

July 30, 1940.

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2,209,496

AUTOMATIC COMPRESSION CONTROL FOR ENGINES

Filed Feb. 15, 1939

4 Sheets-Sheet 1

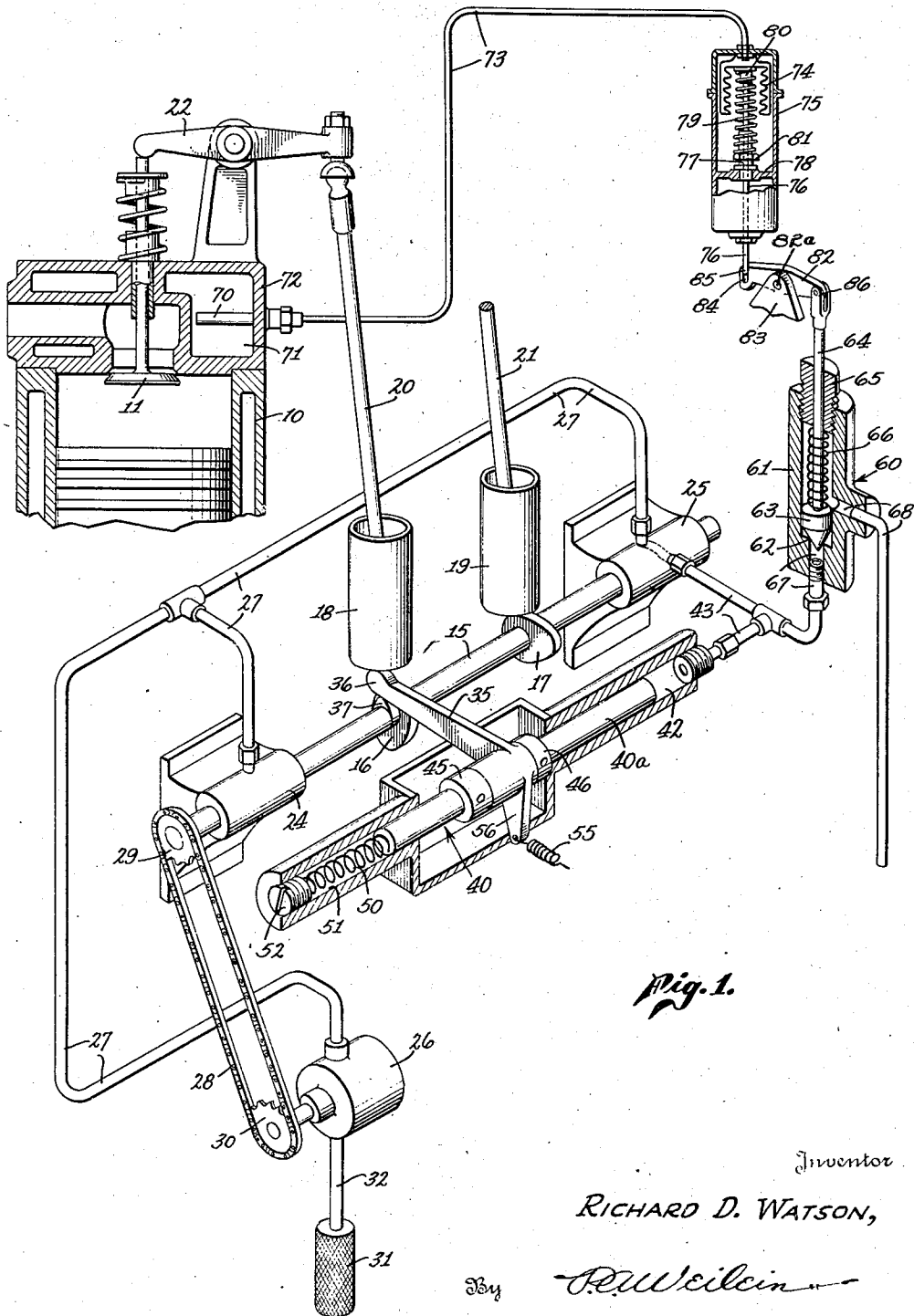


Fig. 1.

