No. 676,642. Patented June 18, 1901.

J. WALRATH.

STARTING MECHANISM FOR EXPLOSIVE ENGINES.

(Application filed Oct. 26, 1900.)

(No Model.) 3 Sheets—Sheet 1.

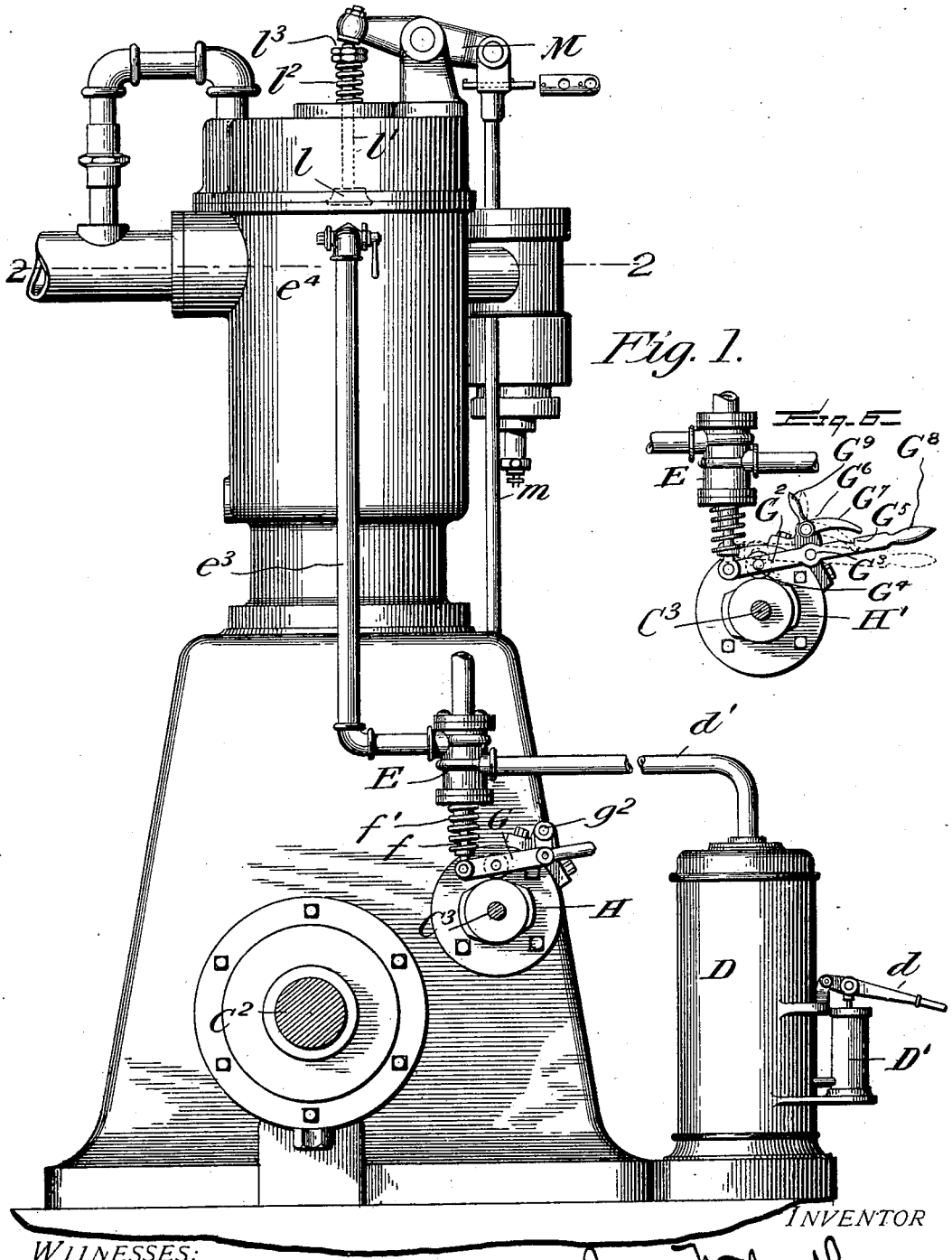

Fig. 1.

