

[72] Inventor **Joseph R. Harkness**
Germantown, Wis.
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 [73] Assignee **Briggs & Stratton Corporation**
Wauwatosa, Wis.

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Primary Examiner—Al Lawrence Smith
 Attorney—Ira Milton Jones

[54] **AUTOMATIC COMPRESSION RELIEF
 MECHANISM**
 6 Claims, 6 Drawing Figs.

[52] U.S. Cl. 123/182
 [51] Int. Cl. F01L 13/08
 [50] Field of Search 123/182,
 113, 90, 90.15, 90.16, 90.17, 90.18

References Cited

UNITED STATES PATENTS

3,395,689 8/1968 Kruse 123/182
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ABSTRACT: During each revolution of the engine camshaft at cranking speed, a camshaft-carried pin effects momentary unseating of a valve and opening thereby of a compression relief port in the combustion chamber of the engine, to reduce the cranking effort. The pin is guided for lengthwise sliding movement axially along the exterior of the camshaft, and it is automatically moved to an inoperative position by a centrifugally responsive control member whenever the camshaft is rotated at the higher speeds that obtain during operation of the engine under its own power.

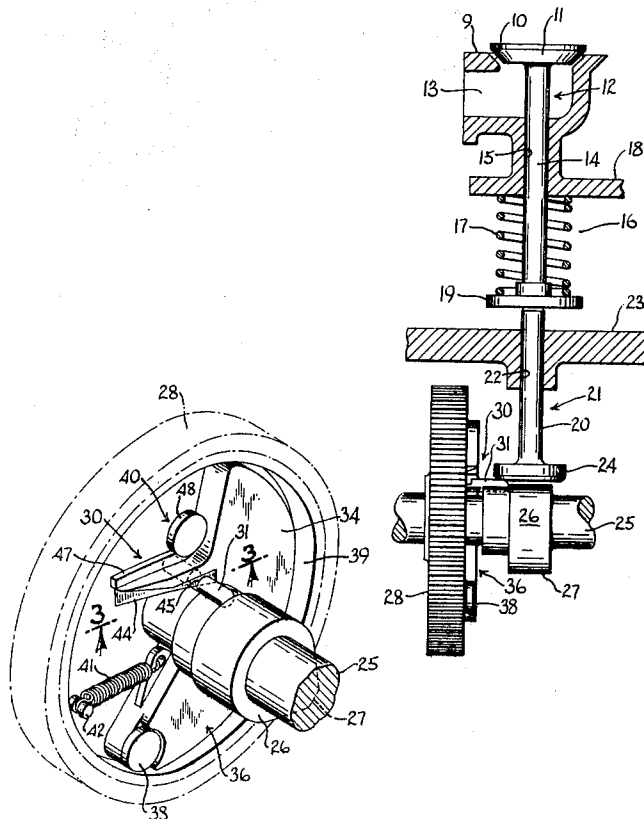


FIG. 1.

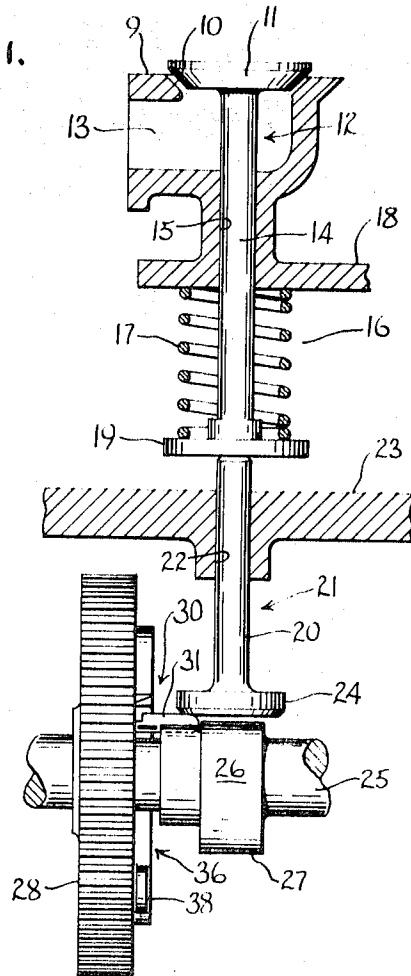


FIG. 2.

