Oct. 23, 1951 J. SCHNEEBERGER 2,572,768

TWO-STROKE INTERNAL-COMBUSTION ENGINE

Filed May 5, 1948 2 SHEETS—SHEET 1

Fig. 1.

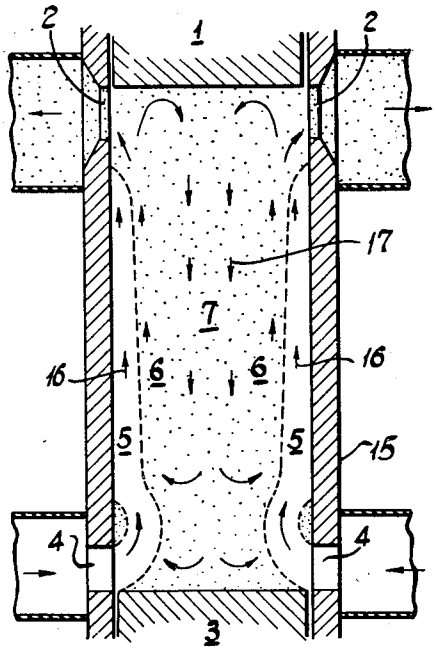


Fig. 2.

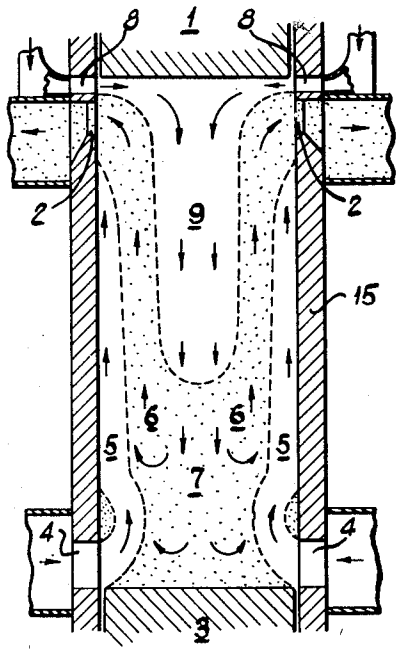


Fig. 3.

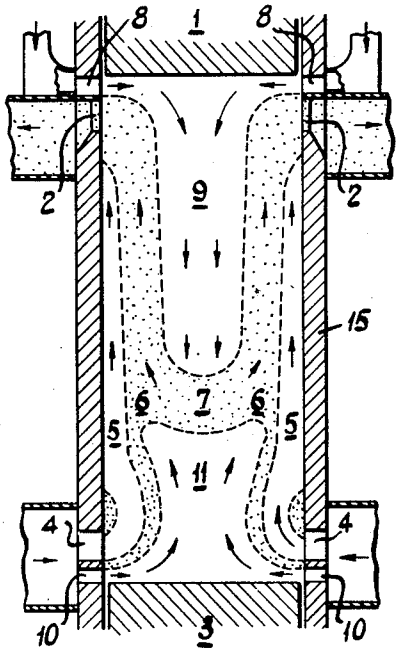
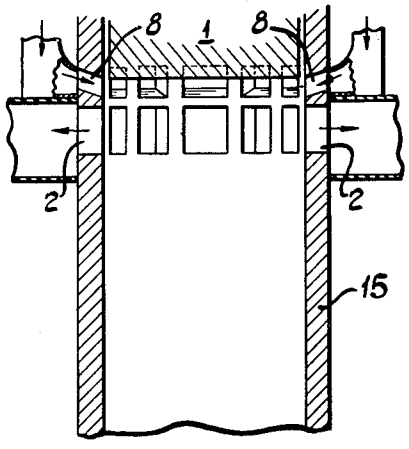


Fig. 4.



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TWO-STROKE INTERNAL-COMBUSTION ENGINE

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Fig. 6.

