H. H. WIXON.

EXPLOSIVE ENGINE.

APPLICATION FILED MAR. 11, 1907.

947,566. Patented Jan. 25, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

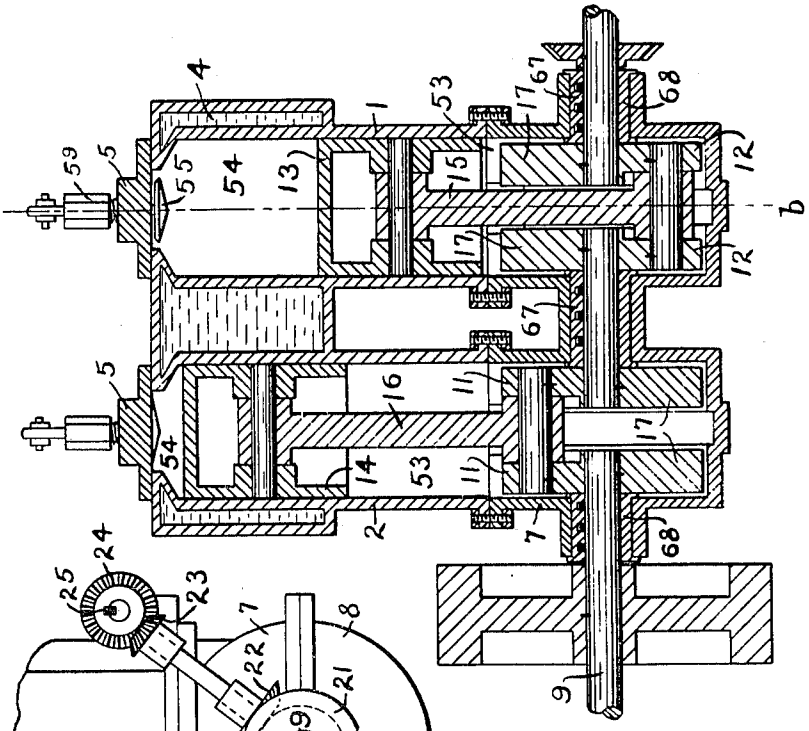
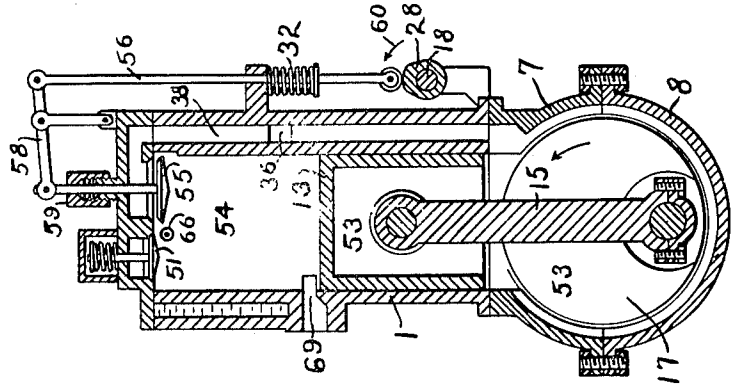


Fig. 3.

Fig. 2.



WITNESSES:

