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DIESEL ENGINE STARTING MEANS AND METHOD

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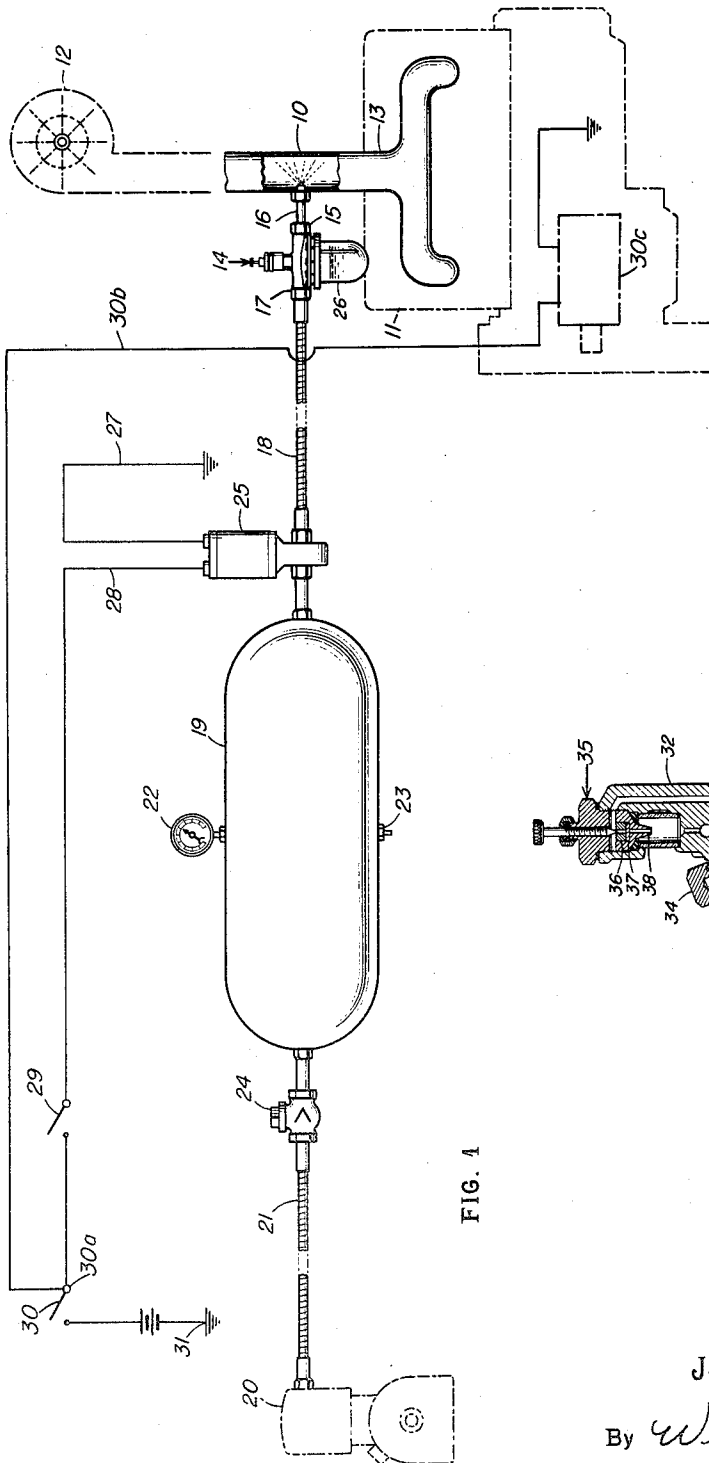


FIG. 4

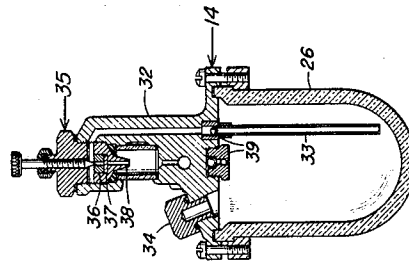


FIG. 2

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DIESEL ENGINE STARTING MEANS AND METHOD

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8 Claims. (Cl. 123—179)

The present invention relates broadly to means and a method for starting engines and, more particularly, diesel engines.

Dependent for firing upon the heat developed during the compression stroke, diesel engines are notoriously difficult to start in cold weather, with consequent excessive load on and wear of the electrical or other cranking system.

One possible solution for this problem is to add to the combustion mixture of diesel oil and air a charge of a relatively low firing or flash point liquid such as ethyl ether, so as to lower the initial firing temperature of the fuel. To this end it has been attempted to introduce a charge of such a liquid into the intake manifold, using a pump or squirt can, and depending upon the usual blower by which air is drawn into the manifold to mix the liquid with the air. A difficulty with this proposal is that the blower is driven by the diesel engine and during the cranking stage revolves at too low a speed to insure thorough mixing of the additive with the air and consequent uniform distribution to the several cylinders. Another difficulty is that the introduction of the additive is entirely under the control of the operator, rendering it haphazard both as to charge and as to time relative to actuation of the starter. Also, the liquid additive sometimes reaches a cylinder as a liquid slug with possible consequent damage to the cylinder wall by relatively large scale explosions.

