A. BJUR.

COMPOUND INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JAN. 16, 1914.

1,146,840.

Patented July 20, 1915.

2 SHEETS—SHEET 1.

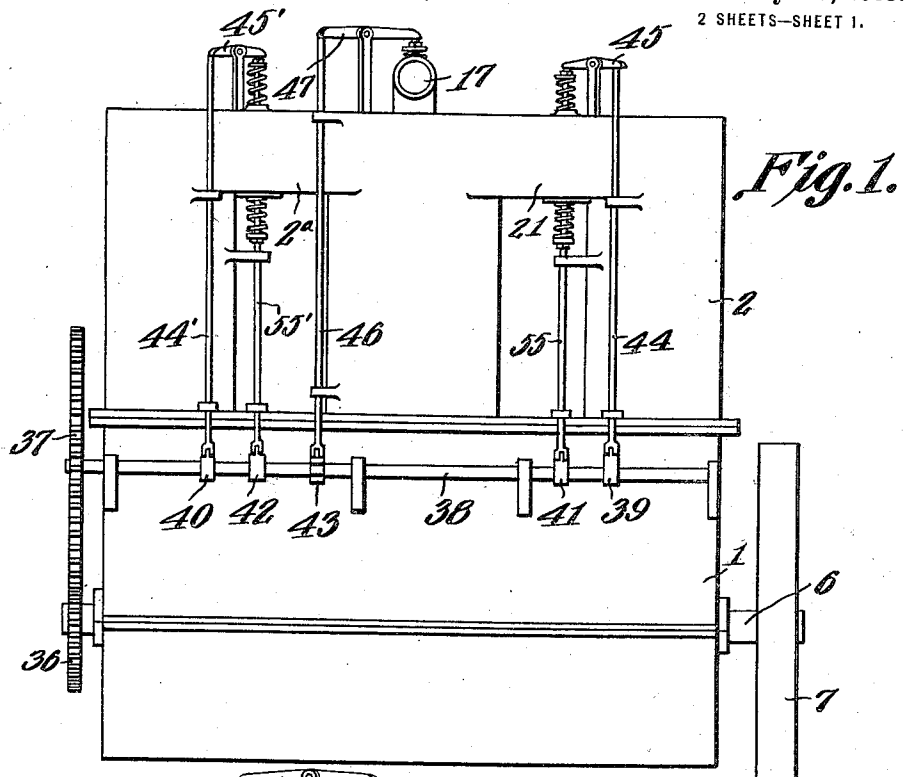

Fig. 1.

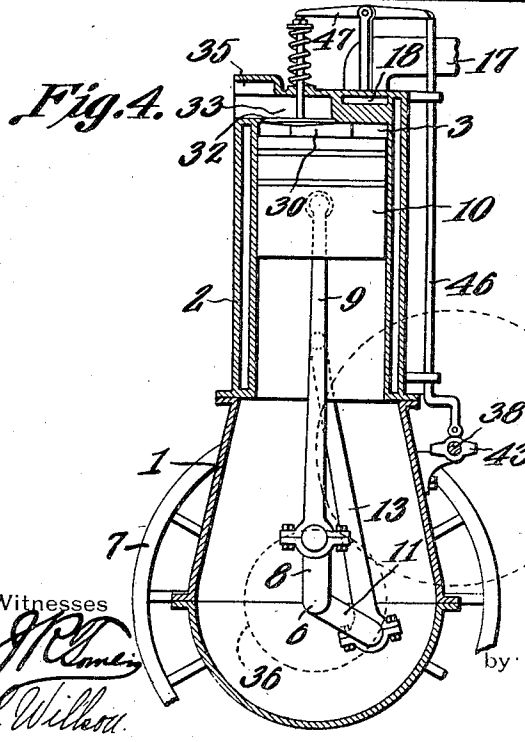

Fig. 4.

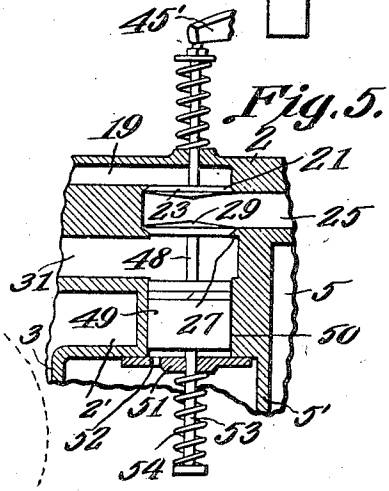

Fig. 5.

Witnesses

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2 SHEETS—SHEET 2.

Fig. 2.

