Jan. 5, 1954 R. P. ERNEST 2,664,864

ENGINE HEAD

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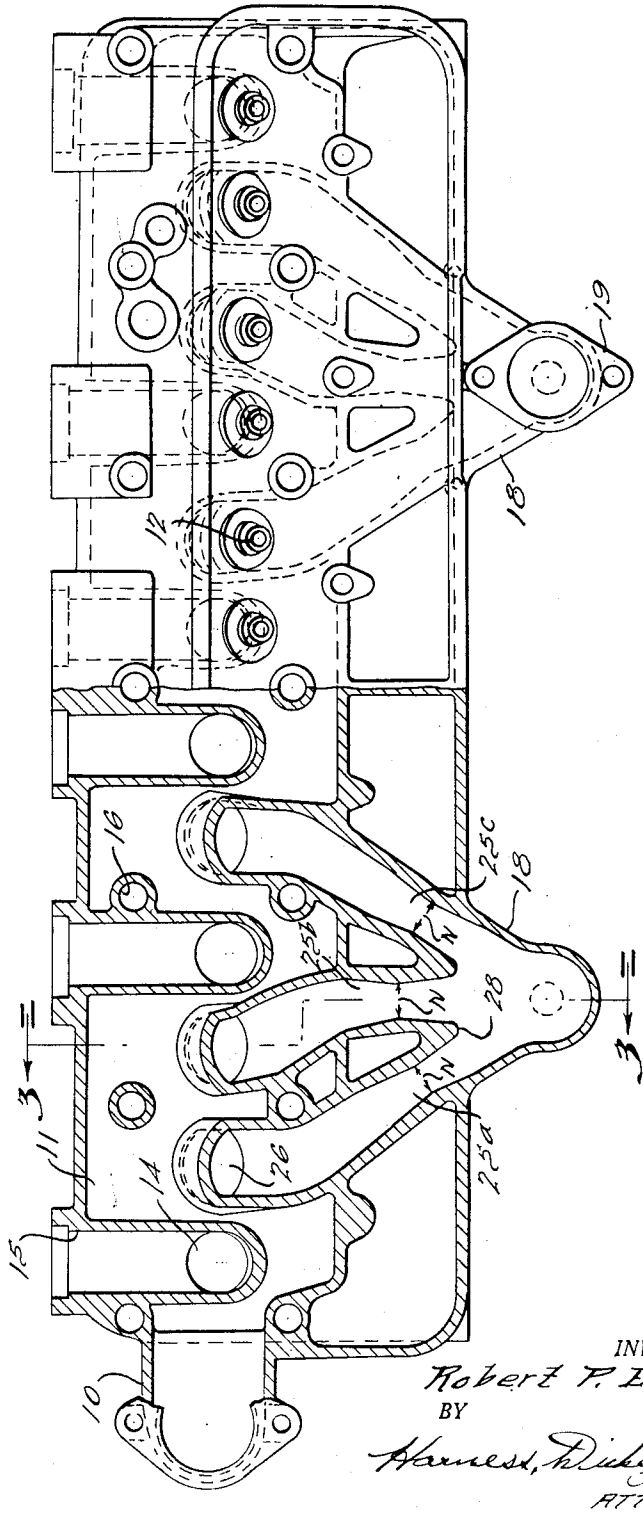

Fig. 1.

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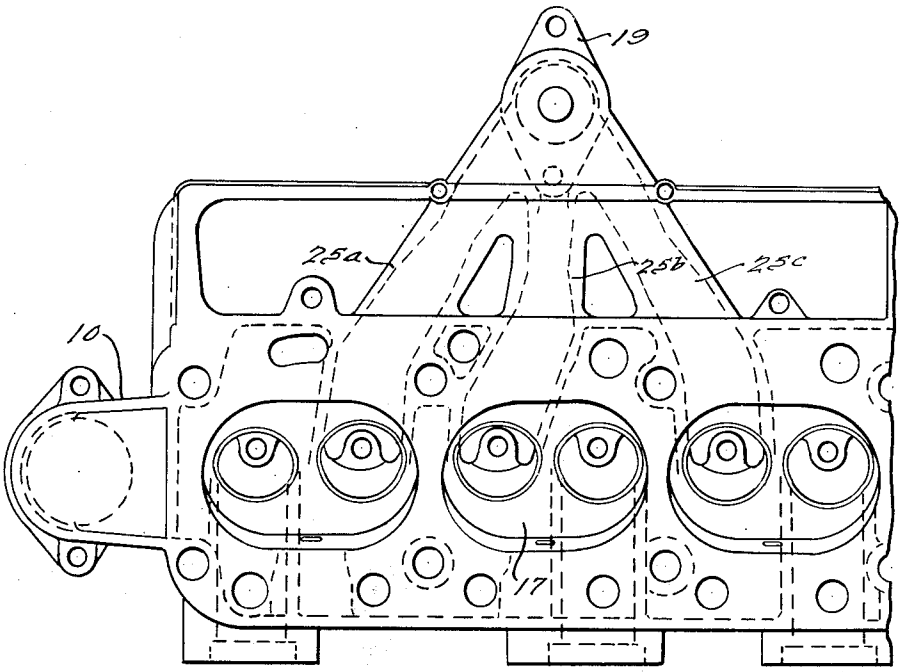

