PUBLISHED
MAY 11, 1943.
BY A. P. C.

F. NALLINGER ET AL
INTERNAL COMBUSTION ENGINE
Filed April 30, 1940

Serial No.
332,506

Fig. 1.

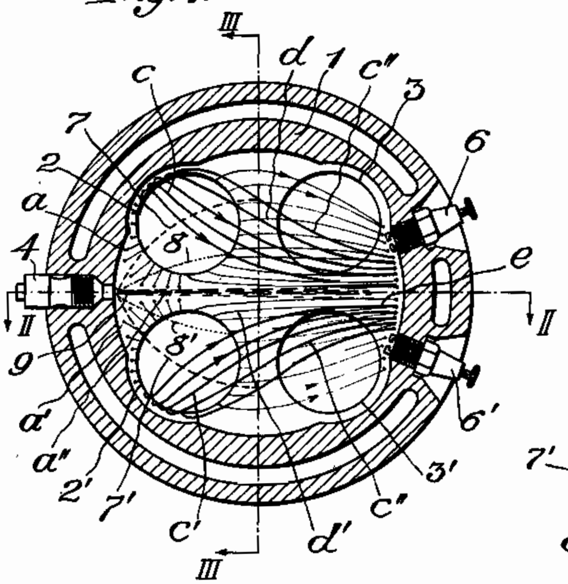


Fig. 4.

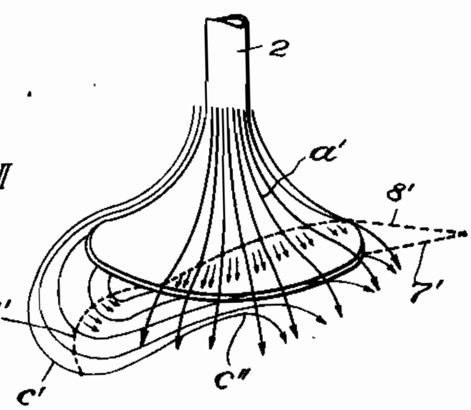


Fig. 2.

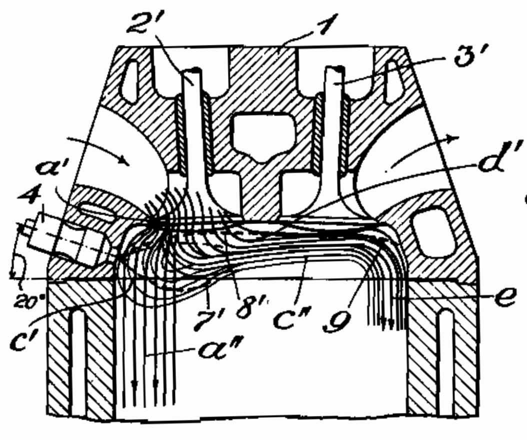
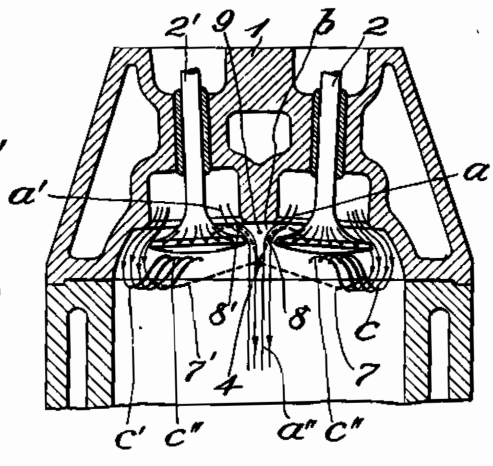


Fig. 3.



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Published May 11, 1943 **Serial No. 332,506**

ALIEN PROPERTY CUSTODIAN

INTERNAL COMBUSTION ENGINE

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Application filed April 30, 1940

This invention refers to a fuel injection type internal combustion engine specially injecting a volatile fuel as gasoline or the like with an ignition by an ignition device, and aims at an improved manner of operation of such engines, specially by means of a most uniform enriching of the combustion air with fuel which seems to be of great importance for such engines. Above all, the invention takes reference to the circumstance that at a valve governed intake the air enters the cylinder space in comparatively thin and wide jets or streams having essentially the form of a plane or a band.

According to the above, the invention consists in the fact that with an interior combustion engine, specially of the kind described, the fuel jets must be injected in such a manner that they essentially extend within the taken-in air currents, spreading band- or plane-formed, vertically or slantingly to the streaming direction of the air, seen in a view into this plane.

