Feb. 5, 1935. L. M. WOOLSON 1,990,153

INTERNAL COMBUSTION ENGINE

Filed Aug. 29, 1930 2 Sheets-Sheet 1

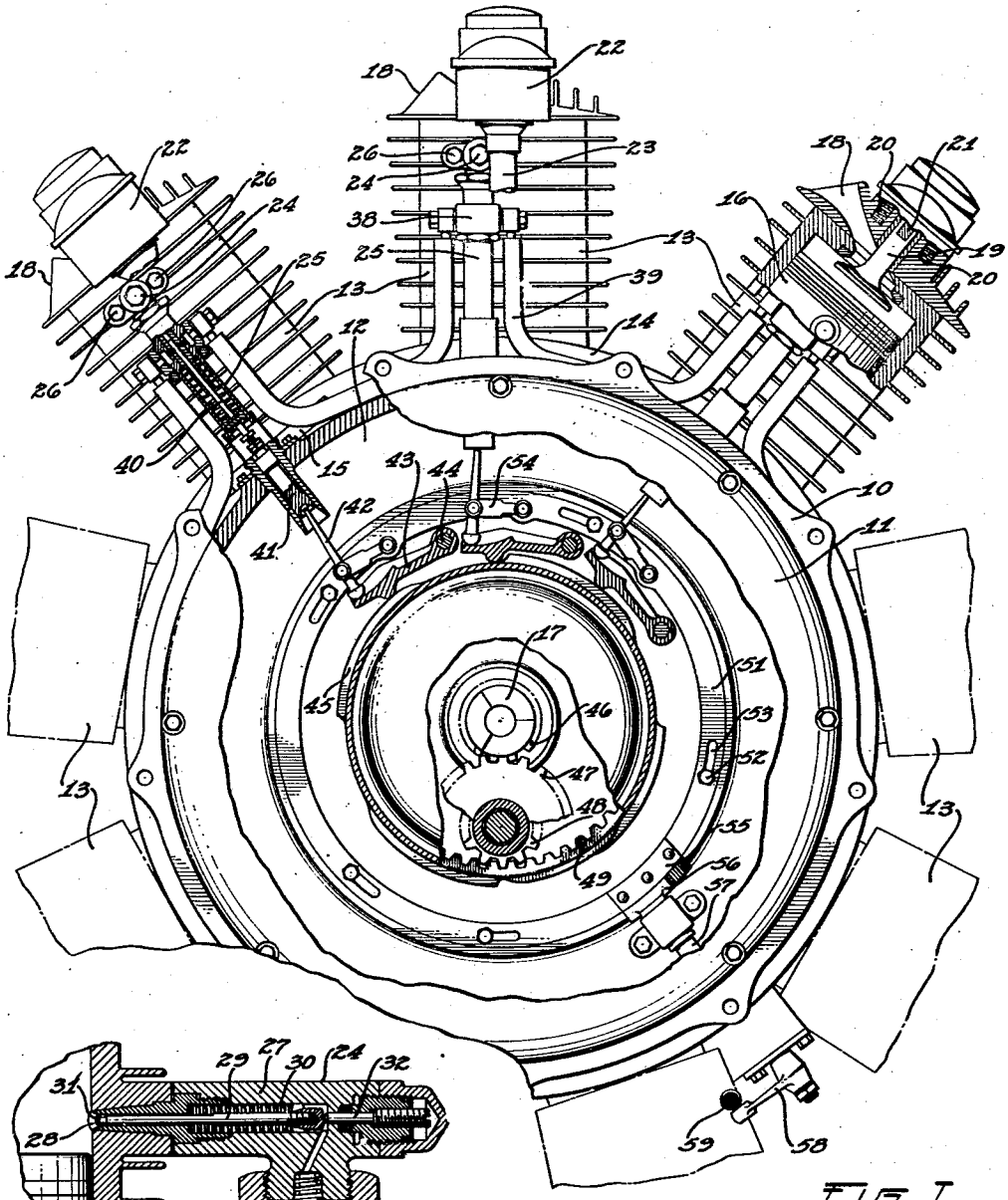


FIG. I

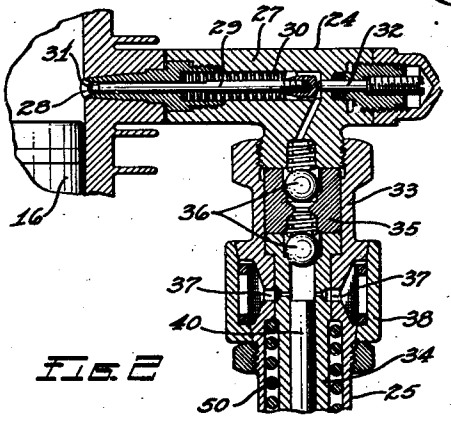


FIG. 2

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INTERNAL COMBUSTION ENGINE

Filed Aug. 29, 1930 2 Sheets-Sheet 2

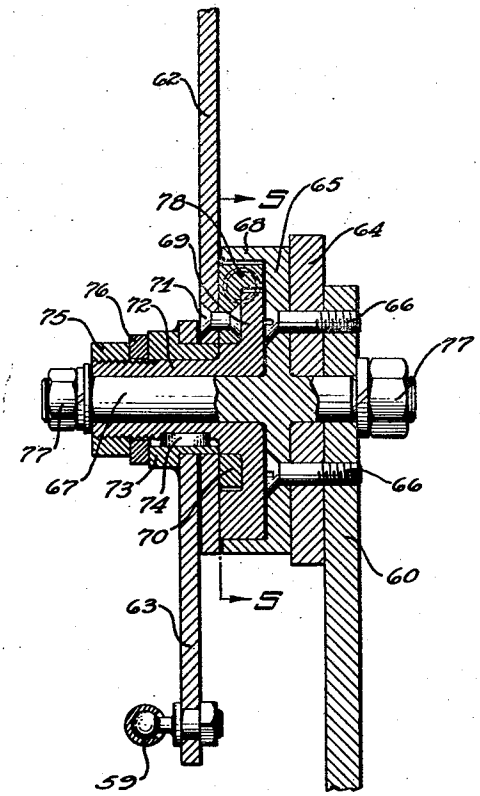


FIG. 4

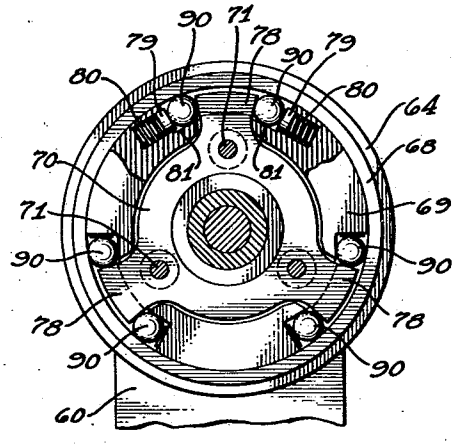


FIG. 5

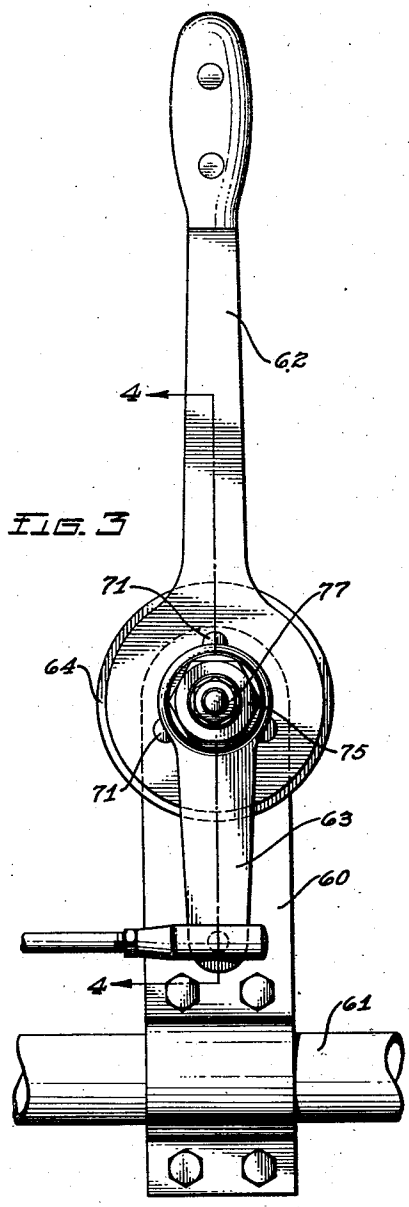


FIG. 3

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Patented Feb. 5, 1935 1,990,153

UNITED STATES PATENT OFFICE

1,990,153

INTERNAL COMBUSTION ENGINE

Lionel M. Woolson, deceased, late of Detroit, Mich., by Emma F. Woolson, executrix, Bloomfield Village, Mich., assignor to Packard Motor Car Company, Detroit, Mich., a corporation of Michigan

Application August 29, 1930, Serial No. 478,586

7 Claims. (Cl. 192—8)

This invention relates to internal combustion engines and more particularly to mechanism controlling the fuel explosive charges delivered to engine combustion chambers.

It is the general object of the present invention to provide a novel and improved anti-creep device for maintaining a common regulator, for a plurality of engine fuel injection devices, in any desired position of its adjustment.

More particularly it is an object of the invention to provide a double clutch anti-creep device for the actuating mechanism of a regulator with which a plurality of fuel injection devices of an internal combustion engine are associated.

