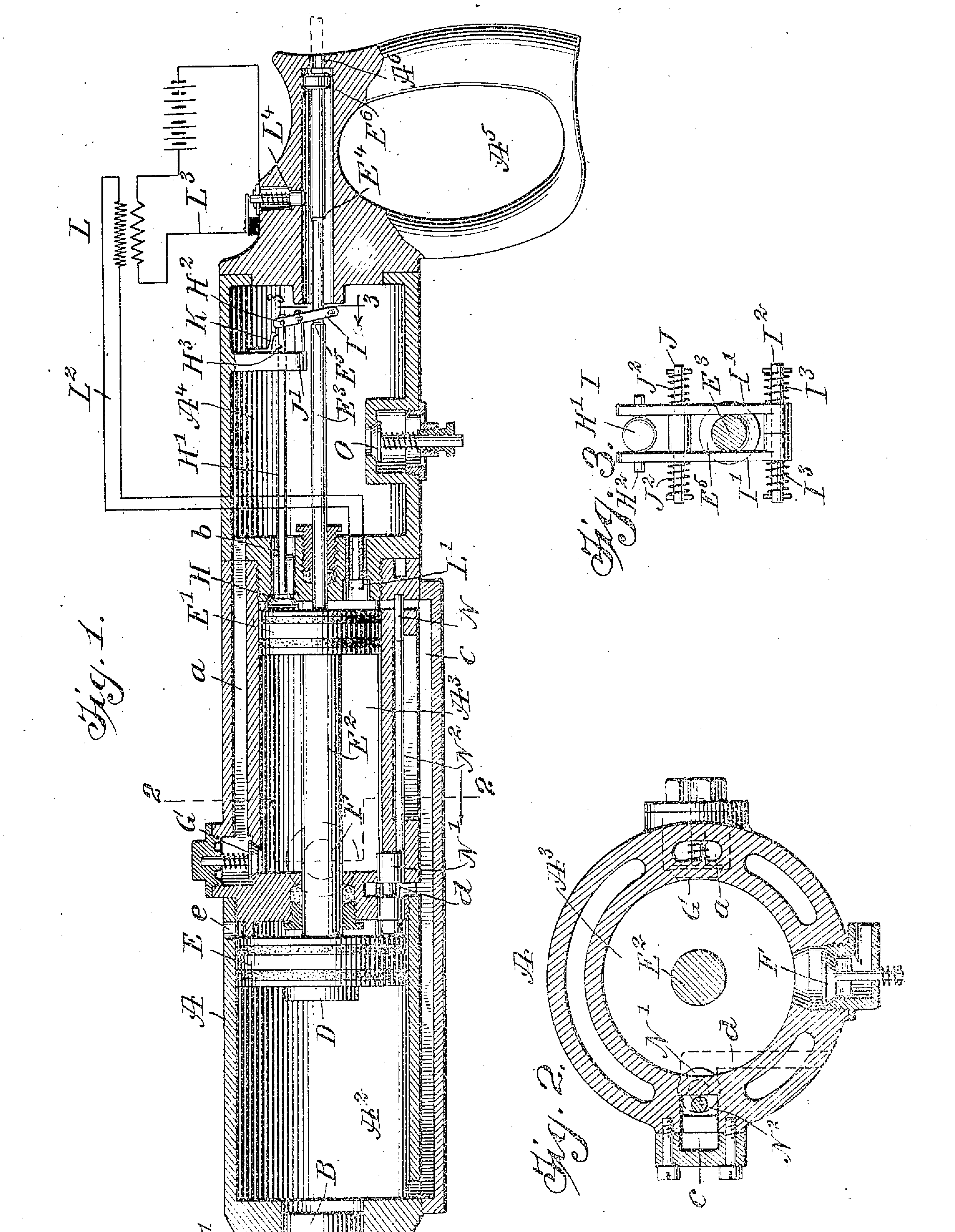
No. 865,889. PATENTED SEPT. 10, 1907.

A. K. HARFORD.

HAMMER.

APPLICATION FILED OCT. 6, 1906.



WITNESSES

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HAMMER.

No. 865,889. Specification of Letters Patent. Patented Sept. 10, 1907.

Application filed October 6, 1906. Serial No. 337,681.

