United States Patent

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[72] Inventor Raymond L. Ellingsen
Oshkosh, Wisconsin
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[73] Assignee Brunswick Corporation
Chicago, Illinois
a corporation of Delaware

[54] **TWO CYCLE ENGINE PORTS AND METHOD OF MAKING THE SAME**
6 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **123/1,** 29/156.4; 83/54: 90/11; 92/163, 123/65, 123/73, 123/193
[51] **Int. Cl.** **B23p 15.00;** B23c 3/00; F02f 1/77
[50] **Field of Search** 123/73A, 65A, 193, 193C; 90/11, 11.3; 29/156.4; 83/54; 92/163

[56] **References Cited**
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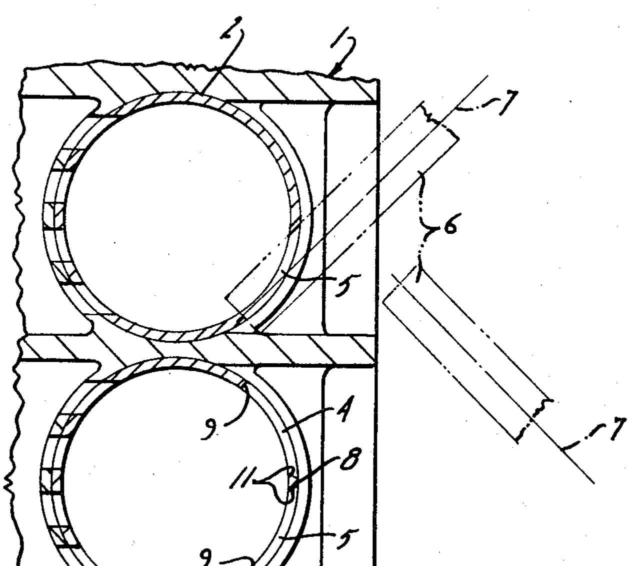
Primary Examiner—Wendell E. Burns
Attorney—Roy T. Montgomery

ABSTRACT: A pair of inlet ports are provided on one side of the cylinder with a bridge of the liner therebetween and with the far sides thereof squared to give added inlet capacity, by successive end milling operations in which the mill is advanced along a chord of the cylinder for each port from an initial cut adjacent the bridge to a position of completion where the end of the mill leaves a vertical far edge for the port. A similar construction and method may be provided for the exhaust port on the opposite side of the cylinder. If desired, this construction and method may be utilized to construct a single substantially rectangular port.



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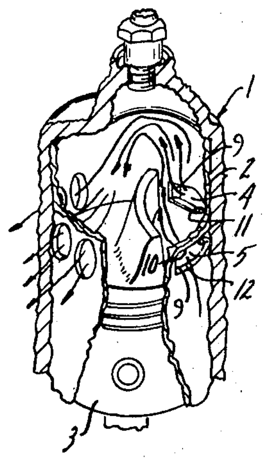

