(No Model.)

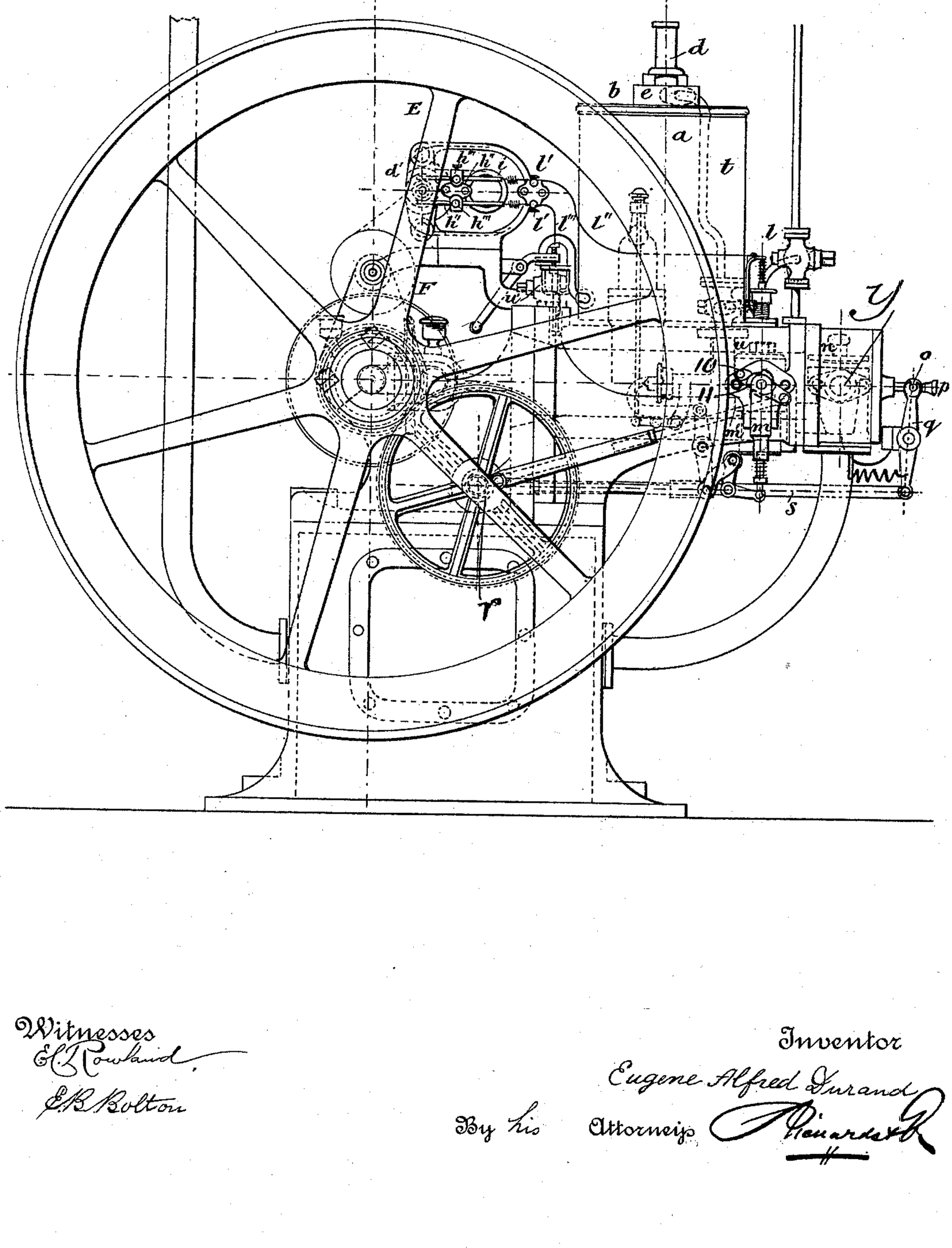
4 Sheets—Sheet 1.

E. A. DURAND.

CARBURETED AIR ENGINE.

No. 497,048. Patented May 9, 1893.

FIG. 1.



