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3,107,659

TWO-CYCLE INTERNAL COMBUSTION ENGINE

Filed Dec. 28, 1960

2 Sheets-Sheet 1

FIG. 1

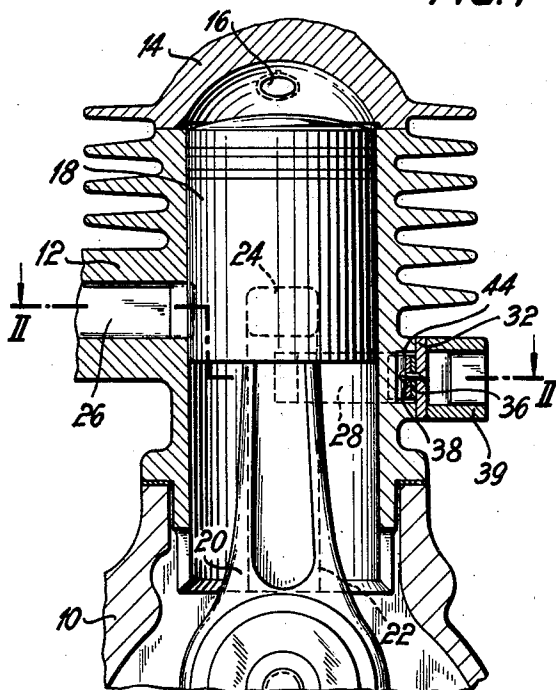
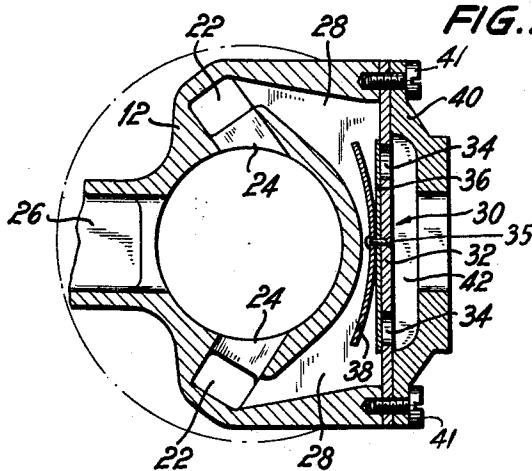


FIG. 2



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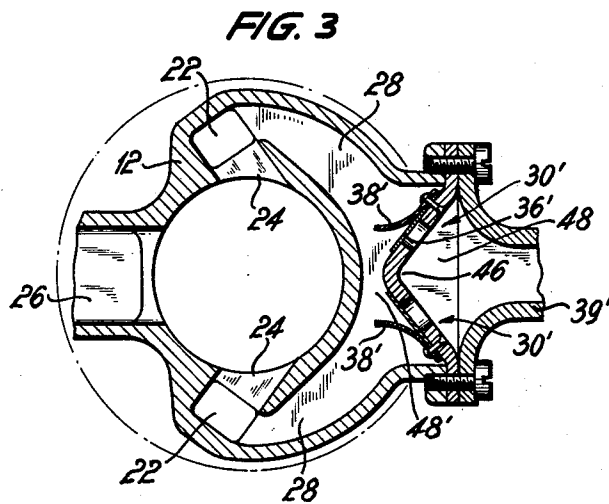
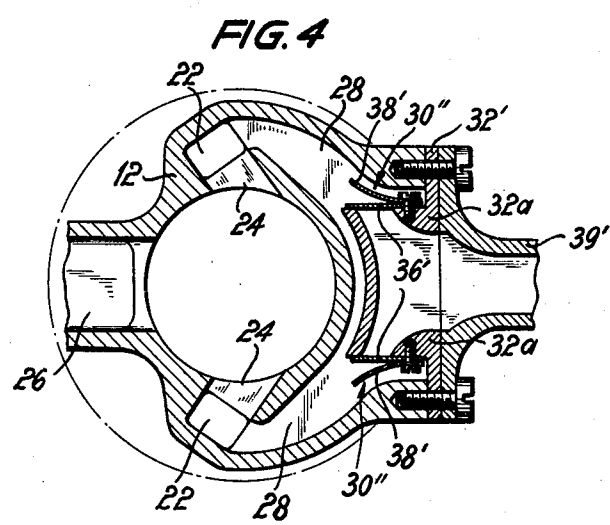
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2 Sheets-Sheet 2



