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[54] **DIESEL ENGINE MANIFOLD AIR PREHEATER
AND STARTING SYSTEM EMPLOYING THE SAME**
4 Claims, 3 Drawing Figs.

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ABSTRACT: A diesel engine manifold air preheater in the form of an aspirating pump and fuel nozzle positioned in the path of the engine intake airstream, coupled to a static fuel supply and an independent source of pressurized air with the pressurized air causing aspirated fuel to be discharged by said nozzle in atomized form into the engine airstream for ignition of the same.

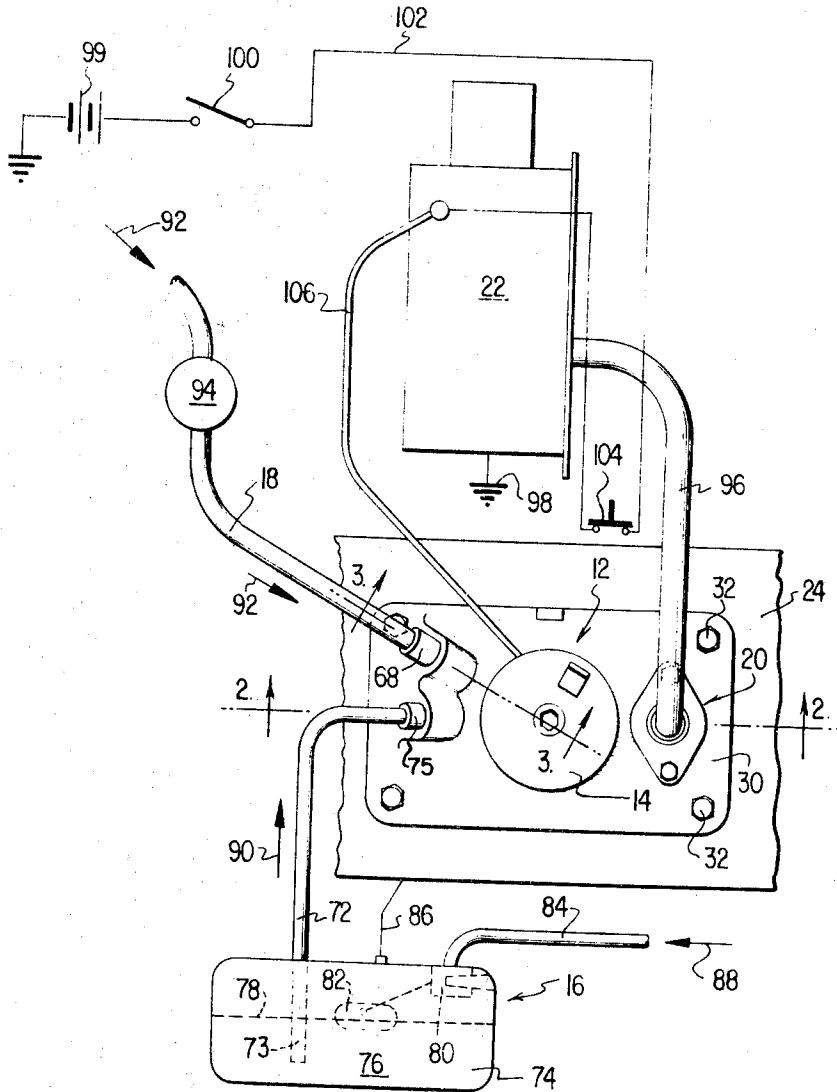


FIG. 3

DIESEL ENGINE MANIFOLD AIR PREHEATER AND STARTING SYSTEM EMPLOYING THE SAME

Due to the difficulty of starting diesel engines in cold weather, it is a universal requirement to preheat the engine intake air. In the past, the intake air passing to the engine manifold was preheated by means of a small burner including a fuel nozzle and a glow plug with the fuel being supplied under some pressure by means of a hand pump. Such systems are therefore dependent upon a manual operator.

