(No Model.)

C. W. WEISS.

EXPLOSIVE ENGINE.

No. 543,163. Patented July 23, 1895.

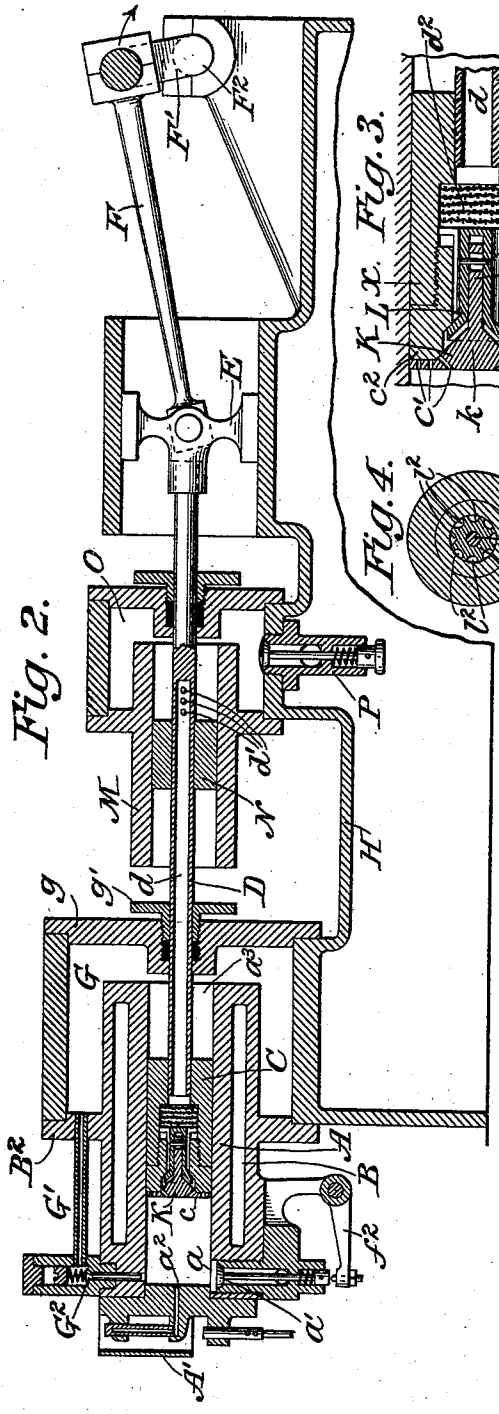

Fig. 2.

Fig. 3.

Fig. 4.

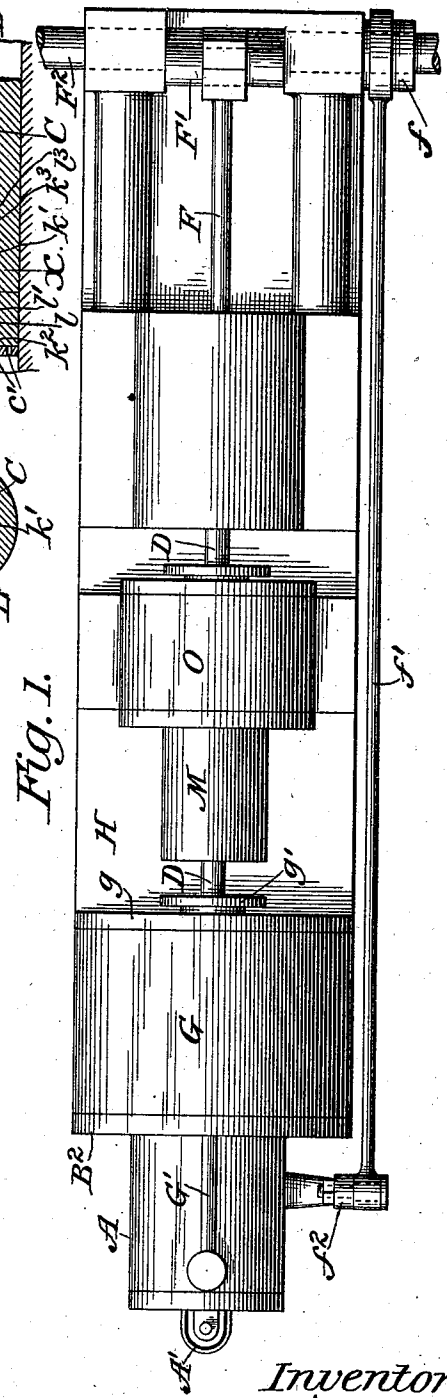

Fig. 1.

