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W. L. BLACKBURN
OPPOSED PISTON ENGINE

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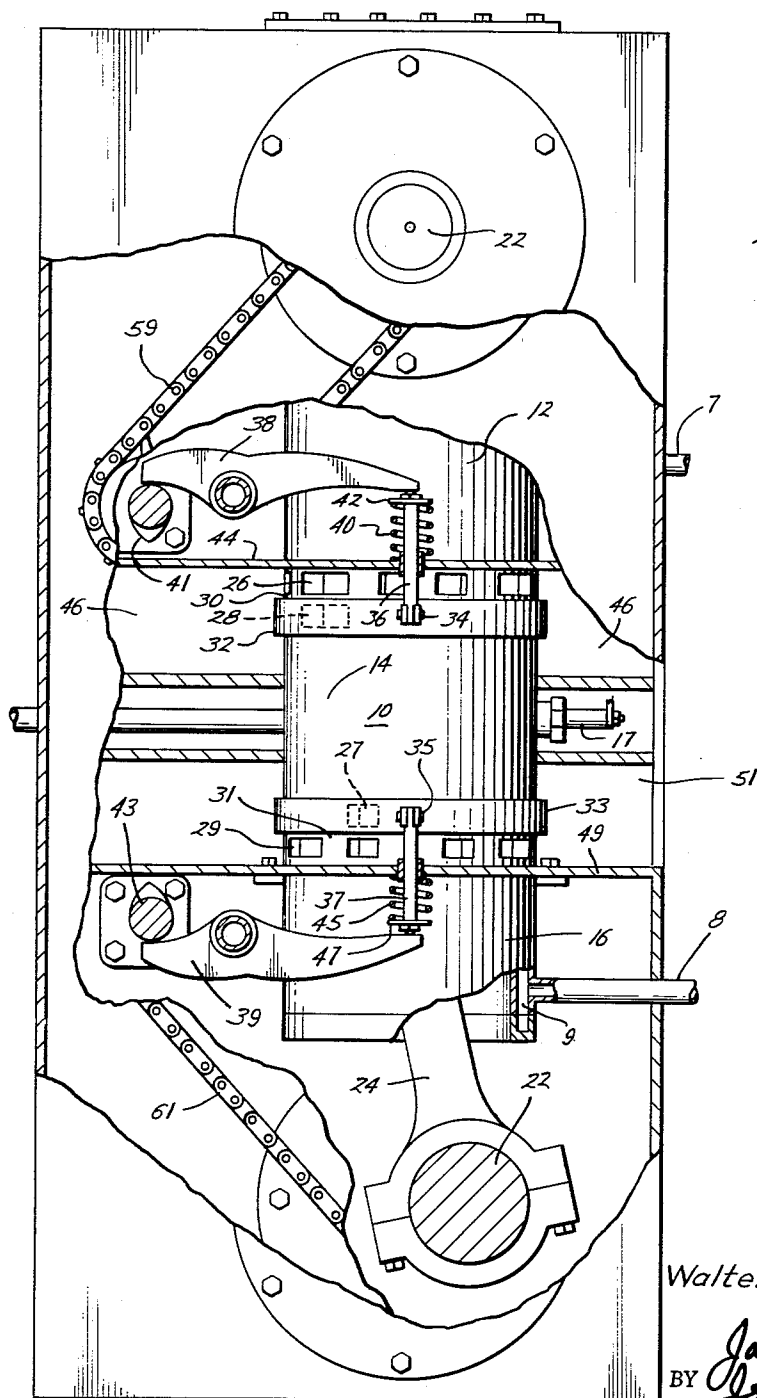


Fig. 1

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OPPOSED PISTON ENGINE

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The present invention relates to opposed piston engines and is more particularly related to improved opposed piston engines in which a liner is reciprocated to open and close exhaust and intake ports.

