Feb. 3, 1959 F. W. HAMILTON 2,871,843

CARBURETOR CHOKE MECHANISM

Filed Oct. 20, 1955 2 Sheets-Sheet 1

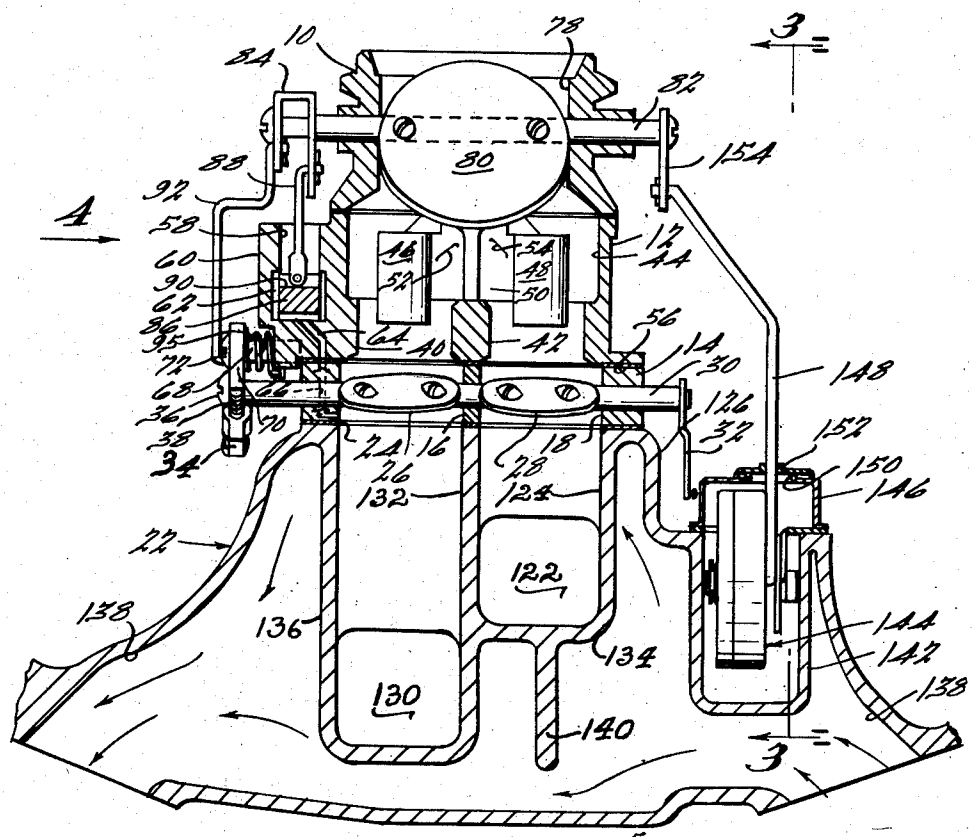


FIG. 1.

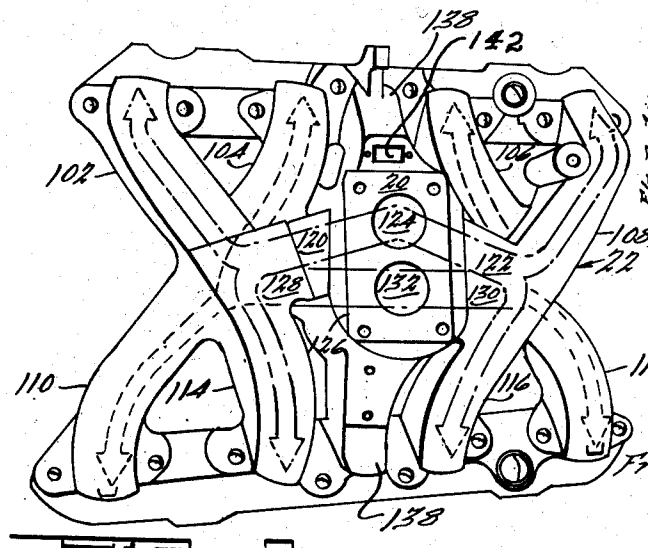


FIG. 2.

