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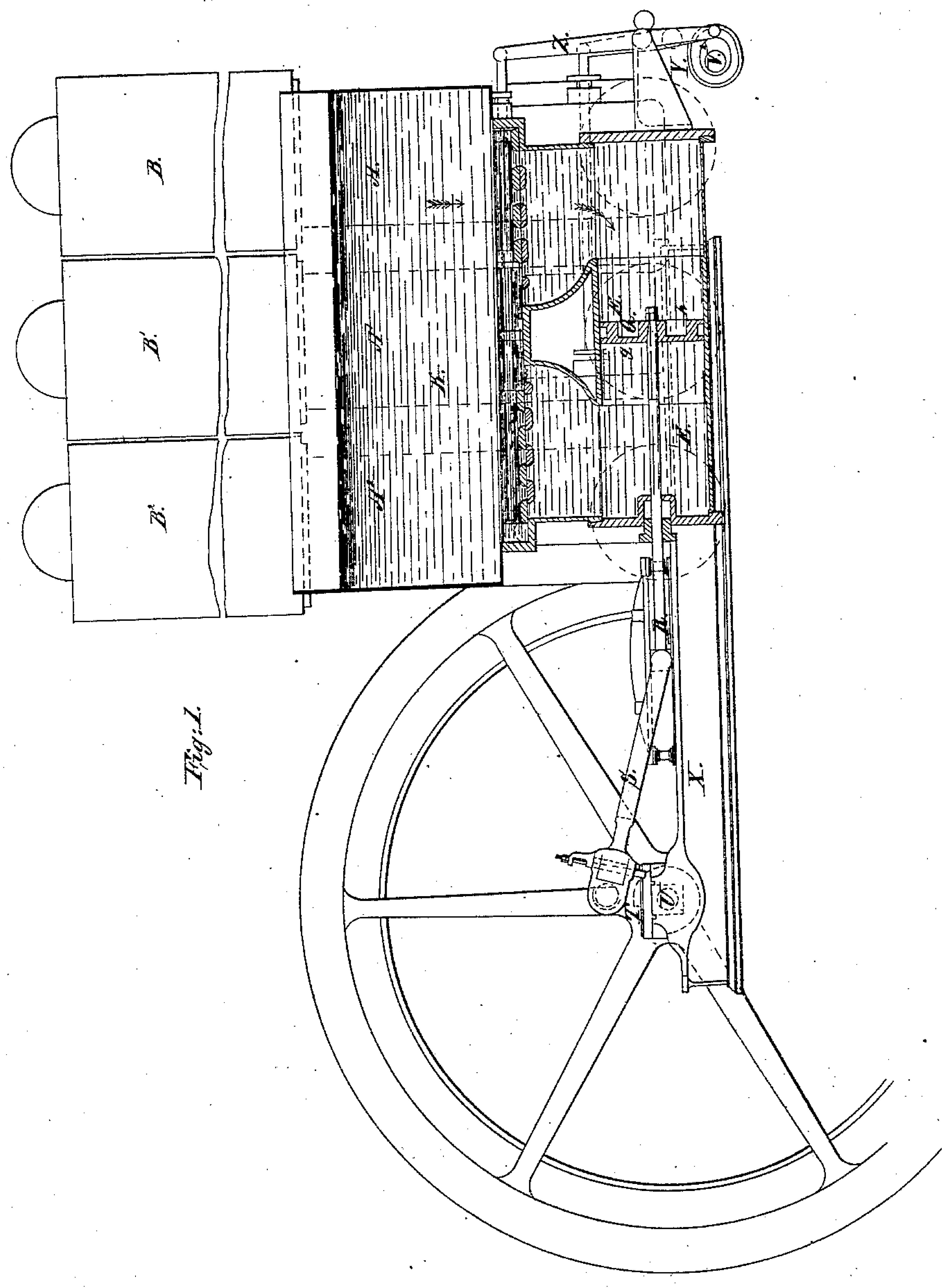
P. HUGON.

GAS ENGINE.

No. 41,299. Patented Jan. 19, 1864.



Witnesses

W. J. Cuts

J. L. Coombs

Inventor:

Pierre Hugon

by A. Pollok

his atty.

4 Sheets—Sheet 2.

P. HUGON.

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Fig: 2.

