April 20, 1965 W. J. LINN 3,179,096

CRANK CASE VENTING SYSTEM FOR DIESEL TYPE ENGINES

Filed May 23, 1963 2 Sheets-Sheet 1

FIG. 1.

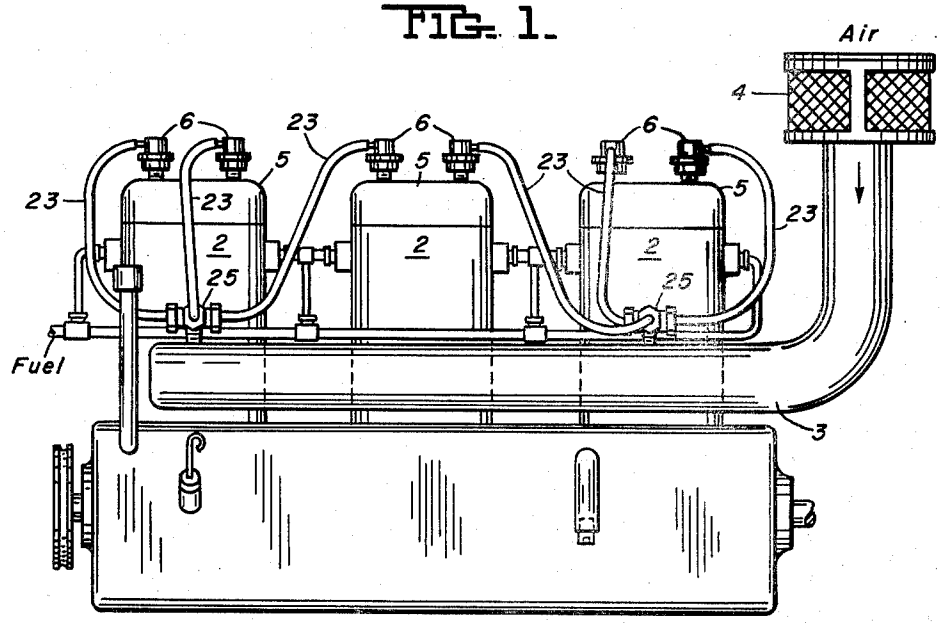
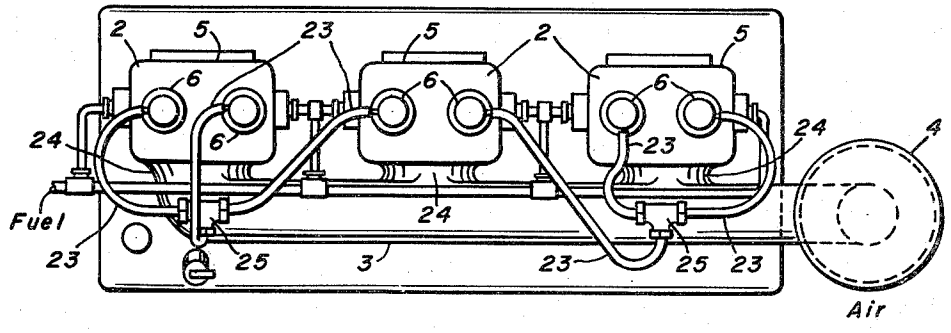


FIG. 2.



