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FUEL FEEDING DEVICE FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JUNE 26, 1919.

1,411,034. Patented Mar. 28, 1922.

2 SHEETS—SHEET 1.

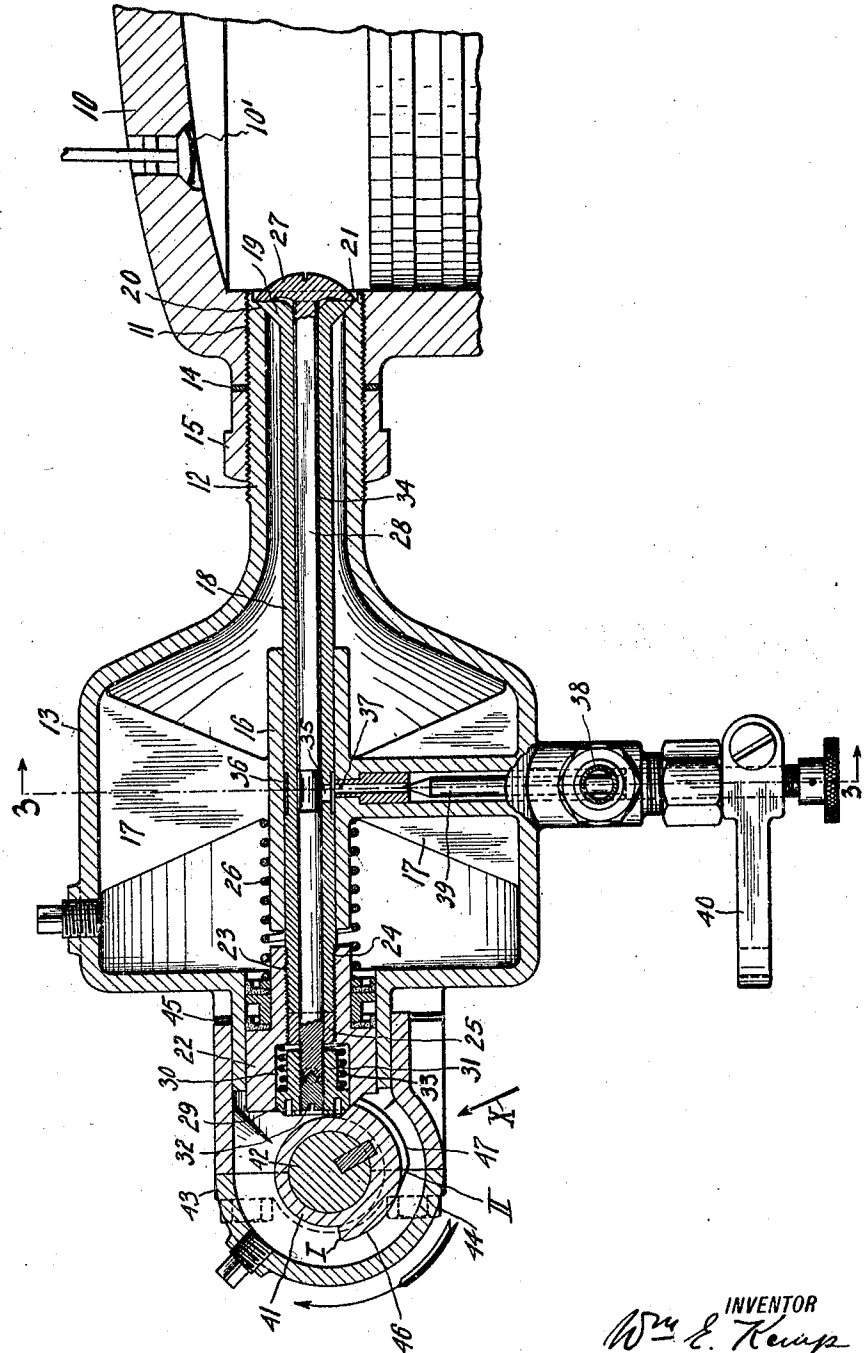


Fig. 1.

