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2,616,675

AIR TEMPERATURE CONTROL FOR CARBURETORS

Filed June 26, 1947

3 Sheets-Sheet 1

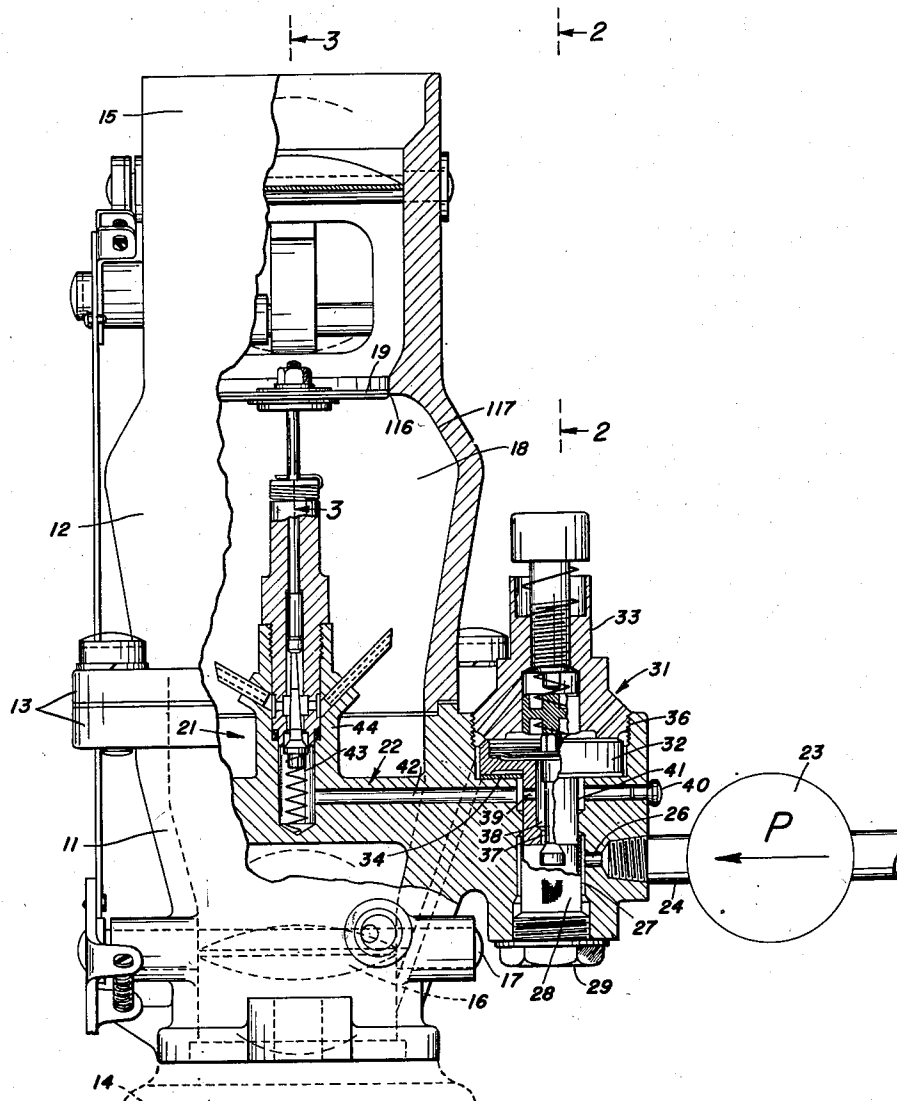


FIG. 1.