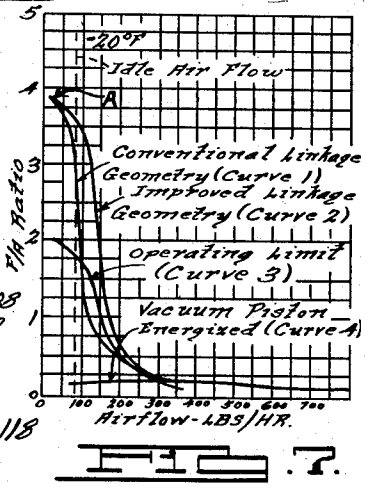


FIG. 3.

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CARBURETOR CHOKE MECHANISM

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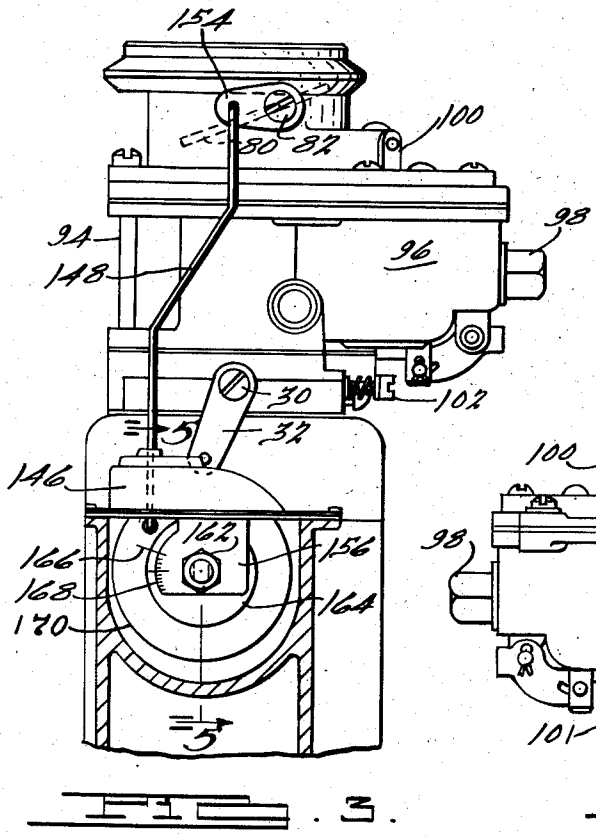


FIG. 3.

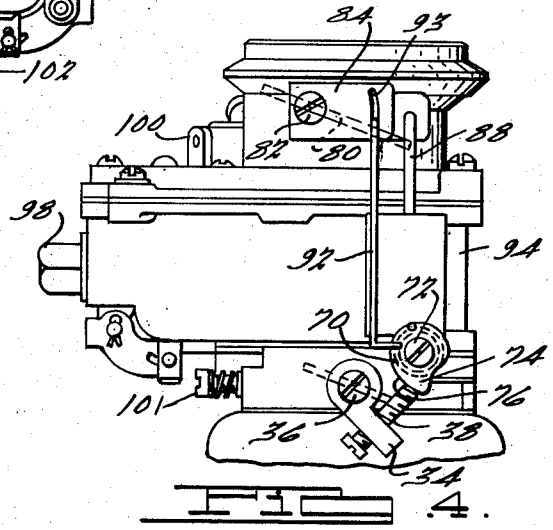


FIG. 4.

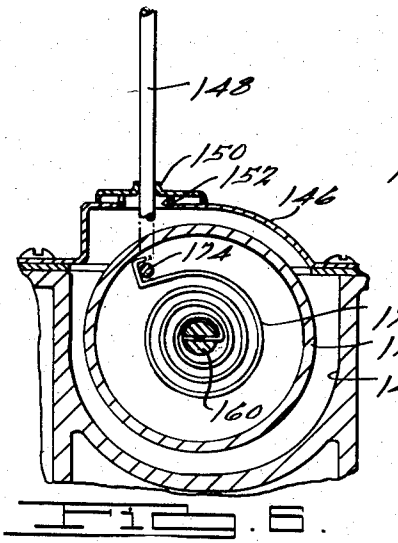


FIG. 6.

