 is in mesh with the gear 51, it will be impossible to throw the pinion 42 into mesh with the gear 50 until the pinion 43 has been disengaged from the gear 51, because the slide 71 locks the slide 57 in the position in which its gear is disengaged. Both pinions may, however, be placed out of mesh at the same time, although both cannot be in mesh at the same time.

Inasmuch as the part 47 of the two-part-frame counter-shaft is carried in brackets on the spring-mounted underframe it necessarily has a certain amount of motion, and this motion may be either a vertical or a side swaying motion or a compound movement resulting from the two. The frame counter-shaft 47 48 serves to transmit the power from the engine-shaft, which is also mounted on the spring-mounted underframe to the gearing by which the road-wheels are driven, which gearing is mounted on the rigid frame to which the wheels are attached—namely, the perch-frame. Inasmuch as it is desirable to transmit the power from the frame counter-shaft to the driving-gearing by the direct and positive engagement of gears—rather than, for instance, by chains or similar devices—it is necessary to provide in some manner for taking up the movement of the engine and its shaft due to the movement of the frame on which they are mounted. While this may be accomplished in various ways, it is preferably done by making the frame counter-shaft in two parts, connecting the two parts by a link, as has been heretofore described, and connecting the link to the two parts of the

frame counter-shaft by means of universal joints.

While the link 49 may be connected to the parts 47 48 by any suitable form of universal joint, each of said parts 47 48 is preferably provided with an enlarged portion or socket, the socket on the part 47 being marked 75 and that on the part 48 being marked 76. The socket 75 is preferably provided with two pairs of bearing blocks or surfaces 77 78, these surfaces being formed on the interior of the socket. These surfaces receive between them blocks 79 and 80, which blocks are secured to the link 49 by a pin 81. The pin 81 passes loosely through perforations in the end of the link 49, so that the link is permitted a swinging movement around the pin. The socket 76 is provided with two pairs of bearing-surfaces 82 and 83, which are similar to the surfaces 77 and 78, and in addition this socket has two curved bearing-surfaces 84 85, said surfaces being located at right angles to the surfaces 82 83 and being secured to the socket in any suitable manner, as by screws 86. Engaging the surfaces 82 83 are blocks 87 88, these blocks being held in position by a pin 89, which passes loosely through a perforation in the end of the link 49. The blocks 87 88 not only bear against the surfaces 82 83, but also bear against the bearing blocks or surfaces 84 85 and have their surfaces which come in contact with these blocks rounded off on a curve which corresponds with the curve of these blocks.

From the construction which has been described it will be seen that the link 49 has a sliding connection with the part 47 of the two-part shaft by means of bearing-blocks 79 and 80 and at the same time is permitted to have an angular movement around its pin 81. The connection between the link 49 and the part 48 of the two-part shaft not only permits an angular movement about its pin 89, but in addition to this movement there is a rocking movement permitted by this connection in a plane which is at right angles to the plane in which the angular movement takes place.

The part 48 of the frame counter-shaft is mounted in two bearings 90, these bearings being carried on a bracket 91, which is secured to the cross-bar 10, which has been before referred to as extending across the perch-frame. It will be seen, therefore, that one part of the two-part shaft 47 48 is supported on the perch-frame and the other part on the underframe, and that the necessary movement between the two parts of the shaft, due to the movement of the spring-mounted frame, is permitted by the universal joints.

The part 48 of the two-part-frame counter-shaft carries a pinion 92, which serves to transmit the power to the rear wheels, which in the present form of the invention constitute the driving-wheels. It is necessary, as is well understood, in this class of vehicles to so arrange the gearing that the driving-wheels may be rotated at different speeds, so as to permit the vehicle to turn. This is effected by causing the pinion 92 to transmit its movement to the rear shaft through a differential gearing of the kind ordinarily known as a "jack-in-the-box" or equational box-gearing. The pinion 92 meshes with a gear 93, which is carried on the hood 94 of the equational box-gearing. The said gearing consists of two gears 95 96, the gear 95 being bolted to a collar 97, which is fast to the shaft 8, which, as has been before said, is the rear driving-shaft. The gear 96 is fast to a sleeve 98, which is loose on the shaft 8. The hood 94 has bearings 99 projecting inwardly therefrom, these bearings carrying short axles 100, on which are mounted toothed pinions 101, which engage with the gears 95 96. It is obvious that by this form of gearing the shaft 8 and the sleeve 98 may be driven at the same speeds or at different speeds. If therefore one of the road-wheels be driven from the sleeve 98 and the other from the shaft 8, any necessary changes in the speed, due to turning the vehicle or for other reasons, will be permitted.

