April 21, 1953 A. STOLL 2,635,593

TWO-STROKE INTERNAL-COMBUSTION ENGINE

Filed Sept. 19, 1949 2 SHEETS—SHEET 1

Fig. 1.

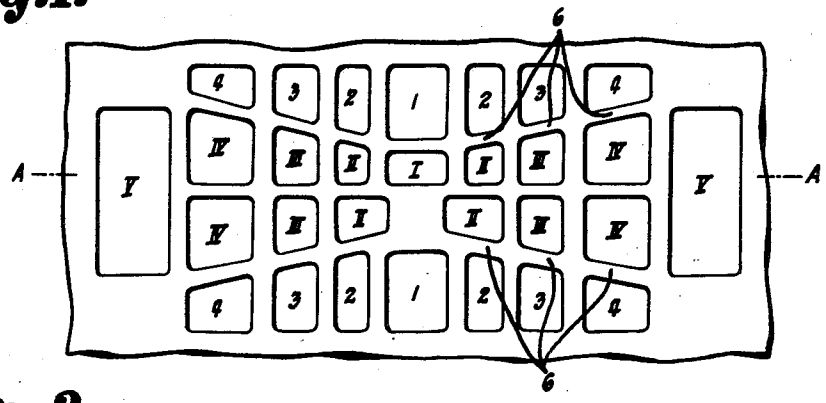


Fig. 2.

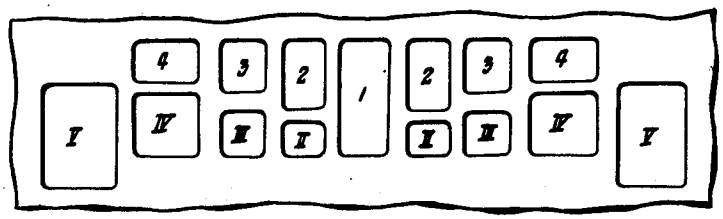
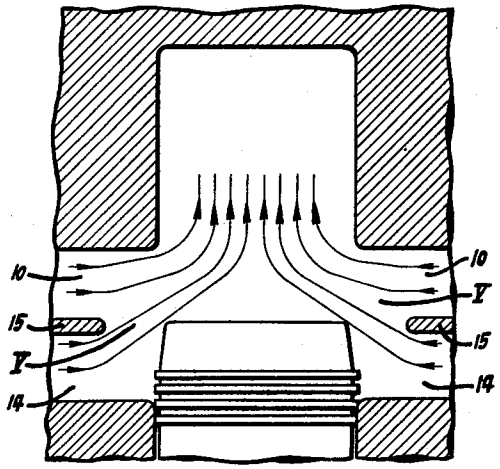


Fig. 3.



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Filed Sept. 19, 1949 2 SHEETS—SHEET 2

Fig. 4.

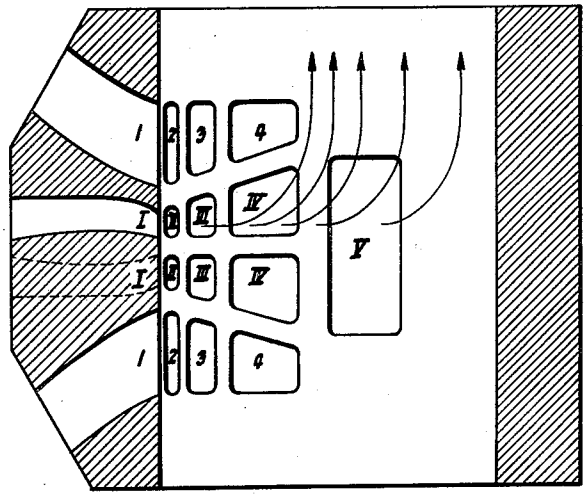
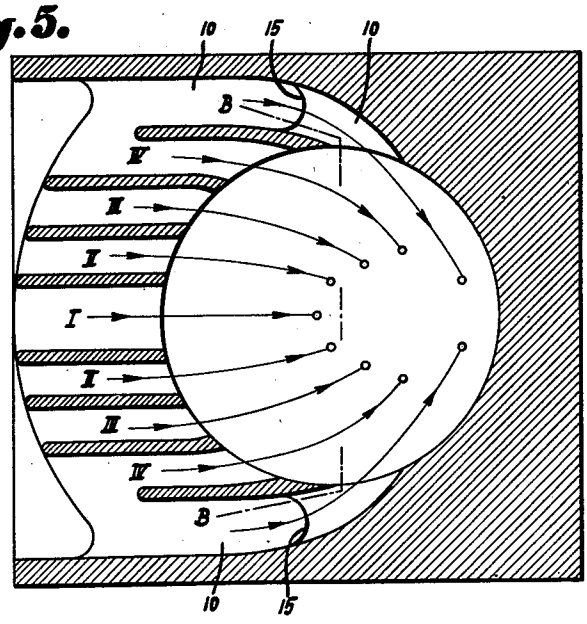


Fig. 5.



