Dec. 24, 1968 R. E. PERLEWITZ 3,417,740

AUTOMATIC COMPRESSION RELEASE FOR INTERNAL COMBUSTION ENGINE

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FIG. 1

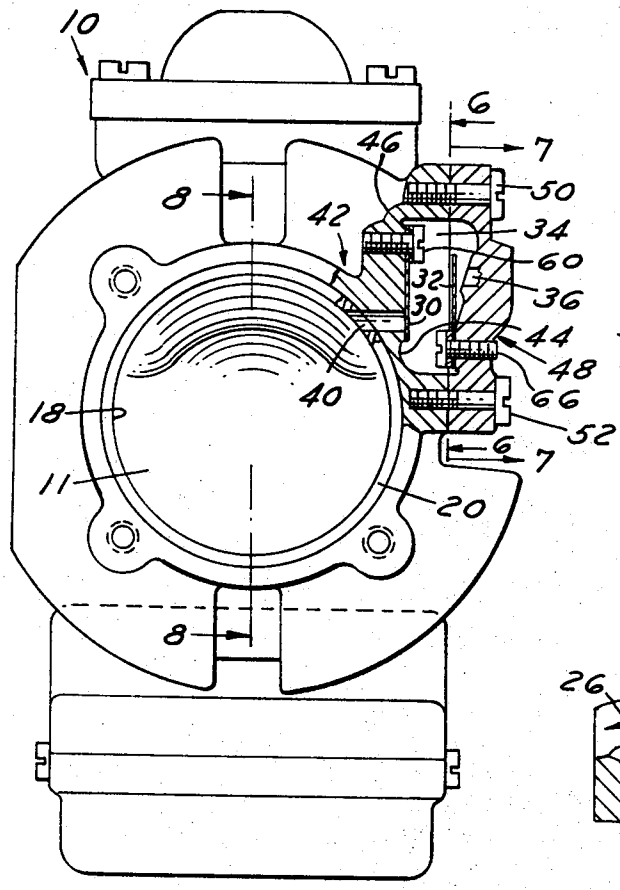


FIG. 3

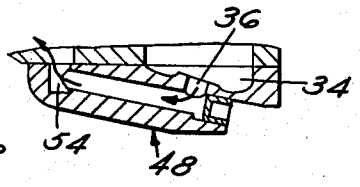


FIG. 4

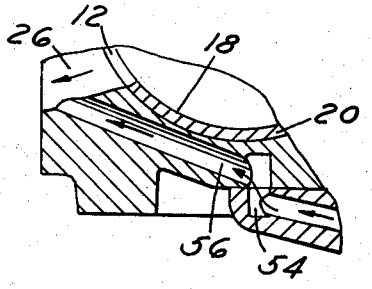
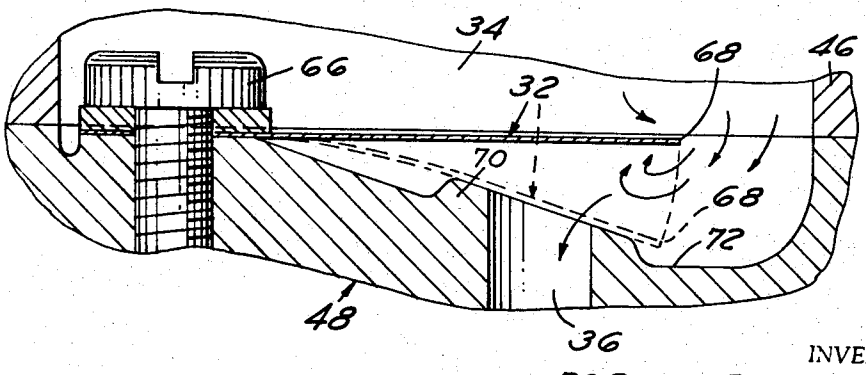


