

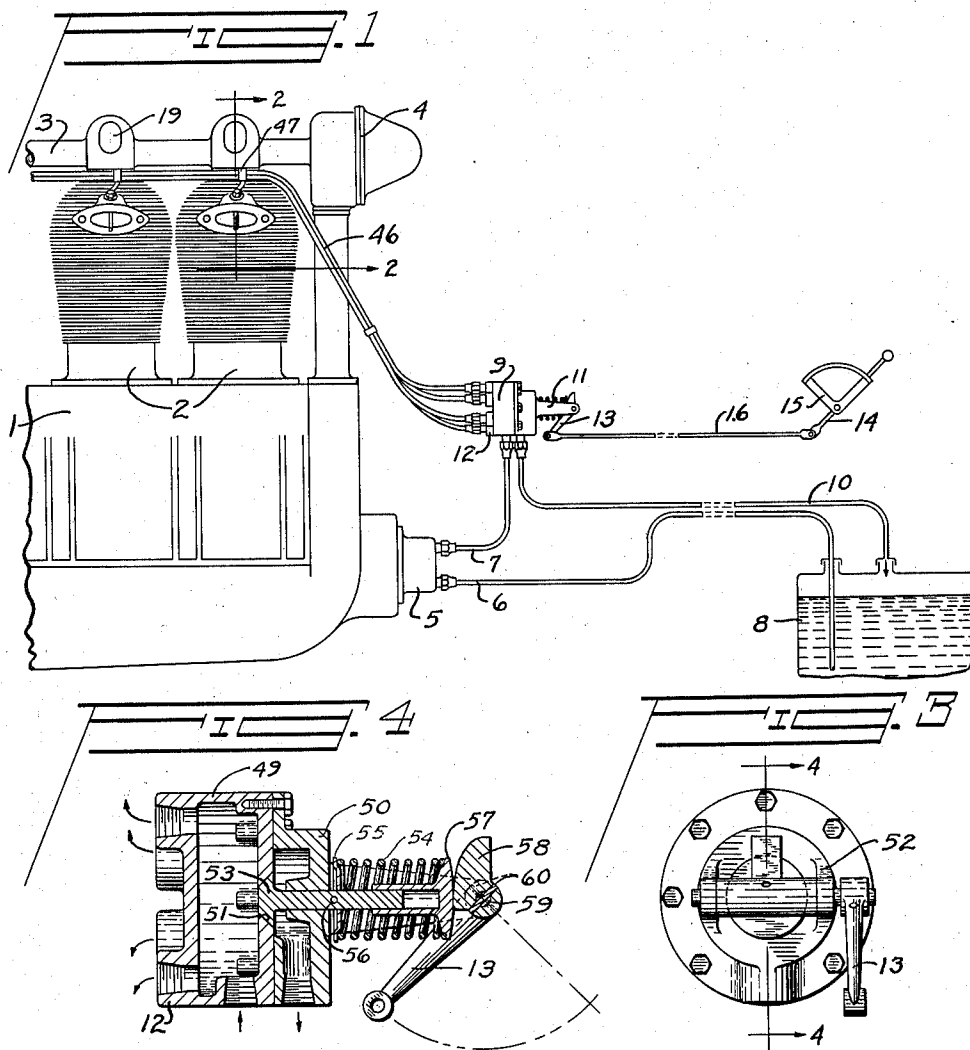
Nov. 12, 1940.