Systems have also been proposed in which the preheater fuel nozzle receives fuel under pressure from the engine fuel pump, in which case, the fuel pump supplies fuel first to the air preheater in order to warm the intake manifold air. The fuel pump is then switched to supply fuel to the diesel engine fuel injectors. These attempts are highly unsatisfactory. It has been proposed to employ the engine fuel pump as a means for supplying both the air preheater and the engine fuel injector simultaneously, but this is unsatisfactory since, due to the diversion of fuel to the fuel injectors, there is insufficient pressure at the air preheater to cause it to atomize the fuel sufficiently for ignition purposes. More importantly, preheaters supplied with pressurized fuel tend to use all of the available oxygen of the incoming manifold air during preheating, thus starving the engine itself.

It is, therefore, a primary object of this invention to provide an improved diesel engine manifold air preheater which achieves proper atomization of the fuel in the preheater nozzle at low fuel flow rates without in any way affecting the operation and delivery of fuel to the engine fuel injectors.

It is a further object of this invention to provide an improved diesel engine manifold air preheater in which the temperature of the engine manifold intake air is satisfactorily increased without interfering with the proper fuel and air mixture required by the engine itself.

It is a further object of this invention to provide an improved diesel engine manifold air preheater in which the engine intake air may be selectively preheated, subsequent to starting, during normal engine running conditions.

It is a further object of this invention to provide an improved diesel engine manifold air preheater in which the time required to start the diesel engine is greatly reduced, while achieving maximum starting reliability, even at extremely low operating temperatures.

Other objects of this invention will be pointed out in the following detailed description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best modes which have been contemplated of applying that principle.

In the drawings:

FIG. 1 is a side elevational view of the diesel engine manifold air preheater system of the present invention;

FIG. 2 is a plan view, partially in section, of the aspirating pump and fuel nozzle component of the preheater system of FIG. 1, taken on line 2-2; and

FIG. 3 is a sectional view of a portion of the aspirating pump and fuel nozzle shown in FIG. 1 taken along line 3-3.

In general, the apparatus of the present invention comprises an improved diesel engine manifold air preheater which employs an aspirating pump and fuel nozzle positioned in the path of the engine intake airstream. The aspirating pump and fuel nozzle are fluid coupled to a static fuel supply positioned below the nozzle and an independent source of pressurized air is selectively coupled thereto. Delivery of pressurized air causes aspirated fuel to be discharged by the nozzle in atomized form into the engine intake airstream. Ignition means adjacent thereto ignite the aspirated fuel to preheat the engine intake air. A float-controlled fuel container is positioned below the nozzle and forms the static fuel supply and a conduit couples the container to the aspirating nozzle with one end of the conduit disposed below the level of the static fuel. The other end of the conduit is coupled to a through passage carried by the nozzle, and a second intersecting passage delivers pressurized air. A normally closed solenoid operated valve is carried by the nozzle within the second

passage. Manual and manifold air temperature responsive switch means act to couple the solenoid valve and the ignition means to a source of electrical power.

Turning first to FIGS. 1, 2 and 3 of the drawings, the principal components of the diesel engine manifold air preheater system in preferred form, include an aspirating pump and fuel nozzle 12, a solenoid operated valve 14, which selectively controls the delivery of pressurized air to the aspirating pump and fuel nozzle 12, a static fuel supply 16, pressurized air delivery conduit 18, electrode ignition means 20 and a vibrator and coil unit 22. The manifold air preheater 10 is operatively positioned in the path of the engine intake air and is preferably carried by the engine intake manifold. In this respect, manifold casing 24 is provided with an opening 26, which acts to receive the air preheater aspirating pump and fuel nozzle 12. This consists essentially of a cast block 28 having a plate-like cover section 30 which is coupled to the manifold casing 24 by a plurality of bolts 32. Block 28 is provided with a longitudinal bore 34 and counterbores 36 and 38. Bore 38 is threaded at its downstream end 40 to carry threaded nozzle element 42, including a protruding nozzle cone 44. The nozzle element 42 is bored at 46 and 48 and cooperates with bore 34 within the block 20 to provide a longitudinally extending through passage for the liquid fuel to the nose cone 44. Liquid fuel enters bore 34 through inclined fuel passage 50 which intersects the same. Screw 51 blocks off one end of bore 34. A vertical passage 52 within block 28 allows the delivery of pressurized air to the chamber formed by counterbore 38 and the inner end of nozzle element 42. The pressurized air moves through the circumferential passage 54 in the nozzle nose cone 44 where it is discharged into the burner cup 56 at relatively high velocity. The aspirating effect which takes place causes the liquid fuel to be sucked out of axial passage 48 where it is highly atomized and discharged into the burner cup 56 adjacent the electrodes, such as electrode 58 carried by electrode means 20. The upper end of vertical air passage 52 is closed off by a normally closed solenoid operated air valve 14. Movable valve member 60 carries rubber tip 61 which is shown as seated in FIG. 2 against a valve seat formed by member 63 within counterbore 62. O-ring 64 acts as a seal for this valve seat member. The valve seat bore 65 is coaxial with passage 52.

