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W. L. SHUCK ET AL

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MANIFOLD ACTUATED ELECTRIC SWITCH DEVICE

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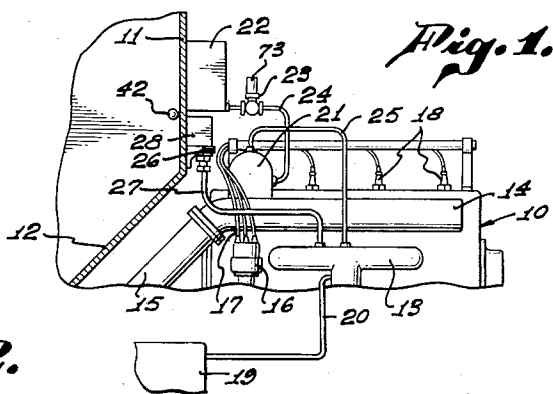


Fig. 2.

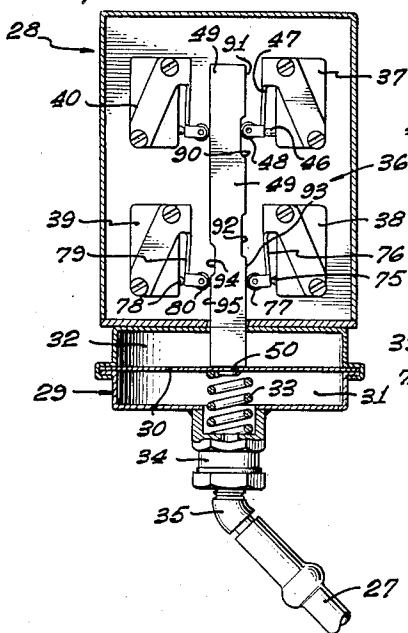


Fig. 3.

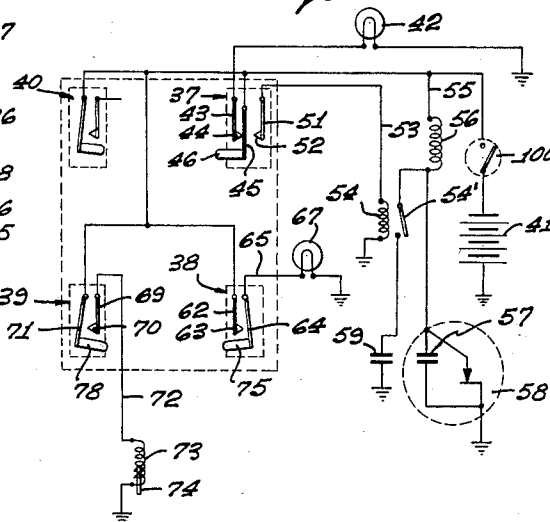


Fig. 4.

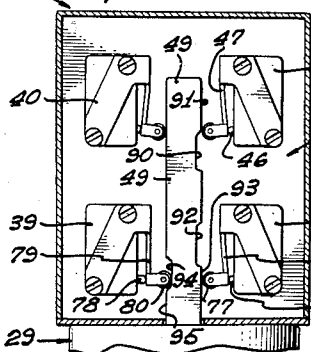
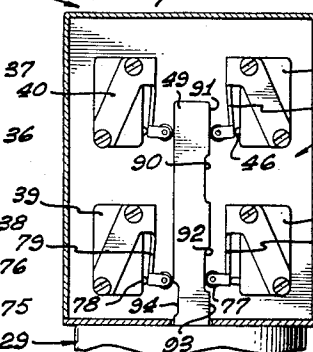


Fig. 5.



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MANIFOLD ACTUATED ELECTRIC SWITCH DEVICE

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11 Claims. (Cl. 123—25)

The invention relates to internal combustion engines and has particular reference to a switch device actuated by changes in manifold pressure for causing actuation of attendant devices and mechanisms, the manipulation of which is directly related to engine performance as reflected in the manifold pressure.

It is well established that in internal combustion engines the pressure present in the intake manifold varies to a considerable degree while the engine is in operation dependent upon demands for power from the engine, the rapidity with which fuel is fed to the engine, and engine performance in general. In point of fact the pressure in the intake manifold is particularly sensitive to changes in engine operation and demand and is a very accurate indicator of the condition of operation of the engine. Moreover, manifold pressures in the intake manifold are strong and positive and can be depended upon as a source of power within a specific range for performing certain work.

