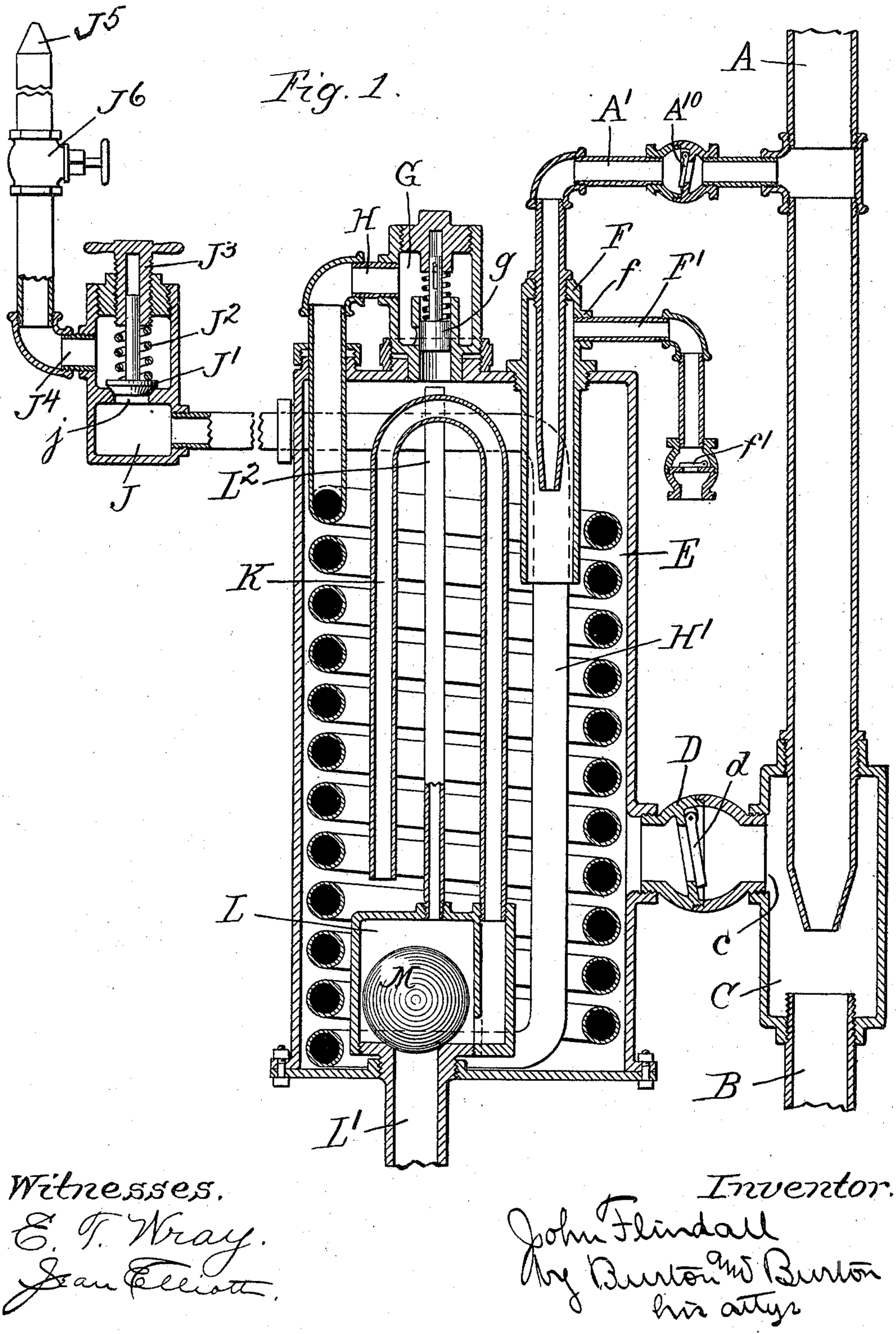
(No Model.) 2 Sheets—Sheet 1.

