(Model.)

2 Sheets—Sheet 1.

E. M. HUGENTOBLER.

HYDRAULIC AIR COMPRESSOR.

No. 342,798. Patented June 1, 1886.

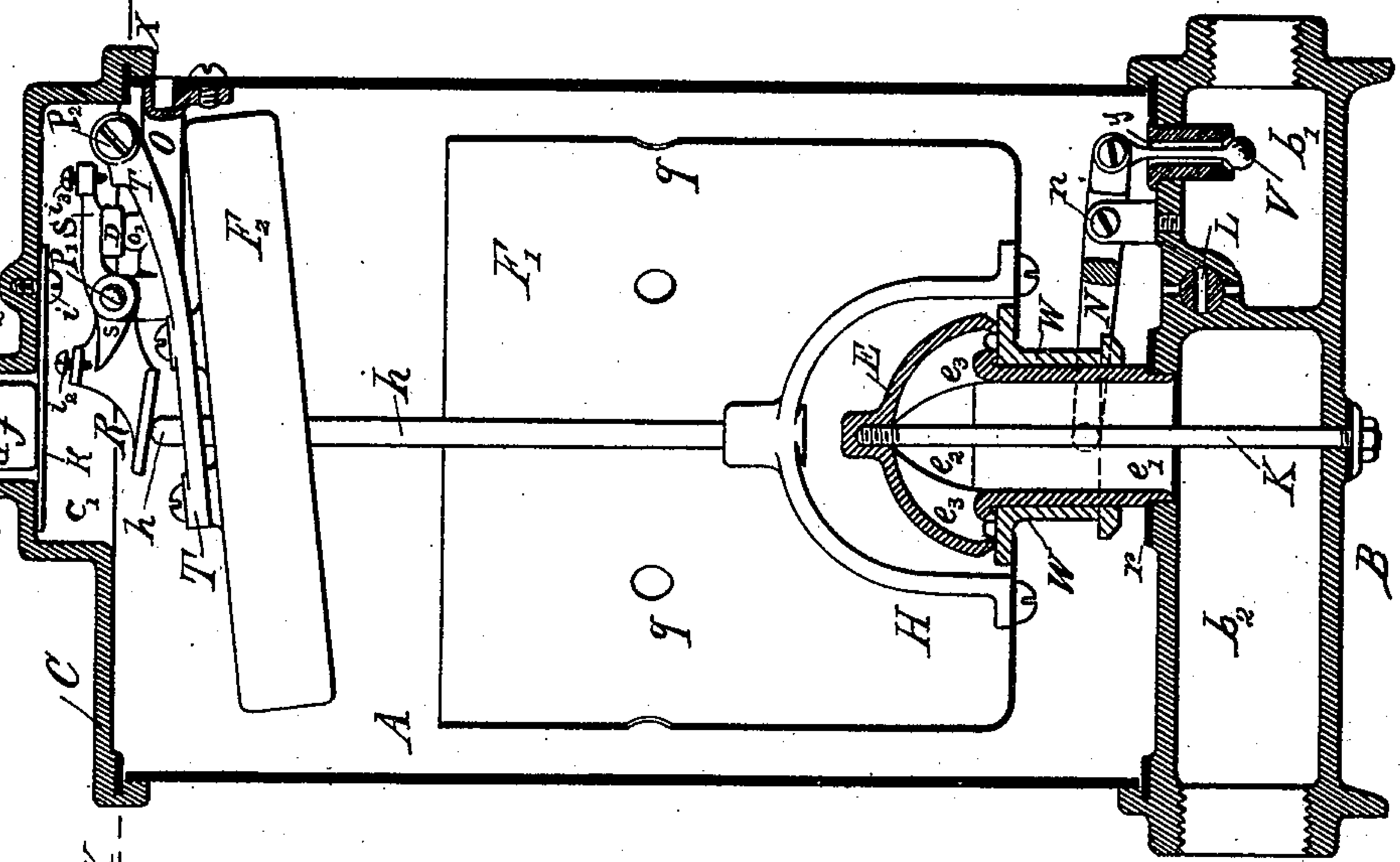

