(No Model.) 2 Sheets—Sheet 1.

# W. E. PRALL.

## STREET CAR MOTOR.

No. 457,792. Patented Aug. 18, 1891.

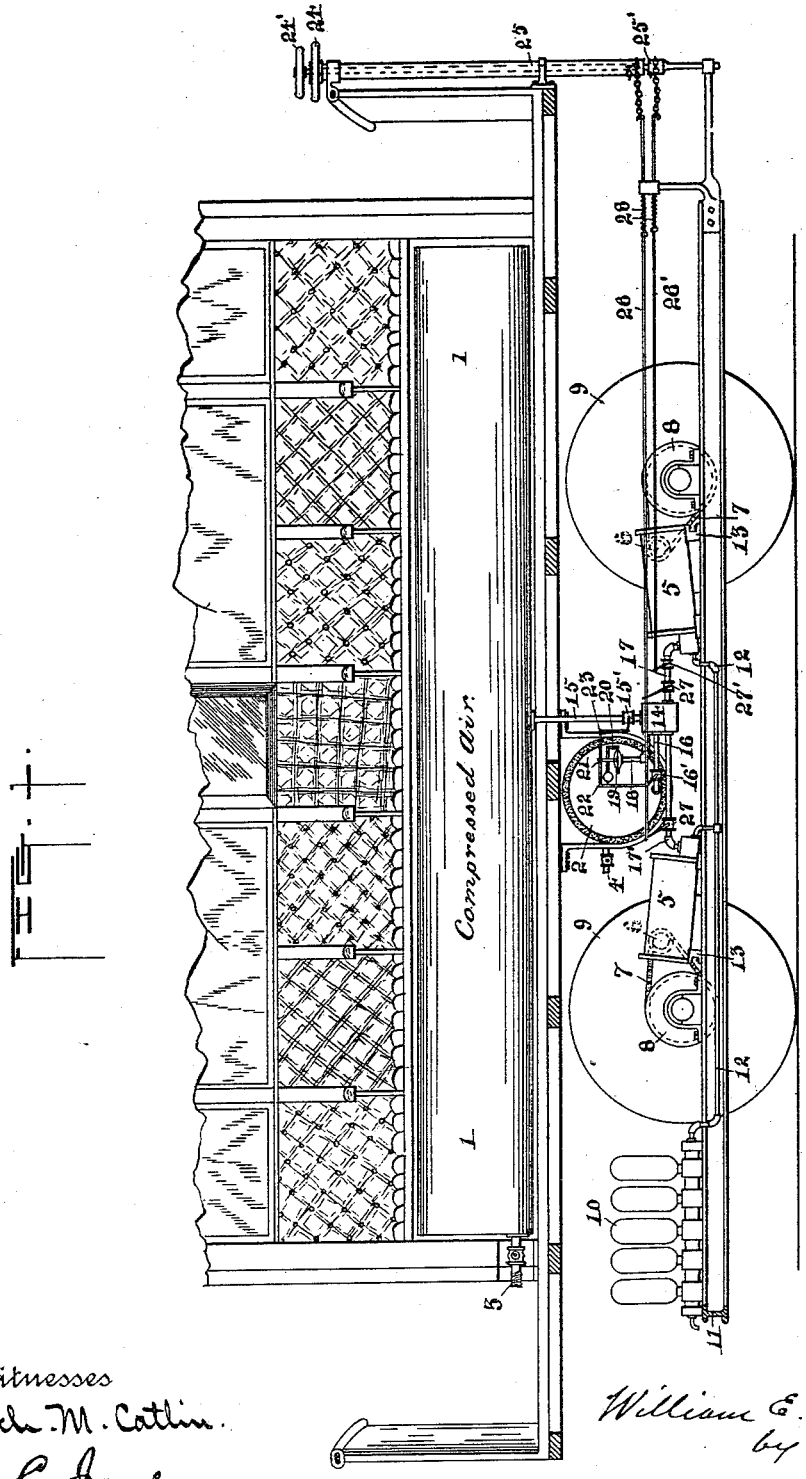


Fig. 1.