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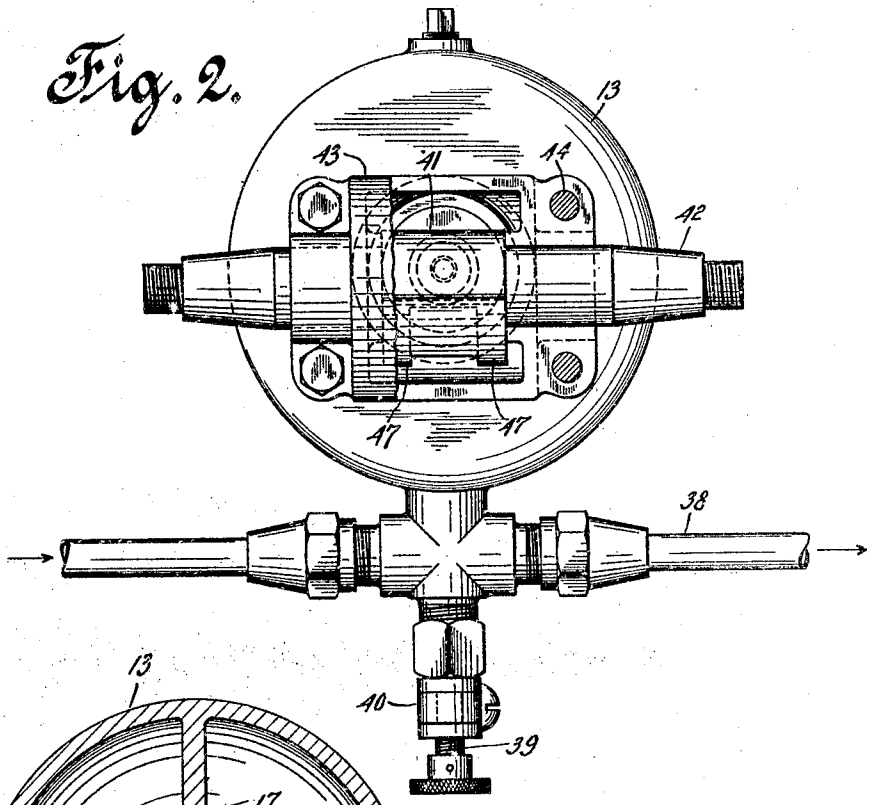
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2 SHEETS—SHEET 2.

Fig. 2.



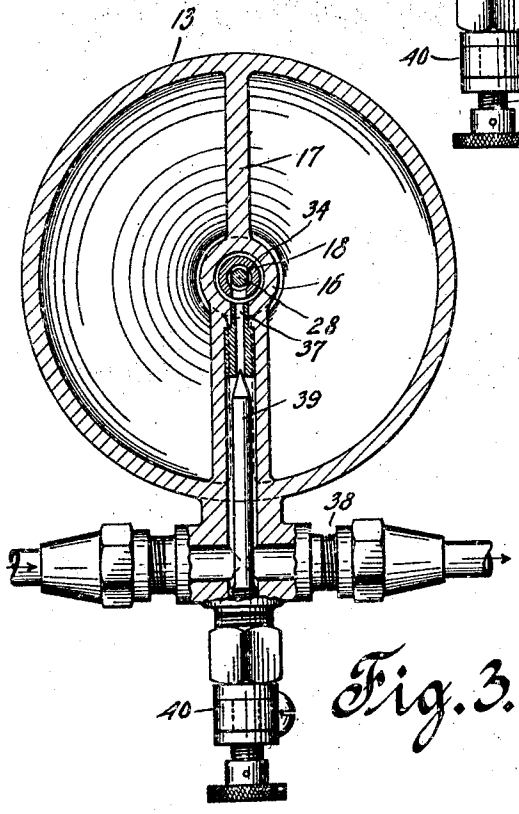
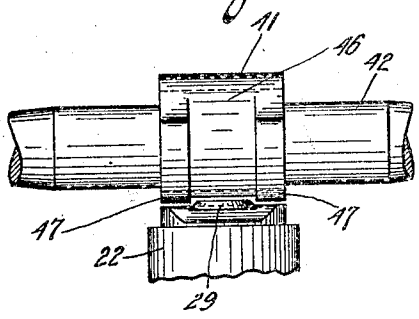


Fig. 3.

Fig. 4.



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FUEL-FEEDING DEVICE FOR INTERNAL-COMBUSTION ENGINES.

1,411,034. Specification of Letters Patent. Patented Mar. 28, 1922.

Application filed June 26, 1919. Serial No. 306,992.

To all whom it may concern:

Be it known that I, WILLIAM E. KEMP, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Fuel-Feeding Devices for Internal-Combustion Engines, of which the following is a specification.

The present invention relates to internal combusion engines, and more particularly to fuel feeding devices for four-cycle engines, in which the air, to which the liquid-hydrocarbon is to be supplied, is caused to flow into the working cylinder of the engine by suction during the charging stroke.