Still another object of the invention is to provide an anti-creep mechanism which is associated with a manually actuated element for regulating mechanism controlling the quantity of fuel injected by a plurality of injection devices associated with a multi-cylinder engine.

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

Fig. 1 is a rear elevation view of a radial Diesel engine, partially broken away and in section to illustrate the fuel control mechanism;

Fig. 2 is a fragmentary sectional view of one of the fuel injection devices;

Fig. 3 is an elevational view rearwardly of the engine showing the regulator actuating mechanism and the anti-creep device associated therewith;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 4.

Referring to the drawings by characters of reference, 10 is the crank case of an internal combustion engine having a rear cover 11 secured thereto and a diaphragm 12 traversing the interior thereof. A plurality of cylinders 13 extend radially from the crank case, and a pair of compression bands 14 are arranged on two sides of the cylinders and overlap flanges, as illustrated at 15, extending therefrom to secure the same against the periphery of the crank case. A piston, as illustrated at 16, is arranged to reciprocate within each of the cylinders, and conventional connecting rod means is provided to connect the pistons with the crank shaft 17 which extends axially through the crank case. A single port 18 extends through the head of each cylinder for the intake of air and the discharge of exhaust, a valve 19 being associated with each of such passages. Springs 20 are arranged to normally maintain the valves in closed position, while power driven mechanisms, indicated at 21, are arranged to open the valves, such mechanisms each extend through housings 22, forming a part of the cylinder head, and casings 23 extending intermediate such housings and the crank case. Such mechanisms can be operated through any suitable drive associated with the crank shaft or some driven part of the engine.

The engine illustrated is particularly designed for use as the power plant of an airship and is of the four-cycle Diesel type. The valves are maintained in open position during the exhaust and suction strokes of the pistons and are closed during the explosion and power strokes of the pistons. During the suction stroke, the air portion of the explosion charge is drawn into the cylinders, preferably in a manner such that it will rotate, and during the compression stroke charges of liquid fuel are injected into the cylinders at a high pressure and in a finely atomized condition so that a combustible mixture will be formed, such mixture being of a character that it will ignite under compression within the cylinders.

