

May 29, 1934.

J. G. VINCENT

1,960,359

INTERNAL COMBUSTION ENGINE

Filed June 4, 1931

2 Sheets-Sheet 1

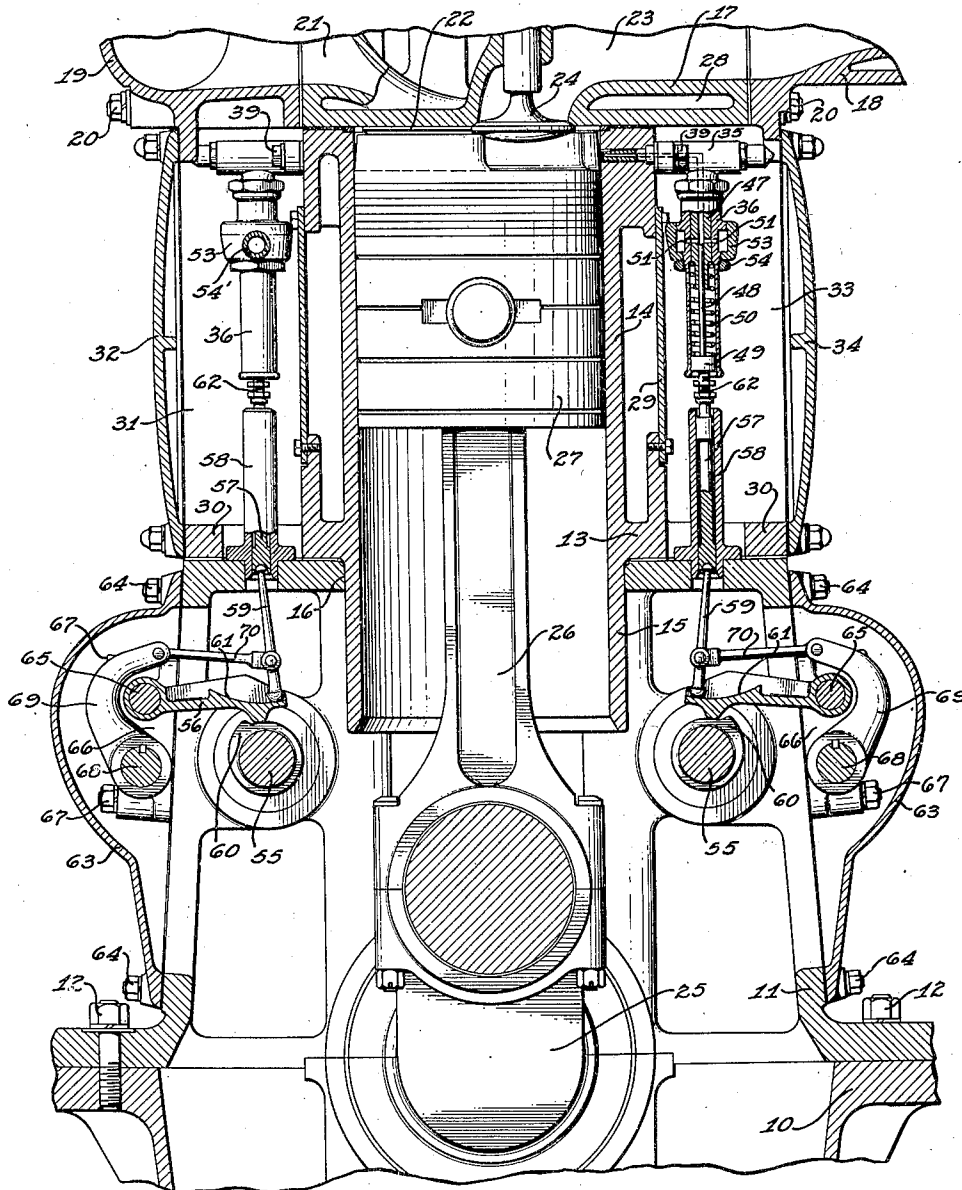


FIG. I

Inventor
JESSE G. VINCENT

By *William T. Hutton*

Attorney

May 29, 1934.