Fig. 1

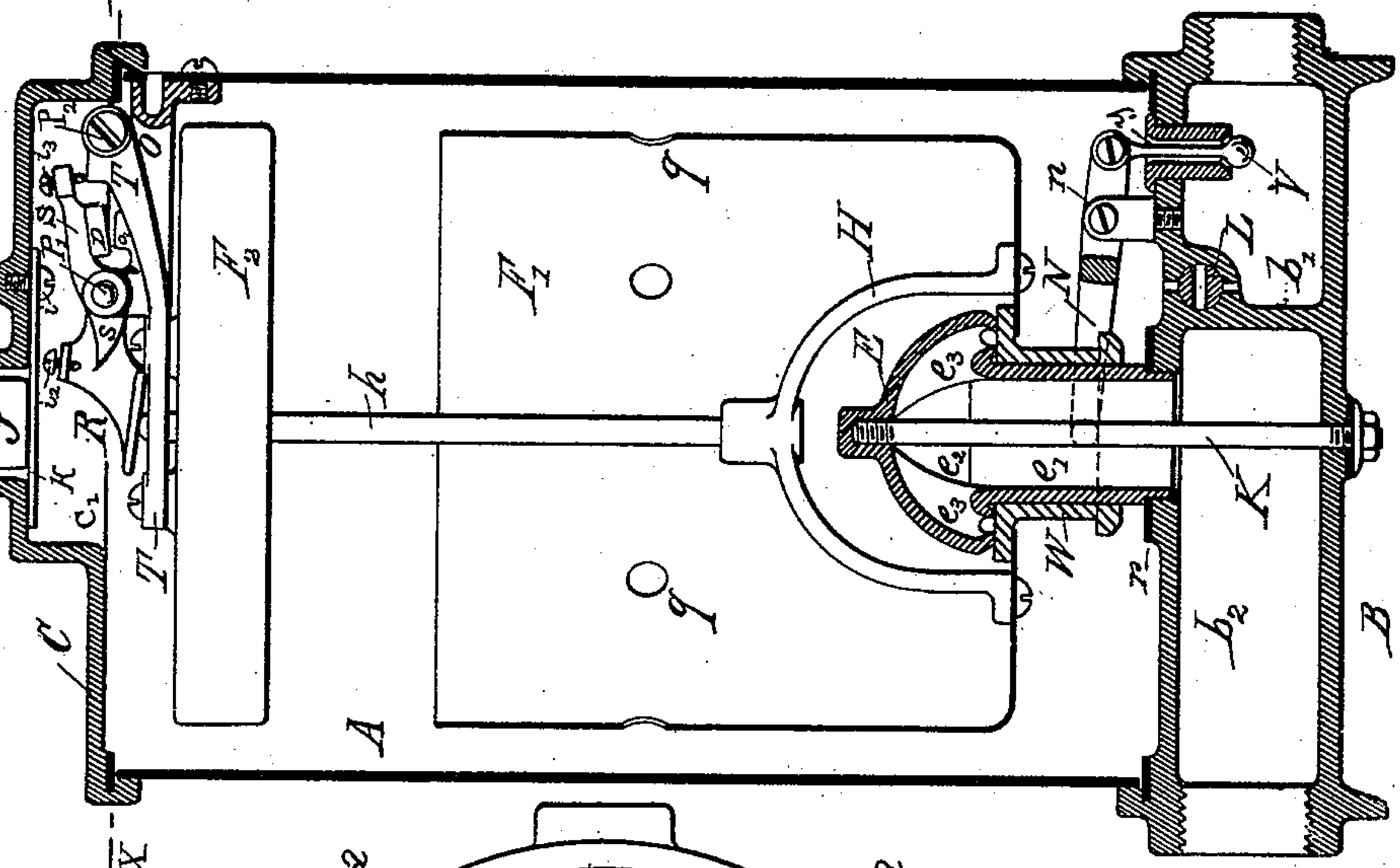

Fig. 2

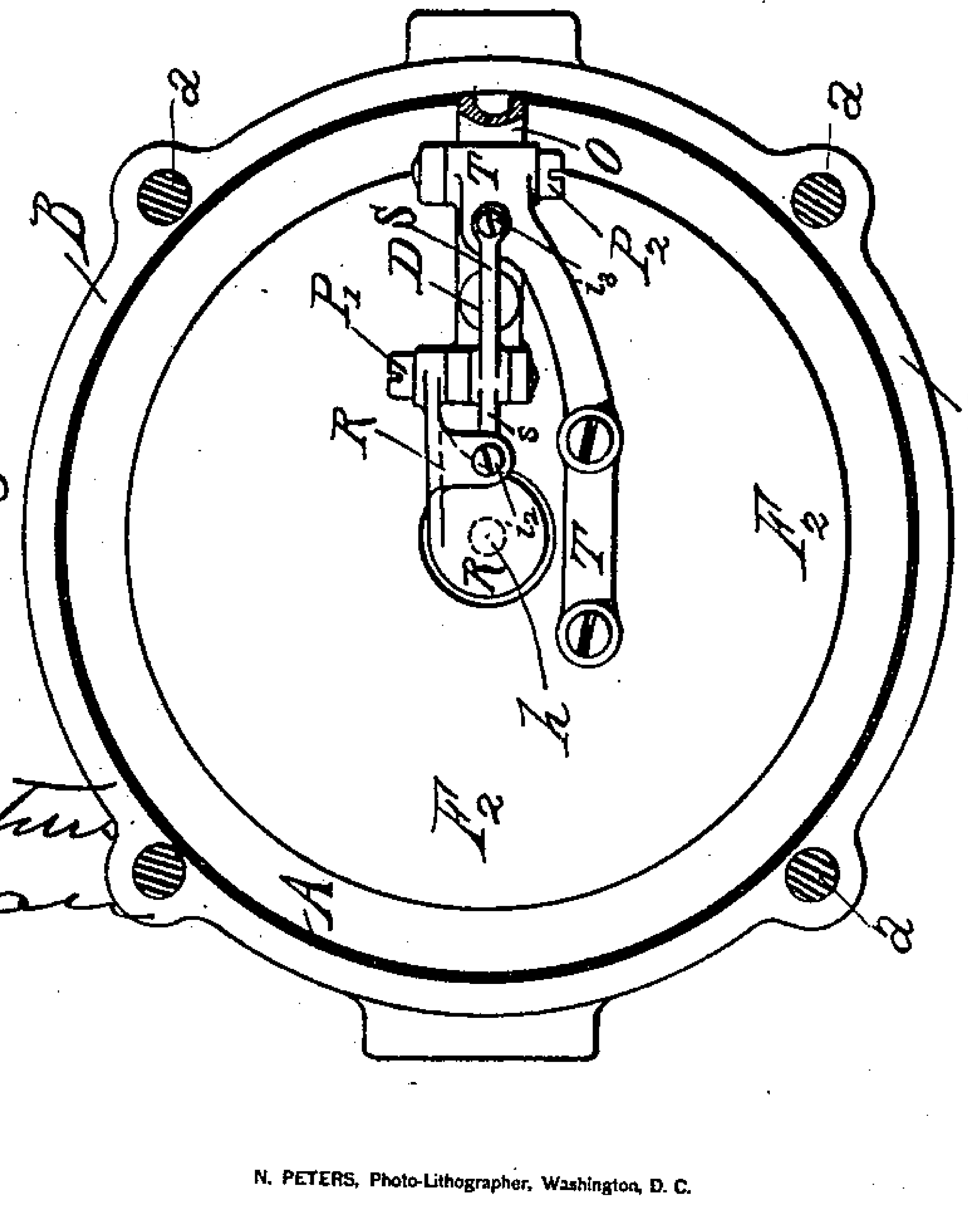

Fig. 5

Witnesses:

Inventor:
E. M. Hugentobler

(Model.) 2 Sheets—Sheet 2.

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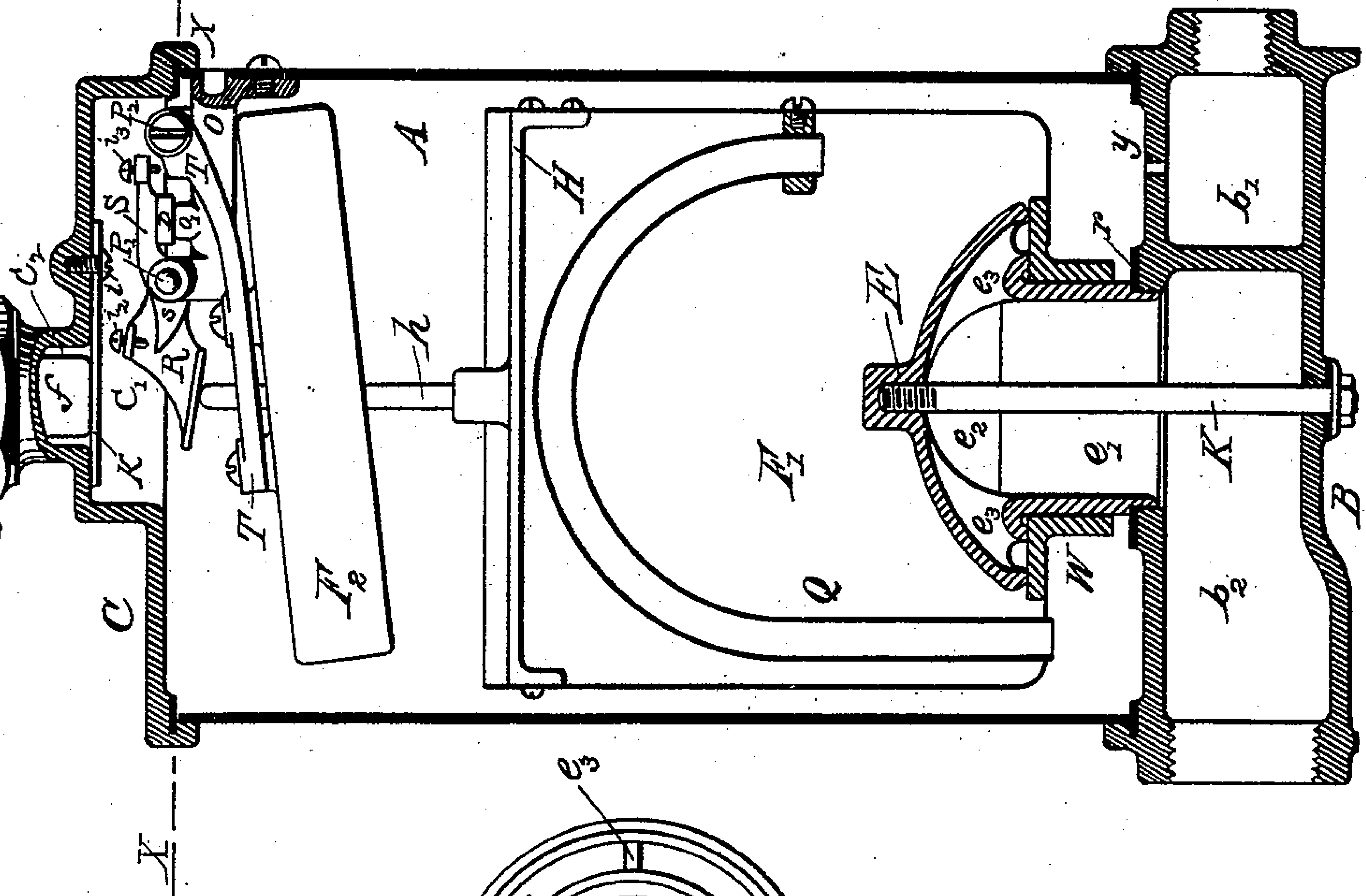

Fig. 4.