Experiments have proven that when intake valves are arranged at the cylinder head of an internal combustion engines, essentially two air currents are created across the valve axle or the cylinder axle, one of these currents running above the valve head and the other below the same, the lower one after passing through the valve-gap being deviated around the rim of the valve head. Preferably the fuel is injected across this band-formed air current, entering either across the head of the opened valve into the valve-gap, or below the same into a current-band deviated for instance by the cylinder wall or the like. The scope of the invention allows to apply both ways of injection with one valve.

If for instance at the top of the combustion space two disc valves are located next to each other on one cylinder side, eventually opposite to two spark plugs, the fuel will preferably be injected in four jets grouped in pairs, one jet of each pair passing at the inner side of an inlet valve, and another respectively at the outside of the valves. The spray nozzle in this instance is preferably located in the symmetry plane of the spark plugs and valves, and practically below the latter and opposite to the plugs.

In the drawing the invention is shown by way of example in one type.

Fig. 1 shows a cross section through the combustion space of an internal combustion engine working with separate ignition and mixture compression.

Fig. 2 is a longitudinal section through line II—II of Fig. 1.

Fig. 3 is a longitudinal section through line III—III of Fig. 1.

Fig. 4 shows an inlet valve diagrammatically drawn in a slanting view form above.

In the shown example the cylinder head **1** shows two inlet valves **2**, **2'** located next to each other in the top of the combustion space. Both valves are placed opposite to two outlet valves **3**, **3'**. Between the inlet valves **2**, **2'** a spray nozzle **4**, inclined by about 20° downward, discharges, and next to the outlet valves opposite to the spray nozzle with little space between them, two spark plugs **6**, **6'** are located. Preferably injection is started when the piston performs its sucking action and moves relative to the crank pin 25 to 30° in back of its upper dead centre downward. At this time both inlet valves are open. Through these the air enters in streaming forms which are the result of a test, and are illustrated by the enclosed drawings. Three distinctly different streaming bands are distinguished from each other. Firstly a certain quantity *a* (Figs. 1 and 3) of air streams towards the nozzle. But as the two streaming bands, leaving the two valves **2**, **2'** influence each other, immediately in front of the mouth of the inlet nozzle **4**, and between the valves **2**, **2'** a slowly streaming dead zone *b* (Fig. 3) remains, below which the two streaming bands *a* and *a'* unite to a single stream-band *a''* (Figs. 2 and 3) in downward direction. A second streaming band, deviated by the proximate cylinder wall, pertaining to each inlet valve, describe below the valve head, an eddy c, c' which moves upward (at c'') towards the middle of the cylinder space. With this one unites a third streaming band *d*, *d'*, immediately leaving the inlet passage, forming together with it a strong total current *e* (Fig. 2) moving across the combustion space and along the top of same. The charging air follows therefore the downward moving piston in two larger air columns *a''* and *e*. Into these streaming bands of the charging air the fuel is injected preferably in four jets **7**, **7'** and **8**, **8'** and in such a manner that it enters the plane of the streaming bands essentially perpendicularly to the streaming direction of the air. Particularly two jets **8**, **8'** which are relative to the axle of the spray nozzle or to the symmetry plane on the inside, inject into the streaming bands *a*, *a'*, and two outer jets **7**, **7'** run across or come in contact with the eddies or stream bands *c*, *c'*. As the fuel jets **7**, **7'** or **8**, **8'** lie inside the plane of the streaming band, they are transversely taken hold of and blown away across the streaming band plane. The fuel quantity of the jets 8 and 8′ distribute in the air currents a″ and d, d′ and the fuel quantity of the jets 7, 7′ in the air currents c, c′. The jets 7, 7′ require relative to the jets 8, 8′ a somewhat higher permeability because they have partly to penetrate the streaming band a or a′. Under circumstances it seems practical to inject the fuel also in a fifth jet 9 (Figs. 1, 2 and 3). This jet which is directed radially and upward enters through the slow streaming zone b and through the valves 2, 2′ and is grasped finally by the uniting streaming bands c, c′ of equal direction. This jet cools the section of the combustion space above the nozzles and specially enriches strongly the section between the spark plugs, as it will not be blown away transversely.

In connection with the described manner of injection it will be preferable to choose a more than normal intersection between the intake start and the outlet end which may amount to 60 to 140°, for example about 90° for a four stroke motor, and for two stroke motors about 110 to 160°. In order to avoid fuel losses at such a regulation of the intake and outlet times it will be practical to inject only after the finished scavenging i. e. immediately before the closing, at the closing or after the closing of the outlet valve.

The expressions applied here, like "band- or plane-formed charging air currents" or "planes" of these currents are naturally to be understood only symbolically, as they do not exclude certain deviations, if only the nature of the invention will be retained. Thus these air currents may have some more or less large spacious extension. Also the injection of the fuel must not take place exactly in the mentioned plane which essentially means a plane contacting the streamband in that place where the fuel jet traverses the air current.

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