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Fig. 2.

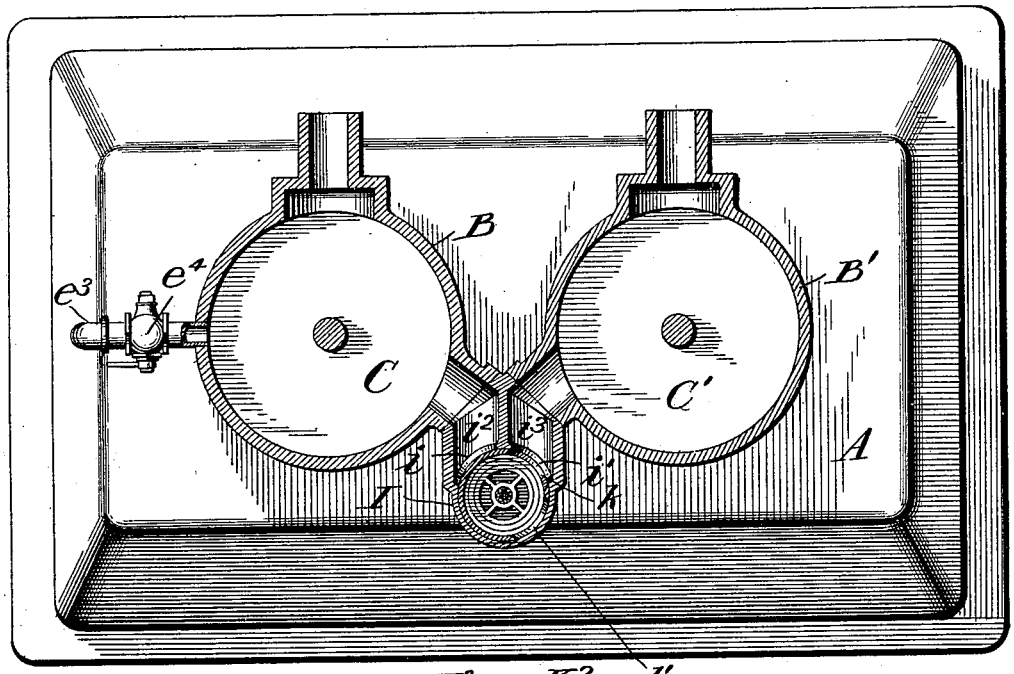

Fig. 3.

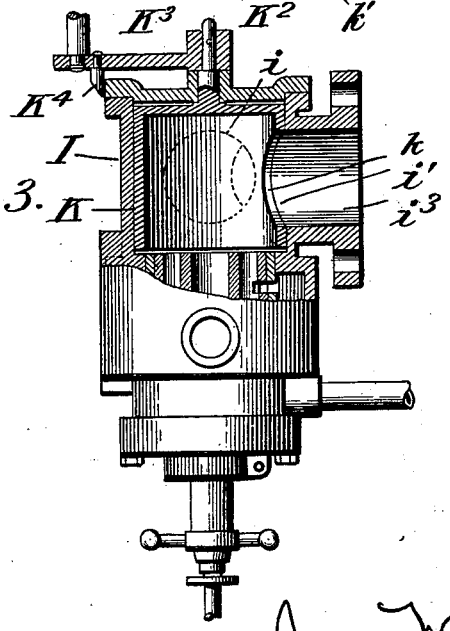

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Fig. 4.

