No. 775,819. PATENTED NOV. 22, 1904.

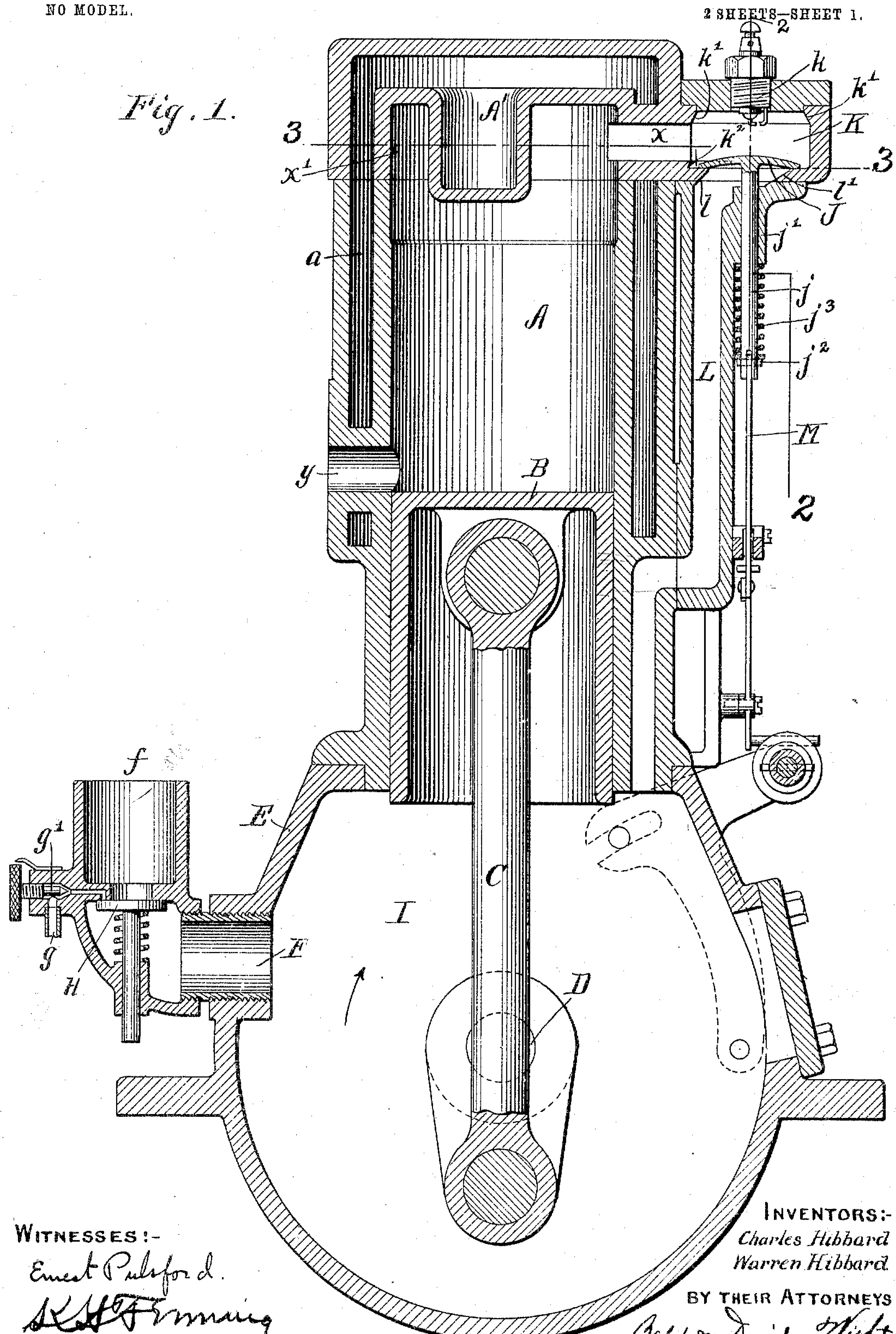
C. & W. HIBBARD.

EXPLOSIVE ENGINE.

