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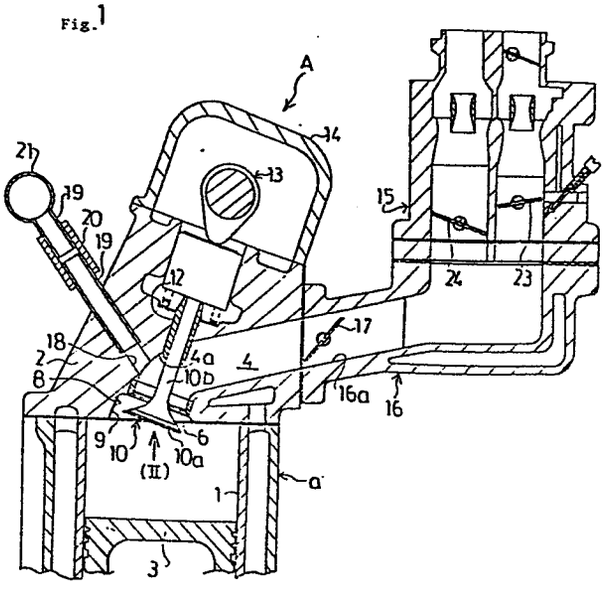
(54) **Intake system of an internal-combustion engine.**

(57) In an internal combustion engine in which an intake passage (4) and an exhaust (5) are juxtaposed adjacent to each other in a cylinder head and in which an intake valve (10) is arranged in a downstream end portion of said intake passage such that its valve stem (10b) is disturbing the flow of intake air there is provided an auxiliary intake passage (18) which communicates with said intake passage downstream of said valve stem. This auxiliary intake passage indirectly expands the intake passage so that the flow rate of the intake air into the cylinder can be augmented to improve the output performance of the internal combustion engine.

Fig. 1



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SPECIFICATION:

TITLE [illegible]
see front page

INTERNAL COMBUSTION ENGINE WITH IMPROVED INTAKE SYSTEM:

The invention relates to an internal combustion engine and in particular to an improved intake system for an internal combustion engine. Internal combustion engines of counterflow type are known. This type of internal combustion engine shows a cylinder which has its intake and exhaust passages arranged in juxtaposition and adjacent to each other in the cylinder head. At the downstream end of the intake passage there is arranged an intake valve in the manner to have its valve stem intersecting the flow of intake air. These internal combustion engines of counterflow type have the problem that the effective area of the intake passage at its downstream end is reduced by the stem, the stem guide etc. of the intake valve arranged therein such that the maximum suction of the internal combustion engine within high-load running range may occasionally be determined by that valve stem portion. As a solution of the problem it is conceivable that the intake passage be enlarged at the portion where the valve stem is arranged. With counter-flow type internal combustion engines however the intake passage is arranged adjacent to the exhaust passage as indicated above, such that an expanded intake passage would interfere with the exhaust passage. Therefore, the expansion of the intake passage is accompanied by remarkable difficulties.

The invention as claimed is intended to remedy these drawbacks. It solves the problem of how to design an intake system to indirectly expand the intake passages such that the flow rate of the intake air into the cylinder can be augmented to improve the output performance of the internal combustion engine.

According to the invention an auxiliary passage is made to communicate with the intake passage downstream of the intake valve stem.

The advantages offered by the invention are mainly that the flow rate of intake air into the engine cylinder can be augmented to improve the output performance of the internal combustion engine.

Two ways of carrying out the invention are described in detail below with the reference to drawings which illustrate two specific embodiments, in which;

Figure 1 is a longitudinal section showing the intake system of the present invention;

Figure 2 is a view taken in the direction of arrow II of Figure 2; and

Figure 3 is a longitudinal section showing another embodiment.

The Figures show an internal combustion engine (a) comprising a cylinder 1, a cylinder head 2 and a piston 3. The illustrated internal combustion engine is of the so-called counter-flow type.

The afore-mentioned internal combustion engine A is equipped with a plurality of cylinders a each of which has its cylinder head 2 formed with an intake passage 4 and an exhaust passage 5.

These intake and exhaust passages 4 & 5 are arranged in the cylinder head 2 in juxtaposition and adjacent to each other and have their downstream end portions bent to communicate with a combustion chamber 8 by way of an intake port 6 and an exhaust port 7, respectively.

