Feb. 15, 1938. A. BOKEMÜLLER 2,108,576

SCAVENGING TWO-STROKE ENGINE

Filed May 3, 1935

Fig.1.

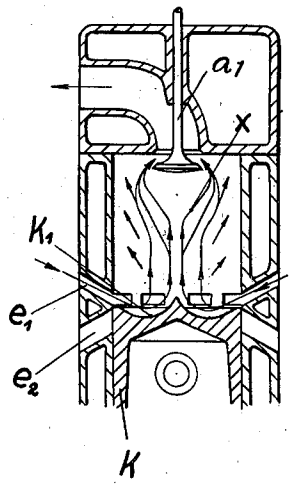


Fig.2.

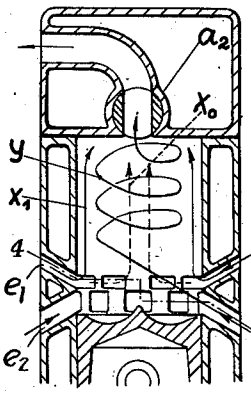


Fig.3.

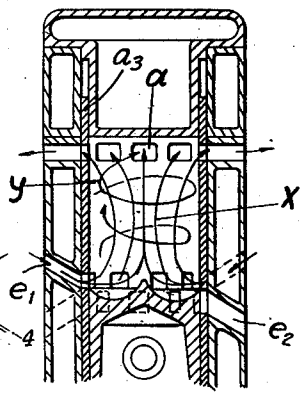


Fig.4.

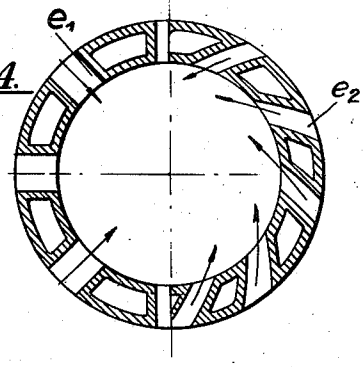
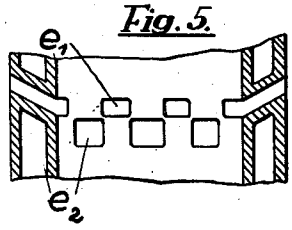


Fig.5.



Inventor

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SCAVENGING TWO-STROKE ENGINE

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12 Claims. (Cl. 123—65)

Two stroke combustion power engines with continuous current scavenging have already been proposed generating simultaneously a scavenging current which enters radially into the cylinder, proceeding in an axial way, and a rotary scavenging current which enters tangentially. This offers, however, the disadvantage that the scavenging current entering radially and proceeding in an axial way towards the exhaust which is to scavenge the inside core of the cylinder space, is too much subjected to the centrifugal effect of the rotary scavenging current, getting into its grip, whereby the scavenging of the inside core suffers.

The invention avoids this disadvantage, setting first of all the scavenging current free, which has a radial direction, and proceeds in an axial way towards the exhaust and then the scavenging current enters tangentially, whilst the interruption of the scavenging currents, especially, proceeds in a reversed direction. By these means a certain time is allowed for the axial scavenging current to develop itself prior to the production of the rotary scavenging current, so that the whirling gases are partly pushed towards the exhaust, and partly towards the cylinder walls. The gases collecting themselves at the cylinder walls are now taken up by the scavenging current starting in a rotary way, respectively proceeding helically, and are pushed towards the exhaust. After interruption of the turning current a sturdy axial whirling current can once more be produced.

In the drawing:

Figs. 1 to 3 show a vertical section through the upper part of the cylinder of an internal combustion engine according to the invention in three characteristic stages of the scavenging process;

Fig. 4 is a cross section on the line 4—4 in Fig. 2, and

Fig. 5 is a diagrammatic view on a larger scale of the portion of the cylinder in the region of the ports.

The admission steered by the piston takes place, on the one side, by the admission ports e_1, directed radially towards the cylinder axis and in an oblique way towards the bottom of the piston K, and, on the other side, by the lower admission ports e_2, conveniently directed in a somewhat oblique way towards the above, which join tangentially the cylinder. The bottom of the piston is hereby conveniently provided with an annular trough K_1 on the upper face of the piston, the limitation of which forms at the moment of liberation of the slots e_1, their continuation directing the scavenging current which leaves these ports, towards the cylinder axis, at the same time directing it upwardly. As shown in Figs. 2 and 5, the ports e_1 and e_2 are arranged in staggered relation to one another so that they follow one another alternately in the circumferential direction.

The exhaust outlet is provided in the cylinder head and the outflow of the exhaust gases is controlled by means of a poppet valve a_1 as shown in Fig. 1, by a rotary valve a_2 as shown in Fig. 2 or by means of a sleeve valve a_3 which uncovers ports a as shown in Fig. 3.

