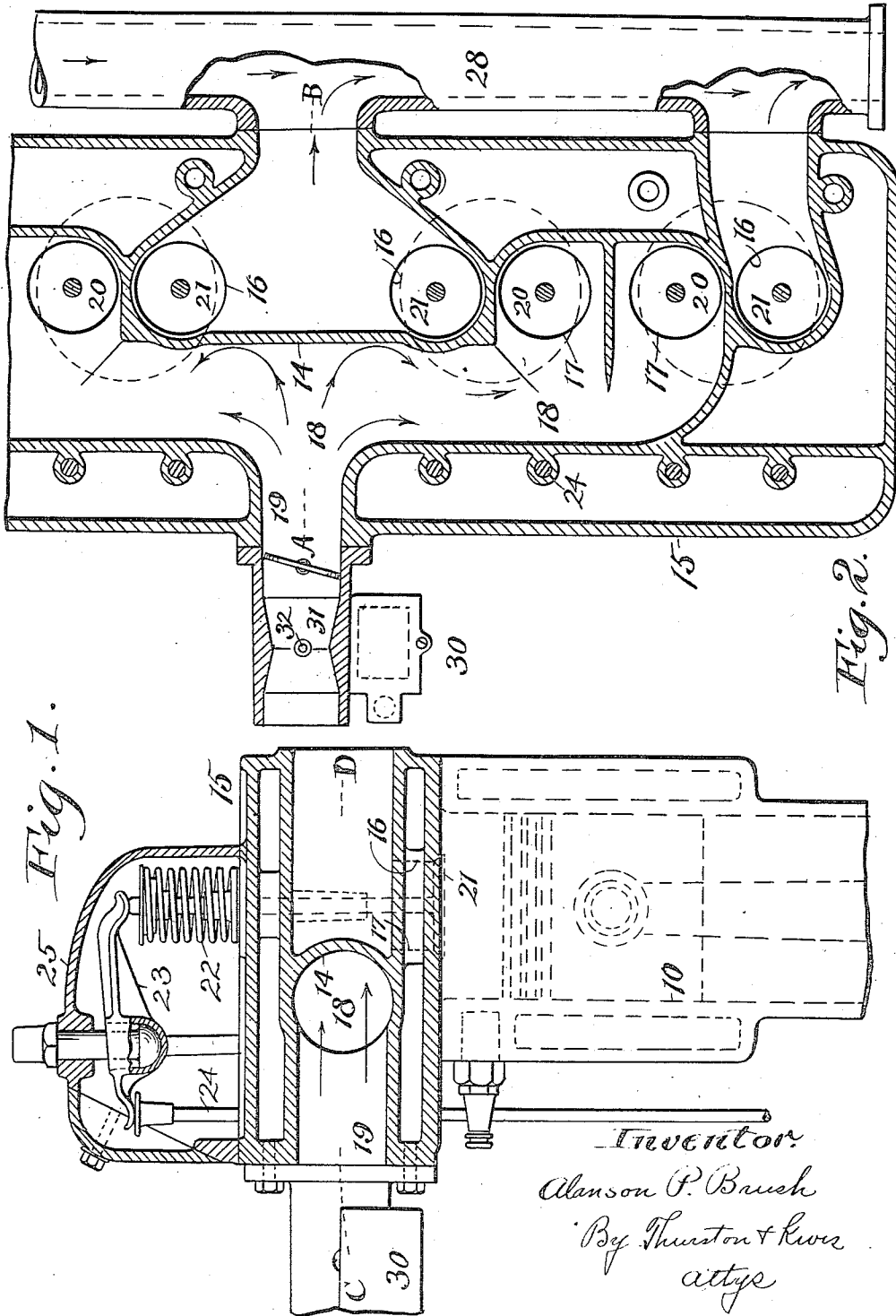


A. P. BRUSH.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED NOV. 27, 1916.

1,265,735.

Patented May 14, 1918.



Inventor:
Alanson P. Brush
By Thurston & Koon
attys

UNITED STATES PATENT OFFICE.