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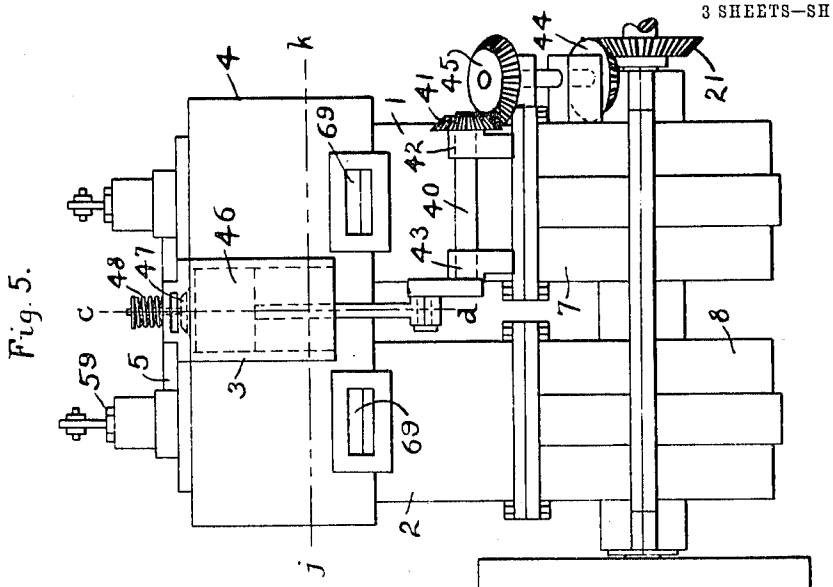

Fig. 5.

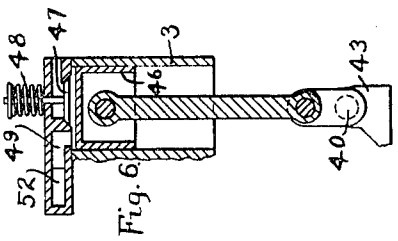

Fig. 6.

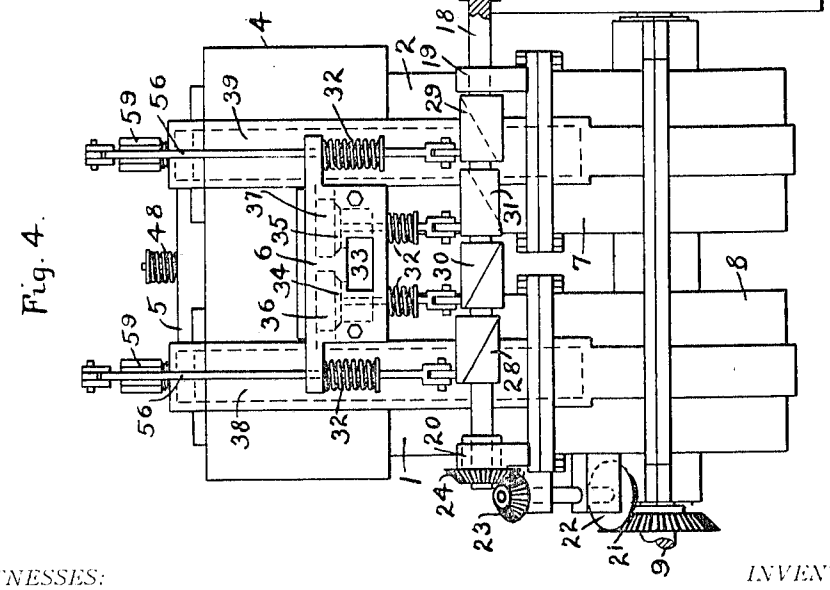

Fig. 4.

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3 SHEETS—SHEET 3

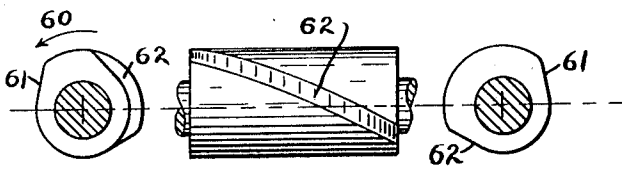

Fig. 7.

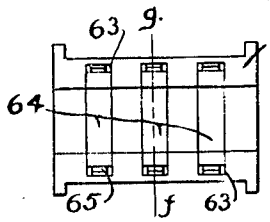

Fig. 8.

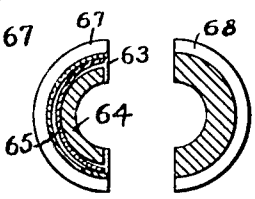

Fig. 9.