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UNITED STATES PATENT OFFICE.

CARL W. WEISS, OF BROOKLYN, ASSIGNOR TO HIMSELF, AND AUGUST MIETZ, OF NEW YORK, N. Y.

EXPLOSIVE ENGINE.

SPECIFICATION forming part of Letters Patent No. 543,163, dated July 23, 1895.

Application filed March 15, 1894. Serial No. 503,683. (No model.)

To all whom it may concern:

Be it known that I, CARL W. WEISS, of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Explosive Engines; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making a part of this specification.

This invention relates to the general class of gas-engines, and particularly to gas-engines, of that type in which the charge is compressed in the motor-cylinder before ignition. The increased efficiency of engines of this type over those in which there is no compression of the charge is well known, and theoretically the efficiency should increase with increased compression. It has been generally held, however, that the practical limit in this direction has been reached because, with the increase in bulk and weight of parts supposed to be required by the greater strains attending increase of compression, the friction of the moving parts and consequently the negative work of the engine increase more rapidly than the efficiency. On the other hand, investigation has shown that it might be possible to prevent the relatively rapid increase of negative work above alluded to and thereby to obtain, in part at least, the theoretical advantage due to an increase of compression. In the present engine the forward movement of the piston is made against the resistance of an elastic medium which is interposed between the piston or some part connected therewith and a suitable rigid and unyielding abutment whereby the strains upon the moving parts, such as the thrust upon the crank and the friction on the cross-head or slide are relieved, and the energy which is stored in the medium by the forward stroke of the piston is imparted again to the piston on its return stroke. The desired effect is most conveniently and effectively secured by maintaining a constant fluid pressure, above atmospheric pressure against the front side of the piston, for which purpose the front end of the motor-cylinder is formed with or communicates with a closed chamber filled with gas or air. The pressure within the chamber is practically constant (assuming the piston to be at rest) and the best results will be obtained when it is somewhat greater than the pressure upon the compressed charge. A further important result is secured by causing the pressure to be exerted upon the front end of the piston within the cylinder, in that the tendency to leakage between the piston and the walls of the cylinder is reduced to an extent corresponding to the degree of the pressure in the front end of the cylinder.

In order that the attempt to embody the principles above referred to in a practical construction might be carried to a successful issue, various improvements have been devised in relation to the means for introducing the fresh charge of the explosive mixture, which have been improved in such a manner as to effect the discharge of the dead gases more thoroughly than has been possible heretofore and with less admixture thereof with the fresh charge, and in relation to other features of construction and operation.

In the accompanying drawings, Figure 1 is a plan view of an explosive engine adapted for the practice of my invention and embodying its mechanical features in an approved form, the crank-shaft of the machine being broken off. Fig. 2 is a vertical longitudinal section through the parts shown in Fig. 1. Fig. 3 is an enlarged longitudinal section through the piston. Fig. 4 is a cross-section of the same.

In the engine represented in the drawings the motor-cylinder A is provided as usual with a water-jacket B and receives a trunk-piston C. To the latter is secured a piston-rod D, which at its outer end is supported and guided by a slide E, and is connected by a link F to the crank F′ of the shaft F^2. The cylinder A is provided with a port *a*, through which the dead gases may be expelled, the port being controlled by a valve *a*′, which is actuated at the proper time to open the port by a cam or eccentric *f* on the shaft F^2 through a rod *f*′ and bell-crank f^2. The motor-cylinder is also provided with a suitable igniting device A′, the ignition of the charge being effected through a port a^2. All of the parts above referred to are well known and may be of any usual or preferred construction. The opera-

tion of the engine itself also, so far as the parts referred to are concerned, is substantially the same as in other engines of this type, the explosive mixture being introduced into the motor-cylinder as the crank passes the dead-center, (and in this case through the piston itself,) being compressed during the return movement of the piston after the dead gases are expelled, and being ignited at the instant of greatest compression.

