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Brille et al.

[11] **3,712,280**

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[54] **ADMISSION CIRCUITS OF DIESEL ENGINES**

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[51] **Int. Cl.**.....**F02b 37/04**

[58] **Field of Search** .....123/198 E, 119 C, 119 CB, 123/119 CD, 119 CE; 165/135; 181/33 K; 417/203, 312; 418/191, 270; 138/149

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[57] **ABSTRACT**

An improved Diesel engine supercharged by a turbo-compressor and corrected by a volumetric compressor correcter device driven from the engine crank shaft at a speed ratio which increases as the pressure delivered by the centrifugal compressor diminishes, in which an exchanger of heat with the cooling liquid of the engine is provided between the turbo-compressor and the volumetric corrector device, and in which the portion of the admission circuit comprised between the heat exchanger and the engine is provided with a heat and sound-insulation system.

7 Claims, 3 Drawing Figures

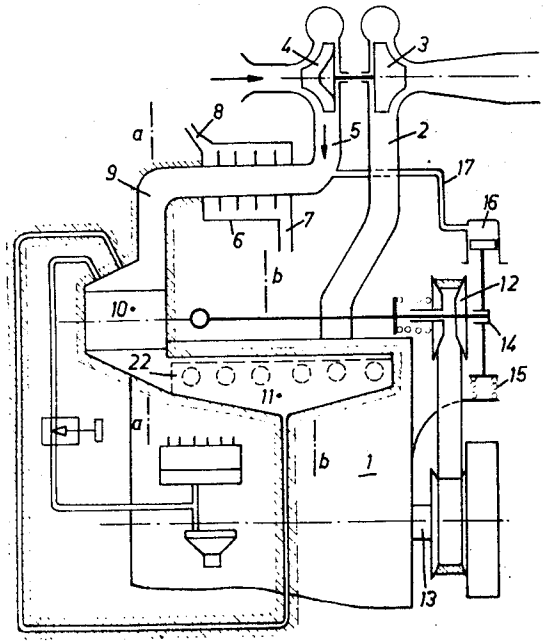


FIG.1

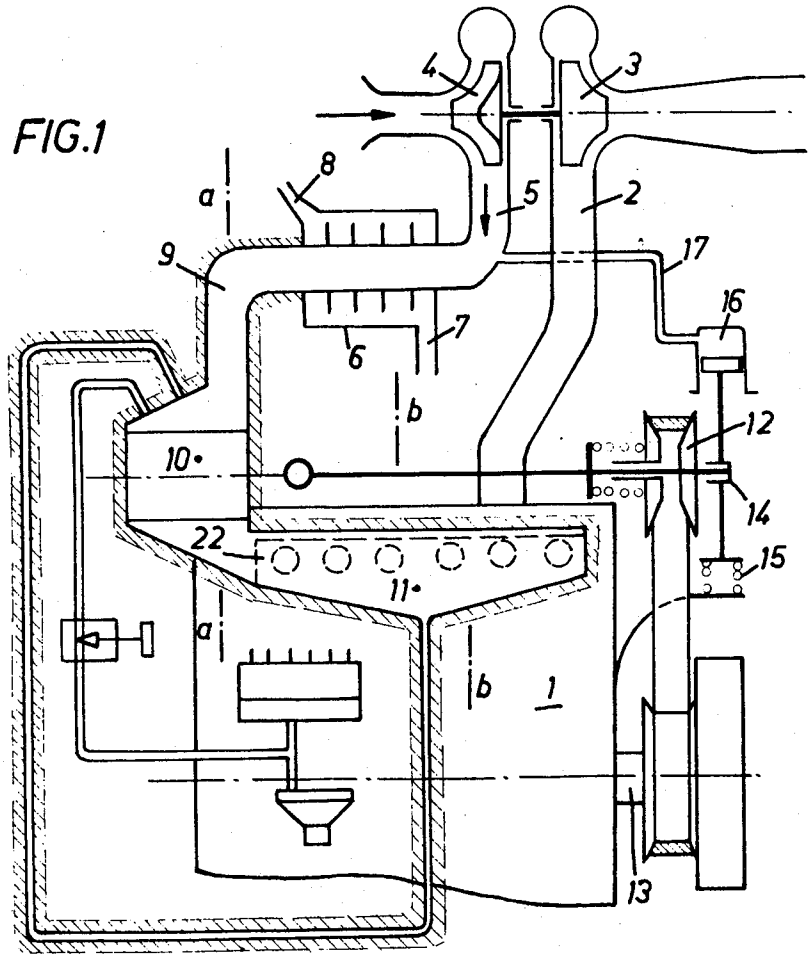


FIG.2

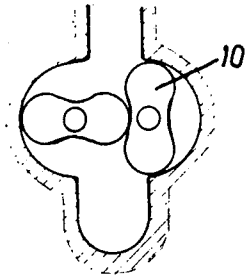
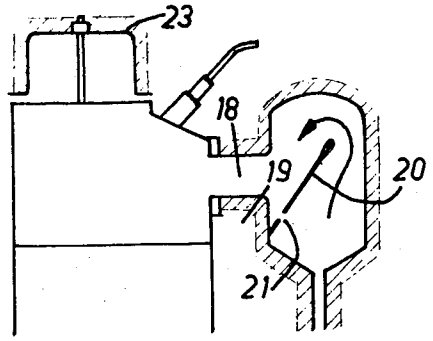


FIG.3



ADMISSION CIRCUITS OF DIESEL ENGINES

The present invention relates to that part of the admission circuit comprised between the outlet of the heat exchanger and the inlet to the cylinder head of a compensated Diesel engine according to French Patent No. 1,577,300 and to the patent application, U.S.A. Ser. No. 794,187 in the name of the present Applicants.

