(No Model.)

4 Sheets—Sheet 1.

E. F. PIERS.

ENGINE FOR DRIVING TRAMWAY CARS.

No. 606,081. Patented June 21, 1898.

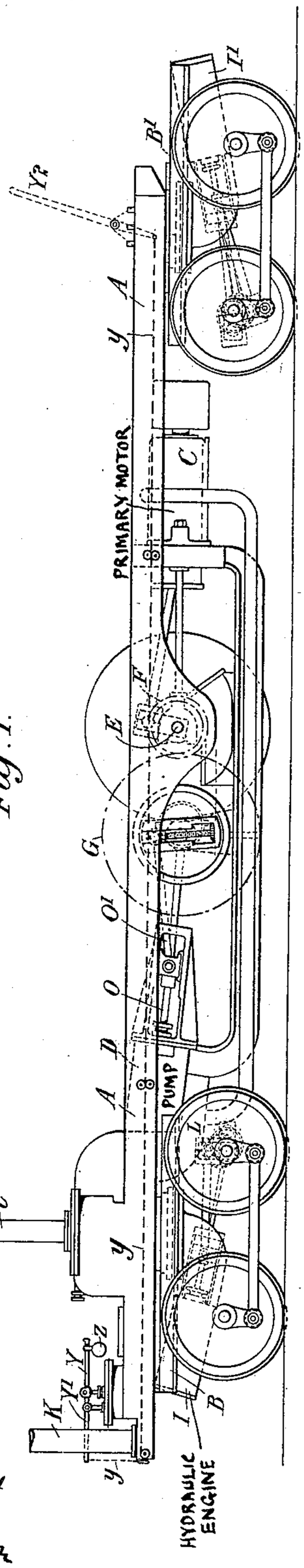

Fig. 1.

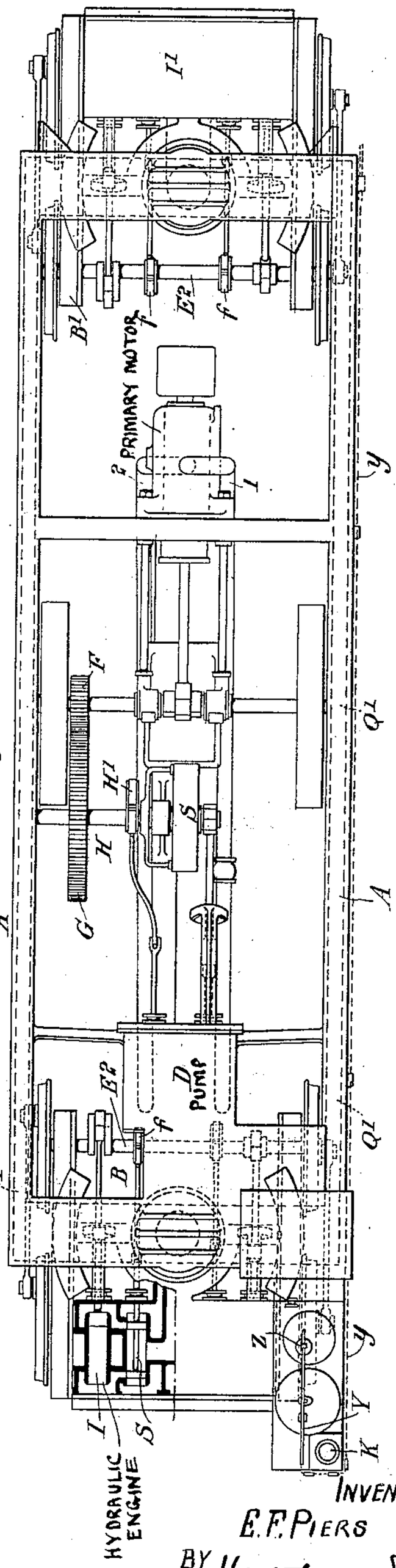

Fig. 2.