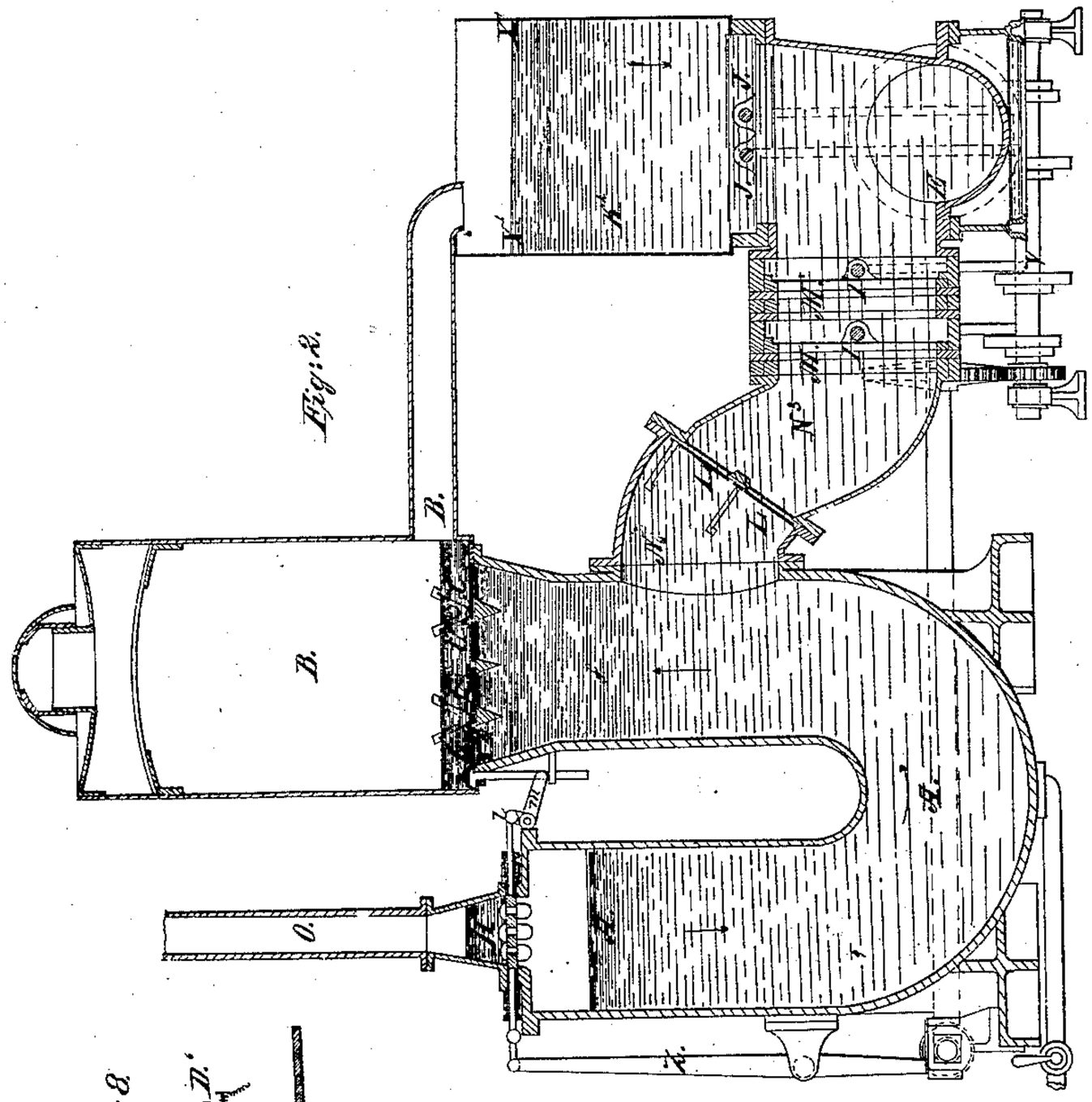


Fig: 8.

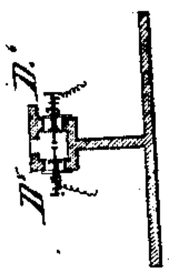


Fig: 7.

