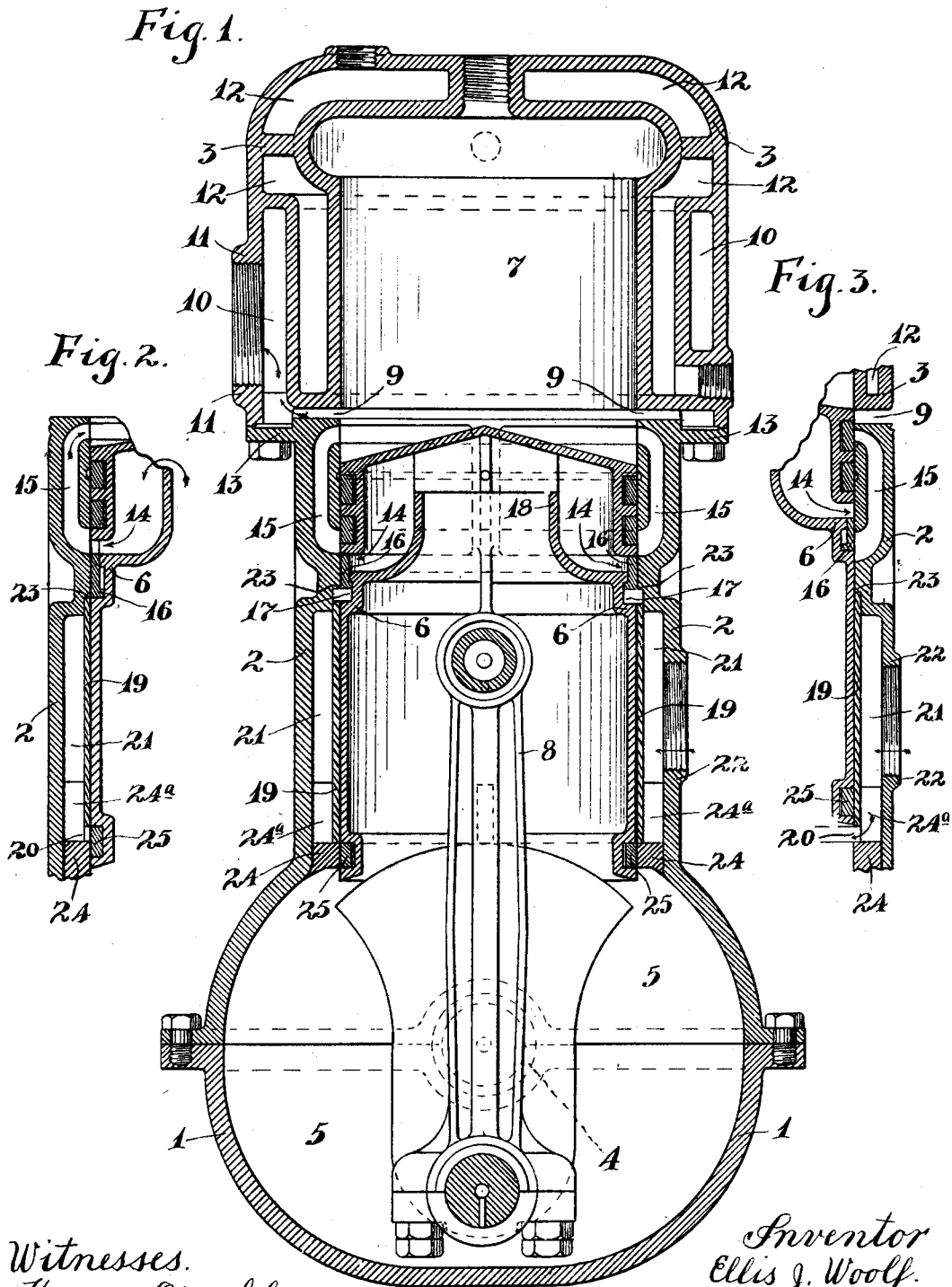


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TWO-CYCLE EXPLOSIVE ENGINE.
APPLICATION FILED OCT. 28, 1908.

1,075,889.

Patented Oct. 14, 1913.



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TWO-CYCLE EXPLOSIVE-ENGINE.

1,075,889.

Specification of Letters Patent.

Patented Oct. 14, 1913.

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To all whom it may concern:

Be it known that I, ELLIS J. WOOLF, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Two-Cycle 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 has for its object to provide an efficient two-cycle explosive engine of simple structure.

To this end, my invention consists of the novel devices and combinations of devices hereinafter described and pointed out in the claims.

The invention is illustrated in the accompanying drawings, wherein like notations refer to like parts throughout the several views.

