PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Internal Combustion Engines Operating with Injection of Liquid Fuel into the Cylinders

We, LANCIA & C. FABBRICA AUTOMOBILI-TORINO—S.A., an Italian Company, of Via Monginevro 99, Turin, Italy, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention relates to internal combustion engines operating with injection of liquid fuel into the cylinders, in particular two-cycle engines, in which the combustion chamber is formed to a great extent by a cavity made in the piston.

The invention has for its object an arrangement which permits of effecting the maximum atomisation of the fuel and a perfect mixing of the liquid particles in the mass of air, in such a manner as to effect the best possible combustion.

According to the invention, each injector for the fuel is mounted in the cylinder head at a position and with an inclination such that the jet of fuel meets the front face of the piston substantially externally of the cavity made in the said piston and so that it is directed towards the edge of the said cavity and over a portion of this edge which precedes, in the direction of the circulation of the air, the plane passing through the axis of the cavity in the piston, and through the point where the axis of the jet meets the front face of the piston in its upper dead point position.

In this way, the jet of fuel is broken up by striking the piston and the liquid particles spread out over an area transverse to the current of air in circulation which consequently meets the mass of liquid particles laterally and carries these particles towards the cavity of the piston and into the interior thereof where their combustion takes place in intimate mixture with the air.

The accompanying drawings show by way of example an embodiment of the arrangement according to the invention, in the case of a two-cycle engine with direct fuel injection and with exhaust through valves;

Figure 1 is a diagrammatic axial section of a cylinder;

Figure 2 is a transverse section of the cylinder on the line 2—2 in Figure 1, and presuming the piston to be at its lower dead point position;

Figure 3 is a view on a somewhat larger scale, of the front face of the piston showing the point struck by the axis of the jet in the position of upper dead point of the piston as also the route of the liquid particles in the interior of the cavity of the piston;

Figure 4 is a view similar to Figure 3 in the case of another construction.

In Figure 1, 1 indicates the engine cylinder, which is closed by a head 2 comprising the exhaust conduit 3 controlled by a valve 4, and an injector 5 at which terminates the conduit 6 for the delivery of the liquid fuel.

The cylinder 1 contains in its interior a piston 7 connected to the driving shaft by a connecting rod 8 and the end surface of the piston is hollowed out eccentrically as shown by Figure 2, the cavity 9 being open towards the head 2 and forming a large portion of the combustion chamber.

The surface of the cylinder 1 is bored, for the introduction of the air, with apertures 10, all being inclined in the same direction.

The injector 5 for the fuel is mounted in the head 2 in such manner that the jet of fuel does not penetrate directly into the cavity 9 but is directed as much as possible transversely to the current of air in circulation.

In the example shown by Figures 1 and 2, where the cavity 9 occupies an eccentric position, the injector 5 is mounted opposite the part not hollowed out of the piston and with its axis inclined with respect to the axis of the cylinder and lying in a diametrical plane (*a*—*b*, Figure 3) of the said cylinder.

In general, the position of the injector 5 is such that the axis of the jet of fuel lies in a plane which, with respect to a plane (*a*—*o*, Figure 3) passing through the axis of the cavity 9, forms an angle of at least 8° on the side of the last-named plane which is in advance of the same plane with respect to the circulation of air in the cylinder and that in this plane,

the axis of the jet forms an angle of at least 15° with the axis of the cylinder, and meets the front face of the piston, in the position of the upper dead point thereof, at a distance from the axis of the cavity 9 which is at least a tenth larger than the radius of the edge of the said cavity.

During the working of the engine, when the piston 7 in its descending stroke uncovers the ports 10, there is produced in known manner, an admission of air which on account of the inclined position of the ports 10 assumes in the interior of the cylinder 1, the circulatory movement indicated by the arrow in Figure 2. This circulatory movement of the air is maintained during the ascending stroke of the piston and it is also transmitted to the interior of the cavity 9 of the piston.

When, as the end of the ascending stroke of the piston, the injection of fuel takes place, with the desired advance, the jet on account of the position indicated of the injector, strikes, at least to a great extent, on the solid front face of the piston, where it undergoes an intense atomisation and the particles of fuel occupy an area which is struck transversely by the current of air in circulation and they are carried into the cavity 9 along the adjacent portion of its side surface. The combustion takes place in the cavity 9, proceeding from the exterior towards the centre over a spiral course as shown in Figure 3.

There is thus produced between the fuel and the air a mixing making the combustion perfect and permitting the maximum output to be attained.

Similar conditions can also be realised if the cavity 9 occupies a central position with respect to the axis of the cylinder.

In this case, the injector is not mounted with its axis in a diametrical plane of the cylinder but in a plane (a—b^1, Figure 4) which forms an angle with the plane (a—o) passing through the axis of the cylinder and of the cavity 9 on the side of the last-named plane which is in advance of the same plane with respect to the circulation of the air in the cylinder. In this case also the combustion in the interior of the cavity 9 follows a spiral course, as indicated in Figure 4.

