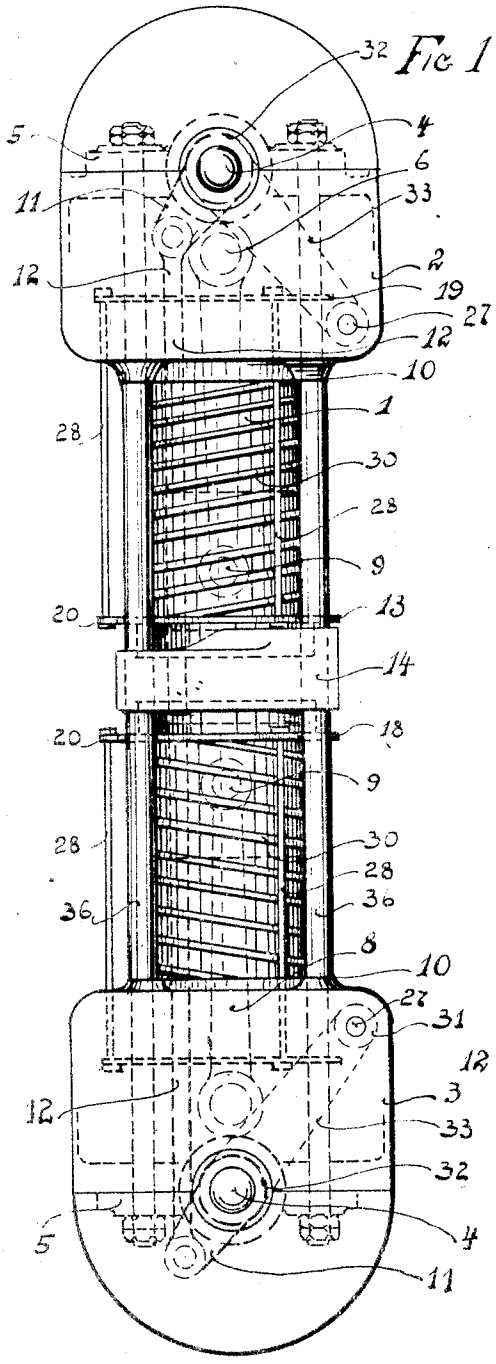
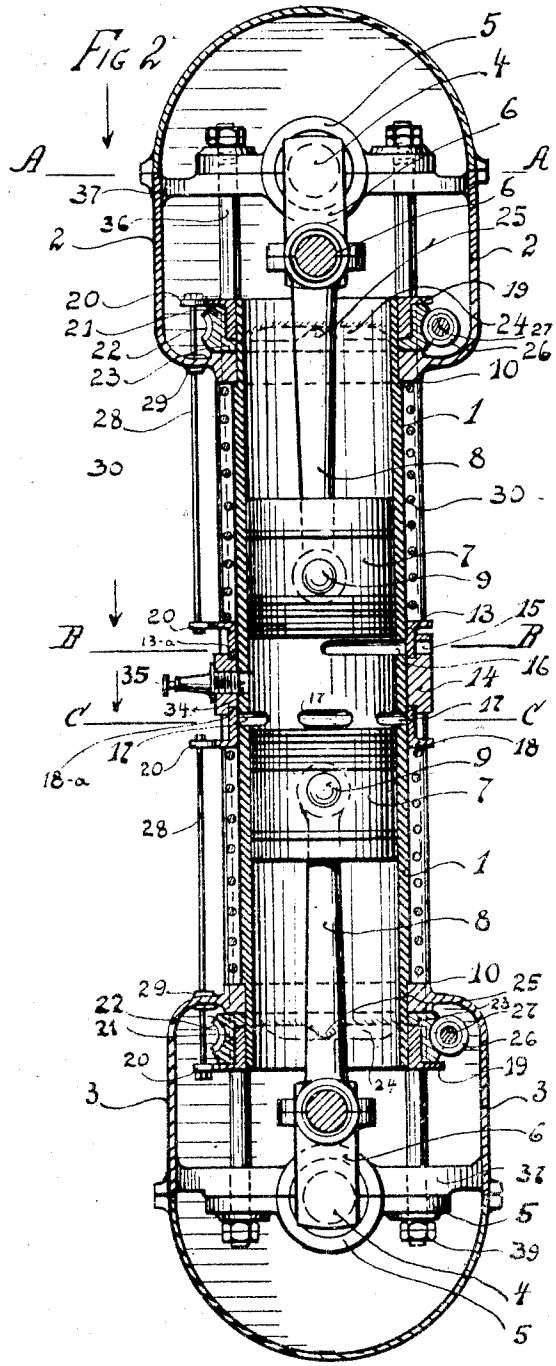
May 3, 1932. F. C. L. D'AIX 1,856,242

