No. 625,887.

Patented May 30, 1899.

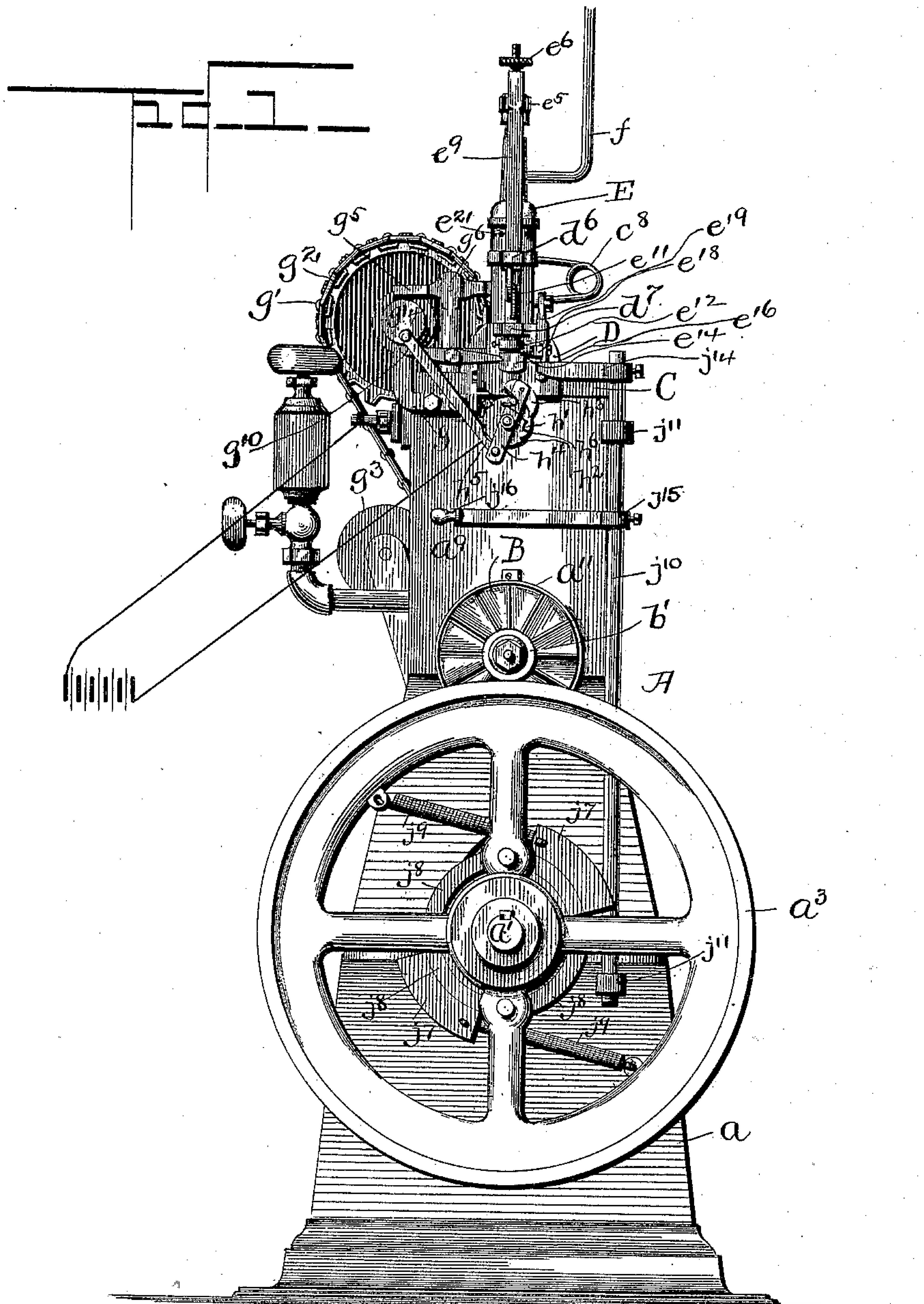
P. LAIR.

ENGINE.

(Application filed Dec. 30, 1897.)

(No Model.)

7 Sheets—Sheet 1.



Witnesses:

Horace G. Seitz

Arthur Page

Paul Lair, Inventor

By Marion & Marion

Attorneys

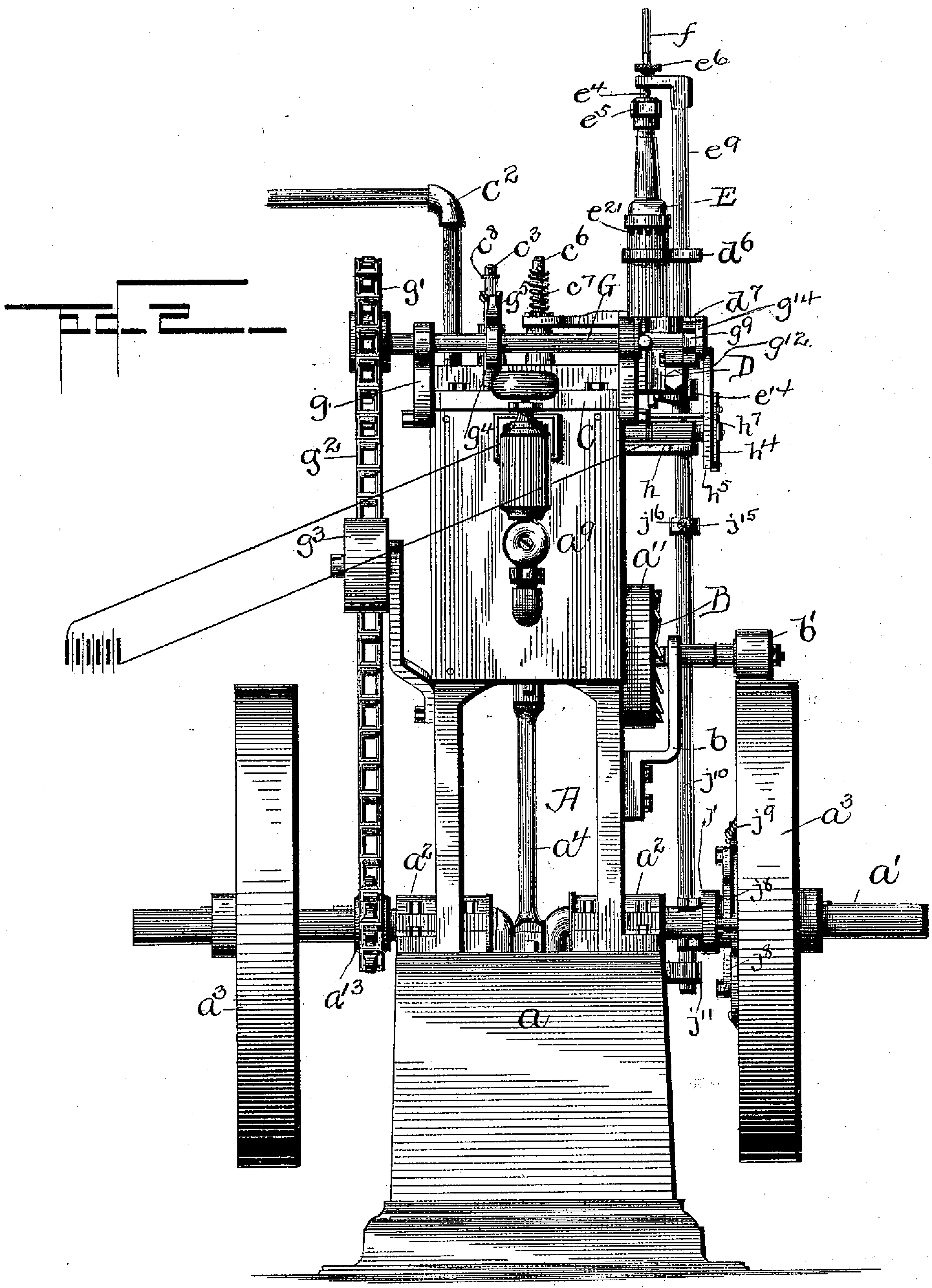
No. 625,887. Patented May 30, 1899.

