(No Model.)

4 Sheets—Sheet 1.

J. H. ELWARD.

STREET CAR MOTOR.

No. 552,109. Patented Dec. 31, 1895.

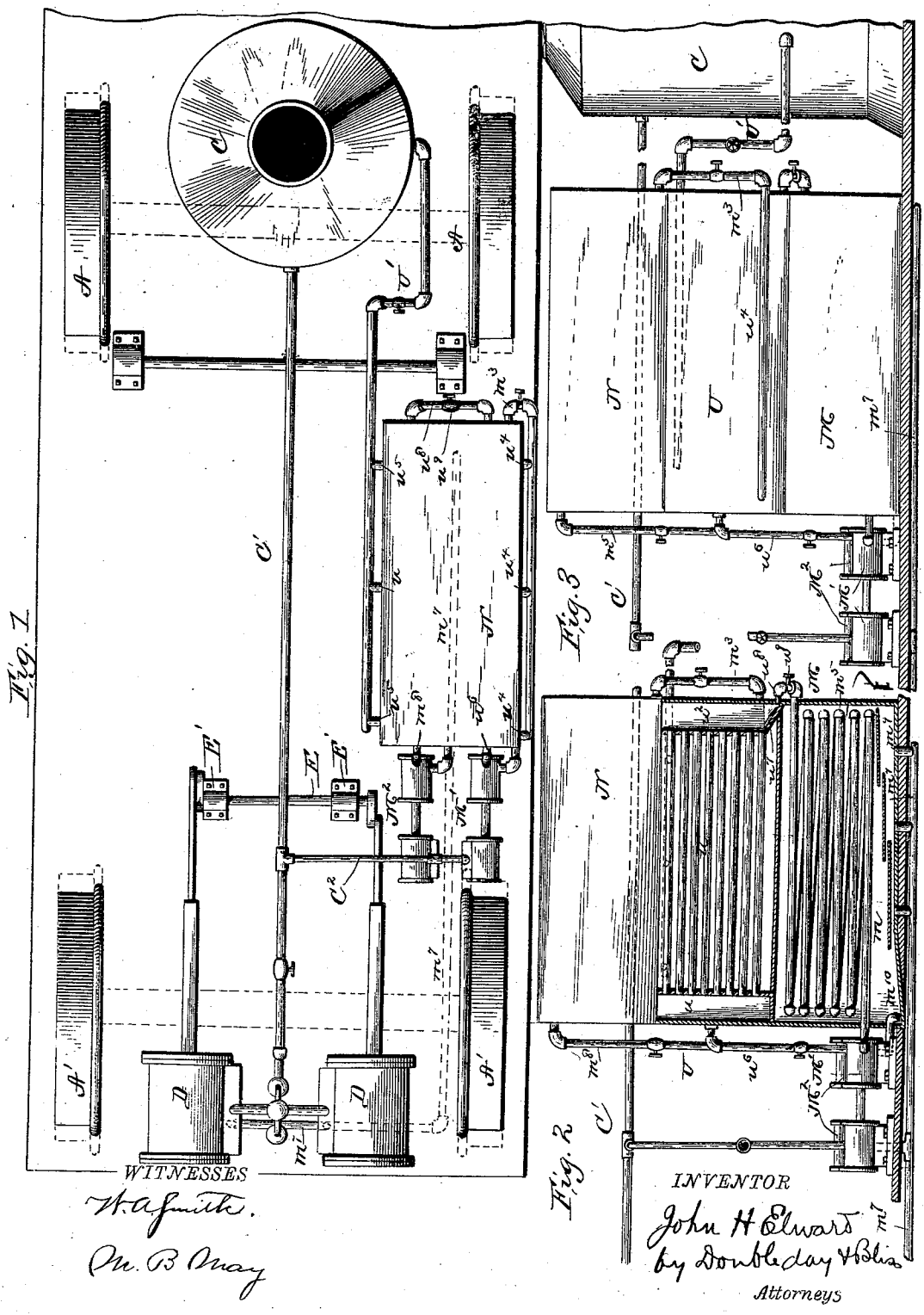

Fig. 1

Fig. 3

Fig. 2

WITNESSES

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(No Model.) 4 Sheets—Sheet 2.