INTERNAL COMBUSTION ENGINE

Filed Sept. 30, 1927 2 Sheets-Sheet 1





Inventor. F. C. L. d'Aix

May 3, 1932. F. C. L. D'AIX 1,856,242

INTERNAL COMBUSTION ENGINE

Filed Sept. 30, 1927 2 Sheets-Sheet 2

Fig 3.

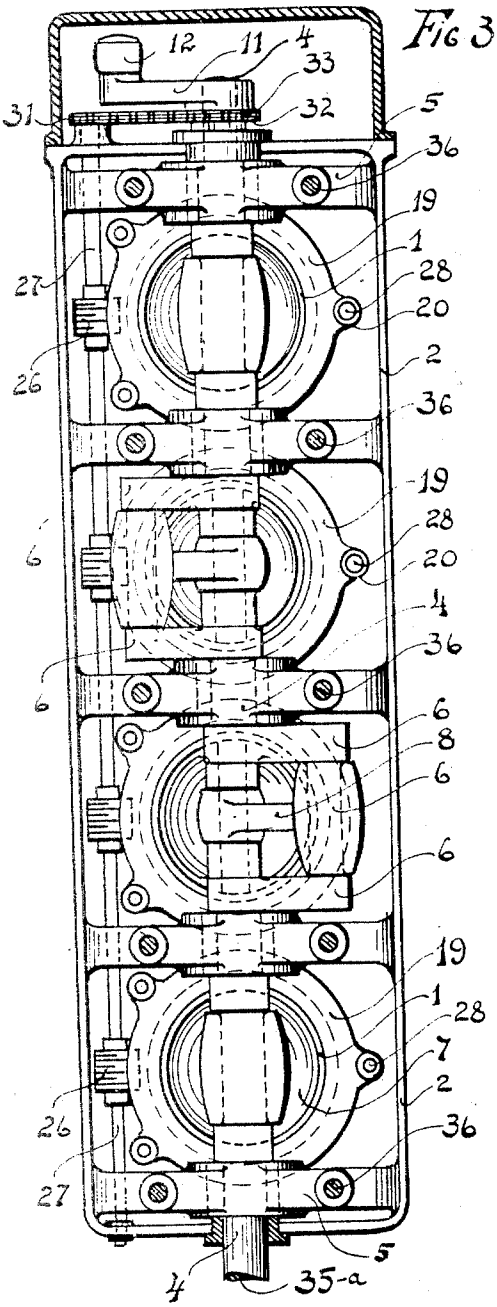


Fig 4

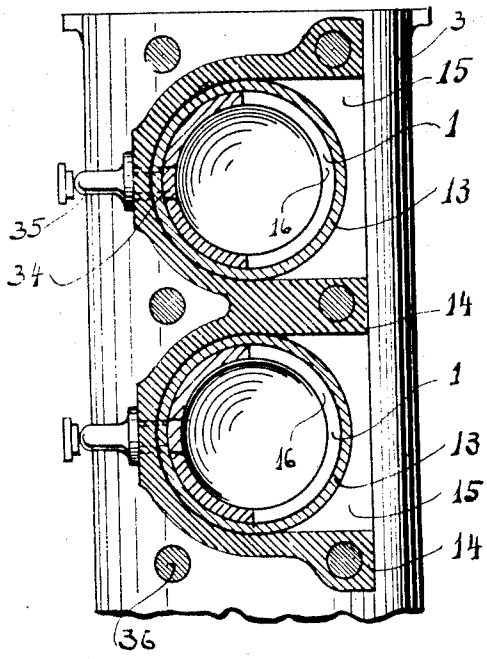
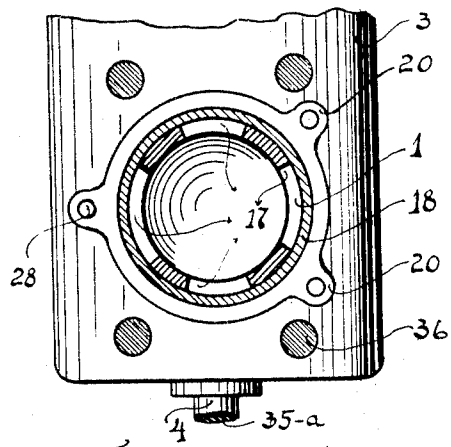


Fig 5.



Fritz C. L. d'Aix INVENTOR.

Patented May 3, 1932 1,856,242

UNITED STATES PATENT OFFICE

FRITZ C. L. D'AIX, OF CHICAGO, ILLINOIS

INTERNAL COMBUSTION ENGINE

Application filed September 30, 1927. Serial No. 223,120.

The invention relates to internal-combustion engines, and in certain of its aspects has especial utility when embodied in four-stroke cycle engines.

The principal object of the invention is to produce an internal-combustion engine of light weight and durable strength wherein the thrusts of the pistons are neutralized, useless power-absorbing vibrations, strains and stresses are avoided and the cylinder and valves are uniformly cooled.

Said invention is an improvement upon the construction disclosed in my Patent No. 1,308,400, dated July 1, 1919, although certain features thereof are applicable to engines of the same general type as that which said patent reveals.

The accompanying drawings, referred to herein and forming a part hereof, illustrate one embodiment of the invention, and, together with the description, serve to illustrate the principle thereof.

Figure 1 is a front view of the engine; Figure 2 is a horizontal-sectional view; Figure 3 is a view taken on the lines A—A of Figure 2, and looking toward the inner side of the engine; Figure 4 is a cross-sectional view taken on the line B—B of Figure 2, and Figure 5 is a cross-sectional view of like character on the line C—C of Figure 2.

Referring to the drawings, illustrating one embodiment of the invention, including one or more than one power unit, as shown in Figure 3, 1 is a cylinder which is open at both ends, and said ends find bearings in casings 2 and 3 respectively. In each casing is mounted a main driven crank shaft 4 which is suitably journaled in bearings 5 and 37, and