P. LAIR.

ENGINE.

(Application filed Dec. 30, 1897.)

(No Model.) 7 Sheets—Sheet 2.



Witnesses:

Horace G. Deitz

Arthur Pagé

Paul Lair, Inventor

By Marion & Marion

Attorneys

No. 625,887.

Patented May 30, 1899.

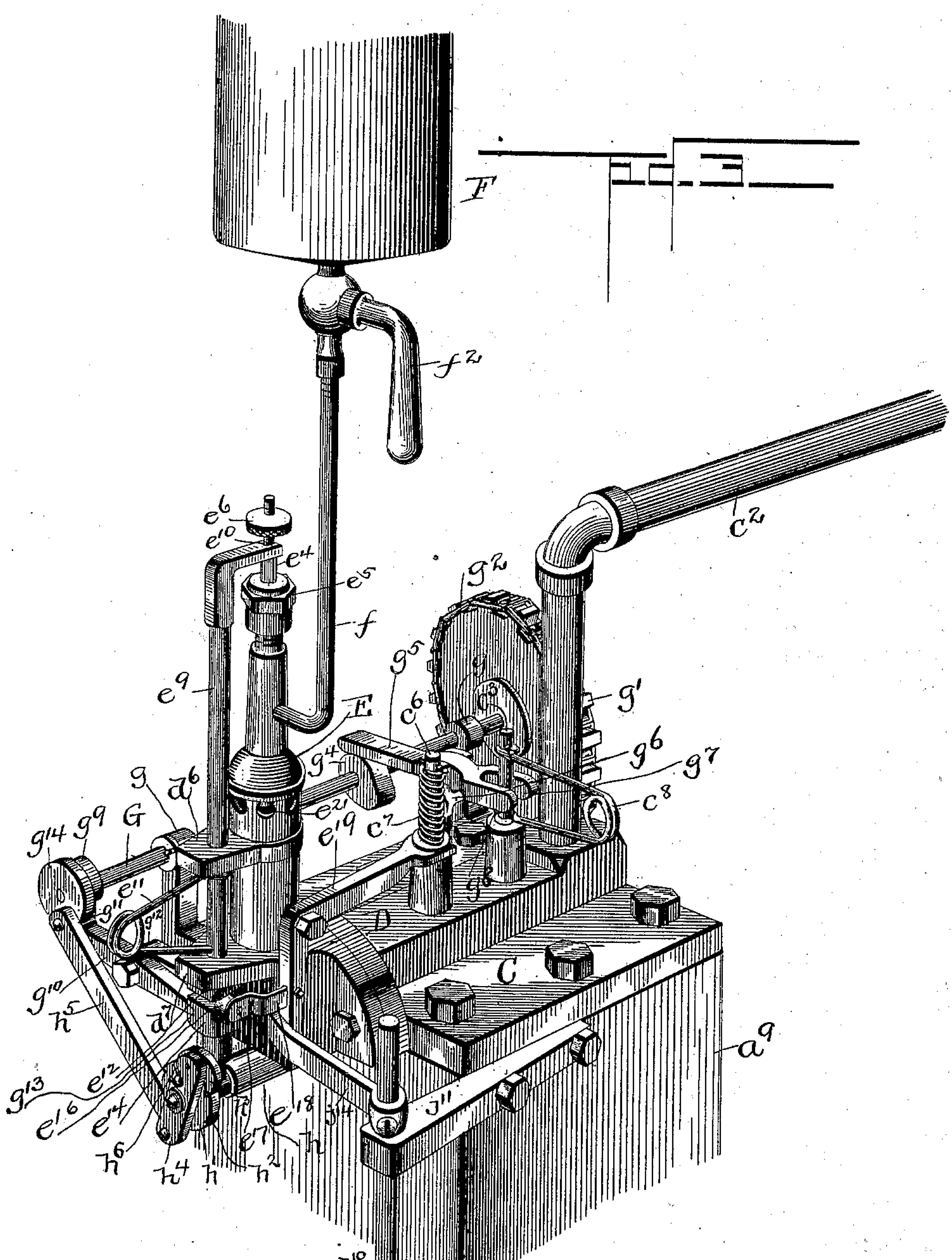
P. LAIR.

ENGINE.

(Application filed Dec. 30, 1897.)

(No Model.)

7 Sheets—Sheet 3.



Witnesses:—
Horace G. Dietz
Arthur Page

Inventor:—
Paul Lair,
By his Attorneys, Marion & Marion

No. 625,887.

Patented May 30, 1899.

