No. 639,541. Patented Dec. 19, 1899.

F. L. & L. H. DYER.

AUTOMOBILE VEHICLE.

(Application filed May 4, 1897.)

(No Model.) 8 Sheets—Sheet 1.

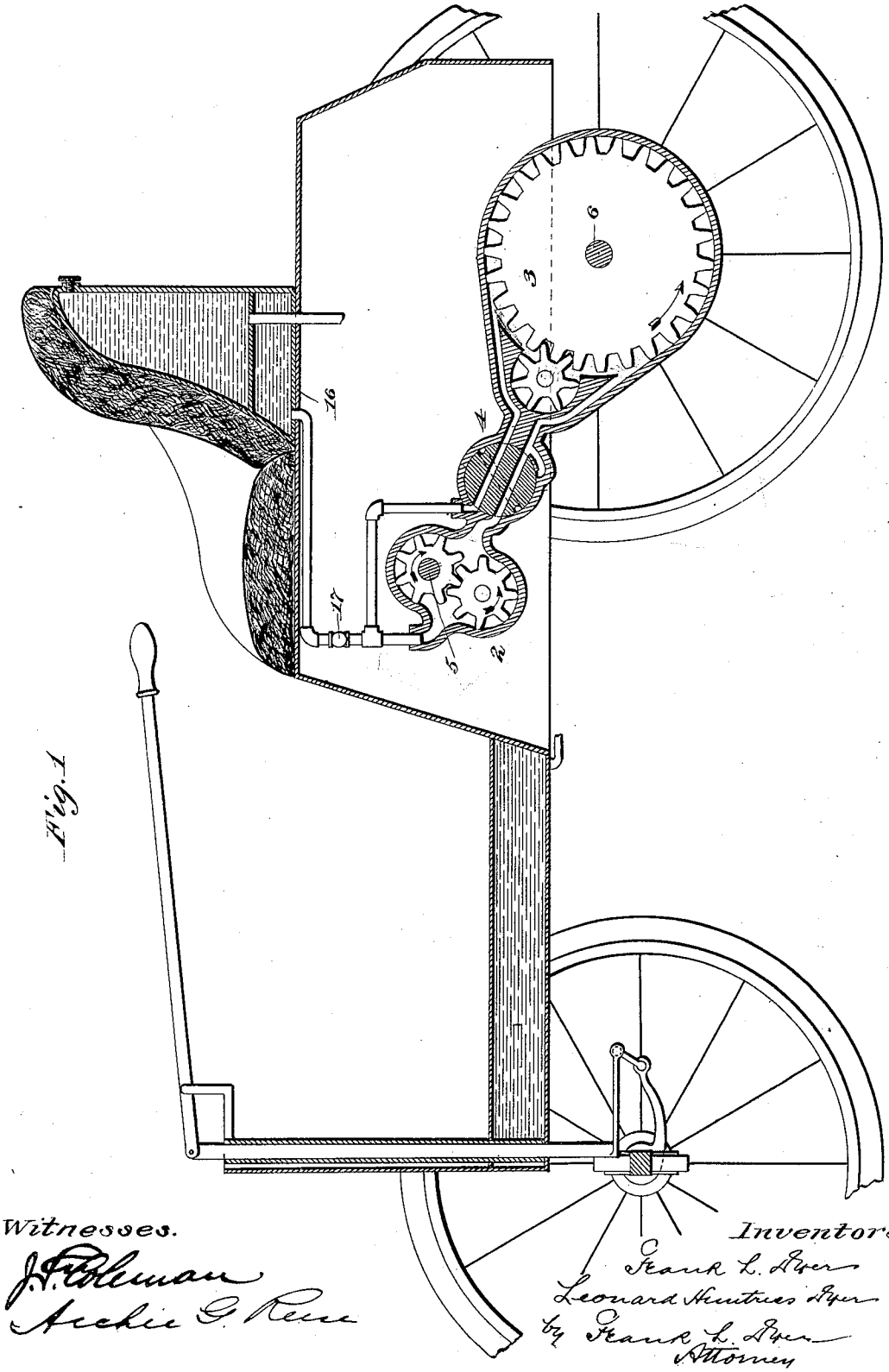


Fig. 1.

Witnesses.
J. F. Coleman
Archie G. Reese

Inventors
Frank L. Dyer
Leonard Huntress Dyer
by Frank L. Dyer
Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 639,541. Patented Dec. 19, 1899.

F. L. & L. H. DYER.

AUTOMOBILE VEHICLE.

(Application filed May 4, 1897.)

(No Model.) 8 Sheets—Sheet 2.

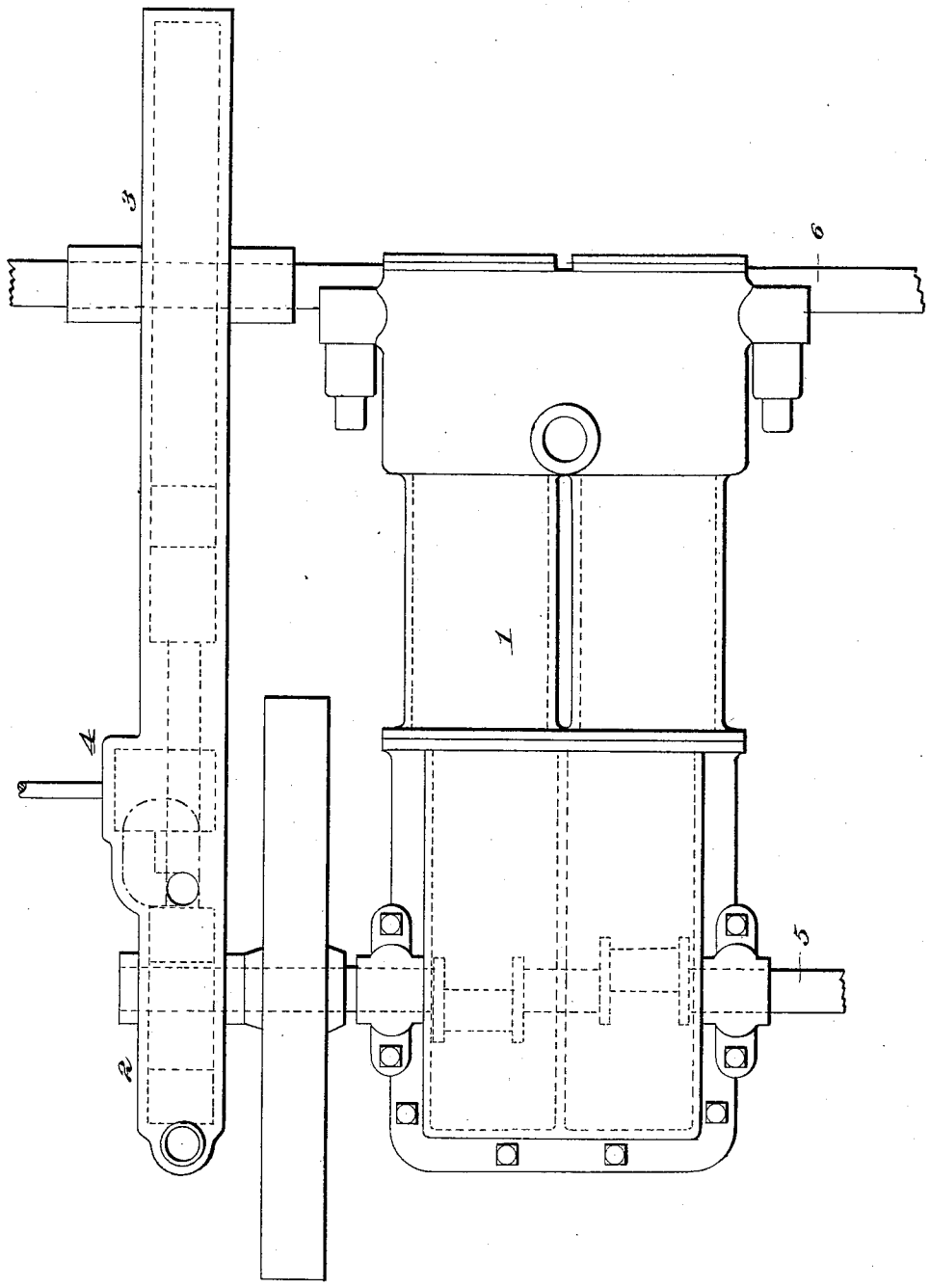


Fig. 2.

Witnesses.

J. F. Coleman

Archie G. Rose

Inventors.

Frank L. Dyer

Leonard Hunting Dyer

by Frank L. Dyer

Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 639,541. Patented Dec. 19, 1899.

F. L. & L. H. DYER.

AUTOMOBILE VEHICLE.

(Application filed May 4, 1897.)

(No Model.) 8 Sheets—Sheet 3.

