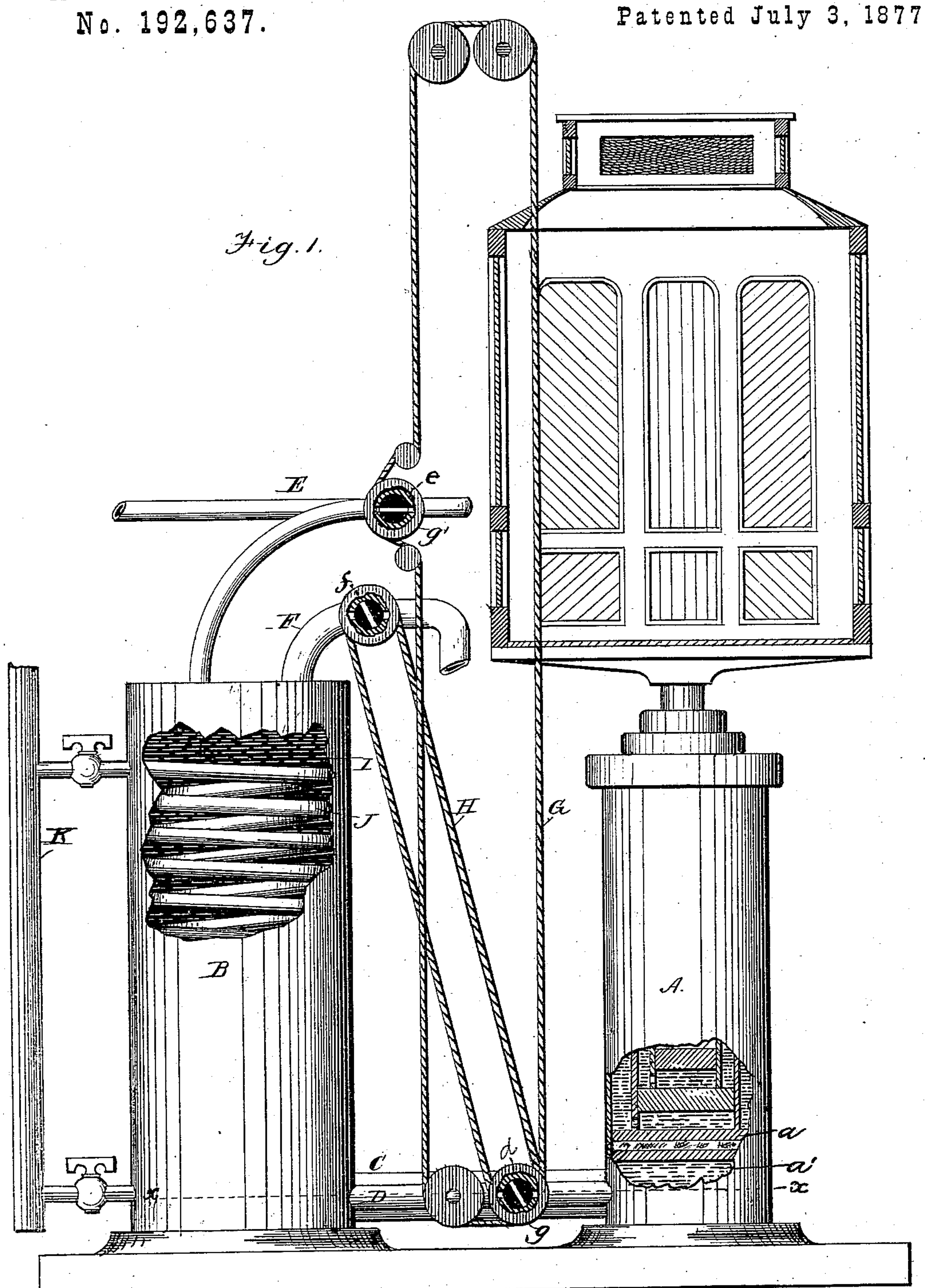
3 Sheets—Sheet 1.

