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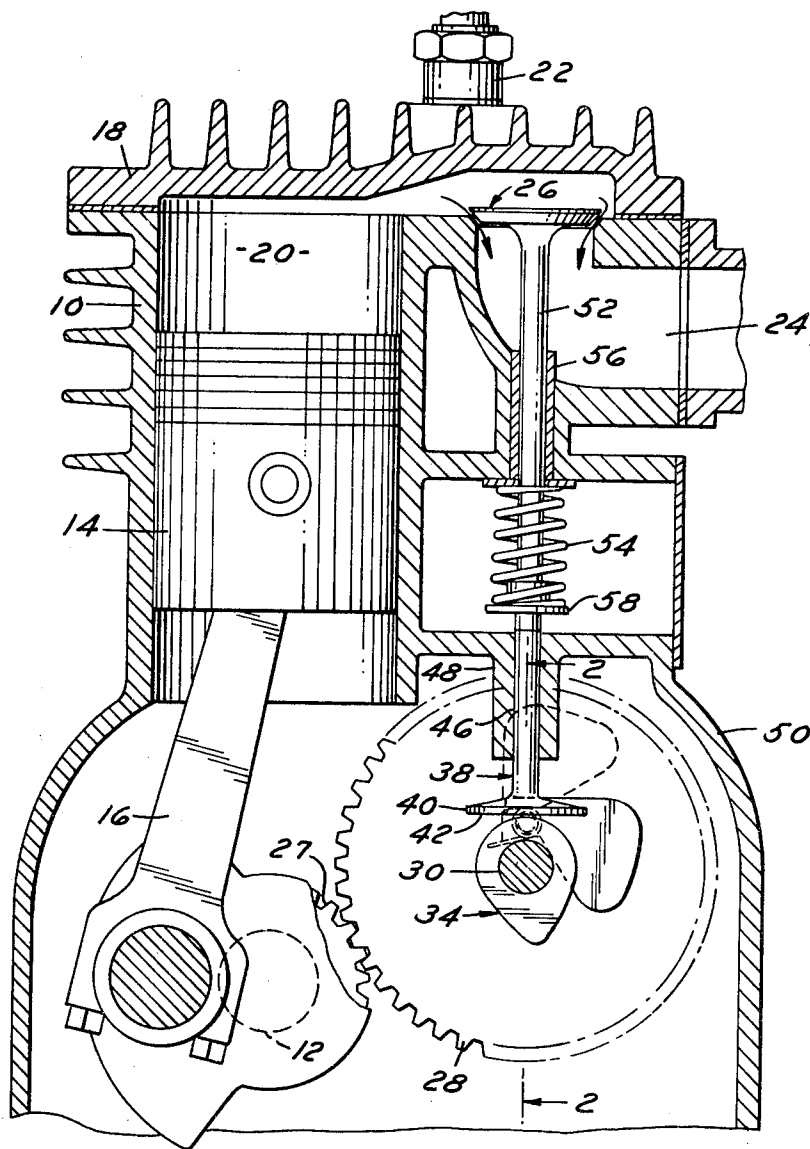
COMPRESSION RELIEF MECHANISM

