

Dec. 31, 1968

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3,418,984

INTERNAL COMBUSTION ENGINE

Filed Dec. 20, 1966

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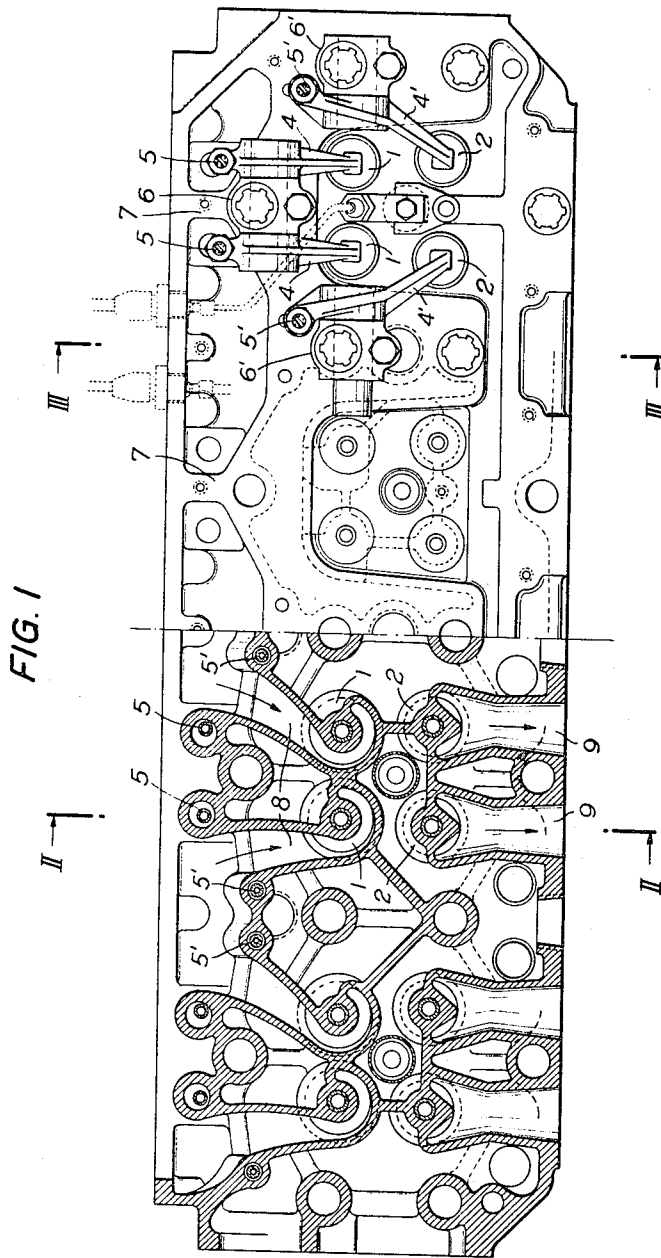


FIG. 1

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FIG. 2

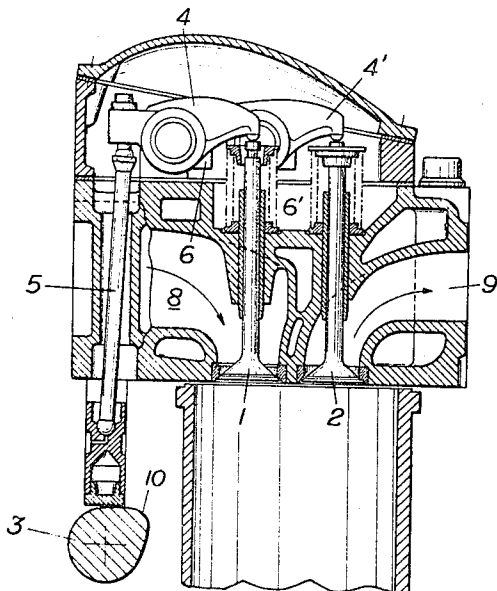
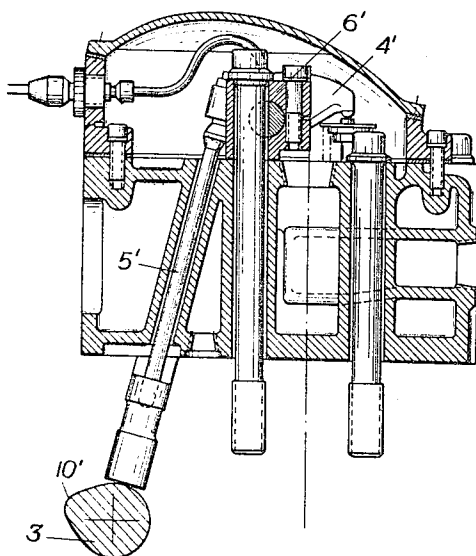


