No. 704,054. Patented July 8, 1902.

F. M. LEAVITT.

CONDENSING PUMPING ENGINE.

(Application filed June 8, 1899.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 1.

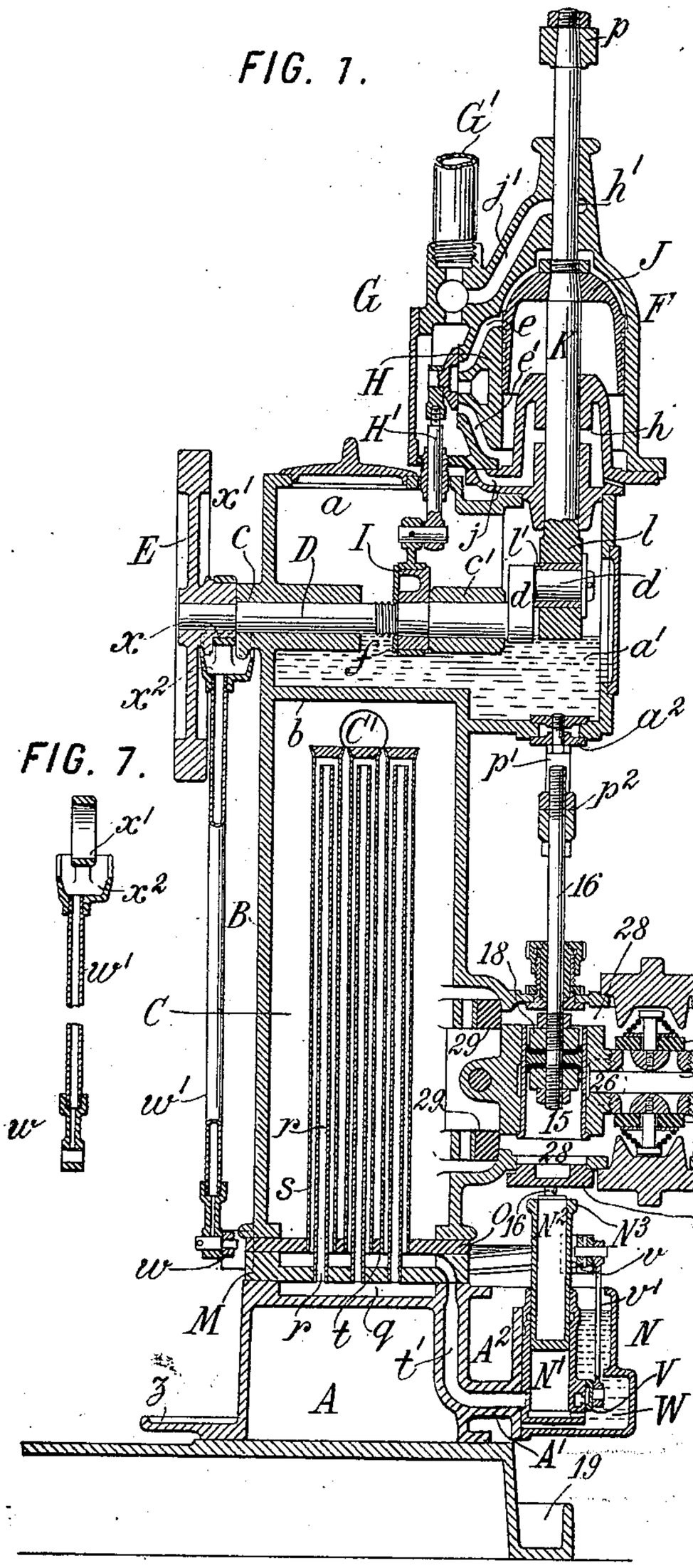
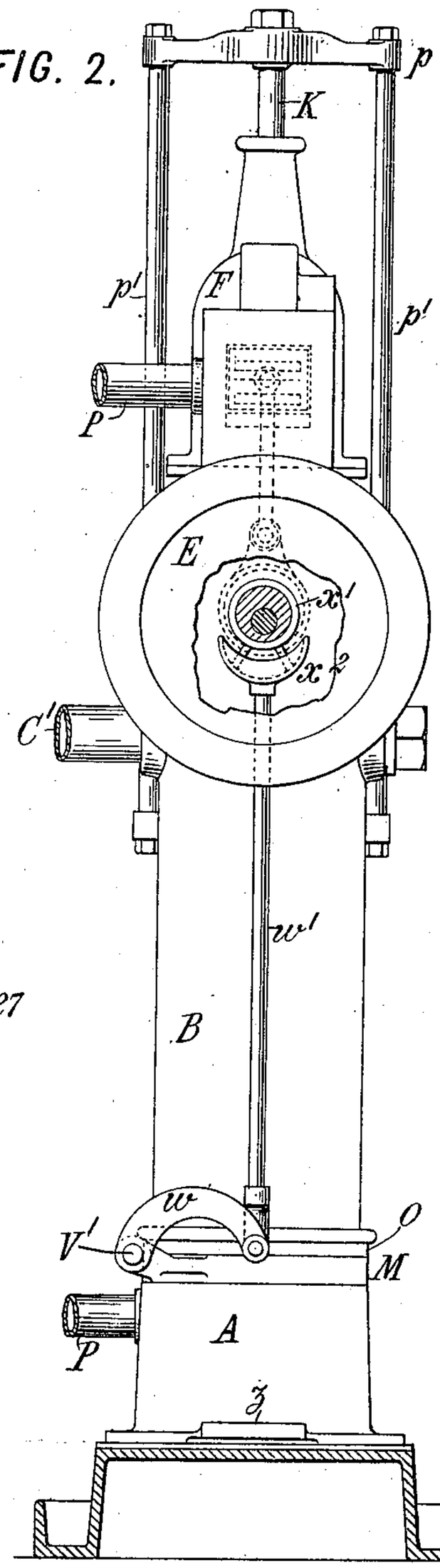