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4 Sheets-Sheet 2

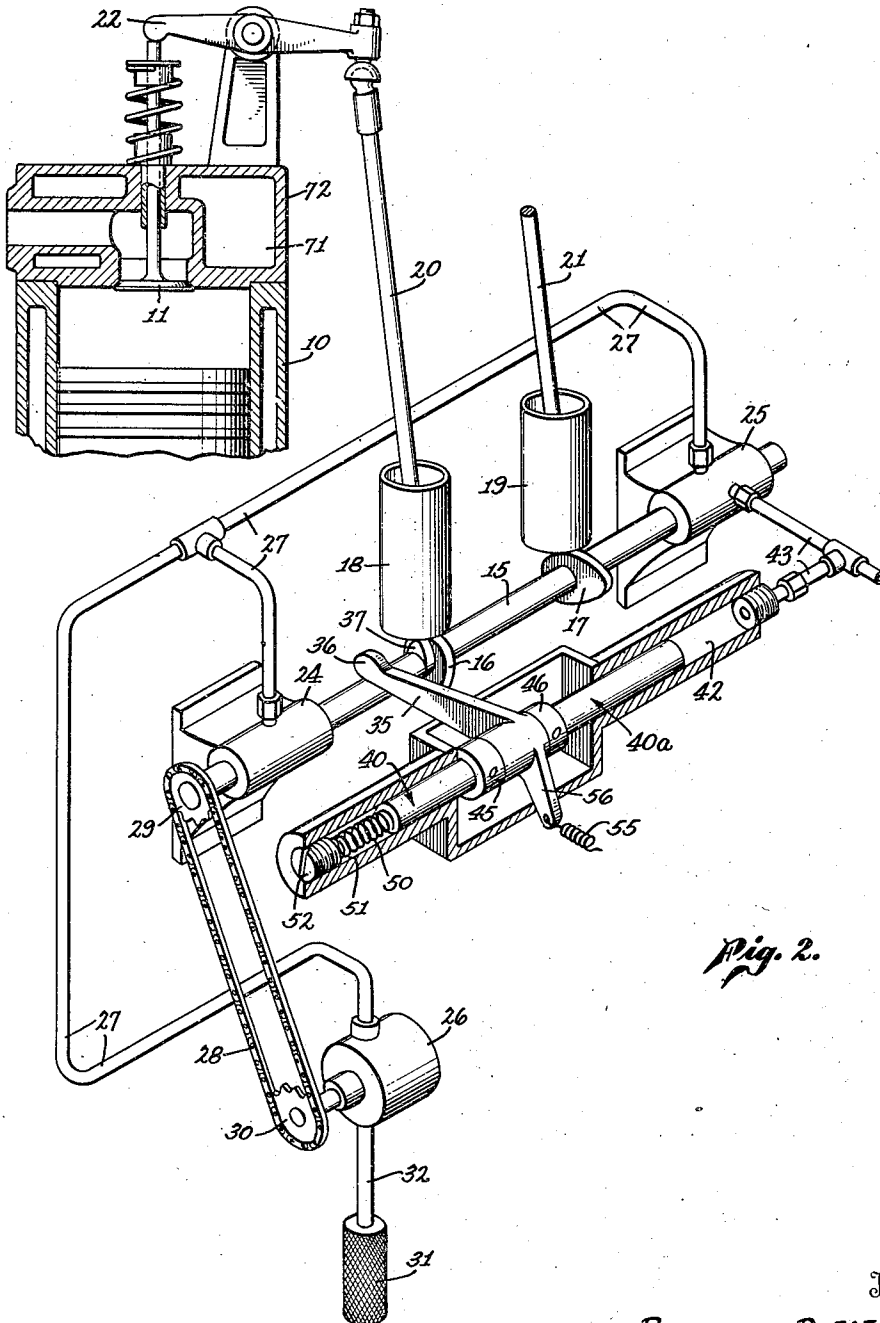


Fig. 2.

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4 Sheets-Sheet 3

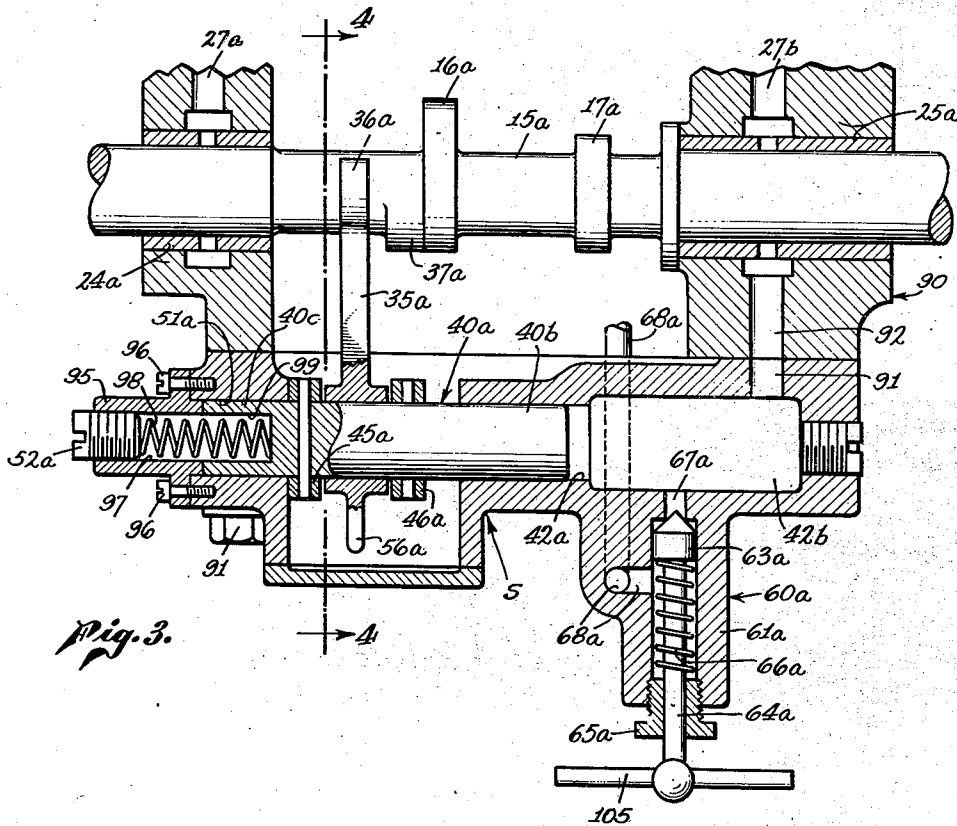


Fig. 3.

