Sept. 8, 1959 R. KLOSS 2,902,986

FUEL INJECTION ENGINE

Filed June 2, 1958

FIG. 1

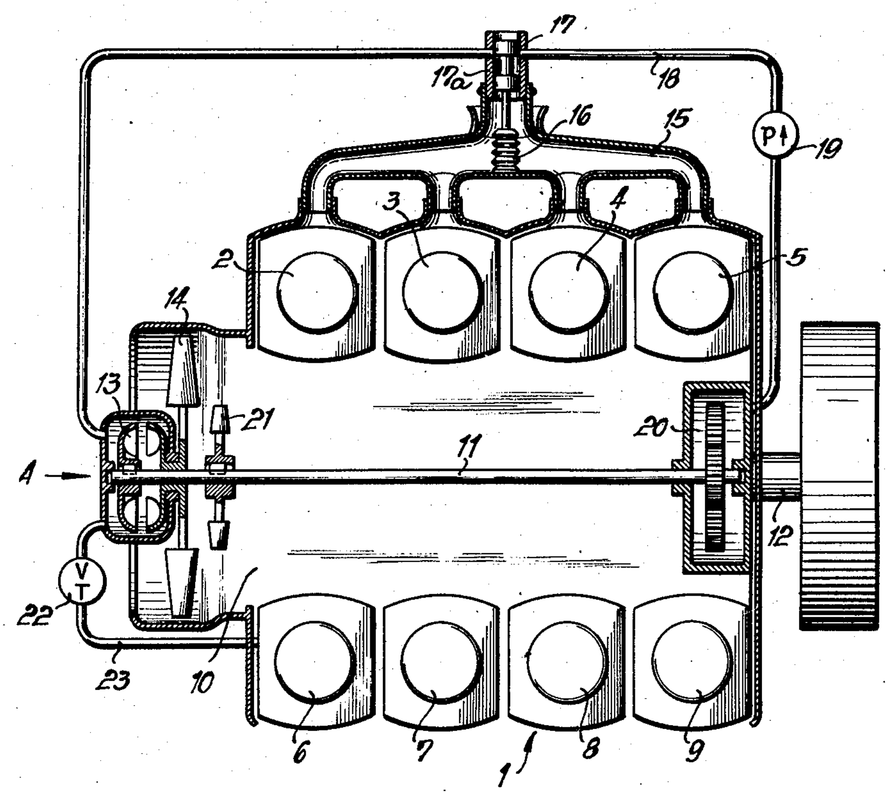
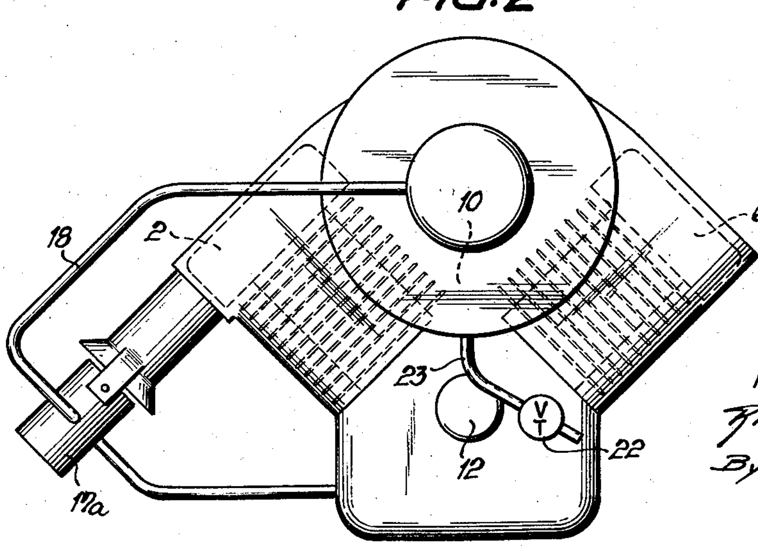


FIG. 2



INVENTOR
Richard Kloss
By
Patent Agent

United States Patent Office

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1

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FUEL INJECTION ENGINE

Richard Kloss, Koln-Buchforst, Germany, assignor to Klockner-Humboldt-Deutz Aktiengesellschaft, Koln, Germany

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3 Claims. (Cl. 123—41.12)

The present invention relates to an air-cooled internal combustion engine, especially self-igniting fuel injection engine, with a blower driven by the engine through a transmission of variable transmission ratio, for instance a hydraulic coupling, in which the blower is adapted to feed cooling air to or withdraw cooling air from the engine, while the delivery of said blower during operation of the engine is controlled by a thermostat arranged in the path of the cooling air flowing away from the engine and adapted to control the transmission ratio of said transmission in conformity with the heated cooling air, and thereby indirectly in conformity with the temperature of the engine.

