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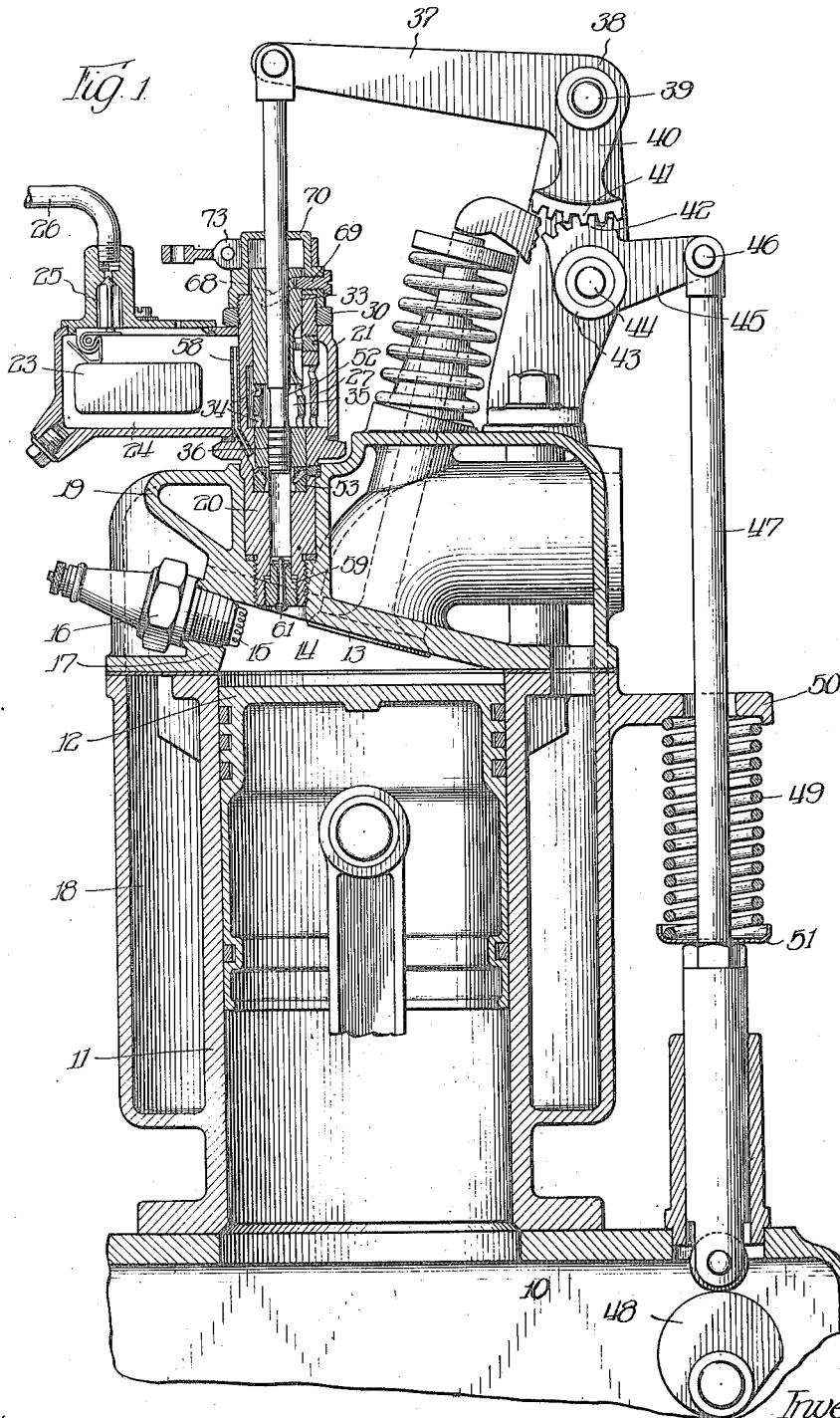
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E. F. WHITE

METERING AND FEEDING DEVICE

Filed Aug. 7, 1922

2 Sheets-Sheet 1



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F. Burkhardt.

