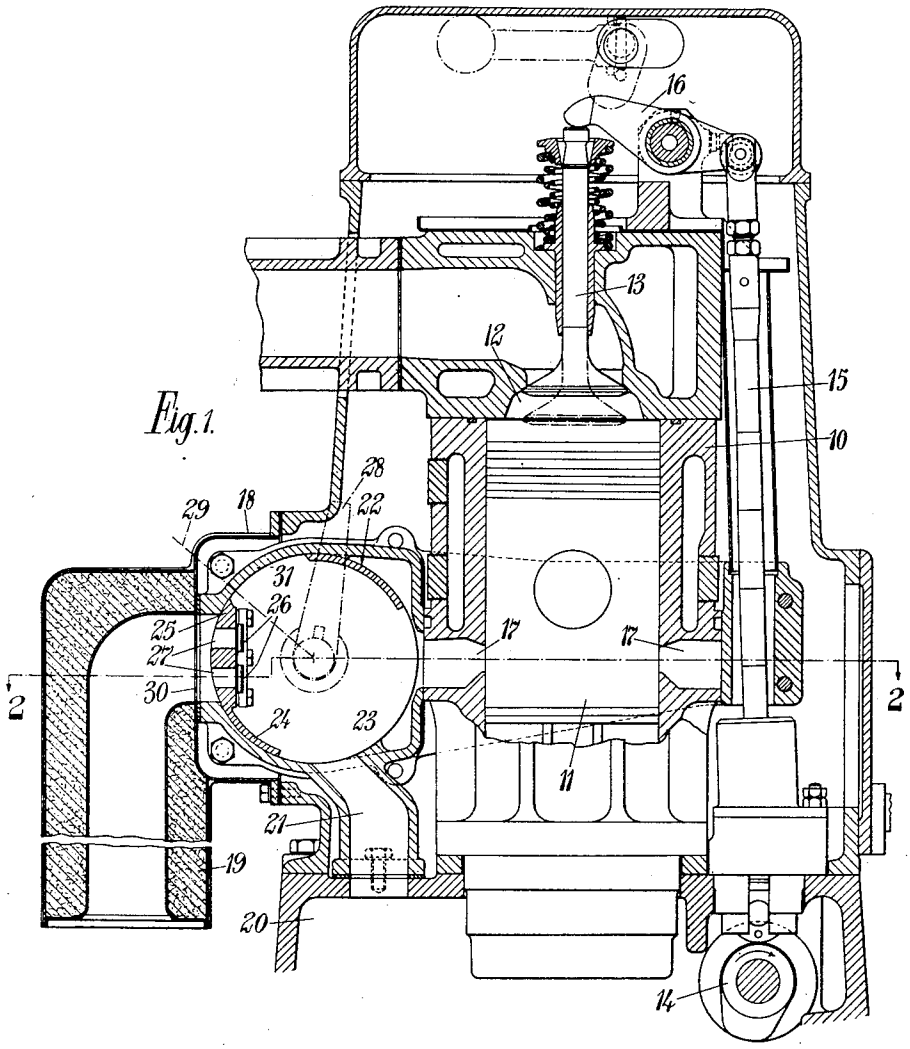
July 2, 1940. A. H. CORNISH ET AL 2,206,632

TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE

Filed Feb. 14, 1939 5 Sheets-Sheet 1

Fig. 1.



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TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE

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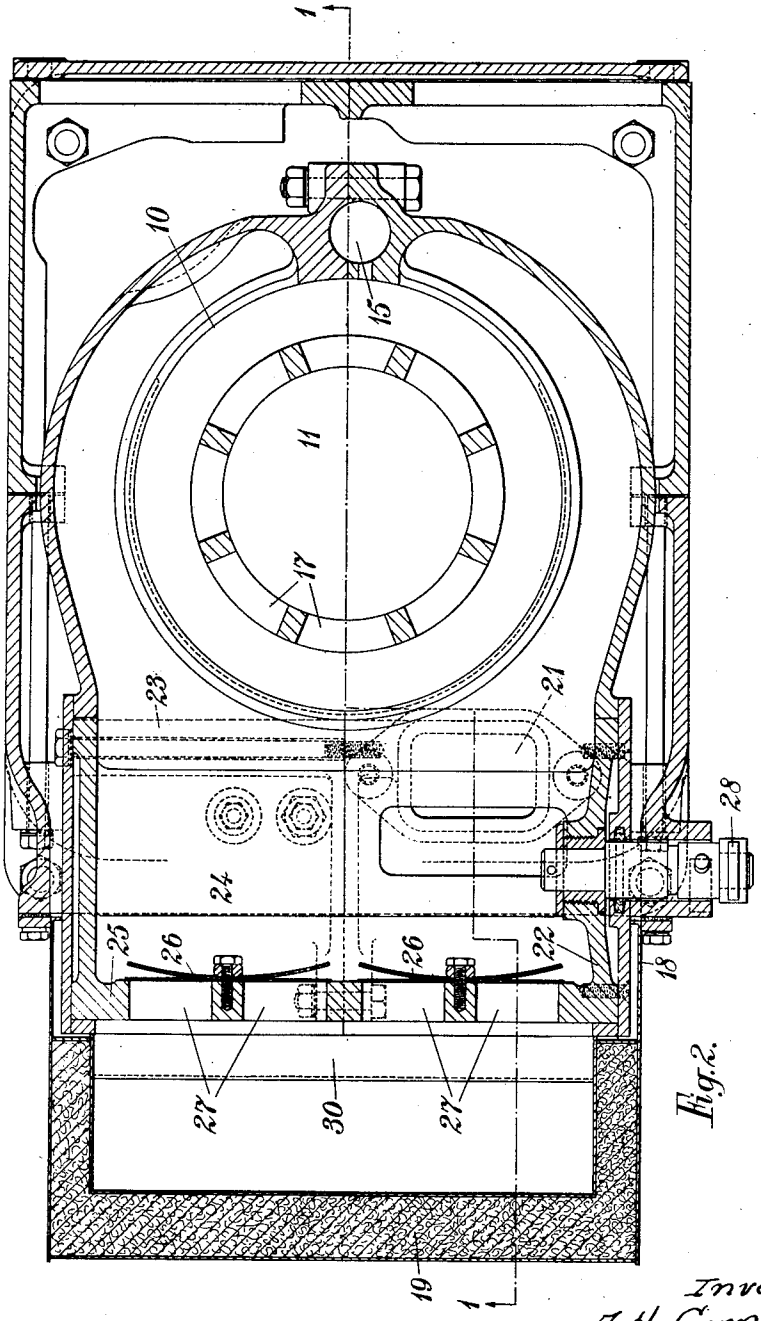


Fig. 2.

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TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE

