Nov. 15, 1927. 1,649,246

G. MORRISEY

INTERNAL COMBUSTION ENGINE

Filed Feb. 23, 1922 2 Sheets-Sheet 1

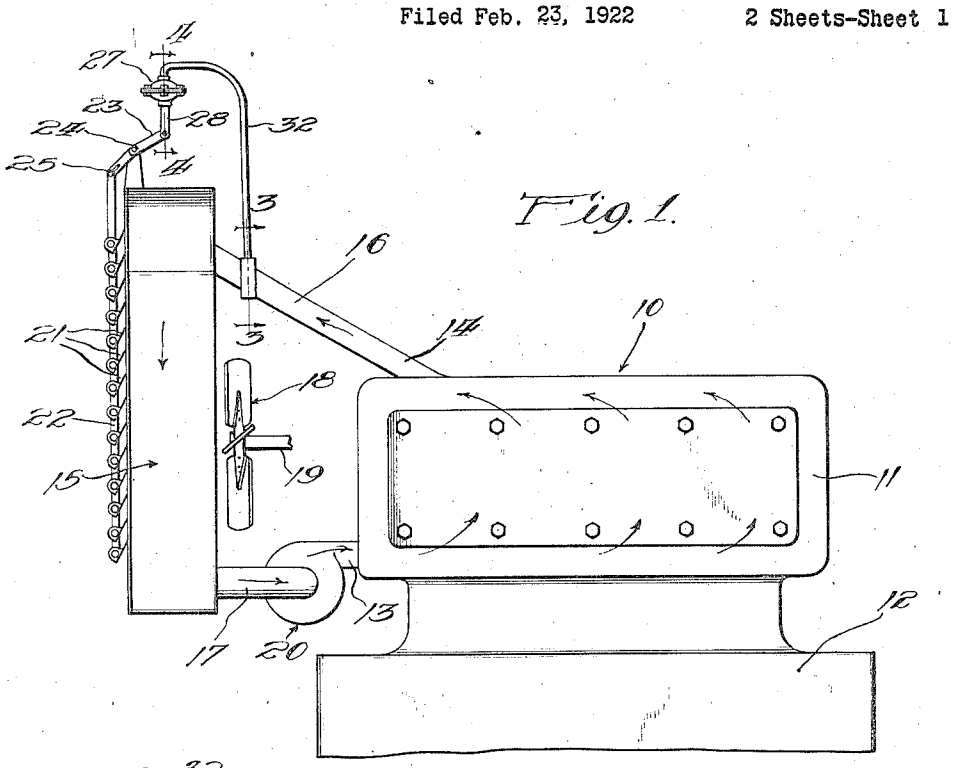


Fig. 1.

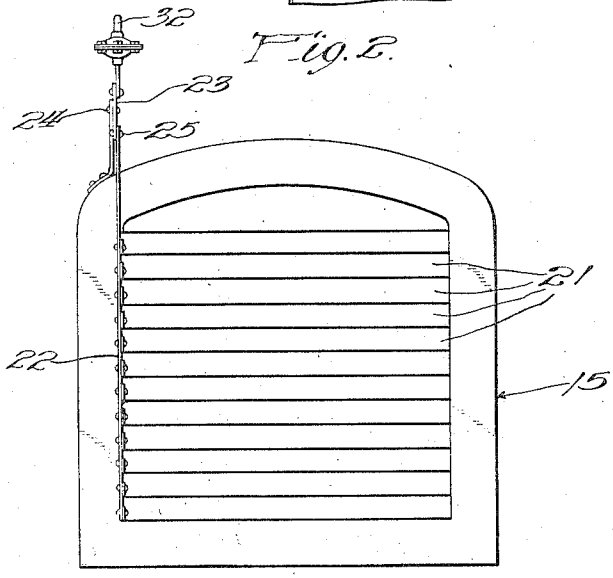


Fig. 2.

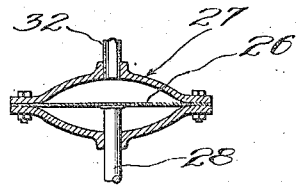
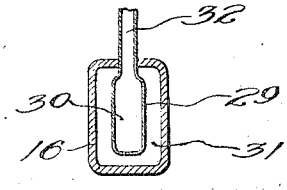


Fig. 4.

Fig. 3.



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INTERNAL COMBUSTION ENGINE

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Fig. 7.

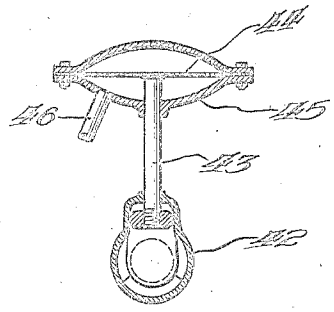


Fig. 5.