The main object of the invention is to provide a feeding mechanism, whereby a predetermined quantity of liquid-hydrocarbon is supplied to the cylinder upon each suction stroke of the working piston of the engine, the liquid-hydrocarbon being entrained, atomized and sprayed by a confined stream and volume of compressed fluid that is produced by and in unison with the operation of the engine.

With these and other objects in view, which will more fully appear as the nature of the invention is better understood, the same consists in the combination, arrangement and construction of parts hereinafter described, pointed out in the appended claims and illustrated in the accompanying drawings, it being understood that many changes may be made in the size and proportion of the several parts and details of construction within the scope of the appended claims without departing from the spirit or sacrificing any of the advantages of the invention.

One of the many possible embodiments of the invention is illustrated in the accompanying drawings, in which:—

Figure 1 is a vertical section taken through a portion of the cylinder of an internal combustion engine, with the improved feeding device thereon; Fig. 2 is a side elevation of the feeding device, part of its cover being broken away to clearly show the interior construction; Fig. 3 is a section taken on line 3—3 of Fig. 1; and Fig. 4 is an elevation of a cam and a portion of the valves of the feeding device, looking in the direction of the arrow denoted by the character X in Fig. 1 of the drawings.

In carrying out the invention, a vessel is provided, containing a valve controlled passage, that leads to the cylinder from the nozzle of a pipe connected with a source of liquid hydro-carbon. The vessel communicates with the engine cylinder at the top of the combustion chamber, the communication being controlled by a valve. The two valves are so arranged in relation to each other that compressed fluid, flowing from the vessel into the cylinder, entrains, atomizes or sprays the liquid-hydrocarbon issuing from the passage. A cam actuates the two valves, this cam being so timed that both valves are in open positions during the suction stroke of the piston in the cylinder, the valve of the said passage closing during the compression stroke, and both valves are in their closed positions during the working and exhaust strokes.

Referring now to the drawings, the numeral 10 indicates the cylinder of an internal combustion engine having a valve-controlled air inlet 10′. The cylinder is furthermore provided adjacent the top of its combustion chamber with a screw-threaded opening 11. With the threads of this opening mesh exterior threads upon the tubular portion 12 of a casing 13. A gasket 14, encircling the said tubular portion, rests against the cylinder, it being held in position by a nut 15 on the tubular portion of the said casing. In the longitudinal axis of the casing is provided a tubular guide 16, connected with the casing, for instance, by ribs 17. Through this guide extends slidably a tubular stem 18, provided upon its end adjacent the cylinder with a poppet valve 19, the conical head of which co-operates with a conical valve seat 20, that is formed upon the outer end of the tubular portion 12 of the casing. In front of the said seat is formed in the tubular portion 12 an annular recess 21. The outer diameter of the stem 18 is substantially smaller than the inner diameter of the tubular portion 12 of the casing, so that, upon unseating the valve 19, a communication is established between the interior of the casing and the interior of the engine cylinder. To the opposite end of the stem 18 is attached a tubular head 22, having interior screw-threads 23, meshing with exterior screw-threads 24 on the stem. An exteriorly threaded locking bushing 25 meshes with the threads of the head 22, permitting of an adjustment of the said head in relation to the stem. A spring 26, bearing

against the head 22 and the ribs 17, serves to hold the valve 19 in its closing position.

Against the valve 19 bears a second poppet valve, denoted by the numeral 27, the stem 28 of which extends through the stem 18 and is provided at its opposite end with a head 29, which is slidably disposed in a recess 30 in the head 22. The head 29 is tubular, having interior threads 31, which mesh with exterior threads on the stem 28. A screw-threaded locking lug 32 meshes with the interior threads of the head 29 and bears against the stem 28, permitting the position of the last-mentioned head to be adjusted on the last-mentioned stem. A spring 33 is disposed within the recess 30 of the head 22 and bears against the latter and the head 29, thus having a tendency to keep the valve 27 on its seat, that is to say on the poppet valve 19. The head 29 projects slightly beyond the head 22, for a purpose hereinafter to be described.

The stem 28 is flattened from about its middle portion toward and to its valve 27, whereby longitudinal passages 34 are formed in the tubular stem 18 of the valve 19, the said passages communicating through a radial bore 35 and peripheral groove 36 in the stem 18 with a nozzle 37, that is connected by a tube 38 with a supply of liquid-hydrocarbon. A needle valve 39 is provided for adjusting the nozzle, and to this valve is fixed a lever 40, that is connected (by means not shown) with a throttle, associated with the air-inlet to the engine cylinder.

