(No Model.)

4 Sheets—Sheet 1.

P. J. McMAHON.

AMMONIACAL GAS MOTOR.

No. 525,859. Patented Sept. 11, 1894.

Fig. 1.

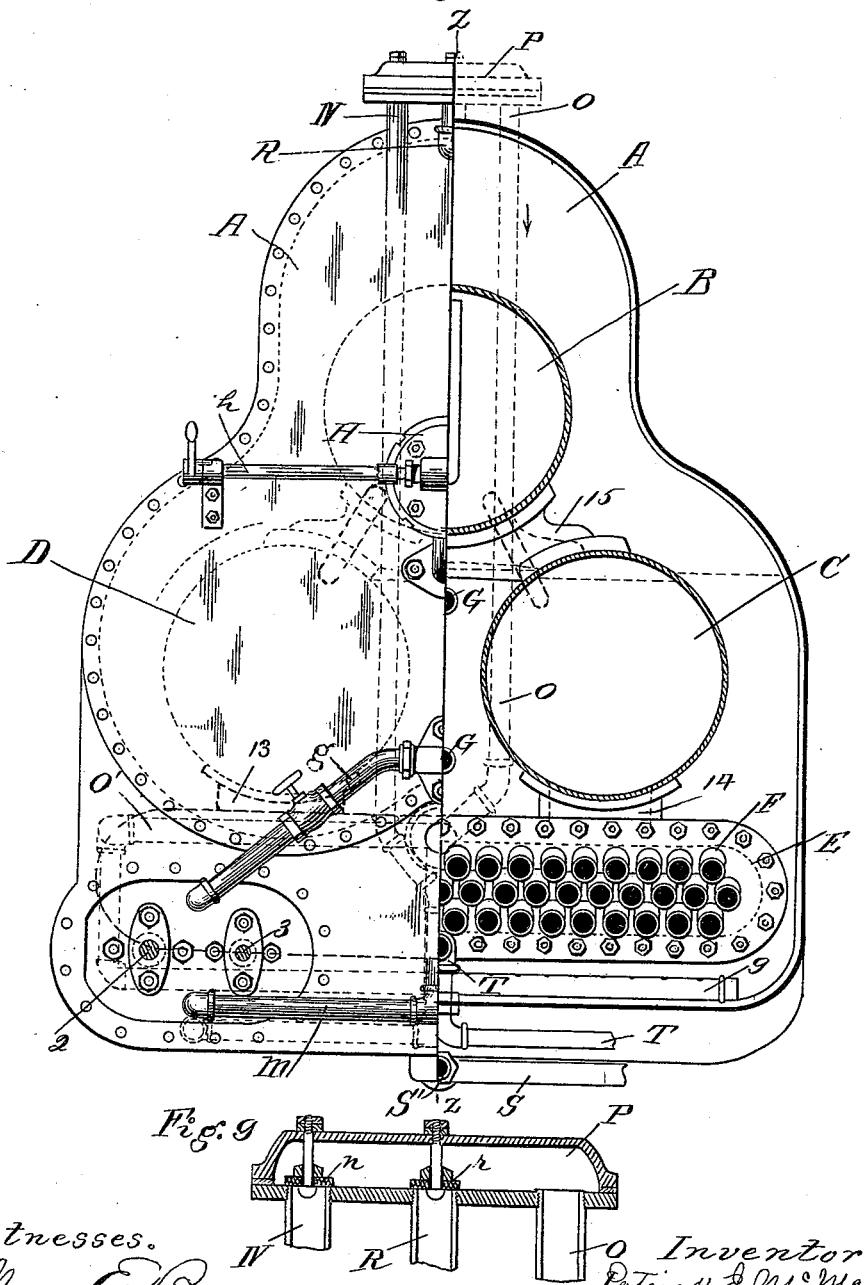

Fig. 9

Witnesses.

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Cyrus Burnap

Inventor
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By his Attorneys

Wall & Brown

(No Model.) 4 Sheets—Sheet 2.