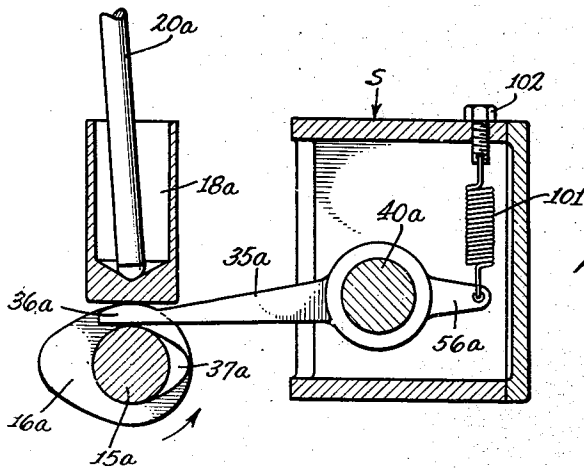


Fig. 4.

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4 Sheets-Sheet 4

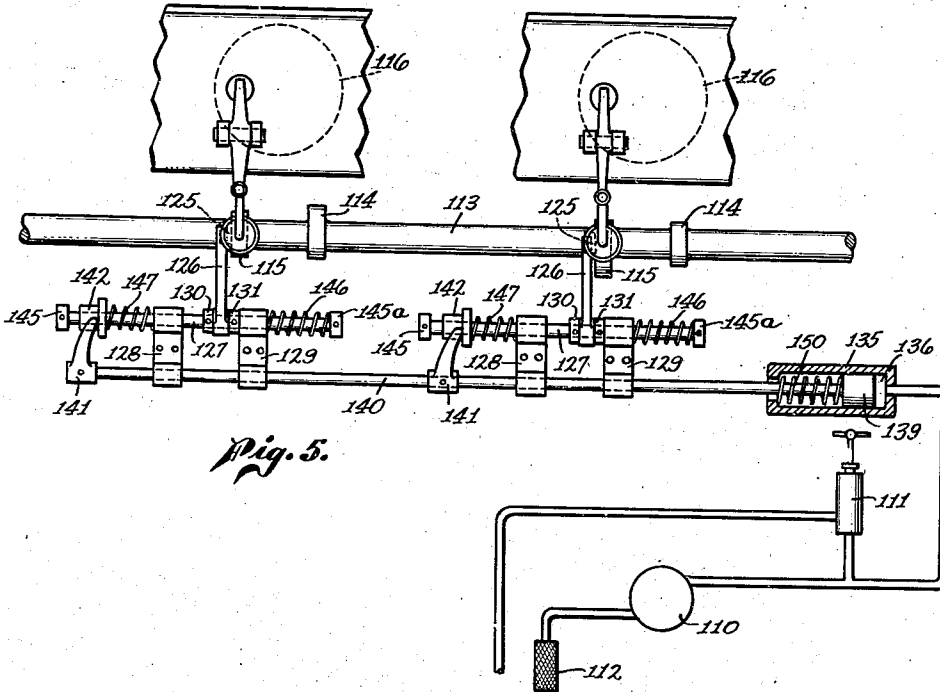


Fig. 5.

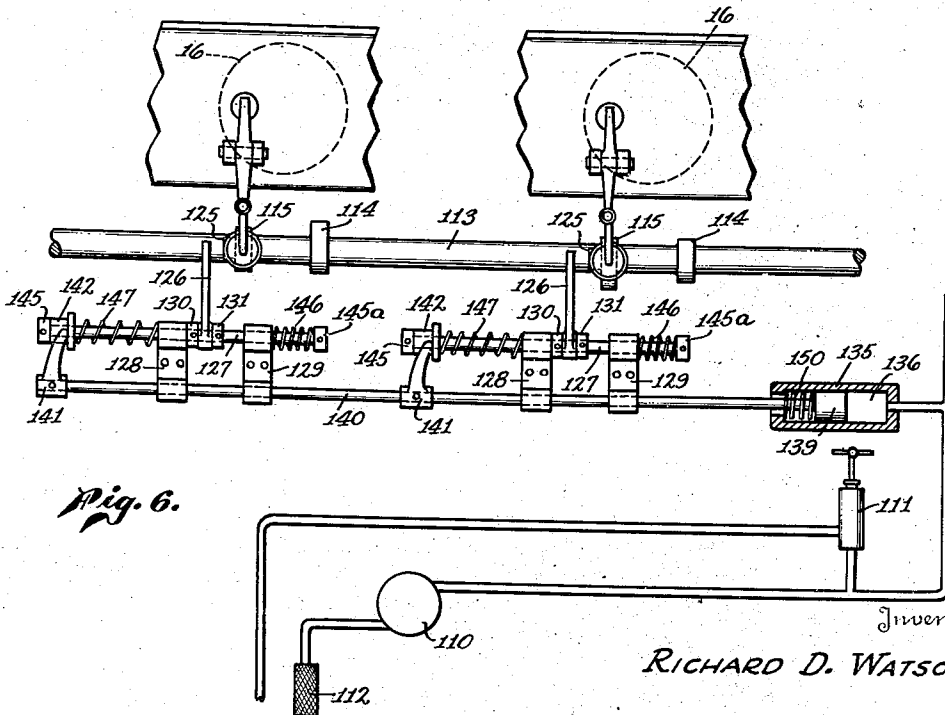


Fig. 6.