Another expedient attempted has been to introduce the additive liquid in capsule form into the fuel tank. However, this method has the definite disadvantage that the highly volatile additive, once introduced, escapes rapidly from the diesel oil, thus affording no assurance of its presence in the fuel mixture injected into the cylinders.

Accordingly, it is an object of the present invention to provide means and a method for facilitating starting of a diesel engine, which overcomes the failures and drawbacks of previous systems.

Another object of this invention is to provide a simple, inexpensive and highly efficient mechanism for promoting and facilitating starting of diesel engines.

In accordance with the teachings of this invention, a highly volatile or other liquid having a low firing temperature or flash point relative to diesel oil, such for example as ethyl ether, is vaporized or atomized and injected under pressure into the intake manifold of the engine, simultaneously with the actuation of the starter, the liquid additive, due to its vapor state and the supercharger action of its injection under pressure, evenly dispersing through the intake air and being uniformly distributed to the cylinders, with resultant almost instant starting of the engine. Due to the uniform distribution of the additive and almost instant starting of the engine, battery, starter, and generator wear and maintenance are markedly reduced, and damage or excessive wear of any of the cylinders is prevented.

It is also an object of this invention to provide a booster starting system for installation as a unit on diesel-

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powered vehicles, which contains a supply cylinder capable of holding air under pressure for protracted periods, and chargeable during operation of the vehicle by the latter's compressor, the system being provided with a safety switch mechanism for limiting the injection of starting fluid to only those situations where it is required, such as in cold weather when the engine has stood idle sufficiently long to dissipate the heat from its last operation.

In a permanent installation, as contemplated by the invention, the mechanical or electrical tie in between starter and booster injection mechanisms, when coupled with means providing a metered charge of the additive, insures no overcharge in the cylinders and the metered charge can be easily and readily adjusted in advance. This is a very important aspect of the present invention since it insures proper and desired starting of the diesel engine, without the possibility of human error or inadvertent mistakes. The inclusion of a metered charge of fuel additive, together with the safety switch, so that flooding of the cylinders is prevented contributes not only faster but safer and more economical starting of a diesel engine.

Other and further advantages and objects of the present invention will be apparent from the following detailed description of an embodiment of the invention, taken together with the accompanying drawings, in which:

Figure 1 is a diagrammatic view, illustrating one system for implementing the invention, and

Figure 2 is a sectional view of one type of liquid additive vaporizing or atomizing and metering device.

In the drawings, the numeral 10 designates an intake manifold of a diesel engine 11 into which intake air usually is drawn by a blower 12, conventionally driven by the diesel motor. On its outlet side 13, the manifold interconnects in the usual manner with the various cylinders of the engine. A vaporizer, generally designated 14, has its outlet 15 connected into the intake manifold 10 by means of conduit 16.

In the disclosed embodiment, the air intake end 17 of the vaporizer 14 is connected by means of pipe or conduit 18, preferably flexible, with a compressed air tank 19 for supplying air under desired pressure to the vaporizer. The compressed air tank 19 may be suitably charged by a compressor 20 through a preferably flexible conduit 21. A pressure gauge 22 to indicate the condition of the air supply, conveniently may be mounted on the tank 19, along with the usual vent and drain plug 23.

Interposed in conduit 21 is a check or one way valve 24, preferably spring-loaded for air-tightness, to permit the tank to be charged by the compressor, while preventing air leakage when the compressor is idle. A solenoid valve 25, also air-tight, is interposed in conduit 18 between tank 19 and vaporizer 14 for the purposes herein-after set forth. A supply of starting or additive liquid, such as ethyl ether or the like, may be stored in the reservoir 26 of the vaporizer 14.

Solenoid valve 25 is actuable through a wiring circuit consisting of ground lead 27 and lead 28 through a booster switch 29 connected in series with the usual starter switch 30, the latter being connected to ground at 31. The terminal 30a of the starter switch 30, through which it is connected to the booster switch 29, is also connected in the usual manner by a lead 30b to a starter motor 30c for cranking the diesel engine 11. Due to this arrangement, the booster system can only be operated when both the booster motor 29 and starter switch 30 are closed. The starter switch, however, is operable independently of the booster system, thus conserving the supplies of compressed air and booster liquid in the booster system for use only when necessary, while pro-

viding positive control means for injecting the additive starting liquid.

In operation, the compressed air from tank 19 or other source, vaporizes or atomizes the booster fluid and blows or drives it in vapor form into the intake manifold. During this period the engine is being cranked by its starter motor (not shown) and, due to the low turnover of the engine, the engine-operated blower 12 is revolving at too low a speed to mix the additive with the air and distribute it uniformly to the several cylinders. However, the pressure injection of the atomized additive during this stage functions as a supercharger and ensures the thorough mixing and uniform distribution of the air and additive required for quick starting of the diesel engine.

