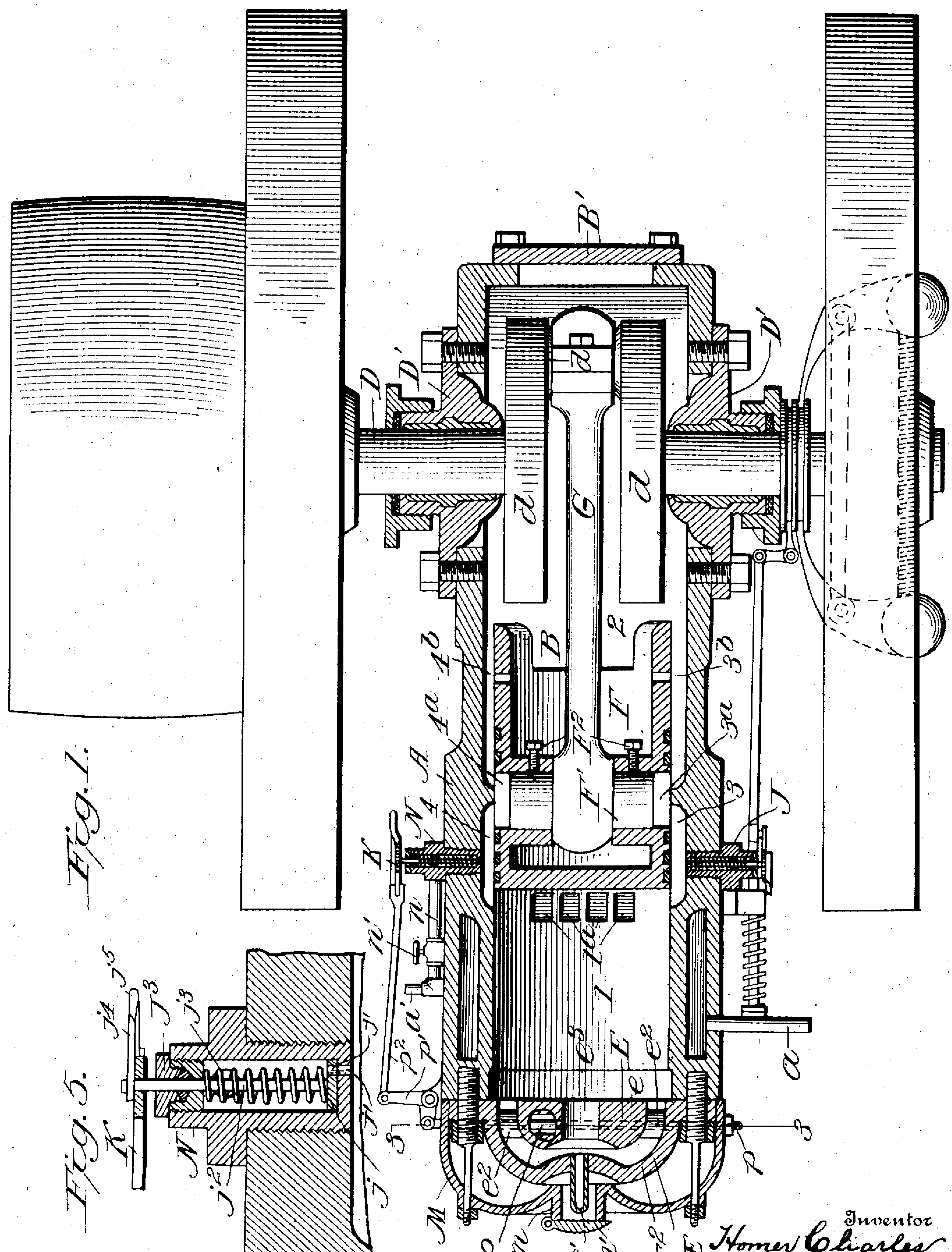
No. 864,831. PATENTED SEPT. 3, 1907.