The first of these Patent Applications relates to a Diesel engine supercharged by a turbo-compressor with a volumetric corrector interposed between the turbo-compressor and the engine, this corrector, of the gear - compressor type, being driven from the engine crank - shaft with a variable speed ratio in order that the volumetric compressor may give a higher delivery pressure as the pressure given by the turbo - compressor diminishes. Between the turbo - compressor and the volumetric compressor is interposed an exchanger of heat with the cooling liquid of the engine which in all cases maintains the temperature of the air at a value close to that of the cooling circuit.

The second Patent Application referred to concerns the same engine completed by a fumigation circuit which introduces, at low loads and low speeds, a certain quantity of fuel into the admission of the volumetric corrector - compressor.

One of the essential characteristics described in this second Patent Application resides in the provision of a recycling circuit which drains-off the unvaporized and unused fuel at the bottom point of the admission collector and re-introduces it into the intake of the volumetric compressor. This branch circuit has in fact the effect, not only of drying the admission manifold for the purposes of safety, but also of oxidizing the part of the fuel which follows this branch circuit several times, which permits the ignition time to be reduced at the moment of injection.

The starting - up of the engine constitutes a special limiting case of low loads and low speeds. Unfortunately, at this moment, the cooling circuit of the engine is at ambient temperature and cannot therefore serve to heat the mixture; on the other hand, at this speed of the engine, the volumetric compressor is subject to considerable leakages in relative value and cannot immediately give large pressures and adequate temperatures. However, the fumigation system combined with the introduction of a small quantity of oil enables these leakages to be reduced so as to obtain on the downstream side of the compressor, a slight over - pressure and a slight increase in temperature.

The main object of the present invention consists of giving a cumulative effect to this increase in temperature by preventing the temperature increases obtained at each revolution of the volumetric compressor from being dissipated by radiation, which is effected by heat - insulating the whole circuit comprised between the heat exchanger and the engine admission, namely:

- the pipe between the exchanger and the volumetric compressor;
- the outer casing of the volumetric compressor;
- the admission manifold and the end connectors for coupling to cylinder;
- finally, the pipe for recycling the fuel, as described above.

This arrangement is all the more useful as the external temperature is lower.

A second characteristic feature of the invention consists of choosing the lagging material in such manner that it combines a sound - insulating effect with the heat insulation effect.

A third characteristic feature of the invention is to effect this insulation by projection, spraying, spreading with a paint or hand brush an adhesive plastified product comprising a certain proportion of heat and sound - insulating material, such as mica, asbestos, etc.

This lagging arrangement is however unusual, since on the contrary it has always been desired to effect the maximum cooling of the admission air, especially in the case of compression in stages. It is certain that at full loads this arrangement is slightly disadvantageous, but it remains preferable to lose a slight advantage at full loads in order to achieve the maximum advantages of the method during starting -up and at partial loads running. This additional possibility for starting - up is essential for operation with poly-carburants, especially with cold fuels.

The heat insulation according to the invention has the effect of maintaining not only the air but also the fumigation liquids at the outlet temperature of the volumetric compressor. It is for this reason that the recycling circuit of the fuel is also insulated.

According to a fourth characteristic feature of the invention, means is provided to prevent the fuel from being introduced directly into the engine in a liquid state. This means resides in the particular structure of the manifold which will be described in more detail in the general description which follows.

The invention will be more clearly understood with reference to the accompanying drawings, in which:

FIG. 1 is a general diagram of the installation showing the heat - insulated portion in the general circuit.

FIG. 2 shows a cross -section taken along the line a - a of the volumetric compressor;

FIG. 3 shows a transverse section taken along the line b — b of the admission manifold of the engine.

The exhaust of the Diesel engine **1** is effected by the pipe **2** through the turbine **3** which drives the centrifugal compressor **4**, the latter compressing the air in the pipe **5** which passes through the exchanger **6** comprising the liquid inlet and outlet **7** and **8**. At the outlet of the exchanger **6**, the compressed air from the pipe **5** passes through the pipe **9** into the volumetric compressor **10**, the delivery of which is effected into the manifold **11**.