P. LAIR.

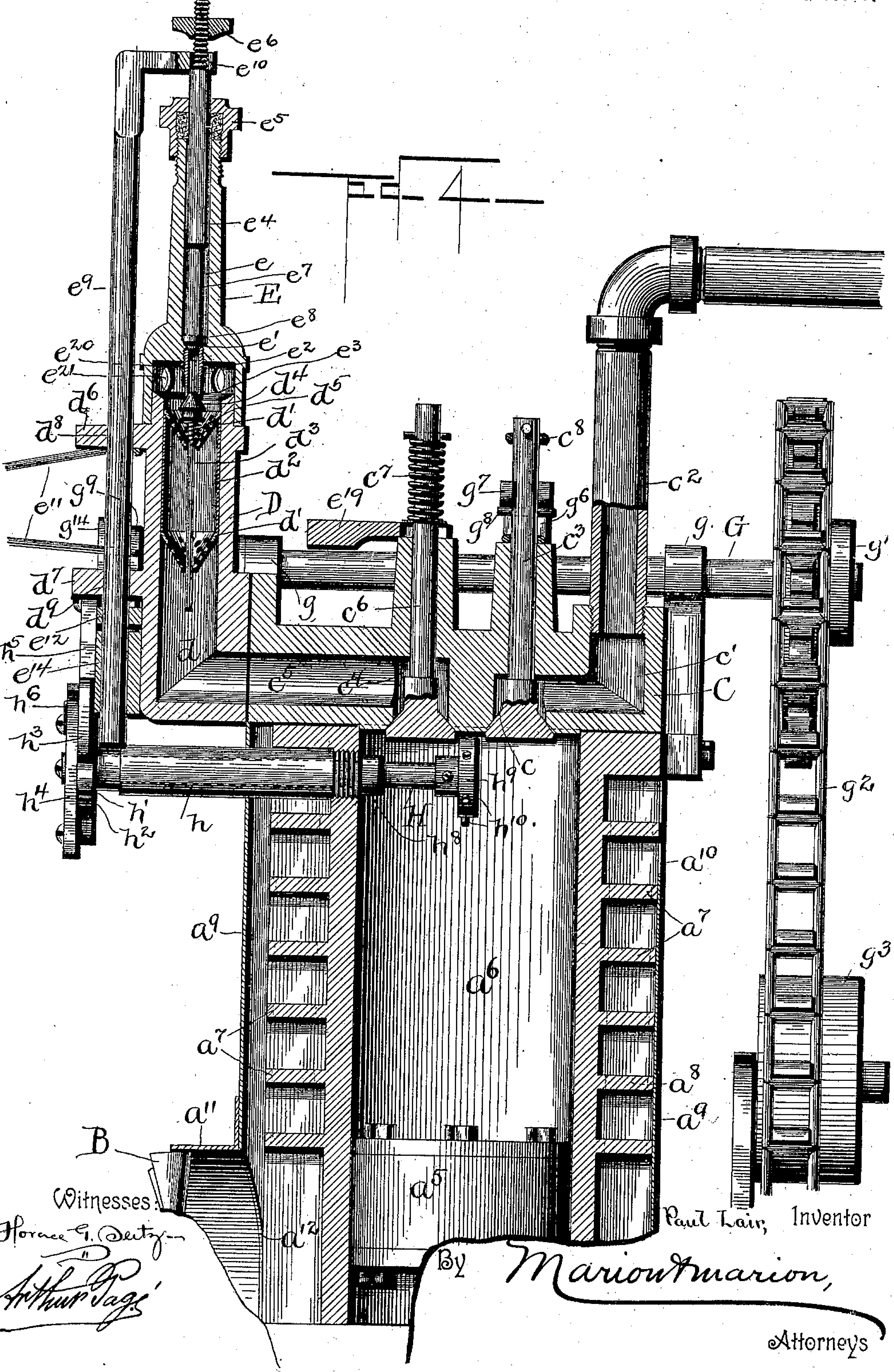
ENGINE.

(Application filed Dec. 30, 1897.)

(No Model.)

7 Sheets—Sheet 4.

Fig. 4



Witnesses:

Horace G. Deitz

Arthur Page

Paul Lair, Inventor

By Marion & Marion,

Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 625,887.

Patented May 30, 1899.

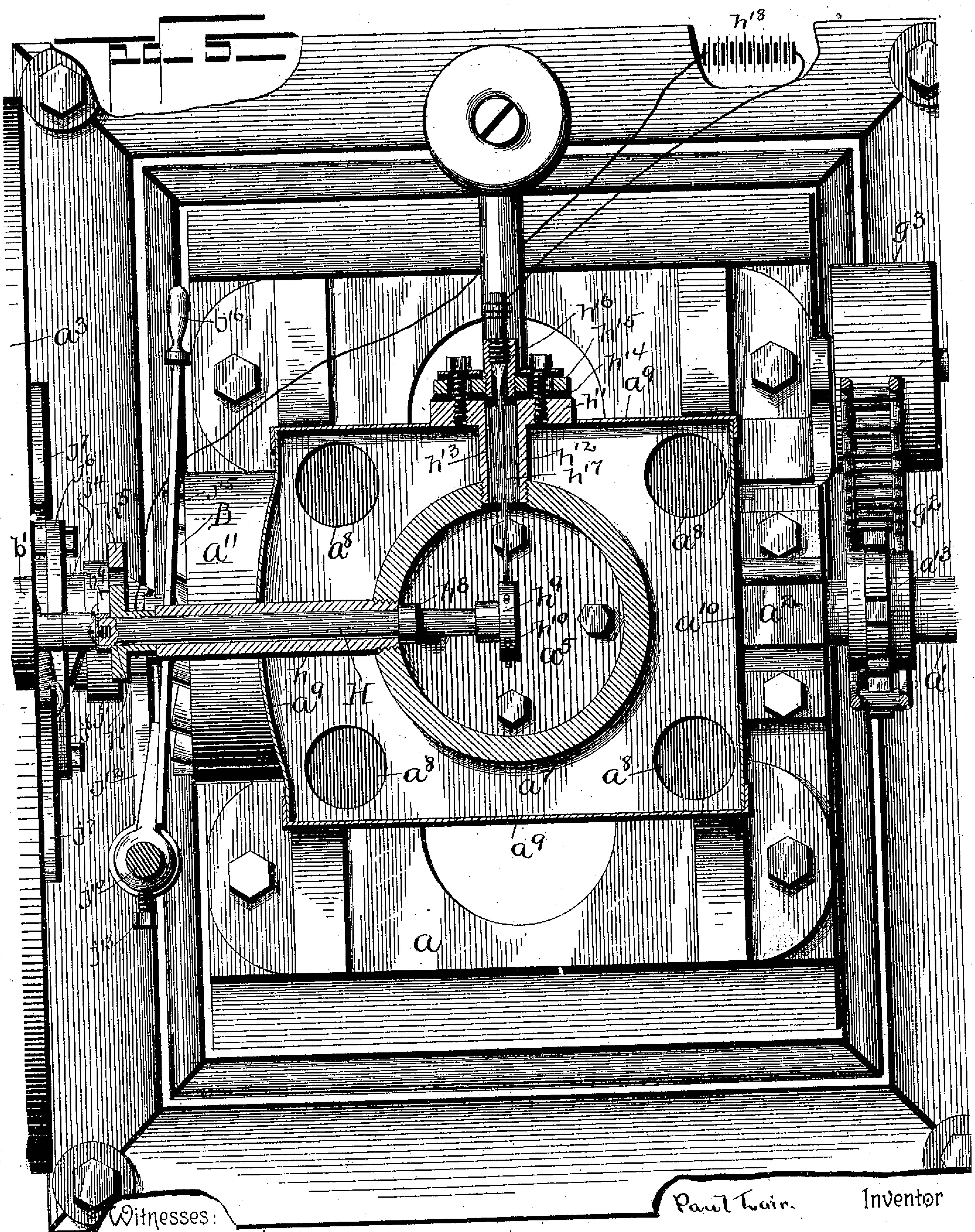
P. LAIR.

ENGINE.

(Application filed Dec. 30, 1897.)

(No Model.)

