Aug. 19, 1941. W. W. LOWTHER 2,252,974

CRANKCASE VENTILATING SYSTEM

Original Filed May 27, 1938 2 Sheets-Sheet 1

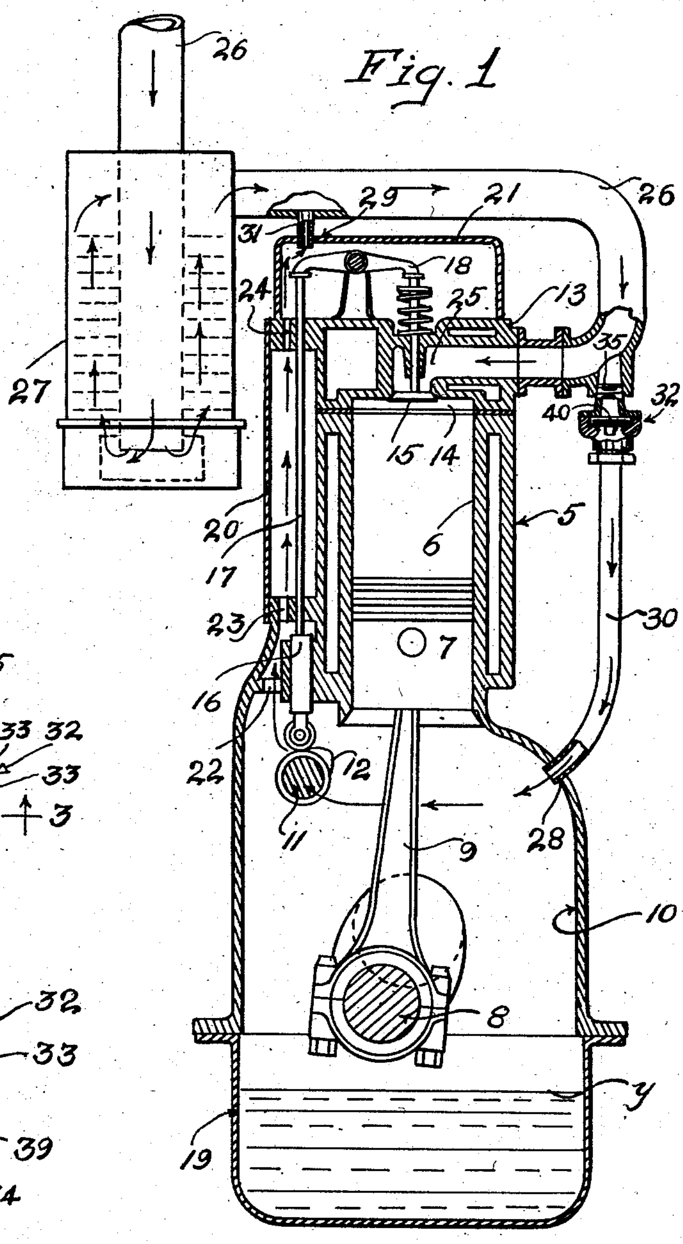

Fig. 2

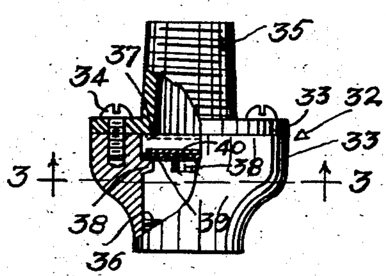

Fig. 3.

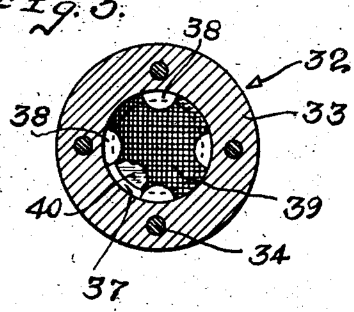

Fig. 4.