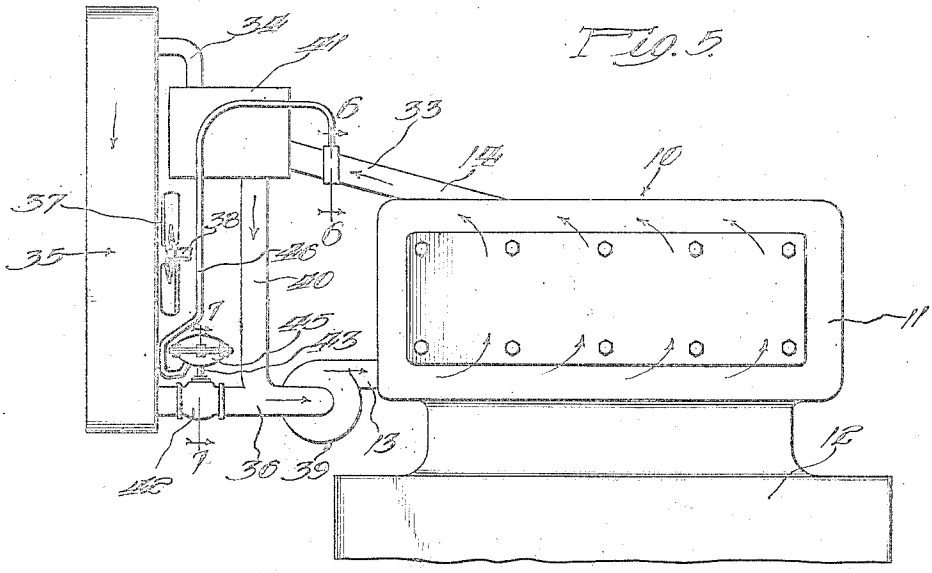
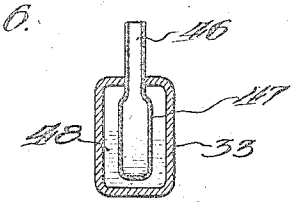


Fig. 6.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

Application filed February 23, 1922. Serial No. 536,706.

This invention has to do with certain improvements in internal combustion engines and their methods of operation. The invention has reference particularly to the construction and mode of operation of internal combustion engines of the jacketed type, in which a liquid is circulated through the cylinder jackets as distinguished from the so-called air cooled type of engine.

In order that the features of the present invention may be better understood, and in order that the mode of operation herein disclosed may be more exactly understood and differentiated from other previous constructions and modes of operation, I will first refer briefly to the construction and mode of operation of certain of the principles involved in engines of this type generally.

I make use of a jacketing liquid having a much higher boiling point than that of water, which jacketing liquid is capable of operation in the engine jacket and through the cooling radiator and passages and auxiliary mechanism without damage to the parts either by reason of its composition and chemical characteristics or otherwise. Such jacketing liquid for improved operation by my new method should also preferably have a boiling point not excessively high, so that under abnormal conditions it will serve as a temperature limiting agent, since on reaching the boiling point ebullition will commence. Furthermore, such jacketing liquid should be stable at all the temperatures to which it will be subjected, cheap, readily obtainable in commercial quantities wherever needed, non-offensive either on account of its odor or other characteristics, and should preferably have such a low freezing point that the danger of freezing would be practically eliminated at winter temperatures. "Straw oil," a petroleum product, is admirably adapted for use as a jacketing liquid for internal combustion engines, since it complies in a most ideal manner with all of the characteristics hereinbefore recited, as well as possessing other very desirable and advantageous qualities. Straw oil is one of a group of wax free oils recovered from paraffine petroleum, said group generally including also mineral seal oil and spindle oil. The oils of this group are redistilled from paraffine oil having a specific gravity of substantially 34° Bé. from which the gasoline and other lighter bodies have been removed. The wax is pressed out from this paraffine oil and the product is redistilled to give this group of oils. The straw oil has a boiling point of substantially 350° C., and pours freely at temperatures as low as 30° C. below zero. The other oils of this group are also well adapted for use according to the present method and invention. Other jacketing liquids will also comply with the requirements previously recited, including particularly the characteristics of a boiling point well above the boiling point of water and the requirements of stability and non-injurious effect on the mechanism.