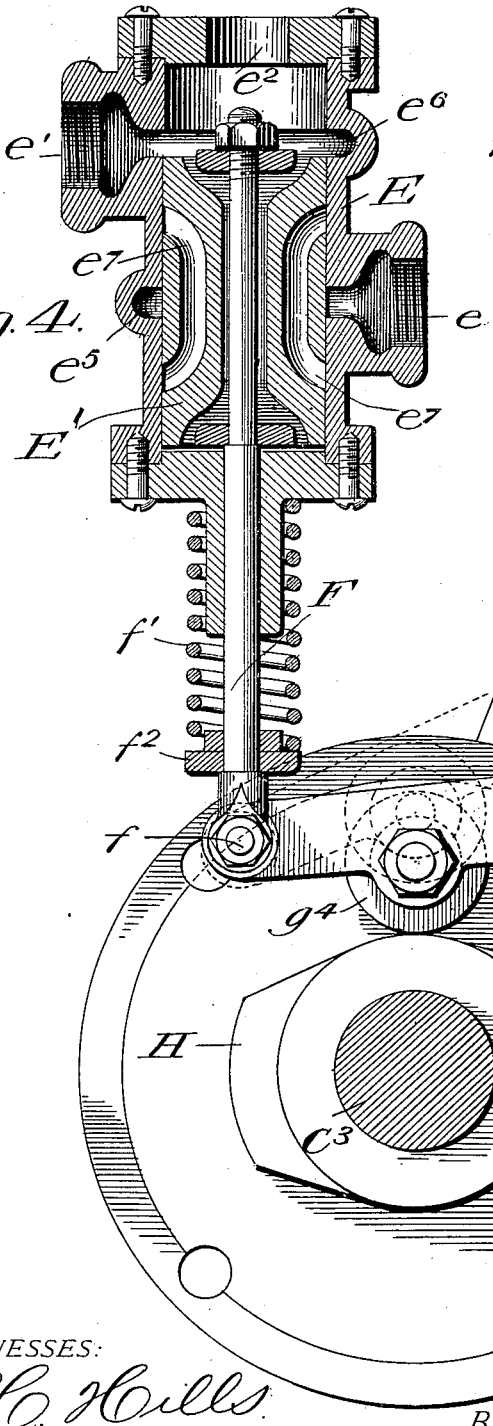
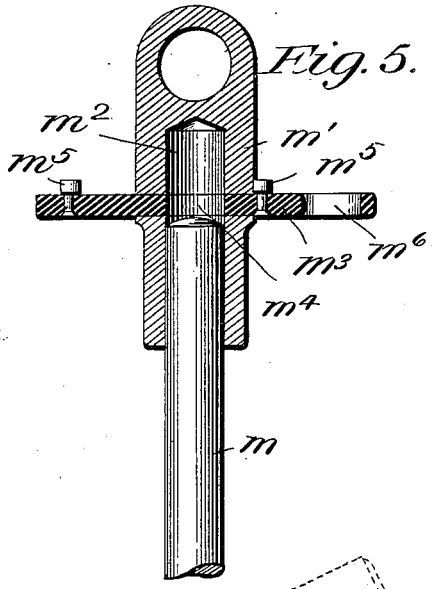


Fig. 5.



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STARTING MECHANISM FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 676,642, dated June 18, 1901.

Application filed October 26, 1900. Serial No. 34,465. (No model.)

To all whom it may concern:

Be it known that I, JESSE WALRATH, a citizen of the United States, residing at Racine, in the county of Racine and State of Wisconsin, have invented certain new and useful Improvements in Starting Mechanism for Explosive-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention is an improvement in starting mechanism for explosive-engines; and it consists in the novel features hereinafter described, reference being had to the accompanying drawings, which illustrate one form in which I have contemplated embodying my invention, and said invention is fully disclosed in the following description and claims.

Referring to the said drawings, Figure 1 represents an end view of an engine embodying my invention. Fig. 2 represents a horizontal section on line 2 2 of Fig. 1. Fig. 3 is a detail view, partly in section, of the cylinder cut-off valve. Fig. 4 is an enlarged view, partly in section, of the compressed-air valve and its operating mechanism. Fig. 5 is a detail sectional view of the means for throwing out of operation the inlet-valve-operating mechanism of the cylinder to which compressed air is admitted. Fig. 6 is a detail view of a modified construction for throwing the compressed-air valve into and out of operation.

