(No Model.) I. R. BLUMENBERG, Dec'd. 2 Sheets—Sheet 1.

W. BLUMENBERG, Administratrix.

VAPOR GENERATOR AND MOTOR.

No. 290,963. Patented Dec. 25, 1883.

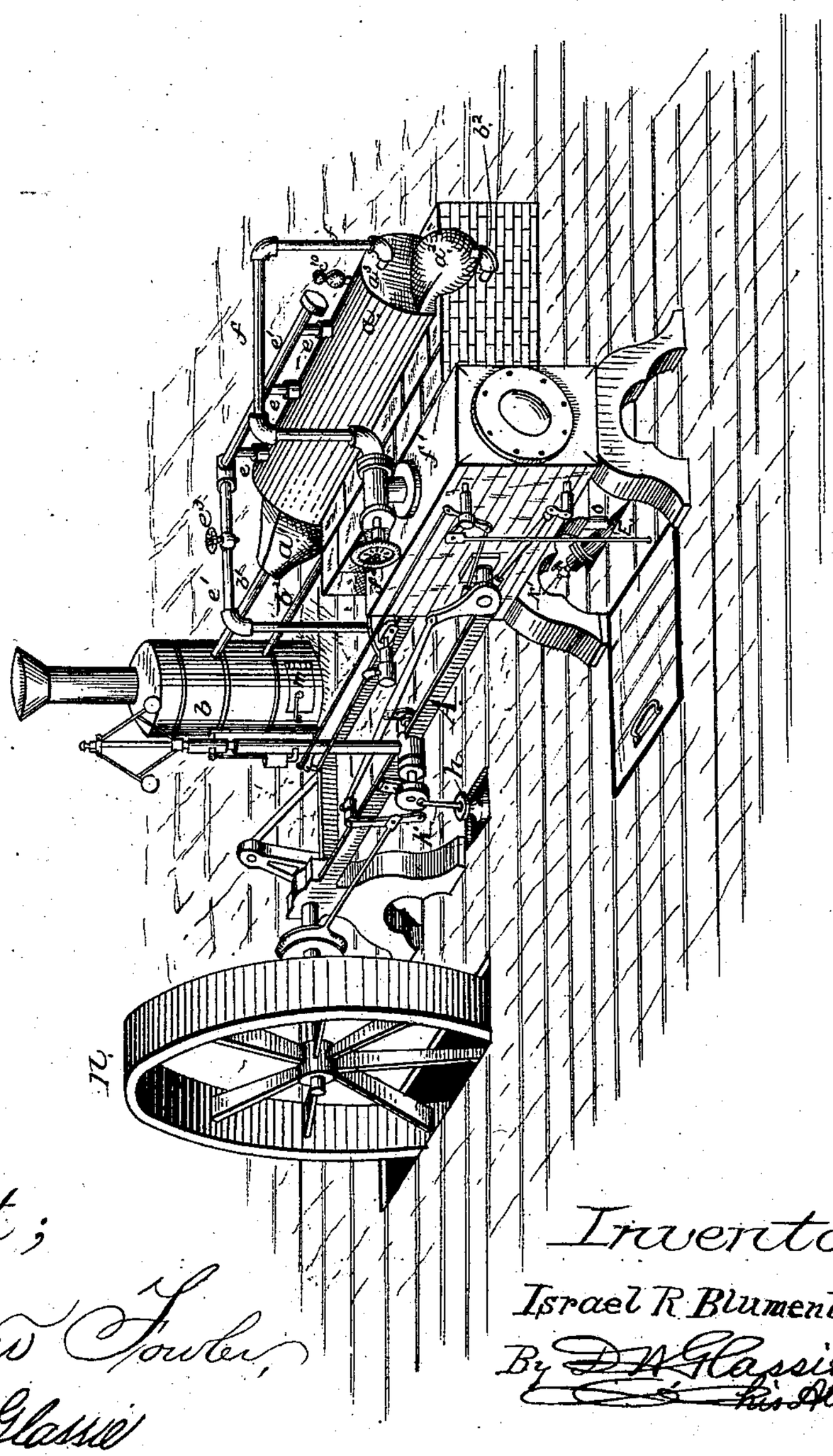

Fig. 1.