In order to relieve the strain upon the driving mechanism in starting and stopping and also the shock to the driving mechanism due to obstructions in the road, it is desirable to interpose a spring connection between said mechanism and the wheels. While this may be done in various ways, the shaft 8 preferably carries a pair of bowed springs 103, which are secured to the shaft in any suitable manner—as, for instance, by bolts 102. The springs 103 take on each side of a pair of blocks 104, secured to the felly of the rear wheel 105. In the same way the sleeve 98 has secured to it by bolts 106 a similar double-bowed spring 107, which engages blocks 108 on the felly of the other rear wheel 109. The driving power for the wheels being transmitted through this spring connection the shocks and strains before referred to are obviated or much relieved.

While any form of steering-gear may be used in connection with a vehicle equipped with the other features of this invention, the steering-gear will preferably be constructed as follows: The front axle 3 is provided with two short extensions 111 112, these extensions being pivoted to the axle 3 by bolts 113, which pass through sockets 114 on the extensions, the sockets being contained between bracket-arms 115 on the axle. The sockets 114 are provided with outwardly-inclined arms 116, these arms being connected for simultaneous movement by a rod 117, which rod is preferably provided with yoked ends 118, into which the arms 116 take, the arms and yokes being pivoted together by bolts 119. One of the yokes 118, herein shown as the one adjacent to the extension 112, is provided with a lug 120. To this lug is pivoted one end of a link 121, the other end of the link 121 being pivoted to an arm 122, which is fast on a worm

wheel-shaft 123. The worm wheel-shaft is perforated and is mounted on a rod 124 which passes through it. The rod 124 is provided with the perforated end 124′, and through this perforation passes a shouldered pin 125, fast on a bracket 126, said bracket 126 being suitably secured to an angle-bar 126′, supported on and forming a part of the underframe 1. The rod 124 is held on the pin by a washer 127 and nut 128 or in any other suitable manner. The lower or inner end of the rod 124 is supported in a hanger 129, which is carried on a flexible connecting bar or link 130, pivoted to the bracket 126 before referred to. The hanger 129 is provided with a lug 131, to which is connected a radius-rod 132. The other end of this rod 132 is secured to the axle in any suitable manner, as by a pin 133 passing through one of the yokes 115, though it might be secured to any part of the perch-frame.

The worm wheel-shaft 123 carries a worm-gear 134, said worm-gear being engaged by a worm 135, mounted on a worm-shaft 136. This shaft is preferably inclined and is provided at its upper end with an operating-wheel 137 and a handle 138. The shaft at its lower end passes through a bearing 139, secured to the frame and is also further supported by a two-armed bracket 140, said bracket being supported by the worm wheel-shaft and engaging the shaft 136 above and below the worm. The novel features embodied in this steering mechanism are claimed in my copending application Serial No. 977, filed January 10, 1900, and no claim is made to them in this application.

Any suitable form of brake mechanism may be used with the vehicle. In the machine shown two forms of such mechanism are illustrated. A brake-bar 145, carrying brake-shoes 146 for acting on the wheels, is shown as swung by links 147 from brackets 148, mounted on the longitudinal sides of the underframe. Connecting-rods 149 serve to connect the brake-bar 145 with a lever 150, which is or may be journaled on the rear axle. The lever 150 is connected by a rod 151 to a lever 152, which is connected to a shaft 153. This shaft 153 is journaled in bearings located just in front of the main water-tank and is controlled by a foot-lever 154. In addition to the brake just described there is or may be any suitable form of friction-brake applied to the main motor or engine shaft. Such a brake is indicated at 155 and is operated through a link 156, connected to a brake-lever 157, mounted on the side of the main frame and extending up alongside the main water-tank.