To all whom it may concern:

Be it known that I, ALBERT KELLOGG HARFORD, a citizen of the United States, and a resident of Oakland, in the county of Alameda and State of California, have invented a new and Improved Hammer, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved hammer, having means driven by the force of an explosive mixture to permit the use of the tool on work which cannot readily be reached by pneumatic hammers and similar tools.

The invention consists of novel features and parts and combinations of the same, which will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a longitudinal central section of the improvement; Fig. 2 is an enlarged transverse section of the same on the line 2—2 of Fig. 1, and Fig. 3 is an enlarged transverse section of the means for controlling the admission valve, the section being on the line 3—3 of Fig. 1.

The barrel or casing A on which the hammer is mounted is provided at its forward end with a bearing A' for the anvil B to slide in, the said bearing opening at one end into a tubular guide C, attached to the bearing, and through which the part to be hammered is introduced, so as to be struck by the anvil B, which in turn receives successive blows from a hammer D attached to a piston E mounted to reciprocate in the hammer cylinder A^2 formed in the barrel or casing A adjacent to and connected with the bearing A'.

The barrel or casing A is provided next to the cylinder with an explosion cylinder A^3 in which reciprocates a piston E' rigidly connected by a piston rod E^2 with the piston E reciprocating in the cylinder A^2. By reference to Fig. 1 it will be seen that the area of the piston E is in excess of that of the piston E'.

In the forward end of the explosion cylinder A^3 is arranged a spring-pressed valve F connected with a suitable source of explosive mixture supply, to charge the forward end of the cylinder A^3 with the explosive mixture at the time the pistons E and E' are on the return stroke. The same end of the cylinder A^3 is connected by a port *a* with a compression chamber A^4 formed on the barrel or casing A adjacent to the cylinder A^3, and this port A is normally closed by a spring-pressed valve G adapted to open when the pistons E and E' are on the forward stroke, so that the charge previously drawn into the cylinder A^3 by way of the valve F is forced out of the cylinder by way of the valve G into the port *a*, to pass from the latter into the compression chamber A^4. The latter is connected by a port *b* with the rear end of the cylinder A^3, and this port *b* is normally closed by a valve H actuated from a rod E^3 attached to and moving with the piston E'. For the purpose mentioned the stem H' of the valve H extends into the chamber A^4 and is connected by a pivot pin H^2 with the side arms I' of a lever I fulcrumed on a pin J carried by a bracket J' arranged within the chamber A^4. The side arms I' of the lever I straddle the rod E^3 between shoulders E^4, E^5 formed on the rod E^3, and hence when the pistons E and E' move into a rearmost position then the shoulder E^5 in striking the lever I imparts a swinging motion to the same to move the valve H into an open position, so that the compressed charge in the chamber A^4 can pass by way of the port *b* into the rear end of the cylinder A^3. When the pistons E and E' move forward a short distance, then the shoulder E^4 engages the lever I, to impart a swinging motion to the same with a view to move the valve H into a closed position, so as to disconnect the chamber A^4 from the rear end of the cylinder A^3. The valve H is locked in a closed position by a spring catch K attached to the bracket J' and engaging a notch H^3 formed in the valve stem H'. Now the charge passed into the rear end of the cylinder A^3 is ignited by an igniting device, preferably in the form of an electric igniting device L, the electrodes L' of its secondary circuit L^2 extending into the rear end of the cylinder A^3, as plainly indicated in Fig. 1. The primary circuit L^3 of the electric igniting device L is provided with a circuit closer and breaker L^4 in the form of a spring-pressed pin adapted to be actuated by a cam E^6 formed on the rear end of the rod E^3, so that when the piston E' has moved forward a distance in the cylinder A^3 and the cam E^6 lifts the pin L^4 after the valve H is closed, then the circuit L^3 is closed and consequently a spark is had at the electrode L' to ignite the charge contained in the rear end of the cylinder A^3, to push the piston E' forward to the end of its stroke. Now this forward movement of the piston E' causes a like movement of the piston E, so that the hammer D strikes the anvil B, thereby exerting a blow on the anvil B, which is transmitted to the part to be hammered.

From the foregoing it will be seen that the piston E' is primarily moved by the compressed charge and after the latter is ignited the piston is forced outward by the force of the explosion, to cause the hammer D to give a powerful blow to the anvil B and the part to be hammered.