W. H. RICHARDS

2,220,949

FUEL FEEDING MEANS FOR INTERNAL COMBUSTION ENGINES

Original Filed Nov. 28, 1936 2 Sheets-Sheet 1



INVENTOR
WILLIAM H. RICHARDS
By Robert V. Laughlin and
Clade Kivity ATTORNEYS

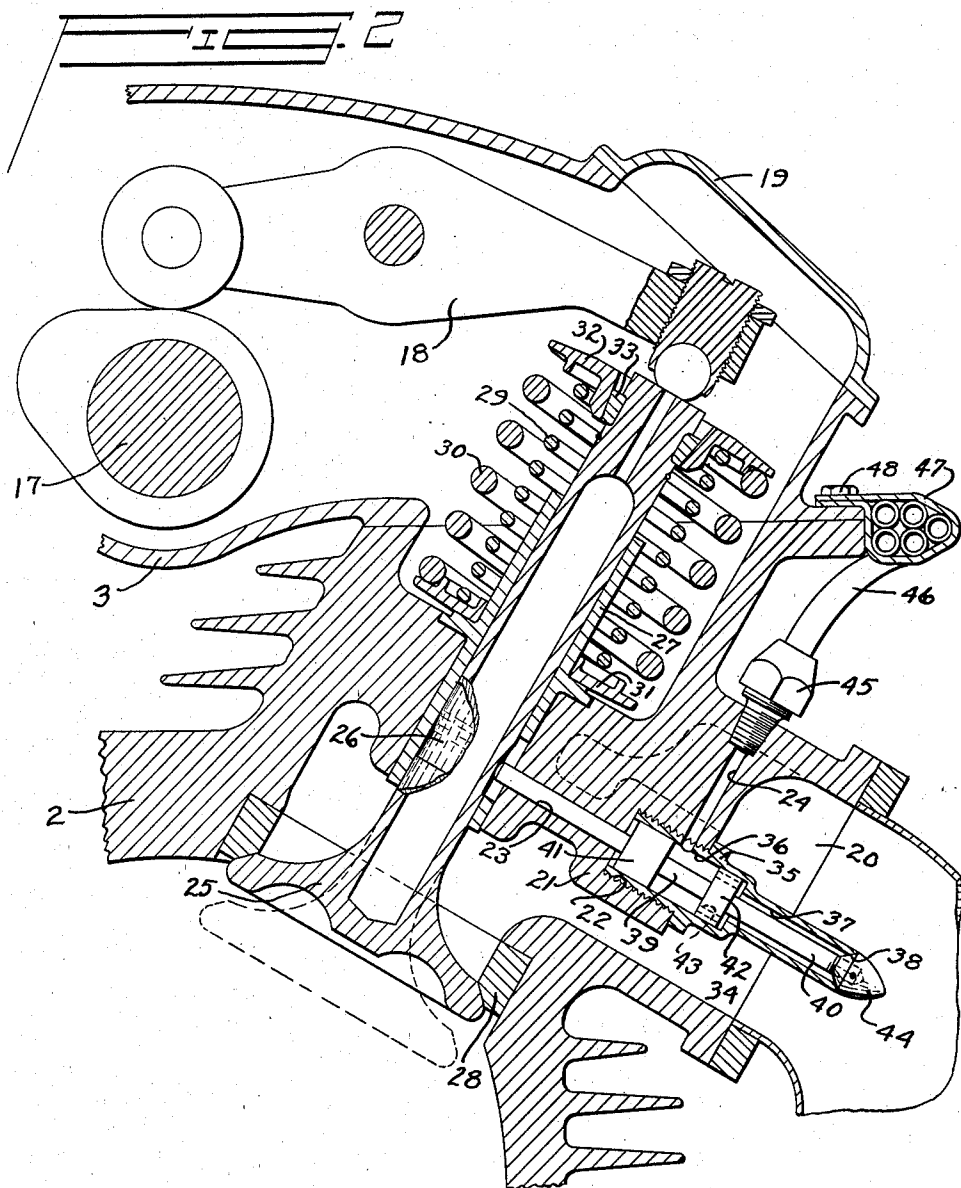
Nov. 12, 1940.

W. H. RICHARDS

2,220,949

FUEL FEEDING MEANS FOR INTERNAL COMBUSTION ENGINES

Original Filed Nov. 28, 1936 2 Sheets-Sheet 2



INVENTOR
WILLIAM H. RICHARDS
BY *Robert V. Laughlin*
Wade Kunitz
ATTORNEYS

UNITED STATES PATENT OFFICE

2,220,949

FUEL FEEDING MEANS FOR INTERNAL COMBUSTION ENGINES

William H. Richards, Dayton, Ohio

Continuation of applications Serial Nos. 113,239 and 253,558, November 28, 1936, and January 30, 1939. This application November 17, 1939, Serial No. 304,966

7 Claims. (Cl. 123—137)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to internal combustion engines and more especially to novel means for feeding fuel to such engines, this application being a continuation of my co-pending application Serial No. 113,239, filed November 28, 1936 and of application Serial No. 253,558 filed January 30, 1939.

The primary object of my invention is to provide a simple, reliable, and positive device for dispensing fuel from nozzles anterior to the inlet valves of the individual cylinders of an internal combustion engine.

Another object of my invention is to provide fuel metering means for internal combustion engines which automatically close against fluid passage upon the introduction of pressure within the fuel circulatory system.

A further object of my invention is to provide means automatically actuating said fuel metering means upon periodic opening of the inlet valves of the individual cylinders of an internal combustion engine.

A still further object of my invention is to provide manually controlled means for varying pressure within the fuel circulatory system to provide proper relationship between air and fuel content of the mixture entering the individual cylinders whereby said mixture is modified to conform to the requirements of variable loads and variable speeds of said internal combustion engine.

Through the novel construction of my fuel metering means, I have provided but one moving part for each individual engine cylinder, thus eliminating entirely the use of spring closing means.

With the foregoing and other objects in view, which will appear as the description proceeds, the invention consists of certain new and novel features and combinations which will be hereinafter more fully illustrated and described in the accompanying drawings and more particularly pointed out in the appended claims.

