July 9, 1946. A. JANSSON 2,403,440

INTERNAL-COMBUSTION ENGINE

Filed Sept. 23, 1944

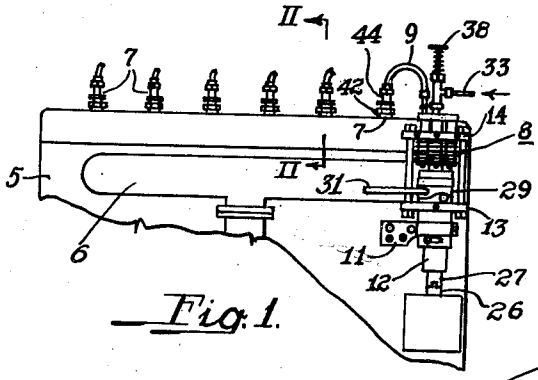

Fig. 1.

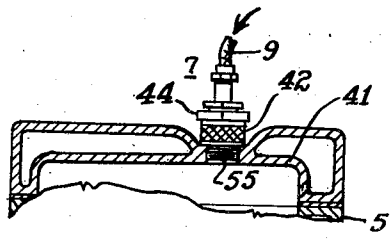

Fig. 2.

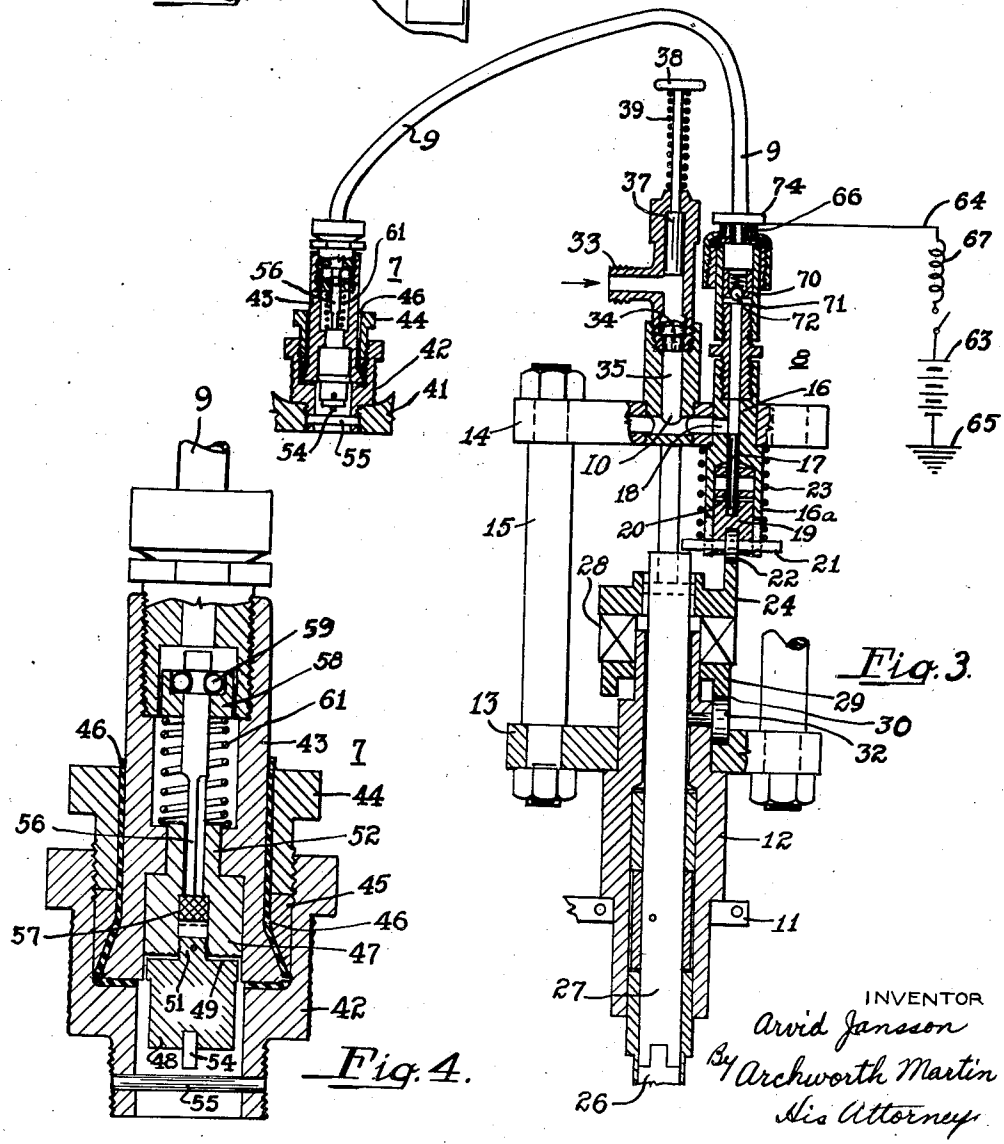

Fig. 3.