7 Sheets—Sheet 5.



Witnesses:

Horace G. Dietz

Arthur Page

Paul Lair. Inventor

By Marion & Marion.

Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

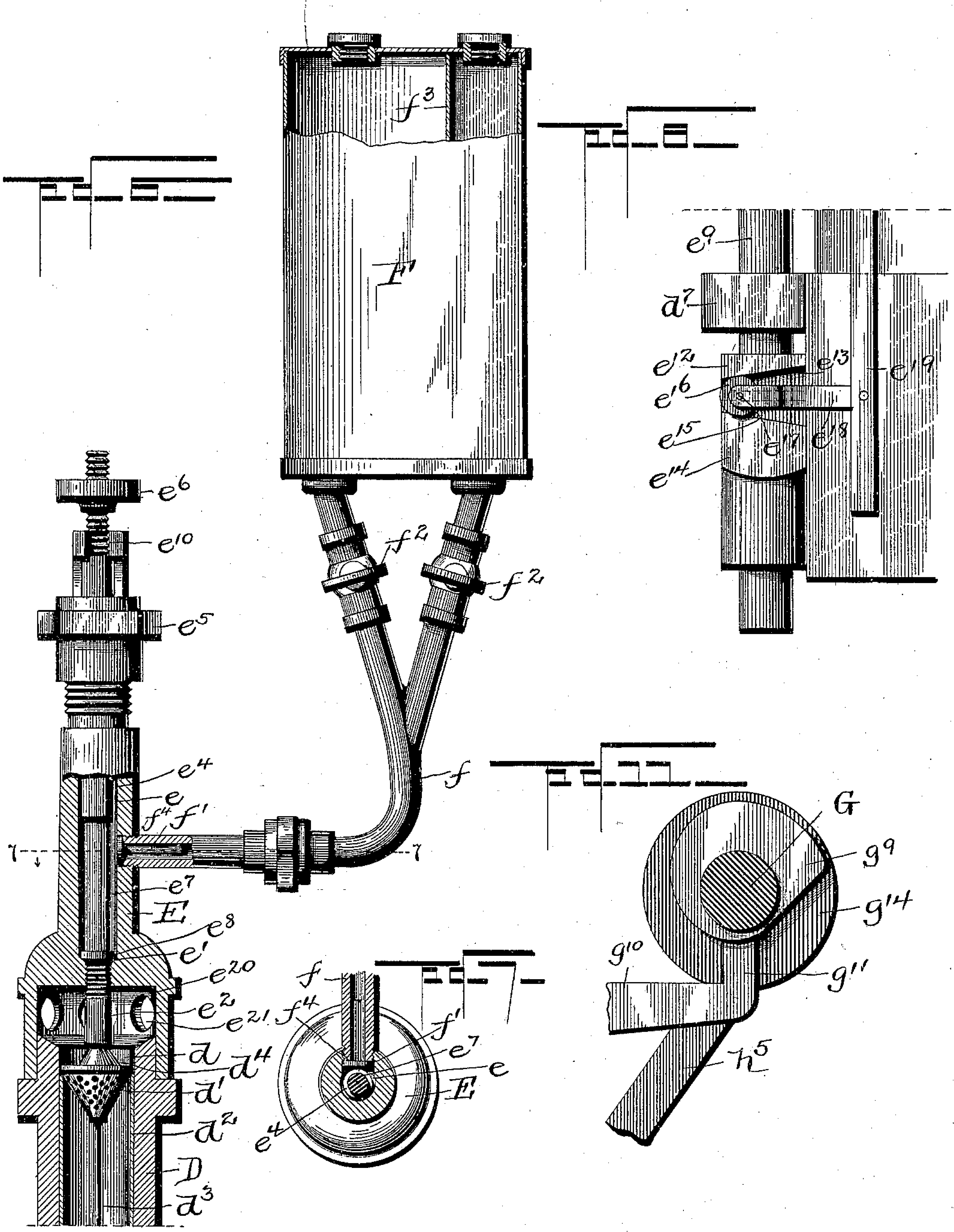
No. 625,887. Patented May 30, 1899.

P. LAIR.

ENGINE.

(Application filed Dec. 30, 1897.)

(No Model.) 7 Sheets—Sheet 6.



Witnesses:

Horace G. Dietz

Arthur Page

Paul Lair, Inventor

By Marion & Marion

his Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

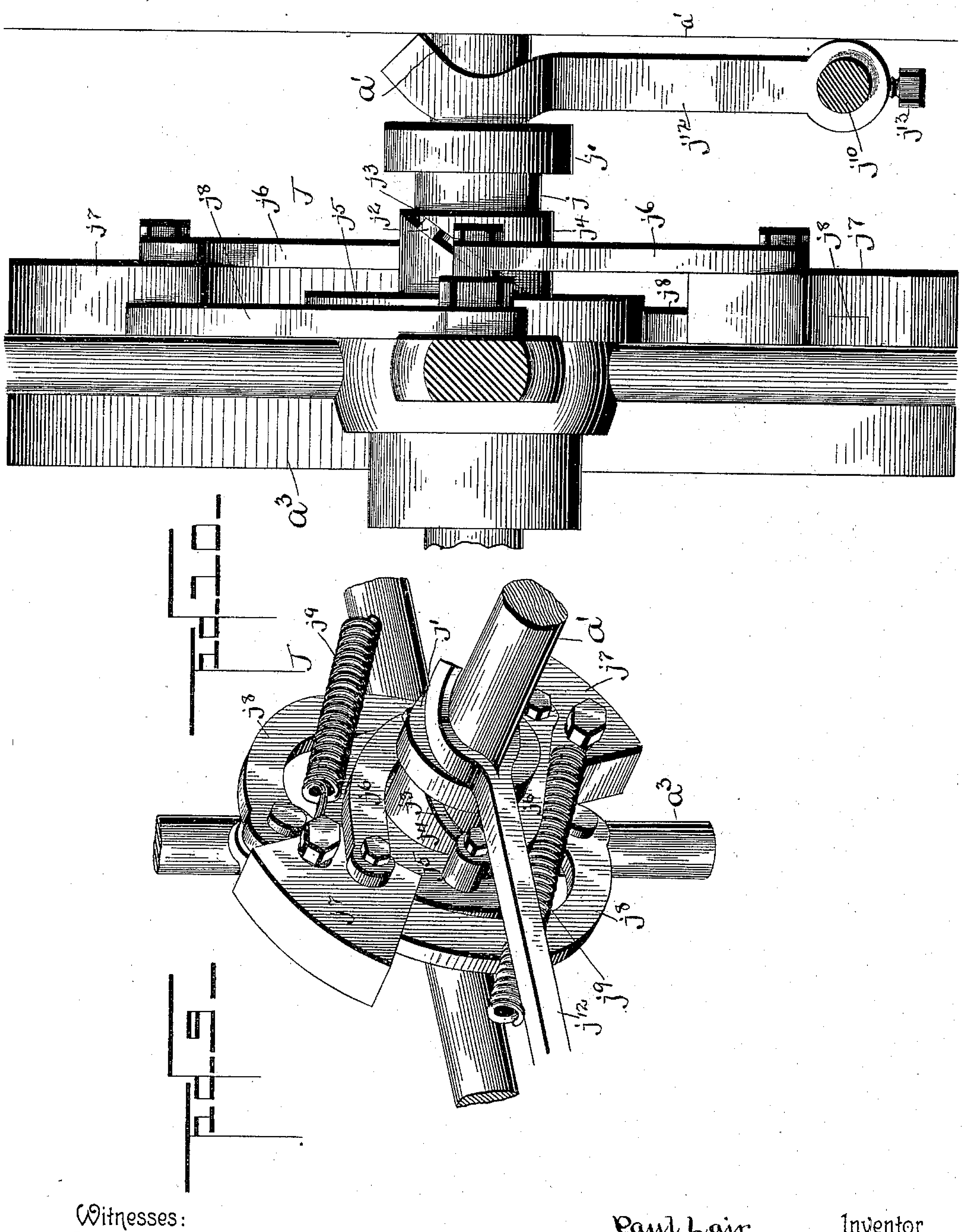
No. 625,887. Patented May 30, 1899.