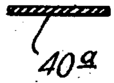

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Fig. 1'

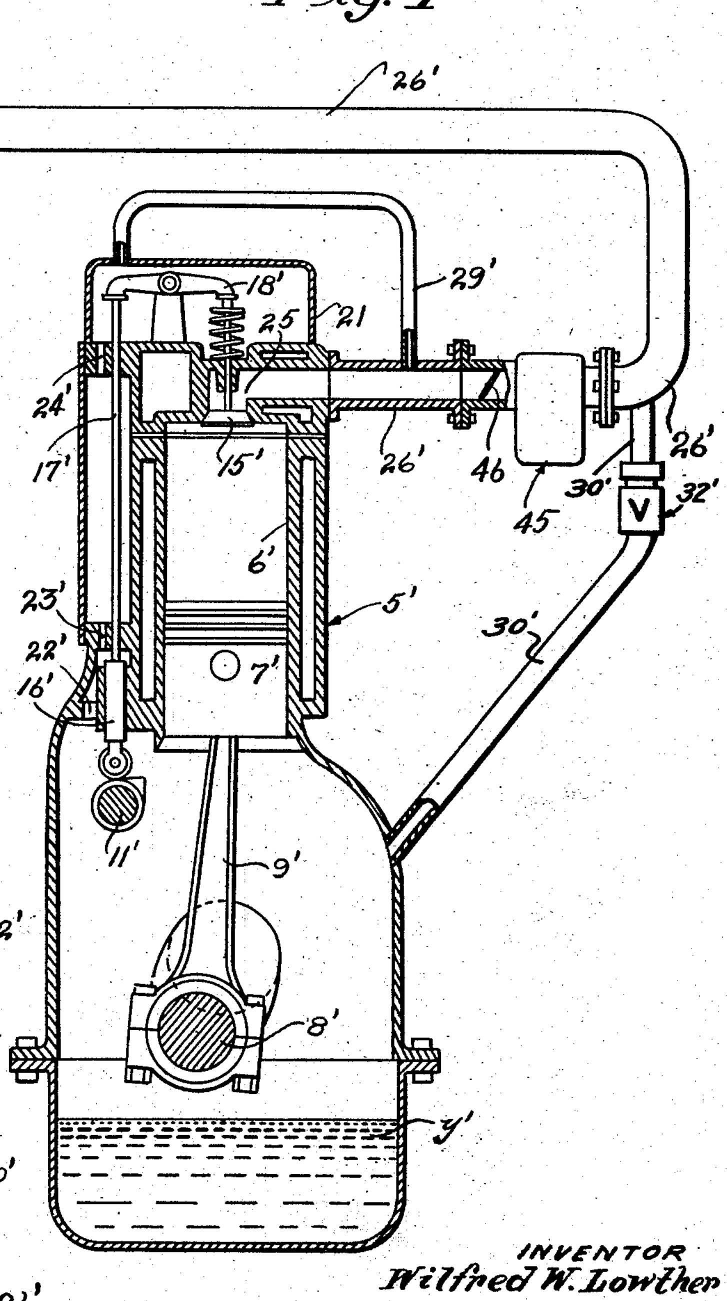
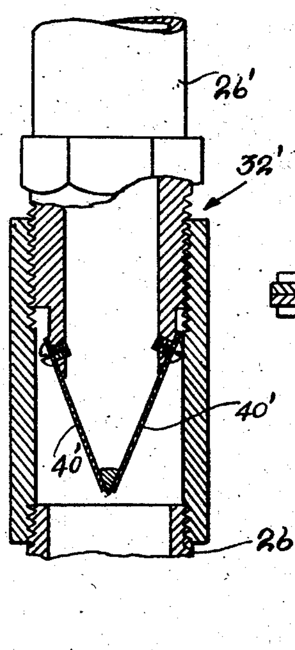


Fig. 2'



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CRANKCASE VENTILATING SYSTEM

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5 Claims. (Cl. 123—1)

This invention relates to internal combustion engines and more particularly to a novel system of obtaining a uni-directional flow of air, under pressure above that of atmosphere, outwardly from the intake manifolds of internal combustion engines, wherein the predominate pressure is above that of atmosphere. While the general principles involved in the system broadly referred to above are adapted for a wide variety of applications, they most readily adapt themselves for use in the ventilation of crank cases of internal combustion engines and, insofar as the present application is concerned, the description thereof will be limited to two such adaptations.