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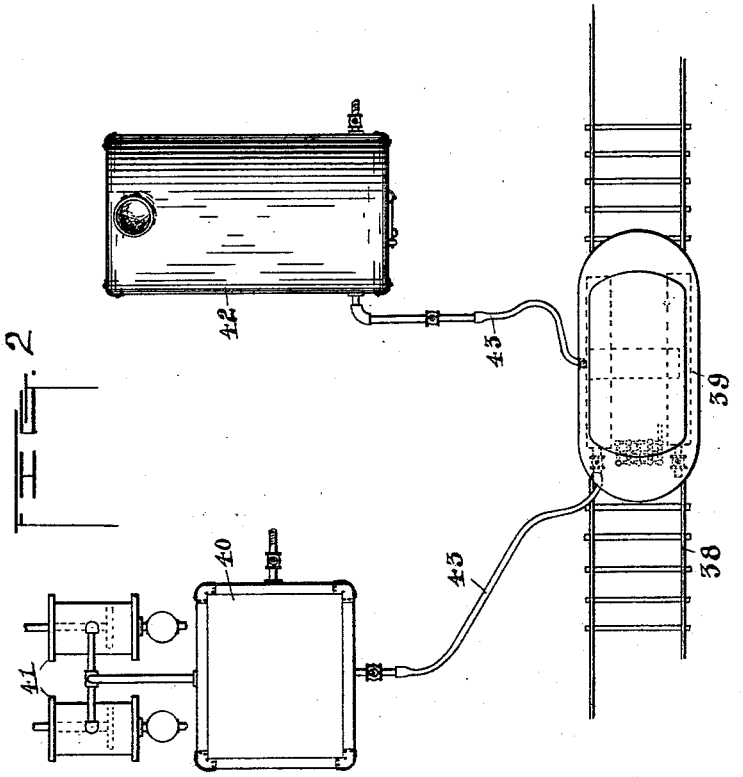


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# UNITED STATES PATENT OFFICE.

WILLIAM EDGAR PRALL, OF WASHINGTON, DISTRICT OF COLUMBIA.

## STREET-CAR MOTOR.

SPECIFICATION forming part of Letters Patent No. 457,792, dated August 18, 1891.

Application filed March 11, 1891. Serial No. 384,603. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM EDGAR PRALL, a resident of Washington, in the District of Columbia, have invented certain new and useful Improvements in Street-Car Motors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

The object of the invention is to provide means for using compressed air and highly-heated water for moving a car, or for like purposes, that shall be adapted both for light and heavy work, and relates to the combination of two engines, a tank for compressed air, a hot-water-storage tank, a condenser, and subsidiary devices; and the invention consists in the matter hereinafter described and pointed out.

Figure 1 of the drawings is a partial longitudinal section of a car with the improvements applied thereto, and Fig. 2 is a diagrammatic view of stationary supply-tanks and car with portable tanks and a condenser.

Numeral 1 represents a tank for compressed air, and 2 a tank for highly-heated water. The latter and the water-pipes are thoroughly protected against loss of heat by radiation.

3 and 4 indicate their respective charging-inlets.

5 indicates one of two engines, having each a sprocket-wheel 6, driven thereby, and 7 denotes chains for transmitting power to the sprocket-wheel 8, which has a fixed connection with the car-wheel 9.

A steam-condenser is indicated by 10.

11 indicates one of two or more rails or bars fixed to the car-body and adapted to support the engines, water-tank, and other devices.

The engines are provided with valve-chests on the lower side of the end, and 12 denotes their respective exhaust-pipes leading to the condenser. The end of each engine opposite to its valve-chest is raised by a support 13, which facilitates the discharge of water from the water-chest and also receives, in part, the pull of the chain.

14 denotes a receiver, communicating with the air-tank by a pipe 15, having a cock 15′, and with the water-tank by a pipe 16, having a cock 16′. Pipes 17 and 17′ also connect its interior with the valve-chests of the respective engines.

18 is a pipe communicating with the interior of the receptable or receiver 14 and with the space below the flexible diaphragm 19. The diaphragm-chamber supports a small post 20, and 21 is a post attached centrally to the diaphragm and made to act as a point of application of power for a lever 22, which is pivotally connected to said post and on which is an adjustable weight. A frame 23 is also attached to the post 21 or to the lever. It has two depending arms loosely connected with crank-arms on the cock-plugs, the arrangement being such that the rise or fall of the diaphragm under variations of pressure in the receiver 14 will raise and lower the frame and turn the cocks. By this means the flow of air and water to the receiver is automatically regulated.

24 is a hand-wheel, and 25 a vertical rod connected by a chain or strap with a horizontal connecting-rod 26 for operating cocks 27 in the pipes 17 and 17′, connecting the receiver and the engines.

24′ is a second wheel, and 25′ and 26′ intermediate rods having suitable chain connection for operating a cock 27′ in pipe 17′. The rods 26 and 26′ are moved in one direction by springs 28. The valve 27′ is normally closed, and the opening of both valves 27 will supply steam to but one engine, except when valve 27′ is opened, as stated.

