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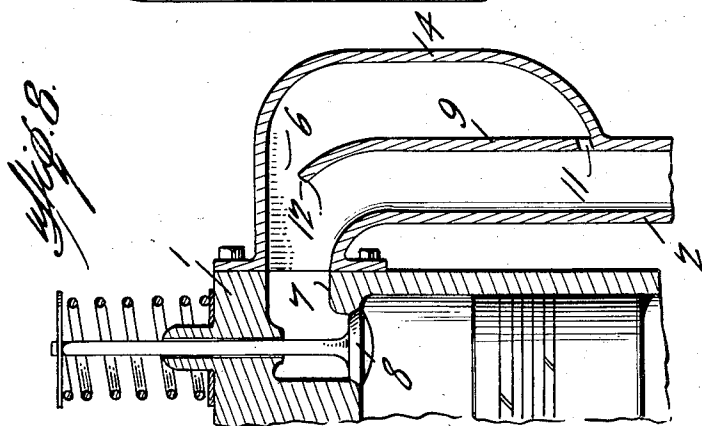
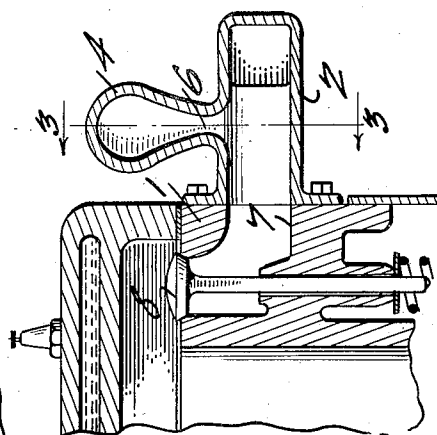
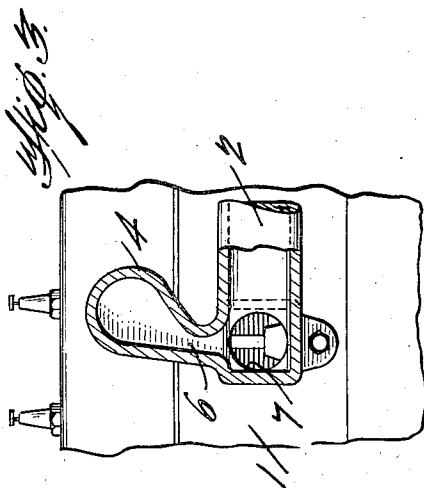
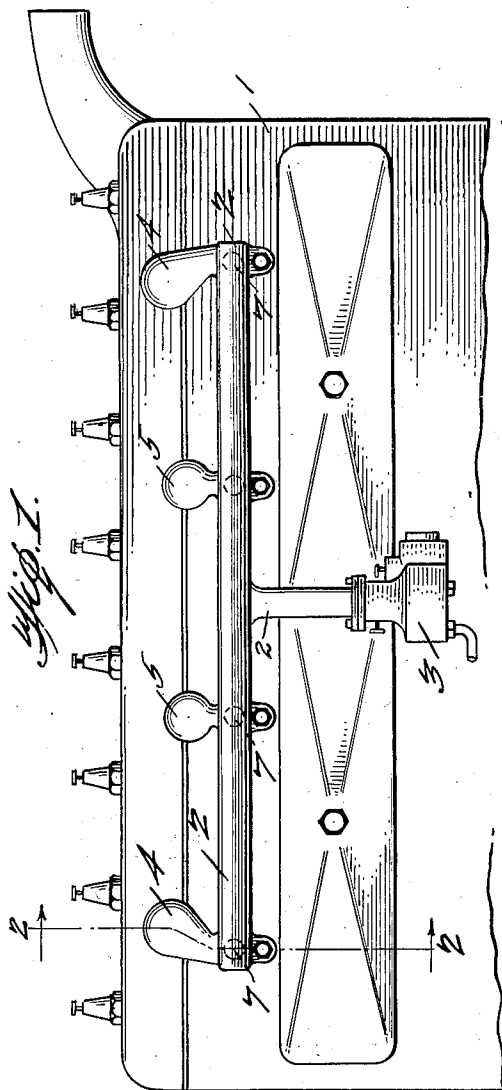
G. A. BARKER

2,014,371

MANIFOLD

Filed April 5, 1932

3 Sheets-Sheet 1



George A. Barker
INVENTOR

By *George A. Barker*
ATTY.

Sept. 17, 1935.