The "Crank-case ventilating system" of my prior Patent No. 2,060,883 of November 17, 1936, has worked out in practice with a very high degree of success in connection with gasoline engines, but that system, being dependent for its operation upon a pressure differential in the engine air intake duct established by a restriction-producing device such as a carburetor or throttle valve, does not readily lend itself to use in connection with the Diesel type of engine, since in this latter type there is usually no carburetor or throttle valve in the engine intake to produce a pressure differential at different points therein. The present crank-case ventilating system makes use of the intermittent pressure surges produced in the engine's intake valve or valves to produce or aid in producing a forced circulation of air from the intake conduit through the engine's crank-case and, hence, is not restricted to use with engines having restriction-producing means such as throttle valves or carburetors in the intake.

As is well known, under operation condition of an internal combustion engine, the predominating pressure in the intake duct leading to the engine's combustion chamber is below atmospheric pressure, or in other words, is a partial vacuum. What is also a fact, although not so widely recognized, is that under the intermittent closing of the intake valve to any cylinder of an engine there is produced for each valve closure, a pressure surge which is momentarily much greater than the predominating or mean average pressure in the intake conduit and which usually exceeds atmospheric pressure. The intermittent pressure surges produced by intermittent closing of the intake valve and resultant rapid stopping of the fast moving air column through the intake conduit may properly be referred to as the air-ram effects in the intake conduit and may hereinafter be referred to as such.

In accordance with the instant invention this intermittent air-ram effect in the intake conduit is harnessed to create or aid in creating a forced movement of air from the engine's air intake conduit to the crank case. Preferably this is accomplished by extending a suitable conduit between the engine's intake conduit, at a point on the atmosphere side of the intake valve, and the crank-case and interposing in that connection or conduit a one-way check valve permitting free flow of air from the engine's intake conduit to the crank-case under intermittent air-ram effects or pressure surges but which prevents return flow of air from the crank-case under alternate lower pressure or partial vacuum conditions of the engine's intake. If air is to be circulated through the crank-case as a result of these pressure surges there must, of course, be provided an air outlet from the crank-case and although this may be direct to atmosphere, such crank-case outlet is preferably connected back to the engine's intake where it will be subject to a predominating vacuum condition of the engine's intake which will further aid in the circulation of air through the crank-case. Further, since it is desired to keep the crank-case as free as possible from dust and other foreign substance and since engines of the present day are almost universally equipped with air cleaners in their air intakes, the air supplied to the crank-case in the manner above described can easily be kept free from air by making the said connection or connections from the crank-case to the intake conduit at a point or points after the intake air cleaner.

This application is in the nature of a division of my co-pending application S. N. 210,409 filed May 27, 1938, and entitled "Crank-case ventilating system." Whereas the claims in this application are confined to the method phase of the invention, the claims of my above identified co-pending application are directed to the broad coverage of the apparatus phase of the invention.

In the accompanying drawings like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a transverse sectional view through an internal combustion engine incorporating one embodiment of the invention;

Fig. 2 is an enlarged detail view in the side elevation with some parts broken away and some parts shown in section of the check valve of Fig. 1;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 2 and looking upwardly, in respect to Fig. 2;

Fig. 4 is a detail sectional view illustrating a valve disc of different material than that illustrated in Figs. 1 and 2 but which may be substituted for the valve disc of Figs. 1, 2 and 3;

Fig. 1' is a transverse sectional view similar to Fig. 1 but illustrating another embodiment of the invention; and

Fig. 2' is an enlarged detail view of the check valve of Fig. 1' with some parts broken away and some parts shown in axial section.

The adaptation of the invention illustrated in Figs. 1 to 4 inclusive, will first be described. The engine illustrated in Fig. 1 is of the conventional character and, as previously stated, may be considered to be of the Diesel or oil burning type, since the intake conduit thereof incorporates no throttle valve or carburetor. Obviously, the engine illustrated may incorporate any number of cylinders, but, for the purpose of this case, it may just as well be considered as a one-cylinder engine.

