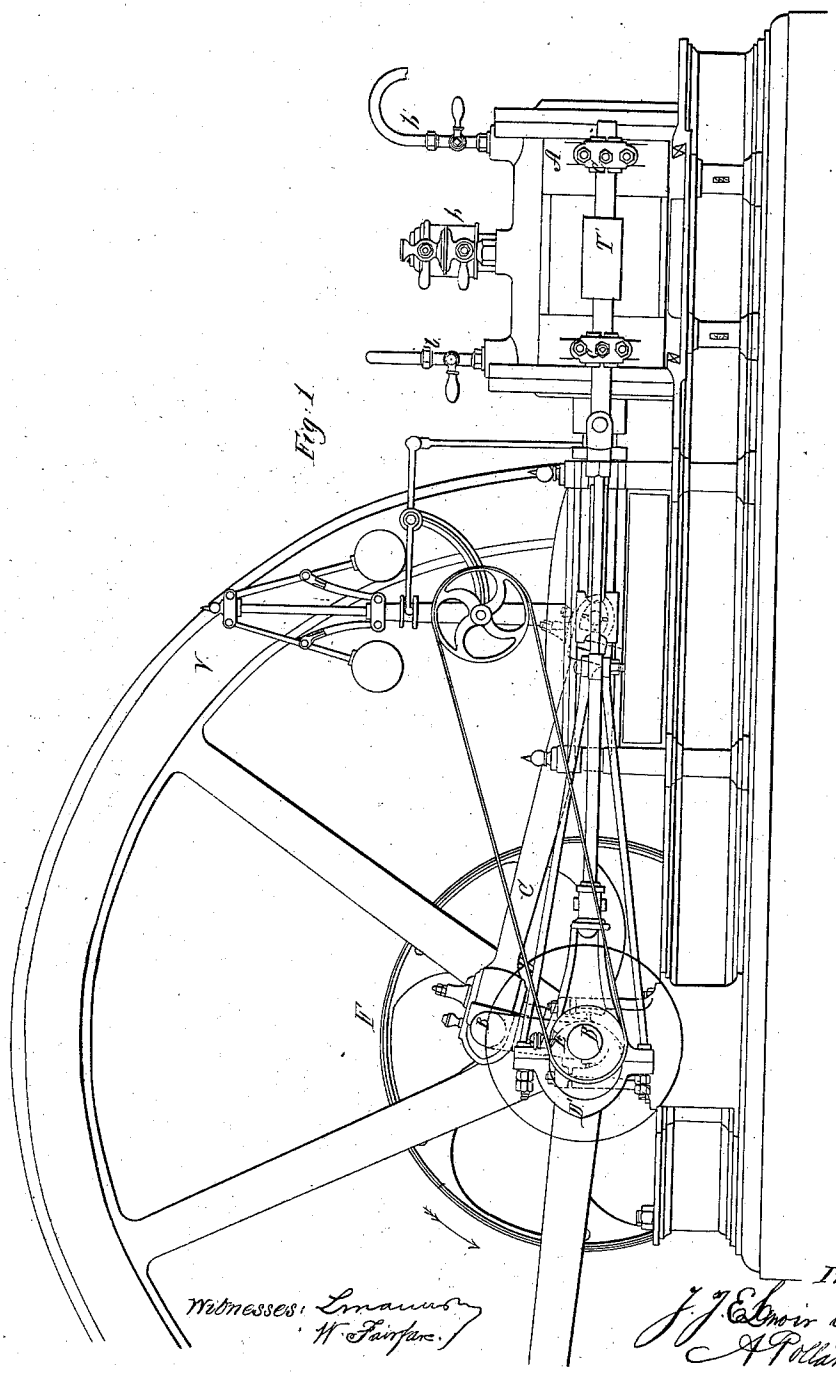
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J. J. E. LENOIR.

AIR ENGINE.

No. 31,722. Patented Mar. 19, 1861.



Witnesses: Lemuel W. Fairfax.

Inventor: J. J. E. Lenoir by A. Pollak Atty.