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AUTOMATIC COMPRESSION CONTROL FOR ENGINES

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Application February 15, 1939, Serial No. 256,497

21 Claims. (Cl. 123—182)

This invention relates to mechanisms for controlling the compression of engines, and particularly to that type of mechanism which relieves the engine of compression to permit a starting device to impart momentum to the engine parts under relatively light loads, and which thereafter permits the reestablishment of compression to allow the engine to become self-operable.

It is an object of the present invention to provide an improved automatically operable mechanism for controlling the compression of engines, especially of the internal combustion type, to facilitate their starting.

It is another object of the invention to provide a device capable of discontinuing the operation of an engine through control of its compression.

A further object of the invention is to provide a device capable of controlling engine compression from a relatively remote point.

Still another object of the invention contemplates a safety device which will automatically discontinue engine operation in the event of defects arising in, or failure of, the lubricating system.

Another object of the invention is to prevent operation of an engine having a defective lubricating system; and to prevent its starting until the defect has been remedied.

Another object of the invention is to safeguard an internal combustion engine from possible damage due to overheating.

A further object of the invention is to provide means for discontinuing engine operation upon excessive heating or complete failure of the cooling fluid.

Another object of the invention is the provision of an automatic system for substantially simultaneously controlling the compression in all of the cylinders of an engine.

A further object of the invention is to provide means for governing the compression in each cylinder of a multiple cylinder engine by means controllable from a common source.

This invention possesses many other advantages and has other objects which may be made more easily apparent from a consideration of several embodiments of the invention. For this purpose there are shown a number of forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the

invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a diagrammatic view illustrating a system of compression control with parts shown in compression releasing position.

Figure 2 is a view similar to Figure 1 showing the parts in a position permitting normal engine operation.

Figure 3 is a section through a modified constructional arrangement of the servo-motor and valve control embodied in the system shown in Figure 1.

Figure 4 is a transverse section taken as indicated by the line 4—4 of Figure 3.

Figure 5 is a diagrammatic view illustrating the system of Figure 1 as applied to a multiple cylinder engine, certain parts being shown in compression releasing position, and

Figure 6 is a view similar to Figure 5, with parts being shown in engine operating position.

The system disclosed in Figures 1 and 2 of the drawings includes the usual cylinder 10 of an engine, preferably of the internal combustion type, having inlet and outlet valves, only the outlet valve 11 being shown in the drawings. The valves are operated from a cam shaft 15 through the instrumentality of cams 16 and 17 normally engageable with valve tappets 18 and 19 producing reciprocation of push rods 20 and 21, which in turn oscillate rocker arms in a usual and well-known manner, the outlet valve rocker arm 22 being the only one shown in the drawing. The cam shaft 15 is driven from the engine crank shaft (not shown), and is journaled in bearings 24 and 25 which are supplied with lubricant by means of a pump 26 having communication with the bearings through the conduits 27. This pump is driven from the engine cam shaft 15 through suitable mechanical means such as the chain 28 connecting sprockets 29 and 30 carried on the respective cam and pump shafts, and pumps lubricant from the usual engine crank case (not shown) through the strainer 31 and intake pipe 32 and exhausting it into the conduits 27 for lubricating various parts of the engine mechanism.

Engines having a relatively high compression ratio can be started against this high compression pressure only by imposing a very heavy load on the battery and starting motor. This is particularly true in connection with Diesel engines, which have compression ratios of as much as 18 to 1. The present invention seeks to provide a system and mechanism obviating the need for starting the engine against this high compression

sion load by relieving the engine of its compression while momentum is imparted to the engine by a starting device operating against a relative light load. After sufficient kinetic energy has been stored in the starting motor and the engine parts, the engine compression can be re-established in order to produce its self-operation.

In the specific example disclosed in Figures 1 and 2, an element is interposed in one of the valve actuating means to prevent the valve from closing when its operating cam is in valve closing position. This element is constituted by a lever finger or arm 35 having an end 36 cooperable with a supplementary cam 37 fixed to the cam shaft 15. This cam 37 is preferably small enough to fall within the base circle of the cam 16 in order to have no effect upon the valve tappet 18 until the lever finger 35 has been interposed between the tappet 18 and the supplementary cam 37. It will be noted that the supplementary cam lobe extends substantially oppositely to the tappet lifting portions of the main cam 16 to prevent complete lowering of the tappet 18 when the lever finger 35 is interposed between the supplementary cam 37 and the tappet 18, and consequently, prevents closing of the associated valve 11. Whenever the lever finger 35 is in such interposed position the associated valve 11 will be prevented from closing completely since the cam contacting surface presented by the finger end 36 extends beyond the base circle of the main cam 16, and a medium within the cylinder 10 will be incapable of being compressed due to its ability to escape through the open valve. Removal of the lever finger 35 from engagement with the supplementary cam 37 will permit normal operation of the valve mechanism and the creation of the usual compression pressure within the cylinder 10.

The particular position occupied by the lever finger 35 with respect to the supplementary cam 37 is determined by conditions of operation of the internal combustion engine. So long as the engine is rotating properly, the lever finger 35 will be maintained out of the path of movement of the supplementary cam 37 and free it from any restraining movement upon the valve tappet 18. But in the event that the engine is stationary, or certain undesirable conditions arise in connection with its operation, the lever 35 will be moved longitudinally along the cam shaft 15 into radial contact with the supplementary cam 37.