FIG. 5



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FIG. 2

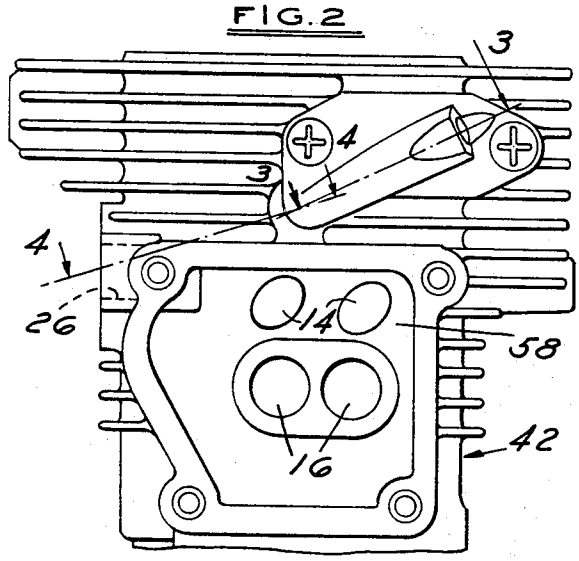


FIG. 8

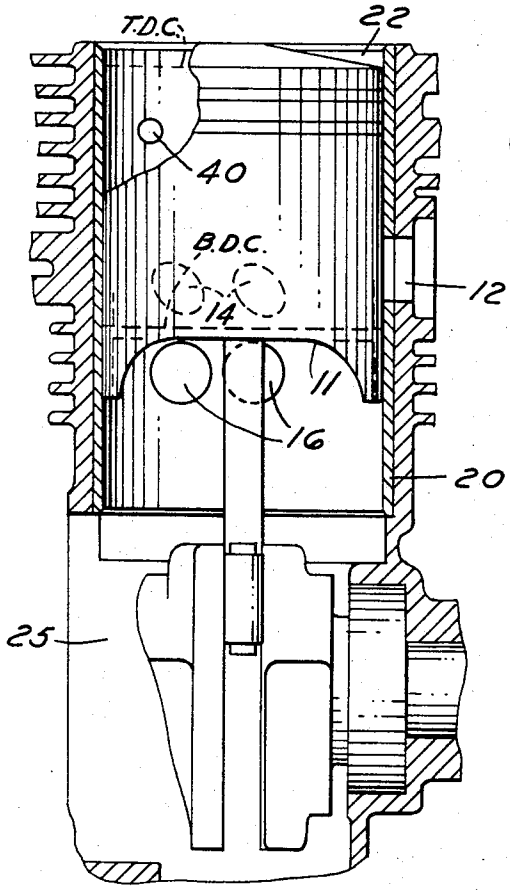


FIG. 6

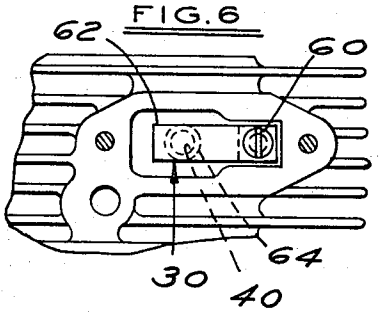
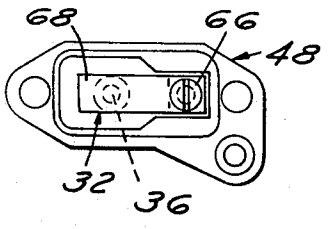


FIG. 7



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AUTOMATIC COMPRESSION RELEASE FOR INTERNAL COMBUSTION ENGINE

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ABSTRACT OF THE DISCLOSURE

An automatic compression release mechanism for an internal combustion engine wherein two independently operating valves, preferably self-biasing reed valves, are mounted to respectively control serially connected inlet and outlet ports of a valve chamber which forms part of a compression release passageway connecting the combustion chamber of the engine with a zone of lower pressure, such as the exhaust passage of the engine. The valves are each one-way check valves acting oppositely to one another. The valve controlling the outlet port is normally biased to an open position so that it remains open when the engine is turned over at the relative slow cranking speeds normally used to start the engine to thereby relieve compression and thus facilitate starting of the engine. The outlet valve projects into the gas-flow stream so that it is yieldably flexed to closed position in response to explosive pressure generated in the passageway when the fuel-air charge is ignited in the combustion chamber, thereby sealing the compression release passage after the engine starts.

An object of the present invention is to provide an efficient, reliably and economical valve mechanism for automatically relieving compression in an internal combustion engine when the same is cranked over at starting speed and which automatically seals the compression release passageway in response to the engine firing so that no power loss occurs while the engine is running.