W. R. COMINGS.

METHOD OF APPLYING POWER IN STEAM, AIR OR GAS ENGINES.

No. 192,637. Patented July 3, 1877.

Fig. 1.



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3 Sheets—Sheet 2.

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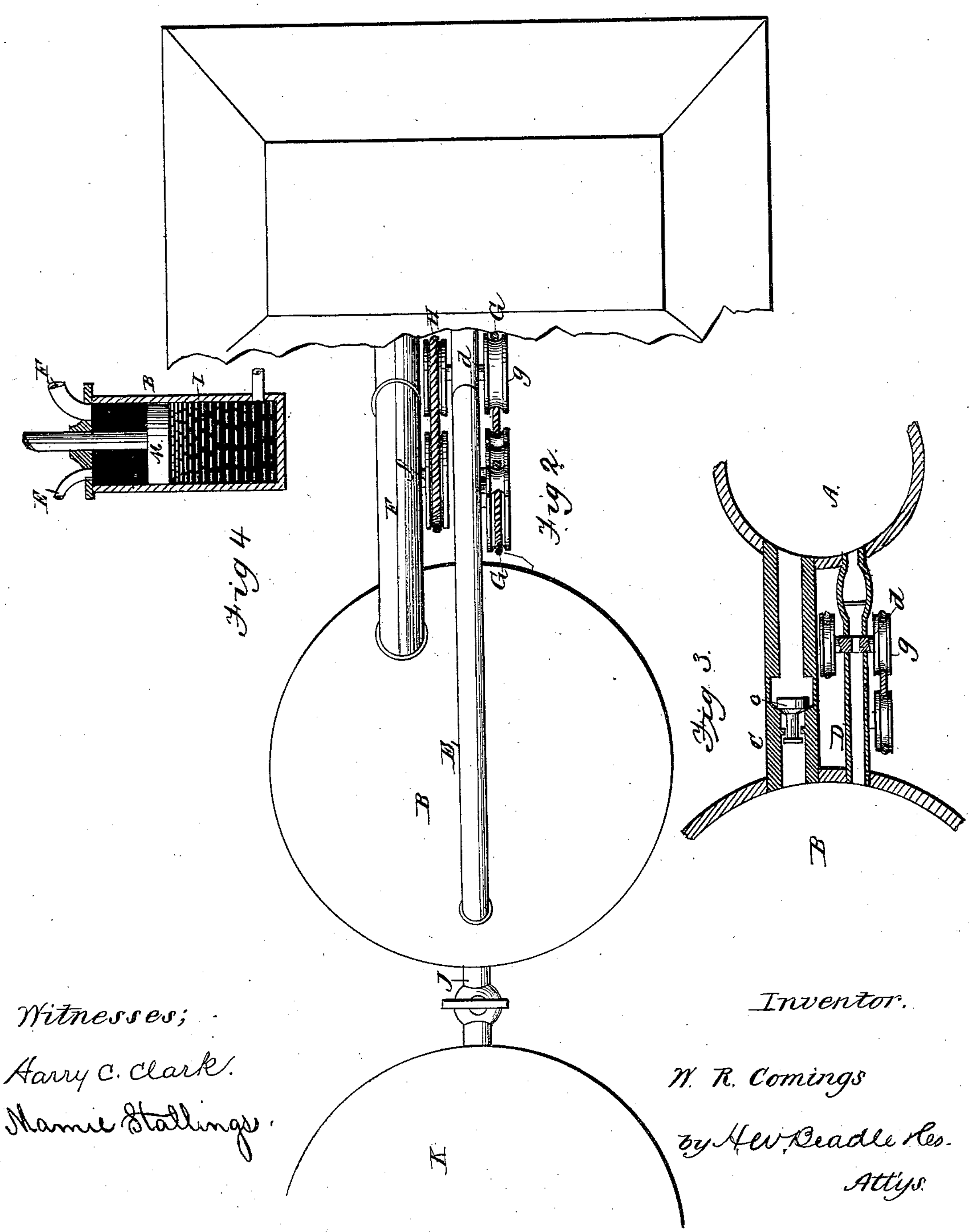