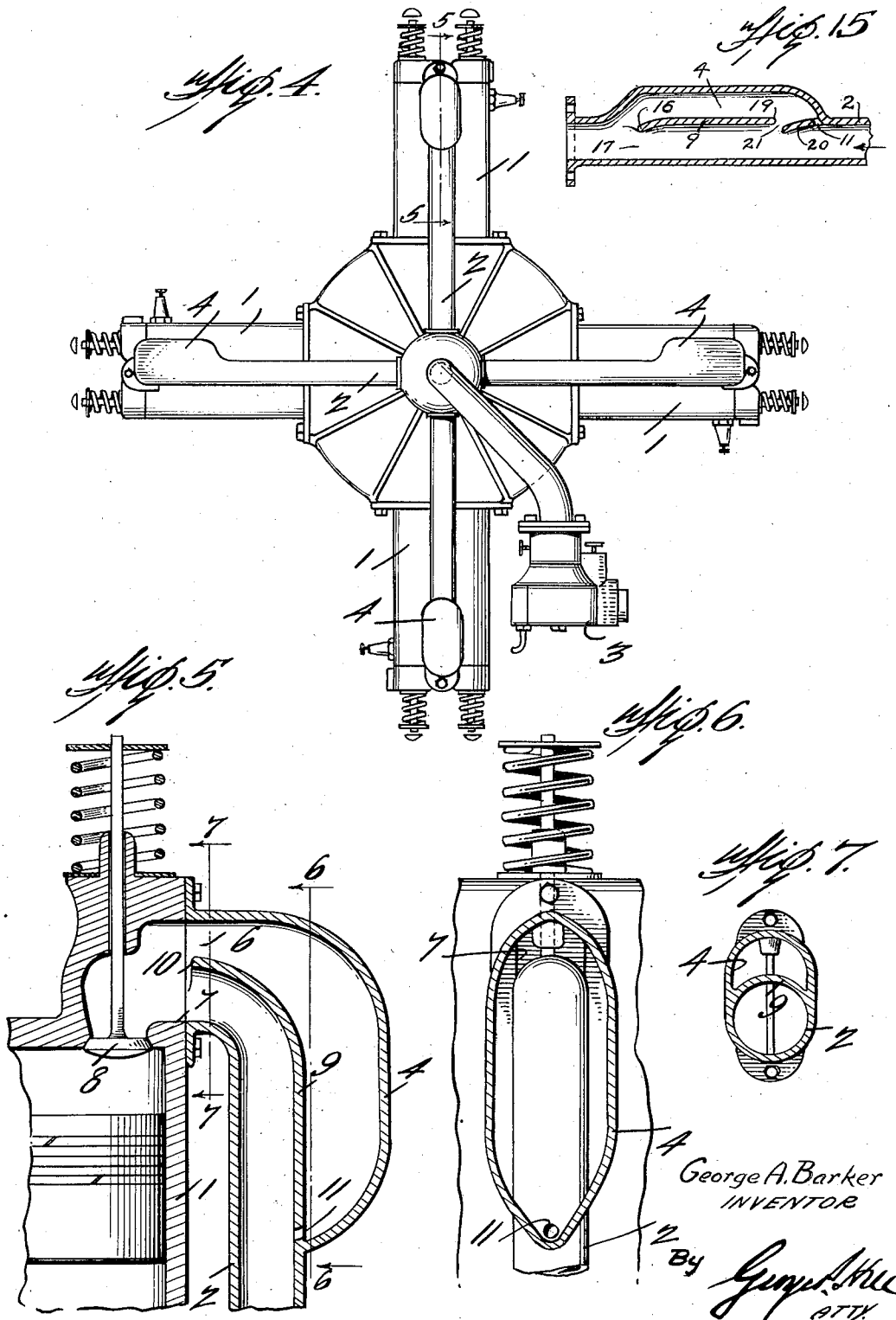
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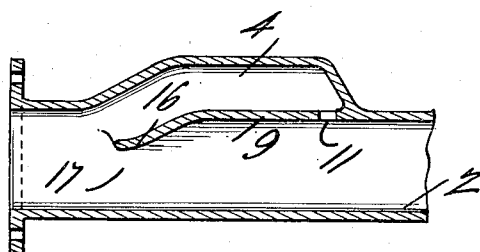
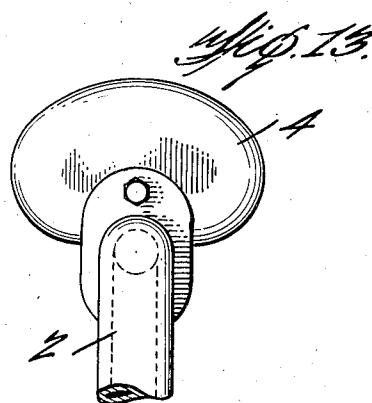
