H. L. BROWNBACK.

EXPLOSIVE ENGINE.

APPLICATION FILED JAN. 20, 1915. RENEWED JULY 9, 1921.

1,414,009. Patented Apr. 25, 1922.

3 SHEETS—SHEET 1.

Fig. 7.

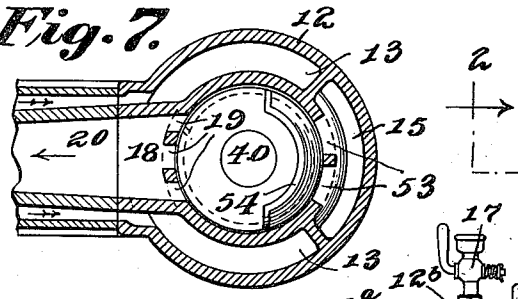


Fig. 1.

Fig. 11.

Witnesses
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EXPLOSIVE ENGINE.

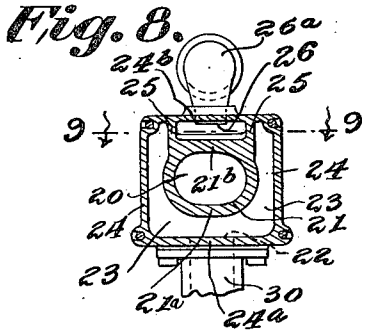
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3 SHEETS—SHEET 2.

Fig. 8.



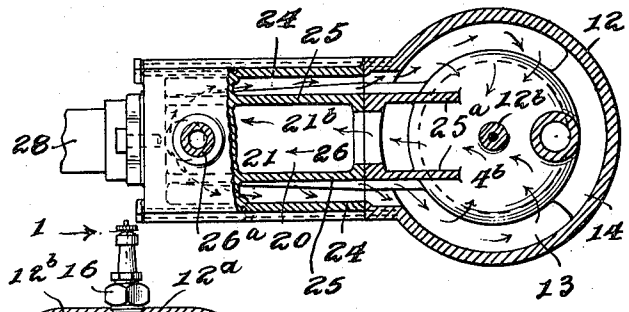


Fig. 9.

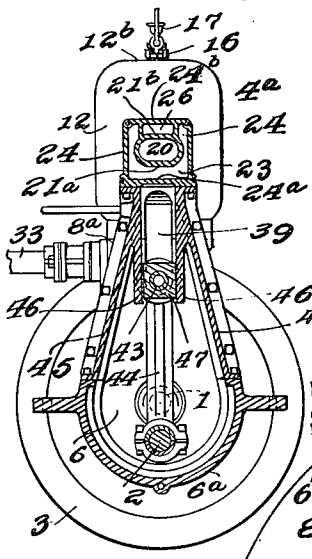


Fig. 10.

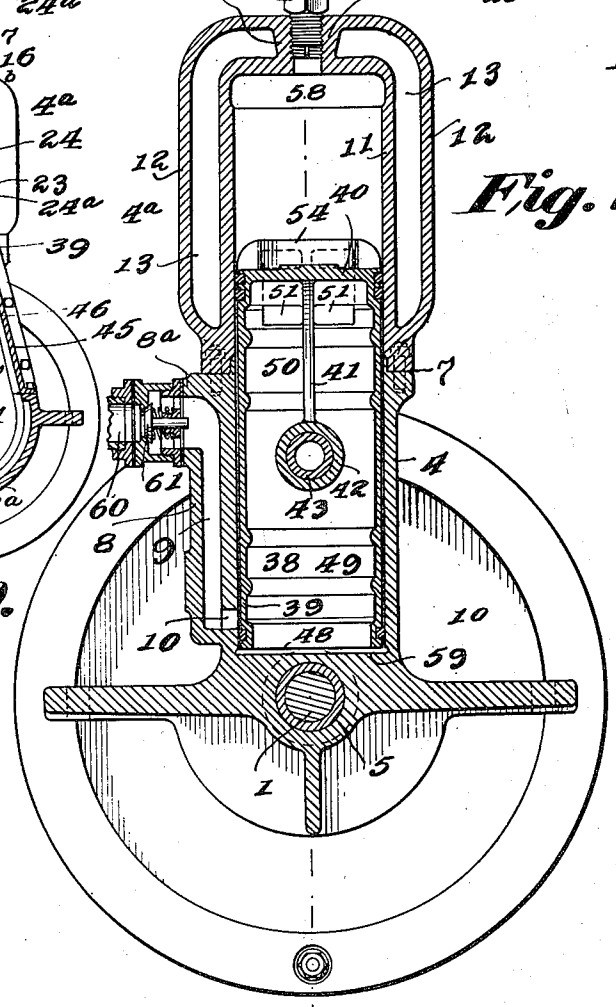


Fig. 2.