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Fig. 3.

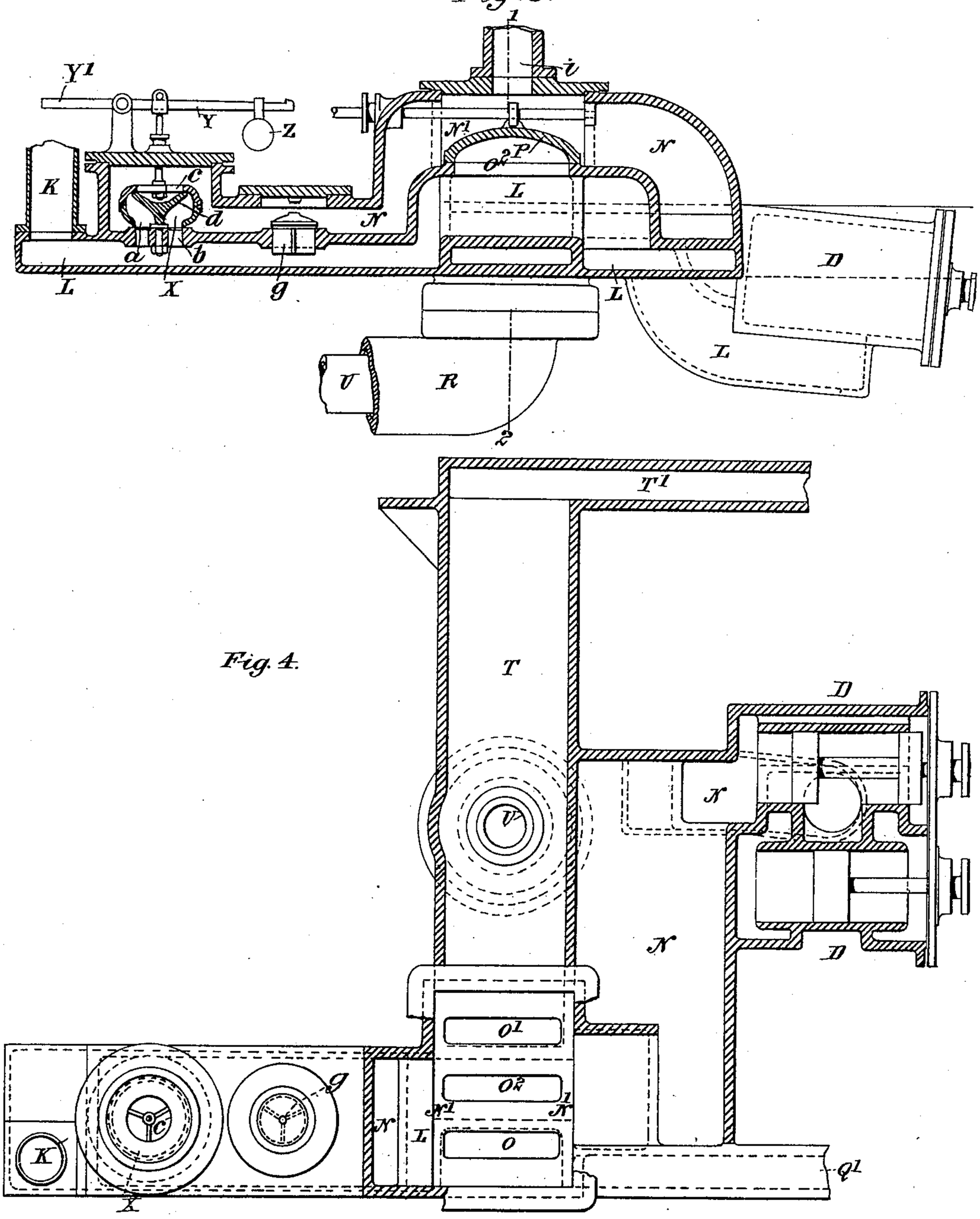

Fig. 4.