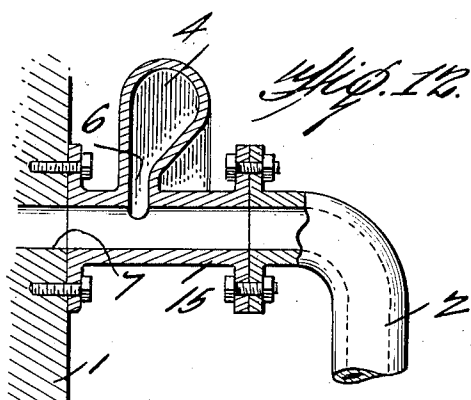
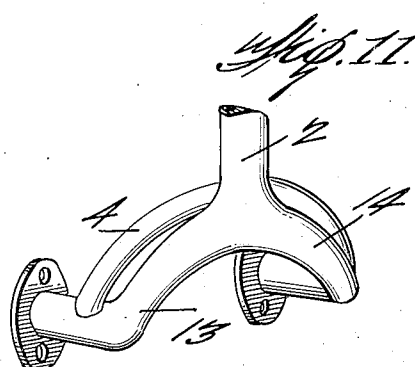
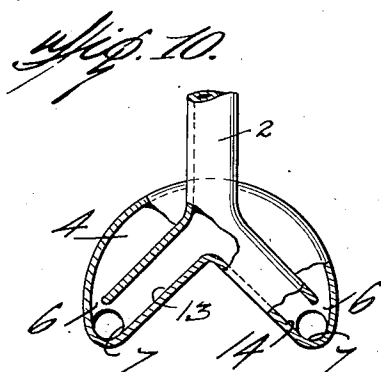
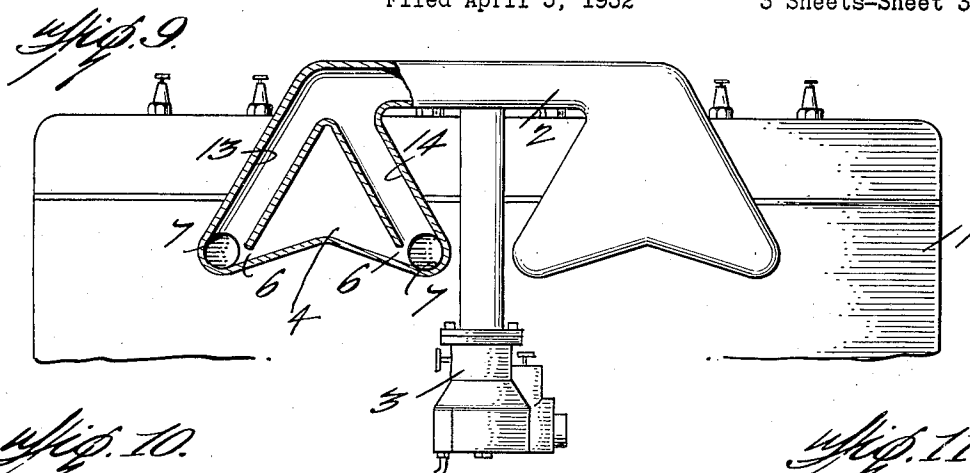


