Aug. 12, 1947. W. KILCHENMANN 2,425,375

FREE PISTON ENGINE

Filed Oct. 2, 1945

Fig. 1.

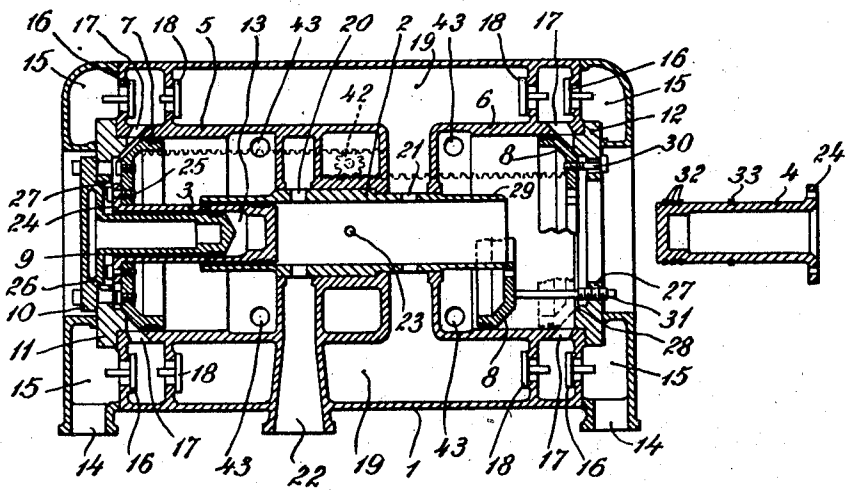


Fig. 2.

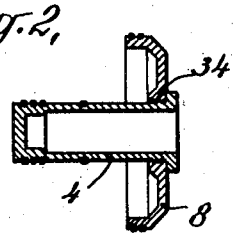


Fig. 3.

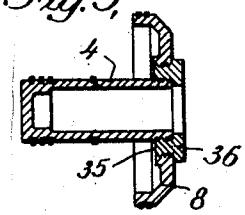


Fig. 4.

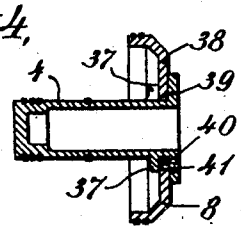
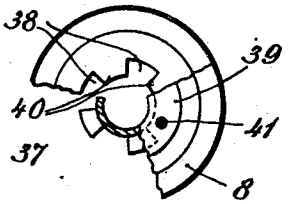


Fig. 5.



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Patented Aug. 12, 1947 2,425,375

UNITED STATES PATENT OFFICE

2,425,375

FREE PISTON ENGINE

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Application October 2, 1945, Serial No. 619,883
In Switzerland April 13, 1945

9 Claims. (Cl. 230—56)

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The invention relates to a free piston engine and consists in that at least one compressor piston is detachably connected to an internal combustion piston in such a way that the internal combustion piston can be built into the engine and removed from it through the compressor piston.

By the invention, the advantage is obtained that the overhaul of the internal combustion piston can be effected without dismantling the corresponding compressor piston. Since the internal combustion piston must be overhauled oftener than the compressor piston, a considerable saving of time and money is attained by the invention.

Several embodiments of the subject matter of the invention are illustrated diagrammatically in the drawings, in which:

Fig. 1 is a longitudinal section through a free piston engine designed as a power-gas producer; and

Figs. 2 to 5 show various arrangements of the detachable connection between the compressor and the internal combustion pistons.

The free piston engine 1 has an internal combustion cylinder 2 in which work the internal combustion pistons 3 and 4, and also the compressor cylinders 5 and 6, in which the compressor pistons 7 and 8 move. Inwardly projecting member 9, whose flange 10 is fixed to the cover 11 of the compressor cylinder 5, serves as a buffer piston. Buffer piston 9 works in the buffer cylinder 13 formed in the interior of the internal combustion piston 3.

The intake system to the compressor cylinders 5, 6 comprises the intake branches 14, the annular intake manifold spaces 15 and the intake valves 16. On the inward stroke of compressor pistons 7, 8 valves 16 open to admit air from intake manifold spaces 15 to the compressor cylinder through passages 17. On the outward stroke of pistons 7, 8 valves 16 close, but valves 18 open and compressed air is delivered back through passages 17 to the delivery space 19 which forms the casing of the whole free-piston engine 1.

When the outlet ports 20 are uncovered by the piston 3 and the inlet ports 21 are uncovered somewhat later by the piston 4, the combustion gases flow through the ports 20 into the exhaust branch 22, while the air from the space 19 enters through the ports 21 into the internal combustion cylinder 2, scavenges out the combustion gases and fills the cylinder with fresh air. The air pressure and the quantity of excess air are adjusted in accordance with the purpose for which the free piston engine is used, i. e. whether it works as a

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power gas producer or in some other manner. A machine using power gas, for instance a gas turbine for giving useful energy from the plant, may be connected to the exhaust branch 22. During the inward stroke of the pistons 3 and 4, the ports 21 and also the ports 20 are closed, and the air in the internal combustion cylinder 2 is so highly compressed that the fuel injected through the fuel valve 23 is ignited and burnt, after which a new expansion stroke takes place. The fuel is supplied by a fuel pump (not shown in the drawing), which is driven for instance by the rack coupling gear 42 between the pistons 7 and 8. The compressor cylinders 5 and 6 are connected to each other and to the rack spaces by means of the openings 43. For the sake of simplicity, the cooling system of the internal combustion cylinder, lubrication and other details irrelevant to this invention have been omitted from the drawing.

