

[54] **AUTOMATIC ENGINE
DECOMPRESSION SYSTEM FOR TWO-
CYCLE ENGINE**

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123/185 BA, 185 F, 185 G, 179 SE

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[57] **ABSTRACT**

Disclosed herein is an internal combustion engine hav-
ing a decompression valve movable to and from a
position closing a port communicating with an engine
cylinder, together with a starting device having a
pinion which is axially movable to engage an engine
starter gear and rotatable so as to crank the engine to
facilitate starting, and a linkage mounted on the en-
gine and engageable with the starter pinion and with
the decompression valve so as to displace the valve
away from the position closing the port in opposition
to a valve biasing spring and in response to movement
of the pinion toward the starter gear.

13 Claims, 2 Drawing Figures

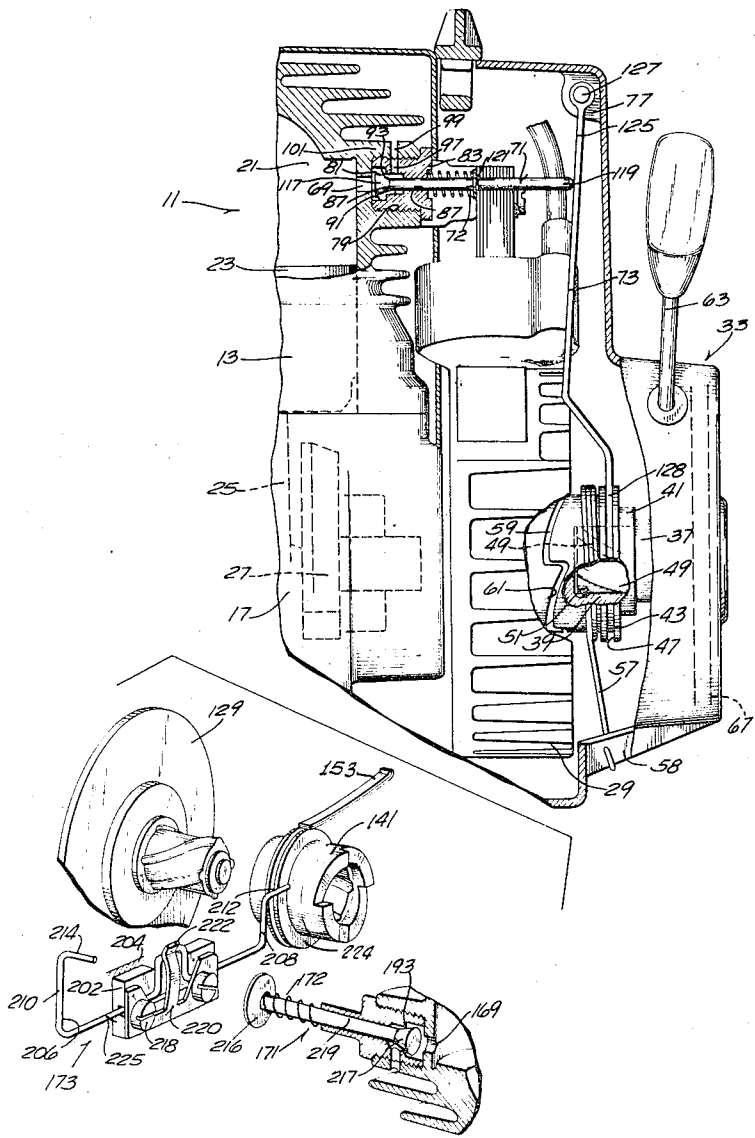


Fig. 1

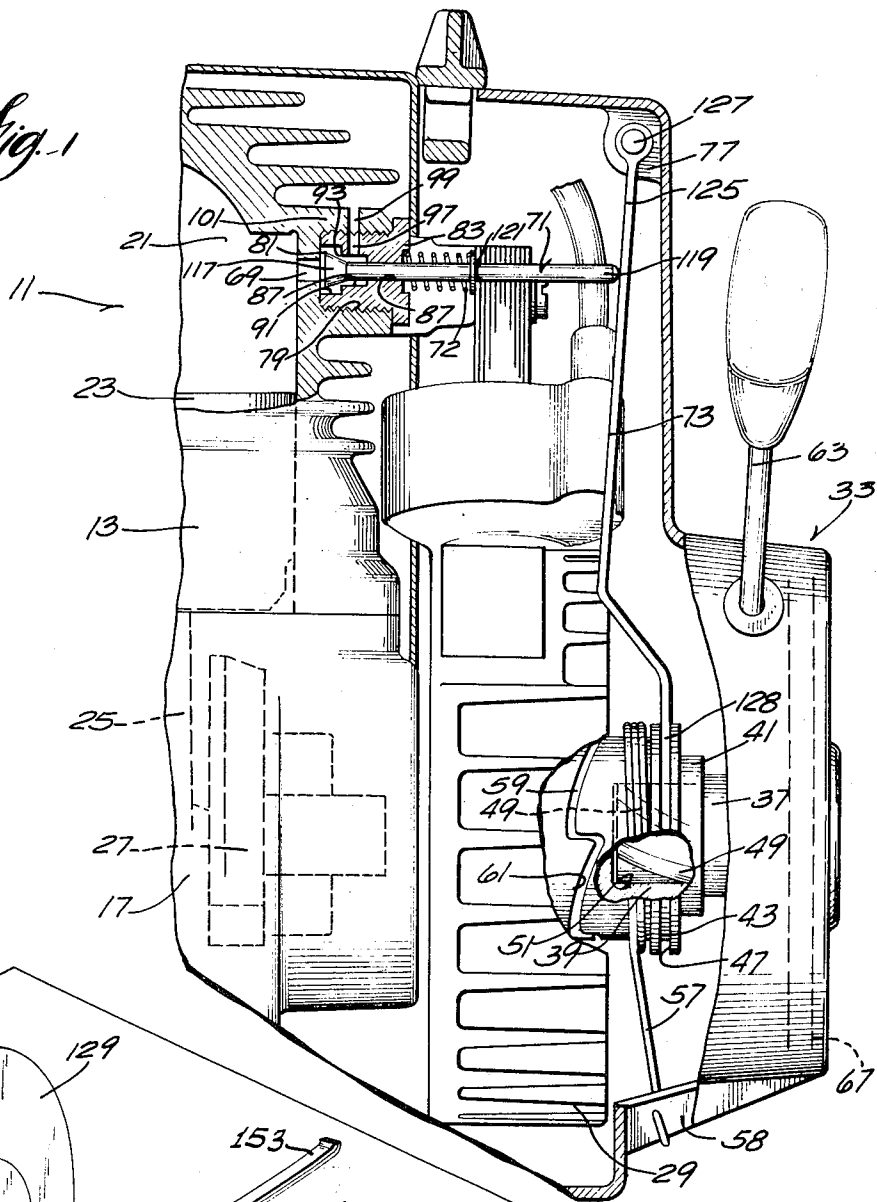
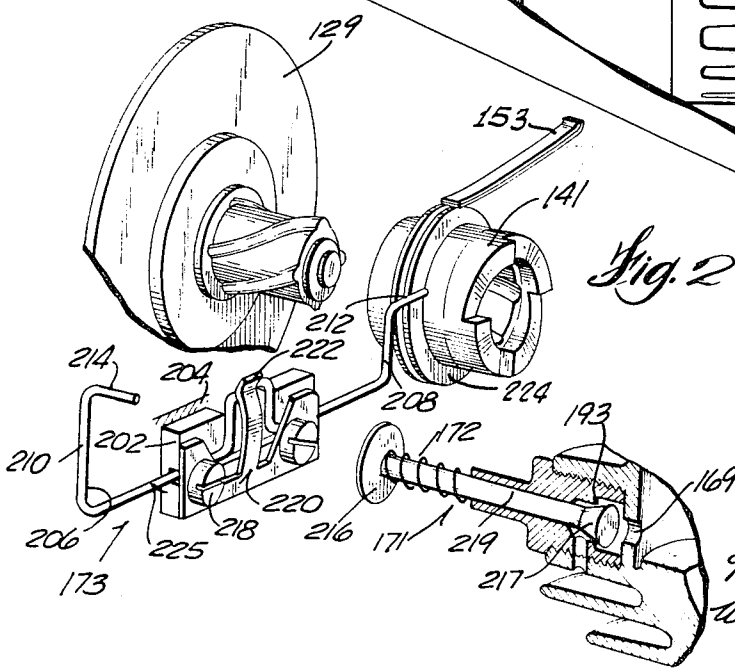