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FIG. 1

START POSITION



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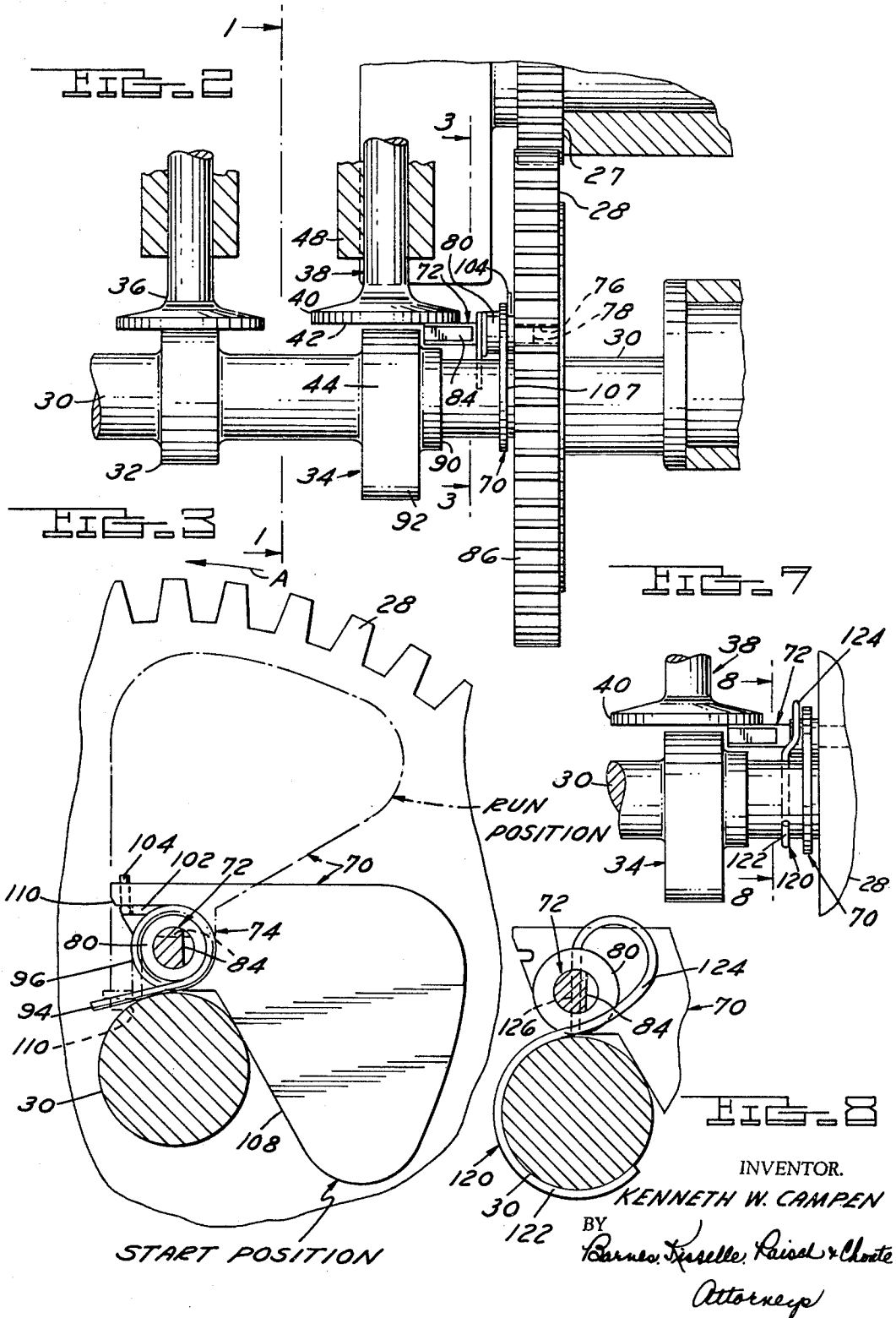
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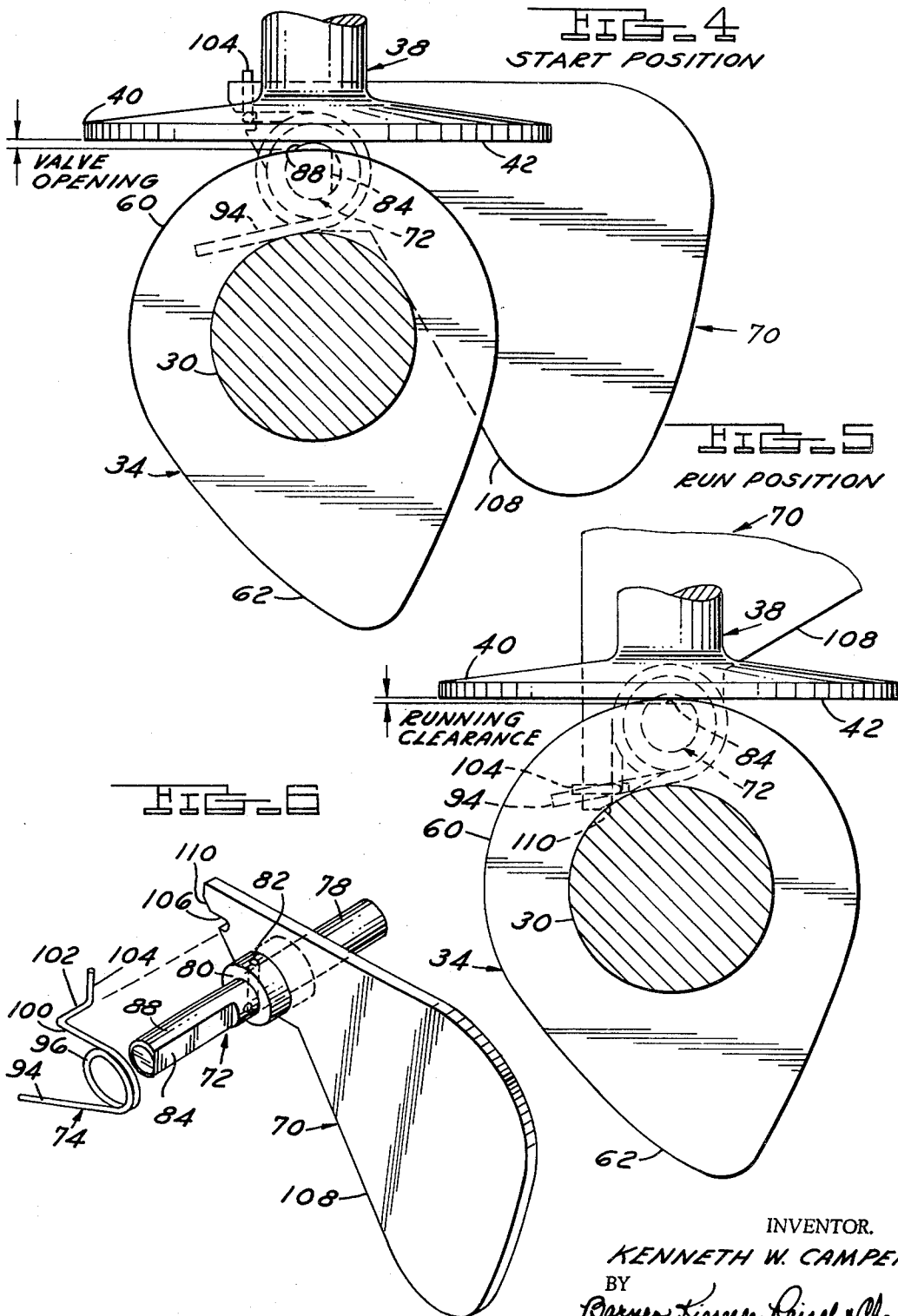
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COMPRESSION RELIEF MECHANISM