APPLICATION FILED NOV. 30, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



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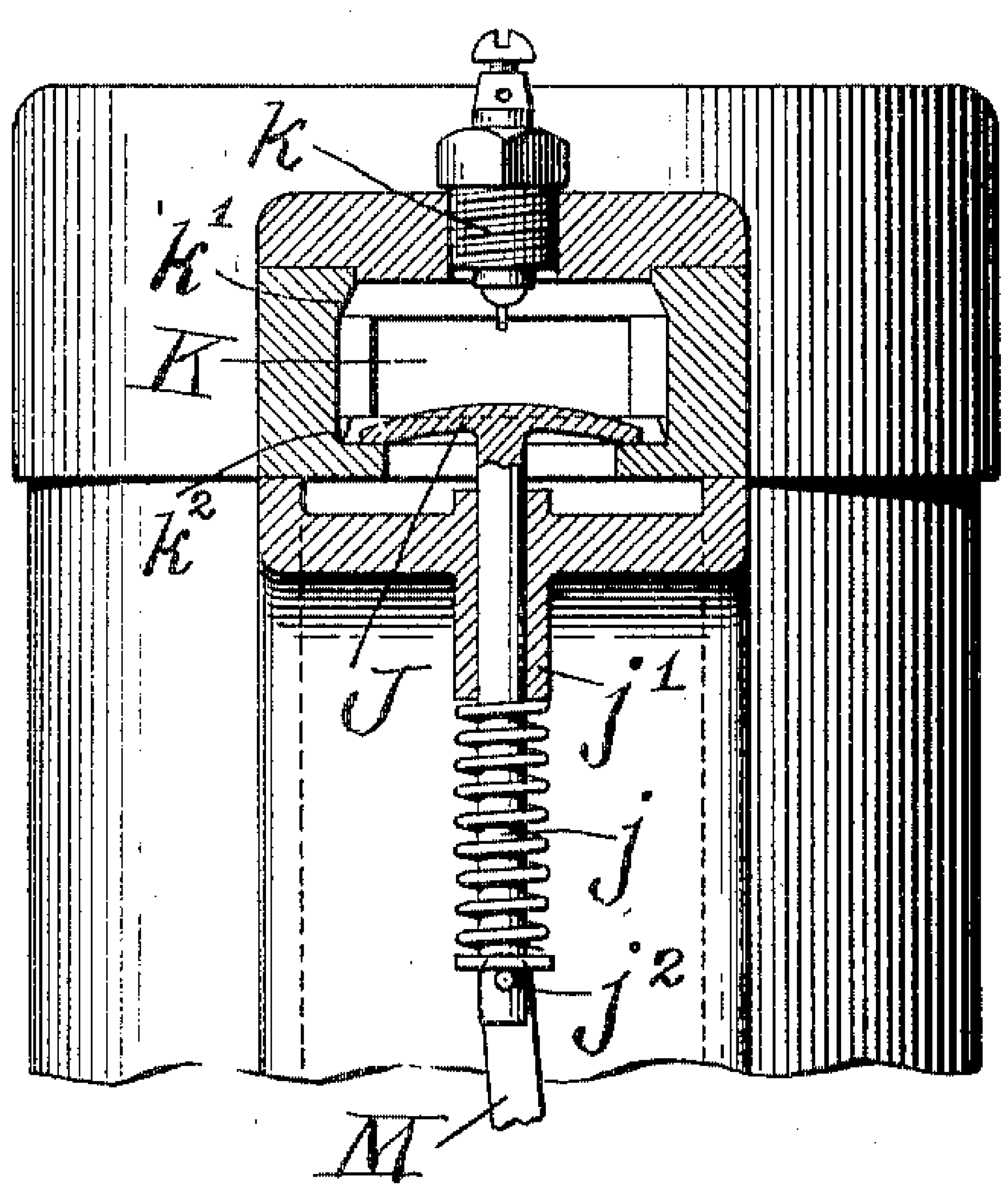


Fig. 2.

Fig. 3.