The temperature at which the jacket liquid will operate, assuming that it is within the boiling point of such liquid, will depend upon the rate of heat generation in the cylinders compared to the rate of heat dissipation in the radiator or other heat dissipating mechanism. By properly relating the rate of heat dissipation to the rate of heat generation, the temperature of the jacket liquid may be maintained at almost any point selected, below the boiling point of the liquid. Inasmuch as it is desirable to operate at all times and under all loads at or near the selected temperature, it becomes also desirable to provide a circulating system of such arrangement that the rate of heat dissipation will be maintained proper with respect to the rate of heat generation so as to maintain the desired temperature of the jacket liquid.

The temperature of 350° C. or thereabouts has been found to be substantially the most economical temperature which can be used for the jacketing medium. Up to substantially this point the increase of jacket temperature shows an increase of economy of operation, and the conditions are such that the cylinder walls may be effectually lubricated; whereas at temperatures higher than substantially 350° C. the lubricating problems become such as to practically offset any further advance of temperature with proper operation. This is an additional reason why

straw oil and other liquids of similar boiling points are very desirable to use for jacketing purposes, since they boil at a temperature which ensures substantially the correct temperature of the cylinder walls for best and most economical operation.

In order that the engine may always operate with the jacketing liquid at or near the boiling point of the liquid, I prefer to associate with the engine suitable devices controlling either the liquid circulation or the cooling air circulation or both, so as to maintain the desired liquid temperature, and in some cases I prefer to provide also automatic control devices for performing these functions so as to maintain the desired operating conditions without special attention on the part of the operator.

In the drawings I have illustrated partly diagrammatically, certain operating arrangements incorporating the features hereinbefore explained, and by means of which the internal combustion engine may be used with jacket liquids capable of maintaining temperatures substantially above those now in use in jacketed engines. In so illustrating certain mechanisms in the drawings, I wish it distinctly understood that I do not intend to limit myself to the application of the features of the present invention to use in connection with the arrangements so illustrated, except as I may do so in the claims, but contemplate the use of said features broadly in internal combustion engines.

Figure 1 shows a side elevation of an internal combustion engine, together with a cooling radiator and circulating system for the jacket liquid, the system being provided with automatic means for directly controlling the circulation of air through the radiator by the temperature of the liquid coming from the engine so as to maintain automatically the desired jacket liquid temperature;

Fig. 2 shows a front view corresponding to Fig. 1;

Fig. 3 shows a fragmentary detailed section taken on the line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 shows a fragmentary detailed section taken on the line 4—4 of Fig. 1, looking in the direction of the arrows;

Fig. 5 shows a view similar to that of Fig. 1, but it illustrates an arrangement of circulation system in which the flow of liquid through the radiator or heat dissipator may be partially shunted in order to maintain the desired automatic temperature control;

Fig. 6 shows a fragmentary section taken on the line 6—6 of Fig. 5, looking in the direction of the arrows; and

Fig. 7 shows a fragmentary section taken on the line 7—7 of Fig. 5, looking in the direction of the arrows.

Referring first to the arrangement shown in Fig. 1, the engine is designated by the numeral 10. It has the cylinders 11 and the crank case 12. The cylinders may be of any of the well known jacket constructions in which liquid jackets are provided around the different cylinders, through which jackets the cooling liquid may be circulated. Owing to the fact that there are many different constructions of engines having jacketed cylinders, I do not deem it necessary to herein specifically illustrate or describe any particular jacket or cylinder construction, since any one skilled in the art will be able to adapt the features of the present invention specifically to any given jacket arrangement. I will state, however, that the jacketed engine shown in Fig. 1 is provided with a jacket liquid inlet 13 and with a jacket liquid outlet 14, so that the jacket liquid may circulate generally in the direction of the arrows shown in Fig. 1, upwardly through the cylinder jackets from the inlet connection 13 to the outlet 14.

I have also illustrated a cooling radiator 15 which may be of any of the well known types of construction, and for this reason I do not deem it necessary to illustrate the construction of the radiator itself in detail. The jacket outlet connection 14 from the upper portion of the engine reaches by a passage 16 to the upper portion of the radiator, and a passage 17 reaches from the lower portion of the radiator back to the jacket inlet connection 13, so that the jacket liquid may circulate through the system in the closed circuit, generally indicated by means of the arrows.

I have also illustrated a cooling fan 18 mounted on the shaft 19 for assisting in drawing the cooling air through the radiator. Furthermore, I have illustrated a pump 20 in the connection 17 for assisting the circulation of the jacket liquid through the system. I do not intend to limit myself either to the use of the cooling air fan or to the circulating pump, except as I may do so in the claims, since it will be evident that in some cases the natural air circulation will be sufficient, and in many cases the natural thermo-siphon jacket liquid circulation will suffice.