H. CHARLES.

THERMOSTATIC REGULATOR FOR EXPLOSIVE ENGINES.

APPLICATION FILED MAR. 2, 1906.

2 SHEETS—SHEET 1.



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Witnesses
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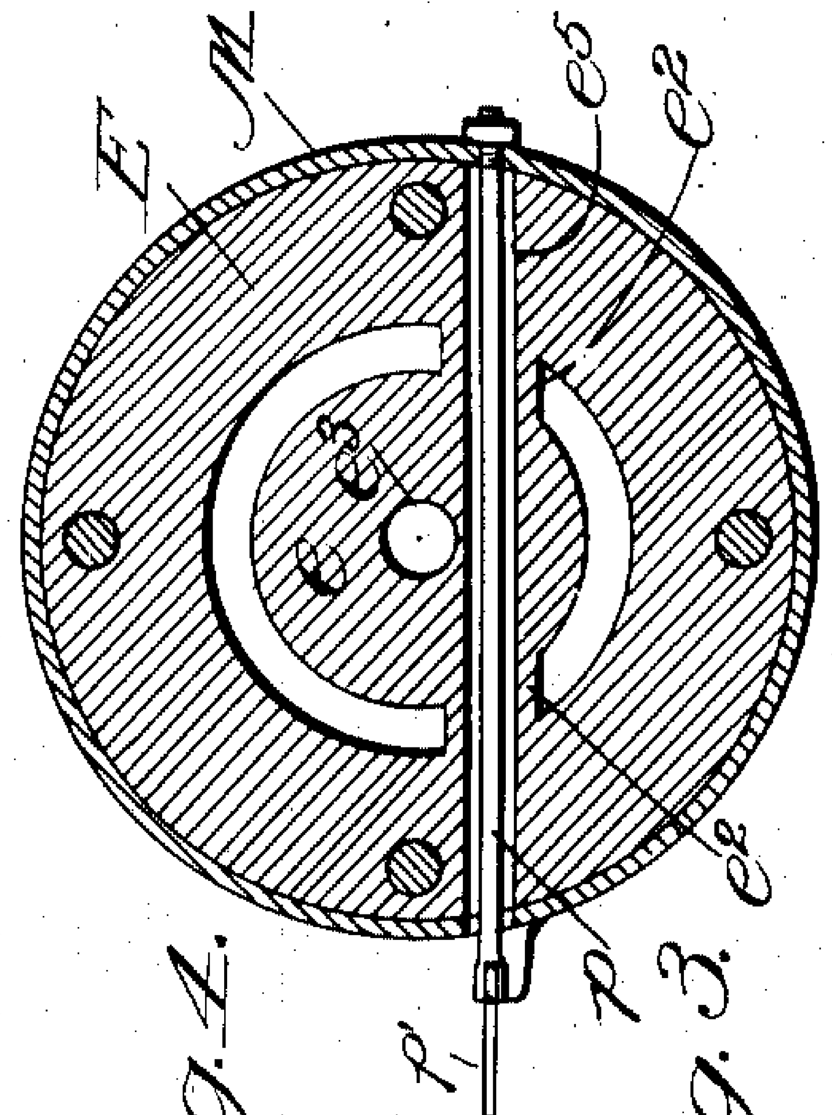

Fig. 4.

