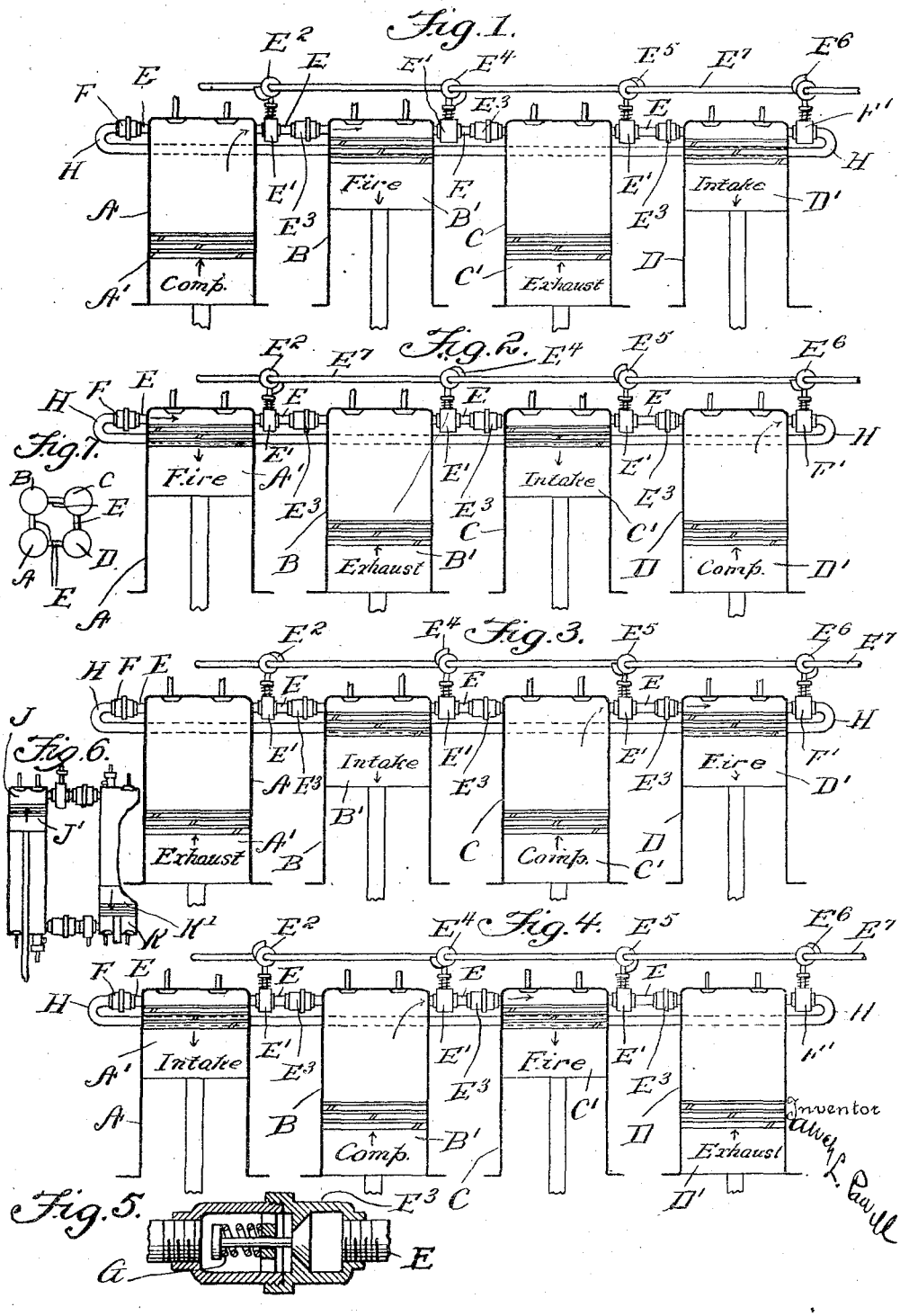
July 14, 1925. 1,545,924

A. L. POWELL

INTERNAL COMBUSTION ENGINE

Filed Dec. 16, 1920



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UNITED STATES PATENT OFFICE.

ALVAH L. POWELL, OF MILES CITY, MONTANA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE A. L. POWELL POWER COMPANY, INC., OF MILES CITY, MONTANA, A CORPORATION OF MONTANA.

INTERNAL-COMBUSTION ENGINE.

Application filed December 16, 1920. Serial No. 431,305.

To all whom it may concern:

Be it known that I, ALVAH L. POWELL, a citizen of the United States, residing at Miles City, in the county of Custer and State of Montana, have 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 provide means for minimizing the effects of back-firing and, at the same time, get a percentage of work from what would otherwise be dissipated energy. This results in added efficiency and greater smoothness of operation. My invention more particularly applies to high compression engines, for the temperature of the cylinder walls added to that of compression, increases the average of premature ignitions among them. Where this takes place the force of the explosion acts on the piston before the crank has completed its stroke, and becomes a brake for a fraction of the movement, effectually reducing the average power. Severe structural stresses are also set up, sometimes involving serious consequences.

In my invention, the force of a preignited charge is diverted to another cylinder where it acts on a piston that is at a point in its stroke where it is ready to transmit pressure to the crank shaft in the direction most favorable to power.