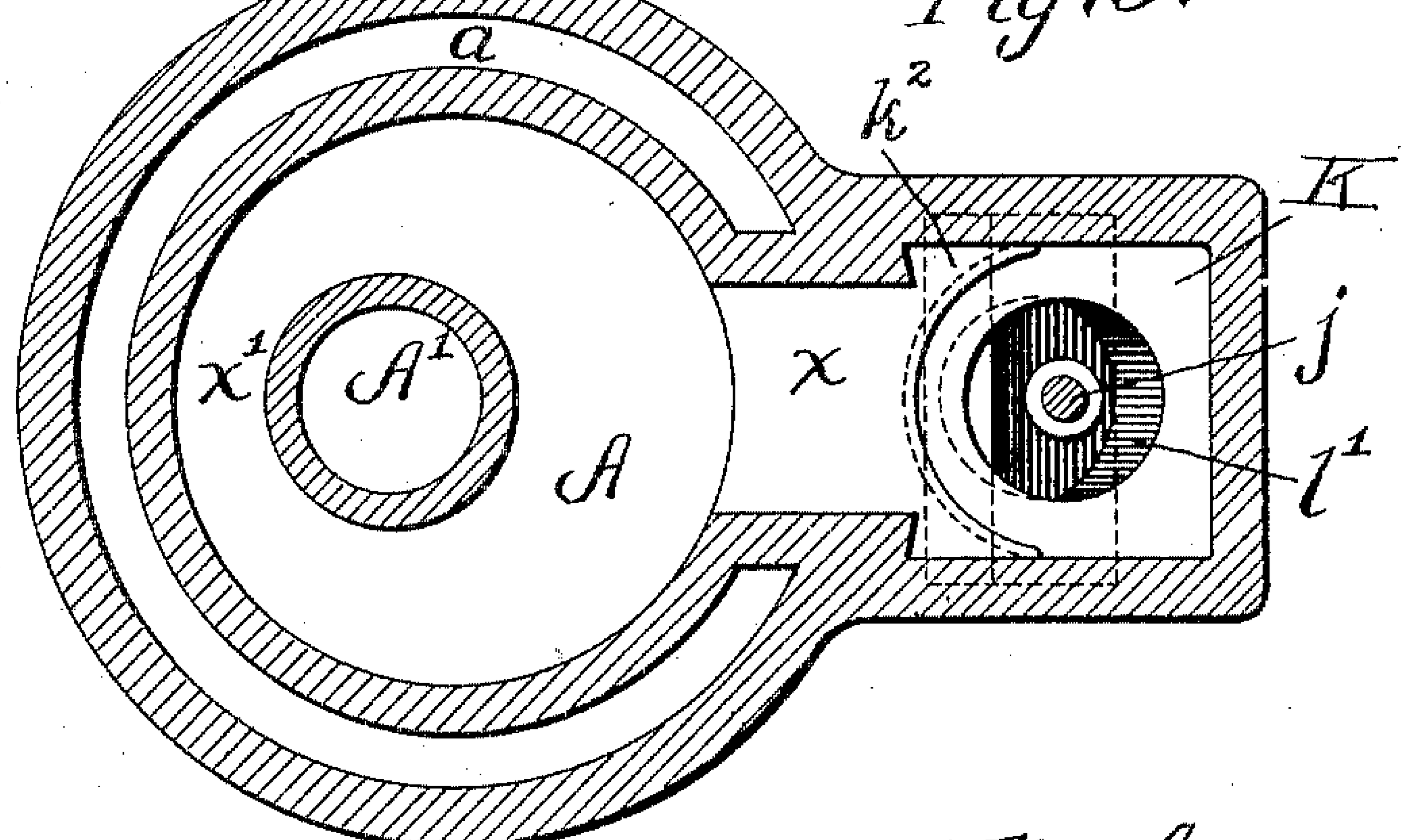
