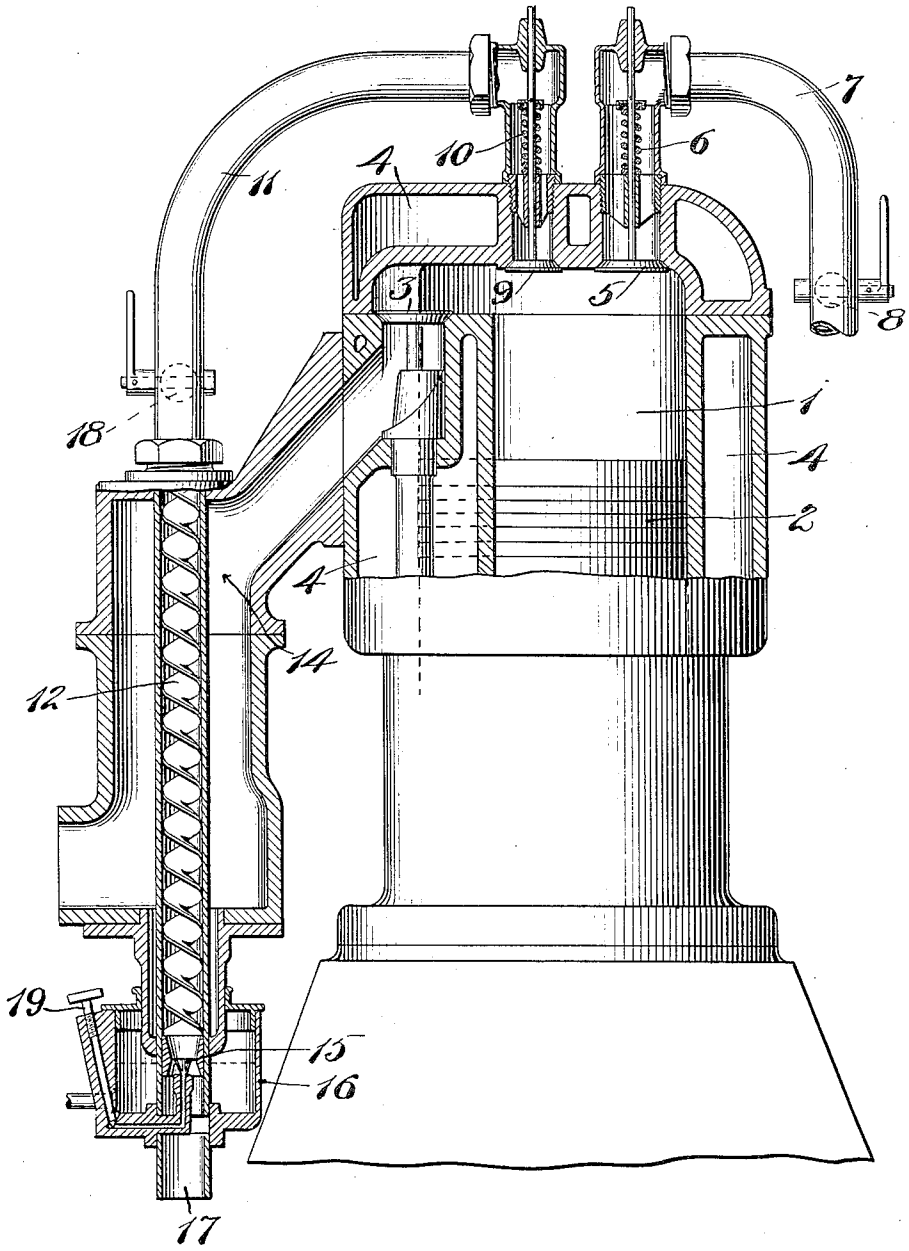
B. C. SMITH.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED DEC. 15, 1916.

1,245,519. Patented Nov. 6, 1917.




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# UNITED STATES PATENT OFFICE.

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## INTERNAL-COMBUSTION ENGINE.

1,245,519. Specification of Letters Patent. Patented Nov. 6, 1917.

Application filed December 15, 1916. Serial No. 137,117.

*To all whom it may concern:*

Be it known that I, BENJAMIN C. SMITH, a citizen of the United States of America, residing at Bayonne, Hudson county, State of New Jersey, have invented a new and useful Internal - Combustion Engine, of which the following is a specification.

This invention relates to improvements in internal combustion engines and is particularly designed to permit of the successful use of the heavy hydro-carbons, such as kerosene, the object being to effect substantial economies without sacrifice to power and efficiency. I have shown the invention herein as applied to a single cylinder engine, although obviously the number of cylinders is immaterial.