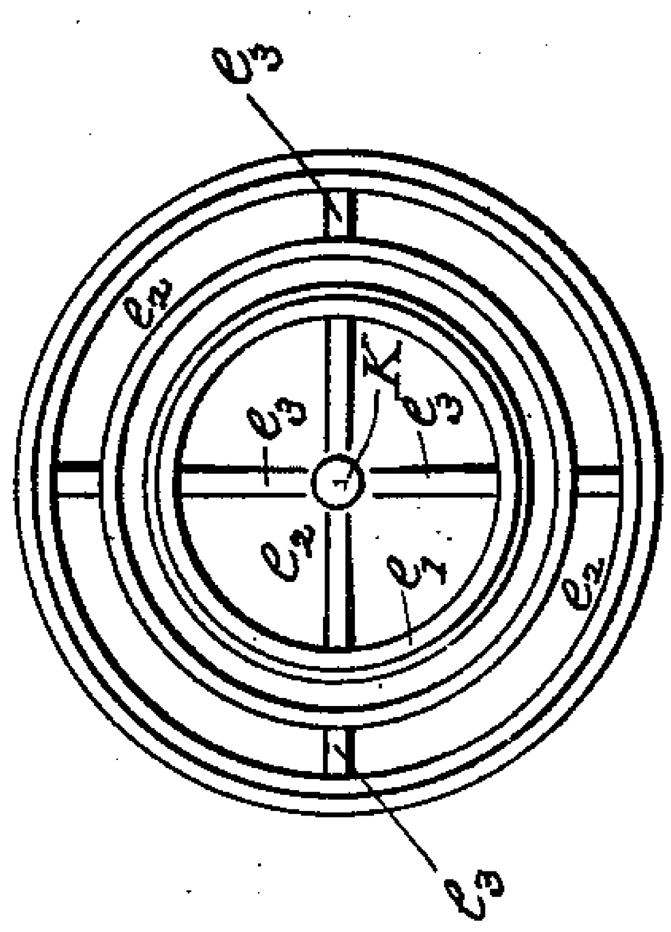

Fig. 6.

