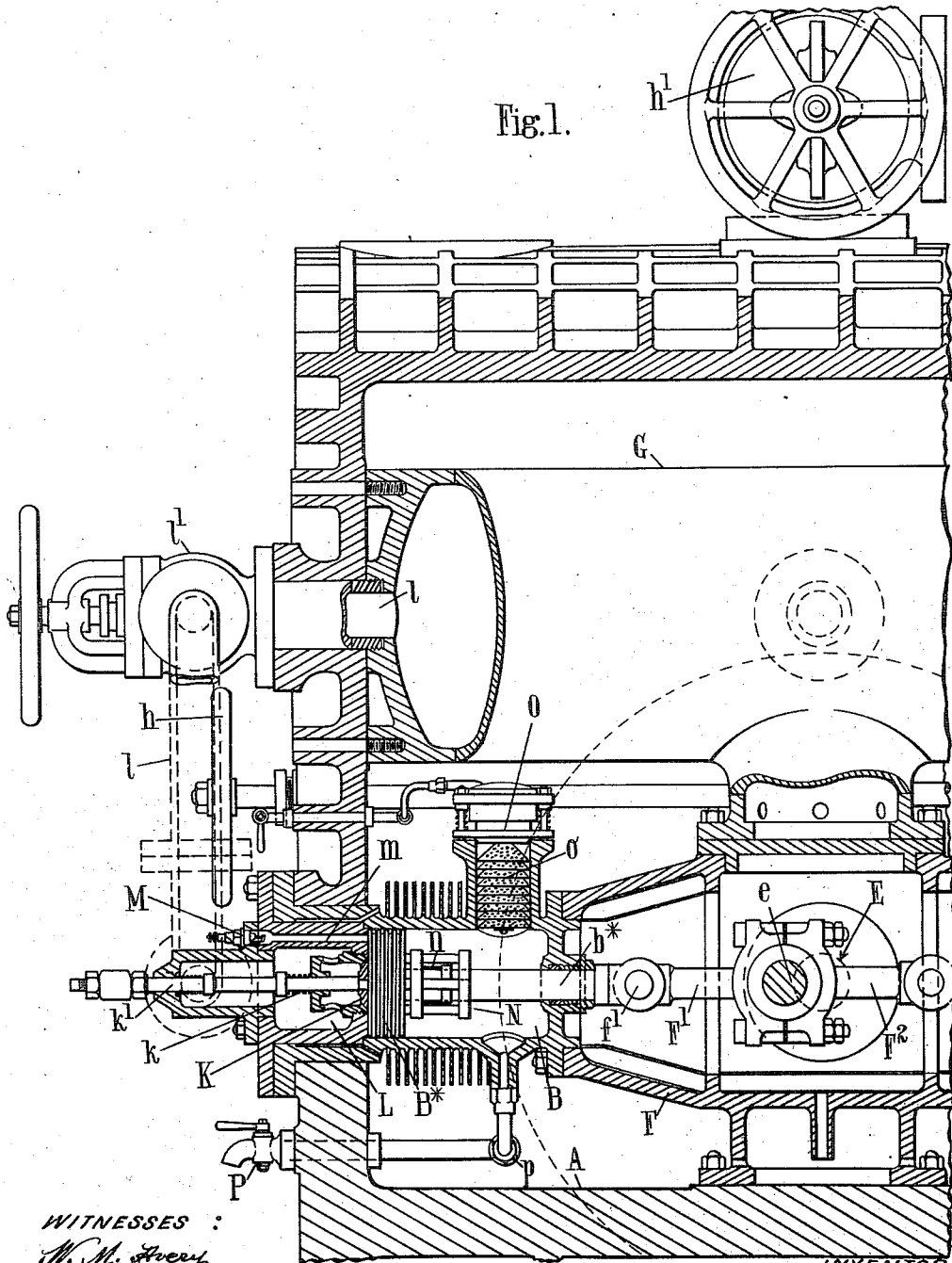


J. MOLAS.
 FLUID PRESSURE HEAT ENGINE.
 APPLICATION FILED JAN. 29, 1909.

973,289.

Patented Oct. 18, 1910.