Witnesses
E. Rowland.
E. B. Bolton

Inventor
Eugene Alfred Durand
By his Attorneys Howard & Howard

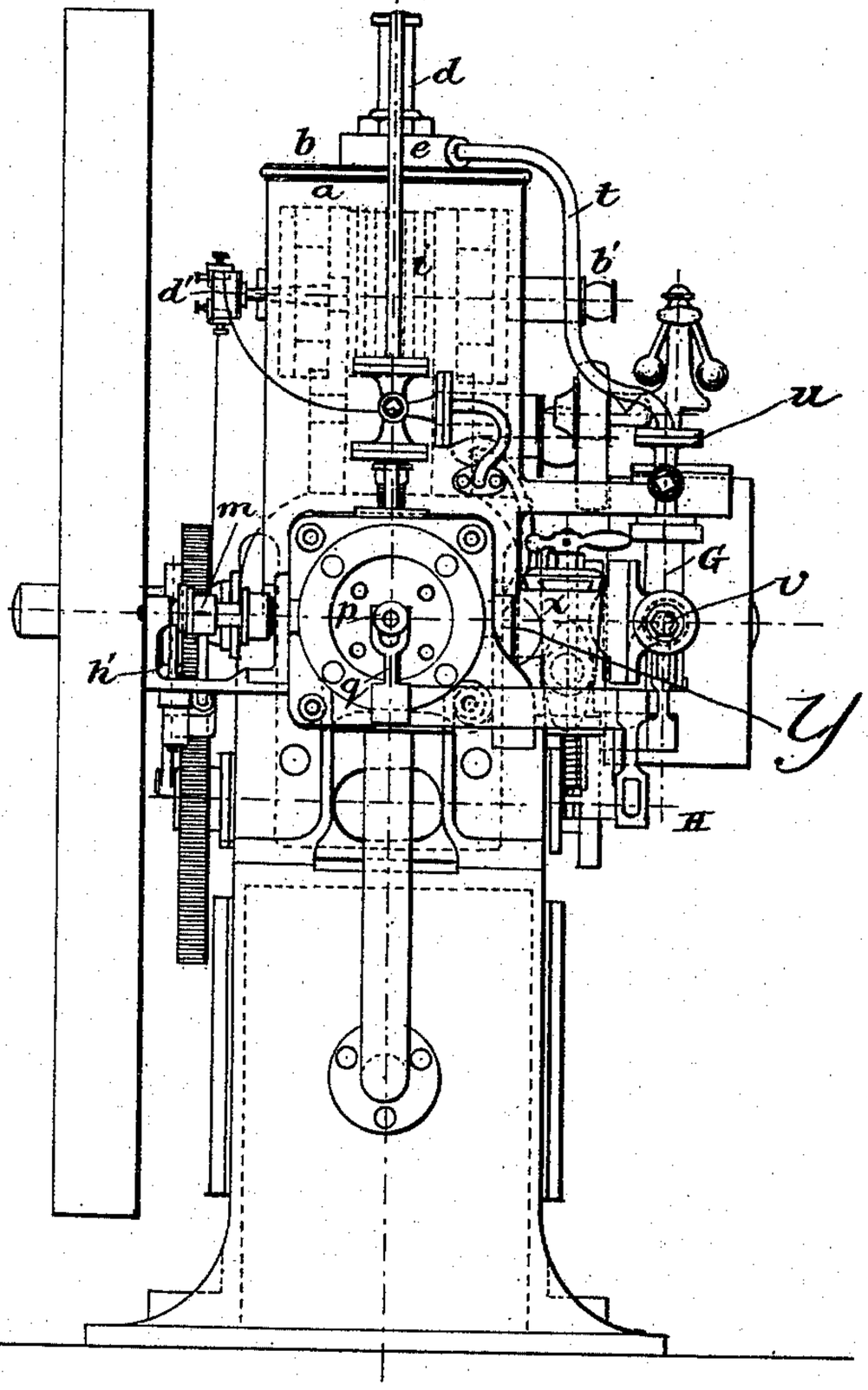
(No Model.) 4 Sheets—Sheet 2.

E. A. DURAND.

CARBURETED AIR ENGINE.

No. 497,048. Patented May 9, 1893.

FIG 2.