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3 SHEETS—SHEET 3.

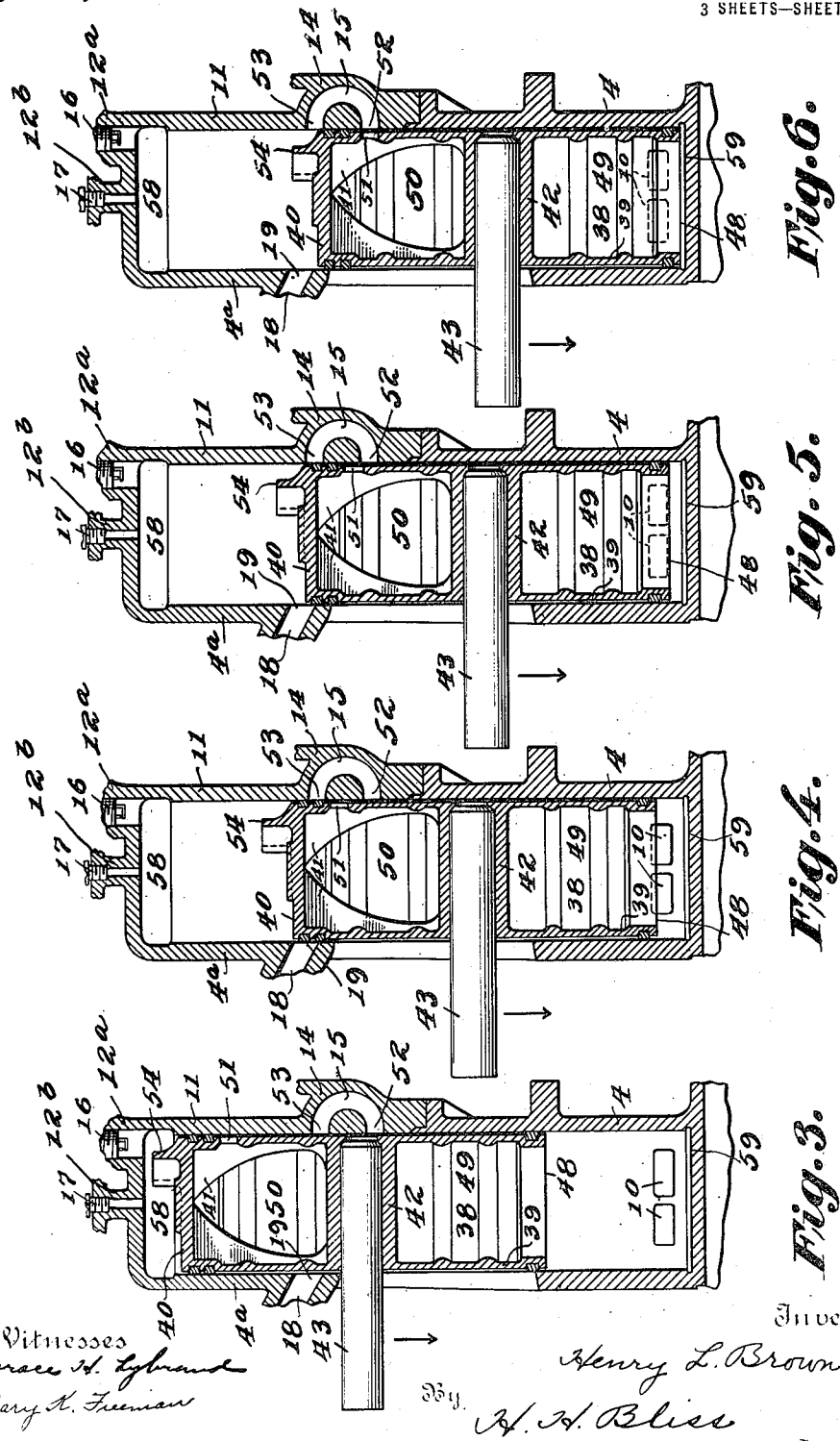


Fig. 6.

Fig. 5.

Fig. 4.

Fig. 3.

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UNITED STATES PATENT OFFICE.

HENRY LOWE BROWNBACK, OF NORRISTOWN, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO TIMOTHY O'LEARY, OF PHILADELPHIA, PENNSYLVANIA.

EXPLOSIVE ENGINE.