Filed Feb. 14, 1939 5 Sheets-Sheet 3

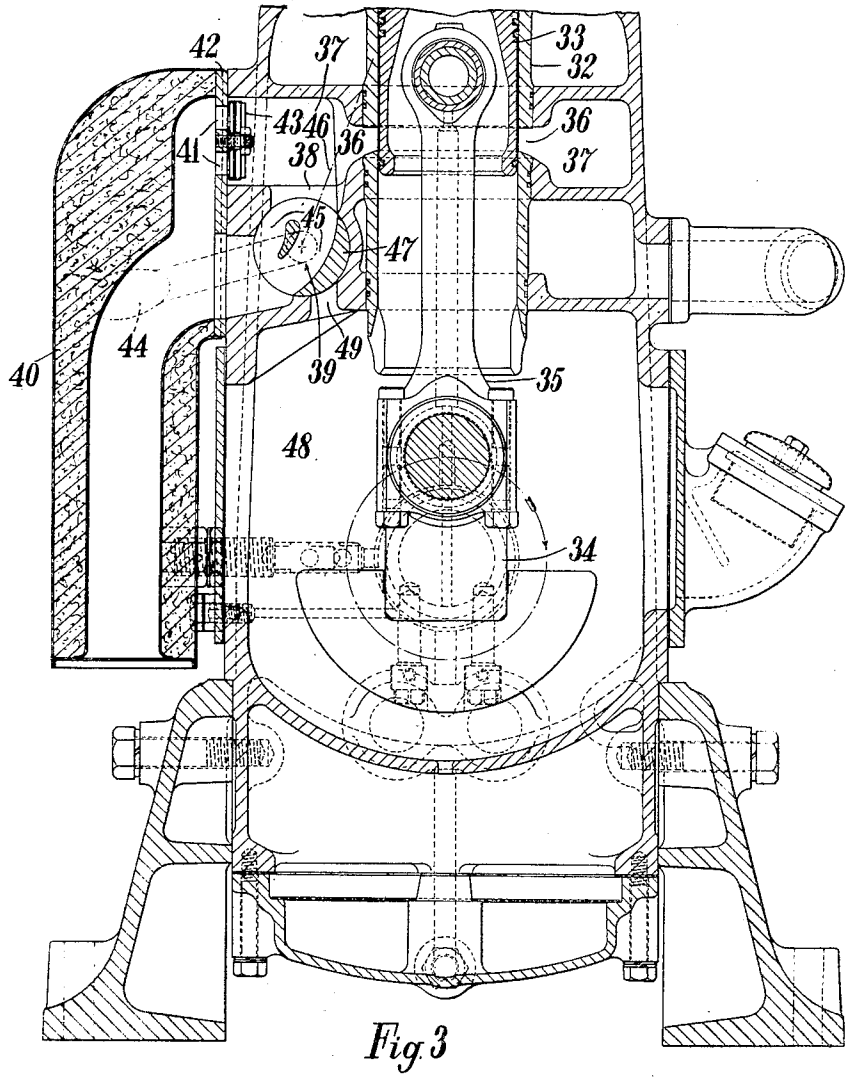


Fig. 3

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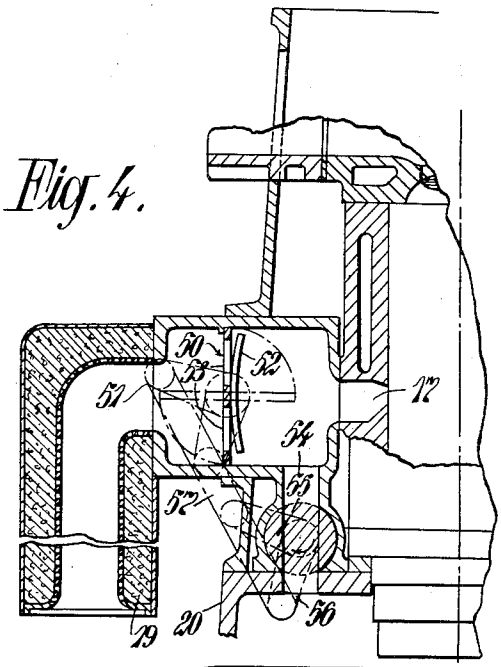
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July 2, 1940. A. H. CORNISH ET AL 2,206,632

TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE

Filed Feb. 14, 1939 5 Sheets-Sheet 4

Fig. 4.