Witnesses
E. Loveland
E. B. Bolton

Inventor
Eugene Alfred Durand
By his Attorneys Richards & Co

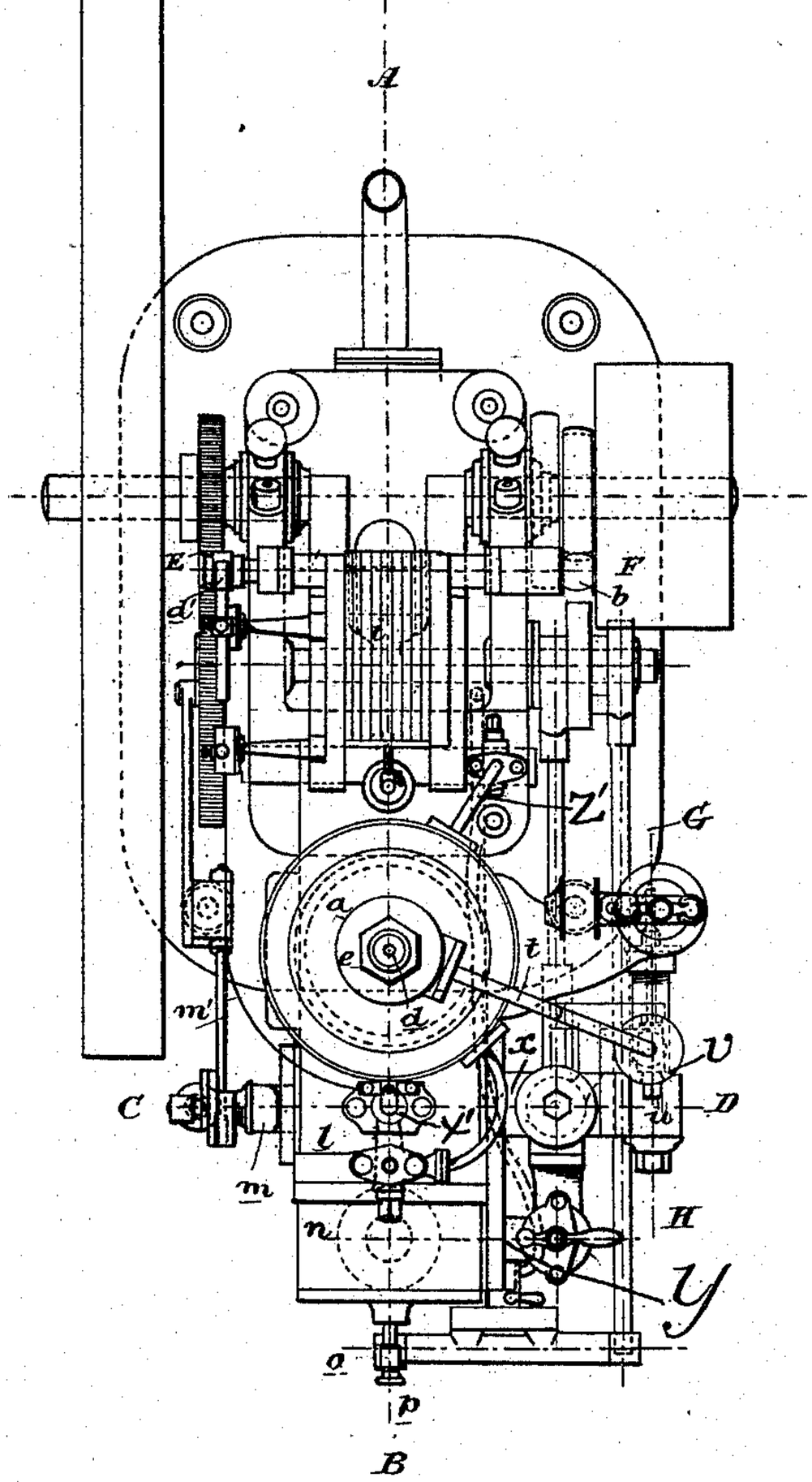
(No Model.) 4 Sheets—Sheet 3.

E. A. DURAND.

CARBURETED AIR ENGINE.

No. 497,048. Patented May 9, 1893.

FIG. 3.



Witnesses
E. Rowland.
E. B. Bolton

Inventor
Eugene Alfred Durand
By his Attorneys Prevard & R

(No Model.)

4 Sheets—Sheet 4.

E. A. DURAND.

CARBURETED AIR ENGINE.

No. 497,048. Patented May 9, 1893.

FIG. 4.