Fig. 2



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AUTOMATIC ENGINE DECOMPRESSION SYSTEM FOR TWO-CYCLE ENGINE

BACKGROUND OF THE INVENTION

The invention relates generally to internal combustion engines. More particularly, the invention relates to arrangements for venting excess pressures from a cylinder during the starting operation by means of a decompression valve so as to avoid retarding piston movement during the compression stroke. While prior engines have employed decompression valves adapted to lower the required starting force, the invention disclosed herein serves to free the operator of any necessity to manually operate the decompression valve.

SUMMARY OF THE INVENTION

The invention provides for an internal combustion engine including automatic means operable in response to actuation of an engine starting device for decompressing a cylinder during engine starting, i.e., for relieving excess pressure in the cylinder. In addition, the invention provides a decompression system which is automatically promptly deactivated upon firing of the engine.

More particularly, the invention provides for pressure relieving operation of a decompression valve in response to movement of a member occurring incident to the operation of an engine starting device.

Still more particularly, the invention provides for operation of a decompression valve in response to movement of a starter pinion into engagement with the starter gear of an internal combustion engine. In this regard, the starter gear can be a part of a flywheel connected to the crankshaft and the pinion can constitute one member of a pull rope starting device.

Still more particularly, the invention provides a linkage which is operable to unseat a valve closing a decompression port in response to movement of a member occurring incident to the operation of an engine starting device. While other linkage arrangements can be employed, the disclosed embodiments include a linkage which is activated by movement of a part of the engine starting device and which is swingable about a fixed axis extending perpendicular to the direction of movement of the decompression valve.

One of the principal objects of the invention is the provision of an arrangement for automatically effecting cylinder decompression in response to engine starting operation of an engine starting device.

Another principal object of the invention is the provision of an arrangement for automatically decompressing an engine cylinder during starting operation in response to movement of a starter pinion to a position operable to crank the engine in response to pinion movement.

Another principal object of the invention is the provision of an automatically operable cylinder decompressing system which serves to afford decompression upon initiation of engine starting action and which is deactivated immediately upon starting of the engine to prevent loss of compression during normal engine operation.

Other object and advantages of the invention include the provision of a cylinder decompression system which operates automatically upon initiation of engine starting operation, which is reliable and effective in

operation, which is economical to construct, and which will provide a long and useful life.

Other objects and advantages of the invention will become known by reference to the following description and accompanying drawings.

DRAWINGS

FIG. 1 is a fragmentary sectional view of an engine including a cylinder decompression system embodying various of the features of the invention.

FIG. 2 is an exploded fragmentary perspective view of another embodiment of a cylinder decompression system embodying various of the features of the invention.

GENERAL DESCRIPTION

Shown in FIG. 1 of the drawings is an internal combustion engine 11 including an engine block 13 defining a crankcase 17 and a cylinder 21 extending from the crankcase 17. Reciprocal in the cylinder 21 is a piston 23 which is connected through a connecting rod 25 to a crankshaft 27 extending through the crankcase 17 and journaled for rotation by the engine block 13. Mounted on the crankshaft 27 exteriorly of the crankcase 17 is a flywheel 29 which can include components constituting a part of the engine ignition system.

Also included in the engine 11 is a starting device 33 comprising a pulley 37 mounted for rotation co-axially with the flywheel 29. Extending co-axially from the pulley is a hub 39 which movably carries a member or pinion 41 including a cylindrical outer surface portion 43 and an outer annular groove 47. Means are provided for causing the pinion 41 to move axially toward the flywheel 29 and to rotate in response to rotation of the pulley 37 in a preselected direction. While various arrangements can be employed, in the disclosed construction, such means includes arcuate ribs or splines 49 extending axially on one of the hub 39 and pinion 41 and cooperating grooves 51 which are formed in the other of the hub 39 and pinion 41 and which matingly receive the splines 49. The means for causing the pinion to move axially in response to rotation of the pulley also include a friction link or spring 57 which is anchored to a part 58 of a frame structure fixedly supported by the engine block 13 and which includes several coils wound about the cylindrical outer surface portion 43 of the pinion 41. The spring 57 lightly grips the outer cylindrical surface portion 43 of the pinion 41 so as to initially restrict rotation thereof and, accordingly, to cause axial movement of the pinion 41 into engagement with the flywheel 29 upon initial rotation of the pulley 37. However, upon engagement of the pinion 41 with the flywheel, further pinion axial movement is prevented, and the looseness of the engagement of the spring 57 with the cylindrical surface portion 43 of the pinion 41 permits rotation of the pinion 41 relative to the spring 57 and in response to rotation of the pulley 37.