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3 Sheets-Sheet 2

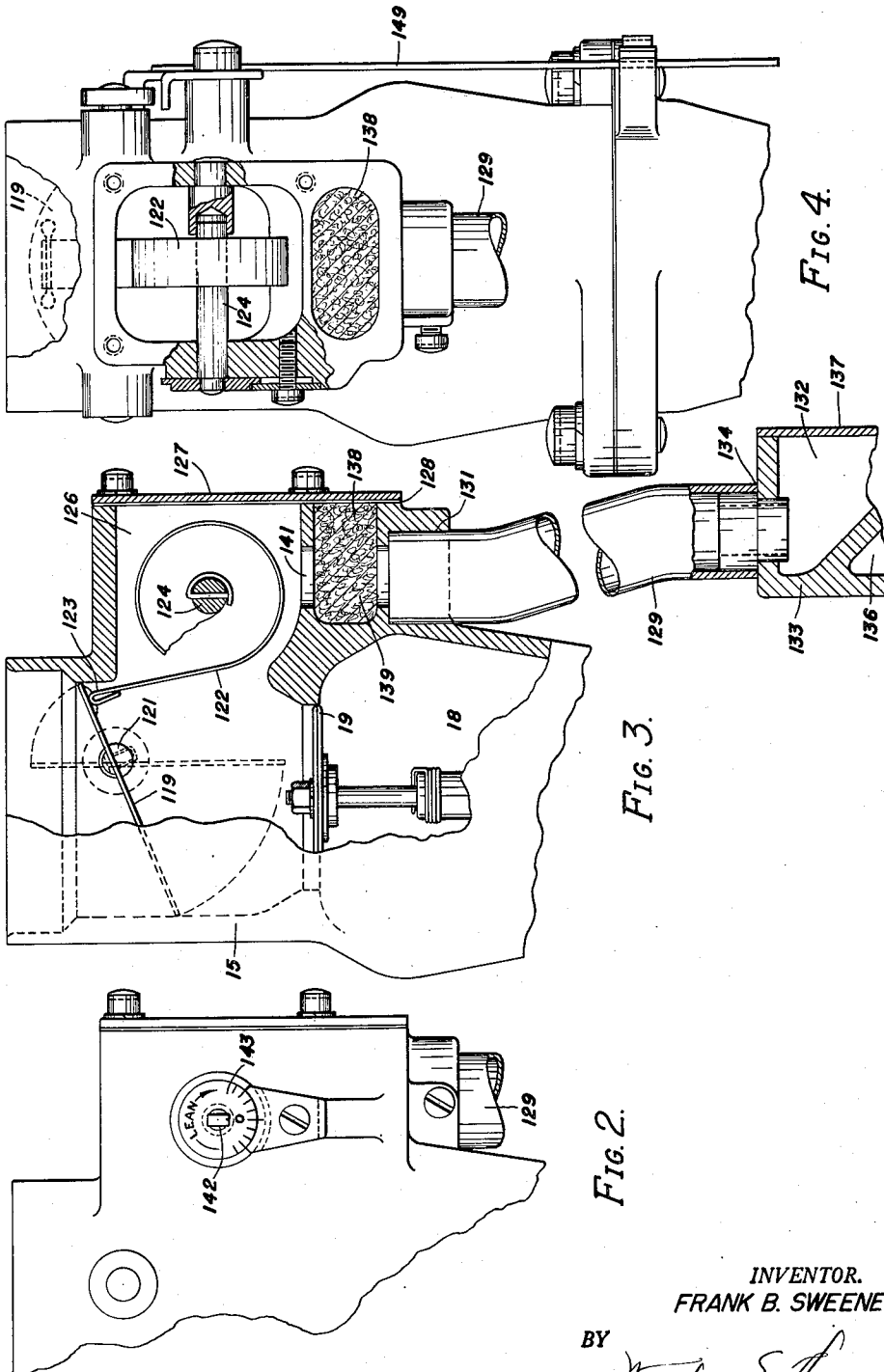


FIG. 2.

FIG. 3.

FIG. 4.

