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Lanpheer

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[54] **MULTIPLE INPUT PORT INTERNAL COMBUSTION ENGINE**

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[73] Assignee: **Brunswick Corporation,** Chicago, Ill.

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[52] **U.S. Cl.**..... **123/73 A,** 123/73 R, 123/65 P, 123/65 PD

[51] **Int. Cl.** .. **F02b 25/18,** F02b 25/00, F02b 25/14

[58] **Field of Search** ..... 123/65 P, 65 PD, 73 R, 123/73 AA, 73 PP, 74 B, 65 A, 73 A

[56] **References Cited**

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2,573,989	11/1951	Sammons et al.	123/65 PD
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Assistant Examiner—L. T. Casaregola
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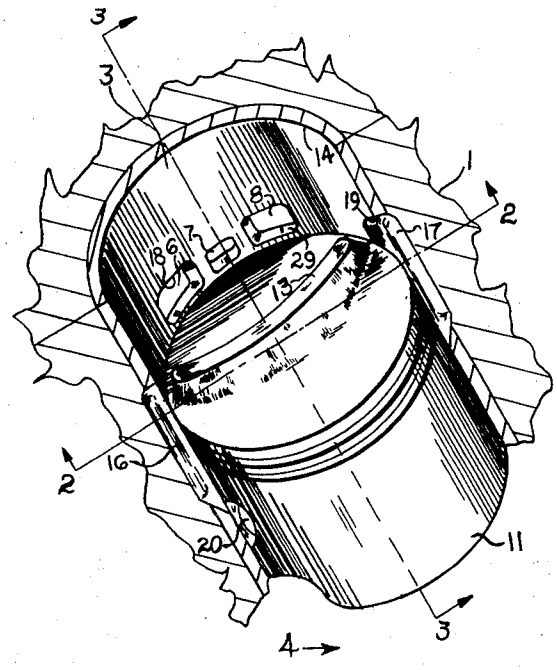
[57] **ABSTRACT**

A two-cycle internal combustion engine wherein the cylinders have a plurality of input or transfer ports through one side of the cylinder wall and a plurality of exhaust ports through the diametrically opposite side wall. Each piston includes a baffle plate extending upwardly from the piston crown, generally curved outwardly from the input ports and located between the inlet ports and an imaginary transverse vertical plane bisecting the piston. The wall directs the fuel-air charges entering through the transfer ports toward each other to define a combined stream which rises to the top of the cylinder as the combusted gases move out through the exhaust ports on the opposite side. Auxiliary inlet channels in the interior of the cylinder wall communicate with apertures in the piston side wall so that a portion of the fuel-air mixture passes therethrough from the crankcase to the combustion chamber without going through the transfer ports.

