H. JUNKERS.

FUEL INJECTING MEANS OF INTERNAL COMBUSTION ENGINES.

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1,162,173.

Patented Nov. 30, 1915.

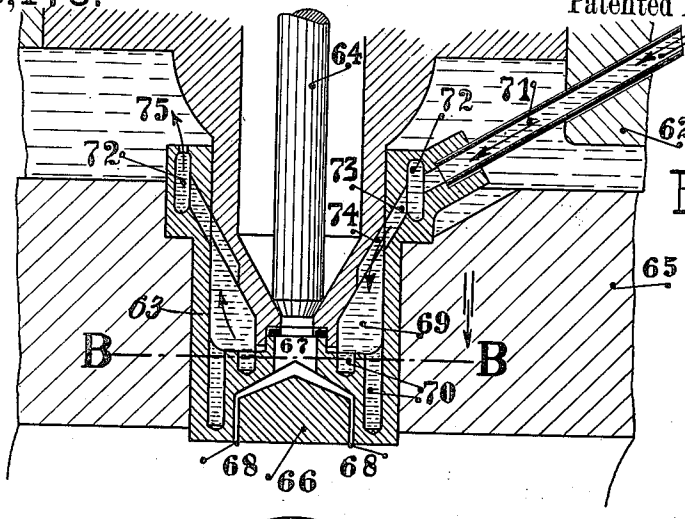


Fig. 1.

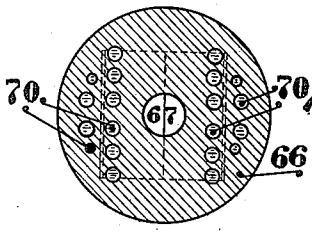


Fig. 2.

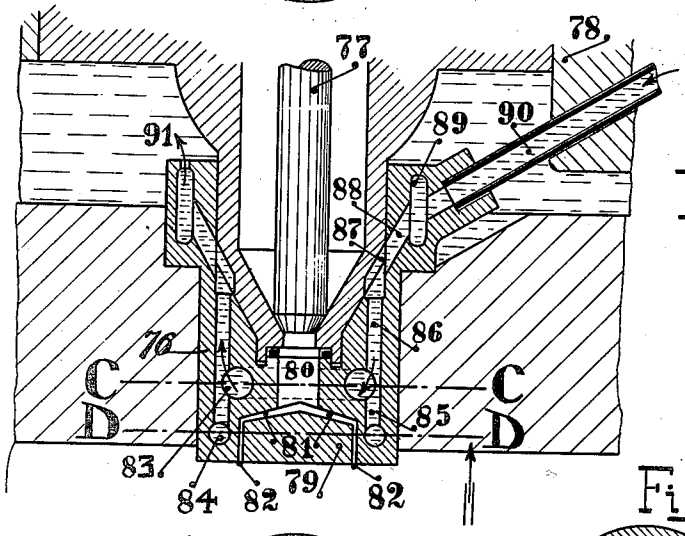
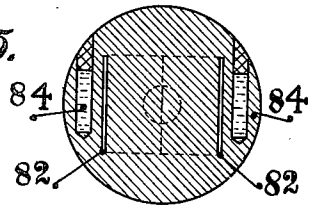
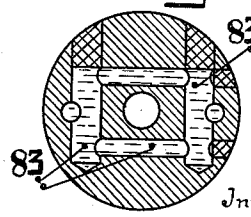


Fig. 3.

Fig. 4.

Fig. 5.





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UNITED STATES PATENT OFFICE.

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FUEL-INJECTING MEANS OF INTERNAL-COMBUSTION ENGINES.

1,162,173. Specification of Letters Patent. Patented Nov. 30, 1915.

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To all whom it may concern:

Be it known that I, HUGO JUNKERS, a citizen of the German Empire, residing at No. 68 Bismarkstrasse, Aix-la-Chapelle, in the Kingdom of Prussia, Empire of Germany, have invented certain new and useful Improvements in and Relating to the Fuel-Injecting Means of Internal-Combustion Engines; 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.

This invention relates to fuel injecting devices for internal combustion engines, and has reference especially to internal combustion engines of the type employing crude oil as the fuel, which oil is admitted to the cylinder in a liquid state.

