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V. U. D. PIERCE
INTERNAL COMBUSTION ENGINE
Filed July 5, 1917

Fig. 2.

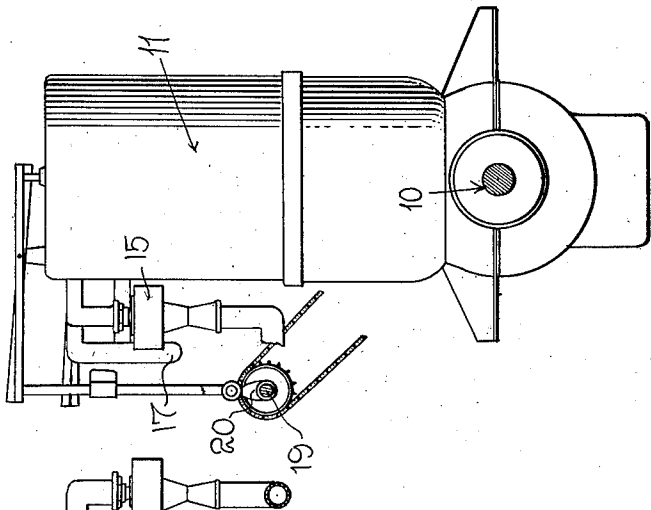
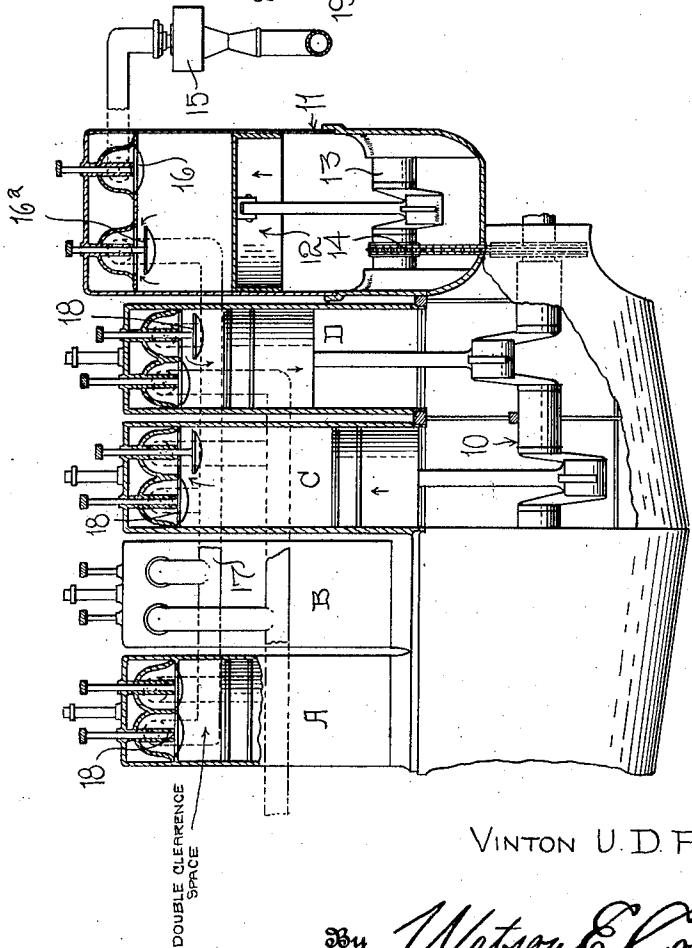


Fig. 1



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INTERNAL-COMBUSTION ENGINE.

Application filed July 5, 1917. - Serial No. 178,692.

To all whom it may concern:

Be it known that I, VINTON U. D. PIERCE, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to internal combustion engines of the four-cycle type, and particularly to means for forcing a charge of fuel into the cylinders of the engine.

While this invention is not limited to use with internal combustion engines designed for the propulsion of aircraft, it is particularly designed for this purpose for the reason that one of the problems in the design of aircraft engines is to secure a maximum of horse power with a minimum of weight.

A further object in the design of engines for aircraft is to keep the engine as simple as possible and depart as little as possible from the standard construction.

To this end, the general object of my invention is the provision of means whereby gas to an amount greater than the cubic capacity of the cylinder may be positively forced into the cylinder on the intake stroke of the piston thereof, the cylinder, however, being made with twice the clearance space of an ordinary cylinder having the same capacity so that final compression will not be increased, but so that the charge will be largely increased for each cylinder and the force of the explosion therefrom largely increased with an increase in the resultant horse power.

