No. 795,422. PATENTED JULY 25, 1905.

E. THOMSON.

MEANS FOR PREVENTING POUNDING IN INTERNAL COMBUSTION ENGINES.

APPLICATION FILED NOV. 27, 1900.

2 SHEETS—SHEET 1.

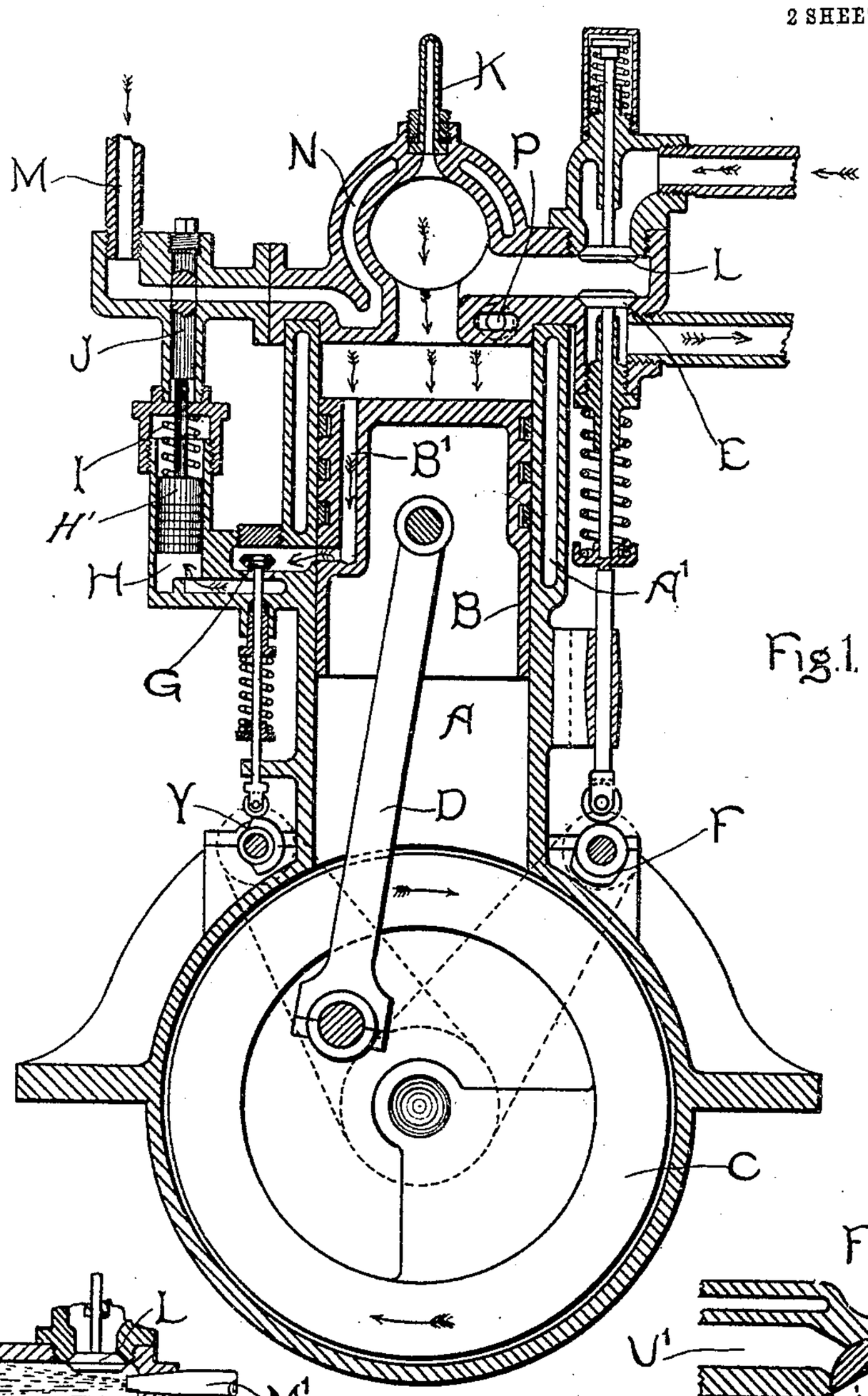


Fig. 1.