The invention is of special utility in internal combustion engines of the type having two pistons reciprocating in opposite directions in the cylinder and operating in accordance with the Diesel cycle. In the operation of such internal combustion engines, certain difficulties have been experienced involving a marked decrease in the efficiency of operation and at times such an engine has even come to a full stop after a comparatively short period of operation. I have discovered that one of the causes of such improper operation is the premature dissociation of the liquid fuel and deposition of certain of the dissociated parts in the passages of the fuel injecting devices. The nozzle through which the liquid fuel is introduced into the cylinder is positioned in that part of the combustion chamber which is subjected to the greatest heat, and the constructions heretofore employed have been such as to permit the liquid fuel passing through the nozzle to become heated to a temperature so high as to result in premature dissociation. Especially is this true in the case of fuel which contains a comparatively large amount of carbon. The dissociated parts of the fuel become deposited directly in the bore of the nozzle, as at this point there is insufficient air to cause their consumption, and thereafter they obstruct or wholly prevent the feeding of the fuel into the cylinder. I have overcome this objectionable characteristic of internal combustion engines employing liquid oil as the fuel by providing for the adequate and efficient cooling of the nozzle at a point close to the fuel injecting opening of the nozzle, so as to prevent such premature dissociation of the fuel and deposit of the carbon and other constituents while passing through the nozzle. The fuel injecting nozzle of an engine of this character is usually provided with a bore or central passageway within which a needle is adapted to reciprocate in order to control the admission of fuel through the nozzle. The fuel in liquid form is admitted to the passageway or chamber within the nozzle and around the needle and is subjected to a high pressure so that when the needle is moved to withdraw it from contact with its seat momentarily, the liquid fuel is forced through a small passage in the nozzle beyond the seat of the needle and admitted to the cylinder. The passage for fuel through the nozzle is usually contracted in size at a point intermediate its ends so as to form a seat with which the needle coacts to control the flow of fuel through the nozzle and beyond this seat the passage for the fuel is of very small cross sectional area and if desired may be divided into two or more separate passages. Preferably, the nozzle is so arranged as to inject the fuel into the cylinder in the form of two or more sheets or layers substantially transverse to the axis of the cylinder. In order to effectively cool fuel admission devices of this character so as to prevent dissociation of the fuel while passing through the nozzle, I provide a chamber or channel for a cooling medium located close to the inner end of the nozzle about that portion of the nozzle from which the fuel issues into the cylinder, that is, about the restricted passage for the fuel beyond the seat of the needle and between that seat and the end of the nozzle entering the cylinder. The cooling chamber or channel is preferably of circular form and encircles the one or more restricted passages for the fuel leading from the seat of the needle to the fuel injecting openings of the nozzle. This chamber is supplied with a cooling medium in any suitable manner, as for instance, by connecting it by suitable ducts with an outside source of supply or with the cooling chamber surrounding the cylinder. By so locating the cooling chamber in the nozzle, the fuel passing through the nozzle is maintained at a temperature sufficiently low to prevent dissociation up to the moment of injecting the

fuel into the cylinder and thus obstruction of the small fuel passages through the nozzle by deposit therein is avoided.

I have illustrated the preferred embodiment of my invention in the accompanying drawings, in which—

Figure 1 is a central section through one form of fuel injecting nozzle showing the means employed for cooling the nozzle close to the end thereof entering the cylinder. Fig. 2 is a section through the nozzle on line B—B of Fig. 1. Fig. 3 is a view similar to Fig. 1 showing a slightly modified construction of the nozzle; and Figs. 4 and 5 are sectional views of the nozzle shown in Fig. 3 on lines C—C and D—D respectively of Fig. 3.

In both forms of the invention illustrated in the accompanying drawings, the nozzle is adapted for use in connection with an internal combustion engine employing slow-burning crude oil as the fuel and operating upon the Diesel cycle, the engine being preferably of the type employing two pistons reciprocating in opposite directions within the cylinder. The nozzle is shown as projecting through the wall of the cylinder so that the fuel issuing therefrom is injected into the cylinder near the center thereof and between the adjacent ends of the two pistons. The nozzle is provided with a central passage therethrough which is contracted in size at a point intermediate its ends so as to form a seat. Within the larger portion of this passage is a needle whose end is adapted to coact with the seat, this needle being provided with mechanism for reciprocating it so that it is periodically withdrawn from contact with its seat momentarily to permit the oil introduced into the nozzle under pressure to pass beyond the needle and into the cylinder. In each case, the nozzle is provided with means for adequately cooling the portion thereof which lies close to the fuel injecting openings; that is, close to the inner end of the nozzle, which end enters the cylinder. This cooling means consists of a channel or chamber for a cooling medium located close to that portion of the passage for fuel through the nozzle which lies beyond the seat for the needle and between that seat and the fuel injecting openings of the nozzle. By effectively cooling this portion of the nozzle closely adjacent to the fuel injecting openings, the premature dissociation of the fuel is largely or entirely prevented, as a consequence of which the passage for fuel through the nozzle remains free and open during a long period of use of the engine, instead of becoming choked more or less by the deposit of the carbon constituents in the fuel.

