

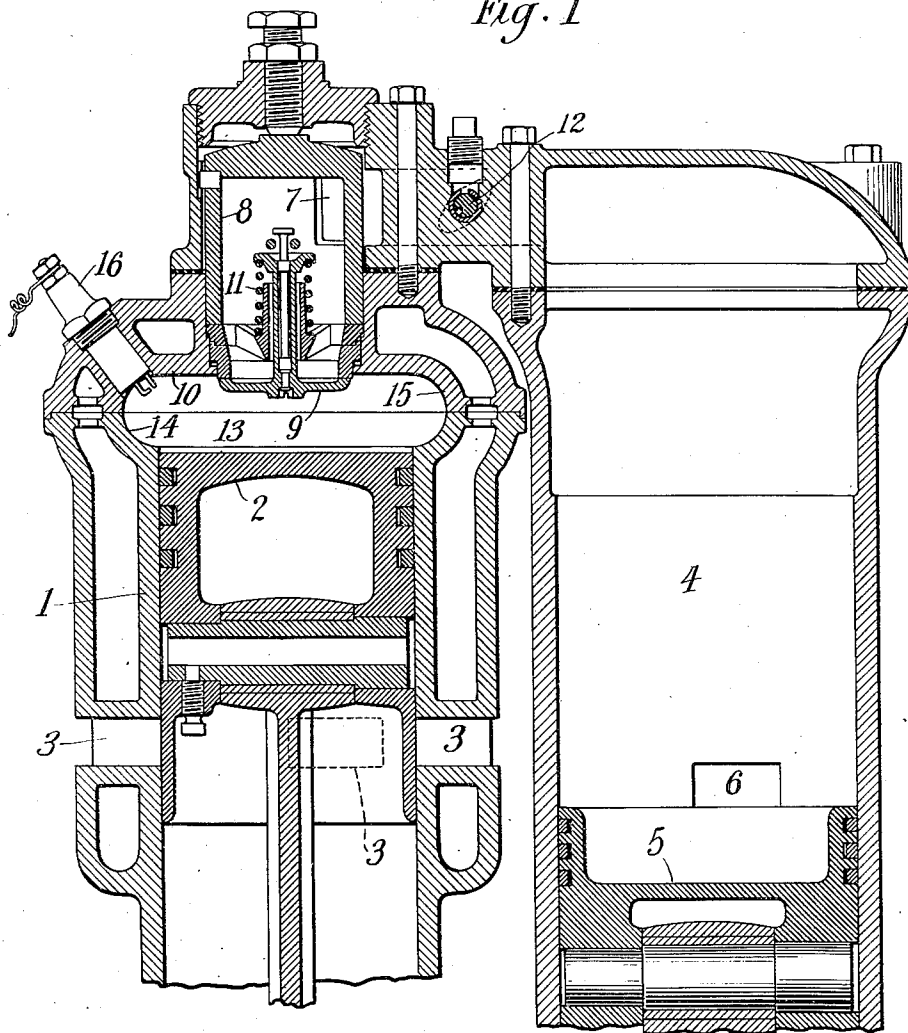
H. W. BEACH.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED MAR. 22, 1905.

931,837.

Patented Aug. 24, 1909.

2 SHEETS—SHEET 1.

Fig. 1



Witnesses
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2 SHEETS—SHEET 2.