Attest;

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his Atty.

(No Model.) I. R. BLUMENBERG, Dec'd. 2 Sheets—Sheet 2.

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Fig 2.

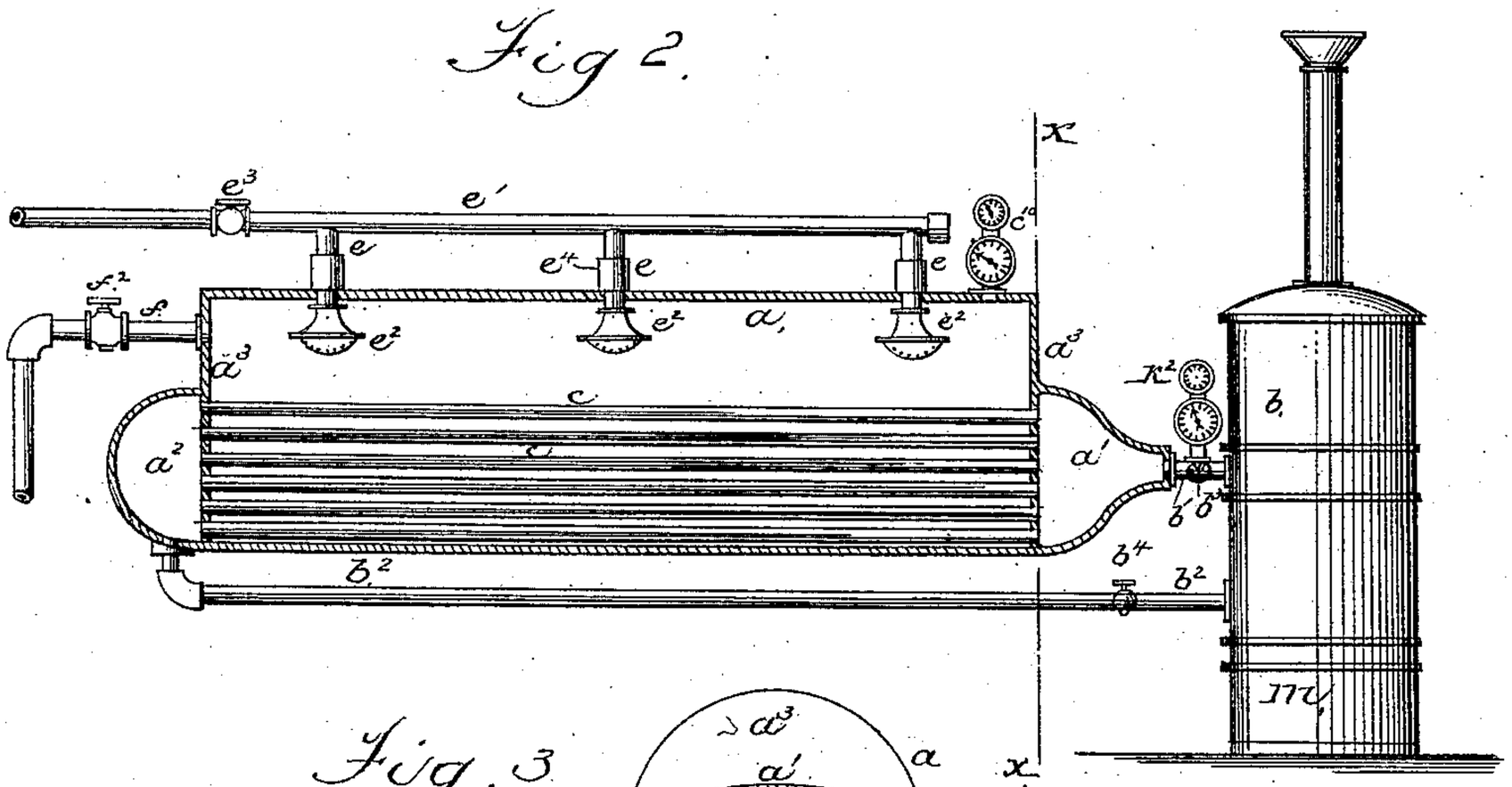


Fig. 3

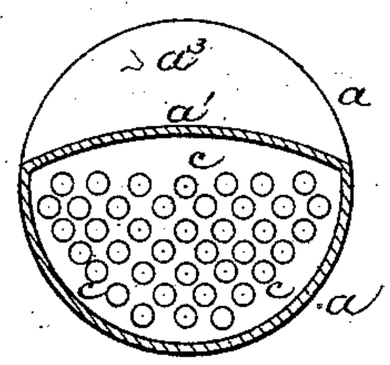
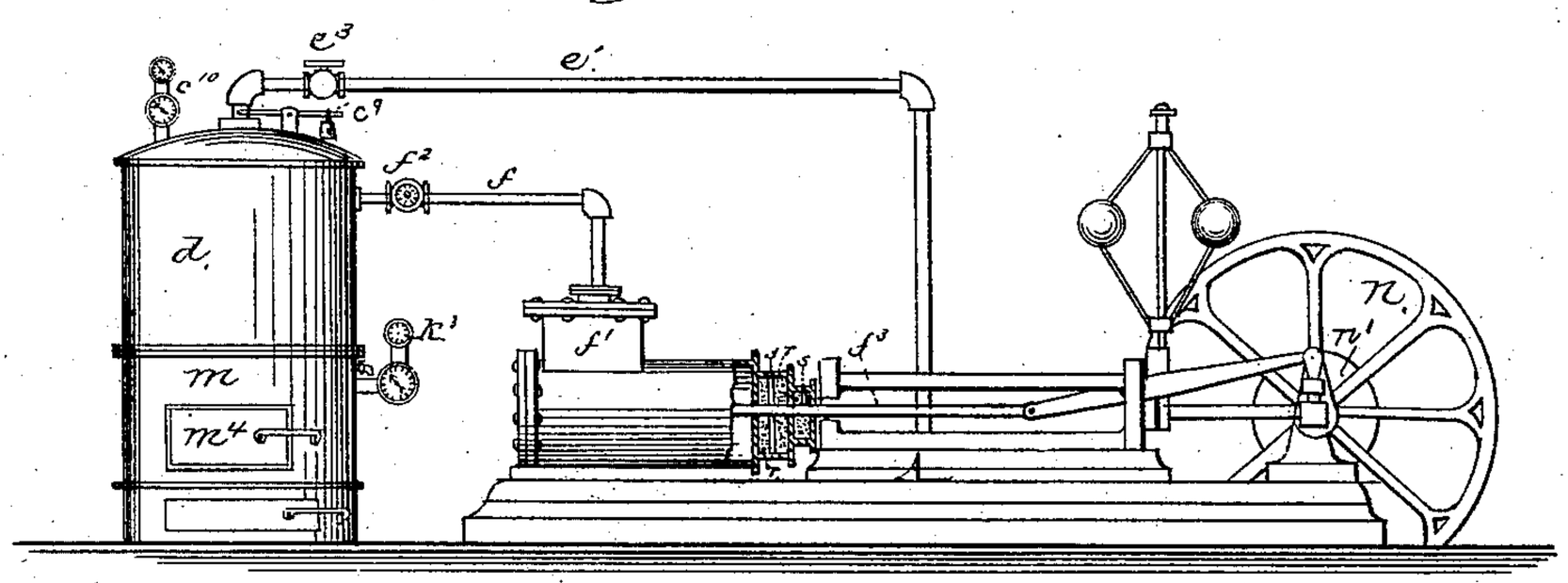


Fig. 4



Attest;

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Inventor;

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UNITED STATES PATENT OFFICE.

ISRAEL R. BLUMENBERG, OF WASHINGTON, DISTRICT OF COLUMBIA; WILHELMINA BLUMENBERG, ADMINISTRATRIX OF SAID BLUMENBERG, DECEASED, ASSIGNOR TO FRANCIS H. SMITH, OF SAME PLACE.

VAPOR GENERATOR AND MOTOR.

SPECIFICATION forming part of Letters Patent No. 290,963, dated December 25, 1883.

