

No. 647,583.

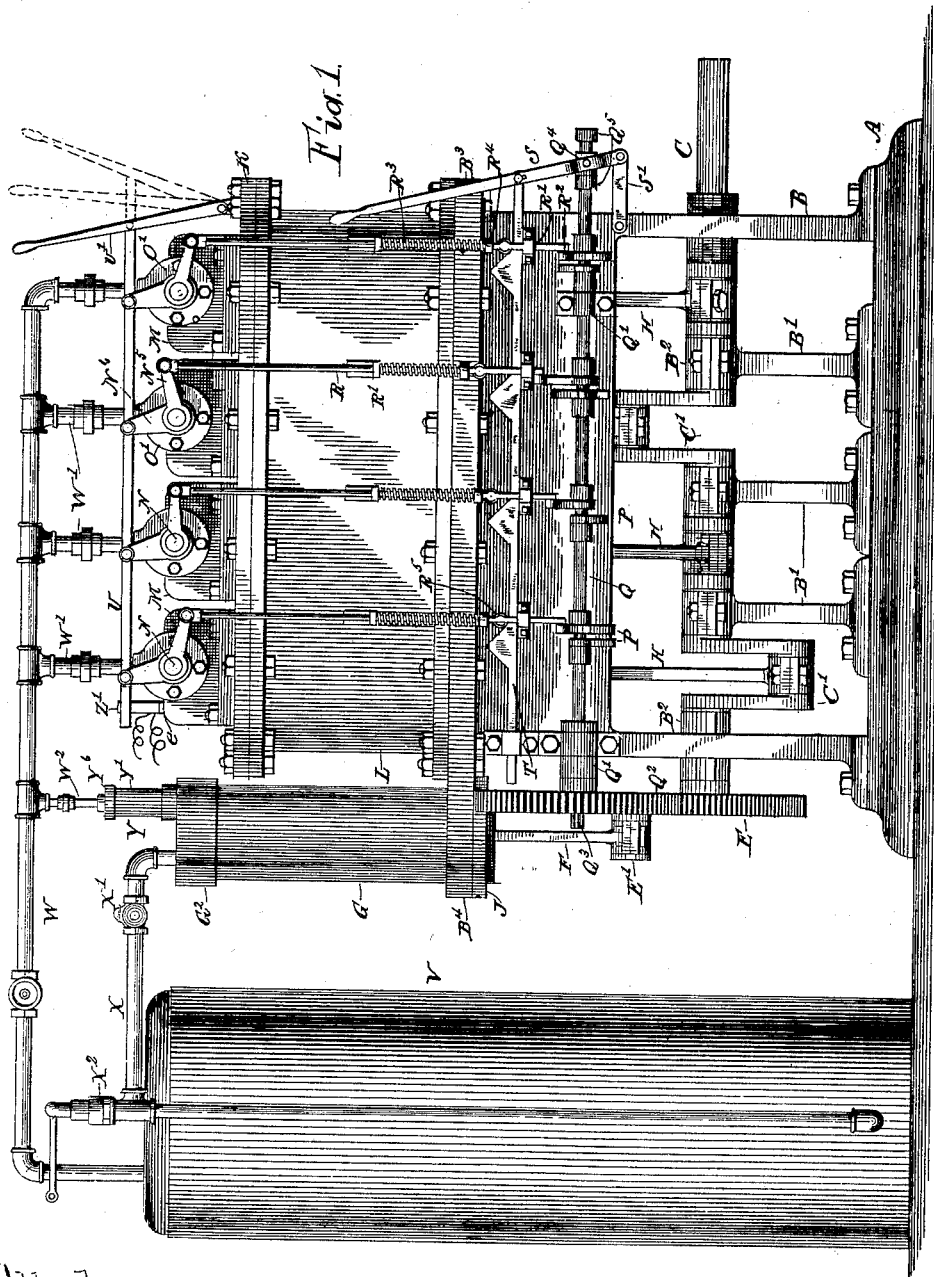
Patented Apr. 17, 1900.

C. A. SCOTT.
EXPLOSION ENGINE.

(No Model.)

(Application filed Aug. 1, 1899.)