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COMPRESSION RELIEF MECHANISM

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15 Claims

ABSTRACT OF THE DISCLOSURE

An automatic compression relief mechanism for an internal combustion engine wherein a rotatable pin revolves with the engine camshaft and has a cam surface movable radially of the camshaft in response to rotation of the pin. The pin is rotated by a centrifugally actuated flyweight in response to engine speed. At low engine speeds the cam surface is extended radially outward to actuate a compression relief valve and at higher engine speeds the cam surface is retracted radially inwardly so as to not actuate the compression relief valve. The flyweight and pin rotate about a common axis and preferably comprise a unitary rigidly interconnected assembly.

This invention relates to internal combustion engines, and more particularly to an improved compression relief mechanism adapted for use in a four-stroke cycle engine.

An object of the present invention is to significantly reduce the cranking effort required to start an internal combustion engine without thereby sacrificing engine power at engine running speeds.

Another object of the present invention is to provide an improved compression relieving mechanism for an internal combustion engine which is automatically controlled by the engine itself to relieve compression only during cranking of the engine to thereby significantly reduce the cranking pull required to start the engine and which is rendered inoperative once the engine is running so that there is no power loss incurred at engine running speeds.

Still another object is to provide an improved compression relieving mechanism of the above character which is economical in construction and highly reliable in operation.

A further object is to provide a compression relieving mechanism which is adapted for installation on existing engines without requiring redesigning or retooling to modify the engine to accept the parts of the mechanism.

A more specific object of the present invention is to provide a compression relief mechanism of the above character in a compact arrangement which is adapted for installation on the camshaft of a four-cycle engine between the usual exhaust cam and timing gear thereof.

Other objects, features and advantages of the present invention will become apparent from the following detailed description and accompanying drawings wherein:

FIG. 1 is a vertical section taken on the line 1—1 of FIG. 2 through a single cylinder four-stroke cycle internal combustion engine embodying the compression relief mechanism of the present invention, the parts thereof being illustrated in their starting position.

FIG. 2 is a fragmentary side elevational view taken partially in section on the line 2—2 of FIG. 1 illustrating the compression relief mechanism and associated engine parts.

FIG. 3 is a fragmentary sectional view taken on the line 3—3 of FIG. 2 illustrating in solid and broken lines respectively the part of the compression relief mechanism in their respective positions at engine cranking and running speeds.

FIG. 4 is an enlarged fragmentary sectional view taken on line 1—1 of FIG. 2 showing the illustrated parts in their start position.

FIG. 5 is an enlarged sectional view similar to that of FIG. 4 but illustrating the parts in their run position.

FIG. 6 is an enlarged partially exploded perspective view of the compression relief mechanism shown separate from the engine.

FIG. 7 is a fragmentary elevational view similar to FIG. 2 illustrating a modified spring construction also in accordance with the present invention.