8 Claims, 6 Drawing Figures



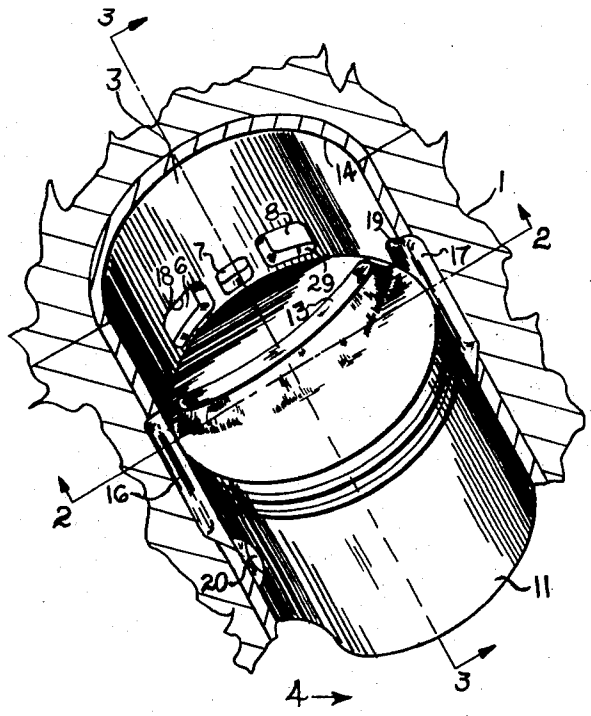


Fig 1

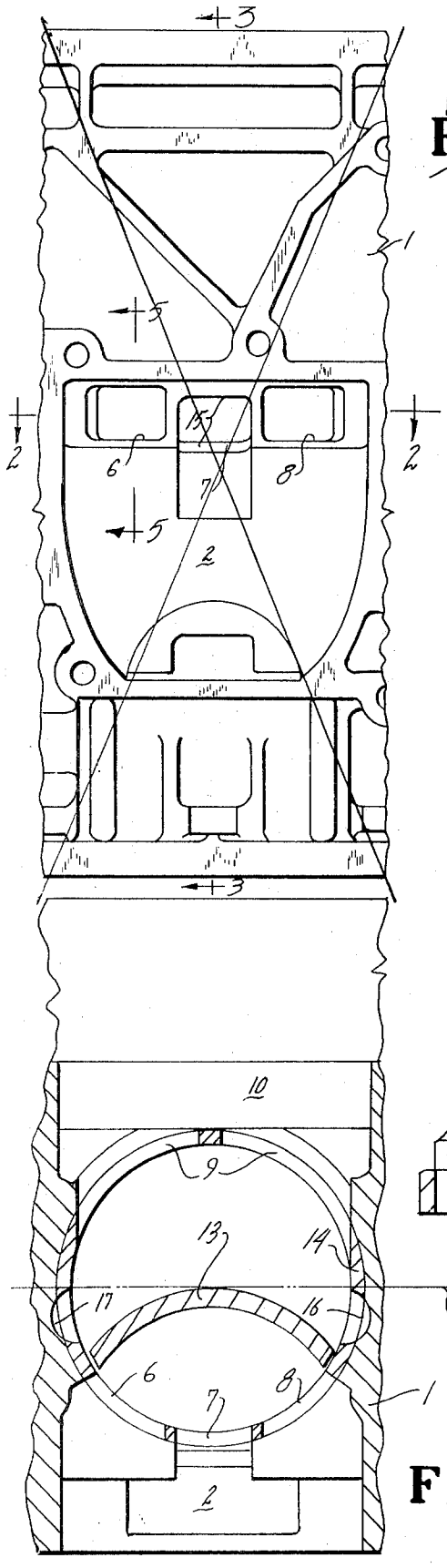


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FIG_1

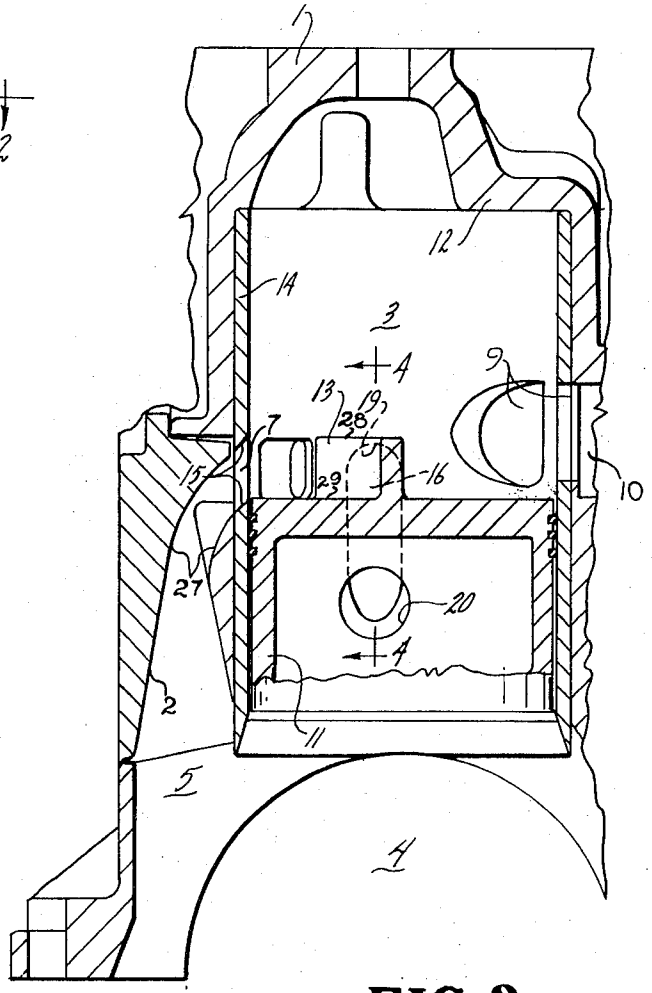

FIG_3

FIG_2

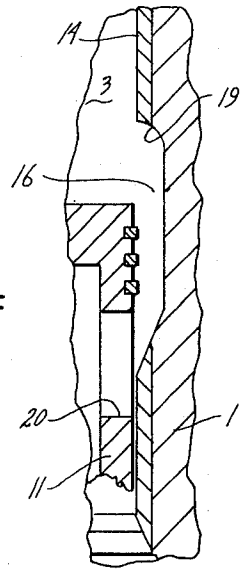

FIG_4

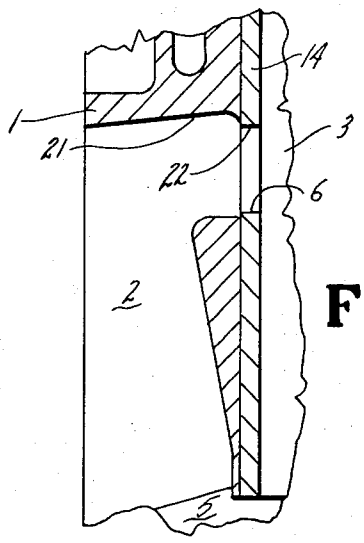

FIG_5

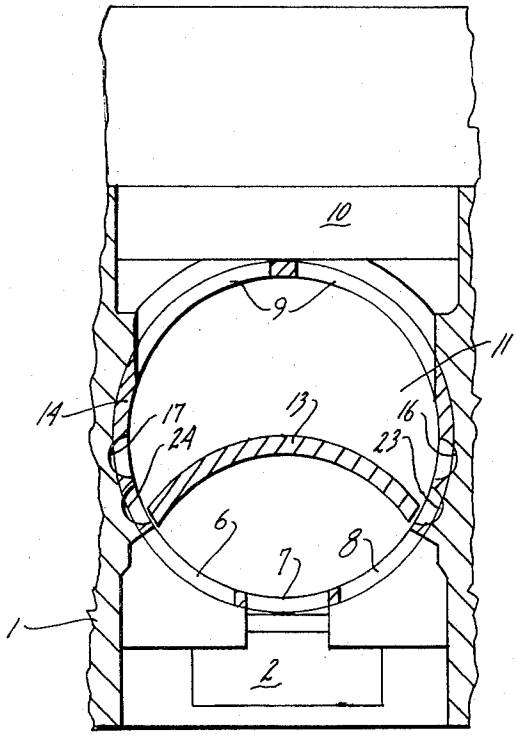

FIG_6

MULTIPLE INPUT PORT INTERNAL COMBUSTION ENGINE

BACKGROUND OF THE INVENTION

This invention relates generally to two-cycle engines with inlet ports to the one side of the cylinder and exhaust ports to the opposite side of the cylinder, and particularly to auxiliary input channels or passages up the inside of the cylinder wall.

In a two-cycle engine, the new charge is introduced into the cylinder during the downward movement of the piston and simultaneously with the exhausting of the combusted gases. This is in contrast to the four-cycle or stroke engine which has a separate stroke during which a charge is introduced into the cylinder. As a result of this difference, the two-cycle engine has a relatively short period in which to introduce the new fuel charge into the cylinder, and an efficient means of scavenging the combusted gases and simultaneously rapidly introducing a new fuel charge into the cylinder is necessary for efficient operation. Thus, in a two-cycle engine maximum transfer input port area is desired to permit the rapid introduction of a fuel mixture into the cylinder during the relatively short exhausting and charging period permitted. Efficiency of charging becomes increasingly important in high speed engines where the exhaust and charging time becomes extremely short.