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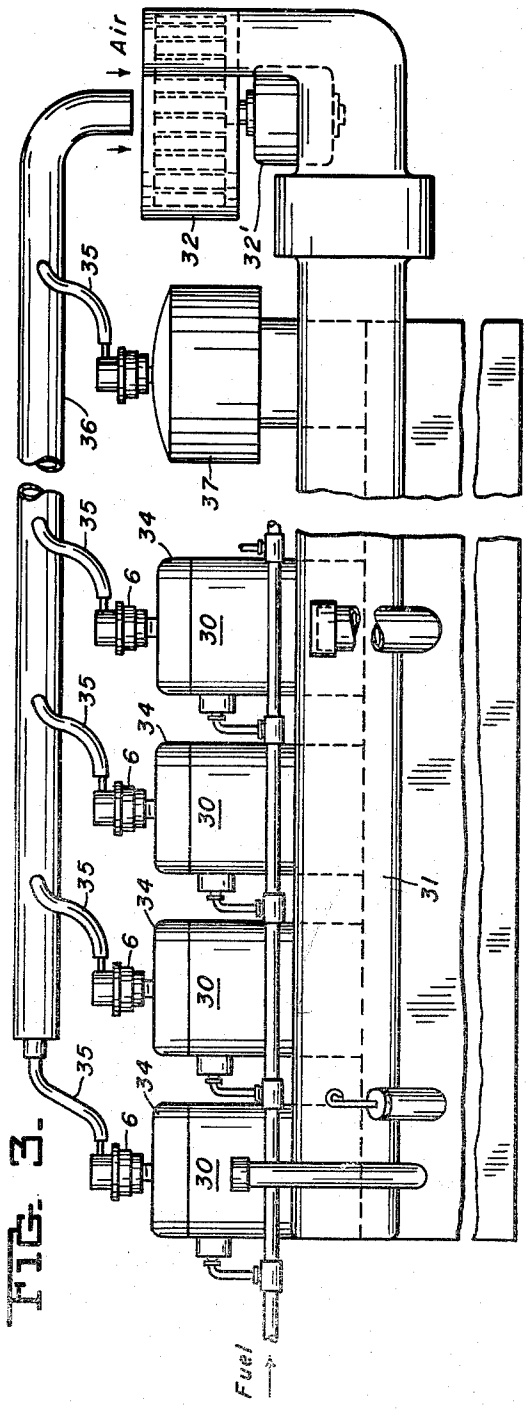


FIG. 3.

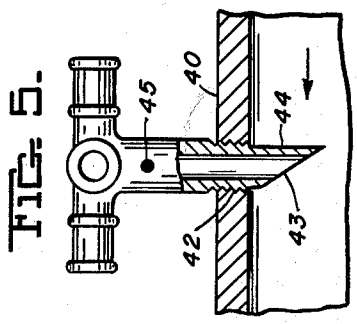


FIG. 5.

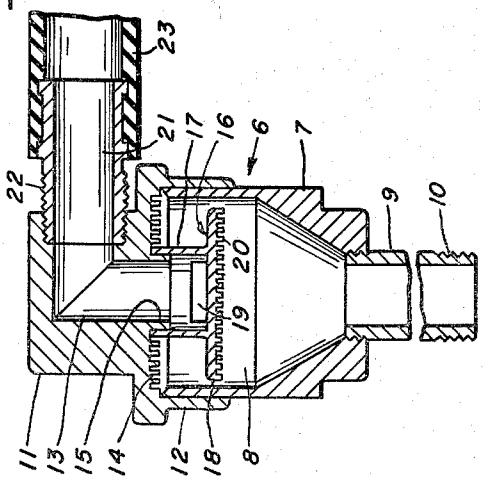


FIG. 4.

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3,179,096

CRANK CASE VENTING SYSTEM FOR DIESEL TYPE ENGINES

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10 Claims. (Cl. 123—119)

This invention relates to internal combustion engines of the diesel type and is for an apparatus or system for venting the gases from the crank cases of such engines. This invention is for an improvement in the apparatus disclosed in my application Serial No. 173,387, filed February 15, 1962, now abandoned, and Serial No. 282,716, filed May 23, 1963.

It is of course well understood that in engines of the diesel type liquid fuel is sprayed through an injector nozzle into each cylinder while air is admitted from an air intake manifold through valves. The air is compressed by the pistons of the engine and under the heat of compression the fuel is fired. As in other four cycle internal combustion engines the crank case contains lubricating oil. Since these engines operate at high compression ratios, gases and vapors blow by the engine pistons into the crank case, from which it is vented, sometimes in the case of motor vehicles downwardly through a vent pipe, and sometimes in diesel locomotives through the roof. However vented to the atmosphere these gases comprise not only combustion products but unburned fuel, cracked hydrocarbon compounds, usually some carbon monoxide, water vapor and air. These gases and vapors not only contaminate the atmosphere, but they contaminate the oil and combine with the oil to produce sludge.

Such engines are generally provided with a valve cover at the top which is in communication with the crank case, the lubricating systems permitting run-down of oil which is circulated by the lubricating system of the engine to the valve mechanism back to the crank case.

