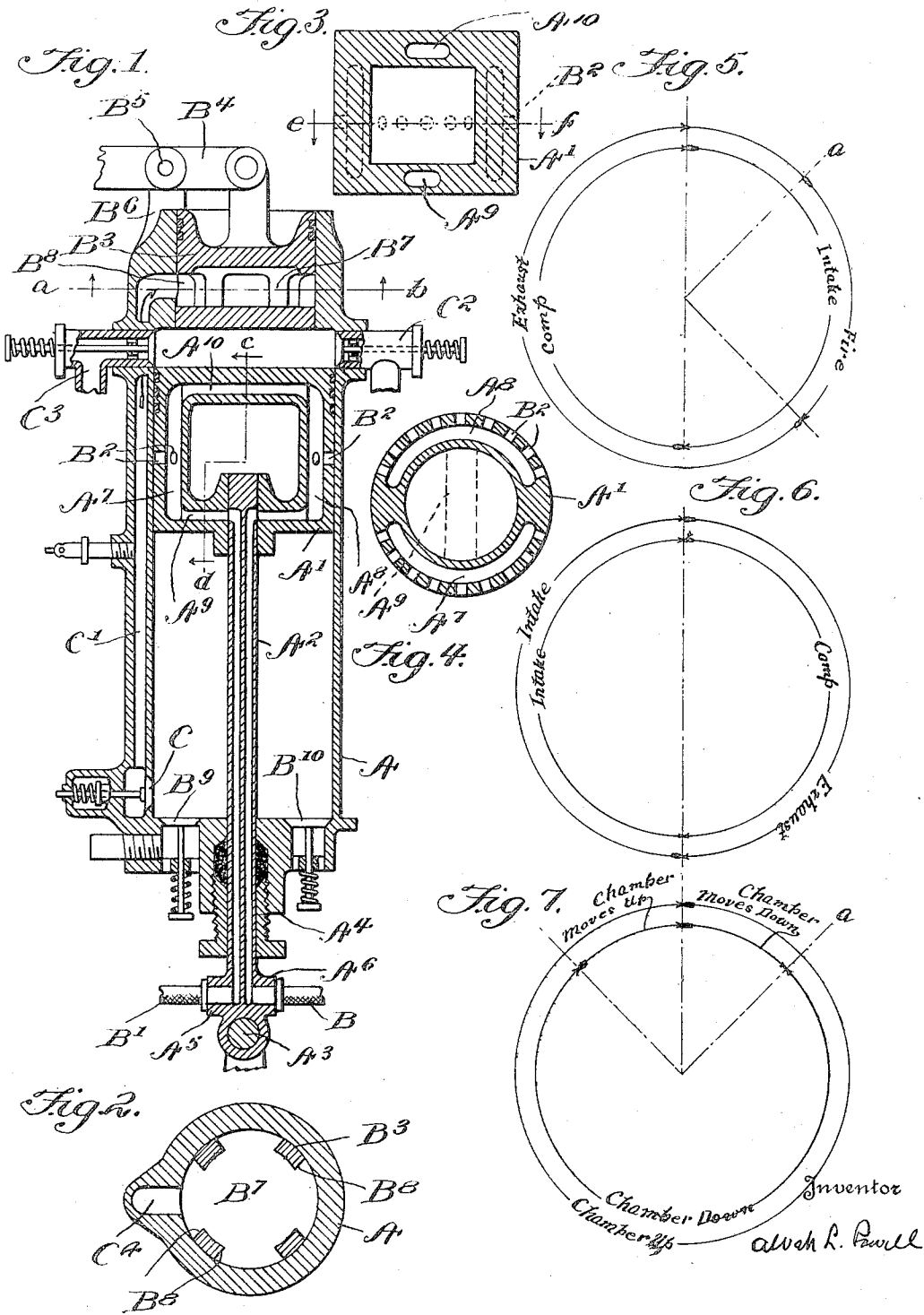


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INTERNAL COMBUSTION ENGINE.
APPLICATION FILED FEB. 2, 1921.

1,433,650.

Patented Oct. 31, 1922.