Reference numeral 9 indicates a recess which is formed in the cylinder head 2 and which defines the aforementioned combustion chamber 8 together with the upper end face of the piston 3 positioned at the top dead center.

Reference numeral 10 indicates an intake valve for opening and closing the aforementioned intake port 6, and numeral 11 indicates an exhaust valve for opening and closing the exhaust port 7.

These intake and exhaust valves 10 & 11 have their valve heads 10a & 10b extending into the combustion chamber 8 in a manner to correspond to the intake and exhaust ports 6 & 7 and their valve stems 10b & 11b arranged downstream of the intake and exhaust passages 4 & 5, respectively, so as to intersect the flows of the intake air and the exhaust gas, and are slidably supported on the wall of the cylinder head 2 through guides 12.

Reference numeral 13 indicates valves actuating cam mechanism which is made operative to drive the aforementioned intake and exhaust valves 10 & 11 and which is mounted in a cover 14 extending from the upper end of the cylinder head 2.

Reference numeral 15 indicates the well-known dual type carburetor which is connected with the upstream end of the intake passages 4 of each cylinder a and through which the intake air is fed to each cylinder a.

Reference numeral 23 indicates a primary throttle valve which is manually operated in the aforementioned carburetor 15, and numeral 24 indicates a secondary throttle valve which is to be opened within a higher-load running range of the internal combustion engine A at a predetermined value.

Reference numeral 17 indicates a control valve which is disposed downstream of the aforementioned intake manifold 16, i.e., at a branch portion 16a of each cylinder a. The control valve 17 is adapted to be opened and closed in association with the aforementioned primary throttle valve 23 and to retain an effective area to some extent even when it is in the most closed position.

The internal combustion engine having the construction thus so far describedhas a problem in that the effective area of the downstream portion of the intake passage 4 of each cylinder a is disturbed and reduced by the valve stem 10b and the guide 12 of the intake valve 10 resulting in that the intake air has its flow blocked by those obstructions to reduce its flow rate.

As means for solving this problem there is provided an auxiliary intake passage 18 which has communication with the intake passage 4 downstream of the valve stem 10b.

The aforementioned auxiliary intake passage 18 is set to have a smaller effective area than that of the intake passage 4 and opens into the downstream side of said passage 4 in the wall downstream of the valve stem 10b with respect to the flow direction, namely, in the wall 4a outwardly of thebent direction and at a slight outwardly dislocation from the valve stem 10a of the intake valve 10 such that it is directed, while intersecting the intake passage 4, in the tangential direction of the cylinder 1, i.e., from the intake port 6 to the outer circumferential portion of the combustion chamber 8 and toward the upper face of the piston 3.

Moreover, the auxiliary intake passages 18 of the aforementioned respective cylinders a are connected with a communication pipe 21 by way of short tubes 19 and connecting pipes 20, respectively.

That communication pipe 21 is made to have such a length as to extend over the respective cylinders a of the internal combustion engine A so that the intake passages 4 of the respective cylinders a are made to communicate with one another by connecting the auxiliary intake passages 18 with said pipe 21 in the aforementioned manner. Because of the difference in the phase of the intake stroke among the respective cylinders a of the internal combustion chamber A thus so far described, the cylinder chamber 1 of the cylinder a in the intake stroke is fed through its auxiliary intake passage 18 with the intake air of the intake passages 4 of the remaining cylinders a separately of the intake air coming from the intake passage 4 so that the flow rate of the intake air into that particular cylinder chamber 1 is augmented.

This augmentation in the intake air flow is especially effective in a high-load running range of the internal combustion engine A.

In a low-load running range including the idling operation, the control valve 17 is so throttled as is shown in Figure 1 so that the flow rate of the intake air to flow directly into the cylinder chamber 1 from the intake passage is reduced to allow most of the intake air to be fed via the auxiliary intake passage 18.

The intake air from that auxiliary intake passage 18 flows at a high speed in the tangential direction into the cylinder chamber 1 from the intake port 6 due to the small effective area of said passage 18 thereby establishing a swirling flow in said cylinder chamber 1.