Fig. 2

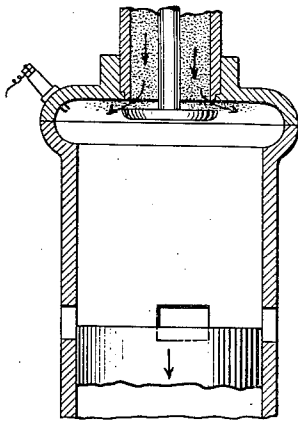


Fig. 3

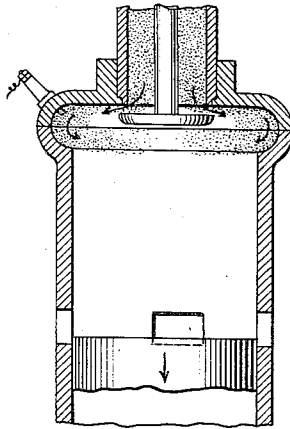


Fig. 4

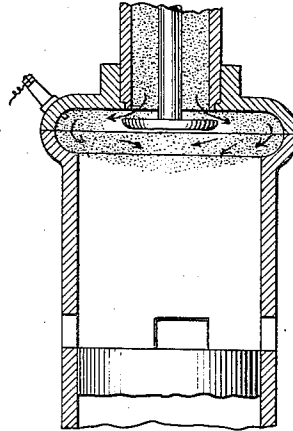


Fig. 5

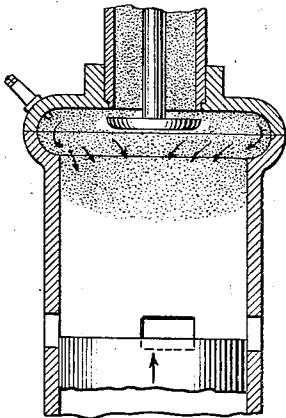


Fig. 6

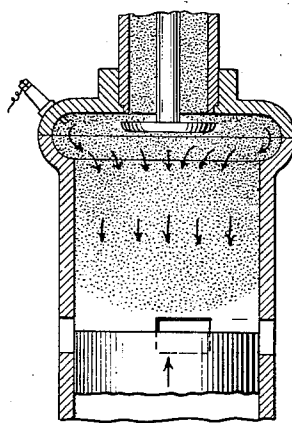
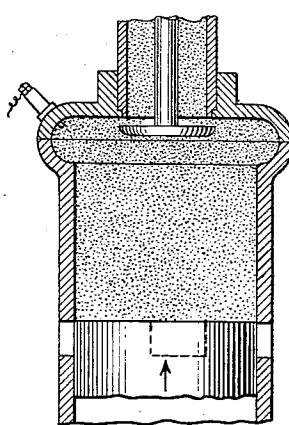


Fig. 7



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UNITED STATES PATENT OFFICE.

HARRY W. BEACH, OF MONTROSE, PENNSYLVANIA.

INTERNAL-COMBUSTION ENGINE.

931,837.

Specification of Letters Patent.

Patented Aug. 24, 1909.

Application filed March 22, 1905. Serial No. 251,440.

To all whom it may concern:

Be it known that I, HARRY W. BEACH, a citizen of the United States, residing at Montrose, in the county of Susquehanna and State of Pennsylvania, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

In the operation of engines which derive their power from the combustion or explosion of a gaseous charge, one of the drawbacks most commonly met with, particularly in motors of the so-called "two-cycle" type, is too great a mixture of the incoming fresh charge with the spent gases resulting from the combustion of the preceding charge. This results largely from the difficulty of getting rid of the products of combustion, whereby too great a proportion of such products remain in the cylinder or explosion chamber after the fresh charge has been introduced. Numerous methods have been proposed for overcoming this defect, some of which have proved more or less satisfactory under favorable conditions. For example, an engine may operate with considerable efficiency when operating at its maximum power, that is, with the maximum charge, but its efficiency may fall greatly on a reduced charge. Again, premature ignition of the charge frequently occurs, due usually to the fact that the preceding charge, diluted with spent gases of the earlier charge, burns too slowly and hence may still be burning when the fresh charge reaches the farther end of the cylinder.

My present invention, while possessing other advantages, is directed chiefly to overcoming the defects above mentioned, and the means which I employ for the purpose depart radically from all existing types of engines with which I am familiar.

Fundamentally, my invention pertains to the admission of the fresh charge to, and the expulsion of the spent gases or products of combustion from, the cylinder; and my object has been to admit the fresh gases in such manner that a minimum quantity of the spent gases will remain in the cylinder or explosion chamber, and that the spent gases will at all times be separated to the most effective extent from the incoming charge.

These objects are attained by causing the fresh charge to enter the working cylinder,

that is to say, the portion of the cylinder in which the piston reciprocates, in the form of a stratum of gas which substantially fills or occupies the entire cross-section of the working cylinder and progresses in a compact body from the inlet end of the cylinder until the cylinder is completely filled. The fresh charge thus acts in a manner analogous to a solid piston or plunger, entering the cylinder at the inlet end and driving the spent gases before it to the exhaust ports. The spent gases are thus in contact with the incoming cylinder or stratum of gas practically only on the face of the latter, and hence admixture or commingling of the old and new charges is reduced to a minimum. Furthermore, by this separation of the fresh from the spent charge, the former does not reach the vicinity of the exhaust ports till substantially all of the old charge has been expelled, and hence liability of premature ignition is practically eliminated. The admission of the fresh charge in this cylindrical or stratum-like form keeps the charge concentrated, however little there may be of it, and hence when ignition occurs the combustion is rapid and the power of the charge is developed efficiently, which is not the case, for well understood reasons, when a throttled or reduced charge is admitted in the usual way and allowed to mingle with the products of combustion resulting from the previous explosion.

