

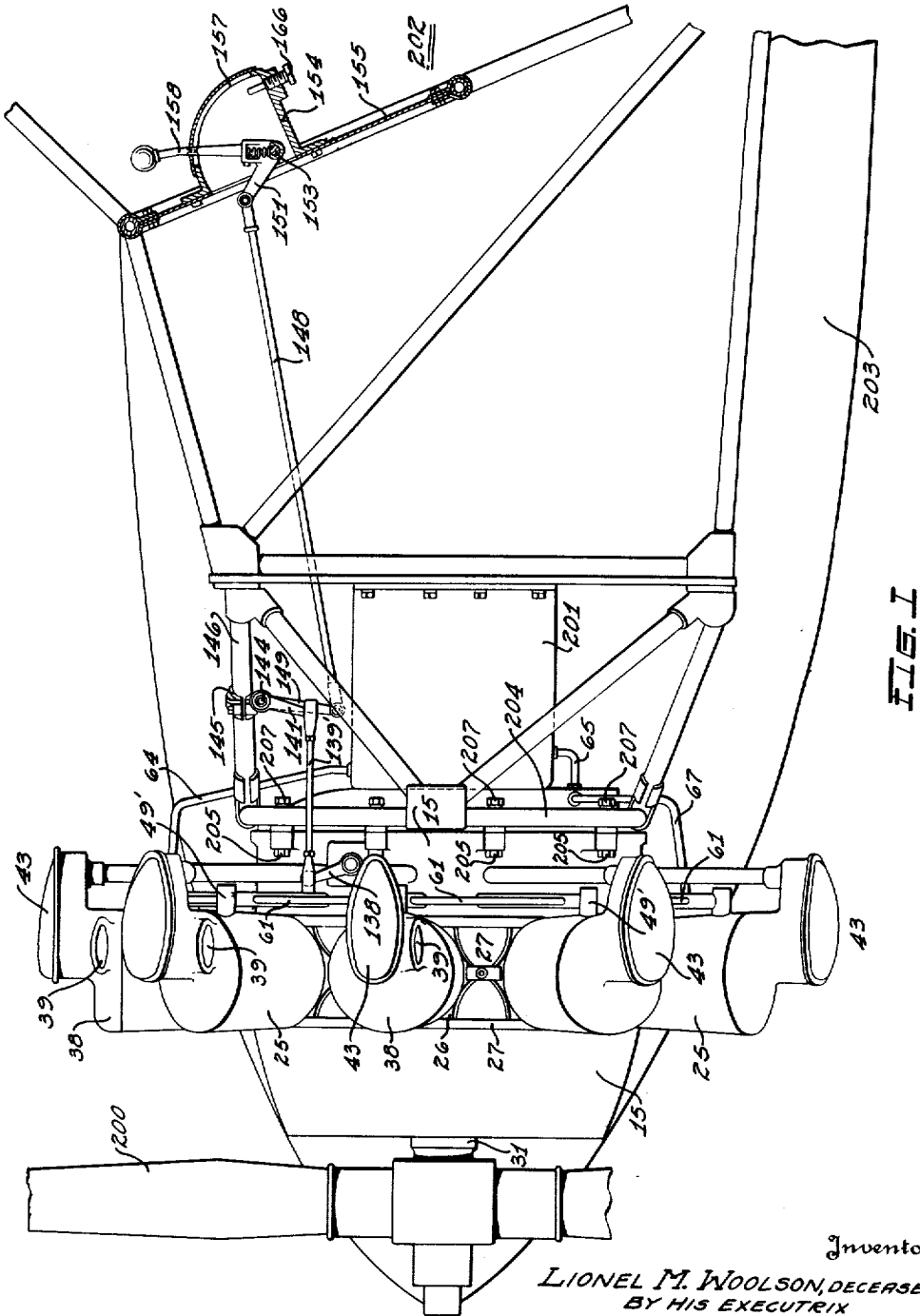
Dec. 5, 1933.