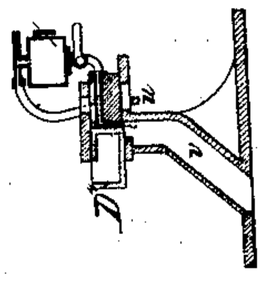
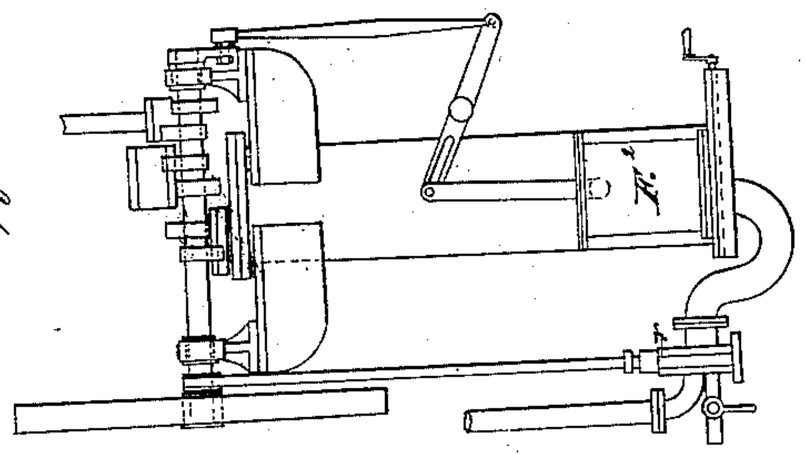


Fig: 4. Ten.



Witnesses:

J. L. Coombs

Inventor:

Pierre Hugon

by A. Pollok

his atty

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P. HUGON.

GAS ENGINE.

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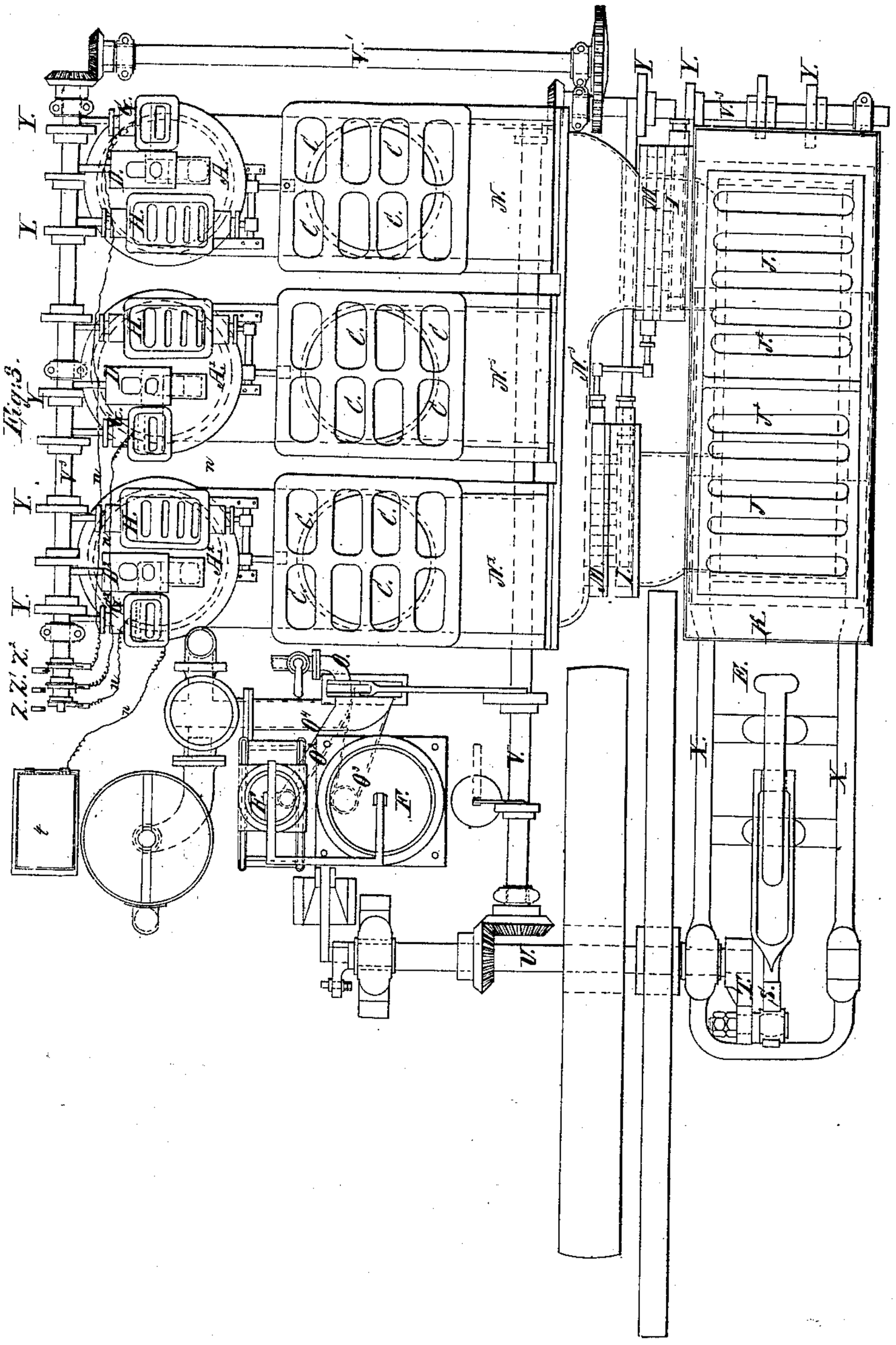
Fig. 3.