Of the conventional parts of the engine the cylinder block thereof is indicated as an entirety by **5**, the cylinder bore thereof by **6**, the piston by **7**, the crank shaft by **8**, the connecting rod by **9**, the crank-case by **10**, the cam shaft by **11**, the intake valve operating cam by **12**, the cylinder head by **13**, the combustion chamber formed in the cylinder head above the cylinder bore **6** by **14**, the spring-closed intake valve by **15**, the roller tappet assembly by **16**, the push rod by **17** and the intermediately pivoted rocker arm by **18**.

In accordance with general practice the bottom of the crank-case **10** is closed by a removable oil pan **19**, containing a suitable body of lubricating oil *y*, and the valve actuating connections **17** and **18** are enclosed by a removable inspecttion plate **20** and a removable hood **21**. Also in accordance with conventional practice, in overhead engines free communication is established between the valve mechanism chamber within the hood **21** and the crank-case **10**. In accordance with the present illustration, such communication is established through passages **22**, **23** and **24**. The cylinder head **13** is provided with an intake port **25** that is controlled by the intake valve **15**, and this intake port **25** is connected to atmosphere through a combustion chamber air intake duct **26** having applied therein a suitable air cleaner **27**.

In accordance with the present illustration the ventilation inlet to the crank-case is made to one side thereof at **28** and the ventilation outlet from the crank-case is made from the valve mechanism chamber within the hood **21** at **29**. The ventilation inlet **29** to the crank-case is connected to the combustion chamber air intake duct **26** at a point intermediate the air cleaner **27** and intake valve **15** by a relatively large area check-valve-equipped crank-case air intake duct **30**, and the ventilation outlet in the crank-case is also connected to the combustion chamber air intake duct **26** at a point intermediate the air cleaner **27** and intake valve **15**. This latter connection between the crank-case and intake duct, however, is preferably made through a relatively small area duct or conduit **31**.

The check valve in the crank-case air inlet duct **30** is indicated as an entirety by **32**, and in accordance with the present illustration, includes a two-part valve body **33**, which parts are detachably secured together by screws or the like **34**. The upper portion of the valve body is formed with an externally threaded tapered neck **35** that is screw threaded into combustion chamber intake duct **26**, and the lower half of the valve body **33** is internally threaded at **36** to facilitate coupling to the conduit **30**. The bore of the upper portion of the valve body **33** is coaxial with but of smaller diameter than that of the lower valve body so as to form, at the point of joindure of the upper and lower portions of the valve body, a shoulder **37** that affords a valve seat. In axially spaced relation to the shoulder **37** the lower portion of the valve body **33** is provided with a series of circumferentially spaced inwardly projecting supporting lugs **38**, on which lugs **38** is seated a wire screen supporting disc **39**. Loosely applied in the space between the valve seat shoulder **37** and the wire screen support **39** is an air pressure actuated valve disc **40**, which valve disc according to the illustration of Figs. 1 and 2, is made of thin sheet metal such, for example, as very light sheet bronze. However, a valve disc made of relatively firm rubber composition has also been found suitable for the purpose, and such a rubber composition valve disc is illustrated in Fig. 4, wherein it is indicated by **40a**. The valve disc **40** obviously must be of smaller diameter than that of the bore in the lower portion of the valve body **33**, so that when it is seated upon the supporting screen **39**, air will be permitted to pass therebetween and the walls of the bore **36** at points intermediate the supporting lugs **38**; but it is equally important that the valve disc **40** be of greater diameter than that of the bore in the upper portion of the valve body **33**, so that when it is in its elevated position against the valve surface **37**, it will completely cut off and close the bore through the upper portion of the valve body.