In said drawings, Figure 1 is a vertical central section through the engine taken crosswise of the crank shaft, with the piston at its lowermost limit of travel. Fig. 2 is a sectional view through a portion of the casting and piston in the same plane as shown in the main view Fig. 1, but with the piston and other parts controlled thereby in the position which they would occupy when the transfer ports are wide open; and Fig. 3 is a view similar to that shown in Fig. 2, but with the piston and the parts controlled thereby in the position which they would occupy when the transfer ports are closed and the intake port is wide open.

A base casting 1, intermediate or main casting 2 and a top casting 3 are rigidly secured together with suitable packed joints. The castings 1 and 2 are of such form that, when properly joined together, they support and inclose a crank shaft 4 and afford a crank shaft compression chamber 5 surrounding the same. In practice, the crank shaft 4 would, of course, be provided with a suitable fly-wheel, not shown. The castings 2 and 3 are of the proper form to cooperate with each other to afford the cylinder in which the piston 6 is mounted to work. The piston 6 is of trunk-like form with a closed head which separates the explosion section or chamber 7 of the cylinder from the crank shaft compression cham-

ber 5; and this piston 6 has its hollow portion or trunk opening directly to the crank shaft compression chamber and cooperates therewith to afford a space into which the explosive mixture is first received and compressed, to a certain extent, before being passed through the transfer ports to the explosion cylinder. The piston 6 is connected by a rod 8 to the crank of the crank shaft 4, and this crank is counterbalanced in the customary way.

The castings 2 and 3 are so formed that when joined together at their parting flanges, they afford between the two sections of the explosion cylinder walls an exhaust port 9 which completely encircles said cylinder and leads to a large exhaust chamber 10 formed in the casting 3 and provided with a nipple 11 for attaching the customary exhaust pipe, not shown. This top casting 3 is also of the proper form to afford the customary water-jacket space 12 surrounding the inner and top walls of the exhaust chamber 10. The two castings 2 and 3 are of such construction that they meet or unite with male and female joints with the parts so arranged that the parting flange 13 of the casting 2 is located below the level of the exhaust port 9, for a purpose which will later appear.

The piston 3 has in its sides a transfer port 14, which is a complete circle with the exception of the bridges therein. The casting 2 has, at its upper end portion, a transfer port 15 which is also a complete circle with the exception of the bridges therein which support the adjacent inner wall of the explosion cylinder. Between the piston 6 and the inner wall of the explosion cylinder is located a ring valve 16 which controls the said cooperating transfer ports 14 and 15. This ring valve 16 is so mounted that it bears tightly against the adjacent cylinder wall and so that the piston will move through said ring valve, for a limited distance, and then pick up and carry the valve therewith during the remainder of its travel in both directions. For this purpose, said ring valve 16 is preferably a split ring which will tightly hug the cylinder wall under its own tension; and, as shown, said valve 16 is of L-shape in cross section with the horizontal flange thereof extending inward and working freely in an annular recess or groove 17 formed in the piston 6, with the

proper clearance for the required free movement of the said piston through the said valve. The parts 14, 16 and 17 are so proportioned, relative to each other, that the upper end of the valve 16 will seat against the upper wall of said port 14 of the piston coincidentally with the seating of the horizontal flange of said valve against the upper wall of the annular groove or recess 17, as shown in Fig. 1 of the drawings. In the hollow piston 6 is located a deflector 18 directly inward of the transfer port 14 and extending upward some distance toward the piston head.

The parts so far described are substantially the same as those disclosed in my pending application S. N. 412,772, filed January 27th, 1908, with the exception of the location of the exhaust chamber 10; and, for the purposes of this case, it is not deemed necessary to trace in detail the action of the ring valve 16 for controlling the transfer ports 14 and 15, as this matter was fully traced in the said earlier filed case. Attention will now be directed to the parts which are new, in this case.

The numeral 19 represents a shell or sleeve adapted to fit the trunk portion of the piston 6 and mounted for a limited sliding motion therewith, for coöperation with said piston to control the intake port 20 leading to the crank shaft compression chamber 5. Said shell 19 also coöperates with the adjacent portion of the casing 2 to afford between the said parts a mixture chest or chamber 21 provided with a nipple 22 adapted to be tapped by a supply pipe from any suitable vaporizer. The limit of the travel of the sleeve or shell 19 with the piston 6 is determined by abutment shoulders or ledges formed in or secured to the casing 2. As shown, the upper abutment shoulder 23 is formed in the casting itself. The lower abutment is formed by an annular ledge 24 adapted to be driven to its proper working position within the casing 2, or to be otherwise secured thereto in proper working position, in any suitable way. When the ledge 24 is thus located, it underlies the lower end of the shell or sleeve 19 and becomes the lower stop or abutment for the same, and also constitutes the lower wall to the mixture chamber 21. The ledge casting 24 is provided with vertical ribs 24^a which serve as guides to the lower end of the shell or sleeve 19. The inner wall of the annular ledge 24 aligns with the inner wall of the shell 19, and both thereof may be said to form portions of the cylinder walls for the piston 6. In the lower end of the trunk portion of the piston 6 is seated a packing ring 25 which coöperates with the shell or sleeve 19 for the control of the intake port 20. This packing ring 25 is preferably a split ring which, by its tension,

will hug the cylinder walls with which it comes in contact, including the parts 19 and 24.