ALANSON P. BRUSH, OF DETROIT, MICHIGAN.

INTERNAL-COMBUSTION ENGINE.

1,265,735.

Specification of Letters Patent.

Patented May 14, 1918.

Application filed November 27, 1916. Serial No. 133,544.

To all whom it may concern:

Be it known that I, ALANSON P. BRUSH, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented a certain new and useful Improvement in Internal-Combustion Engines, of which the following is a full, clear and exact description.

This invention is an improvement in multi-cylinder internal combustion engines, and the object of the invention is to enable the engine to use low grade liquid fuel such as is now available to the public, and obtain the maximum power output for the fuel consumed under different running conditions of the engine.

The invention consists in the construction and combination of parts shown in the drawing and hereinafter described and pointed out definitely in the appended claims.

In the drawings, Figure 1 is a vertical transverse section of the upper part of a multi-cylinder internal combustion engine in which the invention is embodied, the section extending through any one of the cylinders, and extending also through the head plate, but in the plane indicated by line A—B on Fig. 2. Fig. 2 is a horizontal sectional plan view, of a part of the head plate of said engine, the sectional plane being indicated by the line C—D on Fig. 1.

The engine includes a plurality of cylinders 10, disposed in a row as indicated by dotted lines in Fig. 1; and these are preferably, though not necessarily, integral parts of the same casting. The open upper ends of all of the cylinders are closed by a single removable head plate 15, in which are inlet and exhaust passages that communicate with the cylinders by means of valve controlled openings through the lower face of said head plate. One exhaust gas passage 16 and one inlet gas passage 17 communicates as stated with each cylinder; and these are severally controlled by inlet valves 20, and exhaust valves 21;—said valves being closed by springs 22, and opened by rockers 23 which engage the valve stems and are in turn operated by tappet rods 24. These rockers may be pivoted to a cover plate 25 which is removably fixed to the head plate, whereby it will cover and protect the mechanism in the open space between said head plate and cap.

To the extent above described the engine is or may be of familiar construction, and

has been selected because the application of the present invention thereto is easy and the result is a thoroughly practical and efficient motor. It will be understood, however, that the new inventive idea now to be referred to and described is not restricted in its application to engines having the specific construction which is shown in the drawing and is above described.

Within the head plate, and extending lengthwise thereof is a mixture distributing passage, or, as it is commonly called, an inlet manifold, 18, into which air and fuel may flow from a suitable carbureter 30 through an opening 19 in the side of the head plate. The inlet passages 17 which directly discharge downward into the cylinders through the valve controlled inlet openings, are in unrestricted communication with this inlet manifold 18,—being formed as short branches thereof. Directly opposite the inlet opening 19 to this inlet manifold and within the head plate is a thin metal plate 14 which serves as a partition wall to separate the manifold 18 from the middle exhaust gas passage 16, into which the hot exhaust gas from the two middle cylinders discharges. This particular exhaust passage 16 discharges its hot exhaust gases through a hole in the side of the head plate into the exhaust manifold 28. The exhaust gas passages 16 which receive the exhaust from the other cylinders also discharge into this same exhaust manifold as is the common practice. This partition plate 14 is preferably an integral part of the head plate casting, as shown. It is evident that when the engine is running this partition plate will get to be very hot by reason of its direct contact with the hot exhaust gas from two cylinders.

The carbureter 30 may be and preferably should be of the horizontal type; and may be fastened to the head plate directly over the inlet 19 to said gas distributing passage or manifold 18. It may be of any approved construction, such as includes a restricted air tube 31, and a nozzle 32 through which the fuel will be drawn by the reduction of pressure within the air tube due to the suction action of the engine. And, for reasons which will be hereinafter explained, it is best that the fuel jet opening in the nozzle from which the fuel is discharged shall be located in a higher plane than the plane in which the inlet manifold discharges into the cylinders,—that is, shall

be above the plane of the lower face of the head plate. It should be noted also that the diameter of the inlet manifold is considerably larger than the diameter of the air tube 31; wherefore the velocity of the air and fuel stream in the inlet manifold will be less than in said air tube,—which is a reason for designating the inlet manifold as a low velocity inlet manifold.