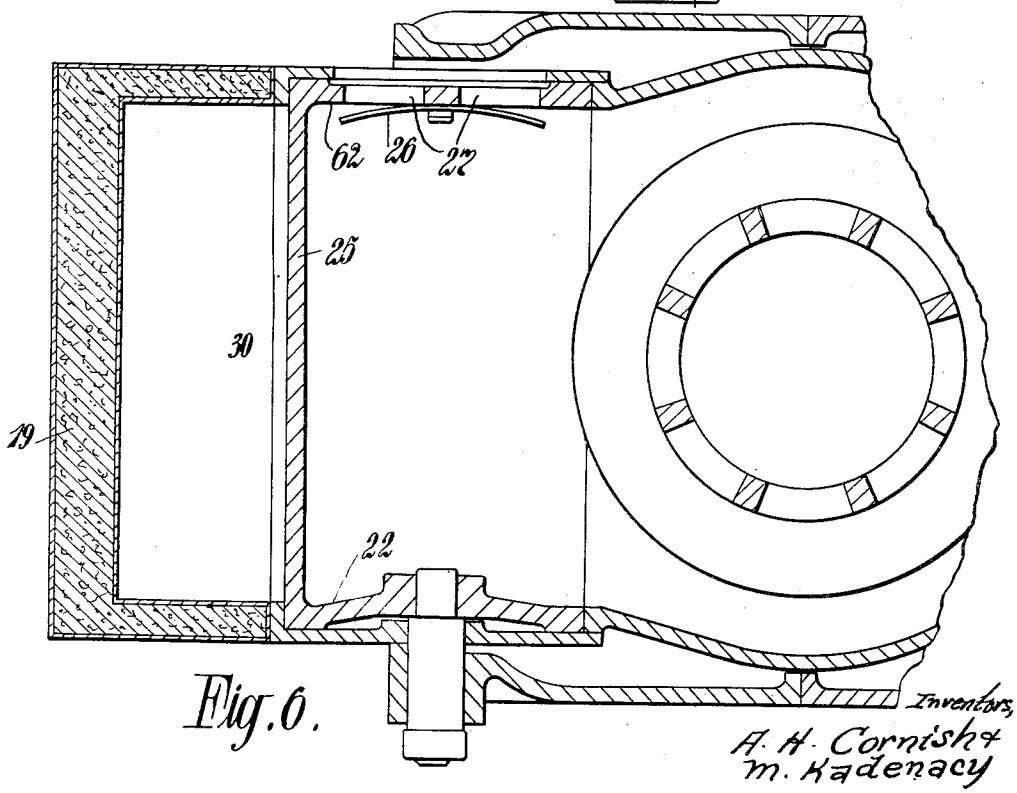


Fig. 6.

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TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE

Filed Feb. 14, 1939 5 Sheets-Sheet 5

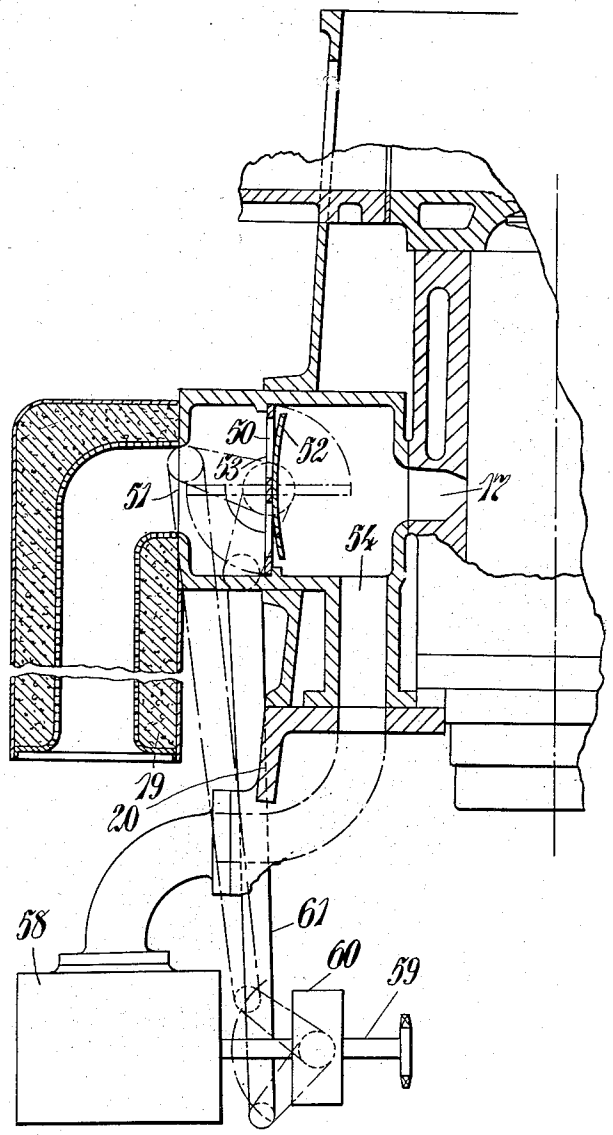


Fig. 5.