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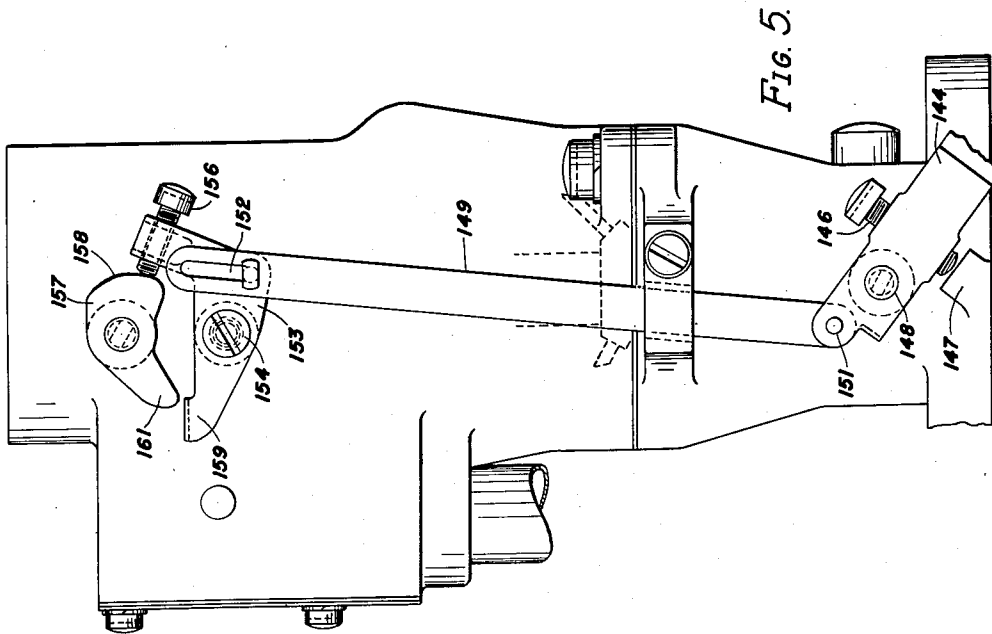
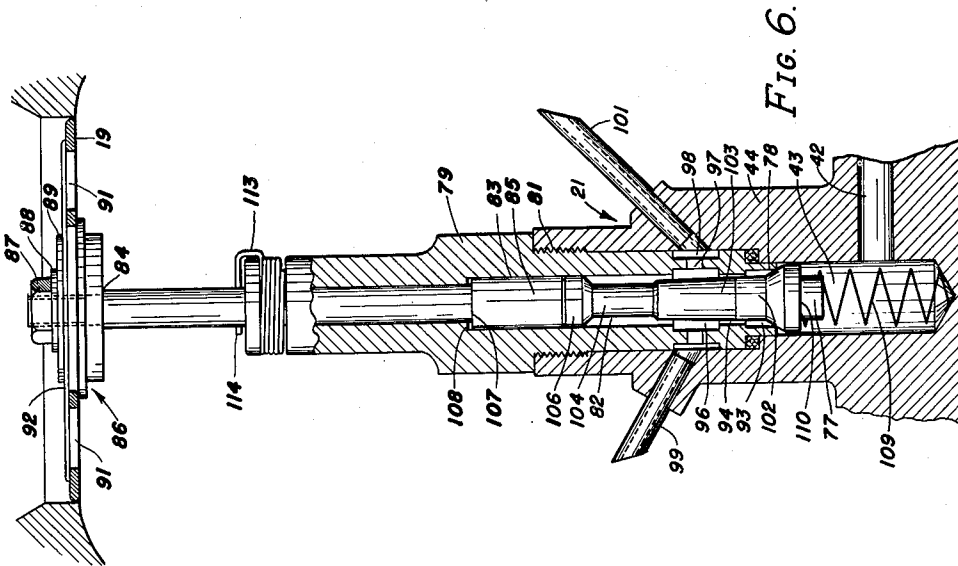
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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,616,675

AIR TEMPERATURE CONTROL FOR
CARBURETORS

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Application June 26, 1947, Serial No 757,159

1 Claim. (Cl. 261—39)

1

My invention relates to an air temperature control for carburetors employed in gasoline engine propelled craft. This application is a division of my application Serial Number 630,257, filed November 23, 1945, and now Patent Number 2,574,670, issued November 13, 1951.

An object of my invention is to provide a simplified and efficient temperature control for the air flowing to the carburetor of an internal combustion engine.

More specifically, my invention contemplates an air temperature control for the air flowing to the carburetor of an internal combustion engine wherein an air metering valve is provided in the air passage to the carburetor and air may flow through the air metering valve either from the atmosphere or through a passage open to atmosphere which is connected to a point adjacent the engine exhaust manifold, the arrangement being such that air is taken either from the connection to atmosphere or the connection adjacent to the exhaust manifold in accordance with the temperature conditions of the engine, the arrangement further being such that all of the air regardless of where it is taken from passes through the air metering valve so that accurate control of the air-gasoline ratio supplied to the carburetor is possible.