An individual fuel injection device is preferably associated with each cylinder and actuating mechanism, driven by a common member and regulated by another common member, is associated therewith. The injection device consists of a nozzle section 24 and a pump section 25, such sections being secured together to form a unit which is attached directly to the cylinders by the bolts 26.

The nozzle section includes a casing 27 having an end portion which projects through the wall of a cylinder and is formed at its outlet end with a flaring opening 28. A bore extends interiorly of the casing from the flared outlet and is adapted to receive the valve member 29 which is normally pressed outwardly by a spring 30, so that the valve head 31 will lie adjacent the flared outlet. In order to prevent the valve head from seating against the nozzle casing, a stop member 32 is adjustably associated with the outer end of the casing and in this manner the outermost position of the valve can be regulated as desired. The pump section includes a casing 33 which is screwed upon a neck portion of the nozzle casing and a barrel 34 is held within the pump casing by a spacer 35. The bore of the barrel is arranged in communication with the bore in the nozzle and a pair of check valves 36 are provided to prevent return flow of oil into the pump sec-

tion from the nozzle section. A plurality of ports 37 extend through the pump casing and the barrel and communicate with the interior of the barrel and with a manifold 38 which is secured around each pump casing in sealed relation thereto, there being a plurality of conduits 39 connecting the adjacent manifolds 38. Fuel oil is introduced under a low pressure by suitable mechanism (not shown) so that the manifolds and conduits are constantly filled with oil during operation of the engine. A plunger 40 reciprocates within each of the barrels, and the movement of such plungers beyond the ports 37 determines the quantity of fuel which is evacuated from the nozzles into the cylinders. When the plungers uncover the ports 37, the bore of the nozzle and that of the barrel and pump section beyond the ports will be maintained filled with oil because of the pressure in the feeding conduits, and hence the effective injection stroke of the plungers after closing the ports 37 determines the quantity in the liquid fuel charges.

Mechanism is associated with each of the plungers for reciprocating the same so that the fuel oil charges will be injected into the partially compressed air charges in a desired sequence of time. A guide rod engages each of the plungers and each have associated therewith an articulated rod 42 which also bears against a rock lever 43 pivotally mounted upon a shaft 44 extending between the diaphragm 12 and the rear cover 11. A cam 45 is driven from the crank shaft 17 by reduction gears 46, 47, 48 and 49, and the cam lobes engage with the rock levers 43 to cause an injection stroke of the rods 42 and 41 and the plunger 40. A coil spring 50 is arranged intermediate each pump casing and pump barrel and bears against the flanged end of the plungers for normally maintaining and moving them to a position uncovering the ports 37 after the cam lobes have moved from beneath the rock levers.

In order to regulate the injection stroke of the plungers, there is provided regulating mechanism which includes a ring 51 rotatably secured against the diaphragm 12 by studs 52, there being slots 53 formed in the ring to permit such rotation. A link 54 is pivotally connected to each of the rods 42 and to the regulating ring so that rotation of the ring will move the rods 42 laterally and will vary the length of the injection stroke of the plungers as may be desired. The rock levers 43 are formed with a curved surface at their free end upon which the sections 42 of the push rods are adjustable longitudinally of the slippers when the ring 51 is rotated. As the action of the slippers is the same at all times, the adjustment of the position of the push rod sections on the curved surfaces will vary the stroke of the push rods relative to the ports 37 and will also vary the time at which they will close the ports. It will be understood that this ring regulator can be adjusted so that the plunger stroke can be regulated in a given range after closing the ports and thus the desired quantity in the fuel devices can be obtained, or the adjustment can be such that upon the injection stroke of the plunger the ports 37 will not be closed and under such circumstances the engine will cease operating.