The admission of the charge in the form of a column or stratum which occupies practically the entire cross-section of the working cylinder is secured preferably by a special construction whereby the charge on entering through the inlet port or valve is caused to flow outwardly and then to be deflected back upon itself and flow inwardly in a plane substantially at right angles to the axis of the working cylinder. The inwardly flowing currents of gas meet at the center, thus forming a stratum of gas across the inlet end of the working cylinder. Inasmuch as the gas cannot go back, and is constantly receiving additional gas from the inlet, the stratum moves forward as a body, driving the spent gases before it. At the same time, as the stratum moves forward it is increased in thickness at the same rate by the incoming gas, so that its formation cannot be materially, if at all, disturbed, by any back pressure of the exhaust or by any eddies or other currents therein. Finally,

the exhaust is completely expelled and the fresh charge fills the working cylinder; or, in operating with a reduced charge, the fresh gas is concentrated in one part of the cylinder, and the products of combustion from the previous charge occupy another part. In both cases the intermingling of the fresh and dead gases is minimized, and the flame is rapidly communicated to all parts of the charge.

In the preferred embodiment of the invention the construction whereby the desired objects are attained consists in a lateral enlargement of the inlet end of the cylinder, forming a flat, transverse, circular chamber, the direction of the walls of which, at their juncture with the cylinder, being substantially at right angles to the axis of the cylinder. The inlet port for the charge is located at the center of the head of the enlargement or chamber, and the valve therefor may be of any approved type. As already described, the gaseous charge on entering the chamber or enlarged portion is directed radially outward. Striking the side walls of the chamber, the gas is deflected and directed radially inward in a plane transverse to the cylinder, thus producing the transverse stratum described above. This preferred embodiment is illustrated in the annexed drawings, in which—

Figure 1 is a sectional view showing the engine cylinder, a pump for delivering the charge thereto, and the inlet or admission valve. Figs. 2 to 7 are diagrammatic views showing the form assumed by the entering charge and its action in forcing out the products of previous combustion.

Referring now more particularly to Fig. 1, 1 is the working cylinder, in which the piston 2 reciprocates. The cylinder is provided with exhaust ports 3, located at the limit of the outward or downward stroke of the piston, so that when the latter reaches that point the ports will be uncovered to permit escapes of the burned gases. The provision of a plurality of ports facilitates the exhaust or outflow of the spent gases and renders more even the distribution of the incoming fresh charge, but a single port may be used instead of several, if desired.

For the purpose of supplying the explosive mixture to the cylinder a suitable pump is provided, consisting of a cylinder 4, and a piston 5 working therein. The pump cylinder receives the mixture through a port 6 when the piston 5 is in its lowermost position and discharges the mixture through a passage 7 into the cage 8 of the inlet or admission valve 9. The latter controls the axial admission port, located at the center of the head 10, through which port the charge is delivered to the engine cylinder. The valve member 9 is preferably of the flat type, constructed and arranged in the manner described in my

co-pending application Serial No. 251,441, filed March 22nd, 1905. The valve is held to its seat by a spring 11, but is adapted to be opened by the pressure of the gas in the passage 7 and cage 8 when the pressure of the products of combustion in the working cylinder is relieved by the opening of the exhaust ports. In the passage 7 is a throttle valve 12, by which the quantity of gas constituting the charge may be regulated, in the usual way.

Above the working cylinder, at the compression end thereof, that is, the end in which the charge is compressed prior to ignition of the charge, is a flat, circular, transverse chamber 13, constituting a compression space in which the charge is compressed by the inward or upward movement of the piston. This chamber is formed, in the present embodiment, by an outward and upward extension 14 of the working cylinder walls and an outward and downward extension 15 of the head 10.

The walls of the chamber thus formed are outwardly curved, as shown, and the direction of the said walls where they meet or join the inner surface or bore of the working cylinder is at right angles to the same and to the axis of the cylinder. Projecting into the compression chamber is an igniter 16, which, as here shown, is of the jump-spark type.