P. LAIR.

ENGINE.

(Application filed Dec. 30, 1897.)

(No Model.) 7 Sheets—Sheet 7.



Witnesses:

Horace G. Deitz

Arthur Page

Paul Lair, Inventor

By Marion & Marion,

his Attorneys

UNITED STATES PATENT OFFICE.

PAUL LAIR, OF LOTBINIÈRE, CANADA.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 625,887, dated May 30, 1899.

Application filed December 30, 1897. Serial No. 664,793. (No model.)

To all whom it may concern:

Be it known that I, PAUL LAIR, a citizen of the Dominion of Canada, residing at Lotbinière, in the county of Lotbinière, Province of Quebec, Canada, have invented certain new and useful Improvements in Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in engines, and has particular relation to the class known as "explosive-engines."

The object of my invention is to provide a device of this character in which the motive power is furnished by the explosion of gas generated from low-grade oils.

A further object is to provide such device with mechanism for accurately mixing and feeding low-grade oils to the explosion-chamber.

A further object is to provide such device with mechanism for automatically regulating the amount of oil for generating purposes, thus controlling the speed of the engine.

A further object is to provide a governor which is accurate in its operation and by means of which the supply of oil to the mixing-chamber and the passage of vapor to the explosion-chamber may be regulated.

A further object is to provide such device with accurately-operating valves for feeding the gas to the explosion-chamber and for passing the exploded gas from said chamber.

A further object is to provide a device which is durable in construction and which can be operated in simple manner and without danger to the operator.

To these and other ends my invention consists in the improved construction and combination of parts hereinafter fully described, and particularly pointed out in the claims.

In the accompanying drawings, in which similar letters of reference indicate similar parts in all of the views, Figure 1 is a side elevation of my improved engine. Fig. 2 is a rear view of the same. Fig. 3 is a perspective view of the upper portion of my device. Fig. 4 is a vertical cross-sectional view of the same. Fig. 5 is a horizontal section taken through the explosion-chamber, showing the mechanism for causing the explosion of the gas. Fig. 6 is a view, partly in section, showing the oil-feeding and mixing mechanism. Fig. 7 is a sectional view taken on line 7 7 of Fig. 6. Fig. 8 is an elevation showing the means for regulating the oil-supply. Fig. 9 is a perspective view of the governor, showing it in its closed position. Fig. 10 is a plan view showing the governor in its open position operating to stop the supply of oil. Fig. 11 is a view showing the cam for operating the oil-controlling valve and plunger.

A designates an engine suitably mounted on the base a. Mounted in bearings a^2, secured to the top of the base a, is the shaft a', having the balance-wheels a^3 secured thereto outside of the base a.

a^4 designates the piston-rod, the lower end of which is mounted on the shaft a' and having at its upper end the piston-head a^5, which is mounted as shown in the drawings.

As shown in Figs. 4 and 5, the exterior of the explosion-chamber is provided with horizontal flanges or ribs a^7, extending entirely around the chamber, each rib being provided with openings a^8. These ribs are inclosed by a casing a^9, said casing having the opening a^{10}. To one side of the casing a^9 and within an encircling band a^{11} I mount a rotary fan B, the bearing b of which is secured to the side of the base. The fan is rotated by means of a small roller b', mounted on the fan-shaft, the position of the roller being such that a tight frictional contact will be had between the peripheries of the roller b' and the balance-wheel a^3. The fan B being mounted in the opening a^{12}, formed in the casing a^9, of the same size as the inner circumference of encircling band a^{11}, any rotation of the balance-wheel a^3 will cause the fan to be rapidly rotated, drawing the outer cold air into the opening a^{12} and forcing the air inward and upward through the openings a^8, around the exterior of the explosion-chamber, and out through opening a^{10}, thus serving to prevent heating of the combustion-chamber and the danger of the explosion of the gas in the explosion-chamber.

The upper end of the explosion-chamber a^6 is closed by means of the top C, which is secured in position by means of bolts extending into the ribs. The top C is provided with an opening c, formed at one side of its center, which opening leads into a lateral channel c', to the outlet end of which is secured pipe c^2. A spring-actuated valve c^3 serves to close the opening c, the valve being adapted to be operated at certain periods, as hereinafter set forth. At the opposite side of the center of the top C a second opening c^4 is formed, said opening having connection with a channel c^5, leading through the top in a direction opposite to that of the channel c', the openings and channels being so arranged that communication between them can only be had through the explosion-chamber a^3. A spring-actuated valve c^6 is provided for closing the opening c^4. The opening c^4 forms the inlet for the gas, while the opening c forms the outlet for the exploded gas.

To one side of the top C, I secure by suitable bolts an extension D, provided with the channel d, extending therethrough, said channel forming a continuation of the channel c^5. At suitable distances in the vertical portion of the channel d I place suitable perforated cone-shaped air and oil mixers d' d', said mixers being held in position by means of collar d^2, placed in said channel d between the mixers d'. A plunger d^3 is mounted centrally in said channel d, passing through said mixers, said plunger being provided at a suitable distance from its top with a valve d^4, the valve and plunger being held in their upper position by means of spring d^5, located between the lower face of the valve and the upper mixer d'. Projections d^6 d^7 extend laterally from the extension D at points near its top and bottom, said projections being provided with openings d^8 d^9 for a purpose to be hereinafter described.

A top E is removably secured to the extension D at its top and is provided with a central opening e, the lower end of which is contracted, as shown at e', for the purpose of forming a valve-seat. A tubular extension e^2 is secured to the top E at its lower end, the extension e^2 extending downward into the upper end of the channel d, the lower end of the channel forming a valve-seat e^3, against which the valve d^4 is adapted to normally rest, the upper end of the plunger d^3 extending into the opening in the extension, this construction preventing the plunger and its valve from passing out of its central position.