Self-igniting fuel injection engines, due to a desired short ignition lag and low wear, must possibly be operated in such a way that the engine when being started will quickly reach normal temperature of operation and will also, when under partial load, and particularly when running idle over a longer period of time, remain sufficiently hot.

Furthermore, it is desired that the engine should not cool off too fast after it has been stopped. It is particularly important that the above mentioned requirements be met with the so-called multi-fuel engines, i.e. with such fuel injection engines which may be operated selectively with diesel fuel or with fuels which are considerably more difficult to ignite. The last mentioned fuels include all petroleum distillates obtained up to about 200° C., i.e. the so-called auto fuels.

If with an air-cooled self-igniting fuel injection engine, the control of the cooling air is governed by a thermostat arranged in the path of the heated-up cooling air flowing away from the engine, a temperature control of the engine in conformity with the above mentioned requirements is not always possible inasmuch as the delivery of cooling air must never be totally interrupted in order to assure that the thermostat will always be acted upon by heated cooling air and will also always be ready to effect its control. If the delivery of cooling air is interrupted for a longer period of time, the engine will become unduly hot. On the other hand, when maintaining a low delivery of cooling air under low load, for instance when idling or when driving downhill, there exists the danger that the engine will cool off too fast and too much.

In an effort to avoid the above mentioned drawbacks, an arrangement has been suggested according to which in addition to the normal cooling air delivery blower there is provided a second or auxiliary cooling air delivery blower of considerably less output than said first mentioned or main blower while said second or auxiliary blower is driven directly by the engine and delivers heated-up cooling air to or by the thermostat. With such an arrangement the thermostat will, also after the main blower has been stopped, remain ready for action at any time so that the thermostat will again start the main blower as soon as the engine temperature exceeds a certain permissible temperature. The auxiliary blower may be driven through the intervention of any suitable shaft of the engine as for instance by the same shaft which drives the main blower through a transmission.

2

It is an object of the present invention further to improve an arrangement of the type set forth in the preceding paragraph.

It is also an object of the present invention to provide a fuel injection internal combustion engine with a main blower and an auxiliary blower, in which over-cooling at low outside temperatures will be avoided.

A still further object of the present invention consists in the provision of a fuel injection internal combustion engine of the type set forth in the preceding paragraphs, in which the auxiliary blower at synchronous speed with the main blower will practically require no power.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing, in which:

Fig. 1 is a diagrammatic representation of a top view of an eight-cylinder engine according to the present invention.

Fig. 2 represents an end view seen in the direction A of Fig. 1.

According to the present invention, both the main blower and the auxiliary blower are designed as axial blowers and are located adjacent each other as closely as possible. This arrangement has the advantage that at synchronous speed with the main blower, the auxiliary blower will practically require no power.

According to a further development of the present invention, when employing multi-cylinder air-cooled fuel injection engines of the type involved, the discharge air of a plurality of the cylinders of the engine is conveyed to the thermostat arranged in the flowing off heated cooling air so that a high degree of safe operation will be assured also if one or more of the cylinders should for one or another reason skip or in such instances in which both blowers are driven by a single engine shaft and are designed as axial blowers arranged behind each other as closely as possible, and also in such instances in which the blowers are of different type and have a common driving shaft or different driving shafts. According to the present invention, for purposes of avoiding over-cooling of the engine, the auxiliary blower is so designed that it will feed such a quantity of cooling air which is less than that required as minimum quantity of cooling air for maintaining the cooling of the engine during idling thereof.

