W. S. WEATHERWAX.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JUNE 23, 1915.

**1,201,401.** Patented Oct. 17, 1916.

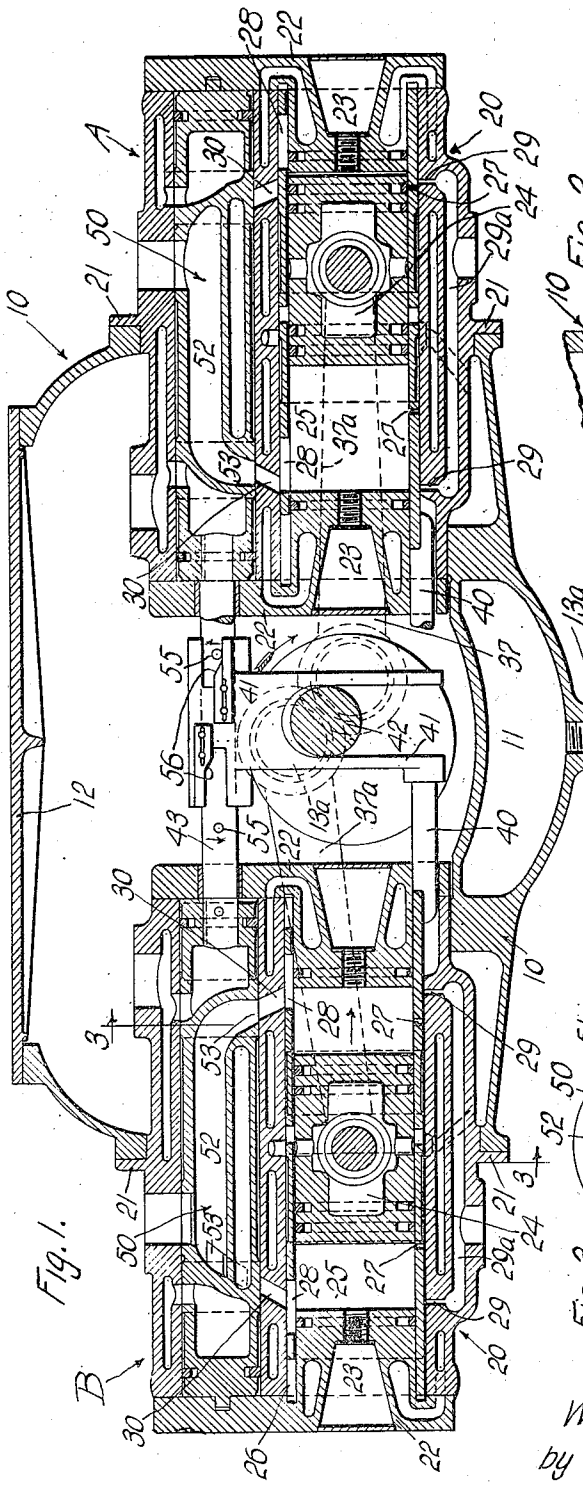


Fig. 1.

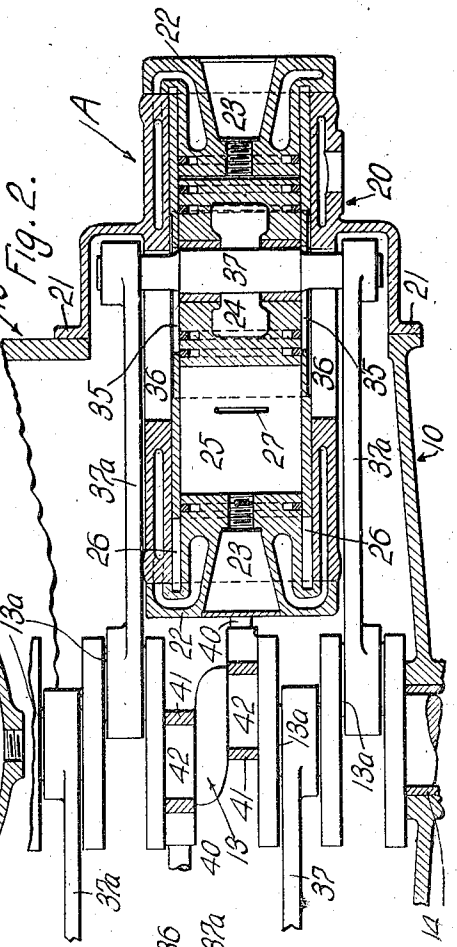


Fig. 2.