Application filed December 20, 1882. (No model.)

To all whom it may concern:

Be it known that I, ISRAEL R. BLUMENBERG, a citizen of the United States of America, residing at Washington city, in the District of Columbia, have invented certain new and useful Improvements in Vapor Generators and Motors, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to a new and useful method of utilizing volatile fluids as a power-motor, as well as improvements in the form, construction, and arrangement of power-vapor generators, heating boilers and furnaces, and of motor-engines, as well as in the mode of adjusting and connecting the several parts one to the other; and it consists in instantaneously converting into power-vapor volatile fluid by automatically, and as it is required, injecting it in a spray or shower, through roses or other similar and suitable devices, into an empty horizontal chamber onto numerous tubes adjusted horizontally in a cluster, and secured in place and heated by steam passing therethrough.

It also consists in horizontally adjusting and securing, in a cluster, by their ends in the opposite ends of a horizontal vapor-generating chamber, under cover of steam chests or domes secured thereon, a large number of small tubes used as steam-ducts, which pass longitudinally through the generating-chamber, through which heat is supplied to vaporize the volatile fluid.

It also consists in heating such longitudinally-adjusted tubes and ducts and the generating-chamber by a continuous flow of steam ejected therein.

It also consists in securing on the ends of the several induction-pipes, within a horizontal vapor-generator, a rose or distributing-nozzle for discharging the fluid, used in a spray or shower on the horizontally-arranged tubes below.

It also consists in securing on the outside, covering a great portion of the ends of a horizontal vapor-generator—one at each end—a steam chest or chamber, preferably dome-shaped, which inclose the open ends of the longitudinally-adjusted cluster of steam-ducts; also, in connecting the said steam chests or chambers by induction and eduction pipes with an auxiliary steam-boiler.

It also consists in the method of injecting volatile fluid into a horizontal vapor-generator having induction and eduction pipes, and a cluster of longitudinally-adjusted ducts or tubes heated by steam received through an induction-pipe attached to the steam-chest on the end of the generator, from an auxiliary steam-boiler with which it makes connection, and by the heat thus acquired to instantly convert the same into power-vapor, the said generator being provided with another steam-chest at the opposite end, connected by an eduction-pipe therefrom with the auxiliary boiler to aid in keeping up a free circulation of fresh hot steam.

Figure 1 is a perspective of a horizontal vapor-generator, showing the induction and eduction pipes, the steam induction and eduction pipes, the general supply pipe and cock, and the receiving and discharging steam-chambers thereto attached, the steam boiler and furnace, a horizontal engine showing the connection-pipes, also the end of the condenser E and the pump *h*. Fig. 2 is a longitudinal vertical section of a horizontal vapor-generator and connecting induction and eduction pipes, showing the arrangement of the distributing-nozzle, the steam ducts or pipes *c*, the steam induction pipe b' and eduction pipe b^2, together with a side elevation of a steam-boiler, *b*, and furnace. Fig. 3 is an end elevation of a horizontal vapor-generator with the steam-chamber removed, showing the open ends and arrangement of the steam-ducts or heating-pipes *c*. Fig. 4 is a side elevation of a combined vertical vapor-generator, steam-boiler, furnace, and ash-pit, and horizontal engine, showing the connecting-pipes, various gages, blow-pipe, and general supply-pipe e'.

Similar letters of reference indicate corresponding parts.

a is a horizontal vapor-generator of metal of great tensile strength, closed at the ends by heads a^3 of the same material, and all the joints made absolutely vapor-tight. It may be constructed in cylindrical or any suitable form that will serve the purpose, in the proportion about as two is to five. I prefer, however, the cylindrical form shown in Figs. 1, 2, and 3,

and is provided with a cluster of small tubes or steam-ducts, *c*, which pass longitudinally through the cylinder *a*, the open ends thereof being secured by vapor-tight joints in the heads a^3, taking up from one-half to three-fifths of the interior of the generator *a*, which is also provided with induction-pipes *c c*, terminating in roses or distributing-noses c^2 c^2, by which the liquid to be used is carried into the generator and distributed in a spray or shower onto the heated metal below; also, with an induction-pipe, *f*, provided with a throttle-valve, f^2, for carrying the generated vapor from the generator to the cylinder *f'* of the motor-engine A.