This swirling flow of the intake air in the cylinder chamber 1 is continued until the end of the compression stroke thereby to bring about an effect that the combustion with the intake air in the combustion chamber 8 is conducted at a high rate and in a stable manner thereby to improve the combustion efficiency.

Incidentally, the aforementioned auxiliary intake passages 18 are directed in the opposite directions to the intake passages 5 at the respective cylinders a because the internal combustion engine A is equipped with the plural cylinders a so as to prevent them from interfering with one another.

Another embodiment will now be described with reference to Figure 3.

In this embodiment, the communciation pipe 21 of the preceding embodiment is connected with the downstream sides of the primary and secondary throttle valves 23 & 24 of the carburetor 15 by way of a conduit 22 so that the auxiliary intake passages 18 of the respective cylinders a bypass the control valves 17 upstream of the intake passages 4 and directly communicate with the carburetor 15.

Incidentally, the aforementioned control valves 17 are fully closed within the low-load running range including the idling operation of the internal combustion engine A.

On the other hand, since the construction of the remaining portions of the embodiment being described is identical to that of the preceding embodiment, it is indicated at identical reference characters, and its explanation is omitted.

Thus, in the embodiment under discussion, the control valves 17 upstream of the intake passages 4 are fully closed, and the primary throttle valve 23 of the carburetor 15 is partially opened to have a small effective area when the internal combustion engine A is within the low-load running range including the idling operation. As a result, the intake air is wholly fed by way of the auxiliary intake passages 18.

More specifically, the cylinder chamber 1 of the cylinder a in the intake stroke is fed with considerable intake air at a high flow rate exclusively via its auxiliary intake passage 18 from the carburetor 15 so that the intensified swirling flow of the intake air than that of the preceding embodiment can be established in the cylinder 1 thereby to further improve the combustion efficiency.

Incidentally, it is similar to the preceding embodiment that the flow rate of the intake air is augmented by the intake air coming from the auxiliary intake passages 18 within the high-load running range.

As has been described hereinbefore, according to the present invention, since the auxiliary intake passages are made to communicate with the intake passages downstream of the valve stems of the intake valves, the so-called counter-flow type internal combustion engine, which has made difficulties in expanding the effective area of the intake passages, is allowed to indirectly expand the intake passages by the aforementioned auxiliary intake passages so that the flow rate of the intake air into the cylinders within the high-load running operation can be augmented to improve the output performance of the internal combustion engine.