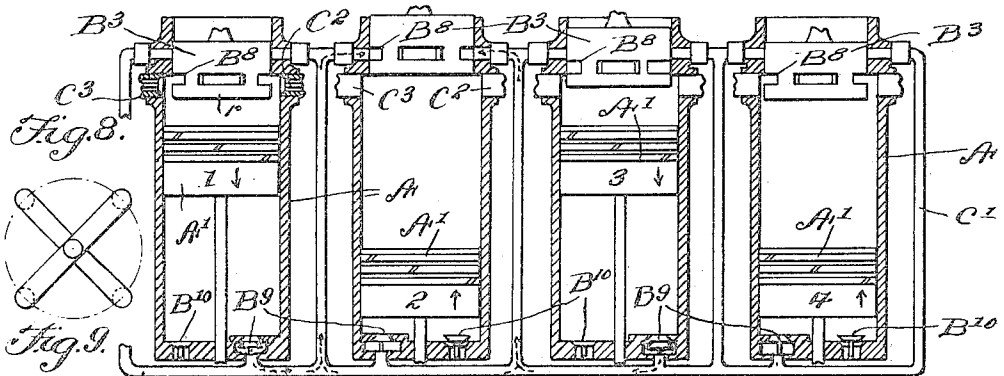
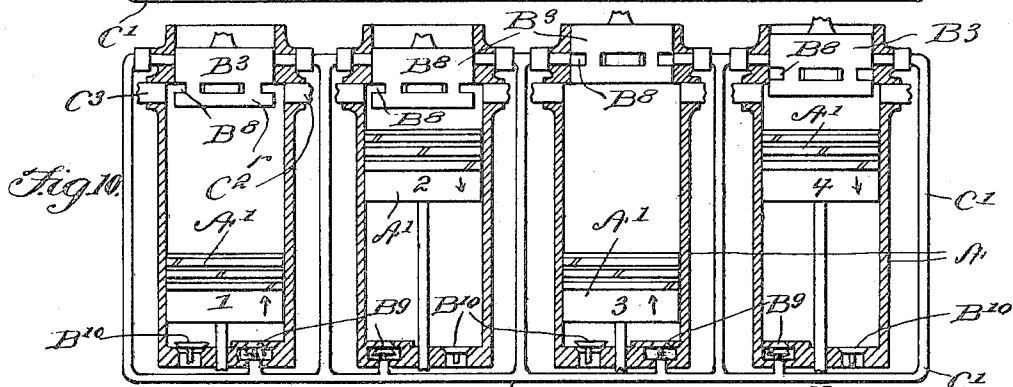
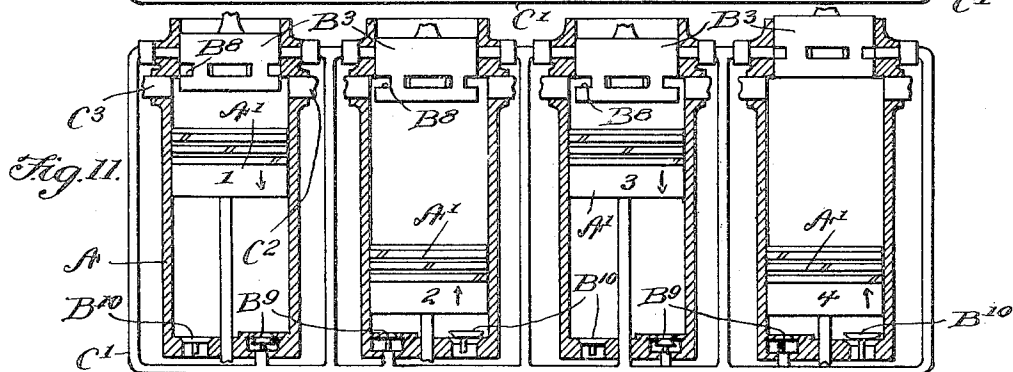
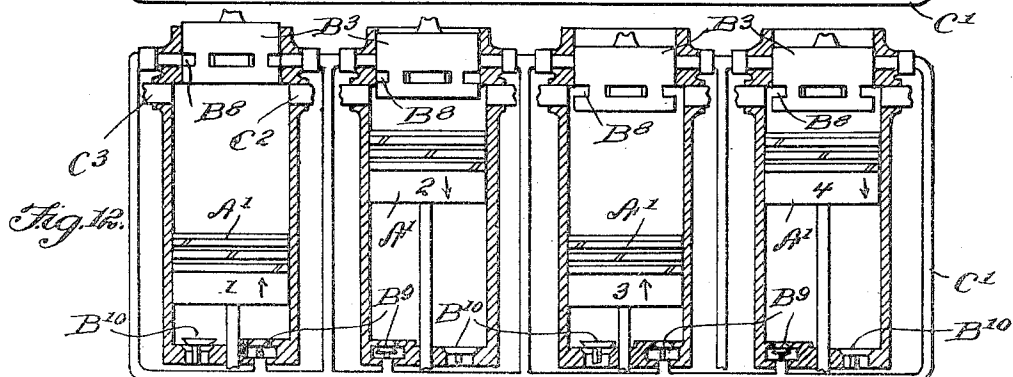
2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.



atlas L. Powell, Inventor.