It is to be understood that the invention which has been heretofore described is not limited to the precise deta ls of construction which have been described and illustrated.

Many changes in construction and arrangement will suggest themselves to skilled mechanics, and it is to be understood that such changes and variations are within the scope of the invention.

What I claim is—

1. In a steam-propelled motor-truck, the combination with a supporting-frame, of a boiler carried thereby, said boiler being located at the front end of the frame, and a bunker for solid fuel also carried by and located at the front end of the frame and in front of the boiler, said bunker being arranged to protect the boiler in case of accident.

2. In a steam-propelled motor-truck, the combination with a supporting-frame, of a boiler carried thereby, said boiler being located at the front end of the frame, a fuel-container also carried by the frame and located at the front end thereof and in front of the boiler, said container having parts arranged to flank the boiler so as to protect it in case of accident.

3. In a steam-propelled motor-truck, the combination with a supporting-frame, of a boiler carried thereby, said boiler being located at the front end of the frame, a two-part bunker for solid fuel carried by the frame and located at the front end thereof and in front of the boiler, the parts of said bunker being arranged to flank the boiler so as to protect the same in case of accident.

4. In a steam-propelled motor-truck, the combination with a supporting-frame, of a boiler carried thereby and located at the front end thereof, a water-tank also carried by the frame and located adjacent to the boiler, a driver's seat located over the tank, an engine supported by the frame and beneath the surface thereof, and driving connections from said engine to the road-wheels of the truck, said connections being located entirely beneath the top of the frame.

5. In a steam-propelled motor-vehicle, the combination with a rigid frame to which the road-wheels are connected, of a spring-mounted underframe, a boiler, coal-bunkers and water-tank carried by said frame, said boiler, bunkers and tank being located at one end of the underframe, an engine carried by the underframe, driving connections from the engine to the road-wheels, said engine and driving connections being located entirely beneath the top of the underframe, substantially as described.

6. In a steam-propelled motor-vehicle, the combination with a rigid frame to which the road-wheels are connected, of a spring-mounted underframe, an engine, boiler and water-tank carried by said underframe, said boiler and water-tank being located at one end of the underframe, and a driver's seat supported over the water-tank, substantially as described.

7. In a steam-propelled motor-truck, the combination with a supporting-frame, of a boiler carried thereon and located at the front end thereof, a water-tank located above the frame and adjacent to the boiler, a supplemental water-tank carried by the frame,

said tank being located near the rear end of the frame and beneath its surface, and an engine carried by the frame and also located beneath its surface and between the water-tanks.

8. In a steam-propelled motor-truck, the combination with a supporting-frame, of a boiler-carrier thereon and located at the front end thereof, a water-tank located above the frame and adjacent to the boiler, a driver's seat supported over said tank, a supplemental water-tank carried by the frame, said tank being located near the rear end of the frame and beneath its surface, and an engine carried by the frame and also located beneath its surface and between the water-tanks.

9. In a steam-propelled motor-vehicle, the combination with a rigid frame to which the road-wheels are connected, of a spring-mounted underframe, a boiler and water-tank carried by the underframe, said boiler and water-tank being located at one end of the underframe, an engine carried by the underframe and located beneath the same, and a supplemental water-tank also carried by the underframe and located beneath the top thereof, substantially as described.

10. In a steam-propelled motor-vehicle, the combination with a rigid frame to which the road-wheels are attached, of a spring-supported underframe, a boiler and engine supported by said frame, and suitable pipes connecting the boiler and engine, said pipes being rigid throughout their length and having rigid connections with the boiler and engine, substantially as described.

11. In a steam-propelled motor-vehicle, the combination with a rigid frame to which the road-wheels are attached, of a spring-supported underframe, a boiler and water-tank supported at one end of the frame, an engine supported beneath the frame, and suitable pipes between the tank and the engine and the boiler and the engine, said pipes being rigid throughout their length and having rigid connections with the boiler, tank and engine, substantially as described.