Fig. 11.

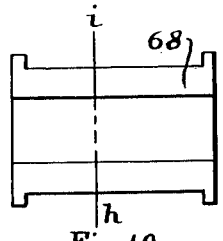

Fig. 10.

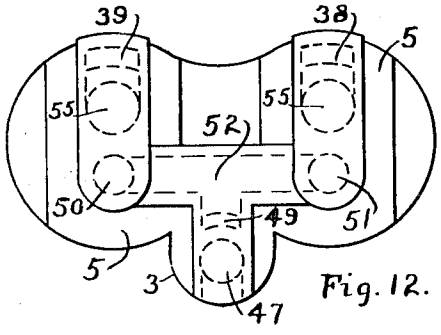

Fig. 12.

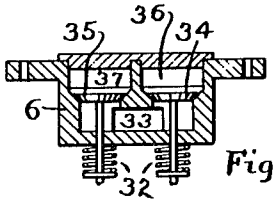

Fig. 14.

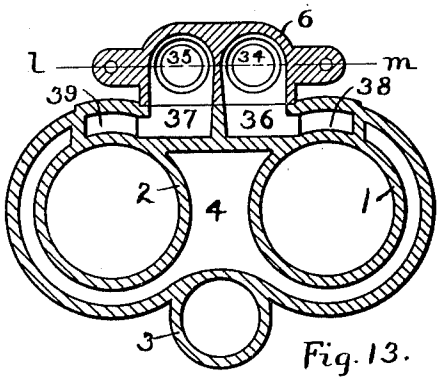

Fig. 13.

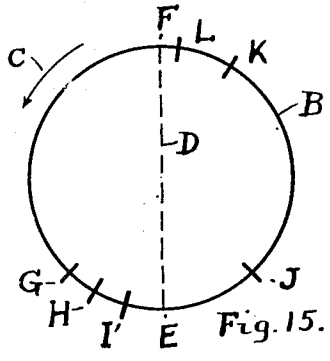

Fig. 15.

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EXPLOSIVE-ENGINE.

947,566. Specification of Letters Patent. Patented Jan. 25, 1910.

Application filed March 11, 1907. Serial No. 361,698.

To all whom it may concern:

Be it known that I, HOWARD H. WIXON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and Improved Explosive-Engine, of which the following description, with accompanying drawings, is declared to be such a full, clear, and exact description as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to internal combustion engines and particularly to such engines in which the combustible is burned explosively on what is commonly called the two stroke cycle.

My improved engine is a modification of the engine shown in my earlier application, Serial Number 343,277, filed November 13, 1906. It follows the general lines of the earlier engine and embodies many of the features suggested but not shown or described in my earlier application.

The object of my present invention is chiefly to improve the construction of my earlier engine; and the invention consists in the features of construction, combination and arrangement of parts, described in the specification, illustrated in the drawings, and particularly pointed out or specified in the appended claims.

My engine is especially adapted for use in automobiles and like service, but can be modified for stationary or other service without departure from the invention.

In the accompanying drawings, Figure 1 is a central longitudinal section of my engine, showing the mechanism and parts on this section; Fig. 2 is a side section of one cylinder along the line *a—b* of Fig. 1, showing the parts and mechanism on this section; Fig. 3 is a view of the lower part of one end, showing the bevel gear drive for the cam and auxiliary pump shafts; Fig. 4 is a view of the camshaft or inlet side, showing the mechanism on this side; Fig. 5 is a view of the other or exhaust side, showing the auxiliary air pump and parts on this side; Fig. 6 is a side section of the auxiliary air pump along the line *c—d* of Fig. 5; Fig. 7 shows three views of one of the transfer valve cams; Fig. 8 is a bottom view of the upper half of one of the crankshaft bearings, and Fig. 9 is a section of the same along the line *f—g* of Fig. 8; Fig. 10 is a top view of the lower half of one of the crankshaft bearings of which Fig. 11 is a section along the line *h—i* (in Fig. 10); Fig. 12 is a top view of the upper end of the cylinders, showing (dotted) the location and arrangement of the air and transfer passages; Fig. 13 is a cross section of the cylinders and inlet valve box along the line *j—k* of Fig. 5; Fig. 14 is a section of the inlet valve box along the line *l—m* of Fig. 13; and Fig. 15 is a diagram to illustrate the cycle of operations of the engine.