Fig. 7.

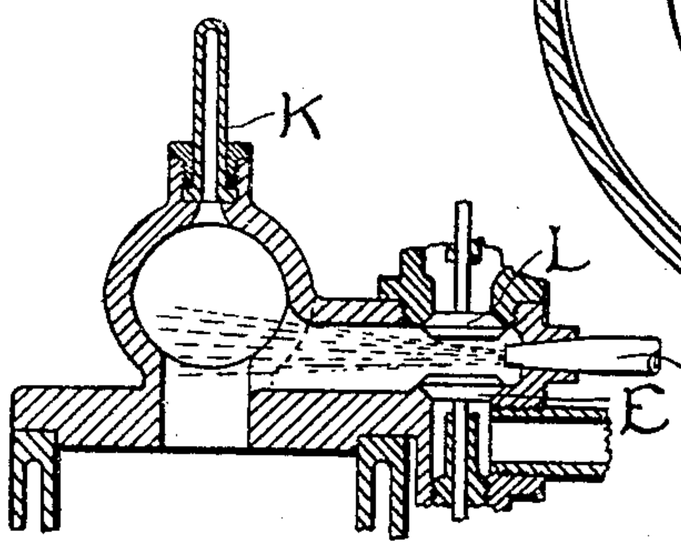


Fig. 8.

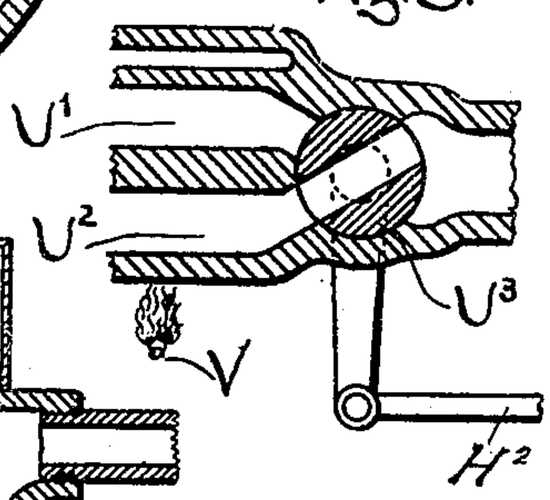
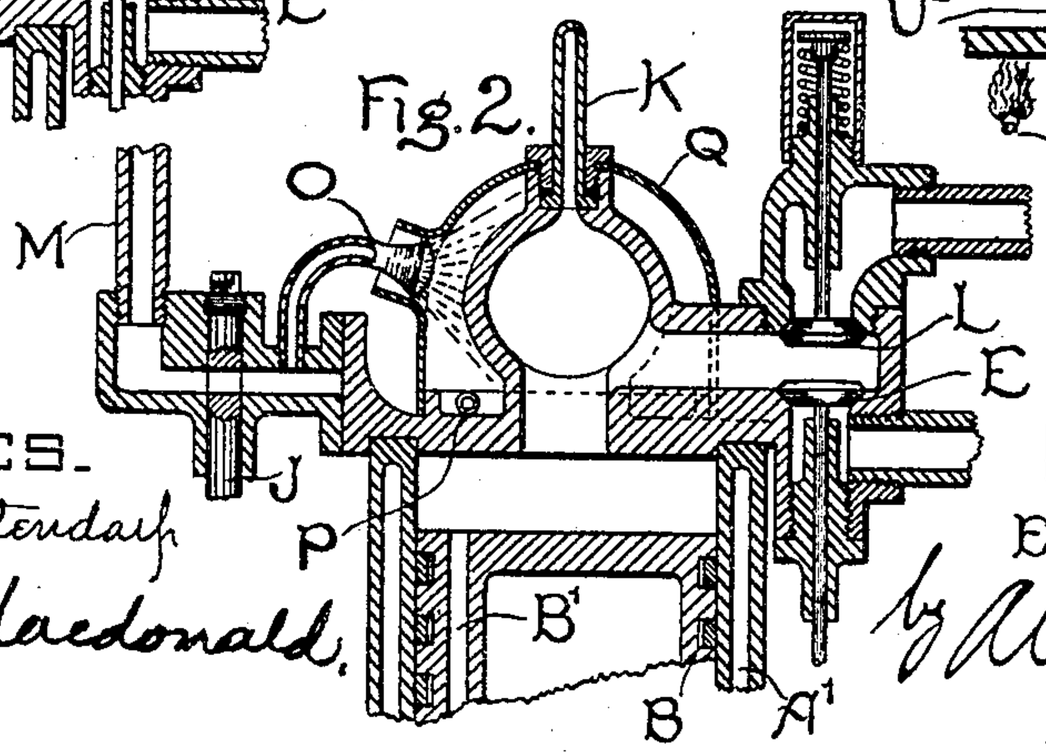


