

Feb. 13, 1923.

1,444,857.

A. TAUB.
INTERNAL COMBUSTION ENGINE.
FILED SEPT 25, 1919.

2 SHEETS—SHEET 1.

Fig. 1

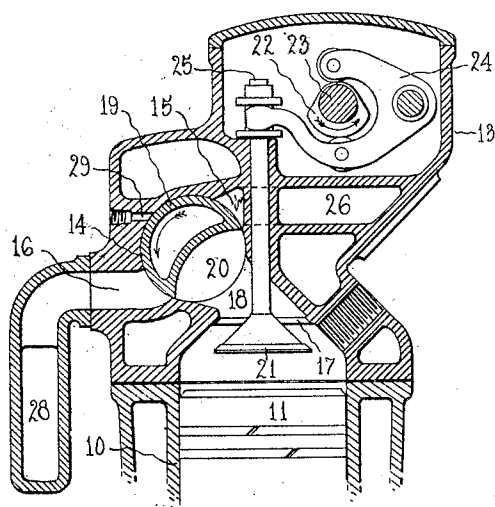


Fig. 2

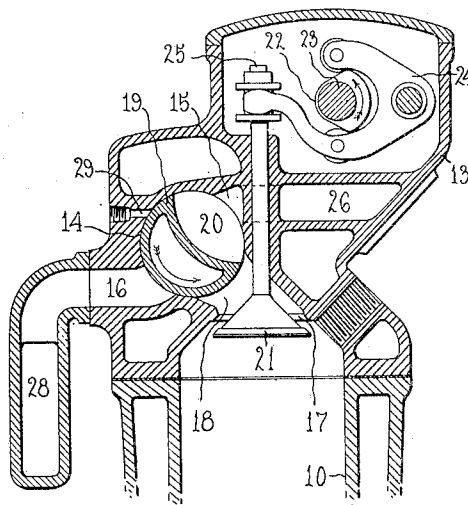


Fig. 3

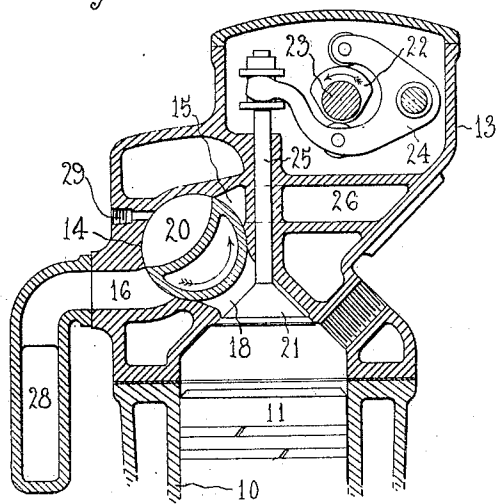
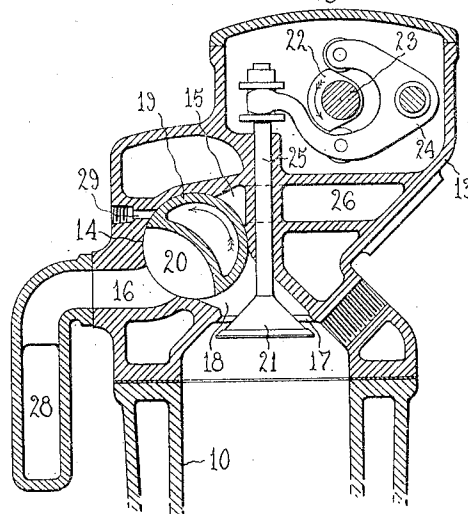


Fig. 4



Inventor
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By his Attorneys
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2 SHEETS—SHEET 2.