L. M. WOOLSON

1,937,740

INTERNAL COMBUSTION ENGINE

Original Filed April 29, 1929 2 Sheets-Sheet 1



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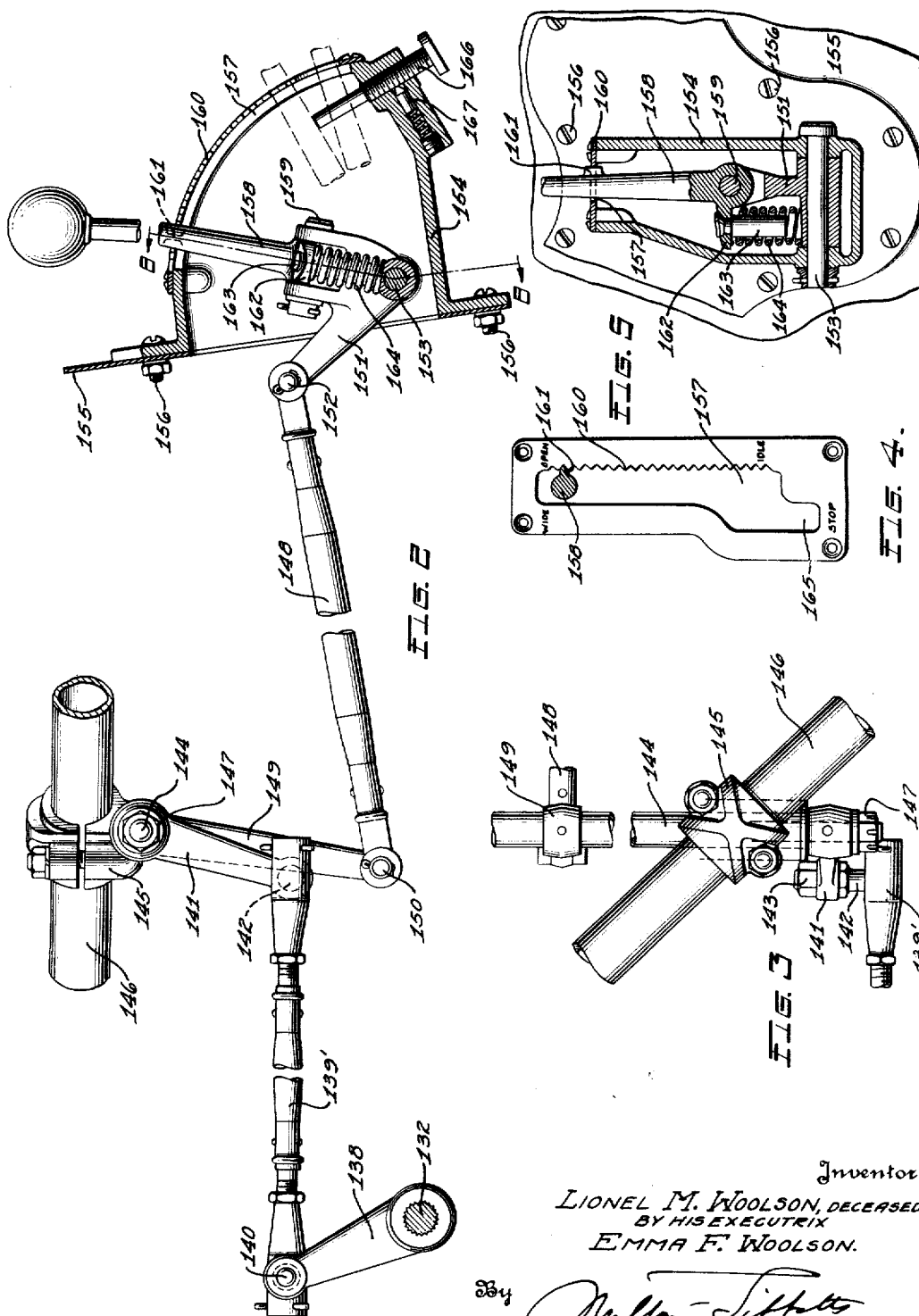
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UNITED STATES PATENT OFFICE

1,937,740

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

Original application April 29, 1929, Serial No. 358,899. Divided and this application February 14, 1931. Serial No. 515,799

2 Claims. (Cl. 74-39)

This invention relates to internal combustion engines and more particularly to the type of engines in which combustion occurs through compression in the working cylinders, and is a division of an application Serial No. 358,899, filed April 29, 1929.

Engines of the Diesel type have been in practical use chiefly with boats, for stationary work and other purposes where lightness, compactness and high speed are not essential requirements. Such engines, therefore, have had little use in the automobile industry, and, so far as Lionel Woolson was aware, have never successfully propelled an aeroplane of the heavier than air type. With the engine illustrated in the drawings, the said Lionel Woolson made many flights with a craft heavier than air, and this application is directed more particularly to control mechanism employed therewith, it being understood however that the engine is equally adapted for purposes other than that of propelling aeroplanes.

An object of the invention is to provide an oil engine in which the quantity and the time of injection of fuel into a plurality of working cylinders can be simultaneously regulated through the manipulation of a common control mechanism.