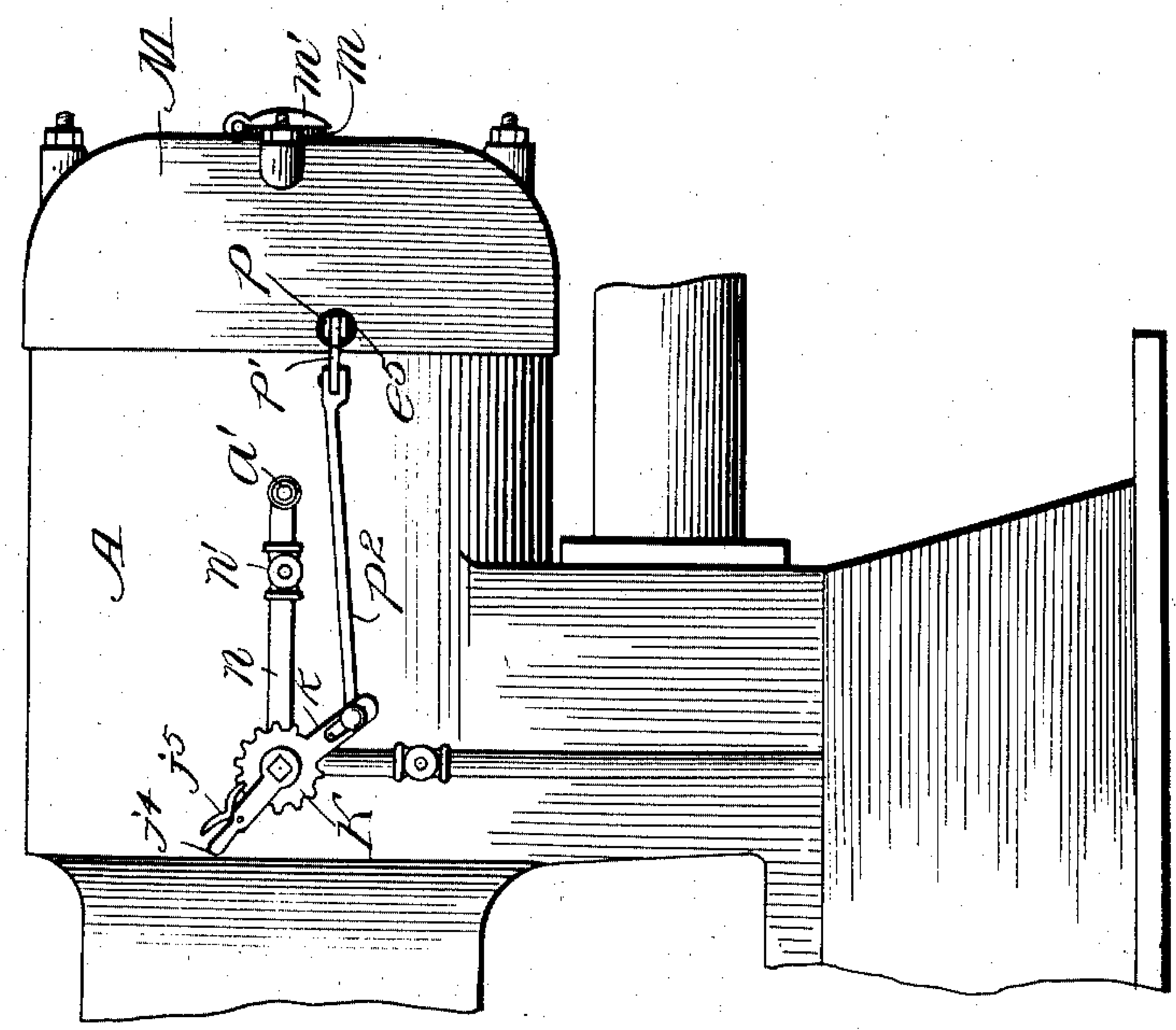

Fig. 3.