According to the present invention conventional vents to the crank case are closed or plugged so that the crank case is sealed against the outflow of gases or the inflow of air except for the blow-by gases, these being the oil filler tube, the crank case vent tube and the oil dip stick. At a plurality of places along the engine, preferably in the valve covers I provide special outlet fittings including an expansion chamber and trap as disclosed in my aforesaid application and these in turn are connected with the air intake of the engine so that as the gases accumulate in the crank case they are conducted to the air intake of the engine. In smaller engines where there is a continuous flow of air to the cylinders through the manifold these gases are discharged into the manifold. In large engines, such as those on diesel locomotives using a blower so that there is a positive or super-atmospheric pressure in the air intake manifold the blow-by gases are conducted to the air intake of the blower. In these large engines having a motor driven air blower, gases also collect in the timing gear casing at one end of the engine and are not infrequently a cause of an explosion that requires extensive repairs to the engines. My invention also provides for such venting of the timing gear casing.

Since with a sealed crank case the flow of gases from the crank case to the air inlet system of the engine is induced only by the difference in pressure inside the crank case and the point of discharge of the gases to the air intake system, atmospheric oxygen is not circulated through the crank case. The combustible elements in the blow-by gases enter the engine cylinders with the air. By introducing these gases close to the place where they enter the cylinder they may be present in sufficient concentration to ignite on the compression stroke of the engine piston and start to heat the air before full compression is reached.

Extensive tests have indicated that the induction of these gases does increase the engine speed at a given throttle position and that air pollution is reduced while the usable life of the oil is substantially extended.

The primary object of the invention, therefore, is to provide an apparatus and system for the venting of crank case gases and reducing oil contamination, air pollution and fuel waste. A further object is to reduce engine damage or health impairment from crank case fumes.

The invention may be more fully understood by reference to the accompanying drawings in which:

FIG. 1 is a schematic side elevation of an engine and the apparatus applied thereto;

FIG. 2 is a top view of FIG. 1;

FIG. 3 is a view similar to FIG. 1 showing schematically a larger type of engine with forced air induction having the present invention applied thereto;

FIG. 4 is a vertical section through one of the expansion chamber and liquid trap units; and

FIG. 5 is a fragmentary sectional view through the manifold with a preferred fitting construction to eliminate back pressure in the vent system.

Referring first to FIGS. 1 and 2, the cylinder blocks of six cylinder diesel type engines are schematically represented as comprising twin cylinder blocks 2 arranged in line. The fuel injection system is schematically shown, but the valves which are concealed under the valve cover and are of conventional construction, and the exhaust manifold which has no bearing on the present invention are, for clarity of illustration, not shown. The air inlet manifold is designated 3 and it leads to a conventional air cleaner 4 at the air inlet. There are valve covers 5 on the top of each cylinder block.

According to the present invention, one or more vapor outlet and expansion traps are secured to each valve cover, two such trap units 6 are here shown mounted on each cover.

Each of these trap units as here shown (see FIG. 4) is generally similar to the device more fully shown and described in my aforesaid copending application, differing only in the way of attaching it to the engine. Each of these devices 6 comprises a body member 7 of generally cylindrical contour having a cylindrical chamber 8 in the upper portion that merges into a funnel-like, or downwardly sloping bottom with a central opening into which is screwed a nipple 9 having a threaded terminal 10 that is screwed into a tapped hole in the valve cover. The inside diameter of this nipple is greater than ¼", preferably not less than ½".

Removably but snugly fitted onto the top of each body is a cover member 11 having a flange 12 that fits about the body 7. It has a top portion with a central outlet passage 13 around which is an area 14 covered with valleys and ridges, these preferably being formed by a series of concentric grooves formed in the inside of the cap. Around the outlet passage there is a depending flange 15. A deflector element 16 has a tubular stem 17 force fitted about this flange, this tubular stem having a disk-like baffle plate 18 at its lower end that is spaced below the area 14 and of less diameter than the diameter of the chamber 8 in which it is positioned. The tubular stem 17 is cut away at 19 to provide large ports through its walls. The lower face 20 of the baffle is also roughened in some way, as by hills and valleys formed by concentric grooves similar to area 14.