A further object of the invention is to provide an extended control device by means of which the operator of an aeroplane can readily manipulate mechanisms to regulate the quantity and timing of fuel delivered to the cylinders of an aeroplane engine of the self-igniting type.

A still further object of his invention is to provide a self-igniting engine of the radial type in which a compact and simple fuel and valve control mechanism is arranged.

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

Fig. 1 is a side elevation, partly in section, of the forward end of an aeroplane having the invention associated therewith;

Fig. 2 is a side elevation of mechanism, for the manual operation of the control ring, associated with struts of an aeroplane;

Fig. 3 is a fragmentary plan view of the por-

tion of the manual control mechanism connected to an aeroplane strut;

Fig. 4 is a plan view of the housing with which the hand lever control is associated, the control lever being shown in section;

Fig. 5 is a sectional view taken on line 8-8 of Fig. 2.

Referring now to the drawings by characters of reference, the housing for the internal combustion engine includes a drum-shaped casing 15 provided with spaced radially disposed openings through which the cylinders 25 project, the cylinders being formed with laterally extending flanges 26 which bear against flat peripheral surfaces formed on the drum casing adjacent the openings. A pair of circular rings 27 are arranged adjacent two opposite sides of the cylinders in a relation to encircle the cylinder flanges, the ends of the rings being drawn together to secure the cylinders to the casing and to create a high compression annularly against the drum casing. The rear end of a crank shaft is formed to receive a crank for starting the engine, while the front end 31 of the shaft is adapted for driving an aeroplane propeller 200.

The engine illustrated is of the nine cylinder radial type, and the combustion takes place through the compression created in the cylinders by the pistons. The cylinder heads 38 are each formed with a venturi passage 39 extending therethrough, such passages being disposed angularly with respect to the axis of the cylinder and tangentially of the cylinder wall. The mouths of the passageways are arranged so that the air stream will move transversely thereacross when the engine is moving or when the propeller is in operation. A suitable spring closed valve is arranged to close each cylinder head passage 39 during the compression and explosion cycles of the engine, while during the inlet and exhaust cycles the valve is open, the passages thereby each serving as both the inlet and the exhaust. The engine illustrated is of the four cycle type and the valves are opened by mechanism operated from the engine shaft and partly enclosed by housings 43 secured to the cylinder heads.

Atomized liquid fuel is injected directly into the working cylinders by devices consisting of an atomizing and injecting section, a separate device being provided for each cylinder and preferably

directly secured thereto. The injection devices are similar and a nozzle casing 49' is screwed into the upper end of the barrel and a head portion extends at right angles to the barrel through an opening in the cylinder wall adjacent the cylinder head.

A low pressure fuel feeding system is associated with the several fuel injection devices. A substantially circular manifold connects the pump barrels and consists of the pump housings and conduits 61 extending intermediate the housings. The housings are provided with fittings to which the ends of the conduits are clamped and the conduits and housings are in communication so that liquid fuel will be conducted from a source of supply, such as the tank 201.

The fuel is moved through the manifold from the source of supply under low pressure and the excess fuel moved through the manifold returns to the source of supply through the conduit 64. A conventional gear pump (not shown) located in the housing 65 is utilized to move the fuel through the manifold and into the injection device, the pump being driven from the crank shaft and connected with the source of supply by the conduit 66 and with the manifold by the conduit 67.

The pump and the manifold are of large capacity so that an excess volume of liquid fuel will be circulated through the manifold during operation of the engine, the ratio of fuel circulated being preferably six times the maximum quantity required by the injection devices. Circulation of this volume of fuel will move air in the manifold therewith, so that the major portion of air will be returned to the supply tank, which is vented, and there will be a very small amount of air moved into the fuel injector. The manifold is arranged at the rear of the engine with the conduits 61 arranged to lie within a plane behind the cylinders and the casing so that no resistance to air is presented to retard speed of an aeroplane or other high speed device propelled by the engine.

In order to regulate the effective stroke of the fuel injection devices, the said Lionel Woolson provides a mechanism which extends to the cockpit 202, of an aeroplane 203, if the engine is used for this purpose, or to some point remote from the engine at which an operator is located.

Arm 138 is secured to the end of a control shaft 132 which protrudes from the casing wall and through the rotation of this arm the segment can be rocked to rotate the ring controlling the stroke of all the fuel pump plungers.