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TWO-CYCLE INTERNAL COMBUSTION ENGINE

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7 Claims. (Cl. 123-73)

This invention relates to two-cycle internal combustion engines, and more particularly to an improved device for admitting fuel to the cylinders of a specific type of two-cycle internal combustion engines.

In this type of engine the explosive mixture of air and fuel is sucked into the crankcase of the engine during the upward stroke of the piston. During the downward power stroke of the piston, the mixture in the crankcase is compressed, and the compressed mixture is admitted to the cylinder cavity through a transfer passage terminating in a port in the cylinder which is uncovered by the piston at a suitably selected time during the power stroke.

It has been previously found advantageous to admit the fuel mixture from a carburetor or the like to the crankcase through the transfer passage. A check valve arranged in the wall of the transfer passage of the known arrangement opens to admit fuel to the passage when the crankcase pressure is low, and closes when the fuel mixture in the crankcase is being compressed.

We have found that this arrangement has several inherent shortcomings which limit its applicability. The primary object of this invention is the general improvement of the type of two-cycle internal combustion engine in which an intake conduit connects the carburetor or its equivalent with a transfer passage of an engine cylinder.

It is conventional, and usually unavoidable that the duct feeding fuel mixture to the transfer passage meet the latter substantially at right angles. The transfer passage is at least partly cut into the cylinder wall and generally must be as short as possible to avoid energy losses during flow of fuel mixture from the crankcase to the cylinder cavity. The normal geometry of the engine does not permit access to such a transfer passage in any other direction than perpendicular to the direction of fluid flow through the passage toward the crankcase while fuel mixture is sucked into the crankcase. We have found that a valve arranged in the transfer passage wall at the angular junction of the intake conduit with the transfer passage is a source of harmful turbulence while fuel mixture is sucked into the crankcase. It is another important object of this invention to avoid or reduce turbulence at the juncture of the intake conduit and the transfer passage as far as possible.

When the check valve controlling fuel admission is installed in the wall of the transfer passage, the latter being of necessity of substantially uniform cross section, the size of the valve opening is limited to a cross section smaller than that of the transfer passage. We have found that the efficiency and power of internal combustion engines of the aforescribed type, and particularly of engines of relatively small displacement, is significantly impaired by the necessarily small cross section of the check valve opening in the known arrangement. A further object of this invention thus is the provision of a fuel sys-

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tem in which the effective check valve aperture is independent of the transfer passage section without altering the configuration of the latter.

It is desirable to equip certain two-cycle engines with a plurality of transfer passages connecting the crankcase with the cylinder cavity to improve exhausting of the spent fuel mixture and thereby the efficiency of the engine. The known fuel admission arrangement is not readily applicable to engines so equipped. An additional object of this invention is the provision of a fuel admitting device which may be employed with an engine having any number or arrangement of transfer passages.

With these and other objects in view, the invention in its basic aspects provides a two-cycle engine of the type described with check valve means which are arranged in a portion of the intake conduit spaced from the transfer passage. A portion of the conduit or a connecting duct is interposed between the valve means and the point of admission of fuel mixture to the transfer passage.

This arrangement has been found to be highly advantageous, particularly in two-stroke internal combustion engines of small displacement such as are being used in light motorcycles and as auxiliary power sources for bicycles. In these engines, a high ratio of power output to weight is essential, and this ratio has been found to be significantly improved by the present invention. The separation of the check valve means from the transfer passage permits all conduits through which the fuel mixture passes to be shaped independently for minimum flow resistance without the need for compromises. The size of the valve aperture becomes independent of the size and configuration of the transfer passage. The device of the invention is readily adaptable to engines equipped with a plurality of transfer passages.