J. G. VINCENT

1,960,359

INTERNAL COMBUSTION ENGINE

Filed June 4, 1931

2 Sheets-Sheet 2

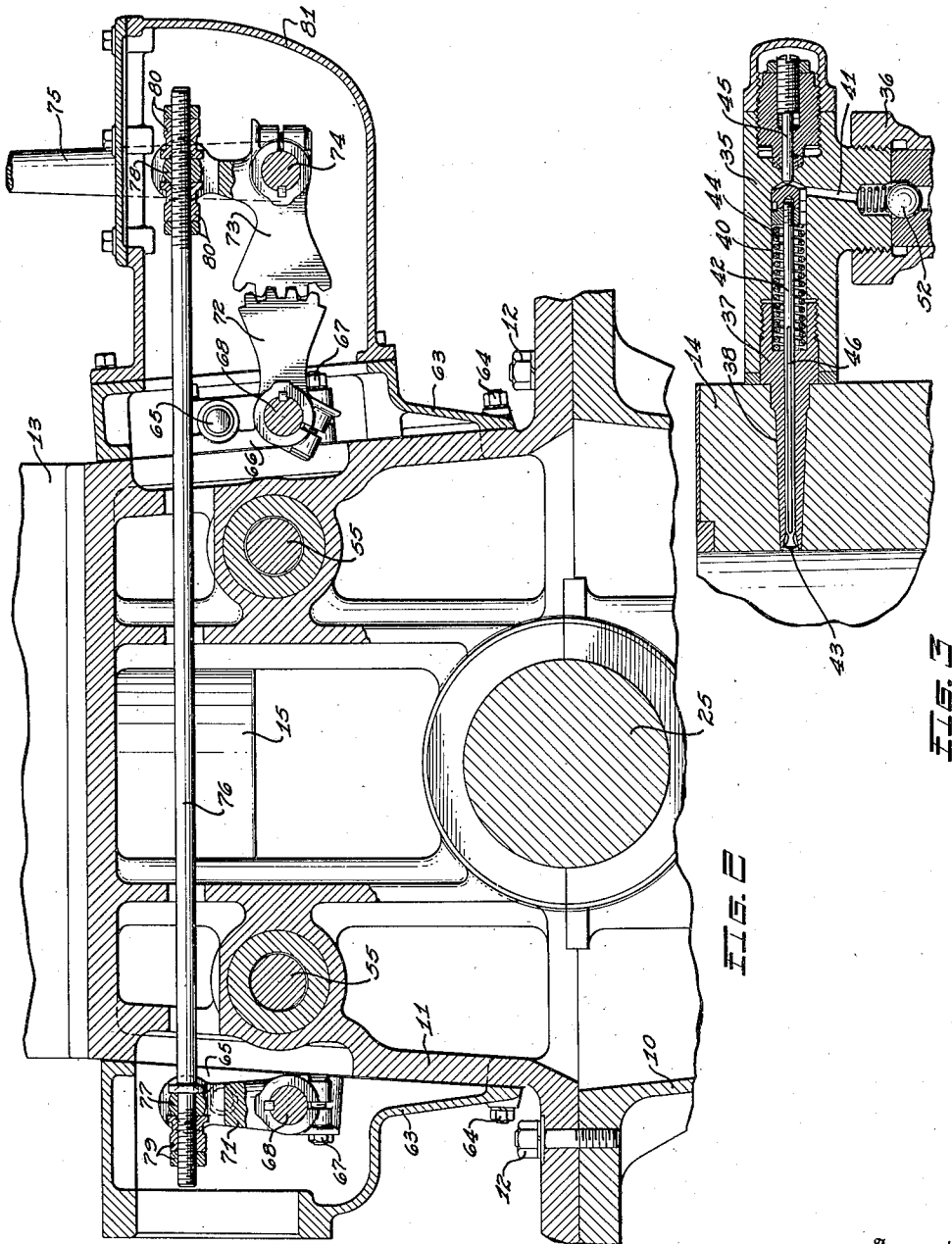


FIG. 2

FIG. 3

Inventor

JESSE G. VINCENT.

