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FOR AUTOMOTIVE VEHICLES

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2 Sheets-Sheet 1

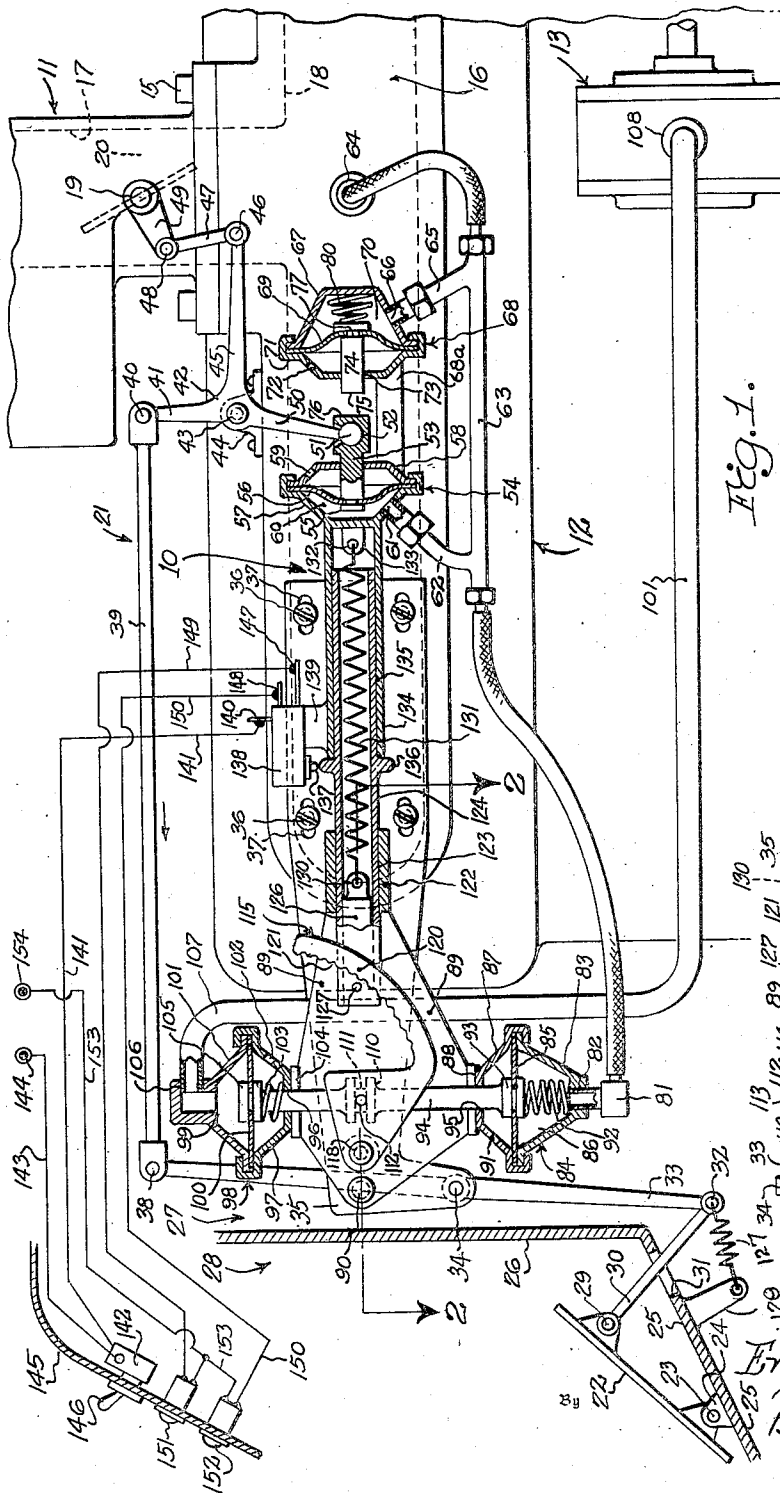


Fig. 1.

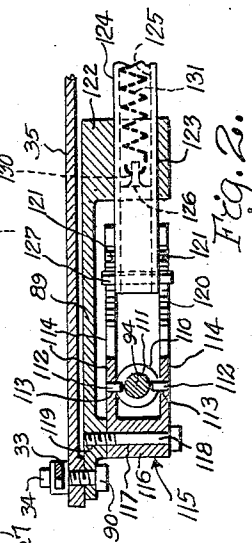


Fig. 2.

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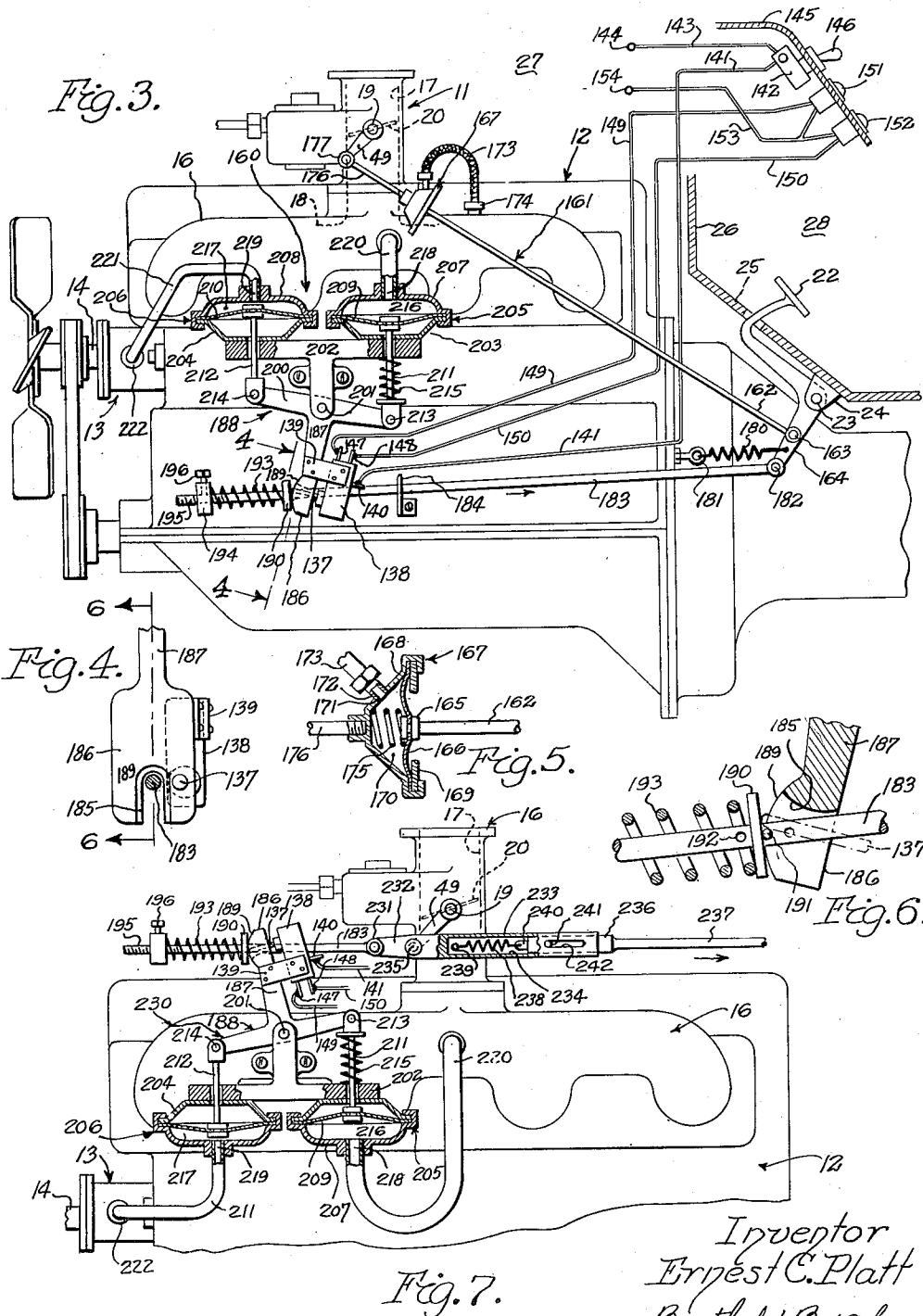
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ENGINE CONDITION SIGNAL ARRANGEMENT FOR AUTOMOTIVE VEHICLES