Fig. 4.

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INTERNAL-COMBUSTION ENGINE

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11 Claims. (Cl. 123—169)

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My invention relates to internal combustion engines, and more particularly to means for supplying and vaporizing liquid fuel thereto and the ignition of the atomized fuel.

One object of my invention is to provide an improved form of vaporizer and ignition device for internal combustion engines, which can readily be applied to various standard types of gasoline or oil burning engines.

Another object of my invention is to provide a vaporizing and ignition system of the character referred to wherein the necessity of a timing switch, a condenser, and a carburetor is avoided.

Another object of my invention is to provide means whereby the ordinary gasoline engine can be converted to operate as an oil burning engine, with consequent fuel economy.

Still another object of my invention is to provide an improved form of pump for supplying fuel charges of desired variable volumes to vaporizing devices.

As shown in the accompanying drawing, Fig. 1 is a side view of a portion of an internal combustion engine with my invention applied thereto; Fig. 2 is an enlarged sectional view, taken on the line II—II of Fig. 1; Fig. 3 is an enlarged sectional view of a portion of the pumping apparatus and of one of the vaporizing and igniting plugs of Fig. 1, and Fig. 4 is a still further enlarged view of one of the plugs.

For convenience of illustration, I have shown my invention as applied to an automobile engine 5, but it will be understood that the invention may be applied to other types of internal combustion engines. The invention has the intake manifold 6, but in this instance, said manifold will be used only for the intake of air to mix with the atomized fuel, in forming the explosive charges. The engine shown is of the six-cylinder type, but for the usual spark plugs, I substitute fuel atomizing and vaporizing plugs 7. Each plug 7 is supplied from one of six fuel pumps 8, a pipe 9 leading from each pump to its associated plug 7.

The pumps 8 are supported on the engine block by a bracket 11, or it can be mounted on the ordinary distributor mounting. The bracket 11 carries a bushing 12 that in turn supports plates or spiders 13 and 14 that are held in assembled relation by bolts 15, the plate 14 supporting the six pump cylinders 8 and a fuel supply header 10 that has passageways communicating with the various pump cylinders.

The pumps 8 are all of like construction and description of one will suffice for all. Each pump comprises a cylinder block 16 within which a

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piston 17 is reciprocated to eject charges of oil into the pipe 9 that leads to one of the plugs 7, the fuel flowing into the cylinder through one of the ports 18 that leads from the header 10. The cylinder block 16 has a skirt portion 16a in which a loose fitting plug 19 is reciprocated, the plug being loosely connected to the piston 17 by a pin 20 and carrying a pin 21 that serves as a shaft for an anti-friction roller 22. A spring 23 is interposed between the plate 14 and the pin 21 to urge the piston 17 downwardly and maintain the roller 22 in contact with a cam surface on a rotatable plate 24, the lower portions of the cylinder skirt 16a being slotted to permit vertical movements of the pin 21. The piston 17 is reciprocated during rotation of the cam plate 24, the raised surface on the cam plate coming into contact with the anti-friction rollers 22 of the various pistons, successively.

When applying the pump mechanism to an automobile engine, it may suitably be connected with the timer shaft 26 that is commonly present on automobiles. To this end, the pump apparatus has a shaft 27 that is coupled with the shaft 26 and is rotatable in the bushing 12. At its upper end, the shaft has splined or slidably keyed connection with the cam plate 24 so that the cam plate can be raised and lowered during rotation of the shaft. The cam plate 24 is supported on an anti-friction bearing unit 28 that is slidable on the sleeve 12, the bearing unit 28 being in turn carried by a collar 29 that has oscillatory movement on the sleeve 12 and has a camming surface 30 on its lower edge that engages and is vertically supported by an anti-friction roller 32 which is journaled in the sleeve 12, it being understood that there are three camming surfaces 30 and three rollers 32 at equally spaced points around the sleeve 12.