In theory there is a distinct advantage in engines of the opposed piston type by reciprocating the sleeve or liner of the cylinder or by reciprocating the cylinder itself. Among the advantages are that substantially perfect timing is obtained in that one piston does not trail the other piston, the exhaust and inlet ports opening and closing are controlled so that exhaust turbo charging and inlet super charging is improved, and efficiency is greatly increased due to the fact that both pistons are in position to expand upon combustion due to the fact that one is not in a trailing position with respect to the other.

It would be highly advantageous to provide such an engine in which the intake and exhaust ports are opened and closed at a high rate of speed and at a rate of speed considerably higher than if the piston opened and closed the ports.

The present invention is directed to an opposed piston type engine in which the cylinder remains stationary but valve means are provided to open and close the exhaust and intake ports in combination with the piston so that the ports are opened and closed rapidly. Thus, advantageously, a very fast opening and closing of the exhaust and inlet ports are obtained and it is unnecessary to reciprocate the cylinder or other means to control opening and closing of these ports so that the cylinder is cooled as a stationary unit thereby avoiding the inherent disadvantages of moving cylinder members and associated members relative to one another having heat differentials.

Accordingly, it is an object of the present invention to provide an engine of the opposed piston type which includes means for opening and closing the exhaust and intake ports very rapidly so that improved exhaust turbo charging, improved inlet super charging and improved scavenging is achieved.

Yet a further object of the present invention is the provision of a valve arrangement which opens and closes the exhaust and intake ports relative to the movement of the pistons opening and closing the intake ports so that the exhaust ports are closed about 15° ahead of the intake ports.

Yet a further object of the present invention is the provision of an improved opposed piston type engine of the above character which utilizes bridged ports and a valve member which opens and closes one set of the bridged ports.

Yet a further object of the present invention is the provision in an opposed piston type engine of bridged ports in which a pair of valve members are actuated to open and close the bridged ports.

Yet a further object of the present invention is the provision of valve means in an opposed piston type engine which very rapidly opens and closes the ports to provide advantageous opening and closing of these ports.

Yet a further object of the present invention is the provision of means by which the exhaust ports are closed sooner than the inlet ports thereby providing a longer and more efficient compression stroke by means of a simplified and improved structure.

Still a further object of this invention is the provision of controlled port closing and opening in a simplified

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manner so that the inlet ports are open longer after the exhaust ports are closed thereby providing increased super charging or scavenging or both.

Yet a further object of the present invention is the provision of improved cooling in that the cylinder remains stationary and the liner or valve arrangement is reciprocated at a portion away from the combustion zone where the moving parts do not have substantially different temperatures.

Other and further objects, features and advantages will be apparent from the following description of presently preferred embodiments of the invention, given for the purpose of disclosure, taken in conjunction with the accompanying drawings, where like character references designate like parts throughout the several views, and where

FIGURE 1 is a fragmentary elevational view, in section, illustrating an opposed piston type engine according to the invention,

FIGURE 2 is a fragmentary elevational view, in section, illustrating a modification,

FIGURE 3 is a view taken along the line 3—3 of FIGURE 2, and

FIGURE 4 is a fragmentary elevational view, in section, illustrating a still further modification.

In order to simplify the disclosure, many of the elements of the engine have been omitted, only the elements of the engine adjacent the valve members which open and close the ports in conjunction with the pistons are illustrated. Obviously, other conventional parts of the engine are utilized to provide a complete engine. Since those parts are conventional, no description thereof is deemed necessary.

Referring now to the drawings, and particularly to FIGURE 1, the engine comprises a cylinder 10 which includes an exhaust zone 12, an intermediate combustion zone 14 and an intake zone 16. Disposed in the cylinder 10 are the opposed pistons 18 and 20 (FIGURE 2) connected by the connecting rods 24 to the crankshafts 22.

The intermediate combustion zone 14 has the firing plug or sparkplug 17 and the stationary cylinder 10 has a water jacket 9 which is supplied cooling liquid by the pipes 8 and 7. Obviously, any desired cooling jacket, integral or otherwise may be used.