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Application March 29, 1952, Serial No. 279,435

15 Claims. (Cl. 340—52)

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This invention relates to automotive vehicle engines and, in particular, to automobile carburetor controls for such engines.

One object of this invention is to provide an automatic carburetor control for automotive vehicle engines operated at varying speeds, whereby the operator is enabled to operate his foot throttle pedal in the normal way but is warned by encountering an increased resistance to depressing the pedal when he attempts to depress it at a rate which causes the engine to operate in a manner which is wasteful of fuel.

Another object is to provide an automatic carburetor control of the foregoing character wherein the warning resistance encountered in operating the engine outside of its economical range is interposed in response to a drop in the intake manifold vacuum below a predetermined manifold vacuum at low operating speeds, and wherein the warning resistance is interposed at high speeds in response to an increase in the water pressure from the water pump.

Another object is to provide an automatic carburetor control of the foregoing character wherein the aforesaid warning resistance is interposed according to the composite and resultant effect of the simultaneously operating influences of intake manifold pressure and cooling water pressure, as set forth in the object immediately preceding, so that the resulting effect is a straight line function of the manifold vacuum and speed in miles per hour, even though the individual effects of manifold vacuum and cooling water pressure are not straight line functions, the variation in one effect compensating for the variation in the other effect to produce straight line action.

Another object is to provide an automatic carburetor control which will enable the operator to maintain a relatively high manifold vacuum indicative of economical engine performance merely by paying attention to the pressure which he feels upon his foot as he depresses the accelerator or throttle pedal, hence does not need to take his eyes off the road in order to watch a dial or gauge for this purpose.

Another object is to provide an automatic carburetor control of the foregoing character which is especially well adapted for use with engine carburetors equipped with so-called enrichment jets which supply additional fuel to the engine at high speeds for increased performance or for use with multiple barrel carburetors for the same purpose, both being exceedingly wasteful of fuel when operated improperly, the operator being instantly

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warned by increased pressure upon his foot in depressing the accelerator pedal too rapidly for economical operation of the engine.

Another object is to provide an automatic carburetor control of the foregoing character which is also useful in the same manner to warn the operator of an automotive vehicle equipped with an automatic transmission when he operates the vehicle uneconomically for obtaining a quick get away by a too rapid depressing of the accelerator or carburetor throttle pedal, the operator being similarly warned by increased resistance to further depressing the throttle pedal when he attempts to depress it too rapidly for economical operation.

Another object is to provide an automatic carburetor control of the foregoing character which warns the operator when he is operating the vehicle in an uneconomical manner, as stated above, but which enables him to override the warning device in the event that he desires exceptional performance regardless of wastefulness in fuel consumption.

Another object is to provide an automatic carburetor control of the foregoing character which not only interposes a warning resistance to the too rapid depressing of the throttle pedal to maintain a constant speed on an approximately level road, but also interposes a warning during accelerating speed conditions where excessive fuel consumption occurs because of enrichment jets or additional carburetor barrels or venturis coming into operation to employ excessive fuel.

Another object is to provide an automatic carburetor control of the foregoing character wherein a visible signal is operated when the operator attempts to operate the vehicle in a manner which is wasteful of fuel.

Another object is to provide an automatic carburetor control for automotive engines operated at variable speeds wherein the control mechanism actuates the carburetor throttle valve or butterfly valve directly and independently of the operator to counteract or at least partially correct the uneconomical operation thereof by the operator and smooth out irregularities of accelerator pedal motion.

Another object is to provide regulated accelerator pedal control on level road driving to discourage the operator from excessive up-and-down motion of the accelerator pedal which in the conventional carburetor operates a carburetor accelerator pump to inject a charge of gasoline into the intake manifold every time the operator depresses the pedal.

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Other objects and advantages of the invention will become apparent during the course of the following description of the accompanying drawings, wherein:

Figure 1 is a diagrammatic side elevation, partly in central longitudinal section, of an automatic carburetor control device according to one form of the invention;

Figure 2 is a fragmentary horizontal section taken along the line 2—2 in Figure 1;

Figure 3 is a side elevation, partly in section, of a modified automatic carburetor control device;

Figure 4 is an approximately vertical section taken along the line 4—4 in Figure 3;

Figure 5 is a central vertical section through a link expanding arrangement used in connection with the device in Figure 3;

Figure 6 is an enlarged fragmentary vertical section taken along the line 6—6 in Figure 4; and

Figure 7 is a side elevation, partly in section, of a further modified automatic carburetor control device.