Inventor:
Ezekiel F. White,
By Wilkinson, Hussey, Byron & Knight
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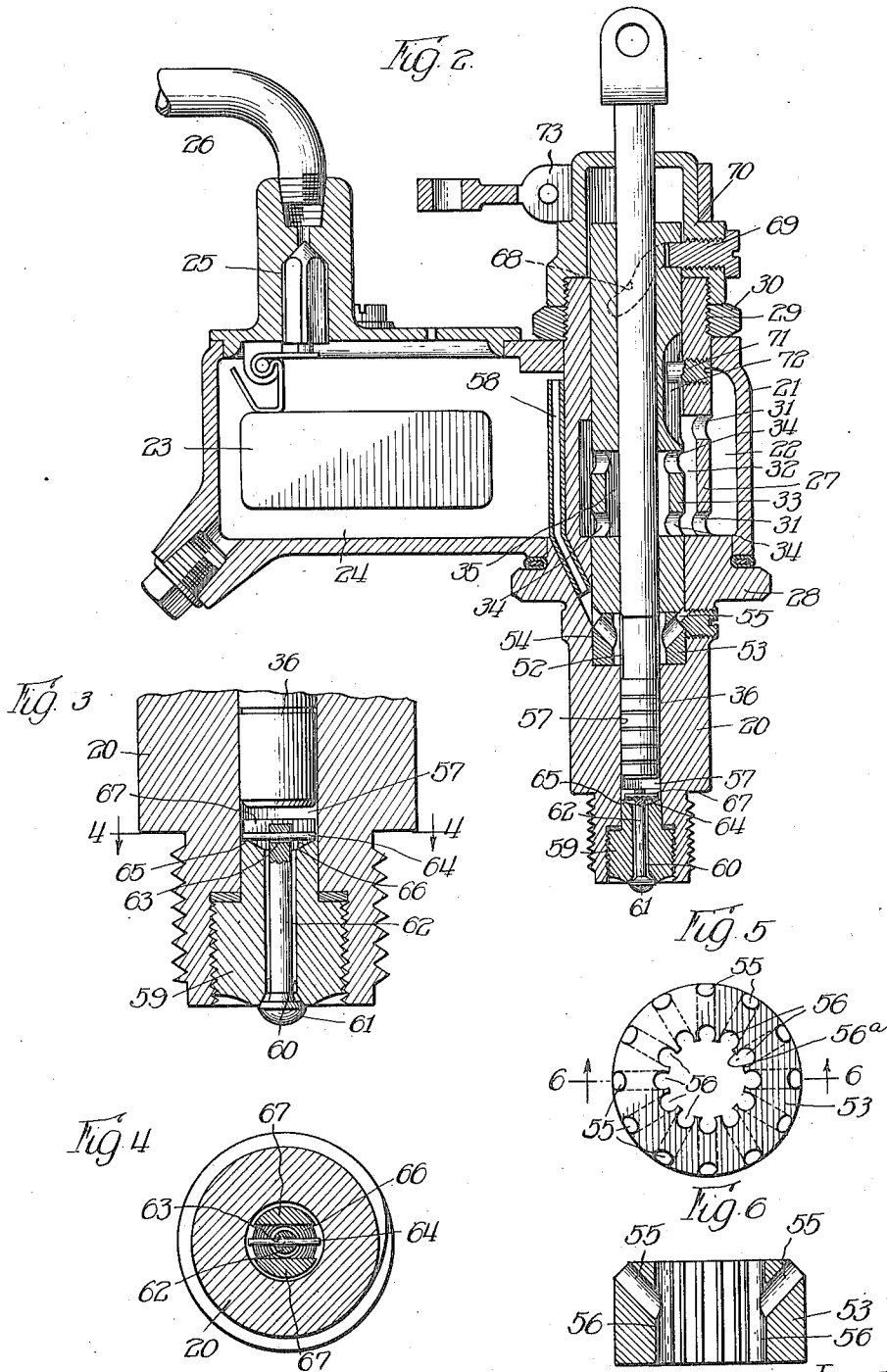
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UNITED STATES PATENT OFFICE.