J. FLINDALL.

AIR COMPRESSING AND COOLING APPARATUS.

No. 585,955. Patented July 6, 1897.

Fig. 1.



Witnesses.
E. T. Wray.
Jean Elliott.

Inventor.
John Flindall
by Burton and Burton
his attys.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

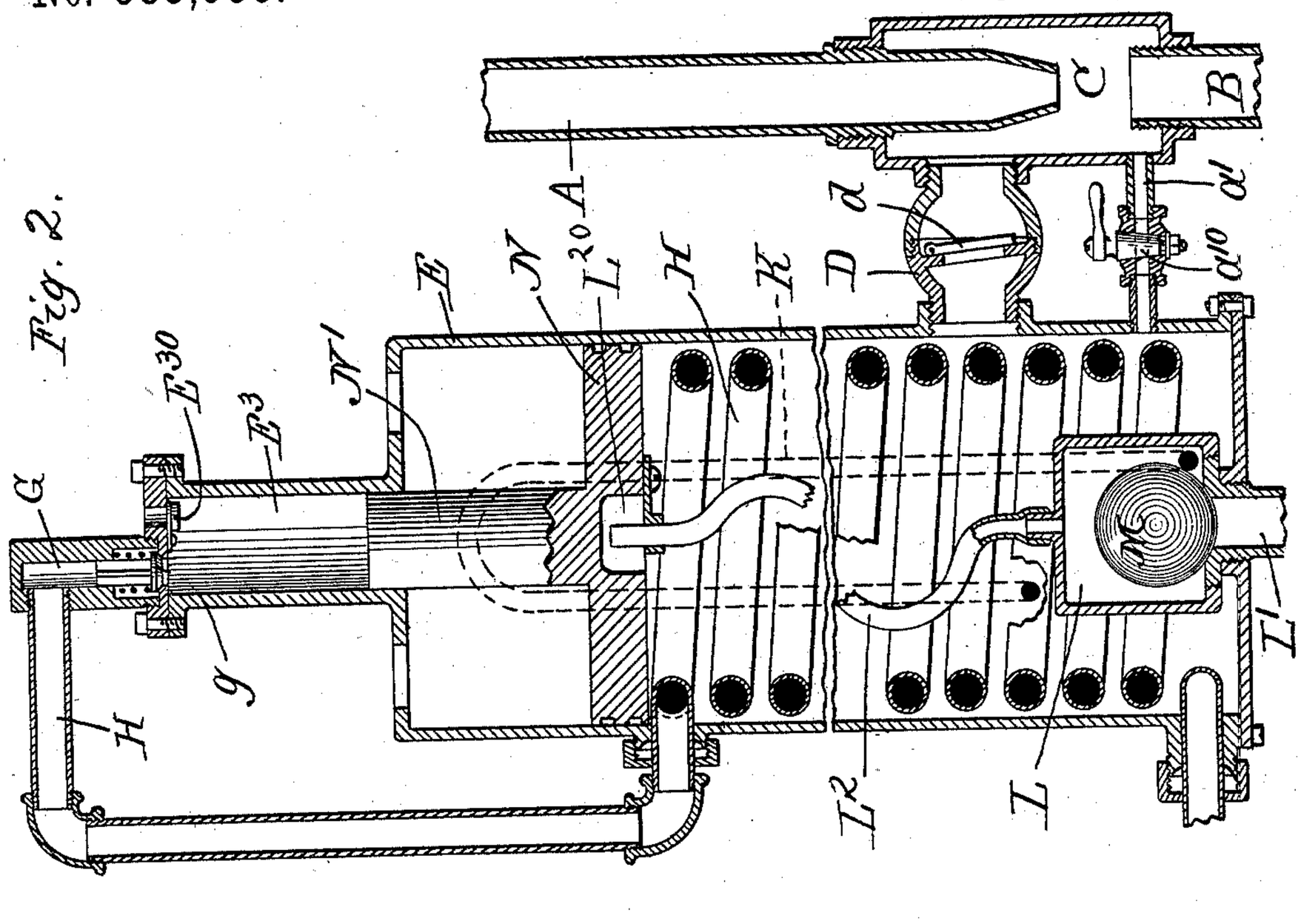


Fig. 3.