The same reference characters indicate similar parts in the different figures.

My engine is constructed with two cylinders 1 and 2, and an air cylinder 3, preferably all in one piece with the water jacket 4. The head piece 5 is bolted to the cylinders and contains the air and transfer valves and passages. The inlet valve box 6 is separate and is bolted to the cylinders on the side. The cylinders are in turn bolted to the crank case which is in two halves 7 and 8, and forms a gas tight compartment for each of the two throws or cranks of the crankshaft 9 at the lower end of each of the cylinders 1 and 2. The cranks 11 and 12 are spaced 180° from each other and have the pistons 13 and 14 attached in the usual manner by connecting rods 15 and 16. The rest of the space in the crank compartments, which is not required for the movement of the connecting rods, is filled in by fillers or counterweights 17 which may be formed integral with the crankshaft or made separate and fastened or bolted thereto in some suitable manner.

On the inlet side of the engine in Fig. 4, the camshaft 18 runs in suitable bearings 19—20 and is driven by the bevel gears 21—22—23—24 from the crankshaft 9 with an even or one to one gear ratio. This camshaft is free to move to the left and right through the gear 24 but is rotated by the gear 24 by means of a square key 25 (in Fig. 3) which is fastened to the gear and engages a slot or keyway in the camshaft. This movement is controlled by the handle or rod 26 which is attached to the camshaft by a ball bearing connection 27 so that the handle or rod 26 remains stationary and can move the rotating camshaft to the left or right as desired. This camshaft carries four cams, one transfer valve cam 28—29 for each cylinder and one inlet valve cam 30—31 for each cylinder, and by shifting the camshaft to the left the timing of the

valves is changed. These valves are normally held closed by the springs 32 but are opened when required by the rollers of the valve rods running on the high part of the cams.

The explosive mixture inlet 33 (to which a carbureter may be attached) branches off to the two inlet valves 34—35 and then through passages 36—37 to the transfer passages 38—39 (shown in Figs. 13 and 14, and dotted in Fig. 4) which connect the opposite ends of their cylinders.

On the exhaust side of the engine in Fig. 5, the crankshaft 40 for the auxiliary air pump 3 runs in suitable bearings 42—43 and is driven by the bevel gears 21—44—45—41 from the engine crankshaft 9 with a two to one gear ratio, so that the air pump piston 46 makes twice the number of strokes as either of the engine pistons. In the section of this pump in Fig. 6, the inlet valve 47 is held in place by the light spring 48 and operates automatically to admit the air to the pump; and the outlet passage 49 leads to the automatic air valve 50—51 of both cylinders through the passage 52 (shown dotted in Fig. 12). Both of these valves are alike, one of them (51) being shown in Fig. 2, and either of them will open when there is more pressure on the back of the valve than in the engine cylinder.