Fig. 2.



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2 SHEETS—SHEET 2.

Fig.3.

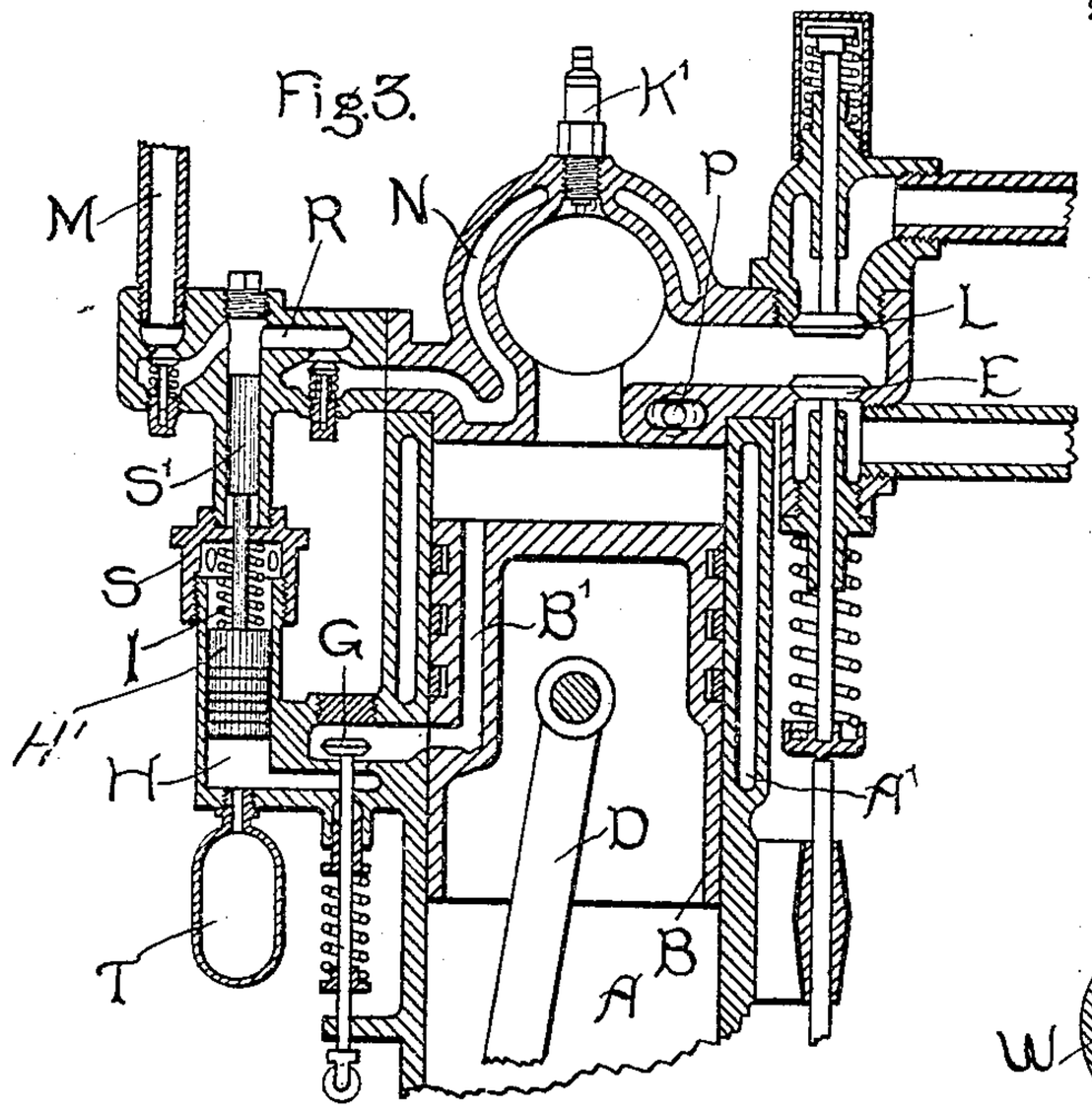


Fig.5.