Fig. 3

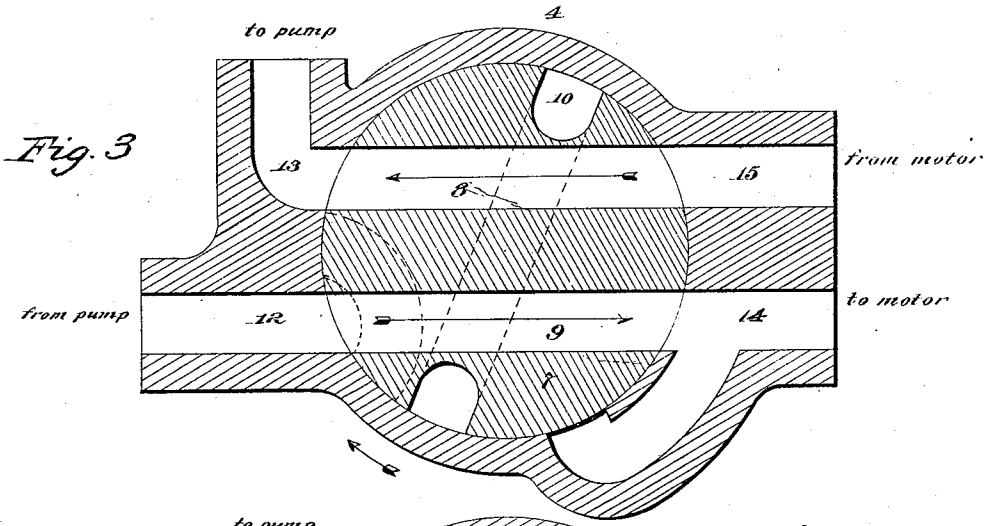


Fig. 4

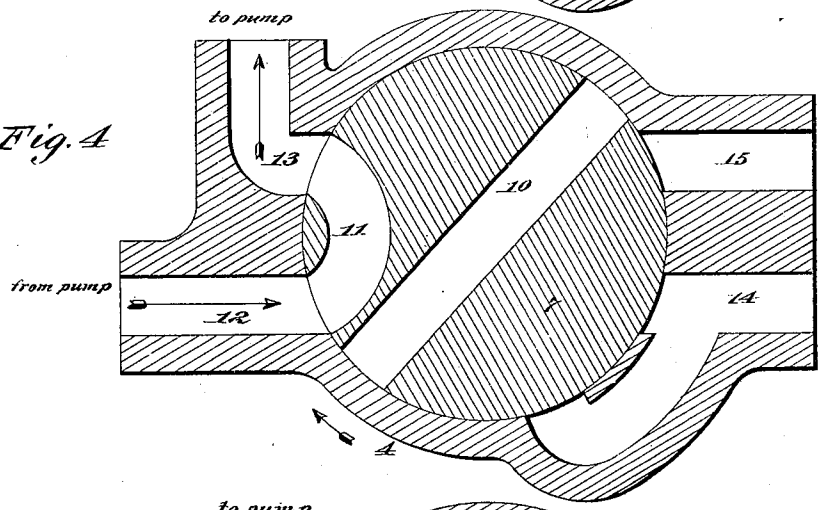
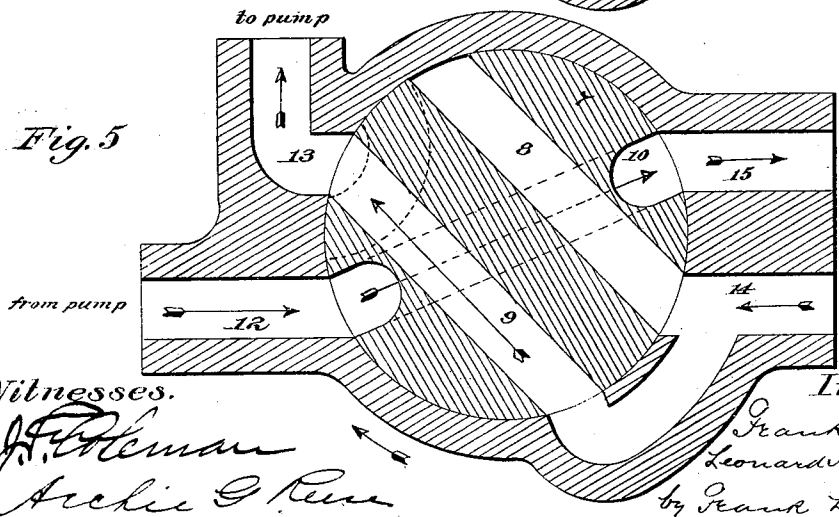


Fig. 5



Witnesses.
J. F. Coleman
Archie G. Rice

Inventors
Frank L. Dyer
Leonard Huntress Dyer
by Frank L. Dyer
Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 639,541. Patented Dec. 19, 1899.

F. L. & L. H. DYER.

AUTOMOBILE VEHICLE.

(Application filed May 4, 1897.)

(No Model.) 8 Sheets—Sheet 4.

Fig. 6

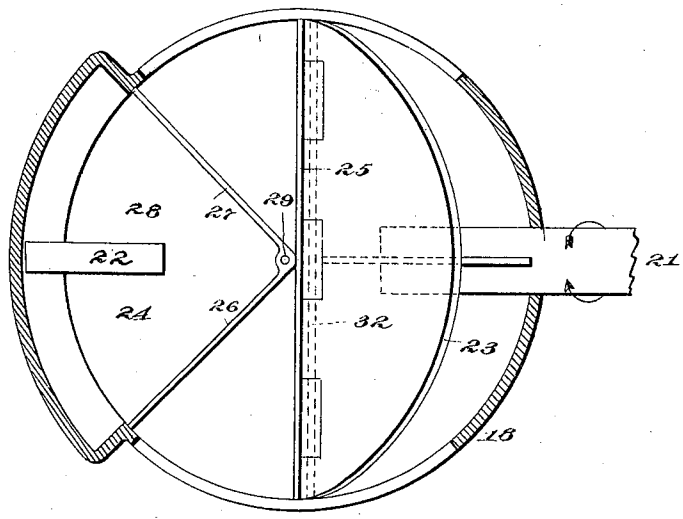


Fig. 7

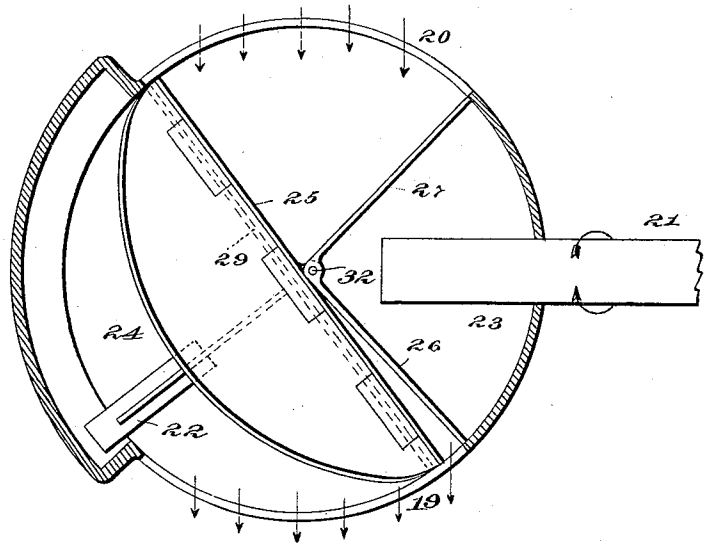
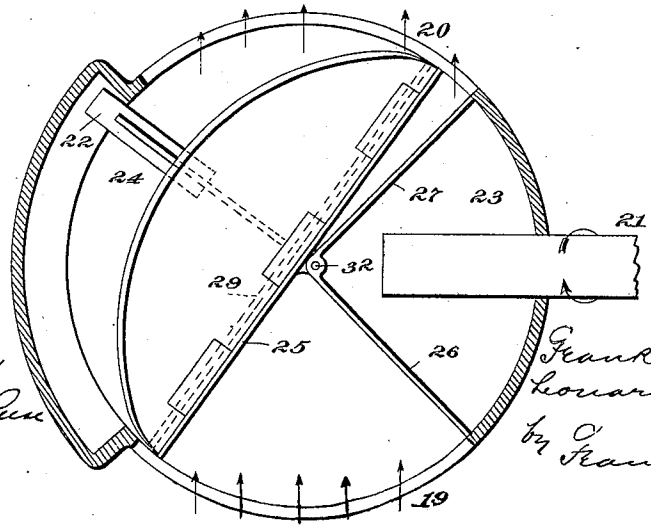


Fig. 8



Witnesses.

J. F. Coleman

Archie G. Rue

Inventors.

Frank L. Dyer

Leonard H. Dyer

by Frank L. Dyer

Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 639,541. Patented Dec. 19, 1899.

F. L. & L. H. DYER.

AUTOMOBILE VEHICLE.

(Application filed May 4, 1897.)

(No Model.) 8 Sheets—Sheet 5.

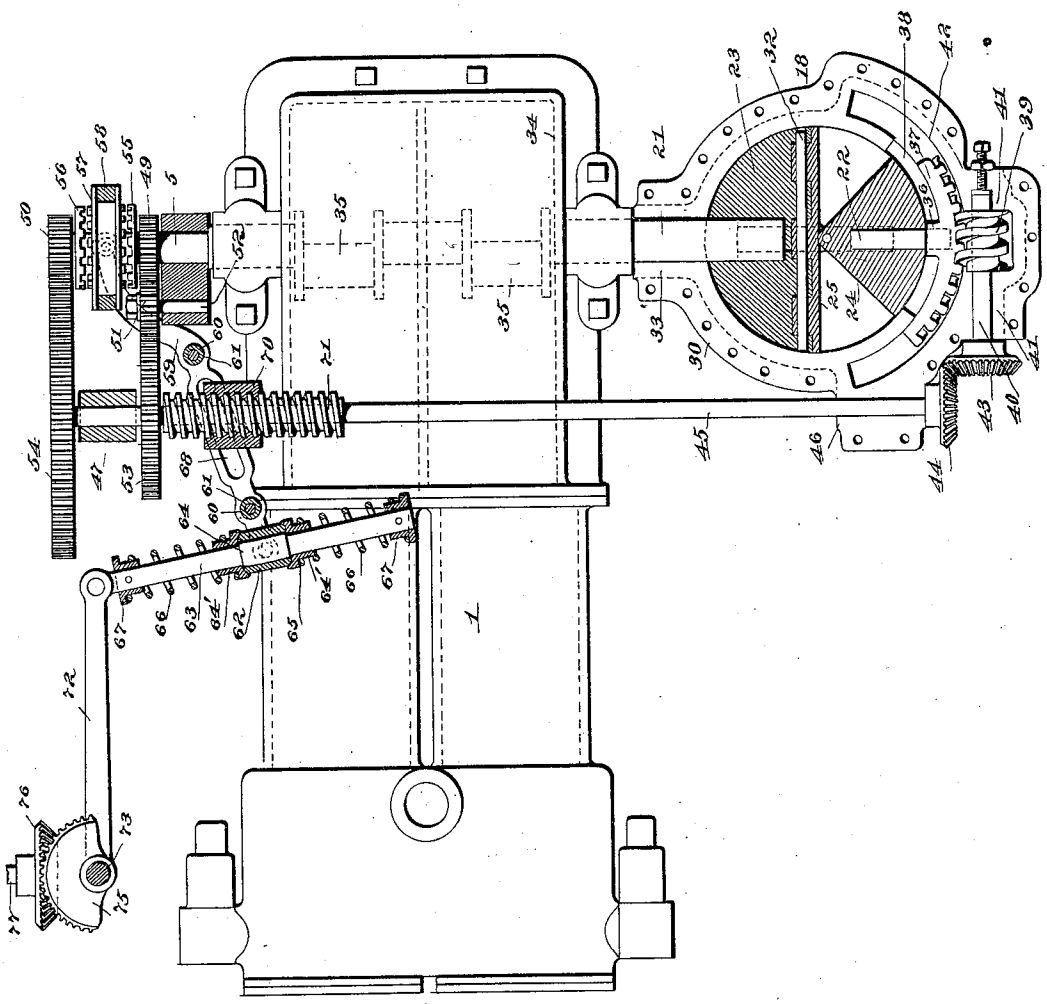


Fig. 9

Witnesses.
J. A. Brennan
Archie G. Reese

Inventors
Frank L. Dyer
Leonard Hamtun Dyer
by Frank L. Dyer
Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 639,541. Patented Dec. 19, 1899.