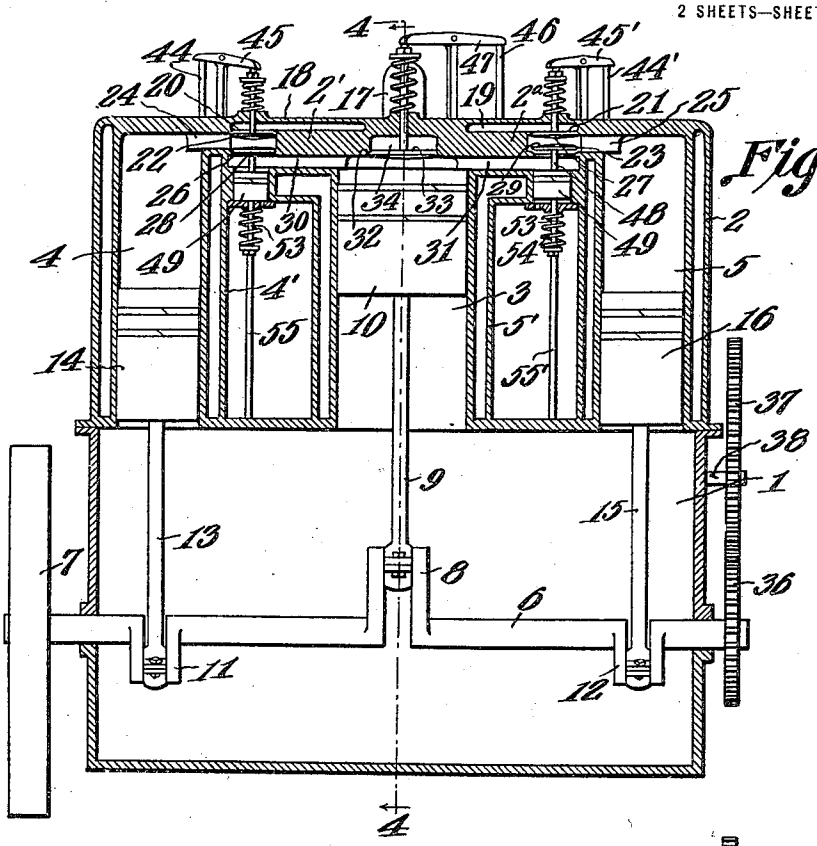
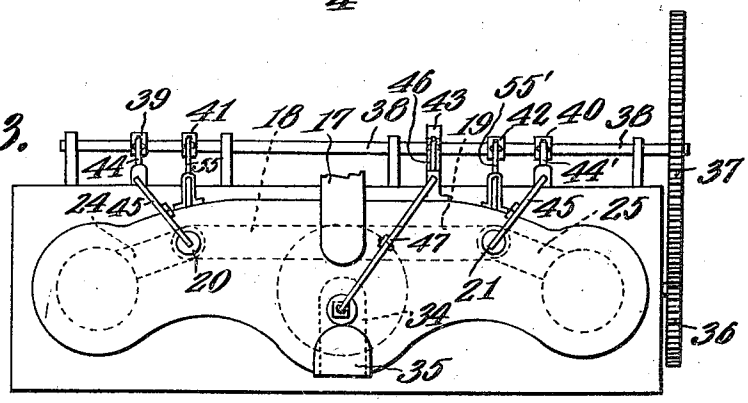


Fig. 3.



Witnesses

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UNITED STATES PATENT OFFICE.

ARTHUR BJUR, OF KULM, NORTH DAKOTA.

COMPOUND INTERNAL-COMBUSTION ENGINE.

1,146,840. Specification of Letters Patent. Patented July 20, 1915.

Application filed January 16, 1914. Serial No. 812,511.

To all whom it may concern:

Be it known that I, ARTHUR BJUR, a citizen of the United States, residing at Kulm, in the county of Lamoure and State of North Dakota, have invented a new and useful Compound Internal-Combustion Engine, of which the following is a specification.

The present invention relates to improvements in compound internal combustion engines, one object of the present invention, being the provision of means, whereby a four-cycle effect is produced with two oppositely disposed cylinders of what is termed high pressure type and a centrally disposed low pressure cylinder, the low pressure cylinder being operated by the exhaust from the two high pressure cylinders so as to receive an impulse every two strokes while the compression or high pressure pistons receive an impulse every four-strokes, thus alternating to produce the desired propelling effect upon the low pressure piston.

A further object of the present invention is the provision of a valve mechanism, by means of which the intake charge is taken at a common or central point and delivered alternately to the respective high pressure chambers, to there be compressed and exploded and delivered through the valve mechanism into the upper end of the low pressure cylinder, the exhaust from the two high pressure cylinders imparting a two-cycle action to the low pressure piston, the cylinder of the low pressure piston being provided with the single exhaust controlled by a mechanically opened valve.