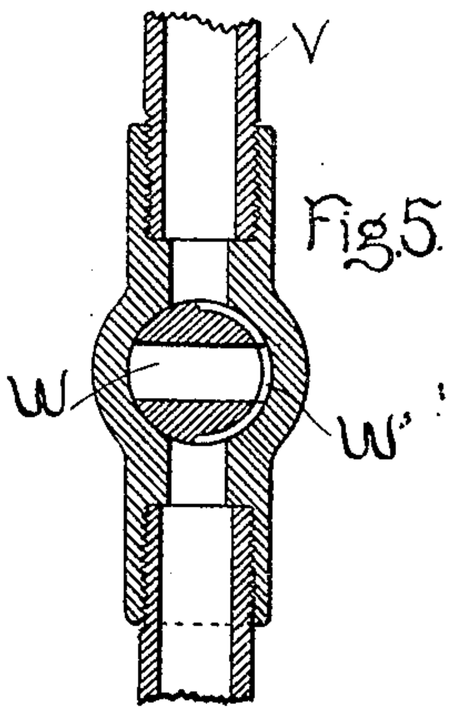


Fig.4.

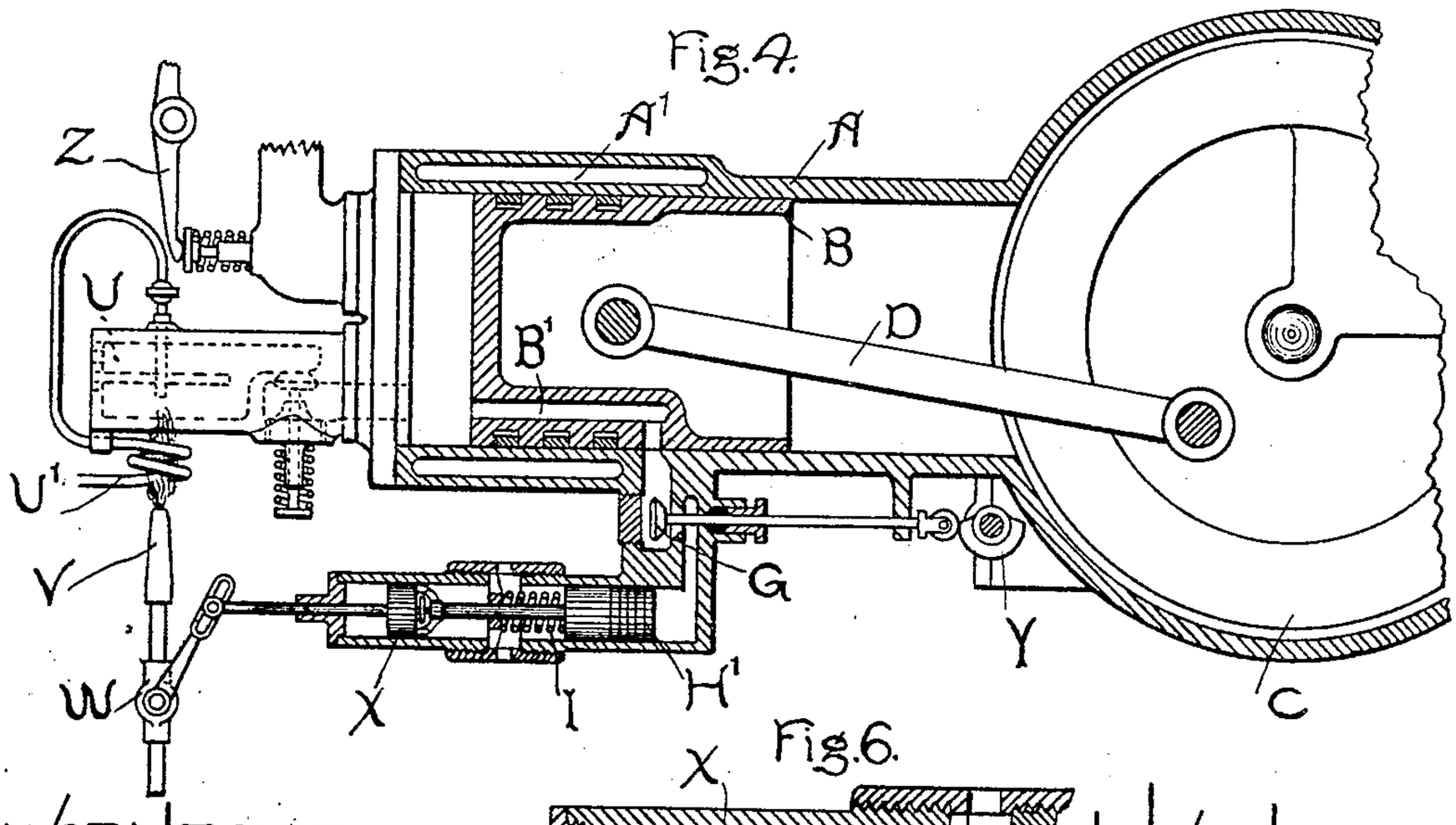
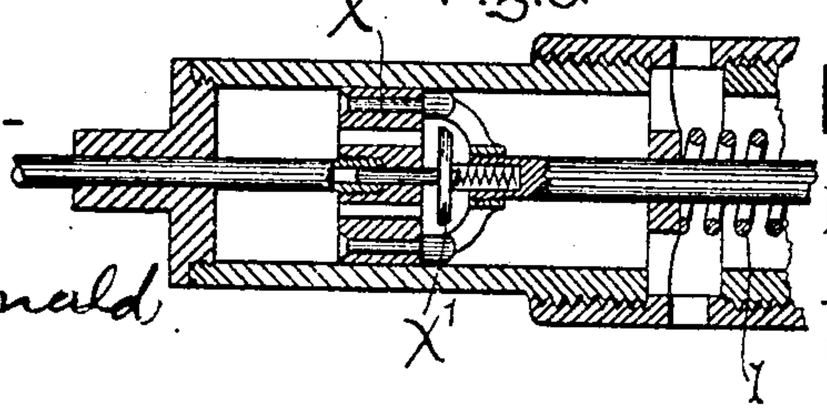


Fig.6.



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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MEANS FOR PREVENTING POUNDING IN INTERNAL-COMBUSTION ENGINES.

No. 795,422. Specification of Letters Patent. Patented July 25, 1905.

Application filed November 27, 1900. Serial No. 37,891.

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Means for Preventing Pounding in Internal-Combustion Engines, of which the following is a specification.

More or less trouble is experienced with internal-combustion engines due to pounding, which pounding is caused by preignition. This is due to the excessive heat of the cylinder or other parts of the engine and is more or less destructive, depending upon the extent of the pounding, sometimes it being necessary to temporarily shut down the engine. Pounding decreases the efficiency of an engine, and the amount of pounding for a given engine varies with the character and amount of the combustible mixture, it being the worst with an engine using a mixture of kerosene or similar fuel. With engines of the latter type it is necessary to run very close to the preignition-point in order to obtain the highest efficiency. When an internal-combustion engine is running under full load and it starts to pound, it sometimes results in bringing the engine to a standstill, besides being very detrimental to the engine structure.

My invention has for its object to prevent pounding in internal-combustion engines, and in the accompanying description and claims appended thereto is set forth what I believe to be novel and to be my invention.

In the accompanying drawings, which illustrate my invention, Figure 1 is a vertical section of an internal-combustion engine; Fig. 2, a vertical section of a slight modification. Fig. 3 is a vertical section of a further modification; Fig. 4, a longitudinal section of an engine, showing a further modification, wherein the vaporizer-flame is varied; Fig. 5, a section of the fuel-controlling valve of Fig. 4; Fig. 6, a sectional view of the dash-pot used in the engine shown in Fig. 4. Fig. 7 shows a means for mixing a spray of water with the combustible for cooling, and Fig. 8 shows a two-part vaporizer for supplying combustible to the engine.