FIG. 8 is a sectional view taken on the line 8—8 of FIG. 7.

Since this invention is primarily concerned with, but not necessarily limited to, single cylinder four-stroke cycle internal combustion engines, the drawings illustrate the invention as embodied in such an engine. As is customary the engine shown in FIG. 1 has a cylinder 10, a crankshaft 12 and a piston 14 operatively connected with the crankshaft through a connecting rod 16. The piston coacts with the cylinder and a cylinder head 18 to define a combustion chamber 20. A spark plug 22 secured in the cylinder head ignites the fuel charge after it has been drawn into the combustion chamber during the intake stroke and then compressed during the compression stroke of the piston, the spark normally being timed to ignite the fuel charge just before the piston completes its ascent on the compression stroke. The fuel charge is drawn into the combustion chamber from the carburetor of the engine through an intake passage controlled by a conventional intake valve (not shown), and the products of combustion are expelled from the cylinder during the exhaust stroke through an exhaust port 24 controlled by a poppet-type exhaust valve 26.

The conventional parts of the valve operating mechanism include a timing gear 27 mounted on crankshaft 12 for rotation therewith and a timing gear 28 similarly mounted on a camshaft 30 and rotatably driven by gear 27 to thereby rotate the camshaft at one-half crankshaft speed. Camshaft 30 carries conventional pear-shaped intake and exhaust cams 32 and 34 (FIGS 1 and 2) which rotate with the camshaft to impart reciprocating motion to the intake and exhaust valves via flat-footed push rods 36 and 38 respectively. The complete exhaust valve train is shown in FIG. 1 and includes push rod 38 which has a circular follower 40 with a flat underface 42 adapted to bear tangentially against and track upon the periphery 44 of cam 34. A stem 46 of the push rod slides in a guide boss 48 of crankcase 50 and butts its upper end against the stem 52 of exhaust valve 26. A valve spring 54 encircles stem 52 between a valve guide 56 and a spring retainer 58 carried on the stem, spring 54 biasing valve 26 closed and also biasing push rod 38 into tracking contact with cam 34.

The above-described engine and valve train parts are conventional, as is the fixed profile of exhaust cam 34 which, as best seen in FIGS. 4 and 5, consists of a base circle 60 and a lobe 62. When the compression relief mechanism described hereinafter is in its inoperative or run position, rotation of cam 34 with camshaft 30 causes normal operation of valve 26 so that it opens and closes in timed relation with the travel of the piston 14 according to conventional engine timing practice. Thus cam lobe 62 is adapted to open valve 26 near the end of the power stroke and to hold the same open during ascent of the piston on the exhaust stroke until the piston has moved slightly past top dead center. When follower 40 contacts base circle 60, spring 58 reseats valve 26 and holds the same closed during the ensuing intake, compression and power strokes. Intake cam 32 is likewise of conventional fixed configuration to control the intake

valve such that it closes completely shortly after the piston begins its compression stroke and remains closed through the subsequent power and exhaust strokes, reopening to admit the fuel mixture on the intake stroke.

Since in a conventional engine the intake and exhaust valves are normally closed for the major portion of the compression stroke, cranking of the engine would be difficult unless some provision is made to vent the combustion chamber 20 during part or all of the compression stroke during cranking of the engine. However, by modifying a conventional engine to incorporate the improved compression relief mechanism in accordance with the present invention, compression relief is automatically obtained at crankcase speeds to greatly reduce cranking effort and thereby facilitate starting. In addition, the mechanism is responsive to engine speed such that it is automatically rendered inoperative at engine running speeds so that there is no compression loss to decrease the efficiency of the engine when it is running under its own power.

Referring to FIGS. 2, 3 and 6, the compression relief mechanism of the present invention is compactly disposed between exhaust cam 34 and gear 28 and preferably consists of only three principal parts, namely a flyweight 70, an auxiliary cam 72 and a return spring 74. The compression release mechanism of the invention is supported on camshaft 30 by being mounted on gear 28, which functions as a mounting plate for pivotally supporting the various parts of the release mechanism. A cylindrical bearing hole 76 is provided through gear 28 located offset from and parallel to the axis of camshaft 30 and with its axis intersecting cam 34 slightly radially inwardly of the base circle 60 of cam 34. Auxiliary cam 72 is preferably formed as a one-piece rod or pin having a cylindrical portion 78 at its right hand end (as viewed in FIGS. 2 and 6) which is rotatably received in hole 76 to provide a pivot bearing support for the compression release mechanism. Flyweight 70 has a cylindrical hub 80 brazed or otherwise suitably secured to the flyweight so as to extend through a circular notch in the flyweight and to protrude from the opposite faces thereof. Pin 72 is adapted to slide through hole 76 and also through the bore of hub 80 and is keyed for rotation with the flyweight. This may be accomplished by a pin 82 inserted through registering holes in hub 80 and cam pin 72 as shown in FIG. 6, or pin 72 may be flattened or otherwise made non-circular in the central portion thereof and the hub bore similarly contoured to form a non-rotatable keying connection, or hub 80 eliminated and the notch in flyweight 70 may itself be so contoured to key directly with pin 72.