For actuating the valves, a cam 41 is made use of. This cam is keyed to a shaft 42, that is rotated in unison with the crank-shaft of the engine, the gearing being such that the cam-shaft makes one revolution for every two complete turns of the crank-shaft. The cam-shaft turns in the direction of the arrow shown in Fig. 1 of the drawings, and is mounted in a housing 43, that is held upon the casing, for instance by screw bolts 44. Between the housing and the body portion of the casing 13 are interposed shims 45. By replacing these shims with larger or smaller ones, as the case may be, the stroke of the valves may be varied, at will. The cam is provided with a face 46, that extends throughout its width and serves to actuate simultaneously both valves, and with raised faces 47, which act on the head 22 of the valve stem 18 only. The design of the cam is such and its shaft is so timed in relation to the crank-shaft that the cam face 46 causes both valves to be unseated from the beginning and during the suction stroke of the piston, the valve 27 being first slightly lifted from its seat by reason of its head 29 projecting beyond the head 22 of the valve stem 18. At the end of the suction stroke, the valve 19 further advances from its seat, but the valve 27 is allowed to occupy its seat. This condition prevails until the piston reaches on its compression stroke the upper dead center, so that a compressed mixture of air and hydrocarbon is forced into the casing 13. During the working and exhaust strokes, both valves occupy their respective seats.

The operation of this device is as follows:—In Fig. 1 of the drawings, the elements of the engine are shown in positions which they occupy at the moment the combustible mixture is ignited, that is to say at the beginning of the working stroke. In these positions the heads of both valve stems are out of contact with the cam faces, the valves being held in their closed positions by the springs, co-operating with their respective stems. Both valves remain closed during the working and exhaust strokes. At the beginning of the suction stroke, the edge I of the cam is brought to bear against the head 29 of the valve stem 28, causing the valve 27 to be lifted from its seat. Shortly thereafter, the head 22 of the valve stem 18 is shifted in the same direction, whereby the valve 19 is unseated, both valves remaining open substantially throughout the suction stroke of the piston in the cylinder. Due to the suction or partial vacuum in the cylinder, liquid-hydrocarbon is caused to flow toward the valve 27 through the passages 34, leaving the same through the annular space that is left between the two valves when both are lifted from their seats. In the casing 13 has been stored during the previous compression stroke, in a manner hereinafter to be described, a compressed mixture of liquid-hydrocarbon and air, which flows during the suction stroke into the cylinder, entraining, atomizing and spraying the liquid-hydrocarbon with which it comes into contact, as it (the compressed mixture) leaves the casing through the recess 21 above referred to. The fuel valve is opened in advance of the opening of the compressed mixture controlling valve to prevent retardation of the liquid-hydrocarbon. The liquid hydrocarbon is effectively broken up, as it flows initially at an angle to the direction of flow of the compressed mixture.

When the piston is near its lower dead center on the suction stroke, the edges II of the cam faces 47 cause a further unseating of the valve 19, carrying with it the valve 27, the latter thus occupying its seat. The valves are kept in these positions until the piston comes near its upper dead center on the compression stroke. During the compression stroke a mixture of hydrocarbon and air is caused to flow into the casing 13, in which it is confined as soon as the valve 19 closes. This compressed mixture acts then on the next suction stroke in the manner above described.

The stroke of either valve may be ad-

justed independently of the other by the locking bushing 25 and locking lug 32, respectively. The strokes of both valves may be adjusted simultaneously by shifting the cam-shaft 42 in the desired direction, interposing shims 45, as required.

If the throttle of the air inlet to the cylinder is brought toward closing position, obviously the vacuum during the suction stroke increases correspondingly. This increased vacuum would ordinarily tend to draw a larger amount of liquid-hydrocarbon from the nozzle. In order to obtain the proper quantity of liquid-hydrocarbon as the degree of suction varies, the needle valve is connected with the throttle, the connection being such that, upon bringing the throttle toward its closing position, the needle valve is also turned toward closing position. Obviously, the connection must be such as to vary the area of the nozzle in relation to the area of the air inlet opening in proportion to the ratio of air and liquid-hydrocarbon of the mixture under normal working conditions.

In case of multi-cylinder engines, each cylinder is provided with a feeding attachment of the type herein described, the nozzles of all attachments being connected to a fuel supply pipe common to all. A single cam-shaft is provided, the cams thereof being staggered in the same manner as the respective cranks of the crank-shaft are disposed in relation to one another.