2 SHEETS—SHEET 1.



WITNESSES:
W. M. French
J. P. Davis

INVENTOR
Jean Molas
 BY *Mummales*

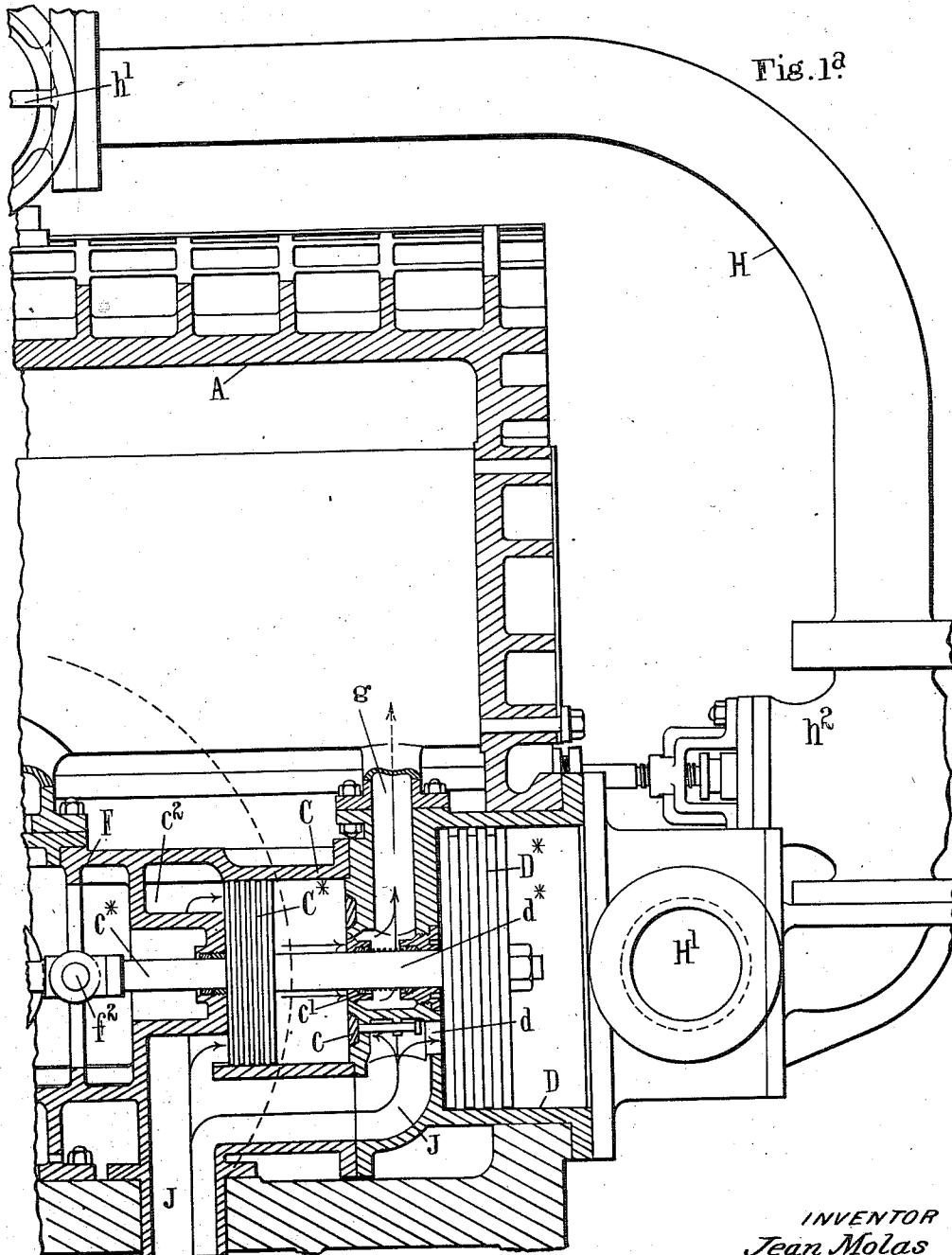
ATTORNEYS

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WITNESSES :
W. M. Avery
J. P. Davis

INVENTOR
Jean Molas
 BY *Mum Co*
 ATTORNEYS

UNITED STATES PATENT OFFICE.

JEAN MOLAS, OF LONDON, ENGLAND.

FLUID-PRESSURE HEAT-ENGINE.

973,289.

Specification of Letters Patent.

Patented Oct. 18, 1910.

Application filed January 29, 1909. Serial No. 475,037.

To all whom it may concern:

Be it known that I, JEAN MOLAS, a subject of the King of Great Britain, and resident of 94 Hewett road, Haringay, London, N., England, engineer, have invented certain new and useful Improvements in Fluid-Pressure Heat-Engines, of which the following is a specification.

This invention relates to the generation and utilization of motive power produced from the combustion of fuel, the main object of the invention being to obtain from the combustion of the fuel the maximum practicable efficiency by providing means for insuring the utilization (as far as practicable) of all the heat units by their conversion into useful work.