A further object is to provide means to this end which while increasing the horse power to a relatively large extent, will not increase the weight of the engine or the complication of the engine proportionately.

Other objects will appear in the course of the following description.

My invention is illustrated in the accompanying drawings, wherein:—

Figure 1 is a vertical sectional view through an engine constructed in accordance with my invention; and

Figure 2 is an end elevation of the engine shown in Figure 1.

It is to be understood that the figures above referred to are very largely diagram-

matic and are merely intended to illustrate the principle of my invention, it being obvious that the mechanism whereby this principle is carried into effect will be variously modified to suit different circumstances of operation and different styles of engines. In these figures A, B, C and D designate the several cylinders of an internal combustion engine having therein the usual pistons, these pistons being operatively connected to the crank shaft 10 in the usual manner. The cylinders are precisely the same as the cylinders of any internal combustion engine, except as regards the cubic contents of the cylinder, and each cylinder should have a capacity such that approximately twice the ordinary charge should be compressible within the cylinders without, however, increasing the degree of final compression. Thus the clearance space between the piston and the head of the cylinder will be larger than the clearance space normally or ordinarily found in internal combustion engines between the head and the piston. This clearance space is proportionately greater than the clearance space normal to normal cylinders of the same capacity, as the pump cylinder is greater in cubic capacity than the engine cylinder.

Disposed in conjunction with the several cylinders is a pumping cylinder, designated 11. The walls of this cylinder may be relatively light. Operating within this cylinder is a pumping piston 12, which also may be relatively light. The piston 12 is reciprocated within the cylinder 11 in any suitable manner and these reciprocations are timed with the reciprocations of the pistons in the cylinders A, B, C and D. I do not wish to limit myself to any particular means for operating this piston 12 but have shown for this purpose a crank shaft 13, driven from the main crank shaft 10 by means of a sprocket chain 14. Where four cylinders are used, the piston 12 should reciprocate twice for each reciprocation of the pistons in the cylinders A, B, C and D.

The cylinder 11 is connected to a carbureter of any suitable construction, designated 15, and the fuel is drawn first into the cylinder 11, and then discharged from the cylinder 11 into successive working cylinders. A valve 16 controls the passage of the fuel from the carbureter into the cylinder 11, this valve, while it may be a check

valve or poppet valve, being preferably a mechanically operated valve. Thus when the piston 12 moves downward upon its induction stroke, the valve 16 opens or is
 5 opened and allows the charge to pass into the cylinder 11. Upon the reverse movement of the piston 12, the valve 16 closes. A valve 16^a controls discharge from cylinder 11.

The cylinder 11 is connected to a manifold 17 by which a charge is conducted to the several cylinders of the engine, the discharge of gas into the several cylinders being controlled by inlet valves 18 of any
 10 suitable construction, there being one inlet valve for each cylinder. I do not wish to limit myself to the location of the inlet valves, as illustrated, nor to any particular means for operating the inlet valves, but I
 15 have shown for this purpose a cam shaft 19 extending along the cylinders and having cams 20 thereon operating the inlet valves. It will be obvious that rotatable inlet valves may be used and that many different suitable constructions might be devised for the
 20 purpose of controlling the movements of the inlet valves. Exhaust valves should also be provided and these may be of any suitable type and as the exhaust valves form no part of my invention, there is no necessity
 25 of particularly describing or illustrating these particular exhaust valves.

The cylinder 11 will have a capacity greater than the capacity of any one of the cylinders A, B, C and D. Thus the cylinder
 30 11, we will assume, will have a capacity twice that of the cylinders A, B, C and D, or have a capacity three-fourths greater than the capacity of the cylinders A, B, C and D. This is a matter of design which may be
 35 obviously modified to suit any special circumstances or as may be found best in practice. Assuming that the cylinder 11 has a capacity twice that of the cylinders A, B, C and D, then upon the intake stroke of the
 40 piston, in any one of the cylinders, as for instance the cylinder D, the piston 12 will be on its instroke and the contents of the cylinder 11 will be forced into the cylinder D. I referred above to the cylinder D as
 45 having a capacity of one-half that of the cylinder 11, but this is not quite right, for the reason that allowance must be made for the clearance so that the cylinder 11 will not have quite twice the capacity of the
 50 cylinder D. As soon as the piston 12 has completed its stroke and the piston in the cylinder D has completed its out stroke, the valve 16^a closes and the valve 18 closes. Upon the next following stroke of the piston
 55 in cylinder D, the nearly double charge in cylinder D will be compressed in the usual manner, but however as the clearance in cylinder D is practically twice that of the clearance ordinarily found in a cylinder of
 60 the same capacity, the compression within

cylinder D will be no greater than the compression usual in internal combustion engines. The charge is then fired in the usual manner. As there is a double charge in the
 65 cylinder, it is obvious that the explosion will have a much greater force than with a single charge and a much greater horse power will be developed.