Fig. 2.

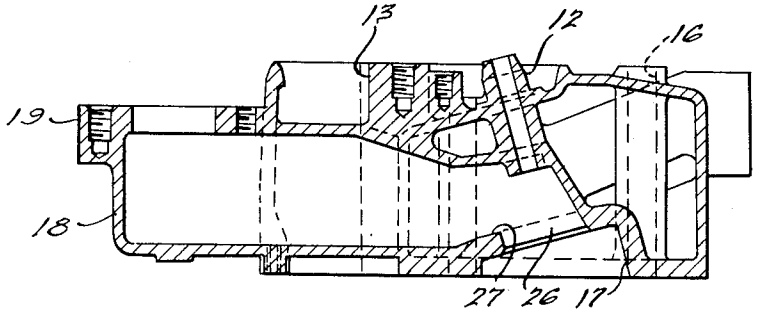

Fig. 3.

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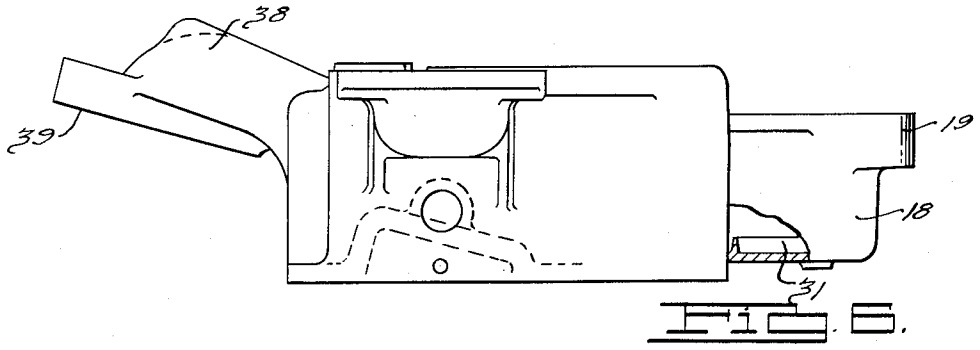

Fig. 6.

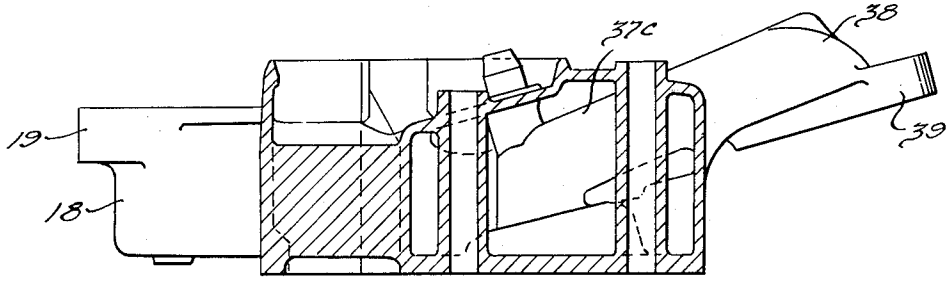

Fig. 7.