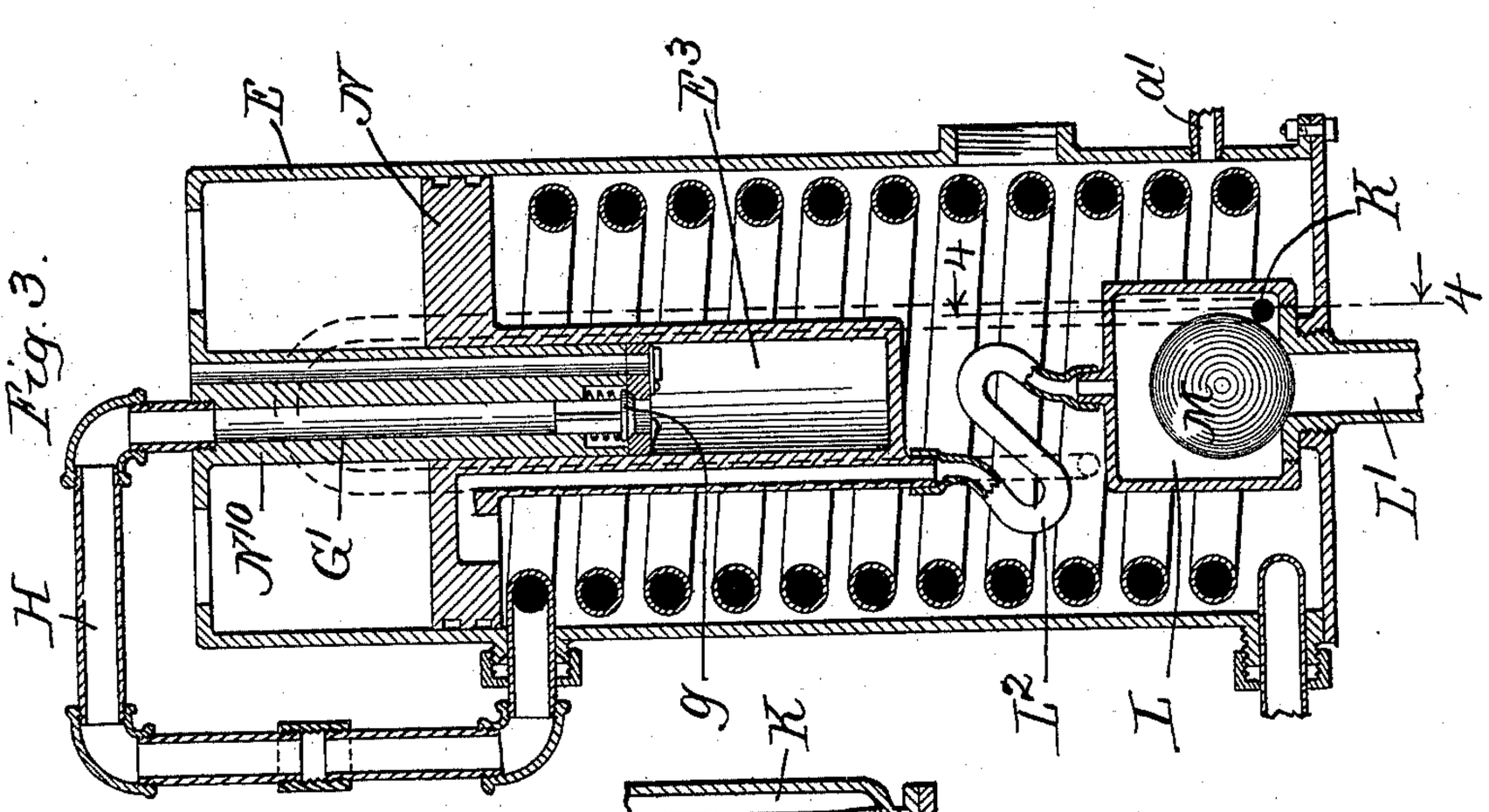
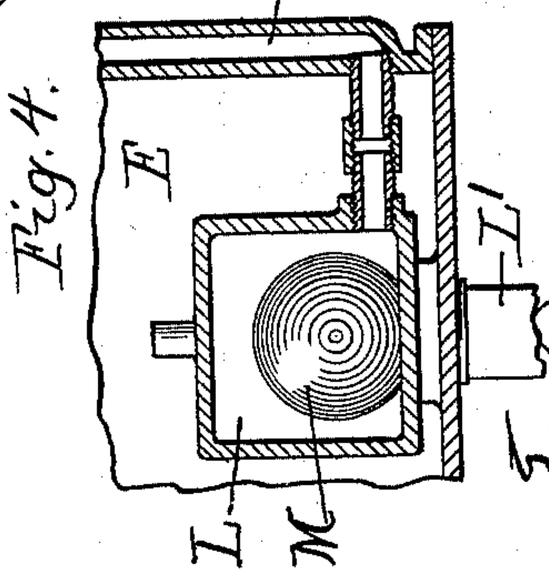