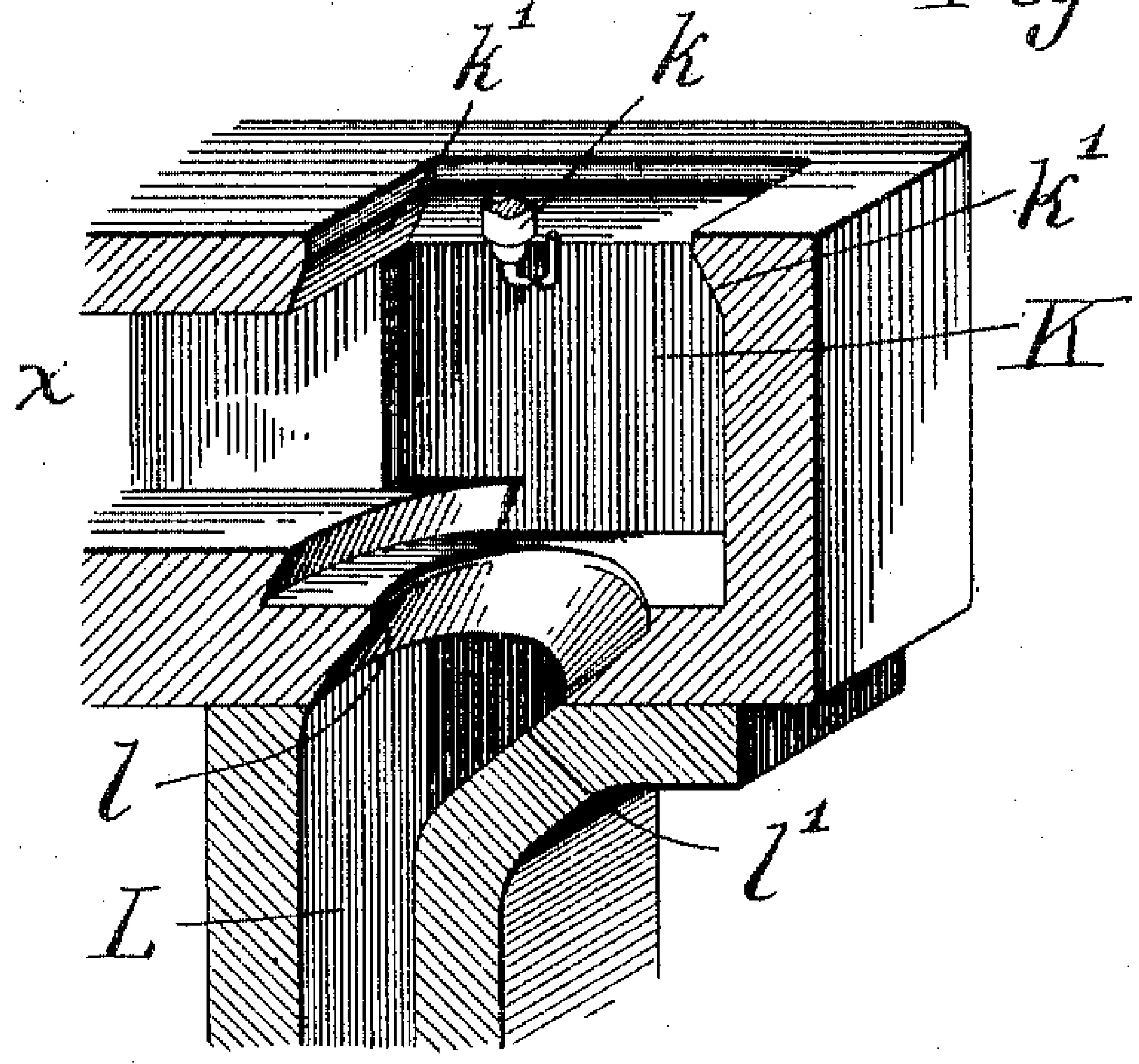


Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES HIBBARD AND WARREN HIBBARD, OF SANDYHILL, NEW YORK, ASSIGNORS OF ONE-THIRD TO SUMNER HIBBARD, OF SANDYHILL, NEW YORK.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 775,819, dated November 22, 1904.

Application filed November 30, 1903. Serial No. 183,212. (No model.)

To all whom it may concern:

Be it known that we, CHARLES HIBBARD and WARREN HIBBARD, citizens of the United States, residing at Sandyhill, in the county of Washington and State of New York, have invented certain new and useful Improvements in Explosion-Engines, of which the following is a specification.

Our invention relates to explosion-engines of the class in which a piston reciprocating in a cylinder is operated by successive explosions of a mixture of gas and air or hydrocarbon vapor or spray and air, and the general objects of our invention are to provide a an engine of this class which, while simple in construction, is powerful and will operate uniformly when running at different speeds or under varying loads.

We preferably embody our invention in a single-acting simple two-cycle engine in which an explosive mixture compressed in the crank-chamber by the working piston is admitted to the working cylinder through a valve-chamber containing igniting devices (such as the electrodes of electrical igniting devices) and having a port through which the mixture is delivered radially to the working cylinder. Opposite this port within the cylinder is located a cylindrical boss, against which the gases, vapors, or sprays impinge and which causes the radial current of the mixture to be broken up into curved currents or eddies, which effectively clear the cylinder of exploded gases and tend to confine the unexploded charges of the mixture to the rear end of the cylinder and prevent any tendency thereof to pass directly to the exhaust-port. This cylindrical deflector is placed eccentrically to the axis of the working cylinder, so as to leave more space between the admission-port and the boss than between the boss and the opposite side of the cylinder, by which arrangement the charges are caused to spread and follow the curved lines of the boss more effectively than they would if the boss were concentric with the working cylinder. The exhaust-port is located near the front end of the cylinder, and the engine is so constructed and operated that when an explosion takes place and the piston moves outward this exhaust-port is uncovered and at the same time the admission-valve is opened by the pressure of gases or vapors from the crank-chamber, and these gases or vapors pass into the cylinder, forcing out any products of combustion that may remain and filling the cylinder behind the piston. The inward or rearward stroke of the piston compresses the gases or vapors, and just before the piston has reached the limit of its inward stroke the charge is ignited, which charge after ignition is further compressed by the inward movement of the piston, after which the piston is forcibly moved on the outstroke.

In this class of engines where the ignition devices are located outside the working cylinder the operation of the engine is sometimes rendered irregular by reason of the fact that the charges admitted past the admission-valve are insufficient to fill both the cylinder and the chamber containing the ignition devices—*i. e.*, the charge for the most part goes to the cylinder—and when the spark is made no explosion takes place, and hence the action of the engine is made irregular. This is especially the case in two-cycle engines when the engine is running at reduced speed or with light charges. We have overcome this objection by so constructing the valve-chamber, which also contains the sparking electrodes or ignition devices, that it tends to retard the passage of the explosive mixture to the working cylinder and to detain it in the valve-chamber, so that while a free passage of the mixture to the cylinder is permitted when the supply is plentiful, as when running at high speed or where the engine is set to run with a heavy load, the passage of mixture is retarded at other times, as where the speed is slow or the valve is set to give small admissions and reduce the horse-power. Thus we insure that there shall be under all conditions enough explosive mixture in the valve-chamber in proximity to the electrodes or ignition devices to produce an explosion at each normal operation of the engine.

In the accompanying drawings, Figure 1 shows a vertical central section through a two-cycle engine embodying our improvements. Fig. 2 is a detail view in section, through the valve-chamber, on the line 2 2 of Fig. 1. Fig. 3 shows a transverse section on the line 3 3 of Fig. 1. Fig. 4 is a view, on an enlarged scale and in section, of the chamber of the admission-valve.

The working cylinder A of the engine may be of usual or of any approved form in general construction. It is shown as being provided with a water-jacket *a*, an admission-port *x*, and an exhaust-port *y*. The piston B reciprocates in the cylinder in the usual way, and it is jointed to the rod C, connected in the usual way with a crank-shaft D, inclosed by a casing E, to which a mixture of gas and air, gasolene and air, or other hydrocarbon mixture is admitted through a port F. In the specific construction shown air is admitted at *f* and gas at *g*. The gas-port is regulated by a needle-valve *g′*, and the admission of both gas and air to the port F is controlled by a check-valve H of ordinary construction. It will be understood that when the piston B moves inward toward the rear end of the cylinder air and gas are admitted past the valve H and that when the piston moves outward the valve is closed by its spring or by the pressure of gases in the crank-chamber I.