UNITED STATES PATENT OFFICE.

ALVAH L. POWELL, OF MILES CITY, MONTANA, ASSIGNOR TO THE A. L. POWELL POWER CO., INC., OF MILES CITY, MONTANA, A BODY CORPORATE.

INTERNAL-COMBUSTION ENGINE.

Application filed February 2, 1921. Serial No. 441,971.

To all whom it may concern:

Be it known that ALVAH L. POWELL, a citizen of the United States, residing at Miles City, in the county of Custer and State of Montana, has invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to improvements in internal combustion engines in which I obtain advantages by the use of multiple cylinders in combination with a system of compression distribution between the related and connected cylinders, and by further providing means for igniting an explosive charge by the heat of a volume of air compressed to a high degree. I also obtain an additional cooling effect by the induction and exhaust of air in front of the piston during part of a cycle. In the accompanying drawings I show a form of my improvement, in which—

Fig. 1 is a sectional elevation of one cylinder and the related parts.

Fig. 2 is a section on *a—b*, Fig. 1 looking in direction of arrows.

Fig. 3 is a section of the power piston, taken on the dotted line *c—d*.

Fig. 4 is a section on line *e—f*, Fig. 3.

Figs. 5, 6, 7, are diagrams of the operation during a cycle.

Fig. 9 is a diagram, showing the order of the crank impulses.

Figs. 8, 10, 11, 12, are vertical elevations, partly in section, of cylinders: pistons and valves being shown at successive parts of cycle.

In Fig. 1, a cylinder, A, contains a piston, A¹, slidable therein and connected, by piston rod A² with a crank connecting rod by a wrist pin, A³. The crank connecting rod and related power shaft parts are not shown. The piston rod A² passes through a gland, A⁴, suitably packed, as indicated in drawing. A² communicates with bosses A⁵, A⁶, the latter bored and connecting with passages in A². These run to a cored space in A¹. Holes in walls of piston lead into this space as shown in sectional view Fig. 1. In Figs. 3, 4, the form of the cored space in piston A¹ is shown. It will be observed that the area is partly divided by solid sections through center, leaving cavities A⁷, A⁸. These are connected by cross channels A⁹,

A¹⁰. Flexible tubes B, B¹, are fitted to the bored bosses A⁵, A⁶, and communicating with a lubricating oil supply. This oil passes upward into piston on one side and downward to the oppositely placed flexible tube on the other. In this way a constant medium for lubrication is furnished, the walls of A being oiled through the holes B², B³.

In the head of A, a bored opening admits a second piston, B³, slidable therein. This piston is operable by a crank lever, B⁴, pivoted on a pin, B⁵, in a cylinder lug, B⁶. The crank lever is operated by a cam on engine that is not shown in the drawing. The piston B³ is cored, the cavity so formed being shown at B⁷. From this cavity there are openings that lead to cylinder wall, and in Fig. 1 one of the openings can be seen while coinciding with an open cored space in wall of cylinder A, at B⁸. These openings are ports and will be so termed in the remainder of this specification.

In the lower head of cylinder A are located operable valves B⁹, B¹⁰. On one side of said cylinder, and near the bottom, there is another valve, C. This is a check valve that controls entrance to a cored hole C¹ in the wall of A. This hole C¹ passes up the side of A to passage C⁴, (Fig. 2) to the port B⁸ in upper head, Fig. 1. On cylinder A there are further provided an operable inlet valve, C², and an operable outlet valve, C³.

I will first describe the operation of one cylinder of my improved engine and then take up the movements of related parts as shown in Figs. 8, 10, 11, 12.

Let it be assumed that a charge of compressed air, at high temperature, fills the cavity C¹ and space B⁷ of piston B³, and that an explosive mixture of air and fuel has been admitted to cylinder A above piston A¹. On starting engine, piston A¹ will move downward until the crank of power shaft has reached a point *a* on crank circle this motion occurs after compression, being indicated in Fig. 5 by the space from end of compression to *a*, this being indicated in Figs. 5, 7. During this movement piston B³ follows it at the same speed, by the action of a cam, not shown. The space between the pistons remains constant during this part of movement. As B³ follows A¹ the port B⁸ in said piston opens into the space above A¹.

A charge of highly compressed air has been trapped in the space B⁷ from the passage C¹ and is transferred to the explosion chamber. The highly compressed air, heated to the necessary temperature by its own compression, comes in contact with and ignites the explosive charge above piston A¹. The latter continues downward, developing power from the combustion that takes place. The high compression of the igniting air is an added volume to the already compressed charge in the combustion chamber. Piston B³ remains down, being held by a dwell on the controlling cam (not shown) and in this position the port into cylinder wall passage C¹ is closed, B³ acting as a piston valve. Piston A¹, on upstroke, drives out the products of combustion through operable exhaust valve C³ that opens for the purpose, and near end of its stroke piston B³ returns to its original position, Fig. 1. On succeeding downstroke valve C³ closes and operable fuel intake valve C² opens and an explosive charge is drawn in. At end of downstroke valve C² closes and the fresh charge is compressed on upstroke.

