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FUEL SUPPLY SYSTEM

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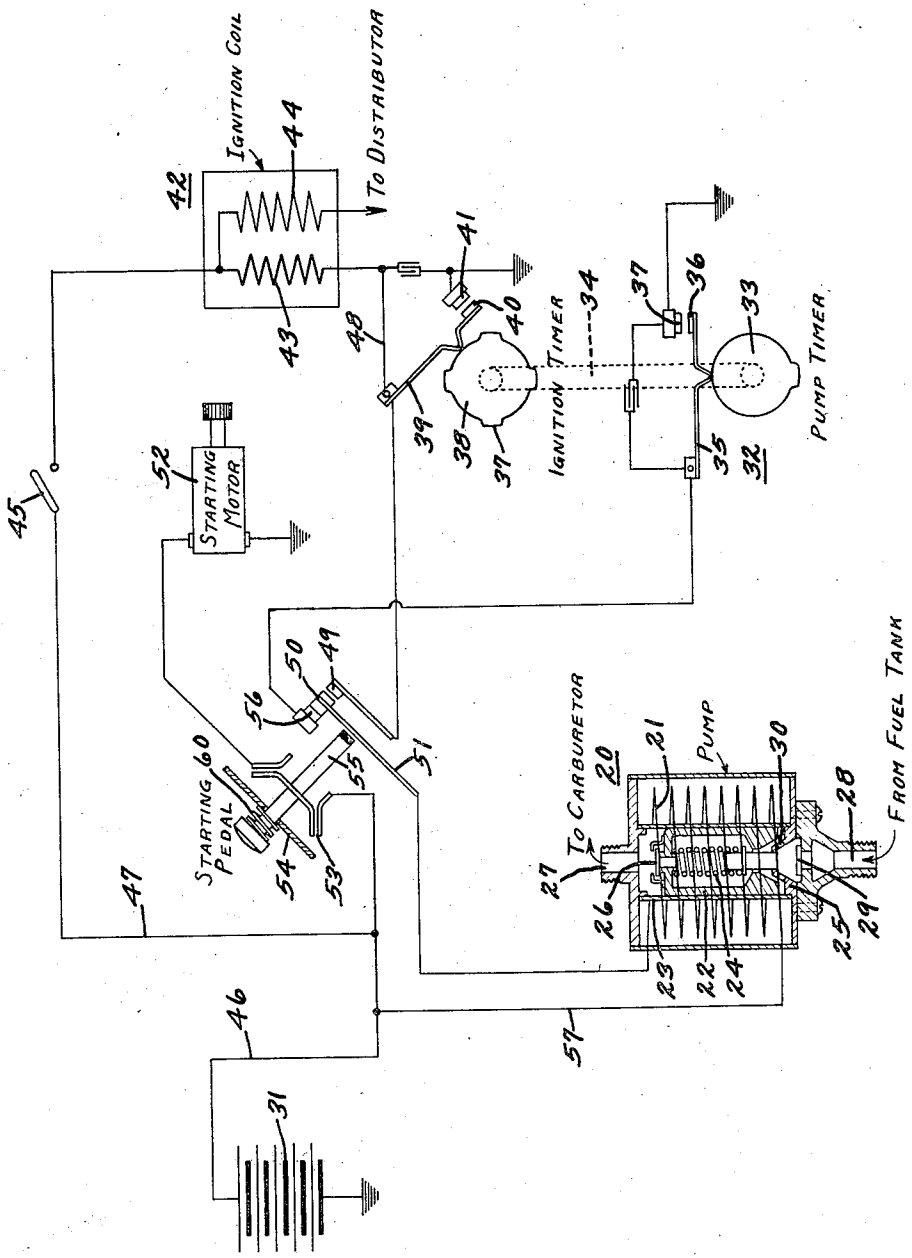

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FUEL-SUPPLY SYSTEM.

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This invention relates to a controlling device for fluid supply systems and more particularly to a controlling device for a fuel pump associated with an internal combustion engine.

It is among the objects of the present invention to control the operation of the fuel supply device for internal combustion engines so that said devices will be operated to deliver a sufficient amount of fuel to the combustion engine, when the engine is being operated at a predetermined slow speed or more especially, when said engine is being cranked.