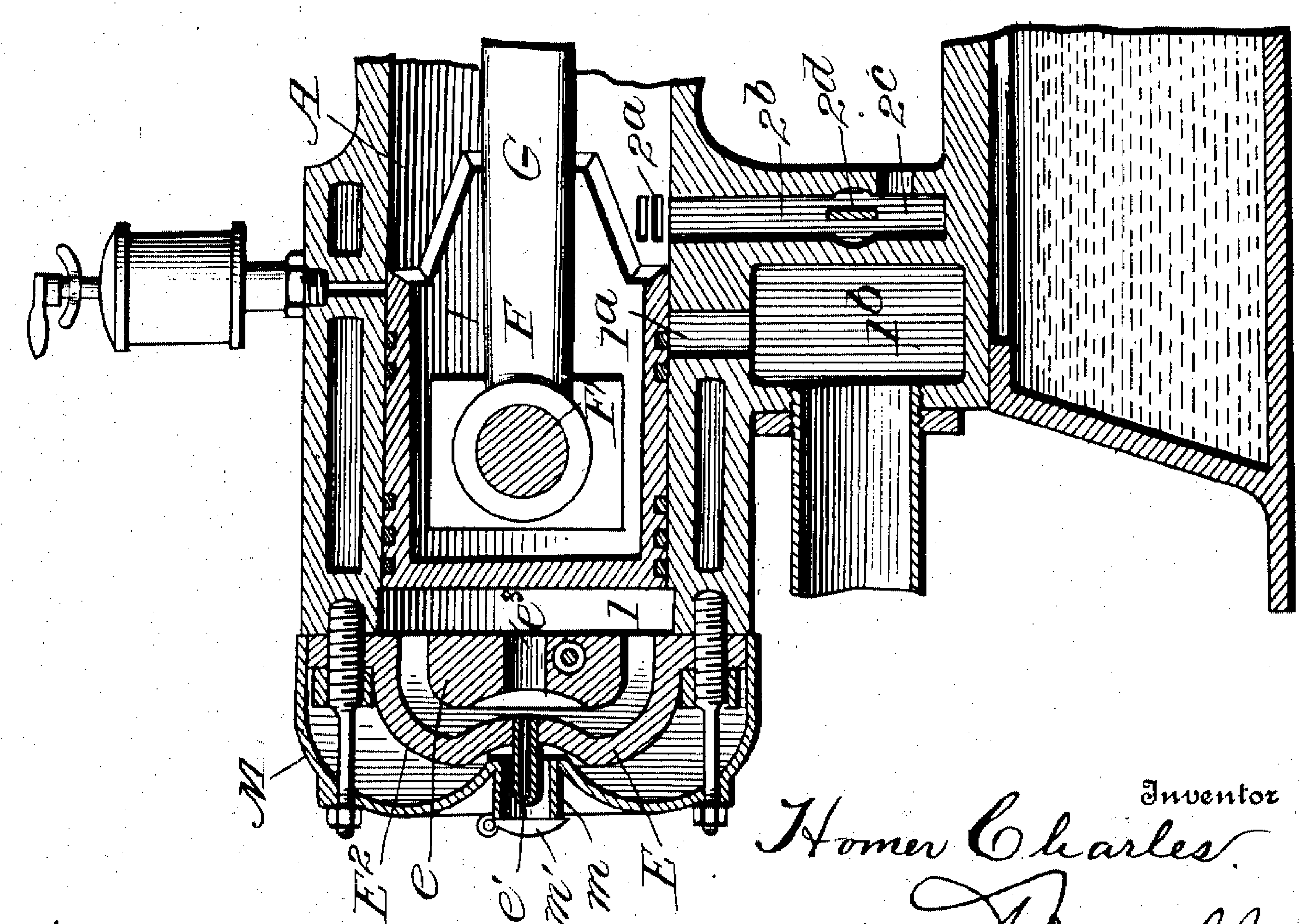

Fig. 2.

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THERMOSTATIC REGULATOR FOR EXPLOSIVE-ENGINES.

No. 864,831. **Specification of Letters Patent.** **Patented Sept. 3, 1907.**

Original application filed February 10, 1905, Serial No. 245,096. Divided and this application filed March 2, 1906. Serial No. 303,840.

To all whom it may concern:

Be it known that I, HOMER CHARLES, of Rapid City, in the county of Pennington and State of South Dakota, have invented certain new and useful Improvements in Thermostatic Regulators for Explosive-Engines; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is an improvement in engines operated by any of the usual explosive mixtures, but particularly designed to use liquid-hydro-carbon such as petroleum or gasolene.