The left hand end of pin 72 (as viewed in FIGS. 2 and 6) has a flat or relieved portion 84 which is adapted to underlie face 42 of follower 40 (FIG. 2) in the assembled position of the compression release mechanism on the camshaft. Pin 72, when mounted with portion 78 in bearing hole 76, and with hub 80 keyed to the pin and abutting against the face 86 of gear 28, is disposed with the cylindrical surface 88 of its left hand end riding on a cylindrical hub 90 which is turned on camshaft 30 adjacent the side face 92 of cam 34 (FIG. 2). Hence pin 72 receives cantilever and rotational support at one end from gear 28, and at the other end hub 90 provides additional support which need only resist the force of engagement of pin 72 with follower 40 which primarily tends to deflect pin 72 radially inwardly relative to the axis of camshaft 30.

Spring 74 comprises a coil spring having one end 94 extending tangentially from the convolutions 96 of the spring and disposed, when the spring is mounted on pin 72 with its convolutions encircling pin 72 adjacent hub 80 (FIG. 2), to bear against the cylindrical surface of camshaft 30 between hub 90 and gear 28 (FIGS. 2 and 3) to thereby provide a reaction point for one end of the spring. The other end of spring 74 extends from the opposite side of the spring convolutions, being formed with

a portion 100 extending tangentially from the convolutions, a portion 102 which is bent at right angles thereto to extend parallel to the axis of pin 72 and which in turn terminates at an end portion 104 which is bent up perpendicular to portions 102 and 100. When the spring is mounted on the pin as shown in FIG. 2, portion 102 extends through a notch 106 in the small end of flyweight 70 and portion 104 extends upwardly alongside face 107 of flyweight 70 which is remote from the spring (FIG. 2) to thereby hook the other end of the spring to the flyweight.

Spring 74 is designed with a preload when so mounted as described above to thereby bias flyweight 70 to its start position as shown in FIG. 4, and in solid lines in FIG. 3, wherein a straight inner edge 108 of the flyweight butts against the cylindrical surface of camshaft 30 when the engine is at a standstill. Flyweight 70 and pin 72 are rotatable in unison about the axis of pin 72 from the start position illustrated in solid lines in FIG. 3 to a run position shown in broken lines in FIG. 3. At run position a stop surface 110 of flyweight 70 butts against the cylindrical surface of camshaft 30 to positively limit further movement of the compression release mechanism in a counter-clockwise direction as viewed in FIG. 3. This rotational or pivotal movement of flyweight 70 and pin 72 from start to run positions is resisted by the yieldable deflection of spring 74, which is calculated to resist such movement until centrifugal force acting on the eccentric mass of flyweight 70, in response to the engine running above a predetermined speed, overcomes the resistance of the spring. This centrifugal force is generated by the flyweight mechanism revolving with the timing gear 28 and camshaft 30 when the same are rotatably driven by the crankshaft at half crankshaft speed.

The resistance of spring 74 is such that at standstill and during initial starting cranking of the engine, the parts will be in their position shown in FIGS. 2 and 4 (and as shown in solid lines in FIGS. 1 and 3). In this position the cylindrical surface 88 of pin 72 will protrude radially outwardly beyond the base circle 60 of cam 34 as best seen in FIG. 4, thus to intervene between the follower 40 and cam 34 so as to lift the follower off the base circle and hold the exhaust valve 26 slightly open for a predetermined portion of the compression stroke of piston 14. Preferably the amount of lift and the duration of the exhaust valve opening is designed to vent combustion chamber 20 while the piston is travelling from bottom dead center to approximately halfway up on the compression stroke so as to reduce the ultimate maximum compression to about half the value it would reach if the exhaust valve were allowed to remain closed throughout the compression stroke. Accordingly, the engine will turn over easily because a substantial part of the compression pressure in chamber 20 will be relieved through the partially open valve 26 to atmosphere via the exhaust passage 24.