In those cases in which no especial effort is made to relate the rate of heat dissipation to the rate of heat generation, the arrangement thus far explained will be sufficient, and the high boiling point jacket liquid will be able to give beneficial results, since it will permit the use of much higher operating temperatures than can be secured with water and will also prevent the attainment of excessively high temperatures. In other cases it may be desirable to provide either manual or automatic means for controlling the rate of heat dissipation as compared to heat gen-

eration, and therefore, I have illustrated in the figures an automatic arrangement for accomplishing this result. In the case of Figs. 1, 2, 3 and 4, a series of vanes 21 are pivoted in front of the radiator, so that they may be turned into such position as to either partially or completely interrupt the air flow through the radiator. These vanes when used may be connected together by a link 22 which may be raised and lowered in order to regulate the amount of opening between the vanes. A lever 23 is pivoted to a stationary point 24 and is connected to the upper end of the link 22 by a pin and slot connection 25. A diaphragm 26 located in a chamber 27 is connected to the lever 23 by a stem 28 so that the up and down movements of said diaphragm will be communicated to the lever and thence to the vanes.

Within the passage 16 is located a small receptacle 29 containing ether or other liquid 30, the chamber 29 being directly heated by the jacket liquid 31 flowing through the passage 16 from the motor to the radiator. A small pressure tube 32 reaches from the chamber 29 to the space within the casing 27 above the diaphragm 26 so that the diaphragm is directly subjected to the vapor pressure created by the ether in the chamber 30. This vapor pressure in turn depends directly upon the temperature of the jacket liquid in the passage 16. Consequently, as the temperature of the jacket liquid rises the pressure within the chamber 29 increases and the pressure on the diaphragm 26 increases forcing it down, tilting the lever 23, and opening the vanes so as to improve the circulation of the cooling air. In this way the temperature of the jacket liquid is maintained more or less constant. By proper design and provision, it will be possible to automatically maintain the temperature of the jacket liquid at or near its boiling point, or at or near 350° C.

Referring to the modified arrangement shown in Figs. 5, 6 and 7, in this case the jacket delivery connection 14 reaches by passages 33 and 34 to the upper portion of the radiator 35, and the lower portion of the radiator reaches by a passage 36 to the jacket intake connection 13 of the engine. A fan 37 mounted on the shaft 38 is illustrated for assisting the air current through the radiator if desired. Furthermore, a circulating pump 39 is illustrated for assisting the circulation of the jacket liquid if desired, but either one or both of these elements may be dispensed with if desired.

In the arrangement shown in Fig. 5, there is established a shunt connection 40 between the passages 34 and 36. The compartment 41 is shown as being located intermediate between the passages 33 and 34, and the shunt connection 40 reaches from the compartment 41 to the passage 36. A valve 42 is located in the passage 36 intermediate between the lower end of the radiator and the lower end of the shunt connection 40. On fully closing this valve 42, the circulation of jacket liquid through the radiator will be completely interrupted and all of the jacket liquid coming from the engine will be shunted directly back through the shunt connection 40, so that the cooling influence of the radiator will be completely eliminated. On fully opening the valve 42 the flow of jacket liquid between the lower end of the radiator and the connection 36 will be allowed to take place freely, so that maximum cooling effect will be produced by the radiator.

The control of the shunt effect may be obtained either manually or automatically. Automatic control is illustrated in Figs. 5, 6, and 7. In this case the valve 42 may be actuated by a stem 43 which is connected to the diaphragm 44, which is subject to the fluid pressure within the chamber 45. Said chamber 45 communicates by means of a small tube 46 with a chamber 47 located in the passage 33 and subject to the temperature of the jacket liquid 48 flowing through said passage. The vapor pressure of ether or other material within the chamber 47 will depend upon the temperature of the circulating jacket liquid flowing through the passage 33. As this temperature rises, the vapor pressure also increases tending to force the diaphragm 44 upwardly and thus opening the valve 42 so as to facilitate the flow of jacket liquid through the radiator. The percentage of liquid flowing through the radiator will thus be increased, correspondingly increasing its cooling action and tending to maintain the temperature of the jacket liquid at the desired point.

Ordinarily, a sufficient amount of jacket liquid will be introduced into the system to completely fill the jacket and passages and the radiator up to a sufficient elevation to insure proper circulation through the system.

The heat generated by the combustion in the cylinder is given up in two ways: first, in the work actually performed in driving the piston, and second, by conduction to the walls of the cylinder. The heat entering the walls of the cylinders is chiefly lost to the jacket liquid. The amount of heat lost to the walls is largely determined by the relative temperatures of the gas and walls, and since the temperature of the gas is practically fixed, it is at once apparent that the higher the temperature of the cylinder walls the smaller will be the heat lost to them. Furthermore, the practically constant temperature of the cylinder walls results in an operation which is largely isothermal, and the increased temperature at which this isothermal operation takes place will result in a large increase in the thermo-

dynamic efficiency of the machine. Nevertheless, as previously explained, the temperature must be such that proper lubrication may take place, and this is possible with temperatures as high as 350° C.