Manifold pressure has been used to a limited extent as a motive power as, for example, in the operation of windshield wipers.

In the operation of motor vehicles which use a combustion engine, inefficient operation is frequently experienced because fuel fed to the engine is not properly regulated. Further still, in the operation of motor vehicles, and particularly in the operation of those vehicles at high speeds, it is desirable to employ some sort of warning signal to a following vehicle when the engine speed is cut and the vehicle is slowed down or stopped.

Efficient operation depends further to a degree upon changing the input of fuel, oil and even water vapor at high speeds over the character of input of fluids at low speeds.

While some attempts have been made in the past to make use of intake manifold pressures to cause operation of gages, such efforts have to a large extent been confined to employment by mechanics and specialists in that the condition of pressure of the intake manifold as relates to engine performance is little or poorly understood by the average operator.

It is therefore among the objects of the invention to provide a new and improved electric switch device which is actuated by changes in pressure in the intake manifold of a combustion engine to perform certain work in the nature of operating signals and operating devices which may be relied upon to alter the flow of fluids into the engine.

Another object of the invention is to provide a new and improved manifold pressure actuated electric switch device which is simple in its construction, operation and assembly and inexpensive to both manufacture and install.

Still another object of the invention is to provide a new and improved manifold pressure actuated electric switch device which is capable of operating a plurality of different switches for the performance of different kinds of work at different manifold pressures.

A still further object of the invention is to provide a

new and improved manifold pressure-responsive electric switch device wherein different electric switches actuated by the device at various pressure levels can be used for a many-fold purpose as, for example, indicating stalled engine condition, indicating economical driving conditions of the engine, indicating a slowing down of the engine in advance of actual deceleration of the vehicle, and in operating any power actuated medium as, for example, controlling injection of fuel, oil or water vapor into the intake manifold under certain special conditions where such changed inflow of fluids is important to efficient operation of the engine.

Also among the objects of the invention is to provide a new and improved manifold actuated switch for controlling condenser capacity in the electric circuit to the distributor and ignition system.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a side elevational view of a typical combustion engine showing the relationship of various engine parts and accessory devices capable of being made use of by the manifold pressure actuated electric switch of the invention.

Figure 2 is an elevational view partially in section revealing diaphragm actuated electric switches showing the device in the position occupied at rest.

Figure 3 is a schematic representation of the diaphragm actuated electric switches and related and associated devices dependent upon positions of the switches for actuation.

Figure 4 is a view of the electric switch portion of the device of Figure 2 showing the condition of electric switches when the intake manifold pressure is in one of the operative ranges.

Figure 5 is a view similar to Figure 4 showing the condition of the switches when the intake manifold pressure is in another of the operative ranges.

In the embodiment of the invention chosen for the purpose of illustration there is shown a combustion engine 10 of a type currently in use on automotive vehicles. The engine as shown is mounted in front of an instrument panel 11, below which is a floor board 12. The engine is shown equipped with an intake manifold 13 and an exhaust manifold 14 which connects to an exhaust pipe 15. A distributor 16 is shown at the side of the engine by means of which electric current is conducted through wires 17 to spark plugs 18 in order to provide ignition for fuel gases admitted into the engine through the intake manifold 13.

To supply fuel to the engine there is shown by way of illustration a fuel tank or reservoir 19 connected by means of a fuel pipe 20 to the intake manifold. A housing 21 is shown mounted directly upon the exhaust manifold 14 which is normally at a relatively high temperature. The housing being so situated is adapted to be employed as a heater. An auxiliary fluid tank 22 is shown connected through a valve 23 to an auxiliary fluid supply line 24 to the heater, there being an auxiliary fluid supply pipe 25 from the heater 21 to the intake manifold 13. A pressure actuated diaphragm device 26 is connected through a tube 27 to the intake manifold in order that the pressure condition of the manifold may be conveyed to the pressure responsive diaphragm device. This in turn is connected to an electric switch device 28 for the manipulation of various auxiliary mechanisms.