FIG. 7.

FIG. 2.



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No. 704,054. Patented July 8, 1902.

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CONDENSING PUMPING ENGINE.

(Application filed June 3, 1899.)

(No Model.) 2 Sheets—Sheet 2.

FIG. 3.

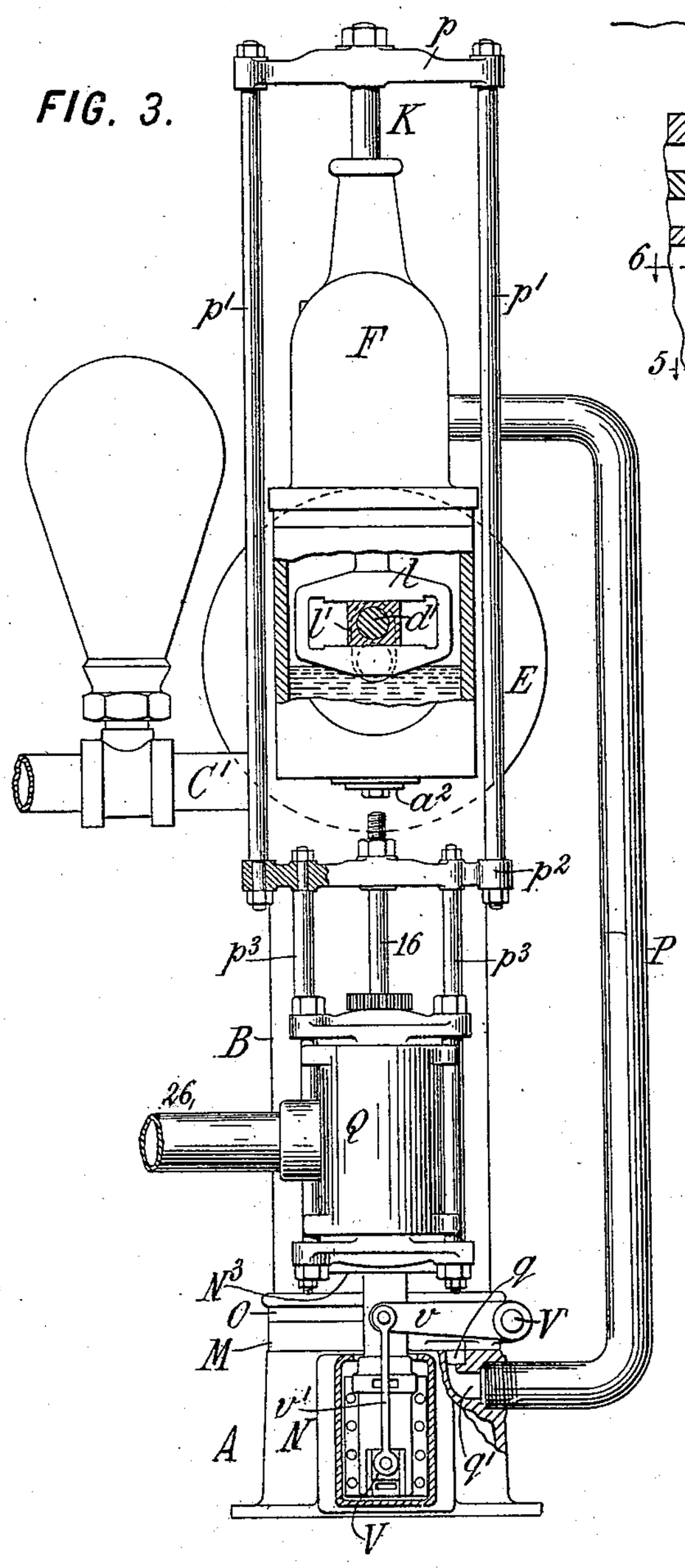


FIG. 4.

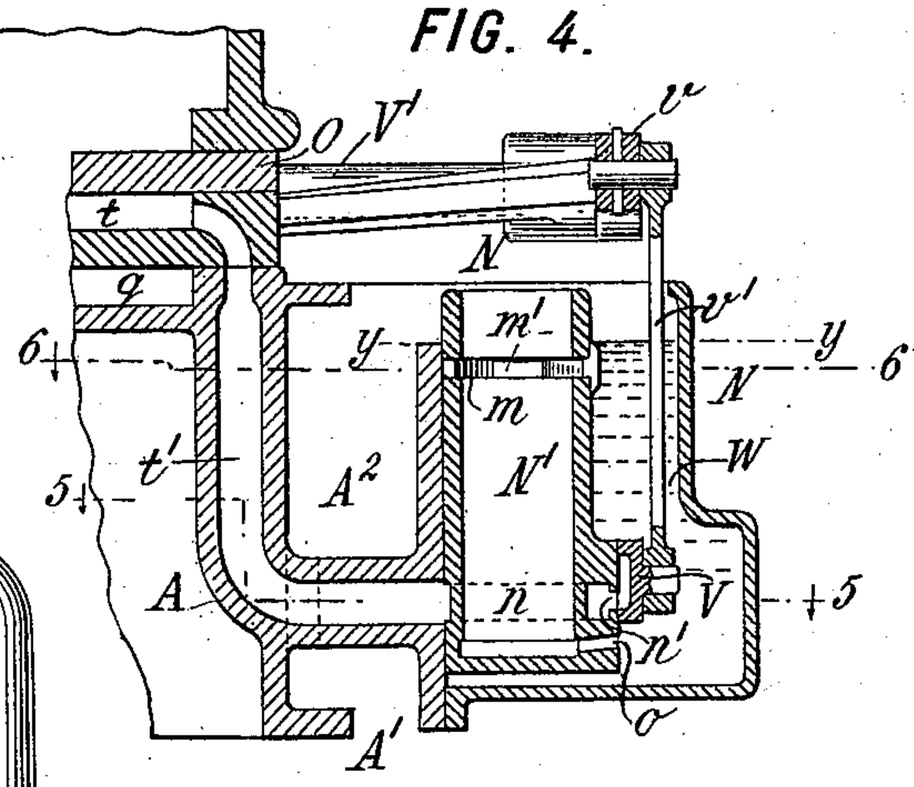


FIG. 5.

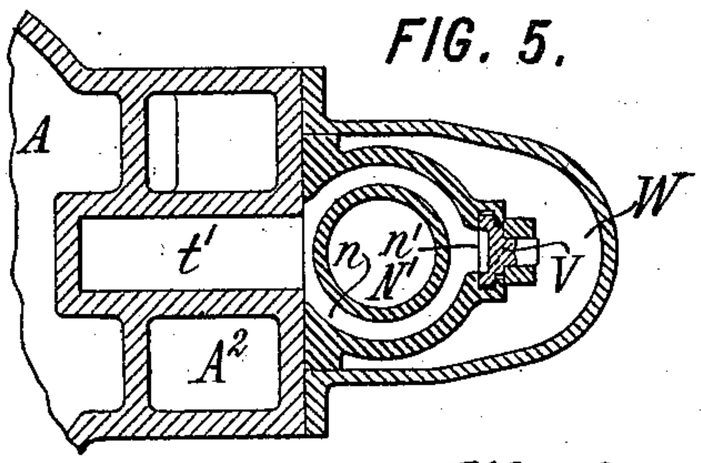


FIG. 6.