Witnesses.
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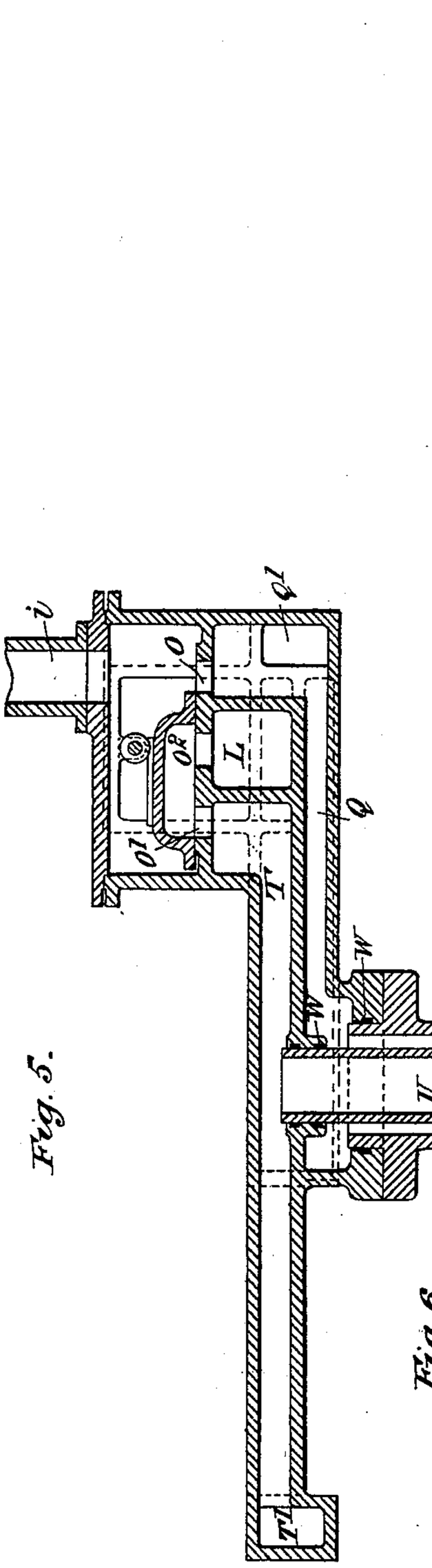

Fig. 5.