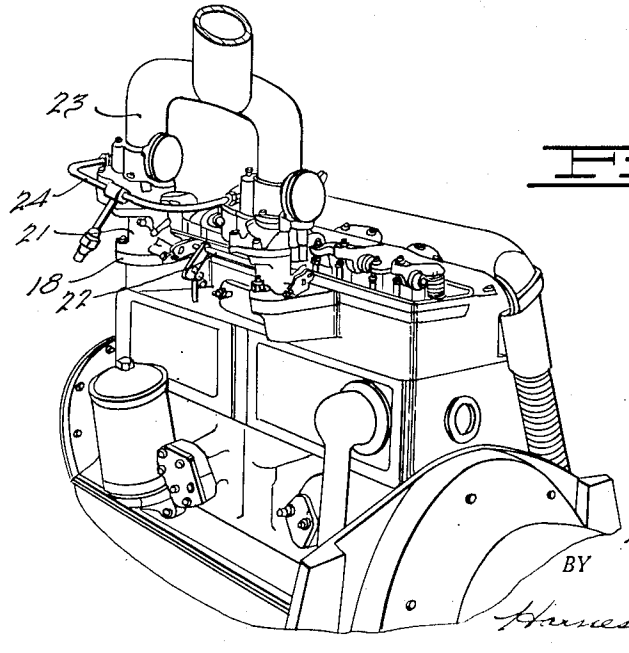

Fig. 4.

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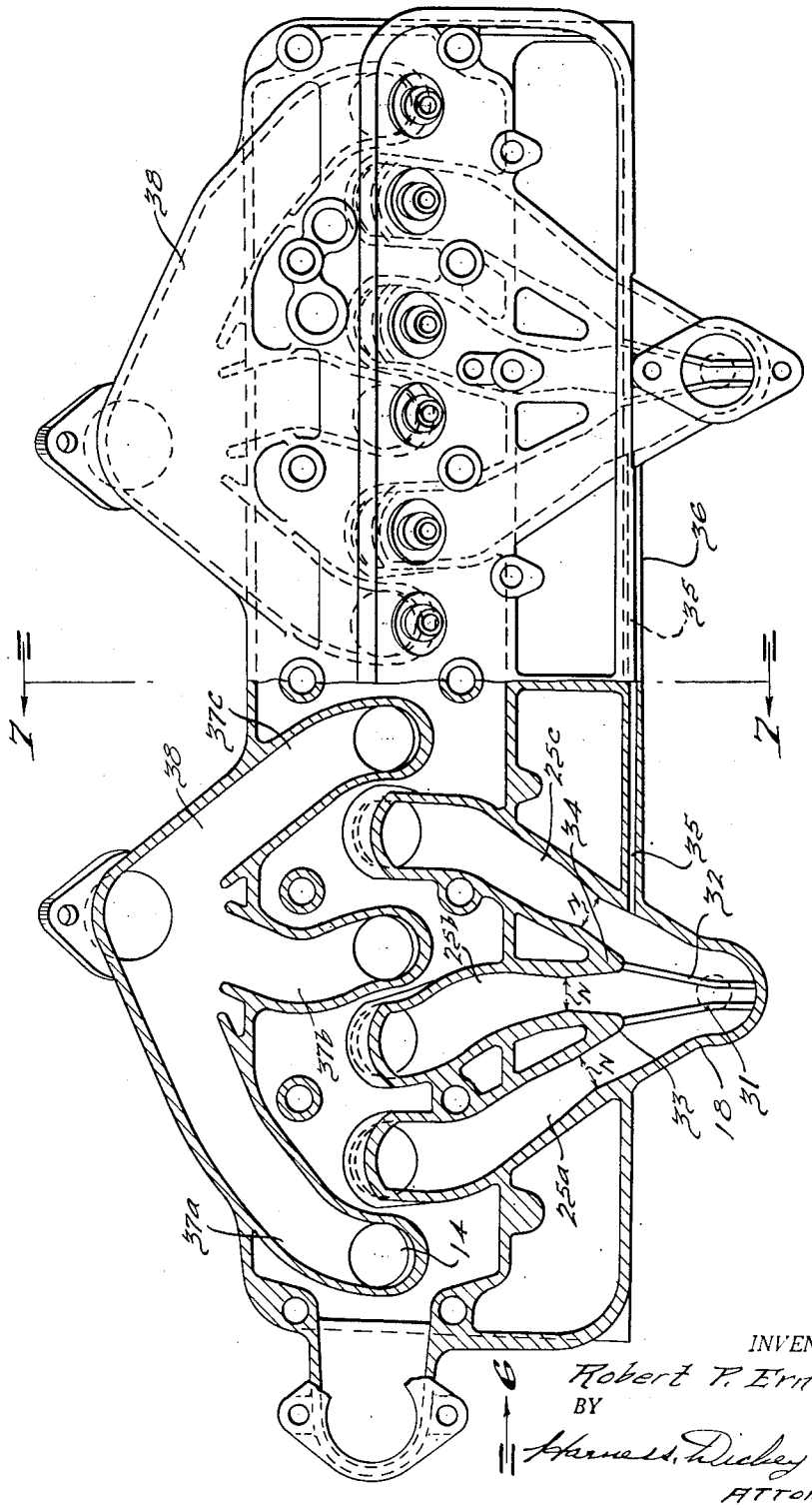

