W. K. HOLZMUELLER.

EXPLOSION ENGINE.

APPLICATION FILED MAY 16, 1910.

988,344.

Patented Apr. 4, 1911.

2 SHEETS—SHEET 1.

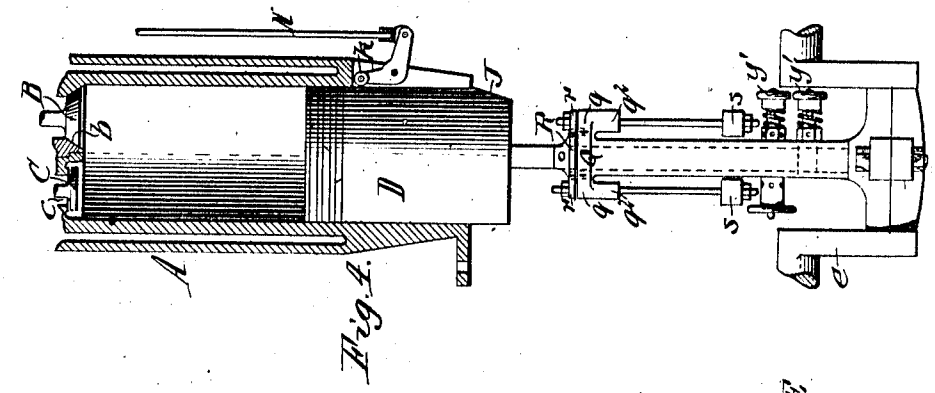

Fig. 4.

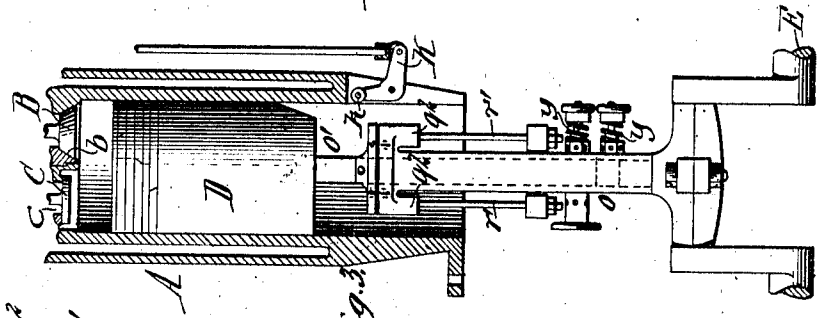

Fig. 3.

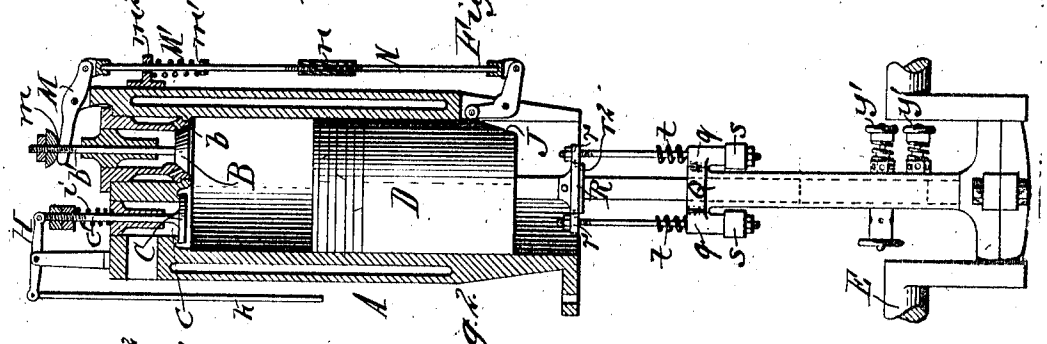

Fig. 6.