The condenser has, preferably, a surface of textile or equivalent material through which air from the engines can escape, and which will condense in its interstices steam and vapor, a suitable receptacle and discharge for water being provided at the lower part of said condenser.

The water in the tank is heated, preferably, to or above 400° Fahrenheit and the air compressed to any desired practicable extent.

In operation compressed air and water are admitted into the receiver 14 from their respective holders and conveyed in a mingled condition to one or both engines, as desired. The hot water will increase the tension of the air and lubricate the engine, and the expansion of the air and the conversion of the hot water into steam in the engine-cylinder will

drive the same. If sufficient air be expanded, it will entirely absorb the heat of the water or steam. If such expansion in the engine and in the exhaust is not sufficient for the purpose, the effect will be secured in the condenser.

When the grade is very easy or the load light, one engine can be used alone, or both may be employed when required.

The regulator connected with the receiver can be adjusted to close or partially close the cocks in the air and water supply pipes at any desired pressure to diminish or increase the supply of water and air.

The application of power to both axles is highly desirable with a heavy load or steep grade.

It will be understood that tanks in any desired number and form may be employed; but the invention contemplates the use of a water tank or tanks of sufficient capacity to contain water in quantity sufficient to drive a car or like vehicle for a trip with the aid, if desired, of a comparatively small quantity of air (as compared with air-driven cars) and without the necessity of carrying a boiler. Gearing of other kinds than that described may be employed, and that the mechanical details generally may be varied as may be convenient, provided that substantially the same principles of operation and construction are employed.

In Fig. 2 is indicated a car-track 38 and a car 39, provided with air and hot-water tanks and condenser, the three latter being indicated by dotted lines. 40 is a stationary air-reservoir, and 41 an air-compressor connected therewith. 42 indicates a reservoir of hot water, which in the present case is represented as a boiler. It should be adapted to hold and supply water under a high pressure. 43 indicates flexible connecting-pipes, by means of which the respective tanks on the car can be charged with air under pressure and with highly-heated water. These reservoirs are stationary and located at convenient intervals near the car-track. In some cases they may be provided at one point only, the car-route being short. In others they may be provided at two or more points, according to the length of the route and the work required.

In all cases it is important that the water tank and pipes be thoroughly defended against loss of heat by radiation, since their rapid movement through the air will dissipate a large amount of heat if the highly-heated reservoirs be not protected. It is also of special importance that efficient condensers be employed to prevent the discharge into the air of a large amount of steam and vapor. For this purpose a condenser having a wall of fibrous material, such as described in my application, Serial No. 380,175, filed February 4, 1891, is preferable, the vapor being condensed in the condenser or in its fibrous wall and the air allowed to freely escape.

I do not herein claim the combination of a condenser, air-tank, protected water-tank, and engine, all located on and carried with the car, and stationary supply-tanks, the combination being such that air is merely heated by the water, which is not itself introduced into the engine-cylinder, that being the subject of an application filed February 4, 1891, by me and serially numbered 380,175.

Having thus described my invention, what I desire to secure by Letters Patent is—

1. The combination of the hot-water-storage tank supplied with highly-heated water under pressure in sufficient quantity to drive the car or other vehicle for a trip, all as specified, said tank being disconnected from a source of heat and adapted to be carried on the vehicle, two engines, pipes connecting said tank and the valve-chests of the engines, cocks in said pipes, and devices whereby the cocks in one or both pipes can be opened or closed at will to run one or both engines, substantially as set forth.

2. The combination of the tanks for compressed air, the hot-water-storage tank, two engines, pipes connecting said tanks and the valve-chests of the engines, cocks in said pipes, and devices whereby the cocks in one or both pipes can be opened or closed at will to run one or both engines, substantially as set forth.

3. The combination of a tank for compressed air, a hot-water-storage tank, a receiver communicating by pipes with both tanks, and pipes communicating with the valve-chests of two engines, substantially as set forth.

4. The combination of a tank for compressed air, a hot-water-storage tank, a receiver communicating by pipes with both tanks, cocks in said pipes, a pressure-regulator communicating with a receiver, a device for connecting said regulator with the cocks, whereby they are automatically opened or closed by variations of pressure in the receiver, and pipes communicating with the valve-chests of two engines, substantially as set forth.

5. In a car, the combination of a tank for compressed air, a hot-water-storage tank, two engines, each geared to turn a separate axle, a condenser having a condensing-wall that will permit the escape of air, and pipes to exhaust from the engines into the condenser, substantially as set forth.

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

WILLIAM EDGAR PRALL.

Witnesses:
BENJ. R. CATLIN,
ARCH. M. CATLIN.