Other objects and advantages of my invention will be set forth more particularly in the claim and will be apparent from the following description, when taken in connection with the accompanying drawings, in which:

Fig. 1 is a view partly in section and partially diagrammatic illustrating the pressure injection carburetor of my invention;

Fig. 2 is a side elevation of a portion of Fig. 1, as indicated by the arrows along the line of 2—2 of Fig. 1;

Fig. 3 is a sectional view taken substantially on the line 3—3 of Fig. 1 in the direction indicated by the arrows;

Fig. 4 is a view partly in section looking from the right of Fig. 3 and with the cover plate of the compartment which houses the air temperature control removed;

Fig. 5 is a side elevation of the pressure injection carburetor of my invention looking from the left of Fig. 1;

Fig. 6 is an enlarged sectional view of a portion of Fig. 1 showing the air and fuel metering valves and their associated parts.

The carburetor of my invention comprises a main body section 11 and a mixing chamber section 12 which are provided with flanges secured

2

together, as shown at 13. The carburetor is connected to the intake manifold, partially indicated at 14, of the engine with which the carburetor is associated. Above the mixing chamber section 12 is an air intake section 15. The particular carburetor illustrated is of the down-draft type which is the preferred form. However, this is primarily for purposes of illustration as the principles of my invention may be incorporated in other types of carburetors.

The carburetor is provided with the usual throttle valve 16, mounted on a shaft 17, carried in bores formed in bosses. The function and operation of a throttle valve are well known in the art to which this invention applies and no description of its function and operation is believed to be necessary. The main body section and the mixing chamber section are provided with passages which are connected to form an air flow passage 18 through which air flows to the intake manifold of the engine under the partial vacuum or subatmospheric pressure conditions created by the reciprocation of the pistons thereof.

The air flow passage 18 is normally almost closed by an air metering disc 19 which is movable from the closed position shown to a partially or fully open position, in accordance with the differential in pressure existent on opposite sides of the air metering disc. The air metering disc assumes a position dictated by the pressure conditions existent and thus its position reflects or measures the volume of air passing through the air flow passage. While I have shown a disc air metering device and believe that this has distinct advantages, other air metering devices might be employed in combination with other parts of the carburetor of my invention.

The air metering disc 19 is connected, in a manner presently described, to a fuel metering valve generally indicated by the numeral 21. The fuel metering valve is located in the fuel line, generally designated by the numeral 22, the fuel line being connected to a fuel pump diagrammatically illustrated by the numeral 23.

The fuel pump 23 is driven in the usual manner from the engine cam shaft and is of a type in common use adapted to deliver gasoline to the fuel line at a substantially constant pressure regardless of engine operating speed. The fuel pump 23 is connected to the fuel line by a pipe 24 which extends into a threaded opening formed in the main body section of the carburetor. A bore 26, communicating with the pipe 24, opens into a chamber 27 in which is housed a strainer

26. Access to the chamber 27 and the strainer 23 for the purpose of cleaning the same, is gained through an opening in the main body section which is closed by a threaded cap 29.

The chamber 27 is in communication with an enlarged opening in the main body section which is adapted to receive a regulating valve assembly, generally indicated by the numeral 31. The regulating valve assembly 31 comprises a valve body section 32 and a cap section 33. The valve body section 32 is supported by an annular wall provided in the casting which forms the main body section 11 of the carburetor. Interposed between the facing surfaces of the valve body section 32 and the annular wall formed in the casting is a gasket 34 to prevent leakage of fuel as will later appear. The cap section 33 of the regulating valve assembly is threaded into the casting as shown at 35. By threading the cap section inward, pressure is applied on the gasket 34 so as to form a seal between the surfaces.

The lower end of the valve body section 32, is provided with a valve seat 37 formed at the end of a bore 38. The bore 38 constitutes a part of the fuel line 22. Extending from the bore 38 are one or more radial passages 39 which open into an annular recess 41. The annular recess communicates with a transversely extending passage 42, one end of which is closed by a plug 40 and which also constitutes part of the fuel line 22. The transverse passage 42 connects with a vertically extending passage 43 formed in an upwardly extending part 44 (Fig. 7) which houses the fuel metering valve assembly 21. The pressure regulating valve 31, its function and operation are described in my above mentioned application and such description need not be repeated herein.