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TWO-STROKE INTERNAL-COMBUSTION ENGINE

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6 Claims. (Cl. 123—61)

1

This invention relates to a two stroke internal combustion engine with one-sided reversing scavenging by means of ports, of the type in which the exhaust ports are arranged above a row of admission ports. It is known that in internal combustion engines the attainable output depends in case of diesel engines on the weight of the air, or, in case of gasoline engines, on the weight of the gas-air mixture which is admitted into the working cylinder while the admission ports are uncovered. In case of two stroke engines the charging of the cylinder causes particular difficulties since the admission of the fresh air or of the combustion mixture is closely connected with the removal of the exhaust gases from the cylinder. In this case not only a swift and perfect feeding of the new charge is required, but also a corresponding removal of the waste gases. It is not possible simply to increase the cross section of the admission ports and possibly also of the exhaust ports, since this would result in a reduction of the effective piston stroke and so of the motor output. An increase of the admission ports only, at the expense of the exhaust ports, likewise would not be a remedy, since in this case the better feeding of the charge would be made illusory by a less efficient removal of the exhaust gas. Again, in case of an enlargement of the exhaust port cross section and a corresponding decrease of the admission port cross section the latter would become too small as to admit into the cylinder a sufficiently large weight of charge during the available time.

It is also known that in two-stroke scavenging, more particularly reversing scavenging a core (exhaust gas column) is resulting in the center of the cylinder, which core is not comprehended in the course of the flow of the scavenging air and which is difficult to remove from the cylinder unless the character of the scavenging is fundamentally altered. However, the complete and quick removal of this exhaust gas core is absolutely necessary in order to charge the stroke volume with fresh air.

According to the invention this problem is solved by a special shape and direction of the single scavenging air jets, in such a manner that the height of the scavenging or admission air ports increases from the middle of the row of ports towards both ends, while the height of the exhaust ports decreases in the same direction. Thus, the port cross section available for each kind of ports is not increased at the expense of the other kind of ports, but it is

2

substantially only locally distributed in another manner. This distribution of the exhaust and admission ports takes place primarily according to the requirements of a swift and complete removal of the exhaust gases. The large exhaust cross sections in the middle of the row of ports permit a very quick flowing off of the bulk of the exhaust gases facing the middle ports in the middle of the cylinder, while the smaller lateral exhaust ports are perfectly sufficient for the substantially smaller quantities of exhaust gas at the sides of the cylinder. This favorable distribution of the exhaust ports is primarily effective to prevent the formation of an exhaust gas core in the middle of the cylinder. Owing to the reduction of the cross section of the central admission ports with respect to the lateral admission ports the kinetic energy of the central scavenging currents is also reduced relatively to that of the outer ones, so that said central currents, hampered by the outer currents, cannot advance to the opposite wall of the cylinder but rise already beforehand and on their way towards the cylinder cover seize the central exhaust gas core, disturb its structure and drive these exhaust gases towards the exhaust ports.

The scavenging of the central space of the cylinder by the central scavenging currents is primarily caused by the air currents issuing from the large lateral scavenging ports which currents advance with great energy between the opposite wall of the cylinder and the scavenging air currents from the other admission ports and assist the erection of these weaker air currents already before reaching the wall of the cylinder, so that the whole scavenging air current directed against the cover of the cylinder fills a substantially larger part of the cylinder volume. The rising scavenging air current is thus enlarged towards the axis of the cylinder, so to speak, so that the scavenging of the exhaust gas present in this central region is ensured.

In double-acting two-stroke engines the partition wall between the upper and lower air admission ducts or channels is advantageously not passed to the cylinder wall, so that these channels terminate in a common port stretching at both sides of the horizontal plane of symmetry of the ports. Since the lateral ports are arranged approximately in the central longitudinal plane of the internal combustion engine or in the vicinity thereof, it is difficult to provide the required cross section for the admission channels if the distance between the cylinders shall not be increased. Therefore, if both the channels of

the upper and also of the lower side are used for each cylinder filling, a large amount of air can be admitted through the lateral ports.

It is also possible, if desired, to omit entirely the small exhaust ports above the two largest outer admission ports, since owing to their size and position they have no decisive share in the removal of the exhaust gases.

Other and further objects, features and advantages of the invention will be pointed out hereinafter and appear in the appended claims forming part of the application.

In the accompanying drawings several now preferred embodiments of the invention are shown by way of illustration and not by way of limitation.

In the drawings:

Fig. 1 is the development of the port region of a cylinder for a double acting two stroke engine,

Fig. 2 is the development of the port region of a cylinder for a single-acting two-stroke engine,

Fig. 3 is an axial section through the cylinder on line B—B of Fig. 5,

Fig. 4 is an axial section through the cylinder of a double-acting internal combustion engine, in a perspective representation,

Fig. 5 is a horizontal section through the cylinder on line A—A of Fig. 1.

Similar reference numerals denote similar parts in the different views.