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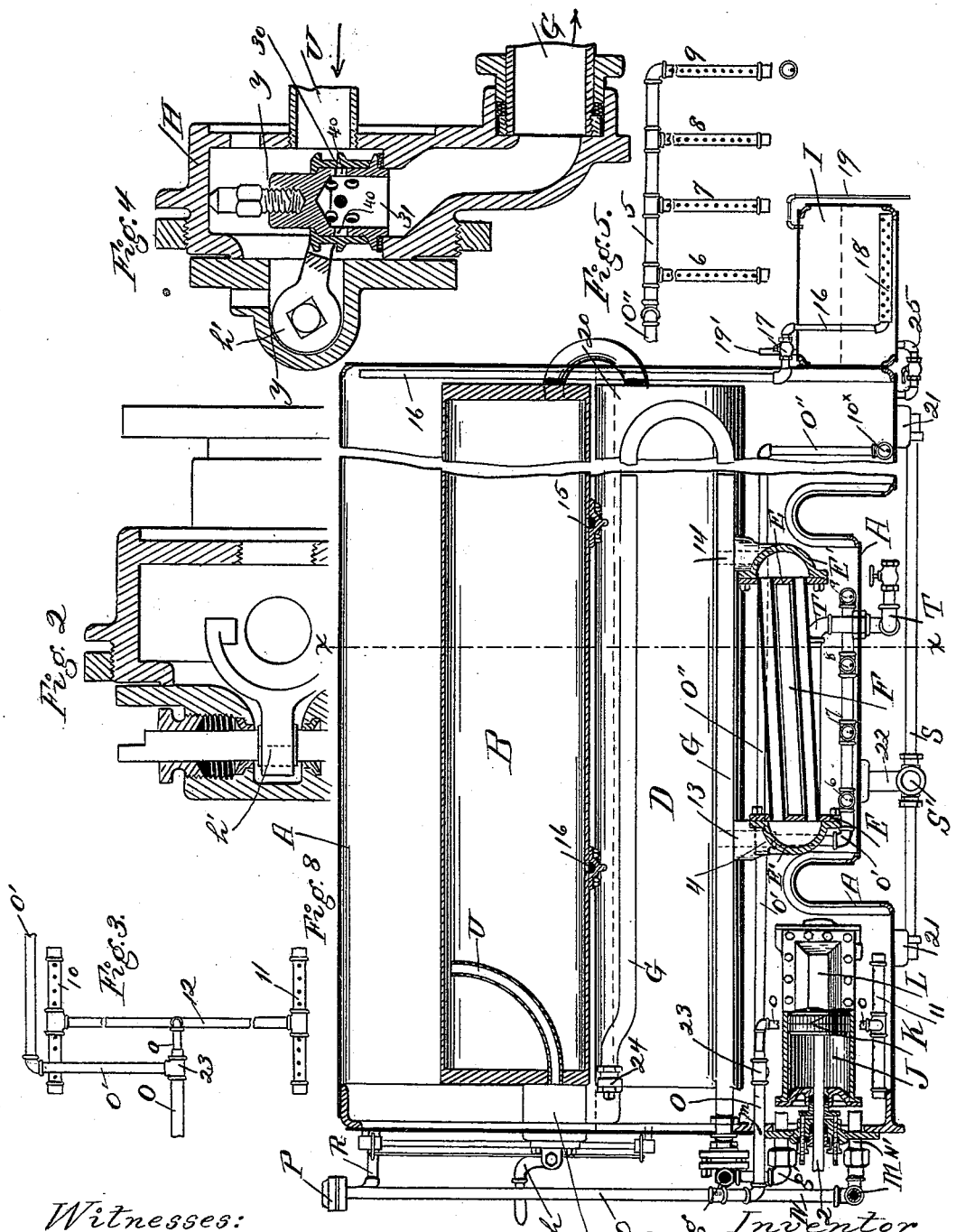

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(No Model.) 4 Sheets—Sheet 3.