As is well known, the compressor **10** is driven at a speed which is variable with respect to that of the crank - shaft **13** by means of the extensible pulley **12** with displaceable flanges; the speed variation is obtained by varying the distance between centers of the two pulleys, i.e., by displacement of the support **41** under the opposite effects of the spring **15** and the cylinder **16**, subjected directly or indirectly through the intermediary of the piping **17**, to the pressure created in the pipe **5** by the centrifugal compressor. It will be recalled that the distance between centers of the two pulleys and therefore the ratio of the respective speeds of the compressor and the engine, increases when the pressure falls in the pipe **5**, i.e., the volumetric compressor increases its compressive action as the compression of the centrifugal compressor is reduced.

All the heat - insulated portion of the circuit is shown hatched, not only in FIG. **1**, but also in FIG. **2** and **3**.

The unusual nature of the invention is well confirmed by the existence of the heat lagging which surrounds the volumetric compressor **10**, whereas in the majority of cases this latter is on the contrary provided with cooling fins.

In this case, the fins are replaced by necessary stiffening ribs, but which do not serve in any way for cooling purposes due to the existence of the lagging.

This lagging is carried out in the manner indicated in the preamble. In addition, it should be stated that the exterior of the deposited layer is coated with a paint or with an insulating product which prevents the lagging from being impregnated with water, fuel or any liquid product, which would be liable to destroy it or to render it ineffective or dangerous.

This protective layer is shown in the drawings in dotted line enclosing the hatched portions.

In FIG. 3, there will be observed the position of the end connectors **18** with respect to the engine, the presence of the connection fillets **19** and the provision of a partition **20** over the length of the manifold and compelling the combustion - supporting air and when so required the fumigation mixture to pass over a baffle which facilitates the segregation of the liquid. However, in the case where liquid particles have passed over the upper portion of the partition **20**, a few holes **21** of small diameter at the lower portion of the partition enable them to be collected from the bottom portion. The extremity **22** (see FIG. **1**) of the sheet metal on the side of the compressor is rolled in such manner that the output of the compressor only passes into the lower section of the manifold.

In FIG. **3** it will be noted that the rocker - arm cover **23** is also isolated in the same way as the parts previously described. This is justified by the noise factor as described below:

1. The control of the admission conditions (temperature and pressure) permits a low volumetric ratio and ensures a low noise level as compared with current Diesel engines.

2. The admission and exhaust noises are filtered by the turbo-machine which in particular damps the pulsations of the engine at the exhaust and of the volumetric compressor at the admission; the exchanger with its baffles also contributes to the damping of the noise.

3. On the other hand, noise of mechanical origin induced by the volumetric compressor and amplified by the vibration of the walls of the manifold becomes preponderant, and it is in order to avoid this that the deposit of insulating product already described has been provided.

4. After the attenuation of these three sources of noise, the mechanical noise of the valve rocker - arm becomes predominant, and it is in order to avoid this that the invention also comprises the sound insulation of the rocker - arm cover **23**.

This arrangement is also unusual, since the rocker - arm cover is generally expected to assist a little in the cooling of the oil.

In the spirit of the invention, it is essential to maintain everywhere a control of the temperature, and for this reason the control of the admission air temperature is assigned to the exchanger **6** and the compressor **10**. Similarly, the control of the oil temperature is assigned to the oil - water exchanger (not shown), it being understood that the cooling liquid of these two exchangers is itself controlled from the radiator by thermostat at one or more levels of temperature, corresponding to the requirements of the circuit.

What we claim is:

1. In a Diesel engine provided with combustion chambers, a crank shaft, a circuit for the circulation of a cooling fluid, an admission circuit for a mixture of air and fuel, an intake manifold communicating with said combustion chambers through end connectors and an exhaust circuit of the type having a turbine operated by the exhaust gases, a centrifugal compressor driven by said turbine, a supercharging volumetric compressor corrector device driven by said crank-shaft at a speed ratio which increases as the pressure delivered by the centrifugal compressor diminishes, and an exchanger of heat with said cooling fluid, the provision of:

a thermal-and-sound insulation of the portion of the admission circuit comprised between the heat exchanger and the intake manifold, said portion including said volumetric compressor.

2. A Diesel engine as claimed in claim **1** and further comprising a branch circuit for recycling the unvaporized fuel from the intake manifold, said circuit being also heat insulated.

3. A Diesel engine as claimed in claim **1**, in which said insulation consists of a layer of a plastified product comprising a high proportion of an insulating product such as mica and/or asbestos.

4. An engine as claimed in claim **3**, in which the insulating layer is applied so that it cannot be impregnated either with water or with fuel or with any other liquid product liable to deteriorate it or reduce its effectiveness and safety.

5. An engine as claimed in claim **1**, in which said intake manifold is provided in the vicinity of said end connectors with a segregating longitudinal partition intended to retain the greater part of the liquid phase of the fuel in the admission circuit.

6. An engine as claimed in claim **1**, in which the rocker-arm cover is sound-proofed by means of a suitable material.

7. An engine as claimed in claim **6**, in which said sound - proofing material is the same as that of the insulation system of the portion of the admission circuit comprised between the heat exchanger and the engine.

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