One improved system is shown in U.S. Pat. No. 3,494,335 to H. R. E. Meier wherein the charge is introduced through a plurality of spaced inlet ports along one side of the piston cylinder, with a curved baffle plate on the piston crown suitably directing the charges upwardly to prevent this passing directly across the cylinder to the exhaust ports. As noted in the Meier patent, a pair of spaced input ports are provided with an intermediate wall section with the two streams especially directed into or over the piston. A centrally located auxiliary port is or may be provided to introduce a directional flow and further increase the port area. In practice it has been found that such a baffle limits the transfer port area that is available to the input side of the baffle or deflector. Further, the baffle should be spaced relatively closely to the inlet ports such that the charge engages the baffle rather than moving upwardly and over the baffle. Thus if the baffle is moved away from the inlet ports to permit increasing of the size of the input ports, the effect of the baffle plate upon the entering charges is significantly reduced and the gases may pass over the top of the baffle and out through the exhaust ports. The use of the intermediate directional port as taught by Meier allows some increase in the spacing with an increase transfer port area.

U.S. Pat. No. 3,494,335 also suggests providing auxiliary ports adjacent to the exhaust ports to introduce a flow similar to the conventional loop scavenging ports with the auxiliary flow sweeping in the opposite direction across the face of the piston and then upwardly over the top of the guide to impinge upon the upward stream of the fuel mixture rising from the input port area. Although the baffle construction appears to provide a significant improvement in the two-cycle engine charging system, a limited input port area is provided with the input port area being generally restricted to approximately 90° of the cylinder circumference.

SUMMARY OF THE PRESENT INVENTION

The present invention is particularly directed to a two-cycle engine employing the input port means in a limited area and a baffle on the piston head in combination with novel auxiliary passageways provided to increase the total input port area. Generally in accordance with the invention, auxiliary charge transfer means are provided in the cylinder wall which open to the exhaust side of the baffle but on the input side of an imaginary plane passing vertically through the piston midway between the input ports and the exhaust ports. Applicant has found that this location of the auxiliary transfer channels very substantially increases the input charge and that, in fact, location of the channels significantly to the exhaust port side of such plane does not improve the charging cycle; apparently because of excessive charge loss through the exhaust ports. The auxiliary input channels are most advantageously located closely adjacent to the exhaust side of where the edge of the baffle meets the cylinder wall.

In accordance with another novel aspect of the invention, the auxiliary charge transfer means or port comprises an elongated axial recess in the wall of the cylinder communicating with a port provided in the piston wall. When the piston rises to a preselected position, some of the pressurized fuel-air mixture or charge passes from the crankcase through the port in the piston wall and up these axial recesses into the combustion chamber.

In accordance with a further novel aspect of the invention, optimum results are obtained by adapting the aforemention auxiliary port arrangement to open to the combustion chamber slightly after the main transfer or input ports have opened. If desired a plurality of such auxiliary ports can be provided in the half of the cylinder to the input port side of the aforementioned imaginary plane through the cylinder to maximize the transfer port area.

In accordance with a still further novel aspect of the invention, Applicant has found that the principal transfer port ducting can be constructed to provide the effect of an increased axial opening by providing a relatively minute recess across the top wall of the transfer duct where it meets the top edge of the inlet port in the cylinder wall. This interruption of the flow path in combination with a sharp edge on the inlet port aperture generates turbulence in the charge which not only cuases it to move downwardly over the top of the piston toward the baffle, as taught by Meier, but more importantly promotes optimum flow of the charge into the cylinder. This effect is particularly valuable when the baffle is spaced significantly further away from the input port.

The invention is thus a highly improved fuel charging system for a two-cycle engine which provides maximizing of the fuel charge and efficient scavenging of combusted gases essentially without loss of fresh fuel charge. Further, the construction can be readily adapted to mass production in a relatively simple and inexpensive construction.