Fig. 14. George A. Barker
INVENTOR

By *George A. Barker*
ATTY

UNITED STATES PATENT OFFICE

2,014,371

MANIFOLD

George A. Barker, Rochester, N. Y.

Application April 5, 1932, Serial No. 603,423

18 Claims. (Cl. 123—52)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

5 This invention relates to internal combustion engines or the like and more particularly to the manifold through which the operating fuel gas is conveyed to the cylinders.

10 The principal object of the invention is to maintain a substantially constant flow of gas within the intake manifold, in the direction of the intake valve, and thereby eliminate surging of the gas in said manifold caused by the closing of the said valve.

15 Another object of the invention is to provide a reservoir with a storage for intake gas in close proximity to the intake valve where said gas may be held under pressure and instantly released to enter the cylinder on a subsequent opening of said valve.

20 A further object of the invention is to increase the volumetric efficiency, as well as the horsepower per piston displacement, of a reciprocating engine.

25 With these and other objects in view, which will become apparent from the following disclosure, the invention resides in the novel details of construction and combinations of parts which are recited in the following specification and particularly pointed out in the claims.

30 Referring to the accompanying drawings, forming a part of this specification, in which like numerals designate like parts in all the views,—

35 Fig. 1 is a side elevation of the cylinder block of an internal combustion engine showing the intake manifold and carburetor, and illustrating the application to said manifold of one form of this invention;

40 Fig. 2 is a sectional view, taken as on the line 2—2 of Fig. 1 looking in the direction of the arrows, illustrating the interior construction of the manifold and its associated compression chamber;

45 Fig. 3 is a sectional view of one end of the manifold, taken as on the line 3—3 of Fig. 2 and looking in the direction of the arrows;

50 Fig. 4 is an elevational view of a radial engine showing the disposition of the carburetor and intake manifold, the latter provided with modifications of the associated compression chambers illustrated in Fig. 1;

Fig. 5 is a vertical sectional view taken as on the line 5—5 of Fig. 4 and looking in the direction of the arrows;

55 Fig. 6 is a vertical sectional view taken as on

the line 6—6 of Fig. 5 and looking in the direction of the arrows;

Fig. 7 is a vertical sectional detail taken as on the line 7—7 of Fig. 5 and looking in the direction of the arrows;

Fig. 8 is a vertical sectional view similar to Fig. 5 but illustrating a modified form of manifold construction, the principal difference lying in the disposition of the median septum or partition wall;

Fig. 9 is a view similar to Fig. 1 but partly in section and illustrating a type of compression chamber particularly adapted for use with a Y shaped manifold;

Fig. 10 is a view, partly in section, illustrating a modification of the type of manifold shown in Fig. 9, wherein the compression chamber is above and to the rear of and not between the branches of the Y;

Fig. 11 is a perspective view illustrating another modification of the Y shaped manifold, wherein the compression chamber consists of a pipe or tube bridging the terminals of, and parallelly disposed to the branches of, the Y;

Fig. 12 is a view similar to Fig. 2 but showing the compression chamber as an independent or separate unit adapted for ready insertion or removal from between the intake manifold and the cylinder block of the engine;

Fig. 13 is an elevational view of the parts shown in Fig. 12;

Fig. 14 is a sectional view similar to Fig. 8 but illustrating a deflected median septum to provide a restriction reducing the cross-sectional area of the manifold passage to the intake port; and

Fig. 15 is a sectional view showing a modification of the construction shown in Fig. 14.

The present and usual types of intake manifolds used on internal combustion engines have an interior diameter or cross-sectional area which is substantially uniform from the carburetor to the intake port of the cylinder block, whereby it follows that the intake port, the intake manifold, and the carburetor port connecting with the manifold, are all of substantially the same area. Further, the combustible fuel gas from the carburetor is drawn through the intake manifold into the cylinders of the engine by the operation of the pistons and the intake valves. That is to say, the piston receding or moving downwardly in a cylinder produces a suction which, when the intake valve is open, draws an amount of fuel gas into the cylinder from the manifold, this amount of gas being retained in the cylinder by automatic closing of said valve at approximately

the limit of the receding or down stroke of said piston. On the upward or advancing stroke, the piston compresses the fuel gas just drawn into the cylinder, this compressed gas being ignited at approximately the limit of the advancing stroke of the piston, the force of the ignited gas driving the piston downward on the next receding stroke at the end of which stroke the exhaust valve is automatically opened to permit the piston on the following upward or advance stroke to force the burned gas out of the cylinder. The cycle is then repeated, fresh fuel gas being drawn into the cylinder on the following down or receding stroke of the piston as just stated.

Thus it will be seen that the fuel gas is drawn very rapidly from the manifold into a cylinder at repeated and separated time intervals, instead of constantly, and that each of these time intervals is equivalent to a little more than one-fourth of the operating cycle, and that the fuel gas is entering the cylinder at high velocity during substantially one-half of one revolution of the engine shaft. For example, a single cylinder engine having a piston displacement of 100 cu. inches and turning over at 2000 R. P. M. will impart a velocity of several hundred feet per minute to the gas flow in the intake manifold. When the intake valve suddenly closes, the fuel gas in the manifold is still under this high velocity, and there is immediately built a pressure of corresponding value in the manifold closely adjacent the intake valve.