As represented in Fig. 2, the front end of the motor-cylinder A is open, as at a^3, but the forward half of the cylinder is inclosed by a housing which forms a chamber G, communicating with the forward end of the cylinder. This chamber is most conveniently formed as a part of the main framing or bed-plate H, the one end of the chamber being closed by a flange B^2, which projects from the other wall of the water-jacket, and the other end being closed by a plate *g*, which is provided with a stuffing-box *g'* for the piston-rod D.

As noted above, I introduce the charge of explosive mixture through the piston itself, for the reason that the dead gases can thereby be more easily and effectually expelled from the cylinder. For this purpose the piston-rod D is formed with an axial bore *d*, which at one end is provided with ports, as at *d'*, for the introduction of the explosive mixture, and at the other end communicates with a port or ports in the piston. It is especially desirable that the fresh charge shall be introduced in such a manner as to cause as little mixture as possible of the same with the dead gases which already occupy the space behind the piston and are to be expelled. Accordingly I fix upon the end of the piston a plate *c*, having a series of perforations, as at *c'*, which communicate with the port in the piston and distribute the incoming gases uniformly throughout the cylinder without establishing such currents as would effect more or less mingling of the fresh charge with the dead gases. The port through the piston is closed by a valve which acts automatically in the usual manner. This valve is ordinarily liable to become choked with carbon occasionally, and as it is somewhat difficult of access considerable annoyance is caused thereby. I have largely overcome this difficulty by making the valve double, so that one part thereof is protected by the other, and will close tightly at the proper time, even if the other portion should be held open by a particle of carbon. As the port is closed tightly by the second part of the valve, although the first is held from its seat, no injury will be done, and the first part will usually clear itself speedily without requiring to be taken out and cleaned. The first part K of the double valve has a head *k* and a stem *k'*. The head *k* finds its seat at k^3. The second part L of the valve is tubular and fits snugly around the stem *k'* of the part K. Its outer end is flared, as at *l*, and finds its seat at *l'*, below or within the seat k^2. The cylindrical portion of the part L fits easily within the port in the piston, but is fluted or grooved exteriorly, as at l^2, to allow the free passage of the fresh charge into the cylinder when both parts L and K are lifted from their seats. The plate *c* might be secured to the end of the piston and form a guard to prevent the disarrangement of the valve, but it is preferably secured to the part K of the valve, and the stem *k'* of the latter is slotted to receive a pin k^3, which is fixed in the cylindrical portion of the part L, which in turn is held in place by lugs l^3. The latter co-operates with a shoulder, which is formed by an annulus c^2, which is screwed into the body of the piston C, and is itself formed with the seats for the double valve.

The fresh charge is forced through the piston-rod and through the piston under a pressure sufficient to expel the dead gases from the motor-cylinder, as is usual in engines of this description. Any suitable means may be employed for this purpose, and a convenient arrangement is represented in the drawings. Upon the bed-plate H, in line with the motor-cylinder A, is secured a charging or pump cylinder M, within which moves a piston N, secured to the piston-rod D. The end of the cylinder M communicates with a chamber O, which is provided with an automatic inlet-valve P. During the backward movement of the piston-rod the explosive mixture is drawn into the chamber O through the valve P, the valve K L being at that time closed, and during the forward movement of the piston-rod the mixture in the chamber O is compressed sufficiently to cause the proper quantity thereof to pass through the bore of the piston-rod and through the valve K L at the instant when the exhaust-port *a* is opened. The lighting back of the fresh gases into the chamber O is effectually prevented by placing sheets of wire-gauze d^2 or its equivalent between the port of the piston and the end of the hollow piston-rod.