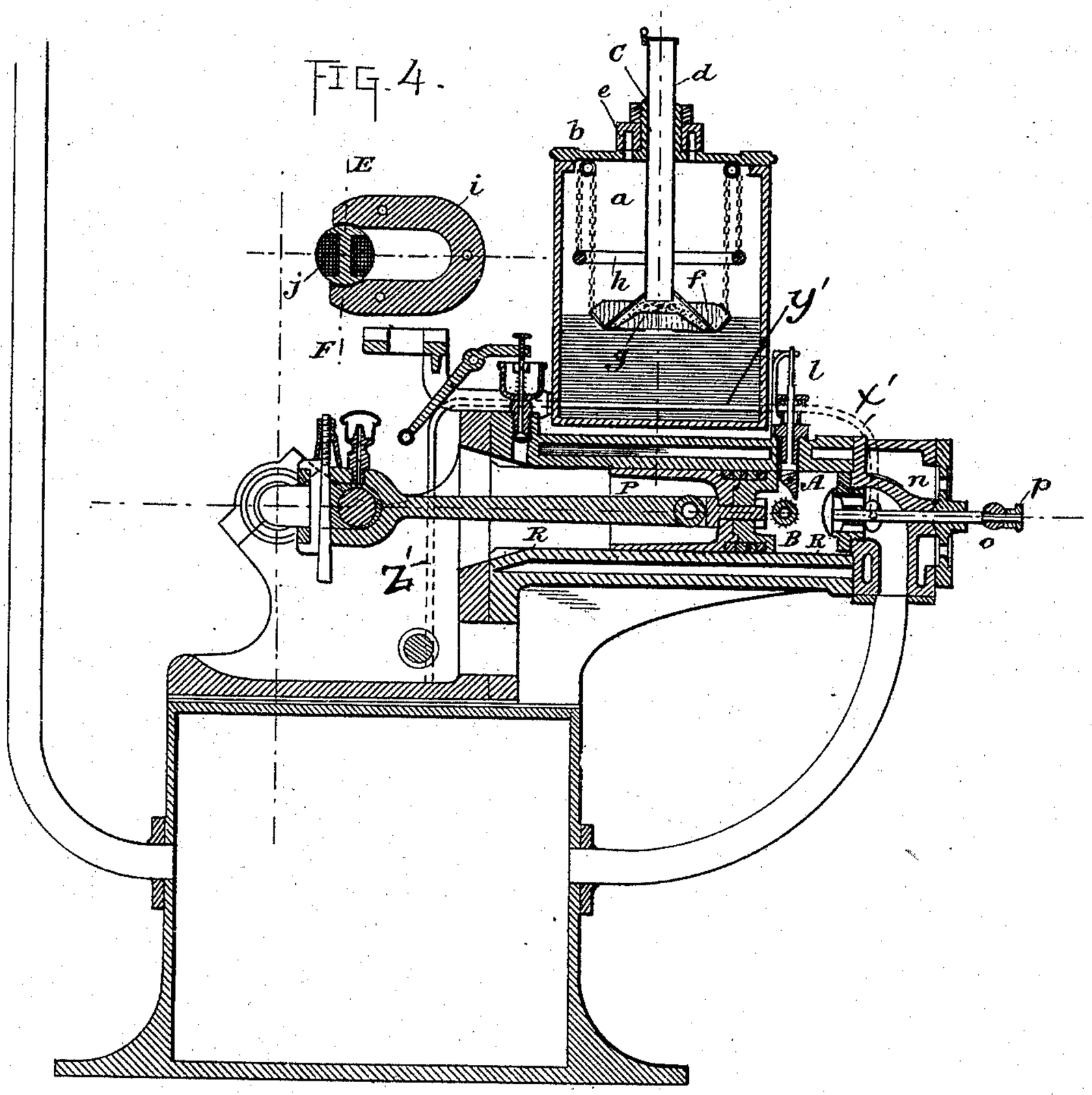


FIG. 5.

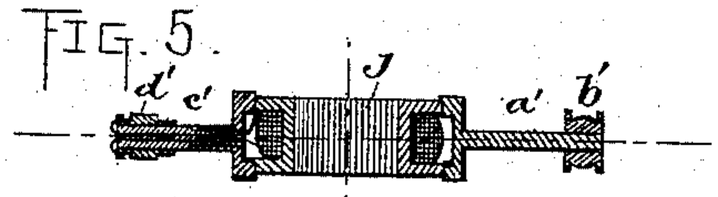


FIG. 7.