In the embodiment of the invention shown in Figs. 1 and 2, the walls 62 and 65 of the cylinder are provided with an opening of a size and shape adapted to receive the fuel injecting nozzle 63. In the present instance, this nozzle is shown as formed of two parts which are secured together, though the construction in this regard may be changed as desired. The nozzle has a passage therethrough for liquid fuel and this passage is contracted intermediate its ends so as to form a seat for coaction with the end of the needle 64. This needle is located within the larger portion of the passage through the nozzle and is provided with means for reciprocating it to carry its end into and out of engagement with its seat so as to control the flow of fuel through the nozzle. The fuel is admitted to the space between the needle 64 and the surrounding wall of the passage through the nozzle and is subjected to pressure so that when the needle is raised from its seat, the fuel passes through the nozzle and into the cylinder. In the construction illustrated, the fuel passing the end of the needle 64 flows into a passage or cavity 67 from which two contracted passages extend laterally in opposite directions and then out to the end of the nozzle. The ends of these branch passages 68 are in the form of elongated slits or a plurality of openings arranged in line so that the fuel issues from the nozzle in the form of two parallel sheets or layers spaced apart by the portion of the nozzle indicated at 66. In order to provide for effectively cooling this nozzle, a circular chamber is provided at 69 encircling the portion of the passage for fuel through the nozzle lying beyond the seat for the needle 64 and between that seat and the fuel injecting openings of the nozzle. From this chamber 69, a plurality of openings or bores 70 extend in close proximity to the passages 67 and 68, and the portions of the passages 68 adjacent to the outlet ends thereof so that the whole of the end of the nozzle entering the cylinder is effectively cooled. The section shown in Fig. 2 illustrates the relation of these bores 70; from this figure it will be seen that there are two rows of bores 70 on each side of the nozzle and that these two rows of bores are disposed on opposite sides of the planes of the adjacent narrow passages 68 for the fuel. In Fig. 1, the cooling water is shown as admitted to the chamber 69 from a source other than the cooling jacket of the cylinder itself. The cooling water flows in through a tube 71 to a chamber 72 encircling the nozzle and from this chamber it passes by ducts 73 and 74 to chamber 69. The water flows out from the chamber 69 and the chamber 72 through a port 75 into the jacket of the cylinder.

The construction shown in Figs. 3, 4 and 5 is similar in many respects to that shown in Fig. 1. The nozzle is indicated at 76, the needle at 77, the restricted passage for the fuel at 80 and its branches at 81, leading to the outlets 82 in the inner end 79 of the

nozzle. The cooling of this end of the nozzle is effected by a chamber 83 encircling the passage 80 between the inner end of the needle 77 and the inner end of the nozzle. The chamber 83 is formed by communicating bores each closed at one end, as shown in Fig. 4. Water is led to the chamber 83 from an outside source by a pipe 90 which leads to a chamber 89 formed in the nozzle and encircling the passageway for fuel through the nozzle. From this chamber 89, ducts 88, 87 and 86 lead to the chamber 83, and a port 91 allows the cooling liquid to flow into the jacket of the cylinder. In order to more effectively cool the extreme inner end of the nozzle, holes 84 are bored transversely in the nozzle close to the inner end thereof, as shown in Fig. 5, and communicating with the openings 86, the ends of these holes 84 being subsequently closed as indicated.

What I claim is:

1. In an internal combustion engine, the combination of a cylinder wall, a nozzle projecting through the wall and having a passage therethrough for the introduction of fuel from the nozzle directly into the cylinder, a needle movably mounted in the nozzle and controlling the flow of fuel therethrough, a channel for a cooling medium formed in the nozzle between the seat of the needle and the inner end of the nozzle so that said channel lies close to the point of admission of fuel from the nozzle into the cylinder, and ducts for carrying a cooling medium to and from said channel; substantially as described.