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2,206,632

UNITED STATES PATENT OFFICE

2,206,632

TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE

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Application February 14, 1939, Serial No. 256,383
In Great Britain February 16, 1938

14 Claims. (Cl. 123—65)

This invention relates to two-stroke cycle internal combustion engines of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass.

More particularly the invention relates to engines of this kind wherein during normal running the fresh charge is admitted to the engine directly from the atmosphere and in which for starting purposes air under pressure is supplied to the engine cylinder from a compressor.

In arrangements of this kind and in which the crank case of the engine functions as the starting compressor in combination with the working piston, it is known to arrange for the compressor to draw its charge from the atmosphere through a non-return valve which may, for example, also control the orifice which during normal running serves for the admission of atmospheric air directly to the cylinder.

Such non-return valves in general are fragile and have a short life when they operate at high speeds. In addition, when these non-return valves are placed on the atmospheric inlet to the cylinder they require to be of very large dimensions, in order to allow the passage of the larger quantity of air required by the engine during normal running.

The object of the invention is to avoid these objections to the use of non-return valves for the purpose indicated above.

According to the invention a passage communicating with the atmosphere and leading to the cylinder and compressor, or to the compressor, is controlled during the starting of the engine by a non-return valve, and means are provided for rendering the non-return valve inoperative at normal running speeds when the working charge of the engine is aspirated directly from the atmosphere to the cylinder, these means being such that the air aspirated to the engine during normal running speeds does not have to pass through the non-return valve when the latter has been rendered inoperative.

For example the non-return valve may be so arranged or mounted that it can be moved bodily out of the path of the flow of air through the duct that it controls during starting. Or during normal running the communication may be cut off between the non-return valve and the compressor or the compressor and cylinder, and in this case a communication will be opened between the cylinder and the atmosphere. Or a passage to the atmosphere may be opened during normal running which provides an easier path to the cylinder than that which is provided through the non-return valve. In this case the non-return valve will be rendered inoperative by the pressure equalisation established on both sides of the valve by the opening of the separate communication to the atmosphere and the connection between the compressor and the cylinder may be shut off during normal running, if desired.

The compressor employed need not be the crank case of the engine and any suitable form of compressor or the equivalent may be employed.

When the arrangement is such that the compressor would continue to function during normal running, in spite of the fact that the non-return valve has been rendered inoperative and it is desired to render the compressor inoperative also, this may be effected separately or by the provision of a single controlling device which is so arranged that it stops the compressor or renders the compressor inoperative at the same time as the non-return valve is rendered inoperative.

Reference will now be made to the accompanying drawings in which some embodiments of the invention are illustrated by way of example only, and in which:

Figure 1 is a two-stroke cycle internal combustion engine of the kind referred to taken partly in section on the line 1—1 of Figure 2.

Figure 2 is a cross-section of the engine according to Figure 1 on the line 2—2 of Figure 1.

Figures 3, 4, 5 and 6 are fragmentary cross-sections of other engines of the kind referred to incorporating further embodiments of the invention.

Referring to Figures 1 and 2, 10 is the engine cylinder in which moves a piston 11 connected to the usual connecting rod and crank shaft (not shown). An exhaust port 12 in the cylinder head is governed by a poppet valve 13 which is controlled from cam 14 by push rod 15 and rocker mechanism 16.

The inlet orifices 17 situated towards the bottom of the cylinder are surrounded by an air belt

which may be connected through valve chamber 18 to the atmosphere via air inlet silencer 19 or, alternatively, to crank case compressor 20 (shown only in part) via passage 21.