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AMMONIACAL GAS MOTOR.

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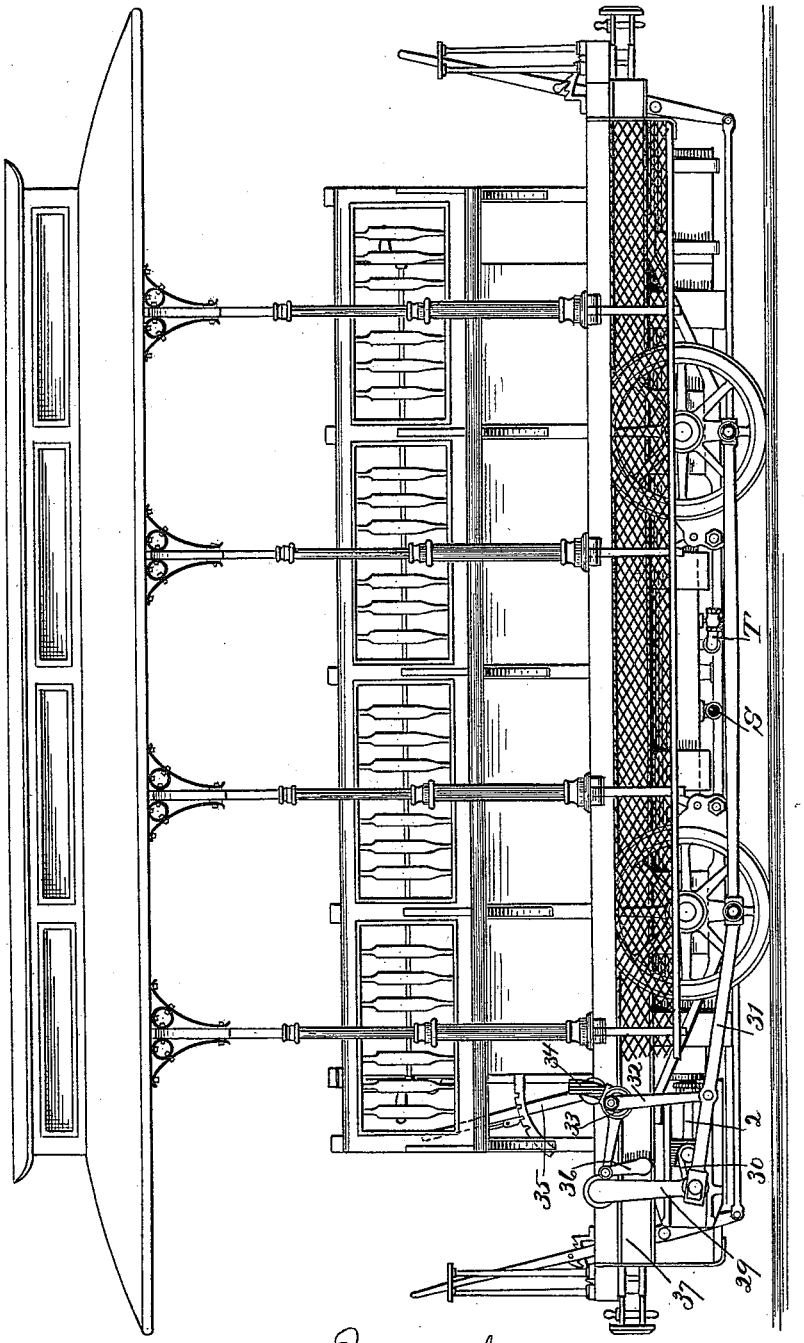

Fig. 6.

Witnesses:
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(No Model.)