The camming collar 29 has connection with a pull-and-push rod 31 that may be operated from the driver's seat or elsewhere to oscillate the collar 29 so as to raise and lower the cam plate 24, to vary the amount of fuel that is ejected from the pump into the line 9 and to the plug 7, upon each upward stroke of the piston 17. It will be seen that during rotation of the shafts 26—27, the pistons 17 will be raised in succession to supply fuel under pressure to their respective plugs 7. The amount of fuel thus supplied will depend upon the length of stroke of the piston 17. When the collar 29 is in the position shown in Fig. 1, the cam plate 24 and hence the pistons will move to their lowermost points and hence idling charges or even no charges of fuel will be supplied. When

the collar 29 is turned somewhat from said position, the cam plate 24 will be maintained at a higher plane and the range of piston stroke will be longer, with consequent increased volume of fuel charges. Thus if the cam plate is held at a higher plane, there will be more fuel supplied than when the cam collar 29 is adjusted to let the cam plate move farther down.

Liquid fuel is supplied from a suitable source, through an inlet 33, past an upwardly closing check valve 34 and through a central port 35 that communicates with the lateral ports in the header 10 that in turn communicate with the cylinder ports 18. The fuel will by-pass the valve when it is in its lower position so that an adequate supply of fuel will flow to the header 10. The check valve 34, when moved upwardly, prevents back flow of the fuel in the conduit 35 of a priming piston 37.

A priming device is provided for forcibly injecting fuel and expelling air from the ports and passageways leading to the plugs 7, preliminary to starting the engine when it has been standing for some time and the passageways and ports are empty of fuel oil. This priming device comprises the piston 37 operated by a plunger handle 38 that is normally held in raised position by a spring 39. Upon upward stroke of the plunger, the suctional force created thereby will draw the valve 34 to its seat and create a vacuum force, which causes an inflow of oil through the inlet 33. Repeated operations of the plunger 38 will thus introduce oil into the system.

Each of the plugs 7 is connected to its cylinder head 41 through means of a fitting 42 that is screwed into the cylinder head in lieu of the usual spark plug. A tube 43 is held in place in the fitting 42 by a clamping nut or bushing 44 that has threaded connection with the fitting 42, the lower end of the tube being flared and anchored or clamped in place when the nut 44 is screwed down, through the medium of a holding collar 45. Suitable insulating materials such as a sheet or sheets 46 of mica are interposed between the tube 43 and the members 42—44—45.

Within the tube 43, plunger members 47 and 48 are provided that are unitarily connected and move as a unit, knurling 49 being provided on the end of the member 47. The member 48 has loose fit in the sleeve 43 so that fuel oil can be forced through the knurls 49 and down to the lower end of the member 48. A knurled plug-like extension 51 is carried by the member 48 and has pinned connection with the member 47, to hold these two members in assembled relation. However, the knurling or ribs on the periphery of the plug 51 are of sufficient size to permit fuel flow downwardly past the plug, to the knurling and past knurling on the side of the member 48, the fuel thus supplied under pressure being thereby atomized.

The plunger member 47 has a tubular extension 52 that is slidable in the sleeve 43 for such distance as to bring an arcing stem or stud 54 on the lower end of the member 48 into and out of engagement with an arcing pin 55 on the plug 42 so that when the member 47 has been moved downwardly to make electrical contact between 54 and 55, and then raised, as hereinafter explained, an arc will be drawn that will ignite the vaporized mixture in the combustion chamber or engine cylinder.

A stem 56, having an enlarged lower end 57 is slidable in the member 52, the mid portion of the stem being grooved or flattened in the member 52, and the lower end thereof similarly loose fitting and knurled, to permit the flow of fuel under pressure down past the stem, to the combustion chamber. The knurling of the members 57, 51, 47 and 48 is such that the oil under pressure from the pumps 8 will be atomized as it is discharged into the combustion chamber.

The upper end of the stem 56 is releasably locked in a socket member 58 by balls 59 in such manner that the stem is held against falling downwardly relative to the socket but can have some upward movement relative thereto. A spring 61 is interposed between the socket member 58 and a shoulder in the sleeve 43 to normally hold the stem in raised position, with the upper surface of the enlargement at 57 shutting off the flow of fuel down past the stem.

