July 19, 1938. C. R. CUMMINGS 2,124,462

ROCKET ENGINE

Filed Aug. 18, 1937 2 Sheets-Sheet 1

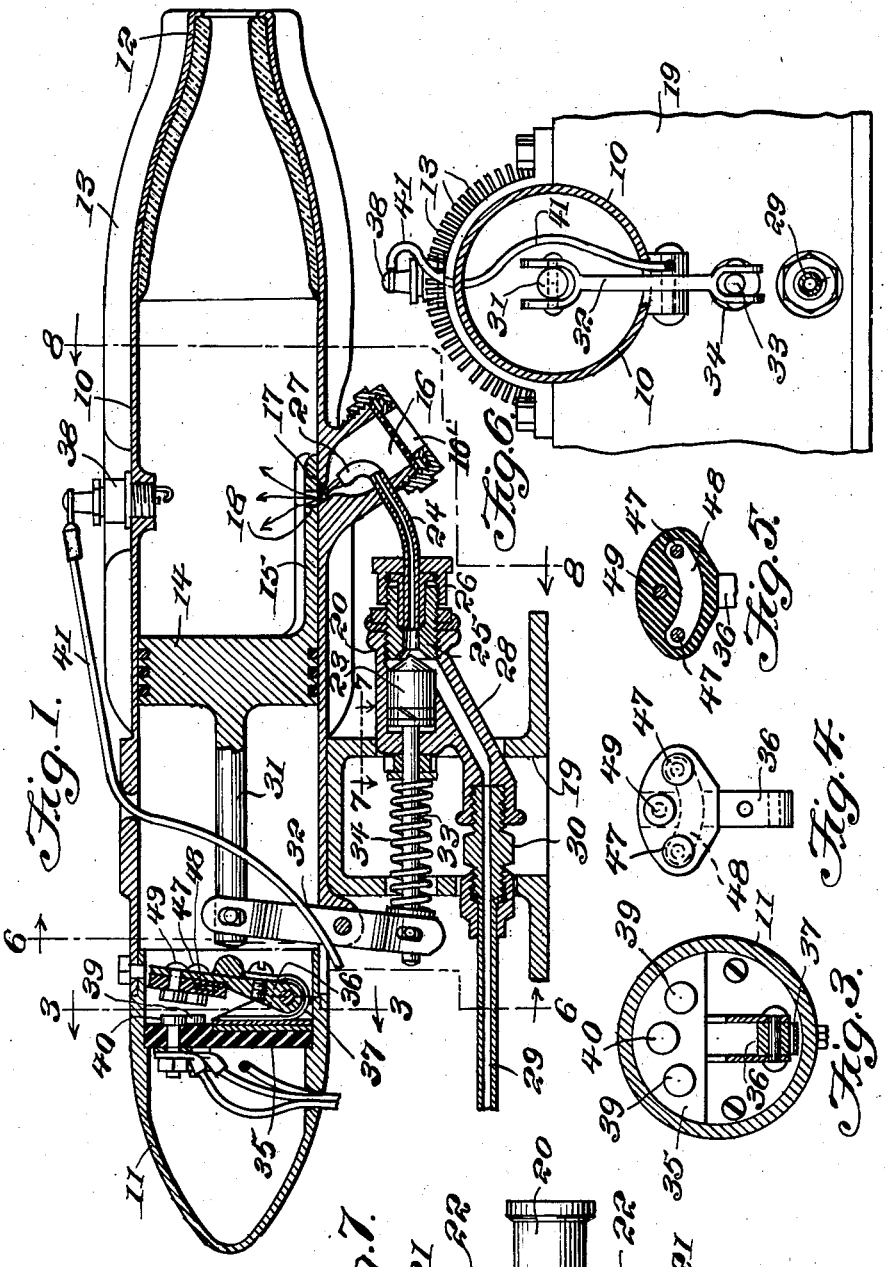

Fig. 1.

Fig. 6.

Fig. 5.

Fig. 4.

Fig. 3.