The valve chamber 18 houses an oscillatory valve 22 having cut away portions 23, 31, masking portion 24 and a portion 25 carrying non-return valves 26 controlling openings 27. The position of valve 22 is controlled by lever arm 28. In the position shown, a connection is established between the crank case compressor 20 and the inlet orifices 17.

When the lever arm is moved to the position indicated at 29, the connection between the crank case compressor 20 and the inlet orifices 17 is cut off by the masking portion 24 and a straight through connection is established between the said inlet orifices 17 and the atmosphere via cut away portions 23, 31, orifice 30, and air inlet silencer 19.

The operation of this embodiment of the invention is as follows:

When it is desired to start the engine, oscillatory valve 22 is adjusted to the position shown in Figures 1 and 2 by means of the lever arm 28 and air under pressure is supplied to the engine cylinder 10 from crank case compressor 20 via passage 21 and cut away portion 23 of rotary valve 22. The non-return valves 26 prevent the escape of air under pressure from the compressor to the atmosphere.

It will be understood that the timing of the opening of the inlet orifices 17 by the piston 11 in relation to the timing of the opening of the exhaust valve 13 will be as hereinbefore specified.

As the engine gains speed the suction effect exerted in the cylinder and at the inlet orifices 17 by the mass exit of the burnt gases is sufficient to open the non-return valves 26, and to draw air from the atmosphere via the inlet silencer 19 and orifice 30 through openings 27 into the engine cylinder to supplement the air delivered by the crank case compressor.

When the engine has attained its normal running speed the supply of air under pressure becomes no longer necessary and the valve 22 is oscillated by the lever arm 28 until the latter takes up the position indicated at 29. In this position the member 25 is moved out of the passage 30 leading to the air silencer 19 and the masking member 24 closes the passage 21 to the crank case compressor 20. A free passage is thus provided from the atmosphere to the engine cylinder via the air silencer 19, orifice 30, cut away portions 31 and 23 of rotary valve 22 and air inlet orifices 17.

Referring to Figure 3 of the drawings, 32 denotes an engine cylinder in which moves a piston 33 driving crank 34 through the connecting rod 35.

Air inlet orifices 36 are provided in the lower part of the walls of the cylinder and lead to air belt 37. Passage 38 leads from the air belt 37 via oscillatory valve 39, to air inlet silencer 40, and further passages 41 in the wall 42 of the air belt also lead to the air inlet silencer 40 and are controlled by non-return valves 43 opening in the direction of the air belt 37. The oscillatory valve 39 is controlled by lever arm 44.

When the lever arm 44 is in the position shown, connection is established between the atmosphere and the engine cylinder via air inlet silencer 40, passages 45 in valve 39, passage 38, air belt 37 and air inlet orifices 36.

When the lever arm 44 is moved to the position 46 the direct passage between the air inlet silencer 40 and the air belt 37 is cut off by closure member 47 and a connection is established between the air belt 37 and a crank case compressor 48 via passages 45 and a passage 49.

The oscillatory valve 39 is moved to the last mentioned position when it is desired to start the engine, so that air under pressure is fed to the engine cylinder from the crank case compressor 48 via passages 49, 45, air belt 37 and inlet orifices 36.

When the suction at the inlet orifices due to the mass exit of the burnt gases exceeds the output of the crank case compressor at any particular moment the non-return valves 43 open and allow air to be drawn in direct from the atmosphere via orifices 41.

During normal running the arm 44 is moved to the position shown in the drawings, cutting off the connection between the air belt 36 and the crank case compressor 48, and air is drawn into the cylinder freely from the atmosphere via air inlet silencer 40, passages 45 in valve 39, passage 38, air belt 37 and inlet orifices 36.

In this case the non-return valves 43 will be rendered inoperative by the pressure equalization established on both sides thereof by the opening of the passages 45 to the atmosphere.

In both the embodiments described the non-return valves, 26 and 43 respectively, may serve as the inlet valves to the compressors.