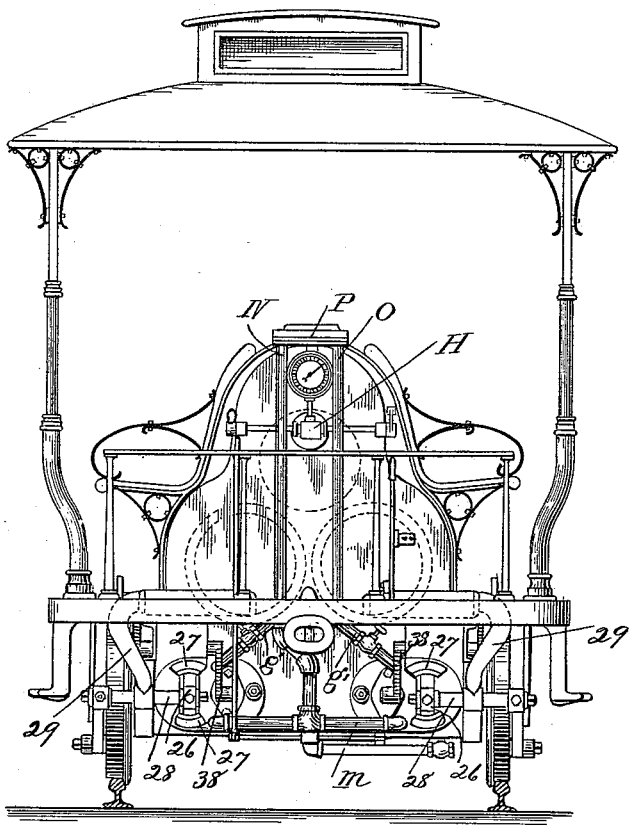
4 Sheets—Sheet 4.

P. J. McMAHON.

AMMONIACAL GAS MOTOR.

No. 525,859. Patented Sept. 11, 1894.

Fig. 7.



Witnesses:
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Cyrus Burnap

Inventor
Patrick J. McMahon
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UNITED STATES PATENT OFFICE.

PATRICK J. McMAHON, OF TANGIPAHOA, LOUISIANA, ASSIGNOR TO THE STANDARD FIRELESS COMPANY, OF CHICAGO, ILLINOIS.

AMMONIACAL-GAS MOTOR.

SPECIFICATION forming part of Letters Patent No. 525,859, dated September 11, 1894.

Application filed December 12, 1891. Serial No. 414,811. (No model.)

To all whom it may concern:

Be it known that I, PATRICK J. McMAHON, a citizen of the United States, residing at Tangipahoa, in the parish of Tangipahoa and State of Louisiana, have invented new and useful Improvements in Ammoniacal-Gas Motors, of which the following is a specification.

My invention relates to improvements in motors operated by ammoniacal gas, and its objects are to provide a motor of greater simplicity and fewer parts, and which is capable of being operated more safely and economically than any of that class of motors at present constructed.

I have heretofore taken out patents in the United States for ammoniacal gas generators, gas engines and motor cars as follows: ammoniacal gas generator, No. 343,598, dated June 15, 1886; ammoniacal gas engine, No. 343,600, dated June 15, 1886; motor car, No. 379,119, dated March 6, 1888; ammoniacal gas engine or motor, No. 420,241, dated January 28, 1890. In my present application I make no claims to the improvements claimed in any of said patents.

I attain the objects of my present invention by mechanism shown in the accompanying drawings, in which similar letters and figures of reference are used to designate the same parts.

Figure 1, represents a front view of the tank, reservoir or absorber proper, with the mechanical parts of the cylinder and driving work removed and one half of the front of the motor cut away upon the line *x*—*x* of Fig. 8, in vertical cross section. Fig. 2 represents a horizontal detail sectional view of the throttle valve upon the line *y*—*y* of Fig. 4. Fig. 3 is a detail view of a portion of the exhaust pipe and some of its connections. Fig. 4, is a vertical sectional view of the throttle valve and its connections. Fig. 5 is a detail of another portion of the exhaust pipe and its connections. Fig. 6, is a side elevation of my motor showing it in condition ready to be operated. Fig. 7 is an end elevation of the same. Fig. 8 is a vertical longitudinal sectional view of my invention upon the line *z*—*z* of Fig. 1. Fig. 9 is a detail view showing the construction of the exhaust check.