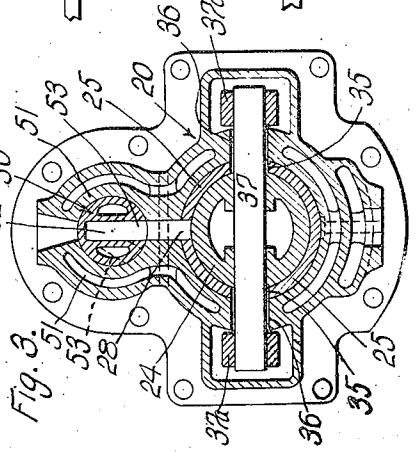


Fig. 3.

Inventor
Walter S. Weatherwax,
by Dyer & Landis
his Attorney.

# UNITED STATES PATENT OFFICE.

WALTER S. WEATHERWAX, OF LOS ANGELES, CALIFORNIA.

## INTERNAL-COMBUSTION ENGINE.

1,201,401. Specification of Letters Patent. Patented Oct. 17, 1916.

Application filed June 23, 1915. Serial No. 35,758.

*To all whom it may concern:*

Be it known that I, WALTER S. WEATHERWAX, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates particularly to double acting internal combustion engines; and this application is in the nature of a continuation in part of my application Serial No. 833,524, filed April 21st, 1914.

The invention to be hereinafter specifically described includes certain features designed particularly for efficiency and simplicity in a double acting engine. Among these features I may mention particularly the combination of valves and the piston and sleeve construction, as hereinafter particularly pointed out. There are various other features which will appear in the following specification, reference being had to the accompanying drawings, in which, for the purpose of this specification, I have illustrated a preferred form of my invention, and in which drawings—

Figure 1 is a vertical longitudinal section of my improved engine, Fig. 2 is a partial plan section of the same, and Fig. 3 is a detail cross section taken as indicated by line 3—3 on Fig. 1.

In the drawings the numeral 10 designates a suitable case or base of any suitable design, being preferably formed as shown in the drawings with an oil reservoir 11 in its lower part, and having a suitable cover plate 12 so that the interior mechanism may be easily reached for inspection and adjustment. A crank shaft 13 is mounted in suitable bearings 14 and may be designed for as many cylinders as desired. In a typical form of my engine, I may use a plurality of opposed units, each unit comprising a double acting cylinder controlled by a valve arrangement hereinafter described. For instance, in the drawing I have shown two units A and B on opposite sides of the crank shaft 13. These units are duplicates of each other; and the following description is given of one unit. A suitable cylinder 20 is mounted at 21 upon the base 10, this cylinder having heads 22 one at each end with provision at 23 for a spark plug; so that there is formed at each end of the cylinder a combustion chamber in which explosive mixture may be admitted and in which it may be ignited at its highest point of compression to expand and act upon a piston 24 reciprocating within the cylinder. The piston 24 is preferably mounted directly in a sleeve 25 which forms a lining for the cylinder, sleeve 25 extending from end to end of the cylinder and extending into annular spaces 26 between the heads 22 and the interior wall of the cylinder 20. This sleeve 25 is provided with inlet ports 27 and with exhaust ports 28, as shown in the various views. The inlet ports 27 are adapted to register with cylinder inlet ports 29 and the exhaust ports 28 are adapted to register with cylinder exhaust ports 30. The sleeve valve 25 is moved longitudinally in a reciprocatory movement; and, preferably, for the purposes hereinafter stated, is moved through a stroke somewhat less than the stroke of the piston 24. The sleeve has opposite longitudinal slots 35 and the cylinder has slots 36; and a trunnion 37 of piston 24 extends transversely outwardly through the slots and is connected at its outer ends with connecting rods 37 which connect with the crank shaft 13, to cranks $13^a$ thereof. The stroke given the piston 24 is such as to leave a combustion chamber at each end of the cylinder of proper size. It will be understood that the combustible mixture is supplied to the parts 29 under pressure properly mixed, being supplied to these ports through the passage $29^a$ from any suitable source.