Referring now to the drawings in greater detail, and first to Fig. 1, it will be seen that the admission ports I, II, III and IV for the upper and lower side of the cylinder are designed in such a way that their height is continuously increasing also within the single ports from the middle of the row of ports towards the sides. Similarly the height of the exhaust ports 2, 3, 4 on top thereof is decreasing. Therefore, the bars 6 of the cylinder wall between the admission and exhaust ports are slanting. In the embodiment as per Fig. 2 the height of the ports is changing in steps from port to port. Depending on the flowing and feeding conditions of the charge a lower admission port I may be arranged below the central exhaust port 1 or said space may be left free entirely (as shown at the lower side of the double-acting engine, Fig. 1), or partly with a view to the piston rod sweeping this space, or the exhaust port 1 may be extended to the lower edge of the rest of the admission ports, as per Fig. 2.

Of a particular importance for the cylinder charge are the lateral admission ports V which have the maximum height of all admission ports and therefore are the first to be uncovered and the last to be covered by the piston. When they are covered, a part of the exhaust cross section is also already covered by the piston. The course of the scavenging current will be seen from Figs. 4 and 5. The last scavenging currents from the lateral admission ports V owing to their increased kinetic energy will advance up to the rear wall of the cylinder and erect each other mutually. They form in front of the cylinder wall a wall of scavenging air at which the scavenging air currents from the smaller admission ports are also erected and caused to flow upwards towards the cylinder cover, seizing the central zone and thus preventing the formation of an exhaust gas column.

It is important for the filling of the cylinders of double-acting internal combustion engines that the two feed ducts 10 and 14 for the upper and lower side of the cylinder cooperate in such a manner that a larger charge is attained. This cooperation is attained by providing the partition wall 15 (Fig. 3) in such a manner that it does not go through to the cylinder wall as in the other admission ports. Thus the charge is permitted to flow into the same part of the cylinder (upper or lower part) from both channels. This is particularly advantageous if owing to a small distance between the cylinders the channels 10 and 14 have to be made small. It is also possible in case of single-acting internal combustion engines to make the ports V larger in a downward direction than the other admission ports if an increased charge can be attained thereby in view of the shape of the piston, or of the feed ducts 10, as the case may be.

While the invention has been described in detail with respect to certain now preferred examples and embodiments of the invention it will be understood by those skilled in the art after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention and it is intended, therefore, to cover all such changes and modifications in the appended claims.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. In a two-stroke internal combustion engine with one-sided reversing scavenging, a cylinder having a row of admission ports and a row of exhaust ports, said admission ports and said exhaust ports being located on the same side of said cylinder and the height of said admission ports increasing from the middle of the row of ports towards both ends, while the height of said exhaust ports decreases in the same direction.

2. In a two-stroke internal combustion engine with one-sided reversing scavenging, at least one cylinder comprising a row of admission ports, a row of exhaust ports and bars between said rows of ports, said admission ports and said exhaust ports being located on the same side of the cylinder and said bars being inclined in such a way that the height of said admission ports increases from the middle of the row of ports towards both ends, while the height of said exhaust ports decreases in the same direction.

3. In a two-stroke internal combustion engine with one-sided reversing scavenging, a cylinder having a row of admission ports, feed ducts leading to said admission ports, and a row of exhaust ports, said admission ports and said exhaust ports being located on the same side of the cylinder and the height of said admission ports increasing from the middle of the row of ports towards both ends, while the height of said exhaust ports decreases in the same direction, and the feed ducts for the two outer admission ports being directed so that their partial charging currents are oppositely directed.

4. In a two-stroke internal combustion engine with one-sided reversing scavenging, at least one cylinder comprising a row of admission ports and a row of exhaust ports, said admission ports and said exhaust ports being located on the same side of the cylinder and the height of said admission ports increasing from the middle of the row of ports towards both ends, while the height of said exhaust ports decreases in the same direction, and the two outer admission ports being at least partly arranged on the side of the cylinder facing the rest of said ports.

5. In a double-acting two-stroke internal combustion engine with one-sided reversing scavenging, at least one cylinder, an upper row of admission ports, a lower row of admission ports, an upper row of exhaust ports and a lower row of exhaust ports, upper and lower feed ducts leading to said admission ports, and partition walls between said feed ducts, the height of said admission ports increasing from the middle of the row of ports towards both ends, while the height of said exhaust ports decreases in the same direction, and the partition walls between the feed ducts leading to the extreme outer admission port terminating at a point before the cylinder wall, in such a way that the two companion upper and lower feed ducts open out into a common port extending at both sides of the transverse middle plane between said rows of ports.

6. In a two-stroke internal combustion engine with one-sided reversing scavenging, a cylinder having a row of admission ports and a row of exhaust ports, said admission ports and said exhaust ports being located on the same side of the

cylinder and the height of said admission ports increasing from the middle of the row of ports towards both ends, while the height of said exhaust ports decreases in the same direction and is reduced to zero above the two extreme outer admission ports having the maximum height.

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