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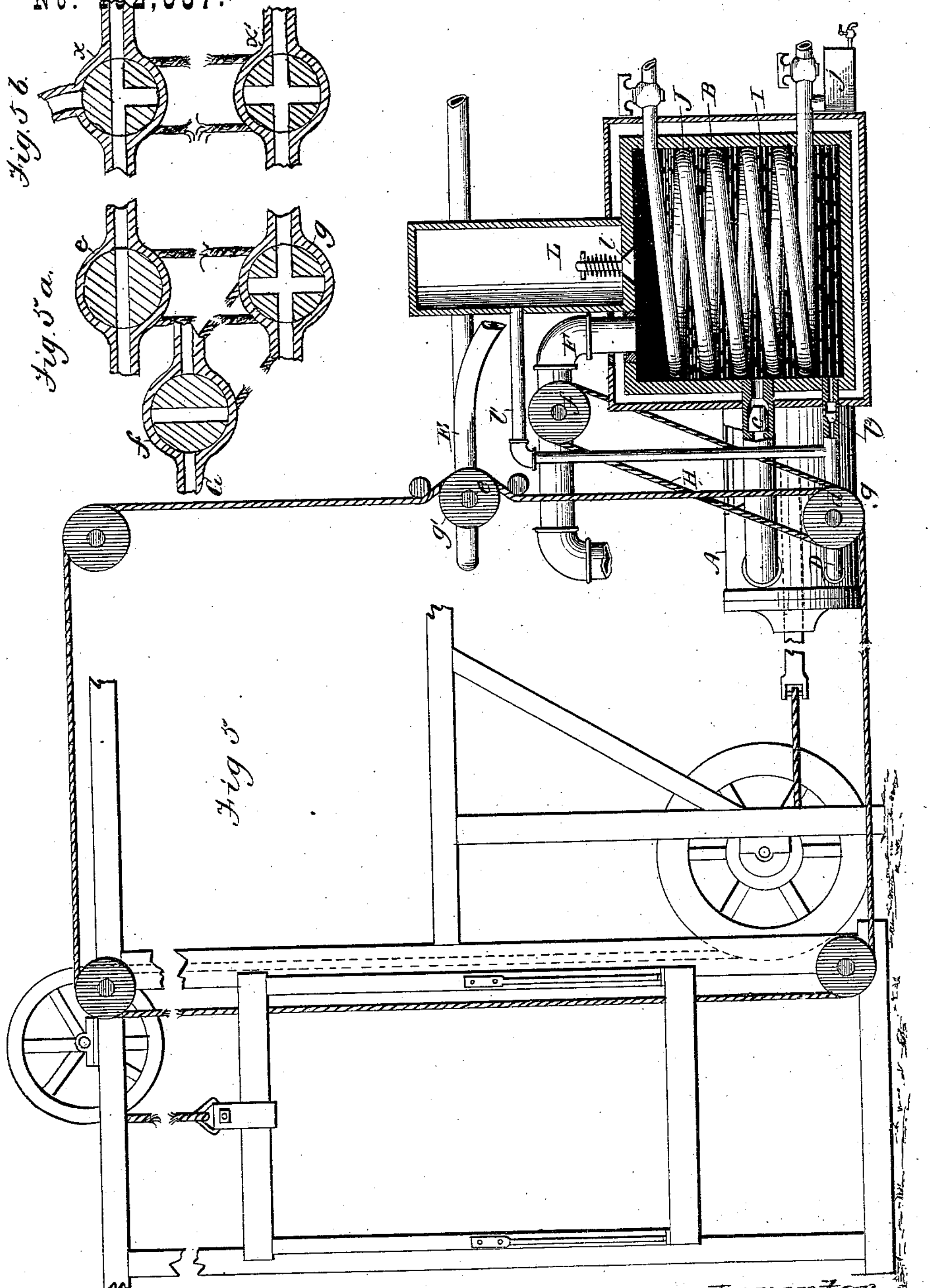

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UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN METHODS OF APPLYING POWER IN STEAM, AIR, OR GAS ENGINES.