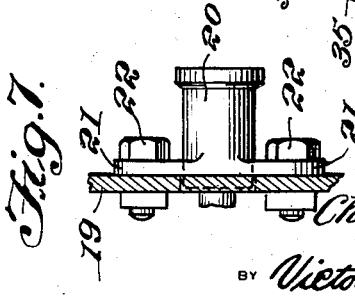

Fig. 7.

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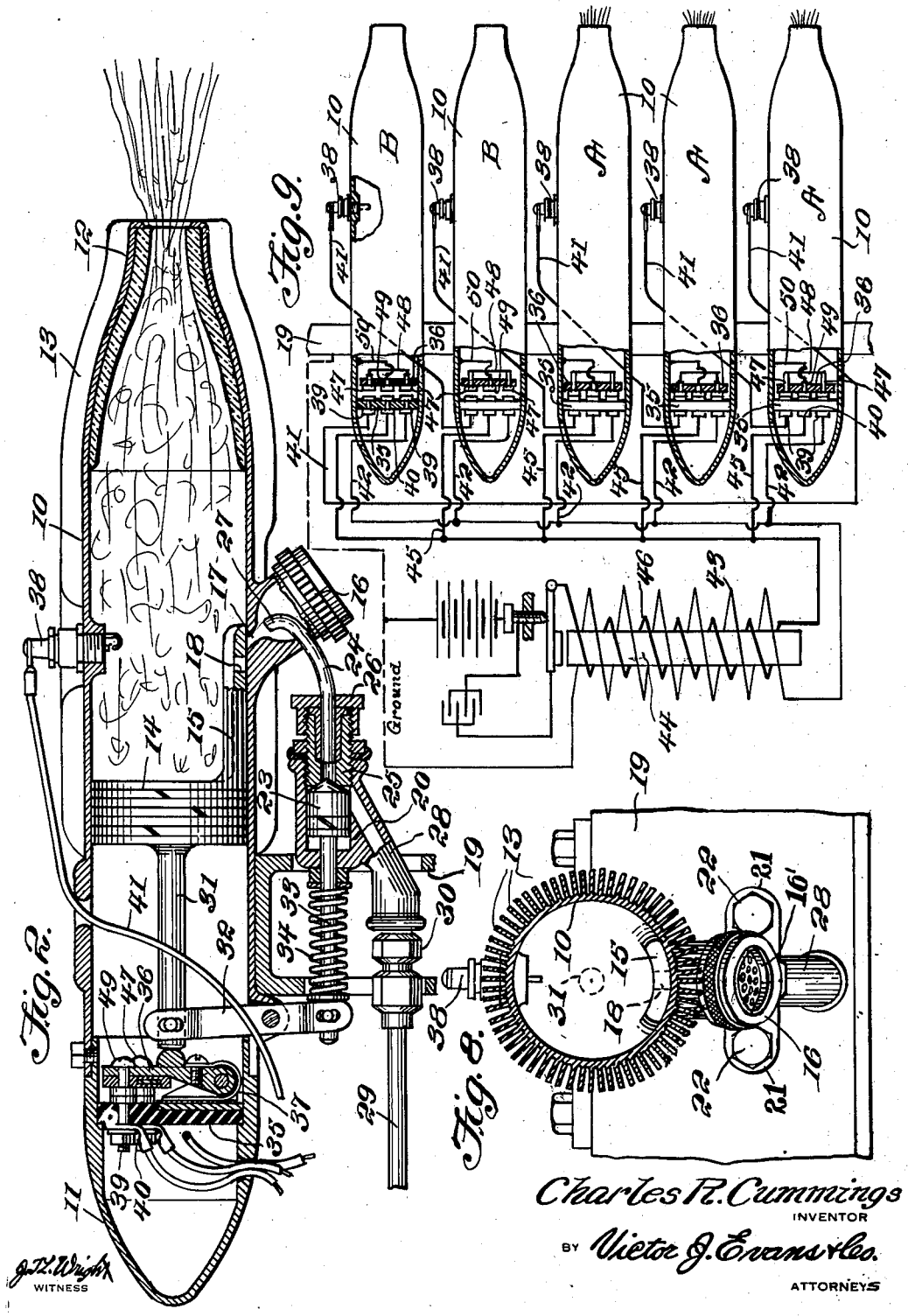

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2,124,462

ROCKET ENGINE

Charles R. Cummings, Fernwood, Pa.