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Fig 4

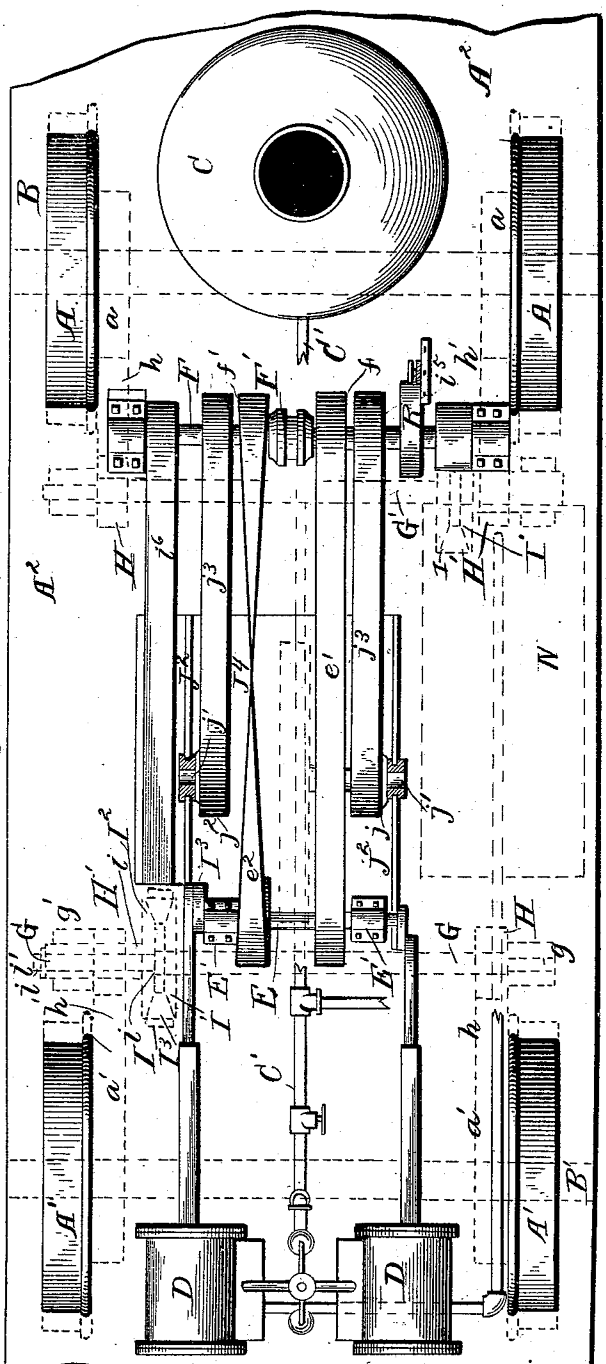
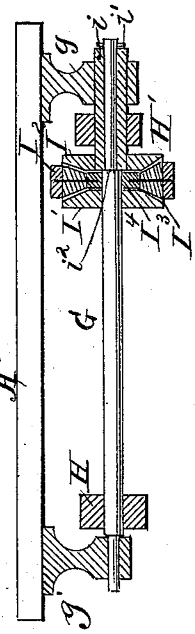


Fig 11



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(No Model.) 4 Sheets—Sheet 3.