After the first firing stroke of the engine, the engine will rapidly build up speed. After the engine speed exceeds a certain predetermined value in excess of cranking speed, the centrifugal force acting on flyweight 70 as it revolves with camshaft 30 overcomes the resistance of spring 74 and pivots the flyweight counter-clockwise as viewed in FIGS. 3, 4 and 5 from the start position of FIG. 4 to the run position of FIG. 5. For example, spring 74 and flyweight 70 may be balanced to produce this movement in the range of from 750 to 1000 engine r.p.m. This pivotal movement of the flyweight will directly impose a turning torque on cam pin 72 which will rotate the pin to its position shown in FIG. 5 in which flat 84 is brought face up and lies below the axial projection of the base circle portion 60 of the periphery 44 of cam 34. In this position normal cam-valve action is restored and thereafter the fixed profile of periphery 44 of cam 34 controls the position of exhaust valve 26 and hence full engine power is restored. Thus after the engine is started and so long as it is running at idling speed or above, cam pin 72 is rendered inoperative and the exhaust

valve will be closed throughout every compression stroke so that the engine can develop its maximum rated power output.

As the engine is brought to a stop, the centrifugal force acting on flyweight 70 decreases until overbalanced by the biasing force of spring 74 which then returns the flyweight to start position (FIG. 4), thereby rotating cam pin 72 to its start position where it will again be operable to effect compression release to facilitate starting.

The compression release mechanism of the present invention thus comprises a radially movable auxiliary or secondary cam (surfaces 88 and 84 of pin 72) which is speed responsive and reliable in operation and which greatly reduces the work required to crank the engine without sacrificing engine performance once the engine begins running. Preferably the compression release mechanism is installed with the parts oriented as shown in FIG. 3 relative to the forward direction of rotation of timing gear 28 as indicated by arrow A in FIG. 3, which corresponds to the forward direction of rotation of the camshaft when the engine is running in forward direction. Hence as pin 72 revolves with camshaft 30 into engagement with the undersurface 42 of follower 40, the cylindrical surface 88 of the cam will form a rounded leading edge which strikes surface 42 to reduce wear of these parts. The force of sliding friction developed between surfaces 42 and 88 generates a clockwise torque on pin 72 as viewed in FIG. 3, tending to assist spring 74 in maintaining flyweight 70 in start position. With this relationship the inertial forces acting on flyweight 70 will also tend to maintain it in start position. However, if desired the mounting orientation of compression release mechanism may be reversed relative to the rotation of the camshaft from that described above, in which event the aforementioned frictional and inertial forces will be cumulative to the centrifugal force acting on the flyweight and the spring force must be adjusted accordingly.

An important relationship of the parts is that the shoulder or hub 90 of camshaft 30 provides a solid abutment to support the free end of pin 72 to give radial support to the pin when it is rotated to its start position, thereby providing direct support bearing contact between follower 40, pin 72 and camshaft 30 to oppose the bias of the valve spring 54. It will be understood that the profile of cam flat 84 can be varied for timing the compression release period with respect to the overall cycle of the engine and may be calculated for each specific engine for optimum results. Also by suitably enlarging the diameter of the free end of pin 72, hub 90 may be eliminated and the free end of pin made to bear on the smaller diameter of camshaft 30.

Another important feature of the present invention is the direct mechanical connection between cam pin 72 and flyweight 70 so that these parts rotate in unison and are essentially a unitary assembly adapted, if desired, to be made as an integral cast, forged or stamped assembly. This not only is economical from the standpoint of a reduction in parts and manufacturing costs but also reduces the number of relatively movable wearing surfaces in the compression release mechanism so that it will hold its adjustment over a greater number of hours of engine operation. The flyweight also provides force multiplication in that the distance from the center of mass of flyweight 70 to its pivot axis greatly exceeds the distance between surface 88 and the axis of rotation of pin 72.

Another advantage is the simplicity of the machining operations required on the engine camshaft 30 to mount the compression release mechanism of the present invention. Thus, shoulder 90 can be lathe turned and/or ground to an accurate diameter, and the same is true of pin 72, permitting close tolerances to be held and insuring a precision valve lift at a minimum of cost. Alternatively, a flat or other surface may be ground or otherwise formed on shoulder 90 to provide a bearing seat for the

free end of pin 72, in lieu of using the cylindrical periphery of shoulder 90. The only other machining necessary is the provision of the bearing hole 76 in timing gear 28, and turning of the periphery of camshaft 30 between hub 90 and face 86 of gear 28. By providing the stop surfaces 108 and 110 on flyweight 70 disposed on opposite sides of pin 72 which cooperate with the cylindrical surface of camshaft 30, no additional stop structure is required to define the end limits of pivotal movement of the compression release mechanism. Due to the manner in which the compression release mechanism is mounted on the camshaft 30, no holes, bores or cavities need be formed in the camshaft, which is advantageous when dealing with camshafts of hollow construction containing an oil lubricating passage or quill-type camshaft constructions.