12. In a steam-propelled motor-vehicle, the combination with a spring-supported underframe, of a boiler and water-tank supported at one end of the frame, a supplemental water-tank supported at the other end of the frame, said supplemental tank being located beneath the frame, an engine also supported by and beneath the frame, and suitable pipe connections between the boiler, tanks and engine, said pipes being arranged beneath the frame so as not to interfere with the carrying capacity thereof, substantially as described.

13. In a steam-propelled motor-vehicle, the combination with a spring-supported underframe, of a boiler and water-tank supported at one end of the frame, a supplemental water-tank supported at the other end of the frame and being located beneath its surface, an engine supported by and beneath the underframe and between the tanks, suitable pipe connections between the tanks, boiler and engine, said connections being arranged beneath the frame, whereby the weight of the parts carried by the frame is distributed throughout its length and its carrying capacity is not interfered with, substantially as described.

14. In a motor-propelled vehicle, the combination with rigid side bars to which the axles of the road-wheels are rigidly connected, a spring-mounted underframe, a motor and motor-shaft carried thereby, a two-part counter-shaft, one part of said shaft being carried on the spring-mounted underframe, and the other part on the side bars, a flexible connection between the two parts of the shaft, driving connections between the motor and that part of the two-part shaft which is supported on the underframe, and driving connections between the road-wheels and that part of the shaft which is supported on the rigid frame, substantially as described.

15. In a motor-propelled vehicle, the combination with rigid side bars to which the axles of the road-wheels are rigidly connected, a spring-mounted underframe, a motor and motor-shaft carried thereby, a two-part counter-shaft, one part of said shaft being carried on the spring-mounted underframe, and the other part on the side bars, a link between the two parts of the shaft, said link being connected to each part of the shaft by a universal joint, driving connections between the motor and that part of the two-part shaft which is supported on the underframe, and driving connections between the road-wheels and that part of the shaft which is supported on the rigid frame, substantially as described.

16. In a motor-propelled vehicle, the combination with rigid side bars to which the axles of the road-wheels are rigidly connected, of a spring-mounted underframe carrying a motor, a two-part shaft, one part of said shaft being supported on the side bars and the other part on the spring-mounted frame, flexible connections between the two parts of the shaft, driving connections between the motor and the part of the shaft which is supported on the spring-frame, and driving connections, including differential gearing, between the other part of the shaft and the road-wheels, substantially as described.

17. In a motor-propelled vehicle, the combination with rigid side bars to which the axles of the road-wheels are rigidly connected, springs carried by said axles, an underframe supported on the springs, a motor suspended from the underframe, a two-part shaft, one part of which is suspended from the underframe, and the other part of which is mounted on the side bars, a flexible connection between the two parts of the shaft, gearing between the motor and that part of the shaft which is supported on the underframe, and differential gearing between that part of the shaft

which is supported on the rigid frame and the road-wheels, substantially as described.

18. In a motor-propelled vehicle, the combination with rigid side bars to which the axles of the road-wheels are rigidly connected, of a spring-mounted underframe, a two-part shaft, one part of which is supported on the underframe and the other part on the side bars, a link between the two parts of the shaft, a sliding and pivotal connection between one end of the link and one part of the shaft, and a pivotal and rocking connection between the link and the other part of the shaft, substantially as described.

19. In a motor-propelled vehicle, the combination with the motor, of connections from the motor to the road-wheels, a pair of gears in said connections, said gears operating to give the road-wheels varying speeds, means whereby either of said gears may be rendered operative, means whereby both gears may be rendered inoperative, and means additional to the means for rendering the gears operative and inoperative for preventing either gear from being put in operation while the other is operative, substantially as described.

20. In a motor-propelled vehicle, the combination with the motor, of connections from the motor to the road-wheels, a pair of gears in said connections, said gears operating to give the road-wheels varying speeds, means whereby either of said gears may be rendered operative, means whereby both gears may be rendered inoperative, means additional to the means for rendering the gears operative and inoperative, for preventing either gear from being put into operation while the other is operative, and independent operating means for said additional means.