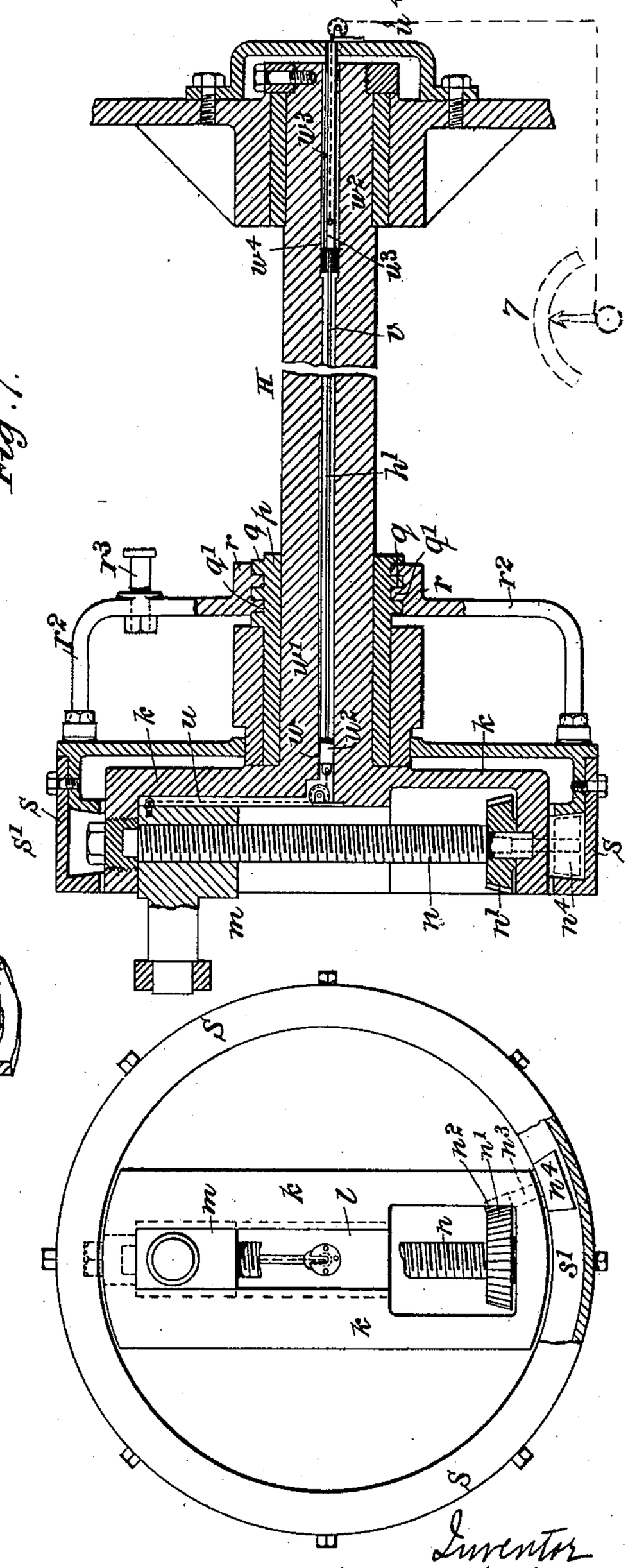

Fig. 7.

Fig. 6.

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FIG. 9.

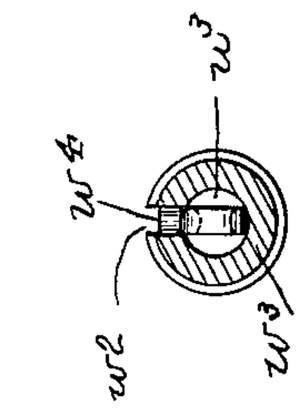


FIG. 8.

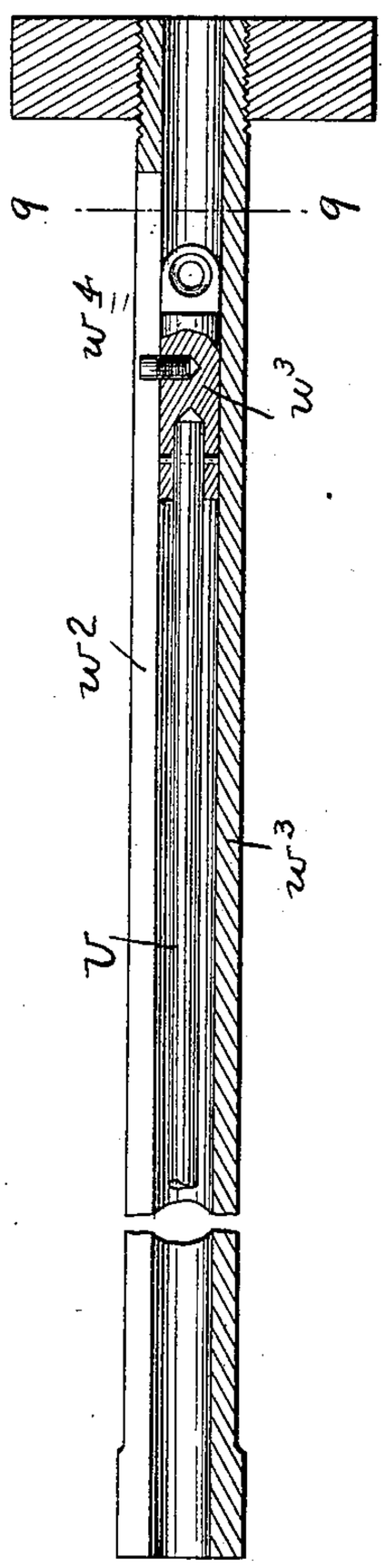


FIG. 10.