With the present and conventional type of manifold, the closing of the intake valve produces a sudden stop to this normal flow of gas under high velocity, and consequently there is a reaction which manifests itself in a compression, followed by a surging and retrograde flow, of the fuel gas in the manifold. This results in the creation of a low pressure area which undoubtedly is at least a partial vacuum in the vicinity of the intake valve. Obviously, when this valve again opens, this low pressure condition reduces the amount of fuel gas that can enter the cylinder, thereby lowering the potential efficiency of operation of the engine. This invention is therefore directed to the partial if not total elimination of this low pressure effect, by a change in construction of the conventional intake manifold.

According to this invention there is provided a reservoir or compression chamber located in the intake manifold in close proximity to the intake port or valve leading to the engine cylinder, said chamber being for the purpose of storing fuel gas during the time that the intake valve is closed and which will be ready for immediate charging into said cylinder as soon as said valve opens. This chamber may be of various shapes and sizes as best suited for the design of particular engines. For example, it may be in the shape of a projection extending radially from the manifold, or it may be formed so as to more closely hug the contour of the manifold. In the drawings these various modifications of form have been particularly illustrated and will be individually described in the following, the general points of similarity in all the views being that 1 represents a cylinder or its casting block, 2 the intake manifold generally, 3 the carburetor, and 4 the reservoir or compression chamber generally and forming the subject matter of this invention.

With particular reference to Figs. 1, 2 and 3 the compression chambers 4 at the ends of the manifold are made slightly larger than the simi-

lar intermediate chambers 5, because the latter are more accessible to the gas supply. These chambers are cast integral with the intake manifold, are bulbous or globular in shape, converging or not as desired into a restricted neck portion 6 at their junction with said manifold, and are disposed in close proximity to the intake port 7 with which the manifold registers.

According to this construction, when the intake valve 8 closes, the fuel gas under high velocity in the intake manifold instead of coming to an abrupt stop continues under rapidly reducing flow, the inertia of the gas causing a considerable portion thereof to enter the chamber 4 and become compressed and trapped therein due to the restricted neck 6. At the next opening of the valve 8 the suction produced by the downwardly moving piston will act upon this entrapped and compressed gas to cause its immediate passage through the intake port 7 into the engine cylinder. By this time, the same piston produced suction will have caused the conventional flow of fuel gas from the carburetor through the manifold to and into said cylinder. Because of the storage of fuel gas in the chamber 4 and the initial flow of this entrapped gas, the peak velocity obtained in the intake manifold is not as great as in the usual or conventional type of manifold. When the valve 8 again closes instead of having a sudden stoppage of gas flow, the gas passes into the reservoir or compression chamber such as 4, after which any surging of gas is confined to the intake manifold proper; thence the cycle repeats as heretofore explained.

This bulbous construction is not unlike the well known water ram used in water systems under pressure. In fact the actions of an intake manifold of an engine, a water ram, and the rapid closing of a valve in a city water system, are very similar. In the latter case a shock absorbing means in the form of an air chamber or bulb is used to cushion or absorb the inertia of the flowing water in the pipe. Since water is practically incompressible, there results a change in volumetric air displacement within the air chamber or, in other words, the original air in the chamber is compressed into a smaller volume. In the device of this invention the fuel gas under high velocity is compressible and readily miscible with air in the chamber 4, wherefore there is no "hammer" effect occurring in this modified manifold when the intake valve closes, the gas becoming entrapped and compressed within said chamber, leaving the gas outside said chamber in the manifold subject only to any surging and retrograde flow. By "surging" is meant the sudden acceleration or movement of the column of fuel gas in any direction, as well as the sudden stopping of the moving column of said gas; in fact by it is meant any change in the directional movement of said gas column.

Figs. 4, 5, 6 and 7 illustrate various views of a form of manifold construction particularly adapted to engines of the radial type and in which it will be noted that the compression chambers 4 partially surround a portion of the branch intake manifold 2. These compression chambers in the horizontal cylinders are placed above the manifold to permit the flow of gas back into said manifold by gravity. The compression chambers on the vertical cylinders partially surround the manifold but are located in front of said manifold; that is, the manifold lies between the compression chamber and the cylinder. These compression chambers of the vertical cylinders are shown

in section in Figs. 5 and 6 and it will be noted that a portion of the wall of the manifold 2 forms a median septum or partition 9 between said manifold and the compression chamber. The end 10 of the median septum in this modification extends to substantially the intake port 7 of the cylinder block. From Fig. 7 it is to be particularly observed that the terminus of the manifold passage is substantially circular being partially formed by the median septum 9, whereas the intake port 7 is of a flattened elliptical shape to register with the similarly shaped terminus of the modified manifold casting; in other words this elliptical shape is occasioned by the fact that the openings of the manifold passage and the compression chamber are adjacently disposed in the same plane. The small bore opening 11 is provided between the manifold passage and the lowest point of the compression chamber 4 to permit drainage from the latter of any condensate that may form therein.