Fig. 5.

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UNITED STATES PATENT OFFICE

2,664,864

ENGINE HEAD

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Application August 31, 1950, Serial No. 182,571

14 Claims. (Cl. 123—52)

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This invention relates to internal-combustion engines and more particularly to engine or cylinder heads therefor, wherein a fuel mixture is to be distributed to a plurality of cylinders in an economical and efficient manner.

In conventional internal-combustion engines it has been customary in the past to attempt to provide means for supplying air-fuel mixture to the cylinders in such fashion that efficient performance is achieved at high speeds, and at the same time the distribution is sufficiently equalized at low speeds to prevent erratic or inefficient performance when the engine is idling or warming up. In the conventional rake or gallery types of intake manifolds it has been customary, in order to keep the fuel in a proper state of suspension for distribution to the cylinders, to limit the cross-sectional area of the distributor section of the manifold so that especially at idling speeds sufficient velocity is maintained to prevent entrained liquid particles from dropping out of the mixture. As alternatives to this expedient, or supplemental thereto, the mixture must be made sufficiently rich, and of sufficiently high intake temperature, so that the cylinder or cylinders which receive the leanest mixture will receive a rich enough mixture for proper performance. These methods of design have obvious shortcomings, since a higher mixture temperature, as well as the throttling effect of a limited manifold cross-sectional area, will result in decreased output and volumetric efficiency at higher speeds, and furthermore, increasing the richness of the mixture to accommodate the leanest cylinder will make the mixture too rich for the other cylinders, decreasing the economy of performance. In order to overcome these disadvantages it has been proposed to provide multiple manifolding in the form of branches which extend from each intake port to, or nearly to, the riser. However, this design still has the inherent disadvantage of greatly differing passage lengths from the carburetor to the various cylinders, thus making it difficult to achieve proper distribution without use of the aforementioned expedients.

It is, therefore, an object of present invention to provide a system for supplying the air-fuel mixture to an internal-combustion engine which will achieve equalized distribution of the mixture to various cylinders, and which will keep the fuel in suspension at lower manifold velocities. In association with this object it is within the contemplation of this invention to provide a system which can use a leaner mixture, especially at idling speeds and which because of the even

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distribution through the cylinders will achieve a greatly improved output and economy of operation.

It is a further object to provide a fuel supply system as described, which will result in a high volumetric efficiency and in which by elimination of the conventional gallery or distributor, relatively large fuel intake passages may be employed without a decrease in the efficiency of distribution at idling speeds.

It is also an object to provide a construction as described above which by eliminating the conventional application of heat to the manifold, can supply a fuel mixture to an internal-combustion engine at relatively low intake temperatures, thus resulting in a denser change and a concurrent high mean effective pressure, but which nevertheless has means for efficiently distributing and vaporizing heavy fuel fractions which collect in the intake system.

It is another object to provide an internal-combustion engine having a novel fuel supply system which can be fabricated at a greatly decreased cost by eliminating the necessity of casting an intake manifold, and in which the fuel supply system may be cast integrally with the cylinder head.

Other objects and advantages of the invention will become apparent upon consideration of the present disclosure in its entirety.

The essential features of the invention which achieve the above described objects comprise an internal combustion engine which entirely eliminates the conventional intake manifold gallery or distributor carrying the fuel mixture from a single carburetor, and substitutes therefor a pair of spaced-apart mixture distributing chambers supplied by a pair of positively linked complete carburetors, each chamber having connected thereto a plurality of relatively short radial passages leading to the intake ports of one half of the cylinders. These passages are so designed that they are, as far as is geometrically possible, of substantially equal length, and each preferably has a section of Venturi shape. The distributing chambers are unheated by the exhaust system, but the end of each passage adjacent its corresponding port is preferably provided with an inclined dam which is heated directly from the combustion chamber for insuring complete vaporization. In a modified form of the invention means are provided for insuring equalization of the intake pressures, as well as equal distribution of the heavy fuel fractions, and a novel

exhaust arrangement is provided to cooperate with the intake system.