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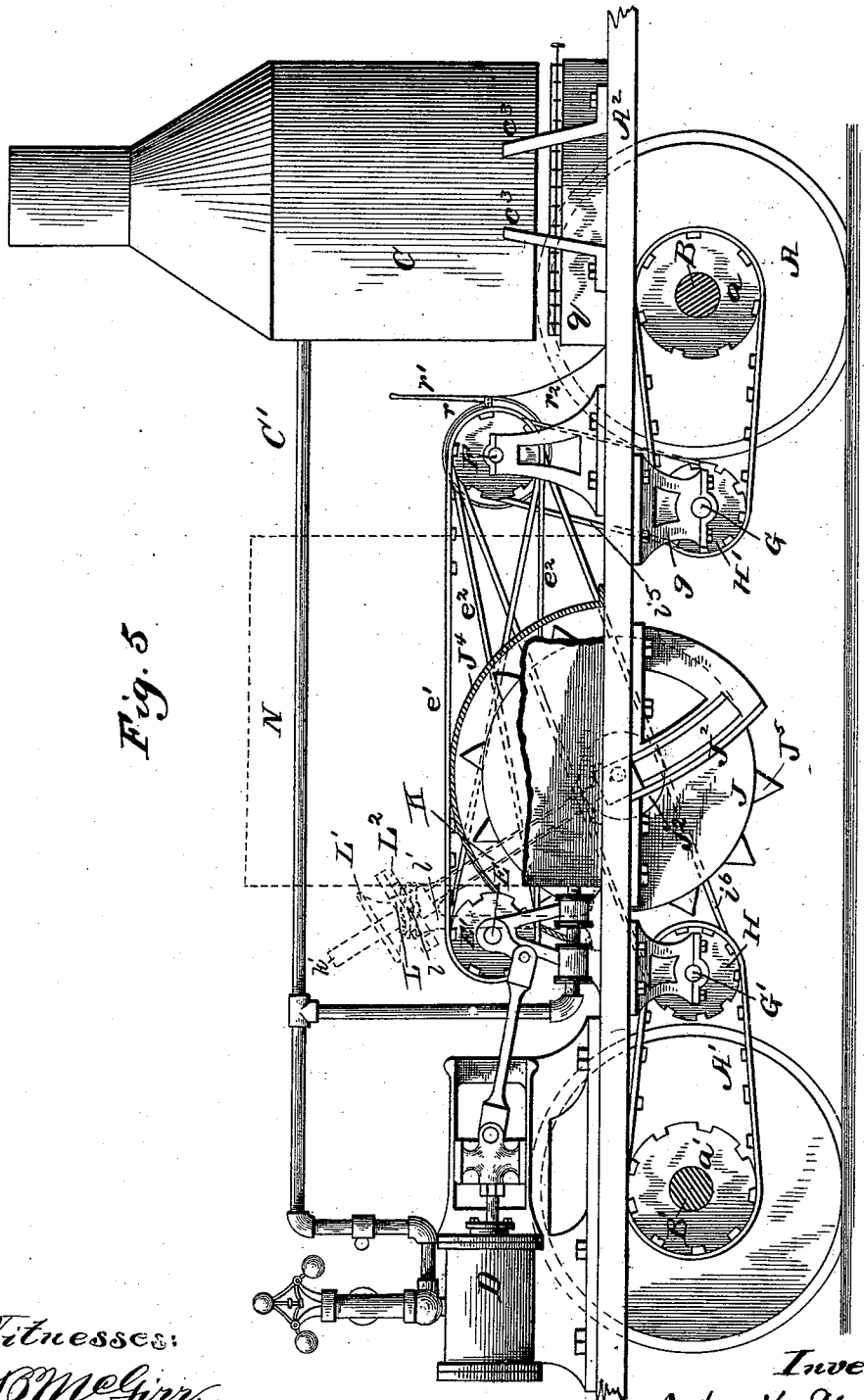

Fig. 5

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(No Model.) 4 Sheets—Sheet 4.

J. H. ELWARD.

STREET CAR MOTOR.

No. 552,109. Patented Dec. 31, 1895.

Fig 6.