FIG. 8.

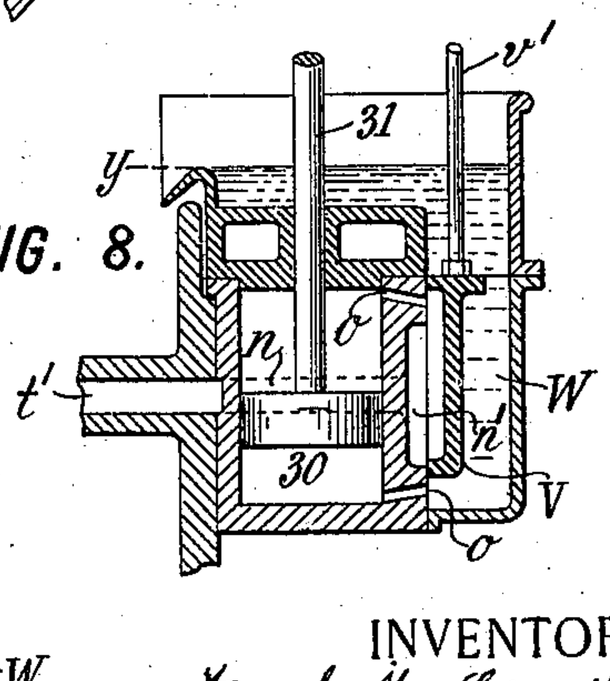
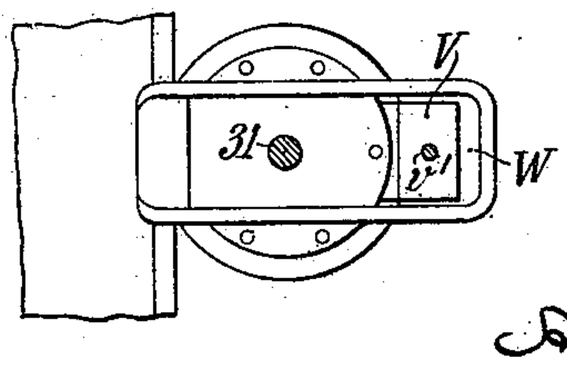


FIG. 9



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UNITED STATES PATENT OFFICE.

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CONDENSING PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 704,054, dated July 8, 1902.

Application filed June 3, 1899. Serial No. 719,236. (No model.)

To all whom it may concern:

Be it known that I, FRANK M. LEAVITT, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Condensing Pumping-Engines, of which the following is a specification.

This invention relates to condensing or low-pressure pumping-engines, and particularly to atmospheric or vacuum engines.

Atmospheric or vacuum engines are operated by atmospheric pressure due to the condensation of the steam, no pressure of steam in the boiler being necessary, although a minimum pressure of three or four pounds is desirable to cause the steam to circulate. Such engines, because of carrying no boiler-pressure, or practically none, are especially adapted for use where no licensed engineer is employed and accordingly find a large field for pumping and small power purposes in domestic establishments, shops, &c. It is important that an engine adapted for such uses shall be of such construction that no skilled attention is necessary and that it shall not be liable to stoppage or loss of efficiency. For this reason the use of packing should be avoided wherever possible, the parts should be self-oiling, and the operating mechanism should be of such construction that it is not liable to get out of order. By my present invention I seek to produce such an engine, and I especially aim to improve the air-pump construction, the efficiency of which as an essential element of a vacuum-engine is of the utmost importance. I also provide certain improvements in the general construction of the engine, all as more fully hereinafter set forth.

My invention is in part applicable to condensing or low-pressure engines operating under ordinary conditions.

Referring to the accompanying drawings, of which Figures 1 to 7, inclusive, show the preferred form of engine embodying my invention, Fig. 1 is a vertical section. Fig. 2 is a rear elevation. Fig. 3 is a front elevation. Fig. 4 is an enlarged fragmentary vertical section of the air-pump construction. Fig. 5 is a horizontal section on the line 5 5, Fig. 4. Fig. 6 is a similar section on the line 6 6, Fig. 4. Fig. 7 is a vertical section of a detail. Fig. 8 is a fragmentary vertical section answering to Fig. 4, but showing a modification; and Fig. 9 is a plan of Fig. 8.