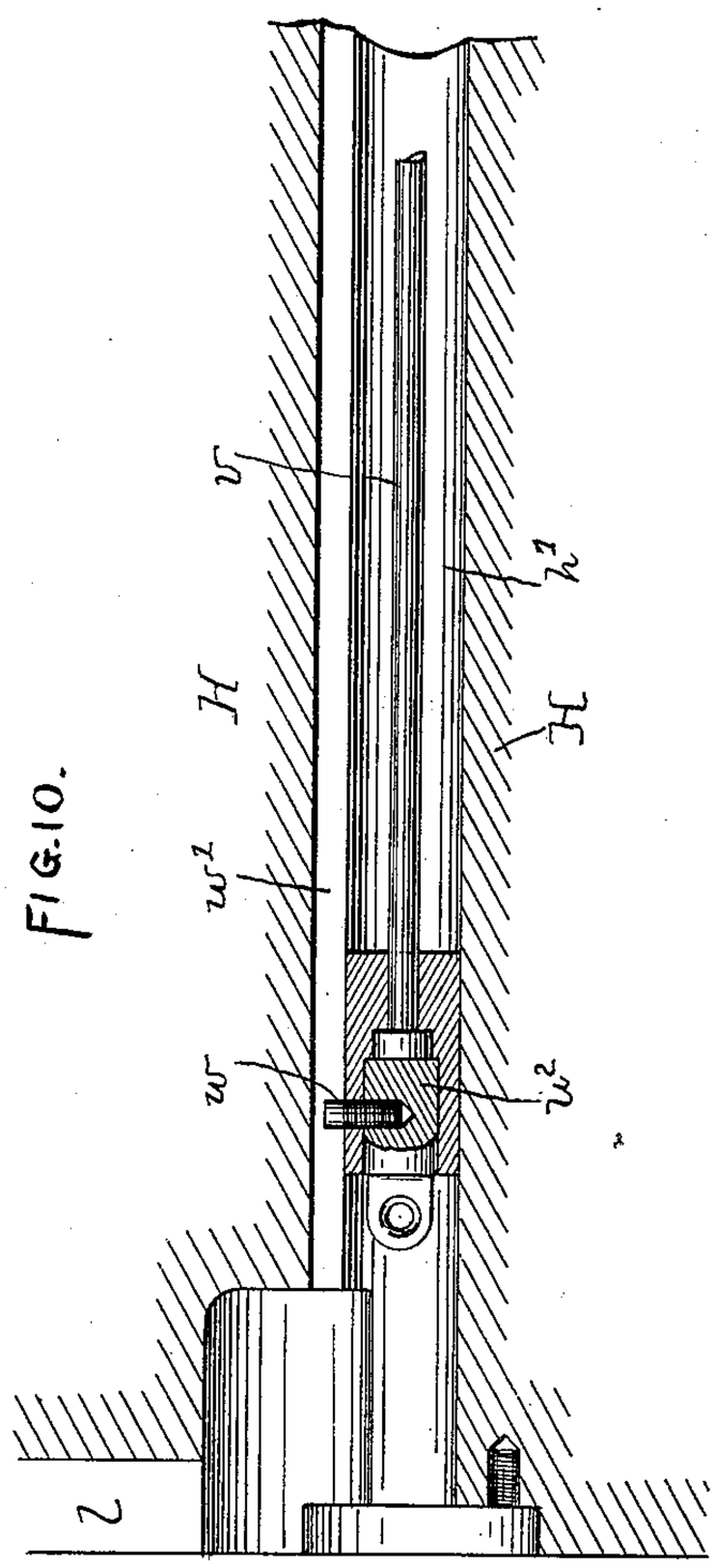
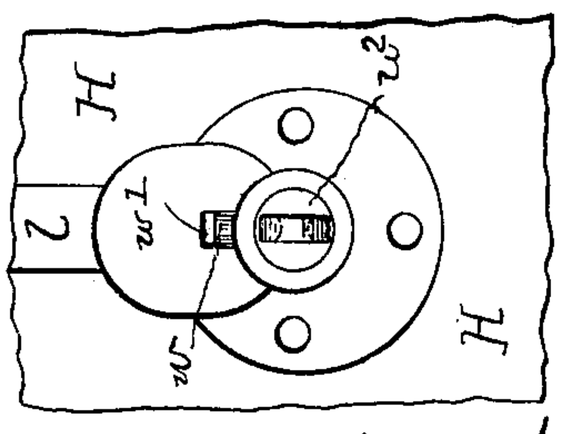