Under operation of the engine the intake valve **15** will, of course, be opened during the downward intake strokes of the piston **7** so as to permit air to be drawn from the atmosphere through the intake conduit **21** and interposed air cleaner **27** to the combustion chamber **14** through the intake port **25**, and said valve will be closed at the termination of the intake stroke of the piston and will remain closed during the succeeding compression, explosion and exhaust strokes of the piston. This rapidly occurring series of air intake cycles will produce a low pressure or relatively high vacuum condition in the intake conduit as a result of the restriction to air flow afforded by the conduit **26** and interposed air cleaner. In other words, under operating conditions of the engine the mean average pressure condition in the intake conduit, as measured, for example, by the conventional U-tube manometer, will be a sub-atmospheric pressure or so-called partial vacuum. However, as previously indicated, the pressure in the intake conduit is not constant even under constant throttle and constant load but does, in fact, reach its lowest pressure or greatest condition of depression during the intake stroke of the piston, at which time the valve **15** is open; and then, upon closing of the intake valve **15**, the abrupt stopping of the rapidly moving column of air through the intake conduit **26** results in momentary rise in pressure within the intake conduit, which oftentimes quite considerably exceeds atmospheric pressure. These pressure surges, while quite great in extent, are, nevertheless, of such short duration as compared to the duration of the extreme low pressure periods, that the average condition within the intake conduit is still considerably below atmospheric pressure.

Operation of Figs. 1 to 4, inclusive

Under the above described conditions existing in the air intake conduit 26, under operation of the engine, the valve disc 40 will be elevated to its upper valve closed position, shown by dotted lines in Fig. 2, during all times that the pressure within the intake conduit 26 at the point of connection of the conduit 30 thereto is below that existing in the crank-case 10, during pressure-surge intervals caused by rapid closing of the valve 15 and resulting in pressure surges in the intake conduit 26 which exceed the pressure existing in the crank-case 10. Hence, each time the valve 15 is closed the pressure surge within the conduit 26 will momentarily be sufficient to open the valve 32 and cause injection of air from the intake conduit 26 through the valve 32 and conduit 30 to the crank-case, and this intermittently injected clean fresh air will be returned to the intake conduit 26 through the crank-case outlet conduit 31.

By means of the conduit 31, which is open to flow of air in either direction, the crank-case is subject to the mean average pressure condition existing in the intake conduit 26, and this materially aids in the circulation of air through the crank-case. It has been found desirable to maintain a pressure condition in the crank-case slightly above that of atmosphere, so that the tendency will be to blow air out through any such small leaks as may occur in even a well sealed crank-case rather than draw air in through such possible leaks; and this condition can quite readily be brought about with the system described by merely so proportioning the air-handling ability of the crank-case inlet 30 and crank-case outlet 31 as to obtain the desired pressure balance. In arriving at a proper balance to obtain this slight positive pressure condition in the crank-case, piston blow-by must, of course, be taken into consideration. Usually, the cross-sectional area of the conduit 31 will be much less than that of the conduit 30.

Figs. 1′ and 2′

In Fig. 1′ the conventional parts of the engine illustrated are substantially like those indicated in Fig. 1 and are indicated by like characters plus the prime mark. In Fig. 1, however, the engine may, as previously indicated, be assumed to be of gasoline burning type since a carburetor 45, having a conventional butterfly throttle valve 46, is illustrated as being interposed in the intake conduit 26′.

The ventilating system of Figs. 1′ and 2′ is similar to that of Figs 1 to 4 inclusive, and includes a crank-case air inlet conduit 30′ from the engine's intake to the crank-case having interposed therein a one way check valve 32′ that is similar to that of Figs. 1 to 4, and a crank-case air outlet conduit 29′ that connects the crank-case to the engine's intake conduit 26′ in a manner similar to that of conduit 29 of Figs. 1 to 4. Insofar as the operation of this form of ventilating system is concerned, the check valve 32′ could be exactly the same as the check valve 32 of Figs. 1 to 4 but a slight somewhat different form is illustrated for the purpose of example, and is, in fact, equally adapted to either of the forms herein illustrated. The valve 32′ is provided with a pair of flap valve elements 40′ that co-operate with opposite valve seats 37′. These valve flap elements are formed of resilient sheet material and are rigidly anchored each at one point by anchoring screws or the like 47. Under conditions of vacuum or sub-atmospheric pressure within the intake conduit 26′, the flap valve elements 40′ seat tightly against their respective seats 37′ and prevent movements of air in a direction from the crank-case to the intake conduit, but under pressure surge conditions within the intake conduit when the pressure therein becomes above that within the crank case, the flap valve elements 40′ readily yield and permit free passage of air from the intake conduit to the crank-case.