In the figures:

Fig. 1 is a top plan view of a cylinder head embodying the features of my invention, the view being partly cross-sectioned for clarity;

Fig. 2 is a bottom plan view of part of the cylinder head;

Fig. 3 is a cross-sectional view taken along the line 3—3 of Fig. 1, and showing one of the intake passages;

Fig. 4 is a perspective view of an internal combustion engine embodying the cylinder head shown in Figs. 1 to 3;

Fig. 5 is a top plan view, partly in cross-section of a cylinder head with a modified intake structure, and having a modified exhaust system integral therewith;

Fig. 6 is an end view of the cylinder head shown in Fig. 5; and

Fig. 7 is a cross-sectional view taken along the line 7—7 of Fig. 5.

The cylinder head shown in Figs. 1 to 4 which embodies the features of my invention may be of otherwise conventional design, and constructed by standard methods using conventional materials. It may be stated that although the principle of the invention is applicable to other types of power plants, the invention is particularly adapted for use with four-stroke cycle, six-cylinder in-line engines, and is further designed to be of especial advantage in engines wherein the exhaust manifold would ordinarily be disposed opposite the intake system. The cylinder head is provided with a water connection 10, which leads to a water jacket 11 surrounding the combustion chambers. Valve stem supports 12 and rocker arm supports 13 are provided on the upper portion of the head. In the embodiment illustrated in Figs. 1 to 4, the cylinder head is designed to accommodate a rake type of exhaust manifold (not shown) which is connected to exhaust ports 14 by means of exhaust passages 15. Bolt holes 16 are provided at spaced intervals along the cylinder head for attaching it to the engine block, and, as is best seen in Figs. 2 and 3 the lower surface of the head is provided with combustion chambers 17.

The fuel supply system comprises a pair of mixture distributing chambers 18 on the side wall of the cylinder head opposite the exhaust manifold. These chambers are of substantially identical inwardly flared shape, and are disposed in spaced relation on the side of the head, each chamber being preferably cast integrally with the head and adjacent a group of three cylinders. For illustrative purposes, each chamber is shown as adapted to receive thereabove a carburetor of the downdraft type, although the invention is equally applicable to other types of carburetors. For this purpose, a flange 19 is provided at the upper end of each chamber, having bolt holes to which a carburetor 21 may be attached as shown in Fig. 4. Each of these carburetors is complete in itself, and they are both adapted to be simultaneously controlled by the accelerator pedal, the carburetors being positively connnected by adjustable linkage means 22 for this purpose. Air supply connections 23 and fuel supply connections 24 lead to the carburetors, these connections being preferably fed by common sources of air and fuel respectively. It will thus be seen that each chamber 18 is independently supplied with an air-fuel mixture from its corresponding carburetor, and that

there can be no mixture flow from the carburetor on one side of the engine to the chamber on the opposite side. It will also be observed that no portion of either chamber 18 is directly supplied with heat from any source, especially from the exhaust system as would be customary in conventional intake systems.

As stated previously the chambers 18 are each adjacent a group of three cylinders, and the arrangement is preferably such that the line of symmetry of the chamber is substantially aligned with the centerline of the middle cylinder of the group. For example, the chamber 18 shown in Fig. 2 is substantially aligned with the central combustion chamber 17 of the three supplied by that chamber. Each chamber 18 has leading therefrom a group of three intake passages 25. These passages are in a generally radial arrangement with the passage 25*a* leading to the outer cylinder of each group and the passage 25*c* leading to each inner cylinder being disposed on either side of passage 25*b* leading to the center cylinder, as will be seen especially in Fig. 1. The passages are of a substantially uniform length within the geometrical limits of design and each passage leads to an intake valve port 26. For this purpose the intake valve ports are preferably so arranged that the ports for the outer cylinders of each group are adjacent the central cylinder as seen in Fig. 2, so that passages 25*a* and 25*c* lie about 30° on either side of passage 25*b*. The latter passage is so designed as to be curved throughout a greater portion of its length than either of passages 25*a* and 25*c*, thus giving it a total length and resistance nearly equal to that of its flanking passages. The inner surfaces of passages 25 are preferably smooth and their cross-sectional area decreases to a narrow section N (exaggerated in the figures for purposes of clarity) and then increases uniformly toward the valve ports for a predetermined distance, becoming constant thereafter, thus providing a Venturi effect in the outer portions of the passages. The design of the passages is such that the Venturi effect in each passage will result in uniform velocities of the mixture in all the passages.