General arrangement

Modern engines used in modern automotive vehicles operated at varying speeds can be, and frequently are, extremely wasteful of fuel when they are operated in a manner which causes the manifold vacuum to drop below an efficient operating pressure. This is particularly true of engines having carburetors equipped with devices for obtaining exceptional performance in get-away or speed, such as, for example, engines equipped with so-called enrichment jets which come into operation above a certain speed, such as 50 miles an hour, in order to provide increased fuel for high speed operation. This is also true of engines equipped with so-called multi-barrel carburetors wherein additional venturis come into operation above a certain operating speed or under conditions where abnormal get-away is demanded by the operator. This is likewise true in the case of vehicles equipped with automatic transmissions, particularly those employing fluid couplings or fluid torque converters which can also be operated in a wasteful manner resulting in excessive consumption of fuel.

Ordinarily, an engine operates economically when the manifold vacuum lies between 14 and 18.5 inches of mercury. When, however, the manifold vacuum drops below this range, the fuel consumption increases rapidly, and when the vacuum drops below 7 inches of mercury, the fuel consumption increases enormously, resulting in great waste. Such waste occurs, for example, when the operator, upon the change of lights at a traffic signal, attempts an excessively quick get-away by forcing the throttle pedal rapidly to the floor. The opening of the butterfly or throttle valve in a carburetor exerts a very critical effect upon the consumption of fuel, and a difference in a few degrees in the throttle valve opening can sometimes mean a considerable difference in fuel consumption. This excessive waste of fuel, moreover, does not always occur at high speeds, for there is a similar wasteful range of speeds below approximately 15 miles an hour, wherein an operator can also operate his automobile uneconomically even though he thinks he is operating it economically by running at a low speed.

The present invention provides a device which warns the operator when he is operating the vehicle wastefully, by interposing an increased resistance to depressing the accelerator or throt-

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tle pedal when the operator attempts to depress that pedal more rapidly than is conducive to economical operation of the engine. The invention operates generally in the manner set forth in the previously-stated objects of the invention and produces the results therein described. In particular, the invention provides what is in effect an expansible link connected to the linkage interconnecting the throttle pedal and the carburetor throttle valve or butterfly valve, the expansion and contraction of this link being operated at low speeds in response to the rise or fall of the vacuum in the intake manifold, at high speeds in response to the increase in pressure of the cooling water coming from the water pump, and at intermediate speeds by a composite of the manifold vacuum and water pump pressure. These pressures operate diaphragm motors to swing a stepped or notched cam which determines the extent to which an expansible link can be expanded and consequently the extent to which the throttle pedal can be operated before the pressure point or increased resistance is applied and felt by the operator's foot. A variable stop arrangement also cooperates with the expansible link and cam mechanism to warn the driver when he is exceeding the economical operating range in accelerating the vehicle in order to change its speed. Modifications of the invention provide different mechanism for interposing the warning pressure and for operating the carburetor throttle or butterfly valve automatically in response to changes in the manifold vacuum and water pump pressure.

Expansible link mechanism with throttle control cam

Referring to the drawings in detail, Figure 1 shows an automatic throttle control device, generally designated 10, as applied to the control of a carburetor, generally designated 11 attached to an automotive vehicle engine, generally designated 12, and shown only diagrammatically and in part. The engine 12 is equipped with a conventional water pump 13 having a shaft 14 driven from a rotating part of the engine in the usual way. The carburetor 11, on the other hand, is bolted or otherwise attached as at 15 to an intake manifold 16 in which, as is well known, a partial vacuum occurs in varying amounts at varying speed and load conditions. The carburetor 11 and engine 12 are shown in a purely diagrammatic way and it will be understood that the invention is adaptable to substantially any form of internal combustion engine employing a carburetor and installed in an automotive vehicle. The carburetor 11 is provided with a passageway 17 leading to the intake manifold passageway 18.

Extending across the carburetor passageway 17 is a shaft 19 carrying the usual throttle valve or butterfly valve 20. The intake manifold passageway or chamber 18 leads to the intake valves of the various cylinders (not shown) as is well known to those skilled in the automotive engine and vehicle art. In order to rock the throttle valve shaft 19 to and fro and consequently vary the amount by which the throttle or butterfly valve 20 closes the carburetor passageway 17, a linkage and lever system, generally designated 21, is provided. This varies in different installations in different vehicles, the arrangement shown being purely diagrammatic in order to show the operation of the invention in a concise space. As shown, the system 21 includes an accelerator pedal or throttle pedal 22 pivotally

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mounted as at 23 upon a bracket 24 attached to the floor board 25, which continues upward in the usual bulkhead 26 between the engine compartment 27 and the operator's compartment 28. Pivotally connected as at 29 to the upper part of the throttle pedal 22 is a link 30 which passes through a hole 31 in the floor board 25 and is pivotally connected as at 32 to the lower end of a lever 33. The lever 33 is pivotally mounted on a fulcrum 34 supported by a bracket or supporting plate 35 which is bolted as at 36 to the intake manifold 16 and is provided with elongated slots 37 for adjustment purposes, as explained below in connection with the operation of the invention.

Pivotally connected as at 38 to the upper end of the lever 33 is a link 39, the forward end of which is pivotally connected as at 40 to the upper arm 41 of a T-lever 42 which is pivotally mounted as at 43 on a bracket 44 which is bolted or otherwise secured to the intake manifold 16. The T-lever 42 has three arms, the second arm 45 being pivotally connected as at 46 to a link 47 which in turn is pivotally connected as at 48 to a crank arm 49 mounted on the throttle valve shaft 19. As a consequence, when the accelerator or throttle pedal 22 is depressed to increase the speed of the engine by opening the throttle or butterfly valve 20 within the carburetor passageway 17, the link 30 swings the lever 33 in a counterclockwise direction around its fulcrum 34, pulling the link 39 in the direction indicated by the arrow adjacent thereto and consequently rocking the T-lever 42 around its fulcrum 43. This causes the arm 45 of the T-lever 42 to push upward on the link 47 and crank arm 49, rotating the throttle valve shaft 19 in a clockwise direction to increase the width of the opening between the throttle valve 20 and the walls of the carburetor passageway 17, and consequently increasing the speed of operation of the engine 12.

The third arm 50 of the T-lever 42 (Figure 1) is connected by a ball and socket joint 51, 52 to one end of a plunger 53 of a diaphragm motor, generally designated 54. The opposite end of the plunger 53 is connected as at 55 to the center of a flexible diaphragm 56 mounted in a casing 57 which is closed on one side by a cover 58 having an air opening or vent 59. The motor casing 57 has an air-tight connection at its rim with the rim of the cover 58 so that the casing 57 and diaphragm 56 enclose an air-tight vacuum chamber 60.