Application August 18, 1937, Serial No. 159,762

3 Claims. (Cl. 60—35.6)

This invention relates to rocket engines and has for an object to provide a novel single piston unit wherein the explosive impact of fuel gas is exerted directly against the atmosphere thus utilizing the force to its fullest extent and permitting the use of a very light structure.

A further object is to provide novel means for controlling the supply of explosive gas and air so that maximum propulsion will be obtained due to the reaction caused by the gases escaping from the rocket.

A further object is to provide apparatus of this type which will be formed of a few strong, simple, and durable parts, which will be light and compact, which will be inexpensive to manufacture, and which will not easily get out of order.

With the above and other objects in view the invention consists of certain novel details of construction and combinations of parts hereinafter fully described and claimed, it being understood that various modifications may be resorted to within the scope of the appended claims without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings forming part of this specification,

Figure 1 is a longitudinal sectional view of a single cylinder of a rocket engine constructed in accordance with the invention and showing the parts in position to entrain combustible gas and air into the cylinder.

Figure 2 is a longitudinal sectional view of the cylinder showing the parts in the position assumed at the moment of the explosion.

Figure 3 is a cross sectional view taken on the line 3—3 of Figure 1 showing the primary and secondary induction coil contacts of the ignition switch.

Figure 4 is a front elevation of the movable switch arm showing the primary and secondary induction coil contacts.

Figure 5 is a sectional view of the switch arm showing the secondary contacts connected together so that the explosion in each cylinder will fire the next succeeding cylinder.

Figure 6 is a cross sectional view taken on the line 6—6 of Figure 1.

Figure 7 is a detail cross sectional view taken on the line 7—7 of Figure 1 showing the mounting of the gas valve.

Figure 8 is a cross sectional view taken on the line 8—8 of Figure 1 showing the valve and the piston in rear elevation.

Figure 9 is a diagrammatic view showing the ignition devices and electrical connections therefor.

Referring now to the drawings in which like characters of reference designate similar parts in the various views, each unit of the engine is shown to comprise a cylinder 10 which is closed at the front end 11 and is reduced and open at the rear end 12. The cylinder is provided with longitudinal cooling fins 13 extending throughout the length of the combustion chamber at the rear end of the cylinder. A piston 14 is slidably mounted in the cylinder and is provided with a skirt 15 which forms a valve to control admission of a combustible mixture into the cylinder from the mixing chamber 16.

The mixing chamber extends obliquely to the axis of the cylinder and is provided with a port 17 through which the mixture enters the cylinder when a similar port 18 in the piston skirt 15 is in registration therewith. The mixing chamber communicates with the atmosphere through an air port 16' at the bottom.

The cylinder 10 is mounted on a suitable supporting bracket 19 which may be of any suitable shape to dispose a plurality of the cylinders either in a row or in the form of an annulus, and in either parallel relationship or staggered relationship.

A valve housing 20, best shown in Figure 7, is provided with mounting ears 21 which are bolted as shown at 22 to the support 19. A plunger type valve 23 is mounted in the housing 20. A gas pipe 24 enters a valve seat 25 which is screwed into the housing and a gland nut 26 is screwed on to the seat to provide a leak-proof joint. The free end of the pipe enters the mixing chamber and is bent to extend along the axis of the chamber and provide a discharge nozzle 27.

A gas supply pipe 28 is formed integral with the housing and projects into the channel of the support 19 where it is coupled to the gas line 29 by a coupling 30. The rod 31 of the piston 14 is connected by a rock link 32 to the rod 33 of the piston type valve 23. A helical spring 34 is sleeved on the rod 33 and, as pressure of exploded gas in the combustion chamber recedes the spring opens the gas valve 23 and simultaneously pushes the piston 14 back to open the ports 17 and 18 for supplying the combustion chamber with a new charge.

In front of the piston rod 31 a stationary switch member 35, formed of insulating material, is fixed in the front end of the cylinder. A switch arm 36 is pivoted in the cylinder between the stationary switch member 35 and the end of

the piston rod 31. The switch arm will be struck by the piston rod, and moved to closed circuit position, when the piston is driven forwardly about $\frac{3}{16}$ of an inch by the force of the explosion. A spring 37 is secured to the switch arm and bears against the stationary switch member to return the switch arm to open circuit position after each actuation.