In order to obtain this object, one form of the invention includes a fuel pump, the operation of which is controlled by the engine. Means are provided for changing the ratio of the frequency of pump operation with respect to engine operation, so that during cranking, this ratio may be increased. This means is controlled by apparatus adapted to render the engine starter operative to crank the engine.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred embodiment of one form of the present invention is clearly shown.

The view in the drawing is a diagrammatic view, showing the various elements of the system and their respective electrical connections.

The fuel pump is designated by the numeral 20 and comprises a magnet coil 21 and a reciprocating piston 22 normally held in the upper position in a cylinder 23 by means of a spring 24. A magnet core 25 projects up into this cylinder 23, said core being adapted to be energized by the energization of the magnet coil 21 for drawing the piston 22 down in the cylinder 23 against the operation of the spring 24. When the piston is moved downwardly by magnetic attraction, any fuel within the hollow portion of said piston will be forced out past the check valve 26 carried at the top of said piston into the space in the cylinder 23 above the piston. Upon de-energization of the magnet coil the spring 24 will move the piston upwardly in the cylinder 23, thereby pushing any fuel in said cylinder above the piston out through the port 27 to the carburetor via any suitable connection pipe not shown on the drawing. This upward movement of the piston will also draw fuel from the fuel tank not shown, but which is in communication with the channel 28 formed in the bottom portion of the pump, fuel passing through the channel 28 will lift the check valve 29 and enter through suitable openings 30 into the interior portion of the piston from where this fuel will be projected past the valve 26 onto the next downward stroke of the piston. The pump is operated by means of intermittently breaking circuit connections of the pump magnet coil with the storage battery 31.

The engine operated pump controlling means for causing the pump to be intermittently operated comprises a pump timer designated by the numeral 32. This pump timer includes a single lobe cam 33 mounted on and driven by the engine driven shaft 34. The cam 33 is adapted to operate a contact carrying arm 35 which carries the contact 36 adapted to cooperate with the stationary contact 37. The cam 33 being provided with only one lobe will tend to make and break the circuit across the contacts 36 and 37, one time for each revolution of the engine driven shaft 34.

The means for changing the ratio of the frequency of pump operation with respect to the engine operation includes the engine ignition timer which comprises a cam 38 mounted on and driven by the engine driven shaft 34. The cam shown in the figure is provided with four lobes and is adapted to operate an arm 39 carrying contact element 40. This contact element is adapted to be moved into engagement with the stationary contact 41.

The engine ignition system includes an ignition coil 42 provided with the usual primary and secondary windings 43 and 44 respectively. The ignition coil is brought into circuit by means of the closing of the switch 45 at which time current may flow from the battery 31, through the wires 46 and 47, across the switch 45, through the primary winding 43, thence through the wire 48, arm 39, across the contacts 40 and 41 when closed, back to the battery via ground connections.

The means for changing the ratio of the frequency of pump operation with respect to the engine operation also includes the stationary contact 49 and the common con-

tact element 50 carried by the contact arm 51.

As has been mentioned heretofore, this means is controlled by apparatus which renders the engine starter operative thus cranking the engine. The engine starting system comprises a starting motor 52 adapted to be brought into circuit connection with the battery 31 to crank the engine, by means of switch 53 controlled by a starting pedal 54. The starting pedal 54 is provided with a projection 55 which, when the starting pedal is depressed to close circuit connections between the storage battery 31 and the starting motor 52 to crank the engine, will engage with the arm 51, moving the common contact 50 out of engagement with the stationary contact 56 in circuit connection with the arm 35 of the pump timer, and moving same into engagement with the stationary contact 49 in circuit connection with the arm 39 of the ignition timer. Thus while the engine is being cranked or while the starting pedal is depressed circuit connections for the pump will be as follows:

From the battery 31, through wires 46 and 57, through the controlling coil 21 of the pump, thence to the common contact arm 51, across the contacts 50 and 49, to the arm 39, thence across the contacts 40 and 41, back to the battery via the ground connections. It may be seen that when the lobes of the cam 38 move the arm 39 to cause engagement between the contacts 40 and 41, the coil 21 of the pump will be energized to move the piston 22 downwardly in the cylinder 23 against the pressure of the spring 24. When the lobe rides from under the arm 39, this circuit will be broken by the disengagement of the contacts 40 and 41, causing a de-energization of the coil 21 of the pump, permitting the spring 24 to affect the return of the piston 22 to its normally upper position within the cylinder. This may be termed one pulsation of the pump. From the foregoing it may be seen that while the ignition timer is in circuit with the pump, four distinct pulsations will be given the pump for each single revolution of the engine driven shaft 34.