In the accompanying drawings:

The figure is a side elevation mainly in section showing conventionally the various parts of my invention.

1 represents an engine cylinder. 2 represents the usual piston therein. The connecting rod, crank-shaft, fly-wheel, cam shaft and the like, (not shown) are of the conventional form. 3 represents a mechanically operated exhaust valve which, as is common in engines of this type, is opened upon the exhaust stroke to permit the burnt gases to be expelled. Any suitable cooling medium may be employed, such as water, which may be circulated through a suitable water jacketed space 4. 5 is an air intake valve which may be of the automatic suction type. This valve is closed by the usual spring 6 and controls an air passage through which air is fed from a suitable pipe 7 in which may be located a suitable controlling valve 8. 9 is a fuel inlet valve which may be of the automatic suction type and which controls the fuel passage. 10 is the usual spring for closing the valve 9. The fuel is supplied through the pipe 11. This fuel is in the form of a relatively rich gas which may be formed in a generating apparatus such as disclosed in detail in my former Patent #1,122,038, to which reference may be had for a full description. In the present case it is sufficient to say that the gas generator is indicated at 12. To assist in gas generation the generator is maintained in a hot condition by the exhaust gases which pass out through an exhaust passage 14 which surrounds the generator. 15 is a jet through which the liquid fuel is supplied to the generator tube 12. 16 represents conventionally a fuel feed tank in which the fuel is maintained at a suitable level relatively to the jet 15 so that the suction past the jet will draw off a proper quantity of liquid fuel to mix with the air that enters through the open end 17 to form within the generator 12 a gas of the desired richness. 18 conventionally represents a valve for the fuel supply pipe 11. It will be noted that the fuel admission valve 9 is located in the cylinder 1, and that the air admission valve 5 is likewise located in said cylinder.

My present invention results in a very substantial improvement in the operation of the engine from the standpoint of power and efficiency for the following reasons. In the former case all of the air which was mixed with the fuel for the purpose of forming the explosive mixture was admitted through the end 17. As a result of that construction the air and fuel and the resultant mixture became very hot and highly expanded before it entered the cylinder, and would hence not generate as much power as though an equally effective mixture were introduced at a lower temperature.

If any attempt were made to reduce the temperature of the mixture between the generator and the admission valve, the cooling of the mixture would result in condensation of the fuel in the fuel pipe from which it would follow that such a gas introduced into the cylinder would deposit on the walls thereof solid particles of liquid fuel which would only incompletely burn and hence result in the rapid formation of carbon deposit, which, as is well known, seriously reduces the efficiency of the engine.

In the present construction I form in the generator tube a gas of relatively greater richness than in my former case, and this relatively rich hot gas is conducted directly into the cylinder wherein it is mixed with relatively cooler air, thus, the actual mixing of the relatively rich gas and the air for the purpose of producing the proper final mixture does not occur until the gas and air are actually within the walls of the cylinder. I have found that by this construction and method of operation there is very little tendency to carbonize, that is to say, harmful condensation of fuel is largely

eliminated and the efficiency of the engine is greatly increased.

19 conventionally represents the stem of a valve for controlling the jet 15. It should be understood that I contemplate that I may use any suitable form of regulating or adjusting means for controlling the various operating parts to secure the desired results.

While I have shown the valves 5, 9 of the well known puppet or self-acting type, it is common practice to mechanically operate such valves and in some cases it may be desirable to employ any of the well known mechanical means used for that purpose. I have shown my invention only in one form but I appreciate that a wide variety of modifications may be made in the design and in the construction and arrangement of parts without departing from the spirit and scope of the invention.

The engine may be started in any desired way. Ordinarily, in starting an engine designed to operate with fuel such as kerosene, gasolene is first used until the parts have become properly heated whereupon the kerosene supply is substituted for the gasolene supply.

It will be seen from the foregoing that my invention contemplates the forming of said mixture directly in the cylinder by bringing together therein the relatively hot rich gas and the relatively cool pure air in the proper proportions to make a combustible mixture. By forming the final mixture at this point instead of externally of the cylinder, the danger of condensation is greatly reduced since the rich gas may be maintained in a gaseous state up to almost the moment of ignition, the last very short period of time being used to adulterate the gas down to the degree needed to make a proper combustible mixture. Obviously, if slight condensation should occur within the cylinder by reason of the contact of the hot gases with the cooler air admitted into the cylinder, the products of condensation formed therein, that is to say, fine drops or globules of liquid fuel, would have no movement in a direction to cause them to impinge on the cylinder walls, but would simply remain in suspension so as to be more readily burned than if the same were actually lodged on said walls. Therefore, my invention contemplates not only an apparatus for effecting this novel formation of an explosive mixture, but also a new method of forming such a mixture in an engine of the internal combustion variety.