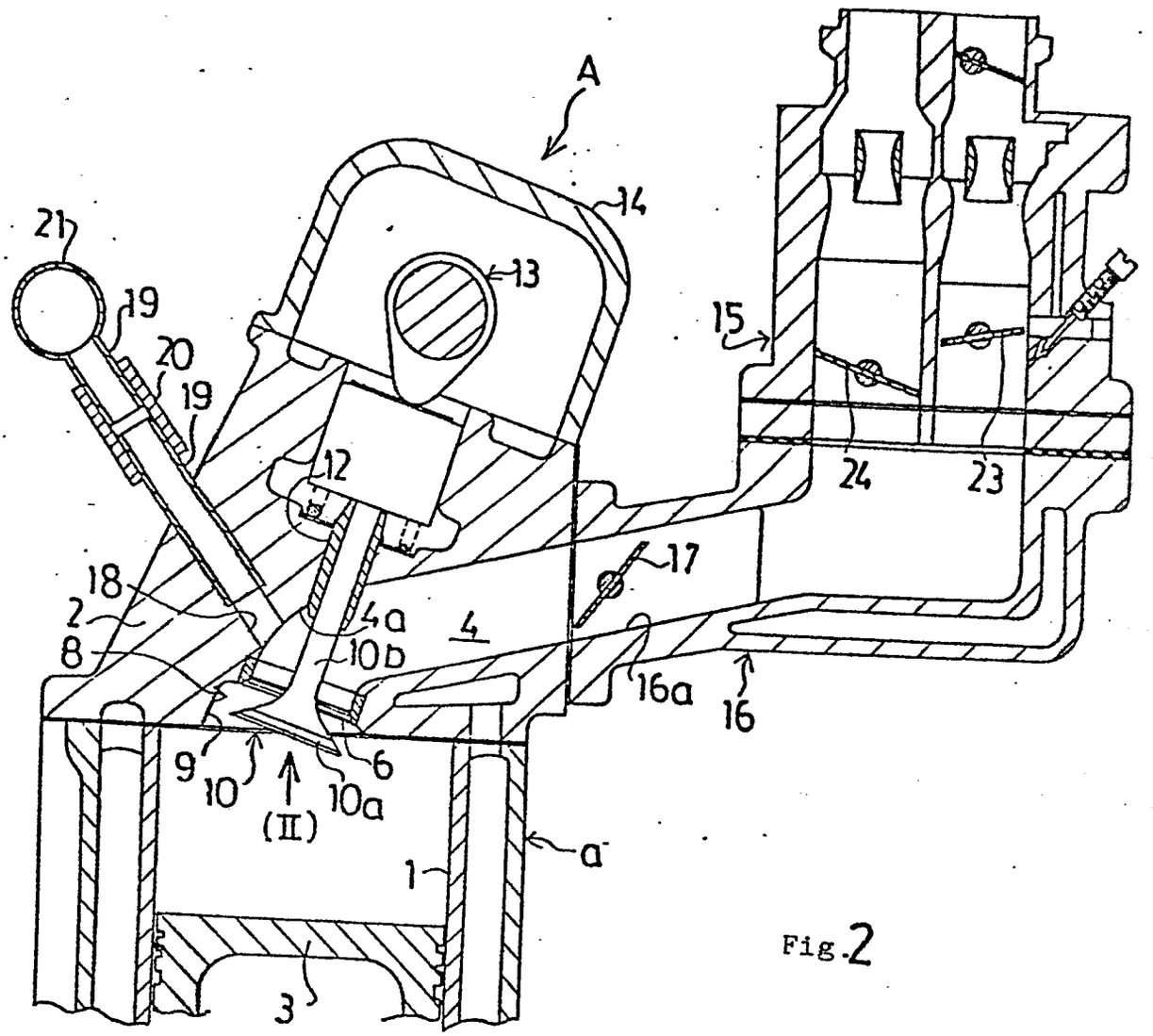
CLAIMS:

1. An internal combustion engine of the type in which an intake passage (4) and an exhaust passage (5) are juxtaposed adjacent to each other in an cylinder head (2) and in which an intake valve (10) is arranged in a downstream end portion of said intake passage such as to have its valve stem (10b) intersecting the intake air flow, characterised in that an auxiliary intake passage (18) is made to communicate with said intake passage (4) downstream of said valve stem (10b).

2. Internal combustion engine according to claim 1, characterised in that the respective intake passages (18) of each further cylinder (a) are connected by means of a communication pipe (21).

3. Internal combustion engine according to claim 2, characterised in that said communication pipe (21) is connected to the downstream sides of primary and secondary valves (23, 24) of a carburetor (15) by virtue of a conduit (22) so that the auxiliary intake passages (18) of the respective cylinders (a) bypass throttle valve (17) of which each is located in the intake passage portion upstream of said intake valve (10).

Fig.1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(II)
a
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Fig.2