The combustible charge is exploded by a conventional spark plug 38 which projects into the combustion chamber. The cylinders may be fired in any desired order but in the present embodiment of the invention a number of cylinders A are fired in predetermined order and the firing of these cylinders is adapted to fire the next succeeding number of cylinders B in predetermined order through the electrical connections of the switch members, as shown diagrammatically in Figure 9.

The stationary switch member 35 of each cylinder is provided with a pair of switch contacts 39 and with a single switch contact 40. One of the switch contacts 39 is connected to the spark plug 38 of the next succeeding cylinder by conductor wire 41. The other contact of the pair is connected by a wire 42 to one end of the secondary winding 43 of a vibrator type induction coil 44. The single switch contact 40 is connected by a wire 45 to one end of the primary winding 46 of the induction coil.

The movable switch arm 36 is also provided with a pair of switch contacts 47 which are connected together by a metal plate 48, as best shown in Figure 5, so that when the switch arm is in circuit closing position the high tension ignition circuit is closed to fire the spark plug of the next adjacent cylinder. The switch arm is also provided with a single switch contact 49 which is grounded by a wire 50, to the cylinder. Thus the primary circuit of the induction coil will be closed when the switch arm is in circuit closing position to cause the vibrator type coil to operate and fire the next succeeding cylinder when the explosion in a particular cylinder has moved the respective piston to move the respective switch arm to circuit closing position.

In operation, gas or vaporized fuel of any desired type enters the combustion chamber of the cylinder, under pressure. The jet of gas draws atmospheric air through the air port 16' into the mixing chamber 16 from which the explosive mixture escapes into the cylinder. The gas mixture is fired by the next preceding cylinder. The explosion moves the piston 14 forwardly so that the switch arm 36 is moved to circuit closing position to immediately fire the next succeeding cylinder. As pressure of spent gases in the combustion chamber recedes, the valve spring 34 simultaneously opens the gas control valve 23 and pushes the piston 14 to initial position ready for the next cycle.

From the above description it is thought that the construction and operation of the invention will be fully understood without further explanation.

What is claimed is:

1. In a rocket engine, a plurality of cylinders forming combustion chambers open to the atmosphere, a mixing chamber connected to each cylinder, a valve for controlling fuel supply to the mixing chamber, a piston in the cylinder, a spark plug connected to each cylinder, a switch in each cylinder, a connection between the piston and the valve arranged in such manner that movement of the piston under impulse of the explosion simultaneously effects closing of the switch and the seating of the valve, and means connecting the spark plug of each cylinder with the switch of the preceding cylinder and arranged in such manner that closing of the switch in one cylinder fires the next succeeding cylinder.

2. In a rocket engine, a cylinder closed at its front end and having its rear end reduced and open, a piston slidably mounted in the cylinder, a spark plug extending into the cylinder, a mixer communicating with the cylinder rearwardly of the piston, a switch mounted in the cylinder forwardly of the piston, and including a fixed contact and a movable contact, forward movement of the piston under impulse of the explosion moving the movable contact to circuit closing position, an ignition switch controlled by the switch for energizing the spark plug, a fuel controlled valve connected to the mixer, and a connection between the piston and the valve arranged in such manner that forward movement of the piston under impulse of the explosion simultaneously effects closing of the switch and the seating of the valve.

3. In a rocket engine, a plurality of juxtaposed cylinders forming explosion chambers closed at the front end and open at the rear end, pistons in the cylinders, a mixer connected to each cylinder communicating with the cylinder in rear of the piston, a skirt on the piston sealing the mixer during the explosion and unsealing the mixer in normal position, means for supplying fuel to the mixer, ignition means for each cylinder, ignition circuits for the cylinders, a switch in each cylinder controlling the ignition circuit of the next succeeding cylinder, a rod on each piston adapted to close the respective switch when the piston is moved forwardly under impulse of the explosion, and a pivoted rock link connected to the piston rod and to the valve and adapted to seat the valve when the piston is moved forwardly.

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