FIG. 3



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3,418,984

**INTERNAL COMBUSTION ENGINE**

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Filed Dec. 20, 1966, Ser. No. 603,276

Claims priority, application Austria, Oct. 12, 1966,

A 9,569/66

3 Claims. (Cl. 123—90)

**ABSTRACT OF THE DISCLOSURE**

An internal combustion engine having two intake valves and two exhaust valves for each cylinder arranged in a row along the side of the engine and having a camshaft for operating the valves with separate cams for each valve and a push rod and rocker arm for each valve actuated each by one cam of the camshaft.

The invention relates to an internal combustion engine comprising two intake valves and two exhaust valves located one behind the other in the longitudinal direction of the engine and actuated by means of a camshaft via a push rod and rocker arm. This conventional design offers the advantage of comparatively short valve ports resulting in a lesser resistance to flow, but this advantage is offset by the drawback inherent in a considerably greater overall length as compared with internal combustion engines comprising only one intake and one exhaust valve for each cylinder, due to the fact that more space is required for the accommodation of the relatively bulky control mechanism required for the operation of the four valves.

With various conventional variants of this type of engine two identical valves are operated by a single rocker arm. These rocker arms are either fork-shaped or attached to a parallel single-arm lever each. With these variants, particularly with the last-mentioned design, the two rocker arms are bound to differ widely with regard to both their length and transmission ratio. Another conventional design provides for the operation of one pair of valves by means of a fork-shaped rocker arm, the other pair of valves being actuated via two angl levers interconnected by means of a push rod, the lever close to the pair of valves also featuring fork-shaped extremities. The decisive drawback inherent in all of these conventional types of engines resides in the fact that apart from the objectionable increase in overall height as mentioned above they are suitable for high-speed operation under certain circumstances only, if at all, the main reason being the inadequate rigidity of the mechanical transmission elements of the valve gear.

It is the purpose of the present invention to provide an internal combustion engine suitable both for high loads and high speed and yet being of compact construction, taking full advantage of the familiar features of the four-valve design. For that purpose, according to the invention, each valve has its own associated rocker arm and the camshaft is provided with a separate cam. Consequently, it is possible for the rocker arms to be very short and rigid so that the overall height will not be increased. This is particularly important with V-type internal combustion engines where an increase of the overall height of the rows of cylinders entails a corresponding increase of the width of the engine.

Since a separate cam is associated with each valve, the surface pressures prevailing on the cam and on the valve tappet are comparatively low, resulting in a considerably longer life of the control elements even in high-speed, heavy-duty engines.

According to a preferred embodiment of the invention

the rocker arms and push rods of the intake valves are located in parallel planes extending through the axes of the intake valves in perpendicular relation to the camshaft, the two rocker arms of the exhaust valves of each cylinder being so arranged as to form an acute angle opening in the direction of the inlet side of the engine, each of the inlet ports terminating on the inlet side of the engine between the push rod of an intake valve and the push rod of an exhaust valve. This arrangement makes it possible for the suction ports to be comparatively short and to have a large cross-section. Besides, these suction ducts are preferably symmetrical so as to produce the same convenient flow conditions in both intake valves. Due to the absence of necked-down portions and abrupt turns in the area of the suction ports, resistance to the flow of the medium is very moderate which is particularly important for supercharged engines.

According to a further feature of the invention it is possible to provide for rocker arms of the intake and exhaust valves of substantially equal length and with the same leverage, and to arrange the push rods of the exhaust valves in planes extending in perpendicular relation to the camshaft and inclined toward the exhaust side of the engine. Substantial uniformity in the layout of the control elements of the intake and exhaust valves also makes for approximately equal forces and surface pressures prevailing on the camshaft and in the bearings and articulations of the rocker arms of all valves. Moreover, due to the inclination of the push rods of the exhaust valves the cross-section available for the intake ports is increased.

In order to further increase the width of cross-sections for the intake ports it is advisable to abandon the conventional method of accommodating the camshaft in the diaphragm plates of the crankcase and to arrange the camshaft in accordance with another feature of the invention in diaphragm plates extending between the push rods of the intake valves of each cylinder in perpendicular relation to the camshaft. Consequently, the push rods of the exhaust valves of adjacent cylinders can be arranged very close to each other, that is, almost in the plane of the bearing wall.