10 During the operation of the engine the mixture of air and atomized but largely unvaporized fuel, formed in the carbureter, enters the manifold 18 substantially at right angles thereto, and directly toward the op-
15 posite hot partition wall which is located in the path of said inrushing stream of air and fuel spray. The tendency of the unvaporized particles of fuel to continue their line of travel even when the air flow is de-
20 flected, and especially when the velocity of the air stream is suddenly reduced, as it will be, is thus taken advantage of in that these unvaporized particles of fuel con-
25 tinue their direction of travel until a very large proportion of them come into actual contact with said hot partition plate which is directly in their line of travel, and there-
30 by they are instantly vaporized forming a dry gas, which readily mixes with the air, and goes with it to the several cylinders. It is to be noted that practically all the heat imparted to the fuel and air mixture by this hot plate is concentrated in the fuel content of the mixture.

35 It is not unusual to have the gas distributing manifold in the removable head plate of an internal combustion engine, but heretofore such gas manifold passages have been of such small dimensions as that there
40 will be very little reduction in the velocity of the air flowing through them after such air leaves the carbureter.

It has long been understood by engineers that a multiple cylinder engine burning a
45 fixed gaseous fuel mixed with air may have an intake manifold of as large size as may for any reason be convenient or desirable; since the fuel and the ingoing air mix easily and naturally, and have practically
50 no disposition to separate, or, to use the more common expression in this connection, to segregate. With exceedingly volatile liquid fuels which are easily convertible into what is commonly called a dry gas, the
55 manifold conditions are substantially the same as with a fixed gas. But with the use of fuels which can only be wholly vaporized either by long exposure to the air, which, obviously, the operation of an engine
60 does not permit, or by the application of heat, the manifolding problem is complicated.

It is common practice with the liquid fuels available today for internal combustion engines, to make the intake manifold

passages as small as possible to the end that high air velocities shall be maintained therein sufficiently high to insure that the atomized fuel shall be carried along by said air. With these facts in mind, it is apparent 70 that great care must be exercised in the form of the manifold passages, since with unvaporized fuel, however finely it may be atomized, two difficulties are always present in multiple cylinder engine operation. One 75 is the tendency of the particles of fuel to condense upon the walls and accumulate at any points of low air velocity producing the result commonly known as loading. This loading with the ordinary type of updraft 80 manifold occurs in its worst form when the power output of the engine is reduced by partially closing the throttle, and thereby producing a relatively low velocity of the air through the intake manifold. If, or 85 when, it is desired to increase the power output of an engine after it has operated for some time at a reduced power output, the increase in air velocity in the ordinary updraft manifold picks up and carries into 90 the cylinders an oversupply of fuel with a resultant sluggishness and uncertainty of engine performance.

It is customary to overcome or try to overcome this defect by heating the air drawn 95 into the carbureter so that the heated air will vaporize the fuel and prevent loading. It is, however, obvious that if the ingoing air is sufficiently heated to produce complete vaporization, the air will contain a 100 very considerable amount of unnecessary heat not given up to the fuel, with the result that the air will be so expanded by this excess heat that it will not enter the cylinders at as great density as will be se- 105 cured with colder air, and this results in reduced compression and consequently reduced power output.

Another tendency toward defective operation of high velocity manifolds as a 110 means for handling relatively low grade fuels in multiple cylinder engines is what may be called the separator action; that is, whenever the air stream changes direction the unvaporized particles of fuel have a 115 strong tendency to follow the original air course, therefore, if the manifold is not formed with the utmost care, this results in an unequal distribution of the fuel to the various cylinders.

A third objection to the high velocity inlet manifold is also quite obvious. The relatively long passage required for distributing fuel and air in the multiple cylinder engine has, through friction, a very con- 125 siderable retarding action on the flow of the gases which increases rapidly as the velocity increases.