In the side section in Fig. 2 of one cylinder of which both are alike, except that the moving parts of one are spaced for operation 180° or one-half revolution behind the other, the transfer passage 38 connects the pump or crank case chamber 53, formed by the lower end of the cylinder and crank case, with the upper end of the cylinder or explosion chamber 54. The transfer valve 55 for this passage is normally held closed by the spring 32, through the rod 56 and lever 58, and its stem is surrounded by the packing box 59 to prevent leakage. This valve is opened by the cam 28, of which Fig. 7 gives enlarged views, and closed by the spring 32. This cam 28 (Fig. 7) is shown for rotation in the direction of the arrow 60 and its forward edge 61 is parallel with the camshaft so that the transfer valve is always opened at about the same time, but its rear edge 62 slants across the cam so that the transfer valve is allowed to close earlier or later depending on the position of the camshaft 18 as explained in connection with Fig. 4. The corresponding inlet valve cam 30 (Figure 4) is similarly shaped, but is reversed and spaced so that its slanting edge engages the inlet valve roller just after the transfer valve closes, and then the inlet valve is held open for the required time and allowed to close always at about the same time. The exhaust from the explosion chamber 54 is as usual by a port 69 in the cylinder wall, which is uncovered or opened by the working piston 13 when the said piston is at or near the bottom of its stroke.

My improved form of crankshaft bearing, illustrated in Figs. 8 to to 11, inclusive, is especially designed to prevent leakage of compression around or past the crankshaft from pressure in the crank case. The lower half 68 of the bearing (Figs. 10 and 11), which receives the wear, is similar to the ordinary plain half round bushing. As this half of the bearing wears down in use, the upper half 67 of the bearing (Figs. 8 and 9) is made with a number of circular slots 63 into which are fitted the (nearly) half round rings 64 which are pressed out against the crankshaft by the flat spring strips 65 so that as the lower half of the bearing wears down, the rings 64 fill in the resultant space in the top of the bearing and thereby prevent leakage of gas past the crankshaft. An igniter 66 (Fig. 2) of some suitable kind, preferably electrical, is provided in the compression space of the explosion chamber.

The operation of this engine is similar to that of my earlier form and is as follows in each cylinder, considering therewith the diagram in Fig. 15 in which the circle B represents the crank circle in the direction of the arrow C and the dotted line D represents the stroke of the engine piston: On the up stroke of the engine piston (E to F) the inlet valve is opened by its cam and the explosive mixture (gas and air or carbureted air) is drawn into the lower end of the cylinder or pump chamber through the inlet and transfer passages. On the down stroke of the piston (F to E) the explosive mixture is compressed in the crank case or pump chamber to about 8 or 9 pounds, and at the same time a charge of air is drawn in and compressed in the auxiliary air pump. At the point G the exhaust begins from the explosion chamber through the exhaust port and continues to the point J. At the point H the pressure in the explosion chamber has fallen sufficiently low so that the air pressure from the auxiliary air pump opens the automatic air valve (51 in Fig. 2) and admits the charge of air into the explosion chamber, the bulk of it entering before point I is reached where the transfer valve (55 in Fig. 2) is opened by its cam and the full charge of explosive mixture enters (through the transfer passage) the explosion chamber (in addition to the air charge) driving out the products of combustion (exhausting) to the point J. The combined displacement capacity of the pump chamber and the auxiliary air pump should be sufficient to entirely displace the burned charge from the explosion chamber. Now if the full power is desired from the engine, the camshaft 18 is moved to the corresponding

position (by the handle 26 in Fig. 4). Then the transfer valve will close at J and the entire charge of explosive mixture will be retained and compressed in the upper end of the cylinder on the up stroke (E to F) to point L where it is exploded by the igniter. At the same time on the up stroke just after the transfer valve closes, the inlet valve is opened by its cam (and held open to about F) admitting another explosive charge to the crank case pump chamber; and also during this time the auxiliary air pump draws in and compresses another charge of air, but as there is now a high pressure in this cylinder (or explosion chamber) its automatic air valve is held closed and the air charge enters the other cylinder which is just exhausting, and in this manner the auxiliary air pump delivers a charge of air alternately to each cylinder as one cylinder is exhausting while the other is on compression. On the next down stroke (F to E) expansion of the exploded mixture takes place from F down to exhaust G doing work, and at the same time the mixture in the crank case is compressed and the auxiliary air pump draws in and compresses a charge of air ready to be delivered at exhaust as before. It will be understood that the cycle of operations for each cylinder is completed at each revolution of the crankshaft and that the cycle of one cylinder is one half revolution or 180° behind the other as is usual in the ordinary form of two cylinder two cycle engine. If less than full power is desired from the engine, the camshaft 18 is moved correspondingly (to the left of the position in Fig. 4) by the handle 26. The transfer valve then will be opened as before at point I, but instead of closing as before at point J it is held open for a longer period by its cam and closes at a point between J and K depending on the position of the camshaft, so that part of the explosive mixture (which has entered the explosion chamber) will be returned to the pump chamber again, leaving only such charge in the explosion chamber to be ignited as is required to produce the desired power. The inlet valve to the pump chamber is not opened by its cam until the transfer valve closes as there is no suction in the pump chamber before then, and the inlet valve is then held open until the piston reaches the top of its stroke (F) so that sufficient explosive mixture is drawn in to again make a full charge in the pump chamber ready for compression as before.