As shown most clearly in Fig. 6, the fuel metering valve 21 includes a frusto-conical valve element 77, normally adapted to engage a seat 78, formed on the end of a valve housing member 79. The valve housing member is threaded into telescopic relation with the upwardly extending part 44 of the main casting of the carburetor, as shown at 81. The valve element 77 is integral with a valve stem 82 which is reciprocable in a bore 83 formed in the valve housing member 79. The upper end of the valve butts against the lower end of a stem 85 connected to the air metering disc 19.

Adjacent its upper end the stem 85 is provided with a shoulder 84 upon which is seated disc elements, generally indicated by the numeral 86. The upper end of the stem is threaded to receive a nut 87, a washer 88 and a backing plate 89 lying beneath the nut and being confined thereby. The air metering disc is preferably circular and has a pair of openings or ports 91. A flat thermostatic spring element 92 lies beneath the backing plate 89 and normally closes the ports 91. However, under certain conditions of operation, as will presently appear, the thermostatic spring element 92 when heated may curl upwardly to uncover the ports 91.

The valve housing 79 at its lower end, has an enlarged part 93 of the bore 83 and above this is formed a cylindrical portion 94 of reduced diameter which constitutes a part of the metering section of the valve. Above the metering section is an enlarged portion 95 which connects with radial passages 97 which open into recesses 98 communicating with fuel nozzles 99 and 101. The valve stem has a cylindrical part 102 normally substantially in registry with the enlarged bore 93. Above the cylindrical part 102 is a tapered or

other accurately formed section 103 which, when the valve 77, 78 is in a partially open position, registers with the cylindrical metering section 94.

Above the metering section of the valve stem is a part 104 of reduced diameter and above the reduced part 104 is a cylindrical section 106 which forms the abutment which is engaged by the end of the disc stem 85. The disc stem has a shoulder 107 adapted to engage a shoulder 108 formed in the bore 83 to limit the upward movement of the air metering disc. A spring 109 is seated in the bottom of the passage 43 and engages the bottom of the valve stem, as shown at 110, to urge the valve stem and the disc stem in an upward direction to close the fuel valve and the air metering disc. Since movement of the air metering disc is transmitted to the fuel metering valve element 77 by the abutting relation of the stems, the fuel valve stem is substantially free floating so that the valve element 77 will accurately engage its seat 78.

At the upper end of the valve housing 79, a spring 113 is coiled around the circumference of the valve housing, as shown, and its end 114 encircles and presses on the disc stem. This pressure exerted on the stem dampens the vibration of the parts.

As shown in the drawings, even when the valve element 77 is on its seat 78, a clearance exists at the metering gap between the metering section 94 of the valve housing and the tapered metering section 103 of the valve stem. However, as soon as the valve element 77 moves off its seat, the flow of fuel to the engine nozzles comes under the control of the fuel metering elements 94, 103. Downward movement of the valve stem increases the clearance between the parts and additional fuel is supplied to the nozzles, assuming constant fuel pressure. The enlarged bore 93 acts as a well beneath the metering section in which, at all times, a reservoir of fuel is maintained. When the engine is operating and the valve 77, 78 is partially open the well of fuel is under pressure. This arrangement insures a steady and uniform flow of fuel throughout the annular space between the metering parts 94, 103. Moreover, since there is at all times a clearance at the metering section and fuel flows through this space under pressure, there is little likelihood that the metering section will become clogged with dirt.

It will also be observed that a well of fuel exists below the fuel metering valve. When the fuel metering valve is opened slowly the displacement of fuel in the well by the valve has almost no effect insofar as increasing the fuel flow through the metering section of the valve. However, if the engine is being accelerated rapidly, the displacement of the liquid in the well causes momentarily a somewhat increased fuel flow through the metering section of the valve.