EZEKIEL F. WHITE, OF CHICAGO, ILLINOIS.

METERING AND FEEDING DEVICE.

Application filed August 7, 1922. Serial No. 580,101.

To all whom it may concern:

Be it known that I, EZEKIEL FIELD WHITE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Metering and Feeding Devices, of which the following is a specification.

This invention relates to metering and feeding devices. One object of the invention is to provide a simple, durable and efficient fuel metering and feeding device which is capable of thoroughly pulverizing fuel for use in internal combustion engines under moderate pressure conditions as compared with pressure conditions required in the Diesel type of engine, and without the use of the elaborate auxiliary air and fuel apparatus necessary in the Diesel type of engine.

Another object is to provide a device for accurately measuring and feeding fluids under economic conditions.

Another object is to provide a device for accurately measuring fuel, mixing it with air, compressing the mixture and discharging it in a highly pulverized condition into the cylinder of a gas engine in a manner to meet the various requirements for economical and efficient operation.

Another object is to provide a simple and efficient method for preparing a fluid charge and treating same in a manner to secure improved results.

These and other objects are accomplished by means of the arrangement disclosed on the accompanying sheets of drawings, in which—

Figure 1 is a vertical sectional view of my improved metering and feeding device shown applied to an internal combustion engine, which latter also is shown in vertical section;

Figure 2 is an enlarged vertical sectional view of the metering and feeding device;

Figure 3 is a vertical sectional view of the lower valved end of the device shown on a larger scale than that in Figure 2;

Figure 4 is a sectional view taken in the plane of line 4—4 of Figure 3;

Figure 5 is a top plan view of a member into which fuel is drawn from the plunger cavity by capillary attraction preparatory to being transferred to the compression chamber; and

Figure 6 is a vertical sectional view of the

same member taken in the plane of line 6—6 of Figure 5.

The various novel features of the invention will be apparent from the following description and drawings and will be particularly pointed out in the appended claims.

My improved metering and feeding device is illustrated in connection with an internal combustion engine 10 to which said device is applied. The internal combustion engine may be of any approved type having a cylinder 11 in which a piston 12 is mounted for reciprocation. A valve 13, which in this case is an inlet valve, controls the main supply of air to the combustion chamber 14, and a similar valve in the rear thereof, not shown, controls the exhaust of the waste products of combustion. A heating element 15 used for the initial explosions is secured to the inner end of a plug 16 which is threaded into one wall 17 of the combustion chamber. In this instance the cylinder is surrounded by a water jacket 18. The head 19 of the cylinder is also provided with space for the circulation of water. The head of the cylinder is provided with an opening into which my improved metering and feeding device is inserted so that the lower or discharge end of the device is located to discharge a highly compressed and heated fuel mixture into the combustion chamber 14.

The metering and feeding device includes a main casing member 20 and another casing member 21. Within the latter casing member 21 is a fuel supply chamber 22 into which the fluid or hydrocarbon to be measured and fed is controlled by a float valve 23 mounted in a communicating supply receptacle 24, the hydrocarbon or other fluid being supplied to the receptacle 24 through a valve control opening 25 from any suitable source 26. The main casing member 20 has an annular portion 27 extending upwardly from a collar portion 28 formed intermediate the length of the casing 20. The upper end of the casing portion 27 is provided with a thread 29 with which a nut 30 cooperates for clamping the casings 20 and 21 together. The casing portion 27 has a plurality of openings 31 through which hydrocarbon passes from the supply chamber 22 into an annular space 32 surrounding a throttling sleeve 33 which also has a plurality of openings 34 through which the hydrocarbon may flow from the annular

space 32 to the chamber 35 within the sleeve 33.