Witnesses:

W. Hughes

J. L. Coombs.

Inventor:

Pierre Hugon

by A. Pollock

his atty

4 Sheets—Sheet 4.

P. HUGON.

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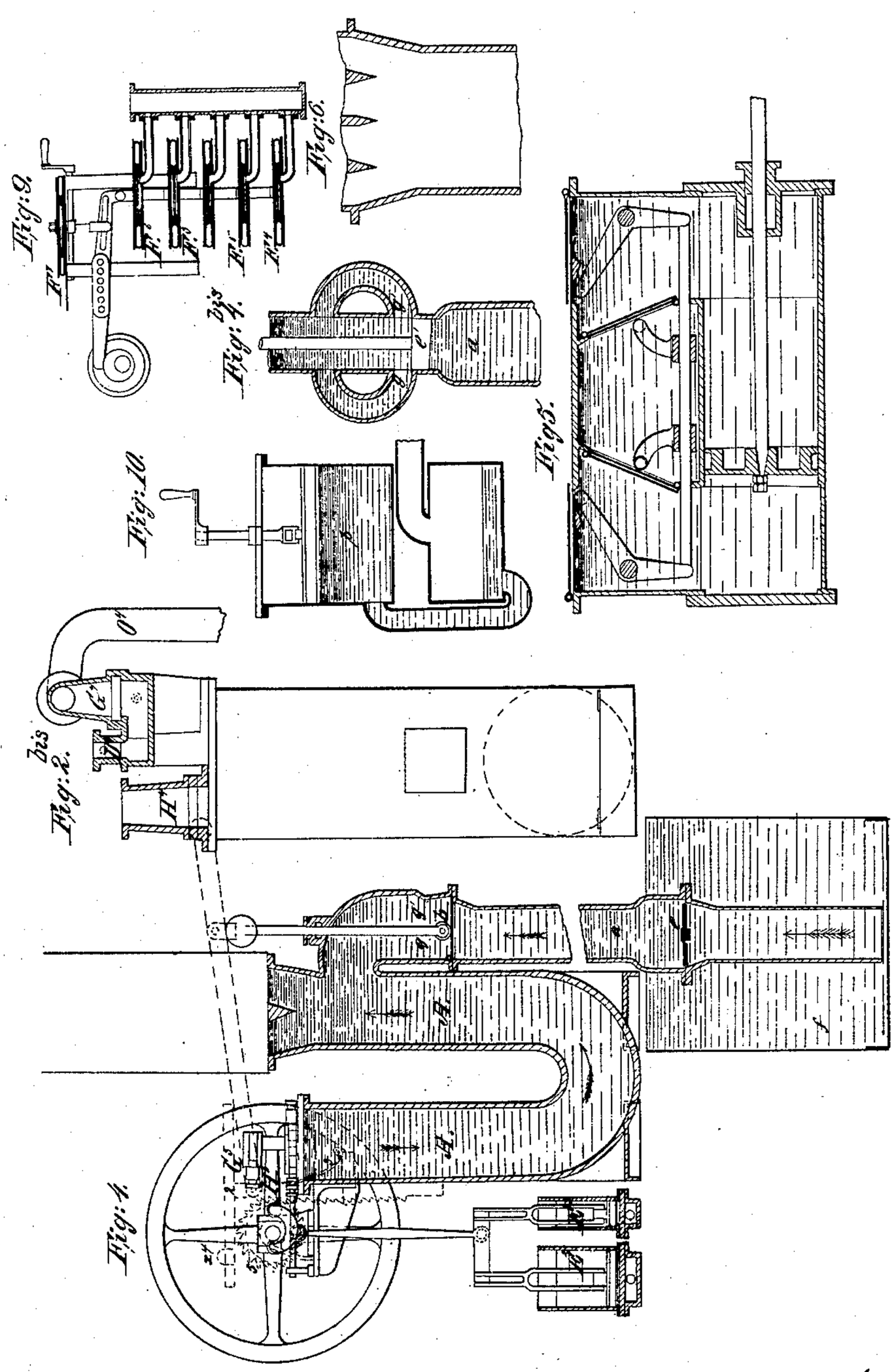