Referring now to the drawing in detail, the air-cooled internal combustion engine shown therein is generally designated with the reference numeral **1** and has two rows of four cylinders each **2**, **3**, **4** and **5**, and **6**, **7**, **8** and **9**. The two rows are arranged at an angle to each other so as to form a V-type engine as will be evident from Fig. 2. Arranged within the V-shaped chamber **10** of the engine is a shaft **11** which is driven in any convenient manner by the engine crankshaft **12** (see Fig. 2). Through the intervention of a hydraulic coupling **13**, shaft **11** drives a main blower **14** designed as axial blower. The blower **14** feeds and delivers cooling air into the V-shaped chamber **10** between the two cylinder rows **2**—**5** and **6**—**9**. From here the air passes to the zones to be cooled of the engine, especially to the cylinders. After the air has passed by the cylinders **2**, **3**, **4** and **5**, the heated-up cooling air is in part collected and conveyed through a collecting manifold **15** having arranged therein a thermostat **16** which controls a valve spool **17** of a valve **17**a. Valve spool **17** is interposed in a conduit **18** leading from a pump **19** to the fluid coupling **13**. The arrangement is such that the valve spool **17** in response to the respective position of the thermostat **16** controls the flow of fluid from pump **19** to coupling **13** and thereby the slip of the latter and thus the speed of the blower **14** so as to maintain the most favorable engine temperature over the entire load range of the engine. Pump **19** receives its fluid from a reservoir **20**.

In order to assure that thermostat **16** will also be acted upon and will be ready to exert its control action when the blower **14** is at a standstill, for instance during a longer idling period, or when the engine is under no load, shaft **11** has mounted thereon an auxiliary blower **21** near the coupling **13**, which auxiliary blower similar to the main blower **14** is designed as axial blower. Auxiliary blower **21** is adapted during the operation of the engine independently of the speed of the main blower **14** continuously to deliver cooling air to the cooling zones in conformity with the reaction of thermostat **16**. Thus, as long as the engine is in operation, the thermostat **16** will be acted upon by the cooling air. The auxiliary blower **21** delivers a quantity of cooling air which is less than that required to maintain the cooling of the internal combustion engine during idling operation. An over-cooling of the idling engine will thus be avoided at very low outer temperatures.

It will be appreciated that the oil from the fluid coupling **13** will be able to return to the crank case of the engine through conduit **23** and an adjustable throttle **22** interposed therein.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawing but also comprises any modifications within the scope of the appended claims. Thus, while highly satisfactory results have been obtained if the output of the auxiliary blower is about one-tenth of that of the main blower, also other ratios may be selected.

What I claim is:

1. In combination with an air-cooled fuel injection engine: a main cooling air blower; a transmission having a variable transmisison ratio and drivingly connecting said blower with said engine; a thermostat arranged in the path of cooling air heated up by and flowing off from said engine and controlled by said main blower; said thermostat being operatively connected to said transmission to control the transmission ratio thereof, and thereby also the delivery of said main blower, in conformity with the temperature of the cooling air passing by said thermostat; and an auxiliary cooling air blower having an output considerably less than that of said main blower and being directly drivingly connected to said engine for conveying cooling air heated up by said engine to said thermostat, both said main cooling air blower and said auxiliary cooling air blower being designed as axial blowers and being very closely arranged one behind the other.

2. In combination with an air-cooled fuel injection engine having a plurality of cylinders: a main cooling air blower; a transmission having a variable transmission ratio and drivingly connecting said blower with said engine; a thermostat arranged in the path of cooling air heated up by and flowing off from said engine and controlled by said main blower; said thermostat being operatively connected to said transmission to control the transmission ratio thereof, and thereby also the delivery of said main blower, in conformity with the temperature of the cooling air passing by said thermostat; an auxiliary cooling air blower having an output considerably less than that of said main blower and being directly drivingly connected to said engine for conveying cooling air heated up by said engine to said thermostat, both said main cooling air blower and said auxiliary cooling air blower being designed as axial blowers and being very closely arranged one behind the other, and conveying means conveying the air flowing off from some of said engine cylinders to said thermostat.

3. In combination with an air-cooled fuel injection engine: a main cooling air blower; a transmission having a variable transmission ratio and drivingly connecting said blower with said engine; a thermostat arranged in the path of cooling air heated up by and flowing off from said engine and controlled by said main blower; said thermostat being operatively connected to said transmission to control the transmission ratio thereof, and thereby also the delivery of said main blower, in conformity with the temperature of the cooling air passing by said thermostat; and an auxiliary cooling air blower having an output considerably less than that of said engine for conveying cooling air heated up by said engine to said thermostat, both said main cooling air blower and said auxiliary cooling air blower being designed as axial blowers and being very closely arranged one behind the other, said auxiliary cooling air blower being so dimensioned as to deliver a quantity of cooling air which is less than that required for the cooling of the engine while idling.

No references cited.