formed on each shaft is a crank 6 which is connected with piston 7 by a connecting rod 8 and a wrist pin 9, the two pistons being disposed within the cylinder 1 and adapted to reciprocate to and from each other. The cylinder 1 finds its bearing in the casings 2 and 3 respectively, and is provided with shoulders 10 against which said casings rest. The casings 2 and 3 are firmly pressed against the shoulders 10 by the tie rods 36, which at the same time hold the separable parts 5 of the bearings in position.

The crank shafts 4 of any one of the units are each provided at one end with a crank 11, and these two cranks 11 are united by a connecting rod 12, Figures 1 and 3, whereby both shafts 4 are compelled to make the same revolutions and to travel synchronously, forcing the cranks 6 to revolve in such directions that the pistons 7 will reciprocate in opposite directions within the cylinder 1.

Suitable means are provided for successively causing admission, compression and explosion of the power-producing gas, and expulsion of the products of combustion. In the embodied form of such means, there are employed cylindrical ring valves 13 and 18 fitting closely around and adapted to slide on the cylinder 1. Around said cylinder 1 is a suitable casing or manifold 14 which is to be connected with a desired carbureter, or other fuel supplying device, leading to its opening 15. The valve rings 13 and 18, when in closing position, rest closely with their ends in grooves 13—*a* and 18—*a* of said casings or manifold. From the opening 15, an intake-port 16 communicates with the interior of the cylinder 1, said port 16 being, preferably, of arcuate form and also, preferably, of somewhat less size than a semi-circumference of the cylinder 1. Suitable exhaust ports 17 are also formed in the cylinder 1, and these exhaust ports are, preferably, of arcuate form, and of such length as to approximate a semi-circumference of the cylinder 1. The intake port 16 and the exhaust ports 17 are so spaced in the cylinder 1, as to lie proximate the inner ends of the pistons 7 when said pistons are in their innermost positions.