F. L. & L. H. DYER.

AUTOMOBILE VEHICLE.

(Application filed May 4, 1897.)

(No Model.) 8 Sheets—Sheet 6.

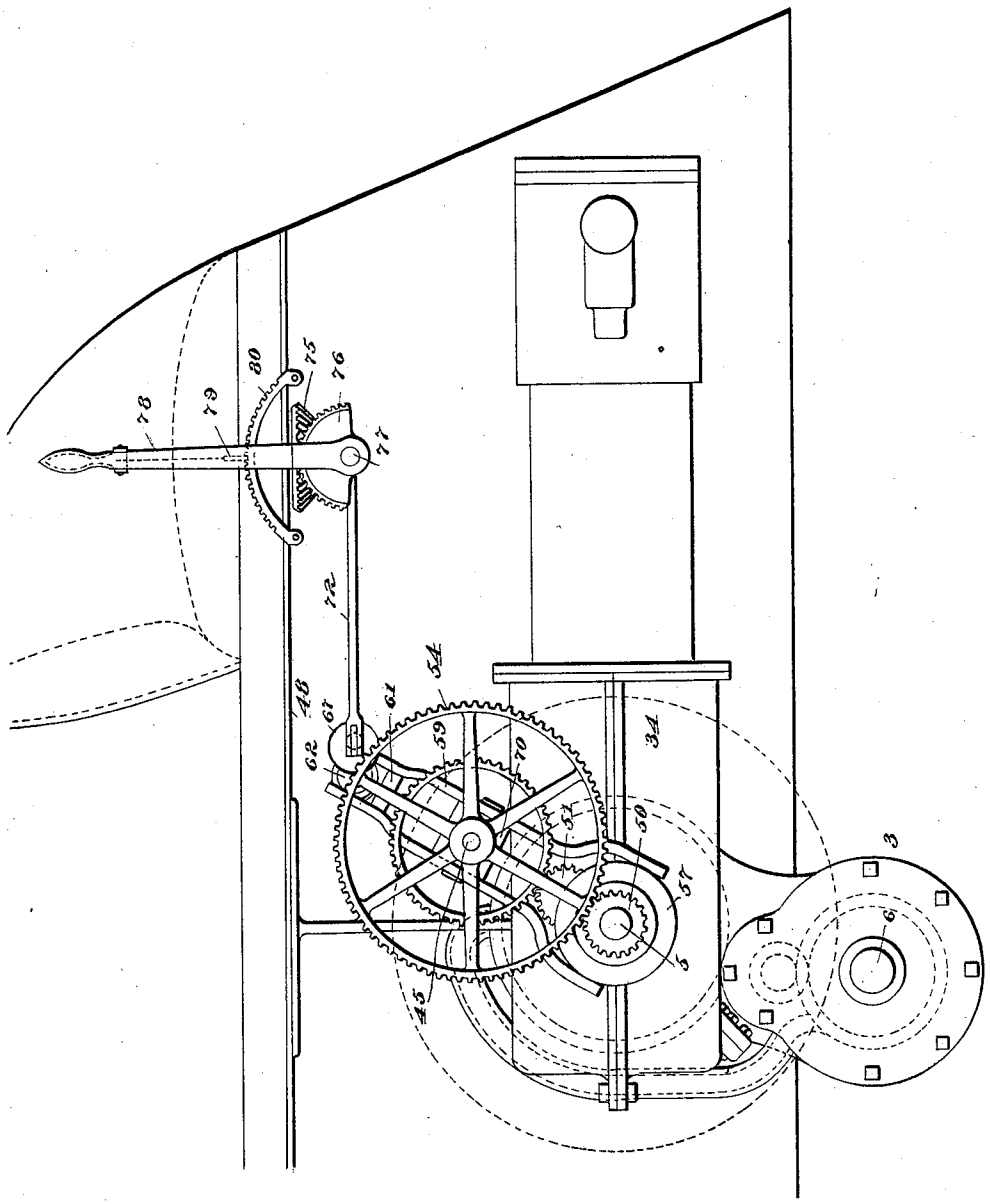


Fig. 10

Witnesses.
J. F. Coleman
Archie G. Reese

Inventors
Frank L. Dyer
Leonard Hunting Dyer
by Frank L. Dyer
Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 639,541. Patented Dec. 19, 1899.

F. L. & L. H. DYER.

AUTOMOBILE VEHICLE.

(Application filed May 4, 1897.)

(No Model.) 8 Sheets—Sheet 7.

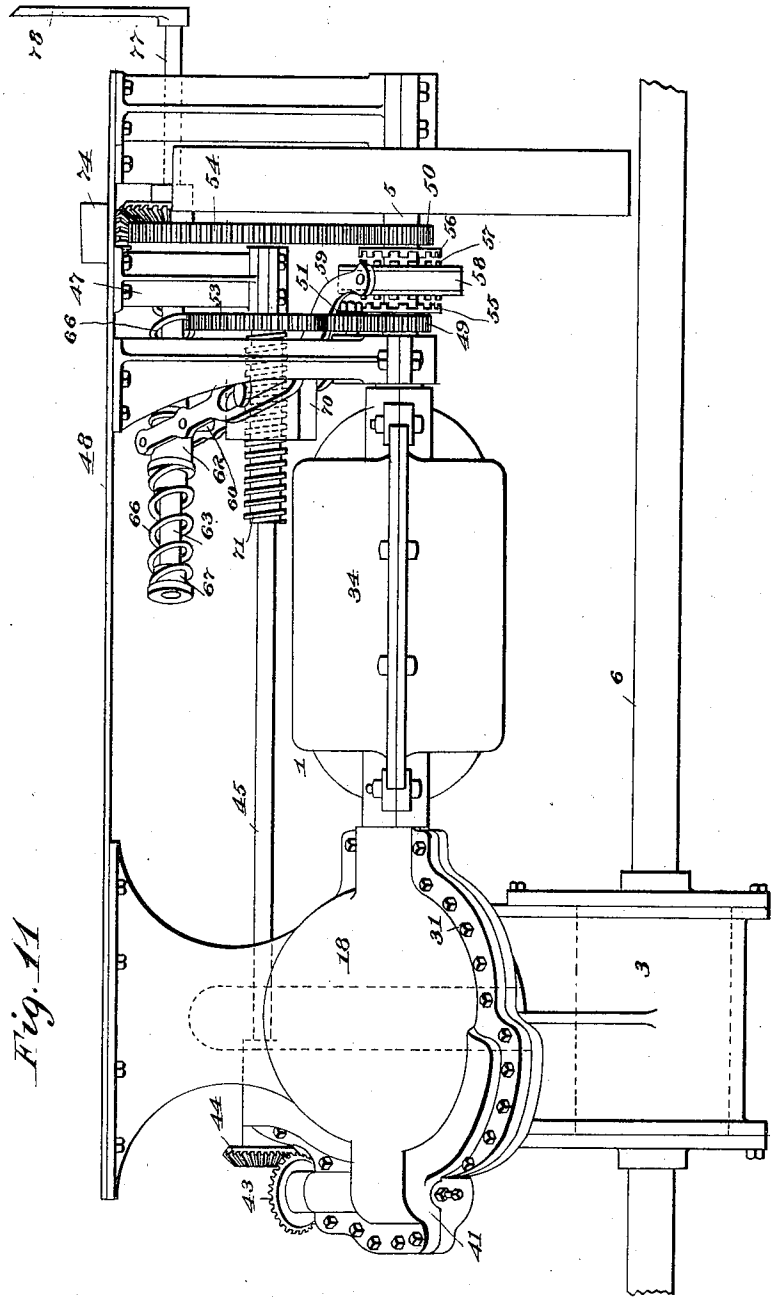


Fig. 11

Witnesses.
J. H. Coleman
Archie G. Rice

Inventors
Frank L. Dyer
Leonard Hunting Dyer
by Frank L. Dyer
Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 639,541. Patented Dec. 19, 1899.

F. L. & L. H. DYER.

AUTOMOBILE VEHICLE.

(Application filed May 4, 1897.)

(No Model.) 8 Sheets—Sheet 8.