A plunger e^4 is mounted in the opening e, a stuffing-box e^5, located at the upper end of the top, serving to close the opening e, yet allowing of the vertical movement of the plunger. The plunger has its upper end screw-threaded for the reception of an adjusting-nut e^6, the purpose of which will be hereinafter described.

The plunger e^4 has its diameter reduced for a portion of its length, as shown at e^7, and has its lower end cone-shaped to form the valve e^8, adapted to normally rest on the valve-seat e'.

Mounted within the openings d^8 d^9 and having a vertical movement therein is a rod e^9, the upper end of which is bent at an angle, as shown in Fig. 4, the end of the rod being provided with a kerf e^{10}, which is adapted to normally rest on the top of the plunger e^4, the rod being held in this position by means of the spring e^{11}.

The rod e^9, below the lower projection d^7, is provided with a fixed collar e^{12}, having its front face provided with an inclined way e^{13}. Mounted on the rod e^9, below the collar e^{12}, is a sliding collar e^{14}, the front face of which is provided with the inclined way e^{15}, the two inclined ways e^{13} e^{15} being arranged at opposite angles, as best shown in Fig. 8. Located at the front of the collars e^{12} e^{14} and between the inclined ways e^{13} e^{15} is a roller e^{16}, mounted on a pivot e^{17}, secured to one end of a link e^{18}, the opposite end of said link being pivotally connected to one end of a bell-crank lever e^{19}, pivotally connected to the extension D, said lever e^{19} having its opposite end bifurcated to engage with the valve c^6, below spring c^7, located thereon, to normally hold the valve closed. It will be apparent from this construction that if any upward pressure is applied to the sliding collar e^{14} the rod e^9 will be moved upward by reason of the roller e^{16} engaging with the fixed collar e^{12}, and this upward movement of the rod e^9 will cause the kerfed end of the rod to engage with the adjustable nut e^6 on the plunger e^4, raising the plunger e^4 and lifting the valve e^8 off its seat e', allowing the liquid that may be in the opening e to pass downward into the extension e^2, where it is held by the valve d^4. Upon releasing the pressure on the sliding collar e^{14} the spring e^{11} will cause the rod e^9 to move downward, thus engaging with the top of the plunger e^4 and forcing it downward. This downward movement of the plunger e^4 and the valve e^8 at its lower end causes a pressure to be applied on the liquid in the extension e^2, which is forced downward, opening the valve d^4 and allowing the liquid in the extension to pass downward into the mixing-chamber e^{20}, where it is associated with air which enters through openings e^{21}, formed in the walls of the mixing-chamber e^{20}, the valve e^8 having in the meantime been forced downward on its seat, preventing the further passage of the liquid to the extension e^2 until the valve is again lifted from its seat and the operation repeated. When the liquid has passed into the mixing-chamber e^{20} and becomes associated with the air, it passes downward through the mixers d' d', where the thorough mixing causes the liquid to be formed into a vapor, which passes downward and into the explosion-chamber a^6 when the valve c^6 has been opened, as hereinafter described.

F designates an oil-receptacle within which the oil is retained and from which it passes into the opening e through tube f, connected to the top E at one side. A valve f' is placed at the inner end of the tube to prevent the return of the oil to the tube f. A stop-cock f^2 is inserted in the tube to cut off the supply of oil when the engine is not running.

While I have described the oil-receptacle shown in Fig. 3 of the drawings, yet in view of the fact that to obtain the best results I start the engine with a light volatile oil, such as gasolene, and after the engine has been completely started change to a denser oil, such as refined petroleum or coal oil, I prefer to make the receptacle as shown in Fig. 6, where the receptacle is divided into two parts by means of the partition f^3, each part being provided with an opening leading into the tube f, each opening being provided with a stop-cock f^2. It will be apparent that when the valve e^8 of the plunger e^4 is raised the back pressure against the oil in the opening e will exert itself against the valve f' and close it against its seat f^4, preventing the flow of oil into the opening e, the compressed oil serving to hold it in place until the downward movement of the plunger e^4 will serve to release this pressure and allow the valve to leave its seat, the oil resuming its flow into the opening e.

In the rear of the top C and in suitable bearings g I mount a longitudinal shaft G, to one end of which I attach the sprocket-wheel g', adapted to be driven by the sprocket a^{13}, mounted on the shaft a', through the medium of sprocket-chain g^2, adapted to be kept taut by means of the adjustable roller g^3, secured to the side of the casing a^9. The sprocket-wheels g' and a^{13} are so arranged that two revolutions of the sprocket-wheel a^{13} cause one revolution of the sprocket-wheel g', for a purpose hereinafter described.

An eccentrically-mounted cam g^4 is mounted on the shaft G in rear of the valve c^3, upon which is adapted to ride the rear end of lever g^5, pivotally mounted in bearing g^6, secured to the top C. The front end of the lever g^5 is bifurcated, as at g^7, the ends being adapted to engage with a suitable stop g^8, secured on the valve c^3.

It will be apparent that when the cam g^4 revolves the rear end of the lever g^5 will be raised, thus forcing downward the valve c^3 against the action of the spring c^8, mounted on the valve c^3, thus opening the valve while the rear end of the lever is in its raised position. As the cam g^4 turns the lever g^5 will be released from the raising action of the cam and the spring c^8 will close the valve and keep the rear end of the lever g^5 in engagement with the upper face of the cam g^4.

Near the front end of the shaft G is secured a cam g^9, its face having the form shown in Fig. 11. An arm g^{10}, having its rear end bent upwardly, as at g^{11}, is pivotally mounted in a bearing g^{12}, secured to the rear of the extension D, the said upwardly-bent portion g^{11} being adapted to rest against the face of the cam g^9. The free end of the arm g^{10} is mounted in an opening g^{13}, formed in the rear face of the sliding collar e^{14}. From this construction it will be apparent that as the shaft G revolves, carrying with it the cam g^9, the arm g^{10} will be rocked on its pivot and cause a corresponding movement of the sliding collar e^{14}, which in turn operates the plunger e^4, as hereinafter set forth. It will be seen that the arm g^{10} is moving practically all the time; but such movement has no effect on the plunger e^4, except when the rod e^9 reaches a point near its top or bottom limit of movement. This allows of a steady movement of the operating parts and prevents any danger of accidents caused by the sudden movement of any of the parts.