Suitable mechanism is provided for the rotation of the regulating ring 51. It will be observed that the springs 50 exert a force against the plungers and the rods 41 and 42 tending to move the regulating ring 51 in a clockwise direction, looking at the rear of the engine, which reduces the length of the plunger injection strokes, and this creeping condition is accentuated by any vibration of the engine. This tendency to change the ring position is undesirable because of the reduction in the quantity of fuel charges which will become less and less and finally stop the engine, and in order to maintain the ring 51 in any position of adjustment and at the same time impose no force which will cause an extra application of power in order to rotate the ring 51, there is provided a clutch mechanism which forms a part of an extension control or operating mechanism for the regulating ring.

A rack 55 is fixed to the regulating ring and a gear segment 56, fixed upon the rotatable shaft 57, is arranged to mesh with the rack. The shaft extends through the crank case and is provided with a fixed arm 58 to which is pivotally connected an extension rod 59, preferably extending rearwardly from the engine to the cockpit of the airship in which the engine is mounted. A bracket 60 is fixed to a strut 61 of the airplane fuselage and operating mechanism, including a hand lever 62, a lever 63 and a clutch device intermediate such levers, is arranged so that it will reciprocate the extension rod 59. A bearing plate 64 is arranged adjacent the upper end of the bracket 60 and a stationary race member 65 is secured against the bearing plate and to the bracket by means of screws 66. The fixed outer race 65 is formed upon a shaft 67 and includes a peripheral flange 68 forming a housing for the inner race 69 of the clutch device and for the actuating member 70 which is secured to the hand lever 62 by rivets 71. The inner race is provided with an elongated hub 72 with which a carrier 73 is fixed to rotate by the key 74, such carrier being welded to the lever 63, or secured thereto in some other suitable manner. A nut 75 is screwed upon the hub 72 against a washer 76 for securing the carrier 73 axially upon the hub of the inner race member. Nuts 77 are screwed upon the ends of the shaft 67 to secure the inner race axially upon the shaft to assist in retaining the outer race with the fixed bracket 60. As before stated, the fixed race forms a housing for the inner race and for the actuating portion of the member 70. The inner race is provided with a plurality of spaced recesses in its periphery into each of which an arm 78 of the actuator member extends. Balls 90 are arranged in such recesses upon opposite ends of the arms, and bearings 79 urge the balls against the arms of the actuating member through pressure of coil springs 80 which are seated in recess extensions. The bottom of the recesses are disposed at an angle relative to the surrounding annular surface of the outer race member and the balls are of such diameter that they will wedge intermediate such adjacent faces of the race members, and thereby prevent any relative movement thereof. It will be seen that the angular surfaces 81 are arranged so that one of the balls in each recess will wedge between the race members upon a relative movement in either direction.

The lever 62 is mounted to rotate upon the carrier member 73, while the actuator section 70 thereof telescopes a hub portion of the inner race member and is rotatable thereon. Manual movement of the lever 62 in either direction will move the actuator section 70 therewith and the arms 78 will unwedge the balls tending to impede movement of the inner movable race in the direction of the lever movement. The arms 78 will move such balls and release them from wedged

position and into a relation serving as a means of transmitting movement to the inner race member, it being obvious that the balls on the opposite sides of the arms 78 will not impede such movement. Rotation of the inner race, in this manner, is transmitted to the carrier 73 because of the keyed connection 74 and likewise to the lever 63 which is welded to the carrier, and such movement of the lever 63 is transmitted to actuate the rod 59 which in turn will rotate the shaft 57 and cause the gear segment 56 to rotate the regulator ring 51. The clutch device becomes automatically effective to prevent relative movement of the race members when application of force against the lever 62 ceases and at the same time offers little impediment to the manual operation of the lever. With the control mechanism described, the regulating ring 51 can be readily rotated, as may be desired, and will be locked in any position of adjustment within its range of movement. Movement of the ring counter-clockwise, as viewed in Fig. 1, will move the push rod sections 42 toward the free end of the slippers and adjustment in this direction increases the distance that the plungers are moved after closing the ports 37, thereby increasing the quantity of the fuel charges delivered. Movement of the ring in a clockwise direction shifts the inner end of the push rod sections 42 toward the pivoted end of the slippers and adjustment in this direction lessens the stroke of the plungers after closing the ports 37 except at the extreme end of such adjustment whereupon the plungers in their movement will not close the ports and thus there will be no fuel delivered.