According to the present invention the fuel (preferably in the form of vaporized oil or gas) is burned under pressure in a closed chamber immersed in a reservoir of the elastic fluid which constitutes the ultimate source of motive power, said chamber being constituted by or connected with the cylinder or working chamber of an internal combustion motor (which for convenience may be termed the generating motor) whereby the pressure produced from the heat of combustion is utilized, in the first place to effect the introduction, under pressure, of the gaseous products of combustion into the reservoir already mentioned, and secondly, to simultaneously actuate air-compressing apparatus immersed in said reservoir and serving to highly compress (into a container or containers preferably immersed in the same reservoir) air which constitutes the atmospheric constituent of the combustible mixture.

It has been proposed to mount an internal combustion engine and an air compressor in such manner that the compressed air may be forced through the cylinder of the internal combustion engine and stored with the products of combustion in a reservoir, and it has also been proposed to arrange an internal combustion engine and an air compressor in a reservoir adapted to contain the air compressed by said air compressor, some of the products of combustion passing into said reservoir, and it has further been proposed to generate steam in a boiler by forcing into such boiler the products of combustion of a four-stroke internal combustion cylinder contained therein.

In the present apparatus the moving parts

of the motor through whose instrumentality the pressure accumulated within the reservoir is converted into useful work (and which for convenience may be termed the working motor) may be so connected (preferably mechanically) to the moving parts of the generating motor and of the air compressor, that these three instrumentalities are constrained to operate in unison with one another at predetermined relative velocities.

The fluid contents of the reservoir may consist of the gaseous products of combustion either alone or together with air or other elastic fluid. Thus the reservoir may constitute a generator of steam produced by the action, upon a body of water contained in the reservoir, of the heat from the motor immersed therein, the products of combustion from this motor being discharged into the water and mingling with the steam produced therefrom. In the event however of steam not being employed, such excessive rise of temperature within the reservoir as would tend to cause injury to the apparatus, may be prevented by the introduction (either at will or under the control of an automatically acting device) of a suitable quantity of water.

The power developed by the generating motor is absorbed partly in effecting the expulsion from the combustion chamber into the reservoir (and therefore against the pressure existing in the latter) of the products of combustion, and partly in simultaneously effecting the compression of atmospheric air into the container or containers, so that none of the energy resulting from the combustion of the fuel is wasted.

The generating motor being immersed in the reservoir, all the heat developed in or by the motor, whether resulting directly from combustion, or from internal friction, is absorbed by the fluid contents of the reservoir and thus rendered available for conversion into motive power. Similarly the working motor, if immersed in the reservoir, is exposed to the temperature existing therein, so that no loss of heat can occur in connection with this second motor either by radiation or in the transmission of the motive fluid from the reservoir to the motor. It is preferred to also immerse the air compressor in the reservoir for a like reason. The introduction of the fuel is preferably effected under pressure.

The working motor may be a fluid-pres-

sure engine of any convenient kind, as for example a turbine or a rotary or reciprocating engine, the preferred arrangement comprising a series of generating motors, air compressors, compressed air containers, and working motors in equal or equivalent numbers, all immersed in a single fluid-pressure reservoir and all having their pistons or other moving parts coupled or geared to the same shaft in such manner as to obviate the occurrence of a dead point in the movement of any reciprocating part of the mechanism and insure the apparatus being self-starting at any point in the revolution of the shaft.

It will be obvious that the consumption of fuel may be very readily adjusted (either at will or by automatically acting means) to exactly meet the demands of the working motor, so that while no loss need occur in consequence of power being generated in excess of actual requirements, the output of the working motor may be varied with a flexibility not attainable with an internal combustion engine pure and simple.

Figs. 1 and 1* of the accompanying drawings show in vertical section from front to back of a convenient arrangement of apparatus embodying the present invention, the section being taken along the main axis of one of the mechanical units (each comprising an internal combustion or "generating" motor, an air compressor and compressed air container, and a "working" motor, with their various adjuncts) whereof a series may be comprised in the complete apparatus.

A is the reservoir (hereinafter, for convenience, called the "boiler") for the elastic fluid which constitutes the ultimate source of motive power, and B, C and D the cylinders respectively of the generating motor, air compressor, and working motor comprised in the single mechanical unit illustrated, the axes of the several cylinders being arranged in alinement with one another in a horizontal plane extending from front to back of the boiler A, while the axes of different units would be arranged side by side parallel to one another.