Fig. 4.



Witnesses.
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UNITED STATES PATENT OFFICE.

JOHN FLINDALL, OF CHICAGO, ILLINOIS.

AIR COMPRESSING AND COOLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 585,955, dated July 6, 1897.

Application filed February 4, 1896. Serial No. 577,980. (No model.)

To all whom it may concern:

Be it known that I, JOHN FLINDALL, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Air Compressing and Cooling Mechanism, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved appliance by which the ordinary supply of water under pressure for domestic purposes may be utilized to compress air and absorb the heat rendered sensible by such compression, so that such compressed air may be in condition to be utilized by permitting its expansion under proper conditions to produce refrigeration.

It consists in improved mechanism by which the water-pressure is utilized to compress the air.

It consists also in such arrangement of the water-chamber and the air-passages that the water under pressure, while operating to compress the air, simultaneously operates to cool the same.

It consists also in expedients by which the water thus used to compress and simultaneously cool the air is drawn from the chamber in which it operates for this purpose by the ordinary use of water in the house in order to admit a new supply of water to such chamber for the purpose of renewing the pressure and continuing the cooling process.

It consists also of improved mechanism by which the water-supply, even at low pressure, compresses the air to a much higher tension.

It comprises also further details of construction, which are specified in the claims.

In the drawings, Figure 1 is a vertical section of one form of my refrigerating device, in which the air-tension producible is limited to the water-pressure. Fig. 2 is a similar section of a modified form, in which the air-pressure producible is in excess of the water-tension. Fig. 3 is a similar section of a further modification, having the same characteristics stated with respect to the form shown in Fig. 2, but having the parts rearranged for the purpose of reducing the exterior dimensions. Fig. 4 is a detail section at the line 4 4 on Fig. 3.

A represents a water-supply pipe; B, a continuation of the same leading to the house system or to any particular part or faucet therein.

C is a chamber constituting a coupling uniting the pipes A and B, having a lateral or by-pass opening *c*, controlled by a check-valve *d*, opening inwardly with respect to said chamber, whose body D is screwed into said opening, and which serves as a coupling to connect the chamber C, and thereby the pipes A and B, with the body of a cylinder E, which is the compression and cooling chamber.