The system as above described is shown applied to a conventional bus system or installation, which has its own compressor 20 and, due to the air tight mechanism involved, including check valve 24 and solenoid valve 25, is adapted to maintain sufficient pressure in tank 19 to function for a period of two days or more. Therefore, even though the bus stands idle overnight or over a week-end, the device is still operable. In order to maintain a sufficient air pressure, in the illustrated embodiment, to operate the system over such a protracted period of time, it is essential that air and vapor tight means lead into and out of the compressed air tank. This is accomplished on initial installation, by the use of non-leaking check and solenoid valves at either end of the air tank. The preferred flexible piping beyond the valves then comes into play to prevent transmission of service shocks to the valves and the rigid fittings mounting them on the tank.

One type of vaporizer which has proved effective is shown in section in Figure 2 of the drawings. It consists of a bowl or like reservoir 26 in sealed engagement with a casing 32. Siphon tube 33 opens into the bowl which can be fed through filler plug assembly 34, or in any other desired manner, with the booster or additive fluid. A needle assembly, generally indicated 35, is used in connection with pressure plate 36, throttling disc 37, and drip gland 38, to adjust the flow and charge of booster fluid as necessary to obtain the desired atomization and amount to be introduced. Ball check valves are provided at 39 and 40 to insure air tight operation in conjunction with the various seals utilized.

It will be apparent from the foregoing description that a metered charge of a relatively low firing point additive liquid can be introduced in vaporized or atomized form into a diesel engine in combination with the usual diesel fuel, to implement or facilitate starting. The metered charge prevents overcharging or flooding the cylinders. The charge can be regulated by adjustment of the needle valve in the vaporizer assembly.

Additionally, the electrical system incorporates a booster switch in series with the starter switch, and in order to impart a charge of additive fuel to the engine it is necessary to close both the engine starter switch and the booster switch. The starter switch, however, is independently operable, such as when the engine is warm. The air pressure generated, either through the compressed air storage tank, or other means, serves to vaporize the additive fuel and force it into the intake manifold. There it acts as a supercharger to ensure thorough mixing of the air and additive and uniform distribution of the mixture to the several cylinders during the cranking stage when the usual blower is inadequate for this purpose due to its low r.p.m.

Manifestly various modifications can be effected, some of which have been described hereinbefore, without departing from the spirit and scope of the present invention as defined in the appended claims.

I claim:

1. A method of promoting starting of a diesel engine having an intake manifold, a diesel fuel supply for sup-

plying diesel fuel to said engine, a booster starting system, said fuel supply and starting system each being interconnected with the intake manifold, and an engine starting system, comprising introducing under superatmospheric pressure into said intake manifold from said booster starting system an atomized fluid of low firing temperature relative to said diesel fuel simultaneously with actuation of said engine starting system.

2. In a system for promoting starting of a diesel engine equipped with an intake manifold, a diesel fuel supply interconnected with said manifold for supplying diesel fuel to said engine, and an engine starting system, the improvement comprising a supply of a liquid of low firing temperature relative to said diesel fuel, means for atomizing and injecting said liquid from said supply under superatmospheric pressure into said intake manifold, and means operatively associated with said starting system and said atomizing and injecting means for causing operation of said atomizing and injecting means simultaneously with operation of said starting system while permitting independent operation of said starting system.

3. In a system as claimed in claim 2, said engine starting system including an electrical circuit and a starter switch therein, said atomizing and injection means including a source of air under pressure, means for conveying said air from said source to said atomizing and injecting means and means interconnected with said conveying means for preventing actuation of said atomizing and injecting means in the absence of activation of said starter switch.

4. In a system as claimed in claim 3, said conveying means including a conduit, the means for limiting actuation of said atomizing and injecting means including a solenoid valve and a booster switch connected therewith and in series in said electrical circuit whereby closing of both said starter switch and said booster switch are required to actuate said atomizing and injecting means.

5. In a system as claimed in claim 4, a low firing temperature liquid metering means in said liquid atomizing and injecting means for preventing overcharge of the atomized low firing temperature liquid in said engine.

6. In a system as claimed in claim 5, said metering means including a reservoir, and an adjustable needle valve between said conveying means and said reservoir for measuring the amount of said liquid admitted to said reservoir.

7. A system for promoting starting of a diesel engine equipped with an intake manifold comprising a source of air under pressure, a source of a low firing temperature liquid, a vaporizer connected to said intake manifold, conduit means connecting said air and liquid sources with said vaporizer, a solenoid actuated valve interposed in said conduit means between said air source and said vaporizer, an electric circuit connected to said valve through an engine starter switch, and a booster switch in said circuit in series with said starter switch whereby actuation of said valve to introduce air under pressure to said vaporizing means is possible only when both said switches are closed, while said starter switch may be closed to start said motor independently of closing of said booster switch.

8. A system as claimed in claim 7, said source of air under pressure comprising a tank of compressed air.

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