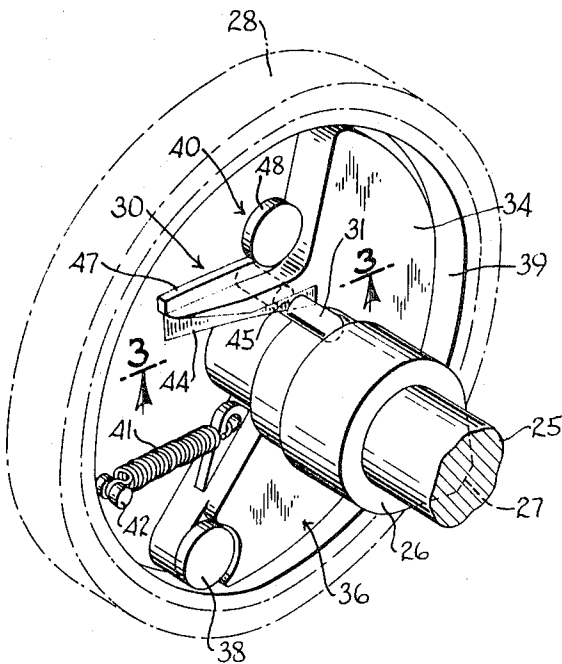
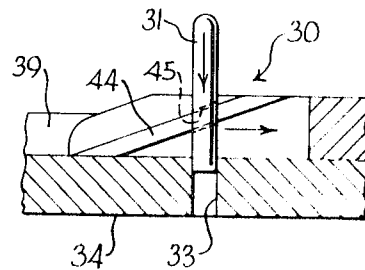


FIG. 3.



INVENTOR
Joseph R. Harkness
By *William Jones*
ATTORNEY

FIG. 4.

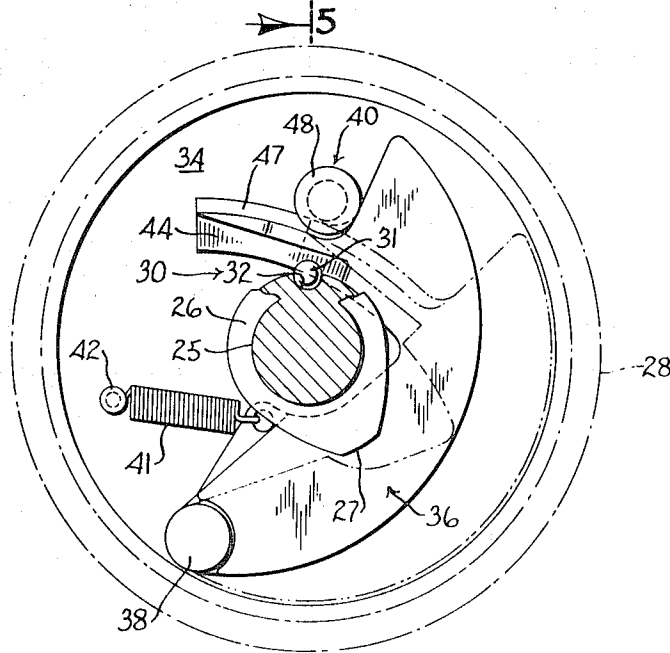


FIG. 5.