By

Mullon & Tilton

Attorney

UNITED STATES PATENT OFFICE

1,960,359

INTERNAL COMBUSTION ENGINE

Jesse G. Vincent, Detroit, Mich., assignor to
Packard Motor Car Company, Detroit, Mich.,
a corporation of Michigan

Application June 4, 1931, Serial No. 542,110

12 Claims. (Cl. 123—139)

This invention relates to internal combustion engines and more particularly to fuel control mechanism for engines of the oil injection type.

An object of the invention is to provide a control mechanism for regulating the delivery strokes of fuel injection devices so that charges projected by dual injection devices to the cylinders of a compression-ignition engine can be varied uniformly and simultaneously through a single manipulation thereof.

Another object of the invention is to provide a control mechanism for fuel injection devices arranged diametrically of an engine cylinder so that a single manipulation thereof will uniformly vary the fuel charges delivered by both the devices.

A further object of the invention resides in the novel manner of associating a fuel injection device and its actuating mechanism with an engine so that it is readily accessible.

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 fragmentary, vertical, sectional view of an in-line compression-ignition engine, showing my invention associated therewith;

Fig. 2 is another fragmentary, vertical, sectional view of the engine, illustrating the control mechanism;

Fig. 3 is a medial sectional view of the nozzle portion of one of the fuel injection devices associated with a fragmentary portion of one of the cylinders.

Referring now to the drawings by characters of reference, 10 indicates the lower half of a crank case upon which the upper half of the crank case 11 is mounted, such crank case sections being secured together by bolts 12 which extend through abutting flanged portions thereof. Mounted upon the upper half of the crank case is a cylinder block 13 and arranged in longitudinal alignment in such block is a plurality of cylinders 14, the skirt portions 15 of which project a considerable length below the bottom of the block and extend into openings 16 formed in the top wall of the upper half of the crank case. A head block 17 is mounted upon the top of the cylinder block and an exhaust manifold 18 is secured to one side thereof, while an air inlet manifold 19 is secured to the other side thereof by suitable means such as bolts 20.

The engine illustrated is of the four-stroke cycle type and passages 21 connect the air inlet

manifold with the interior of the cylinders, such passages extending through the head block and having a control valve 22 associated therewith. Passages 23 also extend through the head block and connect the cylinders with the exhaust manifold, and such passages are controlled by valves as indicated at 24. It will be understood that the air inlet valves 22 are open during the intake stroke of the engine whereupon air is drawn into the cylinders, that the exhaust valves 24 are open during the exhaust strokes of the engine, and that all the valves are closed during the compression and working strokes of the engine.

Extending through the crank case and supported by suitable bearings is a crank shaft 25 from which connecting rods 26 extend to pistons indicated at 27 and arranged to reciprocate within the cylinders. The pistons 27 are provided with a slot across the end portion thereof to permit clearance of the valves when top center is approached and also to confine the air and fuel mixtures at the highest compression.

The engine structure illustrated is of the water-cooled type and suitable passages, as indicated at 28, are provided in the head while side plates 29 enclose chambers along the sides of the cylinder blocks through which water is circulated. The cylinder block is formed with a lower outwardly projecting flange portion 30 along each side, which rests upon the top wall of the upper crank case section. The air intake manifold extending along one side of the head block overhangs the base flange of the cylinder block therebelow and a chamber 31 is thereby provided for the reception of the fuel injection devices, such chamber being closed by the removable side plate 32. The head block and exhaust manifold overhang the other base flange 30 of the cylinder block and form therewith another compartment 33 in which fuel injection devices are housed, such compartment being closed by the removable side plate 34.

