July 3, 1928. 1,675,623

A. TAUB

INTERNAL COMBUSTION ENGINE

Filed Feb. 14, 1925

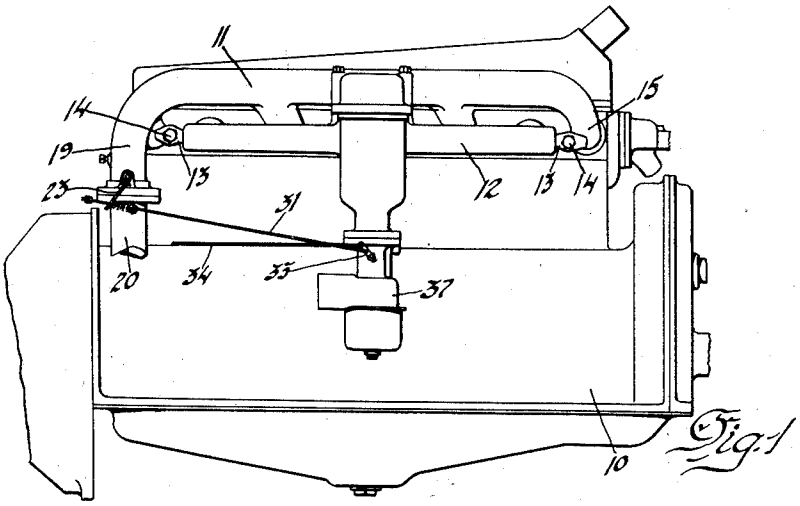


Fig. 1

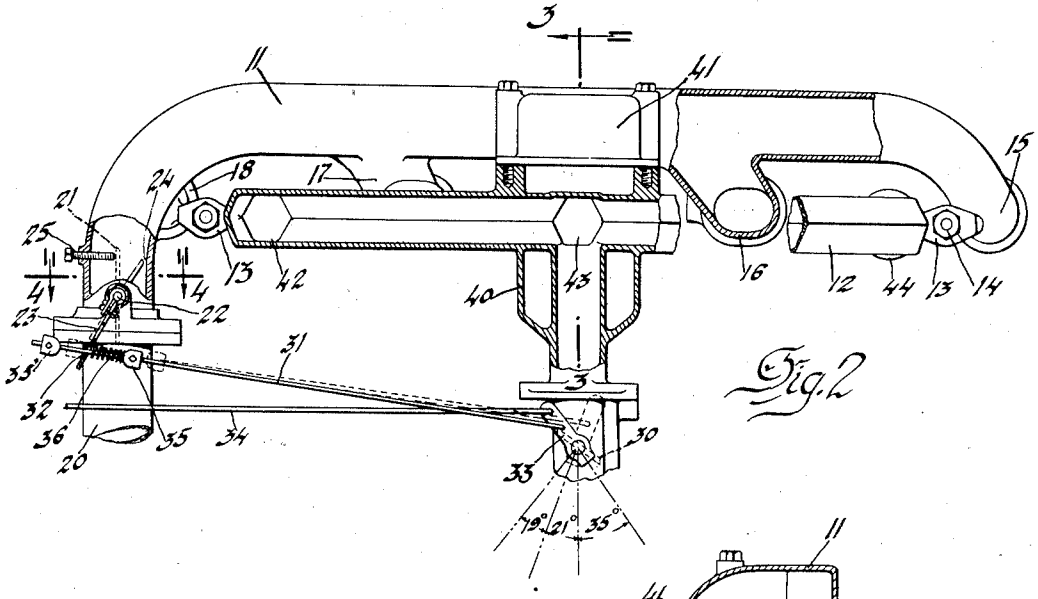


Fig. 2

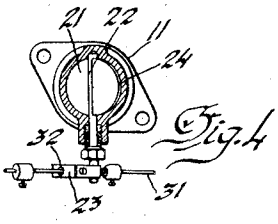


Fig. 4

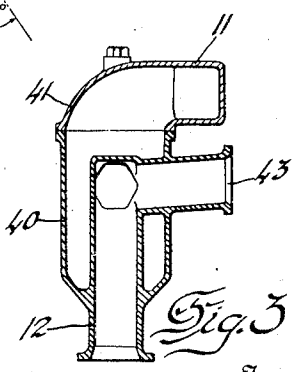


Fig. 3

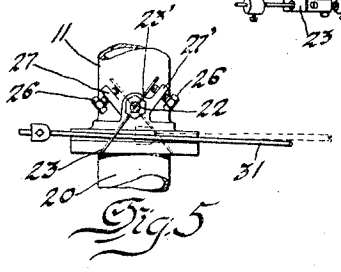


Fig. 5

Inventor

Alex Taub

By Attorney

Blackmore, Spencer & Flint.

Patented July 3, 1928. 1,675,623

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 February 14, 1925. Serial No. 9,256.

This invention relates to internal combustion engines and is particularly concerned with the regulation of the character of the combustible charge.