Fig. 5

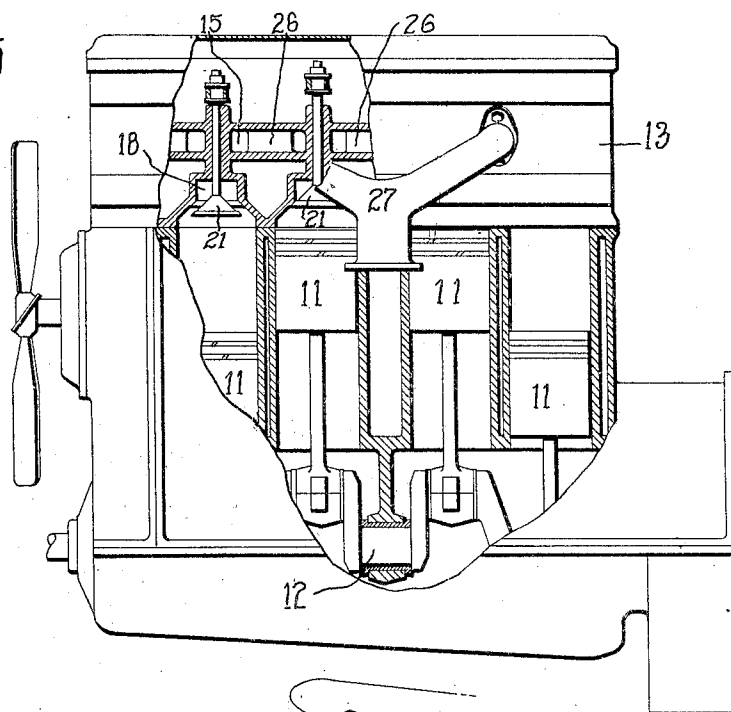
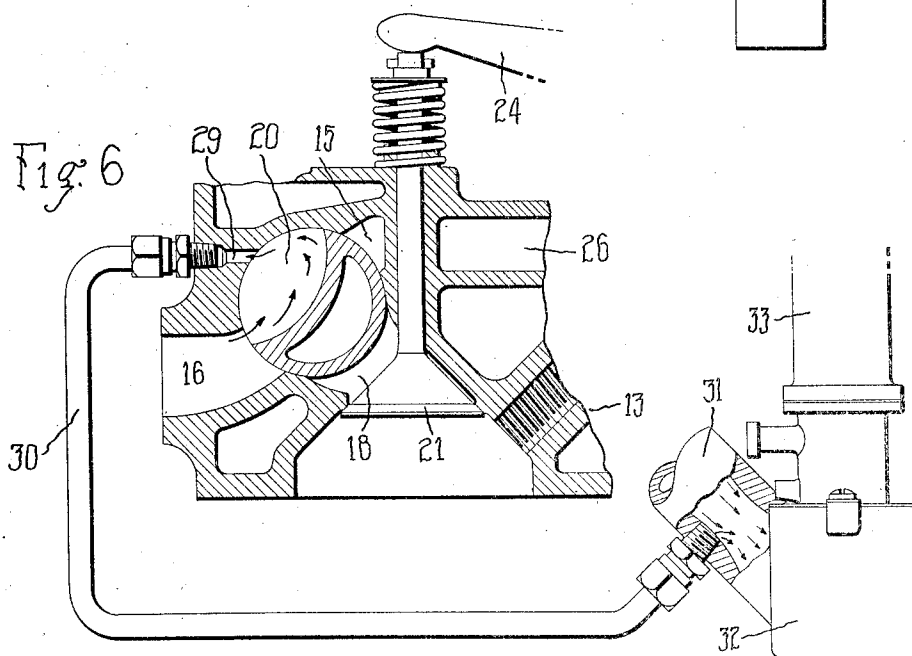


Fig. 6



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Patented Feb. 13, 1923.

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UNITED STATES PATENT OFFICE.

ALEX TAUB, OF DETROIT, MICHIGAN, ASSIGNOR TO GENERAL MOTORS CORPORATION,
OF DETROIT, MICHIGAN, A CORPORATION OF DELAWARE.

INTERNAL-COMBUSTION ENGINE.

Application filed September 25, 1919. Serial No. 326,234.

To all whom it may concern:

Be it known that I, ALEX TAUB, a subject of the King of Great Britain, but who have declared my intention of becoming a citizen of the United States, and resident of Detroit, Wayne County, State of Michigan, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal combustion engines, and particularly to the construction and arrangement of the valves and elements associated therewith for controlling the supply of combustible mixture to the cylinder of the engine, and the exhaust therefrom of the gases resulting from the burning of the combustion mixture within the engine cylinder.