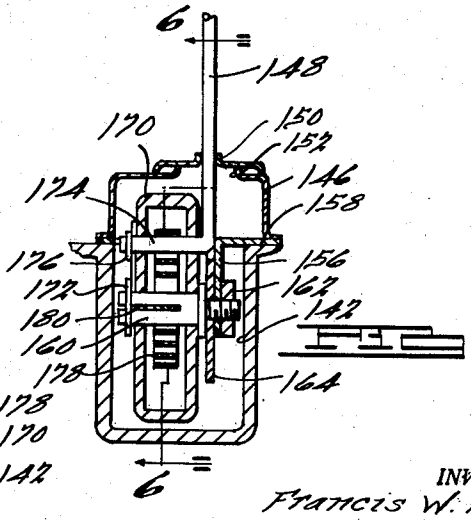


FIG. 5.

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CARBURETOR CHOKE MECHANISM

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Application October 20, 1955, Serial No. 541,752

12 Claims. (Cl. 123—119)

My present invention is generally believed related to liquid fuel carburetors for use with internal combustion engines. More particularly, my invention comprises a new and improved carburetor choke mechanism which is possessed of improved operating characteristics.

This application comprises a continuation-in-part of my copending application Serial No. 478,677, filed December 30, 1954 and now abandoned.

The choke mechanism of my present invention is capable of being successfully employed in combination with a large variety of carburetor mechanisms of known construction. However, for the purpose of particularly describing one structural environment for my invention, I have presently disclosed a dual barrel carburetor which is especially adapted to be used with an internal combustion gasoline engine of the automotive type. This carburetor structure comprises a cast body portion in which are formed a pair of downdraft fuel mixing conduits with a choke valve situated on the upstream side thereof, said conduits communicating with the engine intake manifold. During operation the choke valve may be caused to close the mixing conduit entrance during engine starting and engine warmup operation to increase the static pressure drop in the carburetor throat which in turn results in an enriched fuel mixture. To provide for automatic operation of the choke valve, an engine temperature responsive thermostatic element is often provided for opening and closing the same; and to produce sufficient breathing capacity during idling operation when the engine is cold, an automatic unloader mechanism is often provided to "crack open" the choke valve under these conditions, said mechanism being inoperative to control the position of the choke valve when the engine reaches its normal operating temperature. Further, a suitable fast-idle mechanism is normally employed to "crack open" the throttle valves during idling operation when the engine is cold and when the choke valve is near its fully closed position.

The choke valve is usually of the offset type so that the air forces acting thereon as the air enters the mouth of the mixing conduits tend to open the choke valve while the thermostatic element opposes such an opening movement and urges the choke valve toward a closed position during engine starting and warmup.

In carburetors having such automatic chokes it has been common practice to mount the above-mentioned thermostatic choke control element on the upper portion of the carburetor casting substantially in alignment with the shaft on which the choke valve is secured. To provide the thermostatic element of such a choke control element with an engine temperature signal, a hot air conduit or heater tube is interposed between the engine exhaust manifold and the region surrounding the thermostatic element, said region communicating with the engine intake manifold through passage means formed in the carburetor body. Air is caused to enter the heater tube at a convenient location and it is heated as it passes through that portion of the heater tube which traverses the exhaust manifold conduit.

When the vehicle engine operates at or near wide open throttle at relatively low speeds, the engine intake manifold vacuum pressure is reduced and the rate of flow of heated air through the heater tube is correspondingly reduced. During operation of the vehicle up a continuous grade, and during similar vehicle maneuvers which cause a "lugging" of the engine over a sustained period of time, the rate at which heated air is conducted into the region of the thermostatic element is insufficient to enable the choke control to maintain the choke valve in the open position. Consequently, the choke valve is rotated in these instances toward a closed position and the fuel-air mixture ratio is thereby enriched until the mixture is no longer readily combustible thus stalling or "flooding" the engine.

The choke valves of such conventional carburetors are normally coupled to the thermostatic element in such a way that the choke closing effort of the thermostatic element is substantially the same regardless of the angular position of the choke valve. If means are provided for adjusting the choke closing effort at an optimum value during engine starting and warm-up, the choke closing effort during warm engine operation would be too great. Conversely, if the choke closing effort during warm engine operation is fixed at an optimum value, the choke closing effort during starting and warm-up would be insufficient to permit satisfactory engine operation under these latter conditions. Consequently, it has been the practice to strike a compromise and adjust the device so that the closing effort is at an optimum value only at some intermediate choke position between the two extremes. As a result, the choke characteristics at any other choke position leaves much to be desired.