Among the objects of the invention is to regulate the escape of the hot gases from the engine so as to utilize to better advantage the heat therein contained.

Another object is the regulation of the proportion of residual burned gases mixed with the fresh charge.

These and other objects will more readily be seen by those skilled in the art with the reading of the following specification.

In the operation of an internal combustion engine it has been found advantageous to vary the character of the charge mixture by changing the proportion of exhaust gas which usually forms a constituent thereof. A small amount of exhaust gas, which, of course, comprises inert constituents of the original charge and products of combustion, is ordinarily retained in the clearance space of the cylinder at the end of the exhaust stroke and becomes a part of the next charge. Owing, however, to usual varying pressure conditions in the outlet passages of different cylinders of a multi-cylinder engine the mass of exhaust gas retained in the different cylinders is not uniform nor is it ordinarily controllable. Minor variations will therefore occur in the quality of charge as affected by the proportion of residual gases present and the proportion of such gases will become greater with increase of speed and the resultant normal increase of back pressure in the exhaust passages and reduction of pressure in the intake passages.

In accordance with the present invention it is proposed to reverse the above order and to cause to be present in the fuel mixture a larger proportion of exhaust gases than usual, at low or intermediate speeds, decreasing the amount in a predetermined ratio as the speed increases, and to effect this variation by restricting the outflow of exhaust gases from the cylinders. By this means one is enabled to retain in the cylinder any desired amount of residual gases, to render substantially uniform the amount retained in the various cylinders of a multi-cylinder engine, and to vary in predetermined manner, as may be found desirable, the amount of residual gases so retained. A further advantage is that the increase in back pressure and resultant increase in quantity and temperature of exhaust gases retained in the exhaust passages may be used to enhance the heating effect of mixture-heating devices arranged to utilize exhaust gas as a heating medium.

In the accompanying drawings showing one form of apparatus in which the invention may be embodied:

Fig. 1 is a side elevation of an internal combustion engine with features of the invention associated therewith;

Fig. 2 is an elevation showing on an enlarged scale, and partly in vertical section, the manifolds and associated parts of Fig. 1;

Fig. 3 is a vertical section on line 3—3 of Fig. 2;

Fig. 4 is a horizontal section on line 4—4 of Fig. 2; and

Fig. 5 is a fragmentary view of a modified form of adjusting means.

Referring to the drawings, 10 indicates an internal combustion engine, shown as of the six-cylinder type, comprising an exhaust manifold 11 and an intake manifold 12. So far as concerns the principal features of the invention these manifolds may be of any usual or desired form, the exhaust manifold being shown as positioned above the intake manifold and both manifolds being secured to the engine block as by clips 13 and bolts 14. Branches of the exhaust manifold lead from the exhaust ports of the engine block as at 15, 16, 17, 18, and the rear end is turned downwardly as at 19 to connect with an exhaust pipe 20 extending to a suitable point for discharge of the gases. At some convenient location in the manifold on the exit side of the exhaust port connections is an obturating device as damper 21 mounted upon spindle 22 which spindle extends to the outside of the manifold. On the outer end of the spindle is fixed an actuating lever or arm 23 which is preferably flexible to permit a certain amount of bending after the damper has reached its end positions.

The valve or damper 21 is so constructed or mounted as to leave some opening for passage of gases when in "closed" position, as by so shaping it that a space 24 is left at the edge of the valve member when closed as far as the construction permits. Means is provided to limit the opening and closing movements of the damper. The walls of the passage or suitable abutments thereon may serve for this purpose as in the closed position

shown in Fig. 4. It is preferred, however, to provide adjustable stops such, for example, as the set screw 25 shown in Fig. 2. In a modified form illustrated in Fig. 5, the arm 23 is extended beyond the spindle 22 as at 23′ and set screws 26, 26′, positioned in threaded apertures in the lugs 27, 27′, respectively, are arranged to contact with the extension 23′ and thereby determine the limits of movement of the valve or damper.

The desired adjustment of damper 21 in order to vary as desired the outflow of exhaust gases may be accomplished either automatically or directly by the operation. As shown, means is provided to vary the position of the valve in predetermined relation to that of the throttle valve 30 which controls the flow of fuel mixture to the intake manifold 12 from the carburetor 37. This means may include a rod 31 passing loosely through an aperture 32 in the arm 23. The other end of the rod is pivotally connected to the throttle lever 33 which may be actuated in any novel or suitable manner as by rod 34 extending to actuating devices accessible from the driver's position. Stops 35, 35′ are adjustably mounted on rod 31 on opposite sides of arm 23. A coiled spring 36 is also mounted on rod 31 between the stop 35 and the arm 23. The spring is of sufficient length to maintain the valve 21 in the closed position shown in full lines in Figs. 2 and 4 until the rod 31 has been moved to the right far enough to bring the stop 35′ into engagement with the arm 23. As the rod is moved further to the right the arm 23 is moved positively by stop 35′ until the valve 21 is in full open position, shown in dotted lines in Fig. 2. A slight further movement of the rod to the right is permitted by the flexibility of arm 23.