The aforementioned functions are achieved in the instant case by mounting the lever 35 for oscillation upon a shaft 40 having one end 40a forming a piston slideable within a fluid cylinder 42. Fluid under pressure can be conveyed from the lubricating conduit lines 27, or from one of the engine bearings, by conducting it through the branch line 43, communicating with an end of the fluid cylinder 42. It will therefore be seen that the rotation of the crankshaft, cam shaft, or other rotatable parts of the engine will operate the lubricating pump 26 to force fluid to the various bearings and other parts of the engine, and also exert a pressure upon the fluid within the cylinder 42 to move the piston 40a therein. This movement will be communicated to the lever 35 since it is restrained from axial movement with respect to the piston shaft 40 by the oppositely disposed collars 45 and 46 pinned or otherwise suitably secured to the shaft 40. In the event that the piston 40a moves sufficiently, the lever 35 will be disengaged from the supplementary cam 37 and permit normal operation of the associated valve mechanism. However, the shaft 40

and lever 35 oscillatable thereon are normally urged in a direction opposite to that induced by the fluid under pressure by the spring 50 confined within the cylinder 51 and acting against one end of the shaft 40 piloted within this cylinder. The compression of the spring can be determined by means of the adjusting plug 52 threaded into the outer end of the cylinder 51.

The operation of the parts so far described can now be understood. A stationary condition of the engine results in the lack of pressure in the lubricating system in view of the fact that the pump 26 is not being driven. The helical spring 50 can therefore urge the lever finger 35 into a position in which its outer end 36 will engage with both the supplementary cam 37 and the valve tappet 18, preventing closing of the associated valve 11 in the manner aforementioned. If the engine is cranked by a suitable starting device, the pump 26 will be rotated and pressure built up in the fluid system. The more rapid the motion of the engine parts, the greater the speed of the pump and also the pressure generated by it. A condition is eventually reached wherein the engine parts are rotating at a sufficient speed to overcome any starting compression that can be built up in the cylinder 10. When this condition is developed, sufficient pressure will also be produced in the lubricating system and in the fluid cylinder 42 to force the shaft 40 and its piston 40a outwardly against the action of the spring 50 and free the lever from contact with the supplementary cam 37. The compression then obtained in the cylinder 10 will be sufficient to ignite injected fuel (in the case of a Diesel engine) or ignition of compressed fuel (in the case of an engine operated on the Otto cycle). So long as the engine is operating under its own power, the lubricating pump 26 will generate sufficient pressure to hold the shaft 40 and its piston 40a in proper position against the action of the spring 50 and maintain the lever finger 35 out of compression releasing position with respect to the supplementary cam 37 and the valve tappet 18. But upon stopping of the engine or loss of lubricating pressure in any other manner the spring 50 can reestablish radial engagement between the supplementary cam 37 and lever finger 35 and prevent further operation of the engine by continued relieving of its compression. The lever finger 35 is held in proper radial contact with the supplementary cam 37 by means of the helical spring 55 connected to the lever extension 56 and to some stationary member.

Since the system described is dependent upon the pressure of the lubricating fluid for permitting self-operation of the engine, it will be apparent that loss of this pressure will produce stopping of the engine by relieving its compression through the interposition of the lever finger 35 between the supplementary cam 37 and the valve tappet 18. Accordingly, should the pump fail, or leakage occur in the lubricant system, or the lubricant supply in the crank case sump become exhausted, the pressure in the fluid cylinder will drop and the engine stopped before any damage has been done through lack of proper lubrication. Furthermore, the engine cannot be started until the defect in the lubricating system has been remedied.

Reliance upon a fluid for controlling the operation of the engine also renders possible the use of a relatively simple expedient for stopping the engine at will. This can be accomplished by incorporating a control valve 60 in the lubrication

system. This valve includes a body 61 having a seat 62 for receiving a valve head 63. A valve stem 64 is fixed to the head 63 and extends through a plug 65 threaded into the body 61. The valve head 63 normally engages the seat 62 under the influence of the helical spring 66 to prevent flow of the fluid from the system through the control valve 60. The valve head 63 can be raised at will from its cooperable seat 62 by manually grasping the outer end of the valve stem 64, or a suitable handle fixed thereto (Figures 5 and 6), which action will permit the lubricating fluid to escape to the engine sump (not shown) through the valve inlet and outlet conduits 67 and 68, and thereby permit the spring 60 to position the lever finger 35 in radial contact with the supplementary cam 37 to relieve the engine of compression by preventing closing of the valve 11.

The pressure relief valve 60 can also be operated in other ways, as by connecting a suitable remotely controlled solenoid with its stem (not shown). It can also be controlled remotely in dependence upon the operating temperature of the engine, being cause to open in the event of excessive heating of engine cooling elements, such as cooling water. In the specific example shown in Figure 1, a thermostat bulb 70 is connected in the water cooling jacket 71 of the cylinder head 72, with a line 73 leading from the bulb 70 to an expandible bellows 74 contained within a housing 75. One end of the bellows is fixed to the housing in such a manner as to form a leakproof joint therewith, and the other end operates against a push rod 76 slideable in a guide sleeve 77 fixed to an intermediate partition 78 in the housing 75. Expansion of the fluid in the thermostat bulb 70 and its communicating line 73 upon increase in the temperature of the cooling water in the jacket 71, will tend to force the push rod 76 downwardly against the action of a spring 79 encircling the rod 76 and engageable with a head 80 secured to its upper end and also with a nut 81 adjustably threaded on the guide sleeve. The push rod 76 extends through the housing 75 and is operatively connected with a lever 82 fulcrumed on a suitable stationary supporting bracket 83. The connection may be in the form of a slot 84 in one end of the lever receiving a looped portion 85 of the push rod 76 to provide a lost motion therebetween. The other end of the lever is connected with the valve stem 64 through the pivotal connection 86.