As shown in greater detail in Figure 2, the diaphragm device consists of a housing 29, across the center of which

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is stretched a flexible diaphragm 30 forming one side of a lower pressure chamber 31 in the housing 29. An upper chamber 32 is substantially open to the atmosphere so as to be subject to atmospheric pressure. A spring 33 serves to normally maintain the diaphragm in undistorted position, as illustrated in Figure 2. At the bottom of the housing 29 is a fitting 34 to which is connected a bib 35 in turn connected to the tube 27 which, as previously indicated, is adapted to connect into the intake manifold of the combustion engine 10. Accordingly, whatever pressure exists in the intake manifold 13 will be reflected immediately in the pressure chamber 31 of the diaphragm device.

Mounted immediately adjacent the diaphragm device is a switch mounting 36 which may be in the form of a closed container having one wall adapted to have switches 37, 38, 39 and 40 mounted thereon. Each of the switches 37, 38, 39 and 40 is an electric switch preferably of a micro switch size capable of turning on and off an electric circuit. Reference is made to Figure 3 for an understanding of the normal condition of the switches herein referred to. The position of the switches in the schematic diagram of Figure 3 is the same as the position of the switches shown in Figure 2. This is normal or inoperative position, namely, the position of the switches when the engine is dead and the ignition turned off.

As shown an ignition switch 100 is connected at one side to a common terminal for all the switches and at the other side to a storage battery 41 of the vehicle. In circuit with switch 37 is a light 42 which may be designated as a warning light or as an economy light or both. The terminal of the light 42 remote from ground connects to a switch arm 43 having a contact point 44 thereon in engagement with a moving switch arm 45. A plunger 46 on the switch arm is adapted to bear against a resiliently swinging finger 47 having a roller 48 thereon, which roller is adapted to roll along an actuator arm 49 connected at its lower end rigidly to the center of the diaphragm 30 at the point 50. Therefore as the diaphragm flexes up and down, the actuator arm 49 will shift up and down in response to diaphragm movement.

In the same switch 37 is a second switch arm 51 having a contact point 52 thereon normally open with respect to the switch arm 45, as shown in Figure 3. The switch connects through a lead 53 to a relay coil 54 and thence to ground. A relay switch 54' is connected in circuit with the battery 41 and ignition switch through an ignition coil 56. When the switch 54' is closed a circuit is completed through a condenser 59 which augments the capacity of a conventional condenser 57 in a distributor 58. Additional condenser capacity is desirable under certain operating conditions and inasmuch as the manifold pressure is a direct measure of the operating needs of the engine, that pressure can be used to directly control the condenser capacity through the agency of the switch 37.

Switch 38 is shown provided with a switch arm 62 having a contact point 63 thereon normally open or disengaged from an armature 64. The switch arm is supplied with current from the ignition switch. The armature is connected through a lead 65 to a warning light 67 and thence to ground. As indicated, the warning light will normally be de-energized and therefore unlighted even though the ignition switch is turned on.

The switch 39 contains a switch arm 69 having a contact point 70 normally open with respect to an armature 71. The armature 71 is supplied through the ignition switch 100 and the switch arm is connected to a solenoid 73 and thence to ground, thereby to actuate a solenoid core 74 in the solenoid whenever the switch is closed.

A plunger 75 on armature 64 of the switch 38 bears against a finger 76 which through roller 77 engages the actuator arm 49. Similarly a plunger 78 bears against

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finger 79 thereby to urge roller 80 against the actuator arm 49. In the chosen embodiment the switch 40 is considered as a spare.

As illustrated in Figure 2, the switches are positioned in the adjustment they would have with the motor at rest and the ignition switch open. When the ignition switch 100 is closed, current will flow through the switch arm 43 and switch arm 45, thereby passing current through the light 42. This will be the condition before the engine 10 is started. The light 42 therefore serves as a warning light to indicate that the engine is stalled or not running, in any event, though the ignition is turned on.

When the engine is started, the manifold pressure will lower in the intake manifold 13 to an amount usually 18" to 21" of mercury and this pressure condition will be translated to the pressure chamber 31, causing the diaphragm to depress. A recess 90 in the actuator arm 49 in which roller 48 normally rests will change position as the actuator arm 49 moves down until a relatively raised portion 91 on the arm strikes the roller 48, shifting the finger 47 toward the right, as viewed in Figures 2 and 3, thereby to open contact at the switch point 44, causing the light 42 to be extinguished. At the same time contact is closed at the switch point 52, thereby making contact with the relay coil 54 and adding condenser 59 to the ignition circuit.