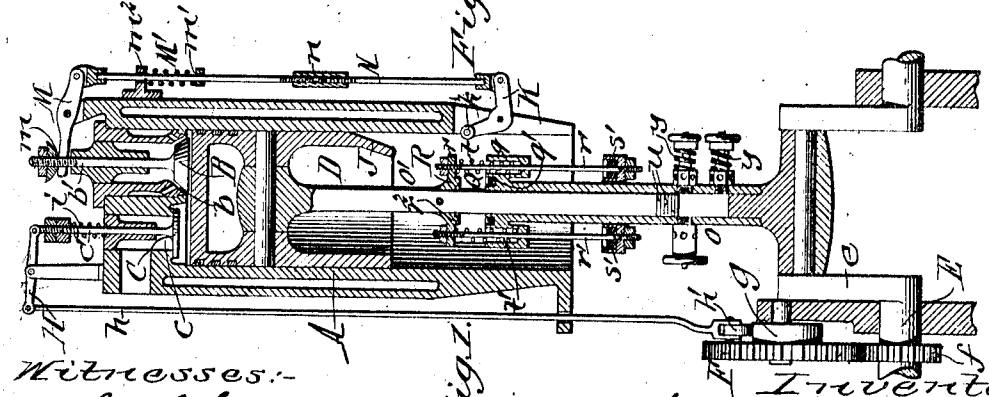

Fig. 7.

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2 SHEETS—SHEET 2.

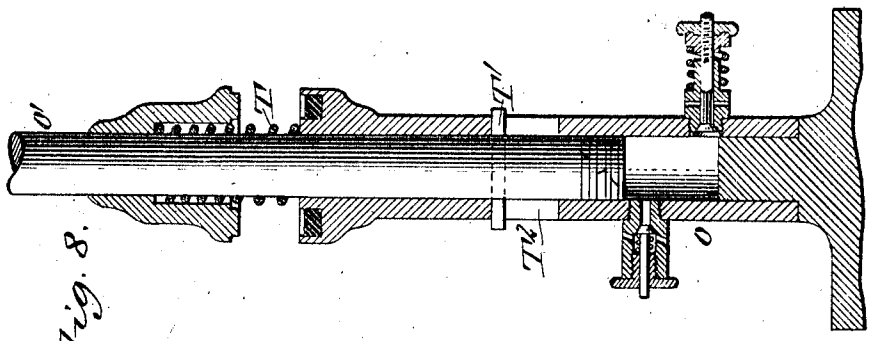

Fig. 8.

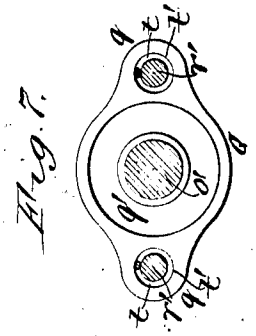

Fig. 7.

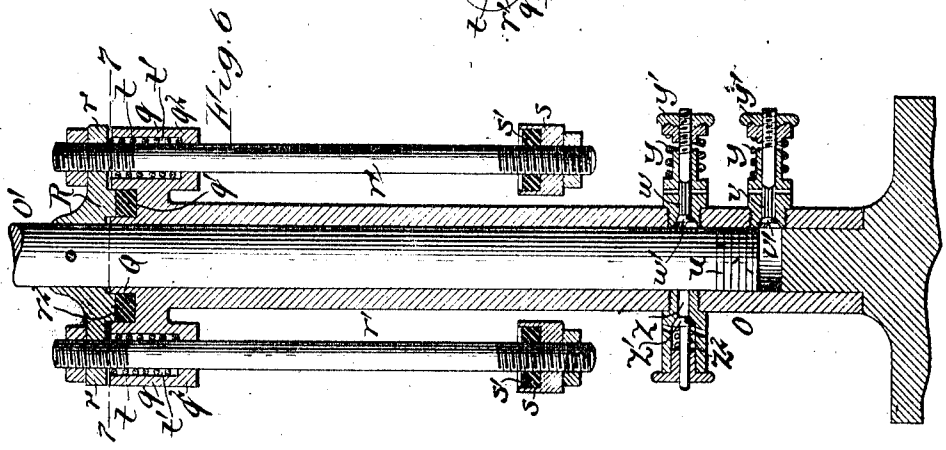

Fig. 6.