Membrane valves in which a flexible membrane moves toward and away from a valve opening have been previously employed in two-cycle engines of the aforescribed known type, and such valves may advantageously be employed with the present invention.

Other features and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description of preferred embodiments thereof when considered in connection with the accompanying drawings, wherein:

FIG. 1 shows a portion of a single-cylinder two-cycle internal combustion engine in section on the cylinder axis;

FIG. 2 illustrates the engine of FIG. 1 in radial section on the line II-II;

FIG. 3 is a sectional view of another embodiment of the invention corresponding to FIG. 2; and

FIG. 4 shows a third embodiment of the invention in a sectional view analogous to that of FIG. 2.

Referring now to the drawing in detail, and initially to FIGS. 1 and 2, there is seen a single-cylinder two-cycle engine of generally known construction having a crankcase 10 on which a finned air-cooled cylinder block 12 is mounted. The cylinder is closed by a cylinder head 14 provided with a threaded bore 16 for a sparkplug, as is conventional. A piston 18 reciprocates in the cylinder and its movement is converted into rotary movement of a shaft by a connecting rod 20 cooperating with a crankshaft (not shown in detail).

The cavities of the cylinder block 12 and crankcase 10

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are connected by two transfer passages 22 which are partly cut into the wall of and extend within the cylinder block 12 and terminate in slot shaped respective ports 24 in the cylinder. A single exhaust port 25 is provided on substantially the same level as the transfer ports 24.

Each of the transfer passages 22 communicates with a respective connecting duct 28 at a point intermediate the orifices of and extend within the passage in the cylinder and the crankcase. The ducts 28 are also cut into the wall of the cylinder block and form the terminal portions of an approximately semi-annular or U-shaped composite conduit about the cylinder cavity the central or bight portion of which is confined between the wall of the cylinder cavity proper and a check valve 30.

The valve consists essentially of an elongated support plate 32 which covers a corresponding opening in the cylinder block and is itself formed with two apertures 34 approximately in line with the two connecting ducts 28. A rivet 35 attaches the center portion of an elongated flexible membrane member or flap 36 and the corresponding portion of a rigid, arcuately bent strap member 38 to the support plate 32. The membrane member 36 is interposed between the support plate 32 and the strap member 38 in such a manner that it is free to move with a flowing fluid between a position in which its two free ends abut against the support plate 32 and close the apertures 34, and another position in which the free ends of the member 36 abut against the strap member 38 and open the apertures 34 to flow of fuel mixture into the connecting ducts 28. The support plate 32 together with a flanged end portion 40 of the intake duct 39 of the engine is secured to the cylinder block 12 by means of two bolts 41. The space 42 defined between the flange portion 40 and the support plate 32 constitutes a manifold the discharge channels of which lead toward the apertures 34.

As best seen from FIG. 1, the valve assembly 30 is installed in a recess 44 in the cylinder block 12 which connects the two ducts 28 and is not entirely obstructed by the elements of the valve 30.

The valve 30 is shown in FIG. 2 in the position assumed during the downstroke of the piston 18 when the increasing pressure in the crankcase 10 urges the membrane member 36 against the support plate 32, thereby closing the apertures 34. The fuel mixture previously compressed in the crankcase is thus forced through the transfer ports 24 into the cylinder cavity as soon as the ports are cleared by the piston 18.

During the subsequent upward movement of the piston 18, negative pressure develops in the crankcase 10. An explosive fuel mixture is drawn through the intake duct 39, through the opening valve 30, the connecting ducts 28, and the transfer passages 22 into the crankcase 10. The source of the fuel mixture has not been specifically illustrated. It may be a conventional carburetor connected to the duct 39, or the duct 39 itself may be an integral part of a carburetor not otherwise shown.

While suction is developed in the crankcase 10, the explosive mixture enclosed in the cylinder is compressed by the upward movement of the piston 18, and is detonated when the piston 18 approaches top dead center, as is well known in itself. The expanding gases of combustion force the piston downward, thereby compressing the portion of the fuel mixture previously drawn into the crankcase, and another cycle begins.