FIG. 11.



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UNITED STATES PATENT OFFICE.

EUSTACE F. PIERS, OF LONDON, ENGLAND.

ENGINE FOR DRIVING TRAMWAY-CARS.

SPECIFICATION forming part of Letters Patent No. 606,081, dated June 21, 1898.

Application filed March 17, 1896. Serial No. 583,612. (No model.)

To all whom it may concern:

Be it known that I, EUSTACE FITZ-MAURICE PIERS, baronet, mechanical engineer, a subject of the Queen of Great Britain and Ireland, residing at 21 Lime street, in the city of London, England, have invented certain Improvements in Connection with Engines for Driving Tramway-Cars and other Vehicles, of which the following is a specification.

My invention relates to improvements in connection with motive-power engines for driving tramway-cars and other vehicles; and it consists of a combination and arrangement of apparatus hereinafter described whereby the starting and stopping of the vehicle can be readily effected by means of a valve under the control of the driver, means being also provided for varying the speed as desired. The combination also comprises a bogie or bogies, on which the body of the vehicle is mounted to facilitate the passage of the vehicle around curves, and an arrangement of passages through the axis or axes of the bogie or bogies, through which the motive fluid passes to and from the motor or motors, by which motion is given to the vehicle.

I will describe my invention with reference to the accompanying drawings, which represent it as applied to a tramway-car, from which its application to other vehicles will also be readily understood.

Figure 1 represents in side elevation the lower portion of the car. Fig. 2 is a plan of the same, partly in section. Fig. 3 shows in sectional elevation the passages for the motive fluid and the arrangement of the valves and pump. Fig. 4 is a horizontal section of the same. Fig. 5 is a vertical section on the line 1 2, Fig. 3. Fig. 6 is an end elevation of the speed-regulating device, and Fig. 7 is a longitudinal section thereof. Fig. 8 is an enlarged view of a portion of the right-hand end of Fig. 7. Fig. 9 is a section on line 9 9 of Fig. 7. Fig. 10 is an enlarged view of a portion of the left-hand end of Fig. 7, and Fig. 11 is an end view of Fig. 10.

A is the framing on which the body of the car is built and which is mounted on bogies B B′ to facilitate the passage of the car around curves.

In any suitable part of the car, but preferably beneath the floor and bolted to the framing A, is a primary motor C, which is preferably a gas or oil engine, for working a pump D, formed in one with or bolted to the framing A.

E is the crank-shaft, driven by the motor C, the said shaft being mounted in bearings on the framing A and carrying a pinion F, gearing with a spur-wheel G on a second crank-shaft H, also mounted in bearings on the frame A, which shaft H operates, by means of an eccentric H′, the valve-rod of the pump D. This shaft is provided with an arrangement of mechanism for altering the stroke of the pump, as hereinafter described.