I have herein referred to the chamber G as a closed chamber. It is closed so far as the escape of gases therefrom is concerned, having no outlet whatever except into the front end of the cylinder, of which it virtually forms a part. It may have, however, an inlet, which under certain conditions is operative to permit gas to enter the chamber, but when the engine is working normally has no function whatever. This inlet, which is indicated at G' and is represented as provided with an automatic valve G^2, permits the required pressure in the chamber G to be established by the first two or three explosions within the cylinder A, the valve G^2 closing as soon as the pressure within the cylinder falls, in order to prevent reduction of the pressure in the chamber G. The inlet G' is not essential in practice, however, for the reason that the pressure in the chamber G would in any case be established after a few more revolutions of the engine by the leakage between the piston and the cylinder-walls, which leakage will

continue in a greater or less degree until the mean pressure in said chamber is established. Thereafter the leakage will be inconsiderable, being reduced in proportion to the pressure within the chamber. It will be observed that the pressure in the chamber G remains substantially constant and that usually in degree it will be greater than the pressure under which the charge is compressed within the cylinder A, but less than the maximum pressure developed by the explosion. Under these conditions the gas within the chamber offers an elastic resistance to the forward movement of the piston and will thereby relieve the piston-rod and its connections to the crank-shaft of the excessive strain they would be otherwise subjected to at that time. Moreover, it receives and stores up a portion of the energy developed by the explosion and imparts it again to the piston on its rearward movement, whereby the crank-shaft receives two impulses in each rotation.

I claim as my invention—

1. In a gas engine, the combination of a motor cylinder, a second or pump cylinder in line with the first, pistons in said cylinders connected to move together and a conductor through which the charge is forced from the pressure chamber of the pump cylinder and is delivered into the motor cylinder through the motor piston, substantially as shown and described.

2. In a gas engine, the combination of a motor cylinder, a piston having a port therein, a hollow piston rod, a second cylinder in line with the first, a second piston fixed to said rod and adapted to move in said second cylinder, said hollow rod having inlet ports in advance of the second piston, and a chamber communicating with the forward end of the second cylinder and having an inwardly opening port, substantially as shown and described.

3. In a gas engine, the combination of a motor cylinder, a piston having a port therein, a chamber communicating with the inclosed space in front of the piston and tightly closed to prevent reduction of pressure by escape of its contents, a second cylinder in line with the first, a second piston connected to the first and adapted to move in said second cylinder, said pistons being connected by a conductor having inlet ports, and an inwardly opening valve to permit the admission of gas to said second cylinder, substantially as shown and described.

4. In a gas engine, the combination of a cylinder having an exhaust port at its rear end and having its forward end tightly closed, a hollow piston rod passed through the front end of said cylinder, a piston in said cylinder having an inlet port communicating with the hollow piston rod, a valve closing said port and opening toward the rear end of said cylinder, a perforated plate secured to the head of said valve and covering said piston, its perforations communicating with said port whereby the incoming charge is evenly distributed, and means to introduce the charge into the hollow piston rod, substantially as shown and described.

5. In a gas engine, the combination of a cylinder, a piston therein, said piston having a single port formed through it and said single port having two valve-seats formed in its walls, a valve plug adapted to rest upon the innermost seat and an independent valve plug having a stem entered in and guided by the first valve plug and adapted to rest upon the second valve-seat, both of said valve plugs opening in the same direction, substantially as shown and described.

6. In a gas engine, the combination of a cylinder, a piston therein, said piston having a single port formed through it and said single port having two seats formed in its walls, and a two-part valve in said port, one part independent of and covering the other, and opening in the same direction, and each part adapted to close said single port, substantially as shown and described.

7. The combination of a motor cylinder, a piston having a port therein, an independent pump cylinder, means to conduct the charge from the pump cylinder to the port in the piston, and wire gauze interposed between the port and the conductor to prevent lighting back, substantially as shown and described.

8. In a gas engine, the combination of a motor cylinder having at its end behind the piston an exhaust port for the burned gases, a tightly closed compression chamber communicating with the front end of said cylinder, and a pump cylinder communicating with the space behind the motor piston for the delivery of the explosive charge thereto, whereby the fresh charge may be delivered under pressure to the motor cylinder without necessitating openings through the wall of the motor cylinder which would reduce by leakage the efficiency of the compression chamber substantially as shown and described.

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

CARL W. WEISS.

Witnesses:
A. N. JESBERA,
A. WIDDER.