Further details of the invention will be more fully described with reference to the accompanying drawings in which:

FIGURE 1 shows a top view of the cylinder head of an internal combustion engine, partly as a horizontal section,

FIGURES 2 and 3 each represent a vertical section on lines II—II and III—III, respectively of FIG. 1.

The cylinder head shown belongs to a row of cylinders of a V-type internal combustion engines comprising eight cylinders. Each cylinder is provided with two intake valves 1 arranged one behind the other in the longitudinal direction of the engine and two exhaust valves 2 of a similar arrangement, all of the valves being actuated by means of the camshaft 3 extending alongside the engine cylinders.

Associated with each intake valve 1 is a separate rocker arm 4 which is actuated via a push rod 5 by means of a separate cam 10 of the camshaft 3. The two rocker arms 4 and their push rods 5 are symmetrical in relation to a normal plane of the cylinder head containing the cylinder axis and mounted in pairs on a common centrally arranged valve rocker bracket 6. The vertical cylinder head wall 7 located between the two push rods 5 extends (in a manner not shown) inside the crankcase so as to form a partition containing the bearings of the camshaft 3.

Associated with each exhaust valve 2 is a separate valve rocker 4' actuated by means of a separate cam 10'

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of the camshaft 3 via an inclined push rod 5'. The valve rockers 5' of the exhaust valves 2 present a lateral crank so that the valve rockers of a pair of exhaust valves form an acute angle which is open in the direction of the intake side of the engine. This crank of the valve rockers 4' makes it possible for them to be mounted on valve rocker brackets located on both sides of the intake valves 1, the adjacent valve rockers 4' of consecutive engine cylinders being jointly mounted on a single valve rocker bracket 6'. The valve rockers 4' of the exhaust valves 2 have approximately the same length and the same leverage as have the rocker arms 4 of the intake valves 1. This produces the predetermined inclination of the push rods 5' in the direction of the exhaust side of the engine. As a result of the crank of the valve rockers 4' the push rods 5' of adjacent cylinders are located very close to each other so that a large cross-sectional width will be available for each of the inlet ports 8 terminating between the push rod 5 of an intake valve 1 and the push rod 5' of an exhaust valve 2. This arrangement provides for short inlet ports 8 avoiding necked-down portions and sharp bends so as to facilitate the flow of the medium. Likewise, the outlet ports 9 are short and present a large cross-section and terminate in parallel relation to each other at the sidewall of the cylinder head.

As illustrated particularly in FIG. 2, the arrangement and location of all rocker arms 4 and 4' produces a very low overall height of the cylinder head as has formerly been possible only with internal combustion engines comprising one intake valve and one exhaust valve for each cylinder. The short and rugged construction of the valve rockers 4 and 4' also ensures a high degree of rigidity of the valve gear so as to make it particularly suitable for high speeds.

The scope of the invention is not restricted to the embodiment of the invention hereabove described by way of example, a number of variants depending on the particular design of the associated internal combustion engines being possible, particularly with regard to the shape and location of the valve rockers, without exceeding the scope of the present invention.

**I claim:**

1. An internal combustion engine comprising two intake valves and two exhaust valves for each cylinder, the intake valves as well as the exhaust valves being arranged in a row alongside the engine, a camshaft for the operation of the said valves comprising separate cams

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for each valve, a push rod and a rocker arm associated with each of the said valves and actuated each by one cam of the said camshaft, the said rocker arms and push rods of the intake valves being located in planes extending in perpendicular relation to the said camshaft and including the axes of the said intake valves, the said two rocker arms of the exhaust valves being so arranged as to form an acute angle opening towards the engine, one intake passage each originating with one of the said intake valves and extending between the push rod of the associated intake valve and the push rod of the adjacent exhaust valve in the direction of the intake side of the engine.

2. An internal combustion engine as claimed in claim 1, wherein the rocker arms of the said intake and exhaust valves are substantially of equal length and present the same leverage, the push rods of the said exhaust valves being inclined towards the exhaust side of the engine and located in planes extending in perpendicular relation to the said camshaft.

3. An internal combustion engine comprising two intake valves and two exhaust valves for each cylinder, the intake valves as well as the exhaust valves being arranged in a row alongside the engine, a camshaft for the operation of the said valves comprising separate cams for each valve, a push rod and a rocker arm associated with each of the said valves and actuated each by one cam of the said camshaft, and partitions extending in perpendicular relation to the said camshaft and between the push rods of the said two intake valves of each cylinder, each of the said partitions having a bearing for the said camshaft.

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AL LAWRENCE SMITH, *Primary Examiner*.

U.S. Cl. X.R.

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