I have illustrated in the drawings hereinafter referred to and will describe my invention as applied to and used in connection with an internal combustion engine of the four stroke single poppet valve type, wherein the combustible mixture flows into and the burned gases flow from the cylinder through a single port controlled by a single positively opened poppet valve, and in which a distributing valve is provided for directing the inflowing combustible mixture from the usual inlet or supply conduit toward the port aforesaid and for directing the outflowing exhaust gases from said port into the exhaust conduit of the engine; although various of the features of my invention, regarding the same in its broader aspect, are capable of use with other types or kinds of internal combustion engines, and in fact with internal combustion engines of any kind or type.

As an example of such an engine the United States patent to Rollin Abell, for internal combustion engine, No. 1,311,200, July 29, 1919, may be cited and, while I have illustrated my invention as applied to and used in connection with an internal combustion engine similar to the one disclosed in the said patent, my invention is in no way limited to single poppet valve engines of the particular construction disclosed in the said patent or the equivalent thereof, and is indeed capable of use with internal combustion engines generally, and other than those of the single poppet valve class.

The object of my invention is to reduce to as great an extent as possible the waste

of combustible mixture heretofore met with in internal combustion engines in which the flow of combustible mixture into and of exhaust gases from the cylinder of the engine takes place through a single port, and through a single passage of greater or less length leading to and for which said port forms an outlet. Thus in the present form of single poppet valve engines operating upon a four stroke cycle there is ordinarily a passage or chamber of considerable volume between the distributing valve and the combined inlet and outlet port which is closed by the poppet valve, and which passage or chamber is left full of combustible mixture at the termination of the suction stroke. Afterward and when the said port is placed in communication with the exhaust passage or conduit by the distributing valve, and when the poppet valve is opened, the burned gases flowing from the cylinder will push the combustible mixture present in the chamber referred to out from said passage and into the exhaust conduit, thus wasting a considerable amount of combustible mixture each cycle of operation of the engine. This waste of combustible mixture is obviously the greater the greater the total volume of the passage, chamber, or space through which both the combustible mixture and the exhaust gas flow, and is of such a magnitude as to result in serious loss of efficiency even in engines designed with special reference to reducing the volume of such common passage as much as possible.

As above stated the object of my invention is to reduce the loss in efficiency due to the wasting of combustible mixture trapped in the common supply and discharge passage immediately without and beyond a single valve past which both the inflow of combustible mixture and the outflow of exhaust gases take place; to which end my invention contemplates the removal of the combustible mixture trapped in the said common passage during the intervals between each fuel supply or charging phase, and the next following exhaust stroke of the cycle of operation of the engine, irrespective of the elements or features of the engine which provide or form the said passage and irrespective of the particular mechanism or device employed for removing the mixture from the said common passage. My invention regarded in its more specific aspects,

however, involves the removal of the combustible mixture from the common passage by suction and the replacement of the mixture by exhaust gas derived from the exhaust system of the engine; and the supplying of the combustible mixture thus removed from the common passage to the conduit through which the combustible mixture flows to the engine so that the mixture thus salvaged is returned to and mixed with the fresh mixture which flows to the engine; the combustible mixture withdrawn from the common passage being conducted through a conduit which discharges into the inlet conduit of the carburetor whereby the engine is supplied with combustible mixture in the specific embodiment of my invention illustrated in the drawings.

With the above and other objects of invention in view, my invention consists in the improvement in and relating to internal combustion engines illustrated in the accompanying drawings and hereinafter described and claimed; and in such variations and modifications thereof, within the scope of the concluding claims, as will be obvious to those skilled in the art to which my invention relates.

In the drawings wherein the preferred embodiment of my invention is illustrated:

Figures 1, 2, 3 and 4 are sectional views showing the upper end of the cylinder and the valve mechanism of an internal combustion engine in which my invention is present, the several views showing the positions of the various parts corresponding with the four principal phases of the cycle of operation of the engine.

Figure 5 is a view in section for the most part, and in which the engine is shown in side elevation.

Figure 6 is a view employed to illustrate the operation of my invention.