Upon the injection of fuel through the line 9, pressure will be exerted on the upper end of the member 52 to move such member downwardly, against the expansive force of the spring 61, to the point at which the arcing stud 54 engages the contact member 55. The continued application of pressure will then be exerted on the upper end of the stem and on the enlarged head 57 of the stem to move it further downwardly and permit the forcing of oil past the member 57 and the knurled surfaces to the combustion chamber. Upon retraction of fuel pump piston 17, pressure in the plug 7 will be relieved, allowing the spring 61 to move the stem 56 and the tubular member 47 up thus breaking the electrical contact at 54—55 and forming an arc to explode the mixture in the combustion chamber, the member 57 serving as a check valve to prevent backfiring through the plug.

This relief of pressure in the plug 7 through retraction of the pump piston 17 is provided by means of a piston 70 that is slidable in a tube 71 and carries a check valve 72, located above the piston 17. Upon a pressure stroke of the piston, oil will force the piston member 70 upward to a dead stop and then force the oil past the check valve 72. Upon a retraction or suction stroke of the piston 17, the check valve will be closed and the piston 70 drawn downwardly, thus relieving pressure in the line 9 and in the plug, thereby permitting the spring 61 to raise the plunger 47 and draw an arc. This manner of drawing or creating an arc is more effective and dependable than in the case of ordinary spark plugs that have a gap of fixed distance.

Electrical current is supplied from a battery 63 through a reactance coil 67 and a conductor 64 to a contact plate 75 which has engagement with all of the pipes 9 and thence with the various plugs. The pipes 9 are insulated at 66 from the pumps. The current, by reason of the insulation at 66, is conducted by the pipes 9 to the arcing studs 54, and the arcing bars 55 are grounded to the engine and thence to the battery circuit at 65. The reactance coil 67 will, when the circuit is broken at 54—55, cause an electrical surge sufficient to produce the arcs for exploding the mixture.

I claim as my invention:

1. A device for atomizing motive liquid supplied thereto under intermittently-applied pressures, and for exploding the same, comprising a tubular plug member adapted for connection to a cylinder of an internal combustion engine, an electrical contact member carried at the inner open end of the tubular member, a plunger movable axially in the tubular member, under pressure of the motive liquid, an atomizing element associated

with the plunger, for atomizing the liquid supplied thereto and discharging it into the cylinder, an electrical contact member carried by the plunger and movable into engagement with the other contact member upon inward movement of the plunger, and means for automatically moving the plunger outwardly in the intervals between application of liquid fuel pressures, to effect the forming of an arc between the contact members and thereby explode the atomized liquid.

2. A device for atomizing motive liquid supplied thereto under intermittently-applied pressures, and for exploding the same, comprising a tubular plug member adapted for connection to a cylinder of an internal combustion engine, an electrical contact member carried at the inner open end of the tubular member, a plunger movable axially in the tubular member, under pressure of the motive liquid, an atomizing element associated with the plunger, for atomizing the liquid supplied thereto and discharging it into the cylinder, an electrical contact member carried by the plunger and movable into engagement with the other contact member upon inward movement of the plunger, means for automatically moving the plunger outwardly in the intervals between application of liquid fuel pressures, to effect the forming of an arc between the contact members and thereby explode the atomized liquid, and a check valve past which the liquid will flow to enter the cylinder, but operable to prevent back flow when the plunger is being retracted upon the forming of an arc.

3. A device for supplying explosive fluid to a cylinder of an internal combustion engine and exploding the same therein, comprising a tubular member arranged to receive motive fluid under intermittently-applied pressures and to conduct the fluid into the cylinder, a plunger in the tubular member and movable toward the cylinder under pressure impulses and past which the fuel will flow into the cylinder when the plunger is at its inner position, means returning the plunger to its outer position at intervals between applications of fluid pressure, means preventing back flow from the cylinder when the plunger is in its outer position, and means effective to form an electric arc to explode the fluid when the plunger moves toward its outer position.

4. A device for controlling the supply of explosive fluid to a cylinder of an internal combustion engine, and exploding the fluid, comprising a member movable in one direction to admit the fluid to the cylinder, and movable in the opposite direction to prevent back flow from the cylinder, and means actuated by said member during its second-named movement to form an electric arc for exploding the fluid in the cylinder.

5. A device for controlling the supply of explosive fluid to a cylinder of an internal combustion engine, and exploding the fluid, comprising a member movable in one direction to admit the fluid to the cylinder, and movable in the opposite direction to prevent back flow from the cylinder, and means actuated by said member during its second-named movement to form an electric arc for exploding the fluid in the cylinder, the said means comprising relatively-movable electric contact members mounted on said member and in the cylinder, respectively.