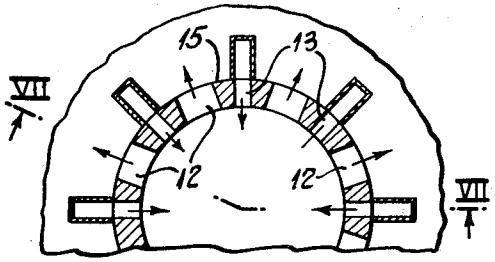


Fig. 5.

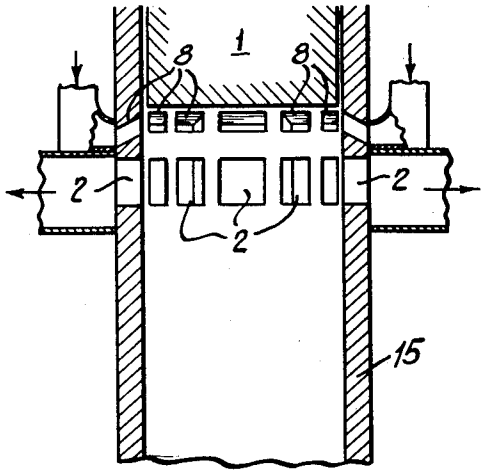


Fig. 7.

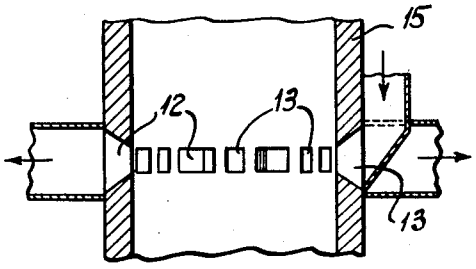
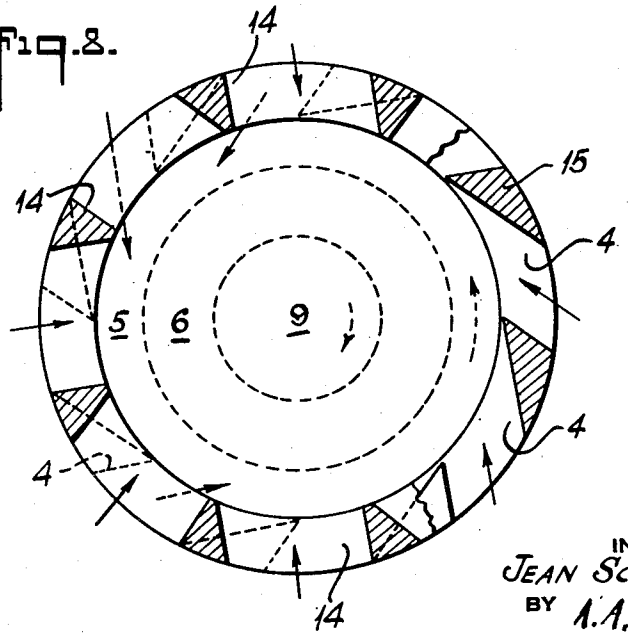


Fig. 8.



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TWO-STROKE INTERNAL-COMBUSTION ENGINE

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6 Claims. (Cl. 123—65)

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The present invention relates to two-cycle internal combustion engines with uniflow scavenging and more particularly to an improved scavenging system therefor. The invention is applicable to single piston engines as well as to opposed piston engines.

It is an object of the present invention to provide an improved scavenging arrangement in two-cycle internal combustion engines whereby, in combination with the conventional substantially tangential admission of scavenging air in the form of a swirl into the cylinder, additional scavenging air is introduced in substantially radial direction. Whereas the tangentially admitted air has a tendency to adhere to the interior cylinder wall, the additional air forms a core in the center of the cylinder.

It is an object of the present invention to provide an improved scavenging arrangement in two-cycle internal combustion engines whereby, in combination with the conventional substantially tangential admission of scavenging air to one end of the cylinder, additional scavenging air is admitted in substantially radial direction to the other end of the cylinder.

It is an object of the present invention to provide an improved scavenging arrangement in two-cycle internal combustion engines whereby, in combination with the conventional substantially tangential admission of scavenging air to one end of the cylinder, additional scavenging air is admitted in substantially radial direction to the same end of the cylinder and further additional scavenging air is admitted in substantially radial direction to the other end of the cylinder. In this case the tangentially admitted air will circulate along the interior cylinder wall and the additional air admitted substantially radially at both ends of the cylinder forms masses in the center of the cylinder moving toward one another.