Referring now to the drawings, the reference numerals 10 designate the cylinders of a multiple cylinder internal combustion engine and the number of which varies in different engines; four cylinders arranged side by side and the pistons 11 of which act to drive a single crankshaft 12 being present in the embodiment of my invention illustrated. The upper ends of said cylinders are closed by a single head 13, although a separate head may obviously be provided for each cylinder; and valve mechanism is provided for each cylinder which valve mechanisms are all alike, so that the valve mechanism for one cylinder only need be and will hereinafter be described in detail.

A valve chamber 14 is associated with each engine cylinder and into which a combustible mixture supply passage or conduit 15 leads and through which passage combustible mixture is supplied from a suitable carburetor or equivalent charge forming de-

vice, while an exhaust conduit or passage 16 leads from the valve chamber 14 to the external air. The valve chamber of each cylinder is placed in communication with the interior thereof through a port 17, which is connected by or through a passage or conduit 18 with the valve chamber 14; the said passage or chamber being extremely short and in substance a part of the port in the embodiment of my invention illustrated. Heretofore, however, this passage has often been of considerable length in internal combustion engines of the single poppet valve type and has formed a pocket or chamber often of considerable volume; and within which combustible mixture is trapped between the distributing valve and the poppet valve each cycle of operation of the engine, which mixture has heretofore been carried into the exhaust passage upon the exhaust phase of the cycle and wasted.

Located within the valve chamber is a rotating distributing valve 19 having a recess or chamber 20 adapted as the valve is rotated, at half the speed of the crank shaft as is usual in engines of the type illustrated, to alternately establish a communication between the inlet passage 15 and the common passage 18 and port 17, and between said port and passage and the exhaust passage 16, to thereby provide for the flow of combustible mixture into and of burned gases out from the cylinder through the single port 17.

The port 17 is itself controlled by a single reciprocating valve 21 which is most usually of the poppet type, and which valve is operated by a cam 22 upon a cam shaft 23 which is driven in any way at half the speed of the crank shaft of the engine. The form of the cam is such that the valve 21 is kept open upon the exhaust and suction or intake strokes of the piston within the cylinder for which the valve in question is provided, and closed upon the compression and working strokes of the cycle of operation of the engine; and motion is communicated to the said valve through an oscillating lever 24 which is operated by the cam 22 and the free end of which operatively engages the end of the stem 25 of the valve in the form of my invention illustrated; although my invention is in no way dependent upon the particular means employed for operating the poppet valve, and any suitable mechanism may be employed without departing from my invention.

The inlet passages 15 of all the cylinders communicate with and derive their supply of combustible mixture from a single longitudinally extending passage 26 within the head 13, and from a manifold 27 which communicates with a suitable carburetor and discharges into said passage; while all the exhaust passages 16 discharge into a

single exhaust manifold 28, as is usual in multiple cylinder internal combustion engines.

The reference numeral 29 designates a passage provided in the valve chamber 13 and so arranged as to register with the pocket or chamber 20 in the rotating distributing valve 19 during a portion of each rotation of said valve, and the reference numeral 30 designates a conduit one end of which communicates with the said passage 29 while the other end thereof discharges into the air inlet 31 of a carburetor 32 whereby the engine is supplied with combustible mixture, the mixture flowing to the engine through a mixture supply conduit 33 which communicates with the inlet manifold 27.

Figure 1 shows the parts in the position which they occupy at the beginning of the suction or intake stroke of the cycle of operation of the engine, the single valve 21 being open and the distributing valve 19 being just about to open up a communication between the inlet passage 15 and the port 17 with which the valve 21 cooperates.

The valve 19 which has been open during the preceding exhaust stroke remains open during the first down or suction stroke of the cycle, at the end of which the parts assume the position shown in Figure 2 with the poppet valve in the phase of closing upon its seat and the distributing valve shutting off communication between the inlet passage 15 and the port 17 and common passage 18.

The valve 21 remains closed during the second or compression stroke of the cycle, and also during the third or working stroke; during which stroke the parts assume the position shown in Figure 3 at the end of the compression stroke, and the positions shown in Figure 4 at the end of the working stroke.