The present invention is directed to means for opening and closing the exhaust ports 26 and 28 and the intake ports 27 and 29 which are here shown as bridged ports by the bridging members 30 and 31.

The slide valve elements 32 and 33, in the form of ring members are disposed about and close the lower set of exhaust ports 28 and upper set of intake ports 27. The valves 32 and 33 are each connected to a pair of diametrically opposed structural elements 34 and 35 (only one being shown) which are connected to a pair of valve stems 36 and 37 which engage and are actuated by the cam followers 38 and 39 which follows the cams 41 and 43, respectively.

In order to assure that the valve stems 36 and 37 and cam followers 38 and 39 snugly engage the cams 41 and 43 at all times the springs 40 and 45 are provided which engage the spring retainers 42 and 47 secured to the valve stems 36 and 37 respectively and also stop against and engage the walls 44 and 49 of the exhaust header 46 and intake header 51, respectively.

Thus, rotation of the cams 41 and 43 move the cam followers 38 and 39 thereby moving the valve stems 36 and 37 and the valves 32 and 33 for opening and closing the exhaust ports 28 and intake ports 27 as desired.

It is noted the valves 32 and 33 move only within the exhaust header 46 and the intake header 51 and that the movement of the valves relative to the ports is sufficiently

far from the combination zone 14 so that there are no substantial thermal differences between the exterior of the exhaust zone 12 and intake zone 16 of the cylinder 10 and the sliding valves 32 and 33.

The cams 41 and 43 are driven by the chains 59 and 61 from the crankshafts 22. As previously mentioned, at least a pair of cam assemblies are used to open and close each ring valve to insure efficient operation. Obviously, more may be provided, if desired. Any desired cam and timing arrangement may be utilized, as desired.

In operation, the pistons 18 and 20 by sliding over and beyond the exhaust ports 26 and inlet ports 29 open and close these ports. Preferably, the valves 32 and 33 close the other set of exhaust ports 28 and inlet ports 27, respectively, at the same time the pistons close the exhaust ports 26 and the inlet ports 29. This provides large port area and fast opening and closing which advantageously provides exhaust turbo charging, better scavenging at lower scavenging pressure and super charging.

If desired, the valves 32 and 33 may open and close the ports 28 and 27, respectively, earlier or later than the pistons open and close the ports 26 and 29, respectively. For example, the exhaust ports 28 may be closed earlier in order to build up scavenging pressure. Also, the intake ports 27 may be closed earlier to increase the effective compression stroke.

All other parts, as mentioned previously, are conventional. An effectively efficient rapid closing and opening of the ports is provided. Also, it is unnecessary to move the cylinder 10 to provide opening and closing of ports other than by the piston with all its inherent disadvantages and the moving parts do not have substantial thermal differences thereby providing smooth and effectively efficient operations.

FIGURE 2 illustrates a modified valve arrangement for opening and closing the exhaust ports. For convenience of description, in FIGURE 2 the reference letter "a" has been added to the same numerals in FIGURE 1 to designate corresponding parts.

Turning now to FIGURE 2, the bridged ports 26a and 28a of the cylinder 10a are both closed by a pair of ring-like slide valve members 32a and 33a. In this case the cam follower 36a is hollow to receive the cam follower 37a which bears against the underside of the cam 38a, the cam follower 36a bearing against the upper side of the cam 38a. In this case a second spring 41a has been added which bears against the underside of the flange 43a connected to the follower 37a and against the spring retainers 45a secured to a stationary part of the engine, such as the cylinder 10a. Also, the cam follower 36a is slotted at 49a to permit the arm 47a to extend outwardly and engage the ring slide valve 33a so that it may move in response to movement of the cam follower 37a.

While not shown, another arrangement for moving the ring-like slide valves 32a and 33a is provided on the other side of the cylinder to insure smooth opening and closing and no binding of the valve members with the outer wall of the cylinder.

