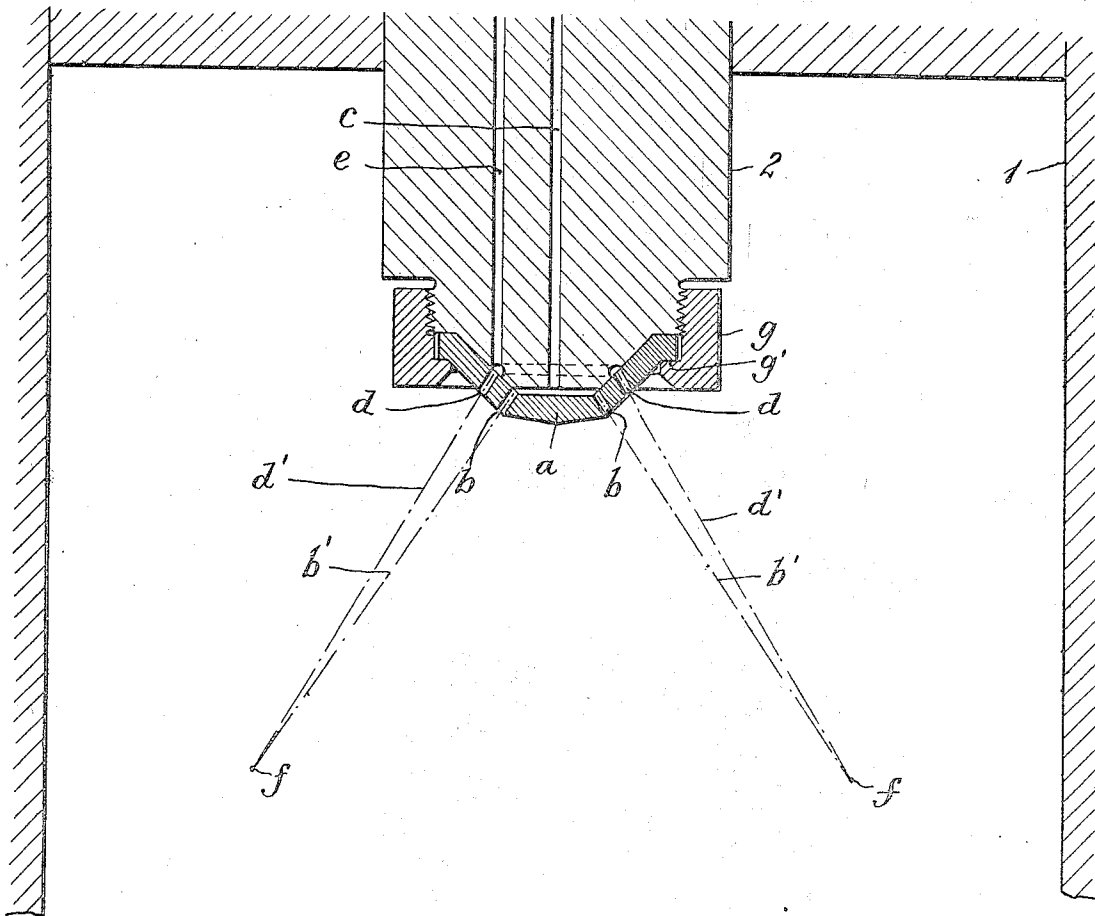


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1,494,020

W. RIEHM
METHOD OF INJECTING FUEL INTO INTERNAL COMBUSTION ENGINES
AND APPARATUS THEREFOR
Filed Feb. 28, 1922



INVENTOR
BY *Wilhelm Riehm*
Pennie, Davis, Marwin, & Edmonds
ATTORNEYS

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WILHELM RIEHM, OF AUGSBURG, BAVARIA, GERMANY, ASSIGNOR TO THE FIRM
MASCHINENFABRIK AUGSBURG-NUERNBURG, GESELLSCHAFT, OF AUGSBURG,
GERMANY, A CORPORATION OF GERMANY.

METHOD OF INJECTING FUEL INTO INTERNAL-COMBUSTION ENGINES AND APPARATUS THEREFOR.

Application filed February 28, 1922. Serial No. 539,906.

To all whom it may concern:

Be it known that I, WILHELM RIEHM, a citizen of Germany, residing at Augsburg, Stadtbachstrasse 7, State of Bavaria, Germany, have invented certain new and useful Improvements in Methods of Injecting Fuel into Internal-Combustion Engines and Apparatus Therefor; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to the injection of fuel into the cylinders of internal combustion engines, and has to do particularly with the injection of heavy fuels which must be associated with a lighter fuel in order to effect satisfactory ignition.

In the use of heavy oils, or similar fuels having a relatively high ignition point, it is common to employ a secondary fuel, preferably a lighter hydrocarbon of relatively low igniting temperature, for the purpose of attaining an initial combustion in the engine cylinder to generate a temperature sufficiently high to ignite the heavier fuel. The two fuels are commonly injected independently through separate openings. This process of ignition is, however, subject to certain disadvantages, such as frequent failure of the heavy fuels to ignite, due to the fact that the burning of the ignition fuel heats the gases within the engine cylinder locally to a temperature sufficiently high to cause ignition of the principal fuel, but does not raise the temperature of the entire cylinder to such a degree. Consequently, an excessive amount of the lighter ignition fuel must be used so that the temperature at all parts of the cylinder is sufficiently high to ignite the principal fuel. Furthermore, it is necessary that the ignition fuel be injected somewhat previous to the injection of the main fuel, so that combustion may be well under way at the time of the principal injection. To satisfactorily employ the above system of ignition relatively complicated fuel injection apparatus is required, and an unduly large amount of ignition fuel is consumed.