The sleeve valve 25 is connected by rod 40 with a yoke 41 which engages a crank 42 on the crank shaft 13, said yoke being mounted upon the valve rod 43 above and being capable of a reciprocatory movement. The crank pin 42 is arranged at about thirty five degrees advance ahead of the corresponding crank pin $13^a$. Thus, the crank 42 for the sleeve valve of the unit B as shown in Fig. 1, is arranged at about a thirty five degree advance ahead of the uppermost crank $13^a$ in this figure, which is the crank connected to piston 24 of the unit B. The throw of the crank 42 is considerably less than the throw of crank $13^a$; so that the travel of the sleeve valve 25 is considerably less than the travel of the piston 24. Consequently, the length of the slot 35 in sleeve 25 need only be long enough to accommodate the movement of the piston 37 relative to the sleeve; and this movement is

comparatively short, owing to that fact that the sleeve travels back and forth substantially with the piston. The piston is made sufficiently long to cover the slot 35 at all times. The sleeve itself covers the slots 36 in the cylinders. It will be seen that this construction has a distinct advantage over a similar construction in which the piston is placed directly in the cylinder without the interposition of the sleeve valve 25. In such a case, the piston must necessarily be made sufficiently long to cover the slot 36 at all times; this would necessitate an excessively long cylinder making the whole engine excessively long; and this is a difficulty to be particularly guarded against.

The inlet of explosive mixture under pressure is controlled exclusively by the ports in the sleeve valve. But the exhaust is controlled partly by the sleeve valve and by a rotary valve 50. The sleeve exhaust ports 28 are adapted to register with the cylinder exhaust ports 30 and these cylinder exhaust ports lead directly into a valve casing 51 in which the valve 50 is located. The valve 50 has a common exhaust passage or chamber 52 with ports 53 one at each end, said ports being adapted to register with the cylinder exhaust ports 30. Rotation of the valve 50 is accomplished by the mechanism now described. A valve rod or stem 43 extends out of the casing, as is shown in Fig. 1, and the reciprocating yoke 41 is slidably mounted directly upon this valve stem. The valve stem has two pins 55 adapted to be engaged by the adjustable inclined places 56 mounted upon the yoke 41; the inclined places being arranged in such manner that the valve stem 43 will be rotated alternately in opposite directions as the yoke 41 reaches points near the opposite ends of its stroke. Thus, as shown in Fig. 1, the right hand inclined plane 56 is just about to engage the right hand pin 55 to move the pin and to rotate the valve stem 43 in the direction indicated by the arrow near that pin 55; and this rotation of valve stem 43 will rotate valve 50 so as to bring left hand port 53 into register with left hand cylinder exhaust port 30. This takes place near the end of the movement of yoke 41 to the right in Fig. 1 and when the piston 24 is at about four fifths stroke toward the right in Fig. 1. On movement in the opposite direction, the left hand inclined plane 56 will engage the left hand pin 55 to move the pin and the valve stem 43 in the direction indicated and this will throw the valve 52 back to the position in which it is shown in Figs. 1 and 3, with the right hand port 53 in register with the right hand cylinder exhaust port 30 and with the left hand port 53 out of register with cylinder exhaust port 30. It will be noted that the movement of the valve 50 takes place near the end of the piston stroke and approximately at the end of the stroke of yoke 41 and of the stroke of the sleeve valve 25.