The fuel injection devices arranged within the compartments 31 and 33 are associated with each cylinder so that dual diametrically-arranged devices project liquid fuel charges into the upper portion of each cylinder which, with the associated piston, forms a combustion chamber. Such devices are similar and, consequently, a description of one will suffice. The device is preferably formed with a nozzle section and a pump section, the nozzle section including a casing 35 while the pump section includes a casing 36 and the pump casing is screwed upon a

depending threaded portion of the nozzle section. An auxiliary extension 37 is screwed axially into one end of the nozzle casing and is formed complementary to an opening 38 in the cylinder wall and the unit is rigidly secured to the cylinder wall by suitable fastening means such as bolts 39. Within the casing and its extension is an axially extending passage 40 which communicates at its interior end with a passage 41 projecting through the neck upon which the pump casing 36 is screwed. A valve member 42 is arranged within the passage 40 and the head 43 of the valve is maintained adjacent the flared end of the passage adjacent the cylinder by means of the coil spring 44. In order to limit the outward movement of the valve so that the head will not strike against the end wall of the extension in which the passage is formed, there is a stop member 45 which can be adjusted to limit movement thereof toward the seat. It will be understood that fuel under a high pressure is moved through the passages 40 and 41 from the pump section and during such injection movements the valve member 42 is moved toward the interior of the cylinder, there being grooves 46 in the valve stem to permit oil flow through the passage in the nozzle extension.

Within the pump casing is a barrel 47 within which the pump plunger 48 is arranged to reciprocate, the lower end of the pump plunger terminating in a guide portion 49 which is slidably mounted in the lower portion of the pump casing, and a coil spring 50 in the pump casing serves to move the plunger into a position such that it will uncover the radial ports 51 extending through the barrel and casing and communicating with the interior of the barrel which communicates with the passage 41 when the one-way valve 52 is open. Surrounding the radial ports 51 is a housing 53 which is wedged upon the pump casing by a nut 54, and such adjacent housings on each side of the cylinder block are connected by conduits 54', thus providing manifolds from which fuel oil under pressure is introduced into the barrel when the plunger 48 uncovers the ports 51.

It will be seen that the device is ineffective to inject fuel charges into the cylinder until the plunger 48 is moved upwardly to a point where it closes the ports 51, whereupon the supply line is cut off and the fuel trapped thereby in the nozzle and the upper part of the pump will be projected under high pressure in quantities varying with the distance the plunger moves after closing the ports 51. By adjusting the movement of the plunger beyond the ports 51, the quantity of fuel injected into the cylinders can readily be regulated and the adjustment of the plunger can be made such that it will not close the ports 51 during its upward movement, and under such circumstances the engine, of course, will not run as there is no supply of fuel injected.

A cam shaft 55 extends along each side of the engine within the open side of the upper half of the crank case and suitable means (not shown) are provided for rotating such cam shafts in opposite directions and at the same speed relatively. Mechanism is arranged between the cam shafts of each of the pump plungers, each of which consists of a rock lever 56 and an articulated push rod structure consisting of a section 57 reciprocable in the guide member 58 and a movable section 59 which engages the free end of the rock lever. The free end of the

rock lever is provided with a boss arranged to ride upon the cam 60 suitably fixed with the shaft 55 and it is also formed with a longitudinally extending curved surface 61 upon which the articulated push rod section 59 is movable to change its stroke and, consequently, the stroke of the plunger 48 with which the adjustable push rod extension 62 engages. When the articulated push rod sections 59 are in the position shown in Fig. 1, a maximum plunger stroke will result and when the sections 59 are adjusted so that they bear against the opposite end of the curved surfaces 61 on the rock levers 56, then the plunger stroke will not be sufficient to close the ports 51 and thus the plunger stroke and the consequent volume of the fuel charge delivered thereby can be regulated.

Side plates 63 enclose the open sides of the upper crank case half and are detachably secured thereto by bolts such as indicated at 64. A shaft 65 extends along each side of the engine and is suitably mounted in bearings such as indicated at 66, which are secured to the sides of the upper cylinder section by bolts 67. Shafts 68 are also carried by the bearings 66 and mounted upon such shafts are levers 69 which curve around the pivoted rock levers at their upper ends. The ends of such curved levers are connected with the sections 59 of the push rod structures by means of links 70 and it will be seen that rotation of the shafts 68 will cause a rocking movement of the curved levers 69 and actuation of the links 70 which will adjust the push rod sections 59 longitudinally along the curved surfaces 61 of the rock levers 56, and in this manner control of the plunger strokes is had.