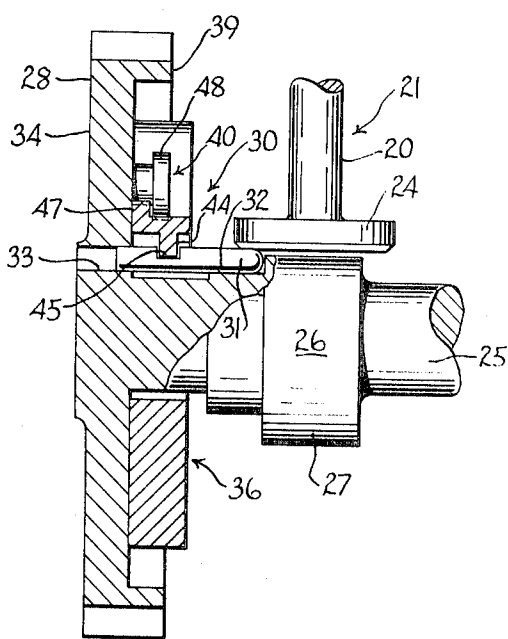
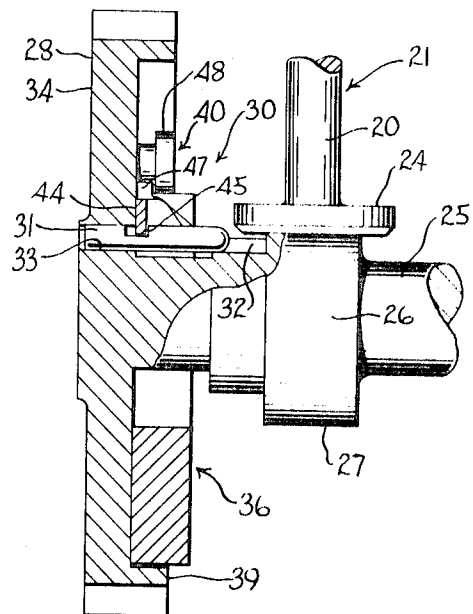


FIG. 6.



INVENTOR
Joseph R. Harkness
By *William Jones*
ATTORNEY

AUTOMATIC COMPRESSION RELIEF MECHANISM

This invention relates to mechanism for relieving compression in the combustion chamber of an engine during cranking thereof, for the purpose of substantially reducing the manual effort required to start the engine.

More particularly, the invention has reference to compression relief mechanism which is automatically rendered ineffective when the engine starts and achieves a normal running speed, so as to assure that the engine will then operate most efficiently without loss of compression.

Compression relief mechanisms of the type herein concerned are especially useful on single cylinder internal combustion engines wherein starting is effected manually, as by a rope. Several compression relief schemes have been proposed in the past, as for example in U.S. Pat. Nos. 3,314,408; 3,362,390; 3,381,676; and 3,395,689. Some of these not only required costly machining and assembly operations on the engine camshaft, but also involved the use of compression relief and centrifugally responsive actuating mechanisms therefor that were complicated and expensive to produce.

The purpose of this invention is to provide improved and simplified centrifugally controlled compression relief mechanism for the combustion chamber of an engine, and more particularly for an engine of the single cylinder variety.

For that purpose, it is an object of the invention to provide a centrifugally controlled compression relief mechanism comprising a valve-actuating member which is slidable back and forth in a groove in the exterior of the camshaft between an operative position effecting momentary lifting of a valve and opening thereby of a venting port in the combustion chamber of the engine, and an inoperative position at which the valve-actuating member has no effect upon said valve. A weighted centrifugally responsive control member pivotally mounted on the camshaft gear has a motion-transmitting connection with the valve-actuating member to move it to both of said positions thereof, and which connection also helps hold the valve-actuating member assembled on the camshaft.

With these observations and objectives in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings, which exemplify the invention, it being understood that such changes in the specific apparatus disclosed herein may be made as come within the scope of the appended claims.

The accompanying drawings illustrate one complete example of the embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

FIG. 1 is a view partly in section and partly in side elevation, illustrating the centrifugally controlled compression relief mechanism of this invention;

FIG. 2 is a perspective view thereof;

FIG. 3 is a fragmentary view illustrating details of the driving connection between the centrifugally responsive control member and the valve-actuating member, taken on the line 3—3 of FIG. 2.

FIG. 4 is cross-sectional view through the camshaft, showing how the compression relief mechanism is mounted on one side of the camshaft gear;

FIG. 5 is a view partly in section and partly in side elevation illustrating the operative position of the valve-actuating mechanism, and taken on the line 5—5 of FIG. 4; and

FIG. 6 is a view similar to FIG. 5 but showing the valve-actuating mechanism in its inoperative position.

Referring now more particularly to the drawings, FIG. 1 discloses portions only of an internal combustion engine having a combustion chamber (not shown) above one wall 9 of the engine block, and a port 10 in said wall through which the combustion chamber can be vented. The port 10 can comprise the annular seat for the head 11 of the exhaust valve 12 for the combustion chamber, by which the latter is communicable with an exhaust passage 13 when the head 11 of the valve is lifted off of its seat.