Fig. 8 illustrates a construction quite similar to that shown in Fig. 5 except that the median septum 9 does not extend to the intake port 7, and the outer wall of the compression chamber 4 terminates in what would ordinarily be the circular terminus of the manifold passage. Stated in other words, according to Fig. 8 there is only one opening into the modified manifold casting which registers with the intake port 7, and this opening is substantially circular and of the approximate diameter of the manifold passage 2. The end 12 of this median septum is relatively close to the outer wall of the chamber 4 creating therebetween the restricted neck of passage 6 into said chamber, the other extremity of said septum being provided with the aforementioned drain 11 for condensates from said chamber. From Figs. 5, 8, 14 and 15 it will be clearly seen that the compression chamber is truly connected in parallel with the intake passage, communication being positively established at both ends of the chamber by the dual ports such as 6 and 11.

In Fig. 9 there is shown a type of compression chamber 4 which may be utilized in connection with a main manifold 2 terminating in diverging branch passages such as 13 and 14 each leading to the intake port 7 of an engine cylinder. In this type of manifold the compression chamber 4 is substantially triangular in shape being located between the diverging passages, the inner wall of each passage being cut off at the intake port end thereof to provide a restricted throat or passage 6 into said chamber 4. From said figure it will be understood that fuel gas will travel alternately and successively in the passages 13 and 14 according to which intake valve is open at the time. When the gas travel is in passage 13 then there will be movement of gas from the chamber 4 toward the inlet port associated with said passage and this automatically draws some of the gas in passage 14 into said chamber. Naturally the same gas flow takes place, only in alternate manner, when the other direction of gas travel is toward the inlet port associated with passage 14. Therefore, it will be evident that the chamber 4 always has gas therein ready for immediate discharge into either inlet port and in advance of the main flow of gas from the carburetor when the intake valves open.

Fig. 10 shows a somewhat similar construction wherein the main manifold 2 is provided with divergent branch passages 13 and 14 each leading to the intake port 7 of an engine cylinder, but here the compression chamber lies to one side of

and above said passages instead of therebetween. The restricted throat 6 is likewise present in this modification.

The main manifold 2 of Fig. 11 is also branched forming the passages 13 and 14, but by this modified form of the invention the compression chamber 4 is a pipe or tube which may be straight or curved and which not only connects the branch passages 13 and 14 near their extremities but which also has a diameter substantially equal to the diameter of the manifold branch, wherefore there is not the decided restricted throat as illustrated in Figures 9 and 10.

Figs. 12 and 13 illustrate a modified form of the compression chamber 4 which is integral with a small independent section 15 of manifold so that it may be inserted between the cylinder block 1 and the main intake manifold casting 2 leading from the carburetor. The chamber 4 is bulbous or globular in transverse section with the restricted throat 6, and is fan shape or semi-circular in longitudinal section.

In Fig. 14 is shown a construction in which the fuel gas can pass straight through the modified manifold. Here the compression chamber 4 is formed externally of the manifold passage, with the intermediate wall 9 constituting a median septum and having its end portion 16 deflected inwardly of the manifold passage to provide a reduced cross-sectional area of said passage indicated at 17. By this construction the aforementioned restricted throat 6 of the chamber 4 is substantially eliminated, but the filling of the chamber 4 is augmented. That is to say, when the intake valve is open the fuel gas from the carburetor will be drawn toward said valve and in this movement the travelling gas will have an exhausting effect at 17 upon the chamber 4 producing therein a substantially negative pressure or partial vacuum. When the valve closes then the gas between the chamber and said valve is put under slight compression by the inertia of the travelling gas. This increased pressure at the intake port and the reduced pressure in the chamber 4 naturally accentuates the retrograde flow of gas into said chamber.

In Fig. 15 is illustrated a modification of the construction shown in Fig. 14 wherein the median septum is formed with both ends free, the forward end 17 similar to the corresponding end of the septum of Fig. 14 but the rear end 19 not joined to either the outer chamber wall or the manifold wall. There is also provided a short wall 20 which may be an extension of the manifold wall and which partially divides the expansion chamber from the manifold passage. This wall is integrally joined to the manifold substantially at the junction of the rear end of the compression chamber 4 with the manifold, and at said joint said wall is provided with the drainage perforation 11.