FIG_1

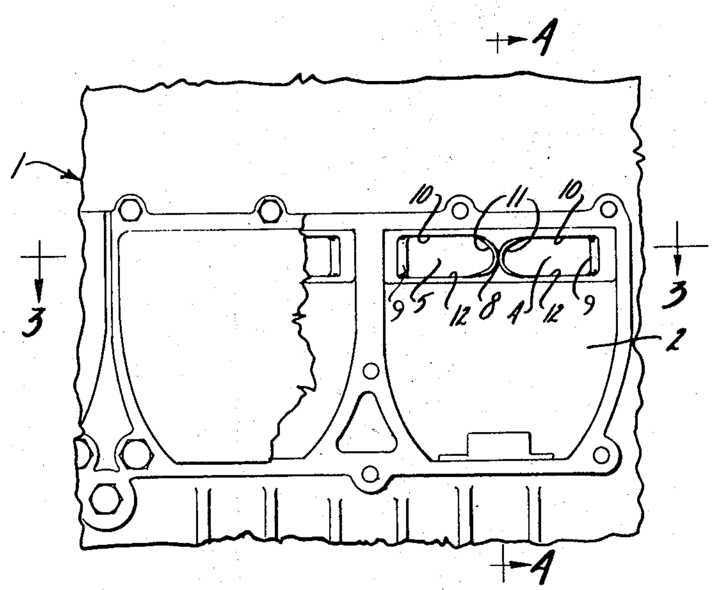

FIG_2

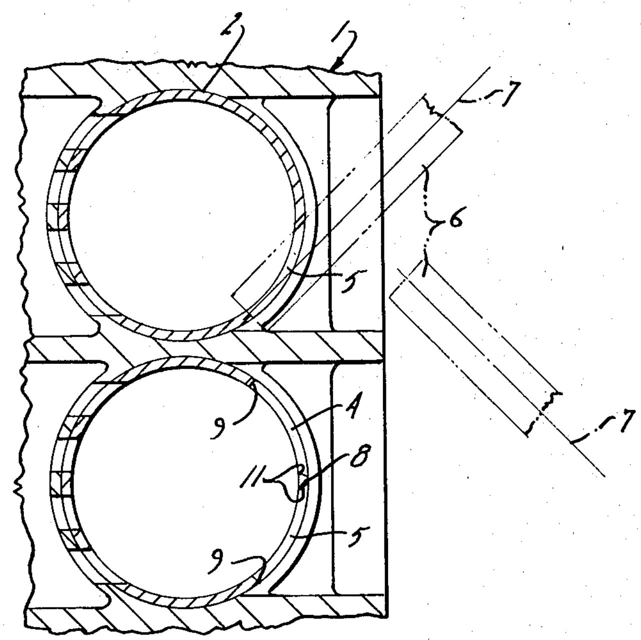

FIG_3

INVENTOR.
RAYMOND L. ELLINGSEN
BY
Andrus, Sceales, Starke & Sawall
Attorneys

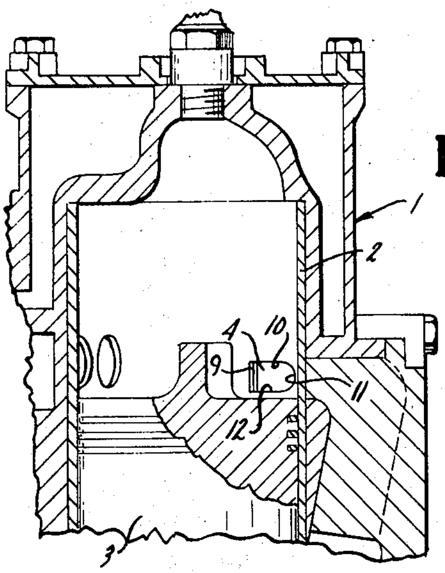

FIG_4

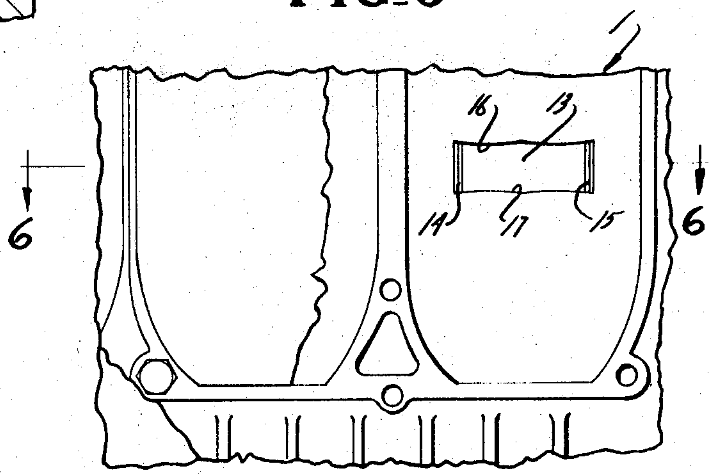

FIG_5

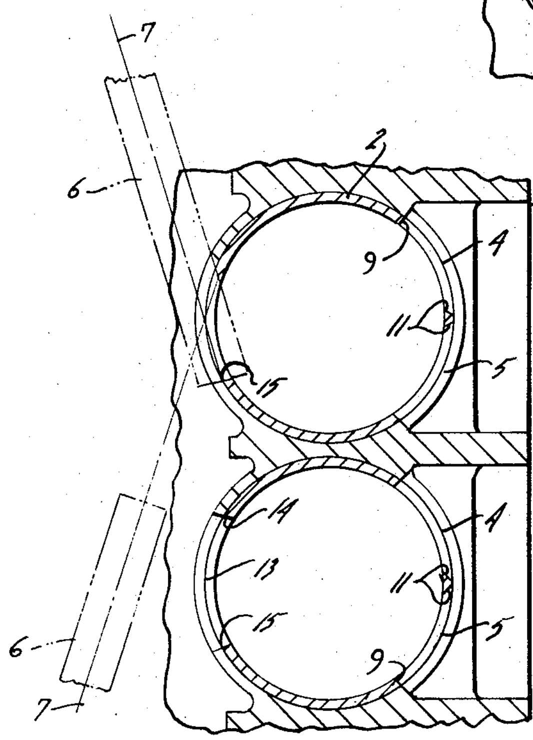

FIG_6

INVENTOR.
RAYMOND L. ELLINGSEN
BY
Andrus, Sceales, Starke & Sawall
Attorneys

TWO CYCLE ENGINE PORTS AND METHOD OF MAKING THE SAME

This invention relates to two-cycle engine ports and a method of machining the same.

The invention has been applied to the construction of inlet ports for two-cycle engines of the type referred to in the copending U.S. Pat. application of Herman R. E. Meier, Ser. No. 726,398 filed May 3, 1968, and assigned to a common assignee herewith. Such ports are, however, useful for either exhaust or inlet ports of other types of two-cycle engines.

In the construction of two-cycle engines in the past it has been common to provide several circular or nearly circular ports for both the intake or the exhaust as by drilling through the wall of the cylinder and the sleeve liner therefor. In this practice the inlet ports might be drilled on one side of the cylinder by advancing the drills axially either radially of the cylinder or in parallel paths. The same was true for the exhaust ports on the opposite side of the cylinder.

The circular or nearly circular openings thus provided are not considered the most efficient since the piston does not uncover the full width of the port immediately.

Where high efficiency and/or more port area is desired additional machining operations have been employed to make the openings more nearly rectangular in shape. Such operations have been expensive and time consuming in the past.