The object of my invention is to provide mechanism for starting explosive-engines by means of compressed air (or steam) in order to do away with the necessity of turning the engine-shaft by hand, which, especially in large engines, is a tedious and laborious process.

In the accompanying drawings I have illustrated a double-cylinder explosive-engine having my improvements embodied therein; but my invention is applicable to engines having one or more cylinders.

In the drawings, A represents the base or frame of the engine, B B′ the two cylinders, and C C′ the pistons operating therein and connected to the crank-shaft C^2 in the usual manner.

D represents a supply-tank for fluid under pressure, which is preferably filled with compressed air by means of a suitable pump D′, connected therewith, the pump-piston being connected with and operated by a hand-lever *d*. The compressed-air tank D is provided with an outlet-pipe *d*′, which is connected with the inlet-port *e* of the casing E of a controlling-valve. (Shown in detail on an enlarged scale in Fig. 4.) The valve-casing E is also provided with a cylinder-port *e*′ adjacent to its upper end, and an exhaust-port e^2, the cylinder-port *e*′ being connected by a pipe e^3 to one of the engine-cylinders (in this instance cylinder B) adjacent to its upper end. The pipe e^3 is provided with a cut-off valve e^4, which controls the admission of the compressed air to the cylinder.

E′ represents the reciprocating valve in the valve-casing E, which is so constructed that in one position (at one end of its stroke) it establishes connection between the inlet-port *e* and the cylinder-port *e*′ and in the other position (at the opposite end of its stroke) it establishes connection between the cylinder-port *e*′ and the exhaust-port e^2. The valve-casing E is provided in this instance with an annular groove e^5, communicating with the inlet-port *e*, and a similar groove e^6 above the groove e^5, communicating with the cylinder-port *e*′. The valve E′ is so constructed that when in its lowest position it extends from the bottom of the casing to but not above the annular groove e^6, thus placing in communication the cylinder-port *e*′ and exhaust-port e^2. Said valve is also provided with one or more longitudinally-extending passages e^7 e^7, opening at the sides of the valve, which when the valve is raised to its highest position establish communication between the annular grooves e^5 and e^6 (and therefore the inlet-port *e* and the cylinder-port *e*′) and closing the exhaust-port.

F indicates the valve-stem, which extends downward through the bottom of the valve-casing and has its lower end connected at *f* with one end of a valve-actuating arm or lever G, which is provided at its opposite end with a pivot-aperture *g* and handle *g*′. The engine base or frame is provided with a part (in this instance a block G′, bolted to the base A) provided with two apertures g^2 g^2 in different vertical planes, in either of which may

be placed a removable pivot-pin g^3, which is passed through the aperture g in the arm or lever G. In this manner the arm G may be pivoted at will in either of the two apertures $g^2 g^2$. The arm G is also provided with a friction-roll g^4, which is adapted to be engaged by a double cam H on the second-motion shaft C^3 of the engine, which derives its motion from the crank-shaft in the usual manner, so as to rotate once for each two revolutions of the crank-shaft. The arrangement is such that when the arm G is pivoted in the lower aperture g^2, as shown in full lines, Fig. 4, the roll g^4 will be engaged by the cam H and the valve E′ will be reciprocated twice for each revolution of the second-motion shaft. If the arm G is pivoted in the upper aperture g^2, however, as shown in dotted lines, Fig. 4, the cam H will not engage the friction-roll g^4 and the valve E′ will remain in its lowest position, where it is held by a spring f', surrounding the valve-stem f, between the valve-casing E and a collar f^2 on the stem f.