In each cylinder B, C and D, a piston B*, C* or D* (as the case may be) is fitted to work; all these pistons, in the case of each unit, having the same length of stroke and being constrained to reciprocate in unison with one another. For this purpose the piston rods b^* , c^* and d^* are coupled to a single crank e on a crank shaft E mounted to rotate between the cylinders B and C, the axis of the shaft intersecting at right angles the axes of all the units. The piston rod b^* of the generating motor, and that c^* of the air compressor, are coupled directly to the crank e , from opposite sides of the latter, by the connecting rods F^1 , F^2 , which are jointed to the respective piston rods at f^1 , f^2 , while the piston rod d^* forms a rigid con-

tinuation of the rod c^* as indicated, so that the pistons C* and D* work together in tandem. The cranks e , in the case of the respective units of the series, would be placed at such angular distance apart as to prevent the occurrence of a dead point in the revolution of the crank shaft E.

The interiors of all the cylinders, excepting so far as hereafter otherwise stated, are completely shut off from direct communication with the interior of the boiler A, while the crank shaft E and connecting rods F^1 , F^2 work in a casing F which forms a tunnel extending from end to end of the boiler.

G is a container for compressed air, mounted in the boiler A above the cylinders B, C and D, these cylinders occupying the lower part of the boiler. Any convenient number of such containers or "bottles" may be employed, it being understood that in the example illustrated one such bottle is appropriated to each unit of the apparatus.

The boiler A is kept partially filled with water, what may be termed the steam space in the upper part of the boiler being in communication with the valve chests of the several working motors comprised in the complete apparatus, through a pipe H and stop and regulator valves h^1 , h^2 , whereof the latter is controlled from the front of the boiler by means of a handwheel h .

H^1 represents the common exhaust pipe from the cylinders D of the various working motors. In the example illustrated, the cylinder D is shown as single-acting, the working stroke of the piston D* being from right to left, while the left or inoperative side of the piston is in constant communication with the external atmosphere through an aperture as at d in the corresponding end of the cylinder. The air compressor cylinder C is also single-acting, the suction stroke of the piston C* being from right to left, during which air is drawn into the cylinder from the external atmosphere through the spring-closed non-return suction valve c in the right-hand end of the cylinder. During the compression stroke from left to right, the air thus inhaled is compressed within the cylinder until, on the pressure rising above that in the bottle G plus that exerted by the spring whereby the non-return delivery valve c^1 is normally held closed, this valve opens automatically and allows the compressed air to pass through the passage g into the bottle.

The left or inoperative side of the piston C* is in constant communication with the external atmosphere through a passage c^2 in the corresponding end of the cylinder C; this passage, the outer side of the suction valve c , and the aperture d in the cylinder D all open preferably from a common air-supply conduit J which leads from the exterior of the boiler as indicated.

In the cylinder B of the generating motor, the combustion takes place at the left-hand or rear side of the piston B*, the combustible mixture being admitted to this end of the cylinder through a valve K which opens inward and is normally held closed by a spring as at *k*, the spindle *k*¹ of the valve (which is preferably arranged in axial alinement with the cylinder B as shown) passing outward through a stuffing box and being positively actuated to open the valve K at the proper times by means of cam mechanism (not shown) driven from the shaft E. When the valve K is open, communication is established between the interior of the cylinder B and a chamber L which is constantly supplied with compressed air from the bottle or container G through a pipe *l* under initial control of a stop valve *l*¹. The fuel, whether gas, oil, spray or vapor, or other combustible, is also supplied under pressure by any suitable means (not shown), the admixture of fuel with this compressed air being effected at any convenient point before the charge passes through the valve K into the cylinder, according to the nature of the fuel employed.

If desired, the supply of fuel may be governed automatically in accordance with variations of pressure in the boiler A.

M indicates an electrical sparking plug, situated at the outer end of a passage *m* which communicates with the rear end of the cylinder B and thus constitutes in effect an explosion chamber.

The generating motor works on a two-phase cycle, the piston B* making its working stroke toward the right in the drawing. The exhaust valve is mounted in the piston, and closes in the same direction as that in which the piston travels in performing its working stroke, so that the valve remains closed (under the pressure developed in consequence of the explosion) during the working stroke until a tappet N connected with the valve, by encountering the forward end of the cylinder B toward the end of said stroke, causes the exhaust valve to open against the pressure whereby, up to that moment, it had been held closed. The pressure at the left or explosion side of the piston is thus permitted to pass to the right side thereof, the exhaust valve remaining open during the return or exhaust stroke of the piston in consequence of the pressure of a spring *n* reinforced by the pressure of the elastic fluid at the right side of the piston. On the piston reaching the end of this return stroke the exhaust valve is closed by encountering the left or rear end of the cylinder. At the commencement of the next or working stroke of the piston B*, the valve K is opened to admit the combustible charge which, being under pressure, serves (prior to ignition) to start the stroke of the piston; ignition taking place immediately on

the valve K being closed at the point of cut off, so that the remainder of the working stroke is performed under the increased pressure due to combustion.