3 Sheets—Sheet 1.



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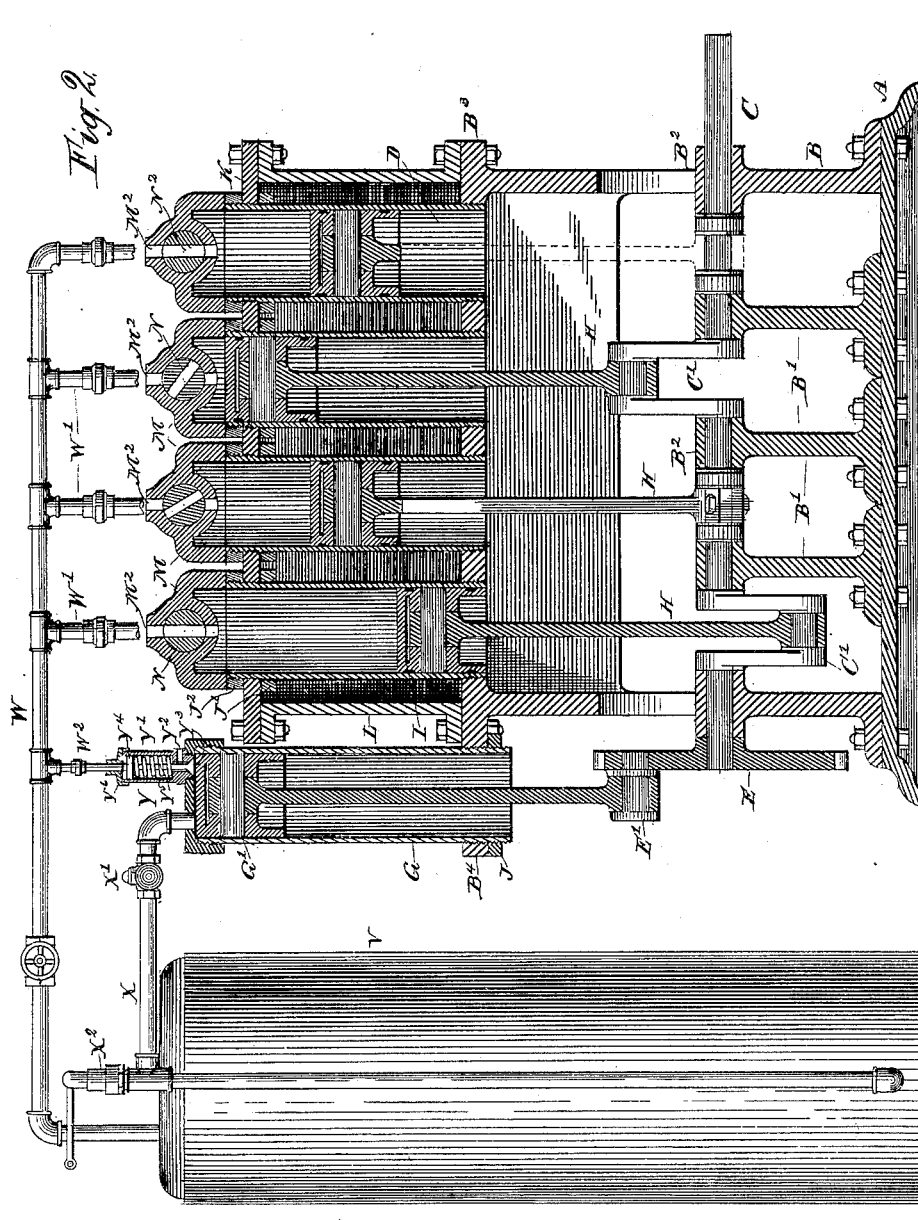
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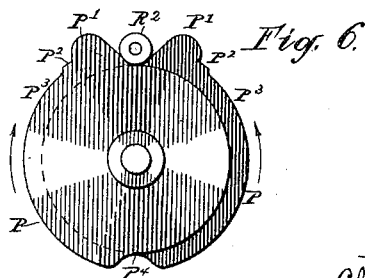
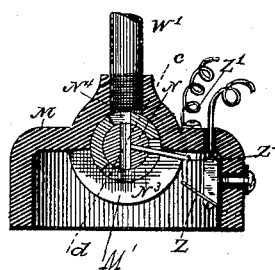
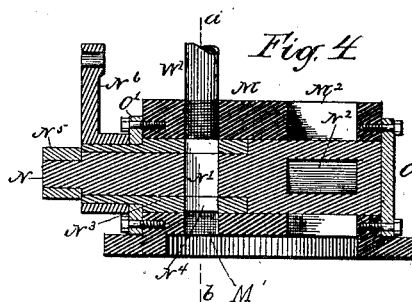
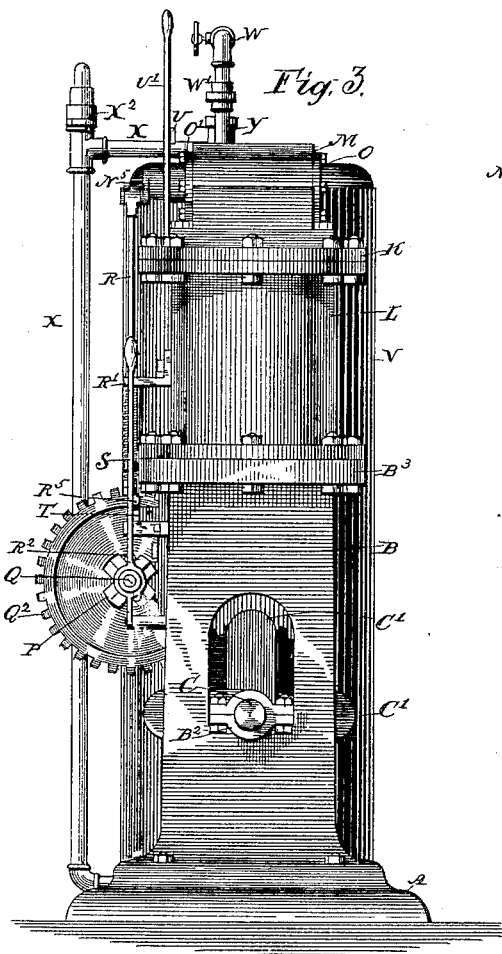
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UNITED STATES PATENT OFFICE.