Mounted for guided reciprocation within the sleeve 33 and the casing 20 is a plunger 36 which may be actuated by any suitable mechanism. In this particular instance the upper end of the plunger is pivotally connected to one end of an arm 37 of a bell crank lever 38 pivoted at point 39, the other arm 40 of the bell crank lever having a toothed segment 41 meshing with a toothed segment 42 mounted on a bell crank lever 43 pivotally supported at 44. One arm 45 of the bell crank lever 43 is pivotally connected at 46 to the upper end of a rod 47 which is actuated in an upward direction by a cam 48 and in a downward direction by a spring 49, the latter of which is interposed between an abutment 50 on the engine and an abutment 51 on the rod 47. From these operating connections it will be apparent that the plunger is given a direct positive upward movement, the downward movement being exerted through the spring 49.

The plunger 36 has a single groove 52 in which a measured charge of hydrocarbon is received from a supply point which, in this instance, is the space 35 within the sleeve 33 and transfers such measured charge of hydrocarbon to a member 53 mounted in an enlarged bored portion 54 in the main casing 20. It will be noted that the member 53 has a plurality of circumferentially spaced openings 55 extending downwardly and inwardly to channels 56 communicating with the central opening 56^a in said member and through which said central opening the plunger 36 reciprocates. When the plunger is in its lower limit of movement the fuel carrying groove 52 therein is in open communication with the channels 56 and the openings 55 leading therefrom, whereby, when the fuel carrying groove 52 is within the member 53, the fuel is drawn from said groove 52 in the member 36 into the channels 56 and openings 55 of the member 53 as a result of capillary attraction. When the plunger 36 is again raised, a partial vacuum is formed in the compression chamber 57 which is located in the lower part of casing 20, whereby when the plunger reaches its upper limit of movement and the openings 55 then being in open communication with the compression chamber 57, the hydrocarbon or fuel drawn into the openings 55 and channels 56 will be quickly drawn into the compression chamber 57, especially in view of the fact that the upper ends of the openings 55 are also in open communication with atmospheric air through air connections 58. In other words, as soon as the plunger 36 reaches its upper limit of movement the fuel which previously has been drawn into the openings 55 and channels 56 is quickly forced into

the compression chamber 57 by the suction action or the rush of air into the compression chamber 57.

The lower end of the compression chamber is provided with a plug 59 through which an opening 60 leading from the compression chamber 57 extends. This opening normally is closed by a valve 61 formed at the lower end of a stem 62 having an aperture 63 in the upper end through which a valve control spring or member 64 extends. This spring 64 rests upon the rim 65 of a beveled seat 66 formed between the upstanding legs 67 of the plug 59.

Let it be assumed that a charge of fuel and air has been forced from the intermediate member 53 into the compression chamber 57 when the plunger was in a raised position. Upon the next downward stroke of the plunger this mixture of fuel and air is compressed and when the pressure in the compression chamber exceeds the pressure in the combustion chamber 14, just prior to the piston 12 reaching the upper end of its upper or compression stroke, the valve 61 is opened against the tension of the spring 64, whereupon the compressed and heated fuel mixture is shot into the combustion chamber 14 in a pulverized condition. In the combustion chamber such fuel mixture is combined with additional air which has previously been supplied to the combustion chamber 14 past the air valve 13. The final mixture of fuel and air is exploded initially as a result of an electric current being passed through the heating coil 15, and later as a result of the hot walls of the combustion chamber and the heat of compression of the air.

As mentioned above, the fuel is transferred from the fuel supply point 35 to the intermediate apertured member 53 by the single groove 52 in the plunger 36. Although but a single groove 52 is provided, a varied quantity of fuel may be transferred thereby. In this connection it will be noted that the upper end of the sleeve is provided with a cam groove 68 in which is received the inner end of a set screw 69 which extends through a nut 70. Accordingly, if the nut 70 is rotated, the inner end of set screw 69 rides in the cam groove 68 in a manner to raise or lower the sleeve. The result of such action is to expose a larger or smaller amount of the fuel carrying groove 52 to the fuel in the supply chamber 35.