Witnesses:

W. J. Capt

J. d. Connelly

Inventor:

Pierre Hugon

by A. Pollok

his atty

UNITED STATES PATENT OFFICE.

PIERRE HUGON, OF PARIS, FRANCE.

IMPROVEMENT IN GAS-ENGINES.

Specification forming part of Letters Patent No. **41,299**, dated January 19, 1864.

To all whom it may concern:

Be it known that I, PIERRE HUGON, of Paris, in the Empire of France, have invented certain new and useful Improvements in Machinery for Obtaining and Applying Motive Power; and I do hereby declare the nature of my said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, reference being had to the drawings hereunto annexed—that is to say:

I have observed in gas-engines that the direct action of the gaseous mixture when exploded to obtain motive power formed a great difficulty in its application arising from the instantaneousness of the effect produced. I then thought of employing this instantaneous explosive force by making it act upon an intermediate body. I at first tried air and caused the explosive force to compress the air in a receiver, the air afterward pressed upon one face of a piston, while the vacuum produced in the tube from which the air had been expelled caused a vacuum on the other face and moved the piston; but the great elasticity of air and the short duration of the explosion, or the high temperature produced, caused unsatisfactory results.

Now, the present invention consists in the employment of water instead of compressed air, and in causing the explosive force of the gaseous mixture to act upon an intermediate column of water, and thus indirectly upon the piston. The cylinder in which the piston works is separated from the tubes wherein the explosion takes place. The power resulting from the dilatation of the gases is employed to expel a certain quantity of water from the explosion-tube and to produce a vacuum, the effect of which is added to that due to the condensation of steam arising from the combination of the hydrogen and oxygen, and can be utilized in the cylinder. The several reservoirs of the engine are arranged in such manner that the same water always circulates in the engine, and that that which has been expelled from the tube fills the cylinder on the side opposite to the chamber, which is at the moment in connection with the vacuum produced. The cylinder being originally full of water it is the exhausting toward the vacuum of the liquid contained in one of the chambers which produces the movement of the piston. The water expelled from the tube which fills the opposite chamber, the capacity of which increases gradually, acts in the same manner at the following explosion. The result of this method of employing the power produced at the instant of the combination of the gases is that the shock produced by the sudden and instantaneous dilatation of the mixture is not transmitted immediately to the motive parts. The power is applied to an independent liquid, which is freely displaced by the pressure exercised upon its surface. The contact of the gaseous residuum with water, the temperature of which never exceeds 113° Fahrenheit, allows the steam produced to be partly condensed, and to increase, owing to expansion. The utilization of the vacuum is rendered as perfect as possible by the presence of water in all parts of the engine, for it is never filled except by columns of liquid, the movement of which determines that of the piston. Water enters every part of the engine. It is water which, displaced by water when the explosion takes place, makes the vacuum as perfect as possible.