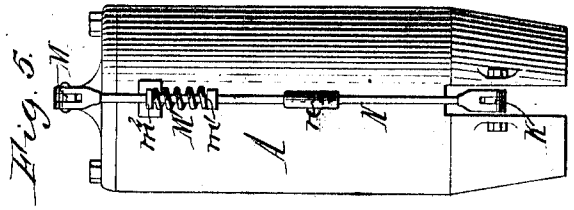

Fig. 5.

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UNITED STATES PATENT OFFICE.

WALTER K. HOLZMUELLER, OF BUFFALO, NEW YORK.

EXPLOSION-ENGINE.

988,344. Specification of Letters Patent. Patented Apr. 4, 1911.

Application filed May 16, 1910. Serial No. 561,522.

To all whom it may concern:

Be it known that I, WALTER K. HOLZMUELLER, a subject of the Emperor of Germany, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Explosion-Engines, of which the following is a specification.

This invention relates more particularly to four-stroke cycle explosion engines and has for its object the production of an engine of this type in which a greater expansion of the exploding fuel is obtained and a more thorough expulsion of the dead gases effected, thereby increasing the efficiency of the engine.

In the accompanying drawings consisting of 2 sheets: Figure 1 is a vertical longitudinal section of an upright explosion engine embodying my improvements, the parts being shown in the position which they occupy at the beginning of the suction stroke of the piston. Figs. 2, 3 and 4 are fragmentary views similar to Fig. 1 showing different positions of the parts during the operation of the engine. Fig. 5 is a side elevation of the working cylinder at right angles to Figs. 1–4. Fig. 6 is a fragmentary longitudinal section, on an enlarged scale, of the connecting rod and associated parts of the engine. Fig. 7 is a horizontal section in line 7—7, Fig. 6. Fig. 8 is a fragmentary longitudinal section showing a modified construction of the connecting rod embodying my invention.

Similar letters of reference indicate corresponding parts throughout the several views.

Although my invention is applicable to horizontal as well as vertical explosions, the same is shown in the accompanying drawings as embodied in a vertical engine.

A represents the upright working cylinder of the engine which is provided at its upper or rear end with an inlet port *b* for the fuel such as gas or gasolene and an outlet port *c* for the burned fuel. The inlet and outlet ports are controlled respectively by inlet and outlet valves B, C which close outwardly and open inwardly and are provided with upwardly projecting stems b^1, c^1 which are guided on the adjacent stationary part of the engine.

D represents the working piston which reciprocates lengthwise in the cylinder, and E the crank shaft provided with a crank *e* which is operatively connected with the piston.

Any suitable means may be employed for opening the exhaust or outlet valve during the exhaust stroke of the piston but closing the same during the suction, compression and explosion strokes of the same. The preferred means for effecting this operation of the outlet valve which are shown in Fig. 1 of the drawings comprise a counter shaft, a gear pinion *f* secured to the crank shaft and meshing with a gear wheel F on the counter shaft, a cam *g* turning with the counter shaft and gear wheel, a rock lever H pivoted on the cylinder and having its inner arm engaging with the outer end of the exhaust valve stem, a shifting rod *h* guided on the cylinder and having its upper end connected with the outer arm of the rock lever while its lower end is provided with a roller h^1 which engages with said cam *g*, and a spring *i* applied to the stem of the exhaust valve and operating to hold the latter yieldingly in its closed position.

The opening and closing of the inlet valve may be effected solely by the variation in pressure within and without the cylinder as the piston moves forward and backward when the engine is arranged horizontally but when the engine is arranged vertically the inlet valve is preferably closed positively at a predetermined part of its forward stroke by means preferably comprising an incline or cam J arranged at the front end of the piston, an elbow lever K pivoted on the cylinder and provided on its inner arm with a roller *k* which is adapted to be engaged by the cam J for turning the elbow lever K, a rock lever M pivoted on the cylinder and with its inner arm against a nut or shoulder *m* on the stem of the inlet valve, a connecting rod N connecting the outer arms of the rock lever M and elbow lever K and constructed in sections which are adjustably connected by a right and left threaded sleeve *n* and a spring. The inlet valve may be yieldingly held in its closed position by means of a spring M^1 which is preferably applied to the rod N and bears at one end against a shoulder m^1 on the rod and at its other end against a bracket m^2 on the cylinder in which the rod N is guided.