In order to effect driving connection of the pinion 41 with the crankshaft 27, and consequent starting of the engine, when the pinion 41 is in engagement with the flywheel 29, both the flywheel 29 and the pinion 41 include respective annular gears or ratchet surfaces 59 and 61 which affords driving of the flywheel 29 by the pinion 41 in one direction and permits disengagement

of the pinion 41 by the flywheel 29 when rotating at a faster rate in the same direction. Thus, when the engine 11 starts, it rapidly attains a rotary speed in excess of the rate of rotation of the pinion 41, thereby effecting driving the pinion 41 out of driving engagement with the flywheel 29 and toward a retracted position adjacent to the pulley 37.

The pulley 37 can be cause to rotate in the direction which is effected to drive the pinion 41 toward the flywheel 29 and to start the engine 11 either directly by a pull rope 63 or through a recoil starter spring 67 which is coiled to store energy in response to the operation of the pull rope 63. Except for the groove 47, as thus far described, the construction is conventional.

In accordance with the invention, means are provided for decompressing the cylinder 21 to facilitate initial piston movement accompanying starting of the engine. In this regard, there is provided a decompression port or passage 69 communicating with the cylinder adjacent the head end thereof, together with a valve member 71 which is movable to and from a position closing the port 69 and means in the form of a spring 72 biasing the valve member 71 toward the position closing the port. Also included is a linkage 73 which is pivotally mounted on a part 77 of a frame fixed on the engine block 13 and which is engageable with both the movable starter pinion 41 and the valve member 71.

More particularly, the linkage 73 is arranged so that movement of the pinion 41 toward the position of driving engagement with the flywheel 29 to start the engine 11 also serves to displace the linkage 73 so as to move the valve member 71 against the action of the spring 72, away from the position closing the cylinder port 69. As a consequence, the cylinder 21 is communicated with the atmosphere or at least with an area of lesser pressure than that which would otherwise occur during piston movement toward the head end of the cylinder 21, whereby to facilitate piston movement accompanying starting of the engine.

Upon ignition of the engine, the piston travel and accompanying crankshaft rotation will immediately cause the flywheel 29 to drive the pinion 41 away from its driving position, thereby permitting closure of the port 69 by the valve member 71 in response to action of the spring 72 so as to afford normal engine operation.

More particularly, in the construction disclosed in FIG. 1 the engine block 13 includes a threaded cylindrical recess 79 communicating with a passageway 81 which opens into the cylinder 21 and constitutes a part of the port 69. Rotatably threaded into the recess 79 is a plug 83 having an axial bore 87 communicating with a series of two counterbores 89 and 91 respectively, which counterbores form part of the port 69. The junction of the two counterbores 89 and 91 defines a shoulder comprising a valve seat 93. In addition, the inner or smaller counterbore 89 communicates with a radial bore 97 which also constitutes part of the port 69 and which, in turn, communicates with the atmosphere through a registering bore 99 in a cooling fin 101 of the engine block 13.

The valve member 71 extends through the bore 87 and includes a frusto-conically shaped valve part 117 engageable with the shoulder or seat 93 to close the port 69 and a stem 119 which extends through the bore 87 and outwardly thereof. The stem 119 carries a collar

or snap ring 121 which forms one seat for the spring 72 which is seated at its other end against the plug 83 and which extends in surrounding relation to the valve stem 119 so as to urge the valve stem 117 outwardly from the plug 83, thereby seating the frusto-conical valve part 117 against the seat 93 to close the port 69.

