ABSTRACT OF THE DISCLOSURE

Automatic engine decompression apparatus for relieving or reducing the pressure of compression of an internal combustion engine at slow speeds in which a cam lever is rotatably disposed in a groove in the cam shaft of an engine for rotation between a self-locking position at which a portion of the cam lever projects radially outwardly of a camming portion of the cam shaft and a second position in which the valve tappet engaging position is withdrawn into the camming portion of the cam shaft for operation of the engine without the decompression function.

This invention relates generally to internal combustion engines and is more particularly directed to decompression apparatus for use with internal combustion engines incorporating cam operated valve mechanisms for controlling the flow of gasses to and from internal combustion chambers.

In the prior art with which my invention is concerned, the use of internal combustion engines having increased compression ratios has resulted in greatly increased starting or cranking torque requirements whether the force be manually or mechanically applied. Prior art apparatus has recognized the desirability of providing a partial decompression of the combustion chambers in an internal combustion engine to reduce the starting or cranking torque required when initiating the operation of an engine. Such apparatus has included provisions for allowing at least some of the compressed gas in a combustion chamber to escape to the atmosphere to relieve the pressure therein through the use of, on one hand, simple, impractical duct and valve arrangements connected directly to the combustion chamber and which are manually operable, and on the other hand, mechanisms which seek to operate directly upon the valve associated with a combustion chamber to open the valves during a suitable time of the operating cycle of an engine during the starting phase of operation of an engine. The last referred to mechanisms have resulted in complicated mechanical structures which have proven to be mechanically and economically impractical.

As will be described in greater detail in the appended specification, my invention utilizes a decompression cam that is automatically operative in response to the speed of an engine and which provides an uncomplicated and reliable operation in relieving the compression during slow speed starting or cranking operations of an internal combustion engine utilizing cam operated valves. This is accomplished by providing a pivotally mounted decompression cam lever within the cam portions of a camshaft in such a manner as to render the lever self-locking in a first compression releasing position when the camshaft is at rest or at a low speed and in a second inoperative position in response to rotation of the camshaft above a predetermined speed.

It is therefore an object of my invention to provide a novel and improved automatic decompression apparatus for an internal combustion engine.

Another object of my invention is to provide an improved decompression apparatus for an internal combustion engine that is self-locking in a decompression releasing position.

Another object of my invention is to provide a novel and improved decompression apparatus for internal combustion engines that is of small and compact construction.

A still further object of my invention is to provide a novel and improved decompression apparatus for internal combustion engines that is substantially maintenance free.

A still further object of my invention is to provide a novel and improved decompression mechanism for an internal combustion engine that is uncomplicated and inexpensive to fabricate and manufacture and maintain.

These and other objects of my invention will become apparent from the appended specification, claims and drawing, in which—

FIG. 1 is a sectional perspective elevational view of one embodiment of my invention shown in a typical operating environment incorporating portions of an internal combustion engine;

FIG. 2 is a side elevational view, partly in broken away section, illustrating one embodiment of my invention;

FIG. 3 is a similar side elevation view, partly in broken away section illustrating the embodiment of FIG. 2 in a progressed operative disposition; and

FIG. 4 is a sectional view of the apparatus shown in FIG. 2 of the drawings with a broken away portion of an internal combustion engine added for the purposes of illustration.

Referring to the drawings, in which like elements have been identified by like reference characters, a portion of an internal combustion engine is shown in broken away and full outline in FIG. 1 of the drawing as including an engine block 17, having a valve seat 30, a valve 18 reciprocally journeled for operation between open and closed positions and a fragmentary portion of a camshaft 16, including a cam portion 11, that is rotatably disposed below an adjustable tappet linkage reciprocally disposed intermediate cam portion 11 and valve 18. A further cam member 22, which may be described as a decompression cam is shown in the form of a lever-like member that is rotatably journeled about an axis transverse to the longitudinal axis of camshaft 16. A suitable groove is provided in camshaft 16 in proximity to cam portion 11 so that decompression cam 22 may operate between positions of radially outward extension above the surface of cam portion 11 and inwardly retracted position within cam portion 11 to affect the characteristic of cam portion 11 in accordance with the principles and operation set forth in greater detail below. This will provide the desired decompression by opening valve 18 at a suitable time during the cycle of operation of an internal combustion engine so as to reduce starting, or cranking torque requirements during the initial starting phase of operation of the engine.