The return movement of the pistons E and E' is caused by the force of the exhaust gases, and for this purpose the rear end of the cylinder A^3 is connected with the forward end of the cylinder A^2 by a port *c*, from which leads an exhaust port *d* to the atmosphere. The port *c* adjacent to the cylinder A^3 is controlled by a valve N, and the exhaust port *d* is controlled by a valve N', and the valves N' and N are connected with each other by a valve stem N^2, and the valve N' is adapted

to be moved into a closed position by the piston E′ at the time the latter moves to the end of its forward stroke. A return movement is given to the valves N′ and N by the piston E at the time the latter returns to the end of its rearmost stroke. Now when the several parts are in the position shown in Fig. 1 it is evident that the piston E is free to move forward in the cylinder A^2, as the latter connects with the atmosphere by way of the ports *c* and *d*, the valve N′ then being in an open position and the valve N in a closed position. After the explosion has taken place in the cylinder A^3 and the pistons E′ and E have moved forward to nearly the end of their stroke, then the piston E′ engages the valve N′ and moves the same forward so as to close the port *d* and cause the valve N to open to allow the exhaust gases in the rear end of the cylinder A^3 to pass by way of the port *c* into the forward end of the cylinder A^2, to press against the piston E so as to return the same to its rearmost position and with it the piston E′. Now when the piston E moves into its rearmost position it shifts the valve N′ into an open position and the valve N into a closed position. In order to relieve the chamber A^4 of any excessive pressure a relief valve O is provided, as indicated in Fig. 1. The rear end of the hammer cylinder A^2 is provided with a port *e* to the atmosphere, to avoid compression in this cylinder.

The rear end of the barrel or casing A is preferably provided with a handle A^5 under the control of the operator, to conveniently manipulate the tool so as to properly engage the same with the work to be treated at the time.

In order to start the device, use is made of a rod inserted through an opening A^6 in the handle and threaded into the end of the cam E^6 for moving the latter, and consequently the rod E^3 and the pistons E and E′, forward and backward until the desired explosive charge is had in the cylinder A^3.

From the foregoing it will be seen that an explosion device is used to impart a reciprocating motion to the hammer D, to cause the latter to give blows in rapid succession upon the anvil B engaged with the work at the time.

The lever I is provided with spring-pressed side arms I′ to allow the rod E^3 to pass between the said side arms I′ after the shoulder E^4 has imparted the desired swinging motion to the lever I, and at the time the pistons E′ and E are moving to the ends of their outer stroke. As shown in Fig. 3 the lower ends of the side arms I′ are mounted to slide on a rod I^2 on which are coiled springs I^3 pressing the side arms I′ towards each other, similar springs J^2 being mounted on the pivot J for the same purpose, that is, to hold the side arms I′ normally in engagement with the reduced portion of the rod E^3 extending between the shoulders E^4 and E^5, said springs I^3, J^2, however, allowing the side arms I′ to move apart after the shoulder E^4 has given the desired swinging motion to the lever I, so that the rear end of the rod E^3 can slide between the side arms I′ until the pistons E′ and E are at the end of their forward stroke.

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

1. A hammer comprising a barrel open at one end for the introduction of the part to be struck, said barrel having an explosion cylinder and a hammer head cylinder, connected pistons in said cylinders, a hammer head connected with the piston in the hammer head cylinder, an explosion device for imparting movement to one of the pistons whereby to drive them in one direction, and means whereby to cause the exhaust gases to act on the other piston to drive the pistons in the opposite direction.

2. A hammer comprising a barrel open at one end for the introduction of the part to be struck, an anvil movable in the said barrel, a hammer head for striking the said anvil, and an explosion device for imparting a reciprocating motion to the said hammer head.

3. A hammer comprising a barrel open at one end for the introduction of the part to be struck, an anvil movable in the said barrel, a hammer head for striking the said anvil, and an explosion device for imparting a reciprocating motion to the said hammer head and arranged in the barrel, said hammer head being adapted to be actuated in one direction by the force of an explosion, and to be returned by the force of the exhaust gases.