Inclosing the open ends of the tubes or steam-ducts *c*, secured on the ends a^3 of the generator *a* by steam-tight joints, are deflecting steam chests or chambers *a' a²*, connected by induction and eduction pipes *b' b²* with a steam-boiler, *b*, all the various joints of which are made steam-tight. The generator *a* is also provided with a vapor-gage, c^{10}, and a safety-valve, c^9. The induction-pipes *c* are provided with check-valves c^4, and are attached to a general supply-pipe, *c'*, having a stop-cock and check-valve, c^3, which pipe, by its opposite end, connects with a pump, *h*. The steam induction pipe *b'* and eduction pipe b^2, provided with stop-cocks b^3 and b^4, respectively, connect the vapor-generator with the steam-boiler. Steam from the boiler *b* is carried through the induction-pipe *b'* to the deflecting heating steam chest or chamber *a'*, from which it is distributed to and passes through the steam-duct *c* into the deflecting steam-chamber a^2 at the opposite end of the generator, from which it is carried back again to the steam-boiler by the eduction-pipe b^2. It will be observed that the continuous supply of fresh vigorous steam will expel the inert and partially-condensed steam and keep the parts heated up to the temperature requisite for vaporizing the volatile liquor. So soon as the generating-chamber *a* and the ducts *c* are heated to the temperature required, the volatile fluid is injected through the pipes *c* and thrown in a shower or spray upon the cluster of heated tubes *c* below, where it is instantaneously converted into power-vapor and carried through the eduction-pipe *f* to the engine-cylinder *f'*, where, by direct impact acting upon the piston f^3, the engine A is actuated, which, among its other duties, through an eccentric, propels the liquor-supply pump *h*, which in turn automatically and continuously supplies the vapor-generator with volatile fluid, whereby the momentum is kept up, and the power made continuous and uniform.

Instead of using a steam-boiler, *b*, constructed specially for the purpose, the vapor-generator may be attached by the pipe *b'* to a boiler, generating steam for any other purpose, using the surplus or waste steam thereof, thus economizing fuel and saving money. The power-vapor having been used, exhausts its force, and through an exhaust-pipe immediately escapes into a condenser, where it is returned to a fluid state, and returned to the reservoir by a connecting-pipe, to be reused *ad infinitum*. The several joints, as well of the vapor-generator and the connecting induction and eduction pipes as the engine-cylinder, steam-ducts, induction and eduction pipes, and the various connections, are so constructed, adjusted, arranged, and packed as to prevent any possibility of escape either of the vapor or steam.

To be more clearly understood, I desire to say the joints, valves, and connections of the steam ducts, pipes, and steam-chests are so constructed, arranged, and packed that the escape of vapor and steam is wholly impossible, and the possibility of the vapor and steam coming together wholly precluded. The throttle-valve f^2, the joints and connections of the eduction-pipe *f*, the connections and valves of the induction-pipes *c*, as well as the several connections and valves of the cylinder *f'*, are so constructed, arranged, and packed that there is no possibility of the vapor leaking out or escaping, and to the end that the vapor may not escape by way of the channel of the reciprocating rod f^3 of the engine-piston within the packing-box *r* of the cylinder *f'*, I construct a tank or reservoir or chamber, *s*, through which the piston reciprocating rod moves, and fill it with glycerine or other similar material that will also serve as a lubricant, so that in addition to serving as a packing, and to fill in the interstices and seal up the channel through which the reciprocating rod passes, and thus prevent the escape of the vapor, it will act as a lubricator, and the reciprocating rod, in passing backward and forward, will automatically lubricate the interior of the cylinder.

s' is a drop or fountain lubricator, constructed in the extreme outer wall of the packing-box.

While I describe herein the construction and arrangement of my fluid-packing device, as I seek to protect it by Letters Patent in another application now pending, I do not specifically claim it in this application.

I do not confine myself to the use of any character of joint-packing for the purpose indicated above. I prefer, however, to use the packing invented by myself, and secured to me by Letters Patent No. 230,996, and dated August 10, A. D. 1880.