Referring to FIGS. 7 and 8, a modified form of compression release mechanism also in accordance with the present invention is shown in operative assembled position on camshaft 30. The principal difference between the modified mechanism and that described previously resides in the biasing spring 120 which consists of a generally S shape wire having a large semi-loop portion 122 which partially encircles and snugly resiliently embraces camshaft 30, and a small loop portion 124 which terminates in a straight portion 126 which in turn extends through the registering key pin holes in hub 80 and cam pin 72. Spring 120 thus serves both the biasing function of spring 74 and also the keying function of pin 82 to lock flyweight 70 to cam pin 72.

In both of the illustrated embodiments of the compression release mechanism, due to the limited axial clearance between cam 34 and gear 28, the compression release mechanism is preferably installed by first slipping cam pin 72 through hole 76, inserting the same from the right hand side of gear 28 as viewed in FIG. 2, hub 80 being held in position adjacent face 86 of gear 28 in registry with hole 76 to receive the pin coaxially there-through. The flyweight and cam pin are then secured together either by pin 82 or by the keying extension 126 of spring 120. The mechanism is thus axially captured by hub 80 bearing against gear face 86 to prevent axial movement to the right as viewed in FIG. 2, and by face 92 of cam 34 preventing movement of pin 72 axially to the left as viewed in FIG. 2.

It is also to be understood that the compression relief mechanism of the present invention may be mounted adjacent intake cam 32 to operate on the intake valve rather than the exhaust valve, particularly in those engines in which the intake cam is located adjacent the timing gear 28. In this event compression relief is accomplished by pin 72 delaying the closure of the intake valve so that the same is held off its seat during the major portion of the compression stroke. Assuming that the intake valve normally closes when piston 14 has traveled one eighth of its total ascent in the compression stroke, pin 72 is oriented so that pin surface 88 projects adjacent the lagging side of the lobe of the intake cam to produce the requisite lift for holding the intake valve off its seat until piston 14 has traveled say three fourths of its total ascent in the compression stroke. This modification would require some redesign of the camshaft.

In some applications it may be preferred to provide a third valve the sole purpose of which is to relieve compression during starting, in which case a compression relief mechanism of the present invention may be mounted adjacent a circular rather than pear-shaped cam and valve movement effected solely by pin 72 when the same is projected to its operative position.

I claim:

1. In an internal combustion engine having a combustion chamber valve, a lifter for said valve, a camshaft and cam to engage the valve lifter and open the valve, and compression relief mechanism to engage the valve lifter to hold the valve open when the cam would otherwise

allow it to close, the improvement in said compression relief mechanism comprising:

an auxiliary cam member adjacent said cam and valve lifter,

said auxiliary cam member comprising a rotor pin for which the camshaft has a bearing seat on which the pin may turn on its longitudinal axis, said pin having a part to extend above the cam to engage said valve lifter when the rotor pin is rotated to one position in response to low engine speed and which is below the cam so as not to engage the valve lifter when the rotor pin is rotated to another position in response to high engine speed, and said pin being revolved about the axis of said camshaft by said engine, and

a flyweight connected to said rotor pin for rotation therewith about the rotational axis of said pin so as to be pivotable coaxially therewith to impart said rotational movement to said pin.

2. In an internal combustion engine having a combustion chamber valve, a lifter for said valve, a camshaft and cam to engage the valve lifter and open the valve, and compression relief mechanism to engage the valve lifter to hold the valve open when the cam would otherwise allow it to close, the improvement in said compression relief mechanism comprising an auxiliary cam rotor adjacent said cam and valve lifter, pin rotating mechanism responsive to engine speed, said rotor having a part to extend above the cam to engage said valve lifter when the rotor is rotated to one position in response to low engine speed and which is below the cam so as not to engage the valve lifter when the rotor is rotated to another position in response to high engine speed, said rotor comprising a pin, said camshaft having a bearing seat for said pin on which the pin may slide as it rotates on its longitudinal axis, one end of said pin being disposed adjacent the cam and valve lifter and having said part thereon, the other end of said pin having a rigid connection with said rotating mechanism by which rotational movement is imparted to said pin, said pin being revolved about the axis of said camshaft by said engine, said rotating mechanism comprising a centrifugal weight driven by the engine through said pin and a mounting connection between said weight and pin by which said weight is carried on said pin and said pin is rotated by said weight in response to engine speed.