My engine is therefore an engine of indirect action. It utilizes the explosive force, and the vacuum resulting from the combination of different kinds of gas mixed with air, and when the explosion of the gas takes place a vacuum is formed in a tube or chamber separated from the cylinder, and produces by the displacement of an intermediate column of water the to-and-fro movement of the piston, and consequently the rotation of the driving-shaft of engine. My invention is thus based upon the substitution for the direct action of ordinary gas-engines of an indirect action, which is exerted by means of an intermediate column of water upon the surface of the piston when the explosion of the mixture takes place. The explosion of the gaseous mixture is produced at the top of the column of water intended as the medium to change the sudden effect of the explosion to an effect more easily utilized.

Having thus set forth the nature of my invention in general terms, I proceed by the aid of the accompanying drawings to describe the manner in which I carry it into effect.

Figure 1 is a sectional elevation of my improved machinery; Fig. 2, an end view, partly in section; Fig. 2^{bis} a side view of one of the tubes A, and Fig. 3 a plan of my engine and

gas pump. Figs. 4, 4bis, and 4ter are different views of a section-pump, hereinafter described, with my gas-pump applied thereto. Fig. 5 is a section of the cylinder E of the motive engine carrying valves I^2 I^3 J^3 J^4, which may be substituted for the distributing-slides I I$'$ J J$'$, Fig. 2. Fig. 6 shows an arrangement of the valves of the generating-tube which may be adopted. Figs. 7 and 8 are views in section of the slide D for inflaming the mixture of gas and air inclosed in the box *x* with passage through the tube *v*. Fig. 9 is a view of the fans or blowers F^4 to F^8 for introducing the inflaming-mixture. Fig. 10 shows a reservoir, P, for the inflaming-mixture.

A A$'$ A^2 are tubes of siphon form, in which the combination of the explosive mixture takes place, and in which the vacuum is formed. The same effect is produced in each of the tubes A A$'$ A^2, the number of which may be varied. These tubes are surmounted by as many receptacles B B$'$ B^2, which prevent the water forced from the tubes being expelled outside. The smaller branch of the tube A is closed by a cover, with slides D G H, Fig. 3. The larger branch of this tube has valves C C$'$ C^2 C^3 C^4 at its extremity, which remain closed by their own weight. These valves are immersed in a reservoir, B, Fig. 2. In a certain variable part of the larger branch of the tube A is a passage, N, connecting it with the cylinder E of the engine. This cylinder has two inlets and two outlets for the liquid. Upon these inlets and outlets are four slides, I I$'$ J J$'$, Fig. 2. The slides I I$'$ communicate with the tube A, wherein the vacuum is produced, and the slides J J$'$ with the basin K, where the water driven from the tubes enters. Gas enters the gas-pump by tubes O$'$ O^2, Fig. 3, and air enters the air-pump by the tube O^3. The distribution of the mixture of air and gas takes place by the tube O^4. The rod R of the piston Q of the cylinder E transmits motion to the air and gas blowers or fans F F$'$ F^2 F^3 through the connecting-rod S, crank T, and shaft U. (See Figs. 3, 4, and 4ter.) The shaft U transmits the motion through suitable gear to the shafts V V$'$ V^2 V^3, which actuate, through cams Y and levers Z, the slides of the tubes A A$'$ A^2 and of the cylinder E. Electric wires *n* put the induction apparatus *t$'$* in communication with the slides G G$'$ G^2, Z Z$'$ Z^2 are rollers carrying plates for inflaming the mixture.