Specification forming part of Letters Patent No. **192,637**, dated July 3, 1877; application filed December 11, 1876.

To all whom it may concern:

Be it known that I, WILLIAM R. COMINGS, of New Britain, in the county of Hartford and State of Connecticut, have invented a new and useful Improved Method of and Apparatus for Applying Power in Steam, Air, or Gas Engines; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

This invention consists, mainly, first, in an improved method of applying power in an engine having its piston moved by an elastic fluid through the medium of a liquid volume, consisting in heating the liquid volume to a temperature sufficient to prevent condensation of the elastic fluid, and in applying the power to the elastic fluid expansively, so that its expenditure may be varied during each stroke of the piston to correspond with the work to be done; second, in an improved method of applying power in an engine having its piston moved by an elastic fluid through the medium of a liquid volume, consisting, essentially, in controlling the supply and exhaust of the elastic fluid so that its expenditure may be varied during each stroke of the piston to correspond with the work to be done, and in controlling the movement of the liquid volume, so as to prevent its backward flow; third, in an improved method of applying power in an engine having its piston moved by an elastic fluid through the medium of a liquid volume, (consisting, essentially, first, in heating the liquid volume to a sufficient temperature to prevent the condensation of the elastic fluid; second, in controlling the supply and exhaust; and, third, in applying the power directly to the liquid volume without intervening mechanism;) and, fourth, in an improved method of preventing condensation in an engine having its piston moved by an elastic fluid through the medium of a liquid volume, consisting, essentially, in heating the liquid volume to a temperature sufficient to prevent the condensation of the elastic fluid.

It consists, further, in the special apparatus employed to carry my methods practically into effect, all of which will be fully described hereinafter.

In the drawings, Figure 1 represents a side elevation, partially in section, of my improved apparatus as applied to a hydraulic telescopic elevator; Fig. 2, a plan view of the same; Fig. 3, a transverse section taken on the line *x x*, Fig. 1; Fig. 4, a vertical sectional elevation of the tank, provided with a piston interposed between the main power and the fluid volume; and Fig. 5 a modification of my apparatus applied to the cylinder of a hoist-elevator.

To enable others skilled in the art to make and use my invention, I will now proceed to describe fully its construction and manner of operation.

A represents the main cylinder of an elevator, of any of the well-known forms, and *a* its piston, of the usual well-known construction.

B represents a tank of any proper construction and suitable strength, which equals or exceeds in cubic capacity the cylinder A, as indicated in the drawing.

C represents a pipe of comparatively large area, by means of which the interior of tank B is connected with the chamber *a'* of the cylinder, as shown.

c, Figs. 3 and 5, represents a check-valve of any proper construction, placed in pipe C, which is adapted, in the well-known manner, to permit the flow of liquid from tank B to cylinder A, but to prevent absolutely its return.

D represents a pipe of comparatively small area, by means of which, also, the interior of tank B is connected with the chamber of the cylinder, as shown.

d represents a valve of any proper construction, which is adapted to control the return of the liquid from cylinder A to tank B, as will be hereinafter described.

E represents a supply-pipe adapted to deliver steam, compressed air, or any elastic fluid from any suitable source into the tank B.

e represents a valve of any proper construction, which is adapted to control the supply of steam or air, as will be hereinafter described.

F represents an exhaust-pipe leading from tank B to any proper point of discharge, and *f* a valve of proper construction adapted to control the exhaust, as will be hereinafter described.

G represents a shifting-rope conveniently arranged for operation in the usual well-known or other proper manner.

g g' represent wheels attached to the spindles of valves *d* and *e*, which are adapted, as shown, to receive partial revolution from the rope to actuate the valve.