Pounding is directly due to preignition of the charge of combustible admitted to the working cylinder. This is occasioned by the undue heating of the parts, which may come about in a number of different ways. In the operation of an internal-combustion engine there is a gradual increase from an incipient pounding to one which is very destructive to the engine. Since pounding is due to preignition and the latter is due to excessive heating, the remedy lies in controlling the amount of heat which can be developed in the working parts of the engine. In carrying out the invention means are provided for reducing the temperature of the combustible. This may be accomplished by passing a cooling medium over or through the metal parts of the engine, or the cooling may be accomplished by directly reducing the temperature of the combustible at or about the instant it enters the firing-chamber or the cylinder. In order to avoid having a constantly-acting device, in carrying out my invention I utilize the incipient preignition of one or more charges to control or to actuate a suitable cooling device. By this means I utilize the first effect of what is considered a fault in the normal operation of an engine for a useful purpose. It is not to be understood, however, that this incipient pounding continues after the cooling device has been set into operation, for it ceases just as soon as the temperature has been sufficiently reduced, and the cooling device remains inactive until the parts again become too hot.

The engine illustrated in the drawings is of the four-cycle type; and it consists of a main cylinder A, a moving piston B, and a fly-wheel C, which is connected to the piston by a connecting-rod D. The structure of the piston varies somewhat from that of the ordinary piston in that a passage B′ is provided, which under certain conditions will permit a portion of the charge to pass from a point back of the piston into the cylinder H for controlling or actuating a cooling device, as will be described more fully hereinafter. The admission of combustible to the cylinder is controlled by a spring-pressed valve L, the latter being arranged to open on the suction-stroke of the piston. The exhaust is controlled by a spring-pressed exhaust-valve E, which is actuated by a cam F, the latter being driven from the main shaft of the engine. The lower end of the stem for actuating the valve is provided with a roller that engages with the cam F, which cam is driven at the requisite speed to open the exhaust-valve at the proper instant and to permit it to close at the time combustible is admitted to the cylinder.

Situated on the left-hand side of the engine is a second cam-carrying shaft Y, which is directly connected to the main shaft of the engine, as indicated in dotted lines, and is arranged to open and close the spring-pressed valve G. The valve G is located in the passage between the valve-operating cylinder H and the main cylinder of the engine. Mounted for vertical movement in the cylinder H is a piston for actuating a water-controlling valve, which is normally pressed downward by the coiled compression-spring I. The upper end of the piston is provided with a valve J, having an opening therein to regulate the admission of the cooling medium, the latter being of any desired character.

The cylinder is provided with a water-jacket A′ of ordinary construction, and the head thereof contains the ignition-tube K, which is removably secured in place. The head is provided with a firing-chamber that communicates with the inlet-pipe through the spring-pressed admission-valve L. Under normal conditions there is no flow of cooling fluid—such as water, for example—from the pipe M through the chamber N, formed in the head; but when the parts get hot enough to cause preignition a certain amount of the burning gases will pass through the passage B′ into the cylinder H and by reason of their pressure cause the valve J to open and admit water to the jacket, the pipe P acting as a drain or outlet for the water thus admitted.

Assuming that a certain ignition-point is desired and that preignition is to be prevented, the cam for actuating the valve G is so set that when the piston is in the position shown, Fig. 1, the valve will be open. With the parts arranged as shown it is assumed that the fly-wheel of the engine is moving in a clockwise direction and that preignition has taken place, the small arrows indicating the direction of the force exerted upon the piston. In addition to the combustible which is expending its force on the piston-head a certain amount will pass into the passage B′, formed in the piston, as indicated by the arrows, and thence through the valve G into the valve-actuating cylinder H. This will push the piston upward to the position shown, thereby causing the valve J to open and permit water or other cooling medium to pass from the pipe M through the chamber or jacket N into the pipe P and out. The passage of the water or other cooling medium will cool the head, and therefore reduce the temperature of the parts and prevent further preignition. By properly adjusting the relation of the valves and passages the instant that incipient preignition takes place more or less water is admitted in the manner described, and the temperature of the parts is reduced and further incipient pounding, which takes place simultaneously with preignition, is prevented.