21. In a motor-propelled vehicle, the combination with a power-driven shaft, of a pair of transmitting-gears driven therefrom and operating to drive the vehicle at a given speed, a second pair of gears driven from the motor-shaft and operating to drive the vehicle at a different speed, means whereby the gears of each pair may be put in and out of mesh, means additional to the means for putting the gears into and out of mesh for preventing the gears of one pair from being thrown into mesh while the gears of the other pair are in mesh, independent operating means for said additional means, and means whereby the gears of both pairs may be thrown out of mesh.

22. In a motor-propelled vehicle, the combination with a power-driven shaft, a pair of transmitting-gears driven therefrom and operating to drive the vehicle at the given speed, a second pair of gears driven from the motor-shaft, and operating to drive the vehicle at a different speed, means whereby the gears of each pair may be put in and out of mesh, means additional to the means for putting the gears into and out of mesh, for preventing the gears of one pair from being thrown into mesh while the gears of the other pair are in mesh, independent operating means for said additional means, and means whereby the gears of both pairs may be thrown out of mesh.

23. In a motor-propelled vehicle, the combination with the motor, of two pairs of gears driven therefrom and operating to drive the vehicle at different speeds, one gear of each pair being slidably mounted, a slide for controlling the position of each sliding gear, whereby a gear of each pair may be moved into and out of mesh, locking devices for holding the slides in position so that the gears of one pair shall be in mesh and the gears of the other pair out of mesh, and means for preventing the withdrawal of the locking devices for the gears which are out of mesh until after the gears which are in mesh shall be thrown out of mesh, substantially as described.

24. In a motor-propelled vehicle, the combination with a driving-shaft, of two slidably-supported gears, two slides, one for controlling the position of each gear, two gears with which the first two gears are arranged to mesh, a locking-slide for controlling the position of the gear-controlling slides, said slide operating to lock the controlling-slides so that one gear will be in mesh with the gear which it drives and the other gear will be out of mesh with the gear which it drives, and means for preventing the movement of the locking-slide until the slide which controls the gear which is in mesh shall have been thrown so that its gear is out of mesh, substantially as described.

25. In a motor-propelled vehicle, the combination with a driving-shaft, of two gears of unequal diameter mounted thereon, two gears also of unequal diameter, said gears being driven by the first-named gears, two slides for controlling the position of the first-named gears, a locking-slide located between these two slides, the two slides having grooves which are engaged by the locking-slide, said grooves being arranged so that when the locking-slide engages one of them its gear will be in operative position, and when the locking-slide engages the other one, its gear will be in inoperative position, substantially as described.

26. In a motor-propelled vehicle, the combination with a power-driven shaft, of two gears of unequal diameter slidably mounted thereon, two slides for controlling the position of the two gears, one of said slides having a locking-groove and two perforations and the other slide having a groove and one perforation, a bracket arranged between the two slides and having two perforations with which the perforations in the slides can be made to register, a locking-slide carried by the bracket and adapted to engage the groove in one slide and when in such engagement to be held therein by the other slide, and a locking-pin adapted to pass through the perforations in the bracket and slides and hold the slides in position, substantially as described.

27. In a motor-propelled vehicle, the combination with an axle, of a pair of wheels loosely mounted thereon, a spring interposed between the axle and one of the wheels, whereby said wheel is driven from the axle, a sleeve mounted on the axle, a spring interposed between the other wheel and said sleeve, whereby said wheel is driven from the sleeve, a differential gear arranged to drive the axle and the sleeve either at the same or at varying speeds, and means for driving the differential gear, substantially as described.

28. In a motor-propelled vehicle, the combination with an axle, of a pair of wheels loosely mounted thereon, two projections on the felly of each wheel, and two double springs, one for each wheel taking on each side of the projection, whereby one half of each spring acts to drive the wheels in one direction and the other half of each spring acts to drive the wheels in the opposite direction, and means for rotating the springs, substantially as described.

29. In a motor-propelled vehicle, the combination with an axle, of a pair of wheels loosely mounted thereon, said wheels having projections on their fellies, a spring secured to the axle and engaging the projections on one of the wheels, a sleeve mounted on the axle, a spring secured to the sleeve and engaging the projections on the other wheel, and means for driving the sleeve and the axle either at the same or varying speeds, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOHN EDWARD THORNYCROFT.

Witnesses:
F. J. BROUGHAM,
HENRY A. BROUGHAM.