Referring again to FIG. 1 of the drawings, the typical operating portions of an internal combustion engine of the class utilizing cam operated valves is shown including a fragmentary portion of an engine block indicated generally by reference character 17, which has a valve port 29 which may be connected to a source of gaseous fuel or may comprise an exhaust passageway, and in either event, is in fluid communication with the top portion of engine block 17 which contains a suitable hard surface valve seat portion 30 that is adapted to sealingly receive a complementary shaped portion of a valve member 18. The top of engine block 17 and the port defined intermediate valve seat portion 30 and valve 18 is typically in fluid communication with a combustion chamber in an engine. Valve 18 is shown having a downwardly extending stem.
portion that is reciprocably journaled in a suitable valve guide 19 and is spring biased downwardly to a closed position through a biasing valve spring member 20 that is disposed intermediate the lower portion of valve guide 19 and a suitable stop, or valve spring keeper device disposed in locking engagement with the lower portion of the valve 18. A reciprocally operable tappet member 21 is shown provided with suitable screw threaded clearance adjusting means at its top end and its bottom end in operative engagement with the periphery of cam portion 11 on camshaft 10. The above described portion of an internal combustion engine is considered typical and may take other forms, any of which may be found in well known internal combustion engines.

In the illustrated embodiment of my invention, a camshaft 10 with an integrally associated cam portion 11 having a nominal base circle 12 (FIG. 4) is shown including a groove 13 that is disposed adjacent to and, in the illustrated embodiment, extending axially inwardly of cam portion 11 and opens radially outwardly of camshaft 10. Camshaft 10 is also shown provided with an axially extending coaxially disposed bore opening 14 which may be closed at its right hand end with a suitable screw thread member. A transversely extending opening, 16, is shown extending completely through cam portion 11 on camshaft 10 for purposes to be explained below.

A decompression cam 22 is shown in the form of a longitudinally elongated lever means having a rear end 23, a front end 24, an upwardly extending valve operator engaging portion 25, a downwardly extending portion 26 and a transversely extending pivot opening 27 disposed intermediate upwardly extending portion 25 and front end 24 with respect to its longitudinal axis, as indicated on FIG. 2 of the drawings. Decompression cam 22 is pivotally disposed on pivot pin 28 that extends through transverse opening 16 in cam 11 in pivot opening 27 in decompression cam 22. A pin member 31 is shown reciprocably and slidably disposed in longitudinal bore 14 in camshaft 10 with its forward end in engagement with the downwardly extending portion 26 of decompression cam 22 and its rearward end in engagement with a suitable biasing means, shown in the form of a compression spring 32.

As may be noted in FIGS. 2 and 3 of the drawings, decompression cam 22 is operative between two positions. FIG. 2 illustrates the position during which decompression of an engine is to be momentsarily effected by momentarily operating a valve associated with a combustion chamber during a compression function by the extension of upwardly extending portion 25 above the surface of cam portion 11 on camshaft 10. In FIG. 3 of the drawings, decompression cam member 22 is shown in the position that is assumed after an engine has been started and has reached a predetermined speed of operation, with upwardly extending portion 25 retracted inwardly of the periphery of cam portion 11 on camshaft 10. In FIGS. 2 and 4, decompression cam 22 is shown biased to the first decompression release position with upwardly extending valve operator engaging portion 25 extending radially outwardly of the base circle 12 of cam portion 11 on camshaft 10. It should be noted that the upwardly extending portion 25 is disposed to the right of pivot pin 28, as indicated by the arrow on FIG. 2, and that this produces a self-locking feature as may be apparent from the forces and directions of components of forces from consideration of FIG. 2.