I represents the mixing-chamber, to which the explosive mixture is supplied in any desired way, the particular arrangement for supplying the explosive material and air not being shown and described herein, since it forms no part of my present invention. The mixing-chamber I is provided with two apertures i and i', each of which is connected by a separate passage (i^2 and i^3, respectively) with one of the engine-cylinders. (See Fig. 2.)

K represents a cylindrical cut-off and regulating valve mounted rotatably in the mixing-chamber I and provided with apertures k and k', adapted to register with the apertures i and i'. The valve K has an axial stem k^2 extending through the top of the mixing-chamber and provided with a handle k^3 and index k^4, adapted to travel over an indicating-scale, so that the position of the valve can be known at all times to the operator. The valve K can be turned so as to open both apertures i i' full or only one of said apertures, and in either case it can be turned so as to partially or wholly close the said aperture or apertures.

Each cylinder of the engine is provided with the usual puppet-valve for admitting the explosive mixture to the cylinder, said valves being operated by cams on the cam or second-motion shaft C^3 of the engine, one of said valves being shown in dotted lines at l in Fig. 1. Each valve l is provided with a stem l', extending up through the head of the cylinder and provided with a spring l^2, surrounding the stem between the cylinder-head and a collar l^3 on the valve, to hold the valve normally closed. Adjacent to each valve-stem is a pivoted arm or lever M, one end of which is adapted to engage the upper end of the stem l' and depress the valve to open it and admit the mixture to its respective cylinder. The other end of the lever M is connected to a vertically-movable rod m, the lower end of which is actuated by a cam on the cam-shaft C^3 to impart the required movement to the valve at the proper time. It is desirable to prevent the valve l of the cylinder which is being driven with compressed air from opening while the compressed air is being used, and to this end I provide a simple device for disconnecting the valve-actuating rod m from that valve. This device is illustrated in Figs. 1 and 5. The upper end of the rod m is provided with a casting m', which is pivotally connected to the arm M, as shown, and is provided with a vertical socket m^2, in which the rod m can slide. The casting m' is also provided with a horizontal sliding plate m^3, extending across the said socket m^2 and provided with an aperture m^4, adapted to register therewith. This plate can be moved transversely across the socket m^2, so as to bring a solid portion of the plate over the end of the rod m, in which case the vertical movements of the rod m will operate the arm or lever M and the valve l; but when the plate m^3 is shoved in so as to bring the aperture m^4 in line with the socket the rod m will simply work up and down through the aperture m^4 and will not actuate the valve. The plate m^3 is provided with stops m^5 m^5 to limit its movements horizontally, and it is conveniently provided with an aperture m^6 to enable it to be moved from one position to another by the operator.

The operation of the devices hereinbefore described in starting the engine is as follows: The air-tank having been first filled with air compressed to the desired degree, the cut-off valve K is turned so as to cut off communication between the mixing-chamber I and the cylinder B and open communication between the mixing-chamber and the cylinder B′. The slide m^3 is pushed in, as shown in Figs. 1 and 5, to disconnect the rod m from the valve l for cylinder B, and the lever G is moved to its lowest position and secured by the pivot-pin g^3. The operator will then see that the engine-crank operated by cylinder B is just off the dead-center and will then open the air-valve e^4 and admit compressed air from the tank D to the cylinder B. The cylinder B and piston therein will operate exactly like a steam-engine under the control of the reciprocating valve E′. With the first revolutions of the crank-shaft the other cylinder B′ will be filled with explosive mixture, which will be compressed and ignited in the ordinary way. The use of compressed air in cylinder B will be continued until the balance-wheel has acquired momentum and the charges in cylinder B′ are being exploded in a satisfactory way, when the engine will be running with two cylinders, one using the compressed air and the other the explosive mixture. The valve e^4 is then closed, the lever G is placed in its upper position, (shown in dotted lines, Fig. 4,) the cut-off valve K is turned so as to admit the explosive mixture to cylinder B, and the slide m^3 is drawn out so as to connect up the lever M with valve-operating rod m. The

engine then proceeds under the action of cylinder B′ and its piston and the momentum of the balance-wheel until the cylinder B is working properly under the explosions of the charges of explosive mixture, when the engine will be running under full power.