Now as soon as the engine becomes self-operating, pressure on the starting pedal 54 is released at which time the spring 60 will come into effect to return said pedal to its normal circuit breaking position. The return of the pedal to normal position will permit the common contact carrying arm 51 to move the contact 50 out of engagement with the contact 49 and cause said common contact to engage with the contact 56. The pump 20 is in circuit connection with its regular timer under these conditions and current will flow through the following circuit: from the battery 31 through wires 46 and 57, pump operating magnet coil 21, through the common contact carrying arm 51, across the contacts 50 and 56, to the arm 35, thence across the contacts 36 and 37, back to the battery via the ground connections. The cam 33 of the pump timer being provided with one lobe will cause this circuit to be made and broken once during each revolution of the engine driven shaft 34, so that while the engine is operating the pump will receive one pulsation for each revolution of the engine driven shaft 34.

From the foregoing it may be seen that the ratio of the pump operation to the pump of the engine driven shaft 34 during the operation of the engine is one to one, while the ratio of the pump operation to said shaft while the engine is being cranked is four to one. Obviously the invention is not to be limited to apparatus operating according to these ratios, but the invention may include other forms which operate according to other ratios of pump cycle frequency to engine cycle frequency.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

What is claimed is as follows:

1. A fluid supply device for an internal combustion engine provided with a starter; comprising in combination, a control for the engine starter; a magnetically operated pump; circuit interrupters concurrently driven by the engine, one of which operates more often than the other per engine revolution, either one of the interrupters being separately adapted to intermittently connect the pump with a source of current to cause the pump to pulsate; and means associated with the control for the engine starter and the separate interrupters whereby the pump will be connected to the interrupter adapted to operate it more often per engine revolution, while the engine starter control is being operated to cause cranking of the engine.

2. A fluid supply device for an internal combustion engine provided with an electric starter comprising in combination, an electric starter control; a source of electrical energy, engine driven current interrupters one of which operates more often than the other per engine revolution; an electrically operated pump normally in circuit connection with the interrupter operated the lesser number of times per engine revolution; and means associated with the control for the electric starter for connecting the pump with the interrupter that operates more often per engine revolution when the starter control is manipulated to cause functioning of the electric starter to crank the engine.

3. A fuel supply device for an internal combustion engine provided with an electric

starter comprising in combination, a current source; an electric fuel pump; an engine driven ignition timer including an interrupter adapted to be operated a predetermined number of times per engine revolution; an engine driven pump timer including a circuit interrupter adapted to be operated less frequently per engine revolution than the ignition timer interrupter; a starting switch for connecting the electric starter with the current source; and means operated by said starting switch when making circuit, for connecting the fuel pump with the ignition timer, said means connecting the fuel pump with the pump timer when said starting switch is open.

4. A fuel supply device for an internal combustion engine provided with an electric starter, comprising in combination, an electric starting control; a current source an electric fuel pump; ignition and pump circuits, interrupters including operating devices mounted on a common engine driven shaft, the operating device of the ignition interrupter being adapted to cause the ignition circuit to be interrupted more frequently per engine revolution than the interruptions of the pump circuit by means of the pump interrupter; and a switching device associated with the control for the electric starter so constructed and arranged that, when said control is operated to cause the electric starter to crank the engine, the fuel pump is disconnected from the pump timer and connected with the ignition timer to increase the frequency of pump operations for each revolution of the engine during engine cranking operation only.

5. A fuel supply device for an internal combustion engine comprising, in combination, an electromagnetic pump; a plurality of engine driven circuit interrupters respectively for causing the pump magnet to be energized at different frequencies relative to engine operation; and means for connecting one or the other of said circuit interrupters to the pump magnet.

6. A fuel supply device for an internal combustion engine provided with a starting device, comprising in combination, means for controlling the starting device; an electromagnetic pump; a plurality of engine driven interrupters respectively for causing the pump magnet to be energized at different frequencies relative to engine operation; and means associated with the means for controlling the starting device, for connecting one or the other of the interrupters with the pump magnet.

In testimony whereof I hereto affix my signature.

CHARLES F. KETTERING.