It has also been proposed to admit both fuels through the same injection nozzle. Such a method has proven satisfactory in

effecting reliable ignition of the fuel, but after a relatively short time of operation leads to accumulation of asphalt or similar tarry deposits within the injection valve and upon the parts of the cylinder adjacent this valve. Furthermore, at the end of the main injection operation the injection nozzle is filled with the heavy fuel. At the beginning of the succeeding injection period, when it is desired to first force the lighter ignition fuel into the cylinder, the nozzle must first be freed of the residual fuel from the preceding injection period. Thus a considerable quantity of heavy fuel finds its way prematurely into the cylinder and is deposited upon the cylinder walls without being completely burned or, at best, is only inefficiently utilized.

It is a principal object of the present invention to provide a method for ignition of heavy fuels in the cylinders of internal combustion engines in a convenient and efficient manner, which avoids the above mentioned difficulties.

More specifically, it is an object of the invention to effect satisfactory ignition in a system of the above type in which the ignition fuel and working fuel are independently injected into the cylinder, the working fuel being passed directly to the hottest portion of the combustion chamber.

It is a still further object to provide an apparatus for carrying out the above method in a convenient and satisfactory manner.

I have illustrated a preferred embodiment of my invention in the accompanying drawing, which is a vertical sectional view, somewhat diagrammatic, showing an internal combustion engine cylinder embodying my improved apparatus.

Referring to the drawing, 1 indicates the wall of the engine cylinder provided with the usual inwardly extending member 2, which carries the parts of the injection valve. The injection nozzles are preferably formed in an independent cap member *a* normally secured in position at the lower end of the member 2 by threaded ring *g* having an inwardly extending annular flange *g* for engaging a cooperating flange provided at the periphery of member *a*.

The supporting member 2 is traversed

longitudinally by fuel passages *e* and *c* leading from the supply reservoirs for the ignition fuel and heavier operating fuel, respectively. I have illustrated a single passage for each of the two fuels, but it is obvious that any desired number of such passages may be employed. The fuel passage *e* is in communication with a plurality of injection nozzles *d* spaced concentrically around the member *a*. Fuel may be admitted to the passage *e* and the injection nozzles *d* by any well known method, not shown, and is injected into the cylinder along a course approximately indicated by the dotted line *d'*. Under the particular conditions of operation the jet *d'* of fuel will ignite at a point *f*, whose location within the cylinder may be determined with a fair degree of certainty. In a similar manner the principal fuel may be admitted to the passage *c*, from whence it will make its way out through the spaced injection nozzles *b* and will traverse a course similar to that indicated by the line *b'*. The direction of extent of the injection nozzles *b* is such as to direct the jet of heavy fuel at an angle to the jet of ignition fuel and cause it to intersect the ignition jet substantially at the point *f*. Thus the heavy fuel is injected directly to the hottest part of the combustion chamber. The injection of the two fuels may occur simultaneously, or the ignition fuel may be admitted slightly before the principal fuel, if desired.

While I have indicated that the injection nozzles *b* and *d* consist of a plurality of openings uniformly spaced around the member *a*, it is obvious that any other arrangement may be employed. I preferably employ one ignition fuel nozzle to each nozzle for the injection of the heavier fuel, as shown.

While I have illustrated a preferred embodiment of apparatus for carrying out my improved method, it is understood that va-

rious modifications may be made in the details of construction and arrangement of parts without departing from the spirit of the invention, as defined in the appended claims.

I claim:

1. Fuel injection apparatus for internal combustion engines, comprising means for projecting an ignition fuel to the engine cylinder along diverging paths, and independent means for injecting diverging jets of working fuel directly to the point of ignition of said ignition fuel.

2. Fuel injection apparatus for internal combustion engines, comprising inlets for projecting diverging jets of ignition fuel into the engine cylinder, and a plurality of inlets for introducing diverging jets of working fuel into the cylinder at angles to said first jets, said fuel jets intersecting at substantially the point of ignition of the ignition fuel.

3. Fuel injecting apparatus for internal combustion engines, comprising inlets for projecting diverging jets of ignition fuel into the engine cylinder, and a plurality of independent openings for introducing working fluid into the cylinder at angles to said first jets, said fuel jets intersecting at substantially the point of ignition of the ignition fuel.

4. Fuel injection apparatus for internal combustion engines, comprising a plurality of inlets for admitting jets for ignition fuel to the engine cylinder, and a plurality of cooperating inlets for introducing jets of working fuel into the cylinder directed respectively to the ignition points of the several jets of ignition fuel.

In testimony whereof I affix my signature.

WILHELM RIEHM.

Witnesses:

ALEXANDER DE SOTO,
ALEXEIS PHILIPPOFF.