Referring to Fig. 2, I have shown a slight modification of my invention, wherein the water is sprayed on the head of the tube by means of a sprinkler O. The action of the sprinkler is controlled by the valve J, which is of the same construction as is illustrated in Fig. 1 and operated by the same means. Surrounding the head of the cylinder and also the nozzle of the sprinkler is a casing Q. This casing is connected in any suitable manner with the drain P.

In Fig. 3 I have shown a further modification in which preignition is utilized to actuate a small water-pump S, which pump receives its supply from any suitable tank or other source of supply. In this figure an electric ignition device K′ is substituted for the hot tube of the previous figures. The head of the cylinder is provided with a chamber or jacket for receiving water or other cooling medium. Extending from this chamber to the supply-pipe M is a passage R, containing two check-valves. These check-valves are arranged to automatically open and close as the pump-piston S′ moves up and down. The pump is actuated by a piston and cylinder, a coiled spring I tending at all times to push the piston downward. To the lower end of the cylinder H is attached a vessel T, which constitutes a gas-pocket.

Assuming that preignition has taken place and that the passage B′ in the piston is opposite the passage containing the valve G, a certain amount of the combustible, which has been previously admitted to the main cylinder and fired, will pass through the passage B′, thence through the valve G into the cylinder H and gas-pocket T. The piston will not move its full stroke the instant the products of combustion are received from the main cylinder, but will gradually move upward as the gas leaves the gas-pocket T. As soon as the force of gas has been expended the spring I will return the piston to its place. The controlling-valves are actuated in the same manner as described in connection with Fig. 1.

In Fig. 4 I have illustrated a further modification of my invention, wherein the cooling is accomplished by varying the temperature of the combustible which is supplied to the ignition-chamber. U represents a vaporizer which is secured to the head of the cylinder and is kept hot by the flame from the burner V. The pipe U′ leads from the source of fuel-supply to the vaporizer, and in this pipe is included one or more turns or coils through which the flame of the burner passes. This serves to more or less vaporize the fuel before it reaches the main vaporizer. The admission of fuel to the burner is controlled by a valve W, the construction of which is shown in section in Fig. 5. The valve is arranged with a transverse passage W and a by-pass W′ of limited area. This is so arranged that a certain amount of fuel is always permitted to pass to the burner, there-

by insuring the parts being kept hot and at the same time preventing the burner-flame from going out. The valve is provided with a link and an arm which makes a pin-and-slot connection with the rod of the actuating-piston H′.

In order to check sudden movements of the valve-operating lever, a dash-pot is provided, which is best shown in Fig. 6. When the dash-pot piston X is actuated by the piston H′ in a forward direction, the flap-valve X′ opens; but as soon as the piston starts to move back the valve closes and the return movement is relatively slow. Between the piston H′ and the fixed part or abutment is a coiled compression-spring I, which tends at all times to move the actuating-piston back to its normal position, which means an open throttle for the burner. The construction and arrangement of the passage B′ and valve G for controlling the admission of gas to the cylinder H is the same as is described in connection with the previous figures. In the previous figures the valve controlling the admission of combustible to the main cylinder is controlled by a spring and is opened by suction. In the present instance the valve is positively opened by the lever Z.

In Fig. 7 is shown a pipe M′ for admitting a spray of water to the firing-chamber or cylinder-head. In this case the admission of water may be controlled by a valve or pump which is actuated by the means illustrated in any of the other figures.

Fig. 8 illustrates my improved regulator acting on the valve admitting combustible to the firing-chamber or cylinder. Two vaporizer tubes or compartments U′ and U^2 are shown. These are heated by the flame from the burner V, which may or may not be regulated in the manner illustrated in Fig. 4. The compartments are provided with a common valve U^3, which is actuated through any suitable device from the piston H′ (shown in the previous figures) by the rod H^2. The flame being located directly below the compartment U^2, this compartment will be much hotter than the compartment U′, since the latter is somewhat remote from the flame. By adjusting the valve U^3 to a midway position an equal amount of combustible from both compartments will pass into the engine, but by changing the position of the valve the relative amounts can be varied at will. When the engine tends to preignition, the valve would set itself so as to admit more of the cooling mixture. On the other hand, when the ignition is satisfactory the valve would be so set as to admit the mixture from both compartments in the proper proportions, or the parts may be so arranged that under normal conditions combustible is supplied from the hotter compartment only.

