April 23, 1935. H. C. EDWARDS 1,998,662

INTERNAL COMBUSTION ENGINE

Filed June 1, 1931

FIG. 1

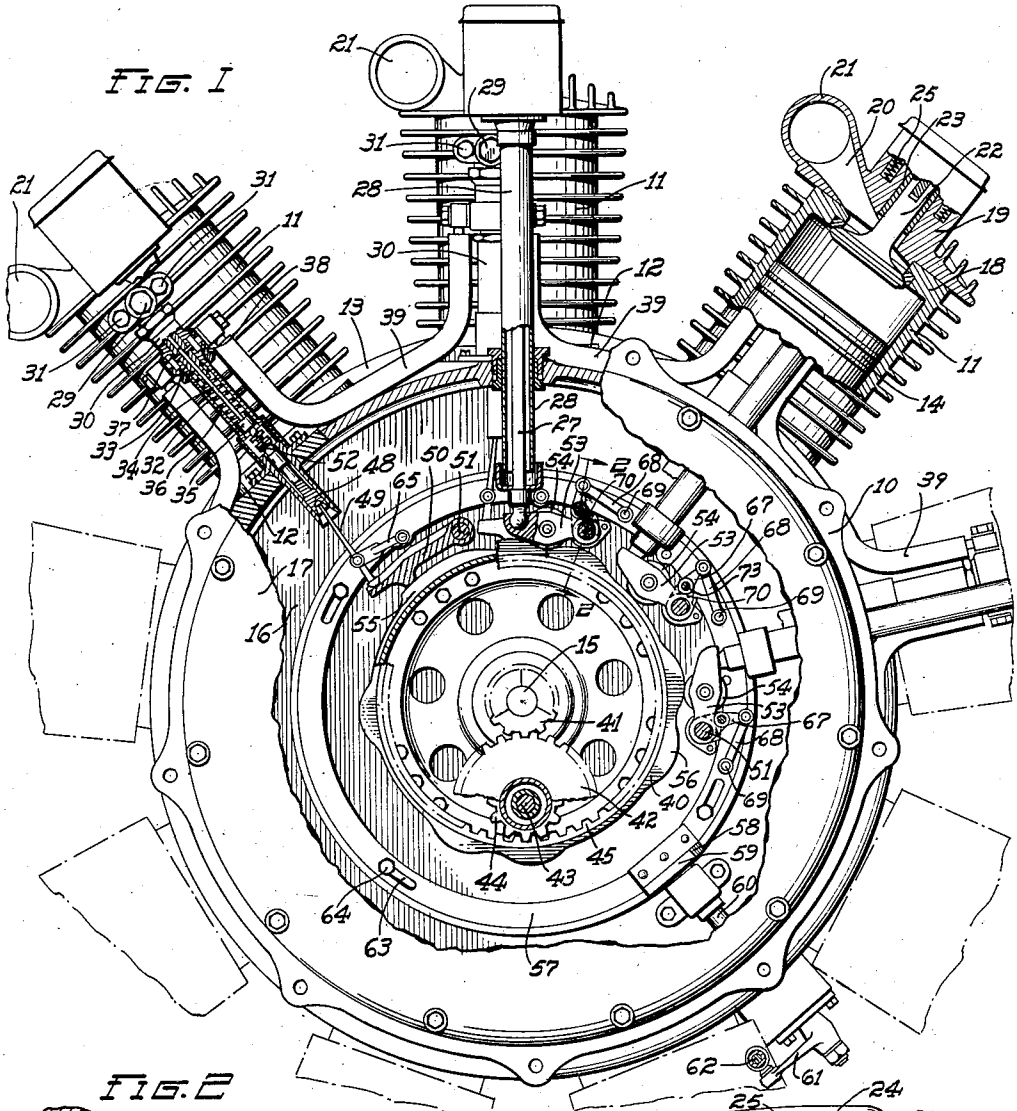


FIG. 2

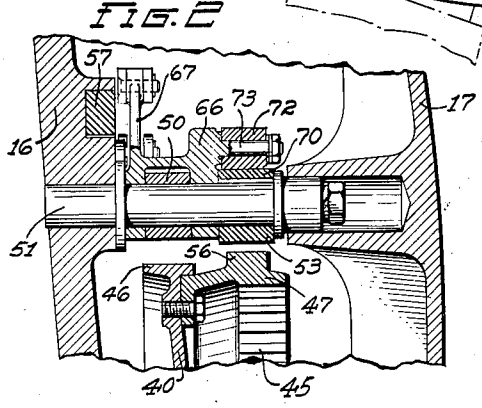
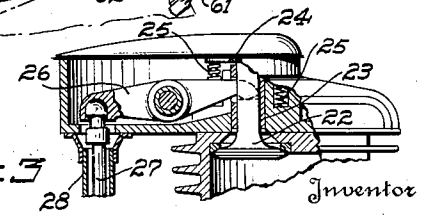