The connection between the piston and crank of the crank shaft is so constructed as to cause the piston to move with a comparatively short stroke while drawing the

fuel into the cylinder and also while compressing the same but to cause the piston to move with a stroke of greater length while under pressure of the exploding charge of fuel and while expelling the spent or dead gases from the cylinder. The means for this purpose shown in Figs. 1–7 are constructed as follows: o, o^1 represent the front and rear sections of a divided pitman or connecting rod whereby the piston and crank are connected, said sections being slidable relatively to each other and connected respectively with the crank shaft and piston. The front section o is preferably constructed in the form of a tube or cylinder and is pivotally connected at its front end with the crank of the crank shaft. The rear section o^1 is pivotally connected at its rear end with the piston while its front end slides lengthwise in the rear end of the tubular front section o.

Q represents a buffer, head or collar arranged on the rear end of the front pitman section and R a similar buffer head or collar arranged on the rear pitman section in rear of the front buffer head Q. On its opposite sides the front buffer head is provided with laterally projecting buffer ears q, q and the rear buffer head is similarly provided on its opposite sides with laterally projecting buffer ears r, r arranged in line with the ears q, q.

r^1, r^1 represent a pair of draft rods arranged lengthwise on opposite sides of the pitman sections and connected at their rear ends with the ears r, r while their front parts slide through the ears q, q and are provided in front of the latter with buffer collars s, s.

On the front side of the rear buffer head the same is provided with an annular rib r^2 which is adapted to engage with an annular cushion q^1 of leather or similar material seated in a correspondingly shaped groove on the rear side of the front buffer head. Each of the buffer ears q is provided on its front side with a forward projection q^2 which is adapted to engage with a cushion s^1 of leather or similar material seated in a pocket on the rear side of the corresponding buffer collar s.

t, t represent two expansion springs each surrounding one of the draft rods between the respective front and rear buffer ears and preferably seated at its front end in a pocket t^1 in the front buffer ear.

The operation of the parts of the engine thus far described is as follows: In Fig. 1 the parts are represented in the position which they occupy at the beginning of the suction stroke of the working piston, in which position the piston is arranged in its rearmost position, the crank of the crank shaft is arranged in its rearmost position and nearest the cylinder, the pitman sections are drawn apart, the front buffer head and ears are out of engagement with the rear buffer head and front collars and the expansion springs t are compressed between the rear and front buffer ears. As the crank turns forwardly to its foremost position the same first moves idly together with the front pitman section independently of the piston and rear pitman section until the front buffer ears q, q have engaged with the buffer collars s, s after which the piston and rear pitman section are compelled to move with the crank and front pitman section to the end of the forward movement of the crank, as shown in Fig. 2. During this movement of the piston the fuel valve is opened and admits a charge of fuel into the cylinder. During the first part of the subsequent backward movement of the crank the same together with the front pitman section moves independently of the rear pitman section and piston until the front buffer head engages the rear buffer head after which these parts move together to the end of the rearward stroke of the crank, as shown in Fig. 3, thereby leaving a clear space in the rear end of the cylinder in which the charge of fuel is compressed. While the pitman sections are thus moved upon each other the pitman is shortened and the springs t, t are compressed. Upon now igniting the charge of compressed fuel by any suitable means the pressure of the exploding gases in the cylinder drives the piston forward with a working stroke together with the front and rear pitman sections and crank to the end of the forward stroke, as shown in Fig. 4. During the subsequent backward stroke of the piston, the exhaust valve is opened to permit the products of combustion to escape and at this time the piston, front and rear pitman sections and crank move in unison to the end of the rearward stroke of the piston, to the position shown in Fig. 3, thereby expelling the main part of the spent gases. When, however, the crank at this time reaches the end of its backward movement the piston and rear pitman section continue their rearward movement under the action of the springs t, t until the piston reaches the rear end of the cylinder, as shown in Fig. 1, thereby lengthening the pitman section and causing the piston to expel the remainder of the burned gases and entirely clear the cylinder of burned gas preparatory to drawing in a fresh charge of fuel during the next forward stroke of the piston. The piston is prevented from striking the rear end of the cylinder during the exhaust stroke by properly proportioning the tension of the springs t, t so that they only continue to move the piston rearwardly beyond the rearward throw of the crank to cause the piston to stop short of the rear end of the cylinder. When the pitman sections are pushed together the fullest extent undue jarring at