Extension operating mechanism is associated with the arm 138, and as shown in Figs. 2 to 5 of the drawings the mechanism is mounted upon an aeroplane and extends from the engine to the cockpit within easy reach for control by the operator. A link 139' is pivotally attached at its forward end to a pin 140 secured to the end of the arm 138, and this link is formed in telescoping sections screwed together to permit longitudinal adjustment. The rear end of the link is suspended from an arm 141 and is pivotally connected thereto by a bearing member 142 having an end secured to the arm 141 by the nut 143. A shaft 144 is carried by clamps 145 which are secured to the engine mounting struts 146 and the upper end of the arm 141 is secured to an end of such shaft by the nut 147. Another link 148 is pivotally secured at its forward end to the depending end of the arm 149 by the pin 150, the upper end of the arm being secured to the shaft 144.

The rear end of the link 148 is pivotally secured to the rock arm 151 by a pin 152, such arm being pivotally mounted to be rocked forward and rearward upon a shaft 153 carried by a housing 154 secured to the dash 155 in the cockpit. The housing is secured to the dash by screws 156 and is provided with a curved upper wall having a slot 157 therein through which the control hand lever 158 extends. The rock arm carries a longitudinally extending pin 159 upon which the lower end of the lever is pivotally mounted so that it can rock laterally. A slotted plate 160 is secured over the open top of the housing and the edge of the plate at one side of the slot is notched to receive the retainer lug 161 formed with the lever. The plate conforms to the plane of the arc in which the lug rocks when the lever is moved forward or rearward. A flange 162 extends laterally from the base of the lever and a pin 163 is secured to depend therefrom, such pin serving as a retainer for the surrounding coil spring 164 which is compressed between the flange and the hub of the rock arm. The spring normally holds the lug 161 in engagement with a desired notch in the plate, so that no forward or rearward movement of the lever can be made without first rocking it laterally against the force of the spring, until the lug is moved sidewise to clear the notches.

The rocking of the lever forward or rearward imparts a similar movement to the rock arm, the link and the arm 149, which rocks the shaft 144 to impart the lever movement to the arm 141, the link 139' and the arm 138, which in turn rotates the shaft 132. When the hand lever is in the forward position the fuel pump actuating mechanism is adjusted so that the injection devices inject the maximum quantity of fuel into the cylinders, while when moved rearward to the lower portion of the notched side of the plate the pump mechanism of the injection devices will operate just sufficiently to inject the smallest quantity of fuel and still obtain a combustion of the fuel charge. The range therefore is indicated upon the plate as wide open and idle, for the lever positions.

The slot in the plate 160 is offset at 165 in order to permit further downward movement of the lever beyond idle, such that the control mechanism will adjust the pump actuating mechanism so that they will be ineffective, and when the throttle mechanism is in such position no fuel will be delivered to the cylinders and, consequently, the engine will not run. There are times when continuous running will be desired and in such event Lionel Woolson provides an adjustable stop member 166 which can be screwed into position in the offset portion of the housing to prevent the stick from being moved into a position which will not permit the delivery of fuel to the cylinders. A spring pressed key 167, in the wall of the housing, is arranged to bear frictionally against the screw stop member and prevent its accidental movement.

A ring supporting member 204 is arranged at the forward end of the strut structure in the fuselage, and bolts 205 extend through the supporting member and a portion of the engine casing, nuts 207 being screwed upon the bolts to secure the motor to the frame. The aeroplane illustrated, with the exception of the engine and its controls, is of conventional form and a further description is therefore not thought to be necessary.

The engine herein described has been run at 150

more than one thousand R. P. M. and weighs less than four pounds per developed horse power, and has propelled an aeroplane within the air for many flying hours. Insofar as Lionel Woolson was aware, a self-igniting engine had never before been built which had successfully propelled a heavier than air plane. The engine control described herein is entirely effected through movement of the lever 158 which is an improvement over plural control mechanism heretofore employed with aeroplane engines.

Various changes can be made in the details of construction described without departing from the spirit of the invention and the scope of what is claimed.

What is claimed is:

1. In a throttle control mechanism for engines, an actuator lever for the mechanism, a stationary housing having an offset slot therein through which the lever extends, one side of said slot being formed with recesses with which the lever engages to maintain the mechanism stationary in desired adjusted position, the offset portion of the slot being arranged to receive the lever when the mechanism is in position closing the throttle, and adjustable means arranged to be extended into the offset portion of the slot to prevent entrance of the lever therein.

2. In a fuel control mechanism, a fixed housing wall having a straight slot and an offset continuation therein, said housing wall being serrated along one side of the slot, a pivoted handle extending through the slotted wall, a lug on the handle engageable with the serrated wall, and adjustable means associated with the wall and adapted to regulate the degree of handle movement in the continuation.

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

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