Any suitable means may be employed for the purpose of igniting the combustible mixture at the proper time, such means being too well known to require either illustration or detailed description.

While I have referred to admitting "air" through the conduit 7 and past the valve 5 to adulterate the rich gas, I wish to have it understood that by the use of the term "air", as employed heretofore and in the following claims, I mean to include any adulterating medium that will support combustion that may be mixed with the relatively rich gas so as to form a proper mixture.

What I claim is:

1. In an internal combustion engine, a cylinder, a piston therein, an exhaust valve, a fuel admission port leading into the cylinder, a valve therefor, an air admission port leading into the cylinder, a valve therefor, means for forming a relatively rich combustible gas at a relatively high temperature and for conducting said gas through said fuel admission port into said cylinder, said air admission valve operating to admit air at a relatively cooler temperature to said cylinder with means for controlling the relative proportion of air to gas admitted to said cylinder.

2. In an internal combustion engine, a cylinder, a piston therein, an exhaust valve, a fuel admission port leading into the cylinder, a valve therefor, an air admission port leading into the cylinder, a valve therefor, means for forming a relatively rich combustible gas at a relatively high temperature and for conducting said gas through said fuel admission port into said cylinder on the suction stroke of the engine, said air admission valve operating to admit air at a relatively cooler temperature to said cylinder on said suction stroke, with means for controlling the relative proportion of air to gas admitted to said cylinder.

3. In an internal combustion engine of the four-cycle variety, a cylinder, a piston, an exhaust valve for permitting the burnt gases to be expelled on the exhaust stroke, a fuel admission port opening into said cylinder and a valve therefor, an air admission port leading into said cylinder and a valve therefor, means for forming a relatively hot rich combustible gas and for conducting the same to said fuel admission port, said air admission valve and said fuel admission valve operating on the suction stroke of said engine to admit both gas and air into said cylinder at said time whereby the latter will adulterate and cool the former to produce a combustible mixture, and means to prevent the escape thereof on the compression stroke of said engine and means for regulating the relative proportions of the gas and air admitted to said cylinder.

4. The method of forming a combustible mixture for use in an internal combustion engine comprising simultaneously introducing into the cylinder through separate ports and mixing therein a relatively hot rich gas and relatively pure cool air, the proportions of said gas and air admitted and mixed being suitable to form a combustible mixture.

5. The method of forming a combustible mixture for use in an internal combustion engine comprising, simultaneously introducing into said engine through separate ports and mixing therein a relatively hot rich gas and relatively cool pure air, the proportions of said gas and air admitted and mixed being suitable to form a combustible mixture.

6. The method of forming an explosive mixture for use in an internal combustion engine comprising, introducing into an engine cylinder, a relatively hot rich gas and cooling and adulterating the same within the cylinder sufficiently to form a relatively cool explosive mixture.

7. The method of forming an explosive mixture for use in an internal combustion engine comprising, drawing into the cylinder a relatively hot rich gas, and a cooler combustion supporting adulterating medium in a sufficient quantity to adulterate said rich gas to such a degree that it may be ignited at relatively low compression.

8. In an engine of the internal combustion type, a cylinder, a piston, means for heating and conducting into said cylinder a relatively rich gas while in a hot state, means for conducting into said cylinder a relatively cooler combustion supporting adulterant for said gas, with means for regulating the relative proportions of said rich gas and said combustion supporting adulterant admitted into said cylinder.

9. In an internal combustion engine, a cylinder, means for generating and conducting into said cylinder a relatively hot rich gas, means for conducting into said cylinder a relatively cool combustion supporting adulterant for said gas, means for drawing said gas and adulterant into said cylinder whereby they will contact and mix therein and whereby said mixture formed in said cylinder will be cooler than the temperature of the relatively rich gas introduced.

10. In an internal combustion engine, a cylinder, means for generating from the heavier hydrocarbons, a relatively hot rich gas and for conducting the same into said cylinder, means for conducting into said cylinder a cooler combustion supporting adulterant for said rich gas to form an explosive mixture, with means for regulating the relative proportion of said gas and adulterant admitted with means for drawing said gas and adulterant into said cylinder and for compressing the resultant mixture to a degree where the same may be easily ignited to cause an explosion for the generation of power.

BENJAMIN C. SMITH.