It will be seen that the push rod sections 59 on opposite sides of the cylinder must be moved in opposite directions to provide the same adjustment of the pump strokes in the devices associated therewith and, consequently, I provide a control mechanism which will rock the shafts 68 in opposite directions. To this end one of the shafts 68 has fixed thereto an arm 71, while the other shaft 68 has fixed thereto an arm 72 having a gear segment upon its outer end and adapted to mesh with another gear segment on the angular lever 73 which is fixed on a shaft 74; the shaft 74 has fixed thereto a lever 75 by means of which it can be rocked through manipulation by the operator controlling the engine. A tie rod 76 extends transversely through the upper crank case section and is adjustably secured at its ends to the arm 71 and to the lever 73. The tie rod projects through a boss 77 carried by the arm 71 and a boss 78, carried by the lever 73, and nuts 79 are provided adjacent the boss 77 for adjustably securing one end of the tie rod, while two sets of nuts 80 are associated with the boss 78 to adjustably secure the other end of the rod, and such adjustment should be arranged so that the shafts 68 will be rocked simultaneously and uniformly in order that the push rod sections will be adjusted in the same manner. It will be understood that rocking of the lever 75 will rotate the shaft 74 which in turn will rock the lever 73 and cause rotation of one of the shafts 68 through the gear segment connections and will rotate the other shaft 68 in opposite directions and the same degree through the tie rod connections between the lever 73 and the arm 71.

A housing extension 81 is detachably associ-

ated with one of the side plates 63 and the shaft 74 is mounted therein together with the angular lever and a portion of the tie rod connection.

5 It will be seen that I have provided a control mechanism for dual injection devices which can be uniformly and simultaneously adjusted to vary the charges delivered, and that the fuel injection devices and their operating and control mechanisms are associated with the engine
10 in a manner such that they can be readily assembled and serviced.

While I have herein described in some detail a specific embodiment of my invention, which
15 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
20 departing from the spirit or scope of my invention.

What I claim is:

1. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising
25 pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods, associated with the plungers, pivoted rock levers with which the push
30 rods are adjustably related, the adjustment of said push rods on said rock levers varying the stroke of the plungers, a cam shaft on each side of the cylinders associated to engage the rock levers, a rock shaft adjacent each cam
35 shaft, means connecting the rock shafts, means for actuating the connecting means to rotate the rock shafts, and link means connecting the articulated push rods with the adjacent rock shaft, the rotation of said rock shafts moving
40 the link means and adjusting the relation of the articulated push rods with the rock levers to vary the plunger strokes.

2. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising
45 pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plunger, pivoted rock levers with which the push
50 rods are adjustably related, a cam shaft on each side of the cylinders associated to engage the rock levers, a rock shaft adjacent each cam shaft, means connecting the rock shafts including a tie rod, means for actuating the connecting
55 means to cause rotation of the rock shafts, and link means connecting the articulated push rods with the adjacent rock shaft, the rotation of said rock shafts moving the link means and adjusting the relation of the articulated rods
60 relative to the rock levers and thereby varying the plunger strokes.

3. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising
65 pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plungers, pivoted rock levers with which the push rods are
70 adjustably related, a cam shaft on each side of the cylinders associated to engage the rock levers, a rock shaft adjacent each cam shaft, means connecting the rock shafts including gear segments, means for actuating the connecting means
75 to rotate the rock shafts, and link means connecting the articulated push rods with the ad-

jacent rock shafts, the rotation of said rock shafts moving the link means and adjusting the relation of the articulated rods with the rock levers and thereby varying the plunger strokes.

4. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising
80 pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plungers, pivoted rock levers with which the push rods are
85 adjustably related, a cam shaft on each side of the cylinders associated to engage the rock levers, a rock shaft adjacent each cam shaft, means connecting the rock shafts including a tie rod and gear segments, means for actuating the connecting
90 means to rotate the rock shafts, and link means connecting the articulated rods with the adjacent rock shaft, the rotation of said rock shafts moving the link means and adjusting the relation of the articulated rods with the rock levers to vary the plunger strokes.

5. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising
95 pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plungers, pivoted rock levers with which the push rods are adjustably related, a cam shaft
100 on each side of the cylinders associated to engage the rock levers, a rock shaft adjacent each cam shaft, means connecting the rock shafts to rotate them in opposite directions, means for actuating the connecting means to cause
105 rotation of the rock shafts, and link means connecting the articulated push rods with the adjacent rock shaft, the rotation of said rock shafts moving the link means and adjusting the relation of the articulated push rods similarly
110 with the rock levers to vary the plunger strokes uniformly.

6. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising
120 pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plungers, pivoted rock levers with which the push rods are adjustably related, a cam shaft on each
125 side of the cylinders associated to engage the rock levers, a rock shaft adjacent each cam shaft, means connecting the rock shafts, means for actuating the connecting means to rotate the rock shafts, and means connecting each of
130 the articulated push rods with the rock shafts including an arm fixed to a rock shaft and a link pivotally connected to the arm and to a section of the push rod, the rotation of said rock shafts varying the stroke of the plungers.
135

7. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising
140 pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plungers, pivoted rock levers with which the push rods are adjustably related, a cam shaft on each side of the cylinders associated to engage
145 the rock levers, a rock shaft adjacent each cam shaft, means connecting the rock shafts including an angular lever, means for actuating the connecting means to rotate the rock shafts, and link means connecting the articulated push rods with the adjacent rock shaft, the rotation of

said rock shafts moving the link means and adjusting the relation of the articulated rods with the rock levers to vary the plunger strokes.

8. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plungers, pivoted rock levers with which the push rods are adjustably related, a cam shaft on each side of the cylinders associated to engage the rock levers, a rock shaft adjacent each cam shaft, link means connecting the articulated push rods with the adjacent rock shaft, the rotation of said rock shafts moving the link means and adjusting the articulated push rods to vary the plunger strokes, and connecting means between the rock shafts including an arm fixed to one rock shaft, a gear segment fixed to the other rock shaft, a bell crank geared to the gear segment, a shaft on which said bell crank is mounted, a tie rod connecting the bell crank with the arm on the rock shaft, and a lever fixed to the shaft on which the bell crank is mounted for rocking the same, movement of the lever causing similar rotation of the rock shafts in opposite directions.

9. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plungers, pivoted rock levers with which the push rods are adjustably related, a cam shaft on each side of the cylinders associated to engage the rock levers, a rock shaft adjacent each cam shaft, link means connecting the articulated push rods with the adjacent rock shaft, the rotation of said rock shafts moving the link means and adjusting the relation of the articulated rods with the rock levers to vary the plunger strokes, means connecting the rock shafts including an adjustable tie rod, and means for actuating the connecting means to cause rotation of the rock shafts.

10. In an in-line plural cylinder internal combustion engine, fuel injecting means comprising pumps including plungers at the sides of the cylinders, the stroke of said plungers determining the fuel volume delivered in the charges, articulated push rods associated with the plungers, pivoted rock levers with which the rods are adjustably related, a cam shaft on each side of the cylinders driven in opposite directions and associated to engage the rock levers, a rock shaft adjacent each cam shaft, means connecting the rock shafts, said means causing the rock shafts to rotate in opposite directions when rotated, means for actuating the rock shaft connecting means to cause rotation of the rock shafts, and link means connecting the articulated push rods with the adjacent rock shaft to adjust the same on the two sides of the cylinders, the rotation of said rock shafts moving the link means and adjusting the relation of the articulated rods in opposite directions on the two sides of the cylinders to vary the plunger strokes uniformly.

11. In an internal combustion engine, fuel injection devices on opposite sides of the engine for injecting charges into a cylinder, each of said devices including engine actuated pump mechanism adjustable to vary the volume of the charges injected, interconnected adjusting means associated with the pump mechanisms, and means associated with the interconnected means and operable to regulate the individual adjustment of said pump mechanisms.

12. In an internal combustion engine, fuel injection devices on opposite sides of the engine for injecting charges into a cylinder, each of said devices including engine actuated pump mechanism, adjusting means for each pump mechanism, connector means between the adjusting means of the pump mechanisms, and means associated to regulate the position of the connector means and thereby regulate the adjustment of the pumps.

JESSE G. VINCENT. 120

50	125
55	130
60	135
65	140
70	145
75	150