In accordance with the provisions of the patent statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out in other ways.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an internal-combustion engine, the combination of a main cylinder and piston, a passage formed in said piston, an auxiliary cylinder receiving gas under pressure from the cylinder-passage, a piston working in the auxiliary cylinder, and a cooling means operated by the auxiliary piston.

2. In an internal-combustion engine, the combination of a main cylinder and piston, an auxiliary cylinder and piston, a port between the two cylinders which is uncovered at a certain point of the stroke of the main piston so that under conditions of preignition explosion-gases will enter the auxiliary cylinder, a valve independent in its action of both pistons which controls the said port and is itself opened by the main shaft, and a cooling device that is controlled by the auxiliary piston.

3. In an internal-combustion engine, the combination of a main cylinder, a piston therefor, having an opening extending from the head to a point intermediate the ends, an auxiliary cylinder, a port between the main and auxiliary cylinders, which coincides with the opening in the main piston and is uncovered each stroke, a piston in the auxiliary cylinder, a valve operated thereby, and a cooling medium which is controlled by the valve.

4. In an internal-combustion engine, the combination of a piston, a cylinder, a firing-head for the cylinder having a jacket into which a cooling medium may enter, a valve which intermittently opens and closes to permit a cooling medium to pass into the jacket, means for actuating the valve, and a valve which controls the action of said means.

5. In an internal-combustion engine, the combination of a main piston and cylinder, means for admitting a charge of combustible, an auxiliary piston and cylinder, a passage between the cylinders which is uncovered at each stroke of the main piston, a positively-actuated valve in said passage, and a means controlled by the auxiliary piston for reducing the temperature of the combustible.

6. In an internal-combustion engine, the combination of a main piston and cylinder, means for admitting a charge of combustible an auxiliary piston and cylinder, a passage between the cylinders which is uncovered at each stroke of the main piston, a receptacle connected with the auxiliary cylinder forming a gas-pocket, and means actuated by the auxiliary piston for varying the temperature of the combustible.

7. In an internal-combustion engine, the combination of a main piston and cylinder, a

firing-head for the cylinder, a cooling-jacket therefor having an inlet and an outlet passage, a valve for regulating the passage of cooling fluid through the jacket, an auxiliary piston and cylinder separate from the main piston and cylinder for actuating the valve, and a valve actuated by the main shaft for admitting a certain amount of explosion-gases to the auxiliary cylinder each time that preignition takes place.

8. In an internal-combustion engine the combination of a piston having a passage formed therein which extends from the head to a point intermediate the ends, a cylinder, an auxiliary piston and cylinder, a passage extending between the cylinders, one end of which is in communication with the passage in the main piston at definite intervals, a means for reducing the temperature of the engine, a valve controlling said means, which valve is moved in one direction by the auxiliary piston when preignition takes place, and a spring for moving the piston in an opposite direction.

9. In an internal-combustion engine, the combination of a main piston having a passage formed therein for conducting the explosion-gases due to preignition, a main cylinder, a firing-head for the cylinder, a water-jacket therefor having an inlet and an outlet passage, a valve regulating the passage of water through the jacket, an auxiliary piston and cylinder for actuating the valve, and a valve for admitting a certain amount of explosion-gases from the main cylinder through the passage in the main piston to the auxiliary cylinder each time that preignition takes place.

10. In an internal-combustion engine, the combination of a main piston and cylinder, an auxiliary piston and cylinder, a valve actuated by the auxiliary piston for admitting a cooling medium to the engine, and a gas-pocket communicating with the auxiliary cylinder for retarding the action of the auxiliary piston.

In witness whereof I have hereunto set my hand this 23d day of November, 1900.

ELIHU THOMSON.

Witnesses:

DUGALD MCK. MCKILLOP,

ROBERT SHAND.