The embodiments of the invention illustrated in FIGS. 3 and 4 operate in substantially the same manner as the engine illustrated in FIGS. 1 and 2, but they differ therefrom in structural features.

In the apparatus shown in FIG. 3 in a view corresponding to that of FIG. 2, the valve 30' is equipped with a support plate 46 which is elongated in shape and angularly bent in its center portion. The two apertures in the plate 46 are selectively closed by two flaps 36' which are individually riveted to the support plate 46 together with individual arcuately bent strap members 38'. The flaps 36' and strap members 38' are elongated and one of their end

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portions is riveted to the support plate 46 whereas the other end portion of each flap 36' is freely movable between the plate 46 and a corresponding strap member 38'. Because of the configuration of the support plate 46, the space 48 in front of the plate 46 serves as a distributing manifold, but such a manifold function is also partly assumed by the space 48' adjacent the plate 46 and facing the ducts 38.

As compared to the arrangement seen in FIG. 2, the device illustrated in FIG. 3 provides a somewhat different pattern of flow for the incoming fuel mixture and favors equalization of pressure in the space 48' behind the support plate 46. Yet another flow pattern is developed in the embodiment of the invention shown in FIG. 4 which aims at substantially streamlined flow through the check valve.

As seen in FIG. 4, a support member 32' defines a forked flow path the two discharge channels of which may be closed by individual flaps 36' backed by strap members 38' in the same manner as previously described in connection with the embodiment illustrated in FIG. 3. When the flaps 36' open the respective valve passages 30', fluid may flow substantially unimpeded from the intake duct 39' which in this instance is the discharge duct of a carburetor not otherwise shown into the connecting ducts 28. A portion of the support member 32' defines with the external wall of the cylinder a narrow passage which permits pressure equalization between the two ducts 28.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and the scope of the invention set forth in the appended claims.

What we claim is:

1. In a two-cycle internal combustion engine, a cylinder block defining a combustion chamber, a crankcase, at least two transfer passages extending within said block and terminating in said chamber and crankcase, a single intake conduit, check valve means in said conduit, and at least two connecting ducts extending within said block, each of said ducts communicating at one end with one of said passages at a point intermediate said terminals, said ducts forming a substantially semi-annular composite conduit having a central or bight portion, said composite conduit communicating with said valve means at said central or bight portion.

2. In a two-cycle internal combustion engine, a cylinder block defining a combustion chamber, a crankcase, at least two transfer passages extending within said block and terminating in said chamber and crankcase, a single intake conduit, check valve means mounted to control the intake to said engine and including at least two independent check valves, and at least two connecting ducts extending within said block, each of said ducts communicating at one end with one of said check valves and at the other end with one of said passages at a point intermediate said terminals.

3. In the engine as set forth in claim 2, manifold means interposed between said independent check valves and said intake conduit.

4. In the engine as set forth in claim 3, said manifold means including at least two channels leading to said connecting ducts, each of said channels being controlled by one of said check valves.

5. In a two-cycle internal combustion engine, a cylinder block including a wall defining a combustion chamber, said wall being formed with a plurality of transfer ports, a crankcase, a plurality of transfer passages, each of said passages extending within said block and opening into said crankcase and one of said ports, each of said ports connecting said chamber and one of said passages, a single intake conduit, check valve means in said conduit, and a plurality of connecting ducts extending within said block, each of said ducts communicating with said valve means and one of said transfer passages at a point intermediate

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the openings of the respective passage into said crankcase and the respective transfer port.

6. In the engine as set forth in claim 5, said connecting ducts generally following the circumferential boundary of said block.

7. In the engine as set forth in claim 5, said valve means including a support member secured to said cylinder and being formed with a plurality of apertures, each of said apertures communicating with said intake conduit and one of said connecting ducts, and a flap member movable on said support toward and away from an aperture closing position.

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