1,414,009. Specification of Letters Patent. Patented Apr. 25, 1922.

Application filed January 20, 1915, Serial No. 3,337. Renewed July 9, 1921. Serial No. 483,612.

To all whom it may concern:

Be it known that I, HENRY L. BROWNBACK, a citizen of the United States, residing at Norristown, in the county of Montgomery and State of Pennsylvania, have invented certain new and useful Improvements in Explosive Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to improvements in engines of the class in which use is made of an explosive mixture of air and gas or vapor. The improvements pertain to devices by which a more uniform and even action is obtained in delivering charges of mixture to the explosion chamber; devices for lowering the temperature quickly of those parts of the piston which are adjacent to the explosion chamber and maintaining them at a uniformly low temperature; means for effecting the cooling of the walls of the explosion chamber and of the exhaust duct, and for causing the circulation of the water around the exhaust duct and the explosion chamber; and, generally, to an arrangement of the parts of the apparatus by which it, as a whole, is simplified in construction, which permits the parts to be readily separated for cleansing and repairing, and also permits them to be readily manipulated at the time of manufacture.

In the drawings:

Fig. 1 is a vertical section of an engine embodying my improvements taken on the line 1—1 of Fig. 2.

Fig. 2 is a vertical section on the line 2—2 of Fig. 1.

Figs. 3, 4, 5 and 6 are vertical sections of the piston and the cylinder, showing the former in its several successive positions, during a cycle, relatively to the latter.

Fig. 7 is a cross section on the line 7—7 of Fig. 1.

Fig. 8 is a section on the line 8—8 of Fig. 1.

Fig. 9 is a section on the line 9—9 of Fig. 1.

Fig. 10 is a section on the line 10—10 of Fig. 1.

Fig. 11 is a view of the gas exhaust and water circulating structure detached.

The main shaft is indicated by 1, it having crank 2 and a fly wheel 3. The cylinder comprises the lower part 4 and the upper part 4^a, the lower part being cast with the bearings at 5 and 5^a for the shaft. The cylinder base is also cast with a plate 6 which forms the inner wall of a housing, to be further described, the outer wall of this housing having a plate at 6^a which together with that at 6 forms a cavity or enclosure for the crank 2. The two parts 4 and 4^a of the cylinder are tightly fitted and bolted together at the seat 7.

The lower part 4 is cast with an enlargement 8 and an outward turned boss 8^a in which is formed a duct 9 extending to the port 10 where the gas mixture is drawn into the cylinder.

The upper part 4^a is cast with an interior wall 11, forming the upper part of the cylinder, proper, and an exterior wall 12 which extends not only around the sides but also over the top of the wall 11, there being a water jacket chamber 13 between them. At 12^a the casting is formed with a tubular part having a passage which receives the spark plug 16, and a second tubular part 12^b which receives the pet cock 17. The upper part 4^a of the cylinder also has a metal mass at 14 in which there is formed a transfer port 15, to be described. At 18 there is a tube or duct which commences with the exhaust ports 19 and communicates with a duct section 20 in a tubular element 21. The latter is cast with a bottom wall 21^a and a top wall 21^b. Integral with the tube 21 are exterior vertical walls 24, a bottom wall 24^a and a top wall 24^b. These parts provide a large chamber or duct 23 around three sides of the exhaust duct 20. 25, 25 are vertical walls between this chamber 23 and an upper chamber or duct 26 through which the water returns outward from the cooling jacket chamber 13 around the cylinder. The walls 25, 25 register with walls 25^a in the cylinder casting, the latter extending up along the exhaust side and partly over the top of the cylinder (see Figs. 1 and 9).

These walls and ducts cause the water to flow from the port 22 into the chamber 23 around the outer end of the exhaust duct 20, then inward along and around said duct toward and through the upper passage 26. The latter communicates with the elbow 26^a, the final escape pipe 27 being secured thereto.

To the outer end of the section 21 of the exhaust duct is fitted the final section 28.

29 indicates the pump as an entirety. It

comprises the barrel 30, the solid piston plunger 31, the pitman 32, the feed and discharge ducts, and suitable valves 35, 36. The water is supplied to the feed duct 33 past ball valve 34 to the piston 31; and its back flow is prevented by ball valve 36 on seat 37.

It will be seen that all of the pump connections for supplying cooling water and all of the final water discharge ducts (as those at 26ª, 27), together with the devices for receiving the exhaust gases, form a system of parts, which system, as a unit, is attached to, and is separable from, the cylinder, the cylinder casting being merely formed with portways which register with portways in this separable unitary structure.