The outer end of the stem 119 is engaged by the linkage 73 which, in the construction disclosed in FIG. 1, is provided by a link 125 which is pivotally mounted at 127 to the frame part 77 about an axis transverse to the direction of movement of the valve member 71. The link 125 includes a portion 128 which is engaged in the annular groove 47 on the outer surface of the pinion 41. Accordingly, when the pinion 41 moves axially toward the flywheel 29, the link 125 is rocked about its pivot 127 and the valve stem 119 is moved inwardly of the plug 83 against the action of the spring 72 to displace the valve part 117 from the seat 93 and thereby open the port 69 to the atmosphere.

When the pinion 41 moves axially away from the flywheel 29 to its retracted position adjacent to the pulley 37, such movement causes the link 125 to move in the counterclockwise direction as shown in FIG. 1 about its pivotal mounting 127 and permits the spring 72 to move the valve member 71 to the position closing the valve part 117 against the seat 93 to close the port for normal engine operation.

Thus, it will be seen that upon starting of the engine 11, axial movement of the pinion 41 toward its position of driving engagement with the flywheel 29 serves to displace the valve member 71 so as to open the port 69 and communicate the cylinder 21 with the atmosphere. However, as soon as the engine 11 is started, the starter pinion 41 will move away from the flywheel 29, and toward its retracted position permitting the valve spring 72 to engage the valve part 117 against the seat 93 and thereby close the port 69.

Shown in FIG. 2 is a schematic showing of another arrangement for displacing a valve member 171 so as to open a port 169 in response to movement of a starter pinion 141 into engagement with a flywheel 129. As in the embodiment just described above, there is provided a linkage 173 which, in response to axial movement of the starter pinion 141 toward the flywheel 129, cooperates with both the starter pinion 141 and the valve member 171 so as to displace the valve member 171 against the action of a valve spring 172 so as to displace the valve part 217 away from the valve seat 193, thereby opening the port 169.

In the particular construction shown in FIG. 2, the linkage 173 comprises a link 225 which is rotatably housed in an anchor block 202 fixed to a starter housing 204 mounted on the engine block 13. More particularly, the link 225 comprises a wire-like member having a central U-shaped bite 206 from which project oppositely extending aligned portions 208 and 210. Extending from the outer end of the portion 208 is a bent portion 212 which is engageable with a shoulder 214 on the outer surface of the starter pinion 141, such that when the starter pinion 141 moves axially toward the flywheel 129, the link 225 is caused to rotate about the axis of the aligned portions 208 and 210, which axis extends transversely of the direction of travel of the valve member 171.

Extending from the outer end of the other portion 210 is another bent portion 214 having an end adapted to engage against a flange 216 fixed to the end of the valve stem 219. Thus, when the link 225 is rotated in the clockwise direction as viewed from the left in FIG. 2, in response to travel of the starter pinion 141 to the right, the end of the bent portion 214 of the link 225 engages the flange 216 to cause displacement of the valve stem 219 to the right against the action of the spring 172, thereby opening the relief port or passageway 169 communicating with the cylinder.

Means are provided for biasing the link 225 in the counterclockwise direction to a position which will not interfere with action of the valve spring 172 to engage the valve part 217 of the valve member 171 against the valve seat 193. In this regard, there is mounted on the anchor block 202, as by screws 218, a spring member 220 having a resilient leaf 222 which engages the outer end of the bite portion 212 of the link 225 to cause rotation of the link 225 into the position which does not interfere with action of the valve spring 172. Such action of the link spring 220 also serves to bias the starter pinion 141 toward its retracted position against the pulley.

It will be seen that, in the construction shown in FIG. 2, friction is applied to the starter pinion 141 to effect axial movement toward the flywheel 129, in response to rotation of the starter pulley in a clockwise direction, by a leaf member or spring 153 which is supported on a frame or housing connected to the engine block and which bears against an annular surface 224 on the starter pinion 141.

In operation, the friction force exerted by the leaf member 153 to cause axial movement of the starter pinion 141 toward the flywheel 129 is sufficient to overpower the action of the link spring 220. However, the link spring 220 serves to effect positive disengagement of the link 225 from the valve stem 219 when the starter pinion 141 is retracted to its position adjacent the pulley.