Before setting the machinery to work the tubes A A$'$ A^2, the reservoirs B B$'$ B^2, the tubes N N$'$ N^2, the cylinder E, and the basin K, up to about the point X$'$, Fig. 2, must be filled with water. When these different parts contain liquid, as aforesaid, if a certain quantity of an explosive mixture be introduced through a suitable tap, slide, or valve into the small branch of the tube A A A, and if there be brought in contact with such mixture either an electric spark, an incandescent platinum wire, a gas-jet, (by means of the inflaming-slide D, Figs. 7 and 8, which advances to inflame the mixture in the orifice *v*, a which then recedes to have its jet *t* relighted, the explosion having extinguished it by the fixed jet *u*,) there will be combination of the oxygen of the air and of the hydrogen of the gas, with a considerable disengagement of heat. The vapor resulting from this combination will become immediately red hot, as well as the gases not combined, and there will ensue dilatation of the vapor and of the gases, and considerable power will be produced, which will drive a certain portion of water contained in the tube A through the valves C C$'$ C^2 C^3 into the reservoir B, which will run out into the basin K; but in a very short time the gases remaining after combustion will cool and the steam will condense in contact with the water contained in the tube A. The valves C C$'$ C^2 C^3 will close immediately, and there will be a vacuum produced proportional to the quality and quantity of the mixture introduced, at least to a certain extent. This vacuum may vary. When produced in the tube A, it opens the valves L L$'$, and closes on the contrary, by means of the pipe N^3 the similar valves corresponding with the other tubes, A$'$ A^2, and shuts them off in consequence from the machine. It remains, therefore, only to open the passages M M$'$, and the piston Q of the motive engine E, by the arrangement of its slides I and J$'$, becomes on one side, *g*, in contact with the vacuum of the tube A, and on the other side or face, *h*, in contact with the water of the basin K, submitted to atmospheric pressure. This piston necessarily works in the direction of the vacuum with a force equal to the vacuum produced in the tube A. The piston in working causes the water contained on the face *g* to replace a certain portion of that which has been expelled from the tube A during the combination of the explosive gases; but on reaching the end of its stroke the slides I and J close and the slides I$'$ and J$'$ open. The piston is again placed in contact with the vacuum of the tube A by its face *h*, and its face *g* is then in contact with the water in the basin K. It returns back, or makes a back-stroke, and the water on its face *h* fills up the vacuum still existing in the tube A. If during this movement of the piston, which, by means of the crank T, transmits rotary motion to the shaft U, as in ordinary steam-engines, there has been introduced by the pumps or fans F^4 F^5 F^6 F^7 F^8, Fig. 9, a certain quantity of the mixture in the tube A$'$, and this mixture is inflamed at the moment when the crank completes its entire revolution and has attained the dead-point, the same effect which has been produced by the tube A will be reproduced by the tube A$'$, and the engine E will continue to work. It will be the same with the tube A^2 and all the other tubes which might be employed; but while the tube A$'$ works the engine the escape-slide H of the tube A will open, and by the crank *l m*, Fig. 2, will cause the tail or finger *n$'$* to rise, and

by means of the tappet *p* open the valve or valves C C′ C² C³. Pressure due to the difference in the water-level in the larger branch of the tube A will press upon the gases resulting from combustion contained in the small branch, where the combination of the explosive mixture took place, and will expel them through the slide H into the tube O; then the slide H will close. The inlet-slide G will open to introduce the mixture, which will be inflamed at the proper time, as has been above explained, and these same workings will be repeated indefinitely in each tube.

The vacuum-forming tubes A A′ A² may be placed unlimited number to work a machine by means of the valves L L′, which insulate them completely from each other. The speed of the engine depends up to certain limits on the degree of vacuum-generating tubes and on the size of the inlet and outlet passages for the water from the cylinder of the motive engine. By means of the pumps and air and gas blowers, the stroke of which is increased or diminished at will, the quantity and quality of the mixture to be introduced into the tubes is regulated, and therefore the vacuum is diminished or increased (always within certain limits) according to the power to be used. It is unnecessary to add that the position occupied by the vacuum generating tubes may be varied at will. They may be placed parallel on both sides of the engine, or on one side only. They may be placed perpendicularly to the shaft of the engine on one or both sides, or otherwise. The tubes A may be cast in a piece with the cylinder E and the frame X. The valves C C C L L′, &c., may vary indefinitely both in form and material. The slides for distributing the water in the cylinder may also vary both in form, material, and position. They may be placed horizontally, vertically, or inclined. The slides of the tubes may be replaced by taps or valves, if desired. The same with the slides; or the surfaces on which they run may be furnished with bronze, brass, or gun-metal plates, or others little liable to oxidation. The means of moving the slides, whether of the tubes or of the cylinders, may be imparted without any lever directly on the rods of the slides by means of double cams or by other suitable mechanical means.