With the foregoing and other objects in view which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed can be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings Figure 1 is a side elevation taken from the valve operating side of an internal combustion engine embodying the present invention. Fig. 2 is a longitudinal central sectional view through the complete engine. Fig. 3 is a top plan view of the complete engine. Fig. 4 is a section taken on line 4—4 of Fig. 2. Fig. 5 is an enlarged detail view showing one of the intake valves and the controlling valve for admitting the exhaust from one of the high pressure cylinders to the low pressure cylinder.

Referring to the drawings, the numeral 1 designates the crank case and base of the engine which carries the casting 2 so constructed as to provide the central low pressure cylinder 3 and the two oppositely disposed high pressure cylinders 4 and 5, the bridging portions 2′ and 2ª being provided and carrying the ports or channels for forming communication with the upper ends of the respective cylinders as will presently appear. Thus the two open spaces 4′ and 5′ are provided in the casting 2 between the low pressure cylinder 3 and the respective high pressure cylinders 4 and 5.

The crank shaft 6 is provided with the fly or balance wheel 7 and has the three cranks 8, 11 and 12, the same being so disposed that all cranks are disposed at an approximate 120 degree position relatively to each other. Connected to the central crank 8 is a piston rod 9 which is operably connected to the low pressure piston 10 mounted for reciprocation within the low pressure cylinder 3.

Connected to the high pressure crank 11 is a piston rod 13 which has operably connected thereto, the high pressure piston 14 mounted for reciprocation within the high pressure cylinder 4, while the piston rod 15 operably connects the crank 12 to the other high pressure piston 16 which is mounted for reciprocation within the remaining high pressure cylinder 5.

A single intake manifold 17 is provided in this engine, the same being disposed to be operably connected with any form of carbureter (not shown), and for directing the explosive charge into the two branches 18 and 19 which are cast within the upper portion of the member 2 and project in opposite directions through the reduced portions 2′ and 2ª of the said casting.

The respective branches 18 and 19 discharge through the valve seated ports 20 and 21 respectively, controlled by the mechanically opened spring closed intake valves 22 and 23 respectively. Leading from the port 20 is a port 24, which leads into the upper end of the high pressure cylinder 4, while leading from the port 21 is a port 25 which leads into the upper end of the opposite high pressure cylinder 5. Thus it

will be seen that the explosive charge admitted through the manifold 17 will be delivered in opposite directions into the upper ends of the respective high pressure cylinders 4 and 5.

To permit of the desired compression and exhaust of the burnt gases from the respective high pressure cylinders 4 and 5, valve controlled ports 26 and 27 respectively, are provided to control the direction of the burnt gases into and through the ports 30 and 31 respectively, to the upper end of the low pressure cylinder or chamber 3. In order to control the ports 26 and 27, the spring closed mechanically opened valves 28 and 29 are disposed to control the ports and therefore constitute exhaust valves for the high pressure cylinders 4 and 5 and intake valves for the low pressure cylinder 3.

The admission and exhaust of the explosive charge to the respective high pressure cylinders 4 and 5 are so timed as to produce four-cycle effects in both of the high pressure cylinders, alternately exhausting therefrom into the low pressure cylinder 3 so as to impart a two-cycle effect to the low pressure piston 10, such low pressure piston 10 thus being operated entirely by the exhaust charges from the two high pressure cylinders 4 and 5. With this construction it is therefore evident that a single exhaust control for the complete engine is only necessary, a port 32 of large area being led from the upper end of the low pressure cylinder 3 and controlled by the mechanically opened spring closed valve 33, the exhaust charge from the low pressure cylinder being led into the channel 34 and out of the exhaust manifold 35. Thus the intake manifold 17 is disposed at a diametrically opposite point to the exhaust manifold 35 both at the upper end of the engine casting.

Although the ports or branches 18 and 19 are shown cast integral in the present structure, it is evident that the same may be constructed of conduits or outside piping and still be within the scope of the present invention.

In order to provide a means for properly timing the operation of the respective valves heretofore described, to produce the four-cycle effect in the two high pressure cylinders 4 and 5 and a two-cycle effect in the low pressure cylinder 3, a driving gear 36 is keyed upon the crank shaft 6 and operably engages the large gear 37, which is twice the diameter of the gear 36, so that the counter shaft 38 will be rotated once every two revolutions of the crank shaft 6.

Keyed upon the counter shaft 38 are the two intake valve controlling cams 39 and 40, by means of which the respective valves 22 and 23 are controlled for admitting the intake of the carbureted charge to the high pressure cylinders 4 and 5, while the two cams 41 and 42 control the respective exhaust valves 28 and 29 which direct the exhaust to the upper end of the low pressure cylinder 3 heretofore described.

A single double cam 43 is keyed upon the counter shaft 38, and is disposed to operate the main exhaust valve 33, at every two cycle movement of the low pressure piston 10.