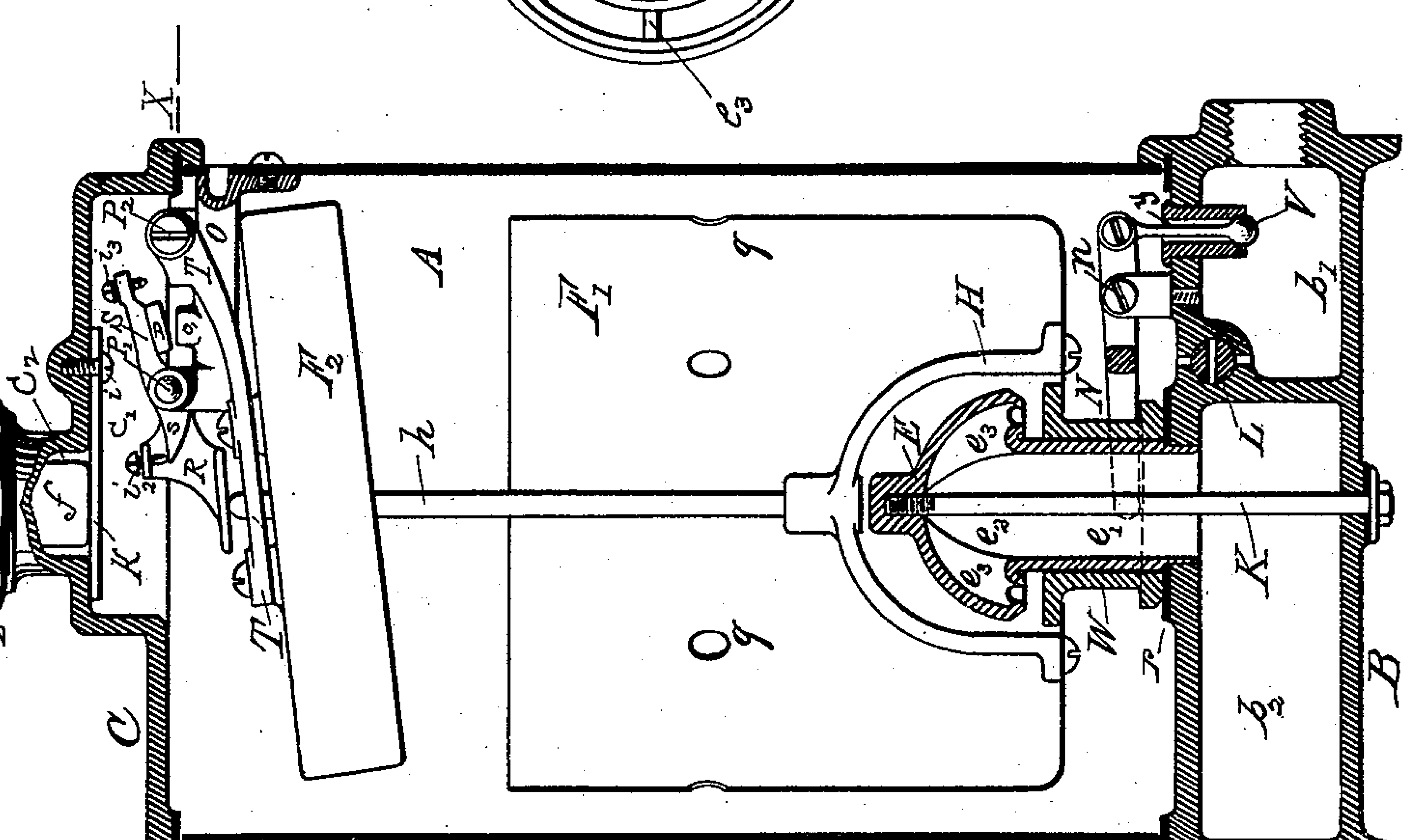

Fig. 3.

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UNITED STATES PATENT OFFICE.

EMIL M. HUGENTOBLER, OF NEW YORK, N. Y.

HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 342,798, dated June 1, 1886.

Application filed October 21, 1885. Serial No. 180,478. (Model.)

To all whom it may concern:

Be it known that I, EMIL M. HUGENTOBLER, a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Hydraulic Air-Compressors, of which the following is a specification.

My invention relates to that class of hydraulic air-compressors which consist in principle of an air-tight vessel provided with suitable valves for the admission of fresh air and the discharge of compressed air, and with suitable valves or ports for the admission of water from the source of supply, and for the emission of it, together with an automatic mechanism actuated by the rise and fall of the water in the vessel, which mechanism, operating the air and the water valves, causes the water alternately to rise and fall in the vessel, compressing and expelling the air as it rises and drawing in a charge of fresh air as it falls; and my invention relates more particularly to such small types of that class as are generally used for dispensing, by means of air-pressure, beer, ale, and other liquids.

My invention consists in certain novel mechanical devices and in their novel combinations to produce the required action, as described at length below; and also consists, as regards the smaller types of hydraulic air-compressors above referred to, in constructing an air-tight casing, to which water from the supply is admitted uninterruptedly, the water-inlet valve being thereby dispensed with and a suitable mechanism being provided for operating the water-outlet and air-inlet valves.

In the accompanying drawings, Figure 1 represents a vertical section of an apparatus embodying a part of my invention, the different working elements being shown in the positions occupied at the beginning of compression. Fig. 2 is a vertical section of the same apparatus just after compression has been completed, and when the air-relief valve is being opened by the independent relief mechanism for the expulsion of the small amount of compressed air remaining in the top of the machine, and the consequent relief of pressure on the water-outlet valve. Fig. 3 is a vertical section of the same apparatus during the exhaust period when the compressor is being emptied of water and replenished with fresh air, the relief-valve being held open for the admission of this air. Fig. 4 is a vertical section during compression of a modified form of the first apparatus embodying another part of my invention, and in which the supply of water to the compressor is uninterrupted. Fig. 5 is a horizontal section on the plan of dotted line X X, Figs. 1, 2, 3, and 4, and in connection with such figures serves to illustrate the mechanism for opening at the end of compression, and keeping open during the period of exhaust, the combined relief and admission air-valve. Fig. 6 is an inverted plan of the water-outlet channel.

Similar letters of reference designate corresponding parts in all the figures.

The compression vessel or chamber consists of three parts—one a casing, A, preferably of circular shape, such as a piece of seamless tubing, a base-piece, B, and a top piece, C. The three pieces are secured together, with proper intervening packing, by means of long bolts *a*, outside of the casing A, passing through suitable lugs on the pieces B and C, and which draw all three pieces together.

On the top C is formed a suitable recess or pocket, C′, for admitting the combined relief and admission air-valve D and its operating mechanism.

On the upper part of the recess C′ is formed another smaller one, C^2, in the top of which is located the port or passage *d* for the discharge of compressed air.

In the recess C^2 lies a small float, *f*, which a strip of metal or guard, K, secured to the top piece, C, by means of a screw, *i*, prevents from falling out of place. The guard K must be so constructed, however, that while it keeps the float *f* in the recess C^2 it admits of a free flow of air from the compressor to the discharge-port *d*. The function of the float *f* is to rise and close the port *d*, and thereby prevent any water from passing through it, in case at the end of compression the mechanism for causing the water to be exhausted should fail in its operation, and thereby allow the water to rise to the top of the machine.

Above the air-passage *d* is a check-valve, *d′*, of any suitable pattern, to prevent the compressed air from returning to the compressor while the latter is discharging water. The check-valve here shown is of the well-known form of a rubber nipple, with its end split, slipped over a teat formed around the upper part of passage *d*. A hood-shaped fitting, *m*, surrounds the valve, and may be set to carry the compressed air in any required direction through the branch *m'*. The fitting is held to the top piece, C, with proper intervening packing, by means of a coupling, screw-collar, or nut, m^2, engaging with a thread cut on said piece C.