The operation of the construction as above set forth would be as follows: The oil-receptacle F, (shown in Fig. 6,) having been filled with the gasolene and the less volatile oil, the stop-cock f^2 to the gasolene portion of the receptacle is opened, the gasolene flowing downward into the opening e. The balance-wheels a^3 are then rotated by any suitable means, causing the piston a^5 to be operated and also causing the shaft G to be rotated, which in turn operates the plunger, as hereinbefore set forth. The piston-head a^5, fitting the cylinder or explosion-chamber a^6 closely, when moving downward forms a vacuum in the chamber a^6, which serves to draw the valve c^6 off of its seat against the action of the spring c^7, which is formed of sufficient power to keep the valve c^6 on its seat when no heavy pressure is exerted to draw the valve off of its seat. The opening of the valve c^6 allows of the entrance of the vapor (formed by the mixing of the air and gasolene, as hereinbefore described) into the explosion-chamber. This vapor is introduced while the piston-head is being moved downward, the valve c^6 immediately closing upon the return movement of the piston. As the piston moves upward the vapor is compressed, and when the piston has reached its upward limit of movement the vapor is exploded by means hereinafter described, the expanding vapor forcing the piston downward, but without opening the valve c^6 by reason of the fact that no vacuum is formed at this period of the operations. When the piston has reached its lower end, the lever g^5 is operated upon by the cam g^4 and opens the valve c^3, through which the exploded vapor passes during the upward movement of the piston, the spring c^8 returning the valve c^3 to its seat as the cam g^4 revolves, the valve being closed when the piston reaches its upward limit of movement.

As the shaft G makes but one revolution while the shaft a' revolves twice, it will be seen that the valves c^3 c^6 will be operated but once during two complete movements of the piston, the operation of the valves being at the time the piston is in the following positions: The first downward movement of the piston serves to open the valve c^6 for the inlet of the vapor. The upward movement which follows compresses the vapor. The second downward movement is caused by the exploding of the vapor, and the ensuing upward movement, by reason of the opening of the valve c^3, forces the exploded vapor out through outlet-pipe c^2. The force exerted by the explosion of the vapor is sufficient to cause the balance-wheels to make two complete revolutions between each explosion.

After the machine has started the stop-cock f^2 to the gasolene portion of the oil-receptacle F is closed and the stop-cock f^2 of the heavier oil portion is opened, the heat generated by the several explosions being sufficient to warm the top C, aiding in the forming of the vapor from the heavier oil.

In producing the explosion of the vapor after it has been compressed in the explosion-chamber a^6 I preferably make use of the electric spark emitted on the contact of positive and negative poles located within the explosion-chamber, the current to produce which is derived from a cell-battery located at some suitable point, the wires leading therefrom being connected to the engine at suitable points, as hereinafter described.

The mechanism used for producing the spark at the proper time is best shown in Figs. 3, 4, and 5, and is as follows:

H designates a shaft extending from the side of the engine through the casing and into the explosion-chamber, and is revolubly mounted in a suitable elongated bearing h, secured in the casing and to the walls of the explosion-chamber. The outer end of the shaft is provided with a wheel h', having notches h^2 formed on its outer face for the reception of one end of a pawl h^3, which is pivotally mounted on one end of a lever h^4, pivotally connected to the end of the shaft H. An arm h^5 is pivotally connected to the lower end of the lever h^4, the rear end of said arm being pivotally connected to the face of a disk g^{14}, located on the end of the shaft G in such manner that as the shaft G revolves, carrying with it the disk g^{14}, the lever h^4 will be rocked on its pivot, causing the pawl h^3, which is held in engagement with one of the notches h^2 by suitable means, such as spring h^6, to turn the wheel h' a suitable distance and then return to its former position, the wheel being held against any backward movement by the engagement in one of the notches h^2 of one end of a suitable bar h^7, secured to the casing. To hold the shaft in its proper position, a collar h^8 is provided, said collar being secured in position against the inner end of the elongated bearing h. The inner end of the shaft H is provided with a disk h^9, to the face of which are secured pins h^{10}, corresponding in number and position to the notches h^2 on the wheel n'. It will be apparent from this construction that as the shaft G makes one complete revolution the shaft H will make a revolution equal to the distance between the pins h^{10}.

To the rear of the casing and on a plane with the shaft H, I secure a plate h^{11}, having an extension h^{12} secured to the walls of the explosion-chamber a^6. The plate and extension are provided with a central opening h^{13}, which leads into the explosion-chamber. Secured to the rear face of the plate h^{11}, but insulated therefrom by suitable insulation h^{14}, is a plate h^{15}, to the center of which is secured a tube h^{16}, within which is secured a finger h^{17}, the front end of which extends through openings h^{13} into the explosion-chamber, where it is adapted to come in contact with the pins h^{10} as the shaft H is rotated. One of the wires from the battery h^{18} is secured to the rear end of the finger h^{17}, the other being connected to some suitable part of the engine, preferably the bearing h. From this it will be apparent that the front end of the finger h^{17} and the pins h^{10} form the respective poles of the circuit and that as the shaft H is rotated a spark will be emitted whenever the finger h^{17} and one of the pins h^{10} contact with each other.

As there is a direct connection between the movement of the piston and the movement of the shaft H by means of shaft a', sprocket a^{13}, sprocket-chain g^2, sprocket-wheel g', shaft G, disk g^{14}, arm h^5, lever h^4, pawl h^3, and wheel h', it will be apparent that the spark can only be produced at the instant when it is required, thus preventing any danger from a premature explosion of the vapor.

It will be apparent that the amount of fluid admitted to the mixing-chamber will be regulated by the length of the stroke of the plunger e^4, the stroke of the plunger being regulated by the position of adjusting-nut e^6, it being obvious that as the distance between the lower face of the adjusting-nut e^6 and the upper end of the plunger e^4 increases the length of stroke of the plunger e^4 will decrease, thereby decreasing the supply of fluid in the mixing-chamber. Therefore when the adjusting-nut e^6 has been adjusted to the proper point the amount of fluid passed into the mixing-chamber will not vary excepting under certain circumstances, which I will now proceed to describe.

It is obvious that the adjusting-nut e^6 will be adjusted to a point where the length of the stroke of the piston will pass sufficient fluid into the mixing-chamber to cause the engine to operate the connected machinery when in use. When the machinery is stopped or when used in connection with machinery such as a planer, where the power needed is increased and diminished intermittently, it will be apparent that when the need of power is diminished the engine will be driven at an increased speed, and at such times it is desired that the supply of fluid to the mixing-chamber should be decreased, and this is accomplished by means of the device applied to the lower end of the rod e^9. (Best shown in Fig. 9.) The collar e^{12} being fixed on the rod, it is obvious that when the roller e^{16} is raised it will raise the rod e^9, and to raise the collar e^{16} the collar e^{14} is provided, as hereinbefore described. As long, therefore, as the roller remains in one fixed position the rod e^9 will be raised to the same height with each revolution of the shaft G, and the amount of fluid passed into the mixing-chamber will be the same with each stroke of the plunger e^4. If, however, the roller e^{16} is moved toward the right, the sliding collar e^{14} will be moved upward a greater distance on the rod e^9 before the top of the roller e^{16} will contact with the inclined way e^{13}, and as the sliding collar e^{16} has a fixed vertical movement the rod e^9 will not be moved the full length of its stroke and will therefore shorten the stroke of the plunger e^4, allowing of the passage of a less quantity of fluid.