Leading from a port or opening 61 in the casing 57 is a branch pipe 62 connected to the main vacuum pipe 63, partly rigid and partly flexible, which in turn as one end leads to a connection 64 with the intake manifold chamber 18. A second branch pipe 65 leads from the pipe 63 to a port 66 in the casing 67 of a second diaphragm motor, generally designated 68, mounted on a bracket 68a connected to the diaphragm motor 54. The diaphragm motor 68 has a diaphragm 69 therein secured at its rim to the rim of the casing 67 in an air-tight manner to form an air-tight chamber 70 therein. The diaphragm 69 is protected by a cover 71 having a vent 72 therein and also having a hole 73 in the center thereof for the passage of a stop plunger 74, the outer end 75 of which is adapted to move into engagement with the outer end 76 of the plunger 53. The inner end of the plunger 74 is connected as at 77 to the central portion of the diaphragm 69, and engages one end of a compression spring 80, the opposite end of which is seated against the inner wall of the casing 67. Consequently,

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when the vacuum in the diaphragm motor chamber 70 drops, the diaphragm 69 and plunger 74 move to the left under the influence of the expanding compression spring 80.

From its connection at 64 to the manifold chamber 18, the main vacuum pipe 63 runs to a coupling 81 which is seated in a port 82 in the casing 83 of a diaphragm motor, generally designated 84. The motor 84 is provided with a diaphragm 85 which with the casing 83 encloses a diaphragm motor chamber 86. The casing 83 and diaphragm 85 are sealed at their margins in an air-tight joint with a cover 87 secured as at 88 to a bracket or supporting plate 89 which is pivoted as at 90 to the bracket plate 35. The cover 87 is provided with an air vent 91.

Mounted within the casing 83 is a compression spring 92 which engages one end 93 of a connecting rod 94 and normally urges it upward. The end 93 of the connecting rod 94 is attached to the center of the diaphragm 85 in the same manner as the plungers 53 and 74 are connected to their respective diaphragms, and extends outward and upward through a hole 95 in the cover 87 and across the pivoted supporting plate 89, entering hole 96 in the cover 97 of a diaphragm motor, generally designated 98 and has its upper end 99 connected to the central portion of the diaphragm 100 within the casing 101 of the diaphragm motor 98. The cover 97 is provided with an air vent 102 and contains a compression spring 103 which urges the connecting rod 94 and diaphragm 100 upward. The cover 97 of the diaphragm motor 98 is mounted as at 104 on the pivoted supporting plate 89. The diaphragm 100 and casing 101 at their margins are connected to one another in an air-tight joint and enclose a motor chamber 105. The casing 101 is provided with a port 106 to which is connected a water pipe 107 leading to the outlet or pressure port 108 of the cooling water pump 13, whereby cooling water under pressure varying with the speed of the motor 12 is supplied to the chamber 105 to act against the diaphragm 100 of the diaphragm motor 98.

The midportion of the connecting rod 94 is provided with an enlargement 110 containing an annular groove 111, the opposite sides of which are engaged by inwardly-projecting pins 112 (Figure 2) seated in the holes 113 in the twin cam members 114 of a rocking throttle control cam, generally designated 115. The cam members 114 are interconnected by a hub 116 which is bored at 117 to receive a pivot screw 118. The latter is threaded into a hole 119 in the pivoted supporting plate 89. The cam members 114 are provided with arcuate cam arms 120 having roughened concave arcuate portions or contact edges 121. The supporting plate 89 is enlarged at its free end 122 and is there provided with a bore 123 which slidably receives an inner tubular member 124.

The tubular member 124 is provided with a bore 125 which is closed at one end by a plug 126 (Figure 2) fixedly secured therein. Extending laterally from the tubular member 124 at its rearward end is a pin 127 positioned to frictionally engage the roughened arcuate portions 121 of the cam arm 120 when the accelerator pedal 22 is depressed but normally disengaged therefrom. The pin 127 extends outward in opposite directions from the tubular member 124 (Figure 2) and, if desired, also extends through the plug 126. In order to retract the carburetor throttle linkage 21, a tension spring 127 extends from the lower

end of the lever 33 to a bracket 128 beneath the floor board 25.

The opposite ends of a tension spring 131 are attached to holes 130 and 132 in the plug 126 and ear 133 respectively, the latter being connected to the end wall of the diaphragm motor casing 57. The tension spring 131 is less powerful than the compression spring 80, so that the latter may override the former. Also attached to the casing 57 and extending rearwardly therefrom is an outer tubular member 134 which telescopes with the tubular member 124, having a bore 135 which slidably receives the tubular member 124.

Projecting from the inner tubular member 124 intermediate its ends is an annular enlargement 136 which is adapted to engage the operating plunger 137 of a conventional single pole double-throw switch 138 mounted on a bracket 139 attached to the outer tubular member 134. Electric current is supplied to the single pole double-throw switch 138 through the lug 140 from which a wire 141 runs to one pole of an energizing switch 142, from the other pole of which a wire 143 runs to a point of connection 144 to a source of electric current such as the storage battery of the vehicle. The switch 142 is mounted on the dash 145 of the vehicle and is provided with an operating lever 146.

The single pole double-throw switch 138 is provided with two alternately energized poles or lugs 147 and 148 from which wires 149 and 150 respectively run to one pole each of a pair of warning signal devices 151 and 152 from the opposite poles of which a wire 153 runs to a point of connection 154 of electric current of opposite polarity to the point of connection 144 and connected to the same source of electricity such as the storage battery of the vehicle. The signal devices 151 and 152, like the energization switch 142, are mounted on the dash 145 of the vehicle and are distinguishable from one another in some suitable manner, as for example, by providing the signal device 151 with a red bulb and/or lens, and the signal device 152 with a green bulb or lens.

Operation

The operation of the automatic carburetor control device 10 of Figure 1 depends upon the principle that at ordinary speeds the fuel economy of the vehicle is indicated by the presence of a high vacuum in the intake manifold of the engine. This vacuum is, of course, caused by the suction exerted by the pistons during their intake strokes. If the operator, however, opens the carburetor throttle valve 20 too rapidly in accelerating the speed of the vehicle, he admits an excess of air through the carburetor passageway 17, reducing the vacuum in the intake manifold passageway 18. This results in a waste of fuel which the engine is incapable of efficiently utilizing at that particular moment. As a consequence, the operation of the automatic carburetor control device 10 of the invention at ordinary speeds, for example, up to approximately 45 to 50 miles per hour, is made to depend upon and be actuated in response to the variation in the intake manifold vacuum and also in a speed sensitive factor such as cooling liquid pressure.