the end of this movement is avoided by engagement of the rib on the rear buffer head with the cushion on the front buffer head and when the pitman sections are drawn apart the fullest extent undue jarring is prevented by engagement of the front buffer ears with the cushions on the buffer collars.

When the machine is arranged horizontally the piston owing to the frictional contact between the same and the cylinder, will remain at rest until the front buffer ears engage with the buffer collars after which the piston moves with the crank to the end of its forward stroke. But when the engine is working in an upright position the piston owing to its weight would, in the absence of any provision to prevent it, be liable to drop by gravity and follow the crank in its forward stroke an undue extent and thus draw into the cylinder an excess charge of fuel. This, however, is prevented by engagement of the cam J with the roller of the lever K and closing of the inlet valve when the piston has moved forward sufficient to draw into the cylinder the proper charge of fuel, as shown in Fig. 2, thereby arresting the further forward movement of the piston under the action of gravity owing to the tendency to produce a vacuum in the cylinder and preventing the same from following the crank at this time to the end of its forward stroke.

Sudden pulling apart and pushing together of the pitman sections is retarded or prevented so as to cause the machine to operate with no perceptible noise or pounding. This is preferably effected by utilizing the tubular front pitman section as the cylinder and the rear pitman section as the piston of a dash pot or air cushion. On the periphery of the front end of the rear connecting rod section the same is provided with one or more packing rings u which produce a tight joint between the coöperating ends of the front and rear connecting rod sections the same as commonly done between the working cylinder and piston of a gas engine. At the lower or front end—the air cylinder within the front pitman section is provided with a main air inlet port v which is controlled by an outwardly closing check valve v^1 and in rear of the main port v the front pitman section is provided with an auxiliary air inlet port w which is controlled by an outwardly closing check valve w^1. Each of the inlet check valves v^1, w^1 is yieldingly held in its closed position by a spring y bearing against an adjustable screw nut y^1 on the stem of each of these valves.

In line with the auxiliary inlet check valve or nearly so the front pitman section is provided with an air outlet port z which is controlled by an outwardly opening check valve z^1 which is yieldingly held in its closed position by a spring z^2. Upon pushing the pitman sections together the air escapes freely through the port z and the sections move easily until the rear pitman section covers the port after which the air trapped in the front end of the front pitman section offers a greater resistance to the collapsing movement of the pitman sections and causes the end of this movement to be effected slowly and quietly.

When the rear pitman section is pulled out of the front pitman section during the last part of the exhaust stroke of the piston by the springs t,—the main air inlet port v is uncovered and considerable resistance is offered to the separation of the pitman sections, so that the piston will not strike hard against the rear end of the cylinder. But when the pitman sections are separated fully during the last part of the suction stroke of the piston the auxiliary air inlet port w is also uncovered, so that air can enter through both ports v and w and thus reduce the resistance and permit the pitman sections to separate freely and prevent the crank from dragging the piston along to the end of the suction stroke of the crank. It will thus be noted that in the operation of this engine a charge of fuel is drawn into the same which only partially fills the cylinder but that this charge when ignited is permitted to expand approximately twice as much as the volume of the charge, thereby developing a greater amount of power from a given quantity of fuel. Furthermore, all the burned products are completely removed from the cylinder after each explosion, thereby avoiding contamination of the new charge of fuel and enabling the maximum power to be derived from the fuel.