As the engine is brought up to speed under normal operating conditions, the pressure condition in the intake manifold will continue relatively low so that the roller 48 remains on the high portion 91 of the actuator arm. During operation of the engine, should the throttling of the engine be inexpertly manipulated so that fuel is fed to the engine when not needed, the pressure condition in the intake manifold will change to a somewhat higher stage, returning the diaphragm toward its initial position, thereby raising the arm 49 so that the roller falls again into the recess 90 causing the light 42 to become illuminated. This, therefore, becomes a signal to the operator of the vehicle that fuel is not being fed into the engine at an economical rate. The feeding of fuel can then be changed to a rate such that the light 42 remains dark.

As the engine is running along at relatively high operating speed, the intake manifold pressure as previously indicated will be low. Low condition causes the actuator arm 49 to be shifted to a lower position against the resistance of the spring 33 and to a position sufficiently low that the roller 77 rides upon a raised portion 93. The switch 38 will therefore remain open and the warning light 67 extinguished. Should the operator of the vehicle remove his foot from the accelerator pedal, thereby diminishing the flow of fuel through the intake manifold to the engine, this condition will be immediately reflected in a lowering of the intake manifold pressure, which pressure, being transferred to the pressure chamber 31, will cause the diaphragm 30 to move down far enough so that the roller 77 falls into the recess 92, as illustrated in Figure 5. This causes the switch 38 to close by reason of movement of the armature 64 from right to left, as viewed in Figures 3 and 5, thereby closing the circuit through the warning light 67 which becomes illuminated. Hence the warning which will be located at the rear of the vehicle will flash on in advance of the operator being able to press the usual brake pedal which under ordinary circumstances is depended upon to flash a signal to an oncoming vehicle at the rear. Although a reduction in engine speed will ultimately create a condition wherein the manifold pressure will again change to a low pressure, the signal will have been given prior to the vehicle being driven at a steady lower speed.

It is commonly understood that combustion engines when driven at a high rate of speed ordinarily need more oil. Also they can be more efficiently operated at higher speeds when a slight amount of water vapor is injected

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with the supply of fuel. At lower speeds sufficient oil reaches the engine without an auxiliary supply being requisite. At lower speeds the injection of water vapor is less desirable. For higher, normal driving speeds a recess 94 may be provided in which the roller 80 can fall. The recess 94 has some length or land so that the roller 80 may remain in the recess throughout an appreciable range of movement of the actuator arm 49 at the desired pressure range. When the roller 80 lies in the recess 94, switch 39 will be closed. This is the condition illustrated in Figure 4. By closing the switch 39 solenoid 73 is energized, making it possible to shift location of the core 74. This motion may be employed to turn on the valve 23, thereby to admit contents of the reservoir 22 into the heater 21 wherein the contents can be vaporized by heat passed to the heater from the exhaust manifold and the vaporized contents passed through the auxiliary fluid supply pipe 25 to the intake manifold 13 from which it can reach the engine. When the engine speed shifts so that roller 80 rides up on a raised portion 95 of the actuator arm 49, the switch 39 will be opened, de-energizing the solenoid 73, thereby causing through suitable conventional mechanism the valve 23 to be closed. This shuts off the supply of auxiliary fluid and the engine will then continue to receive only the conventional supply of fuel through its intake manifold.

The illustration of Figure 1 is intended as illustrative in that the reservoir 22 may be one for auxiliary oil or one for water. If need be two such reservoirs could be supplied both joined to an auxiliary fluid supply line and suitable valves for injection of their respective fluid into the intake manifold, the structure merely being a multiple of the illustration of Figure 1. Either vaporized or unvaporized fluids can be added. Moreover, the auxiliary fluid may be engine fuel, if desired, for special operating needs.

There has accordingly been shown and described a particularly effective, simple, electric switch edvice so arranged with respect to a diaphragm actuated arm that the switches can be set to open and close at any selected pressure stage of the intake manifold. The pressure condition, therefore, of the intake manifold can be made use of to cause any one of a plurality of electric circuits in which are electric devices for the performance of certain work or the indication of certain signals, all of which are directly related either to the operating condition of the motor, or the vehicle, or both.

While we have herein shown and described our invention in what we have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of our invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pressure at different stages of engine operation the combination of a housing having a pressure chamber, a pressure-responsive element in the housing movable to positions throughout different ranges and closing one side of the pressure chamber, a tube communicating between the pressure chamber and the manifold, an electric switch member, a switch actuator member, one member of said members being mounted stationarily and the other of said members being mounted on said pressure-responsive element and extending to a location adjacent said one member and movable in response to movement of the pressure-responsive element, one of said members having an area adapted to hold the other member in one position and another area adapted to hold said other member in another position, whereby the switch is shifted

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in response to movement of said pressure-responsive element to a selected position.

2. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pressure at different stages of engine operation the combination of a diaphragm housing having a pressure chamber, a pressure-responsive diaphragm in the housing closing one side of the pressure chamber, a tube communicating between the pressure chamber and the manifold, a switch mounting on the housing, an electric switch on said mounting, a switch actuator on said diaphragm extending to a location adjacent said switch and movable in response to movement of the diaphragm throughout different ranges, an armature on the switch, said switch actuator having a portion thereof of selected linear extent engageable with the armature at a selected position range of said actuator and diaphragm and the remaining portion of said switch actuator having a position out of potential engagement with the armature whereby the switch is shifted in response to diaphragm position in said selected position range.

3. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pressure at different stages of engine operation and including a source of electric power connected thereto the combination of a pressure-responsive device having a pressure chamber connected to said manifold, a pressure-responsive member therein movable in response to changes in manifold pressure to outer and inner lineal ranges, an actuator member and an electric switch member, one of said members being mounted on and movable with the diaphragm, said electric switch including an armature having one position of engagement with said actuator member at rest position and at positions in one of said ranges, a warning light adapted for location at the rear of the vehicle, said warning light being in a series circuit with the switch and the source of electric power, said switch being normally open, said actuator member including trip means extending throughout a lineal range conforming to one of said outer and inner ranges and operably engageable with the armature only when the manifold pressure is sharply changed to said other range whereby to energize said warning light when manifold pressure shifts to the stage prevalent as gas supply to the engine is cut off.

4. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pressure at different stages of engine operation and including an ignition switch and a source of electric power connected thereto the combination of a pressure-responsive diaphragm device having a pressure chamber connected to said manifold and wherein no communication prevails between opposite sides of said diaphragm, a diaphragm therein and an actuator arm mounted on and movable with the diaphragm in response to changes in manifold pressure to outer and inner lineal ranges, an electric light switch including an armature in constant physical communication with said arm and having one position of engagement with said arm at rest position and at positions in one of said ranges, a warning light adapted for location at the rear of the vehicle, said warning light being in a series circuit with the light switch, the source of electric power and the ignition switch, said light switch being normally open, said arm including trip means extending throughout a lineal range conforming to one of said inner and outer ranges and operably engageable with the armature throughout the other of said ranges only when the manifold pressure is sharply lowered thereby to shift said arm to the other of said ranges whereby to energize said warning light when manifold pressure shifts to a stage prevalent as gas supply to the engine is cut off.

5. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pres-

sure at different stages of engine operation and including an ignition switch and a source of electric power connected thereto the combination of a pressure-responsive diaphragm device having a pressure chamber operably connected to said manifold, a diaphragm therein secured at the edge and having the center thereof subject to a reciprocating motion and an actuator arm mounted at the center of and movable with the diaphragm in response to changes in manifold pressure throughout a plurality of lineal ranges, an electric light switch including an armature having one position of engagement with said arm within one range and at a rest position and another position throughout another of said ranges, a stalled engine light in circuit with the light switch, the source of electric power and the ignition switch, said light switch being normally closed and adapted to energize said light when the ignition switch is closed, said arm including trip means operably engageable with the armature only when the manifold pressure changes under engine operation and said arm moves to locations throughout another range whereby to open said light switch to de-energize said light when said engine is operating.

6. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pressure at different stages of engine operation and including an ignition switch and a source of electric power connected thereto the combination of a pressure-responsive diaphragm device having a pressure chamber operably connected to said manifold, a diaphragm therein secured at the edge and having the center thereof subject to a reciprocating motion and an actuator arm mounted at the center of the diaphragm and movable with the diaphragm in response to changes in manifold pressure throughout upper and lower ranges, an electric light switch including an armature having one position of engagement with said arm at a rest position and throughout a position in one of said ranges adjacent rest position, a warning light in circuit with the light switch, the source of electric power and the ignition switch, said light switch being normally closed and adapted to energize said warning light when the ignition switch is closed, said arm including trip means operably engageable with the armature only when the manifold pressure changes under engine operation and said arm moves throughout a location in the other of said ranges whereby to open said light switch to de-energize said warning light when said engine is operating under efficient operating conditions.

7. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pressure at different stages of engine operation and including an ignition switch and a source of electric power connected thereto the combination of a pressure-responsive diaphragm device having a pressure chamber operably connected to said manifold, a diaphragm therein secured at the edge and having the center thereof subject to a reciprocating motion and an actuator arm mounted at the center of the diaphragm and movable with the diaphragm in response to changes in manifold pressure throughout different ranges, an electric light switch including an armature having one position of engagement with said arm within a range of movement adjacent a rest position, a warning light in circuit with the light switch, the source of electric power and the ignition switch, said light switch being normally closed and adapted to energize said light when the ignition switch is closed, said arm including trip means operably engageable with the armature only when the manifold pressure changes under engine operation and said arm moves throughout a range outside of said first-identified range whereby to open said light switch to de-energize said warning light when said engine is operating and throughout a range of efficient operating conditions.

8. In a motor vehicle having a combustion engine, an intake manifold, an exhaust manifold and an auxiliary

fluid supply the combination of a pressure-responsive diaphragm device having a pressure chamber operably connected to the intake manifold, a diaphragm therein movable in response to pressure changes in the intake manifold whereby at high engine speeds the diaphragm moves in one pressure range and at low engine speeds the diaphragm moves in another pressure range, an actuator arm mounted on and movable with the diaphragm, an electric switch having an armature means normally in engagement with the arm when the arm and the diaphragm are in position in one of said ranges, a trip on said arm cooperable with the armature means in the other of said pressure ranges whereby to change the position of said switch, a heater, a liquid reservoir connected to the heater and a liquid line from said heater to said intake manifold, a valve between the reservoir and the heater having an electric actuator therefor, said electric actuator being in circuit with said switch and adapted when energized by the closing of the switch to change the position of said valve whereby to change the flow of liquid through said heater to the intake manifold.

9. In a motor vehicle having a combustion engine, an intake manifold, an exhaust manifold and an auxiliary fluid supply the combination of a pressure-responsive diaphragm device having a pressure chamber operably connected to the intake manifold, a diaphragm therein movable in response to pressure changes in the intake manifold whereby at high engine speeds the diaphragm moves in one pressure range and at low engine speeds the diaphragm moves in another pressure range, an actuator arm mounted on and movable with the diaphragm, a normally open electric switch having an armature means normally in engagement with the arm when the arm and the diaphragm are in position in one of said ranges, a trip on said arm cooperable with the armature means in the other pressure range whereby to effect closing of said switch, a heater on the exhaust manifold, a separate liquid reservoir and a liquid line from said reservoir through said heater directly to said intake manifold, a normally closed valve between the reservoir and the heater having a solenoid actuator therefor, said solenoid being in circuit with said switch and adapted when energized by the closing of the switch to open said valve and admit liquid through said heater to the intake manifold.

10. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pressure at different stages of engine operation and including a source of electric power connected thereto the combination of a pressure-responsive device having a pressure chamber connected to said manifold, a pressure-responsive member therein movable in response to changes in manifold pressure to outer and inner ranges, an actuator member and an electric switch member, one of said members being mounted on and movable with the diaphragm, said electric switch including an armature having one position of engagement with said actuator member at rest position and at positions in one of said ranges, a distributor having a condenser therein connected to said source of electric power, an auxiliary condenser connected with said source of electric power in parallel with the first identified condenser, the circuit to said second identified condenser having a relay switch therein responsive to operation of said electric switch and said pressure responsive device.

11. In a motor vehicle having a combustion engine including an intake manifold subject to changes in pressure at different stages of engine operation the combination of a housing having a pressure chamber, a pressure-responsive element in the housing movable to positions throughout different ranges and closing one side of the pressure chamber, a tube communicating between the pressure chamber and the manifold, a plurality of electric switch members, a switch actuator member, one of said members being mounted stationarily and the other of said members being mounted on said pressure-responsive element and

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extending to a location adjacent the first-identified member and movable in response to movement of the pressure-responsive element, one of said members having an engagement area of uniform extent and a plurality of lineally extending areas at different inner and outer locations offset relative to said area of uniform extent, the other of said members having engaging elements adapted to engage said one member both within respective offset areas and throughout portions of said area of uniform extent whereby the switch members are variously shifted in response to movement of said pressure-responsive element to different ranges of position.

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