The base-piece B is provided on its under side with two chambers or chests—one, *b'*, to which water is admitted from the source of supply, and another one, b^2, which is connected to the waste. The inlet-chamber *b'* is provided with a valve, V, opening inwardly, which the pressure of the water in the chamber *b'* always tends to close, and which, when opened, admits water from the said chamber to the compressor. A lump of metal is left in casting at the back of the chamber *b'*, and into it is fitted a cock, the section only of which appears in these drawings, and the handle of which may be operated from the outside. This cock L, which is entirely independent from the automatic mechanism of the compressor, and which is shown shut off, serves through suitable ports or passages to establish a communication between the chamber *b'* and the casing A, so that water may be admitted to the casing without passing through the valve V. This has to be done to prime the compressor when it is first put up, and will be explained at length hereinafter.

The connection between the waste-chamber b^2 and the inside of the casing A is made through a mushroom-shaped piece, E, composed of a hollow stem, *e'*, and a hollow head, e^2, the two being shown here as cast together and held by the ribs e^3. (See Fig. 6.) The under side of the head is turned so as to form two annular concentric seats on the same horizontal plane, (leaving an annular port between them,) so that a disk of suitable diameter sliding up around the stem *e'* will close the annular port under the head of the mushroom-shaped piece. The sleeve or stem *e'* has a shoulder turned on its lower end and fits into an aperture leading into the waste-chamber b^2. It is drawn to the shoulder and secured in position by means of the stud K, running through the bottom of the chamber b^2 and provided on the outside with a nut and packing-washer.

Between the shoulder on the stem *e'* and the base-piece B is interposed a rubber washer, *r*, which serves to insure a tight joint, and also fills another purpose, as will be shown hereinafter.

The outlet-valve W consists of a thimble or sleeve riding very freely up and down on the stem *e'* of the mushroom-shaped piece E. The upper portion of this thimble is widened out in the shape of a disk (preferably rubber-faced when muddy water is to be encountered) of sufficient diameter to close the annular port under the head of the mushroom-shaped piece E. The valve W is made fast either by soldering or by any other means, insuring a tight and permanent joint to a concentric circular open-top float or bucket, F', which therefore rides up and down with the valve W on the stem *e'* as a guide. A stirrup-shaped piece, H, is secured to the valve W or to the float or bucket F' in such a manner as not to interfere with the piece E when the bucket F' rises. The stirrup-shaped piece H is surmounted by a rod, *h*, standing in the center or axis of the bucket F'.

The inlet-valve V is fastened to one end of a lever, N, pivoted in a suitable journal, *n*. The other end of the lever N is forked, so that the two branches of the fork will ride on either side of the sleeve-shaped portion of valve W, and when the latter moves up the two branches of the fork will be struck by a collar formed on the lower end of said valve W. The forked end of the lever N is of sufficient length and weight to overbalance the weight of the valve V on the other end and lift it to its seat, and this will take place whenever the valve W is down. On the other hand, when the valve W goes up the shoulder on its lower end strikes the forked end of the lever N and carries it upward, thereby opening the valve V.

The bucket F' is perforated with one or more holes, *q*, on a horizontal line, the function of which will be explained hereinafter.

O is the air-valve stand. It is fastened securely to the side of the casing A. It carries a raised valve-seat, O', and is drilled or cored in such a manner as to make the valve seat communicate with the outer air. The stand O carries on suitable raised brackets on either side of the valve-seat O' two horizontal stationary pins, P' and P^2, on which are pivoted three levers, R, S, and T, the levers R and S rocking on the pin P' and the lever T on the pin P^2. The lever R is composed of a vertical part and two horizontal parts set one above the other, the upper one carrying a screw, i^2, for adjustment, and the lower one resting on the top of the rod *h*, carried by the bucket F'. The lever S carries on one side the combined relief and admission air-valve D, and on the same side, but farther out, a set-screw, i^3, for adjustment. The other end of the lever S is in the shape of a small point or toe, *s*, which comes between the two horizontal parts of the lever R and immediately under the screw i^2 on the same lever R. The lever T carries a closed float, F^2, securely fastened thereto. This float is of annular shape, so as to allow the rod *h* to meet the lever R. The position of the lever T is such in relation to the lever S that when the float F^2 rises and the lever T swings upward accordingly, the latter strikes against the screw i^3 on the lever S, and by pushing it up causes the valve D to open.

The parts shown in Fig. 4 are the same as in Figs. 1, 2, 3, 5, and 6, and their relative functions are the same, with the exception that the inlet-valve V, its operating-lever N and bearing n, and the priming-cock L are dispensed with, and the inlet-valve is replaced by a permanently-open port, y. In this view the perforations q on the sides of the bucket F′ are done away with, and in their place is shown a siphon-pipe, Q, secured to and through the bottom of the bucket F′, the long branch of the siphon communicating with the outside and the short branch being inside said bucket F′.