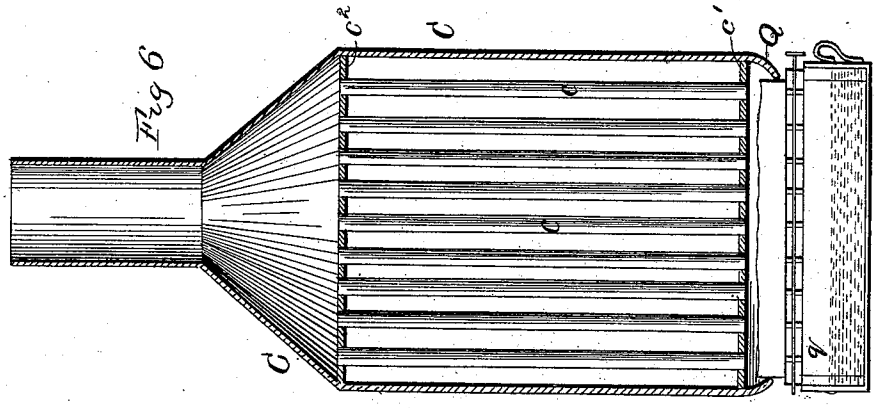


Fig 10

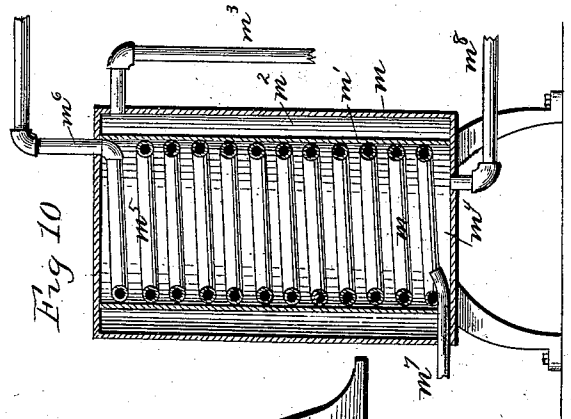


Fig 7.

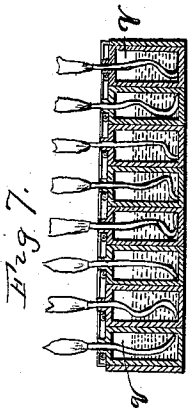


Fig 8

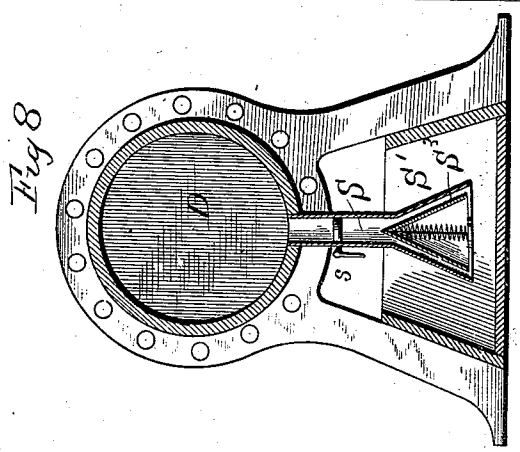
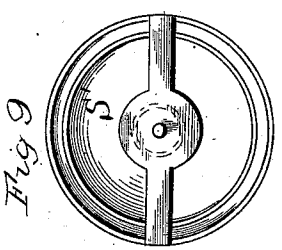


Fig 9



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UNITED STATES PATENT OFFICE.

JOHN H. ELWARD, OF WHITEWATER, WISCONSIN.

STREET-CAR MOTOR.

SPECIFICATION forming part of Letters Patent No. 552,109, dated December 31, 1895.

Original application filed December 23, 1887, Serial No. 258,846. Divided and this application filed April 30, 1890. Serial No. 350,103. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. ELWARD, a citizen of the United States, residing at Whitewater, in the county of Walworth and State of Wisconsin, have invented certain new and useful Improvements in Street-Car Motors, of which the following is a specification, reference being had therein to the accompanying drawings.

Figure 1 is a plan of a car or motor adapted to contain my improvements. Fig. 2 is a vertical section of the water-tank and condensing apparatus. Fig. 3 is a side view of said parts. Fig. 4 is a top plan view showing the parts by which the power is applied. Fig. 5 is a side elevation showing the same. Fig. 6 is a vertical section of the boiler. Fig. 7 is a transverse section of the heater. Fig. 8 is a vertical section of one of the engine-cylinders, showing the devices for receiving the drip. Fig. 9 is a bottom plan view of the valve for the drip devices. Fig. 10 is a vertical section of a modified condenser. Fig. 11 shows one of the lower shafts detached.