Further and other objects of the present invention will be hereinafter set forth in the accompanying specification and claims and shown in the drawings, which by way of illustration show what I now consider to be preferred embodiments of the invention.

In the drawings:

Fig. 1 is a diagrammatic sectional illustration of a conventional scavenging system.

Fig. 2 is a diagrammatic sectional illustration of a scavenging system according to the invention.

Fig. 3 is a diagrammatic sectional illustration of a modified scavenging system according to the invention.

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Fig. 4 is a diagrammatic longitudinal sectional illustration of a portion of an internal combustion engine cylinder having modified auxiliary scavenging ports according to the invention.

Fig. 5 is a longtudinal sectional view of a portion of an internal combustion engine cylinder equipped in another modified manner with auxiliary air ports.

Fig. 6 shows a cross section through an internal combustion engine cylinder equipped with a further modification of an auxiliary scavenging air port system according to the invention.

Fig. 7 is a longitudinal sectional view of the cylinder illustrated in Fig. 6 and taken along line VII—VII in said figure.

Fig. 8 is a cross sectional view of an internal combustion engine cylinder showing yet another modification of an auxiliary air port arrangement according to the invention.

Like parts are designated by like numerals in all figures of the drawing.

Fig. 1 shows diagrammatically what happens in the cylinder of a single piston and an opposed piston internal combustion engine with conventional provisions for uniflow scavenging. In a single piston engine the piston 1 opens in its exhaust position the exhaust ports 2. In an opposed piston engine piston 1 opens the exhaust ports 2 and thereafter the other piston 3 the scavenging ports 4. The latter are usually disposed tangentially for well known reasons and cause rotation of the scavenging air about the longitudinal axis of the cylinder. Because of this rotation and the fact that the density of the scavenging air is about twice as great as that of the combustion gas in the cylinder which must be removed, a centrifugal effect is produced which causes the scavenging air 5 to move along the interior cylinder wall soon after the air is admitted. The air adheres to the interior cylinder wall and forms a tubular mass which moves toward the outlet ports in the direction of arrows 16. At the moment illustrated in Fig. 1 the scavenging air has almost reached ports 2. Due to the tubular configuration of the rotating scavenging air body a core 6, 7 is formed by the exhaust gases within the air body. This core rotates relatively slowly under the influence imparted thereon in the previous operating phase. This rotation is slowly accelerated by the air current rotating around the gas core. At first the scavenging action is favorable because the rotating current of relatively dense air separates the air from the gas except for a little mixing taking place in the border zone 6 between the mass of

air 5 and the gas 7. The scavenging air has a displacing effect exclusively which is advantageous for scavenging, and the displaced gas flowing through ports 2 carries only a negligible amount of air with it.

At the moment shown in Fig. 1 clean scavenging air 5 begins to flow unused through ports 2. From this moment on the air has no displacing effect and removal of the gas core 6, 7 depends solely on a mixing effect taking place at the border zone 6. This causes great loss in the scavenging process because air escapes either mixed with gas through ports 2 or unused altogether. A central downstream has developed in the unmixed gas as indicated by arrows 17 which throws gas continuously into the lower parts of the cylinder where it is mixed with scavenging air. In this second period the scavenging effect is very small.

The above described disadvantages are avoided by an arrangement according to the invention as diagrammatically illustrated in Fig. 2. Additional auxiliary substantially radial scavenging air inlet ports 8 are provided at the exhaust end of the cylinder 15. The auxiliary air entering through these ports produces an auxiliary air current 9 which flows counter to the main current 5 and does not rotate or rotates very slowly. This auxiliary current stays in the center of the gas core 7 which retained a slow rotation from the previous operating period which rotation is continuously accelerated by friction with the fast rotating tubular scavenging air body 5. This rotation increases toward the center of the cylinder. The auxiliary air current 9 is thus held in the center and descends and follows the also axially downstreaming gas 7 and replaces the exhaust gas by clean scavenging air.