The stem 14 of the valve is guided in a hole 15 in the block, and extends into a spring compartment 16. A coiled spring 17, which encircles the valve stem, is confined between the top wall 18 of the spring compartment 16 and a spring seat flange 19 on the bottom of the stem to yieldingly hold the valve head down on its seat 10.

The stem 20 of a tappet 21 projects through a guide hole 22 in the top wall 23 of the engine crankcase and into the spring compartment. The tappet stem is coaxial with that of the valve 12, and its extremity is engageable with the underside of the spring seat flange 19 to lift the valve 12 and open the port 10 so as to vent the combustion chamber whenever the tappet is moved upwardly. Such upward movement of the tappet results from force applied to an enlarged foot 24 thereon by means of a cam 26 on the engine camshaft 25 during each revolution thereof. The cam 26 has a single lobe 27 arranged to lift the tappet and open the exhaust valve 12 at the beginning of each exhaust stroke of the engine piston (not shown).

The camshaft is driven from the engine crankshaft (not shown) through a gear on the latter meshing with a gear 28 twice its diameter on the camshaft. The gear 28 is located axially adjacent to the cam 26.

During cranking of the engine to start the same, the valve 12 ordinarily remains closed on the compression stroke of the engine piston. This is one of the main reasons why an operator must exert so much force while manually turning over the engine to start the same. It is well known that the manual effort required to crank the engine can be substantially reduced by venting the combustion chamber during each compression stroke of the engine piston an extent sufficient for the relief of enough pressure from the combustion chamber to facilitate cranking, but without interfering with starting of the engine.

This is the purpose of the improved compression relief mechanism 30 of this invention. The compression relief mechanism comprises a valve-actuating pin 31 which is endwise slidably received in an outwardly opening axial groove 32 in the exterior of the camshaft. The inner end portion of the pin loosely projects into an axial hole 33 in the web 34 of the camshaft gear, and its outer end portion extends toward the cam 26.

The mounting of the valve-actuating pin is such as to dispose it with its peripheral portion projecting out of the camshaft groove 32 and at a slightly greater radial distance from the camshaft axis than the "low" surface of cam 26. This is to say that the surface of the pin 31 which is farthest from the camshaft axis lies a slight distance outside of the base circle of the exhaust cam. Accordingly, when the pin 31 is advanced axially along the exterior of the camshaft toward the cam 26 to an operative position at which its outer end portion travels in an orbit under the foot 24 on the tappet, it will push up on the tappet and cause the latter to effect slight unseating of the valve 12 and opening of the port 10 so as to vent the combustion chamber to the exhaust port 13 once each revolution of the camshaft.

It is to be understood, of course, that the valve-actuating pin 31 must be so located angularly on the camshaft as to effect unseating of the valve 12 during the compression stroke of the engine piston. This will result in placement of the compression relief member 31, or valve-actuating pin, nearly diametrically opposite the lobe 27 on the exhaust cam 26.

The compression relief pin is normally maintained in the operative position described whenever the engine is at rest or is being cranked, so as to effect slight unseating of the exhaust valve 12 once each revolution of the camshaft up until the time the engine is started and running under its own power. At that time, the pin is retracted by mechanism that operates automatically in response to centrifugal force generated in consequence of rotation of the camshaft at substantially higher than cranking speed.

The mechanism for retracting the compression relief member 31 to its inoperative position after the engine starts comprises a control member 36 in the form of a weighted lever, which flatwise overlies the face of the web 34 of the

camshaft gear 28 adjacent to the cam 26, and is shaped to have end portions lie at opposite sides of the camshaft axis. One of said end portions is supported on a pivot 38 fixed in the web 34 of the gear to mount the lever thereon for swinging motion about an axis parallel to the camshaft axis and just inside of an axially extending annular rim portion 39 on the gear.