As is best seen in Fig. 3, the floor of each passage 25 is substantially horizontal outwardly of its combustion chamber, the inner end of each passage adjacent the valve port 26 being provided with an upwardly inclined floor portion 27 forming a dam for the collection and vaporization of liquid particles of the heavier fractions which drop out of the mixture. It will be noted that the position of dam 27 is such that it is directly at the source of heat, namely combustion chamber 17, so that fuel collecting the chamber or the passage will flow up against the dam (or to the right as seen in Fig. 3) and be quickly vaporized by the heated surface.

In operation, air-fuel mixture will be supplied by carburetors 21 to chambers 18 and will flow from each chamber into passages 25. It will be observed that due to the arrangement of the passages relative to chamber 18 a substantially equal amount of mixture will flow into each of passages 25*a*, 25*b*, and 25*c*. Since the passages are of substantially equal length and have approximately identical heat balances relative to the cylinder head, the type of mixture arriving at each intake port 26 will be very nearly the same and because of the relatively short path which the mixture travels to arrive at each cylinder, there will be little opportunity for set-

tling out of the entrained particles. Any fuel which does collect in the chamber passages will be vaporized upon reaching dam **27** at the end of the passages. It is thus possible to design passages **25** of relatively large cross-sectional areas, to decrease the mixture temperature so as to achieve high output, volumetric efficiency and B. M. E. P. and low specific fuel consumption.

Table A below illustrates in tabular form the results achieved in testing the novel engine head installed in a stock six-cylinder in-line engine, the results being compared with equivalent figures using the conventional manifold together with both a single and a dual carburetor.

Table A

	Conventional manifold single carburetor	Conventional manifold dual carburetor	Novel engine head with two carburetors
Max. B. M. E. P., p. s. i.	133	136	146
Max. vol. eff., percent	78	81	89
Max. B. H. P.	129	131	143
Max. torque, ft.-lbs.	206	206	222
Min. br. spec. fuel cons., lbs./B. H. P.-hr.	0.465	0.465	0.455

It will be observed from the above results that by use of the intake system described above vastly improved results are obtained both in the power output and in the operating efficiency of a standard engine.

Figs. 5 to 7 illustrate a modified embodiment of the engine head having an intake system essentially the same as that of Figs. 1 to 4 but having several additional features designed to improve still further the results achieved by that intake system. As one of said features, each of the mixture distributing chambers **18** in Figs. 5 to 7 are provided with a pair of ridges **31** and **32** which are aligned respectively with the junctures **33** and **34** of the intake passages **25**. These ridges rise from the floor of each chamber **18** a short distance and extend from the outer wall of the chamber, diverging inwardly toward the passages. The purposes of ridges **31** and **32** is to distribute equally the heavy fuel fractions which may settle out in chambers **18** before reaching the passages **25**. It will be seen that liquid fuel droplets which settle on any part of the floor of chamber **18** will be held by ridges **31** and **32** in the area in which they settle, and since the settling tends to be distributed evenly over the chamber, each of passages **25***a*, **25***b* and **25***c* will receive substantially equal amounts of liquid fuel. This construction is especially advantageous when the engine is operating on an incline from the horizontal, since it will be obvious that without ridges **31** and **32** the liquid fuel would tend to flow toward the lowermost point of chamber **18**, thus being fed unequally to the three passages **25**.

The modification of Figs. 5 to 7 is further provided with a tubular aperture **35** within side wall **36** which extends between and connects the two mixture distributing chambers **18**. The function of this tubular passage **35** is to equalize the intake depressions between the two halves of the engine, especially at idling speeds. For this purpose the cross-sectional area of passage **35** is sufficiently small to prevent substantial flow of mixture between the two chambers **18**, but at the same time to permit the slight flow necessary to equalize minor differences in pressure which may occur, thus increasing the smoothness of operation of the engine.