The present invention provides a simple procedure for machining separate port openings wherein there is a substantial horizontal upper edge for the opening with at least one side edge of the port substantially vertical, thereby approaching a rectangular port and greatly improving the control of the flow of gases therethrough. The invention can also be utilized to make a single substantially rectangular port.

In carrying out the invention each port is formed by advancing an end mill along a chord of the cylinder to the cylinder wall and stopping the milling operation at a point where the edge of the port immediately facing the end of the mill is substantially vertical.

A preferred embodiment of the invention is illustrated in the accompanying drawings in which:

FIG. 1 is a perspective view of a portion of a cylinder and piston with parts broken away to show the port construction;

FIG. 2 is a front elevation of a portion of a multicylinder block showing the spaced inlet ports in elevation;

FIG. 3 is a horizontal transverse section taken on line 3–3 of FIG. 2 through a portion of a multicylinder engine block illustrating schematically the formation of the completed ports for one cylinder and the milling operation for machining the ports in the other cylinder;

FIG. 4 is a vertical transverse section through a cylinder on line 4–4 of FIG. 2;

FIG. 5 is a view similar to FIG. 2 showing a substantially rectangular port for each cylinder; and

FIG. 6 is a horizontal transverse section taken on line 6–6 of FIG. 5 illustrating schematically the formation of a single substantially rectangular port for one cylinder and the milling operation for machining the ports in the other cylinder.