Fig. 12

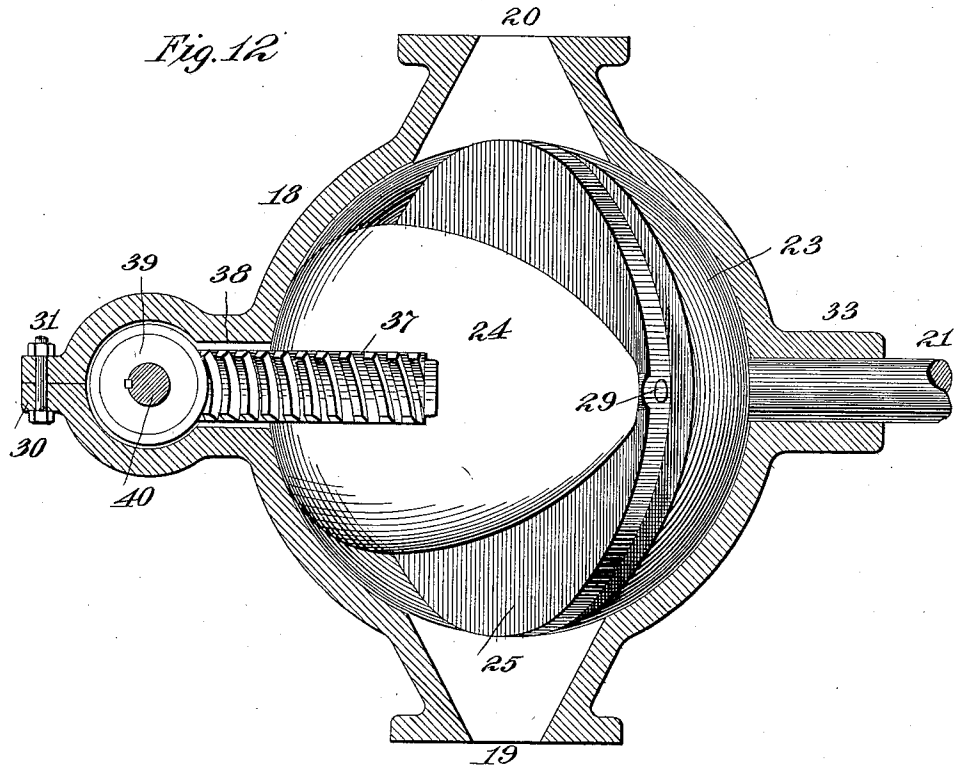
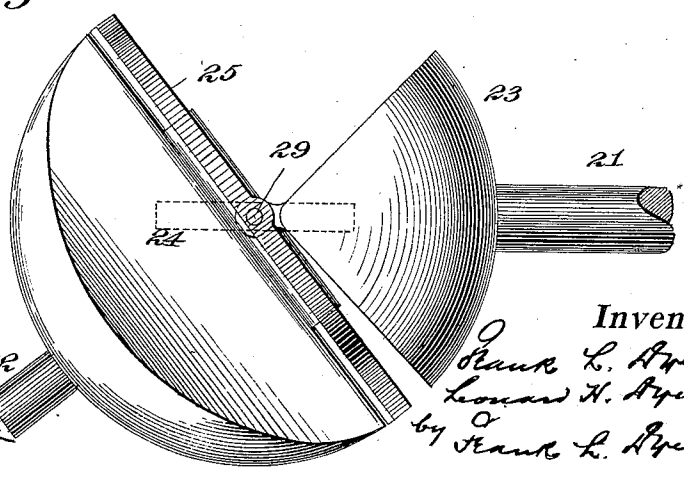


Fig. 13



Witnesses:

Jas. F. Coleman 2d

Jno. R. Taylor

Inventors

Frank L. Dyer

Leonard H. Dyer

by Frank L. Dyer

Att'y.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FRANK L. DYER AND LEONARD HUNTRESS DYER, OF WASHINGTON, DISTRICT OF COLUMBIA.

AUTOMOBILE VEHICLE.

SPECIFICATION forming part of Letters Patent No. 639,541, dated December 19, 1899.

Application filed May 4, 1897. Serial No. 635,066. (No model.)

To all whom it may concern:

Be it known that we, FRANK L. DYER and LEONARD HUNTRESS DYER, citizens of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Automobile Vehicles; and we do hereby declare the following to be a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to automobile vehicles, commonly known as "horseless carriages," and more particularly it relates to improvements in driving mechanism for the same. In the preferred form of driving mechanism we make use of an improved type of variable-supply pump or motor of variable speed, and such pump or motor, considered alone, also forms a part of our present invention and will be separately claimed. The improved driving mechanism which we have invented is capable of other uses than in connection with automobile vehicles and will be claimed by us as a separate invention.

The particular advantage of our driving mechanism when used with an automobile vehicle is that it enables a petroleum, oil, and other explosive motor to be practically and successfully employed. Such an explosive-motor, as is well known, runs at a high rate of speed and is provided with automatic regulating mechanism by which the speed is maintained practically constant irrespective of the load. This regulation is usually effected either by varying the quantity of the explosive introduced into the cylinder or cylinders or by increasing or decreasing the number of effective explosions in the cylinder or cylinders. Such an explosive-motor, besides running at a constant or approximately constant speed, is incapable of reversal and must run always in the same direction, and, furthermore, it must be started by hand—that is to say, the fly-wheel must be turned several times in starting in order that the proper cycle of operations may be commenced.

Aside from the disadvantages of an explosive-motor to which we have referred it is well adapted for use in an automobile vehicle on account of its lightness, ease of operation, comparative absence of heat, low cost, and economy of fuel. The driving mechanism which we have invented is particularly adapted for use with such an explosive-motor, and by means of that invention we overcome the disadvantages inherent in such motors and to which we have referred. In other words, we are enabled to drive an automobile vehicle at any speed from absolute rest to maximum and in either direction.

Prior to our invention gearing for partially accomplishing this object had been constructed wherein various arrangements of gear wheels, chains, belts, cones, or ratchet movements had been utilized; but all of such prior devices were objectionable in that in changing from one speed to another it was either necessary to disconnect the gearing for an instant and allow the engine to run free, in which case the working parts would be subjected to heavy strains and the vehicle would not attain the increase or decreased speed smoothly, or else intermediate friction-clutches were employed requiring delicate adjustment and subject to rapid wear. Such prior driving mechanisms have been further objectionable in that they are heavy, cumbersome, noisy, and unclean and are capable of but few variations of speed. For example, with such prior inventions the gearing would be so arranged as to provide for speeds of, say, four, eight, twelve, and sixteen miles per hour forward and a single speed of two miles per hour backward. In starting from rest, therefore, the vehicle would immediately attain a speed of four miles per hour, and if a further increase were desired the speed would be immediately augmented to eight miles per hour, and so on, so that it would be impossible to obtain delicate variations and the rapid increase or decrease in the speed would of course be objectionable to the occupants of the vehicle. With our invention, as stated, we are enabled to obtain any desired speed whatever up to the maximum, which we accomplish by a direct transmission of power at all times.

Broadly considered, the driving mechanism forming the subject of this invention consists of an endless movable liquid column—such as water, oil, glycerin water, or other

suitable liquid interposed between the driving-engine and one or more of the vehicle-wheels—of means for moving said liquid column, and of means for increasing or decreasing the volume or speed and for changing the direction of movement in whole or in part of said liquid column in some instances.

In carrying out our invention we attach to the driving-engine a suitable pump having liquid connections to a motor attached to the driving-wheels of the vehicle either directly or indirectly. The connections between said pump and motor are preferably continuous, so that the column of liquid will be driven constantly from the pump to the motor, forming an unyielding connection between said pump and motor, whereby the two will partake of substantially the same rotation without lost motion.

In order that the speed and direction of the motor may be altered independently of the speed and rotation of the pump, it is necessary either that the direction and amount of liquid delivered to the motor should be varied at will or else that the motor be so constructed as to run at different speeds and in different directions with a constant liquid-supply. These changes in speed and direction of the motor may be accomplished in a variety of ways. For instance, the capacity of the pump or motor for expelling or receiving liquid may be varied or the direction of movement of the liquid column may be changed by reversing the inlets or outlets of the pump or motor, or the capacity and direction of discharge of said pump may be fixed and constant, while the amount of liquid and its direction of movement reaching the motor may be varied by shunting off a portion thereof and allowing it to return direct to the pump without passing through the motor and without performing useful work. In the latter case the changes in direction of movement of the liquid column may be brought about by simply reversing the inlets and outlets of the motor by any suitably-arranged valve.

In describing and illustrating our invention we will first show and describe a driving mechanism comprising a constant-feed pump and a constant-supply motor, the changes in speed of the latter being effected by shunting off a portion of the liquid delivered by the pump through a by-pass and the direction of rotation of the motor being changed by means of a three-way valve interposed between the pump and motor, and we will show and describe, second, a gearing comprising a variable-feed pump, with means for varying the feed thereof, and a constant-supply motor, the changes in speed of the latter being effected by increasing or decreasing the feed of the pump and the direction of rotation of the motor being changed by changing the direction of feed of the pump.

The improved variable-feed pump which we have invented is believed to be entirely and radically new, and while it is of especial utility in the specific adaptation to an automobile vehicle it is capable of other and effective use, and we will therefore make special claims to the same. Such a variable-feed pump when receiving a liquid or fluid will operate as a motor, the speed and direction of which may be varied while the supply is constant, and the claims which we propose to make thereon will be broad enough to cover the same when used as a pump or as a motor.

In order to better understand the nature of our invention, attention is directed to the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a side view, partly in section, of a conventional form of automobile vehicle, showing the application thereto of our improved driving mechanism wherein a constant-feed pump and a constant-supply motor are used; Fig. 2, a plan view of the pump and motor shown in Fig. 2 and illustrating also the explosive-engine; Figs. 3, 4, and 5, enlarged sections of a valve which may be used in connection with the driving mechanism shown in Figs. 1 and 2 for changing the speed and direction of the motor; Figs. 6, 7, and 8, diagrammatic sectional views of our improved variable-feed pump or motor, illustrating the operation thereof; Fig. 9, a plan view, partly in section, of the preferred construction of driving mechanism employing a variable-feed pump; Fig. 10, a side view thereof, illustrating also a part of the vehicle; Fig. 11, an end view; Fig. 12, a vertical section through the casing of the pump, showing the sectors and piston in elevation; and Fig. 13, a separate elevation of the sectors and piston at right angles to Fig. 12.