The engine thus illustrated is a double-acting vacuum-engine having a surface condenser, a single-acting air-pump, said air-pump and a double-acting water-pump being arranged in line with the engine-cylinder.

I will now proceed to describe the particular and preferred construction shown, it being understood that my present invention is not by any means limited to the use of all the features of this construction.

In the construction shown in the drawings the active parts of the engine are mounted upon an upright hollow standard, which, as shown, comprises as its principal parts a base-section A and a main section B, the latter being formed with a chamber C, in which is located the condenser of the engine. The upper part of the standard is divided from the chamber C by a wall or partition *b* and, with its forward extension *a'*, forms an oil-chamber *a*, within which the rotary shaft D is chiefly located. This shaft rotates in bearings *c c'*, formed in the walls of the oil-chamber *a*, and one end thereof extends out through the bearing *c* and carries the fly-wheel E. The oil-chamber *a* is designed to contain oil, preferably to the level shown, whereby the shaft-bearings and eccentric-bearing are made self-lubricating. An opening is formed in the lower wall of the extension *a'*, so that the chamber *a* can be drained when necessary, and a closure a^2 is provided for such opening, as shown in Fig. 1. Upon the top of the oil-chamber is located the steam-cylinder F and its steam-chest G, the latter being of the usual construction and having the usual slide-valve H, connected to the eccentric I on the shaft D by the strap *f* and connecting-rod H'. The steam-chest G is connected to the boiler by a steam-pipe G'. The valve H acts to open and close the steam-ports *e e'* in the usual manner. The steam-cylinder F is shown as formed with dome-shaped upper and lower walls, the piston J being of dome shape to

conform thereto. The piston-rod K extends through both ends of the cylinder, and its lower end is connected to the crank *d* in any suitable manner. In the construction shown the lower end of the piston-rod is formed with a slotted cross-head *l*, in which works a sliding block *l'*, the crank-stud *d'* turning in said block, whereby the shaft D is rotated. The upper end of the piston-rod K extends through the top of the cylinder F and carries a cross-head *p*, which is connected by two rods *p'* to a similar cross-head p^2 beneath the cylinder and to which is connected the upper end of the water-pump rod 16 and of a pair of rods p^3 for operating the air-pump.

The water-pump Q is double-acting and is shown as constructed with a shell Q', which is preferably cast integrally with the standard. The pump-cylinder 15 is located vertically in said shell and in line with the piston-rod K. The pump-rod 16 extends out through a stuffing-box and carries at its lower end the pump piston or plunger 18, which is provided with reversely-cupped packing-rings confined in place in a usual manner. The lower end of the pump-cylinder is closed by a cap 17, by removing which the pump plunger and rod may be withdrawn. The pump-shell has formed within it the chamber 25, which is located in front of the pump-cylinder 15 and to which leads the suction-pipe 26. The usual suction-valves 27 27 control the upper and lower outlets from said chamber 25, which outlets lead to the upper and lower passages 28 28. The discharge-valves 29 29 control the flow from said passages 28 into the condenser-chamber C in a usual manner, as best shown in Fig. 1. The water discharged into the chamber C circulates around the condenser-tubes, to be referred to, for the purpose of cooling such tubes and condensing the exhaust-steam in the usual manner and discharges through the pipe C'. This special construction of pump forms no necessary part of my present invention.

Between the base A and standard B are clamped condenser-tube plates M and O, in which are respectively mounted the inner and outer condenser-tubes *r* and *s*. The inner tubes *r* are open at their upper ends and communicate at their lower ends with a chamber or depression *q*, which is formed between the base A and the plate M, this chamber *q* communicating with the exhaust from the engine-cylinder through a pipe P, Fig. 3, the lower end of which connects with the base A, in which is formed a passage *q'*, (shown in Fig. 3,) leading to the chamber *q*. The outer tubes *s* are closed at their upper ends and communicate at their lower ends with a chamber or depression *t*, formed between the plates M and O. The chamber *t* is connected to the air-pump N by a passage *t'*, formed in the base A, to which the air-pump N is suitably fixed.