4. A hammer, comprising a barrel open at one end for the passage of the part to be struck, the said barrel having a compression chamber, an explosion cylinder and a hammer head cylinder, connected pistons in the said cylinders, a hammer head carried by one of the pistons, an anvil arranged in the open end of the barrel and adapted to be struck by the said hammer head, a valve controlled by the said pistons and controlling the connection between the said compression chamber and the said explosion chamber, and an igniting device for the said explosion chamber.

5. A hammer comprising a barrel open at one end for the passage of the part to be struck, the said barrel having a compression chamber, an explosion cylinder and a hammer head cylinder, connected pistons in the said cylinders, a hammer head carried by one of the pistons, an anvil arranged in the open end of the barrel and adapted to be struck by the said hammer head, a valve controlled by the said pistons and controlling the connection between the said compression chamber and the said explosion chamber, an igniting device for the said explosion chamber, and means for controlling the said igniting device from the said pistons.

6. A hammer comprising a barrel open at one end for the passage of the part to be struck, the said barrel having a compression chamber, an explosion cylinder and a hammer head cylinder, connected pistons in the said cylinders, a hammer head carried by one of the pistons, an anvil arranged in the open end of the barrel and adapted to be struck by the said hammer head, a valve controlled by the said pistons and controlling the connection between the said compression chamber and the said explosion chamber, an igniting device for the said explosion chamber, and connected valves controlled by the said pistons and controlling the connection between the said cylinders and between the hammer head cylinder and the atmosphere.

7. A hammer comprising a barrel open at one end for the passage of the part to be struck, the said barrel having a compression chamber, an explosion cylinder and a hammer head cylinder, connected pistons in the said cylinders, a hammer head carried by one of the pistons, an anvil arranged in the open end of the barrel and adapted to be struck by the said hammer head, a valve controlled by the said pistons and controlling the connection between the said compression chamber and the said explosion chamber, an igniting device for the said explosion chamber, and a valved connection between the forward end of the explosion cylinder and the said compression chamber.

8. A hammer comprising a barrel open at one end for the passage of the part to be struck, the said barrel having a compression chamber, an explosion cylinder and a hammer head cylinder, connected pistons in the said cylinders, a hammer head carried by one of the pistons, an anvil arranged in the open end of the barrel and adapted to be struck by the said hammer head, a valve controlling a connection between the explosion cylinder and the compression chamber, a rod moving with the said pistons and having spaced shoulders, and a lever controlled by the said shoulders and connected with the stem of the said valve to open and close the latter.

9. A hammer comprising a barrel open at one end for the passage of the part to be struck, the said barrel having

a compression chamber, an explosion cylinder and a hammer head cylinder, connected pistons in the said cylinders, a hammer head carried by one of the pistons, an anvil arranged in the open end of the barral and adapted to be struck by the said hammer head, a valve controlling a connection between the explosion cylinder and the compression chamber, a rod moving with the said pistons and having spaced shoulders, and a lever controlled by the said shoulders and connected with the stem of the said valve to open and close the latter, the said lever having spring pressed side members between which passes the said rod.

10. A hammer comprising a barrel open at one end for the passage of the part to be struck, the said barrel having a compression chamber, an explosion cylinder and a hammer head cylinder, connected pistons in the said cylinders, the piston in the said hammer head cylinder being of greater area than the piston in the explosion cylinder, a hammer head carried by one of the pistons, an anvil arranged in the open end of the barrel and adapted to be struck by the said hammer head, a valve controlled by the said pistons and controlling the connection between the said compression chamber and the said explosion chamber, an igniting device for the said explosion chamber, and connected valves controlled by the said pistons and controlling the connection between the said cylinders and between the hammer head cylinder and the atmosphere.

11. A hammer comprising a barrel open at one end for the introduction of the part to be struck, said barrel having an explosion cylinder and a hammer head cylinder, said hammer head cylinder being of greater diameter than the explosion cylinder, pistons in each of said cylinders, said pistons being connected together, a hammer head connected with the piston of greater diameter, an explosion device for imparting movement to the piston in the explosion cylinder whereby to drive the pistons in one direction, and means whereby to cause the exhaust gases to act upon the piston of larger diameter to move the pistons in the opposite direction.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALBERT KELLOGG HARFORD.

Witnesses:
ARTHUR P. ANDERSEN,
WALTER D. VIOLICH.