It will be noted that my present invention is largely a very practical, compact, and efficient construction of an engine built on the same general principles of my earlier invention, the two working cylinders being used to give a more even application of power and also to balance the moving parts. The arrangement of the auxiliary air pump gives a quick injection of the air charge when it is needed, and the mechanical operation of the inlet and transfer valves makes higher engine speeds practical as well as reducing the loss due to the resistance of the valves.

It is obvious that many of the features of construction, which are combined to perform more than one function or operation, can be separated without departure from the invention, such as for instance the transfer valve which is used both to control the transfer of the charge to the explosion chamber and also to control the return of part of the charge to the pump chamber for power regulation.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. The combination with a two cylinder two cycle explosive engine of the class described, of a single acting auxiliary air pump, means to operate said pump at twice the speed of the engine, and means whereby the air charge is delivered alternately to each of the engine cylinders, substantially as described.

2. In a two cycle explosive engine, the combination of a crank case forming a pump chamber, an attached cylinder forming an explosion or working chamber at its outer end and having therein a working piston which is common to both of said chambers, an inlet passage to the pump chamber, a normally closed inlet valve controlling said passage, an inlet cam having operating means therefor in connection with the engine shaft, means coöperating with said inlet cam and said inlet valve whereby the cam operates to open the valve to admit a charge of explosive gas to the pump chamber, a transfer passage directly connecting the pump and explosion chambers around the cylinder, a normally closed transfer valve controlling said transfer passage, a transfer cam having operating means therefor in connection with the engine shaft, and means coöperating with said transfer cam and transfer valve whereby the transfer cam operates to open the transfer valve to allow the transfer of the explosive charge to the explosion chamber during exhaust therefrom of the burned charge of the previous explosion.

3. In a two cycle explosive engine, the combination of a crank case forming a pump chamber, an attached cylinder forming an explosion or working chamber at its outer end and having therein a working piston which is common to both of said chambers, means to admit a charge of explosive gas to the pump chamber, a transfer passage directly connecting the pump and explosion chambers around the cylinder, a normally closed valve controlling said passage, a cam which operates said valve and is so shaped that it will open said valve to allow the

transfer of the explosive charge to the pump chamber and which can be shifted or moved so that various portions of the cam will also hold said valve open during more or less of the up or outward stroke of the engine piston thereby allowing a part of the explosive charge to be returned to the pump chamber, means to operate said cam in connection with the engine shaft, means to shift or move said cam during operation of the engine to regulate the speed or power of the engine, means coöperating with said cam whereby the cam operates the valve and a separate valve for admitting air under pressure to said cylinder.