In the drawings I have shown the power mechanism and the power-transmitting devices as being all arranged on a car more or less specially intended for carrying them—that is to say, one adapted to operate as a locomotive for one or more other cars; but it will be understood that more or less of the parts so shown can be situated on a car intended for the purposes of carriage.

As shown, a platform or main frame is provided, it being represented as a whole by A^2, and to it are secured bearings of any suitable character. The axles are represented by B B'. Upon these are mounted the wheels A A', these being loose on the axles and therefore independent of each other. Each wheel A A' has an outwardly-extending hub a a' formed with it, or a wheel equivalent thereto can be connected therewith.

Power generating and transmitting devices are constructed and arranged as follows.

C represents a boiler which is heated by means of oil-lamps, the latter and the boiler to be hereinafter described more fully. The steam-chamber is by means of a pipe C' connected with one or more engine-cylinders D.

As shown, there are two cylinders arranged to balance each other in relation to the crank-shaft, which is shown at E, and which is mounted in suitable bearings E' secured to the platform and, if preferred, integral with the engine-frame. The crank-shaft E is by means of belts e' e^2 connected with a second shaft F, belt e' being adapted to drive said second shaft directly, while the belt e^2 is crossed so as to impart a reverse movement to the second shaft. The belt-pulleys f f' are loose on the second shaft, but are adapted to be engaged therewith by means of a clutch F', which, as shown in Fig. 4, is of a kind in which use is made of friction for effecting the engagement, the sliding and feathered part terminating in convex cones, which are adapted to engage with concave recesses in the face of the pulleys f f'. In this respect there can be more or less modification, although I prefer a friction-clutch in order to attain certain ends, which will be fully understood from the following description.

When the clutch is in engagement with the pulley f, the movement of the driven parts is such that the car advances in one direction; but if the clutch be slipped into engagement with the other pulley f' the movement of the vehicle will be in the opposite direction. The power is not taken directly to the ground or track wheels in the ordinary manner; but I have devised a construction and arrangement of parts by which the wheels shall be driven either together or independently one of the other, the first application of the power being advantageous when the resistance to both the ground or track wheels of either pair is the same and the latter application of the power being desirable when there is a difference between the resistance to the movement of one wheel and that to the motion of the other.

G represents a third shaft mounted upon the car preferably parallel to the shaft E and below the platform. The situation, however, of this shaft in either of these respects can be varied. That shown is desirable, as power can be taken conveniently by ordinary belting from the second shaft, and moreover it (shaft G) can be so situated as not to occupy space desired for other parts.

The shaft G is mounted in bearings g g' and

is provided with two driving-pulleys H H′ and a receiving-pulley I, the shaft being virtually made in two independent parts so far as concerns the two driving-pulleys H H′. To attain this I prefer to apply a sleeve *i* to the shaft at one end and secure the pulley H′ to this sleeve, the sleeve being entirely free to rotate upon the shaft or to have the shaft rotate in it and being held from longitudinal movement by a pin, as at *i′*, and a shoulder at i^2. Then to apply the power to the shaft proper and to the sleeve, I employ a compensating-gear in immediate conjunction with the receiving-pulley I, which gear, as shown, comprises two oppositely-arranged bevel-wheels I′ I^2, one keyed to the shaft G and the other formed with or secured to the sleeve *i*, and between these places a suitable number of bevel-pinions I^3 which are pivotally connected to the receiving-pulley I, the latter being in this case virtually a ring secured to the outer ends of the pinions and corresponding to the flange of an ordinary pulley.

To properly support the bevel-pinions I^3 and the ring I, a ring or loose collar I^4 is loosely fitted to the shaft G and receiving the inner and outer ends of the pivot-screw which fastens the pinion, these parts I I^4 constituting the receiving-pulley.