In all of the different views corresponding parts are designated by the same reference-numerals.

Before describing in detail our invention as illustrated in the different views we desire that the following terms, designating certain parts thereof, shall be understood in order that there may be no confusion: By "prime motor" we include any prime mover of any description, whether operated by the expansion of a fluid or by the successive explosions of an explosive gas or vapor. By "pump" we mean, unless otherwise limited, any device for delivering a column of liquid under pressure, whether such pump be rotary, reciprocating, or otherwise. By "motor" we mean a device for transmitting motion from a moving column of liquid under pressure—such, for instance, as a rotary or reciprocating engine. In all the forms of our device which are illustrated in the drawings these three members are employed in one form or another. The prime motor and pump are always coupled together either directly—that is, on the same shaft—or indirectly by means of intermediate gearing. The column of liquid is always interposed between the pump and motor, and the latter is conpled to

the driving wheel or wheels of the vehicle either directly or indirectly or by means of a friction-clutch.

The various modifications to be described relate particularly to the means employed for varying the speed and direction of rotation of the motor.

In the drawings, 1 is the explosive-engine, 2 the pump, and 3 the motor. The column of liquid is shown at 4.

5 is the shaft of the engine, which in all the figures is shown as connected directly to the pump, and 6 is the driving-shaft of the vehicle, which in all the figures is shown connected directly to the motor.

Having reference to Figs. 1, 2, and 3, the direction of rotation of the pump (which is of a common type) being shown by arrows, the column of liquid will be forced in the direction indicated by the arrows and will be delivered to the motor and rotated in the direction indicated to drive the vehicle forward.

In order that the speed of the motor may be varied independently of the pump, a portion of the liquid between the pump and motor is shunted off through a by-pass. This is best accomplished by means of a suitable valve or valves, that shown in Fig. 1 and in detail in Figs. 3, 4, and 5 being preferred. This valve comprises a hand-operated barrel 7, having passages or ports 8, 9, and 10 therein, and a by-pass 11 in line with the port 10 and to one side of the ports 8 and 9. The exit and inlet ports 12 and 13 from and to the pump are sufficiently deep to aline with both the ports 8 and 9 and with the by-pass 11.

In Figs. 1 and 3 the valve is shown as forming a passage directly to the motor, which runs in an opposite direction to that of the pump. On the valve being turned in the direction of the arrow at the outside of the casing the ports 8 and 9 will be moved away from the inlet and outlet ports 12 and 13, so as to gradually close the clear passage from the exit 12 of the pump to the inlet 14 of the motor. At the same time the by-pass 11 will be slightly opened to accommodate the balance of the liquid not passing to the motor, which will then pass from the exit 12 directly to the inlet 13 of the pump. This movement of the valve may be continued to gradually shunt the liquid from the motor, and thereby gradually decrease its speed and at the same time to gradually increase the amount of liquid shunted through the by-pass, so that it passes directly from the exit to the inlet of the pump. The by-pass will be entirely open and the ports 14 and 15 to and from the motor completely closed in the position shown in Fig. 4, wherein all the liquid will be shunted through the by-pass, and since the exit and inlet to the motor are completely closed the motor will be securely locked against rotation. In this position of the ports the pump can be rotated without resistance other than that required to move the liquid through the by-pass. The explosive-engine can therefore be readily started by giving it a few turns with the hand and allowing it to rotate freely, and it will continue to rotate even though the motor is entirely stopped. Further movement of the valve will gradually close the by-pass until the position shown in Fig. 5 is reached, where the passages to and from the motor will be crossed or reversed, causing the motor to run in the opposite direction at full speed.

With such a valve as we have described it will therefore be seen that when the vehicle is at rest the valve will be in the position shown in Fig. 4, the pump operating at full speed and forcing its entire supply of liquid through the by-pass, that upon moving the valve from the position shown in Fig. 4 gradually toward the position shown in Fig. 3 the speed of the motor forward will be gradually increased, and that by moving the valve from the position shown in Fig. 4 to that shown in Fig. 5 the speed of the motor backward will be gradually increased.

The valve shown may be connected to a hand-operated lever arranged in any convenient position adjacent to the operator.

In order to provide for any leakage of the liquid either through the motor or pump, we prefer to employ a tank or receptacle 16, located above the pump and supplying liquid thereto, and in the pipe connecting said tank with the pump we prefer to interpose a check-valve 17, by which will be prevented the forcing of the liquid from the driving mechanism into said tank. This check-valve is of use principally when the vehicle is running downhill, and it prevents the motor acting as a pump from forcing liquid into the tank 16. In this way we maintain the liquid column always between the pump and motor, so that the speed of the motor will be the same whether it receives power from the pump or delivers power to the pump on steep inclinations.

In Fig. 1 we illustrate the tank or receptacle 16 as being located immediately beneath the cooling-water tank, which supplies water for cooling the explosive cylinders, and it is well understood that the cooling-water itself may be used in the liquid column. In said figure we also illustrate in front of the seat, beneath the floor of the vehicle, an oil-tank for containing oil or other fuel for the explosive-engine.

The device which we have just described constitutes a simple form of driving mechanism embodying our invention; but we prefer to use instead of the by-pass just described a pump having a variable capacity or a motor having a variable speed with a constant feed. Any form of variable-feed pump may be employed; but the one illustrated in the remaining figures of the drawings is preferred. This pump consists, essentially, of a spherical shell having two quarter-sectors mounted on shafts which pass through the walls of the shell. One shaft is connected to one of the

sectors and is driven by the explosive-engine or other motor. The other shaft constitutes simply a guide for the other sector and may be connected therewith and work loose in a bearing or else work loose in a bearing in the sector. Normally the two shafts are arranged at an angle to each other and at the full capacity of the pump. The angle between the shafts is about one hundred and thirty-five degrees. The two shafts may, however, be brought into line or the movable shaft be moved to one side or the other of the driving-shaft. The inner sides or edges of the two sectors are arranged at right angles and hinged at opposite sides of a disk-shaped piston. In opposite sides of the shell, at right angles to the plane of movement of the movable shaft, are elongated ports for ingress and egress of liquid. When the two shafts are in line and power is applied to the driving-shaft, the piston will rotate in a plane at right angles to that of the shafts and the pump will be inactive; but when the movable shaft is moved to a greater or less extent to one side or the other of the plane of the driving-shaft and power is applied to the driving-shaft the piston will partake of a wabbling motion in its rotation, each half of both its faces advancing and retreating alternately toward and from the adjacent face of one of the sectors, one of these movements being performed in each half-revolution of the driving-shaft. Since there are four faces on the two sectors, with each of which one half of the piston on one side or the other coöperates, there will be for each rotation of the driving-shaft four movements of the piston-faces toward the faces of the sectors and four movements of the piston-faces away from the faces of the sectors. As the piston-faces move away from the faces of the sector liquid will be drawn by suction between the same, and as the piston-faces move toward the faces of the sectors that liquid will be expelled from between the same. Since the extent of oscillation or wabbling of the piston depends upon the extent of inclination of the movable shaft, we are enabled to vary the capacity of the pump by varying the inclination of the movable shaft, and since the wabbling motion of the piston will be reversed by moving the movable shaft to one side or the other of the plane of the driving-shaft we are enabled to change the direction of movement of the liquid forced by the pump by moving the movable shaft to one side or the other of the plane of the driving-shaft.

In Figs. 6, 7, and 8 we show, diagrammatically, the main operating parts of a variable-feed pump, such as we have referred to. 18 represents the spherical shell, having the ports 19 and 20 therein. We particularly draw attention to the fact that in these figures the inlet and outlet ports in the cylinder are shown for the purpose of clearness one-quarter of a revolution away from their correct locations. As stated, these ports are in a plane at right angles to the path of movement of the movable shaft; but in order that the operation of the pump may be better understood we have shown them in line with the path of movement of the movable shaft. One of the openings in the shell is correctly located in Fig. 9 by dotted lines. 21 is the driving-shaft; 22, the movable shaft; 23 and 24, the sectors, and 25 the disk piston, fitting snugly in the spherical shell. In order that the principle of operation of this pump may be better comprehended, we illustrate each sector as being composed of two semicylindrical portions 26 and 27, coming together at their base-lines, arranged at an angle of forty-five degrees to one another and secured by a cross-piece or partition 28. The driving-shaft 21 and movable shaft 22 are shown as being bifurcated, each of them straddling and being secured to one of the cross-pieces 28 of the respective sectors. The sectors 23 and 24 are arranged at right angles, as shown, and the apexes thereof are secured to the piston 25 by hinged joints 29 29. These joints are made sufficiently tight to prevent appreciable leakage.

In Fig. 6 the movable shaft 22 is shown in the same plane as the driving-shaft 21, this being the inactive position of the pump—namely, when liquid is not being forced through the same.

It will be noted that when the driving-shaft 21 is driven in the direction of the arrow the sector 23 will be rotated within the spherical shell, carrying the piston therewith and rotating the sector 24 and the movable shaft 22. The apexes of the two sectors will therefore turn in a plane at right angles to the axial line of the two shafts, and therefore the piston will be rotated in the spherical shell in that plane. For this reason the parts of the pump in the position shown in Fig. 6 do not tend to approach or recede from each other, and in consequence no liquid is forced through the same; but instead liquid in the pump is bodily moved around within the shell with the sectors and has no tendency to pass out of the shell.

In Fig. 7 we illustrate the operative parts of the pump in the positions which they maintain when the pump is working almost to its full capacity for forcing liquid in one direction—that indicated by the arrows. Power being applied to the driving-shaft, the sectors 23 and 24, the piston 25, and the movable shaft 22 will be rotated, as before. It will be noted, however, that the movable shaft 22 rotates in a plane at an angle with respect to that of the driving-shaft, so that the piston 25 will not rotate in a single plane, but will alternate between the planes of the two shafts, at one part of its rotation being in the plane of the driving-shaft and then leaving that plane and approaching the plane of the movable shaft. In this way the piston partakes of a wabbling motion in the spherical shell and alternately approaches the faces

of the sectors, the extent of approach being of course limited to the divergence of the planes of the two shafts. In other words, as the movable shaft approaches the plane of the driving-shaft the extent of wabbling of the piston is correspondingly reduced.