In the construction illustrated, the cast engine block **1**, only a portion of which is shown, provides one or more cylinders **2** in each of which a piston **3** is adapted to reciprocate as is well understood for internal combustion engines of the two cycle reciprocating piston type.

For such engines it is quite desirable to provide one or more inlet ports on one side of the cylinder for the ingress of intake gases and one for more exhaust ports on the opposite side of the cylinder for the egress of exhaust gases. The upper edges of the exhaust ports are generally located somewhat higher in the cylinder wall than the upper edges of the inlet ports so that the piston uncovers the exhaust ports first, thereby generally releasing the pressure in the cylinder before opening the inlet ports.

It is desirable that the ports have a substantially rectangular shape presenting a horizontal upper edge of substantial length rather than being circular or of oval shape wherein the upper edge is curved, since with the curved upper edge the uncovering of the ports by the piston is gradual and does not have the efficiency in flow characteristics that is desirable.

The present invention provides such an upper horizontal edge for the ports and thereby effects a higher efficiency in gas flow for either or both the exhaust and the inlet.

In carrying out the invention the two-spaced inlet ports **4** and **5** for an engine of the type described in the Meier application identified above may be readily milled by separate milling operations as illustrated in FIG. **3** and wherein the end mill **6** in each instance is directed generally along a chord **7** of the cylinder from a starting position near the bridge **8** between the ports to be milled. The mill is then advanced axially as it rotates until the lead end thereof reaches a point at which the axial advance is stopped and the outer vertical edge **9** for the corresponding port opening is thus formed. Upon stopping the milling action at this point the port thus produced will have a substantial length of horizontal upper edge **10** between the vertical outer edge **9** and a generally elliptical inner edge **11**. The lower edge **12** of the ports **4** and **5** will be horizontal and generally will correspond to the upper edge **10** in length. As shown, the axis of the mill **6** is very nearly tangential to the inner cylindrical surface of the cylinder **2** but the angle the mill enters the cylinder may be varied to obtain the desired port shape.

A single substantially rectangular port for a cylinder may be constructed in the same manner, as shown in FIG. **5** and FIG. **6**. It is possible to eliminate the bridge and to combine the two-port openings into one, provided the total circumferential extent of the single slotlike port **13** thus provided does not result in an interference with the reciprocation of the piston rings past the port. Generally an unbridged opening should not exceed 72° in circumferential extent.

In the construction of FIG. **5** and FIG. **6**, two separate milling operations similar to those shown in FIG. **3** but arranged so as to eliminate the bridge are employed in producing the single slot exhaust port **13**. The end edges **14** and **15** of port **13** are substantially vertical. The upper and lower edges **16** and **17**, while not exactly a straight line, extend horizontally for the full distance between the ends **14** and **15**.

The invention thus provides a method of easily and inexpensively producing substantially rectangular ports.

I claim:

1. The method of producing a port for a cylinder of a two-cycle internal combustion engine, comprising milling the wall of the cylinder with the axis of the mill disposed substantially tangential of the wall of the cylinder, and stopping the milling operation at a position where the lead end of the mill leaves a substantially vertical end edge for the port.

2. The method of claim **1** wherein thereafter a mill is employed in a direction to provide a corresponding opposite vertical end edge for the port.

3. The method of claim **1** wherein a successive milling operation is employed and is separated circumferentially from the former milling operation to provide a central bridge between two ports.

4. The method of producing a port for a cylinder of a two-cycle internal combustion engine, comprising end milling the wall of said cylinder along a chord of said cylinder and stopping the end milling operation at a point where the lead end of the mill leaves a substantially vertical end edge for the port.

5. The method of claim **4** wherein a successive end milling operation is employed to provide a single port wherein both end edges are substantially vertical.

6. The method of claim **4** wherein a successive end milling operation is employed to provide two ports separated by a central bridge, each having substantially vertical outer end edges.