FIG. 3



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INTERNAL COMBUSTION ENGINE

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5 Claims. (Cl. 74—53)

This invention relates to internal combustion engines and more particularly to engines of the compression-ignition type.

In one method of operating such engines, the liquid fuel and air charges are introduced separately into the combustion chambers in the cylinders to form combustible mixtures which ignite from heat developed by compression. Some form of injection device including a plunger is usually utilized to deliver fuel charges to the cylinders and such mechanism is ordinarily reciprocated by engine operated cam means and spring return means. With such injection devices, the quantity of the liquid fuel delivered is regulated through adjustment of the plunger strokes, and usually, the plunger operating mechanism for the several plungers is adjusted by a single control means so that the engine can thus be stopped through non-delivery of fuel or the desired fuel quantity can be injected.

Occasionally such fuel control devices become stuck, or the pump operating mechanism gets beyond control, so that the engine runs wild through the continued delivery of large volume fuel charges, and under such conditions there is no way of cutting off the fuel supply unless the main delivery line is disconnected. It also often happens that the imposing of a sudden load upon the engine will cause it to get out of control and run wild, which continues because of inability to quickly control the injection plunger operations. It is also well known that considerable power is required to obtain the proper crank shaft momentum in order to start an engine of this type because of the high pressure necessarily developed in the cylinders to obtain sufficient heat to cause ignition of the mixtures and, therefore, cranking of such engines requires a considerable effort.

An object of this invention is to obviate the above-mentioned difficulties through the use of pressure relief means in the cylinders under manual control.

Another object of my invention is to provide fuel injection control mechanism and an air valve control mechanism for a compression-ignition type of engine which can be regulated through the manipulation of a single mechanism.

A further object of the invention is to provide an engine of the compression-ignition type in which there is a control member for regulating fuel charges injected by pressure means and for opening the exhaust valves of the cylinders in its range of movement beyond which the fuel injection has been cut off.

Other objects of the invention will appear from the following description taken in connection with the drawing, which forms a part of this specification, and in which:

Fig. 1 is a rear end elevation, partly broken away and partly in section, illustrating a radial compression-ignition type of engine with which my invention is associated;

Fig. 2 is a fragmentary sectional view of the same taken on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary view of one of the cylinders and its head, partly in section and partly in elevation, illustrating the valve control means and a portion of the operating mechanism therefor.

Referring now to the drawing by characters of reference, 10 indicates a barrel-type of crank case from which cylinders 11 extend radially. Flanges 12 extend from two opposite sides of the cylinder and a pair of compression bands, as indicated at 13, extend around such flanges and clamp the cylinders against the periphery of the crank case. In each of the cylinders there is a piston, as indicated at 14, and such pistons are connected to the crank shaft 15, extending axially through the crank case, by suitable connecting means of the well known rod type. Within the crank case there is arranged a transversely extending wall 16 which is parallel to a rear detachable crank case wall 17 and between such walls is a compartment within which mechanism for operating cylinder valves in the fuel injection devices is arranged and operated. Each cylinder is formed with an integral dome 18 upon which is detachably mounted a head 19. In the engine illustrated I have shown a single port 20 extending through the head and dome and terminating in a transversely extending open end conduit 21 through which air is drawn into the cylinders to form a part of the fuel mixture and through which exhaust passes outwardly from the cylinder after the working stroke. The ports 20 are preferably arranged at an angle to the axis of their associated cylinder, also tangentially of the inner wall thereof and in the form of a venturi whereby air passing into the cylinders will be caused to rotate and move at a fast rate of speed. Associated with the inner end of each of such ports is a control valve 22 arranged to reciprocate in a bearing 23 fixed in a passage extending in an axial direction through the cylinder head.