In the form shown in Fig. 1 the pipe A has a branch A′ back of the coupling-chamber C, which leads also into the chamber E at the upper part. More specifically, I provide a pipe or thimble F, which is inserted down from the upper end of the chamber E and protrudes a few inches below the top, this thimble having a lateral opening *f* outside the cylinder, at which there is connected a branch F′, having an air-inlet valve *f′*, and into the upper end of the pipe F the branch water-pipe A′ protrudes and extends downward some distance below the top of the cylinder E, but stops short above the end of the pipe F, and is preferably constructed or provided with a tapered discharge. In the branch pipe A′ there is a check-valve A^{10}, which admits water to the cylinder, but prevents its return. At the upper end of the chamber E it has an air-outlet controlled by an outwardly-opening check-valve *g*, from whose chamber G beyond the seat of the valve the pipe H leads back into the chamber E, where it is formed into a spiral coil near the wall of the cylinder. I have shown the spiral commencing at the upper part and continuing to the bottom, the end of the pipe being then turned inward and extended up within the coil, as seen at H′, and emerging from the cylinder at the upper part and extending to any convenient point, where it connects with a chamber J, having an outlet at *j*, controlled by a valve J′, which is seated by the pressure of a spring J^2, whose tension may be regulated at will by the screw J^3. From the valve-chamber beyond its seat a pipe J^4 leads to the refrigerator or cooling room or apartment to be cooled and terminates therein in a small nozzle J^5, the discharge through which may be controlled by

a valve J^6, which is preferably located as near to the nozzle as possible.

The operation of the device, as thus far described, may be now understood.

The water-supply entering through the branch A′ and discharged from the lower end of that branch within the pipe F operates as an injector, drawing air past the check-valve f' until the cylinder E is filled with water high enough to seal the lower mouth of the pipe F, and if the water-pressure is strong air will be drawn until the water rises some little distance past said mouth. Eventually, however, the water will cease to draw air, but will continue to discharge through the pipe A′ into the chamber E until the tension of the air, which will occupy the upper part of the chamber above the water and the pipe H to the valve J′, is equal to the water-pressure or to the resistance of the valve J′, which must not exceed the maximum water-pressure, but may be even less. Disregarding for the present the discharge of air, which may be permitted through the nozzle J^5, it will be noticed that whenever water is drawn from the pipe B, the pressure through the branch A′ being diminished or entirely taken off, some portion of the water passing out through B will be received from the chamber E, past the check-valve *d*. This result is rendered more certain and increased in degree by the detail structure shown in the coupling-chamber C, consisting in extending the pipe A thereinto beyond the by-pass opening controlled by the check-valve *d* and reducing the end of the pipe and having it operate somewhat as a trome to draw water by friction past the valve *d* out of the chamber E; but even without this specific construction any considerable draft of the water from the pipe B will be supplied partly from the chamber E. The size of the cylinder E should be such in respect to the ordinary consumption in the house and the frequency with which the water is drawn for such consumption that said chamber E will not be likely to be completely filled in the intervals between the drawing of water for the house through the pipe B during ordinary use in the daytime; and this being the case there may be a constant discharge of air from the nozzle J^5 and a constant maintenance of pressure in the chamber E by the inflow of water in the intervals between the outflows caused by drawing water from the pipe B. The air compressed in the chamber E will be heated by such compression, and that heat being reabsorbed by the water as the air passes through the coil of the pipe H within the chamber E the air will reach the valve J′ substantially at normal temperature, or nearly as cool as the water-supply, but under the tension produced in the chamber E, and will be discharged past that valve when it exceeds the pressure to which the valve is set. The air compressed to the tension determined by the adjustment of the screw J^3 is now subject to the control of the valve J^6 and may be permitted to discharge past said valve at will and at any rate consistent with maintaining the desired pressure back of such valve, and being under tension and at normal temperature it is in condition to be made available for the purpose of refrigeration according to well-known principles. The mechanism or expedients for this function form no part of my invention and are not illustrated.

In order to avoid the cessation of the discharge in case the water should be drawn through the pipe B at too great intervals, as at night, when the water is not much in use, it is important to provide means for automatically emptying the chamber E as frequently as it becomes nearly filled and before the water can pass out into the pipe H. For such purpose I provide the siphon K, which leads from the valve-chamber L, which is located at the bottom of the chamber E and has a free discharge at L′, controlled by the float-valve M, which is seated within the chamber L. The siphon has its crest near the top of the chamber E, and its shorter leg opens a short distance above the valve-chamber L. A vent-pipe L^2 extends from the top of the chamber L up within the chamber E, opening freely in said chamber above the crest of the siphon.