The lever extends around one side of the camshaft and its opposite end is engageable with a headed stop 40, fixed to the web of the camshaft gear, to define the inner limit of swinging motion of the control member about the axis of its pivot 38. It is normally held at this inner limit by a tension spring 41 connected between the control member and an anchoring pin 42 on the camshaft gear.

The spring 41 is strong enough to hold the control member 36 in its innermost position during rotation of the camshaft at engine-cranking speeds. However, its force is overcome by the centrifugal force which acts upon the control member after the engine has started and the camshaft is rotated at any of the speeds at which the engine is normally operated under its own power. The control member then swings outward, away from the camshaft to its outer limit of motion defined by engagement thereof with the annular rim 39 on the camshaft gear.

During such outward swinging motion of the control member in response to centrifugal force acting thereon, it effects retraction of the valve actuating or compression relief pin 31 to its inoperative position completely withdrawn from under the foot 24 on the tappet 21, to then allow normal actuation of the exhaust valve by its cam 26, and efficient operation of the engine without loss of compression. Such retracting motion is imparted to the compression relief pin by means of a motion-transmitting connection between it and the control member which is operable to effect axial sliding of the compression relief member both toward and from its operative position is consequence of back-and-forth swinging motion of the control member about its pivotal support. This motion-transmitting connection comprises an elongated fin on one of the members, and a notch in the other of said members, in which the fin is engaged.

As seen best in FIGS. 3 and 5, the fin 44 is formed on the end portion of the control member 36 remote from its pivot 38, and the notch 45 is formed in the outer surface of the compression relief pin 31. The fin 44 is arcuately curved concentrically with the axis of the pivot 38 for the control member so that it will remain substantially tangent to the periphery of the camshaft at the zone where the latter is joined to the camshaft gear in any position of the control member on its pivot. The fin is also skewed out of parallelism with the adjacent face of the web of the camshaft gear, as are the sides of the notch 45 (see FIG. 3) so that that side of the fin which is farthest from the web normally engages the opposing side of the notch 45, as when the engine is at rest, to hold the compression relief pin 31 in its operative position (FIG. 5).

As the control member 36 swings outwardly in response to centrifugal force, the fin 44 acts as a cam and engages the side of the notch 45 nearest the web of the camshaft gear to impart retracting motion to the compression relief pin and withdraw it to its inoperative position.

It is important to note that the fin is also provided with an elongated ridge 47 which extends flatwise along the web of the camshaft gear and slidingly engages under the head 48 of the stop 40, to guide the swinging motion of the control member 36 about its pivot 38 at a point remote from the latter. The ridge 47, of course, is also arcuately curved and concentric to the axis of the pivot 38, but it is normal to the camshaft axis throughout its length.

From the foregoing description, together with the accompanying drawings, it will be apparent that this invention provides an improved automatically operated compression relief mechanism, which features novel means for guiding the motion of its centrifugally responsive control member and for transmitting back-and-forth movement thereof into motion of a compression relief member in a groove in the exterior of the camshaft.

I claim:

1. An engine having a combustion chamber with a port therein, and having a camshaft with a gear thereon, and a compression relief member carried by the camshaft to normally effect momentary unseating of a valve and opening of said port for the relief of compression in the combustion chamber once each revolution of the camshaft, characterized by:

A. means mounting the compression relief member on the exterior of the camshaft for guided motion lengthwise of the camshaft axis, between a normally operative valve unseating position and an inoperative position at which it has no effect upon said valve;

B. a centrifugally responsive control member mounted on said gear for back and forth motion between defined limits, along a path substantially normal to the camshaft axis;

C. spring means to hold the control member in one of said limits whenever the camshaft is rotated at less than a normal engine-running speed, said spring means being yieldable to permit movement of the control member toward the other of said limits in response to centrifugal force thereon during acceleration of the camshaft to engine-running speeds;

D. and cam means for translating movement of the control member toward said other limit of motion thereof into movement of the relief member toward its inoperative position, comprising

1. an abutment on said relief member,
2. and a fin on the control member extending crosswise of the camshaft and lengthwise alongside said abutment.

2. The engine of claim 1, wherein:

A. a notch in the relief member, opening away from the camshaft, defines a pair of opposing abutments spaced apart in the direction of the camshaft axis,

B. and said fin being engaged in said notch and being cooperable with each of said abutments to move the relief member back and forth between its operative and inoperative positions in consequence of back and forth movement of the control member.