Each bogie B B′ carries a pair of hydraulic engines I I′, into which water is pumped under pressure by the pump D, the said pump drawing water from the chamber K, which may constitute a tank or communicate with a tank or other source of supply. The water from the tank passes to the pump by the passage L, Figs. 3 and 4, and is forced by the pump through the passage N into a box or chamber N′, containing ports or passages O O′ O^2 and a D slide-valve P, under the control of the driver to conduct the water to the hydraulic cylinders through either the port O or O′, according to the direction in which the vehicle is required to travel. The port O communicates by a passage Q and pipe R with the valve-boxes S of the hydraulic engines I and by the passage Q′ and a pipe corresponding to the pipe R with the valve-box of the hydraulic engines I′. The port O′ in the valve box or chamber N communicates by the passage T and pipe V with the valve-boxes of the hydraulic engines I and also by the passage T′ and a pipe corresponding to the pipe V with the valve-boxes of the hydraulic engines I′. The port O^2 communicates with a passage L, through which the pump D is supplied. It will thus be seen that by a simple movement of the D-valve P the port O or O′ can be made to communicate with the port O^2 and so reverse the motion of the hydraulic engines to propel the vehicle in either direction, as required. The pipes R and V are arranged concentrically one within the other and pass through the axes of the bogies B B′ to the hydraulic engines, the said pipes being provided with stuffing-boxes or cup-leathers, as shown at

W, to permit of the movement of the bogies on their axes.

In the partition which divides the passages L and N is provided an equilibrium-valve X, preferably of the Cornish type, and to this valve is connected a lever Y, provided with an adjustable weight Z, by means of which the pressure at which the hydraulic engines are required to work may be regulated. This valve is constructed so that the area of the part *a* which rests on the seat *b* is greater than the area of the part *c* which rests on the seat *d*, whereby when the pressure of the water on the under side of the valve exceeds that of the weighted lever Y, which tends to keep the valve on its seat will raise the said valve and allow the excess of pressure of water to pass into the passage L. The lever Y is provided with a handle Y′, convenient for the driver to operate, so that he can open the said valve and thereby allow the water to pass direct from the passage N into the passage L instead of allowing it to enter the hydraulic engines, thereby removing the motive power from the engines I and so retarding or stopping the car, while the motor C and pump D may continue to work. So soon as the driver releases the lever Y′ the valve X will close, and the water again coming under pressure and acting in the hydraulic engines restarts the vehicle. The lever Y can be operated from the opposite end of the car by any suitable means, for instance, as shown in Figs. 1 and 2. The lever Y is connected by a chain or cord *y* to a lever Y^2, by means of which the controlling apparatus can be operated.

The valves of the hydraulic engines are preferably piston-valves and are worked by eccentrics *f* on the crank-shaft E^2, to which the piston-rods of the hydraulic engines are connected.

In the partition which divides the water-passages N and L there is provided a valve *g*, which valve, in the case of the hydraulic engines tending to race from any cause—for instance, in descending an incline—so as to cause the volume of water supplied to the engines by the pump to be less than the volume swept out of the engines by their pistons, the said valve opens and admits water from the passage L to make up the deficiency. An air-chamber *i* communicates with the passage N to maintain pressure on the pistons of the hydraulic engines.

The gas or oil engine is surrounded by a water-jacket connected by pipes 1 and 2 with the suction-passage of the pump D, so as to cause the water to circulate through the water-jacket to keep the engine cool, the water being drawn from the jacket by the pump D through the pipe 2 and the pipe 1 being provided, if desired, with a valve which will admit water to the jacket, but prevent it from returning by the said pipe to the suction-passage of the pump.