CHARLES A. SCOTT, OF CEDAR RAPIDS, IOWA.

EXPLOSION-ENGINE.

SPECIFICATION forming part of Letters Patent No. 647,583, dated April 17, 1900.

Application filed August 1, 1899. Serial No. 725,772. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. SCOTT, a citizen of the United States, residing at Cedar Rapids, in the county of Linn and State of Iowa, have invented certain new and useful Improvements in Explosion-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.

This invention relates to engines actuated by gas, gasoline, or other explosive vapor, and has for its object to so construct engines of this class as to render them more perfectly automatic, especially in starting, and make them more convenient and efficient and more perfectly applicable to the propulsion of boats, street-cars, automobiles, and the like.

The nature of the improvements will fully appear in the description and claims following, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of an engine embodying my invention. Fig. 2, Sheet 2, is a vertical section of the same in the plane of the center of the crank-shaft. Fig. 3, Sheet 3, is an end elevation of the same as seen from the right of Fig. 1. Fig. 4 is a vertical section of one of the cylinder-heads central to the valve. Fig. 5 is a cross-section of the same in the line *ab* of Fig. 4. Fig. 6 is a plan view of a pair of the valve-actuating cams.

Similar letters of reference indicate corresponding parts.

On a suitable base A are mounted the main frame B and the intermediate bearings B', which are provided with boxes B² to take the crank-shaft C. This is provided with a number of cranks C' to correspond with the number of cylinders D, which are preferably four in number. At one end of the crank-shaft is a gear E, provided with a crank-pin E' to take a connecting-rod F, coupled at the upper end with the piston G' of an air-pump G. The other cranks connect by corresponding rods H with pistons I in the engine-cylinders D, as clearly shown in Fig. 2.

With a view to simplicity and economy in construction the cylinders for the engine and air-pump are made of sections of tubing threaded at both ends and at the lower ends screwed into corresponding threaded holes

in the flat top plate B³ of the main frame. By the use of a jam-nut J the position of any cylinder may be adjusted vertically, the connections to the top of such cylinder being of course made after such adjustment.

The upper ends of the engine-cylinders pass through holes in a flat plate K, registering with the holes in the top plate of the main frame. This plate K rests on jam-nuts J', and above it are other jam-nuts J², serving to make a tight firm joint. Between this plate and the top plate of the frame is secured an oblong drum L, which serves as a water-jacket for the engine-cylinders. The pump-cylinder, which needs no water-jacket, is mounted in a projecting portion B⁴ of the top plate, as shown.

The upper end of each engine-cylinder is closed by a head M, provided with inlet-port M' and exhaust-port M². Each head is also provided with a suitable valve to control the transmission of potential or unexploded and exhausted gas, an oscillating valve for this purpose being illustrated. This consists of a plug N, having ports N' and N² registering with the inlet and exhaust ports in the head, respectively. It is to be observed, however, that these ports pass through the plug in planes oblique to each other, as indicated in Fig. 4, so as to register with the ports in the head at different times in the oscillation of the valve. The inlet end of the plug is reduced in size, and around this portion is mounted a sleeve N³, provided with a corresponding port N⁴. The outer diameter of the sleeve corresponds to the larger diameter of the plug. The hole for the valve in the head is closed at one end by a head-plate O, serving as an abutment for that end of the valve, and both the valve and sleeve are held in proper position by a ring O', fitting a reduced part of the sleeve and secured to the opposite side of the head. To the extreme outer end of the valve is attached an arm N⁵, by which it is oscillated. A similar arm N⁶ connects with the sleeve, which thereby serves as a throttle and for regulating the charge.