3. The engine of claim 2, further characterized by:

A. pivot means mounting the control member on the camshaft gear for back-and-forth swinging movement about an axis parallel to that of the camshaft and at the side thereof remote from the relief member;

B. a stop member on the camshaft gear engageable by the control member to define said one of its limits, said stop member being located at the opposite side of the camshaft and alongside said fin;

C. and cooperating surfaces on the stop member and the camshaft gear, between which a portion of the fin is engaged to guide the movement of that part of the control member which is remote from the pivot means.

4. An engine having a combustion chamber with a valve controlled port therein, and having compression relief means on its camshaft operable during each revolution thereof at engine starting speeds to effect momentary unseating of said valve and opening of said port for the relief of compression in the combustion chamber so as to thereby facilitate cranking of the engine, said compression relief means being characterized by:

A. a centrifugally responsive control member which is caused to move in one direction relative to the camshaft in consequence of acceleration of the camshaft to engine-running speeds;

B. a valve-actuating member which is supported for bodily motion relative to the camshaft toward and from an operative valve unseating position along a path extending lengthwise of the camshaft axis;

C. and cooperating cam means on said members operable to translate centrifugally produced movement of the control member into motion of the valve-actuating member out of its operative position, comprising

1. an abutment on the valve-actuating member accessible from the exterior of the camshaft,

2. and an elongated part on the control member which extends across the camshaft and over the valve-actuating member, said part having a surface thereon which is skewed out of normal with respect to the camshaft axis and which engages with said abutment to effect motion of the valve actuating member out of its operative position in consequence of movement of the control member in said one direction.

5. An internal combustion engine having a centrifugally responsive control member on its camshaft which is yieldingly urged toward a first position maintaining a compression relief member in an operative position effecting momentary unseating of an engine valve during each revolution of the camshaft at engine cranking speeds, and which control member is movable to a second position under the influence of centrifugal force thereon in consequence of rotation of the camshaft at higher speeds, to thereby render the relief member inoperative, characterized by:

A. a gear on the camshaft by which the latter is driven from the engine crankshaft;

B. means mounting the control member on said gear for back-and-forth motion along a path substantially normal to the camshaft axis;

C. cooperating means on the gear and on the control member defining said first and second position of the control member;

D. means mounting the compression relief member on the exterior of the camshaft for guided motion lengthwise of the camshaft axis, toward and from said operative position of the relief member;

E. a notch in the relief member, opening outwardly, way from the camshaft and defining opposing abutments with surfaces generally transverse to the camshaft axis;

F. an elongated fin on the control member extending lengthwise of said path and in substantially tangential relation to the camshaft throughout the permitted range of control member movement, said fin being received in

said notch and engaging the abutments defined thereby so as to provide cooperating cam means through which force is imposed upon the relief member to produce translatory motion thereof toward and from its operative position in consequence of movement of the centrifugally responsive control member between said first and second positions thereof; and said fin overlying the bottom of the notch in the relief member to hold the same against displacement from the exterior of the camshaft.

6. An engine having a combustion chamber with a valve-controlled port therein, and having compression relief means on its camshaft operable during each revolution thereof at engine starting speeds to effect momentary unseating of said valve and opening of said port for the relief of compression in the combustion chamber so as to thereby facilitate cranking of the engine, said compression relief means being characterized by:

A. a centrifugally responsive control member;

B. means supporting the control member from the camshaft for rotation therewith and for rocking motion relative thereto about an axis fixed with respect to the camshaft and parallel thereto, so as to provide for rocking of the control member in one direction as a consequence of acceleration of the camshaft to engine-running speeds;

C. a valve-actuating member separate from but adjacent to the control member;

D. means supporting the valve-actuating member on the exterior of the camshaft for guided bodily motion relative to the camshaft and to the control member, toward and from an operative valve unseating position along a path which is parallel to the camshaft axis;

E. and cooperating cam mean on said control and valve-actuating members operable to translate centrifugally produced motion of the control member in said direction into motion of the valve-actuating member out of its operative position.

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