The present application is a division of my application for Patent filed February 10, 1905, Serial Number 245,096, for explosive engines, and the object of the present invention is to provide means for automatically regulating the temperature of the igniting head, or working-chamber, so that the explosive mixture will not be prematurely ignited; and by the novel construction and method of operating my engine the dangers and annoyances of "back-firing" are obviated and the engine rendered exceedingly sensitive to the action of the "governor".

The various novel features and combinations of parts embraced within the invention are summarized in the claims hereinafter enumerated, and in order to impart fully and clearly the operation and construction of a practical one-cylinder engine embodying the invention I refer to the accompanying drawings and describe the same in detail as follows:

In the drawings—Figure 1 is a horizontal section through an explosive engine embodying my present invention. Fig. 2 is a detail vertical section through the cylinder end of the engine. Fig. 3 is an enlarged detail side elevation of the cylinder end of the engine. Fig. 4 is a cross-section on line 3—3, Fig. 1. Fig. 5 is an enlarged view of the valve.

I have illustrated the present invention as applied to a preferred form of engine constructed as follows:

The cylinder A contains the working or explosive chamber 1, and the housing B incloses the crank *d* of the main-shaft D, said crank being preferably formed by disks and connecting wrist-pin, for the purpose of reducing the air capacity of the crank-chamber, which forms the pump-chamber 2 of the engine, and should be air-tightly closed on all sides. Access can be had to the pump-chamber 2 through openings in its sides and end, the side openings being closed by the journal-bearing plates D′ of the main-shaft, and the end opening by a plate B′ all securely bolted to the housing as shown. Access can be had to the working-chamber by removing the head E thereof.

The working and pump-chambers are separated by the piston F, connected to the crank by a pitman G, one end of which may be directly connected to the crank-pin *d*, and its other end to a pin F′ secured in a transverse opening in the piston by bolts F^2.

Formed in the walls of the casing and housing, intermediate the pump and working-chambers, are mixing-chambers or recesses 3 and 4, which are normally closed by the piston so as to be out of communication with either the pump or working-chamber, but when the piston is at or near the end of its working (inward air-compressing) stroke, and after the exhaust ports have been uncovered, said mixing-chambers 3 and 4 are momentarily put in communication with the working-cylinder, by the piston slightly uncovering the ends of the chambers 3 and 4 as in Fig. 1;—and at the same time said chambers 3 and 4 are momentarily put into communication with pump-chamber 2, by means of ports or passages 3^a, 4^a, in the walls of the piston, which at that time establish communication between the inner ends of chambers 3 and 4 and channels or ports 3^b, 4^b, opening into the pump-chamber as shown.

The exhaust ports 1^a are arranged near the inner end of the working-chamber, so as to be uncovered by the piston just before the chambers 3 and 4 are opened thereby, and will be closed by the piston just after said chambers are closed. The exhaust ports all communicate with a common passage 1^b from which the waste products escape to any desired point of discharge. Air is admitted into the pump-chamber through ports 2^a, connecting with a common passage 2^b, into which air is admitted through an opening 2^c, and a valve 2^d is placed in said passage to regulate the admission of air therethrough.

Preferably the engine is mounted upon a fuel reservoir which is preferably air-tight, so that pressure can be accumulated therein sufficient to insure the proper feed of fuel to the vaporizing chamber 3 with which it communicates through a suitable pipe; the admission of oil into the chamber 3 being controlled by a suitable regulating and controlling valve J preferably like that shown in Fig. 5.