As the speed of the vehicle increases, the manifold vacuum gradually drops while the pressure of the cooling water from the cooling pump gradually rises. Accordingly, at speeds of approximately 30 to 40 miles per hour, the cooling water pressure has increased to the point where it gradually takes over control of the device 10. Figure 75

1 shows the positions of the parts while the vehicle is traveling approximately 60 miles per hour, with the water pressure holding the diaphragm 106 of the diaphragm motor 98 against the spring 103 and with the throttle valve or butterfly valve 20 well open. At the same time, the cooling water pressure has moved the diaphragm 85 and plunger 94 of the diaphragm motor 84, swinging the cam 115 in a clockwise direction so that the pin 127 lies opposite the portions of the contact edges 121 toward the ends of the cam arms 120. Since the pin 127 is out of contact with the cam arms 120 except when accelerating, the cam arms 120 move freely to and fro in response to changes in the intake manifold vacuum or cooling water pressure of both.

Let it be assumed that the engine has just been started, creating a high vacuum in the intake manifold 16, whereas the cooling water pressure is very low. Accordingly, the device 10 at low speeds and at idling speed is controlled substantially entirely by a high vacuum in the intake manifold passageway 18. This vacuum causes the diaphragms 56 and 69 of the diaphragm motors 54 and 63 and their plungers 53 and 74 to be retracted into the positions shown in Figure 1.

To increase the speed of the engine and vehicle, the operator depresses the accelerator pedal 22 in the usual way, rocking the levers 23 and 42 in a counterclockwise direction, thereby moving the crank arm 49 and throttle valve shaft 19 in a clockwise direction, and opening the throttle valve 20. So long as the operator opens the throttle valve 20 no faster than the engine is able to utilize the fuel supplied to it and thereby to maintain a sufficiently high vacuum in the intake manifold passageway 18, the diaphragms 56, 69 and 85 remain in their advanced positions of Figure 1, and the telescoping tubular members 124 and 134 remain held together by the tension spring 131 and move as a unit in response to the counterclockwise rocking of the arm 50 of the T-lever 42. Since the switch 138 moves bodily with the outer tubular member 134 by reason of its bracket 139 being mounted thereon, its operating plunger 137 remains in contact with the enlargement 136 on the inner tubular member 124, maintaining the circuit closed between the switch connections 140 and 143 and consequently lighting the green signal lamp 152. Consequently, if the operator is depressing the accelerator pedal 22 at an efficient rate so as to maintain a high manifold vacuum, he is notified of the efficient and economical operation of his engine by the burning of the green signal lamp 152 and by his feeling only the normal resistance of the accelerator pedal 22.

If, however, the operator is impatient and depresses the accelerator pedal too rapidly, so that the throttle valve 20 opens faster than the engine is able to absorb the air coming through the passageway 17 and the intake manifold vacuum consequently drops, the lowering of the vacuum in the chambers 60, 70 and 86 of the diaphragm motors 54, 63 and 84 causes the diaphragms 56, 69 and 85 to return to their normal positions, thereby causing the ends 76 and 75 of the plungers 53 and 74 to move toward and into engagement with one another, the plunger 74 being so urged by the spring 80, which, it will be recalled, is more powerful than the spring 131. As a consequence, with the plungers 53 and 74 in abutting engagement with one another, and with their casings 57 and 67 rigidly interconnected by the

bracket 68a, they and the outer tubular member 134 together with the switch bracket 139 and switch 138 move to the right as a unit as the operator further depresses the accelerator pedal 22. The inner tubular member 124, however, is prevented from moving by the engagement of the sharp-edged pin 127 with the notches 121 of the cam arms 120, hence remains stationary momentarily. The outer tubular member 134 moves relatively to the inner tubular member 124 together with the diaphragm motors 54 and 68 and their interconnecting bracket 68a as the T-lever 42 rocks counterclockwise on its pivot 43, stretching the tension spring 131. The stretching of this tension spring 131, which is already in a state of pre-tension, sets up an additional force which is felt by the operator in his foot as he pushes the pedal 22 downward. At the same time, the switch 138 and its plunger 137 move to the right away from the enlargement 136, whereupon the plunger 137 is free to move downward, breaking the circuit between the switch connections 140 and 143 and closing the circuit between the connections 140 and 147. This action de-energizes the green signal light 152, causing it to go out, and energizes the red signal light 151, causing it to go on. The operator is thus warned both by the increased pressure encountered by his foot and by the burning of the red signal light 151 that he is attempting to open the throttle valve 20 more rapidly than the engine can utilize fuel.

If the operator wishes to continue to operate his engine economically, he relaxes his pressure on the foot pedal 22, permitting the throttle valve 20 to close slightly, causing the vacuum to rise in the passageway 18 of the intake manifold 16. This re-actuates the diaphragm motors 54, 68 and 84, causing the plungers 53 and 74 to return to the positions shown in Figure 1, whereupon the outer tubular member 134 and switch 138 slide toward the left along the inner tubular member 124, re-engaging the switch plunger 137 with the enlargement 136. This breaks the circuit between the switch connections 147 and 140 and closes the circuit between the switch connections 140 and 143, de-energizing the red signal light 151 and re-energizing the green signal light 152. During the foregoing action, the bracket 39 supporting the moving parts of the device 10 pivots on the pivot pin 90 mounted on the bracket 35, as the lever arm 50 swings to and fro.

If, however, the operator disregards the above warnings, he can override the increased pressure due to the tension spring 131 and obtain increased performance even if that performance is wasteful of fuel. This is particularly true in the case of vehicles equipped with automatic transmissions, where excessively quick getaway at a traffic signal is usually accomplished at the expense of economy of operation. The cam 115 is swung to and fro by the diaphragm motor 84 in response to the change in the vacuum conditions in the intake manifold, so that the pin 127 engages the notches 121 at different locations along the arcuate arms 120, and hence positions the inner tubular member 124 at correspondingly different locations.

When the vehicle speed rises above approximately 30 to 40 miles an hour, the manifold vacuum normally drops, even with efficient operation of the engine. Meanwhile, however, the pressure of the cooling water delivered through the pipe 101 from the water pump 13 has been steadily rising and exerting its force against the diaphragm 98 of the diaphragm motor 98. At

low speeds, this force is too weak to greatly affect the operation of the vacuum diaphragm motor 84, but at the above higher speeds it takes over the operation of the cam 115 from the vacuum diaphragm motor 84. Accordingly, at these high vehicle speeds, the water pressure diaphragm motor 98 shifts the rod 94 to and fro and consequently swings the control cam 115 to and fro around its pivot pin 118 to engage the cam notches 121 with the sharp-edged pin 127 on the end of the inner tubular member 124, in the same manner as is accomplished by the vacuum diaphragm motor 84 at lower operating speeds.