The distributing valve 19 opens communication with the exhaust passage 16 and the valve 21 opens somewhat before the end of the third or working stroke of the cycle, as shown in Figure 4, as is usual in internal combustion engines; and the poppet valve remains open during the fourth or exhaust stroke and the suction stroke of the next cycle, as will be appreciated.

The design, proportion, and port arrangement of the elements which constitute my invention is such that the exhaust phase of the cycle commences somewhat before the end of the working stroke, and such that the fuel supply passage remains open after the end of the suction stroke, in order to secure a more complete evacuation of the burned gases and a more complete filling of the cylinder prior to the compression stroke, in accordance with common and approved practice in internal combustion engine design.

After the closing of the valve 21, at the end of the suction stroke or the fuel supply

phase of the cycle of operation of the engine, and before the next following exhaust stroke of the cycle, the recess or pocket 20 of the valve 19 moves into a position in which a communication is established between the passage 29 and the exhaust passage 16, as illustrated in Figure 6 of the drawing; whereupon and because of the reduction in pressure or suction effect present in the air inlet passage 31 of the carburetor 32 the combustible mixture which was trapped within the said pocket 20 will be withdrawn therefrom, and will flow through the said conduit and into the air inlet passage and mix with the air passing into the carburetor and form a part of the combustible mixture flowing from the carburetor to the engine. The outflow of combustible mixture from the pocket 20 will be accompanied by a flow of exhaust gas from the exhaust passage 16 into the pocket, and some of the exhaust gas may in fact find its way along the conduit 30 and into the air inlet conduit 31. The amount of such exhaust gas, however, when present at all will be small, and its presence will do no harm in the combustible mixture supplied to the engine, as it will act merely as a dilutant the same as the nitrogen which enters the carburetor along with the air.

It will be appreciated that my invention regarded in its broader aspect does not necessarily contemplate a return of the combustible mixture salvaged as hereinbefore explained to the air intake of the carburetor and the mixing thereof with the combustible mixture which is supplied to the engine. Such a disposal of the mixture thus recovered is, however, an obvious and effective plan of disposal, and the specific form of my invention illustrated provides a device in which the mixture saved is disposed in that manner.

The form of my invention illustrated is to a considerable degree self regulating in character, so far as concerns the suction effect exerted along the conduit 30 and within the pocket or recess 20 when the distributing valve reaches a position in which the recess is in communication with both the passage 29 and the exhaust passage 16. This comes about because of the fact that the suction effect in the air inlet 31 becomes less as the engine is throttled, thus reducing the flow through the conduit 30 when the engine is running slowly and avoiding the introduction of an increasing quantity of exhaust gas into the mixture when the engine is operating under slow speed or under conditions involving excessive throttling; which would be likely to occur if for example, the conduit 30 discharged directly into the mixture supply conduit 33 between the throttle valve and the engine. On the other hand the suction

effect exerted along the conduit 30 when the throttle is open will be sufficient to insure the removal of all the combustible mixture trapped within the recess 20; and

5 under all conditions of operation it will be appreciated that the flow of combustible mixture from the said recess and along the said conduit will be accompanied by a flow of inert exhaust gas into the pocket, thus
10 leaving the pocket full of burned gas when it comes opposite the common passage 18. It therefore follows that when the exhaust from the cylinder takes place the gas which will be pushed ahead of the outflowing ex-
15 haust gas and discharged into the exhaust conduit will be exhaust gas from the preceding exhaust stroke, as distinguished from unburned combustible mixture trapped within the recess in question as would other-
20 wise and as has heretofore been the case.

Having thus described and explained my invention, I claim and desire to secure by Letters Patent:

1. In an internal combustion engine, a
25 passage or chamber through which combustible mixture flows towards the engine cylinder and through which exhaust gas flows from the cylinder; and means for causing exhaust gas to flow through said passage
30 during the interval between each fuel supply phase of the cycle of operation of the engine and the next following exhaust stroke of the cycle.

2. In an internal combustion engine, a
35 chamber through which combustible mixture flows toward the engine cylinder and through which exhaust gas flows from the cylinder; and means for causing exhaust gas to flow through said chamber and into
40 the fuel supply conduit leading to the engine during the interval between each suction stroke of the cycle of operation of the engine and the next following exhaust stroke of the cycle.