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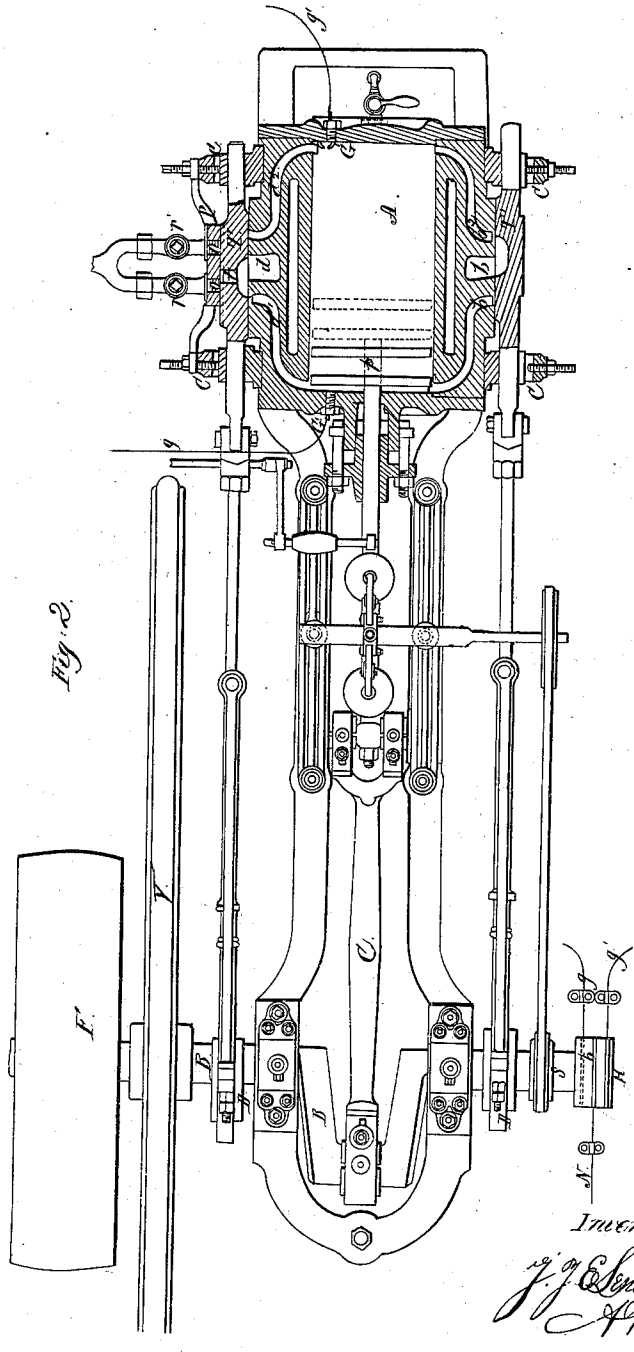


Fig. 2.

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Fig. 3

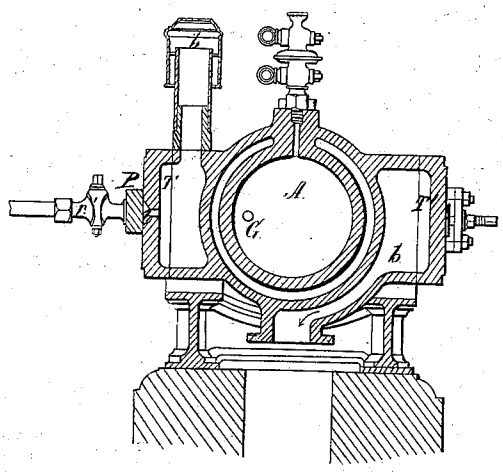
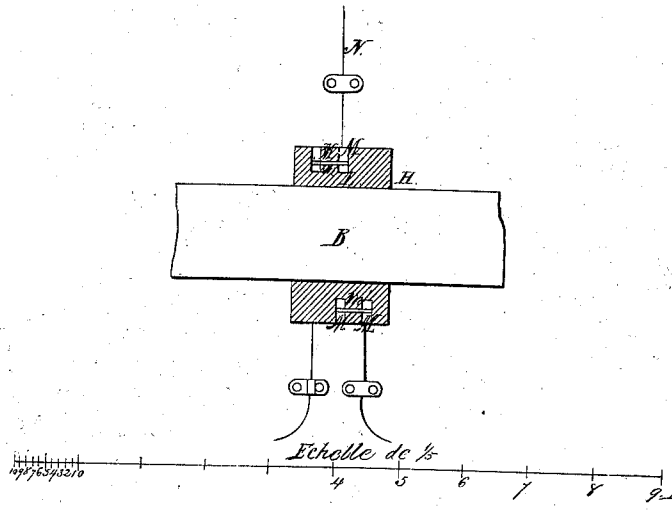


Fig. 4



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UNITED STATES PATENT OFFICE.