My horizontal generator having been set up, as indicated, and all necessary connections made with the pump *h*, the fluid-reservoir F, and the engine A, the power-vapor is generated by heat produced by steam obtained from the boiler *b*, passing into the steam-chest *a'*, thence through the steam-ducts *c* into the steam-chest a^2, and out through pipe b^2, as hereinafter described.

The induction-pipes *c*, preferably copper pipes of about seven-eighths of an inch in diameter secured in the crown of the vapor-generator, are provided with check-valves e^4 near the shell of the generator, to prevent the vapor from forcing its way out through the supply-pipe *e'*, and thence to the pump *h*, and

terminate in roses e^2 within the generator *a*, and are connected with the supply-pipe *e'*. The roses e^2 are of any approved design that will best perform the function of distributing the volatile liquid in a shower or spray over the most extensive surface. The supply-pipe *e'* is an ordinary metal pipe about seven-eighths of an inch in diameter, provided with a stop-cock or globe-valve, e^3, to regulate the flow of the volatile liquor. The pipe *e'* is connected at one end with the induction-pipes *e*, and at the other with the pump *h*, and is used for conveying the fluid from the reservoir F to vapor-generator *a*.

The eduction-pipe *f* should be constructed of metal of considerable tensile strength, may be of any diameter requisite, and provided with a throttle-valve, f^2, through which the flow of the vapor from the generator to the cylinder *f'* of the engine A is regulated. This pipe is secured by one end to the generator *a* by a vapor-tight joint, and by the other end to the engine-cylinder A by a similar joint.

c^{10} is an ordinary vapor-gage to show the pressure.

c^9 is an ordinary weighted safety-valve connected by a pipe, c^5, with the surface-condenser E, or any other condenser used, so that if by any chance there should be too heavy a head of vapor in the generator it would escape through the safety-valve to the condenser, be immediately converted into fluid, and avoid accident.

k^2 and k^3 are the ordinary steam-gages used to indicate the pressure of the steam in the boiler.

A is a motor-engine, vertical or horizontal, having a band-wheel, *n'*, and a balance-wheel, *n*, and in addition to its other functions through a shaft, *h'*, attached to an eccentric and connected with the pump *h*, it automatically supplies the fluid to the generator *a*. Connected with the engine by an exhaust-pipe, *o*, is a surface-condenser, E.

E is a surface-condenser, fully described in the specification to Letters Patent No. 238,754, granted to me March 15, A. D. 1881, and is used for condensing the vapor after it has been used in the cylinder *f'* before it is returned through the pipe *o'* to the reservoir F, and is attached to the engine by the exhaust-pipe *o*. While I prefer this style of condenser, I do not confine myself exclusively to its use or to any form, using as well the coil-pipe or any approved form in use. *k'* are blow-pipes on the condenser E.

h is a force-pump, operated through the reciprocating shaft *h'* by an eccentric on the engine A. By the pump *h* the fluid is drawn from a reservoir, (not shown,) through a suitable connecting-pipe, and injected into the empty chamber of the vapor-generator *a* through the pipes *e' e* and distributing-nozzles e^2.

The various parts having been adjusted and connected as herein shown, the reservoir supplied with fluid, and steam for heating obtained, the pump is set to drawing liquid from the reservoir F through the pipe o^3, and forcing it to the generator *a*, where, through the induction-pipes *e* and roses e^2, it is distributed in a shower or spray upon the heated tubes *c*, where it is immediately converted into power-vapor, and by the eduction-pipe *f* carried to the cylinder *f'*, and made to actuate the piston f^3 of the motor-engine, escaping thence through the exhaust *o* to the condenser E, where it is again converted into fluid and returned to the reservoir F, to be again used. The operation being continuous, the fluid is used *ad infinitum* without loss or waste, and there being no escape for the steam there is no loss of water, a barrel of water per day being sufficient to run an engine of from twenty to one hundred horse-power, and as after the first heating the boilers are not replenished by cold water but by partially-condensed steam, it will require less fuel to keep up the temperature required to generate vapor.