In this preferred adaptation of the invention to engines having throttle valve equipped carburetors in the intakes, the operation of a ventilating system is substantially the same as described in connection with Figs. 1 to 4, inclusive when the throttle valve is open and the engine operating under comparatively high speed or load conditions, but when the throttle valve 46 is closed down to slow speed, low load or idling positions, ventilation of the crank case will be maintained largely by virtue of the extremely high vacuum or low sub-atmospheric pressure then present in the intake conduit at the point of connection of the conduit 29′. Otherwise stated, the velocity through the intake conduit 26′ will decrease as the throttle valve 46 is moved from open toward closed position and will be so low when the valve 46 reaches its idling position shown in the drawings that the tendency for air to move into the crank case through the conduit 30′ as a result of air ram effects in the conduit 26′ will be very low. However, in about the same degree as the positive pressure air ram effects decrease under closing of the throttle valve, the degree of vacuum within the conduit 26′ at the engine side of the throttle valve will be built up and will become increasingly more effective so that the velocity of air movement through the crank case will be maintained quite uniform under widely varying degrees of engine speed or load. When the throttle valve is fully closed to its low speed idling position illustrated, circulation will be maintained through the crank case largely by virtue of the average pressure differential within the intake conduit 26′ at opposite sides of the throttle valve, as in the crank case ventilating system of my prior patent before herein identified, although even under these conditions there will be a lower pressure maintained within the crank case of the present system by virtue of the slight positive pressure pulsations or air ram effects within the conduit 26′ at the point of connection of conduit 30′. Of course, when the throttle valve is open the restriction produced thereby will be so low that the system will function almost identically to that of Figs. 1 to 4.

I claim:

1. The method of obtaining an intermittent but unidirectional flow of air outwardly from an engine's air intake duct to a chamber wherein the predominant pressure is above the mean average pressure in the intake duct, but is below the pressure in the intake duct during intermittent pressure surges therein produced by air-ram action resulting from intermittent rapid closing of the engine's intake valve, which consists in automatically establishing communication between the intake duct and said chamber during intermittent pressure surges in the intake

duct when pressure rises above that in said chamber, and automatically cutting off such communication during intervals when the pressure in the engine's intake duct is below that in said intake chamber.

2. The method of obtaining an intermittent but unidirectional flow of air outwardly from an engine's air intake duct to the crank chamber of the engine wherein the predominant pressure is above the mean average pressure in the air intake duct but is below the pressure in the air intake duct during intermittent pressure surges in the intake duct produced by air-ram action resulting from intermittent rapid closing of the engine's intake valve, which consists in automatically establishing communication between the intake duct and crank chamber during intermittent pressure surges in the intake duct when pressure rises above that in the crank chamber, and automatically cutting off such communication during intervals when the pressure in the intake duct is below that in the crank chamber.

3. The method of ventilating crank chambers of internal combustion engines which consists in providing two passages between the engine's air intake duct and its crank chamber, subjecting the crank chamber to the mean average pressure in the intake duct through one of said passages, and subjecting the crank chamber to only the high pressure surges produced in the engine's intake duct, as a result of rapid closing of the intake valve, through the other of said passages.

4. The method of obtaining a uni-directional flow of air outwardly from an engine's intake conduit to the engine's crank chamber through one passage and outwardly from the engine's crank chamber to the engine's intake duct through another passage, which consists in permitting constant uninterrupted flow through one of said passages and automatically cutting off communication between the intake duct and crank chamber through the other of said passages during intervals when the pressure in the intake duct is below that in the crank chamber, and automatically reestablishing communication through said last named passage during intervals when the pressure in the intake duct rises above the pressure existing in the crank chamber.

5. The method of flowing air outwardly from an engine's air intake conduit to a zone of application whereat the mean average pressure is above the mean average pressure condition in the intake duct, which consists in automatically establishing communication between the engine's intake duct and said zone of application during intervals when the pressure in the intake duct exceeds that at said zone of application as a result of air-ram action produced by abrupt closing of the engine's intake valve, and automatically closing off communication between the intake duct and said zone of application during intervals when the pressure in the engine's intake duct is below that existing at said zone of application.

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