When the ground or track wheels are equally resisted, the pinions I^3 are stationary relatively to the bevel-wheels I′ I^2, and they transmit power equally thereto. If the resistance to one wheel becomes greater than that to another, so that it tends to move slower, the pinions I^3 begin to revolve relatively to the wheels I′ I^2, and the greater part or all of the motion is transmitted to that wheel (I′ or I^2) which is meeting the least resistance. In this way the application of the power is effected in such manner that there is no cramping or binding of either wheel upon the track or the ground or in turning curves or corners.

The pulleys H H′ are connected by belts *h h′* to the hubs *a a′* of the wheels A. If desired the other track or ground wheels A′ can be also connected by belts to the shaft G; but I prefer to employ another shaft G′ with compensating-gear, the pulleys and gearing thereon being substantially similar to those already described in connection with the shaft G. The pulleys I of the compensating-gears are connected by belts i^5 i^6 to the second or clutch shaft F.

It is well known that motors of the class to which belongs the present machine are liable to be completely stopped either by the condition of the ground or of the track or by obstruction in the form of snow or ice, and in some localities during the winter motors of this class have to be laid aside. To overcome this I have devised and shown the following device: J represents a supplemental traction-wheel adapted to be put into and drawn out of engagement with the ground. It is preferably provided with spurs or teeth, as at J^5, to insure a grip upon the ground, as illustrated. Its shaft *j′* is mounted in a sliding bearing which is fitted to a curved guide J^2 fastened and braced to the platform. Upon the shaft *j′* one or more driving pulleys j^2 are placed, connected by belts j^3 with the second or clutch shaft F. The said guide J^2 is curved around the axis of said shaft F so that the belt will always preserve the same relation to the driving and the driven parts. The up-and-down throw of the wheel J should be sufficient to bring it high enough when lifted up to be out of the way of objects which may project up from the ground, and at the same time sufficient to allow it to swing down to get firm engagement with the ground. At J^4 there is a curb or cover which can be employed to inclose the upper part of this wheel, and, if desired, this may be extended below the car-platform far enough to cover the lower part when the wheel is out of operation.

To effect the movement of the wheel in the guide use may be made of any suitable means. I have shown a yoke K having legs pivotally connected to the shaft *j′*, and at the upper end united to a threaded rod *k′* which engages with a nut L. This nut can be rotated by a hand-wheel L′. It is held in place by a hinged support L^2 carried by trunnions *l* mounted in uprights *l′*. When the hand-wheel is turned in one direction, the wheel J is lowered and can pressed firmly against the ground. When the hand-wheel is turned in the opposite direction, the wheel J will be elevated, and with these parts any suitable lock can be combined to prevent the wheel from accidentally being lowered.

The bearings of the shaft *j′* are formed with the guide parts j^5, and with the bearings proper j^4 fitted to the guide. Above and below, if desired, are placed coiled springs j^6. These will yield to allow the bearings to move in either direction, if necessary, and overcome the complete rigidity with which wheel J would be held if they were not used.

By having the nut arranged to oscillate and by having the lower end of the legs *k* hinged to the bearings the screw-rod can adapt itself to the bearings notwithstanding the fact that they follow a curved path in falling and rising.

In order to avoid the escape of steam from the car I employ a condensing apparatus at M. As shown, it consists of a chamber *m* containing a coiled pipe m^5, which at the lower end is connected to a pump M′ adapted to compress ammonia. Above the chamber *m* there is a gas-receiving apparatus U having an initial chamber *u*, a set of pipes *u′* and a delivery-chamber u^2, said pipes *u′* communicating with both of said chambers. The chamber or compartment in which the pipes *u′* are situated is provided with water-orifices at the bottom communicating with one or more pipes u^4, which, by means of a pipe m^3, can be supplied with water from the tank N. The water escapes from said chamber through exit-pipes u^5 at the top, communicating through a pipe U′ with the boiler C.

The pump M′ is supplied in any suitable

way with ammonia, and the latter is thereby compressed and forced through pipes u^6 into chamber u and pipes u', where the heat is abstracted from it and it is reduced to liquid form. There is a constant circulation of water from the tank N through the chamber inclosing said pipes u', the water coming from the tank N. It passes thence, after becoming warm, through the pipes u^5 and U′ to the boiler. Thus the ammonia-cooling chamber becomes a feed-water heater for the boiler.