In vapor-motors a perfect lubricator is absolutely requisite, as the lubricator used must of necessity perform the double function of causing the parts to move smoothly and act as a complete barrier to the escape of the vapor used as a motor through the movement of the piston.

Experience has demonstrated that no lubricator has yet been discovered that meets these requirements better than glycerine, which can be stored in the following manner, and made to serve as an excellent fluid packing, as well as a lubricant.

I construct in the packing-box *r* of the cylinder *f'* of the motor-engine A a tank, reservoir, or chamber, *s*, through which the piston reciprocating rod f^3 moves. This chamber is filled with glycerine or other similar lubricator, which fills in and seals up the channels surrounding the piston-rod, which, as it passes backward and forward, automatically lubricates the parts; and with the further view to keeping the piston free in the extreme outer wall of the cylinder or packing-box *r*, I construct a second lubricating-chamber, *s'*. While I describe this device here, I only do so to show its connection and association, as I have now pending an application for a patent on this feature.

I am aware that numerous attempts have heretofore been made to advantageously employ vapor generated from bisulphide of carbon and other volatile fluids as an active motor agent, and many devices have been designed to that end. The difficulty heretofore has been to so construct the machinery as to secure a steady, uniform, reliable power, and at the same time economize fuel, space, cost of machinery, and money, as well as to produce something that may be introduced into every-day use. I claim that by my invention I have accomplished this, in that by my cluster of steam ducts or tubes within apparently limited space I present on the one side an extensive surface to the heating medium, steam, and on the other an extensive area heated for generating the

vapor required; that by injecting the volatile fluid in a spray into the empty heated chamber enlarged by the many tubes *c*, I regulate and can keep up a uniform power without increasing my consumption of fuel, be it greater or lesser; that by preventing the escape of vapor by my packing, which practical experience has demonstrated cannot be surpassed, if it can be equaled, by any packing now in use, and the peculiar construction of my cylinder, and by condensing and by reusing the fluid and by returning the half-condensed steam to the auxiliary boilers, I economize the fuel required or necessary for raising water from its normal temperature to that of boiling water, and avoid enormous expense. As compared with steam, exclusive of the difference between the cost of my motor and that of steam-motors of equal or less power and the economy of space as an item of importance, I would suggest that the specific heat required to raise bisulphide of carbon from a comparable to a boiling-point, water being one or unit, is .248967; or, in other words, it takes only about one-fourth as much heat to raise bisulphide of carbon from ordinary temperature to its boiling-point as it does water to its boiling-point. This cut off three-fourths of the fuel for that part of the work. Again, the latent heat of vaporization—*i. e.*, the amount of heat required to convert a unit of a body at its boiling-point from the liquid to its vapor state, both liquid and vapor being at the same temperature—of bisulphide of carbon is only one-fifth of that of water, or one-sixth of the amount of heat required by water will do the same work with motors constructed as herein shown. The loss of heat by radiation from my motor will be very much less than where steam is employed, for two reasons: First, the lower temperature—that is, the 180° of heat required to vaporize the fluid used in this class of motors as compared with the 240° or more required for steam-engines—as the ratio of radiation advances rapidly as the temperature rises, and then the smallness of my generator as compared with steam-boilers, presents much less surface for the emission of heat. These and other equally cogent reasons are worthy of due consideration when about to invest in a power-motor.

Vapor-motors are no more complicated nor difficult to understand, but are much more easily handled than a steam-motor, and are perfectly tractable. By simply turning or opening the valve e^3, I can raise my power from zero to five hundred pounds pressure to the square inch, and by reversing or closing the valve reduce it again to zero, the whole operation taking less than half a minute, and this with but from three to ten pounds of steam-pressure for heating purposes. Vapor-motors are safer than steam, for the moment the pump ceases to supply the fluid or the valve e^3 is closed the power to do mischief is gone. If, however, by any chance too great a pressure of vapor is permitted to accumulate in the generator, the safety-valve will give way and inject the vapor into the condenser, where it is immediately resolved into a harmless liquid. Even should an explosion take place, there are no ponderous boilers to be rent and with superheated steam and boiling water made the instruments of death and destruction.