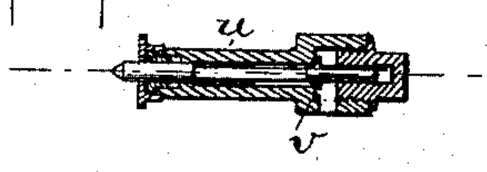
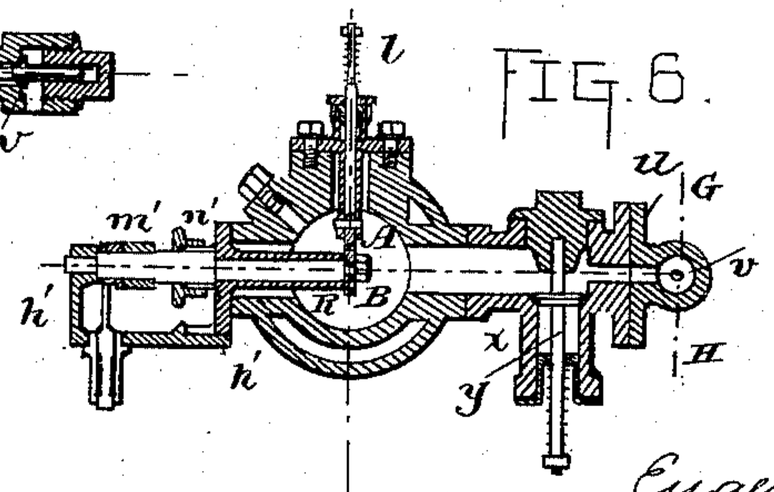


FIG. 6.



Witnesses
E. Rowland.
E. B. Bolton

Inventor
Eugene Alfred Durand
By his Attorneys Richards & Geo

UNITED STATES PATENT OFFICE.

EUGÈNE ALFRED DURAND, OF PARIS, FRANCE.

CARBURETED-AIR ENGINE.

SPECIFICATION forming part of Letters Patent No. 497,048, dated May 9, 1893.

Application filed July 16, 1888. Serial No. 280,151. (No model.) Patented in France November 27, 1886, No. 180,435; in Belgium April 23, 1888, No. 81,525; in England April 24, 1888, No. 6,088; in Italy May 5, 1888, No. 23,414; in Spain May 14, 1888, No. 8,252, in Russia May 25, 1888, No. 14,202, and in Austria-Hungary September 24, 1888, No. 18,502 and No. 34,376.

To all whom it may concern:

Be it known that I, EUGÈNE ALFRED DURAND, a citizen of the Republic of France, and a resident of the city of Paris, in the Republic of France, have invented certain new and useful Improvements in Carbureted-Air Engines, (for which I have received Letters Patent in France, No. 180,534, dated November 27, 1886; in Belgium, No. 81,525, dated April 23, 1888; in England, No. 6,088, dated April 24, 1888; in Austria-Hungary, No. 18,502 and No. 34,376, dated September 24, 1888; in Italy, No. 23,414, dated May 5, 1888; in Spain, No. 8,252, dated May 14, 1888, and in Russia, No. 14,202, dated May 25, 1888;) and I do hereby declare that the following is a full, clear, and exact description of the same.

The invention has for its object an improved motor working by means of a detonating mixture composed of carbureted air and pure air, which I ignite by means of an electrical apparatus working without a battery and in which the feed of carbureted air is effected with great regularity by means of an automatic carburetor with a float which may or may not be warmed by a branch from the exhaust, and the tightness of the cylinder of the carburetor is assured by an escape-valve which is easy to be cleaned. This is a compressed air and gas motor, the action of which may be considered as divided into four periods as follows. The aspiration of the carbureted air and the atmospheric air, forming together a detonating mixture, is performed by the piston of the cylinder during the first period; the same piston compresses this mixture during the second period; there is ignition and explosion in the third period; and evacuation of the products of combustion in the fourth period.

In the accompanying drawings: Figure 1 represents a front elevation; Fig. 2 an end elevation; Fig. 3 a plan view and Fig. 4 a longitudinal vertical sectional view on line A. B. of Fig. 3, of a motor engine embodying my invention. Fig. 5 represents a longitudinal sectional view on line E F of Figs. 1, 3, and 4, of the movable bobbin turning in the bunch of magnetized plates which constitute with it the electric generator of the igniting apparatus. Fig. 6 represents a vertical transverse sectional view on line C D of Fig. 3. Fig. 7 represents a longitudinal sectional view on line G H of Figs. 2, 3 and 6, of the pipe or neck *u* serving to admit the carbureted air into the cylinder.

The same letters and numerals of reference indicate the same parts in the several figures.