4. The combination with a two cycle explosive engine having a crank case forming a pump chamber, an attached cylinder forming an explosion or working chamber at its outer end and having therein a working piston which is common to both of said chambers, an inlet passage to the pump chamber, a normally closed inlet valve controlling the admission of the explosive charge to the pump chamber, means to permit a more or less part of the admitted explosive charge in the explosion chamber to be returned to the pump chamber to regulate the speed or power of the engine, and means to permit exhaust of the burned charge from the said explosion chamber; of means to operate the said inlet valve, comprising a camshaft having operating means therefor in connection with the engine shaft, a cam which is mounted on said camshaft and is so shaped that various portions of it will operate to open the inlet valve earlier than other portions, means coöperating with said cam and said valve whereby the cam operates the valve, and means to shift or move the cam during the operation of the engine whereby various portions of the said cam are caused to operate said valve as and for the purpose described, the said shifting means coöperating with the means to permit the return of part of the explosive charge to the pump chamber.

5. The combination with a two cycle explosive engine having a crank case forming a pump chamber, an attached cylinder forming an explosion or working chamber at its outer end and having therein a working piston which is common to both of said chambers, means to admit a charge of explosive gas to the pump chamber, means to transfer the explosive charge to the explosion chamber, and means to permit exhaust of the burned charge from the said explosion chamber; of a passage connecting the two chambers, a valve in said passage adapted to control the same, a camshaft having operating means therefor in connection with the engine shaft, a cam which is mounted on said camshaft and is so shaped that various portions of it will operate to open said valve during a more or less part of the upward or outward stroke of the engine piston and thereby permit a part of the explosive charge in the explosion chamber to be returned to the pump chamber to regulate or control the speed or power of the engine, means coöperating with said cam and said valve whereby the cam operates the valve, and means to shift or move the cam (relatively to the part that operates the valve) during operation of the engine whereby various portions of said cam are caused to operate said valve.

6. In a two cycle explosive engine, the combination of a crank case forming a pump chamber, an attached cylinder forming an explosion or working chamber at its outer end and having therein a working piston which is common to both chambers, an inlet passage to the pump chamber, a normally closed inlet valve in said inlet passage controlling the admission of the explosive charge to the pump chamber, means to transfer the explosive charge from the pump chamber to the explosion chamber, means to permit exhaust from the explosion chamber, a passage directly connecting the two said chambers around the cylinder, a normally closed valve in said connecting passage controlling the same, a camshaft having operating means therefor in connection with the engine shaft, a cam on said camshaft having means coöperating therewith to operate the said inlet valve, a cam on said camshaft having means coöperating therewith to operate the valve in the said passage connecting the two chambers, each of said cams being so shaped that various portions of them will operate to open their respective valves for a longer time than other portions, and said cams being also so set and shaped with relation to each other and the engine parts that the valve in the connecting passage is opened during a more or less part of the up or outward stroke of the engine piston to permit the return of part of the explosive charge to the pump chamber and then the inlet valve is opened during the remainder of the up stroke of the engine piston to permit the admission of the explosive charge to the pump chamber, and means to shift or move the said camshaft or cams during operation of the engine whereby more of the explosive charge is returned to the pump chamber and less charge admitted through the inlet or vice versa.

7. In a two cycle explosive engine, the combination of a crank case forming a pump chamber, an attached cylinder forming an explosion or working chamber at its outer end and having therein a working piston which is common to both of said chambers, an inlet passage to the pump chamber, a normally closed inlet valve in said passage controlling the admission of the explosive charge to the pump chamber, a transfer passage directly connecting the two cham-

bers around the cylinder, a normally closed transfer valve controlling said transfer passage, means to permit exhaust of the burned charge from the explosion chamber, a camshaft having operating means therefor in connection with the engine shaft, an inlet cam on said camshaft having means cooperating therewith to operate the said inlet valve, a transfer cam on said camshaft having means coöperating therewith to operate the said transfer valve, each of said cams being so shaped that various portions of them will operate to open their respective valves longer than other portions, and said cams being also so set and shaped with relation to each other and the engine parts that the said transfer valve is opened by its cam to permit the transfer of the explosive charge from the pump chamber to the explosion chamber and held open during a more or less part of the up or outward stroke of the engine piston to permit the return of part of the explosive charge to the pump chamber and then the inlet valve is opened by its cam during the remainder of the up stroke of the engine piston to permit admission of the explosive charge to the pump chamber, and means to shift or move the camshaft or cams during operation of the engine whereby more of the explosive charge is returned to the pump chamber and less charge admitted through the inlet or vice versa, substantially as described.