The passage 13 leads to a radial opening 21 into which is screwed a nipple 22 over the outer end of which is fitted one end of a flexible tube 23 of synthetic or oil resistant rubber, plastic or the like.

Screwed into the manifold 3, preferably at two such points near opposite ends of the manifold is a nipple fitting 25 having three branches. The numeral 24 indicates the

points at which the intake manifold connects to the cylinders. Each branch has a nipple to which the other end of a tube 23 is fitted so that gases may flow from each unit 6 into the inlet manifold, and two three way nipples in the engine here shown provide a convenient disposition of these tubes, requiring only two tapped holes in the manifold for all six tubes. Clearly three two way connectors, or six individual connectors could be used just as well. Preferably the inner ends of these fittings are constructed as shown in FIG. 5 and hereinafter more fully described.

The crank case of the engine is sealed by closing the conventional crank case vents, as by plugging the vent tube, the oil filler tube and sealing the oil level indicating dip stick. Gases generated in the crank case rise along the length of the engine into the several valve covers. They escape under their own pressure into the units 6 where oil mist carried by the gases strikes the surfaces 14 and 20 and runs back into the valve cover while the gases flow into the intake manifold. Because of there being several of the units 6 along the length of the engine all parts of the crank case are uniformly vented.

In very large marine and locomotive diesel engines the cylinders are generally separate, as indicated at 30 in FIG. 3. The fuel injection system is schematically illustrated and the air intake manifold to the cylinders is designated 31. Diesel locomotive generally have twelve such cylinders in line all supplied by the same manifold but FIG. 3, which is schematic shows much of the engine broken away. With such engines, a super-charger in the form of a motor driven blower fan 32 forces air into the air intake manifold. The motor for driving the blower is indicated at 32'.

In this type of engine each cylinder has a separate valve cover 34 and one of the trap units 6 as heretofore described is mounted on each valve cover. Each has a tube 35, corresponding to the tubes 23 of FIGS. 1 and 2, but these tubes here connect into a relatively larger diameter manifold or duct 36 that terminates at the intake of the air blower or fan 32.

In this figure there is also schematically indicated a timing gear housing at one end of the engine 37 and it too is tapped and provided with a unit 6 and tube 35 leading to the duct 36.

It is preferred that the duct 36 terminates at the blower intake where the gases flowing therefrom enter the current of air being drawn into the blower but where the suction of the fan has little effect in creating any subatmospheric pressure or substantial vacuum in the duct 36 or in the engine crank case since such a vacuum would impart a high velocity to the blow-by gases and carry oil vapor and mist from the crank case, whereas it is desirable that the crank case blow-by gases flow through the duct 36 because of their own pressure being slightly above atmospheric pressure. It is for the same reason that all nipples and tubing have an internal diameter of more than a quarter of an inch, preferably not less a half inch and the passages through the devices 6 have a generally comparable minimum free opening therethrough.

With diesel engines as herein described both on trucks and locomotives equipped with this system I have been able to reduce the fuel opening at idling speed, or to increase the engine speed at the same idling adjustment, including a more efficient combustion of fuel and to substantially improve the life of the crank case oil. The exhaust gases are noticeably cleaner and free of soot because of better combusiton through the burning with the fuel of the carbon monoxide and volatile hydrocarbons in the crank case gases. In diesel engines speed is varied by throttling the fuel; whereas in gasoline engines of the conventional type the air is throttled. Consequently the air to fuel ratio is reduced when the engine is working under load with an open throttle, tending to burn the fuel less effectively and produce more smoke. Under the same conditions where the engine is working under load there are more blow-by gases rich in combustibles in the crank case. The introduction of these combustibles into the air flowing to the engine produces a hotter explosion in the cylinder. The hotter explosions result in more complete combustion of the raw fuel. This accounts for the cleaner exhaust gases and lowered soot deposit in the exhaust system and more efficient use of fuel. On dynamometer tests the brake horsepower of a diesel engine has been increased as much as five horsepower on a commercial truck over the horsepower produced by the same engine with the crank case vented to atmosphere.