It will be observed by reference to Figs. 1 and 2 that the head E is chambered so as to leave a central portion or mass *e* which is practically separated from the outer portion or shell E^2, but connected therewith by stays e^2. This part *e* has a central aperture e^3 directly opposite a tube e' fixed in a small aperture in the shell E^2 of the head, said tube being closed at its outer end. The hot gases circulate around this mass *e* and into the tube e'. The mass *e* becomes very hot and will retain its heat for a long time and in practice remains at such a high temperature that when the gases are compressed, by the return stroke of the piston and forced into contact with this mass *e*, they wil be ignited by its heat. So long as the engine is in operation this mass *e* is maintained at the desired temperature by the heat of the burning gases in the working-chamber. When it is desired to start the engine the tube e' may be heated in a very few moments by a torch applied to the exterior thereof, to cause ignition of the gases admitted into the working-chamber, thereafter the retained heat in the mass e is sufficient to ignite the gases as described. The mass e will retain its high temperature from 15 to 30 minutes after the engine has stopped, under ordinary conditions, and beng isolated from the shell E^2 it does not part with its heat so rapidly as the shell. As a further protection against loss of heat, the shell may be inclosed in a casing M which is attached to the head as shown and is provided with a central tube m surrounding the projecting tube e' and having its end closed by door m' through which access can be had to tube e' to heat the latter when necessary.

Oil may be supplied to mixing-chamber 4 in the same manner as it is supplied to chamber 3 if desired, but I preferably use chamber 4 for the purpose of moistening a portion of the air admitted into the explosive chamber, by mixing it with steam or hot water which is admitted into chamber 4 through a valve N preferably constructed as shown in Fig. 5, and automatically controlled by the thermostatic regulator.

Just sufficient water or steam is admitted into chamber 4 to provide additional explosive elements in the mixture and regulate the temperature of the burning gases so that if the temperature rises above the desired point more water or steam is admitted, and if it falls below the desired point the supply of steam or water is lessened. In practice I have found that this enables me to regulate and maintain the temperature of the igniter-head at the desired point so that there will be no danger of premature ignition of the gases in the working-chamber, and consequent hammering and shock attendant upon such premature firing.

The regulating valve N preferably consists of a hollow casing screwed into an opening in the side-wall of the engine, communicating with chamber 4. In the inner end of this casing is a small aperture J′ which is controlled by a disk-valve j having an aperture j' adapted to register with aperture J′. Disk j is fixed on a stem j^2 which extends outside the casing through a suitable stuffing-box J^3, and a spring j^3 is interposed between the stuffing-box and disk so as to seat the latter closely against the head. On the projecting end of the stem is hung a notched plate K, having a depending arm k connected to the thermostatic governor. Fixed on the outer end of the stem j^2 is a hand-lever j^4, provided with a catch j^5 adapted to engage the notches in the plate K, and lock the valve thereto. By varying the engagement of the hand-lever and plate, the apertures in disk j can be thrown more or less in or out of register with aperture J′, and thus regulate nicely the admission of water or steam into chamber 4; and by shifting plate K the register of the said apertures can be varied without disturbing the adjustment of the valve relative to the plate

The valve N may be connected to any suitable steam or water supply, and as shown in the drawing, it is connected by pipe n with a pipe a' leading from the water-jacket of the cylinder A, the water being supplied to said jacket from a pipe a. The pipe n may be provided with a cut-off valve n' if desired. The valve N is adjusted to supply the proper amount of water or steam to the chamber 4 required for the normal operation of the engine, and is automatically regulated by means of a thermostatic regulator which will increase or diminish the supply according to the temperature of the igniting head E. For this purpose a thermostatic tube or rod p formed of any desired and proper metal or combination of metals, is passed through an opening e^5 in the head E, said rod or tube being formed of a composition of metals which will cause expansion or contraction of the rod by heat. One end of this rod is fixed, and the other end is connected to the short arm of an amplifying lever p', the long arm of which is connected by a rod p^2 with the short arm k on the stem of the valve N.

If the temperature rises the expansion of the rod causes more or less opening of the valve N. If the temperature falls below the desired point the contraction of the rod causes an increased closing of the valve and thus the supply of water or steam to chamber 4 is automatically regulated. This feature is a very valuable one in connection with the engine and forms the subject matter of this application.