In the accompanying drawings I show an application of my invention, in which Figs. 1, 2, 3, 4, represent the working parts of a four cycle, four cylinder engine at various points of stroke.

Fig. 5 is a sectional detail of the self-acting relief valve. Fig. 6 is a modification of my invention. Fig. 7 is a plan view, illustrating a cylinder arrangement to shorten pipe connections.

In Fig. 1 four cylinders are shown, in each of which a piston is at a different point of the cycle. In cylinder A piston A^1 is on upstroke, for compression; in cylinder B piston B^1 is moving out on power stroke, the charge having been fired. In C piston C^1 is on exhaust stroke. In D piston D^1 is on intake stroke. Between the cylinders are connecting pipes, E, and on each section there are two valves. Valve E^1 is cam operated, a cam, E^2, being shown between A and B. This valve controls the time during which the effect of an explosion can pass to another cylinder for, until it has been uncovered, the cylinder proper, in this case A, remains cut off from all the others. On the pipe line E is also placed a valve E^3. The construction of this valve is shown in Fig. 5. It is an ordinary check valve, spring weighted to open only when pressure has passed a given point. Each pipe unit is equipped in the same way, the explanation given covering all.

The four cams E^2, E^4, E^5, E^6, are mounted on a cam shaft, E^7, supported at convenient points in the engine, and operated from the power shaft by conventional means, not shown.

The valves F, F^1, on the outside of cylinders A and D, are connected by a return bend in the pipe E, as clearly shown in drawing, Fig. 1

Let it be assumed that piston A^1 is on compression stroke, and that ignition takes place prematurely. On completion of part of the upward compressing stroke valve E^1 would be opened by the cam E^2, and remain so until end of compression. The pressure in A will therefore pass valve E^1, going to the check valve E^3. As soon as the pressure exceeds the tension of the spring G on the valve shown in Fig. 5, this valve will yield and the heated gases will pass to cylinder B. The piston B^1 will then be on outstroke, having fired. As preignition in A cannot affect B until valve E^2 has opened E^1, and this will not take place until some point past middle of stroke, the pressure in B will be falling when valve E^1 opens. The pressure in B will rise, the heat in the gases from A being converted into work by the piston B^1. It is not to be understood that all the heat developed in a cylinder will thus be changed into work. By reason of the enlarged volume of expansion due to the area of two cylinders being involved, the effective pressure must be lower than it would be ordinarily. At the same time, part of the heat usually lost would positively appear as work, the general structure of the engine being thus protected from the ill-effects of back firing.

Figs. 1, 2, 3, 4, give each cylinder through its respective cycle. It is evident that what holds true for cylinders A and B will ap-

ply to the others; that is, the pressure from B would pass to C; from C, to D; while from D it would pass to A, through the pipe line formed by the bends at H, H. Should no back fire take place, the engine would run as it usually does.

In Fig. 6 I show a modification from the description made above. In this, the cylinder is closed at both ends, the piston acting as in a two stroke engine. The firing chambers are shown at J and K. Assuming preignition in J, then the force will pass to the rear of piston K^1. Similarly, a premature explosion in K would pass to rear side of piston J^1. The effect on the crank shaft would be the same as in the construction already described.

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

1. In an internal combustion engine, the combination of a series of cylinders, connecting means between said cylinders, relief valves in said connecting means, and controlling valves governing the operative period of said relief valves.

2. In an internal combustion engine, the combination of a series of cylinders, pistons in said cylinders, connecting means between said cylinders, positively operable valves in said connecting means, relief valves in said connecting means and means for opening and closing said first mentioned valves so as to govern the operative period of said relief valves.

3. In an internal combustion engine, the combination of cylinders, pistons in said cylinders, communicating pipes between said cylinders, a cam operated valve in each of said communicating pipes, a relief valve in each of said communicating pipes operable by a charge of a predetermined minimum force, each of said cam operated valves being opened when the piston in one of the adjacent cylinders thereto is on compression stroke and remaining open until the end of the compression stroke so that if preignition takes place, a part of the expanding gases will pass through the cam operated valve and open the relief valve and thence pass into the next cylinder.

4. In an internal combustion engine, the combination of four cylinders, pistons in said cylinders so arranged that when one of said cylinders is on compression stroke, a second piston is on firing stroke, a third is on exhaust stroke and a fourth is on intake stroke, a communicating means between the first and second cylinders, a communicating means between the second and third cylinders, a communicating means between the third and fourth cylinders, and a communicating means between the first and fourth cylinders, a cam operated valve and a relief valve in each of said communicating means, and means to open each of said cam operated valves on the compression stroke of a cylinder adjacent thereto so that in case preignition occurred in said cylinder the expanding gases would pass through the cam operated valve, open the relief valve and expend its force in the next cylinder.

5. In an internal combustion engine, a combination of cylinders, pistons in said cylinders, communicating pipes between said cylinders, a valve in each of said communicating pipes, means whereby each of said valves is opened during a portion of the cycle of said pistons, a fluid controlled valve in each of said communicating pipes adapted to be opened when the charge in the cylinder adjacent thereto back-fires, thereby allowing a portion of the charge to pass into the next cylinder.

In testimony whereof I affix my signature.

ALVAH L. POWELL.