Attention is now called here to the fact that the so-called gas passage or manifold 130

within the head as shown in the drawing is or may be large as it can be made within said head plate. It may be, and preferably should be very much larger in diameter than the air tube of the carbureter. Therefore, there will be within this manifold a decided reduction in air velocity; in fact, the high velocity will be maintained only in the carbureter itself, and in the very short passage necessary to connect it with the low velocity distributor passage or manifold. The air, which is flowing through the carbureter air tube at a velocity so high that it will cause the fuel to be atomized, will carry in suspension the atomized fuel particles into the larger dimensioned manifold passage which is extended at right angles to the inrushing stream of air and fuel spray. There will be an immediate reduction of air velocity, and an immediate necessary deflection of the air stream, with the result that the unvaporized fuel particles will continue their direction of travel and will therefore impinge directly against the hot partition plate. They will absorb heat, therefore, and will be immediately vaporized, forming a dry gas that will join and become thoroughly mixed with the low velocity air stream which is flowing through the inlet manifold to the several cylinders.

Attention is here called to the fact that this hot plate 14 is of limited area and forms only a small part of the walls of the inlet manifold, and that care has been taken to limit as much as possible the extension of the heat from this plate to other parts of the wall of the inlet manifold. In the particular construction shown this result is accomplished by so constructing the water circulating spaces that they substantially embrace all of the intake manifold except the said hot plate; wherefore all of the wall of the manifold except this hot plate is kept as cool as the circulating water can keep it. It follows, therefore, that while the fuel will be heated enough to transform the fuel spray into a dry gas, the air absorbs the minimum of heat possible and is therefore expanded as little as possible.

Because of this small dimensioned hot plate, located as stated, and because of the care taken to keep all other parts of the wall of the inlet manifold as cool as possible, it is evident that while the fuel is gasified practically all the heat given off to the fuel and air mixture is concentrated in the fuel content of the mixture; and the desirable result is secured that the mixture of fuel and air as a whole contains a close approximation to the least amount of heat which will establish and maintain the conditions of a fixed gas mixture, with its absence of segregation, and maintenance of maximum density for the purpose of securing the maximum compression and power output.

It is also apparent that in this construction friction losses due to high velocity are reduced to a minimum, since high velocity is required only through a very short passage and preferably an absolutely straight one comprising the carbureter air tube and the inlet passage 19. This also adds to the possible maximum power output of the engine as against the usual high velocity manifold which in multiple cylinder engines contains a number of bends.

The arrangement shown has another advantage growing out of the fact that it is what may be termed a downdraft manifold, in that the fuel is not lifted after the fuel spray enters the air tube of the carbureter; but on the contrary, the fuel enters the cylinders at points below the carbureter nozzle discharge jet opening. This is particularly advantageous in starting a cold engine, as the force of gravity aids to prevent any loading, and to cause the fuel which is fed when starting to flow naturally and directly into some or all of the cylinders, whereby the least possible excess of fuel is used for starting purposes. The starting of a cold engine with present available fuels is possible without preheating because these fuels consist, not of one, but of many grades of hydrocarbons, some of which are easily vaporized at low temperatures; and a sufficient excess of fuel is fed into a cylinder of a combustion engine so that some of the volatile portions of the fuel will produce an explosive mixture, and starting is thus secured.

Another advantage is that a minimum amount of running of the engine will heat up the hot partitions and thus establish normal running conditions.

Having described my invention, I claim:

1. In a multiple cylinder internal combustion engine, the combination of an intake manifold which is in valve controlled communication with the several cylinders of the engine, means by which to heat a small portion only of the wall of said manifold, means to substantially prevent the spread of heat from said heated portion to other portions of the wall of the said manifold, and means to so direct the flow of the charge mixture in said manifold that the inertia of the relatively heavy unvaporized fuel content of said mixture will cause it to impinge against said heated portion of the wall of the intake manifold.