H represents a belt or band, by means of which the movement of valve *d* is communicated to the valve *f* in the exhaust-pipe.

The special construction of these valves, and the means for operating them, may be varied; but it is essential in all cases that the construction should be such that the supply of steam can be controlled independently of the exhaust.

I represents a volume of practically incompressible liquid, such as water or glycerine, which is employed between the main power and the piston of the cylinder as intermediate means for transmitting power from the former to the latter.

J represents a coil of pipe contained in tank B, the ends of which communicate, in any proper manner, with a boiler, K, Fig. 1, or other proper source of heat-supply. *j* represents a chamber or vessel of proper construction, by means of which the waters of condensation may be collected and drawn off.

The operation is substantially as follows: When it is desired to raise the cab or platform, the shifting-rope is actuated in the proper manner to open the valve *e* in the steam-supply pipe to a greater or less extent, according to the load to be lifted.

The steam thus admitted to tank B acts by its pressure to force the liquid volume contained therein through the large pipe C into the chamber *a'*, Fig. 1, below the piston *a* of the elevator-cylinder, the check-valve *c*, Fig. 3, freely permitting flow in this direction.

The movement of the displaced water actuates, of course, the piston of the cylinder to raise it in the usual well-known manner.

The valve *e* in the steam-supply pipe is actuated without affecting the operation of the other valves, and hence, by opening it more or less fully, according to the load to be lifted, the elastic fluid, serving as a main power, is made to act expansively, in the usual well-known manner. For instance, if it is desired to lift a light load, the valve *e*, controlling the steam-supply, is opened to its full extent, allowing steam to enter the chamber at full pressure; but before the piston *a* has completed its stroke the valve *e* is actuated so as to instantly cut off the supply, and the body of steam thus admitted and confined in the chamber will then act by expansion to displace the liquid beneath it, and drive the piston through the remainder of its stroke, but with a lifting power diminished just in proportion to the grade of expansion employed. Thus if the volume of steam admitted at full pressure and cut off was equal to one-tenth the volume of the cylinder, the elevator would be raised with one-tenth the lifting capacity that would have been given to it by allowing the steam to enter at full pressure through the entire stroke of the piston or pistons.

The steam is thus made to act expansively on what is called the "cut-off" principle.

If, instead of opening the valve to its full limit for a short period of time, it is opened to a very slight extent throughout the entire movement, the steam will expand as it enters, and actuate the elevator-piston, as before, with a lifting capacity proportionate to the grade of expansion produced by allowing the steam to enter through the partially-open valve. Thus if the valve was opened to one-tenth the amount necessary to permit the steam to fill the chamber at full pressure, then the lifting power of the elevator would be, as before, one-tenth of its maximum; but a quantity of steam would be employed at full pressure equal to only one-tenth the amount necessary to raise the elevator with its full load.

It will thus be readily seen that, by opening the steam-supply valve to a greater or less extent, a lifting-power can be given to the elevater exactly proportionate to the load to be carried up, and also that the consumption of power can be perfectly adjusted to the requirements of the load.

By this last method the steam is caused to act expansively on the "throttling" principle, in distinction from the former method by cut-off.

When the elevator reaches the desired point it may be stopped by closing the supply-valve, and when stopped it will be securely held from descent by the check-valve *c*, which absolutely prevents the return of the fluid volume.

When it is desired to lower the elevator the shifting-rope G is properly actuated to open the valve *f* controlling the exhaust, and the valve *d* controlling the flow of liquid from the cylinder to the tank, in consequence of which the pressure will be removed from the tank, and hence the fluid volume may be forced back into the same by the return of the piston of the cylinder.

The operation of the valves in detail may be set forth as follows:

To raise the elevator the shifting-rope is pulled up to a greater or less extent, according to the necessities of the case, and the valves *d*, *e*, and *f* are, consequently, all revolved to a corresponding extent. The construction of these valves, however, is such that only the valve *e* will be in position to open, the other valves, though partially revolved, still remaining closed. When it is desired to stop the elevator the rope is pulled down to its first position, and, consequently, the supply of steam is shut off.