It has already been noted that the upper parting flange 13 of the casting 2 is located below the level of the exhaust port 9. The purpose of so locating this flange 13 is to permit a little water to be admitted to the exhaust chamber at this point from the overflow out of the water jacket space 12, or other source, if this should be deemed desirable for any purpose. Inasmuch as the ledge 13 is below the level of the exhaust port 9, water so admitted will not flow by gravity into the explosion cylinder, but will be carried out by the exhaust either in the form of water or steam. It will, of course, be understood that the explosion cylinder will be fitted with the customary sparking plug, and the water jacket 12 with the customary circulating pipes.

Having regard now to the action of the new parts marked with the numerals 19 to 25, inclusive, it may first be noted that the mixture chest or chamber 21 completely encircles the shell or sleeve 19, and that the intake port 20 is therefore also a complete circle, entirely surrounding the trunk portion of the piston 6. The positions of the upper abutment or stop shoulder 23 and the lower abutment or ledge 24, relative to the length of the shell or sleeve 19, are such as to permit the limited movement of the shell or sleeve 19 with the piston 6 required to secure the desired actions therefrom; and the packing ring 25 is so located in the trunk of the piston 6 and is of such height as to coöperate with the shell or sleeve 19 to close the intake port 20 until after the mixture compressed in the chamber 5 has been transferred through the ports 14 and 15 to the explosion cylinder 7. The shell or sleeve 19 is of such length, with reference to the stroke of the piston 6, that the packing ring 25 will coöperate therewith to move the same into its uppermost position and hold it there throughout substantially the whole of the piston's suction stroke, and will also coöperate with said shell to move the same into its lowermost or intake closed position and hold it there throughout substantially the whole travel of the piston while compressing the mixture within the base compression chamber and, at the same time, maintain a tight joint between the said parts.

Let it be assumed that a charge of explosive mixture has previously been drawn into the crank shaft chamber 5 and has been compressed, to the degree required, by the movement of the piston 6 downward into its extreme position, as shown in Fig. 1. Then, on the upward movement of the piston, the parts will be brought into the position shown in Fig. 2, at which time the transfer ports

14 and 15 will be in registration and wide open so as to permit the transfer of the mixture therethrough and into the explosion cylinder 7; and, during all this time and until the valve 16 is moved upward by the piston 6 far enough to close the transfer port 14, the intake port 20 to the crank shaft compression chamber 5 will be closed by the packing ring 25 and the lower end portion of the trunk of the piston. After the transfer ports 14 and 15 have been closed by the valve 16, then, under the continued upward movement of the piston 6, the intake port 20 will begin to open, and when the parts reach the position shown in Fig. 3, said intake port will be wide open, thus permitting the mixture to flow freely from the chest or chamber 21 to the crank shaft compression chamber 5. The action of the packing ring 25 on the shell or sleeve 19 insures the movement of said shell or sleeve by the piston. Whenever the shell 19 abuts against the shoulder 23, its upward movement is, of course, stopped, and thereafter the piston will move on upward through the said shell or sleeve 19 to the limit of the piston's travel, and, during this time, the shell or sleeve 19 will be held in its uppermost position by the frictional contact therewith of the packing ring 25 and the trunk of the piston, thus keeping the intake port 20 open as long as there is any suction action produced within the chamber 5 by the upward movement of the piston 6. Then as soon as the piston begins to move downward, under the effect of the explosion, it will carry with it the shell or sleeve 19 until the latter strikes the abutment ledge 24 and thereby closes the intake port 20; and then, thereafter, the piston will move on downward through the shell or sleeve 19 until the parts reach the position shown in Fig. 1, thus compressing the mixture within the crank shaft compression chamber 5 and the hollow piston 6, as required for making the next charge through the transfer ports 14 and 15 under the control of the ring valve 16. In this connection, it may be noted that almost instantly after the piston 6 begins to move downward, under the effect of the explosion, it will pick up the previously dropped valve 16 and carry the same therewith throughout the remainder of its downward travel, thus keeping the transfer port 14 of the piston closed throughout the major portion of the piston's explosion stroke, and at all times when the transfer port 15 in the cylinder wall is not closed by the body of the piston itself. Hence, two things follow, to-wit, the exploded charge cannot blow back through the transfer ports into the crank shaft compression chamber, and thus there can be no back explosions in that chamber; and, secondly, as soon as the intake port 20 is closed by the shell 19, under the initial downward

movement of the piston 6, the piston will begin to compress the mixture within the chamber 5.