The construction of the air-pump N is an important feature of my present invention and is designed to avoid the disadvantages of those now in use. As before stated, engines of this class are particularly designed for use by persons having no engineering knowledge, and they are largely used in localities where it would be difficult to procure skilled attention. As their operation depends upon atmospheric pressure, due to the condensation of steam, the air-pump forms a very important part of their construction. By reason of the character of their use it is desirable to avoid packings wherever possible, because of their friction, their liability to become worn, and the necessity of skilful attention to preserve their efficiency, such as the average user is unable or unwilling to give. By this invention I dispense with all packing for the air-pump and avoid the necessity of attention of any kind on the part of the user. To accomplish this, I seal the air-pump plunger in water, so that it works without danger of leakage inward of air. I also do away with the use of puppet-valves, which must be closely fitted to their seats and which are open to the objection that dust and grit often lodge on their seats, and thus cause leakage. The preferred construction of these features of my invention is best shown in Figs. 1, 4, 5, and 6. The pump-cylinder N' is here shown as inclosed in a water-chamber W, formed by fastening an open-topped shell to an extension A', forming part of the base A. The pump-cylinder N' is fastened to the extension A' within said shell and is provided with a passage *n*, Fig. 5, which leads from the passage *t'* around said cylinder to its front, where it communicates by a port *n'* with the water-chamber W. Below the passage *n* the cylinder is formed with a lateral passage or port *o*, communicating also with the chamber W, as shown. At its upper end said cylinder is also formed with an annular internal groove or passage *m*, which is in free communication with the interior of the chamber W by means of the radial passages *m'*. V is a slide-valve working over the ports *n'* and *o* and acting alternately to open communication between the pump-cylinder and condenser and the cylinder and chamber W. As shown in the drawings the pump-plunger is beginning its downstroke and the valve V is stationary in its upper position, closing communication with the condenser and allowing flow from the cylinder through port *o* to the water-chamber W. At the completion of the downward stroke of the plunger the valve V moves to its lower position, bridging the ports *n'* and *o*, thus closing communication with the water-chamber and allowing flow from the chamber *t* of the condenser through passages *t'* and *n* and ports *n'* and *o* to the interior of the cylinder.

The pump slide-valve V is reciprocated in a positive manner by any suitable mechanism, preferably directly from the power-shaft D. For this purpose I mount an eccentric *x*

upon this shaft and provide any suitable mechanism for communicating movement from this eccentric to the slide-valve V. I have shown the eccentric-strap x' as mounted on a connecting-rod w', which extends down and couples with the end of an arm w, which is fixed on one end of a rock-shaft V', on the other end of which is fixed an arm v, to the end of which is joined a valve-rod v', which couples to the slide-valve V. The rock-shaft V' is shown as mounted in bearings formed on the condenser-tube plate M. I adopt this connecting mechanism by preference, because it enables me to mount the eccentric x on shaft D outside of the oil-chamber a and between this chamber and the fly-wheel E, on the hub of which wheel the eccentric may be integrally formed, as shown.

The air-pump plunger N^2 is an ordinary bucket-plunger and fits easily into the cylinder N'. According to my invention the water-chamber W is designed to be filled with water up to the level y, Fig. 4, and the air-pump is hence immersed in the water so contained in the chamber. At the first operation of the engine the chamber W should be filled with water to allow of the initial action of the air-pump; but thereafter the liquid seal is maintained by the pump itself, the chamber receiving its entire discharge. The air discharged will rise to the top and pass off and the water of condensation will remain in the water-chamber to the level y. The water finds a free communication with the upper part of the plunger N^2 through the radial passages m' to the internal groove m, and the plunger thereby works through this liquid seal, which effectually prevents any leakage of air downwardly around the plunger. Some water will leak into the cylinder; but even a comparatively large quantity of such leakage will be of no consequence, as the air-pump is of such large capacity that it can easily dispose of it. Any considerable leakage of air would, however, overtax the pump and destroy the vacuum. In the described construction the use of packing is avoided, which is an important advantage in engines of this character. The use of a slide-valve also has the advantage that if any particles of grit work onto its seat they are forced off by the movement of the valve, and hence do not give rise to leakage. The water overflowing from the chamber W falls into a chamber A^2, formed in the base A, from which it may run off into channel 19, whence it may be led by a pipe to any suitable waste. The air-pump is mounted in line with the steam-cylinder and receives its movement directly from the steam-piston. The plunger N^2 is formed with a cross-head N^3, which is connected to the cross-head p^2 of the water-pump by the connecting-rods p^3.