It will be seen that by my invention engines of large power can be started with a minimum of manual labor on the part of the operator and the necessity of turning the balance-wheel and shaft by hand is unnecessary, except to move the crank for the cylinder using compressed air off the dead-center.

It is perfectly obvious that the starting apparatus just described can be applied to engines having one cylinder or more than two cylinders without departing from my invention.

In Fig. 6 I have shown a modified form of apparatus for throwing the lever for operating the compressed-air valve into and out of operative relation with the actuating-cam. In this construction, H′ represents the cam, and G^2 the lever pivoted to the frame at G^3 and carrying the friction-roll G^4, which engages the cam. The lever G^2 is provided with a locking notch or shoulder G^5, which is engaged by a pawl G^6, pivoted at G^7 to the frame, when the lever is moved by its handle G^8 into position to raise the roll G^4 out of operative relation with the cam H′. The pawl G^6 is provided with a handle G^9 for throwing it out of engagement with the lever G^2 when it is desired to lower the lever into operative relation with the cam.

What I claim, and desire to secure by Letters Patent, is—

1. In an explosive-engine, the combination with the cylinder and the engine-valves for admitting explosive material, of a cam on the engine-shaft for operating said valve, operating devices for said valve having a part adapted to engage said cam and a movable part, adjacent to said valve for throwing said devices out of operative relation with said valve, means for supplying fluid under pressure to start the engine, a connection extending therefrom to the cylinder separate from the engine-valve, a movable auxiliary valve for controlling the supply of fluid under pressure, a cam on the engine-shaft for operating said valve, devices for operating said valve including a lever connected to said valve and having a part for engaging the cam, and means for moving said lever into and out of operative relation with said cam, whereby the engine-valve and the auxiliary valve can be thrown into and out of operation without affecting their operating-cams, substantially as described.

2. In an explosive-engine, the combination with the engine-cylinder, of a fluid-pressure supply connected with said cylinder, a cut-off valve therefor, a controlling-valve separate from the engine-valves, interposed between the cylinder and the fluid-pressure supply, a cam actuated by the engine-shaft, a lever normally out of operative relation to said cam, operatively connected to said controlling-valve, and means for pivotally securing said lever in position to be engaged by said cam, substantially as described.

3. In an explosive-engine, the combination with the engine-cylinder, an inlet-valve therefor for explosive mixture, operating mechanism therefor including a vertically-reciprocating rod operated from the engine, a part adapted to be moved by said rod, having a socket engaging said rod, and a transverse slide mounted in said part, extending across said socket and having an aperture adapted to register with said socket, of a fluid-pressure supply connected with said cylinder, and a cut-off valve therefor, substantially as described.

4. In an explosive-engine, the combination with the engine-cylinders, of means for supplying explosive mixture to said cylinders, means for cutting off the supply of explosive mixture to one cylinder without affecting the other, of a fluid-supply connected with said latter cylinder, a controlling-valve therefor operated by the engine, a cut-off valve for the fluid-pressure supply and mechanism for throwing said controlling-valve into and out of operation whereby fluid under pressure can be admitted to drive one cylinder while the other is in connection with the supply of fluid under pressure, and then the supply of fluid under pressure can be cut off and explosive mixture can be admitted to both cylinders, substantially as described.

5. In an explosive-engine, the combination with the engine-cylinder, of a fluid-pressure supply connected with said cylinder, a cut-off valve therefor, a controlling-valve separate from the engine-valves, interposed between the cylinder and the fluid-pressure supply, a cam actuated by the engine-shaft, a pivoted lever operatively connected to said controlling-valve and having a part adapted to be engaged by said cam, and a pawl for engaging the said lever to hold it out of operative relation with the cam, substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses.

JESSE WALRATH.

Witnesses:
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EFFA M. CHADWICK.