Of particular importance is the fact that the wall of the air flow passage (Fig. 1) from the point 116 which marks the closed position of the air metering disc, slopes outwardly and downwardly as shown at 117. The outward and downward sloping shape of the wall is accurately determined so that for any part-open position of the air metering disc and the fuel metering valve, the proper ratio of fuel to air will be supplied in accordance with the speed and load at which the engine is operating. In general, the air flow passage is shaped so that the fuel to air ratio is decreased with increased air flow and heavier loads preferably until approximately full throttle position is reached.

5

In Figs. 2, 3 and 4, I have shown a means for controlling the temperature of air flowing to the carburetor. In the air intake section 15 of the carburetor, I have provided a valve 119 preferably of the butterfly type. The butterfly valve is fixed to a shaft 121 and the blades of the valve on opposite sides of the shaft are of unequal width so that a flow of air through the valve tends to swing the valve in a counter-clockwise direction, as viewed in Fig. 3, to move the valve toward an open position.

The tendency of the valve to open is resisted by a thermostatic coiled spring 122 one end of which, as shown at 123, is attached to the valve and the other end of which is wound about and attached to a shaft 124. The spring 122 is of the bi-metallic type so that when it is subjected to heat it expands or uncoils. The expansion permits the butterfly valve to move toward an open position as dictated by the air flow through the air intake 15.

The bi-metallic spring is mounted in a compartment 126 closed by a cover 127, the meeting surfaces of the margins of the opening and the cover 127 being sealed by a gasket 128. A pipe 129 is connected to the carburetor, as shown at 131, and to an air chamber 132 formed in the exhaust manifold 133, as shown at 134. The hot gases discharged from the engine circulate through passage 136 formed in the exhaust manifold and fresh air is admitted to the air chamber 132 through openings 137.

A second compartment 138 is formed in the carburetor casting which is also closed by the cover 127. The compartment 138 is filled with a suitable material 139 which may be spun glass or noncorrosive metal wool, capable of removing dust and dirt which may enter the pipe 129. The walls of the compartment 138 are provided with suitable flow passages 141 through which air is supplied to the compartment 126. The function of the material 139 is not only to filter out dust and dirt particles but also to interpose, in the path of flow of air from adjacent the exhaust manifold, a resistance such that preferably when the butterfly valve is in a fully open position, no air will pass through the pipe 129.

The purpose of the above arrangement is to enable a flow of warm air to the carburetor when the engine is relatively cold and, at the same time, prevent a flow of warm air to the carburetor when the engine is warm. Thus, when the thermostatic spring 122 expands, due to the passage of warm air over it and the butterfly valve starts to open, the resistance to flow of air from the exhaust manifold is such that the air supplied to the carburetor through the pipe 129 is decreased. In the preferred arrangement, the flow of air to the carburetor should cease when the butterfly valve is fully open.

One of the important features of the carburetor of my invention lies in the fact that all the air passing to the carburetor is metered air since all the air passes through the opening controlled by the air metering disc 19. In the conventional arrangements with which I am familiar, the warm air from adjacent the exhaust manifold is supplied to the intake manifold at a point below the air metering device and usually below the throttle valve. This by-passed air is unmetered.

When the engine is initially started and is cold, the air metering disc 19 moves to a partially open position, as dictated by the differen-

6

tial in pressure on opposite sides of the disc. The air is drawn from adjacent the exhaust manifold which heats up very rapidly, causing in addition to an expansion of the thermostatic spring 122, an expansion of the thermostatic spring 92 which normally closes the ports 91 through the air metering disc. Assuming the engine is permitted to warm up at idling speed, the opening of the ports occurs with the engine operating at the same speed. Upon opening the ports 91 the pressure differential on opposite sides of the air metering disc is increased, thereby permitting the air metering disc to move to a more nearly closed position to thereby cut down the flow of fuel through the fuel metering valve without a corresponding decrease in the flow of air. If the engine is operated at relatively high speed when cold, the same effect is produced, the fuel-air ratio being decreased as the engine warms up.

It is contemplated, in the preferred arrangement, that no air shall be drawn from the exhaust manifold when the engine is up to temperature and the butterfly valve 119 is in its fully open position. For this purpose an adjusting knob 142 is provided which enables the adjustment of the tension of the thermostatic spring element 122. Upon rotating the adjustment knob 142 in a clockwise direction, aided by a suitable scale 143, the tension of the thermostatic spring element 122 may be lessened so that the butterfly valve reaches a fully open position somewhat prior to the engine reaching its running temperature.