The modification of Figs. 5 to 7 is further provided with a novel form of exhaust system which is adapted to cooperate with the manifold system described above. This system comprises two separate groups of passages, each leading from three adjacent exhaust ports. The passages **37***a*, **37***b* and **37***c* in each group extend in converging fashion from their corresponding exhaust ports **14** and lead into two spaced-apart exhaust chambers **38** on the side of the engine head opposite mixture distributing chambers **18**. As best seen in Figs. 6 and 7, the exhaust passages are upwardly and outwardly inclined, and the chambers **38** are provided with inclined flanges **39** adapted to be secured to the remainder of the exhaust system by such means as a common header (not shown). It will be observed that due to the streamlined nature of passages **37** ideal flow conditions will be allowed resulting in a minimum back pressure and a minimum of residual gases in the combustion chamber. Due to the converging nature of the passages and the inwardly flared shape of chambers **38** it is possible to cast the exhaust system integrally with the head without danger of cracking the casting. Since each chamber **38** draws exhaust from only three adjacent cylinders, the problem of reverse flow in the exhaust system is eliminated if the conventional firing orders are used. The system also has the advantage of eliminating the conventional gasket between the exhaust manifold and the head, thus obviating the usual problem of a blown or otherwise damaged gasket due to expansion of the exhaust manifold under operating conditions.

It will be obvious that other modifications of the invention could be constructed embodying some but not all of the features shown in Figures 5 to 7. For example, a modification containing the tubular aperture **35** between the distributing chambers but having a conventional exhaust system would be possible.

I claim:

1. An intake system for a multicylinder internal-combustion engine or the like, comprising a plurality of mixture distributing chambers in longitudinally spaced relation on the engine head, each of said distributing chambers being disposed substantially opposite the midpoint of a group of intake ports, means for mounting a carburetor on each of said distributing chambers to supply an air-fuel mixture thereto, and a plurality of passages of nearly equal length within said engine head and extending from each of said distributing chambers in generally radial relation, each of said passages connecting a distributing chamber with one of the intake ports in its corresponding group.

2. An intake system for a multicylinder internal-combustion engine or the like comprising a plurality of mixture distributing chambers in longitudinally spaced relation on the engine head, each of said distributing chambers being disposed substantially opposite the midpoint of a group of intake ports, a plurality of passages of nearly equal length within said engine head and extending from each of said distributing chambers in generally radial relation, and means for connecting an independent carburetor to each of said distributing chambers.

3. In an engine head for a multicylinder internal-combustion engine, an intake system comprising a plurality of mixture distributing cham-

bers in longitudinally spaced relation on one side of said engine head, said distributing chambers being of inwardly flared shape, a plurality of intake ports, each of said distributing chambers being disposed substantially opposite the mid-point of a group of intake ports, and a plurality of passages of nearly equal length within said engine head and extending from each of said distributing chambers in generally radial relation, each of said passages connecting a distributing chamber with one of the intake ports in its corresponding group, whereby each of said distributing chambers distributes the mixture only to its own group of intake ports.

4. An intake system for a six-cylinder internal-combustion engine comprising a pair of mixture-distributing chambers in longitudinally spaced relation on the engine head, each of said distributing chambers being disposed substantially opposite a group of three adjacent cylinders, means for mounting a carburetor on each of said distributing chambers to supply an air-fuel mixture thereto, and three passages of nearly equal length extending radially from each of said distributing chambers within said engine head, each of said passages connecting a distributing chamber with one of the intake ports in its corresponding group.

5. In an engine head for a multicylinder internal-combustion engine, an intake system comprising a plurality of mixture distributing chambers in longitudinally spaced relation on one side of said engine head, a plurality of combustion chambers in said head, each of said distributing chambers being disposed substantially opposite the midpoint of a group of adjacent combustion chambers, and a plurality of passages of nearly equal length within said engine head and extending from each of said distributing chambers in generally radial relation, each of said passages connecting a distributing chamber with one of the combustion chambers in its corresponding group, whereby each of said distributing chambers distributes the mixture only to its own group of combustion chambers.

6. In an intake system for an internal-combustion engine, a plurality of mixture distributing chambers in spaced-apart relation on said engine, each of said chambers being adjacent a group of intake ports, a carburetor operatively connected to each of said chambers, passages leading from each of said chambers to each of the intake ports in its adjacent group, whereby each of said carburetors will only supply its corresponding group of ports, and a tubular connection between said chambers, said connection being of sufficient size to allow equalization of pressures within said chambers while preventing substantial mixture flow therebetween.