It will be apparent that if the roller e^{16} be moved a sufficient distance toward the right the contact between the top of the roller e^{16} and the inclined way e^{13} will be made at such a point as will prevent the rod e^9 from having any upward movement or not sufficient to raise the plunger from its seat, in which case there will be no inlet of fluid into the mixing-chamber, no vapor being formed, and the engine stopped in its movement until more fluid is introduced. It will be apparent, therefore, that if the amount of fluid passed into the mixing-chamber can be automatically regulated the engine can be regulated to run at any desired speed by means of the regulation by the adjusting-nut e^6 of the approximate amount of fluid passed into the mixing-chamber and the regulation of this amount by means of the automatic moving of the roller e^{16} to the right as the speed increases. This automatic movement is caused by means of a governor, which I will now describe, and its connecting parts.

J designates a governor mounted on the shaft a', in connection with spokes of one of the balance-wheels a^3. Mounted on the shaft a' and having a movement longitudinally of said shaft is a collar j, having an enlarged flange j'. The collar j is provided with radially-extending lugs j^2 j^2, extending from opposite sides of the collar, said lugs being adapted to ride in grooves j^3, formed in the circumference of a loose collar j^4, mounted to revolve on the collar j. The grooves j^3 extend diagonally across the circumference of the collar j^4, as best seen in Fig. 10, and it will be apparent that by reason of the lugs j^2 riding in said grooves if said collar j^4 be rotated the lugs will be moved longitudinally of the axle and move the collar j and flange j' in the same direction. A flange j^5 is formed on the loose collar j^4, to the side of which are pivotally connected the inner ends of arms j^6. The outer ends of arms j^6 are pivotally connected to weights j^7, pivotally connected on opposite sides of the collar j^4, by means of arms j^8, pivotally connected at one end to the spokes of the balance-wheel a^3 and each having its other end secured to the weight j^7. By this construction it is evident that as the wheel a^3 revolves the weights j^7 will be forced outward by centrifugal force, the movements of the weights outward being in the form of a tangent, by reason of its being connected by means of arms j^6 j^8 to the flange j^5 and spokes of the wheel a^3. As the weights move outward the flange j^5 is rotated, causing the collar j to move inward toward the base a. To prevent the weights from moving outward excepting when the wheels a^3 are revolved at great speed, I connect to the rim of the wheel a^3 and the weight j^7 a strong spring j^9. (Best shown in Fig. 9.)

A vertical rod j^{10}, mounted in suitable bearings j^{11}, is located at the side of the engine, the rod j^{10} being provided at a suitable point with an inwardly-extending bifurcated arm j^{12}, the bifurcated end of the arm being adapted to loosely embrace the shaft a' between the base a and the flange j' of the collar j, the arm j^{12} being held against movement on the rod j^{10} by means of set-screw j^{13}. The upper end of the rod j^{10} is provided with an inwardly-extending arm j^{14}, the inner end of which is adapted to rest against the lower end of the bell-crank lever e^{19}. By this construction it will be readily understood that as the speed of the balance-wheels a^3 increases and the governor acts, the arm j^{12} will be moved inwardly, turning the rod j^{10} which in turn moves the arm j^{14} inwardly, and moving the lower end of the bell-crank lever e^{19} toward the right. As the link e^{18} is secured to the bell-crank lever, this movement of the governor will cause the roller e^{16} to be moved to the right, with the result as hereinbefore described. The rod j^{10} can also, if desired, be rotated by means of lever j^{15}, secured thereto, said lever having a handle j^{16}. The moving of the bell-crank lever has also the effect of increasing the tension of the spring c^7, thus requiring a greater vacuum in the explosion-chamber a^6 to open the valve c^6.

The operation, it is thought, has been clearly indicated above, and it is therefore not repeated, as the description is such as to make a repetition entirely superfluous.

The advantages of this construction are many and include the absolute freedom from any danger of premature explosion, there being no spark of any kind about the engine at any time excepting at the moment when its use is required, and then at the point where needed.

The opening of the inlet-valve by the vacuum formed in the explosion-chamber is a great advantage, inasmuch as the fluid which is in the mixing-chamber will be drawn downward, together with the air which is drawn in through the openings to the mixing-chamber, and both be rapidly formed into vapor as it is being drawn through the heated top. This enables me to use a less volatile oil than gasolene, decreasing the cost of running and also the danger of explosion.

The regulating of the supply of fluid to the mixing-chamber forms an efficient means for keeping the engine running at a steady speed, thus increasing the uses to which the engine may be put. The ability to stop the engine by moving the handle j^{16} places the running under perfect control at all times, and the stopping will be easily accomplished by simply turning off the supply of fluid.

While I have herein shown and described an engine which is neat and attractive in its appearance, durable in its construction, and simple in its operation, it is to be understood that I do not limit myself to the precise construction shown and described, but claim the right to use any and all equivalents to the end that I may be protected to the fullest extent in the benefits which may accrue by reason of my improvements.

Having thus described my invention, what I claim as new is—

1. In a vapor-engine the combination with an extension having a vapor-forming chamber; of a top having an opening; a plunger in said opening; an inlet for the oil; a rod adapted to move said plunger intermittently; a fixed collar on said rod; a sliding collar on said rod; means for making a contact between said fixed and said sliding collar at a predetermined period in the movement of said sliding collar; and means for imparting a movement to said sliding collar.

2. In a vapor-engine, the combination with an extension having a vapor-forming chamber; of a top having an opening; a plunger in said opening; an inlet for the oil; a rod adapted to move said plunger intermittently; a fixed collar on said rod; a sliding collar on said rod below said fixed collar; means for imparting a movement to said sliding collar; and means for making a contact between said fixed and sliding collars at a predetermined period in the movement of said sliding collar.

3. In a vapor-engine, the combination with an extension having a vapor-forming chamber; of a top having an opening; a plunger in said opening; an inlet for the oil; a rod adapted to move said plunger intermittently, said rod having a fixed and a sliding collar; means for imparting movement to said sliding collar; and means for automatically forming a contact between said fixed and said sliding collars, the point of contact being determined by the movement of the engine.

4. In a vapor-engine, the combination with an extension having a vapor-forming chamber; of a top having an opening; a plunger in said opening; an inlet for the oil; a rod adapted to move said plunger intermittently, said rod having a fixed and a sliding collar; a roller movable between said fixed and said sliding collars, forming a contact, the movement of said roller being regulated by the movement of the engine; and means for imparting a movement to said sliding collar.

5. In a vapor-engine, the combination with an extension, having a vapor-forming chamber; of a top having an opening; a plunger in said opening; an inlet for the oil; a rod adapted to move said plunger intermittently, said rod having a fixed and a sliding collar; a contact-roller between said fixed and said sliding collar; an arm connected to said sliding collar and adapted to move the same on said rod; and means for imparting an oscillating movement to said arm.

In witness whereof I have hereunto set my hand in presence of two witnesses.

PAUL LAIR.

Witnesses:
ALBINI BLAIS,
CHAVIGNY DE LA CHEVROTIÈRE.