The invention includes means whereby the fuel-controlling valve ring 13 and the exhaust-controlling valve ring 18 are so timed in their movements as to sequentially admit the explosive mixture to the space between the pistons, when said pistons move away from each other, and to expel the waste gases when the said pistons approach each other.

In the embodied form, the fuel-controlling valve ring 13 and the exhaust-controlling valve ring 18 are each connected with rods 28 engaging flanges 20 of rotating ring 19 which loosely fits the cylinder 1, and are each actu-

ated by means consisting of the rotary ring 19, another ring 21 encircling and rotatable on said ring 19 and provided with worm teeth 22 on its circumference and with a flange 23 at its inner end, a cam face 24 on the inner end of said rotary ring 19, a lug 25 carried by said other ring 21, a worm 26 mounted on a shaft 27 and engaging said worm teeth 22, said rods 28 which have bearings 29 in the casing 2 or 3 and a spring 30 encircling the cylinder 1 and extending from the casing 2 or 3 to the adjacent valve ring 13 or 18. It will be observed that all of the aforesaid elements will cooperate to produce timed reciprocations of the valve rings 13 and 18, the lug 25 and the cam 24 operating to move one of said valve rings in one direction, and the spring 30, having been compressed by the movement of said valve ring, acting to reverse the movement. The described actuating devices, it will be noted, are duplicated at each end of the engine.

The shaft 27 is provided at one end with a sprocket wheel 31, which connects with another sprocket wheel 32 by means of a silent chain 33 running over said sprocket wheels, the sprocket wheel 32 being mounted on the shaft 4 from which it receives its motion. Thus, the rotation of the shaft 4 will cause the worm 26 and its associated elements to be actuated, thereby producing the required reciprocations of the valve rings 13 and 18.

Ignition of the explosive mixture is produced by a spark plug 35 screwed into the casing or manifold 14, to which said mixture has access through the opening 34.

The end of the shaft 4, shown as broken away at 35—*a* may be connected with any known driven element.

The thrusts of the explosion which are in opposite directions against the pistons 7, are equalized by the rods 36 which are preferably four in number for a single cylinder and extend through parts 37, which are connected to casings 2 and 3, and also through the bearings 5 of shafts 4, their ends being provided with nuts 39.

The operation of the engine is as follows:

Assuming that the engine is running, and is about to start on the gas-intake stroke, the fuel-controlling valve ring 13 will move away from its present position until the port 16 in the cylinder 1 is in communication with the intake opening 15 of the carbureter. Both pistons 7, under the momentum of the engine, then move away from each other and outward towards the ends of the cylinder 1, thus creating the suction for drawing in the charge of fuel. By the time the pistons have reached half the distance of their full travel outward, the worm ring 21, at one side end of the cylinder 1, will have turned sufficiently to shift the fuel-controlling valve ring 13 to its full opening, and when said pistons make their second half of travel in that direction, the worm ring 21 will slowly release said valve 13, so that the adjacent spring 30 may move it slowly back to thereby close said port 16 and interrupt the flow of gas from the carbureter to the cylinder 1, when the pistons have arrived in their final suction position.

The pistons on their return strokes, compress the charge between them, and this charge is then ignited and exploded to give the power impulse to the engine, a suitable device being employed to time the explosion. Under the impulse of the explosion, the pistons are driven apart, and absorb practically the entire energy of the fuel. As the pistons 7 end the explosion stroke, the exhaust valve 18, actuated by the instrumentalities at the other end of the cylinder in the manner described in connection with the operation of the fuel-supply valve 13, is moved to open the exhaust ports 17, whereupon, the pistons approach each other and expel the burnt gases from the cylinder 1. Also, as the pistons complete the exhaust stroke, the exhaust valve 18 moves back and closes said exhaust ports, the burnt gases having meantime been eliminated, leaving the engine ready for a new charge of fuel.