In the modified construction shown in Fig. 8, the separation of the pitman sections is aided by a spring T surrounding the rear pitman section and bearing at its opposite ends against the front and rear buffer heads while the separation is limited by a transverse pin T^1 secured to the rear pitman section and adapted to engage with the rear ends of slots T^2 in the front pitman section. In this construction the auxiliary inlet port w and check valve w^1 are omitted.

I claim as my invention:

1. An explosion engine comprising a cylinder, a piston in the cylinder, a shaft having a crank, a pitman having sections connected respectively with the cylinder and crank, one of said sections having the form of a retarding cylinder and the other the form of a piston fitting into said retarding cylinder, and means for controlling the admission and escape of the air from the closed end of said retarding cylinder.

2. An explosion engine comprising a cylinder, a piston in the cylinder, a shaft having a crank, a pitman having sections con-

nected respectively with the cylinder and crank one of said sections having the form of a retarding cylinder and the other the form of a piston fitting into said retarding cylinder, and means for controlling the admission and escape of the air from the closed end of said retarding cylinder comprising an air inlet check valve arranged at the front end of said retarding cylinder and an air outlet check valve arranged on the retarding cylinder in rear of the air inlet check valve.

3. An explosion engine comprising a cylinder, a piston in the cylinder, a shaft having a crank, a pitman having sections connected respectively with the cylinder and crank, one of said sections having the form of a retarding cylinder and the other the form of a piston fitting into said retarding cylinder, and means for controlling the admission and escape of the air from the closed end of said retarding cylinder comprising a main air inlet check valve arranged at the front end of said retarding cylinder, an auxiliary air inlet check valve connected with the retarding cylinder in rear of the main air inlet check valve, and an air outlet check valve connected with the retarding cylinder in rear of the main air inlet check valve.

4. An explosion engine comprising a working cylinder, a working piston in the cylinder, a shaft having a crank, a pitman having a front cylinder section pivoted on the crank, and a piston section pivoted on the working piston and sliding lengthwise in the cylinder section, front and rear buffer heads arranged on the cylinder and piston sections, respectively, of the pitman and each provided with laterally projecting buffer ears, and draft rods arranged lengthwise of the pitman sections and each connected at one end with an ear of one section and provided with a collar adapted to bear against an ear of the other section.

5. An explosion engine comprising a working cylinder, a working piston in the cylinder, a shaft having a crank, a pitman having a front cylinder section pivoted on the crank and a piston section pivoted on the working piston and sliding lengthwise in the cylinder section, front and rear buffer heads arranged on the cylinder and piston sections, respectively, of the pitman and each provided with laterally projecting buffer ears, draft rods arranged lengthwise of the pitman sections and each connected at one end with an ear of one section and provided with a collar adapted to bear against an ear of the other section, and a spring interposed between the pitman sections.

6. An explosion engine comprising a working cylinder, a working piston in the cylinder, a shaft having a crank, a pitman having a front cylinder section pivoted on the crank, and a piston section pivoted on the working piston and sliding lengthwise in the cylinder section, front and rear buffer heads arranged on the cylinder and piston sections respectively of the pitman and each provided with laterally projecting buffer ears, draft rods arranged lengthwise of the pitman sections and each connected at one end with an ear on the piston section and sliding through an ear on the cylinder section and provided in front of the last mentioned ear with a buffer collar, and springs each surrounding a draft rod between the corresponding buffer ears of the pitman sections.

7. An explosion engine comprising a working cylinder, a working piston in the cylinder, a shaft having a crank, a pitman having a front cylinder section pivoted on the crank, and a piston section pivoted on the working piston and sliding lengthwise in the cylinder section, front and rear buffer heads arranged on the cylinder and piston sections respectively of the pitman and each provided with laterally projecting buffer ears, and draft rods arranged lengthwise of the pitman sections and each connected at one end with an ear of one section and provided with a collar adapted to bear against an ear of the other section comprising a cam on the piston, a rock lever adapted to be shifted by said cam, a rock lever connected with the inlet valve, and a connection between said rock levers.

Witness my hand this 10th day of May, 1910.

WALTER K. HOLZMUELLER.

Witnesses:
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ANNA HEIGIS.