From the foregoing, it will be seen that no spring seated or gravity seated valve is required to be lifted either to get the mixture into the compression chamber 5 or to get the same transferred through the ports 14 and 15 into the explosion cylinder 7. From this fact, and the further important fact that the available intake port 20 is so large, it may be said that there is practically never any time when a vacuum continues in the chamber 5. Otherwise stated, just as fast as the piston 6 increases the volume of the crank shaft compression chamber, by its upward movement, after the transfer of the previous charge has taken place, this available volume will be instantly occupied by the mixture flowing freely thereinto through the intake port 20. It may, therefore, be truly said that all the displacement made by the piston 6 on its upward movement after the previously compressed charge has been transferred, through the ports 14 and 15, to the explosion cylinder, becomes available for drawing into the base compression chamber mixture for the next charge through the intake port 20. Still otherwise stated, the intake port 20 is open for a longer time than where spring seated or gravity seated valves are employed, which must be lifted under the suction action of the piston; and, because of this fact a full charge equal to the displacement of the piston 6 becomes available without any waste of power by the engine. These advantages, in respect to the intake to the base compression chamber, taken together with the advantages due to the large transfer ports 14 and 15 controlled by the ring valve 16 fully set forth in my previously filed case, enable me to secure a two-cycle engine which is highly efficient. I can get an abundantly sufficient charge into the explosion cylinder when the engine is running at high speed. Put in still another way, I get an engine having all the advantages of the so-called three-ported two-cycle engine without any of the disadvantages due to the presence of the third port in that class of engines.

By actual usage, I have demonstrated that ring valves, like the valve 16, and seated in respect to the cylinder and piston as there shown, will effectively do the work and be free from noise.

What I claim is:—

1. In a two-cycle explosive engine having a crank shaft compression chamber, the combination with the cylinder and the piston, of a shell or sleeve fitting said piston and working in said cylinder with freedom for a limited movement of said sleeve in respect to said cylinder and of said piston in respect to said sleeve, and which sleeve coöperates with

the wall of said cylinder to afford a supply chest or chamber for the explosive mixture and which chest is opened to and cut off from said compression chamber by said sleeve as moved by said piston, substantially as described.

2. In a two-cycle explosive engine having a crank shaft compression chamber, the combination with the cylinder of a trunk piston opening to said compression chamber and a shell or sleeve fitting said trunk piston and working in said cylinder with freedom for a limited movement of said sleeve in respect to said cylinder and of said piston in respect to said sleeve, and which sleeve coöperates with the wall of said cylinder to afford a supply chest or chamber for the explosive mixture and which chest is opened to and cut off from said compression chamber by said sleeve as moved by said piston, substantially as described.

3. In a two-cycle explosive engine having a crank shaft compression chamber, the combination with the cylinder of a trunk piston opening to said compression chamber and a shell or sleeve fitting said trunk piston and working in said cylinder with freedom for a limited movement of said sleeve in respect to said cylinder and of said piston in respect to said sleeve, stops which determine the travel of said sleeve, and which sleeve coöperates with the wall of said cylinder to afford a supply chest or chamber for the explosive mixture and which chest is opened to and cut off from said compression chamber by said sleeve as moved by said piston and limited by said stops, substantially as described.

4. In a two-cycle explosive engine having a crank shaft compression chamber, the combination with the cylinder of a trunk piston opening to said compression chamber, a shell or sleeve fitting said trunk piston and working in said cylinder with freedom for a limited

movement of said sleeve in respect to said cylinder and of said piston in respect to said sleeve, stop ledges on said cylinder which determine the travel of said sleeve, a packing ring fitted to said piston adapted to have frictional engagement with the said sleeve for moving the sleeve with the piston within the limits determined by said stop ledges and which sleeve coöperate with the wall of said cylinder to afford a supply chest or chamber for the explosive mixture and which chest is opened to and cut off from said crank shaft compression chamber by said sleeve as moved by said piston, substantially as described.

5. In a two-cycle explosive engine having a crank shaft compression chamber, the combination with the cylinder of a trunk piston separating the explosion chamber from said compression chamber and opening to said compression chamber, coöperating transfer ports in the walls of said cylinder and in the sides of said piston, a ring valve mounted on said piston and controlling said transfer ports under motion imparted thereto by said piston, and a shell or sleeve fitting the trunk portion of said piston and working in said cylinder with freedom for a limited movement of said sleeve in respect to said cylinder and of said piston in respect to said sleeve, and which sleeve coöperates with the wall of said cylinder to afford a supply chest or chamber for the explosive mixture and which chest is opened to and cut off from said compression chamber by said sleeve as moved by said piston, substantially as described.

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

ELLIS J. WOOLF.

Witnesses:

H. D. KILGORE,
M. E. RONEY.