A reference to the figure under consideration will show that the piston possesses four active faces, two on each side, each face comprising the surface to one side of the connection with the corresponding sector, and that each of these active faces coöperates with the adjacent face of one of the sectors. The wabbling motion of which the piston partakes causes the active faces thereof to approach and recede from the corresponding faces of the sectors. Taking into consideration only a single operative face of the piston and the adjacent face of one of the sectors it will be observed that during each rotation of the shaft 21 these faces recede from each other and then approach each other, the extent of movement being, as stated, proportional to the deflection of the movable shaft from the plane of the driving-shaft. As the two faces referred to recede in Fig. 7 they are in communication with the inlet 20, and therefore draw by suction liquid through said inlet into the space between said faces. This separation of the two faces takes place during the half-rotation of the shaft 21, and at the end of that time the space between the two faces will be just cut out from the inlet 20, and that space will be of its maximum size and be filled with liquid. During the remaining half-rotation of the shaft 21 the two faces approach each other, being at that time in communication with the exit-opening 19, so that the liquid which was drawn in between said faces will then be expelled through the opening 19. Since there are four operative faces on the piston coöperating with four faces on the sectors and since when operating to the maximum capacity the space between each two active faces equals, substantially, one-fourth of the contents of the spherical shell, it will be seen that at each rotation of the driving-shaft 21 a bulk of liquid equal, substantially, to the contents of the spherical shell will be drawn by suction therein and forced out of the same. In Fig. 8 the same parts of the pump are arranged so as to force a maximum quantity of the liquid in the opposite direction from that shown in Fig. 7. In this figure the movable shaft 22 has been moved to the other side of the axial line of the shaft 21, and, as will be understood, when the driving-shaft is driven in the same direction a reversal of the movements just described will take place. In other words, during the half-rotation in which any two of the operative faces approached each other in Fig. 7 those faces will recede from each other in Fig. 8.

In Figs. 9, 10, and 11 we illustrate the preferred construction of variable-feed pump embodying the general principles of operation which we have just explained. In these figures the spherical shell 18 is made in two parts, each formed with a flange 30 thereon and bolted together by the bolts 31. The sectors 23 and 24, which are preferably solid, are mounted in the spherical shell, as before explained, and the piston 25 is hinged to said sectors on the heavy pins 32 32. The driving-shaft 21 passes through a bearing 33 into the engine-casing 34 and is driven directly from the cranks 35 of the explosive-engine. The movable shaft 22 is rigidly secured in a bearing-piece 36 and works loosely in a bearing in said sector. The said bearing-piece 36 is preferably formed integrally with a curved rack 37, which works in suitable guides on the outside of the spherical shell, the bearing-piece 36 working in a slot 38, formed in the shell.

39 is a worm mounted on a shaft 40, which worm engages the rack 37 and is adapted to move the same up or down to change the inclination of the movable shaft 22 to one side or the other of the plane of the driving-shaft 21, as will be understood. The shaft 40 is mounted in suitable bearings 41 41, formed in the integral extension 42 of the spherical shell, whereby all of the parts referred to will be effectively closed and leakage of liquid therethrough prevented.

The length of the slot 38 is slightly less than the width of the sector 24, so that at no time will there be communication between the upper and lower faces of said sector through said slot. If desired, the bearings 41 may be suitably packed as a further safeguard against leakage through the same.

While we prefer to change the inclination of the movable shaft 22 by means of a worm and worm-rack, as that shown and described, for the reason that with such an arrangement the movable shaft will retain any position in which it may be placed and also a very powerful device for moving the same is thereby secured, yet we desire to have it understood that the said movable shaft may be moved relatively to the axial line of the driving-shaft by any other means.

While the shaft 40 might be connected directly to a hand-wheel or other mechanism to allow it to be rotated by hand for shifting the inclination of the movable shaft 22, we prefer to change the inclination of that shaft by the power of the explosive-engine itself, as in that way it can be done more quickly and easily. When, therefore, the shaft 22 is to be shifted to any position or inclination by the power of the engine itself, we may adopt the mechanical connections illustrated in the drawings for this purpose.

Mounted on the shaft 40, outside of the bearing 41, and preferably in quite close contact therewith, is a beveled gear 43, which meshes with a corresponding beveled gear 44, keyed to a shaft 45. The shaft 45 is mounted in a bearing 46, formed integral with the pump-casing, and in a bearing 47 near its outer end,

supported in any suitable way, such as from the supporting-plate 48.

The driving-shaft 5 of the explosive-engine is provided with two loose gears 49 and 50 thereon, said gears being preferably held against lateral movement by collars. (Not shown.) The gear 40 meshes with an intermediate gear 51, mounted on a pin 52 in the main bearing of the shaft 5, and said intermediate gear 51 meshes with a gear 53, keyed to the shaft 45 on one side of the bearing 47. The gear 50 meshes directly with a gear 54, keyed to the shaft 45 on the other side of the bearing 47.

The gear 49 is provided with a clutch-collar 55 thereon, and the gear 50 is provided with a clutch-collar 56 thereon. Splined to the shaft 5 between these clutch-collars 55 and 56, and capable of engagement with either one of said clutch-collars, is a clutch 57 of any well-known construction adapted to be moved into engagement with either of said clutch-collars 55 or 56 in any suitable way. If desired, a direct connection between a hand-lever and the clutch 57 may be effected, so that the clutch 57 may be moved by hand into engagement with either of the clutch-collars to cause rotation of the gear 49 or 50. By this means rotation in one direction or the other of the shaft 45 will be effected, and through the bevel-gears 43 and 44, the worm 39, and worm-rack 37 motion will be communicated to the movable shaft 22 to move it in the desired direction.

When the shaft 22 has been moved to a position to effect a sufficient change of inclination of the piston to result in the pumping of a sufficient amount of liquid to give to the motor the proper speed desired, the clutch 57 may be disconnected from the clutch-collar with which it was engaged, and movement of the gear 49 or 50 will thereby be arrested, so that the shaft 45 will cease to rotate and the movable shaft 22 will occupy the position to which it was brought.

While the direct controlling of the clutch 57 might, in some instances, be satisfactory, we prefer to so operate it as to enable predetermined speeds to be reached. In other words, we consider it desirable to so arrange the device that upon the movement of a lever or other element to a predetermined extent the speed of the motor due to the increase or decrease in the supply of the motor will be gradually raised or lowered until the predetermined point is reached, wherein it will continue to operate at that speed. In Figs. 9, 10, and 11 we show mechanism illustrating the preferred construction of parts for accomplishing this result and which we will now describe. The clutch 57 is provided with a collar 58, mounted thereon so as to allow the clutch to revolve freely with respect to said collar. The said collar is pivoted between two companion levers 59, which straddle the intermediate gear 51 and which are connected together by bolts 60, passing through sleeve 61. The said levers also straddle the shaft 45, as will be seen. At their outer ends the levers are pivoted to a sleeve 62, which is free to slide on a rod 63, the said rod having an enlarged portion 64, over which the sleeve 62 is normally located. Engaging the sleeve 62 at each side is a collar 64', which abuts against the shoulders formed at the ends of the enlarged portions 64. Each of said collars is provided with shoulders 65, against which a spring 66 is seated, the other ends of said springs engaging with collars 67, secured at or near the ends of the rod 63. The companion levers 59 are provided with slots 68 therein, in each of which a pin or stud 69 engages, said pins or studs being formed upon a rectangular nut 70, and said nut works on a screw-threaded portion 71, keyed rigidly to the shaft 45.

In order to operate the rod 63 in the desired manner, any suitable mechanical connections may be used, a type of which is shown.

72 is a lever moved in a horizontal plane and keyed to a vertical shaft 73, mounted in a bearing 74 on the plate 48. The said shaft 73 is provided with a bevel-toothed sector 75, keyed thereto, and with which a bevel-toothed sector 76 engages. The latter sector 76 is mounted on a horizontal shaft 77, suitably supported in bearings from the plate 48, and at the end of the shaft 77 is a suitable hand-lever 78, which is conveniently arranged adjacent to the seat of the vehicle. The said hand-lever may be provided with any suitable locking-bolt 79, engaging with a segment 80. This segment 80 may have indicated thereon the different speeds desired.

The motor 3 is preferably cast integral with the lower section of the pump-casing, as shown in Fig. 10, and is of any suitable character.