With this construction it will be understood that in the valve-chamber L, where the valve M is seated, there is air at the tension produced at the chamber E by the water-pressure and that when the water rising in the chamber E fills the shorter leg of the siphon and flows over the crest and fills the valve-chamber L, floating the valve off its seat, the siphon will be instantly primed and the water will be drawn through it out of the chamber E down to the level of the lower end of the shorter limb or intake-mouth of the siphon. The siphon should be of such capacity relatively to the supply, which can be received from the branch pipe A′, that the chamber will be emptied quickly, notwithstanding the supply, which will continue during the emptying. As soon as the water has fallen below the intake-mouth of the siphon the air entering will break the action and the chamber E will again fill until the siphon is again primed and the discharge repeated.

When by reason of insufficient water-pressure or because greater degree of cooling is necessary than can be obtained without greater compression than can be produced by the water-pressure directly, the modification shown in Figs. 2 and 3 may be employed. In these forms the branch pipe A′, with the appliances connected therewith for drawing in air, are omitted, and the water-supply to the cylinder is taken in preferably near the bottom and preferably below the by-pass or outlet-valve D, as by a small pipe *a*′, which may lead from the coupling-chamber C or from any other point in the water-supply. This pipe *a*′ may have a cut-off valve a^{10},

which will be closed only when the device is intended to be out of use, or which may be partly closed to increase the period of filling and diminishing the frequency of siphonic emptying. In this form no air is taken into the cylinder E, but a piston N is provided adapted to play in the cylinder above the coil of pipe H, which is brought in and emerges at the side. This piston has a reduced portion or stem N′, which plays in a correspondingly-reduced piston-chamber rigid with the cylinder E, from which discharge is afforded beyond the stroke of the piston past the check-valve, which corresponds to the check-valve *g* in the form shown in Fig. 1 and is indicated by the same letter, from whose chamber G, beyond the seat of the valve, the pipe H leads, as in the form shown in Fig. 1. An air-inlet is provided for the piston-chamber E^3 beyond the piston controlled by an inlet check-valve E^{30}. In this construction it will be understood that the pressure producible beyond the reduced piston or piston-stem N′ and in the coil of the pipe H will be to the water-pressure operating back of the large piston in the cylinder E inversely as the area of the two pistons or piston-stem N′ and piston N. For example, the piston N being four inches in diameter and the stem N′ being one inch in diameter, with a water-pressure of twenty-five pounds behind the piston N, an air-tension of four hundred pounds will be producible in the cylinder E^3 and coil of pipe H, with a corresponding increase of the cooling effect which may be produced.

In order to render the device more compact, the form shown in Fig. 3 may be adopted, in which the piston N is guided upon a stem N^{10}, which is rigid with the cylinder E instead of with the piston, such stem being intruded into a chamber E^3, which is rigid with the piston instead of with the chamber E^3, both the piston N^{10} and the chamber E^3 being produced downward into the cylinder E instead of upward. In this construction the valve *g* is located at the lower end of the stem N^{10}, the duct G′ corresponding to the valve-chamber G and being connected from the upper end outside of the cylinder E with the pipe H. The air-intake valve in this construction is also located at the inner end of the stem N^{10}, a duct leading from the valve to the top of the cylinder E. In both forms the upper end of the cylinder E is open to the air, being made in the form of a spider to support the stem N^{10}.