The rear end of the cylinder A is formed with a cylindrical boss A′, which projects outward toward the piston across the radial admission-port *x*. This boss is hollow and connects with the water-jacket *a*. Its axis is eccentric to the axis of the cylinder, thereby leaving more space between the boss and the admission-port *x* than between the boss and the opposite side *x′* of the cylinder. This boss is so arranged as to deflect the charges of explosive mixture which enter the cylinder through the admission-port. If the boss were absent, there would be a tendency for the explosive charges to pass directly from the admission-port to the exhaust-port; but in the arrangement shown these gases strike against the curved wall of the boss and spread in an outward direction about it, curved currents or eddies being formed which effectively clear the cylinder of spent gases and tend to confine the fresh gases at the rear or inner end of the cylinder and to hold them there until the explosion takes place. When the charges are plentiful, they will fill the cylinder completely and free it from products of combustion left by a preceding charge; but when the charges are less plentiful or light they will to a large extent be confined at the rear end of the cylinder. At any rate, experience has shown that the construction which we employ prevents the direct passage of explosive mixture from the admission to the exhaust port. The eccentric arrangement of the boss is also important, because it permits the gases to spread somewhat before striking the surface of the boss. If the boss were concentric with the axis of the cylinder or were closer to the admission-port, they would strike more directly against the boss and would not have the same tendency to follow the curved lines of the surface of the cylinder.

The admission-valve J is contained within a valve-chamber K adjacent to the admission-port *x*. This chamber also contains the electrodes *k* of the ignition devices, as we prefer to use electrical ignition devices, although so far as part of our invention is concerned other ignition devices may be used. The valve-stem *j* passes through a guide *j′* below the valve, and its lower or outer end carries a cross-pin j^2, between which and the guide is interposed a spring j^3, which so presses on the cross-pin as to tend to close or hold closed the admission-valve. The valve-head has a seat on the bottom of the valve-chamber, and below this head is a passage L, leading to the crank-chamber I. The valve-seat is located below the plane of the admission-port *x* and just below the electrodes *k*. The top wall of the valve-chamber is above the plane of the admission-port *x*, and where the top wall joins the side walls the chamber is beveled or inclined on all four sides, as indicated at *k′*. The upper part of the passage L, just below the valve-head, has inclined walls *l l′*, which slope upwardly in an inclined direction toward that part of the valve-chamber opposite the admission-port *x*, by which formation the inflowing gases are directed toward that end of the chamber and are prevented from passing directly to the admission-port. On that side of the valve-chamber where the admission-port is located and just below the plane of the port a rib k^2 is formed, which has an undercut wall sloping from its lower edge upwardly toward the ignition devices. The purpose of thus forming the walls of the valve-chamber is to prevent the direct passage of the explosive mixture through the admission-port to the working cylinder and to detain these gases in the valve-chamber close to the ignition devices.

The formation of the valve-chamber which we have specificially described has been found to successfully perform these functions; but we do not confine ourselves to the precise formation shown and described, as these may be somewhat varied and yet accomplish the same results.

When the engine is running at high speed and there is a free lift to the valve, so that a plentiful charge is admitted at each reciprocation of the engine, the cylinder, as well as the valve-chamber, will always be filled with sufficient explosive mixture to perform the operations in regular order continuously or without interruption; but when the admissions are light, as when the engine is running at low speed or the valve is given only a slight lift to admit only a small quantity of the mixture at each operation, it is important that enough of the mixture should be detained close to the ignition devices to effect an explosion, even though none or only a small quantity of the mixture be admitted to the cylinder, as an explosion in the valve-chamber will cause an expansion which will be communicated to the cylinder and effect the reciprocation of the piston.

The construction and organization which we have shown has been found to be efficient under all circumstances, working well when the supplies of the mixture are plentiful and also when they are very light. If the ignition devices were located in the cylinder itself and the charges admitted were light, they would become so diffused in the cylinder as to prevent explosions under many conditions. In fact, where the ignition devices are thus arranged the valve mechanism could not be adjusted to admit very light charges and obtain successive explosions at regular intervals; but by our improvements, where the ignition devices are located in a separate valve-chamber of small area, the admission-valve can be set to admit a mere puff of the explosive mixture which in any such case will be confined to the valve-chamber and concentrated close to the ignition devices, and hence will always be exploded at the proper time.

The valve-stem *j* is jointed to a rod M, which may be connected with a governor by which the lift of the valve is regulated.

As the governor forms no part of the present invention it is not herein shown or described.