The letter A represents the exterior tank, reservoir or absorber of the construction shown.

B. C. and D represent three interior tanks or boilers properly supported within the main tank or shell A. The boiler B is supported by saddles, as shown, located upon the boilers C and D and is connected therewith by tubes or pipes; the saddles being shown at 15 in Fig. 1 and at 15 and 16 in Fig. 8.

E, E, represent plates with perforations in them into which is introduced a series of pipes F.

E′, E′, represent trough-shaped plates provided with flanges which are bolted or riveted to the plates E, E, so as to form air tight connections thereby forming chambers into which the pipes F lead. These chambers are connected with the main anhydrous ammonia tanks or boilers C and D, by the pipes 13 and 14; and within the upper boiler B is located a pipe U which is the ordinary eduction pipe for the ammoniacal gas that may be generated within said ammonia tanks or boilers.

The pipe U leads out of the boiler B to the throttle valve H and through that it is connected with the gas pipe G which passes between the three boilers to the rear end of the exterior tank, reservoir or absorber A, and, returning between the ammonia tanks C and D, is connected by proper connections with the pipes *g*, *g′*, upon the exterior of the main tank or absorber and are introduced into the respective pressure chests L of the cylinders J and by means of which the pressure chests and cylinders are supplied with the required gas for their operation.

The engine is located within the outer tank or absorber A beneath and between the front portions of the ammonia tanks C and D and is riveted to the front plate of the main exterior shell and held firmly in position by proper supports.

The piston rod 2 of the cylinder and the valve rod 3 of the pressure chest of the cylinder pass through a double packing out of the main tank or absorber as shown. One of the packings is of the ordinary kind employed to prevent the escape of gas or steam from the cylinder, and the second packing is located in the shell of the outer tank and its purpose is to prevent the escape of any water

or ammonia solution from the main tank or absorber.

The piston rod is connected by the pitman 30 with the double crank pin 28 to which is attached the bell crank 29. The outer portion of the double crank pin is connected with the connecting rods 31 which connect with the drive wheels of the motor. By means of the lever 32 which is connected with one of the connecting rods 31, the eccentric 33 and arc 34 are operated whereby the crank arm 36 is given a reciprocating motion, which is connected on the interior of the beam 37 with the crank arm which operates the slide valve in the pressure chest. The lever 35 is the reverse lever which constitutes the means whereby the motion of the motor may be changed or reversed in the usual manner.

Proceding from the valve chest L is the exhaust pipe N, N′, which extends to an exhaust check P provided with check valves. This exhaust check is located at or above the top of the main tank, reservoir or absorber so as to render it practically impossible for a vacuum, formed in the cylinder after it has been exhausted of gas, to draw any of the weak solution from the main tank or absorber down through the exhaust pipe into the valve chest or cylinder.

The construction of the exhaust check P is shown in detail in Fig. 9 where the letter N represents the exhaust pipe, P the exhaust check and O the continuation of the exhaust pipe as it descends down and enters the tank, reservoir or absorber at M. The pipe R connecting with the exhaust check P enters into the upper portion of the tank, reservoir or absorber as shown, and it is evident that the formation of a partial vacuum in the cylinder or valve chest would open this valve and thus establish an equilibrium of pressure between the interior of the tank A and pipe O and thereby prevent the flow of liquid into the cylinder or chest. The exhaust pipe O, after being introduced into the main tank, reservoir or absorber, is connected by the pipe *o* with the cross pipe 12, which is also connected with perforated tubes or flanges 10 and 11 located respectively beneath the cylinders. The exhaust pipe is then extended, in somewhat reduced size O′, to one side of the interior of the tank, reservoir or absorber and is connected as shown in Fig. 5, by pipe O″ to a series of cross pipes, 6, 7, 8 and 9, provided with perforations upon their upper sides, which extend cross-wise underneath the series of tubes F. The exhaust pipe is still further extended by means of a coupling 4, to the rear portion of the main tank or absorber where it, O″ descends and is connected with another cross cylinder or perforated pipe 10 by means of which construction the ammoniacal gas having been exhausted from the cylinder passes through the exhaust pipes N, O, O′ and O″ into several perforated cylinders located beneath the series of pipe F and at 10 in the rear portion of the main tank or absorber.