The ammonia in its condensed form is collected in a reservoir, as at u^7, from which it is drawn by a pipe u^8 and conducted to the coil m^5. At the stop-cock u^9 it is permitted to expand, and, according to its well-known mode of action, it produces a low temperature in chamber M.

The exhaust-steam from the engine at D is conducted through the pipes m^7 to the interior of the condensing-chamber m, there being entrances at m^9. This exhaust-steam is condensed in said chamber m, and the water of condensation is collected in any suitable receptacle, as at m^{10}, whence it is withdrawn by a pump, as at M^2, and forced through the pipe m^8 to the water-tank N.

It will be understood that there can be variations from the construction and relative arrangement of parts shown and that the water and ammonia may be caused to pass from one place to another by any mechanism adapted for the purpose. Instead of separate engines for operating the pumps M′ M^2 power may be taken from one part or another driven by the engines D D.

As shown, the auxiliary engines M′ M^2 receive steam through a feed-duct C^2 and have their exhausts connected with the main exhaust m^7, so that the steam can all be condensed.

If preferred, the ammonia-cooler U and the water-tank can be placed on the car-platform and the fluids can be caused by pumps to flow as desired.

An intermediate cooling medium, such as brine, can be employed to abstract the heat from the steam and be itself in turn cooled by ammonia; but I prefer the present direct application of the ammonia, as I thereby render the apparatus more compact and simple.

The brake which I employ for stopping the driven parts of the mechanism after the clutch is disengaged is represented at R, the one shown being an ordinary friction-brake consisting of a flexible metal band r, having its end secured to a lever r', mounted in a standard r^2. The lever is pivoted at a point between the ends of the band so that when the lever is pushed in one direction the band is caused to press against the periphery of the brake-wheel r^3. By this device the operator can either gradually or suddenly stop the movement of the driven parts. The clutch should be disengaged from both belt-pulleys connected with the engine-shaft, as aforesaid; but instead of this any well-known clutch adapted for this purpose can be employed.

It will be seen that in the drawings I have shown the power-transmitting devices as largely comprising rag wheels and belts with lags adapted to engage therewith, those being more nearly noiseless than either the ordinary gearing and shafting or the common form of metallic sprocket and chain; but it will be understood that in place of the transmitter-chain use may be made of any equivalent connecting devices between the aforesaid shafts.

A single compensating-gear shaft either as at G or G′ can be used. If but one set of compensating gearing devices are connected therewith, the wheels upon the right-hand side of the car can be both driven together, and yet be driven independently of those upon the other side; or two sets of compensating-gears can be mounted upon a single shaft by a proper arrangement of sleeves, such as will be readily understood by one skilled in such structures, whereby substantially the same driving of one wheel independently of the other can be attained as is provided for in the construction shown.

The supplemental vertically-adjustable wheel J is mounted as near the center of the whole apparatus as is practicable, so that when the vehicle is moving in a curved path this supplemental wheel shall be at the center of the arc of curvature of the path, yet the teeth thereon or the periphery thereof will not tend to drag, but, on the contrary, a free rotation will at all times be allowed.

It is well known that street-car motors comprising steam-engines mounted upon cars are very objectionable by reason of the various noises which are incident to the operation of such engines. One of the causes of the noise is the escape from the cylinder of the drip-water, there being, as is well known, a drip-cock connected with the steam-cylinder for the purpose of allowing such water to escape. I avoid the production of noise from the escape of this water by conducting the drip into a receptacle containing a body of water. Such a receptacle is shown as being formed directly in the engine-bed, but, of course, another body of water can be utilized for the same purpose—such, for instance, as that in the water-tank. As shown, the drip-pipes extend directly downward into a water-chamber at S′, the passage through said pipes being controlled by the usual drip-cock s.