The engine illustrated is of the four-stroke cycle and the valve control mechanism is of such a character as to hold the valve open during the

exhaust and intake periods and closed during the compression and power strokes of the pistons. Each valve includes a disk 24 which is secured to its outer end and a plurality of coil springs 25, seated in the associated head to engage the disk and normally urge the valve into closed position. A rock lever 26 is pivotally mounted within the head and arranged to extend through a slot in the valve bearing 23 and to project into a slot in the valve stem for actuating the same. The other end of the rock lever has associated therewith a push rod 27 which extends through a suitable housing 28 into the chamber formed between the walls 16 and 17.

A fuel injection device is preferably associated with each of the cylinders and each of such devices is similar and consists of a nozzle portion 29 and a pump portion 30 which are formed as an integral unit and secured to the cylinder by bolts 31. The nozzles preferably extend through the cylinder wall so that liquid fuel charges can be discharged therethrough directly into compressed air in the cylinders in a finely atomized condition and under a pressure sufficient to penetrate well into the compressed air in the cylinders. The nozzles can be of a type shown in Patent No. 1,690,893, issued November 6, 1928, to Hermann Dorner. The pump sections comprise a casing 32 carrying a barrel 33 in which the pump plunger 34 reciprocates. The plunger is provided with a guide 35 which reciprocates in the casing and a coil spring 36 is arranged in the casing and engages the plunger guide to normally retract the plunger so that it uncovers the ports 37 extending through the casing and the barrel. The housing 38 is wedged tightly on the casing and provides a reservoir with the casing which communicates with the ports 37. Conduit sections 39 connect the adjacent sides of the housings 38 of adjacent cylinders and form therewith a manifold through which liquid fuel oil flows under pressure from a source of supply (not shown). When the plunger uncovers the ports 37, the liquid fuel oil is free to flow through the casing, the barrel, and into the nozzle so that all of the space therein will thus be filled after each plunger injection operation. The stroke of the plunger after closing the ports 37 determines the quantity of fuel injected from the associated injection devices and by regulating the plunger stroke, the fuel supply can be adjusted as desired. When the plunger does not close the ports 37 in its movement toward the nozzle, there will, of course, be no fuel injection into the cylinders and the engine will not run.

Within the chamber formed by the walls 16 and 17 is a dual cam 40 which is rotated from the crank shaft 15 by reduction gearing. Gear 41 is fixed to the crank shaft within the chamber and meshes with the gear 42 carried upon the shaft 43, and rotating with the gear 42 is another gear 44 which meshes with the internal gear 45 formed on the cam 40. This gearing preferably causes the cam to rotate at one-eighth crank shaft speed and to move in an anti-clockwise direction, as viewed in Fig. 1. The cam 40 is provided with two parallel peripheral portions 46 and 47 upon which are formed lobes for actuating the valve mechanism and for actuating mechanism for moving the pump plungers in their injection strokes.

Each of the injection device plunger operating mechanisms consists of an articulated push rod including a guided section 48 and an adjustable section 49, and a rock lever 50 upon the free end of which the adjustable push rod section 49 engages. Such rock levers are pivotally mounted upon pins 51 which are carried by the walls 16 and 17 and extend across the chamber formed thereby. Adjustable extension means 52 is associated with the outer end of each of the push rod sections 48, which extend through the crank case wall, and bears against the plunger guide 35.

In addition to the rock lever 26 and the push rod 27, previously described, each valve opening mechanism includes a rock lever 53, which is also mounted upon one of the pins 51, which carries a roller 54 and receives at its free end one of the push rods 27 extending through the crank case. The lobes 55 on the cam periphery 46 are arranged to lift the rock levers 50 to cause the plunger actuating mechanism to move the plungers toward the nozzle sections, and the cam periphery 47 is provided with lobes 56 for moving the rock levers 53 in a direction to cause the valve operating mechanisms to open the valves.

In order to control the operation of such mechanisms and thereby regulate the fuel charge volume and the opening of the valves, I provide a control ring 57 having a rack 58 thereon with which the gear segment 59 mounted on the shaft 60 engages. The shaft 60 has a lever 61 associated therewith exteriorly of the crank case and a rod 62, or other suitable connecting mechanism, can be associated with the lever 61 for manual operation thereof. The ring 57 is arranged in a circular recess formed in the wall 16 and arcuate slots 63 extend therethrough for receiving bolts 64, such bolts being fastened to the wall 16. It will thus be seen that the ring 57 is free to be rotated a limited amount in opposite directions. Links 65 connect the adjustable push rod sections 49 with the ring, and the rock levers 50 are each formed with a curved face with which the push rod sections engage so that rotation of the ring will change the position of the adjustable push rod sections longitudinally thereon. Such adjustment of the push rod structures will entirely control the stroke of the plungers and regulate the fuel charge volume as may be desired or will stop the engine. When the fuel devices are adjusted, as shown in Fig. 1, the pump plungers will be given their maximum injection strokes, whereas when the ring 57 is rotated clockwise the pump plunger stroke will be reduced.