2. In a multi-cylinder internal combustion engine, the combination of a low velocity inlet manifold which discharges downward through valve controlled openings into the several cylinders of the engine, a carbureter whose air tube is horizontal and of smaller diameter than the inlet manifold and is connected with and is disposed at right angles to said inlet manifold, and

a hot plate within the inlet manifold located opposite the juncture between it and the said air tube and in the path of the stream of air and fuel spray which is discharged by the air tube into the inlet manifold.

3. In a multi-cylinder internal combustion engine, the combination of a low velocity inlet manifold which discharges downward into the several cylinders, a carbureter whose fuel discharge jet opening is above the plane in which said manifold discharges into the cylinders, and whose air inlet tube is of smaller diameter than said inlet manifold,—which air tube is connected with and discharges into said inlet manifold at right angles thereto, and a hot plate within the inlet manifold opposite said air tube and in the path of the stream of air and fuel spray discharged from said air tube, and means to cool a large part of the walls of said inlet manifold.

4. In a multi-cylinder internal combustion engine, the combination with a substantially horizontal inlet manifold which discharges downwardly into the several cylinders through valve controlled openings thereto, a substantially horizontal air tube of smaller diameter than said manifold which discharges into said manifold at a point about midway between its ends, a carbureter connected with said air tube, and a hot plate within said manifold across the path of the stream of air and fuel spray which the air tube discharges into said manifold.

5. In a multi-cylinder internal combustion engine, the combination of the head plate which contains a longitudinally extended inlet manifold that is in valve controlled communication with the several cylinders, there being an inlet opening through the side of said head plate communicating with said inlet manifold, an exhaust passage within said head plate which is separated from the inlet manifold by a thin partition wall that is located opposite the inlet opening to said inlet manifold, and water jacketing spaces within said head plate surrounding the inlet manifold.

6. In a multi-cylinder internal combustion engine, the combination of an inlet manifold which is in valve controlled communication with each of said cylinders, an exhaust passage into which at least one of the cylinders discharges its exhaust gas, a plate of limited area which separates the exhaust passage from the inlet manifold and is located in the path of the incoming mixture of air and fuel spray, and means to limit the

spread of heat from said plate to other parts of the wall of said inlet manifold.

7. In a multicylinder internal combustion engine, the combination with an inlet manifold which is in valve controlled communication with the several cylinders, a carbureter, an air tube which connects the carbureter with said inlet manifold and is at substantially right angles thereto, a small portion of the wall of said inlet manifold directly opposite the point of juncture of the air tube thereof being exposed to the hot exhaust gases from one or more of the cylinders, and the remaining parts of said inlet manifold being surrounded by water jacketing spaces.

8. In a multicylinder internal combustion engine, the combination of a low velocity inlet manifold which discharges downwardly through valve controlled ports into the several cylinders, an exhaust gas passage into which one or more of the cylinders discharge,—there being a metal plate of small dimensions which serves as a wall between said inlet manifold and gas passage,—a carbureter having an air tube which is of smaller diameter than said inlet manifold and which discharges into the same at a point directly opposite said metal plate and in a direction substantially at right angles thereto, a fuel jet nozzle which projects into said air tube,—which air tube is straight and horizontal between said nozzle and the point where the air tube discharges into the inlet manifold, and water jacketing spaces around said inlet manifold to limit the heating of the walls thereof by conduction from said metal plate.

9. In a multiple cylinder internal combustion engine, the combination of an inlet manifold which is in valve controlled communication with the several cylinders of the engine, a carbureter, an air tube which connects the carbureter with said inlet manifold and is at substantially right angles thereto,—a small portion only of the wall of said inlet manifold directly opposite the point of juncture of the air tube therewith being exposed to the hot exhaust gases from one or more of the cylinders, and means to substantially limit the spread of heat from said heated portion to other parts of the wall of said intake manifold.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

ALANSON P. BRUSH.

Witnesses:

E. L. THURSTON,
L. I. PORTER.