Referring to FIG. 3, inclined air passage 66 intersects counterbore 62, above valve tip 61. Air passage 66 is fluid coupled by conduit 18 to an independent source of pressurized air (not shown), such as the air tanks carried by a vehicle, for instance, which may employ the diesel engine as its power means. Conventional fitting 68 allows the conduit 18 to be selectively coupled to the threaded end 70 of passage 66. In like manner, the fuel delivery tube or conduit 72 is fluid coupled by means 75 to the threaded end 76 of the inclined fuel passage 50 (FIG. 1).

Contrary to known manifold air preheater systems, the nozzle does not receive pressurized fuel from either an independent pressurized source, or by diverting a portion from the main fuel pump. Rather, the present system makes use of a separate fuel container acting as a static fuel supply, in which case, the tank end 73 of conduit 72 is immersed in the fuel and fuel is sucked through the nozzle passage 48 by aspiration. The static fuel supply 16 comprises a closed tank 74 which carries liquid fuel 76 at a level shown by dotted line 78, this level being controlled by a float valve 80 including float 82. The fuel supply is fed to static fuel container 74 through fuel supply line 84 from a source (not shown). Appropriately, the float chamber is vented to the manifold by tube 86. Fuel moves as indicated by arrow 88 to container 74 and from container 74 to the nozzle by aspiration as indicated by arrow 90. Aspiration is achieved by delivering high-pressure air through conduit 18 as indicated by arrows 92 from a source (not shown) with the air pressure being regulated by conventional pressure regulator means 94.

The function of vibrator and coil unit 22 is to provide high tension voltage for the electrode means 20 to achieve ignition

of the fuel and air mixture discharged into the burner cup 56 the burner cup having ports 95 through which engine intake air may pass to aid in the burner combustion. The vibrator and coil unit 22 is conventional with the high tension voltage being delivered to the spaced electrodes 58 through lead 96. The vibrator and coil unit is appropriately grounded at 98. A source of voltage 99 is connected to vibrator and coil unit 22 through line 102. The normally open, manually operated single pole, single throw starter switch 100 couples line 102 to unit 22. In series with the manually operated switch 100, is a normally closed thermostatic switch 104 which is automatically operable in response to the temperature level of the manifold air. Switch 104 is therefore operatively coupled to the intake manifold by positioning the same on casing 24. Once the temperature of the engine intake air reaches a predetermined level, the normally closed temperature operated switch 104 opens preventing sparking across electrodes 58 and energization of the solenoid valve 14 through parallel electrical lead 106.

From the above description, the air-operated siphoning pump and nozzle 12 employs selectively delivered air under pressure from supply conduit 18 to develop sufficient suction pressure within the nozzle nose cone 44 to draw liquid fuel from the float chamber fuel supply 16. The highly atomized fuel exiting from the nose cone is ignited by the conventional spark-plug-type igniter 20 and acts to heat the relatively large mass of intake air moving through the engine manifold without removing a large portion of the oxygen from this mass. Operation is achieved by closing the manually operated starter switch 100 which simultaneously energizes the vibrator and coil element 22 to cause sparking of the igniter electrode 58 and opening of the normally closed solenoid-operated air valve 14. The instant valve member 60 moves upwardly, beyond the intersection of inclined passage 66 with vertical counter bores 62, pressurized air at high speed exits from the nozzle cone circumferential passages 54 sucking fuel oil from the static supply through fuel conduit 72. The employment of the spark-type igniter means 20 achieves instantaneous ignition which enables the intake air to be preheated even when the engine is running if the intake is too cold and the engine is running at low speeds. Diesel engines idling at low temperatures sometimes develop a cloud of white smoke when the air is not hot enough, because they do not get total ignition and if left running long enough will actually kill engine operation. This will not occur with the preheating system as disclosed in FIGS. 1 through 3, since, if the temperature of the engine intake manifold is insufficient after starting, the normally closed switch 104, which is temperature-responsive, will remain closed and the spark ignition and solenoid valve 14 will remain energized for continuous operation until the air inlet temperature reached a minimum predetermined level.