JEAN JOSEPH ETIENNE LENOIR, OF PARIS, FRANCE.

IMPROVED AIR-ENGINE.

Specification forming part of Letters Patent No. **31,722**, dated March 19, 1861.

To all whom it may concern:

Be it known that I, JEAN JOSEPH ETIENNE LENOIR, of Paris, in the Empire of France, have invented a new and useful Improvement in Hot-Air Engines; and I hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, which form part of this specification.

This my invention relates to engines, whether stationary or locomotive, in which the motive power is air dilated or expanded or heated by the combustion of an inflammable gas; and it consists in or is based upon two fundamental principles which constitute the characteristic features of my discovery or invention, viz., first, the application of the combination or mixture with atmospheric air of lighting-gas or any other inflammable gas; second, the simultaneous action of both in a machine or engine deriving its elements of function from electricity and operating substantially in the manner of the ordinary steam-engine. From these statements it will appear that although I employ gas and air in the proportions of about eighty-five per cent. of the latter to fifteen per cent. (which, by the way, is a maximum) of the former, this my engine cannot be classed among gas-engines. Indeed, the functions of the gas I employ do not consist in detonating or exploding it, thereby impelling the piston, as this has heretofore been done or suggested, but in the use of the gas as a fuel that can be instantaneously and regularly ignited, and without producing any shock, for the purpose of heating the air that is mixed with it. The air thus dilated or expanded will act on the piston in the same manner as steam would in ordinary steam-engines.

The cylinder, according to my invention, is made to act alternately as the generator of the motive power and as the recipient thereof, the elastic fluid acting with high pressure and expansively, according to the length of the cylinder. The products or residue of the combustion escape at regular intervals at each stroke of the piston, so that when in operation the engine has the appearance of a steam-engine, while in reality it is an engine working with dilated or hot air.

Engines constructed and operating according to my invention are easily regulated by applying the means of regulation or of adjustment upon either of the three component elements—*i. e.*, either upon the admission of air, or upon the flow of gas, or upon the apparatus generating electricity.

Instead of lighting-gas, the liquid hydrocarbons may be used by reducing the same into vapor, also pure hydrogen gas, sulphurous gas, the inflammable vapors or gases produced by the heating of the essence of boghead, gazine tar, or other hydrocarbon, or of the mixture of said substances.

To enable others to make and use this my invention, I shall now proceed to describe in detail an engine constructed according to the principles of my invention.

Figure 1 represents a longitudinal elevation of the engine complete; Fig. 2, a plan view of the same, the cylinder being shown in section. Fig. 3 shows a transverse section of the cylinder.

Upon examination of the figures it will be perceived that this engine is similar or identical with the ordinary steam-engine, and being composed of the same parts it is susceptible of the many modifications of which ordinary steam-engines are.

The cylinder A is cast with a casing, and is arranged so as to have two valve-seats, upon which two separate slide-valves, T and T′, have their play. These valves alternately open at suitable intervals the nozzles $a\ a'\ a^2$, that conduct the air and gas toward each side of the piston, while the nozzles $b\ b'\ b^2$, acting in a similar manner, serve the purpose of exhaust or emission of the products of combustion. The slide-valve T serves for the introduction of the mixture of air and gas, and is provided with an orifice, *t*, communicating with either of the apertures *o o′* in the plate P. This plate is armed with two cocks, *r r′*, admitting of the passage of gas. The introduction of atmospheric air takes place through the orifice *a*, communicating with the tube *t′*, surmounted by a cap, *b*. The slide-valves work entirely uncovered—*i. e.*, without a distributing-chest—and they are guided by brackets *c*, bolted to the cylinder. The arrangement of these brackets is such as to allow of perfect adjustment of the surfaces, respectively, of the slide-valves and the valve-seat by means of a regulating-screw.