While in FIGS. 1 and 2 the fittings 25 may terminate flush inside the manifold, I prefer to provide the inner end with a deflector as shown in FIG. 5, and with such deflector these fittings may also be used where there is a blower on the manifold since the sweep of air around the deflector will draw gases through the fitting and prevent a back pressure into the vent system. In FIG. 5, 40 designates a portion of the intake manifold and 41 is a fitting similar to 25 with three hose attaching nipples thereon. These fittings have threaded lower ends 42 screwed through the wall of the intake with a projecting end portion 43 cut off on an acute angle to form a deflector 44. The arrow in the manifold indicates the direction of air flow, and the fitting is screwed into the intake manifold so as to position the deflector at the upstream side of the fitting. An indicating marker 45 on the stem of the fitting may be provided to enable a mechanic to set the fitting in the right position. The deflector serves to part the air streams flowing around it and create a zone of reduced pressure at the discharge end of the nipple, thereby assuring the flow of gases into the air stream without the air blowing back into the vent system.

While I have shown a preferred construction for the trap elements 6, these may be variously constructed, as shown in the copending applications above referred to. I have found, however, that the use of the baffle in the chamber between the inlet and outlet of such units more effectively prevents any flow of oil into the tubing and air induction system of the engine.

I claim:

1. The combination with a diesel engine having cylinders, a sealed crank case and an air intake manifold system, of crank case gas venting means disposed at spaced intervals along the engine, said gas venting means comprising expansion traps having a body member with a sloped bottom for returning liquid which may collect in said traps to the engine and a cover having a tube leading therefrom to the air intake system of the engine.

2. The combination defined in claim 1 in which the traps and tubes have internal passageways therethrough which at no place restrict the flow area to less than the area of a ½ inch circle whereby the velocity of gas flow is minimized both by the plurality of traps and the area of the passageways.

3. The combination with a diesel engine having cylinders, a crank case sealed against the circulation of atmospheric air therethrough, an air induction system for supplying air to the cylinders, and means for venting crank case gases from the engine to the air induction system comprising a plurality of separate vents each having an expansion chamber element with a funnel like body for returning liquid that collects therein to the engine and a tubular outlet for the passage of gases therefrom, and means for discharging gases from the tubular outlets of the several vents to the air induction system.

4. The combination defined in claim 3 wherein said last-named means comprises a connection through which the flow of gases from a plurality of such tubular outlets is combined for discharge into the air induction system.

5. The combination defined in claim 3 in which the air induction system for the engine comprises a manifold and a blower, the said means for discharging gases from the several tubular outlets comprising a manifold duct to which all of the tubular outlets are connected, said duct terminating at the intake of the blower.

6. The combination defined in claim 3 in which the cylinders have valve cover means with the space enclosed by the cover thereon opening into the crank case, the said vents being mounted on the valve cover means.

7. The combination defined in claim 3 in which there are a plurality of valve covers over the engine cylinders, one of said vents being mounted on each valve cover.

8. The combination defined in claim 3 in which the air induction system for the engine comprises a manifold and a blower, the said means for discharging gases from the several tubular outlets comprising a manifold duct to which all of the tubular outlets are connected, said duct terminating at the intake of the blower, the engine also having a timing gear casing and one of said vents mounted on and opening into the timing gear casing, the outlet for the timing gear casing also being connected with the manifold duct.

9. The combination with a diesel engine having a sealed crank case and cylinders and having an air intake manifold for conducting air to the cylinders, means for venting crank case gases comprising vent elements communicating with the crank case positioned at spaced distances along the engine, each element having a trap for returning liquid to the crank case and having a tube for conducting gases therefrom, a fitting on the air intake manifold to which the tube connects, said fitting having a tubular stem opening into the manifold through the wall thereof and having a deflector on its inner end disposed

upstream with reference to the direction of air flow through the manifold of the axis of the stem of the fitting.

10. In a diesel type engine having cylinders, a crank case, valve cover means communicating with the crank case and an air intake means including a manifold through which air is supplied to the cylinders, the crank case being sealed against the inflow of atmospheric air, the invention comprising a gas outlet fitment secured to the valve cover means, an external duct connected to said fitment for the removal of gases passing out the fitment, the duct terminating in the air intake means, the outlet terminal of the duct being protected against the backflow of air through the duct to the crank case during operation of the engine.

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