3. The improvement of claim 2 in which said camshaft has a mounting plate thereon, said plate having a bearing hole in which said other end of said pin is mounted.

4. The improvement of claim 3 in combination with a spring biasing said weight radially inwardly to oppose centrifugal force on the weight produced by the pin being revolved about the axis of said camshaft.

5. The improvement of claim 2 in which said bearing seat comprises a circular shoulder hub on said camshaft adjacent said cam and said plate comprises a timing gear fixed on said camshaft, said pin having a circular convex surface contact with a circular convex surface of said hub.

6. An automatic compression release mechanism for an internal combustion engine which has a cylinder head, an exhaust valve in the cylinder head, a valve lifter with a spring biasing the valve toward closed position, a camshaft and cam to engage the valve lifter and open the valve, said automatic compression release mechanism comprising a pin for which said camshaft has a bearing seat parallel to its longitudinal axis, said pin being rotatable on said seat and having one end thereof adjacent the cam, said end having a portion extending radially outwardly relative to its axis of rotation and having a contour extendable above the cam to engage the valve lifter when said pin is rotated to one position in response to low engine speed and retractable below the cam so as not to engage the valve lifter when said pin is rotated to another position in response to high engine speed, said

bearing seat on the camshaft providing a positive abutment for the pin to hold the valve open against the bias of the valve lifter closing spring when the pin is rotated to said one position, said pin being revolved about the axis of said camshaft by said engine, and pin rotating mechanism comprising a centrifugally actuated weight connected to said pin for coaxial pivotal movement and revolution therewith to impart said rotation to said pin in response to engine speed.

7. The automatic compression release mechanism of claim 6 in which said pin rotating mechanism comprises a mounting plate for said weight, said plate being connected to the camshaft, and a pintle between the weight and mounting plate whereby rotation of the camshaft and the mounting plate will cause said weight to revolve therewith and develop centrifugal force acting on said weight to rotate it about its pintle, said pin having a motion transmitting and support connection with said weight whereby said weight rotates said pin on its bearing seat in response to speed changes in the camshaft.

8. The automatic compression release mechanism of claim 7 in which the respective rotation axes of said pin, and pintle and weight are coincident.

9. The automatic compression release mechanism of claim 7 in which the weight has a spring opposing centrifugal force and biasing the weight radially inwardly, said weight being asymmetrically disposed with respect to the axis of the camshaft, said weight being behind its pintle relative to the direction of plate rotation.

10. The improvement of claim 9 in which said pin and pintle comprise a cylindrical rod and said portion of said pin comprises a part cylindrical surface and a flat contiguous with said surface.

11. The improvement of claim 9 wherein said spring comprises a coil spring having convolutions encircling said pin and having one end abutting said camshaft and the other end connected to said weight.

12. The improvement set forth in claim 9 wherein said spring comprises a generally S shaped spring wire having a first loop portion at least partially encircling and embracing said camshaft and a second loop portion connected to said weight.

13. The improvement set forth in claim 12 wherein said other end of said spring has a pin portion extending through said pin and weight to key the same together for rotation as a unit.

14. In a compression release mechanism for an internal combustion engine, the combination comprising:

a rotatable camshaft to be driven at a speed proportional to engine speed;

a centrifugal cam mechanism including a weight mounted to revolve with said camshaft about the camshaft axis and pivoted for rotation in a plane substantially perpendicular to and radially of the camshaft axis, and a rotatable pin with a cam surface movable radially of said camshaft in response to rotation of said pin, said pin serving as the axle for, and having a direct connection to, said radially movable weight so that when engine speed is below a preset minimum said cam surface is extended outward and when engine speed exceeds said preset minimum said weight is moved by centrifugal force radially outward to cause said cam surface to be retracted radially inwardly; and

a compression release valve adapted to be opened during at least a portion of each compression stroke of said engine by said movable cam surface when said cam surface is extended radially outward.

15. In a compression release mechanism to operate in conjunction with a camshaft of an internal combustion engine to actuate a compression release valve during part of a compression stroke of said engine during starting, the combination comprising:

a camshaft of an internal combustion engine;

a unitary rotatable cam member and flyweight carried

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by said camshaft having a movable cam surface projecting radially from said camshaft, and being rotatably mounted on said camshaft to retract said cam surface with respect to said camshaft;
said flyweight being pivotally mounted by said cam member and rotatable therewith about the axis of rotation of said cam member to positively support said cam surface in a radially extended position during starting and to pivot to retract said cam surface when said engine exceeds a preset speed; and
a spring urging said weight into position to project said cam surface to said radially extended position.

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