As will be seen, the valves 13 and 18 are positively opened by a cam 25 and closed by a spring 30.

The engine is adapted for cooling by air, and the springs are, preferably, arranged outside of and in contact with the cylinder so as to absorb heat from said cylinder and to break the currents of air passing in proximity thereto, thereby cooling the cylinder. The valves 13 and 18 are likewise exposed to the cooling influences of air currents.

The casing or manifold 14 has openings through which the rods 36 extend and are fixed on said rods by suitable means.

Having thus described my invention, what I claim is:

1. An internal combustion engine, including a cylinder open at both ends, pistons in said cylinder, casings having each an open end communicating with said cylinder, a crank shaft in each of said casings having two cranks and driven by one of said pistons, and a connecting device for compelling synchronous movements of the cranks and the pistons.

2. An internal combustion engine, including a cylinder open at both ends, pistons in said cylinder, casings having each an open end communicating with and surrounding an end of said cylinder, crank shafts having each a bearing in one of said casings and driven by one of said pistons, equalizing rods connecting said bearings, valves and a shaft carrying worm gears for actuating said valves.

3. An internal combustion engine, including a cylinder open at both ends, pistons in

said cylinder, casings having each an open end communicating with said cylinder, two-part bearings disposed one in each of said casings, a crank shaft mounted in each of the bearings and driven by one of said pistons, equalizing rods each engaging and uniting said bearings and the parts thereof, valves and a shaft carrying worm gears for actuating said valves.

4. An internal combustion engine, including a cylinder open at both ends, pistons in said cylinder, casings having each an open end communicating with said cylinder, fuel-controlling and exhaust-controlling valves encircling said cylinders, timed devices for actuating said valves, and driven elements actuated by said pistons.

5. An internal combustion engine, including a cylinder open at both ends, pistons in said cylinder, casings having each an open end communicating with said cylinder, timed devices disposed in said casings for actuating the fuel-controlling and the exhaust-controlling means of the engine, and driven elements actuated by said pistons, said fuel-controlling and exhaust-controlling means being arranged outside of said cylinder.

6. An internal combustion engine, including a stationary cylinder open at both ends, pistons in said cylinder, casings having each an open end communicating with said cylinder, valves encircling said cylinder, timed devices for moving each of said valves in one direction, and springs also encircling said cylinder for moving each of said valves in the other direction.

7. An internal combustion engine, including an air-exposed cylinder, pistons in said cylinder, driven elements connected with said pistons, a manifold encircling said cylinder, supply and exhaust valves also encircling said cylinder, and timed means for actuating said valves.

8. An internal combustion engine, including power-actuated means, driven elements, air-exposed valves, and air-exposed springs for moving said valves in one direction.

9. An internal combustion engine, including power actuated means, driven elements, and a controlling valve actuated in one direction by said means and actuated in the other direction by a spring surrounding the engine cylinder.

10. An internal combustion engine, including a cylinder open at both ends and having a single inlet port and a plurality of circumferential exhaust ports, pistons in said cylinders adapted to move toward and from said ports, driven elements connected with said pistons, air-cooled valves for said ports actuated by said driven elements, and a spark plug for igniting the explosive mixture.

11. An internal combustion engine, including air-cooled controlling valves, springs for said valves, and a worm mechanism for forcing said valves against said springs.

12. An internal combustion engine, including a cylinder open at its end, a piston in said cylinder, a valve encircling said cylinder, a flanged ring encircling the end of said cylinder, a rotary flanged ring surrounding said encircling ring and provided with worm teeth on its circumference, a driven worm meshing with said worm teeth, means connecting said ring with said valve, a lug carried by said rotary ring, and a cam carried by said encircling ring and engaging said cam.

In testimony whereof I affix my signature.

FRITZ C. L. D'AIX.