The auxiliary scavenging air current 9 does not reach the outlet ports and continues to descend in the cylinder, whereas the main current 5 begins to escape through the outlet ports shortly after the moment illustrated in Fig. 2 and ceases to displace the exhaust gas. In contrast to the main scavenging current 5, the auxiliary current retains its displacing effect which promotes scavenging, also during the second scavenging period which follows the period illustrated in Fig. 2. In addition, the auxiliary current 9 replaces the descending core 7 of exhaust gas and avoids undesirable mixing of main scavenging air and exhaust gas by a harmless mixing of main and auxiliary scavenging air.

Fig. 3 illustrates a further improvement according to the invention residing in the provision of auxiliary inlet ports 10 for scavenging air at the intake end of the cylinder. This produces an uprising core 11 of scavenging air in the center of the cylinder. If the ports 10 are provided in combination with the previously described auxiliary ports 8, the central air cores 9 and 11 move toward one another in the gas core 6, 7 and their axial extents are reduced by approximately one half. Reduction of travel time and length of the auxiliary air currents 9 and 11 is critical for the degree of undesired mixture of scavenging air and exhaust gas and the improving effect of this combination exceeds the sum of the individual effects of the auxiliary scavenging currents 9 and 11.

Figures 2 and 3 are merely diagrammatic showings of possible modifications of the invention. The application of the invention is not limited to engines having pistons of equal diameter and/or stroke.

The auxiliary scavenging air inlet ports 8 may be inclined toward the center of the combustion space as shown in Fig. 4 or toward the piston face as shown in Fig. 5.

Auxiliary air admission ports 13 may be interspersed between the gas exhaust ports 12 as shown in Figs. 6 and 7.

The auxiliary ports may extend in substantially radial direction, causing no rotation of the admitted air, or they may extend at an angle to the radial direction as shown in Fig. 8 for promoting a slight rotational movement of the auxiliary air current preferably counter to the rotational movement of the main scavenging air stream. In the modification shown in Fig. 8 the auxiliary air entering through auxiliary ports 14 causes a clockwise rotation of the air core 9 whereas the air entering through main ports 4 rotates counterclockwise along the interior wall of cylinder 15.

While I believe the above described embodiments of my invention to be preferred embodiments, I wish it to be understood that I do not desire to be limited to the exact details of method, design and construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim:

1. In a two-cycle internal combustion engine with uniflow scavenging, a working cylinder, main scavenging air inlet ports provided at one end of said cylinder and being directed tangentially with respect thereto, and substantially radially directed, auxiliary scavenging air inlet ports disposed at the other end of said cylinder.

2. In a two-cycle internal combustion engine, a working cylinder, tangentially directed main scavenging air inlet ports, at one end of said cylinder, gas exhaust ports at the other end of the cylinder, and auxiliary scavenging air inlet ports disposed in said cylinder in longitudinal direction outside of said exhaust ports.

3. In a two-cycle internal combustion engine, a working cylinder, tangentially directed main scavenging air inlet ports, at one end of said cylinder, gas exhaust ports at the other end of the cylinder, and auxiliary scavenging air inlet ports disposed in said cylinder interspersed between said exhaust ports.

4. In a two-cycle internal combustion engine, a working cylinder, tangentially directed main scavenging air inlet ports at one end of said cylinder, and auxiliary scavenging air inlet ports at the other end of said cylinder directed substantially radially and inclined with respect to the longitudinal axis of said cylinder.

5. In a two-cycle internal combustion engine, a working cylinder, tangentially directed main scavenging air inlet ports at one end of said cylinder, and auxiliary scavenging air inlet ports at the other end of said cylinder directed substantially radially and inclined toward the center of the cylinder.

6. In a two-cycle internal combustion engine, a working cylinder having two end portions, tangentially directed main scavenging air inlet ports in said cylinder at one end portion thereof, substantially radially directed auxiliary air inlet ports disposed in the same end portion of said cylinder, and other substantially radially directed auxiliary air inlet ports disposed at the other of said end portions of said cylinder.

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