BRIEF DESCRIPTION OF DRAWINGS

The drawings furnished herewith illustrate a preferred construction of the present invention in which the above advantages and features are clearly disclosed as well as others which will be readily understood by

those skilled in the art from the following description of such illustrated embodiment.

In the drawings:

FIG. 1 is a perspective view of an input portion of the interior of a cylinder for a two-cycle internal combustion engine constructed according to the teachings of the invention.

FIG. 2 is a horizontal cross sectional view of the cylinder of FIG. 1 taken generally along line 2—2.

FIG. 3 is a schematic cross sectional view of the cylinder of FIG. 1 taken generally along line 3—3.

FIG. 4 is an enlarged vertical fragmentary cross sectional view taken on line 4—4 of FIG. 3 through an auxiliary finger port.

FIG. 5 is an enlarged fragmentary view taken generally on line 5—5 of FIG. 1 through an input port; and

FIG. 6 is a view similar to FIG. 2 showing an alternative multiple auxiliary port construction in accordance with the present invention.

DESCRIPTION OF ILLUSTRATED EMBODIMENT

Referring to the drawings and particularly to FIG. 1, an engine cylinder of the invention is illustrated which is particularly suited for forming a part of an outboard motor. The engine block 1 may be formed in a well known manner by die casting with fuel charge transfer passages on one side of the piston chamber and exhaust passages on the other. The transfer passages may be connected to the crankcase chamber 4 or some other suitable pressurized charge source by an integrally cast passageways known to the art. The charge may be an air-fuel mixture as with a conventional carbureted engine or may be only air as with a direct fuel injection engine. Typically the charge is transferred through a transfer passageway which terminates adjacent the axially center portion of the cylinder and is transferred into the cylinder through a plurality of input port means 6, 7 and 8. Three ports 6, 7 and 8 are shown in the illustrated embodiment of the invention. The opposite side of the block is provided with exhaust ports 9 (see FIG. 3) communicating with an exhaust chamber 10 which directs the exhaust gases through a suitable exhaust system. For example, in outboard motion constructions, the exhaust is discharged through the lower unit. Each cylinder has a piston 11 slidably mounted therein and interconnected to a crankshaft, not shown, by suitable connecting rod means. The exhaust ports 9 are mounted directly to the opposite side of the inlet ports 6 – 8 and preferably slightly offset upwardly therefrom toward the cylinder head. The exhaust and inlet ports are respectively uncovered by the piston 11 at appropriate times to effect a proper scavenging of the cylinder of the exhaust or combusted gases and subsequent filling of the cylinder with a fresh fuel charge. The exhaust ports 9 are preferably uncovered slightly ahead of the uncovering of the intake ports 6 – 8 as the piston 11 moves downwardly to initiate exhausting movement of the combusted gases outwardly of the cylinder prior to the introduction of the new charge, which assists in the initiated scavenging. The piston includes a baffle or guide wall 13 in the form of an upstanding flange-like member extending across the piston crown or face in front of the inlet ports 6 – 8. The illustrated guide wall 13 of a concave configuration, although a convex or other suitable configuration may be used, and is of a sufficient height to prevent the incoming gases from passing directly over the top of the baffle and outwardly through the exhaust ports 9. More particularly, the inlet ports, 6, 7 and 8 include a pair of laterally spaced main charging ports 6 and 8 of a generally rectangular configuration and with relatively sharp sidewall edges formed by appropriate milling of the passageways in the wall of the cylinder including the inner special liner wall 14. The ports 6 and 8 are spaced from each other with the third port 7 located intermediate therebetween.

The intemediate port 7 is formed with lower and top walls angled upwardly into the combustion chamber as at 15 so as to project its portion of the charge upwardly between the charges entering through the two main ports 6 and 8, and thus introduce an upward bias to the impacting or meeting flows from ports 6 and 8. That portion of the transfer passage 2 serving ports 6 and 8, has a restriction 26 therein, as seen in FIG. 5, which renders the inner wall thereof substantially normal to the piston axis to promote flow parallel to the piston face. The portion 27 (FIG. 3) of the inner wall aligning with the central port 7 is, on the other hand, milled to direct the charge upwardly into the third port with the desired upwardly directed flow path. This construction is generally in accordance with the construction shown and taught by the Meier U.S. Pat. No. 3,494,335.