To lower the elevator the rope is pulled still farther downward, so that the valves *d f* are revolved far enough to open communication in the pipes D F, while the steam-valve *e* remains closed.

By means of the heating-coil the liquid in the tank B is raised to a temperature equal to or higher than that of steam, (212°,) or that of other elastic fluid employed, in order that the latter, when serving as a main power, may not be condensed by contact with it.

To obtain this high temperature a liquid should be used whose boiling-point is higher than the temperature of the highest pressure of steam employed.

If, however, compressed air or a similar elastic fluid is employed as the main power, the liquid, of course, will not be required to be heated, as no condensation will take place.

A modification of my invention is shown in Fig. 5.

In this figure L represents an auxiliary tank, communicating with the main tank by a pipe or opening controlled by the check-valve *l*.

l^1 represents an auxiliary pipe, by means of which the auxiliary tank is connected to the delivery-pipe D between the valve *d* and the tank B, as shown.

l^2 represents a check-valve located in the main pipe D, as shown, the purpose of which is to prevent the liquid in the tank when passing to the cylinder from entering the auxiliary pipe and returning through the auxiliary tank to the main tank. If desired, however, instead of locating a check-valve in the main pipe D, a valve of ordinary construction may be located in the auxiliary pipe l^1, in which case it should be connected to the valve *d* in such manner as to work in harmony with it.

The operation is as follows:

When the exhaust-valve *f* and the valve *d*, controlling the return of the liquid to the tank, are opened to permit the elevator to descend, the liquid will flow immediately through the auxiliary pipe l^1 into the auxiliary tank L, but not immediately into the main tank B, as its flow in this direction is checked to a greater or less extent until the steam has entirely escaped through the exhaust. When this is accomplished the liquid from the cylinder may flow directly through the main pipe into the tank B, but ceases to flow through the auxiliary pipe l^1.

The check-valve *l* consequently being no longer supported by the steam-pressure, is opened by the weight of the liquid in the auxiliary tank, which latter then flows again into the main tank.

If desired, all the liquid returning to the tank from the cylinder, may be caused to pass through the auxiliary pipe, in which case that portion of the main pipe between the connection with the auxiliary pipe and the tank may be dispensed with.

By the employment of the auxiliary tank and connections, as described, the liquid beneath the piston of the elevator is allowed to escape from the cylinder instantly, and with a uniform velocity when the valve *d* and exhaust-valve *f* are opened to cause the elevator to descend when, without their employment, the liquid would be retarded in its movement by the escaping steam, and its initial velocity consequently accelerated until the exhaust of the latter was completed.

I do not limit myself to the precise construction shown.

The steam or other elastic fluid may be used expansively, either by the employment of a throttle-valve or cut-off, the construction in the latter case being properly modified for that purpose.

In place of a rope for actuating the valves, a rod, adapted to give positive movements, may be employed.

If desired, a piston, M, may be interposed between the main power and the intermediate fluid volume, as shown in Fig. 4.

The main piston of the elevator may be of any proper construction, as stated, but when exposed to a high temperature, as when steam or a similar fluid is employed, it is preferably provided with a central layer of asbestus, felt, or other non-conducting material, as shown in Fig. 1, to prevent the conduction of heat to the upper portions of the elevator.

A coil is used for heating the fluid volume, or a steam-jacket, or other proper means may be used.

The main cylinder of the elevator may also be jacketed in any proper manner to prevent the radiation of heat.

My invention may be employed, of course, for any of the various purposes to which hydraulic pressure is applicable.

Some of the advantages belonging to my invention are as follows:

Steam or compressed air can be used as the main power, and be employed expansively, so that the expenditure of power may be proportioned to the weight to be lifted.