Referring to the drawings, in which numerals of like character designate similar parts throughout the several views:

Fig. 1 shows my invention installed upon an aircraft engine.

Fig. 2 is a partial cross-sectional view of Fig. 1 taken on the lines 2—2.

Fig. 3 shows the rear elevation of the distributor portion of my invention.

Fig. 4 is a cross-sectional view of Fig. 3 taken on the lines 4—4.

In Fig. 1, a crank case 1 of an in-line air-cooled aircraft engine is provided with cylinders 2, a cam-shaft housing 3, an ignition distributor head 4, and a fuel pump 5. The pump 5 is provided with inlet tubing 6 and outlet tubing 7. The inlet tubing 6 is connected to a fuel tank 8, 10 while the outlet tubing 7 is connected to the inlet portion of a fuel distributor 9. A by-pass portion of the fuel distributor 9 is connected to the fuel tank 8 by means of overflow tubing 10, a regulator mechanism 11 controlling flow of fluid 15 from by-pass to tank. The inlet portion of the fuel distributor 9 is provided with six outlets 12. Each of the outlets 12 are connected to an intake portion of the cylinders 2. A control lever 13 of the regulator mechanism 11 is operatively connected to a hand control lever 14 of an engine control 15 by means of a rod or rods 16.

In Fig. 2, the intake half only of the cylinder 2 is shown. The top of the cylinder 2 is surmounted by the cam-shaft housing 3, encasing a cam-shaft 17 and cam-shaft rocker arm 18. A cover plate 19 is provided for adjustment of the tappet portion of the rocker arm 18. The cylinder 2 is also provided with an intake port 20, having a boss and flange 21 provided with a tapped hole 22 and a straight hole 23. A hole 24 drilled into the tapped hole 22 and normal therewith, leads to the upper exterior of the intake port 20. A conventional intake valve assembly is provided for the cylinder 2. It consists of a valve 25 provided with a special under-cut portion 26, a valve guide 27, a valve seat 28, valve springs 29 and 30, valve spring retaining washers 31 and 32 and a valve spring retaining washer locking collar 33.

A fuel meter 34 is fixed to the boss and flange 21. The meter 34 is comprised of a housing 35, provided with major chamber 36, minor chamber 37, and valve seat 38; and a plunger member 39, provided with a stem 40, a working piston 41, a guide piston 42 having fuel passages 43 and a valve 44. The upper end of the hole 24 is provided with a conventional pipe tap for installation of tubing connections 45. An inlet tubing 46 extends upward and forward from the tubing connections 45. Fine similar inlet tubings 46 are secured to the cam-shaft housing 3 by means of a clamp 47 and a cap screw 48. Longitudinal disposition of the aforesaid parts is clearly shown in Fig. 1.

In Figs. 3 and 4, the fuel distributor 9 comprises an inlet portion 49 and a by-pass portion 50. The inlet portion 49 incorporates seven bosses each provided with a conventional pipe tap for installation of tubing connections similar to those of Figs. 1 and 2. A valve seat 51 is provided for fuel passage into the by-pass portion 50. The by-pass portion 50 is provided with a single outlet, having a conventional pipe tap, and with control lever brackets 52. A pressure relief valve 53 and valve spring 54, coaxial with the valve seat 51, are provided with a special valve spring variable loading means. The aforesaid variable loading means comprises a spring washer 55, a spring washer driven pin 56, a piloted spring depressor 57, a depressor cam 58, and a bearing rod 59. The lever 13 and depressor cam 58 are held in proper interrelationship by means of pins 60.

The operation of my invention is as follows: The aircraft pilot positions the hand control lever 14 as shown in Fig. 1 and causes turning of the crankshaft located within the crank case 1. With happening of the foregoing, a fresh supply of fuel flows from the tank 8, through the fuel pump 5, to the inlet portion 49 of the fuel distributor 9. Fuel pressure is immediately raised to the maximum allowed by the relief valve 53, surplus fuel returning to the fuel tank 8 by means of the by-pass portion 50 and overflow tubing 10. Fuel pressure rise in the inlet tubing 46 is contemporaneous with that within the inlet portion 49 of the fuel distributor 9.

Referring to Fig. 1, fuel under pressure from the inlet tubing 46 passes through the hole 24 into the major chamber 36 of the fuel meter 34. With the parts disposition of the above figure and due to area differential between the inner face of the working piston 41 and the valve 44, the plunger member 39 is immediately driven inwardly against the valve 25, thus effectually sealing flow of fuel under pressure from the major chamber 36, through the fuel passages 43 in the guide piston 42, through the minor chamber 37 and out the valve-seat 38. Continued turning of the crankshaft located within the crank case 1 causes periodic openings of the valve 25. With the aforesaid opening, the hardened truncated conical surface forming the upper part of the under-cut portion 26 drives the plunger member 39 outwardly, thus freeing the valve 44 from the valve seat 38 and causing a spray of fuel immediately forward of the intake port 20. Simultaneous inrush of air into the interior of the cylinder 2 picks up the aforesaid fuel injection, with resulting explosive intermixture of the two.