It will be seen therefore that opening movement of the throttle may be accomplished to a certain extent while the valve 21 remains closed. Thereafter a predetermined further opening of the throttle is accompanied by a movement of the valve 21 to full open position which is retained during any further throttle opening. The proportions and adjustment of the actuating elements and the relative ranges of movement of the two valves may be predetermined to give any desired relation between the positions of valve 21 and those of the throttle valve. As illustrative of relations that have been found advantageous, it being assumed that the throttle valve moves through an angle of 75° from closed to full open position, then the first 35° of throttle movement from closed position, including the usual low speed throttle positions, may be permitted before the stop 35′ engages with arm 23 to initiate the opening movement of valve 21. Thereafter the valve 21 is opened in proportion with throttle movement through slightly more than 20° of throttle opening which range covers the usual positions for medium to high speeds. The final opening movement of the throttle is then accomplished without further movement of the exhaust damper.

As a result of this arrangement, the proportion of residual gases retained in the cylinders is much greater than the usual quantity throughout the low speed range, and with decreasing effect, through at least part of the medium range. Furthermore, owing to the relatively high back pressure, the quantity retained in each of the different cylinders is approximately the same, thereby rendering the effect very uniform. The increased proportion of exhaust gases retained, and the higher temperature of such gases, which is concomitant with the higher pressure, not only improves the character of the fuel mixture, increasing its temperature and promoting rapid vaporization, but by materially raising the temperature of the charge, raises the compression at the same time by reason of the well known influence of exhaust gases, reducing the tendency to detonation. The charge is therefore more easily burned even though the proportion of fuel is lower and a greater economy in fuel for a given speed is obtained. In addition the operation of the engine is found to be much smoother. At high speeds or open throttle positions where maximum power is ordinarily desired the back pressure may be reduced to the usual amount by the opening of the exhaust damper to the fullest extent.

The intake manifold may be provided with heating means to promote vaporization of the liquid fuel. In the form illustrated this heating means includes a jacket the walls 40 of which surround a part of the riser and the junction of the riser with the horizontal branches. The jacket is closed at the lower end and the open upper end fits against the lower face of an extension or cap 41 projecting laterally from the exhaust manifold 11. Exhaust gases are therefore free to flow into or out of the space within the parts 40, 41, and thereby heat the enclosed portions of the intake manifold to a high temperature. The manifold passages may be polygonal as shown rather than circular thereby increasing the wall area and promoting vaporization and distribution of deposited liquid to the respective intake openings 42, 43, 44.

A heating jacket arranged as shown is of particular utility in connection with the exhaust control above described since the increased back pressure and resultant increase in the quantity and temperature of the exhaust gases within the jacket entrances the heating effect of the jacket at low speeds when a higher temperature of the vaporizing surfaces is especially desirable. This effect

is obtained without necessitating the use of any dampers or other control devices to regulate the flow of exhaust gas to the heating jacket.

It will be understood that various changes in details of construction and operation may be made without departing from the spirit and scope of the invention and therefore I do not wish to be restricted to the precise details above described except as required by the language of the appended claims in view of the prior art.

I claim:

1. In an internal combustion engine an exhaust manifold having a discharge aperture constituting the sole outlet for exhaust gases from said engine, an intake conduit for combustible mixture, a valve in said outlet, a valve in said conduit, and means connecting the valves, said means being constructed and arranged to operate the first mentioned valve only during an intermediate portion of the operation of the second valve.

2. In an internal combustion engine, an exhaust manifold having a discharge aperture constituting the sole outlet for exhaust gases from said engine, an intake conduit for combustible mixture, a valve in said outlet, a valve in said conduit, operating means for said valves, and means connecting the valves whereby said first mentioned valve is flexibly connected and said last mentioned valve is rigidly connected to said operating means.

3. In an internal combustion engine, an exhaust manifold having a discharge aperture constituting the sole outlet for exhaust gases from said engine, an intake conduit for combustible mixture, a valve in said outlet, a valve in said conduit, a resilient arm and a rigid arm for operating each of said valves respectively, and means connecting said arms.

4. In an internal combustion engine, an exhaust manifold having a discharge aperture, an intake conduit for combustible mixture, a valve in said discharge aperture, a valve in said conduit, a connection between said valves, resilient means carried by said connection serving to return the valve in said discharge aperture to closed position, and a stop to limit the movement of said valve.

5. In an internal combustion engine, an exhaust manifold having a discharge aperture, a valve in said discharge aperture, an intake conduit for combustible mixture, a valve in said conduit, and means connecting said valves constructed and arranged so that the valve in said discharge aperture will remain stationary during the first and last portions of the movement of the valve in said intake conduit.

In testimony whereof I affix my signature.

ALEX TAUB.