The diaphragm motors 54 and 84 operate to control the carburetor 11 under road load or level driving conditions at speeds which do not vary greatly during normal running operation. The stop 74 and the vacuum diaphragm motor 68 which operates it, however, come into play to exert their maximum effect during accelerating conditions, such as starting the vehicle in motion or in passing other vehicles on the road. It is especially operative under vacuum manifold pressures of approximately 7 inches of mercury or less where the waste of fuel is highest under accelerating conditions.

The effect of the water pressure upon the diaphragm motor 98, of course, does not occur suddenly but builds up gradually as the speed of the vehicle increases and the vacuum in the intake manifold 16 gradually diminishes. The resultant action and reciprocation of the rod 94 and consequently the swinging of the notched control cam 115 is a composite of the combined action of the vacuum diaphragm motor 84 and the water pressure diaphragm motor 98, the cooperative action of these motors resulting in an approximately straight line action over the entire speed range of the vehicle.

The operation of the carburetor control device 10 is particularly beneficial not only in connection with the use of vehicles equipped with automatic transmissions, as mentioned above, but also with those having carburetors equipped with so-called enrichment jets or with multiple barrel carburetors, as previously mentioned. The device 10 warns the driver when he is operating the vehicle wastefully, yet permits him to override the warning, if he so desires, in order to obtain excessive performance from a powerful engine.

Modified automatic carburetor control device

The modified automatic carburetor control device, generally designated 160, shown in Figures 3 to 6 inclusive, is similar in principle to the carburetor control device 10 shown in Figures 1 and 2 but differs in construction and also lacks the automatic stop arrangement 68 shown at the right-hand end of Figure 1. The modified carburetor control device 160 is shown with substantially the same construction for the engine 12, carburetor 11, water pump 13, intake manifold 16, and foot pedal 22, and designated with the same reference numerals. The dash 145 is also equipped with the same switches and signal devices connected in the same manner and designated with the same reference numerals and having the same circuit leading to the single pole double-throw switch, also designated with the same reference numerals.

The crank arm 49 of the carburetor throttle valve shaft 19, however, is connected to the foot pedal 22 by a somewhat different linkage, generally designated 161. This consists of a lower rod 162 pivoted at its lower end 163 to the foot

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throttle pedal arm 164 and connected at its upper end 165 (Figure 5) to the center of the diaphragm 166 of a diaphragm motor, generally designated 167. The latter has a casing 168, the rim of which cooperates with a washer or gasket 169 to form an air-tight connection and to enclose and air-tight chamber 170. A port 171 is formed in the wall of the casing 168 and receives the pipe coupling 172 from which a pipe 173, preferably flexible, runs to a coupling 174 leading through the wall of the intake manifold 16 into the intake manifold passageway 18. A compression spring 175 is mounted within the casing 168 and normally urges the diaphragm 166 and casing 168 outwardly in opposite directions, and consequently moves upward an upper rod 176 pivoted at 177 at its upper end to the carburetor crank arm 49.

The foot pedal arm 164 is urged toward the engine 12 by a tension spring 180 connected thereto at one end and to an anchorage or I-bolt 181 on the engine 12 at its other end. Pivotaly connected as at 182 to the foot pedal arm 164 is a rod 183 which passes through a suitably apertured guide bracket 184 on the engine 12 past the switch 138 and through a hole or notch 185 (Figures 4 and 6) in the lower end portion 186 of the lower arm 187 of a T-lever 188. Also mounted on the arm 187 and swinging with it is the bracket 139 carrying the single pole double-throw switch 138 previously mentioned in connection with Figure 1. The notched end 186 of the lower arm 187 is provided with arcuate cam surfaces or edges 189 engaged by a washer 190 mounted on the rod 183 and held in position by a pin 191. The pin 191 projects only slightly beyond the opposite sides of the rod 183 so as to hold the washer 190 in place, and is shorter than the width of the notch 185 so as not to collide therewith. The pin 191 is selectively insertable in any one of a series of holes 192 in the rod 183 (Figure 6) so as to provide different adjustments. The washer 190 is engaged by the operating plunger 137 of the single pole double throw switch 138 so as to operate the latter in response to the swinging of the arm 187 of the T-lever 188, as explained in connection with the operation. A compression spring 193 disposed on the rod 183 between the washer 190 and a stop collar 194 urges the washer 190 against the pin 191. The collar 194 is threaded upon the threaded outer end portion 195 of the rod 183 and is held in place by a set screw 196 for retaining it in its adjusted position so as to enable adjustment of the force of the spring 193.

In addition to the arm 187, the T-lever 188 has a cross arm 200 pivoted as at 201 at substantially its mid-portion to a downwardly-projecting arm of a T-shaped bracket 202 which is bolted or otherwise secured to the engine 12. Mounted on the T-shaped bracket 202 are the cup-shaped covers 203 and 204 of two diaphragm motors 205 and 206 having casings 207 and 208 and diaphragms 209 and 210, respectively. As before, the casings and diaphragms are joined to one another at their rims in an air-tight connection. Secured to the centers of the diaphragms 209 and 210 respectively are plungers 211 and 212 pivoted as at 213 and 214 to the opposite ends of the cross arm 200 of the T-lever 188. The covers 203 and 204 and bracket 202 are bored with excessively large clearances around the plungers 211 and 212 in order to provide air vents. A compression spring 215 is mounted on the plunger 211 so as to urge it downward away from the bracket 202 and

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consequently rock the T-lever 188 in a clockwise direction around its pivot 201. The diaphragm motors 205 and 206 are provided with operating chambers 216 and 217 respectively having ports 218 and 219 connected by pipes 220 and 221 to the intake manifold passageway 18 and water pump outlet or discharge connection 222 respectively.