The improved automatic choke assembly of my instant invention is free of the above-described shortcomings of the automotive chokes of known construction and in addition it is characterized by certain other advantages which result in improved overall carburetor performance as I will subsequently point out.

The provision of an improved carburetor of the type mentioned above being a principal object of my invention, it is a further object of my invention to provide an automatic choke mechanism for a liquid fuel carburetor which is simple in construction, which is reliable in operation and which may be readily installed on conventional gasoline engines.

It is a further object of my invention to provide an automatic choke mechanism for a liquid fuel carburetor which includes a choke valve element and a thermostatic control element for actuating the choke valve element, said thermostatic control element being strategically situated so that it is adapted to sense the choking requirements of the fuel and air mixing elements of the carburetor.

Another object of my invention is to provide an automatic choke mechanism for a liquid fuel carburetor which is characterized by an inherent delay in the opening of the choke valve element during the engine warmup period.

Another object of my invention is to provide an automatic choke mechanism for a liquid fuel carburetor which is characterized by an inherent delay in the closing of the choke valve element while the engine is cooling down.

Another object of my invention is to provide an automatic carburetor choke mechanism which includes a choke valve element and a means for supplying a variable choke valve closing effort thereto, the magnitude of the choke valve closing effort being greater when the

choke valve approaches a closed position than when it approaches an open position.

It is a further object of my invention to provide a new and improved automatic choke device which is possessed of a new and improved operating characteristic.

In carrying forth the foregoing objects, I have provided a downdraft carburetor with a choke valve element disposed within the downdraft conduit means thereof and with a novel linkage mechanism for rotatably actuating the choke valve element to restrict the flow of carburetor intake air during those instances when choking is desired. A pocket may be formed in the engine exhaust gas crossover section of the intake manifold structure and a thermostatic control element may be suitably mounted therein. The above-mentioned linkage mechanism may extend to the interior of the intake manifold pocket and may be operatively connected to the thermostatic control element for varying the choke valve setting in response to variations in engine operating temperature. The manifold pocket is positioned in the exhaust gas crossover passage adjacent the fuel mixing downdraft conduits of the carburetor and is subjected to the heated exhaust gases during operation of the engine.

The temperature to which the thermostatic control element may be heated is independent of engine intake manifold vacuum pressure and is a function only of the engine operating temperature. The strategic location of the thermostatic control element, as above described, enables the same to respond to variations in operating temperature in the proximate vicinity of the carburetor fuel mixing conduits and to provide the proper degree of choking for any operating temperature.

The above-mentioned linkage mechanism comprises one of the principal features of my instant invention and it is comprised of linkage elements which are capable of adjusting the effective leverage between the choke valve shaft and the thermostatic element as the latter expands or contracts due to variations in engine operating temperature.

For the purpose of more particularly describing the novel features of my instant invention, reference will be made in the following description to the accompanying drawings wherein:

Figure 1 shows a transverse cross sectional view of a dual downcraft carburetor for use with an automotive-type gasoline engine;

Figure 2 is a plan view of portions of the manifold system for the above-mentioned gasoline engine and it shows the manifold crossover passage upon which the carburetor of Figure 1 may be mounted;

Figure 3 is a side view of the carburetor of Figure 1 showing in section the manifold pocket within which the thermostatic control element is mounted and is taken along section line 3—3 of Figure 1;

Figure 4 is a side view of the other side of the carburetor of Figure 1 showing a portion of the throttle valve linkage mechanism and the choke valve linkage mechanism;

Figure 5 is a detail sectional view of the thermostatic control element shown in Figures 1 and 3 and is taken along section line 5—5 of Figure 3;

Figure 6 is another sectional view of the thermostatic control element shown in Figure 5 and is taken along section line 6—6 of Figure 5; and

Figure 7 is a graph showing the operating characteristics of the choke mechanism of Figures 1 through 6.