The mode of operation is as follows:

During the downstroke of the piston the upper row of ports e_1 is first uncovered as shown in Fig. 1. By this means the scavenging current or currents x are set up which, after being deflected by the bottom of the piston, flow axially towards the exhaust outlet, pushing the burnt gases to the exhaust and towards the cylinder walls with an upward direction of flow.

As soon as according to Fig. 2 the lower series of ports e_2 has been opened, the effect of the lower series of slots, possessing conveniently a larger cross section, prevails and a helical scavenging current y arises. By the high velocity of the intake current the current receives a considerable centrifugal power so that the same does not get disturbed in any way by the scavenging current entering through the upper slots e_1; on the contrary the same passes along the cylinder wall in an appropriate form, in the shape of a sturdy edge layer x. Hereby it can partially also be put into turning movement by the spiral scavenging current y or the same can eventually also subsist as a partial core-current x_0, so far as this is admissible by the arrangement of the admission ports. As a rule, however, the air entering at e_1 will be entirely diverted from the tangential current y towards the cylinder walls, as shown by the example, flowing in a more or less axial direction or in a helical line towards the exhaust port.

When the piston is going up, another sturdy scavenging of the cylinder core takes place, after closing the lower slots e_2, the rotary scavenging current y losing by its effect and the original core current x is developing itself anew.

The invention is especially designed for Diesel engines, respectively for air compressing machines. The same can of course also be used for mixture-compressing machines according to the purpose of the design. Instead of the piston

represented, a piston with a flat surfaced bottom can also be provided.

I claim:

1. In a two stroke internal combustion engine, in combination, a cylinder having a series of upwardly inclined tangential ports at the lower end thereof, a piston reciprocating in the cylinder and adapted to uncover the said ports for admitting scavenging and charging air to the cylinder so as to flow in a helical current around the cylinder, said cylinder having a series of downwardly inclined radial ports above said first-mentioned ports and the piston end having deflecting means adapted to co-operate with said radial ports for guiding upwardly in the axial direction of the cylinder scavenging air admitted through the radial ports prior to the uncovering of the tangential ports by the piston during the downstroke of the latter and subsequent to the covering of the tangential ports by the piston during its upstroke and an exhaust outlet at the upper end of the cylinder.

2. In a two stroke internal combustion engine, in combination, a cylinder having a series of upwardly inclined tangential ports at the lower end thereof, a piston reciprocating in the cylinder and adapted to uncover the said ports for admitting scavenging and charging air to the cylinder so as to flow in a helical current around the cylinder, said cylinder having a series of downwardly inclined radial ports above said first-mentioned ports and the piston end having a trough therein with the bottom thereof sloping downwardly from the periphery of the piston and then upwardly towards the centre of the piston adapted to cooperate with said radial ports for guiding upwardly in the axial direction of the cylinder scavenging air admitted through the radial ports prior to the uncovering of the tangential ports by the piston during the downstroke of the latter and subsequent to the covering of the tengential ports by the piston during its upstroke and an exhaust outlet at the upper end of the cylinder.

3. In a two stroke internal combustion engine, in combination, a cylinder having a series of upwardly inclined tangential ports at the lower end thereof, a piston reciprocating in the cylinder and adapted to uncover the said ports for admitting scavenging and charging air to the cylinder so as to flow in a helical current around the cylinder, said cylinder having a series of downwardly inclined radial ports above said first-mentioned ports and the piston end having a plurality of depressions therein with the bottoms thereof sloping downwardly from the periphery of the piston and then upwardly towards the centre of the piston adapted to co-operate with said radial ports for guiding upwardly in the axial direction of the cylinder scavenging air admitted though the radial ports prior to the uncovering of the tangential ports by the piston during the downstroke of the latter and subsequent to the covering of the tangential ports by the piston during its upstroke and an exhaust outlet at the upper end of the cylinder.

4. In the method of working an internal combustion engine, the steps consisting in causing a body of scavenging air to flow into the cylinder and upwardly therein in the direction of the cylinder axis towards the end of the exhaust stroke, causing a second body of scavenging air to flow tangentially into the cylinder and upwardly therein in a helical path around the cylinder axis, interrupting the flow of the second-mentioned body of air and subsequently interrupting the flow of the first-mentioned body of air, so as to allow the first-mentioned body of air to flow axially through the cylinder previously to and subsequently to the admission of the helically flowing body of air in order to ensure thorough scavenging of the core of the cylinder interior.

5. In a two stroke internal combustion engine, in combination, a cylinder having a series of upwardly inclined tangential ports at the lower end thereof, a piston reciprocating in the cylinder and adapted to uncover said ports for admitting scavenging and charging air to the cylinder so as to flow in a helical current around the cylinder, said cylinder having a series of downwardly inclined radial ports above said first mentioned ports and alternating therewith circumferentially and the piston end having deflecting means adapted to co-operate with said radial ports for guiding upwardly in the axial direction of the cylinder scavenging air admitted through the radial ports prior to the uncovering of the tangential ports by the piston during the downstroke of the latter and subsequent to the covering of the tangential ports by the piston during its upstroke and an exhaust outlet at the upper end of the cylinder.