T represents a charging pipe for introducing the pure anhydrous ammonia into the pipes F and the chambers formed by the plates E, E, E′, E′, and through the tubes 13 and 14 into each of the ammonia tanks or boilers C and D. This pipe T enters the lower portion of the main tank or absorber at or near its side, passes upwardly and is introduced into an opening in the plate E, as shown. It is also provided with the usual stop cock so that the pipe may be opened or closed. There is another charging and discharging pipe S, provided with an opening S′. This pipe is connected with the lower portion of the main tank, reservoir or absorber, at the points 21 and 22 and by means of this pipe and its connections, weak solution may be introduced and concentrated solution withdrawn from the main tank, reservoir or absorber as hereinafter explained.

Located within and at the rear end of the main tank, reservoir or absorber and extending up near to the top thereof is a pipe 16 which descends toward the bottom of the main tank or absorber and passes out into a tank I. This tube 16 is provided with a check valve 17, and enters into the tank I and is connected with a perforated tube or cylinder 18 located near the bottom of the tank. The tank I is also provided with an exhaust or outlet pipe 19, and is connected with the main tank, reservoir or absorber by the pipe 25 provided with a stop cock.

I make no claim to any special construction of throttle valve or cylinder or valve chest as in their general nature any of the steam cylinders and steam chests, with their various modes of operation thereof, may be employed in my motor; and, so also, of the throttle valve, by means of which the passage of gas from the gas chamber may be controlled and regulated. So far as the engineery is concerned the only practical difference between my motor and the ordinary steam locomotive consists in the employment of ammoniacal gas and aqua-solutions instead of steam and water. I prefer however, to employ a throttle valve illustrated in Fig. 4, in which H represents the casing, inclosing the valve and with which the inlet pipe U and the outlet pipe G are connected; *h′* representing the crank arm which lifts and lowers the sleeve 30 until its openings registering with the openings in the chamber 31 regulate and control the amount of gas passing into the cylinders.

Having thus described the construction of my invention, I now proceed to point out its mode of operation: I cause the main tank, reservoir or absorber to be charged through the pipes S, S′, with a weak solution of aqua-ammonia up to a point so as to cover the two lower boilers C and D. At the same time through the pipe T, I cause the pipes F and chambers formed by the plates E, E′, and the

interior ammonia tanks C and D, to be filled with anhydrous ammonia up to a level shown by the line 20. When thus charged the connections with the pipes S and T are cut off and the motor is ready for operation. The anhydrous ammonia at once volatilizes into ammoniacal gas and the upper boiler B, at once is filled with ammoniacal gas under a certain pressure depending upon the temperature of the ammoniacal gas and of the weak solution. When the motor is first charged, the throttle valve H is opened and the gas passes through the pipe U into the pipe G and from thence through the pipes g, g' to the cylinders and gives the piston heads their reciprocating motion. At each stroke of the piston the exhaust escapes through the valve chest to the pipe N', to the cross pipe M and thence up through the pipe N, the exhaust check P, down through the pipe O into the main boiler or tank, and thence along through the perforated connections beneath the respective cylinders, thence beneath the pipes F and finally to the perforated pipe located at the bottom of the main tank 10.

It is well known that the absorbing power of water is such that ammoniacal gas is at once taken up and absorbed so that the instant the exhaust reaches the water solution it is absorbed and ceases to exert any power. The perforated connections 10 and 11, 6, 7, 8, and 9 are employed to distribute the gas which has been employed in the water. The location of the series of pipes, perforated as shown in Fig. 5, is for the purpose of generating heat in the weak solution by the absorption in the liquid of the exhaust, creating a constant current of warm liquid up through the pipes F beneath and between the boilers C and D. The perforated cylinder or pipe 10 at the rear of the main tank or absorber is constantly effecting the same results by means of the absorption of the ammoniacal gas by the weak solution.