Referring first to Figure 1, the carburetor body includes three principal portions which are separately identified by numerals 10, 12, and 14, the portion 10 being hereinafter referred to as the upper carburetor body portion, the body portion 12 being referred to as the intermediate carburetor body portion and the portion 14 being hereinafter referred to as the lower body portion. The lower body portion 14 is provided with a pair of mixture conduits identified by numerals 16 and 18 and it is secured to an upper surface 20 of a cast conduit portion of the engine intake manifold system, the latter being generally designated by numeral 22. A suitable gasket 24 may be interposed between the mating surfaces of the lower carburetor body portion 14 and the intake manifold portion 22. A pair of throttle valves 26 and 28 are rotatably mounted within the mixture conduits 16 and 18 respectively, and they are secured to a common throttle shaft 30 which is transversely disposed within the conduits 16 and 18 and rotatably journalled in the carburetor body portion 14.

One end of the throttle shaft 30 carries a throttle linkage element 32 which may form a portion of a manually operable throttle linkage mechanism. The other end of the throttle shaft 30 has secured thereto a transversely extending element 34, a screw 36 being provided for this purpose. As best seen in Figure 4, an adjustable stop element 38 is threadably received through a threaded aperture in the element 34.

The intermediate carburetor body portion 12 comprises a pair of throats or venturi passages 40 and 42 which are respectively aligned with mixture conduits 16 and 18 of the carburetor body portion 14. The throats 40 and 42 communicate at the upper ends thereof with a common intake air passage 44 which is defined by the outermost wall structure of the carburetor body portion 12. A pair of small venturi elements 46 and 48 are positioned directly above each of the throats 40 and 42 respectively. These venturi elements 46 and 48 are integrally joined to a centrally disposed fuel metering mechanism, the exterior of which is shown at 50. The individual small venturi elements 46 and 48 are joined to the metering mechanism 50 by means of integral extensions 52 and 54. This metering mechanism is adapted to supply fuel nozzles, one of which extends into each of the small venturi elements 46 and 48, with a controlled supply of liquid fuel which is mixed with the intake air passing through the venturi sections of each of the elements 46 and 48.

The lower surface of the intermediate carburetor portion 12 is secured to the upper surface of the lower carburetor body 14 and a suitable gasket 56 is interposed therebetween as shown.

A vacuum idle unloader cylinder 58 may be formed vertically within an integral extension 60 of the intermediate housing portion 12 and the lower portion thereof may be provided with a plurality of axially extending grooves 62. The interior of the cylinder 58 communicates with the mixture conduit 16 below the throttle valve element 26 through communicating passages 64 and 66 formed in the carburetor body portions 12 and 14 respectively.

A fulcrum element 68 may be formed on the side of the extension 60 and, as best seen in Figure 4, a cam element 70 may be journalled thereon. The cam element 70 may be secured in position by a suitable screw 72 with an extension 74 thereof being free to oscillate substantially in the plane of the above-described throttle element 34. The cam extension 74 is provided with a camming surface 76 which is adapted to contact the adjustable throttle element 38 when the throttle valves assume a closed position as shown in Figure 1.

The upper carburetor portion 10 defines a single carburetor intake air passage 78 which communicates with the above-described air passage 44 and the intermediate carburetor body portion 12. A carburetor choke valve element 80 is positioned within the intake conduit 78 and is secured to a rotatable choke valve shaft 82, the latter being transversely disposed in the air conduit 78 and rotatably journalled at either end thereof in the walls of the carburetor cast body portion 10. One end of the choke valve shaft 82 has secured thereto a linkage element 84, as best seen in Figure 4, said linkage element 84 being adapted to rotate with the choke valve shaft 82 as the latter is actuated. A vacuum idle unloader piston element

86 is slidably received within the above-described cylinder 58 and is operatively joined to the link element 84 by means of another link element 88. It is thus seen that as the piston element 86 moves in a downward direction within the cylinder 58 the choke valve element 80 is caused to rotate toward an open position. The piston 86 is caused to move in response to variations in intake manifold pressure since the portion of the cylinder 58 below the piston 86 is in communication with the intake manifold through the passages 64 and 66, as above explained. The piston element 86 is provided with a transversely extending passage 90 which is adapted to communicate with the above-mentioned longitudinal grooves 62 formed in the cylinder 58 when the piston 86 moves a predetermined distance in a downward direction as viewed in Figure 1. When the passage 90 and the groove 62 are in communication, further downward movement of the piston 86 in response to intake manifold vacuum pressure variations is prevented.