6. A device for supplying explosive fluid to a cylinder of an internal combustion engine and exploding the same therein, comprising a tubular member arranged to receive motive fluid under intermittently-applied pressures and to conduct

it into the cylinder, a tubular plunger in the said member movable inwardly therein under fluid pressure impulses, a spring moving the plunger outwardly between the pressure impulses, a stem movable axially in the plunger and yieldably held in its outward position but movable inwardly relative to the plunger, under said impulses, an electrical arc-forming contact member mounted in the cylinder, an electrical contact member carried by the plunger in position to engage the other contact member when the plunger is in its inward position, and cooperating check valve surfaces on the plunger and the stem, arranged to prevent back flow through the tube when the stem is in its outer position and the plunger is withdrawn to separate the contact members and form an arc.

7. A device for supplying explosive fluid to a cylinder of an internal combustion engine and exploding the same therein, comprising a tubular member arranged to receive motive fluid under intermittently-applied pressures and to conduct it into the cylinder, a tubular plunger in the said member movable inwardly therein under fluid pressure impulses, a spring moving the plunger outwardly between the pressure impulses, a stem movable axially in the plunger and yieldably held in its outward position but movable inwardly relative to the plunger, under said impulses, an electrical arc-forming contact member mounted in the cylinder, an electrical contact member carried by the plunger in position to engage the other contact member when the plunger is in its inward position, means associated with the plunger for atomizing liquids that are supplied thereto under pressure, and cooperating check valve surfaces on the plunger and the stem, arranged to prevent back flow through the tube when the stem is in its outer position and the plunger is withdrawn to separate the contact members and form an arc.

8. A device for supplying explosive fluid to a cylinder of an internal combustion engine and exploding the same therein, comprising a tubular member arranged to receive motive fluid under intermittently-applied pressures and to conduct it into the cylinder, a tubular plunger in the said member movable inwardly therein under fluid pressure impulses, a spring moving the plunger outwardly between the pressure impulses, a stem movable axially in the plunger and yieldably held in its outward position but movable inwardly relative to the plunger, under said impulses, and electrical arc-forming contact member mounted in the cylinder, an electrical contact member carried by the plunger in position to engage the other contact member when the plunger is in its inward position, means associated with the plunger for atomizing liquids that are supplied thereto under pressure, the said atomizing means comprising a knurled element in the plunger, past which the liquids flow, and cooperating check valve surfaces on the plunger and the stem, arranged to prevent back flow through the tube when the stem is in its outer position and the plunger is withdrawn to separate the contact member and form an arc.

9. A device for supplying explosive fluid to a cylinder of an internal combustion engine and exploding the same therein, comprising a tubular member arranged to receive motive fluid under intermittently-applied pressures and to conduct it into the cylinder, a tubular plunger in the said member movable inwardly therein under fluid pressure impulses, a spring moving the plunger

outwardly between the pressure impulses, a stem movable axially in the plunger and yieldably held in its outward position but movable inwardly relative to the plunger, under said impulses, an electrical arc-forming contact member mounted in the cylinder, an electrical contact member carried by the plunger in position to engage the other contact member when the plunger is in its inward position, means associated with the plunger for atomizing liquids that are supplied thereto under pressure, the said atomizing means comprising a knurled element in the plunger and lateral openings in the plunger, past and through which the liquids flow, and cooperating check valve surfaces on the plunger and the stem, arranged to prevent back flow through the tube when the stem is in its outer position and the plunger is withdrawn to separate the contact members and form an arc.

10. An atomizing and ignition plug for the cylinder of an internal combustion engine, comprising a tubular member adapted for connection to the cylinder, to direct fuel thereto, an arc-forming element movable within the tube, and a second arc-forming element, positioned adjacent to the inner end of the tube, in the path of fuel flow, the said elements having relative movement, for making and breaking an electrical circuit therethrough.

11. An atomizing and ignition plug for the cylinder of an internal combustion engine, comprising a tubular member adapted for connection to the cylinder, to direct fuel thereto, an arc-forming element movable within the tube, and a second arc-forming element, positioned adjacent to the inner end of the tube, in the path of fuel flow, the said elements having relative movement, for making and breaking an electrical circuit therethrough, the second-named arc-forming element being carried by the plug adjacent to the inner end thereof, and the plug being adapted for screw-threaded connection with an opening into the cylinder.

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