The piston on its inward, or working-stroke under the action of the expanding gases in the working-chamber, first cuts off the air inlet to the pump-chamber and then compresses such air therein, meanwhile keeping the mixing-chambers 3 and 4 entirely closed. The air being preferably admitted into the chamber 2 without admixture with any explosive. As the piston nears the end of its inward stroke it uncovers the exhaust ports 1^a allowing the burned gases to escape therethrough to the atmosphere, and immediately thereafter communication is established between the mixing-chambers and the working-chamber and simultaneously the ports in the piston establish communication between the pump-chamber and the mixing-chambers, whereupon the air in the pump-chamber rushes violently through the mixing-chambers taking up the small modicums of fuel therein, atomizing it and rushing therewith into the working-chamber. As the piston starts on its return stroke it first closes communication between the mixing-chambers and the pump and working-chambers and keeps the mixing-chambers closed and isolated; it then also closes the exhaust ports 1^a and during the remainder of the non-working stroke of the piston the explosive mixture which has been admitted into the working-chamber is compressed.

I find it desirable to so proportion the ports and the parts that the explosive mixture shall be compressed to a very high extent, say about 70 pounds, by the time the piston reaches the end of its return stroke. As the piston passes the dead center the compression is slightly lessened, whereupon explosion occurs. I have found in practice that so long as the explosive mixture is under increasing pressure it will not explode without direct ignition, but that as soon as the pressure begins to relax it will ignite or explode very readily with comparatively low heat, and owing to this fact I am enabled to successfully use the igniting head or hot plate E for igniting the gases, doing away with any direct flame or sparking apparatus. As soon as the gases are ignited the piston is driven forward and the cycle of operations above described is repeated.

The air rushing through the mixing-chambers 3 and 4 at the moment communication is established between them and the pump and explosive-chambers, sweeps up the small quantities of oil and water admitted into said chambers and vaporizes the same forming an explosive mixture; thus the non-explosive air escaping from the pump-chamber is converted into an explosive mixture when it enters the working-chamber, and the resultant mixture is so thorough that perfect combustion is realized when the gas is ignited.

I do not restrict my present invention—the thermostatic regulator—to the particular form of engine shown in the drawings, which is covered in my application above referred to, as it may be used with advantage in many other forms of explosive engines to regulate the temperature of the exploding-chamber; and it may also be adapted to regulate the supply of explosive fluids or mixtures or elements to the engine.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In an explosive engine, the combination of a working-chamber, a mixing chamber, an igniter head in the working-chamber, a valve controlling admission of fuel or water to said mixing-chamber, and a thermostat passing through the igniter-head and protected thereby from direct contact with the hot gases, and connections between said thermostat and the valve to regulate the temperature in the working-chamber, substantially as described.

2. In an explosive engine, the combination of the working-chamber, an igniter head in one end thereof, a thermostat passing through the head and protected thereby from direct contact with the gases, a cooling medium supply, a valve for regulating said supply, and connections between said valve and said thermostat whereby the admission of the cooling medium is controlled, substantially as described.

3. In an explosive engine, the combination of the working chamber, an igniter-head arranged in one end thereof, and leaving a transverse opening, a thermostat within said opening and protected by said head from direct contact with hot gases, a supply valve adapted to communicate with said chamber, means for regulating said valve, and amplifying connections between said valve and said thermostat whereby the admission of elements through said valve is controlled by said thermostat, substantially as described.

4. In an explosive engine, the combination of the working chamber, the piston therein, a recess in the walls of the cylinder adapted to be covered and uncovered by the piston, an igniter-head in said chamber; means for admitting fluid to said recess, a valve controlling the admission of fluid, a thermostatic bar concealed in said igniter head and protected thereby from direct contact with the hot gases, and connections between said bar and said valve, exterior to the working chamber, for the purpose and substantially as described.

In testimony that I claim the foregoing as my own, I affix my signature in presence of two witnesses.

HOMER CHARLES.

In presence of—
A. K. GARDNER,
ETHEL V. WARNER.