8. In a two cycle explosive engine, the combination of a crank case forming a pump chamber, an attached cylinder forming an explosion or working chamber at its outer end and having therein a working piston which is common to both of said chambers, means to admit a charge of explosive gas to the pump chamber, a transfer passage directly connecting the two chambers around the cylinder, a valve in said passage adapted to control the transfer of the explosive charge to the explosion chamber, an exhaust port in the cylinder wall controlled and opened by the working piston, an auxiliary air pump, and means to introduce the charge of air under pressure from said air pump directly into the explosion chamber in addition to and ahead and independently of the transferred explosive charge substantially as described.

9. In a two cycle explosive engine, the combination of a crank case forming a pump chamber, an attached cylinder forming an explosion chamber at its outer end and having therein a working piston which is common to both of said chambers, means to admit a charge of explosive gas to the pump chamber, means to transfer the said charge to the explosion chamber, an auxiliary air pump, means to introduce the charge of air from said air pump directly into the explosion chamber in addition to and ahead of and independently of the transfer of the explosive charge substantially as described, and means to return a part of said transferred explosive charge back to the pump chamber prior to ignition of the remainder left in the explosion chamber.

10. The combination of a cylinder, a piston working therein, a valve controlling the admission of the explosive mixture to said cylinder, a cam, mechanism interposed between said cam and said valve for actuating the latter, said cam being constructed to cause the closure of said valve at different points in the back stroke of the piston and a valve for admitting air under pressure into said cylinder.

11. The combination of a cylinder and supply chamber, of a piston working therein, a valve controlling the admission of the explosive mixture from the supply chamber to the cylinder, a valve for admitting the explosive mixture to the supply chamber, and cams combined with valve actuating mechanism operated by said cams, said cams being constructed to cause the closure of said valves at different points in the back stroke of the piston when a relative movement is effected between the cams and the valve actuating mechanism.

12. The combination of a cylinder, and supply chamber, a piston working therein, a valve controlling the admission of the explosive mixture to the supply chamber, a valve controlling the admission of the explosive mixture from the supply chamber to the cylinder, longitudinally movable cams having longitudinally varying peripheral enlargements, valve-actuating mechanism operated by said cams, said cams actuating the aforesaid valves, valve actuating mechanism operated by said cams, and means for shifting said cams relatively to said valve-actuating mechanism.

13. The combination in an explosive engine, of a cylinder and a supply chamber, a piston working in both, a valve for permitting the influx of explosive mixture into the supply chamber, a valve for permitting the flow of explosive mixture under pressure from the supply chamber to the cylinder, a cam for operating the valve controlling the flow into the supply chamber, a cam for operating the valve controlling the flow into the cylinder, and means whereby the first aforesaid cam is not permitted to open its valve before the cylinder valve has been closed.

14. The combination in an explosive engine, of a cylinder and a supply chamber, a piston working in both, a valve for permitting the influx of explosive mixture into the supply chamber, a valve for permitting the flow of explosive mixture under pressure from the supply chamber to the cylinder, a cam for operating the valve controlling the

flow into the supply chamber, a cam for operating the valve controlling the flow into the cylinder, and means whereby the first aforesaid cam is not permitted to open its valve before the cylinder valve has been closed, said cam controlling the cylinder valve being constructed to effect the closure of said valves at different points in the back stroke of the piston, by a relative movement effected between the cam and the valve actuating mechanism.

HOWARD H. WIXON.

Witnesses:
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CHARLES L. DIBBLE.