Pistons 3 and 4 are provided on their outer ends with flanges 24 which lie on the outer ends of compressor pistons 7 and 8, respectively and are firmly fixed thereto by means of the screws 25. In consequence of this construction of the compressor pistons and of the detachable connection by means of the flanges 24, the internal combustion pistons can, as shown for the piston 4 in the drawing, be built into the engine or removed from it through their corresponding compressor pistons. It is, however, not necessary for both internal combustion pistons to be fixed in this manner. It would be possible to fix only the piston 4 as described, and to fix the piston 3 to the inner side of the compressor piston 7, so that the piston 3, after this connection has been detached, would be removed from the engine through the cylinder 2 and the compressor piston 8, at the same side of the engine as the piston 4. In this way, it would not be necessary to provide spaces for dismantling at both sides of the engine 1. Particularly in the case of vertically arranged internal combustion cylinders, the removing of the two internal combustion pistons from above would help to reduce the height of the engine.

The flange 10 of the buffer piston 9 has an additional piece 26 which centres the member 9 to the cover 11. The diameter of the piece 26 is chosen so large that when removing the piston 9, the opening 27 in the cover 11 or 12 is free, and this opening is of such a diameter, that the internal combustion pistons 3 or 4, together with the flange 24, can be removed from the engine through it. In this manner, the number of parts which have to be dismantled for overhauling the

internal combustion pistons is the smallest possible. The large compressor covers 11 and 12, and also the compressor pistons 7 and 8 and the coupling rods connected to the latter, remain untouched.

In order that the central position of the compressor pistons 7 and 8 may remain unaffected when removing and inserting the internal combustion pistons 3 and 4, centering additions 28, 29 with tapered surfaces are provided on the covers 11 and 12 and on the ends of the internal combustion cylinder 2. The pistons 7 and 8 are, as shown in the compressor cylinder 6, pressed and held tight by tiebolts 30 against the addition 28 on the cover 12, or by press screws 31 against the addition 23 in the cylinder 2. Afterwards the screws 25 of the flange 24 are loosened. When pressing the compressor piston against the internal combustion cylinder 2, the piston rings 32 and the oil scraper rings 33 can be held by a piston ring compressor, or a tunnel may be provided to facilitate inserting the internal combustion pistons 3 and 4 into the cylinder 2.

In Fig. 2, the detachable connection is formed by means of a screw thread 34 on the internal combustion piston 4, which is screwed into the compressor piston 8.

In Fig. 3, an annular screw 35 with internal and external threads and end flange 36 is provided as a detachable connection between the internal combustion piston 4 and the compressor piston 8. By means of this, it is possible to use an ordinary piston ring compressor or other tool adding to the overall diameter of the part to be inserted for the piston rings even when the compressor piston 8 is centered against the cylinder cover 12 when removing the internal combustion piston 4.

Figs. 4 and 5 show a detachable connection formed in the manner of a bayonet joint. The internal combustion piston 4 is provided with lips 37 which are brought in front of the openings 38 in the compressor piston by rotating the internal combustion piston with reference to the compressor piston. The openings 38 are covered completely by means of the flange 39 when assembling. In order to obtain a firm connection, the lips 37 and the lips 40 are bevelled between the openings 38 on their contact surfaces, so that when turned in one direction, for instance clockwise, a slight pull is effected. For loosening, the turning must then be done in the opposite direction. The securing pin 41 prevents the pistons 4 and 8 from becoming loose after being assembled together.

I claim:

1. A free piston engine having a compressor cylinder closed by a cover, an internal combustion cylinder connected to the compressor cylinder, a compressor piston arranged in said compressor cylinder, an internal combustion piston working in said internal combustion cylinder, said internal combustion piston being detachably connected to said compressor piston, and said cover being fitted with a closable opening so that the internal combustion piston can be built into the engine and removed from it through the compressor piston and through the cover without removing the compressor piston and the cover.

2. A free piston engine as claimed in claim 1, the internal combustion piston of which is provided at the end with a flange which is fixed to the outer surface of the compressor piston.

3. A free piston engine having a compressor cylinder closed by a cover, an internal combustion cylinder connected to the compressor cylinder, a compressor piston arranged in said compressor cylinder, an internal combustion piston working in said internal combustion cylinder, and a buffer piston, said internal combustion piston being formed as a buffer cylinder in order to guide the buffer piston and being detachably connected to the compressor piston, said cover being fitted with an opening closable by means of the buffer piston so that, after dismantling the buffer piston, the internal combustion piston can be dismantled through the opening thus produced.

4. Free piston engine as claimed in claim 1, the compressor piston of which and the cover of the compressor cylinder being provided with recesses or bores, each of which can be brought opposite to each other so that the compressor piston can be held firmly by means of bolts in one or other end position, in order to be able to hold the compressor piston firmly in the inner or outer end position for building-in or removing the internal combustion piston.

5. Free piston engine as claimed in claim 1 in which the cover carries means for centering the compressor piston.

6. Free piston engine as claimed in claim 1 in which the internal combustion cylinder structure carries means for centering the compressor piston.

7. Free piston engine as claimed in claim 1 in which the internal combustion piston is attached to the compressor piston by means of a bayonet joint.

8. Free piston engine as claimed in claim 1 in which the internal combustion piston is attached to the compressor piston by means of a bayonet joint, the portions of said joint carried by each of said pistons having contact surfaces bevelled in relation to one another whereby the two pistons are forced into tight engagement when subjected to a relative rotation.

9. Free piston engine as claimed in claim 1 in which the internal combustion piston is attached to the compressor piston by means of an internally- and externally-threaded sleeve.

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