The cap *b* acts in some measure like a gasometer—*i. e.*, it holds the gas that would have

a tendency to escape. The movement of the piston *p* is transmitted to the main driving-shaft B by means of a connecting-rod, *c*, attached to the crank of the shaft. The two eccentrics D and D′ operate the slide-valves T and T′, and a small pulley, E, imparts movement to a governor on the fly-wheel V. A large pulley, F, transmits the power, and suitable gearing mechanism complete the machinery appertaining to the engine proper.

The cylinder is provided at both of its extremities with the igniting apparatus G G′, which communicates with a suitable distributer of electricity, H, placed upon the main shaft. The distributer is connected with a Rhumkorff apparatus that is supplied from a battery or other source of electricity.

Having thus described the details of machinery I use, I shall now proceed to describe the *modus operandi*. I start the machinery or engine by giving motion to the piston *p*, thereby producing a vacuum behind the piston, which causes the air and gas to penetrate through the nozzles *a a′;* but inasmuch as the slide-valve T opens the orifice *a* before the apparatus is placed in communication with either of the openings *o o′*, through which the gas is introduced, it is evident that a column of air shall have penetrated the cylinder. At this moment the valve T opens the orifices *o o′* in the plate P, and gas as well as air will enter the cylinder, without, however, completely mixing with each other, but forming, as it were, veins or layers of both. The valve then closes the orifices of the cylinder, and the apparatus G, suddenly emitting its electrical spark, ignites the gas, heats the air and its combinations, and dilates it or them to produce the requisite pressure. The products of combustion will then escape through the channel *b′* by the play of the valve T′. The fly-wheel is now in condition to aid the piston in its return movement while the slide-valves T and T′ are shifted. Air and gas are thus introduced at the opposite end of the cylinder, and will be ignited by the second spark from the other apparatus, G′, in the same manner as above described.

My object in introducing a column of air before admitting gas and air is to avoid intimate mixture, as it may happen that the carbonic-acid gas produced by the combustion of the first portion of the gas would prevent the remaining portion of the gas from being perfectly consumed. Gas not consumed can render no useful effect, whereas by allowing a column of air to penetrate in advance of the mixture will insure perfect combustion. As the engine works at a very high temperature, I introduce within the casing water, the quantity of which may be regulated by means of the cock *l*, and heat it or convert it into steam and convey it through pipe *l′* to any place I have use for it.

The electricity I derive from an apparatus shown in Fig. 4, consisting of a sleeve of hard rubber or gutta-percha or other non-conductor, L, in which are embedded metallic segments M M′. The segment M′ is put in constant communication with the conductor of electricity N, and the segment M with the distributing-wire *g g′*, that are secured to the igniting apparatus G G′. The small metallic bars *m m′* unite in contact the distributer with the conductor. The cylinder carries one of the poles. It is therefore easy to watch the operation of the distributer.

In the opening allegation of this specification I have stated that I may use the liquid hydrocarbons as the caloric employed to heat and dilate the air and its combinations. To do this I proceed as follows: I place the substance from which I desire to obtain its gas or vapor in a boiler, in the bottom of which I arrange a jacket or worm, either of which I connect with the exhaust-pipe of the engine. I thus heat the boiler, and as soon as inflammable vapors are produced I receive them in the cylinder. These vapors or gas act in the same manner as lighting-gas, having for effect the heating and dilating of the atmospheric air. I would observe that I reserve to myself the right to introduce atmospheric air alone at that part of the cylinder where pressure is to be exerted, and gas alone where it is to be ignited.

I would mention, in conclusion, that this my invention is applicable, with but slight modification, to all kinds or systems of engines in which steam has heretofore been used; also, that it may be applied to coupler-engines with two or three cylinders, to boats, locomotives, traction and portable engines, &c.; also vertical, horizontal, or inclined cylinders.

Having thus fully described my invention, I claim—

The arrangement in an engine substantially as described, of the parts for the admission to the cylinder successively of air and inflammable vapor or gas in such requisite quantities and proportions as that the former shall act upon the piston by expansion on being heated by the ignition of the latter, as described, in combination with a device for igniting said vapor or gas by electricity at each end of the cylinder, substantially as herein set forth.

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

ET. LENOIR.

Witnesses:
S. MICHAUD,
GEO. HUTTON.