The lower end of the pipes S are situated below the surface of the water in chamber S′ and the water acts to deaden the noise of the escape of the drip-water. To prevent the sucking up of the water from this receptacle into the cylinder at the receding stroke of the piston, a valve S^3 is employed at the lower end of each pipe, this valve being preferably conical in form and fitted to a conical seat in the end of the pipe produced by expand-

ing the lower end thereof, as shown. The valve is normally held in place against the seat by means of the spring s', which, however, can be driven back sufficiently by the pressure of the escaping water and which after the piston-stroke instantly closes the drip-pipe to prevent upward suction.

In Figs. 6 and 7 I have shown in detail the boiler and the heating devices which I employ. The boiler proper has vertical tubes c held in bottom plate c' and crown-sheet c^2. The boiler is preferably elevated and supported on legs or pedestals, as shown at c^3. Beneath the tubes are arranged the lamps $q\,q$ in a compact series. Each lamp extends from one side of the boiler continuously across the bottom thereof, its wick extending under all the tubes of a row. So far as the wick, the wick-tube, and the wick-raising devices are concerned any preferred construction can be adopted. By constructing the lamps and arranging them in the way shown all of the space beneath the boiler can be utilized and a strong flame can be brought to bear upon the whole surface of plate c'. If desired, the hood or shield can be placed around the lamp-chamber, as is shown at Q; but this should not be so tight as to prevent an ample quantity of air from reaching the wicks to support combustion.

In Fig. 10 I have illustrated another form of condenser, dispensing with the ammonia or supplemental cooling medium. As shown, it consists of two concentric cylinders $m\,m'$ connected together so as to form a water-tight chamber m^2. m^3 is a pipe connecting this chamber with the water-tank N. Inside of the inner chamber m^4 is arranged a coiled pipe m^5, which at the lower end communicates with the said annular chamber m^2, and which is at the upper end connected to the bottom of the boiler C. m^7 represents the exhaust-duct from the engine-cylinders which is passed into the lower part of the inner chamber m^4. m^8 is a pipe also communicating with the bottom part of the chamber m^4 and with the water-tank. The water passes through the pipe m^3 from the tank to the chamber m^2, thence through the coiled pipe m^5 to pipe m^6, and to the boiler. While it passes through the chamber m^2 and the coiled pipe it tends to keep the metallic surfaces cool, so that the exhaust-steam which is received from m^7 is condensed on said surfaces and collected in the bottom of the chamber m^4, from which the water is taken through m^8 to the water-tank. At m^2 there is a pump of suitable kind which is used to force the water through the above-described path.

For any of the details herein referred to and not shown in the drawings, reference may be made to my earlier application for vehicle-motor, Serial No. 258,846, filed December 23, 1887, of which application this present one is a division.

What I claim is—

1. The combination with the boiler, and the main engine, of the three part receptacle, having the upper feed water chamber, the lower steam condensing chamber, and the central heating chamber, said condensing chamber and said heating chamber being provided with pipes for the cooling and the heating material, and means for elevating the condensed steam from the heating chamber to the feed water chamber, substantially as set forth.

2. In a street car motor, the combination with the boiler and the main engine, of the water tank, the two part duct for ammonia or equivalent cooling medium, one part of said duct being situated in the passage for the water from the tank to the boiler, and the chamber for exhaust steam, the other part of said duct being in or adjacent to said chamber, substantially as set forth.

3. In a street car motor, the combination with the boiler, the main engine and the water tank of the duct for ammonia or equivalent, cooling medium, means for compressing the ammonia, the water chamber surrounding that part of the said duct wherein the ammonia is under compression and receiving water from said tank, the chamber for exhaust steam containing or adjacent to a part of the ammonia duct and means for permitting the ammonia to expand in the last said part of the duct, substantially as set forth.

4. In a street car motor, the combination with the boiler and the main engine, of the tank, a receptacle for the exhaust steam, means in said receptacle for condensing the steam, means for forcing the condensed steam into the tank supplemental to the boiler, and means between the tank and the boiler for heating the feed water, substantially as set forth.

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

JOHN H. ELWARD.

Witnesses:
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L. D. PUTNEY.