In accordance with one novel feature of the present invention, a pair of auxiliary charge or inlet ports 16 and 17 are provided in the wall of the cylinder 3 for introducing of a charge into the combustion chamber more directly than by channeling it through the transfer passage 2. The special input ports 16 and 17, variously referred to as "finger" ports, are located on the exhaust side of the baffle wall 13, and in particular between such wall and an imaginary bisecting plane 18, (FIG. 2) passing vertically through the cylinder 3 between the inlet and exhaust ports.

Referring to FIG. 2, the main input charge ports 6 – 8 extend across approximately 120° of the cylinder wall directly opposite from the exhaust ports 9. One auxiliary charge port 16 is formed in the cylinder wall adjacent the exhaust side behind one end of the baffle 13 but on the input port side of the center transverse plane 18. The other auxiliary port 17 is similarly formed adjacent the opposite end of baffle 13. In the embodiment of the invention shown in FIGS. 1 – 4, the auxiliary ports 16 and 17 are recesses in the cylinder liner and engine block which extend axially of the cylinder. The auxiliary finger ports 16 and 17 can be machined, milled in or cast integrally into the cylinder or engine block. The top 19 of each finger port is positioned slightly below the top edge 18 of the main charging ports 6 and 8, and the ports project downwardly therefrom to a point significantly below the lower or crankcase edge 29 of such ports. The piston 11 which is slidably mounted within the cylinder 3 is in turn provided with drilled or otherwise formed openings 20 in each side wall which openings are positioned in alignment with the recesses 16 and 17 to provide a means of establishing communication between the crankcase chamber 4 and the finger ports. The finger ports are formed with a sufficient axial length such that the piston openings 20 communicate with the ports 16 and 17 as the head of the piston uncovers the main input ports 6 and 8 for transfer of the main charge to the cylinder. Thus, as the piston 11 moves downwardly, it first opens the exhaust ports 9 to initiate the exhaust of the combusted gases. The piston 11 then opens the main inlet

ports 6 and 8 to initiate the introduction of the fresh charge. At this time, the finger ports 16 and 17, and the intermediate port 7, are still held closed by the piston. The charge openings 20 in the side wall of the piston 11 are, however, already aligned with the lower portion of the respective finger ports 16 and 17 and permit the fuel-air charge to fill the finger ports. After a few further degrees of downward piston movement, intermediate port 7 and the finger ports 16 and 17 are respectively uncovered. The charge stored in the finger ports is then injected upwardly into the combustion chamber 3 at the two points behind the baffle 13 but to the input side of the imaginary transverse plane 18. The extension of the finger ports 16 and 17 is preferably such that the charge will continue to flow upwardly therethrough during the period that the piston moves downardly to completely uncover the main charging ports 6 and 8. Thus, the finger ports 16 and 17 in combination with the openings 20 in the side wall of the piston 11 provide for transfer of additional fuel-air charge following the main charge by a slight delay resulting from this axial offset or downward spacing of the tops 19 of the finger ports with respect to tops 28 of the main ports 6 and 8. The auxiliary ports located as described, significantly increase the fuel charging port area, and provide a very efficient transfer of charge to the cylinder resulting in a significant increase in horsepower output of the engine. Referring to FIGS. 3 and 4, for a cylinder having a bore of 2⅞ inches and a stroke of 2 9/16 inches, one configuration of the auxiliary ports which has been found to be advantageous provides that the port channel 16 and the top 19 be formed by a spherical radius of 0.25 inch with the bottom surface 39 drawn out at an angle of 25° to the cylinder wall. The overall length of the channel is approximately 1.5 inches.