The explanations which I have given of the different organs and working of my apparatus or power-generator show that it may be profitably applied to work all forms and kinds of steam-engines, whether fixed or movable, horizontal, inclined, vertical, rotary, locomotive, or marine. it being only necessary to alter the diameters of the cylinder and the form or section of the passages for the inlet and outlet of the water. This apparatus or generator may be applied to exhaust and to raise water; to make use of it for irrigation, or to direct it onto water-wheels, turbines, and others. for which it would only be necessary to lengthen the tube A to extend above the level of the water to be raised. If it be desired to raise the water to any height by suction only, it is necessary to superpose a series of tubes from six to seven yards, according to the vacuum produced, fixing the tubes on frames or walls, which tubes would work by ordinary means of transmission as a series of suction-pumps. The pumps may also be made to work automatically by the following means: (See Figs. 4, 4bis, and 4ter.) At some point a valve, *b*, which may be replaced by a piston, *e′*, Fig. 4bis, is fitted to them. This valve or piston may be placed at any point in the suction-tube, and is intended to put in motion the air and gas pumps F F′ F² F³, the inlet and inflaming slides G and D, and that O for the escape of the residual gases. These different operations occur as follows: At the moment of the production of the vacuum in the tube or pump serving to raise water in the same manner that it is produced in the generating-tube for the engine. As the water to be raised is only from six to seven yards, all the vacuum produced above six to seven yards may be used to raise the valve *b*, Fig. 4, charged with a weight or the piston *e′*, and therefore they will raise the lever 1, attached to the rack 2, which rack is charged with a movable weight, X⁴. This lever 1 turns round a point, 4. In rising, it lifts up the rack 2, which rubs against the ratchet-wheel 5 by means of the spring 3. This ratchet cannot turn back, being stopped by the tappet 6; but when the valve *b* has passed beyond the point *g′*, Fig. 4, or the piston *e′*, Fig. 4bis, has passed the point *g*² *g*², free passage is left to the water, which fills the vacuum existing in the tube *a*, and when this vacuum has been in part filled, the piston *e′*, or the valve *b*, acting by means of the rod *d* on the lever 1 and the rack 2, in descending, causes, by means of the spring 3, the ratchet-wheel 5 to turn. This wheel is mounted on the shaft which gives motion to the air and gas pumps, and to the distributing-slides from the pump to the tube.

The descending movement of the piston *e′*, or of the valve *b*, is easily explained in this manner: That the escape slide opening first immediately leaves on the valve *b*, or on the piston *e′*, a pressure of water, which causes it to descend with a rapidity depending on the greater or lesser accuracy in the fit of the piston in the cylinder, or of the valve on its exterior floating part, for if the piston or the valve closed completely and hermetically, the liquid or water not being compressible, the stop-valve *e* would prevent the piston or the valve descending; but if a little play is allowed, or some grooves or other means ensuring the same result are adopted, the valve or the piston in descending will cause the liquid that they displace below to rise above them, and at the same time, by means of the toothed rack and ratchet-wheel 5, drive the shaft carrying the different slides and air and gas pumps necessary to the good working of the pump or machine for raising water.

My apparatus or generator does not cause any shock to the different machines that it works. The power is produced and stored outside the cylinder exactly as takes place in an ordinary steam-engine where the boilers perform the part of my tubes in which the vacuum is produced.

Having now described the nature of my said invention, and in what manner the same is to be performed, I declare that my invention is based upon the indirect action of an explosive mixture upon the piston of an engine by means of an intermediate column of water, which is exhausted by the vacuum which the explosion produces in the generating-tubes.

The characteristic features of the invention are: First, the substitution of the indirect action of the exploded mixture for the direct action which takes place in ordinary gas-engines. Second, the indirect action of the explosive power upon the piston-rod through an intermediate column of water, on the surface of which the mixture of air and gas is exploded. Third, the inflaming of the mixture of air and gas in a tube of the receiver separated from the engine cylinder. The vacuum produced in a space separated from the cylinder determines the to and fro movement of the piston. Fourth, the constant circulation of the same water in the machine; and, fifth, the presence of water in every part of the machine for the better utilization of the vacuum.

I claim—

The improved machinery for obtaining and applying motive power, hereinbefore described, and illustrated in the accompanying drawings.

In testimony whereof I have signed my name to this specification before two subscribing witnesses.

P. HUGON.

Witnesses:
E. JAUME,
E. SHERMAN GOULD.