For the purpose of illustrating our invention we show the well-known form of water-motor illustrated in section in Fig. 1. Such a motor, as will be obvious, will run at a speed depending upon the amount of liquid passing through the same. With these premises and the principle of operation of our improved variable-feed pump being understood the operation of the preferred form of device illustrated will be as follows:

When the vehicle is at rest, the parts will be in the position shown in Fig. 9, the movable shaft being therefore in line with the driving-shaft. For reasons which have been explained when the parts are in this position the pump is inactive, and liquid will not be forced through the same. The explosive-engine is now started in the usual way and is operated continuously in the same direction and at the same or approximately the same speed. It being desired, for instance, to start the vehicle forward and to immediately attain the maximum speed, the lever 78 is moved forward to the limit of its movement and the pawl 79 engaged with the rack, so as to lock the lever at that position. This move-

ment of the lever 78 through the intermediate gears 75 and 76 will swing the arm 72 horizontally toward the left in Fig. 9, compressing the spring 66 at the right of the rod 63 and moving the enlarged portion 64 of said rod from beneath the collar 62. The other spring 66 can expand no farther, because the collar 64′ is in contact with the enlarged portion 64. The swinging movement of the arm 72 tending to compress the spiral spring 66 at the right of the rod 63 also causes the companion levers 59 to oscillate on the studs or pins 69 and carry the clutch 57 in contact with the clutch-collar 55, so that the gear 49 will be rotated. This rotation of the gear 49 will communicate motion to the shaft 45 through the gears 51 and 53, and the rotation of said shaft through the bevel-gears 43 and 44, worm 41, and rack 37 will move the movable shaft 22 in the desired direction, either up or down, to effect the correct movement of the liquid to propel the motor in the proper direction. As soon as the operating-arm 78 is locked it requires no further attention on the part of the operator. The spring 66, which has been put under tension, tends to force the collar 62 back to its former position on the rod 63—namely, in line with the enlarged portion 64 thereof—and this tendency maintains the clutch 67 in contact with the clutch-collar 55. The rotation of the shaft 45, however, operating the worm 71, tends to move the nut 70 toward the left in Fig. 9, so as to gradually allow the collar 62 to approach the position desired. These operations continue until the nut 70 has been moved to a position to swing the collar 62 on the rod 63, and a further rotation more or less thereof will swing the companion levers 59 farther over to disconnect the clutch 57 from the clutch-collar 55, so as to bring the shaft 45 at rest, and thereby maintain the movable shaft 22 in its maximum position and provide for forward movement of the vehicle. When it is desired to stop the vehicle, the reverse movements just described take place, the operating-lever 78 being brought back to a vertical position, so as to connect the clutch 57 with the clutch-collar 56. When it is desired to effect a reverse or backward movement of the vehicle, the operating-lever 78 is simply moved back of its vertical position, so as to compress the other spring 66 and carry the clutch 57 into engagement with the clutch-collar 56. In this way and by these means we are not only enabled to interpose between an explosive-engine and the driving-wheel of an automobile vehicle a driving mechanism by which any desired speed both forward and backward may be obtained by absolutely even and imperceptible gradations, but we are enabled to effect changes in speed and direction through the instrumentalities of the explosive-engine itself, and we are further enabled to obtain any desired speed by the movement of a hand-lever to the required position and to maintain that speed constantly without further attention.

Instead of using a pump having a variable supply and operated from the explosive-engine, as we have just described, it will of course be seen that substantially the same results will be obtained if a constant-supply pump is used—such, for example, as that shown in Fig. 1—and a motor employed capable of varying the speeds with a constant supply. Such a motor might be constructed on exactly the same principles as our improved variable-feed pump with but slight modifications. By normally arranging the movable shaft 22 at its maximum inclination with respect to the driving-shaft 21 we obtain, for reasons stated, the maximum oscillation or wabbling of the piston, and in consequence the spaces or pockets which are formed between the piston and the adjacent faces of the sectors are of the maximum size. As the movable shaft 22 is moved toward the plane of the driving-shaft the extent of oscillation of the piston will be gradually decreased. If, therefore, a motor were constructed on the same principles as those of our improved variable-feed pump, it should be so arranged that at the lowest speed the movable shaft 22 would be at its maximum inclination with respect to the shaft 21, and the speed-controlling mechanism should be such as would cause the movable shaft 22 to gradually approach into line with the shaft 21. In this way the oscillation or wabbling of the piston will be gradually decreased, so that a smaller quantity of liquid would oscillate the same, and therefore with a given liquid-supply a greater number of oscillations would be required to take place in order to accommodate that supply. In consequence the speed of the motor would be gradually increased. With respect to the motor, however, there would be a limit of movement, which could be determined by experiment of the movable shaft 22 toward the plane of the driving-shaft 21, and with such a motor it will also be necessary to make use of a by-pass when the vehicle is at rest or else to stop the movement of the explosive-engine. For these reasons, although we consider the latter arrangement to be the mechanical equivalent of our invention, we prefer to employ a variable-feed pump, such as we have described.

With the arrangement shown in Figs. 9, 10, and 11 a tank 16, with connections to the pump and a check-valve in said connections, may be used, as in Figs. 1 and 2 and for the same purpose.

It will be obvious that our improved variable-feed pump is not limited for use in pumping liquids, since it may be effectively utilized as a blower or compression-pump with air and other gases and vapors, and it will be further evident that when such a pump is used as a motor its direction of rotation can be changed either by changing the direction of

movement of the liquid, in which case the play of the movable shaft will always be at one side of the plane of the driving-shaft, or else by moving the said movable shaft to either side of the driving-shaft, in which case the direction of movement of the liquid column will be constant.

So far as we know no one prior to our invention employed between a driving-motor and the vehicle-shaft a variable-speed gearing combined with mechanism operated by the motor for effecting changes in speed of said gearing, and no one prior to our invention employed with such gearing and mechanism a hand-operated lever or other manual device for effecting engagement of the speed-controlling mechanism with the driving-motor, and no one prior to our invention employed with such gearing, mechanism, and manual device an automatic mechanism for disengaging the speed-controlling appliances from the driving-motor, and we shall therefore claim the same broadly, giving to the expression "variable-speed gearing" the broadest and most generic construction that can be placed thereon.

So far as we know, also, no one prior to our invention employed in combination with the driving-shaft of a vehicle a driving-motor, connections between the motor and shaft for driving the latter, means of any description or type for effecting different speeds of the driving-shaft, a hand-operated lever for controlling the said means, and independent mechanism, however constructed or operated, for arresting changes in speed when a predetermined speed is reached, and we shall therefore claim the same broadly. The same combination, with the limitation that the "independent mechanism" shall be automatic, is also believed by us to be broadly new, and therefore it will be claimed generically.

Before claiming our invention we will call attention to the fact that by connecting the explosive-engine with a pump, whether of a variable or constant feed, the operating parts of the pump when the vehicle is at rest will be always in contact with the liquid and a small though uniform resistance thereby imposed on the engine. In this way we prevent the engine from racing violently, as it now does in those vehicles employing mechanical gearing when the engine is running without resistance, in which case the explosions will be relatively infrequent; but since there is no resistance the effect of the explosions is much more pronounced, producing vibrations in the vehicle and making such vehicles objectionable for occupancy when at rest. With our invention the effect is somewhat analogous to the employment of a dash-pot in other mechanical devices for preventing sudden and violent movements of an element without the absorption of power.

From what has been said it is believed that the advantages of our invention in practical use will be appreciated, and they need not therefore be referred to in detail. A driving-gear for automobile vehicles constructed in accordance with our invention can not only be built cheaply and operated economically, but it requires absolutely no attention on the part of the operator. At the same time, for reasons which we have explained in full, the speed is capable of being changed from absolute rest to the maximum, and vice versa, by imperceptible gradations.

Having now described our invention, what we claim as new therein, and desire to secure by Letters Patent, is as follows:

1. In a vehicle, the combination of the driving-shaft thereof, a liquid-motor connected to and rotating said shaft, a prime motor, a pump connected to and driven by said prime motor, a liquid column between said pump and liquid-motor, and manually-controlled means operated by the prime motor for varying the volume or speed of said liquid column, substantially as set forth.

2. In a vehicle, the combination of the driving-shaft thereof, a liquid-motor connected to and rotating said shaft, a prime motor, a pump connected to and driven by said prime motor, a liquid column between said pump and liquid-motor, mechanism normally disconnected from said prime motor but adapted to be connected therewith for varying the volume or speed of said liquid column, and manually-operated means for connecting said controlling mechanism with the prime motor, substantially as set forth.

3. In a vehicle, the combination of the driving-shaft thereof, a liquid-motor connected to and rotating said shaft, a prime motor, a pump connected to and driven by said prime motor, a liquid column between said pump and liquid-motor, mechanism normally disconnected from said prime motor but adapted to be connected therewith for varying the volume or speed of said liquid column, manually-operated means for connecting said controlling mechanism with the prime motor, and means for automatically disengaging said mechanism, substantially as set forth.

4. In an automobile vehicle, the combination of the driving-shaft, a liquid-motor connected to and rotating the same, a variable-feed pump, a liquid column between said pump and said motor, a prime motor connected to said pump, mechanism operated by said prime motor for varying the feed of said pump, and manually-operated devices controlling the latter, substantially as set forth.

5. In an automobile vehicle, the combination of the driving-shaft, a liquid-motor connected to and rotating the same, a variable-feed pump, a liquid column between said pump and motor, a prime motor for driving said pump, mechanism normally disconnected from said prime motor and adapted to be connected therewith for varying the feed of said pump, and manually-operated means for connecting said controlling mechanism with the prime motor, substantially as set forth.

6. In an automobile vehicle, the combination of the driving-shaft, a liquid-motor connected to and rotating the same, a variable-feed pump, a prime motor driving the same, a liquid column between said pump and motor, mechanism disconnected from the prime motor but adapted to be connected therewith for varying the feed of the pump, means for manually engaging said mechanism with said prime motor, and means for automatically disengaging said mechanism, substantially as set forth.

7. In an automobile vehicle, the combination of the driving-shaft thereof, a prime motor, variable-speed gear between said prime motor and said shaft, and manually-controlled means operated by the prime motor for varying the speed of said variable-speed gearing, substantially as set forth.

8. In an automobile vehicle, the combination of the driving-shaft, a prime motor, variable-speed gearing interposed between said prime motor and said shaft, mechanism operated by said prime motor for effecting changes in speed of said variable-speed gearing, and means for manually controlling the said mechanism, substantially as set forth.

9. In an automobile vehicle, the combination of the driving-shaft thereof, a prime motor, a variable-speed gearing interposed between said prime motor and shaft, mechanism normally disconnected from but adapted to be connected with the prime motor for varying the speed of said variable-speed gearing, and manually-operated mechanism for engaging said mechanism with the said prime motor, substantially as set forth.

10. In an automobile vehicle, the combination of the driving-shaft thereof, a prime motor, variable-speed gearing interposed between said prime motor and said shaft, mechanism normally out of contact but adapted to engage with the prime motor, manually-operated means for engaging said mechanism with the prime motor, and means for automatically disconnecting said mechanism from the prime motor, substantially as set forth.

11. Mechanism for driving a vehicle, comprising a prime motor, variable gearing between said prime motor and the shaft of the vehicle, and manually-controlled mechanism operated by the prime motor for varying the speed of said variable-speed gearing, substantially as set forth.