Another object is to provide an automatic compression release mechanism of the above character which is readily adaptable to existing engines and which is easily accessible for cleaning and/or replacement of the parts used therein.

Other objects as well as features and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a top view of the head end of a two-stroke-cycle internal combustion engine equipped with a compression release of the present invention, the same being shown with the head removed and the cylinder block sectioned through the compression release mechanism.

FIG. 2 is a fragmentary side elevational view of the engine cylinder block with the head and transfer chamber cover removed.

FIGS. 3 and 4 are fragmentary sectional views taken on the lines 3—3 and 4—4, respectively, of FIG. 2, illustrating the communicating compression release passageways in the valve chamber cover and engine block.

FIG. 5 is a fragmentary enlarged view of the outlet reed valve and associated outlet port structure of FIG. 1.

FIG. 6 is a fragmentary side elevational view of a portion of FIG. 2 illustrating the valve chamber cavity and inlet reed valve with the cover removed from the valve chamber.

FIG. 7 is a side elevational view of the inside of the valve cover and associated outlet reed valve shown by themselves separate from the block.

FIG. 8 is a sectional view taken on the line 8—8 of FIG. 1 showing the piston in top dead center position with a portion broken away to illustrate the compression release port in the cylinder wall.

The automatic compression release structure of the present invention may be an add-on to a conventional two-stroke cycle single cylinder engine **10** which has the usual piston **11** (FIGS. 1 and 8) controlling exhaust ports **12** (FIGS. 4 and 8), air inlet ports **16** and transfer ports **14** in the wall **18** of a cylinder liner **20**. Generaly speaking, the arrangement consists of a passageway leading from the combustion chamber **22** to a zone of lower pressure relative to the combustion chamber **22** during the compression stroke of piston **11**, such as the crankcake cavity **25** or exhaust passageway **26**. This compression release passageway is controlled by two reed valves **30** and **32** mounted in a valve chamber **34** serially connected in the passageway. Reed **30** is adapted to close communication between combustion chamber **22** (FIG. 8) and valve chamber **34** (FIG. 1) when pressure in the exhaust passageway **26** or other relief zone exceeds combustion chamber pressure, reed **30** thereby serving as a one-way back check valve. The other reed **32** is resiliently self-biased normally open so as to relieve compression during cranking of the engine for starting but is responsive to the sharp blast flow through the compression release passageway when the engine fires so as to be rapidly bent to close the valve chamber outlet port **36** (FIG. 5).

As shown in FIGS. 1, 3 and 4, the compression release passageway includes a vent passage **40** which, for example, may be .156 inch in diameter which extends from the cylinder combustion chamber **22** through liner **20** and block **42** to valve chamber **34**. Chamber **34** is formed by a cavity **44** in a boss **46** cast integrally on the block which is closed by a cover plate **48** secured by two studs **50** and **52** to boss **46**. The vent passage **40** opens into the engine cylinder at a point such that passage **40** will just begin to be covered by the crown edge of piston **11** when the piston has traveled about 80% of its ascent toward its top dead center "T.D.C." position (solid lines, FIG. 8). The compression release passageway also includes chamber **34** and outlet passage **36** which opens at one end to chamber **34** and at its other end **54** (FIGS. 3 and 4) to a passage **56** in block **42** which in turn leads to the exhaust passage **26** of the engine. Alternatively, passage **56** can lead to the charge transfer chamber **58** at a point adjacent the transfer ports, which in turn communicate with the crankcase, or passage **56** can lead directly to atmosphere. However, venting to the exhaust passage insures that released gases pass through the muffler. Venting to exhaust passage or to the crankcase insures that the oil drippings and vented charge are directed to an area where they are least noticeable and least disturbing to the flow of gases from the carburetor. The normally closed back check reed **30** is mounted at one end by a stud **60** on boss **46** to lay flat against the cylinder side of the valve chamber with the free end **62** of reed **30** covering the outlet end of cylinder vent passage **40**. Reed **30** is mounted without any "preloading," i.e., when in closed position it is in a relaxed condition and does not start developing spring bias until it starts bending as it is forced off its seat **64** by the pressure of a charge being compressed in the engine cylinder during the compression stroke of the piston.