As previously pointed out, there are times in the operation of an engine of this character when it is desirable to lessen the pressure within the cylinders and this I propose to accomplish through opening of the valves 22 through the continued movement of the ring 57 in a clockwise direction after the plunger operating mechanism has been adjusted so that the plungers will no longer close the ports 37. In other words, after the ring has been moved to a point where no fuel is being delivered to the cylinders, continued movement of the ring 57 will cause the valves 22 to open. Control members 66 are pivotally mounted on the pins 51 and are arranged to straddle the rock levers 50. At one end of such control members 66 is an arm 67 to which a link 68 is pivoted and such links are also pivoted to the ring 57, as shown at 69. The rock levers 53 are fulcrumed upon the pins 51 and the openings therein, through which the pins pass, are of a larger diameter than that of the pins so that the fulcrum of the levers can thus be shifted. The outer face 70 of the rock levers 53, above the fulcrumed portion, is in the form of a cam surface and such faces are engaged by rollers

72 which are carried by the shafts 73 projecting from the carrier members 66. Movement of the rollers in a clockwise direction will force the fulcrumed end of the rock levers 53 in a direction toward the axis of the crank case so that the free ends associated with the push rods 27 will be moved outwardly and such movement will open the valves 22. It will be understood that the rollers 72 are effective to shift the fulcrum of the rock levers 53 only after the ring has been moved to a position where the fuel plungers of the injection devices no longer close the ports 37 and that while the pump plungers are effective to inject charges, the rollers 72 are in a relation with the cam faces 70 such that they will not change the fulcrum from the position shown in Fig. 1. It will thus be seen that I provide a positive means for holding the cylinder valves open to reduce the pressure in the cylinder and to prevent explosions therein. The valves are held open by the single control mechanism which regulates the fuel injection charges, and thus through means of manipulating a single control member I can regulate the fuel charges and also the pressure in the cylinders. In starting the engine I can reduce the cylinder pressure and if, for any reason, the engine runs wild or any of the fuel pump mechanisms continue to operate, then I can open the cylinders so that there will be no explosions therein.

While I have herein described in some detail a specific embodiment of my invention, which I deem to be new and advantageous and may specifically claim, I do not desire it to be understood that my invention is limited to the exact details of the construction, as it will be apparent that changes may be made therein without departing from the spirit or scope of my invention.

What I claim is:

1. Motion transmitting mechanism comprising an actuator rock lever having a hub portion with a peripheral cam surface, a shaft on which said rock lever hub portion is fulcrumed, a control member pivoted on said shaft, a roller carried by the control member in engagement with the peripheral cam surface of the rock lever hub, and means connected with the control member operable to shift the angular relation of the rock lever on its shaft.

2. Motion transmitting mechanism comprising an actuator rock lever having a hub portion with an eccentric opening extending therethrough and a peripheral cam surface, a shaft extending through the opening on which the lever rocks, control means engaging the cam surface of the rock lever hub operable to shift the angular position of the rock lever on the shaft, and means operable to shift said control means whereby the actuator lever is moved angularly.

3. Motion transmitting mechanism comprising an actuator rock lever having a hub portion with an eccentric opening extending therethrough and a peripheral cam surface, a shaft extending through the opening, a control lever mounted on said shaft adjacent the actuator lever, said control lever having a laterally extending shaft portion projecting across the actuator lever, a roller on the lever shaft engaging the cam surface, and means for rocking said control lever thereby changing the angular position of the actuator lever.

4. Motion transmitting mechanism comprising an actuator rock lever having a hub portion with an opening extending therethrough and a peripheral cam surface, a shaft extending through the opening, a roller engaging with the cam surface and bodily movable rotatably with respect thereto, and means for controlling the position of said roller.

5. Motion transmitting mechanism comprising an actuator rock lever having a hub portion with a peripheral cam surface, a shaft extending through the rock lever hub portion, a control lever mounted on the shaft adjacent the rock lever, a shaft extending laterally from the control lever and overlying the rock lever hub portion, a roller mounted on the laterally extending shaft and engaging the cam surface of the rock lever hub, and means operable to rock said control lever.

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