As the temperature increases in the cylinder head water jacket 71, the fluid in the thermostat bulb 70 will expand, distending the bellows 74 downwardly and producing corresponding movement of the push rod 76 against the action of the spring 79. No motion will be imparted to the lever 82 and relief valve stem 64 until the push rod 76 engages with the bottom of the lever slot 84. Such engagement will only occur upon an excessive rise in the jacket cooling water temperature, which condition will effect a rocking of the lever 82 on its fulcrum 82a and a raising of valve head 63 from its seat 62, which permits venting of the lubricant to the crank case sump through the line 68, and decompression of the engine by movement of the lever finger 35 into proper cam engaging position under the influence of the spring 50.

In effect, the fluid cylinder and piston device 40, 42, etc., and the return spring mechanism 40, 50, etc. constitute a servo-motor operable in ac-

cordance with certain definite engine conditions. The limits of travel of the lever 35 and the piston shaft 40 can be determined by utilizing the restraining collars 45 and 46 as stops abutting against the ends of the respective piston and spring cylinders 42 and 51. The range of movement is chosen so that abutting of the collar 46 against the fluid cylinder 42 occurs upon complete engagement of the lever finger 35 with the supplementary cam 37, while abutting of the other collar 45 against the end of the spring cylinder 51 occurs upon complete disengagement of the lever 35 from the cam 37, as shown in Figure 2.

The servo-motor portions of the system disclosed in Figures 1 and 2 can be compacted, as shown in Figure 3, to form a more practicable structural organization. In this figure, the cam shaft 15a is rotatable in suitable bearings 24a and 25a supplied with lubricant through the ducts 27a and 27b. The servo-motor S is shown attached directly to parts of the engine housing 90 by bolts 91, the fluid pressure cylinder 42a communicating with the cam shaft bearing 25a through the fluid reservoir 42b contained within the servo-motor housing, and the aligned ducts 91 and 92 in said housing and the engine housing 90. The shaft 40a carrying the lever 35a and confining collar stops 45a and 46a heretofore described, includes a piston portion 40b slideable within a bore 51a provided in the end of the servo-motor housing. This bore is closed by a terminal cap 95 secured to the servo-motor housing by screws 96, the cap being provided with a recess 97 receiving a helical spring 98 also confined within a recess 99 in the end of the shaft 40a. One end of the spring 98 abuts against a plug 52a threaded into the cap 95, whereby the spring tension can be adjusted. The lever finger 35a is maintained against the cam shaft 15a or against the supplementary cam 37a by means of the spring 101 attached to the lever extension 56a and to an anchor screw 102 threadedly secured in the servo-motor housing.

The operation of the parts shown in the modification of Figures 3 and 4 is the same as that described in connection with Figures 1 and 2. However, the relief valve 60a is formed integrally with the servo-motor housing, its body 61a extending from the housing and its inlet 67a opening into the reservoir or manifold 42b. The valve outlet passage or conduit 68a extends through the servo-motor housing, communicating with the crank case sump. The valve head 63a, stem 64a, encircling spring 66a, and threaded plug 65a are substantially the same as described in connection with Figures 1 and 2 but the valve is adapted to be operated manually through the handle 105 instead of the automatic means shown and described in connection with Figures 1 and 2.

As shown in Figures 5 and 6, the system is also applicable for use in connection with multiple cylinder engines, effectively controlling compression in each and every one of the engine cylinders. The lubricating pump 110, relief valve 111, strainer 112, etc., occupy the same relative positions as described in connection with Figures 1 and 2. The cam shaft 113 is disclosed as being provided with a plurality of pairs of cams, each pair consisting of a cam 114 for controlling an inlet valve and a cam 115 for controlling an exhaust valve in each cylinder 116.

A supplementary cam 125 is positioned adjacent each exhaust valve cam 115, occupying 75

the same relationship with respect to the exhaust cam as described in connection with Figures 1 and 2. Similarly, a lever finger 126 can be moved into radial contact with each supplementary cam 125 to control the engine compression. Each lever is oscillatably mounted on a shaft 127 slideable in the guides 128 and 129 suitably secured to the engine or some convenient stationary support. As described above in connection with Figures 1 and 2, collars 130 and 131 are fixed to each shaft 127 and are positioned on opposite sides of the lever finger 126 to prevent its axial movement with respect to the slideable shaft 127 and also to act as stops, limiting the extent of travel of the shaft 127 in its guides 128 and 129. Thus, when the collar 131 is abutting against the guide 129, the lever finger is in contact with the supplementary cam 125, functioning to relieve the cylinder from compression. Axial movement of the shaft 127 to cause abutting of the collar 130 against the guide 128, insures movement of the lever finger out of contact with the supplementary cam and permits compression of whatever medium is in the engine cylinder.