This wall 20, however, could be formed otherwise than as such an extension, its function being to provide the septum a means for insuring passage of fuel gas into the compression chamber, which is brought about through the deflection of the forward end of the wall 20 into the manifold passage and the spacing of the walls 9 and 20 to provide the open passage 21 therebetween. This passage 21 is preferably of lesser cross sectional area than the area of communication between the chamber 4 and the manifold passage wherefore, when the intake valve closes, the greater tendency will be for the fuel gas to enter said chamber at its forward end or the end nearest said valve.

From this construction it will be seen that the compression chamber has two communicating openings into the manifold passage, in addition to the condensate drain bore 11, and that each of these two openings has an associated deflected wall construction which causes the column of fuel gas, moving in the direction of the arrow, to have an exhausting effect upon the contents of the chamber 4 thereby creating in said chamber a partial vacuum when the intake valve is open. Upon the closing of this valve, the partial vacuum immediately acts upon the fuel gas to draw a portion thereof through each of said openings into the compression chamber, and any subsequent retrograde flow of the fuel gas in the manifold passage only increases the pressure on the fuel gas previously abstracted from said passage and now stored within the chamber 4.

This invention is not limited to manifolds for radially and vertically disposed engines but is applicable to engines in general. It will be readily apparent to those skilled in the art that this invention may be used with vertical, horizontal, radial, V-type and tandem engines.

It is obvious that those skilled in the art may vary the details of construction and arrangements of parts without departing from the spirit of the invention, and therefore it is not desired to be limited to the foregoing except as may be required by the claims.

What is claimed is:—

1. In an internal combustion engine the combination of an intake manifold comprising a passage; and a compression chamber attached to said manifold and provided with a restricted neck portion communicating with said passage, said chamber further provided with a duct for conveying condensates to the interior of said manifold.

2. In an internal combustion engine provided with a carburetor and a fuel intake port, the combination of an intake manifold for conveying the fuel gas from said carburetor to said intake port and a chamber substantially parallelly disposed to the axis of said manifold to receive a quantity of the conveyed fuel gas, said chamber freely communicating at one end with said intake port and restrictedly communicating at its other end with said manifold.

3. In an internal combustion engine provided with a carburetor and a fuel intake port, the combination of an intake manifold for conveying the fuel gas from said carburetor to said intake port; and a chamber substantially parallelly disposed to the axis of said manifold to receive a quantity of the conveyed fuel gas, said chamber disposed at the intake port end of said manifold and separated therefrom by a common wall, said wall imperforate except for a restricted opening for draining said chamber of any condensate.

4. In an internal combustion engine provided with a carburetor and a fuel intake port, the combination of an intake manifold for conveying the fuel gas from said carburetor to said intake port; and a chamber substantially parallelly disposed to the axis of said manifold to receive a quantity of the conveyed fuel gas, said chamber extending to the junction of said manifold with said intake port and partially surrounding said manifold, the separation between said manifold and said chamber being a common partition perforated only at the end remote from said intake port, said perforation being of far lesser area than the area of communication between said manifold and said chamber at the intake port end of said partition.

5. In an internal combustion engine provided

with a carburetor and a fuel intake port, the combination of an intake manifold for conveying the fuel gas from said carburetor to said intake port; and a chamber substantially parallelly disposed to the axis of said manifold to receive a quantity of the conveyed fuel gas; said chamber extending substantially to the junction of said manifold with said intake port and partially surrounding said manifold, the separation between said manifold and said chamber being a common partition substantially parallel to the opposite wall of the manifold said partition perforated only at the end remote from said intake port, said perforation being of far lesser area than the area of communication between said manifold and said chamber at the intake port end of said partition.

6. In an internal combustion engine provided with a carburetor and a fuel intake port, the combination of an intake manifold for conveying the fuel gas from said carburetor to said intake port; and a chamber substantially parallelly disposed to the axis of said manifold to receive a quantity of the conveyed fuel gas, said chamber extending substantially to the junction of said manifold with said intake port and partially surrounding said manifold, the separation between said manifold and said chamber being a common partition substantially parallel to the opposite wall of the chamber thereby establishing a restricted throat in the manifold, said partition perforated only at the end remote from said intake port, said perforation being of far lesser area than the area of communication between said manifold and said chamber at the intake port end of said partition.