By the employment of a highly-heated liquid volume, the loss of power resulting from the condensation of steam is avoided.

The main power also being applied directly to the intermediate liquid volume without the use of intervening mechanism, I simplify the construction and reduce the cost.

The elevator being lifted by a fluid volume receiving movement from a main power acting continuously and not intermittently, its movement will necessarily be uniform and without shock or jar.

The descent of the elevator also being governed by the flow of liquid through a pipe, its movement also will be necessarily uniform and without shock or jar.

The construction of the apparatus as a whole is exceedingly simple, and it can be produced at a comparatively small cost.

The invention herein described, although adapted for all the various purposes for which hydraulic pressure is used, is only shown as employed in connection with elevators.

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

1. In an engine in which a piston is moved by an elastic fluid through the medium of a liquid volume, the method of applying the power, consisting in heating the liquid volume to a temperature sufficient to prevent condensation of the elastic fluid, and in applying the power to the elastic fluid expansively, as shown, so that its expenditure may be varied during each stroke of the piston to correspond with the work to be done.

2. In an engine in which a piston is moved by an elastic fluid through the medium of a liquid volume, the method of applying the power, consisting in controlling the supply and exhaust of the elastic fluid so that its expenditure may be varied during each stroke of the piston to correspond with the work to be done, and in controlling the movement of the liquid volume, so as to prevent its backward flow.

3. In an engine in which a piston is moved by an elastic fluid through the medium of a liquid volume the method of applying the power consisting, first, in heating the liquid volume to a sufficient temperature to prevent the condensation of the elastic fluid; second, in controlling the supply and exhaust, as shown; third, in applying the power directly to the liquid volume without intervening mechanism.

4. In an engine in which a piston is moved by an elastic fluid through the medium of a liquid volume, the described method of preventing condensation, consisting in heating the liquid volume to a temperature sufficient to prevent the condensation of the elastic fluid, substantially as described.

5. The combination of the piston-chamber, the liquid-chamber provided with means for supplying and exhausting the motive fluid, and a valve interposed between the two chambers for controlling the flow of the liquid, said valve and the steam-valve being independently controlled, substantially as described.

6. In a machine in which the piston is moved by steam-pressure transmitted through a liquid body, the check-valve for preventing the return of the liquid to the cylinder, a valve for admitting the required amount of pressure and means for controlling the exhaust, whereby the supply and exhaust may be independently operated.

7. In a machine in which the power is transmitted through a heated liquid, the heating-coil in combination with the liquid-chamber, substantially as described.

8. The combination of the main tank B, the auxiliary tank L, the check-valve l between them, and the pipes D l^1, connecting said tanks with the piston-cylinder, the construction being such that the backward flow of the liquid volume is permitted while the steam is exhausting, substantially as described.

9. In a machine in which the piston is moved by the pressure of an elastic fluid, transmitted through a liquid volume, in combination with the cylinder A and tank B, the independent supply and exhaust pipes E and F, having valves e and f, adapted for independent operation to permit the use of steam expansively, substantially as described.

10. In combination with an intermediate liquid volume, adapted to be acted upon by steam-pressure, a valve for admitting the required amount of pressure, a check-valve for preventing the backward flow of the fluid when acted on by the pressure, and a piston, substantially as described.

11. In combination with the tank B and cylinder A, the connecting-pipe C, having check-valve c, and the pipe D, having the valve d, as described.

12. In combination with the tank B and cylinder A, the valve d controlling the flow in the pipe D, the valve f controlling the exhaust, and intermediate means, substantially as described, for connecting and operating the two together.

13. In combination with a tank, a steam-supply pipe having a valve independently controlled, and a delivery-pipe having an automatic check, the construction being such that when strain is admitted to the tank the liquid is caused to flow from the tank without possibility of return, substantially as described.

14. In combination with a tank having a steam supply-pipe with an independently-acting valve, a delivery.pipe having a check-valve, and an inflow-pipe and exhaust-pipe, having valves working in harmony, substantially as described.

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