The water, when entering and traveling in the way above described, initially impinges, when in its coldest condition, upon the exceedingly highly heated walls of the exhaust duct at points remote from the cylinder. It then passes, while still comparatively cool, inward along the walls of this exhaust duct section to, and around, the cylinder, and then, as above noted, it travels outward along the upper part of the exhaust duct. Not only is this unitary structure for receiving the exhaust from the cylinder and for supplying the cooling water, a mechanical feature of importance, but the result attained is that the region requiring quick lowering in temperature is kept much cooler than is the case with earlier engines of which I have knowledge.

The main piston is indicated by 38, as an entirety. It has cylindrical walls 39 and and a closed head 40 at its upper end, these being as thin as practicable for the purpose of quickly withdrawing from them the heat which they receive at the times of explosion. It is practically entirely open from end to end, the only body in its interior being the tube 42, which, however, does not entirely close the longitudinal passage. Its lower end 48 is entirely open, the only passage or opening above this bottom being the ports 51 extending laterally through its side wall at a plane as close to the head 40 as permitted by the packing rings. As the wall 39 and the head 40 are, as aforesaid, very thin, they are supplemented by thin webs 41 which are in the transverse planes of the region of the ducts 51. The webs transfer the strains from the head and from the upper parts of the piston walls to the tube 42. The lower part of the long chamber in the piston is indicated by 49 and the upper part by 50. As the gas is forced upward through these chamber sections 49 and 50 in its passage toward the ports 51 it is forced across the webs 41 in its paths toward the ports and rapidly abstracts from them the heat which they, in turn, have as rapidly withdrawn from the head and the upper parts of the piston wall. This cooling action is supplemented by the rapid expansion of the gases as they pass to the explosion chamber, the effect of which expansion I have found to be felt even in the upper part of the gas volume in the piston near the head.

The explosive mixture is transferred from port 51 in the piston through the transfer duct 15 and the ports 52 and 53. This duct is as short as it can be practicably made so that the successive charges shall be instantly transferred with friction and resistance reduced to a minimum and so that the cooling effect of the gas shall be enhanced as much as possible. Ports 51 and 52 register at the instant when the piston is in its lowermost position and at the same time the port 53 is immediately above the head 40. A gas deflector or guide 54 projects upward from the head 40. And I have arranged the spark plug so that the sheet of incoming gas will be projected directly toward this plug which is eccentrically situated in order that the firing sparks will be in the immediate neighborhood of the incoming explosive. This I have found to be a matter of great importance in two-cycle engines. Generally the plug is in the center of the cylinder; and I have discovered that with such engines the missing of firing occurs frequently. This I have entirely obviated by so arranging, in relation to each other, the gas guide 54 and the spark plug that a mass of comparatively pure mixture will be in the neighborhood of the sparker at all instants after the piston closes the exhaust ports. The piston head quickly follows the charge of explosive mixture, and delivers with certainty a quantity of it in explosive condition to the plug, as will be seen when examining Figure 3.

By referring to Figures 3 to 6 the successive steps in the cycle of movement of the piston will be readily understood. In Figure 3 it is shown just as it stops its upward movement during which it has, by suction, caused an inflow of gas from the supply duct 60, past valve 61, through duct 9 and through port or ports 10.

The only ports through the cylinder wall are those at 10, which are close to the bottom, the cylinder being tightly closed by the base plate 59, preferably cast integral with the cylinder wall. There is no gas escape from the piston after the gas passes the plane of the lower open end 48 until it reaches the port 51 close to the head 40. A large volume of gas can be drawn into the piston chamber 49, 50 and into the lower part of the cylinder.

While the piston is moving down from the position in Figure 3 to those in Figures 4, 5 and 6 it closes the valve 61, and the gas between that valve and the piston head is subjected to pressure, an increase of six or eight pounds, approximately, being pre-

determined. Just before the piston reaches the lower end of its stroke it opens the exhaust port 19 to permit the escape of the spent gases of the previous explosion. It then immediately closes the intake ports 10 at the lower end of the cylinder. When the parts reach the position shown in Figure 6 the port at 51 registers with the short transverse duct 15, and a charge of mixture rushes in to the upper cylinder chamber.

It will be seen that the piston being long and hollow insures the retaining of a large volume of gas in a region where it can be immediately passed to the explosion chamber. When it is in its uppermost position there is a volume of gas below the piston head approximately three times as great as that of a charge which is admitted to the explosion chamber. Consequently the missing of an explosion practically never occurs. Even if the supply of gas at 60, from the carbureter should fail, or if the valve at 61, from inertia or otherwise, should fail to act there is a sufficiency of gas in the piston itself to insure enough of a charge during each of several cycles to obtain power impulses from explosions.