3. In an internal combustion engine, a distributing valve having a chamber through which combustible mixture flows toward the engine cylinder and through which exhaust gas flows from the cylinder; and means
50 for transferring the combustible mixture trapped within said chamber from said chamber and into the air supply conduit leading to the carburetor whereby the engine is supplied with combustible mixture
55 during the interval between each suction stroke of the cycle of operation of the engine and the next following exhaust stroke of the cycle.

4. In an internal combustion engine, a distributing valve having a chamber through which combustible mixture flows toward the engine cylinder and through which exhaust gas flows from the cylinder; and means for causing exhaust gas from the
65 engine to flow through said chamber dur-

ing the intervals between each fuel supply phase of the cycle of operation of the engine and the next following exhaust stroke of the cycle.

5. In an internal combustion engine, a distributing valve having a chamber through which combustible mixture flows toward the engine cylinder and through which exhaust gas flows from the cylinder; and means for causing exhaust gas from the engine to flow through said chamber and into the fuel supply conduit leading to the engine during the intervals between each suction stroke of the cycle of operation of the engine and the next following exhaust
80 stroke of the cycle.

6. In an internal combustion engine of the class described having a cylinder, a piston operating therein, a valve chamber, a combustible mixture inlet passage leading into
85 said chamber, an exhaust passage leading from said chamber, and a port through which a communication is established between said chamber and the interior of the engine cylinder; a reciprocating valve for
90 controlling said port; a rotating distributing valve located within the valve chamber aforesaid and having a chamber adapted to alternately establish a communication between said inlet passage and said port, and
95 between said exhaust passage and said port; and means dependent for its operation upon a reduction of pressure within the chamber aforesaid of said distributing valve for causing the combustible mixture trapped within
100 said chamber to flow therefrom and into the fuel supply conduit leading to the engine during the intervals between each suction stroke of the cycle of operation of the engine and the next following exhaust stroke
105 of the cycle.

7. In an internal combustion engine of the class described having a cylinder, a piston operating therein, a valve chamber, a combustible mixture inlet passage leading
110 into said chamber, an exhaust passage leading from said chamber, and a port through which a communication is established between said chamber and the interior of the engine cylinder; a reciprocating valve for
115 controlling said port; a rotating distributing valve located within the valve chamber aforesaid and having a chamber adapted to alternately establish a communication between said inlet passage and said port, and
120 between said exhaust passage and said port; and a conduit leading from the chamber aforesaid of said distributing valve and into the fuel supply system of the engine; said conduit being so arranged that said chamber
125 is brought into communication with it during the intervals between each suction stroke of the cycle of operation of the engine and the next following exhaust stroke of the cycle.

8. In an internal combustion engine of the class described having a cylinder, a piston operating therein, a valve chamber, a combustibile mixture inlet passage leading into said chamber, an exhaust passage leading from said chamber, and a port through which a communication is established between said chamber and the interior of the engine cylinder; a reciprocating valve for controlling said port; a rotating distributing valve located within the valve chamber aforesaid and having a chamber adapted to alternately establish a communication between said inlet passage and said port, and between said exhaust passage and said port; a passage provided in said valve chamber and so located as to communicate with the chamber aforesaid in said distributing valve when said chamber is in communication with the exhaust passage of the engine; and a conduit communicating with said passage and discharging into the fuel supply system of the engine.

9. In an internal combustion engine of the class described having a cylinder, a piston operating therein, a valve chamber, a

combustibile mixture inlet passage leading into said chamber, an exhaust passage leading from said chamber, and a port through which a communication is established between said chamber and the interior of the engine cylinder; a reciprocating valve for controlling said port; a rotating distributing valve located within the valve chamber aforesaid and having a chamber adapted to alternately establish a communication between said inlet passage and said port, and between said exhaust passage and said port; a passage provided in said valve chamber and so located as to communicate with the chamber aforesaid in said distributing valve when said chamber is in communication with the exhaust passage of the engine; and a conduit communicating with said passage and discharging into the air inlet conduit of the carburetor whereby combustibile mixture is supplied to the engine.

In testimony whereof, I have signed my name to this specification this 29th day of August, 1919.

ALEX TAUB.