What I claim is:—

1. In an internal combustion engine, the combination with the engine cylinder having an air-inlet, of a closed casing communicating with the combustion chamber thereof through a valve-controlled opening, a valve-controlled passage leading to said cylinder in proximity of said opening and connected at its other end with a nozzle of a liquid-hydrocarbon supply pipe, and means operated in unison with the engine for establishing a communication between said cylinder, casing and passage during the suction stroke of the piston in the cylinder, leaving the communication between said cylinder and said casing open during the compression stroke and keeping both communications closed during the working and exhaust strokes.

2. In an internal combustion engine according to claim 1, said passage extending through the valve controlled opening of said casing.

3. In an internal combustion engine, the combination with the engine cylinder having an air-inlet, of a closed casing connected by a tubular member with the combustion chamber of said cylinder, a valve adjacent said cylinder for said tubular member, a passage leading to said cylinder in proximity of said tubular member connected at its other end with the nozzle of a liquid-hydrocarbon supply pipe, a valve adjacent said cylinder for said passage, and means operated in unison with the engine for elevating both valves from their seats during the suction stroke of the piston in the cylinder, keeping the valve associated with said tubular member elevated during the compression stroke and seating both valves during the working and exhaust stroke.

4. In an internal combustion engine according to claim 3, said two valves being disposed concentrically and the seat of said passage valve being constituted by said casing valve.

5. In an internal combustion engine according to claim 1, the communication during the suction stroke between the cylinder and passage being opened slightly in advance of the communication between the cylinder and said casing.

6. In an internal combustion engine, the combination with the engine cylinder having an air-inlet, of a closed casing adapted to communicate with the combustion chamber thereof through an opening, a passage leading to said cylinder in proximity of said opening connected at its other end with the nozzle of a liquid-hydrocarbon supply pipe, means for controlling the communication between said opening and cylinder, means for controlling the communication between said passage and cylinder, and means operating in unison with the engine for establishing a communication between said cylinder, casing and passage during the suction stroke of the piston in the cylinder, leaving the communication between said cylinder and said casing open during the compression stroke and keeping both communications closed during the working and exhaust strokes.

7. In an internal combustion engine according to claim 6, said passage leading through said opening.

8. In an internal combustion engine, the combination with the engine cylinder having an air-inlet, of a closed casing adapted to communicate through an opening with the combustion chamber of said cylinder, a passage leading to said cylinder in proximity of said opening and connected at its other end with the mozzle of a liquid-hydrocarbon supply pipe, a valve controlling the communication between said casing and said cylinder, a valve controlling the communication between said nozzle and said cylinder, and a cam rotating in unison with the engine for shifting both valves to opening position during the suction stroke of the piston in the cylinder, leaving the casing valve in open position during the compression stroke and allowing both valves to be closed during the working and exhaust strokes.

9. An internal combustion engine accord-

ing to claim 8, comprising means for adjusting the strokes of both valves independently of each other and also simultaneously, at will.

10. In an internal combustion engine according to claim 8, said valves being disposed concentrically and said casing valve forming a seat for said passage valve.

11. In an internal combustion engine according to claim 8, said valves being disposed concentrically within a recess in said cylinder and said casing valve forming a seat for said passage valve, whereby the direction of flow of the liquid-hydrocarbon is changed as it issues between said valves.

12. The method of feeding liquid hydrocarbon to the cylinder of an internal combustion engine, which consists in charging during the compression stroke of the piston of the engine a closed casing with a compressed mixture of liquid hydrocarbon and air from said cylinder, inducing a flow of liquid hydrocarbon into the cylinder during the next suction stroke and permitting the previous charge in said casing to flow during the said suction stroke into the cylinder past the liquid hydrocarbon, so as to atomize and spray the same.

13. The method of feeding liquid-hydrocarbon to the cylinder of an internal combustion engine, which consists in charging during the compression stroke of the piston of the engine a closed casing with a compressed mixture of liquid-hydrocarbon and air from said cylinder, permitting this charge to flow into the cylinder during the next suction stroke and inducing simultaneously a flow of liquid-hydrocarbon into the cylinder, said compressed charge flowing at an angle to the direction of flow of the liquid-hydrocarbon, whereby the latter is atomized and sprayed.

14. The method of feeding liquid hydrocarbon to the cylinder of an internal combustion engine, which consists in charging during the compression stroke of the piston of the engine a closed casing with a compressed fluid from said cylinder, inducing a flow of liquid-hydrocarbon into the cylinder during the next suction stroke and permitting the previous charge in said casing to flow during the said suction stroke into the cylinder past the liquid-hydrocarbon, so as to atomize and spray the same.

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