With the piston cavity 9 centred with respect to the axis of the cylinder, it is possible to use two injectors which may be arranged, applying the rules indicated, at points diametrically opposite with respect to the axis of the cylinder and which give rise to two spiral circulations one by the side of the other.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. An arrangement for improving the combustion in internal combustion engines operating with injection of liquid fuel into the cylinders, in which the combustion chamber is formed to a large extent by a cavity made in the piston, characterised by each injector for the fuel being mounted in the cylinder in such a position and with such an inclination that the jet of fuel meets the front face of the piston substantially externally of the cavity made in the said piston and is directed towards the edge of the cavity and on to a portion of this edge which precedes, in the direction of the circulation of the air in the cylinder, the plane passing through the axis of the cavity in the piston and through the point where the axis of the jet meets the front face of the piston in its upper dead point position.

2. An arrangement according to claim 1, characterised by the injector being mounted with its active axis in a plane which, with respect to the plane passing through the axis of the cavity in the piston, forms an angle of at least 8° on the side of the last-named plane which is in advance of the same plane with respect to the circulation of the air in the cylinder and in said plane the said active injector axis forms an angle of at least 15° with the axis of the cylinder and meets the front face of the piston, in its upper dead point position, at a distance from the axis of the cavity in the piston which is at least a tenth larger than the radius of the edge of the said cavity.

3. An arrangement according to claim 1 or 2, characterised by the cavity in the piston having an eccentric position and the injector being mounted with its axis in a diametrical plane of the cylinder which does not pass through the axis of the cavity in the piston.

4. An arrangement according to claim 1 or 2, characterised by the cavity in the piston having a central position and the injector being mounted with its axis in a non-diametrical plane.

5. The arrangements for improving the combustion in internal combustion engines operating with injection of liquid fuel into the cylinders substantially as described with reference to Figures 1 to 3 or 4 of the accompanying drawings.

Dated this 12th day of July, 1939.
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Fig. 1

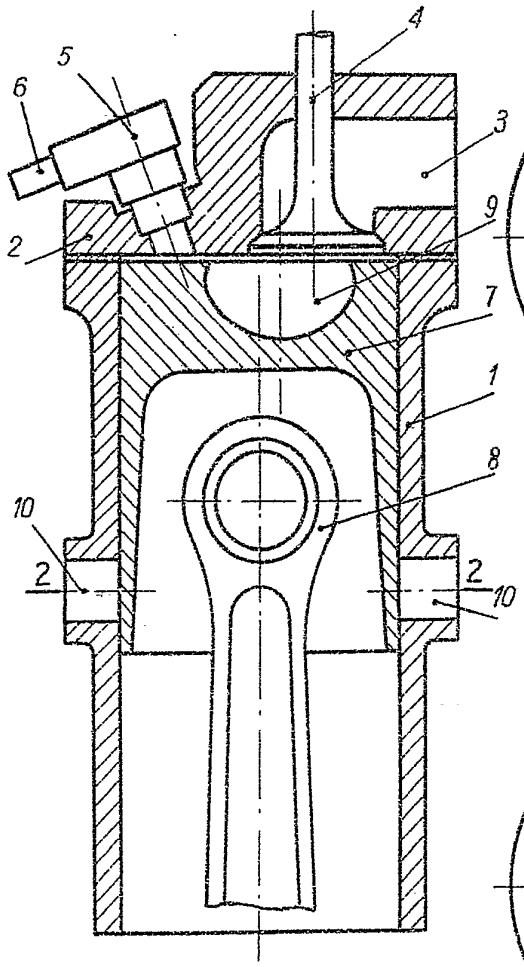


Fig. 3

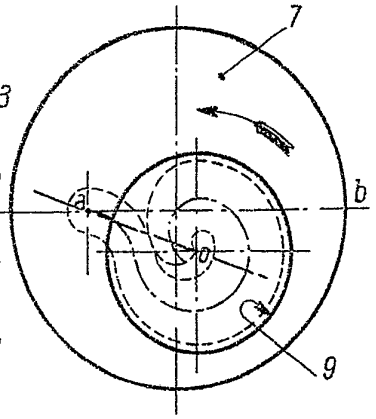


Fig. 4

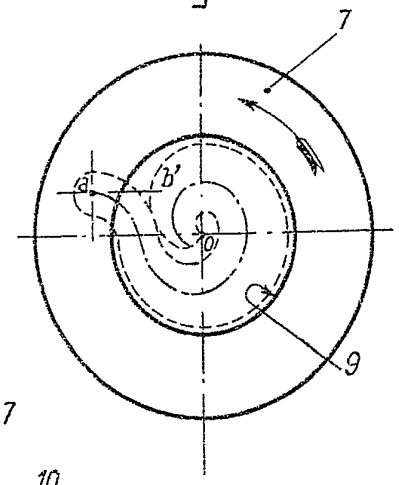
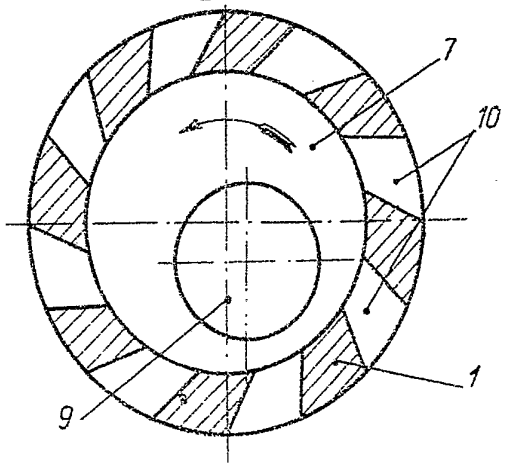


Fig. 2



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