It will be understood that the invention extends broadly to the rendering of the non-return valves inoperative at normal working speeds, while providing a passage for the aspiration of air freely from the atmosphere to the engine cylinder, and the invention is therefore not to be limited to the details of construction hereinbefore given by way of illustration and which may be varied to suit any practical requirements that may have to be fulfilled. Figure 4 shows an example in which the oscillatory valve 22 of Figures 1 and 2 is replaced by a disc or plate valve 50 of the "butterfly type" which is adapted to be oscillated, by means of a lever 51 for example, to close off the communication between air inlet silencer 19 and the inlet orifices 17 in one position or to be moved into a position in which it lies substantially parallel to the direction of flow of the incoming air.

In this example the non-return valves 52 are carried by the disc valve 50 and control orifices 53 therein, to open said orifices only in the direction of the inlet orifices 17. Also, the connection 54 to the compressor is located between the said valve 50 and the inlet orifices 17, and the compressor may be rendered inoperative during normal running, for example, by cutting off the connection between the compressor and the cylinder by a separate control valve 55, the control lever 56 of which may be connected to the control lever 51 of the butterfly valve 50 by link 57 so that when the butterfly valve 50 is open the connection to the compressor is closed and vice versa.

It will be clear, in this embodiment of the invention, that when the butterfly valve 50 is in closed position air is drawn through the non-return valve 52 via the passage 54 and valve 55, into the crank case 20, during the inward stroke of the engine piston, while on the outward stroke of the engine piston air under pressure is delivered to the inlet orifices 17 and flows into the engine cylinder, as it cannot escape through the non-return valve 52.

The present invention is not limited to the use of crank case compressors. For example such compressors may be substituted by separate compressors as illustrated in Figure 5 which shows an arrangement similar to Figure 4 but having a separate compressor 58. The driving shaft 59 of this compressor 58 is shown taken via a clutch 60 which is controlled by a link and lever mechanism 61 connected to the operating lever 51 of the valve 50 so that the starting compressor is rendered inoperative when the oscillatory valve 50 is open directly to the atmosphere.

In this example the valve 55 may be provided if desired.

In another alternative construction illustrated in Figure 6 the non-return valves 26 and orifices 27 of the oscillatory valve 22 of the embodiment illustrated in Figures 1 and 2 of the drawings are carried by an end face 62 of the valve 22, and the member 25 simply serves to close off the orifice 30 during starting. During normal running the non-return valves 26 would be rendered substantially inoperative by the pressure equalization set up on both sides of the valves.

Yet again, the actuation of the various oscillatory valves may be controlled by the engine governor or other tachometrical device, if desired.

We claim:

1. In a two-stroke cycle internal combustion engine of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, a conduit leading from the atmosphere and connected to the inlet orifice, a compressor connected to said conduit, a two position oscillatory valve in said conduit adapted in one position to connect the compressor to the inlet orifice of the cylinder, and in a second position to cut off the connection between the compressor and the inlet orifice and to connect the inlet orifice freely to the atmosphere, and a non-return valve in said oscillatory valve so arranged as to provide one-way communication between the atmosphere and said inlet orifice and so located that it does not affect the flow of air from the compressor to the cylinder.

2. A two-stroke cycle internal combustion engine as claimed in claim 1 wherein said one-way connection between the atmosphere and the inlet orifice is provided only when said oscillatory valve is in its first mentioned position.

3. In a two-stroke cycle internal combustion engine of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, a conduit leading from the atmosphere and connected to the inlet orifice, a compressor connected to said conduit, a two position oscillatory valve in said conduit between said compressor connection and the atmosphere adapted in one position to connect the inlet orifice freely to the atmosphere, and in a second position to interpose a non-return valve in the path between the atmosphere and the inlet orifice so as to provide one-way communication only between the atmosphere and said inlet orifice.

4. In a two-stroke cycle internal combustion engine as claimed in claim 3, means for closing off the connection between the compressor and the cylinder when the oscillatory valve is in its first mentioned position.