Referring particularly to Figure 1, it will be noted that substantially the whole groove 52 is exposed to the fuel in the supply chamber 35 so that when the plunger is moved downwardly from this upward position, the entire groove 52 is filled with oil and transferred to the intermediate member 53. However, it will be appreciated that if the throttling sleeve 33 is raised with respect to the

plunger groove 52, the lower portion of such groove 52 will be unexposed to the fuel supply chamber 35 and, accordingly, only the upper exposed portion 52 of the groove will be filled with fuel, such fuel in the upper portion of the groove 52 resting upon a body or ring of air occupying the lower or unexposed portion of the groove 52. Accordingly, it is apparent that varied quantities of fuel may be transferred to the intermediate fuel receiving member 53. The throttling sleeve 33 is prevented from rotating by a set screw 71 extending into a vertical groove 72 formed in the outer surface of the throttling sleeve 33. In this connection it will be understood that a clamp 73 is secured to the nut 70 for each cylinder, so that the throttling sleeve 33 may be independently adjusted for each cylinder. In this way, in a multiple cylinder engine, the relative charge of hydrocarbon to one cylinder may be varied with respect to that of the others.

In connection with the operation of the device, when the plunger 36 is in the upper part of its stroke, the exposed portion of the metering groove 52 fills with fuel, whereupon the plunger starts on its downward movement carrying the fuel with it. When the plunger 36 reaches the bottom of its stroke, the metering groove 52 is adjacent the capillary member 53 which draws the fuel out of the metering groove and into the channels 56 and openings 55. When the plunger ascends there is a very heavy vacuum formed under the plunger within the compression chamber 57, and just before the plunger reaches its upward limit of movement it uncovers the opening 55, placing the compression chamber with its vacuum in communication with the capillary member 53 containing the charge of fuel. The top of the latter being in communication with the outside air, air accordingly rushes down through the openings 55, sweeping the fuel therefrom and from channels 56 into the compression chamber. When the piston starts on its next downward stroke, closing the passageways between the capillary member and the compression chamber and then continues to descend, it compresses this mixture of fuel and air. The air becomes highly heated by being compressed, the heat from which is absorbed largely by the liquid fuel, thus raising the temperature of the fuel and rendering same more volatile, and, therefore, in a more perfect state for pulverization, which takes place when the pressure in the compression chamber is sufficiently in excess of the pressure in the engine cylinder. Slightly before the plunger 36 reaches the end of its downward stroke, its movement is caused to accelerate by the declivity of the cam 48 which acts in a manner to accelerate the discharge of the

fuel and air into the engine cylinder past the valve 61. This valve has a very narrow seat and is normally held closed by the cantilever spring 64 which is designed to allow the valve to open when the pressure in the compression chamber 57 is sufficiently in excess of the pressure in the engine cylinder to cause a pulverization of the fuel as the latter is shot past the valve 61 into the engine cylinder. The air and fuel while in the compression chamber are intimately mixed, and scattered through the mass of fuel are small globules of air at high pressure and each globule giving off to the surrounding fuel such heat as is generated by the high compression. This high temperature does not manifest itself initially owing to the immediate absorption of the heat by the fuel. This absorption is beneficial as it causes certain fractions of the fuel to vaporize and other fractions to be more volatile and therefore more easily pulverized when being ejected past the valve 61 into the combustion chamber of the engine cylinder.

With this improved metering and feeding device no multiple stage air compressors, no high pressure receiver, no high pressure piping systems, and no need for excessive compression within the engine cylinders are necessary as in the Diesel type of engine. Accordingly, leaks are reduced to a minimum because there are no high pressure on either the fuel or air except at the instant of compression and ejection of the fuel mixture into the combustion chamber.

It is my intention to cover all modifications of the invention falling within the spirit and scope of the following claims.

I claim:

1. In a fuel metering and feeding device, the combination of hydrocarbon and air supply, and a plunger having a single groove in which variable quantities of hydrocarbon are accurately measured, and means whereby said measured charge of hydrocarbon in each case is mixed with air and by said plunger compressed before being discharged from said device.