The automatic carburetor control 160 operates under similar principles and in response to the same action of intake manifold vacuum and water pump pressure, as the automatic carburetor control 10 described in connection with Figures 1 and 2, hence requires only a brief description. The diaphragm motors 205 and 206 of Figure 3 correspond to the diaphragm motors 84 and 98 of Figure 1 in that they are operated by manifold vacuum through the pipe 220 and water pump pressure through the pipe 221 respectively. The plungers 211 and 212 of the two motors 205 and 206 are interconnected by the rocking T-lever 188 to interpose the cam portion 189 of the lever end 186 into or out of the way of the spring-pressed washer 190. When the intake manifold vacuum is high, indicating economical and efficient operation of the engine, the diaphragm 209 of the motor 205 is pulled upward, rocking the lever 188 counterclockwise and pulling the lever end 186 and switch 138 away from the washer 190, which is restrained from moving further by the pin 191 on the rod 183 (Figure 6). The operator can therefore manipulate the accelerator pedal 22 without encountering any abnormal resistance, and the green signal lamp 152 remains burning.

If, however, the operator desires excessive performance, even at the expense of fuel economy and in so doing depresses the accelerator pedal 22 too rapidly for efficient operation of the engine, the manifold vacuum drops in the manner previously described, relaxing the upward pull on the diaphragm 209 of the motor 205 and permitting the spring 215 to rock the lever 188 in a clockwise direction, pushing the cam 189 on the lever end 187 toward and into engagement with the spring-pressed washer 190, as shown in Figure 3, actuating the switch 138. If the operator continues to depress the accelerator pedal 22, his foot experiences not only the normal resistance of the spring 180 but also the additional resistance of the pre-compressed spring 193, as the washer 190 slides to the left along the rod 183 toward the collar 194. This action also extinguishes the green signal light 152 and illuminates the red signal light 151 to warn the operator visually of uneconomical operation.

The carburetor control system shown in Figure 3 contains an additional vacuum diaphragm motor 167 interposed between the carburetor throttle rods 162 and 176 so as to cause the assembly 161 thereof to act as an expansible and compressible link. When the manifold vacuum is high under efficient operating conditions, the link 161 is in its shortened condition because the rod 162 is pulled toward the rod 176 (Figure 5) by the vacuum in the chamber 170 of the motor 167 acting upon the diaphragm 166. When, however, the operator depresses the foot pedal 22 too rapidly for economical operation, the vacuum in the chamber 170 drops, causing the spring 175 to push the rod 162 away from the rod 176, and consequently lengthening the composite rod assembly 161. Since the operator has presumably not moved his foot on the accelerator pedal 22 at that particular moment, the rod 162 momentarily re-

mains stationary, hence the rod 176 moves upward slightly, swinging the arm 49 and throttle valve shaft 19 clockwise and slightly closing the throttle valve 20 to achieve more economy.

Further modified carburetor control device

The further modified carburetor control device, generally designated 230 shown in Figure 7, is for the most part similar in construction to the modification shown in Figures 3 to 6 inclusive, and similar parts are similarly designated. The modification 230 differs principally from the modification 160 in that the bracket 202 with the diaphragm motors 205 and 206 and their connected parts, including the T-lever 188 and switch 138 are mounted in an inverted position upon the intake manifold 16. The connections of these parts are, however, substantially the same and hence require no repetition of description.

In the modification 230, however, the rod 183 instead of being connected to the accelerator pedal or foot throttle 22 is pivoted as at 231 to the solid end portion 232 of a tubular member 233 having a bore 234 in its interior at the opposite end from the solid end portion 232. The carburetor throttle crank arm 49 is pivoted as at 235 to the solid end portion 232 so that it is rocked directly in response to the motion of the rod 183, consequently swinging the throttle valve or butterfly valve 20 of the carburetor 16. Reciprocally mounted within the bore 234 of the tubular member 233 is the head 236 of a rod 237, the tubular member 233 and the rod 237 being resiliently interconnected by a tension spring 238 attached at one end to an anchorage pin 239 extending across the bore 234 of the tubular member 233 and attached at its opposite end to a lug 240 on the head 236. The head 236 and tubular member 233 are further interconnected by a pin 241 on the head 236 slidably engaging an elongated slot 242 in the tubular member 233.

The operation of the automatic carburetor control device 230 of Figure 7 is generally similar to that of Figure 3 and operates upon similar principles. The stop end 186 is of the rocking lever 188 moves into and out of engagement with the spring-pressed washer 190 in response to the change in manifold vacuum as in Figure 3, consequently operating the switch or removing it from operation, as described in connection with Figure 3. In Figure 7, however, the device 230 operates the throttle 20 directly through its connection at the pivot 235 of the throttle crank arm 49. The foot throttle rod 237, being connected resiliently through the pin and slot connection 241, 242 and spring 238, actuates the tubular member 233 and crank arm 49 directly during economical operation only when the stop portion 189 of the rocking lever 188 is withdrawn from contact with the spring-pressed washer 190 so that the pull of the spring 238 is sufficient for this purpose.

Under wasteful operation for excessive performance, the stop portion 189 is interposed in the path of the spring-pressed washer 190 so that the operator must pull the throttle rod 237 against the tension of the spring 238 until the pin 241 engages the right-hand end of the slot 242 and must then overcome the additional thrust of the pre-compressed spring 193 before he can rock the crank arm 49 and shaft 19 of the throttle valve 20 to obtain increased performance. The switch 138 in Figure 7 operates in the same manner as the switch 138 in Figure 3, and requires no additional description.

In the foregoing specification, the term "automotive vehicle" will be understood to mean a self-propelled land vehicle which is operable at variable speeds, such as automobiles, including passenger cars and trucks, tractors for farm, industrial and engineering uses, and military vehicles such as tanks, armored cars, earth-moving equipment and self-propelled guns. The manner of mounting the carburetor control devices shown in Figures 1, 3 and 7 is shown merely for illustrative purposes and not by way of limitation, as it will be obvious that these devices may be mounted upon different parts of the engine than the parts shown, and by the use of differently constructed brackets or supporting structure. It will also be understood that the contour of the arcuate portions 121 of the cam arms 120 in Figure 1 will vary somewhat when applied to different engines due to varying characteristics of manifold vacuum and water pump efficiency in different engines. It will be further understood that the plunger 74 of the vacuum-operated motor 68 of Figure 1 serves to interpose further resistance to the operation of the accelerator pedal when the vacuum in the intake manifold drops below a predetermined value where it indicates excessively wasteful operation, for example, below a vacuum corresponding to seven inches of mercury. This occurs, for example, when the accelerator pedal is depressed so suddenly that the intake manifold vacuum is broken by the sudden influx of air, at which time the depressing of the accelerator pedal also operates a carburetor accelerator pump which injects a charge of gasoline into the throttle valve passageway of the carburetor, giving improved performance but wasting gasoline.