In FIG. 3, the arrow indicating the force applied by the valve operating mechanism is disposed to the left of pivot pin 28 and assists in maintaining the decompression cam in an inoperative retracted position. In FIG. 3, decompression cam 22 is shown in the position that it will assume under normal operating speed of an internal combustion engine above a predetermined magnitude as determined by the mass of rear end 23 of decompression cam 22 which, under the influence of centrifugal forces, as caused by increased speed of rotation of camshaft 10,

causes decompression cam 22 to rotate counterclockwise about pivot pin 28 and against the force applied to pin 31 by compression spring 32, to retract upwardly portion 25 on decompression cam 22 inwardly and to move the point of application of force thereto to the left of pin 28 to assist in maintaining portion 25 in the retracted position whereby the decompression function provided during the initial starting phase of operation of the engine is discontinued.

While the illustrative embodiment shown in the several figures of the drawings includes a pin and compression spring for biasing decompression cam 22 to its operative first position, it is anticipated that other forms of biasing means may occur to one skilled in the art upon becoming familiar with the principles of my invention. For example, decompression cam 22 might be comprised of magnetic material which would tend to exert a clockwise force and maintain decompression cam 22 in the position shown when the engine is operating at a slow speed or below a predetermined rotational velocity. It may also be noted that with certain engine configurations, the force of gravity could also be relied upon to return decompression cam 22 to its first operative position as the speed of an engine is reduced to a minimum magnitude or when the engine is idle. Further, the angular relationship of decompression cam 22 with respect to the configuration of cam portion 11 may be modified to cause a valve to remain open for a longer time, to open before it may normally open or, as in the illustrated embodiment, cause a valve to open and then close after it has first been closed.

Operation

Referring to FIGS. 1, 2 and 4 of the drawings, it will be seen that decompression cam 22 is in its first position with upwardly extending portion 25 disposed to the right of pivot pin 28 (FIG. 2) which is the normal position when an engine is at rest or is rotating at a very low speed, such as the speed normally attained during a cranking and starting operation. Compression spring 32 and pin 31 in engagement with downwardly extending portion 26 on decompression cam operates to tend to maintain cam 22 in the decompression position in addition to the clockwise force provided by the engagement of upwardly extending portion 25 with the bottom end of valve tappet 21. For a predetermined portion of each cycle as determined by the transverse dimension of upwardly extending portion 25 on cam 22, valve 18 is opened slightly to release compression in a combustion chamber that is in fluid communication with port 29 in engine block 17. This is sufficient to substantially reduce the throttle requirement of rotating the engine drive shaft in the starting operation.

Following the initiation of satisfactory combustion within the engine, the speed increases to a predetermined value at which the centrifugal force exerted on portion 23 of cam 22, serves to overcome the biasing force applied to cam 22 by pin 31 and spring 32, and moves the position shown in FIG. 3 of the drawings with portion 23 extending radially outwardly and portion 25 disposed to the left of pivot pin 28 to exert a counterclockwise force on cam 22 to tend to maintain upwardly extending portion 25 radially inwardly of the surface of cam portion 11 on camshaft 10 to discontinue the decompression function and allow the engine to operate under normal compression.

When the engine is shut down, the speed will gradually decrease until it finally attains a rest position. During the period of slowing down, the position of portion 23 on cam 22, and the biasing force provided by spring 32, cam 22 will gradually assume the position shown in FIGS. 1, 2 and 4 and it may be seen that this will occur during any part of a cycle of rotation of camshaft 10 that upwardly extending portion 25 is retracted from engagement with the bottom of valve tappet 21.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modi-
3,395,689

6. The apparatus of claim 1 in which the axis of rotation of the decompression cam means is disposed within the cam portion of the crankshaft and the radially outwardly extending portion thereof is disposed axially toward the groove in the cam shaft when said decompression cam is in operative position to effect decompression of the internal combustion engine.

7. The apparatus of claim 6 in which a biasing means, including an axially extending spring disposed within the groove on the cam shaft is in operative engagement with the decompression cam means.

8. The apparatus of claim 6 in which the decompression cam means is comprised of material exhibiting magnetic characteristics.

References Cited

UNITED STATES PATENTS

3,314,408 4/1967 Fenton ------------ 123—182

WENDELL E. BURNS, Primary Examiner.