I will now explain the working of my improved compressor. When the apparatus is first set up and attached to the water-supply, the several parts are in the positions shown in Fig. 3 and the inlet-valve V is closed; but there is no water in any part of the casing, nor can any enter it, except through the use of the priming-cock L. By turning it on water is admitted into the annular space between the casing A and the bucket F′, which latter, rising with the water, carries the valve W against its seat on the piece E, and at the same time opens the inlet-valve V. At the same time, also, the rod h lifts the lever R, and the weight of the latter being taken off the toe s on the lever S the valve D closes by the weight of the said lever S, to which it is attached. The parts of the apparatus stand, therefore, in the proper position for compression, as shown in Fig. 1. When this point is reached, (and it is detected by the fact that air ceases to blow from the valve D into the atmosphere through the stand O,) the apparatus is primed and the priming-cock L should be turned off; nor need it be touched again as the action of the apparatus henceforth becomes automatic. The water keeps rising in the annular space around the bucket F′ until it spills into it and fills it. The bucket, being now water-logged, would sink, opening in its fall the valve W, were it not for the fact that the pressure by this time reached in the casing A holds the valve W fast against its seat on the under side of the mushroom-shaped piece E. The conditions are such, therefore, at this time that the bucket F′ and valve W are ready to drop as soon as the pressure in the casing A is relieved. The water keeps on rising and reaches the closed float F², and as this float rises the lever T, to which it is attached, swings upward and comes in contact with the set-screw i^2 on the valve-lever S, which latter is lifted thereby, causing the valve D to open. The parts then assume for an instant the positions shown in Fig. 2, during which period of time the small volume of compressed air contained in the upper part of the casing A blows out into the atmosphere through the stand O, thus relieving the pressure throughout the casing A. As soon as this has taken place the water-logged bucket F′ sinks and in its fall opens the outlet-valve W and allows the inlet-valve V to close by the combined action of the water-pressure in the chamber b' and of the weight of the forked end of the lever N. At the same time, by the fall of the rod h, the weight of the lever R is allowed to bear through the set-screw i^2 upon the toe s of the lever S, thereby insuring the maintained opening of the air-valve D regardless of the position of the float F², which naturally falls with the receding water-level. The parts are then in the position shown in Fig. 3. The water keeps on falling until the holes in the side of the bucket F′ are reached, when only the water in the bucket can escape to waste, that in the annular space being retained therein, whereby the bucket soon acquires buoyancy enough to rise, and by so doing to set the parts again in the position for compression, as shown in Fig. 1, and the series of successive operations described above will keep on repeating itself indefinitely.

For the proper and reliable operation of the bucket F′ certain details of construction should be observed. In the first place the lower end of the valve W should, when it is down, form a joint against the top of the base-piece B, so as to keep any water from the annular space from leaking into the bucket F′, and hence to waste, through the center of the valve W and around its loosely-fitted guide, formed by the stem e' of the piece E. This would keep the bucket from rising, as it depends for its buoyancy upon the water being retained in the annular space around it. The lower end of the valve W should, therefore, be faced true, so as to seat nicely on the base-piece B, and to insure this seating (especially when using muddy or gritty water) the rubber washer r, heretofore described, and placed under the shoulder on the stem e of piece E, becomes very useful by affording a soft bearing for the valve W when down.

Another important feature consists in providing the perforations q, heretofore described, in the side of the float or bucket F′. When the water first issues from the inlet-valve V, it is very apt in practice to boil and spurt high up in the casing and then to glance back into the bucket F′, thereby involving the risk of jarring the bucket down, and the valve W with it, before pressure enough has been reached in the compressor to hold said valve to its seat. To remedy this involves the use of a deeper bucket than is actually necessary to insure buoyancy. The remedy, however, is fraught with another evil—viz., that when the water is running out through the valve W during the exhaust period, the bucket F′, being made so much deeper than necessary will become buoyant long before the water is all out of it, and by rising will start the machine compressing. The efficiency of the machine is thus impaired, as all that portion of its contents which remains filled with water after the period of exhaust is so much dead-space unavailable for compression. This defect, due to the exaggerated height of the bucket F′, may be remedied by means of the perforations q on the bucket F′. These perforations are made just above the line at which the water requires to stand in the annular space to float the bucket when empty—in other words, the water-line of the bucket. The bucket F′, therefore, will float as soon as the water is drained out of it. Then, if the water spurts and bubbles out of the valve V, the upper portion of the bucket F′, above the perforations, will prevent it from splashing with any great force or in any great body into the bucket before sufficient pressure is reached in the casing to uphold the valve W to its seat. Neither can any sufficient body of water flow through the perforations *q*, which are small, to jar the valve off its seat. On the other hand, during the exhaust period, the water in the annular space drains the holes *q* in the bucket F′ until it has fallen below the said perforations, and by this means no premature buoyancy is acquired by the bucket F′, which may be drained practically of all its contents before it rises anew.

In Fig. 4 there is shown in place of the perforations *q* on the float or bucket F′ a siphon, Q, secured to and through the bottom of the said bucket F′, the long branch of the siphon communicating with the annular space, while the short branch terminates inside the bucket and does not extend below what was described above as the "water-line" of the bucket. During compression the siphon, as will be readily perceived from its position in the bucket, becomes primed with water, and during the period of exhaust it drains the water from the annular space into the bucket, and hence to waste, until the level in the annular space falls below the short end of the siphon. The flow through the siphon then stops only the water in the bucket draining out, and therefore the bucket begins to acquire buoyancy. In this case the stirrup-shaped piece H, supporting the rod *h*, is replaced by a cross-bar, H, fastened to the bucket, and filling the same purpose.