Having now fully described my device, what I esteem as new, and desire to protect by Letters Patent, is—

1. The method of vaporizing volatile fluids and generating power-vapor by automatically and as it is required injecting volatile fluid in a spray or shower into an empty horizontal metal chamber at right angles with and bringing it in contact with numerous small steam ducts or tubes adjusted therein, which tubes or ducts are heated by currents of fresh steam passing therethrough, substantially as shown and described.

2. A horizontal vapor-generator having steam chests or chambers secured on the ends thereof, and containing a large number of small open horizontal steam-ducts longitudinally adjusted therein, arranged substantially as shown and described.

3. The method of heating a horizontal vapor-generator having steam chambers or chests, one at each end, and containing a large number of open steam-ducts adjusted therein, by introducing and causing to circulate in such ducts a continuous flow of fresh steam obtained from an auxilliary boiler, and by suitable pipes carried thereto, substantially as shown and described.

4. A horizontal vapor-generator provided with numerous small horizontal tubes or steam-ducts, adjusted longitudinally therein and secured by their open ends in the opposite ends thereof, and with deflecting steam chambers or chests secured on the outside at each end thereof over the open ends of such steam-ducts, in combination with steam-induction pipe b', steam-eduction pipe b^2, and steam-boiler *b*, substantially as shown and described.

5. A horizontal vapor generator having deflecting steam chambers or chests secured on the outside at each end thereof, and provided with a large number of open horizontal steam-ducts longitudinally adjusted therein, in combination with eduction-pipe *f*, throttle-valve f^2, and engine-cylinder f', substantially as shown and described.

6. A horizontal vapor-generator having deflecting steam chambers or chests secured on the ends, and a number of small horizontal steam ducts or pipes longitudinally adjusted and secured by the open ends therein, in combination with distributing-roses e^2, induction-pipes *e*, check-valve e^4, general supply-pipe e', valve e^3, and pump *h*, for supplying volatile fluid automatically and as it is required, substantially as shown and described.

7. The method of producing power-vapor by automatically injecting volatile fluid, in a shower or spray through induction-pipes terminating in roses, into a chamber having

an eduction-pipe, a safety-valve, and vapor-gage, and numerous steam ducts or pipes arranged horizontally in a cluster and passing longitudinally through the lower division thereof, the open ends of which ducts are incased with steam chambers or chests provided with steam induction and eduction pipes, substantially as shown and described.

8. A horizontal vapor-generator having induction-pipe *e*, rose e^2, check-valve e^4, and eduction-pipe *f*, a cluster of steam-ducts, *c*, steam chests or chambers a' a^2, in combination with steam-pipes b' b^2, auxiliary steam-boiler *b*, general supply-pipe e', throttle-valve e^3, pump *h*, reservoir F, and with eduction-pipe *f*, throttle-valve f^2, engine-cylinder f', exhaust *o*, condenser E, and reservoir F, the whole constructed, arranged, and connected substantially as shown and described.

9. In combination, steam-boiler *b*, induction-pipe b', eduction-pipe b^2, steam-chest, vapor-generator *a*, induction-pipes *e*, roses e^2, check-valve e^4, supply-pipe e', throttle-valve e^3, pump *h*, reservoir F, eduction-pipe *f*, throttle-valve f^2, engine-cylinder f', exhaust-pipe *o*, condenser E, pipe o', and reservoir F, all adjusted and arranged substantially as shown and described.

10. In combination with a vapor-generator, *a*, provided with induction-pipes having roses for distributing the liquid in a spray or shower upon the naked heated metal below, an eduction-pipe for carrying the generated vapor to the engine-cylinder, a cluster of steam-ducts to provide heat for converting volatile liquid into vapor, steam domes or chests a' a^2, steam-induction pipe b', steam-eduction pipe b^2, steam-boiler and furnace *b*, the latter provided with a steam-gage, a water-induction pipe, a waste-pipe, and a blow-pipe, substantially as shown and described.

In testimony whereof I have affixed my signature, in presence of two witnesses, this 8th day of December, 1882.

ISRAEL R. BLUMENBERG.

Witnesses:

A. P. RUTHERFORD,

HENRY POLSZ.