In both the forms shown in Figs. 2 and 3 it becomes necessary to provide a modified means of equalizing the pressure in the chamber L because of the presence in the chamber E of the piston N, preventing the rigid extension of a pipe corresponding to L^2 to a point above the crest of the siphon. The modification illustrated consists in making the pipe L^2 flexible and attaching it at its upper end to the piston, so that the duct which it constitutes opens above the highest point to which the water can rise. When the water is drawn out of the chamber by the siphon, the water-level, falling to the intake-mouth of the siphon, leaves air above the water to be compressed as the chamber fills, and the distance of the intake-mouth of the siphon below the lowest position of the piston N will be calculated with reference to the water-pressure and the consequent degree of compression to which the air will be subjected as the chamber fills, so that after allowing for compression of air in the siphon and in the chamber L the water-level will never rise high enough to enter the mouth of the pipe L^2, terminating, as it does, in a cavity L^{20} in the under side of the piston.

The modifications shown in Figs. 2 and 3 I do not claim specifically, but I have illustrated them to indicate the scope of my invention in respect to the essential features. These modifications will be the subject of a subsequent application or applications.

I claim—

1. In combination with a water-supply pipe of a house, a by-chamber communicating with said pipe at a point in the latter between the source of supply and the point of consumption, the watercourse between said points being complete independently of said by-chamber; said by-chamber having extent above the point of communication of the water-supply pipe therewith, and having an air-inlet and an air-outlet, also above said point of communication and suitable check-valves to control the same to permit the air to enter only by the inlet and escape only by the outlet, and a pipe or chamber into which the air is forced and compressed by the water entering the by-chamber from the supply-pipe.

2. In a refrigerating apparatus, in combination with suitable means for compressing air by water supplied under pressure, comprising a chamber into which the water under pressure is admitted; a check-valve past which the compressed air is forced by the compression, and which prevents its return; the water-chamber having a drainage-port larger than the supply-port connected to the water-supply system; and a check-valve which permits the water to pass out from the chamber through such port, but prevents its return, whereby the drawing of the water from the supply system tends to withdraw water from the chamber in excess of the supply thereto.

3. In a refrigerating apparatus, in combination with suitable means for compressing air by water supplied under pressure, comprising a chamber into which the water under pressure is admitted; a check-valve past which compressed air is forced by such compression; and a coil or extended passage into which the air is thus forced, such coil or passage being located in the water-chamber, the latter having a drainage-port larger than the supply-port and controlled by a check-valve which prevents the entrance of water into

the chamber through such port; connections from such port to the water-supply system; whereby the intermittent flow of water through such system causes the alternate filling and emptying of the chamber and the cooling of the air in the coil.

4. In a refrigerating apparatus, in combination with suitable means for compressing air by water supplied under pressure, comprising a chamber into which the water under pressure is admitted; a siphon having its intake-opening in such chamber; a supplemental chamber into which the longer limb opens, said supplemental chamber having a free outflow and a float-valve to control the same, and having communication otherwise than through such siphon with the top of the water-chamber; whereby the water-chamber is emptied siphonically preparatory to refilling whenever the water rises therein above the level of the crest of the siphon.

5. In a refrigerating apparatus, in combination with the water-chamber, an air-pipe terminating in the chamber having an intake check-valve and a water-pipe protruding into and discharging in said air-pipe beyond the check-valve and through said air-pipe into the chamber, whereby the water-supply draws air into the chamber; a coil located in the water-chamber and communicating with the upper part thereof; a check-valve which controls such communication, and suitable means for intermittently withdrawing water from the water-chamber, whereby a fresh supply of air is admitted for compression and a fresh supply of water admitted to cool the air so compressed.

6. In a refrigerating apparatus, in combination with a chamber into which water under pressure is admitted and suitable means for supplying air to the upper part of such chamber; a check-valve controlling the emission of air from the chamber; a coil into which the same is emitted, said coil being located in the water-chamber and leading therefrom; a valve which controls the discharge of air from such coil, and means for regulating the pressure necessary to discharge the air past such valve: substantially as set forth.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 31st day of January, 1896.

JOHN FLINDALL.

Witnesses:
CHAS. S. BURTON,
JEAN ELLIOTT.