The tank I, located at the rear of the main tank, reservoir or absorber A is filled with water up to about the dotted line as shown. In case of the collection of any air or watery vapor commingled with ammoniacal gas in the upper part of the main tank, reservoir or absorber, the pipe 16 is introduced which allows it to be blown off down through the perforated tube or cylinder 18. The watery vapors and air are allowed to escape through the water, while any of the ammoniacal gas that may be present is absorbed by the water, and when the water has become saturated with any considerable portion of ammonia it can be transferred from the tank I through the pipe 25 into the main tank, reservoir or absorber as shown.

There may be many changes and variations in the details of construction and arrangement of the parts constituting my invention without departing from the spirit thereof, and I do not wish to be understood as limiting myself to the exact details and form of construction and arrangement shown and described.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a gas motor a frame supported upon and having two or more pair of drive wheels, an exterior shell or tank reservoir attached to and resting upon said frame; said exterior shell provided within its chamber with one or more anhydrous ammonia tanks having a gas chamber; said exterior shell having also one or more engine cylinders rigidly located within its chamber and connected by piston rods and pitmen and connecting rods with the crank pins of said drive wheels; in combination with said engine and cylinders; an exhaust pipe proceeding from the valve chest of said cylinder or cylinders to the interior chamber of said exterior shell or tank reservoir and provided with means for distributing the exhaust gas in the absorbing liquid beneath said cylinder or cylinders and said ammonia tanks substantially as shown.

2. In a gas motor the combination of an exterior shell or tank reservoir provided in its interior chamber with one or more anhydrous ammonia tanks, having a gas chamber, and also with one or more engine cylinders having their proper and usual connections with the drive wheels of said motor; a gas pipe proceeding from said gas chamber out through said exterior shell to a throttle valve; a throttle valve; a gas pipe proceeding from said throttle valve into said chamber and extending along near or between the upper portion of said ammonia tank or tanks to the rear of said exterior shell, and returning along near or between the lower portion of said ammonia tanks; passing out of said exterior shell and forming connections with pipes that re-enter said exterior shell and connect with the valve chests of said cylinder or cylinders; an exhaust pipe proceeding from said cylinder or cylinders out of said exterior shell to an exhaust check and thence returning within said exterior shell and being provided with means for distributing the exhaust gas in an absorbing liquid beneath said cylinder or cylinders and said ammonia tanks; all substantially as shown.

3. In a gas motor an exterior shell or tank reservoir containing within its interior one or more anhydrous ammonia tanks having a gas chamber in combination with an engine cylinder or cylinders located within said shell or tank reservoir; a series of tubes and chambers formed by tube sheets and covers located beneath said ammonia tanks, and having open connections therewith, and a pipe connected with the chambers formed by said tube sheets and their covers whereby said ammonia tanks, said tubes and chambers may be charged with anhydrous ammonia; all substantially as shown.

4. In a gas motor an exhaust pipe proceeding from the valve chest of the engine cylin-

der within the exterior shell or tank reservoir to a point near the top of said shell; an exhaust check connecting with said exhaust pipe and provided with a pipe R leading from said exhaust check into the upper portion of the exterior shell; a return exhaust pipe extending from said exhaust check provided with perforated pipes or tubes located respectively beneath said engine cylinders the pipes F and the ammonia tanks; all substantially as shown.

5. In a gas motor the combination of an exterior shell or tank reservoir with its included anhydrous ammonia tanks and engine cylinder or cylinders and the tank I the pipe 16 check valve 17, and perforated cylinder 18, said tank I being provided with an exhaust pipe 19, and being connected with the exterior shell or tank reservoir by a pipe 25 provided with a stop cock; all substantially as shown.

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

PATRICK J. McMAHON.

Witnesses:
WM. S. CAMERON,
J. LAWRENCE GERRY.