The carburetor which serves to feed my motor is composed of a receiver *a* which receives the carbureted hydrogen that is to be used. This receptacle is furnished with a cover *b* fixed thereon with an air tight joint. This cover carries a smooth sleeve *c* bored to exactly fit the tube *d* allowing the tube *d* to slide through it easily but air-tight. On the cover is also mounted an annular neck or hollow crown *e* serving for the passage of the carbureted air, the circular groove of which ring *e* communicates with holes pierced in the cover. This crown *e* is connected in another direction by means of the tube *t* with the neck *u* in which a valve *v* works (Figs. 6 and 7), the opening of which at the proper moment permits of the aspiration into the carburetor and the consequent admission of carbureted air into the cylinder, for this neck *u* is mounted on the neck *x* (Figs. 2, 3, and 6), with which it communicates and which itself communicates with the cylinder.

Through the sleeve of the cover with a sliding fit slides the tube *d* having an enlarged portion at the lower end on which is fixed, by means of screws, a ring of cork *f* carrying a disk of perforated sheet metal as iron, tin, zinc, or other suitable metal on which is fixed a piece of cork *g*. Between this last and the interior portion of the enlargement of the tube is a bed of iron turnings or chips for the purpose of dividing the air which passes through it (Fig. 4). This combination forms a floating apparatus which is kept in equilibrium by means of a ring *h* acting as a counterweight and suspended by chains passing over small pulleys and attached at their other ends to the ring of cork. This apparatus floats on the hydro-carbon sinking into it only a certain distance which always remains the same whatever may be the level of the liquid.

A coiled pipe *y'* may be placed inside the

recipient a at the bottom and fastened at each extremity to the side of the recipient with an air tight joint. At one end this pipe is connected to and forms a continuation of another tube x' supplied with a cock which communicates with the exhaust pipe. By opening this cock, a part of the exhaust passes through the tubes x' and y' and communicates its heat to the mass of hydro-carbon contained in the recipient. The tube y' at its other extremity communicates with the outer air through the tube Z'. This deviation of the exhaust has for its object not only to prevent the lowering of the temperature of the hydro-carbon as the air becoming carbureted takes up the highest parts, but also to increase the temperature of the liquid mass in cold weather so as to facilitate the separation of the vapors or of the lighter and more volatile parts of the hydro-carbon. The apparatus may also be supplied with a gage to show the level of the liquid.

This carburetor works in the following manner:—The piston P of the motor which acts as an air pump sucks in the passing air through the neck x. This air enters the carburetor through the upper part of the tube d which is open, passes through this tube and through the bed of iron chips or turnings, where it is divided, then through the portion of hydro-carbon included between the bottom of the bed of iron chips and the surface of the liquid mass, in which it becomes carbureted, and so on to the neck e through the corresponding holes of the cover b. Thence it goes into the cylinder R of the motor, passing through the tube t and the neck u, and, as it passes over the valve y which is in the neck x mixes with a certain quantity of circulating air which at that moment is sucked in from outside through this neck by the piston. The valve y of the neck x which communicates with the outer air is in fact open at the same time as the valve v, so that the piston P sucks in at the same time both carbureted air and pure air, which go into the cylinder together there combining and forming a detonating mixture. The electrical apparatus which serves to ignite this mixture comprises a small magneto-electric machine and an arrangement for breaking the electric circuit for the production of the spark for igniting the mixture.

The generator consists of a bunch or body of magnetized steel plates i fastened together and held tightly between two cheeks or face plates, which serve as a frame or support to hold and carry the several parts, and of a bobbin j composed of a number of plates of soft sheet iron upon which is wound a wire of a certain diameter. This bobbin, which always turns in the same direction between the poles of the magnetized bunch or body of plates i, carries two journal spindles. One a' (Fig. 5) is solid and on it is fixed the pulley b' connected by a strap to the shaft of the motor which works it. The other journal spindle c' is hollow and the hollow contains a body of some insulating material pierced lengthwise with two holes, into one of which passes the inside wire of the bobbin and into the other the outside wire,—these two wires being thus completely insulated. On the outside of this same insulating material is fixed a commutator d' composed of two half-ferrules of brass separated from one another the space of a few millimeters. One of these half-ferrules is connected to the end of the outer wire of the bobbin and the other to the end of the inner wire.

Above and below the commutator are placed small brushes h'' h'' of brass wire, always bearing lightly on the commutator.