The space within the cylinder B to the right of the piston B* constitutes an intermediate chamber for the reception of the products of combustion exhausted into it as described. These products are, at each working stroke of the piston, expelled from this space into the interior of the boiler A through a non-return delivery valve O which normally closes an aperture in the top of the cylinder, the movements of the valve being utilized to agitate a series of perforated conical baffles *o* through which the products of combustion pass from the cylinder B to the valve O so that any unconsumed oil or other non-gaseous matters, deposited by the products of combustion on the baffles, will be shaken from the latter and will fall to the bottom of the cylinder, B, whence they may be withdrawn at intervals through a blow-off pipe *p* and valve P at the front of the boiler.

It will be observed that air will be compressed in the cylinder C and expelled thence into the container or bottle G at each working stroke of the generating motor, while owing to the relative angular relation of the cranks *e*, appertaining to the respective units comprised within the complete apparatus, the power developed during the explosion stroke of the piston B* in one unit will serve to also expel the products of combustion from, or to compress the charge in, the cylinder B of another unit, and so on, continuity and smoothness of working being thus insured. At the commencement of the operations, the pressure stored in the container G will render the apparatus self-starting, and it is to be noted that before the apparatus is used in the first instance, it will be necessary to charge the container G with compressed air.

The crank-shaft E, which may be provided with a fly-wheel serves to transmit the power developed in the working cylinder D of each unit to a point outside the boiler A, where it may be employed to perform useful work.

Claims:

1. Liquid fuel burning apparatus for the production of heat for generating steam, comprising the combination of a reservoir, an internal combustion motor, means driven by said internal combustion motor, for compressing atmospheric air, a container adapted to receive air compressed by said air compressing means, said internal combustion motor, said air compressing means, and said container being immersed in said reservoir, and means whereby the air compressed by said means is subsequently used as the atmospheric constituent of the com-

bustible mixture for said internal combustion engine, said means comprising an inlet to said internal combustion engine and a pipe connecting said container to said inlet, substantially as described.

2. Liquid fuel burning apparatus for the production of heat for generating steam, comprising the combination of a reservoir, an internal combustion motor having a combustion chamber immersed in said reservoir, and means whereby the exhaust gases of said internal combustion motor are passed through and in contact with the water in said reservoir, said means consisting in a pipe connecting the combustion chamber of said internal combustion motor to said reservoir, substantially as described.

3. Liquid fuel burning apparatus for the production of heat for generating steam, comprising the combination of a reservoir, an internal combustion motor having a combustion chamber immersed in said reservoir, and means whereby the exhaust gases of said internal combustion motor are passed through and in contact with the water in said reservoir, said means consisting in a pipe connecting the combustion chamber of said internal combustion motor to said reservoir, and means for preventing the water in said reservoir from escaping into said internal combustion motor, said means consisting in a non-return valve in said pipe, substantially as described.

4. Liquid fuel burning apparatus for the production of heat for generating steam, comprising the combination of a reservoir,

an internal combustion motor, means driven by said internal combustion motor for compressing atmospheric air, a container adapted to receive air compressed by said air-compressing means, said internal combustion motor, said air-compressing means, and said container being immersed in said reservoir, an inlet to said internal combustion engine and a pipe connecting said container to said inlet, and a pipe connecting the combustion chamber of said internal combustion motor to said reservoir, substantially as described.

5. Liquid fuel burning apparatus for the production of heat for generating steam, comprising the combination of a reservoir, an internal combustion motor, means driven by said internal combustion motor for compressing atmospheric air, a container adapted to receive air compressed by said air-compressing means, said internal combustion motor, said air-compressing means, and said container being immersed in said reservoir, an inlet to said internal combustion engine; a pipe connecting said container to said inlet; a pipe connecting the combustion chamber of said internal combustion motor to said reservoir, and means for preventing the water in said reservoir from escaping into said internal combustion motor, said means consisting in a non-return valve in said pipe, substantially as described.

JEAN MOLAS.

Witnesses:

GEORGE ERNEST MINTERN,
WILLIAM G. E. DAVIES.