2. In an internal combustion engine, the combination of a cylinder wall, a nozzle projecting through the wall and having an opening therethrough, which opening is contracted in size intermediate its ends to form a seat, a needle in the passage through the nozzle adapted to be reciprocated to carry its end into and out of engagement with said seat, a channel for a cooling medium formed in the nozzle encircling the contracted portion of the passage through the nozzle between the seat of the needle and the fuel injecting opening at the end of the nozzle entering the cylinder, and ducts for carrying a cooling medium to and from said channel; substantially as described.

3. In an internal combustion engine, the combination of a cylinder wall, a nozzle projecting through the wall and having a passage therethrough for fuel, which passage is formed to provide a seat and beyond the seat is divided to form two inlets for fuel which are spaced apart, a needle movably mounted in the nozzle and coacting with said seat to control the flow of fuel through the nozzle, a channel for a cooling medium formed in the nozzle between the seat of the needle and said divided fuel inlet openings, and ducts for carrying a cooling medium to and from said channel; substantially as described.

4. In an internal combustion engine, the combination of a cylinder, a jacket inclosing the same and forming a chamber between it and the cylinder for a cooling medium, a nozzle projecting through the jacket and cylinder and having a passage for fuel therethrough, which passage is formed to provide a seat, a needle mounted within the nozzle and coacting with said seat to control the flow of fuel through the nozzle, a channel for a cooling medium formed in the nozzle at the end of the nozzle projecting into the cylinder and encircling the passage through the nozzle between the seat of the needle and the fuel injecting opening of the nozzle, and a duct connecting the channel in the nozzle with the chamber between the cylinder and its jacket; substantially as described.

5. In an internal combustion engine having two pistons reciprocating in opposite directions within a cylinder and operating on the Diesel cycle, a nozzle for admitting fuel in liquid form to the cylinder projecting through the wall of the cylinder between the two pistons and having a central passage therethrough which is contracted intermediate its ends to form a seat, a needle in the passage through the nozzle coacting with said seat, a channel formed in the nozzle encircling said passage between the seat of the needle and the fuel injecting opening at the end of the nozzle entering the cylinder, and means for conveying a cooling medium to and from said channel; substantially as described.

6. In an internal combustion engine, the combination of a cylinder, a jacket inclosing the same and forming a chamber between it and the cylinder for a cooling medium, a nozzle projecting through the jacket and cylinder and having a passage therethrough for fuel, a needle movably mounted in the nozzle and controlling the flow of fuel therethrough, a channel for a cooling medium formed in the nozzle near the inner end thereof and between the fuel injecting opening of the nozzle and the cooling chamber of the cylinder, said channel encircling the passage for fuel through the nozzle, and a duct connecting the channel in the nozzle with the cooling chamber of the cylinder; substantially as described.

7. In an internal combustion engine, the combination of a cylinder wall, a nozzle projecting through the wall and having a passage therethrough, which passage is formed intermediate its ends to provide a seat, a member movable into and out of coaction with said seat to close and open the passage through the nozzle to permit or prevent the flow of fuel through the nozzle, a channel for a cooling medium located in the nozzle

between said seat and the inner end of the nozzle so as to be close to the point of admission from the nozzle into the cylinder, and ducts for carrying a cooling medium to and from said channel; substantially as described.

8. In an internal combustion engine, the combination of a cylinder wall, a nozzle projecting through the wall and having a passage therethrough for the introduction of fuel from the nozzle directly into the cylinder, a needle movably mounted in the nozzle and controlling the flow of fuel therethrough, a chamber for a cooling medium formed in the nozzle adjacent to the seat of the needle and encircling the passage for fuel through the nozzle, ducts for carrying a cooling medium to and from said chamber, and a plurality of channels extending lengthwise of the nozzle from said chamber toward the end of the nozzle projecting through the wall of the cylinder; substantially as described.

9. In an internal combustion engine, the combination of a cylinder wall, a nozzle projecting through the wall and having a passage therethrough for the introduction of fuel from the nozzle directly into the cylinder, a needle movably mounted in the nozzle and controlling the flow of fuel therethrough, a chamber for a cooling medium formed in the nozzle adjacent to the seat of the needle, ducts for carrying a cooling medium to and from said chamber, channels extending lengthwise of the nozzle from said chamber toward the end of the nozzle projecting into the cylinder, and channels extending transversely through the nozzle adjacent to the inner end thereof and communicating with said lengthwise channels, the said transverse channels having their ends closed; substantially as described.

In testimony thereof I have signed my name to this specification in the presence of two subscribing witnesses.

HUGO JUNKERS.

Witnesses:
EMIL WERGIEN,
HERMANN TISCHER.