The normally open outlet check reed **32** is secured at one end by a stud **66** to cover **48** with its free end **68** overlying but spaced from the valve chamber outlet port **36** in cover **48**, as shown in the 5:1 scale fragmentary view in FIG. 5. The valve seats for both the back check valve **30** and outlet check valve **32** preferably are raised seats. Thus, as best seen in FIG. 5, cover **48** has an annular rim **70** around the chamber opening of passage **36** which projects from the adjacent surrounding surface **72** of cover

48 so that reed 32 when in closed condition seats only on rim 70 (broken line showing, FIG. 5). By so limiting the area of contact between each reed and its seat, it has been found that a problem of valve sticking is overcome which otherwise would occur if the valve were allowed to contact a large surface covered with products of combustion and oil from the engine.

Reeds 30 and 32 are preferably made from type 420 stainless tempered and polished spring steel strip about .004" thickness and adapted to withstand corrosive atmospheres and temperatures of about 800° to 1000° F.

In operation, when piston 11 is starting its ascent and the engine is being manually cranked for starting, combustion chamber pressure will be at a minimum and equal to or higher than atmospheric pressure which is communicated through the relief passages 26, 56, 54, 36 to valve chamber 24. As piston 11 ascends toward top dead center on its compression stroke, the pressure of the fuel-air mixture in the combustion chamber rises above atmospheric pressure, thereby creating a pressure differential which opens reed 30 and causes the fuel-air mixture to flow from combustion chamber 22 to valve chamber 34 via vent passage 40. The gases thus released from the combustion chamber continue on past and around the free end 68 (FIG. 5) of outlet check reed 32 and thence into the cover passageway 36 and are conducted via passages 54 and 56 to the exhaust passage 26. Reed 32 is designed to remain open even when the gas flow across its free end 68 reaches that resulting from maximum engine compression pressure and minimum exhaust passage pressure at or below engine cranking speed. Hence so long as the engine does not fire, compression will be relieved on every compression stroke until piston 11 covers the relief port 40 of the vent passageway. However, outlet check reed 32 closes rapidly onto seat 70 once the fuel-air mixture is ignited and the sharp combustion pressure blast reaches valve chamber 34. At this point piston 11 is starting to cover relief port 40. During the last twenty percent or so of the piston's ascent to top dead center, relief port 40 is closed by piston 11 and remains closed until uncovered again by the piston during the first twenty percent of its descent toward bottom dead center. Once valve chamber 34 has been pressurized by the combustion gases, both reeds 30 and 32 tend to seal their respective ports and thereby retain a high pressure charge of the gases in valve chamber 34 so that both valves 30 and 32 remain closed when the engine is running under its own power.

Preferably, the size and location of relief port 40 and vent passageways provides sufficient venting on the compression stroke during cranking to reduce the maximum compression pressure by about fifty percent over unrelieved compression pressure, e.g., so that compression pressures will be reduced from about 100 p.s.i. to about 50 p.s.i. at cranking speeds. If the engine does not fire on the compression stroke of the piston, then on the subsequent downstroke of the piston after the same has moved downwardly sufficiently to uncover port 40, the pressure differential across valve chamber 34 will still be in a direction tending to open back check valve 30. Hence, at cranking speed and so long as the engine does not fire, valve 30 will cycle with the engine as described above, closing only when port 40 is covered by the piston. Under these conditions outlet check valve 32 will remain open due to its self-biasing force being greater than the drag forces exerted on valve 32 by the gas flow through chamber 34 at cranking speed, thereby relieving compression to reduce cranking effort and thus facilitate starting.

However, once the engine fires, outlet valve 32 will be closed by the rapid increase of pressure in the valve chamber. The subsequent reduction in combustion chamber pressure as the piston uncovers the exhaust ports on its down stroke will cause back check valve 30 to close soon after valve 32, thereby trapping combustion gases in valve chamber 34 at a pressure somewhere between peak compression pressure and peak combustion pressure, e.g., on the order of 200–250 p.s.i. Valves 30 and 32 then remain closed while the engine is running except for a small amount of leakage of combustion gases past valve 30 into chamber 34 to make up for small leakage losses from chamber 34 via valve 32.