What is claimed is:

1. In a remote control mechanism for regulating fuel injection devices, an actuator lever, a hand lever, and a two-way acting ball clutch means between the levers, said clutch means including a fixed race element having a shaft portion on which the levers are rotatably supported.

2. In a remote control mechanism for regulating fuel injection devices, an actuator lever, a hand lever, and a clutch means between the levers comprising a fixed race having a shaft extending therefrom, another race having a hub telescopically associated with the shaft, ball means wedgeably arranged between the races, said lever being rotatably mounted on the hub and said actuator lever being fixed to the hub, and retainer means on the shaft fixing the hub axially.

3. In a remote control mechanism for regulating fuel injection devices, an actuator lever, a hand lever, an actuating member fixed to the hand lever, a two-way ball clutch comprising a fixed race having a shaft portion and a rotatable race mounted on the shaft, said actuator lever being fixed to the rotatably mounted race, said actuating member being rotatably mounted on the rotatable race, means retaining the hand lever axially, and means retaining the rotatable race axially on the shaft.

4. In a remote control mechanism for regulating fuel injection devices, an actuator lever, a hand lever having an actuating element fixed thereto, and a clutch comprising a fixed outer race with a shaft portion, an inner race rotatably mounted on the shaft portion, and two-way acting spring pressed wedge means between the races, said hand lever actuating element releasing the wedge means upon rotation and rotating the inner race therewith, said actuating lever being fixed to the inner race.

5. In a remote control mechanism for regulating fuel injection devices, an actuator lever, a hand lever, an actuating element fixed to the hand lever and having radially extending arms, and a clutch device comprising an outer race having an axially projecting shaft, an inner race rotatably mounted on the shaft, said inner race having recesses through which the actuating element arms extend, said actuator element being fixed to the inner race and the actuating element being rotatably mounted on the shaft, and spring pressed wedge means associated between the races, said actuating element arms releasing the wedge means from driving relation between the races upon rotation and moving the inner race therewith.

6. In a remote control mechanism for regulating fuel injection devices, an actuator lever, a hand lever, an actuating element fixed to the hand lever and having radially extending arms, and a clutch device comprising a fixed outer race having a peripheral flange portion and an axially extending shaft, an inner race rotatably mounted on the shaft and fixed to the actuator lever, said inner race having recessed portions into which the radial arms of the actuating element project and a wall surface adjacent the projecting arms extending angularly to the outer race flange and in opposite directions relatively, and spring pressed balls between the outer race flange and the angular surfaces of the inner race to normally wedge the races together in driving relation, said arms releasing the balls from wedging relation upon rotation.

7. In a remote control mechanism for regulating fuel injection devices, an actuator lever; a hand lever; an actuating element fixed to the hand lever and having radially extending arms; a clutch means comprising a fixed outer race having a peripheral flange and an axially extending shaft, an inner race fixed to the actuator lever and rotatably mounted on the shaft, said actuating element being rotatably mounted on the shaft, said inner race having recessed portions into which the radial arms extend and surfaces adjacent the projecting arms extend at an angle to the outer race flange adjacent thereto and in opposite directions relatively, and spring pressed balls between the outer race flange and the angular surfaces of the inner race normally wedging the races together in driving relation, said arms releasing the balls from wedging relation upon rotation; means fixing the lever and actuating element axially on the rotatably mounted race; and means fixing the inner race axially on the outer race shaft.

EMMA F. WOOLSON,
Executrix of the Estate of Lionel M. Woolson, Deceased.