While I have referred to the cylinder 11 as having a capacity nearly double that of any
 70 one of the cylinders A, B, C and D, yet it is obvious that it may have a less capacity than that or a greater capacity and that if it be desired to also secure a higher compression, the clearance space in the several cylinders may be reduced. I believe, however,
 75 that it is not desirable to reduce this clearance space and increase the compression, as this increases the amount of work which has to be done in order to compress the charge
 80 and to this extent reduces the power of the engine which may be used for doing work. The degree of compression is entirely a matter of practice, which will vary with different types of engines and with different
 85 circumstances of operation.

The problem in flying machine engines is one of power for engine weight and one solution of this problem has been offered in the
 90 use of a plurality of inlet and exhaust valves so that a greater amount of fuel may be drawn into the cylinders on each stroke. This, however, has not been entirely satisfactory. Furthermore it is one of the desiderata of engine constructions that forced
 95 induction be used and this is secured by my improvement. It will be seen that the engine is not increased in weight proportionately to the increase in power, for the reason
 100 that only one cylinder 11 is used for all of the four or more working cylinders A, B, C and D and that this cylinder 11 and the piston operating therein may be of relatively
 105 light construction, because of the fact that there is very little strain on these parts, the fuel being only slightly compressed by being forced into the cylinder with which the pumping cylinder is temporarily connected,
 110 and further it will be seen that the valve mechanism is of an ordinary type, quite commonly used, and that the means for driving the piston 12 may be of the simplest
 115 character. It is, of course, obvious that there will be an increased consumption of fuel proportionate to the increase in power.

Since the pumping means, namely the cylinder 11 and the piston 12 is a reciprocating
 120 pumping means, the current delivered is a pulsating current, and the pumping means is so timed with respect to the charging stroke of the pistons, that a maximum pressure coincides with the charging stroke of each cylinder.

While I have referred to this invention as being particularly applicable to aeroplane
 125

engines, I wish it understood that it is also obviously applicable to ordinary automobile engines, power engines and the engines of motorcraft of all kinds, and that I do not wish to be limited to its use with aeroplane or dirigible engines. Neither do I wish to be limited to the exact arrangement of valves, nor to the particular construction of valve gear shown.

10 Having described my invention, what I claim is:—

1. A multiple cylinder multi-cycle internal combustion engine comprising cylinders and pistons working therein, a carburetor, and an independent pumping means geared to operate successively in synchronism with the suction stroke of each piston; said means being connected between said carburetor and cylinders and provided with relatively extended connections whereby substantially complete vaporization of the fuel occurs during the passage of the charge.

2. A multiple cylinder multi-cycle internal combustion engine comprising cylinders and pistons working therein, a carburetor, and an independent pumping means geared to operate successively to discharge thereto in synchronism with the suction stroke of each piston; said cylinders being provided with a manifold and connections leading from said carburetor to said means and from said means to said manifold.

3. A multiple cylinder internal combustion engine comprising cylinders and pistons

working therein, a carburetor, an independent reciprocating pumping means mounted on said engine and connected between said carburetor and cylinders, and mechanical connections driven by said engine arranged to reciprocate said pumping means twice to one of a piston in synchronism with the suction strokes of the engine pistons whereby charges at pressures in excess of those of the positive pumping capacity of said pistons are drawn in said cylinders.

4. In a multiple cylinder internal combustion engine, the combination with the intake manifold and the carburetor, of reciprocating pumping means arranged between the carburetor and the manifold and controlled by the engine to operate in synchronism on its compression stroke with the suction strokes of the pistons of the respective cylinders to discharge thereinto and arranged to provide a maximum pressure in the manifold at each of the said strokes.

5. In a multiple cylinder internal combustion engine, the combination with the carburetor and the intake manifold, of pumping means arranged between the carburetor and the manifold, and delivering a pulsating current to the manifold whose periods of maximum pressure are timed to coincide with the charging of the cylinders.

In testimony whereof I hereunto affix my signature.

VINTON U. D. PIERCE.