The operation of the engine is as follows, referring more particularly to Figs. 2 to 7: The exhaust ports having been uncovered by the piston valve 9 opens the admission port and the charge as it issues from the admission port is deflected radially outward in all directions in a plane parallel to the head. This action is illustrated in Fig. 2, but for the sake of clearness the gas is shown as flowing in two directions only, to right and left. Reaching the outer walls of the compression chamber the gas is deflected downwardly, and then inwardly in a plane at right angles to the bore and axis of the working cylinder, as shown in Fig. 3. Meeting at the center, the streams form a transverse stratum or layer, which, by reason of the constant inflow of gas from behind immediately begins to increase in thickness, as shown, for example, in Fig. 4, at the same time acquiring at its forward or downward face a rounded or convex contour. This action proceeds, the charge advancing steadily as a distinct, compact body through the working cylinder, as illustrated in Figs. 5 and 6, and driving the burned gases ahead of it through the exhaust ports. Inasmuch as the advancing charge occupies substantially the entire cross-section of the cylinder the fresh gases are in contact with the products of combustion only on the face of the incoming charge and there is very little if any relative movement between the two. Con-

sequently commingling of the two can occur only a very slight extent. Finally, by the time the piston has risen far enough to close the exhaust ports, as in Fig. 7, the dead gases

5 have substantially all been expelled, and since the fresh charge at no time precedes the burned charge, only a very slight amount if any, of the former will be lost through the exhaust ports.

10 It will be noted that there is at all times an approximately even stratification of the fresh and burned charges, and it will be seen that this relation will be the same when the quantity of gas constituting the charge

15 is reduced by the throttle. Consequently, although with a reduced charge more or less of the dead gases may remain in the cylinder, yet on the ensuing compression by the piston the fresh charge will be compressed to a

20 stratum of substantial purity around the igniter. Ignition will therefore take place readily and the combustion will proceed rapidly throughout the charge; whereas in certain other engines with which I am familiar

25 the intermixture of the fresh and spent charges so dilutes or contaminates the former that ignition is uncertain and at times impossible, and the rate of combustion is greatly reduced. Inasmuch as the direction

30 of propagation of the flame is downward the flame exists last at the exhaust ports. But in my engine these are the last points reached by the fresh charge, and hence there is practically no danger of pre-

35 ignition.

It will be noted that the charge flows radially inward from around the circumference of the end of the cylinder. In other words the charge is continuous or unbroken

40 circumferentially.

From the foregoing it will be seen that by my invention the fresh and burned gases are kept in practically distinct bodies; that commingling of the two is very slight; that

45 liability of pre-ignition is practically eliminated; that the efficiency of the engine is not materially reduced when running under throttle. Other advantages will be apparent to those skilled in the art.

50 The use of an admission valve of the kind shown, that is, one which is substantially parallel with the head of the compression chamber, is advantageous but not strictly essential. With such a valve the gases issuing

55 from the admission port are more effectively directed outwardly toward the sides of the chamber. It is also to be understood that the precise means, namely, the pump, shown for delivering the charge to the ad-

60 mission port, is not essential.

While the engine illustrated is of the vertical type it is clear that it could be operated

with the cylinder arranged horizontally or otherwise, and the terms "upward" and "downward", etc., as herein used, are intended to cover engines arranged in any position.

What I claim is:

1. In an internal combustion engine, the combination with the working cylinder, having at the compression end thereof an axial inlet port for the admission of the gaseous charge, of means adjacent to said port for directing the charge radially outward, and means for deflecting the outwardly moving charge backward and radially inward in a circumferentially continuous stratum substantially at right angles to the axis of the cylinder, as set forth.

2. In an internal combustion engine, the combination with the working cylinder, having at the compression end thereof an axial inlet port for the admission of the gaseous charge, of a valve controlling said port and constructed to direct the charge radially outward, and means for deflecting the outwardly moving charge backward and radially inward in a circumferentially continuous stratum substantially at right angles to the axis of the cylinder, as set forth.

3. In an internal combustion engine, the combination with the working cylinder, of means at the compression end thereof for directing radially outward a gaseous charge admitted at the axis of the cylinder, and means for deflecting the outwardly moving charge backward and radially inward, comprising a chamber having walls extending radially outward from the bore of the cylinder the direction of said walls at their juncture with the cylinder being substantially at right angles to the axis of the cylinder, as set forth.

4. In an internal combustion engine, the combination with the working cylinder, of means at the compression end thereof for directing radially outward a gaseous charge admitted at the axis of the cylinder, and means for deflecting the outwardly moving charge backward and radially inward in a circumferentially continuous stratum substantially at right angles to the axis of the cylinder, comprising a flat, transverse, circular chamber of greater diameter than the bore of the cylinder, having its walls at right angles to the bore of the cylinder where the two meet, as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY W. BEACH.

Witnesses:

S. R. SPROUT,
H. H. MORRIS.