To regulate the stroke of the pump-piston and so adjust the speed of the car, there is provided on the shaft H, which is driven from the crank-shaft E of the gas-engine, a frame *k*, Figs. 6 and 7, provided with guides *l*, in or on which is fitted to slide a block *m*, the position of which block with reference to the axis of the shaft H can be adjusted by means of a screw *n*, working in a corresponding screw-thread on the block *m* and carrying a bevel-wheel *n′* in gear with a pinion n^2 on a shaft or spindle n^3, mounted in a bearing in the frame *k*. To the block *m* is connected the piston-rod *o* of the pump D, so that by adjusting the position of this block nearer to or farther from the axis of the shaft H the stroke of the pump-piston will be correspondingly shortened or lengthened, and so vary the pressure of the water. To adjust the position of the block *m*, there is provided on the brass or bushing *p* in the pedestal which supports one end of the shaft H a screw-thread *q*, with which engages a corresponding screw-thread *q′*, formed in a ring *r*, connected by arms r^2 to a hood *s* or casing for the frame *k*. This hood or casing has in the interior an annular groove *s′*, in which runs a wheel n^4, carried on the spindle n^3, hereinbefore referred to. To one of the arms r^2 is connected at r^3 a rod which can be operated by the driver so as to impart to the hood or casing *s* a motion of partial rotation, and thereby in consequence of the engagement of the screws *q* and *q′* cause the said hood to move longitudinally on the bushing *p* and bring one or other of the sides of the annular groove *s′* into contact with the wheel n^4, and thereby rotate through the gearing $n′\ n^2$ the screw *n* and so traverse the block *m* nearer to or farther from the axis of the shaft H, and thus shorten or lengthen the stroke of the pump, and consequently alter the speed of the vehicle according to which side of the annular groove *s′* is brought into contact with the wheel n^4.

To the adjustable block *m* there is connected one end of a cord or chain *u*, the other end of which cord or chain is attached to a swiveled carrier u^2, Figs. 10 and 11, fitted to slide in a passage *h′*, formed longitudinally through the center of the shaft H. The carrier is connected by a rod *v*, Figs. 8 and 10, to another carrier u^3, to which is connected one end of another cord or chain u^4, Fig. 7, the other end of which cord or chain is connected to a pointer or indicator 7, as shown in dotted lines in Fig. 7, in view of the driver to show the speed at which the vehicle is traveling.

The rod *v* is connected to the carrier u^2 in such a manner as to admit of the said carrier rotating with the shaft H without causing the rod *v* and the carrier u^3 to rotate. The carrier u^2 is caused to rotate with the shaft H by a stud *w*, Fig. 10, projecting from the said carrier and engaging in a longitudinal groove *w′*, formed in the passage *h′*. The carrier u^3 is prevented from rotating with the shaft H by a stud or projection w^4, Figs. 8 and 9, on the said carrier engaging in a slot w^2 in a tube

w^3, fitted in the passage h' in the shaft H, on which tube the shaft rotates and in which tube the said carrier u^3 can slide longitudinally. By this arrangement the chains or cords u and u^4 are prevented from twisting.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In motive-power engines for driving tram-cars and other vehicles, the combination of a primary motor and a pump driven thereby, with a bogie carrying a hydraulic engine and provided with communicating passages between the pump and the hydraulic engine, and through the center of the bogie and a valve in the said passages under the control of the driver for controlling the flow of liquid to the hydraulic engine, all substantially as hereinbefore described.

2. In apparatus for starting, driving, regulating the speed, and reversing the motion of tramway-cars and other vehicles, the combination of a gas or oil engine, a pump operated thereby, a hydraulic engine supplied with water by the pump, a supply-tank, and connecting-passages, with a self-acting valve connecting the passage leading from the reservoir to the pump to the passage connecting the pump to the engine, and in the event of the hydraulic engine racing and thereby requiring more water than that supplied by the pump or pumps adapted to open and admit water from the supply-tank to make up the deficiency, substantially as hereinbefore described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

E. F. PIERS.

Witnesses:
WILLIAM F. UPTON,
RUDOLPH CHAS. NICKOL.