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INTERNAL COMBUSTION ENGINE

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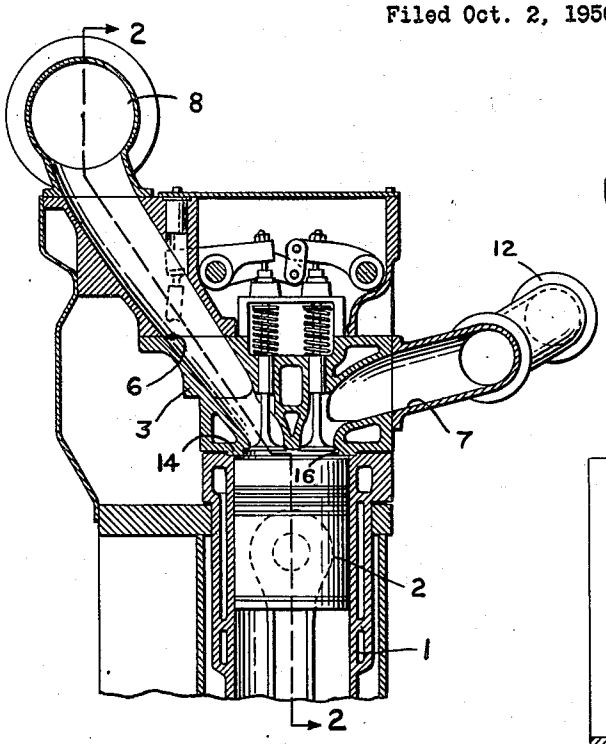

FIG. 1

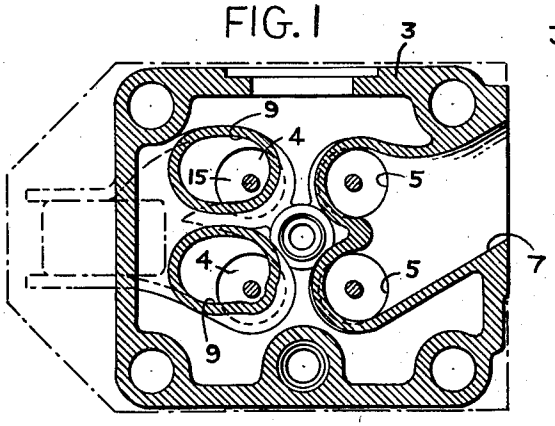

FIG. 3

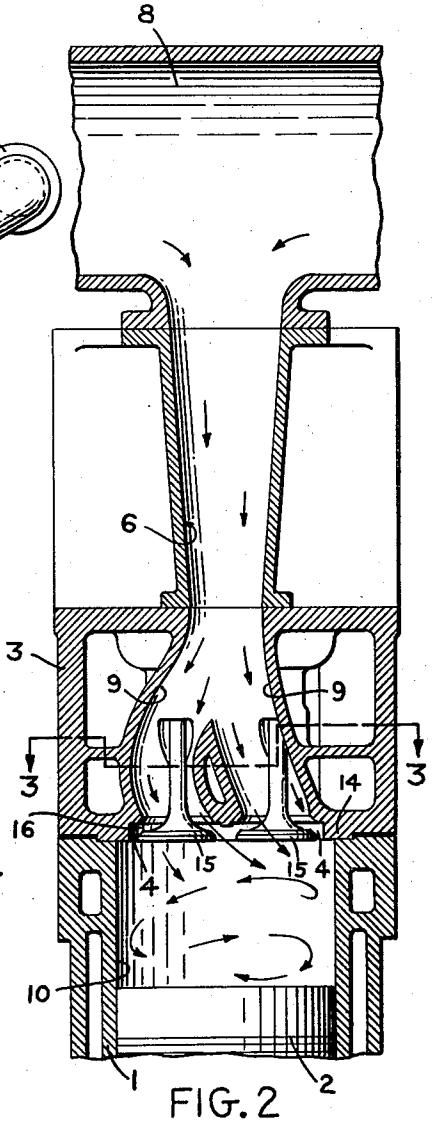

FIG. 2

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INTERNAL COMBUSTION ENGINE

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1 Claim. (Cl. 123—188)

This invention relates to internal combustion engines and more particularly to high pressure four cycle turbocharged diesel engines.

Specifically the invention relates to intake passage and inlet ports design provided, in the present invention, among other advantages, to intensify the supercharging action in the engine cylinder. The intensification is accomplished by providing inlet ports or port eccentrically of the intake passage, and slightly inclining the intake passage as it approaches the said eccentric ports or port to thereby impart a downward swirl in the air entering the cylinder; and providing a taper or Venturi construction in the intake passage to cause a ramming of air through the inlet port or ports, by air issuing from the said Venturi. By thusly intensifying the supercharging action in the engine cylinder, this permits a substantial reduction of valve overlap, which permits optimum performance with high pressure turbocharging, such as pressure ratios of manifold air pressure absolute, to atmospheric pressure absolute of 1.8 to 3.0.