The mechanism for controlling the two intake valves 22 and 23, includes the two vertically reciprocal rods 44 and 44′ which through the walking beams 45 and 45′ are operably connected to the stems of such valves. The cams for operating these rods, namely cams 39 and 40 are so positioned as to impart a four-cycle admission of the explosive charge to the upper ends of the respective cylinders 4 and 5, as heretofore described.

The main exhaust valve 33 is controlled by the rod 46 through the double cam 43, and the walking beam 47, which is disposed as before described to properly depress the valve 33 once every two cycles of the low pressure piston 10.

It is desirable in this type of engine to counteract the force of the pressure from the ports 30 and 31 tending to lift the valves 28 and 29 at an undesirable time, and also to provide for a cushioning or slightly retarding effect upon said valves in their closing movements and in order to accomplish this, the structure as clearly shown in Fig. 5 is devised. The stem 48 which controls the respective valves 28 and 29 is connected to a piston 49 mounted for reciprocation within the chamber 50, a plate 51 sealing the lower end thereof and being provided with a pressure relieving port 52. The extension stem 53 of the valves 28 and 29 is projected through the sealing cap 51 and has mounted thereon, a spring 54 which normally holds said valve downwardly and in closed position. In order to open the valves 28—29, the respective rods 55 and 55′ are provided, there being two of these valves as heretofore described. Thus the cams 41 and 42 are so positioned upon the counter shaft 38, as to properly elevate the rods 55—55′ to impart the desired movements to the valves 28 and 29 to produce the desired four-cycle effect for exhausting of the burnt charges from the respective high pressure cylinders 4 and 5 into the upper end of the low pressure cylinder 3, such exhausting being so timed and arranged as to impart as before described a two-cycle effect to the low pressure piston 10.

The crank of the low pressure cylinder is set 120 degrees after the two high pressure cranks, that is the low pressure crank is 120 degrees from those of the high pressure cylinder in a direction opposite to the rotation of the crank shaft. This arrangement brings the low pressure piston in position to

receive the exhaust charge before the high pressure cylinder has completed its impulse stroke, which arrangement brings about a considerable lap of the impulse upon the high and low pressure pistons and also a lap in the scavenging of said cylinders.

Spark plugs (not shown) are properly mounted within the high pressure cylinders 4 and 5, so that the compressed explosive charges therein may be ignited at the proper time, there being no ignition means provided for the low pressure cylinder 3, for the reason that the exhaust or burnt charges from the respective cylinders 4 and 5 impart the desired movement to the low pressure piston 10.

What is claimed is:

1. A compound internal combustion engine, including a base, a crank shaft journaled therein, three parallel cylinders cast en bloc, the inner one being the low pressure cylinder and the two outer ones the high pressure cylinders, three pistons mounted in the cylinders and operably connected to the crank shaft, an intake manifold having two branches in the head of the casting and terminating at points above and intermediate of the cylinders, each high pressure cylinder being provided with a port open at its top adjacent the low pressure cylinder, said ports being in communication with the respective branches of the manifold, two spring closed mechanically opened valves at the intersection of the branches and ports to control the supply of carbureted air to the high pressure cylinders, there being two oppositely disposed channels leading from the head of the low pressure cylinder and terminating below and in communication with the ports of the high pressure cylinders, two spring closed mechanically opened valves at the intersection of the last two channels and the ports of the high pressure cylinders to control the passage of burnt gases from the high pressure cylinders to the low pressure cylinder, said low pressure cylinder being provided with an exhaust port, and a spring closed mechanically operated valve for controlling said exhaust port.

2. A compound internal combustion engine, including a base, a crank shaft journaled therein, three parallel cylinders cast en bloc, the inner one being the low pressure cylinder and the two outer ones the high pressure cylinders, three pistons mounted in the cylinders and operably connected to the crank shaft, an intake manifold having two branches in the head of the casting and terminating at points above and intermediate of the cylinders, each high pressure cylinder being provided with a port open at its top adjacent the low pressure cylinder, said ports being in communication with the respective branches of the manifold, two spring closed mechanically opened valves at the intersection of the branches and ports to control the supply of carbureted air to the high pressure cylinders, there being two oppositely disposed channels leading from the head of the low pressure cylinder and terminating below and in communication with the ports of the high pressure cylinders, two spring closed mechanically opened valves at the intersection of the last two channels and the ports of the high pressure cylinders to control the passage of burnt gases from the high pressure cylinders to the low pressure cylinder, said low pressure cylinder being provided with an exhaust port, a spring closed mechanically opened valve for controlling said exhaust port, said crank shaft being provided with three cranks, one for each of the pistons, the cranks connected to the high pressure pistons being disposed at 120 degrees from the crank of the low pressure piston.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

ARTHUR BJUR.

Witnesses:
DAVID WIRCH,
E. M. ANDERSON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."