6. In a two stroke internal combustion engine, in combination, a cylinder having a series of upwardly inclined tangential ports at the lower end thereof, a piston reciprocating in the cylinder and adapted to uncover said ports for admitting scavenging and charging air to the cylinder so as to flow in a helical current around the cylinder, said cylinder having a series of downwardly inclined radial ports above said first mentioned ports and alternating therewith circumferentially and the piston end having a trough therein with the bottom thereof sloping downwardly from the periphery of the piston and then upwardly towards the centre of the piston adapted to co-operate with said radial ports for guiding upwardly in the axial direction of the cylinder scavenging air admitted through the radial ports prior to the uncovering of the tangential ports by the piston during the downstroke of the latter and subsequent to the covering of the tangential ports by the piston during its upstroke and an exhaust outlet at the upper end of the cylinder.

7. In a two stroke internal combustion engine, in combination, a cylinder having a series of upwardly inclined tangential ports at the lower end thereof, a piston reciprocating in the cylinder and adapted to uncover the said ports for admitting scavenging and charging air to the cylinder so as to flow in a helical current around the cylinder, said cylinder having a series of downwardly inclined radial ports above said first-mentioned ports and having a larger cross-section than the tangential ports and the piston end having deflecting means adapted to co-operate with said radial ports for guiding upwardly in the axial direction of the cylinder scavenging air admitted through the radial ports prior to the uncovering of the tangential ports by the piston during the downstroke of the latter and subsequent to the covering of the tangential ports by the piston during its upstroke and an exhaust outlet at the upper end of the cylinder.

8. In a two stroke internal combustion engine, in combination, a cylinder having a series of inlet ports at one end thereof for admitting scavenging air to the cylinder, said inlet ports being arranged and directed to cause the air to flow in an

axial stream through the cylinder, said cylinder having further inlet ports at the said end of the cylinder for admitting additional scavenging air to the cylinder, said further inlet ports being arranged and directed to cause the additional scavenging air to flow in a helical path through the cylinder, an exhaust outlet at the other end of the cylinder and controlling means for controlling the flow of scavenging air through said ports, said controlling means co-operating with the ports so as to admit scavenging air through the first-mentioned ports initially and through the second-mentioned ports subsequently.

9. In a two-stroke internal combustion engine, the combination as set forth in claim 8, in which the controlling means for controlling the flow of scavenging air through the ports cuts off the flow of scavenging air through the second-mentioned ports prior to cutting off the flow through the first-mentioned ports.

10. In a two-stroke internal combustion engine, in combination, a cylinder having a series of tangential inlet ports in proximity to one end thereof, for admitting scavenging air to the cylinder to flow in a helical stream in the cylinder, said cylinder having a series of radial inlet ports in proximity to the said end of the cylinder for admitting additional scavenging air to the cylinder, deflecting means in the cylinder adapted to co-operate with said radial inlet ports for deflecting the scavenging air admitted through the radial ports to flow in an axial stream in the cylinder and controlling means co-operating with said tangential and radial inlet ports so as to admit scavenging air initially through the radial inlet ports and subsequently through the tangential ports and to cut off the flow through the tangential ports prior to cutting off the flow through the radial ports, said cylinder having exhaust outlet openings at the end of the cylinder remote from the inlet ports.

11. In a two stroke internal combustion engine, in combination, a cylinder having a series of tangential inlet ports at the lower end thereof, for admitting scavenging air to the cylinder to flow in a helical stream in the cylinder, said cylinder having a series of radial inlet ports at the same end of the cylinder for admitting additional scavenging air to the cylinder, a piston reciprocating in the cylinder and adapted to co-operate with said tangential and radial inlet ports so as to admit scavenging air to the cylinder initially through the radial inlet ports and subsequently through the tangential inlet ports and to cut off the flow through the tangential ports prior to cutting off the flow through the radial ports, said piston having a deflecting surface adapted to co-operate with the radial inlet ports for deflecting the scavenging air admitted through the radial ports to flow in an axial stream in the cylinder, said cylinder having exhaust outlet openings at the upper end of the cylinder.

12. In a two stroke internal combustion engine, in combination, a cylinder having a series of tangential inlet ports in proximity to the lower end thereof for admitting scavenging air to the cylinder to flow in a helical stream in the cylinder, said cylinder having a series of radial inlet ports in proximity to the lower end of the cylinder located above said tangential ports and extending at an angle situated in a plane passing through the axis of the cylinder with respect to said tangential ports, so that the directional lines of the said ports intersect one another in the said plane inside the cylinder, a piston reciprocating in the cylinder and adapted to uncover the said inlet ports for controlling the admission of scavenging air to the cylinder, said piston having deflecting means thereon adapted to co-operate with the radial inlet ports for causing the air admitted through the radial inlet ports to flow in an axial stream through the cylinder and the cylinder having an exhaust outlet at the upper end thereof.

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