On first downstroke of piston A¹ the air in front of it is exhausted through operable valve, B⁹. On succeeding upstroke B⁹ closes and operable valve B¹⁰ opens, a charge of fresh air being drawn in. On succeeding downstroke the valve B⁹, B¹⁰, both remain closed and the air is compressed into cylinder passage C¹, through check valve C, passing up to the cored space in piston B³ and filling it with a fresh charge of compressed air.

In Fig. 5, a diagram of the cycle in the firing chamber is shown. Explosion occurs at a point *a*, and expansion continues for a quarter of stroke. Exhaust follows on downstroke and unstroke. Intake and compression are indicated. Fig. 6 is a diagram of the cycle in the compression chamber in the lower part of cylinder A. On downstroke of piston A¹ a charge of air is driven out through valve B⁹. On upstroke a charge is indrawn through B¹⁰, as marked "intake," and is compressed on succeeding downstroke, passing to cored passage C¹. On succeeding upstroke, intake is repeated, as shown in diagram. Fig. 7 shows the cycle of the piston B³. When A¹ moves down piston B³ follows, for a distance indicated on diagram and remains down while A¹ is on power stroke. A¹ moves up at a point marked "Chamber moves up". The period of dwell is shown on the circles, at points marked "Chamber up", "Chamber down".

In Fig. 8 four cylinders of an engine are shown, with connecting pipes, valves and pistons. The construction is the same as has been described for cylinder A, with the exception that valve C is omitted; valve B⁹

is not operated by a cam, being only an outlet check valve; valve B¹⁰ is an inlet check valve, to prevent return of a compressed charge to the pipe line C¹.

The operation is as follows:

In Fig. 8, piston 1 (A¹) is moving downward, by reason of an exploded charge behind it. In front of said piston a charge of air is being compressed into pipe line C¹, through valve B¹⁰. The same action is taking place with reference to piston 3 (A¹). Pistons 2 (A¹), 4 (A¹), move up, compressing an explosive charge in front of them and indrawing a fresh charge of air through valves B⁹. During downstroke of piston 1 (A¹), secondary piston B³ remains in position shown at *r*, Fig. 8. On return stroke of piston 1 (A¹), piston B³ remains as shown at *r* in Fig. 10. On intake stroke of piston 1 (A¹), secondary piston B³ has receded to position given in Fig. 11. The port B⁸ is cut off. On succeeding upstroke for compression, piston B³ is in position shown in Fig. 12 a highly compressed charge has passed through pipe C¹ and filled cavity in B³, through port B⁸, and as piston reaches end of upward fuel charge compression stroke both pistons descend together until port B⁸ has reached point indicated by *r*, Fig. 8. The charge of air in secondary piston B³ ignites the fuel charge already compressed by piston 1 (A¹), and the latter continues to move, by reason of the pressure developed by the combustion of its own charge, reinforced by the added hot air charge from C¹.

Two cylinders work together for compressing air in C¹ on each downstroke, this charge passing through C¹ to B³. The same relative action occurs with the other pistons, at the same points of stroke, as indicated in the complete cycle of four positions in Figs. 8, 10, 11, 12. I thus secure a large volume of highly compressed air in B³, this serving, by reason of its temperature, as an ignitant, while, by reason of its pressure, it increases the average compression of the combustion charge. This adds to the power of an engine embodying the improvements I have described over one of the same size operating with the usual cycle and form of construction.

What I believe is new and ask to have protected by Letters Patent is—

In an internal combustion engine, the combination of a power cylinder, a power piston, a chamber within said power piston, a piston rod, separate channels in said rod, communicating means from said channels to said chamber, communicating means from said rod to a lubrication source, a gland and stuffing box, means for moving said rod through said stuffing box, inlet and outlet valves in closed end of power cylinder, a longitudinal channel integral with said

cylinder wall, a check valve in said channel, operable fuel admission and exhaust valves in said power cylinder, a secondary piston, means for moving said piston in head of power cylinder, a chamber in said piston, communicating means between said piston and said longitudinal channel, communicating means for exhausting a charge from the chamber in said piston into a combustion chamber, and transmission means from power piston to a crank shaft, substantially as described.

In testimony whereof I affix my signature.
ALVAH L. POWELL.