As the lever 14 of the engine control 15 is advanced, fuel pressure within the inlet tubing 46 is increased, with attendant increase in the amount of fuel delivered to the intake port 20. The effect produced is identical to that obtained by gradually closing the butterfly valve of a conventional carburetor air intake.

It is not the purpose of this invention to work out the technical details of pressure differentials essential to the proper operation of the fuel distributor 9 nor to enter into a discussion as to the best probable material or materials for the plunger member 39 and the housing 35 in view of the extreme temperature ranges to which the cylinder 2 is exposed in passing from starting to full operating condition.

I claim:

1. The combination in an internal combustion engine having a poppet valve for introducing air

into the cylinder of said engine, the stem of said poppet valve including a cammed surface, of injector means operated by longitudinal movement of the cammed surface of said valve stem for introducing fuel into the engine intake.

2. The combination in an internal combustion engine having a poppet valve for introducing air into the cylinder of said engine, the stem of said poppet valve including a cammed surface, of a fuel meter operated by longitudinal movement of the cammed surface of said valve stem, said meter including a valve head the unseating of which permits flow of fuel into the engine intake.

3. The combination in an internal combustion engine having a cylinder head operably connected with means supplying fuel under varying degrees of pressure as well as a poppet valve for introducing air into the cylinder of said engine, the stem of said poppet valve including a cammed surface, of a fuel meter operated by longitudinal movement of the cammed surface of said valve stem comprising, an open-ended housing having a side inlet operably connected with said fuel supplying means, and a plunger member protruding therefrom with one end adapted to be contacted by a predetermined portion of said valve stem cammed surface.

4. The combination in an internal combustion engine having a cylinder head operably connected with means supplying fuel under varying degrees of pressure as well as a poppet valve for introducing air into the cylinder of said engine, the stem of said poppet valve including a cammed surface, of a fuel meter with longitudinal axis passing through and substantially normal to the longitudinal axis of said valve stem comprising, an open-ended cylindrical housing having a side inlet operably connected with said fuel supplying means, and a plunger member having stem portions protruding therefrom such that one of said stem portions is adapted to be contacted by a predetermined portion of said valve stem cammed surface.

5. The combination in an internal combustion engine having a cylinder head operably connected with means supplying fuel under varying degrees of pressure as well as a poppet valve for introducing air into the cylinder of said engine, the stem of said poppet valve including a cammed surface, of a fuel meter with longitudinal axis passing through and substantially normal to the longitudinal axis of said valve stem comprising, a cylindrical housing having bi-diametered open ends and a side inlet operably connected with said fuel supplying means, and a plunger member sealing the greater of said open ends having a stem protruding therefrom adapted to be contacted by a predetermined portion of said valve stem cammed surface, said plunger member having a second stem protruding from and normally sealing the lesser of said open ends and adapted to be intermittently unsealed upon periodic openings of said poppet valve.

6. The combination in an internal combustion engine having a cylinder head operably connected with means supplying fuel under varying degrees of pressure as well as a poppet valve for introducing air into the cylinder of said engine, the stem of said poppet valve including a cammed surface, of a fuel meter disposed normal to said valve stem such that the longitudinal axes thereof meet in a common point comprising, a cylindrical housing having bi-diametered open ends and a side inlet operably connected with said fuel supply means, the greater of said open

ends being adjacent to said poppet valve and the lesser thereof being remote therefrom and terminating in a valve-seat, said fuel meter further including a plunger member sealing the greater
5 of said open ends having a stem protruding therefrom adapted to be contacted by a predetermined portion of said valve stem cammed surface, said plunger member having a second stem terminating in a valve head normally sealing the
10 aforesaid valve-seat and adapted to be intermittently unseated upon periodic opening of said poppet valve.

7. The combination in an internal combustion engine having a poppet valve for introducing air

into the cylinder of said engine, the stem of said poppet valve including a cammed surface, of injector means operated by longitudinal movement of the cammed surface of said valve stem for
5 introducing fuel into the engine intake, said injector means including an open ended discharge tube for said fuel, a valve head adapted to seat against the open end of said discharge tube to
stop said discharge of fuel, a stem on said valve head engaging said cammed surface, and means
10 to close said valve with a force proportional to the pressure of the fuel in said tube.

WILLIAM H. RICHARDS.