Among other novel features of the present invention are: the disposing of the exhaust passage at an angle to permit smooth flow of exhaust gases to the turbocharger, without undue variation of sectional area in the transition from the exhaust port in the cylinder head to circular piping of the exhaust system for the turbocharger, thus retaining exhaust gas energy to the high pressure turbocharging; and the recessing of the cylinder head to permit the piston contour to be smooth with no irregularities due to valve cutouts, normally associated with conventional design. This permits the accelerated swirl of incoming air into the cylinder to be augmented during the scavenging period or admission part of the cycle, securing the necessary turbulence for most efficient combustion of fuel injected.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing an internal combustion engine of a preferred form embodying the invention and the features forming the invention will be specifically pointed out in the claim.

In the drawings:

Figure 1 is a vertical section through a fragment of a high pressure supercharged internal combustion engine showing the improved construction of intake and exhaust passages, etc.

Figure 2 is a vertical section taken on the line 2—2 of Figure 1.

Figure 3 is a horizontal section taken on the line 3—3 of Figure 2.

Referring particularly to the drawings the improved engine includes a cylinder 1 in which a piston 2 reciprocates. The cylinder head 3 is provided with a pair of intake ports 4 and a pair of exhaust ports 5 with which the intake passage 6 and exhaust passage 7 communicate, respectively.

The intake passage 6 has its inlet end opening into the

intake manifold 8 and receives therefrom high pressure air from a supercharger (not shown). The intake passage 6 extends from the intake ports 4 to the manifold 8 in an almost vertical direction, deviating from the vertical only as much as is necessary by mechanical features of the engine construction. That is, the intake passage extends from the intake ports 4 to the manifold 8 at an acute angle to a vertical plane bisecting the axis of the cylinder 1 as clearly shown in Figure 1 of the drawings. As clearly shown in Figure 2 of the drawings the cross-sectional area of the intake passage 6 varies throughout its length to provide a Venturi, and as it approaches the intake ports 4 it divides, as shown at 9 into separate passages inclining slightly towards the intake ports 4 which are disposed eccentrically of the passages 9 as shown in Figure 3 of the drawings. It has been found, in actual use, that by utilizing an almost vertical Venturi passage with eccentrically disposed porting of the intake passage that this intensifies the supercharging resulting in greater turbulence, which in turn results in more efficient scavenging and thus permits a substantial reduction of valve overlap, which has been found essential for optimum performance with high pressure turbocharging. The term "high pressure turbocharging" is used herein to refer to pressure ratios of manifold air pressure absolute, to atmospheric pressure absolute of 1.8 to 3.0. More particularly, it has been found by test in research work, that with the intensified charging provided by the present construction of intake passage and port relation, overlap of intake and exhaust may be reduced to 100 degrees or less, without impairing performance, and at the same time a considerably greater portion of the air is trapped in the combustion chamber 10 of the cylinder 1. This allows operation at loads in excess of 200 B.M.E.P. (brake mean effective pressure) with clear exhaust which has not heretofore been possible with engines of conventional design.

The length of the intake passage 6 to port diameter of one of the intake ports 4 is approximately a ratio of 10 to 1 and the area of the port of the passage to the manifold 8 to the narrowest section of the passage 6 in the cylinder head 3 is a ratio of approximately 1.2 to 1.

The exhaust passage 7, is disposed at an angle (i.e. a slight acute angle to the horizontal) to permit smooth flow of exhaust gases to the turbocharger (not shown), without undue variation of sectional area in the transition from the exhaust ports 5 in the cylinder head to the circular piping 12 of the exhaust system for the turbocharger. The exhaust passage 7 in the head 3 is a single passage gradually curving, without any abruptness, into the angled portion of the passage as shown in Figures 1 and 3 of the drawings.

The cylinder head deck 14 is recessed as shown at 16 on its surface facing the combustion chamber 10 to permit the valve heads 15 to seat therein and permit the top of the piston contour to be smooth with no irregularities due to valve cut-outs. This permits accelerated swirl to be augmented during the scavenging period, securing the necessary turbulence for most efficient combustion of fuel injected into the combustion chamber.

From the foregoing description taken in connection with the accompanying drawings, it will be apparent that a construction of a high pressure four cycle turbocharged internal combustion engine of the diesel type has been provided which provides; a construction suitable for high pressure turbocharging which permits a substantially reduced overlap between scavenging and compression, thereby increasing the air charge trapped in the combustion chamber; a construction having an intake port length ratio to valve diameter of approximately 10 to 1, to provide optimum ram effect of entering air in the cylinder, under increased manifold pressure conditions; improved turbulence, due to swirl effect of air entering the combustion chamber augmented by the eccentrically disposed

intake ports and smooth transition of exhaust passage to obtain retention of exhaust gas energy to the high pressure turbocharging, thus providing for B.M.E.P. in excess of 200 p.s.i.

While in the foregoing the invention has been described as applied to a four cycle turbo-charged internal combustion engine of the diesel type employing a pair of intake ports and a pair of exhaust ports, it is to be understood that the invention is applicable for use both in construction and principal on other types of internal combustion engines without departing from the spirit of the present invention and that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claim.

What is claimed is:

In an induction system for an internal combustion engine having a cylinder and a cylinder head provided with at least one inlet port therein opening into the cylinder, said system being comprised of a vertical intake passage to said inlet port characterized in that the same is disposed at an acute angle to the vertical axis of the cylinder whereby the lower portion thereof is disposed eccentrically of said inlet port to impart a swirl to the gases entering said cylinder, and the medial portion thereof is of smaller cross-sectional area than other portions of said intake passage to provide a Venturi construction therein for also causing a ramming of said gases.

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