A positive intermittent oscillation is imparted to the valves by a series of cams P on a shaft Q, journaled in bearings Q' and provided at one end with a gear Q² of the same size as and meshing with the crank-gear E.

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Motion is transmitted from these cams to the valve-arms through the medium of connecting-rods R, sliding in guides R' and at the lower ends provided with travelers R².
5 Springs R³, mounted on these rods between the upper guides and collars R⁴, serve to actuate the valves in the opposite direction, the cams moving them only in one direction. The shape of the cams is only suggested in
10 Figs. 2 and 3; but the same is shown in detail in Fig. 6. As the projection P' passes under the traveler R² the valve is opened to admit gas to the cylinder, closing as the traveler reaches the point P². After a momentary
15 rest it drops to the point P³, when ignition takes place by the closing and breaking of an electric circuit, as will be more fully hereinafter described. When the full expansive force of the exploded gas has been utilized, the
20 exhaust-port is opened by a still further descent of the traveler (and consequent oscillation of the valve) to the point P⁴. The exhaust remains open about a half-revolution or until the piston reaches the upper end of
25 the cylinder and begins slightly to descend.

It is evident that by simply reversing the cams the motion of the engine will be reversed. Provision is therefore made for accomplishing this, and consists in supplying
30 the cam-shaft with two sets of cams placed in pairs near each other and oppositely arranged, as clearly shown in Figs. 2 and 6, the direction of movement being indicated in Fig. 6 by adjacent arrows. In order to bring
35 either series of cams into engagement with the respective travelers, the cam-shaft is arranged to slide endwise, engaging the gear Q² by a spline Q³. At the other end of the shaft is a sleeve Q⁴ between two collars Q⁵ and
40 connecting with a hand-lever S, fulcrumed on a link S'. This lever also connects with a multiplex cam-bar T, the cams of which are adapted to engage rollers R⁵ and simultaneously lift all the connecting-rods R out of
45 the path of either cam. It will be seen that the separation of the collars Q⁵ allows the cam-bar to move about half its stroke before the cam-shaft moves at all, thereby lifting the connecting-rods to the highest point just
50 as the alternate series of cams pass under the travelers.

The arms of the throttles all connect with a bar U, and this at one end with a lever U', by which the charge may be regulated or entirely cut off at will. This engine being
55 designed more especially for the propulsion of vehicles and the like, no means for automatic regulation have been shown, such devices being unnecessary in engines for such purposes.
60 It is evident, however, that the throttling device, in connection with the valve, may be applied to stationary engines, suitable governing apparatus being provided to actuate the throttle according to the load.

65 Gas for the operation of the engine is supplied to the cylinders in a compressed state from a receiver V through suitable pipes W

and W', leading to the respective cylinder-heads. This receiver is in the nature of a carbureter, being supplied with gasoline or
70 other suitable liquid hydrocarbon, through which air is forced under strong pressure by the pump above described. From the head G² of the air-pump a pipe X leads to the lower end of the receiver and is provided with a
75 check-valve X', and between it and the receiver a pop-valve X², adapted to blow off air at the maximum pressure.

Y is a relief-valve whereby the pumping of air is automatically stopped when the maximum pressure is reached. It comprises a
80 cylinder Y', having a vent at Y² and a valve Y³, to the stem of which is connected a piston Y⁴. Between the piston and the lower end of the cylinder is a spring Y⁵, tending to
85 seat the valve, but yielding when the gas-pressure above the piston is at the maximum. This counter-pressure is supplied by a branch pipe W², connecting with the cylinder-head Y⁶. The opening of this valve of course
90 relieves the pump from pumping air into the receiver, as it is free to pass out through the vent Y².

The electrical igniter is shown in Fig. 5. This comprises a flexible terminal Z, suitably
95 mounted and insulated inside the cylinder-head M, a terminal Z', connecting direct with the engine, as to the cylinder-head itself, and a pin Z², projecting from the valve N and adapted to make contact with the terminal
100 Z at the proper point in the oscillation of said valve. It will be observed that the under sides of the throttle-sleeve and the part of the head adjacent are cut away to allow for the movement of the pin.