In Fig. 7 I have shown an enlarged view of the preferred form of the eccentric-rod w'. A small quantity of oil will leak through the bearing c of the shaft D and lubricate the eccentric-strap x', the surplus being caught in a basin x^2, formed on the upper part of the rod w'. This rod is tubular and the surplus of oil passes down through its bore to lubricate the pivotal connection between the rod w' and the lever w. A receptacle z is conveniently formed in the base A beneath the rod w' to catch any oil dripping from said rod.

It will be seen that my present form of engine resembles in many respects the steam pumping-engine set forth in my application, Serial No. 703,773, filed January 30, 1899, patented December 18, 1900, No. 663, 910. That application shows the same general construction of hollow standard with condenser-chamber within it and oil-chamber a above, in which works the shaft D and above which chamber is located the steam-cylinder. In that application I have described a means for preventing air from being drawn into the cylinder around the piston-rod during the suction-stroke in lieu of the piston-rod packing commonly employed. To this end I form a chamber h in the cylinder-head, this chamber being in open communication with the piston-rod and being in constant communication with the steam-chest G or other source of steam by means of an open duct—as, for example, by a passage j. During the exhaust or power stroke, when the pressure in the cylinder is considerably lower than that of the outer air, any leakage occurring into the cylinder will be of steam from the chamber h.

In my former construction I carried the piston-rod K down through the bottom of the oil-chamber a, the bottom opening therein being provided with a stuffing-box, through which the piston-rod passed. I now avoid this stuffing-box and its attendant friction and liability to leakage by passing the piston-rod K out through the top of the cylinder and connecting its upper end with the pump through the medium of the cross-heads p p^2 and connecting-rods p' p', already described. In so doing I prevent leakage of air into the cylinder around the piston-rod where it passes out through the top of the cylinder by applying the same means heretofore applied by me, as above described and as set forth and claimed in my said application, Patent No. 663,910—that is to say, I provide a steam-chamber surrounding the piston-rod between the cylinder and the outer air, this chamber being shown at h' and being connected by a passage j' with the steam-chest G or other source of steam. I thus substitute for the stuffing-box before used a connection which is almost absolutely free from friction and at the same time avoid any liability of leakage of air into the cylinder.

I have shown in Figs. 8 and 9 a modification of the air-pump. The air-pump shown in these figures is double-acting, comprising a cylinder in which works a piston 30, mounted on a piston-rod or plunger 31. The pump is connected to the condenser by a suction-

passage t', as before described, communicating with a passage n around the pump-cylinder, terminating in a port n' in connection with the slide-valve V, as before described, the only difference in construction being that the discharge-port o is here duplicated by rearon of the pump being double-acting, and the slide-valve is made sufficiently long to coact with the two ports $o\,o$. The water chamber or cylinder W, instead of entirely surrounding the pump-cylinder, or nearly so, is only large enough to inclose the slide-valve V, this portion thereof being vertical and conducting the discharge from the pump over the top thereof to an overflow-level y, so that the water surrounds the plunger or piston-rod 31 where the latter emerges from the top of the pump-cylinder, and thereby forms a water seal or water packing for the plunger to the same effect as in the construction first described.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. In a condensing-engine, an air-pump having a discharge-port, a suction-passage terminating adjacent to said port, a slide-valve adapted to connect said discharge-port with said suction-passage, whereby to place the latter in communication with the pump-cylinder, and adapted to open said discharge-port to permit discharge from said cylinder, and a water-chamber inclosing said valve and receiving the discharge from said cylinder, whereby the water discharged from said cylinder forms a seal for said valve.

2. In a condensing-engine, a standard, formed with an exhaust-passage, a pump-cylinder fitting said standard and formed with a continuation of said passage, and a water-chamber surrounding said cylinder and sealing the joint between said passages.

3. In a condensing-engine, an air-pump cylinder having an annular internal water-groove against its plunger, and a water-chamber surrounding said cylinder and in communication with said groove, adapted to keep said groove filled with water to constitute a water seal around the plunger.

4. In a condensing pumping-engine, the steam-cylinder, water-pump cylinder and air-pump cylinder arranged in line, cross-heads connected to the steam-piston and pump-pistons, parallel connecting-rods connecting said cross-heads, a crank-shaft driven from the engine-piston, an eccentric thereon, a slide-valve for said air-pump, and a mechanical connection from said eccentric to said valve.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

FRANK M. LEAVITT.

Witnesses:
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W. B. BAILEY.