When the engine is shut off the slight leakage permitted by valve 32 as well as the drop in temperature of the gases in chamber 32 as the engine cools off causes the pressure in chamber 34 to drop sufficiently in a period of about 10–20 seconds so that the self-biasing force of valve 32 overcomes the force exerted by the gases and pops valve 32 off its seat and returns it to its normally open position as shown in FIGS. 1 and 5. Chamber 34 then immediately returns to atmospheric pressure, and if the engine is now once again cranked, starting effort will again be reduced as described above. If desired, the leakage rate from chamber 34 may be increased by providing a calibrated restricted orifice in cover 48 so as to bypass valve 32 with a slow leak, or such a leakage orifice may be provided directly in reed 32 in the portion thereof covering port 36 in the closed position of reed 32. Although some leakage is thus desirable past valve 32, valve 30 is operable to keep such leakage to a minimum so that valve 32 does not suffer damage in the manner of a leaky exhaust valve when the engine is running.

I claim:

1. In an internal combustion engine having a cylinder and piston defining a variable volume combustion chamber, an automatic compression release mechanism comprising a passageway communicating at one end thereof with said combustion chamber and at the other end thereof with a zone in which the pressure is lower than the pressure in said combustion chamber during the compression stroke of said piston, a valve chamber having an inlet port and an outlet port serially connecting said chamber in said passageway, a first one-way valve controlling said inlet and closing the same when valve chamber pressure exceeds combustion chamber pressure, and a second one-way valve operable independently of said first valve controlling said outlet and tending to close the same when valve chamber pressure exceeds the pressure in said zone, said second valve being resiliently biased to an open position spaced from said outlet and projecting into the gas flow stream between said inlet and outlet so that said valve is driven to closed position in response to explosive pressure generated in said passageway when a fuel-air charge is ignited in said combustion chamber, said first valve and second valves being both biased to their respective closed positions in response to a pressure build-up in said chamber sufficient to maintain said second valve closed whereby both of said valves tend to be maintained in closed position when the engine is running.

2. The combination set forth in claim 1 wherein said one end of passageway comprises a port in the wall of said cylinder located relative to said piston such that said port is covered by said piston when the same has traveled approximately eighty percent of its asecnt toward top dead center from bottom dead center.

3. In an internal combustion engine having a cylinder and piston defining a variable volume combustion chamber, an automatic compression release mechanism comprising a passageway communicating at one end thereof with said combustion chamber and at the other end thereof with a zone in which the pressure is lower than the pressure in said combustion chamber during the compression stroke of said piston, a valve chamber having an inlet port and an outlet port serially connecting said chamber in said passageway, a first one-way valve controlling said inlet and closing the same when valve chamber pressure exceeds combustion chamber pressure, and a second one-way valve controlling said outlet and tending to close the same when valve chamber pressure exceeds the pressure in said zone, said second valve being resiliently biased to an open position spaced from said outlet and projecting

into the gas flow stream between said inlet and outlet so that said valve is driven to closed position in response to explosive pressure generated in said passageway when a fuel-air charge is ignited in said combustion chamber, said first and second valves comprising first and second resilient reeds each rigidly connected at one end to said engine and having a free end opposite said one end disposed to open and close the associated port of said valve chamber.

4. The combination set forth in claim 3 wherein said outlet comprises a port having a raised rim encircling said port with a flat valve seat formed on said rim of relatively narrow radial dimension relative to the diameter of said outlet port, said free end of the second reed overlying and contacting said seat in closed position and extending generally perpendicular to the axis of said rim such that reed is spaced clear of the wall of said valve chamber in closed position except for the portion of said free end of said second reed contacting said rim valve seat.

5. The combination set forth in claim 3 wherein said valve chamber comprises a cavity in the exterior of said engine and a cover removably secured to said engine and closing said cavity, and wherein said passageway com-

prises: a straight hole extending from said cylinder to an opening in a surface of said cavity, the space in said cavity, a passage in said cover extending from said outlet port to a port in the face of cover disposed against the engine and a passage in said engine extending from said cover port to the exhaust passage of said engine.

References Cited

UNITED STATES PATENTS

790,764	5/1905	Tobey	123—182
1,053,360	2/1913	Coleman	123—182
1,301,807	4/1919	Bouteille	123—105
1,579,985	4/1926	Wheeler	123—182 XR
1,890,584	12/1932	Nardin	123—182

FOREIGN PATENTS

68,789	5/1893	Germany.

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U.S. Cl. X.R.

123—105, 150