What I claim is:

1. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element and consequently respectively increasing and decreasing the force required to be exerted by the operator to move said manual controller manually, a pressure-responsive motor operatively connected to said other element to move the same, and a conduit connecting said motor to said intake manifold for operating said motor in response to the variation in manifold vacuum therein.

2. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller and having a pump-fed liquid cooling system, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element and consequently respectively increasing and decreasing the force required to be exerted by the operator to move said manual controller manually, a pressure-responsive motor operatively connected to said other element to move the same, and a conduit connecting said motor to said cooling system for operating said motor in response to the variation in liquid pressure therein.

3. A warning signal arrangement for indicating

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the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller and having a pump-fed liquid cooling system, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element, a pair of pressure-responsive motors operatively connected to said other element, a conduit connecting one of said motors to said intake manifold for operating one motor in response to the variation in vacuum in said intake manifold, and a second conduit connecting the other motor to said cooling system for operating said other motor in response to the variation in liquid pressure in said cooling system.

4. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller and having a pump-fed liquid cooling system said arrangement comprising a pair of circuit-closing elements, an electric circuit connected to said elements and including an electrically-actuated signal device, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of circuit-closing engagement with said one element, a pair of pressure-responsive motors operatively connected to said other element, a conduit connecting one of said motors to said intake manifold for operating said one motor in response to the variation in manifold vacuum in said intake manifold, and a second conduit connecting the other motor to said cooling system for operating said other motor in response to the variation in liquid pressure in said cooling system to close said circuit and energize said signal device.

5. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element and consequently respectively increasing and decreasing the force required to be exerted by the operator to move said manual controller manually, a pressure-responsive motor operatively connected to said other element to move the same, and a conduit connecting said motor to said intake manifold for operating said motor in response to the variation in manifold vacuum therein, said other element including a cam member operatively connected to said motor and movable thereby into and out of engagement with said one element.

6. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element and consequently respectively increasing and decreasing the force required to be exerted by the

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operator to move said manual controller manually, a pressure-responsive motor operatively connected to said other element to move the same, and a conduit connecting said motor to said intake manifold for operating said motor in response to the variation in manifold vacuum therein, said other element including a pivotally-mounted cam member operatively connected to said motor and swingable thereby into and out of engagement with said one element.

7. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element and consequently respectively increasing and decreasing the force required to be exerted by the operator to move said manual controller manually, a pressure-responsive motor operatively connected to said other element to move the same, and a conduit connecting said motor to said intake manifold for operating said motor in response to the variation in manifold vacuum therein, said resilient element including an expansible member having a pair of relatively-movable parts and a resilient member interconnecting said parts.

8. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller and having a pump-fed liquid cooling system, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element and consequently respectively increasing and decreasing the force required to be exerted by the operator to move said manual controller manually, a pressure-responsive motor operatively connected to said other element to move the same, and a conduit connecting said motor to said cooling system for operating said motor in response to the variation in liquid pressure therein, said resilient element including an expansible member having a pair of relatively-movable parts and a resilient member interconnecting said parts.

9. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element, a pressure-responsive motor operatively connected to said other element, a conduit connecting said motor to said intake manifold for operating said motor in response to the variation in manifold vacuum therein, and a vacuum-operated auxiliary motor communicating with said intake manifold and having a stop plunger movable into the path of travel of said controller-connected element in response to a decline in intake manifold vacuum below a predetermined vacuum.

10. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element, a pressure-responsive motor operatively connected to said other element, a conduit connecting said motor to said intake manifold for operating said motor in response to the variation in manifold vacuum therein, said resilient element including an expandible member having a pair of relatively-movable parts and a resilient member interconnecting said parts, and a vacuum-operated auxiliary motor communicating with said intake manifold and having a stop plunger movable into the path of travel of one of said parts in response to a decline in intake manifold vacuum below a predetermined vacuum.

11. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element, a pressure-responsive motor operatively connected to said other element, a conduit connecting said motor to said intake manifold for operating said motor in response to the variation in manifold vacuum therein, said resilient element including an expandible member having a pair of relatively-movable parts and a resilient member interconnecting said parts, and a pair of vacuum-operated auxiliary motors communicating with said intake manifold, one of said auxiliary motors being connected between one of said parts and said controller and the other auxiliary motor having a stop plunger movable into the path of travel of said one auxiliary motor in response to a decline in intake manifold vacuum below a predetermined vacuum.

12. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller and having a pump-fed liquid cooling system, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element, a pair of pressure-responsive motors operatively connected to said other element, a conduit connecting one of said motors to said intake manifold for operating one motor in response to the variation in vacuum in said intake manifold, a second conduit connecting the other motor to said cooling system for operating said other motor in response to the variation in liquid pressure in said cooling system, each of said motors having a movable plunger, and a movable member connecting said plungers to each other and to one of said elements.

13. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a

manual controller and having a pump-fed liquid cooling system, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element, a pair of pressure-responsive motors operatively connected to said other element, a conduit connecting one of said motors to said intake manifold for operating one motor in response to the variation in vacuum in said intake manifold, a second conduit connecting the other motor to said cooling system for operating said other motor in response to the variation in liquid pressure in said cooling system, each of said motors having a movable plunger, and a pivotally-mounted rocking lever connecting said plungers to each other and to one of said elements.

14. A warning signal arrangement for indicating the operating condition of an automotive vehicle internal combustion engine having an intake manifold with a carburetor regulated by a manual controller, said arrangement comprising a resilient warning signal element, an abutment element, one of said elements being operatively connected to said controller and movable therewith, and the other element being movable into and out of engagement with said one element and consequently respectively increasing and decreasing the force required to be exerted by the operator to move said manual controller manually, a pressure-responsive motor operatively connected to said other element to move the same, a conduit connecting said motor to said intake manifold for operating said motor in response to the variation in manifold vacuum therein, said controller including a pair of elongated members slidably engaging one another, and a resilient element interconnecting said elongated members.

15. An automatic carburetor control arrangement for an automotive vehicle internal combustion engine having an intake manifold with a carburetor having a throttle valve regulated by a manual controller, said control arrangement comprising a driver-operated control member, a first reciprocable motion-transmitting element operatively connected to said throttle valve, a second reciprocable motion-transmitting element operatively connected to said control member, and a vacuum-operated reciprocating motor interconnecting said motion-transmitting elements said motor operatively communicating with said intake manifold and constituting a vacuum-operated collapsible link reciprocating to shorten and lengthen the connection between said motion-transmitting elements in response to variation of intake manifold vacuum, said motor being responsive to a decline in intake manifold vacuum to move said elements relatively to one another to shift said valve toward its closed position.

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