5. In a two-stroke cycle internal combustion engine of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required relay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, a conduit leading from the atmosphere and connected to the inlet orifice, a compressor connected to said conduit, a two position oscillatory valve in said conduit adapted in one position to connect the compressor to the inlet orifice of the cylinder, and in a second position to cut off the connection between the compressor and the inlet orifice and to connect the inlet orifice freely to the atmosphere, a by-pass connection in said conduit about said oscillatory valve and a non-return valve in said by-pass so arranged as to provide at all times one-way connection between the atmosphere and said inlet orifice.

6. A two-stroke cycle internal combustion engine as claimed in claim 3 and having a crank case compressor wherein said non-return valve also functions as the inlet valve to the compressor.

7. In a two-stroke cycle internal combustion engine of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, a conduit leading from the atmosphere and connected to the inlet orifice, a compressor connected to said orifice to supply air under pressure to the engine cylinder during starting, a non-return valve in said conduit clear of the path between said compressor and said inlet orifice, and oscillatable means providing a passage between the atmosphere and said inlet orifice at normal running

speeds of the engine so that the air aspirated from the atmosphere to the engine at such speeds does not have to pass through the non-return valve.

8. A two-stroke cycle internal combustion engine as claimed in claim 7 wherein said oscillatable means moves the non-return valve bodily out of the path of the flow of air through said conduit.

9. A two-stroke cycle internal combustion engine as claimed in claim 7 wherein said oscillatable means causes said non-return valve to be by-passed.

10. A two-stroke cycle internal combustion engine as claimed in claim 7 wherein said oscillatable means moves said non-return valve into a position substantially parallel to the direction of flow of incoming air.

11. In a two-stroke cycle internal combustion engine of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, a compressor connected to said inlet orifice to supply air under pressure to the engine cylinder during starting, a conduit leading from the atmosphere and connected to said inlet orifice, a non-return valve in said conduit clear of the path between said compressor and said inlet orifice, a second conduit leading from the atmosphere and connected to said inlet orifice, a controlled valve in said second conduit, and means for opening said controlled valve during normal running speeds of the engine.

12. In a two-stroke cycle internal combustion engine of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, a conduit leading from the atmosphere and connected to the inlet orifice, a crank case compressor connected to said conduit, a two position oscillatory valve in said conduit adapted in one position to connect the compressor to the inlet orifice of the cylinder, and in a second position to cut off the connection between the compressor and the inlet orifice and to connect the inlet orifice freely to the atmosphere, and a non-return valve in said oscillatory valve so arranged as to provide one-way communication between the atmosphere and said inlet orifice and also between the atmosphere and said compressor when said oscillatory valve is in its first mentioned position.

13. In a two-stroke cycle internal combustion engine of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, a conduit leading from the atmosphere and connected to the inlet orifice, a crank case compressor connected to said conduit, a two position oscillatory valve in said conduit adapted in one position to connect the compressor to the inlet orifice of the cylinder, and in a second position to cut off the connection between the compressor and the inlet orifice and to connect the inlet orifice freely to the atmosphere, a by-pass connection in said conduit about said oscillatory valve and a non-return valve in said by-pass so arranged as to provide at all times one-way connection between the atmosphere and said inlet orifice and to provide one way connection between the atmosphere and said compressor when said oscillatory valve is in its first mentioned position.

14. In a two-stroke cycle internal combustion engine of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when a flow resulting from an adiabatic expansion only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilised in introducing a fresh charge into the cylinder, by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, a conduit leading from the atmosphere and connected to the inlet orifice, a compressor connected to said conduit, means for driving said compressor, a two position oscillatory valve in said conduit between said compressor connection and the atmosphere adapted in one position to connect the inlet orifice freely to the atmosphere, and in a second position to interpose a non-return valve in the path between the atmosphere and the inlet orifice so as to provide one-way communication only between the atmosphere and said inlet orifice and means for disconnecting the compressor driving means when the valve is in its first mentioned position.

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