7. In an internal combustion engine provided with a carburetor and a fuel intake port, the combination of an intake manifold for conveying the fuel gas from said carburetor to said intake port; and a chamber substantially parallelly disposed to the axis of said manifold to receive a quantity of the conveyed fuel gas, said chamber extending substantially to the junction of said manifold with said intake port and partially surrounding said manifold, the separation between said manifold and said chamber being a common partition substantially parallel to the opposite wall of the manifold thereby establishing a restricted throat at the intake port end of said chamber, said partition perforated only at the end remote from said intake port, said perforation being of far lesser area than the area of communication between said manifold and said chamber at the intake port end of said partition.

8. In an internal combustion engine provided with a carburetor and a fuel intake port, the combination of an intake manifold for conveying the fuel gas from said carburetor to said intake port; and a chamber substantially parallelly disposed to the axis of said manifold to receive a quantity of the conveyed fuel gas, said chamber communicating at both ends with said manifold and separated therefrom by a plurality of walls having ends extending into said manifold.

9. In an internal combustion engine provided with a carburetor and a fuel intake port, the combination of an intake manifold for conveying the fuel gas from said carburetor to said intake port; and a chamber substantially parallelly disposed to the axis of said manifold to receive a quantity of the conveyed fuel gas, said chamber extending substantially to the junction of said manifold with said intake port and partially surrounding said manifold, the separation between said manifold and said chamber being a parti-

tion substantially parallel to the opposite wall of the chamber, said partition formed in two parts to provide plural openings between said chamber and said manifold, each part having an end deflected into said manifold to provide exhausting action upon said chamber when said fuel gas is being conveyed toward said intake port, said partition perforated only at the end remote from said intake port, said perforation being of far lesser area than the area of either of the communicating openings between said manifold and said chamber.

10. In an apparatus of the class described, the combination of a manifold having a fuel conducting passage; a chamber attached to said manifold and communicating only therewith, said chamber having a transverse area substantially as great as that of the passage; and an engine block having an intake port for receiving fuel from said manifold, said port in direct communication with said passage and said chamber.

11. In an apparatus of the class described the combination of a manifold having a fuel conducting passage; a chamber communicating only with said manifold and at the extremity of the latter, said chamber having a transverse area at least one half as great as that of the passage; and an engine block having an intake port for receiving fuel from said manifold, said port in direct communication with said passage and said chamber.

12. In an apparatus of the class described the combination of a manifold having a fuel conducting passage; a chamber attached to and partially surrounding said manifold and communicating only with said manifold and at the extremity of the latter, said chamber having a transverse area substantially one half as great as that of the passage; and an engine block having an intake port for receiving fuel from said manifold, said port in direct communication with said passage and said chamber.

13. In an apparatus of the class described the combination of a manifold comprising a fuel conducting passage and a chamber partially surrounding said passage and freely communicating with said passage only, and at the outlet extremity of the latter, said chamber having a transverse area substantially as great as that of the passage; and an engine block having an in-

take port for receiving fuel from said manifold, said port being of a size to communicate directly with said passage and said chamber.

14. In an apparatus of the class described the combination of a manifold comprising a fuel conducting passage and a chamber partially surrounding and communicating only with said passage, said chamber extending to the outlet extremity of said passage and having a transverse area substantially as great as that of the passage; and an engine block having an intake port for receiving fuel from said manifold, said port being of a size to registrably communicate directly with said passage and said chamber.

15. In an apparatus of the class described the combination of a manifold having a fuel conducting passage; a chamber communicating only therewith and having a transverse area substantially as great as that of the passage; and an engine block having an intake port for receiving fuel from said manifold, said port in direct communication with said chamber.

16. In an apparatus of the class described the combination of a manifold having a fuel conducting passage; a chamber communicating only therewith and having a transverse area substantially as great as that of the passage; and an engine block having an intake port communicating directly with said chamber independently of said fuel conducting passage.

17. In an apparatus of the class described the combination of a manifold having a fuel conducting passage; a chamber communicating only with said manifold and in the extremity of the latter, said chamber having a transverse area substantially as great as that of the passage; and an engine block having an intake port for receiving fuel from said manifold, said port communicating directly with said chamber independently of said fuel conducting passage.

18. In an apparatus of the class described, the combination of a single conduit leading from a source of gaseous fuel supply; a chamber formed on the far end of said conduit for receiving a portion of the fuel therein, and an engine block having an intake port for receiving fuel from said conduit, said port in direct communication with said chamber and said conduit independently of each other.

GEORGE A. BARKER.