12. Mechanism for driving a vehicle, comprising a prime motor, variable-speed gearing between said prime motor and the shaft of the vehicle, mechanism normally disconnected but adapted to be connected with the prime motor for changing the speed of the variable-speed gearing, and manually-operated devices for engaging said mechanism with the prime motor, substantially as set forth.

13. Mechanism for driving a vehicle, comprising a prime motor, variable-speed gearing connecting said prime motor with the driving-shaft of the vehicle, mechanism normally disconnected from but adapted to be engaged with the prime motor for effecting variable speeds of said speed-gearing, manually-operated means for effecting said engagement, and means for automatically disengaging said mechanism from the motor, substantially as set forth.

14. An improved variable-feed pump or motor, comprising a casing, a sector therein, an operating-shaft for rotating said sector, a disk piston connected to said sector, and means cooperating with the said shaft for oscillating said piston to any desired extent.

15. An improved variable-feed and reversing pump or motor, comprising a casing, a sector therein, an operating-shaft for rotating said sector, a disk piston connected to said sector, and means coöperating with the said shaft for oscillating said piston in either direction and to any desired extent.

16. An improved variable-feed pump or motor, comprising a casing, a sector therein, a main shaft connected to said sector, a disk piston connected to said sector, a movable shaft hinged to said disk at right angles to said sector, and means for moving said movable shaft to one side of the plane of the main shaft, substantially as described.

17. An improved variable-feed and reversing pump, comprising a casing, a sector therein, a main shaft connected to said sector, a disk piston connected to said sector, a movable shaft hinged to said piston at right angles to said sector, and means for moving said shaft to both sides of the plane of the main shaft, substantially as set forth.

18. An improved variable-feed pump, comprising a spherical casing, two sectors therein arranged at right angles to each other, a disk piston between said sectors and hinged to each of them, a main shaft connected to one of said sectors, a movable shaft connected to the other of said sectors, and means for moving said movable shaft to one side of the plane of the main shaft, substantially as set forth.

19. An improved variable-feed and reversing pump, comprising a spherical casing, two sectors therein arranged at right angles to each other, a disk piston mounted between said sectors, and hinged to each of them, a main shaft connected to one of said sectors, a movable shaft connected to the other of said sectors, and means for moving said movable shaft to both sides of the plane of the main shaft, substantially as set forth.

20. An improved variable-feed pump, comprising a spherical casing, two sectors therein, a piston mounted between said sectors, and hinged to both of them, a main shaft connected to one of said sectors, a movable shaft connected to the other of said sectors, mechanism for operating said movable shaft, and a closed extension of said casing inclosing said operating mechanism, substantially as set forth.

21. An improved variable-feed pump, comprising a spherical casing, two sectors there-

in, a piston mounted between said sectors and hinged to both of them, a main shaft connected to one of said sectors, a movable shaft connected to the other of said sectors, a toothed rack connected to said movable shaft, a worm engaging said rack, and a closed extension of said casing inclosing said worm and rack, substantially as set forth.

22. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein, one of which connects with said prime motor, a piston mounted in said casing between said sectors and hinged to both of them, a movable shaft connected to the other sector, and means for changing the inclination of said shaft, substantially as set forth.

23. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein, one of which connects with the prime motor, a piston in said casing between said sectors and hinged to both of them, a movable shaft connected to the other sector, and means operated by the prime motor for changing the inclination of said movable shaft, substantially as set forth.

24. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein, with one of which the prime motor is connected, a piston in said casing between said sectors, and hinged to both of them, a movable shaft connected to the other sector, mechanism normally disconnected from but adapted to be connected with the prime motor for shifting the inclination of said movable shaft, and manually-operated devices for engaging said mechanism with said prime motor, substantially as set forth.

25. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein, with one of which the prime motor is connected, a piston mounted in said casing between said sectors and hinged to both of them, a movable shaft connected to the other of said sectors, mechanism normally disconnected from but adapted to be connected to the prime motor for changing the inclination of said movable shaft, manually-operated devices for engaging said mechanism with the prime motor, and means for disengaging said mechanism from the prime motor, substantially as set forth.

26. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor is connected, a piston mounted in said casing between said sectors, and connected to both of them, a movable shaft connected to the other sector, a toothed rack connected to said movable shaft, a worm engaging said rack and means for rotating said worm for changing the inclination of the movable shaft, substantially as set forth.

27. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston mounted in said casing between said sectors and hinged to both of them, a movable shaft connected to the other of said sectors, a toothed rack connected to said movable shaft, a worm engaging said rack, and connections between said worm and the prime motor, substantially as set forth.

28. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and hinged to both of them, a movable shaft connected to the other of said sectors, a toothed rack connected to said movable shaft, a worm engaging said rack, an operating-shaft for said worm, and connections between said operating-shaft and the prime motor for driving said operating-shaft in either direction, substantially as set forth.

29. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and hinged to both of them, a movable shaft connected to the other of said sectors, a toothed rack connected to said movable shaft, a worm engaging said rack, a worm-operating shaft, a clutch on the driving-shaft of the prime motor, and intermediate mechanism between

the clutch and the worm-operating shaft for driving said shaft in either direction, substantially as set forth.

30. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and hinged to both of them, a movable shaft connected to the other of said sectors, a toothed rack connected to said movable shaft, a worm engaging said rack, a worm-operating shaft, a clutch on the driving-shaft of the prime motor, intermediate mechanism between the clutch and the worm-operating shaft for driving said shaft in either direction, and manually-operated devices controlling said clutch, substantially as set forth.

31. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and hinged to both of them, a movable shaft connected to the other of said sectors, a toothed rack connected to said movable shaft, a worm engaging said rack, a worm-operating shaft, a clutch on the driving-shaft of the prime motor, intermediate mechanism between the clutch and the worm-operating shaft for driving said shaft in either direction, a manually-operated device controlling said clutch, and mechanism actuated by the worm-operating shaft for disengaging said clutch, substantially as set forth.

32. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and connected to both of them, a movable shaft connected to the other sector, a curved rack connected to said movable shaft, a worm engaging said rack, a worm-operating shaft for said worm, a clutch on the driving-shaft of the prime motor, connections between said clutch and the worm-operating shaft, manually-operated devices for actuating said clutch, a worm on the worm-operating shaft, a nut on the latter worm, and connections between said nut and the manually-operated devices for disengaging said clutch, substantially as set forth.

33. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and connected to both of them, a movable shaft connected to the other sector, a curved rack connected to said movable shaft, a worm engaging said rack, a worm-operating shaft 45 connected to said worm, a clutch on the driving-shaft of the prime motor, connections between said clutch and the shaft 45 for driving the latter in opposite directions, a lever for operating said clutch, a worm 71 on the shaft 45, a nut 70 engaging said worm and connected to said lever, and a manually-operated device connected to said lever, substantially as set forth.

34. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and connected to both of them, a movable shaft connected to the other sector, a curved rack connected to said movable shaft, a worm engaging said rack, a worm-operating shaft 45 connected to said worm, a clutch on the driving-shaft of the prime motor, connections between said clutch and the shaft 45 for driving the latter in opposite directions, a lever for operating said clutch, a worm 71 on the shaft 45, a nut 70 engaging said worm and connected to said lever, manually-operated devices connected to said lever, and a yielding connection between said manually-operated devices and said lever, substantially as set forth.

35. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, and comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and connected to both of them, a movable shaft connected to the other sector, a toothed rack connected to said movable shaft, a worm engaging said rack, a shaft 45 for operating said worm, clutch-collars 55, 56 with connections to the shaft 45 for driving the shaft in opposite directions, a clutch working between said clutch-collars for engaging with either of the same, a lever connected to said clutch, a sleeve 62 connected to said lever, a worm 71 on the shaft 45, a nut 70 engaging said worm and connected with said lever, a hand oper-

ating-lever 72, and connections between said hand operating-lever and the sleeve 62, substantially as set forth.

36. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and connected to both of them, a movable shaft connected to the other sector, a toothed rack connected to said movable shaft, a worm engaging said rack, a shaft 45 for operating said worm, clutch-collars 55, 56 with connections to the shaft 45 for driving the shaft in opposite directions, a clutch working between said clutch-collars for engaging with either of the same, a lever connected to said clutch, a sleeve 62 connected to said lever, a worm 71 on the shaft 45, a nut 70 engaging said worm and connected with said lever, a hand operating-lever 72, and a yielding connection between said hand operating-lever 72 and the sleeve 62, substantially as set forth.

37. In mechanism for driving a vehicle, the combination of a liquid-motor connected to the vehicle-shaft, a prime motor, and a variable-feed pump interposed between said prime motor and said liquid-motor and pumping liquid to the said motor, comprising a spherical casing, two sectors therein with one of which the prime motor connects, a piston in said casing between said sectors and connected to both of them, a movable shaft connected to the other sector, a toothed rack connected to said movable shaft, a worm engaging said rack, a shaft 45 for operating said worm, clutch-collars 55, 56 with connections to the shaft 45 for driving the shaft in opposite directions, a clutch working between said clutch-collars for engaging with either of the same, a lever connected to said clutch, a sleeve 62 connected to said lever, a worm 71 on the shaft 45, a nut 70 engaging said worm and connected with said lever, a hand operating-lever 72, a rod 63 connected with said hand operating-lever, and engaging said sleeve, and springs on both sides of said sleeve connected to said rod, substantially as set forth.

38. In an automobile vehicle, the combination of the driving-shaft thereof, a prime motor, connections between said driving-shaft and motor, means for increasing and decreasing the speed of said driving-shaft, a hand-operated lever controlling the said means, whereby changes in the speed of said driving-shaft will be effected, and independent means for arresting said speed changes when a speed is reached which has been predetermined by the position to which said hand-operated lever is moved in effecting the control of the increase or decrease in the speed, substantially as set forth.

This specification signed and witnessed this 4th day of May, 1897.

FRANK L. DYER.
LEONARD HUNTRESS DYER.

Witnesses:
ARCHIE G. REESE,
L. DELLA MCGIRR.