7. In a head for an internal-combustion engine, a plurality of intake ports, a plurality of mixture distributing chambers in spaced-apart relation on said engine, each of said chambers being adjacent a group of intake ports, passages of nearly equal length leading from each of said chambers to each of the intake ports in its adjacent group, and a connection between said chambers, said connection being of sufficient size to allow equalization of pressures within said chambers while preventing substantial mixture flow therebetween.

8. In a head for an internal-combustion engine, a plurality of intake ports, a plurality of mixture distributing chambers in longitudinally spaced relation on one side wall of said head, passages within said head and leading in generally radial relation from each of said chambers to each of the intake ports of its adjacent group, and a connection between said chambers within said side wall, said connection being of sufficient size to allow equalization of pressures within said chambers while preventing substantial mixture flow therebetween.

9. In an engine head for a multicylinder internal-combustion engine, an intake system comprising a plurality of mixture distributing chambers in longitudinally spaced relation on one side of said engine head, a plurality of combustion chambers in said head, each of said distributing chambers being disposed substantially opposite the midpoint of a group of adjacent combustion chambers, a plurality of passages of nearly equal length within said engine head and extending from each of said distributing chambers in generally radial relation, each of said passages connecting a distributing chamber with one of the combustion chambers in its corresponding group, and an upwardly inclined portion at the end of each of said passages adjacent its corresponding combustion chamber.

10. In a cylinder head for an internal-combustion engine, a plurality of combustion chambers in said head, a plurality of mixture distributing chambers in spaced-apart relation on said head, a plurality of exhaust passages in said head, each of said distributing chambers being remote from said exhaust passages and substantially opposite the mid-point of a group of adjacent combustion chambers, and a plurality of passages extending within said head from each of said distributing chambers to the combustion chambers in its corresponding group, the floor of each of said passages being substantially horizontal outwardly of its combustion chamber and upwardly inclined adjacent its combustion chamber.

11. In a cylinder head for an internal-combustion engine, an intake system comprising a plurality of intake ports, a plurality of spaced-apart mixture distributing chambers on said head, each chamber being adjacent a group of intake ports and having a substantially flat floor, a plurality of passages leading from each of said chambers in generally radial relation to the intake ports in its corresponding group, and ridges on the floor of said chamber in substantial alignment with juncture of adjacent passages, whereby liquid fuel collecting on said floor will be guided into said passages.

12. In a cylinder head for a six-cylinder internal combustion engine, six intake ports, a pair of mixture distributing chambers in spaced-apart relation on one side of said head, each of said chambers being of inwardly flared shape and adjacent the midpoint of a group of three intake ports, three passages leading from each of said chambers to each of the intake ports in its corresponding group, said passages being of nearly equal length and extending in generally radial relation within said cylinder head, and two ridges on the floor of each of said chambers, said ridges diverging inwardly and each ridge being in substantial alignment with the juncture of adjacent passages.

13. In an engine head for a multicylinder internal-combustion engine, a plurality of intake ports and exhaust ports, a plurality of mixture distributing chambers in longitudinally spaced relation on one side of said engine head, each of said distributing chambers being disposed substantially opposite the midpoint of a group of intake ports, intake passages connecting each of

said intake ports to its corresponding distributing chamber, exhaust passages leading from each of said exhaust ports to the opposite side of the engine head, said exhaust passages comprising a plurality of groups, each group extending in generally converging fashion from a group of adjacent exhaust ports, an exhaust chamber formed at the juncture of each of said groups of exhaust passages, said exhaust chambers being in spaced-apart relation, and outlets on said exhaust chambers adapted to feed exhaust gases into a common header.

14. In a cylinder head for a six-cylinder internal-combustion engine, six intake ports, a pair of mixture distributing chambers in spaced-apart relation on one side of said head, each of said chambers being of inwardly flared shape and adjacent the midpoint of a group of three intake ports, three passages leading from each of said chambers to each of the intake ports in its corresponding group, said passages being of nearly equal length and extending in generally radial relation within said cylinder head, and two ridges on the floor of each of said chambers, said ridges diverging inwardly and each ridge being in substantial alignment with the juncture of adjacent passages, the cross-sectional area of each of said passages gradually decreasing and then increasing toward its corresponding intake port, whereby said passages form venturis for the mixture flow.

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