In reading the drawings it is to be understood that the ports illustrated in Fig. 2 are the exhaust-ports. That Figs. 2 and 4 may not be inconsistent it may be assumed that the ports are wider than shown in Fig. 4 or
110 not exactly central, but such as to cut the ports. Referring to Fig. 2, the action of the engine will now be clearly understood. The engine-piston at the extreme left has received a
115 full impulse and the exhaust-port has just opened, to remain open during the whole ascent of the piston, as in the case of the one at the extreme right. The second piston from the left has also received its impulse from
120 the exploded gas and is using the same expansively. The third piston is at the extreme upper limit of its stroke and its inlet-valve is about to open. In short, there is an
125 impulse at each quarter, and as the gas is compressed in an auxiliary cylinder the full efficiency of each engine-piston is secured for a half-revolution of the crank-shaft or the equivalent of two engines with cranks set at right angles and taking an impulse at each
130 end of the cylinder. This construction makes it practicable to dispense with fly-wheels and the great extra weight incident thereto and renders the engine, by reason of its lightness

and compactness in form, peculiarly applicable to the uses hereinbefore mentioned. The compression of the gas outside the engine also renders the engine self-starting. In starting, the initial pressure only is utilized; but in the course of a single revolution the gas in one or more of the cylinders may be used explosively. In order to give proper efficiency to such initial pressure, it should be employed during a longer period than is required in admitting the charge for an explosion, so that this less powerful pressure may act on the piston when the crank is at the point of greatest leverage. To do this with safety, I provide for the temporary cutting out of the igniter, so that an explosion cannot take place when there is an abnormally-heavy charge of compressed gas in the cylinder or the port is open to the receiver. This is accomplished in a very simple manner by breaking the electrical circuit in the igniter.

Referring to Fig. 5, it will be seen that the port in the throttle-sleeve is considerably wider than that through the valve, which allows for the passage of gas through the throttle when thrown considerably farther than the valve. It will be understood that the engine is throttled by turning the throttle to the left, and it may be assumed that at the sparking-point the valve-port reaches the line *c d*. With the valve in that position and the throttle in the position shown the engine is throttled. Now by moving the throttle to the right far enough gas will be admitted to the cylinder; but before the throttle reaches the point of opening the circuit in the igniter is broken and there is no possibility of an explosion taking place. This may be effected in a very simple manner, as by insulating one terminal at *e* and having it contact with the bar *U* during the normal operation of the engine, but break said contact when the bar is thrown to the extreme position to the right, as indicated by the dotted lines in Fig. 1. In starting the engine the operator throws the lever clear over to the extreme right-hand position for a moment and then back to the intermediate normal position. Of course the engine could only run on compressed gas should he neglect to throw the lever back to normal position, but a momentary opening of the throttle is sufficient for starting, whereupon the engine performs its normal functions.

For traction purposes the engine above described possesses several distinct advantages over engines using the explosion-cylinders for compression. Much of the time, as in stopping or descending grades, the engine is not

required for service and the throttle is closed; but all this time the air-compressor is in active use, and not only performs the necessary function of compressing the gas, but this operation produces the useful effect of retarding the movement of the vehicle, whatever it may be. The compression so effected is at no cost whatever, and thus serves to increase the economical efficiency of the engine.

Having thus described my invention, I claim—

1. The combination with an explosion-engine having a vapor-compressor auxiliary to the explosion-cylinders, of a throttle to control the supply of said compressed vapor and isolate the contents of the cylinders from that of the compressor during explosion, an electrical igniter, and an electrical connection of said igniter with the throttle mechanism, whereby the electric circuit may be broken by throwing the throttle to an extreme position in opening, substantially as and for the purpose set forth.

2. In an engine of the class described, the combination of a gas-inlet valve, a connection thereof with an actuating-cam, a cam-shaft provided with duplicate, reversed cams, means for shifting said cam-shaft so as to bring either cam into engagement with the valve mechanism, and means for disengaging the cams from the valve mechanism while the cam-shaft is being shifted, substantially as described.

3. In a gas-engine, the described valve, comprising a cylindrical plug having inlet and exhaust ports therein a cylinder-head to receive the same, and provided with corresponding ports, a sleeve fitting a reduced portion of the valve at the inlet end, and provided with a port registering with said inlet-port, and arms connected with the valve and sleeve, substantially as and for the purposes set forth.

4. The combination of a cylinder-head having inlet and exhaust ports in substantially the same plane, an oscillating valve fitted therein, having inlet and exhaust ports in planes oblique to each other, a connection of said valve with a cam, and a rotary cam adapted to partially rotate the cam for the admission of vapor, move it a little farther to ignite the charge, and still farther to exhaust, substantially as set forth.

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

CHARLES A. SCOTT.

Witnesses:

CHAS. F. COOPER,
J. M. ST. JOHN.