If the flywheel of the motor is turned the bobbin begins to move; each of its poles is magnetized alternately in a contrary direction by passing before the poles of the fixed magnet, and there is produced in the wire an induced current the direction of which changes at each half revolution. The commutator, which I have described, directs this current always in the same direction. On the two cheeks or face plates at the sides of the magnetized bunch, two sockets are fixed acting as plumber blocks for the journal-spindles of the bobbin. On one of these cheeks two small columns are also mounted terminated by a cap of insulating material. One h''' carries the brushes h'' which can oscillate freely. The other serves to connect the brushes with the conducting wires l'' l''.

The breaking of the current and consequent production of the spark is obtained by an arrangement formed of two parts, one marked l, the other marked m, to each of which is fixed the end of one of the two conducting wires.

The vertical part l is composed of a support fixed firmly on the cylinder and fitted to it with a close joint, but insulated from it by means of the insertion of sheets of asbestus and of insulating washers around the bolts. This support carries an igniting finger A, which a small spindle, worked by a spring, tends always to draw downward. A guide for the upper end of this spindle is mounted on this support and serves at the same time as a stop to receive the thrust of the spring. A small stuffing-box prevents any escape around the spindle. The height of the finger A can be regulated at will, so as to compensate for its wearing away.

The part m is composed of a support h' (Fig. 6) fixed firmly on the cylinder with a tight joint, but insulated from it by the insertion of sheets of asbestus and of insulating washers around the bolts. In this support a spindle turns carrying at one end a small toothed wheel B placed beneath the finger A which presses pretty heavily upon it. The other end of the spindle carries a ratchet and pawl 10, 11, Fig. 1 operated by an insulated connecting rod m' (Fig. 1) by which the spindle at the proper moment is made to

turn a certain distance. A stuffing-box n' Fig. 6 prevents any escape round this spindle.

When the flywheel turns and the spindle of the horizontal part is at rest, that is to say during the return of the pawl, the finger resting on the small toothed wheel B gives to the current a circuit completely closed. But if the movement is continued the pawl again engages the ratchet and causes the spindle of the horizontal part to move and consequently turn the wheel B a few teeth, the finger A passing brusquely and with friction from one tooth to the next and so on to as many teeth as pass, which determines as many breaks in the current and as many sparks.

The whole cylinder R, excepting the ends, is surrounded with water the object of which is to prevent it from becoming too hot.

The cylinder head n inside which is the exhaust port, is the part of the motor where the heat reaches the highest pitch. That part of the exhaust pipe nearest the cylinder is formed inside the head n and is surrounded by a cavity in said head represented in section in Fig. 4. I cause the outer air sucked into the cylinder by the piston to enter through this cavity, through the connection Y, Figs. 1, 2 and 3 in which it is heated by contact with the walls thereof and therein absorbs a part of the heat given off by the burned gases in their escape through the exhaust pipe. With the air thus heated a smaller quantity of gas or carbureted air is required to produce a given effect than if the air were admitted at a lower temperature.

To facilitate the cleaning of the exhaust valve, the rod of this valve traverses the exhaust pipe and is fitted at its end with a small collar O in which it can turn. This collar is stopped by a ring or button p fixed on the rod, and carries two small lugs which fit into the bifurcated ends of a forked lever a which serves to give motion to the exhaust valve and which is in its turn worked by a cam r and a connecting rod s. A spring placed on this connecting rod or elsewhere tends always to keep the valve in its seat. The milled button p at the end of the rod of the exhaust valve rod allows, without anything or parts being taken down or removed, of the valve being turned in its seat and thus ground or cleaned.

What I claim is—

1. In combination in a gas engine, the cylinder the piston, the gas supply and controlling valves therefor, the exhaust valve and the operating means therefor including a forked lever, a connecting rod and a cam, the stem of said valve having a loose connection with its lever whereby it may be turned and the button for turning the stem and grinding the valve upon its seat, substantially as described.

2. In combination the piston and cylinder, the gas supply connections, the finger A, the spring stem therefor projecting radially from the cylinder, the shaft journaled on the cylinder and extending under the finger A, the ratchet wheel on the end of the said shaft, the pawl and the ratchet for turning the shaft, the means for operating the same, and the electrical connections to the finger A and to the ratchet below the same, substantially as described.

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

EUGÈNE ALFRED DURAND.

Witnesses:
JULES FAYOLLET,
AUG. VINCK.