2. In a fuel metering and feeding device, the combination of hydrocarbon and air supply, a plunger having a single groove in which accurately measured charges of hydrocarbon are measured and transferred, and means for varying the charge of hydrocarbon received in said groove and means whereby the measured charge of hydrocarbon in each case is mixed with air and by said plunger compressed before being discharged from said device.

3. In a device of the class described, the combination of a fuel supply chamber, a compression chamber, an intermediate chamber, and a plunger having a fuel receiving portion for measuring and trans-

ferring a charge of fuel from said supply chamber to said intermediate chamber into which latter chamber fuel is drawn from said plunger by capillary attraction, and means for conveying said fuel from said intermediate chamber to said compression chamber where the fuel is compressed by said plunger.

4. In a device of the class described, the combination of a fuel supply chamber, a compression chamber, a plunger having a fuel receiving portion for measuring and carrying a charge of fuel from said fuel supply chamber, a member by means of which the fuel is withdrawn from said plunger by capillary attraction, an associated air supply, and means for conveying said fuel from said capillary member by air from said air supply to said compression chamber where a mixture of fuel and air is compressed by said plunger.

5. In a device of the class described, the combination of a fuel supply chamber, a compression chamber, a plunger having a fuel receiving portion for measuring and conveying a charge of fuel from said fuel supply chamber, an associated air supply, and a capillary member into which said charge of fuel is drawn from said plunger, said fuel being withdrawn from said capillary member into said compression chamber with air from said air supply when the plunger is in a given position, said fuel and air being compressed by said plunger preparatory to being discharged from said device.

6. In a device of the class described, the combination of a fuel supply chamber, a compression chamber, a plunger having a fuel receiving portion for measuring and conveying a charge of fuel from said fuel supply chamber, an associated air supply, a capillary member into which said charge of fuel is drawn from said plunger, said fuel being withdrawn from said capillary member into said compression chamber with air from said air supply when the plunger is in a given position, a mixture of said fuel and air being compressed by said plunger preparatory to being discharged from said device, and a pressure control valve for controlling the passage of the compressed mixture from said compression chamber.

7. In combination, an internal combustion engine having a cylinder with a combustion

chamber, and a fuel measuring and feeding device including a fuel supply chamber, a compression chamber, a plunger having a fuel receiving portion for measuring and carrying measured charges of fuel from said fuel supply chamber toward said compression chamber, an associated air supply, a mixture of said fuel and air being compressed by said plunger within said compression chamber, and a pressure control valve for controlling the passage of said compressed fuel mixture from said compression chamber into said combustion chamber when the pressure in said compression chamber exceeds that in the combustion chamber a predetermined amount.

8. In a device of the class described, the combination of a fuel supply chamber, a throttling sleeve mounted in said supply chamber, and a plunger having a fuel receiving portion for measuring and conveying from said fuel supply chamber measured charges of fuel, and means for varying the position of said throttling sleeve for controlling the measured amount of fuel received in said plunger.

9. In a device of the class described, the combination of a fuel supply chamber, a compression chamber, a throttling sleeve mounted in said fuel supply chamber, and a plunger having a fuel receiving portion for measuring and conveying from said fuel supply chamber measured charges of fuel, means for varying the position of said throttling sleeve for controlling the measured amount of fuel received in said plunger, and a capillary member for extracting the fuel from said plunger preparatory to being transferred to said compression member.

10. In a device of the class described, the combination of a fuel supply chamber, a compression chamber, a plunger having a fuel receiving portion for measuring and conveying the fuel from said fuel supply chamber toward said compression chamber in which the fuel mixture is compressed by said plunger, and a pressure control valve for controlling the discharge of the fuel mixture from said compression chamber and including a spring which responds to variations in pressure.

Signed at Chicago, Illinois, this 28th day of July, 1922.

EZEKIEL F. WHITE.