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INTERNAL COMBUSTION ENGINE OF THE SOLID FUEL INJECTION TYPE

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Fig. 1.

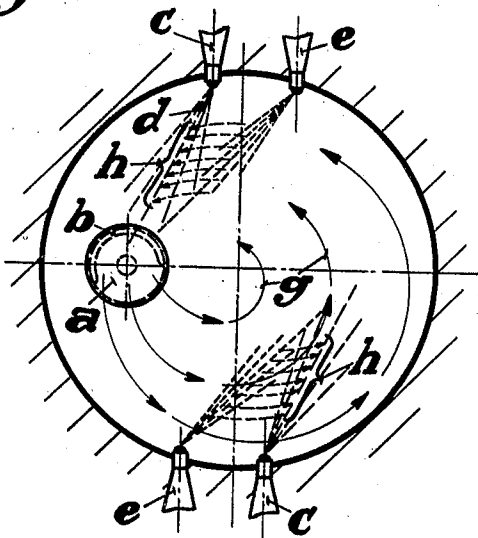
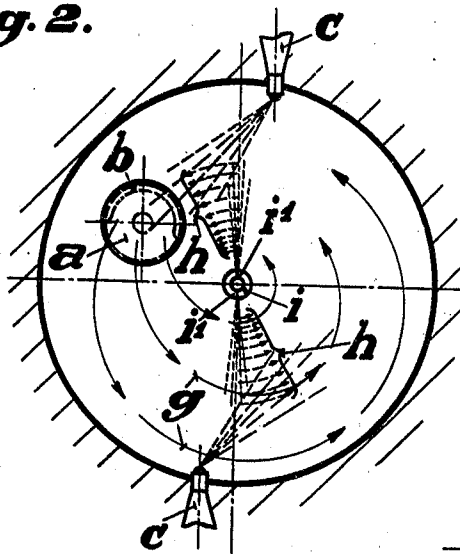


Fig. 2.



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INTERNAL-COMBUSTION ENGINE OF THE SOLID-FUEL INJECTION TYPE

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This invention relates to internal combustion engines of the solid fuel injection type. An arrangement of two separate fuel valves in internal combustion engines with air injection working on two different fuels, a light igniting oil and a heavier combustible oil, is known. It is also known in internal combustion engines with airless spray (i. e. engines of the solid fuel injection type) to arrange the separate pipes for both fuels within the body of a nozzle and to direct the fuel sprays in such a way that the heavy oil spray meets the ignition oil spray at a point suitable for ignition. This latter arrangement has proved, generally, unsuitable, because the nozzle is too large in comparison with the cylinder and takes up so much space that it cannot be accommodated.

The present invention employs the first mentioned arrangement and avoids the disadvantages resulting from the use of the airless spray or solid injection of the heavy oil, by using the said arrangement in conjunction with a known rotary or circulatory movement of the combustion air. In this invention the ignition oil nozzles and the heavy oil nozzles are arranged in such a way that the flames from the ignition oil are driven towards the sprays of the heavy oil and strike the latter at the moment most suitable for ignition. The ignition oil nozzles may be situated in front of the heavy oil nozzles and arranged laterally in the cylinder, but they can in certain cases be situated centrally in the cylinder cover.

Each of the above-mentioned forms of the invention is shown diagrammatically in the drawing in which Fig. 1 shows the arrangement with both fuel nozzles arranged laterally or adjacent the side wall of the cylinder, and Fig. 2 shows the light fuel nozzle arranged centrally.

a is the air inlet valve, which by way of example is provided with a screen *b* for imparting to the ingoing air a rotary or circulatory movement as indicated by the arrows *g*.

In the construction according to Figure 1 there are arranged laterally in the wall of the cylinder and diametrically opposite one another nozzles *c* for the heavy oil spray *d*, and nozzles *e* for the ignition oil spray *f*. The latter nozzles are placed at such a distance in front of the former and are so directed that the ignition oil flames resulting from the sprays *f* are caught by the rotating or circulating air, as shown by the arrows *h*, and driven against the simultaneously injected sprays *d* of the heavy oil so as to strike them at the moment when the ignition oil flames possess the greatest heat intensity, so that proper ignition of the heavy oil is assured. As shown clearly in the drawing, the nozzles *c* and *e* for the heavy oil and the light oil respectively have discharge ports so arranged as to direct the streams into the combustion space of the cylinder in closely adjacent and converging paths. The light oil fuel stream from the nozzle *e* is in small angular advance of the heavy oil stream, such angular advance being coordinated with the rotational speed of the air. As shown, the front oil stream has an effective angular advance of substantially less than 60° with reference to the rear oil stream. The light oil fuel stream from the nozzle *e* being in front of the heavy oil stream from the nozzle *c* and thereby acting somewhat as a shield for the heavy oil stream, is more forcefully acted upon by the rotating air, and is driven more rapidly than the heavy oil in the direction of rotation of the air. This serves to carry the light ignition oil into the path of movement of the heavy oil substantially throughout the extent of the heavy oil stream very shortly after the time of injection of the light oil. This secures an intimate mixing of the light oil flames at the time of their greatest heat intensity with heavy oil throughout a large part of the heavy oil stream, thereby securing highly effective ignition of the heavy oil stream and an efficient combustion within the cylinder.

The arrangement shown in Figure 2 differs from the above only in so far that a central nozzle *i* having a number of openings *j* for the ignition oil sprays is placed centrally in the cover of the cylinder. The number of such openings *j* will depend upon

the number of the heavy oil nozzles *c*. These openings are so directed that the ignition oil is introduced in streams which lie closely adjacent and in front of the heavy oil streams, whereby the ignition oil flames indicated by the arrows *h* are driven by the rotating or circulating air against the heavy oil sprays and strike them at the most favourable moment for ignition.

The invention is based essentially on the fact that the ignition of the ignition oil does not extend instantaneously through the whole combustion chamber but occurs locally and that therefore it is at such local spots that the most suitable temperature for the ignition of the heavy oil is to be found. Thus combustion of the heavy oil is made possible by a minimum consumption of ignition oil.

What is claimed is:

1. An internal combustion engine of the character described comprising, in combination, a cylinder having a combustion space therein, means for introducing combustion air into said combustion space and for imparting rotary motion thereto, means for injecting a heavy combustible fuel into said combustion space, and means for injecting a light ignition fuel into said combustion space in a separate but closely adjacent stream in small angular advance of said combustible fuel, whereby the rotating combustion air carries said ignition fuel into contact with said combustible fuel shortly after injection and during the time of ignition of said ignition fuel.

2. In the operation of an internal combustion engine using fuel injection, the method which comprises introducing combustion air into the cylinder and imparting rotary motion thereto, injecting a combustible fuel oil into the moving air within said cylinder, and injecting a lighter and readily ignitable ignition fuel into the moving air within said cylinder along a separate but closely contiguous path on the same cylinder side and in front of the combustible fuel oil, the positioning of the separate streams within the combustion space being coordinated with the rotational speed of the air such that the rotating combustion air carries the ignited ignition fuel into contact with said combustible fuel oil shortly after injection and at the time of burning of said ignition fuel to insure combustion of such combustible fuel oil.

In testimony whereof I have hereto affixed my signature.

DR. WILHELM RIEHM.