From the above, it is seen that the improved diesel engine manifold air preheater for the present invention insures proper preheating of the intake air without materially exhausting its oxygen content. Further, both the liquid fuel and the pressurized air for operating the aspirating pump and fuel nozzle forming the principal component of the heater are derived from independent pressurized air and static fuel sources, which in no way affect the delivery of either fuel and air to the engine cylinders. The manifold air preheater is readily assimilated into an automatic diesel engine starting system allowing operation of the preheater during starting, or selectively, subsequent to starting if manifold air temperatures remain below a predetermined minimum level.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

I claim:

1. An improved diesel engine air preheater comprising: an aspirating pump and fuel nozzle positioned in the engine intake air stream, means for selectively coupling pressurized air

to said aspirating pump and fuel nozzle, a static fuel supply, means for fluid coupling said static fuel supply to said aspirating pump and fuel nozzle, a pressure vent connected at one end to said static fuel supply and adapted for connection at the other end to the engine intake air stream adjacent said aspirating pump and fuel nozzle, said aspirating pump and fuel nozzle having a first longitudinally extending passage carrying said liquid fuel and a second concentric passage carrying said pressurized air, a normally closed solenoid operated valve for preventing air delivery to said second passage, ignition means operatively positioned for igniting the atomized fuel discharged from the nozzle, a source of voltage, means for electrically connecting said solenoid operated valve and said ignition means in parallel, manual switch means for selectively coupling said voltage source to said ignition means and said solenoid operated valve, and a normally closed intake manifold temperature-responsive switch series coupled to said manual switch means and said source of voltage.

2. In combination with a diesel engine having a cylinder air intake conduit, a cylinder air preheater system comprising: an aspirating pump and fuel nozzle positioned in the engine intake air conduit, means for selectively coupling pressurized air to said aspirating pump and fuel nozzle, a static fuel supply, means for fluid coupling said static fuel supply to said aspirating pump and fuel nozzle, a pressure vent connected at one end to said static fuel supply and connected at the other end to the engine intake air conduit adjacent said aspirating pump and fuel nozzle, said aspirating pump and fuel nozzle having a first longitudinally extending passage carrying said liquid fuel and a second concentric passage carrying said pressurized air, a normally closed solenoid operated valve for preventing air delivery to said second passage, ignition means operatively positioned for igniting the atomized fuel discharged from the nozzle, a source of voltage, means for electrically connecting said solenoid operated valve and said ignition means in parallel, manual switch means for selectively coupling said voltage source to said ignition means and said solenoid operated valve, and a normally closed intake manifold temperature responsive switch series coupled to said manual switch means and said source of voltage.

3. An improved diesel engine air preheater comprising: an aspirating pump and fuel nozzle positioned in the engine intake air stream, a closed fuel container positioned below said nozzle, a conduit having one end coupled to said aspirating pump and fuel nozzle and the other end disposed below the level of fuel with said container, a pressure vent connected at one end to said fuel container above the level of said fuel and adapted for connection at the other end to the engine intake air stream adjacent said aspirating pump and fuel nozzle, means including a solenoid operated valve for selectively coupling pressurized air to said aspirating pump and fuel nozzle, ignition means operatively positioned for igniting the atomized fuel discharge from the nozzle, a source of voltage, means including a manual switch for selectively coupling said voltage source to said ignition means and said solenoid operated valve, and means including a switch operative responsive to the intake air temperature for decoupling said ignition means and said solenoid operated valve whenever the temperature of the intake air reaches a predetermined level.

4. An improved diesel engine air preheater comprising: an aspirating pump and fuel nozzle positioned in the engine intake air stream, a fuel container coupled to said aspirating pump and fuel nozzle, means for selectively coupling pressurized air to said aspirating pump and fuel nozzle, ignition means operatively positioned for igniting the atomized fuel discharge from the nozzle, means including a manual control for actuating said ignition means and said pressurized air selective coupling means, and means operative responsive to the intake air temperature for deactuating said ignition means and said pressurized air selective coupling means whenever the temperature of the intake air reaches a predetermined level.