I am aware that relatively long hollow pistons combined with long cylinders closed at both ends and having inlet ports at the lower ends of the cylinders, are within the general design that has been heretofore followed by one or two earlier parties. But I believe myself to be the first to have constructed such engines with the important features which are herein set forth. In the earlier constructions of this restricted sub-class supplemental supply ports have been formed above the bottom ports (corresponding to those at 10 in the present mechanism) with the result that two impulses of incoming gas are experienced.

I have found that the second of these impulses of incoming gas acts to shorten the period during which the pressure in the upper part 50 of the piston chamber is lowered after a charge escapes through ports 51 and 52. I desire to utilize the effect of the inertia in the travel of the gas from the lower part of the piston chamber to the upper part (which inertia prevents the pressure from being as high in the upper part as in the lower part) in order to secure a greater cooling effect in the neighborhood of the parts heated by the explosions.

Hence I eliminate the parts which supply gas mixture at a second port above the bottom ports 10, and so relate the parts as to maintain, practically constantly, a gradation in pressure in the gas below the cylinder head, the gas in the uppermost region tending continually to be expanded in relation to the gas in the lower part of the cylinder. With a long hollow piston such as that in the present construction and reciprocating very rapidly the pressure at the upper end drops many times a minute and the balancing is retarded by the inertia of the upward flow of gas.

Hence, as above described, I have cylinder walls which are imperforate above the ports 10.

The tube 42 (which, as above remarked, serves to compensate for the thinning of the piston walls 39 and its head 40 and to receive the thrusts and strains from the webs 41 also) serves as a holder for the wrist shaft 43 which is rigidly fastened therein. To this wrist shaft is hinged a pitman 44. 45 is a housing (having as part of its outer wall the above specified plate 6^a) which encloses the pitman and the ends of the wrist shaft 43 and also acts as a support, brace and guide for the moving parts. 47 is a slide guide on the outer end of the shaft 43 and fitted in a guideway 46 in the housing or frame 45.

I have shown a timer at 55 with a shaft and driving gear at 56 and also have indicated the main shaft 1 as being provided with ball bearings at 57. These adjuncts, however, can be of any well known or suitable form.

It will be seen that the parts are so constructed and arranged that the engine is very simple. There are no power driven valves, the main ports being controlled entirely by the piston itself, and the device at 61 being merely a check valve. I effect the mingling of the gas components of the explosive mixture at points entirely outside of the engine proper, in a carbureter or equivalent mechanism, the present engine being distinguishable from the earlier ones in the same general class which have had the parts so arranged as to effect the mixing of the explosive ingredients at one point or another within the engine proper. All the preliminary compression is here effected within the piston itself and the closed lower end of the cylinder, the structure in this respect differing from those which depend upon the crank case or some other outside apparatus for securing the preliminary compression. The gas exhaust and water circulating structure (having the tubes and walls 21, 24, 24^a, 25, &c.) being separable from the main cylinder permits the latter to be easily cast and readily manipulated while being finished and fitted. The gas exhaust duct at 20 rapidly expands longitudinally outward to permit the quick escape of the gas. It is arranged to extend from the exhaust port of the cylinder outward in the longitudinal axial plane of the shaft, and consequently a pump of few parts and simple in construction can be driven directly from the shaft, and be so arranged that the incoming water shall be driven directly against the outer end of the gas exhaust duct

section 20. The timer is arranged oppositely to the exhaust, and the feed duct is arranged to direct the gas inward on lines transverse to the shaft. Consequently the front side of the engine is without obstructing projections and the apparatus as an entirety can be conveniently arranged in restricted space.

What I claim is:

In a two cycle explosive engine, the combination with the elongated cylinder with closed top and bottom ends, the elongated hollow cylindrical piston, the crank shaft, the initial inlet port at the bottom of the cylinder delivering gas on lines transverse to the axial plane of the shaft, the pitman outside of the cylinder connected to the piston and to the crank shaft, the exhaust port in the cylinder at points intermediate of its ends, the exhaust duct extending on lines in the longitudinal axial plane of the shaft, the water jacket around the explosion chamber, the water circulating duct around the exhaust duct, the pump having a reciprocating piston, and the pump pitman driven directly from the shaft, said pump piston being arranged to propel water on lines toward the exhaust duct and thence through the water jacket chamber.

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

HENRY LOWE BROWNBACK.

Witnesses:
ROYAL W. URIE,
ROBERT P. LOGAN.