Both of the disclosed embodiments include arrangements in which a port communicating between the atmosphere and a cylinder is opened in response to movement of a component of the engine starter during the initial engine starting operation. Accordingly, excessive compression will not take place in the cylinder due to piston reciprocation until after ignition of the engine. Thereafter, the starter pinion will be promptly displaced toward its retracted position permitting the valve to close the port to afford normal engine operation.

Various of the features of the invention are set forth in the following claims.

What is claimed is:

1. An internal combustion engine comprising an engine block defining an engine cylinder having a port, a crankshaft rotatably supported by said engine block, a valve movable to and from a position closing said port, means biasing said valve toward said position closing said port, an engine starter mechanism including a rotary element and a member operably associated with said rotary element and movable relative thereto and to and from a position in driving connection between said crankshaft and said rotary element to facilitate starting of the engine, and a linkage mounted on a part fixed

with respect to said engine block and being operably engageable with said member and said valve to displace said valve from said port closing position against the action of said biasing means in response to movement of said member to said position of driving connection, whereby to permit gas flow relative to said cylinder through said port.

2. An internal combustion engine in accordance with claim 1 wherein said engine block includes a recess and a passageway between said recess and said cylinder adjacent the head end thereof and wherein the engine further includes a plug threadedly received in said recess and including a bore communicating with said passageway, a first counterbore extending from said bore, a second counterbore extending from said first counterbore, said first and second counterbores defining a valve seat, and a radial bore extending from said first counterbore and communicating with the atmosphere.

3. An internal combustion engine in accordance with claim 2 wherein said valve comprises a stem movable in said bore in said plug and a valve part engageable with said seat.

4. An internal combustion engine in accordance with claim 3 wherein said means for biasing said valve toward said position closing said port includes a collar on said stem located exteriorly of said bore and a spring in surrounding relation to said stem and seated against said collar and said plug.

5. An internal combustion engine in accordance with claim 1 wherein said linkage comprises a link pivotally mounted about an axis which is fixed relative to said engine block and which extends perpendicularly to the direction of valve movement, said link including a portion engageable with said valve to effect port opening movement of said valve in response to movement of said member to said position of driving connection.

6. An internal combustion engine in accordance with claim 5 and further including spring means resiliently biasing said link away from engagement with said valve.

7. An internal combustion engine in accordance with claim 6 wherein said spring means also serves to bias said member away from the position of driving connection.

8. An internal combustion engine in accordance with claim 1 wherein said means biasing said valve toward said position closing said port also serves to urge said linkage so as to urge said member away from said position of driving connection.

9. An internal combustion engine comprising an engine block defining an engine cylinder having a port, a crankshaft rotatably supported by said engine block, a valve movable to and from a position closing said port, means biasing said valve toward said position closing said port, a pull rope starter including a rotatably mounted pulley with a hub extending axially therefrom, and a pinion carried on said hub for movement to and from a position in driving connection with said crankshaft to facilitate starting of the engine, said hub and said pinion including means affording movement of said pinion to said position in driving connection with said crankshaft in response to rotation of said pulley, and a linkage mounted on a part fixed with respect to said engine block, said linkage including means connecting said pinion to said valve to displace said valve

from said port closing position against the action of said biasing means in response to movement of said pinion to said position in driving connection with said crankshaft.

10. An internal combustion engine in accordance with claim 9 wherein said engine block includes a recess and a passageway between said recess and said cylinder adjacent the head end thereof and wherein the engine further includes a plug threadedly received in said recess and including a bore communicating with said passageway, a first counterbore extending from said bore, a second counterbore extending from said first counterbore, said first and second counterbores defining a valve seat, and a radial bore extending from said first counterbore and communicating with the atmosphere.

11. An internal combustion engine in accordance with claim 9 wherein said linkage comprises a link

pivotaly mounted about an axis which is fixed relative to said engine block and which extends perpendicularly to the direction of valve movement, said link including a portion engageable with said valve to effect port opening movement of said valve in response to movement of said member to said position in driving connection with said crankshaft.

12. An internal combustion engine in accordance with claim 11 and further including spring means resiliently biasing said link away from engagement with said valve.

13. An internal combustion engine in accordance with claim 9 wherein said means biasing said valve toward said position closing said port also serves to urge said linkage so as to urge said member away from said position in driving connection with said crankshaft.

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