We claim as our invention—

1. An explosion-engine comprising a working cylinder having a radial admission-port for the explosive mixture, and a boss closed at its inner end projecting inwardly from the rear end of the cylinder having an annular space around it for the circulation of the explosive gases and which is shaped to receive the explosive mixture from the admission-port and to retard its passage toward the exhaust-port of the cylinder.

2. An explosion-engine comprising a working cylinder having a radial admission-port near its rear end for the explosive mixture and an exhaust-port near its opposite end and a boss closed at its inner end projecting inwardly from the rear end of the cylinder, which has an annular space around it and the surface of which is shaped to retard the passage of the explosive mixture toward the exhaust-port and to cause it to circulate at the rear end of the cylinder.

3. An explosion-engine comprising a working cylinder having a radial admission-port near its rear end for the explosive mixture, and a boss having a closed inner end projecting inward from the rear end of the cylinder having an annular space around it and the surface of which facing the admission-port is curved transversely but longitudinally parallel or substantially so with the axis of the cylinder.

4. An explosion-engine comprising a working cylinder having a radial admission-port for the explosive mixture, and a cylindrical boss projecting inward from the rear end of the cylinder across the path of the incoming charges of explosive mixture the axis of which is eccentric to the axis of the cylinder, and which has an annular space around it for the circulation of the gases whereby they are impeded or held for a time at the rear end of the cylinder.

5. An explosion-engine comprising a working cylinder having a radial admission-port near one end for the admission of explosive gases and an exhaust-port near the opposite end and a cylindrical boss projecting inward across the path of the incoming explosive mixture and the axis of which is eccentric to the axis of the working cylinder and which has an annular space about it for the circulation of gases.

6. An explosion-engine comprising a working cylinder having a radial admission-port near its rear end and an exhaust-port near its opposite end and a cylindrical boss projecting inward from the rear end of the cylinder across and beyond the plane of the admission-port and the axis of which is eccentric to the axis of the working cylinder.

7. An explosion-engine comprising a working cylinder, an admission-valve and igniting devices and a valve-chamber inclosing the ignition devices which communicate with the working cylinder and the walls of which are formed with inclined deflecting-surfaces which converge toward the ignition devices.

8. An explosion-engine comprising a working cylinder, an admission-valve and ignition devices, and a valve-chamber inclosing the ignition devices, formed with a port communicating with the working cylinder and with a valve-seat connecting with a deflecting-surface which directs the inflowing mixture away from the admission-port of the cylinder and which is also formed with a deflecting-surface at the admission-port and close to the valve whereby light charges are prevented from passing directly from the valve-seat to the admission-port and are deflected toward the ignition devices.

9. An explosion-engine comprising a working cylinder, an admission-valve and ignition devices, and a valve-chamber inclosing the ignition devices, provided with a port communicating with the working cylinder and with a valve-seat close to said admission-port, said chamber being formed with a deflecting-shoulder close to the admission-valve which prevents the explosive mixture from passing directly to the valve when the valve is opened

to a small extent but across which the explosive mixture readily passes when the valve is opened more fully.

10. An explosion-engine comprising a working cylinder, an admission-valve and ignition devices, a valve-chamber inclosing the ignition devices and to which the explosive mixture under pressure is admitted, and which is formed with a deflecting surface or shoulder near the valve-seat and near the admission-port to the cylinder which prevents the flow of the explosive mixture from the valve-seat to the admission-port of the cylinder when the valve is opened to a small extent, said valve-chamber being also formed with inclined surfaces converging toward the ignition devices whereby small charges are concentrated at the ignition devices.

11. An explosion-engine comprising a working cylinder, an admission-valve and ignition devices and a valve-chamber inclosing the ignition devices and formed with a valve-seat connecting with a deflecting-surface which directs the inflowing mixture away from the admission-port of the cylinder and which is also formed at the top with inclined surfaces converging toward the ignition devices whereby the explosive mixture is concentrated at the ignition devices when small charges are admitted.

In testimony whereof we have hereunto subscribed our names.

CHARLES HIBBARD.
WARREN HIBBARD.

Witnesses:
JAMES C. GIBSON,
CHARLES C. COWEN.