In operation, this arrangement is the same as that described in connection with FIGURE 1 except that both sets of ports are opened and closed rapidly so that effective turbo exhaust charging is provided and early closing permits of a longer effective compression stroke. While only one set of ports is illustrated, the other set is the same and has been omitted to shorten the disclosure.

Referring now to FIGURE 4 a still further modification is illustrated. For convenience of reference the reference letter "b" has been added to parts corresponding to those of FIGURES 1-3.

It is noted in FIGURE 4 that the arrangement is identical to that of FIGURES 2 and 3 except that the ports 26b are not bridged and that the valve members 32b and 33b engage one another to completely close the single set of ports 26b. As explained in connection with

FIGURES 2 and 3, while only one valve arrangement for one set of ports is illustrated, the other set of ports is similarly opened and closed.

The arrangement in FIGURE 4 provides high efficient exhaust turbo charging and provides a longer compression stroke, the arrangement providing for a very rapid opening and closing of these ports.

If desired, of course, a single valve such as illustrated in FIGURE 1 may be utilized to close the ports in FIGURE 4, however, the arrangement of FIGURE 4 provides for a more rapid opening and closing of the exhaust ports. In any of the arrangements illustrated, any number of followers and cams may be utilized to provide effective opening and closing of the ports. Also, if desired, one set of ports may be opened and closed by a piston with the other set of ports being opened and closed by the valve arrangement disclosed.

It is noted that an engine constructed according to the present invention advantageously does not allow exhaust gases to expand in the intake zone which is the case when using rotary type valves disposed on the outside of the exhaust and intake zones.

The present invention, therefore, is well adapted and suited to attain the objects and ends and has the advantages and features mentioned as well as others inherent therein.

While representative examples of the invention have been given for the purpose of disclosure, numerous changes in details and arrangement of parts may be made which are within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In an engine, a stationary cylinder, a crankshaft, a piston in the cylinder connected to the crankshaft, ports in the cylinder, an annular header disposed about the ports, a ring-like slide valve disposed about said ports and wholly within the header, means including an element movably extending through said header arranged to move said slide valve in a direction opposite to that of the piston in response to rotation of the crankshaft, and means sealing said element with respect to the header.

2. In an engine, a stationary cylinder, a pair of opposed pistons in the cylinder, said cylinder provided with exhaust and intake ports, a pair of crankshafts, means connecting one each of the pair of pistons to one each of the pair of crankshafts, an annular exhaust header disposed about said exhaust ports, an annular intake header disposed about the intake ports, a slide valve disposed wholly within at least one of the headers opening and closing the ports therein, at least one cam follower movably extending through the header actuating said slide valve, a cam engaging each cam follower and arranged so that upon rotation of the cam the slide valve is actuated to open and close the ports in a direction opposite to that of the movement of its adjacent one of the pair of pistons, and means sealing the header and the follower.

3. In an engine, a stationary cylinder, a pair of opposed pistons in the cylinder, said cylinder provided with exhaust and intake ports, an annular exhaust header disposed about said exhaust ports, an annular intake header disposed about the intake ports, one of said exhaust and intake ports comprising a set of bridged ports, a slide valve disposed wholly within the header having the bridged ports, at least one cam follower movably extending through the header actuating said slide valve, a cam engaging each cam follower whereby upon rotation of the cam the slide valve is actuated to open and close one set only of the set of bridged ports, and means sealing the header and the follower.

4. The invention of claim 2 where the ports in the header having the slide valve therein comprise a pair of sets of axially-spaced ports and circumferentially-arranged ports about the cylinder and the slide valve comprises a pair of slide valves opening and closing one each of said

sets of ports, and where the cam follower comprises a pair of cam followers one each connected to each slide valve, said cam followers both being actuated by said cam.

5. The invention of claim 2 where the slide valve comprises a pair of slide valves, the cam follower comprises a pair of cam followers, one each actuating each slide valve, and said cam followers are actuated by the cam thereby providing rapid opening and closing of said ports.

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