The lever fingers 126, 126 are mounted for independent oscillation to permit their operation in conjunction with the supplementary cams 125, 125, which are angularly displaced on the cam shaft with respect to one another in view of the usual angular displacement of the exhaust cams relative to one another. For this reason, a separate shaft 127 is provided for oscillatably mounting each of the lever fingers. However, the axial positions of the levers with respect to the supplementary cams are governed by a common servo-motor 135 operable substantially simultaneously upon all of the slideable shafts. This servo-motor includes a cylinder 136 in communication with the engine lubricating system, there being a piston 139 slideable within the cylinder 136 and a piston rod 140 connected thereto and extending through the cylinder for reciprocation in the guideways 128, 129. A yoke 141 for each cylinder is pinned or otherwise suitably secured to the extended piston rod 140, each yoke being operable upon a flanged collar 142 slideable upon the shaft 127. Each shaft 127 carries collars 145 and 145a pinned to its ends. A spring 146 encircling the rod 127 between one of the guides 129 and a collar 145a, serving to urge the lever finger 126 into radial contacting position with the supplementary cam 125. A spring 147 of much greater compressive strength than the spring 146 encircles the shaft 127 between the other guide 128 and the flanged collar 142, tending to slide this collar along the shaft 127 into contact with the fixed collar 145, and thereafter slide the shaft 127 in its guideways 128, 129, to move the lever finger 126 out of contact with the supplementary cam 125.

When lubricating pressure is lacking in the system, a spring 150 encircling the piston rod 140 within the cylinder 136 will move the piston 139 toward the inlet end of the cylinder and correspondingly slide the flanged collars 142 along their respective rods 127 against the action of the springs 147. This relieves the effect of these springs upon the slideable rods 127 and the lever fingers 126, permitting the springs 146 of lesser compression to move the rods 127 and position the fingers 126 into radial contact with the supplementary cams 125, thereby relieving all of the cylinders of compression. Upon the creation of sufficient pressure in the lubricating system the piston 139 will be moved in the cylinder 136

against the action of its engaging spring 150 and will move the yokes 141 away from the flanged portions of the collars 142, allowing the springs 147 of greater compressive strength to force the flanged elements 142 against the collars 145 on the shafts and move the lever fingers 126 out of radial contact with the supplementary cams 125, permitting the establishment of compression in all of the engine cylinders and its subsequent self-operation.

It will be appreciated that the multiple compression relieving system can also have the same safety and control features described in connection with the single cylinder system of Figures 1 and 2.

I claim:

1. A system for controlling the compression of engines having valve actuating mechanism including means adapted to be interposed in said valve actuating mechanism for preventing closing of a valve actuated thereby, means tending to interpose said first means, and means controllable by the engine operation for maintaining said first means in non-interposed position.

2. A system for controlling the compression of engines having valve actuating mechanism including means adapted to be interposed in said mechanism for preventing closing of a valve adapted to be actuated thereby means tending to interpose said first means, and means responsive to motion of engine parts for shifting said interposed means from the path of movement of said valve actuating mechanism.

3. A system for controlling the compression of engines having valve actuating means including means adapted to be interposed in said means for preventing closing of a valve adapted to be actuated thereby resilient means for interposing said means, fluid pressure responsive means for positioning said interposed means out of the path of movement of said actuating means, means operable by said engine for imparting pressure to a fluid, and means for conducting said fluid under pressure to said pressure responsive means, whereby said interposed means is movable from the path of movement of said valve actuating means.

4. A system for controlling the compression of engines having valve actuating means including means adapted to be interposed in said means for preventing closing of a valve adapted to be actuated thereby resilient means for interposing said means, fluid pressure responsive means for positioning said interposed means out of the path of movement of said actuating means, means operable by said engine for lubricating engine parts by fluid under pressure, and means for conducting said fluid under pressure to said pressure responsive means, whereby said interposed means is movable from the path of movement of said valve actuating means.

5. A system for controlling the compression of engines having valve actuating means including means adapted to be interposed in said means for preventing closing of a valve adapted to be actuated thereby, means responsive to motion of engine parts for shifting said interposed means from the path of movement of said actuating means, and control means for determining the position of said interposed means with respect to the path of movement of said valve actuating means.

6. A system for controlling the compression of engines having valve actuating means including means adapted to be interposed in said means

for preventing closing of a valve adapted to be actuated thereby resilient means for interposing said means, fluid pressure responsive means for positioning said interposed means out of the path of movement of said actuating means, means operable by said engine for imparting pressure to a fluid, means for conducting said fluid under pressure to said pressure responsive means, whereby said interposed means is movable from the path of movement of said valve actuating means, and valve means for decreasing the pressure of said fluid to permit positioning of said interposed means in the path of movement of said valve actuating means.

7. A system for controlling the compression of engines having valve actuating means including means adapted to be interposed in said means for relieving said engine of compression by preventing closing of a valve operable by said actuating means, means responsive to motion of engine parts for shifting said interposed means from the path of movement of said actuating means, and means responsive to a characteristic of an engine cooling means for permitting positioning of said interposed means in the path of movement of said actuating means.

8. A system for controlling the compression of engines having valve actuating means including means adapted to be interposed in said means for preventing closing of a valve adapted to be actuated thereby, fluid pressure responsive means for positioning said interposed means in and out of the path of movement of said actuating means, means operable by said engine for imparting pressure to a fluid, means for conducting said fluid under pressure to said pressure responsive means, whereby said interposed means is movable from the path of movement of said valve actuating means, valve means for decreasing the pressure of said fluid to permit positioning of said interposed means in the path of movement of said valve actuating means, and means responsive to a characteristic of an engine cooling means for operating said valve means.