Applicant also has found that the pair of main ports can be further axially enlarged in a cross charging engine to increase the charging efficiency by modifying the top edge opening as shown in FIG. 5. The upper wall of the transfer passage 2 adjacent to the pair of ports 6 and 8, is recessed as at 21, terminating inwardly of the cylinder liner 14 to define a relatively sharp edge as at 22 to the charging ports 6 and 8. For example, Applicant has found that milling of the recess as illustrated to a depth of about 0.125 inch, results in a very significant improvement in the charging. Applicant theorizes that the combination of the relatively shallow recess 21 and sharp edge 22 creates a charge turbulence during transfer which tends to direct the charge through the main ports 6 and 8 into the cylinder with a downward bias. This downward bias permits enlarging of the opening or main transfer ports in the axial direction to further promote transfer of the charge. The sharp edge 22 may be integrally cast directly into the unit.

The downward bias is most significant in avoiding the tendency of the charge to move directly over the wall and permits the outward placement of the deflector wall. The construction can be advantageously employed with any deflector system however such as that employed with the conventional cross scavenging port.

The embodiments of the invention shown in FIGS. 1 - 5 have provided exceptionally satisfactory results. If desired, however, the charge input port area might be even further increased by introducing an additional inlet port means between the ports 16 and 17 and plan 18. For example, in FIG. 6, additional ports 23 and 24 are shown which even slightly overlapping the baffle 13, but with all ports remaining on the inlet side of the reference plane 18. In this embodiment, the piston is provided with one or more pairs of appropriately spaced openings, not shown, for selective alignment with the several finger ports on each side of the main charging ports.

The present invention provides a means of improving the charging of a two-cycle internal combustion engine in a relatively inexpensive and surprisingly effective manner.

While the principles of the invention have been described in connection with the above specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of the invention.

I claim:

1. In a two-cycle engine generally of the cross-scavenged type having a piston reciprocally mounted within a cylinder, main charge inlet ports and an exhaust port positioned on opposite sides of an imaginary plane vertically bisecting the cylinder, and baffle means extending upwardly of the face of the piston concave to said charge inlet ports and positioned entirely to the inlet side of said reference plane to deflect the inlet gas flow from said charge inlet ports, an improvement comprising auxiliary inlet port means located on the exhaust port side of said baffle means but entirely on the inlet side of said imaginary reference plane each of said auxiliary inlet port means communicating with the crank case of the engine, and being configured to discharge upwardly and radially inwardly of said cylinder so as to introduce additional fuel-air charge behind said baffle means and to the inlet side of said imaginary plane.

2. The device of claim 1, wherein said auxiliary inlet port means includes a first and a second port located circumferentially to the opposite sides of said charging ports and substantially between said baffle means and said reference plane.

3. The device of claim 1, wherein a plurality of said auxiliary ports are provided on each side of said main inlet port means.

4. The device of claim 1, in which said auxiliary port means comprise a recess in the cylinder wall and a through opening in the side wall of the piston.

5. The device of claim 4, wherein the top of said auxiliary port is spaced downwardly from the top of said charging ports and wherein said auxiliary port extends downwardly below the bottom edge of said main charging ports so as to maintain communication between the opening in said piston and said auxiliary port as the top of the piston moves downwardly below the top edge of said main charging port.

6. The device of claim 1, wherein said charging ports encompass approximately a 120° span of the cylinder wall, and said auxiliary inlet port means are located to the opposite sides of said charging port means and within 30° of the outer edge of said charging ports to maintain the input port area within the 180° sector on the cylinder encompassing the charging ports.

7. The device of claim 6, wherein said auxiliary input port means are finger ports having an upper head end located beneath the top edge of the main charging ports.

8. The device of claim 1, in which said auxiliary port means include a pair of finger ports defined by axial recesses in the cylinder wall to the opposite sides of said

directing means and a pair of corresponding through openings in the side wall of the piston, said finger ports being spaced downwardly from the top edge opening of the main charging ports and extending substantially below the bottom edge of the charging ports to maintain communication with the opening in said piston as said piston moves downwardly fully opening the main charging ports.

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