The operation is as follows: Supposing the crank shaft to be rotating in the direction indicated, then the piston of the left hand unit B, for instance, will be moving in the direction indicated, to the right in Fig. 1. A charge has been introduced and ignited and is expanding at the left of the piston and is driving the piston to the right. The exhaust port at the right hand end is open, exhausting the products of a previous combustion on that side of the piston. As the piston nears the end of its stroke to the right, the sleeve valve 25, also moving to the right, cuts off registry between ports 28 and 30 at the right hand end and stops further exhaust; and just as the exhaust is cut off, the right hand inlet port 27 registers with the inlet port 29 and allows a fresh mixture under pressure to be forced into the combustion space to the right of the piston. This mixture is ignited and expands, driving the piston back toward the left. It will be understood that the inlet closes just before the piston reaches the end of its stroke, in order to allow ignition and explosion at the point of highest compression. The sleeve valve 25 has already begun to move toward the left and the exhaust port 28, on the right, will have again registered with the exhaust port 30 before the piston 24 reaches the left hand end of its movement; but the right hand rotary valve port 53 is out of register with the port 30, having been moved out of register with that port as the piston reached the right hand end of its movement. The piston moves on toward the left under pressure of the expanding gases; and as it approaches the end of its stroke in this direction, the valve 52 is turned so as to register the right hand exhaust port 53 with the cylinder port 30 allowing the exhaust gases to escape into and through the chamber or passage 52. At this time, the left hand exhaust port 53 is out of registery with the left hand port 50, so that the exhaust gases from the right hand end of the cylinder cannot enter the left hand end of the cylinder. On the return of the piston 24 to the right, the exhaust is open during practically the entire return stroke, allowing the exhaust to be expelled; and, then, at the end of the stroke, the exhaust is closed as hereinbefore stated, and the inlet is opened. The operation of the other end of the cylinder is exactly the same as described, the two ends operating alternately, so that every stroke of the piston back and forth is a power stroke. It will be noted that the inlet is entirely controlled by the sleeve valve whereas the exhaust is controlled jointly by the sleeve valve and the rotary valve 50. The exhaust is opened by the final action of the rotary valve 50; but the exhaust is closed by the action

of the sleeve or of the sleeve and the rotary valve 50 combined, the sleeve ports closing just before or simultaneously with the closing of the ports of the rotary valve.

Having described a preferred form of my invention, I claim:

1. In a double acting engine, a cylinder having a head at each end and a combustion chamber in each end of the cylinder, a single piston in the cylinder adapted to coöperate with the two combustion chambers at the opposite ends of the cylinder, there being inlet and exhaust ports for the combustion chambers at the opposite ends of the cylinder, a single sleeve valve concentric with the cylinder having ports coöperating with the said inlet and exhaust ports to control admission and exhaust of fluid thereto, a single rotary valve having ports coöperating with said exhaust ports to lead exhaust from both said ports to a common exhaust chamber, and means for coöperatively moving the sleeve valve and rotary valve with the piston.

2. In a double acting engine, a cylinder having a head and a combustion chamber at each end and having inlet and exhaust ports for each combustion chamber, a single sleeve valve fitting within the cylinder extending from end to end therein and having ports coöperating with said inlet and exhaust ports for each combustion chamber, a single piston in the cylinder within the sleeve valve adapted to coöperate with the opposite combustion chambers, a rotary valve having ports leading to a common chamber, said ports coöperating with said cylinder exhaust ports, and means to move said rotary and sleeve valves coöperatively with the piston.

3. In a double acting engine, a cylinder having a head at each end and a combustion chamber in each end of the cylinder, a single piston in the cylinder adapted to coöperate with the two combustion chambers at the opposite ends of the cylinder, there being inlet and exhaust ports for the combustion chambers at the opposite ends of the cylinder, a single sleeve valve concentric with the cylinder having ports coöperating with the said inlet and exhaust ports to control admission and exhaust of fluid thereto, there being a slot through the cylinder wall commensurate in length with the piston stroke and a slot through the sleeve shorter than the cylinder slot, a transverse piston trunnion extending outwardly through both slots, and means to move said sleeve valve coöperatively with the piston.