It will be appreciated that if the engine is being driven in cold weather, the air under the hood may be relatively cold. This cold air will have an effect on the thermostatic spring 122 contracting it, closing the butterfly valve somewhat and drawing some warm air from adjacent the exhaust manifold. If desired, the knob 142 may be adjusted so that at all times some air is drawn from the exhaust manifold or the knob may be adjusted for summer and winter driving. However, it will be apparent that I have provided a means for controlling the temperature of the air flowing to the carburetor.

When the engine is at its running temperature, assuming normal atmospheric temperature conditions, and with air from the exhaust manifold cut off, the thermostatic spring element 92 still retains its curled position with the ports 91 open, due to the fact that the air drawn into the carburetor is somewhat warm, being drawn from beneath the hood of the now warm engine. I contemplate adjusting the thermostatic spring element so that when the engine is operated on warm days; the ports will be at least partially open without the engine being warm, as when the atmospheric temperature is high little or no additional fuel is required at starting. On extremely cold days the ports may never fully open if the temperature of the air beneath the hood does not rise sufficiently. It will be particularly noted that all the air passing to the carburetor is metered, the opening of the ports merely decreasing the fuel-air ratio for any particular set of conditions.

Referring now to Figure 5, I have shown an improved so-called fast-slow idle mechanism suitable for use with the carburetor of my invention. Mounted on the arm 144 which controls the throttle is an adjustable screw 146 the end of which is adapted to engage an abutment 147. The arm is pivoted at 148 and has a long link 149

pivoted to the end thereof, as shown at 151. The link has a lost motion connection 152 to a rocker arm 153 pivoted at 154.

The rocker arm 153 carries an adjustable screw 156 which is adapted to engage a cam 157 having a lobe 158. The cam is mounted on the projecting end of the butterfly valve shaft 121 (Fig. 3). The rocker arm 153 has a tail piece 159 which is adapted to engage a cooperating tail piece 161 formed on the cam.

When the engine is cold the parts are in the approximate position shown in Fig. 5 with the cam lobe 158 limiting the closing of the throttle since the arm 144 moves in a clockwise position to close the throttle. It will be noted that the lost motion connection 152 is at the bottom of the slot and the engagement of the screw with the cam lobe limits clockwise movement of the arm 144 and hence the closing of the throttle. As the engine warms up the cam moves clockwise, as viewed in Fig. 1, in accordance with the opening of the butterfly valve. This permits the throttle to close more fully. When the engine is warmed up, the end of the screw 156 is out of engagement with the cam lobe and control of the idling speed and the position of the throttle is taken over by the screw 146 and abutment 147.

It will be appreciated that both the fast and slow idle positions of the throttle may be adjusted by the screws 156 and 146. Should the butterfly valve tend to stick it is kicked open by the engagement of the tail pieces 159 and 161. However, it will be noted that this engagement can occur only when at substantially full open throttle, because of the lost motion connection, when presumably the engine is at running temperature and the butterfly valve should be open.

While I have shown the preferred form of the carburetor of my invention it will be apparent that various changes and modifications may be made therein, particularly in the form and relation of parts, without departing from the spirit of my invention as set forth in the appended claim.

I claim:

In a carburetor wherein an air passage is connected to a variable source of temperature of air supply and a throttle valve is located in said air passage comprising, in combination, an air metering valve movable from a position substantially to closing said passage to an open position in accordance with the pressure conditions existent in said air passage, said passage having an opening to atmosphere and an opening connected to the variable source of temperature of air supply, a valve normally closing the opening to atmosphere, a thermostatic spring element connected to said valve and to maintain said valve closed whereby the air supply for the carburetor is drawn from the variable source of temperature of air supply, said passage and the opening thereto being arranged so that the air from the variable source of temperature of air supply passes over said thermostatic spring element and all of the air from both said openings passes through the air metering valve, said air metering valve having a port, a thermostatic element normally closing said port, said thermostatic element moving toward an open position when the volume of air drawn from the variable source of temperature of air supply is reduced due to the action of said thermostatic spring element.

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