It will be understood that in the use of a jacket liquid operating at temperatures substantially above 100° C., the mechanism should be properly designed and proportioned for such operation. Furthermore, the mechanism and various connections should be properly designed and of proper materials to operate successfully at these increased temperatures. It has been very customary to use connections between the liquid jacket and the radiator including rubber hose, but in many cases it will be found desirable to substitute other material in order to successfully withstand the increased temperatures in continuous operation. For example, it may become desirable to use copper tubing for the jacket liquid connections.

Furthermore, the use of increased temperatures will generally involve a reduced fuel consumption due to increased economy of engine operation. This will entail a corresponding change in the total amount of heat energy generated in the operation of the engine. Owing, however, to the fact that the specific heat and also the specific gravity of the oil are less than those of water, it follows that the heat carrying capacity of the oil per cubic inch is less than that of water, so that a correspondingly increased rate of circulation of the liquid should be used. Consequently, the operation at substantially increased temperatures will generally involve a redesign or reproportion of the parts and equipment in order to establish and maintain the desired operating conditions.

When the jacketing liquid comprises straw oil or one of the other oils which are produced from petroleum from which the gasoline or other lighter constituents have been removed, which lighter constituents are used as the fuel for the internal combustion engine, it follows that the jacketing liquid and the fuel are both derived from the same initial raw product at different stages of the distillation of the same. In such case the use of straw oil or another oil of this group as a jacketing liquid involves a method of operation in which the jacketing liquid, derived from the same original source as the fuel also serves to improve the economy in the use of said fuel in the motor. It is further noted that inasmuch as the straw oil and the other oils of this group lie intermediate between the kerosenes and gasolines and napthas on the one hand and the heavier lubricating oils on the other hand, their usefulness in the industrial arts has heretofore been to some extent limited to such purposes as for use as fuels under boilers, etc. The use of these oils as jacket liquids will greatly increase their field and range of usefulness and establish a greatly increased market for them.

While I have herein mentioned only a single jacket liquid material which may be satisfactorily used for the jacket liquid according to the method and arrangement of the present invention, still I do not intend to limit my invention to the use of this or any other particular liquid material, except as I may do so in the claims. Furthermore, while I have herein shown and described only certain embodiments of apparatus for practicing the method of the present invention, still I do not intend to limit myself to this or any other form of apparatus, except as I may do so in the claims.

I claim:

1. A jacket system for a liquid jacketed internal combustion engine including the liquid jacketed cylinders thereof, a jacket liquid within said jacket, and means for dissipating heat absorbed by said jacket liquid from the cylinders, said jacket liquid comprising wax free straw oil having a boiling point of substantially 350° C., substantially as described.

2. A jacket system for a liquid jacketed internal combustion engine including the liquid jacketed cylinders thereof, and means for dissipating heat from said jacket including a jacket liquid within said jacket comprising wax free straw oil having a boiling point of upwards of 300° C., substantially as described.

3. A jacket system for a liquid jacketed internal combustion engine including the liquid jacketed cylinders thereof, and means for dissipating heat from said jacket including a jacket liquid within said jacket comprising wax free oil from petroleum having a distilling point intermediate between the kerosenes and the lighter lubricating oils, and having a boiling point of upwards of 300° C., and the characteristic of flowing freely at temperatures substantially as low as 30° C. below zero, substantially as described.

4. A jacket system for a liquid jacketed internal combustion engine including the liquid jacketed cylinders thereof, and means for dissipating heat from said jacket and limiting the running temperature thereof to a point suitable for normal operation of the engine with satisfactory lubrication of the cylinders, including a jacket liquid within said jacket comprising wax free redistilled oil from petroleum having a distilling point intermediate between the kerosenes and the lighter lubricating oils, and having a boiling point of upwards of 300° C., and a specific gravity of substantially 34° Bé., substantially as described.

5. A jacket system for a liquid jacketed

internal combustion engine including the liquid-jacketed cylinders thereof, and means for dissipating heat from said jacket and controlling the running temperature thereof within limits suitable for satisfactory lubrication with a maximum temperature of the cylinder walls consistent with such condition, including a jacket liquid within said jacket comprising wax free oil from petroleum having a distilling point of upwards of 300° C., and a specific gravity of substantially 34° Bé., substantially as described.

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