9. A system for controlling the compression of an engine having a plurality of cylinders, valves cooperable with said cylinders for controlling engine operation, individual means for actuating a valve for each cylinder, separate means adapted to be interposed in said individual means for relieving its associated cylinder of compression by preventing closing of its valve, and means responsive to motion of engine parts for shifting said interposed means from the path of movement of said actuating means.

10. A system for controlling the operation of an engine having a cylinder and valve cooperable therewith for controlling the compression therein, valve operating means comprising cam means, means operatively connecting said cam means with said valve, and means adapted to be interposed between said cam means and connecting means for preventing closing of said valve regardless of the position of said cam means.

11. A system for controlling the operation of an engine having rotatable means, a cylinder and cooperable valve for controlling the compression in said cylinder, valve operating means comprising cam means and means operatively connecting said cam means with said valve, means adapted to be interposed between said cam means and connecting means for preventing closing of said valve regardless of the position of said cam means, and means responsive to

rotation of said rotatable means for shifting said interposed means to permit closing of said valve.

12. A system for controlling the operation of an engine having rotatable means, a cylinder and cooperable valve for controlling the compression in said cylinder, valve actuating means comprising a cam shaft carrying a cam, means operatively connecting said cam with said valve, means adapted to be interposed between said cam shaft and connecting means for preventing closing of said valve regardless of the position of said cam, fluid pressure responsive means for shifting said interposed means to permit closing of said valve, means responsive to rotation of said rotatable means for imparting pressure to a fluid, and means for conducting said fluid under pressure to said pressure responsive means.

13. A system for controlling the operation of an engine having rotatable means, a cylinder and cooperable valve for controlling the pressure in said cylinder, valve operating means comprising cam means and means operatively connecting said cam means with said valve, means adapted to be interposed between said cam means and connecting means for preventing closing of said valve regardless of the position of said cam means, and servo-motor means responsive to rotation of said rotatable means for shifting said interposed means longitudinally of said cam means to permit closing of said valve.

14. A system for controlling the operation of an engine having a cylinder and cooperable valve for controlling the pressure in said cylinder, valve operating means comprising cam means and means operatively connecting said cam means with said valve, lever means adapted to be interposed between said cam means and connecting means for preventing closing of said valve regardless of the position of said cam means, and servo-motor means mounting said lever means for oscillation and adapted to shift the same longitudinally of said cam means to permit closing of said valve.

15. A system for controlling the operation of an engine having a cylinder and cooperable valve for controlling the pressure in said cylinder, a cam shaft carrying cam means, means operatively connecting said cam means with said valve, lever means adapted to be interposed between said cam means and connecting means for preventing closing of said valve regardless of the position of said cam means, fluid pressure responsive means mounting said lever means for oscillation, means for imparting pressure to a fluid, and means for conducting said fluid under pressure to said pressure responsive means to shift said lever means longitudinally of said cam shaft away from said cam means to permit closing of said valve.

16. A system as defined in claim 15, including means for opposing the action of said fluid under pressure tending to maintain said lever means in interposed position.

17. A system for controlling the operation of an engine having a cylinder and cooperable valve for controlling the pressure in said cylinder, a cam shaft carrying cam means, means operatively connecting said cam means with said valve, a fluid cylinder, a piston slideable in said fluid cylinder, lever means oscillatably mounted on said piston and adapted to be interposed between said cam means and connecting means for preventing closing of said valve regardless of the position of said cam means, means for imparting pressure to a fluid, and means for conducting

said fluid under pressure to said fluid cylinder for shifting said piston and lever means longitudinally of said cam shaft and away from said cam means to permit closing of said valve.

- 5 18. A system for controlling the operation of an engine having rotatable means, a cylinder and cooperable valve for controlling the compression in said cylinder, a cam shaft carrying cam means, means operatively connecting said cam means
10 with said valve, a fluid cylinder, a piston slideable in said fluid cylinder, lever means oscillatably mounted on said piston and adapted to be interposed between said cam means and connecting means for preventing closing of said valve
15 regardless of the position of said cam means, a pump driven by said rotatable means for imparting pressure to a lubricant, means for conducting said fluid from said pump to said fluid cylinder for shifting said piston and lever means
20 longitudinally of said cam shaft and away from said cam means to permit closing of said valve.

19. A system as defined in claim 18, including means for opposing movement of said piston under the action of said fluid and urging said
25 lever means to interposed position.

20. A system for controlling the compression of an engine having a plurality of cylinders, valves cooperable with said cylinder for controlling engine operation, individual means for actuating a valve for each cylinder, a cam shaft
30

carrying a plurality of cam means angularly disposed with respect to each other, a lever adapted to be interposed between each of said cam means and said individual means for relieving its associated cylinder of compression by preventing
5 closing of its valve, a separate shaft oscillatably supporting a lever for movement longitudinally of said cam shaft to and from its interposed position, and common means for simultaneously shifting said shafts longitudinally.
10

21. A system for controlling the compression of an engine having a plurality of cylinders, valves cooperable with said cylinders for controlling engine operation, individual means for actuating a valve for each cylinder, a cam shaft
15 carrying a plurality of cam means angularly disposed with respect to each other, a lever adapted to be interposed between each of said cam means and said individual means for relieving its associated cylinder of compression by preventing
20 closing of its valve, a separate shaft oscillatably supporting a lever for movement longitudinally of said cam shaft to and from its interposed position, common means for simultaneously shifting
25 said shafts in one direction longitudinally to urge said levers to interposed positions, and individual means for urging each shaft in the opposite direction to move its lever from interposed position.

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