4. In a double acting engine, a cylinder having a head and a combustion chamber at each end, and having inlet and exhaust ports for each combustion chamber, a single sleeve valve fitting within the cylinder extending from end to end therein and having ports coöperating with said inlet and exhaust ports for each combustion chamber, a single piston in the cylinder within the sleeve valve adapted to coöperate with the opposite combustion chambers, there being a slot through the cylinder wall commensurate in length with the piston stroke and a slot through the sleeve shorter than the cylinder slot, a transverse piston trunnion extending outwardly through both slots, and means to move said sleeve valve coöperatively with the piston.

5. In a double acting engine, a cylinder having heads and combustion chambers at opposite ends, a sleeve fitting within the cylinder, a piston in the sleeve adapted to cooperate with the opposite combustion chambers, there being a slot through the cylinder wall commensurate in length with the piston stroke and a slot through the sleeve shorter than the cylinder slot, a transverse piston trunnion extending outwardly through both slots, and means to move the sleeve coöperatively with the piston through a longitudinal stroke shorter than the piston stroke.

6. In a double acting engine, a cylinder having heads and combustion chambers at opposite ends and having inlet and exhaust ports to register with said cylinder ports by longitudinal movement of the sleeve, a single piston within said sleeve adapted to coöperate with the opposite combustion chambers, there being a longitudinally extending slot in the cylinder wall commensurate in length with the piston stroke and a shorter longitudinal slot through the sleeve, a transverse piston trunnion extending outwardly through said slots, and means to move said sleeve cooperatively with the piston through a stroke shorter than the piston stroke, said sleeve moving back and forth substantially with the piston and the piston being of such length as to always cover the sleeve slot.

7. In a double acting engine, a cylinder having a head at each end and a combustion chamber in each end of the cylinder, a single piston in the cylinder adapted to coöperate with the two combustion chambers at the opposite ends of the cylinder, there being inlet and exhaust ports for the combustion chambers at the opposite ends of the cylinder, a single sleeve valve concentric with the cylinder having ports coöperating with the said inlet and exhaust ports to control admission and exhaust of fluid thereto, a single rotary valve having ports coöperating with said exhaust ports to lead exhaust from both said ports to a common exhaust chamber, and means for coöperatively moving the sleeve valve and rotary valve with the piston, the movements of the valves being such that the sleeve valve controls the closing of the exhaust and the rotary valve controls the opening of the exhaust.

8. In a double acting engine, a cylinder having a head and a combustion chamber at each end and having inlet and exhaust ports for each combustion chamber, a single sleeve

valve fitting within the cylinder extending from end to end therein and having ports coöperating with said inlet and exhaust ports for each combustion chamber, a single piston in the cylinder within the sleeve valve adapted to coöperate with the opposite combustion chambers, a rotary valve having ports leading to a common chamber, said ports coöperating with said cylinder exhaust ports, and means to move said rotary and sleeve valves coöperatively with the piston, the movements of the valves being such that the sleeve valve controls the closing of the exhaust and the rotary valve controls the opening of the exhaust.

9. In combination, a cylinder and sleeve concentric with and coöperating with the cylinder, a piston in the cylinder and sleeve, there being a slot through the cylinder wall commensurate in length with the piston stroke, and a slot through the sleeve shorter than the cylinder slot, a transverse piston trunnion extending outwardly through both slots, and means to move the sleeve coöperatively with the piston through a longitudinal stroke so that the movement of the sleeve relative to the piston is less than the movement of the piston relative to the cylinder.

In witness that I claim the foregoing I have hereunto subscribed my name this 15th day of June, 1915.

W. S. WEATHERWAX.

Witnesses:
JAMES T. BARKELEW,
ELWOOD H. BARKELEW.