Another part of my invention, represented in Fig. 4, consists of an air-compressor composed of an air-tight casing, to which water is admitted uninterruptedly from the source of supply, and in which an automatic mechanism, actuated by the rise and fall of the water, opens an air-inlet valve and a water-outlet valve when the water-level rises to a certain point at the top of the casing, and also closes simultaneously these same valves when the level falls to a certain point at the bottom of the casing, said casing being provided with an automatic valve, *d*′, for the discharge of compressed air. The water admitted to such a type of machine during the period of exhaust is necessarily wasted; but I find it practicable to operate such a machine to advantage when made of the small size generally used for dispensing liquids under air-pressure as the water-outlet valve may be made large enough to empty the water out practically in an instant, thereby making the waste of water inappreciable.

The mechanism illustrated in Fig. 4 for operating the water-outlet and air-inlet valves in a compressor of this type is the same as that shown in Figs. 1, 2, 3, and 5; but the priming-cock L, the inlet-valve V, and its lever N, with support *n*, are dispensed with. The operation of this mechanism may be understood readily by reference to the drawings, and in the light of the description given above. No priming of the machine is required when first setting it up, and the valves W and D are operated by the bucket F′ and float F^2 and the intervening devices and connections shown, substantially in the manner described above, while the bucket F′ is no longer made to control the supply of water. In this example the holes *q*, in the side of the bucket F′, or, as shown in Fig. 4, the short end of the siphon Q may be placed lower, as less buoyancy is required to lift the bucket now relieved of the work of opening the inlet-valve V against pressure.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a hydraulic air-compressor, in combination with the outlet-fitting E, the annular outlet-valve W, working up and down on the stem *e*′ of fitting E as a guide, and shaped so as to close the annular port under head e^2 of fitting E when up, and so as to form a tight joint on the base-piece B when down, all substantially as described.

2. In a hydraulic air-compressor, in combination with the outlet-valve W, guided on the stem *e*′ of the outlet-fitting E, the open-top float or bucket F′, concentric thereto, and having the outlet-valve W permanently secured to its bottom, substantially as specified.

3. In a hydraulic air-compressor, in combination with the outlet-valve W, guided on the stem *e*′ of the outlet-fitting E, the concentric open-top float or bucket F′, having the annular valve W permanently secured to its bottom and provided with the lateral perforations *q*, substantially as and for the purpose specified.

4. In a hydraulic air-compressor, in combination with the open-top float or bucket F′, and the concentric annular outlet-valve W, secured to the bottom thereof and working on the stem *e*′ of outlet-fitting E as a guide, whereby the discharge of water from the compressor must take place through the bucket F′, a water-inlet port, *y*, located outside of and below said bucket F′, substantially as specified, and for the purpose set forth.

5. In a hydraulic air-compressor, in combination, the open-top float or bucket carrying the outlet-valve W, and the rod *h*, the air-valve D, and the levers R and S, fulcrumed on the pin P′ of the air-stand O, all these parts being connected and operating in such a relation to each other that when the bucket F′ is up the valve D is allowed to close by its own weight and that of its supporting-lever S, and when the bucket F′ is down the valve D is opened by the weight of the lever R, and, lastly, the closed float F^2, attached to the lever T, fulcrumed on the pin P^2, said float being located above the bucket F^2, so that it is not buoyed by the water until the bucket F^2 becomes waterlogged, and serving to open the

valve D, and by relieving the pressure in the casing, which holds the valve W to its seat, to allow the waterlogged bucket F′ to sink and open the valve W, substantially as set forth.

6. A hydraulic air-compressor composed of an air-tight casing to which water from the source of supply is admitted uninterruptedly, an automatic air discharge-valve, d', an air inlet valve, D, and an outlet-valve, W, both of which latter valves are connected to and operated by a suitable automatic mechanism actuated by the rise and fall of water in the casing in such a manner as to open said valves when the water rises to a certain level and to close them when the water falls to a certain point, all substantially as described.

7. In a hydraulic air-compressor, the combination, with an air-tight casing to which the water is admitted uninterruptedly, of an automatic air-outlet valve, d', an open-top float or bucket, F′, outside of which the water enters the casing and through which and the valve W, concentric and carried with it the water is exhausted, the annular outlet-valve W, which is lifted to its seat on the outlet-fitting E whenever the bucket F′ becomes buoyant, and which is held up to its seat by the pressure in the casing even after the bucket F′ is waterlogged, the air-valve D, which, by means of the rod h and levers R and S, is made to seat when the bucket F′ is up and to open when it is down, and the closed float F^2, located above the bucket F′, which becomes buoyed after said bucket is waterlogged, but held up by the pressure in the casing, said float F^2 serving to open the air-valve D to relieve the pressure and allow the bucket F′ and valve W to fall and the water to drain through the outlet fitting E, valve W, and the bucket F′ itself, all substantially as described.

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