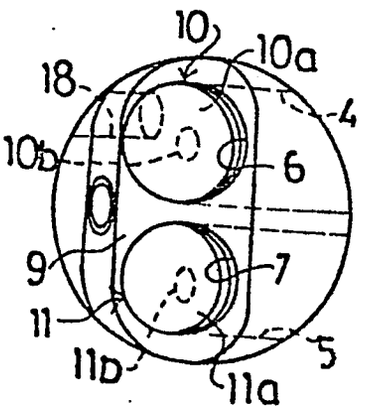
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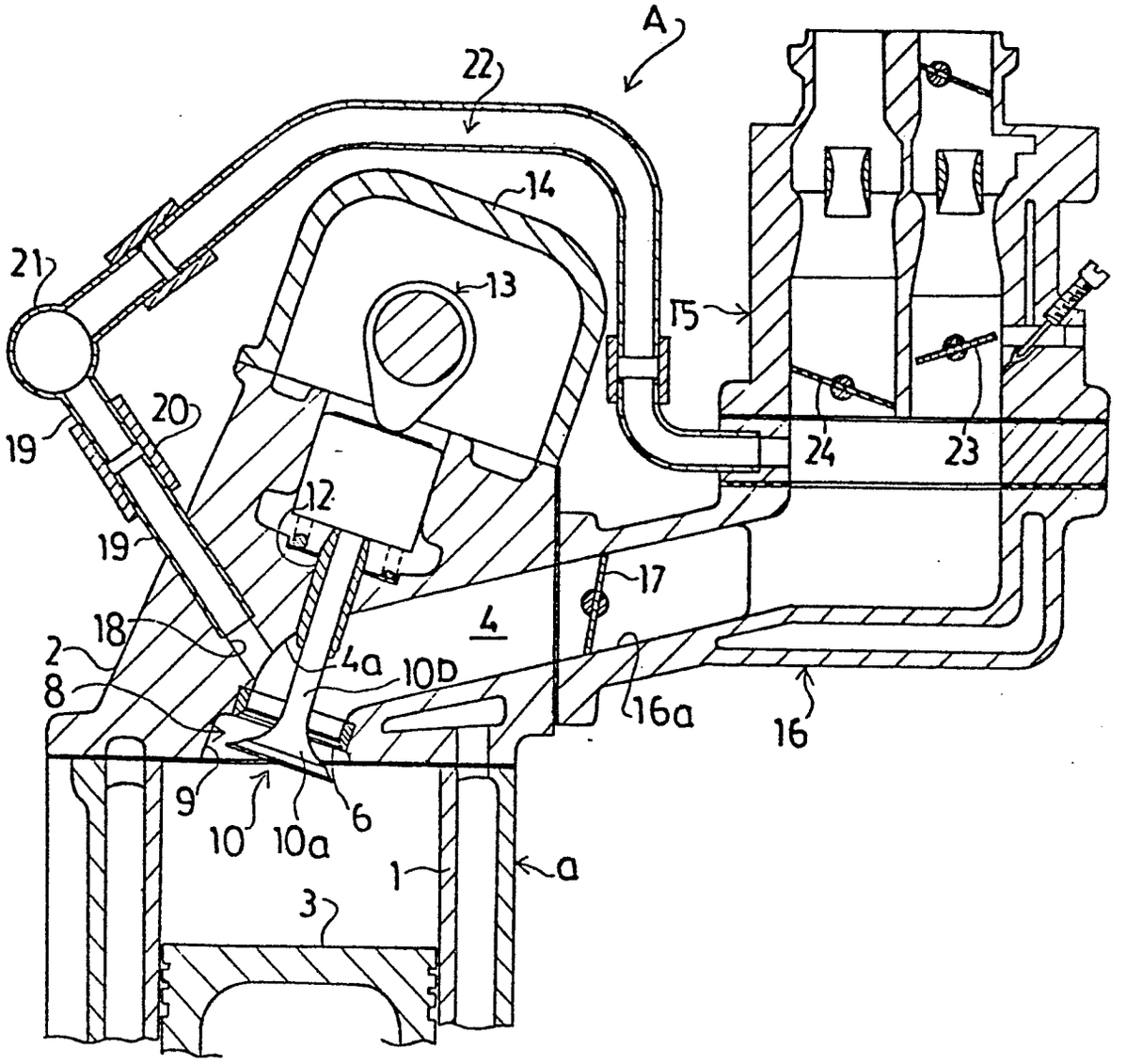
Fig. 3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EUROPEAN SEARCH REPORT

0100790
Application number

EP 82 10 7553

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X,Y	FR-A-1 129 970 (WESLAKE) *Page 1, left-hand column; page 2, left-hand column, paragraph 13 to right-hand column, paragraph 2; page 3, right-hand column; figures 1,2,10*	1-3	F 02 F 1/42 F 02 M 35/10
Y	US-A-4 253 432 (TOYOTA) *Column 3, line 52 to column 4, line 28; figures 1-2*	2,3	
A	US-A-4 292 944 (YAMAHA) *Column 2, line 36 to column 3, line 22; figures 1,2*	1,3	
A	GB-A- 971 211 (STARK) *Page 1, lines 12-54; page 2, lines 22-105; page 3, line 120 to page 4, line 7; figures 1-3*	1	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	FR-A-1 079 530 (DAIMLER BENZ) *Page 1, left-hand column, paragraph 4; right-hand column, paragraph 2; figures*	1	F 02 F F 02 M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30-03-1983	KOOIJMAN F.G.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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