As illustrated in Figure 1, the cylinder 58 may communicate with the atmosphere thereby permitting atmospheric air to be drawn through the passages 64 and 66. However, it is often preferable to form the cylinder so that it communicates with the interior of the air passage 78 on the upstream side of the choke valve element 80 rather than directly with the atmosphere. Since a conventional air cleaner, not shown, is normally situated on the upstream side of the air intake passage 78, the air which would be delivered to the cylinder 58 in the latter case would necessarily be relatively clean air that is free of foreign matter.

Another portion of the linkage element 84 may be operatively connected to the above-described cam element 70 by means of a linkage element 92. It is thus seen that as the choke valve element 80 is moved toward a fully closed position, the cam element 70 will be caused to contact the adjustable element 38 carried by the throttle linkage element 34 thereby causing the throttle valves 26 and 28 to be "cracked open" to provide a fast idle. A lost motion slot connection between linkage elements 92 and 84 is provided at 93 to permit the choke valve 80 to open independently of the cam element 70 and the throttle valves. As best seen in Figure 1, a coil spring 95 may be provided about fulcrum 68 to normally bias cam element 70 in a counterclockwise direction as viewed in Figure 4.

The three carburetor cast body portions 10, 12, and 14 may be secured together by means of bolts 94, as best seen in Figures 3 and 4, to form an integral assembly. A conventional air cleaner device may be secured to the top of the carburetor body portion 10 if desired although such a device is not illustrated in the drawings. The intermediate carburetor body portion 12 further includes a fuel bowl 96 having a fuel inlet fitting 98 as best seen in Figures 3 and 4. A portion of an accelerator pumping mechanism may be seen in Figures 3 and 4 at 100, and a conventional idle adjusting element 101 may also be provided in the lower carburetor body portion 14.

Referring next to Figure 2, a portion of the intake manifold system for a typical V-8 gasoline engine is shown and it comprises a plurality of intake conduits individually shown at 102, 104, 106, 108, 110, 114, 116, and 118 which are adapted to deliver a combustible mixture to each of the eight cylinders of the engine. The conduits 102 and 114 communicate with a single conduit portion 120, and the conduits 108 and 116 communicate with a single conduit portion 122. The conduit portions 120 and 122 in turn communicate with a vertically extending passage 124 which forms a continuation of the carburetor mixture conduit 18, said passage 124 being formed in a carburetor mounting flange identified in Figures 1 and 2 by numeral 126. The conduits 104 and 110 pass below the conduits 102 and 114 as viewed in Figure 2, and they communicate with a common conduit portion 128. Likewise, the conduits 106 and 118 pass below the conduits 108 and 116, as viewed in Figure 2, and they communicate with a common conduit portion 130. Conduit portions 128 and 130 in turn communicate with a vertically extending passage 132 formed in the carburetor mounting flange 126. The passage 132 is adapted to communicate with and form an extension of the above-described mixture conduit 16. For the purpose of clarity, the passage of combustible mixture through each of the above-described intake manifold conduits is represented by arrows, the arrows representing the flow of mixture through conduits 102, 108, 114, and 116 being defined by dash and dot lines and the arrows representing the flow of the mixture through conduits 104, 106, 110, and 118 being defined by dotted lines.

The above-described mixture passages 124 and 132 are defined in part by intake risers generally designated by the numerals 134 and 136 respectively, said risers being integrally formed with the carburetor mounting flange and the intake conduit structure as part of an integrally cast assembly. The intake riser 134 communicates with the conduit portions 120 and 122 at the lower end thereof and the intake riser 136 communicates with the conduit portions 128 and 130 at its lower portion. Since the conduit portions 128 and 130 must necessarily be formed below the conduit portions 120 and 122 as above explained, the intake riser 136 is formed deeper than the intake riser 134, this being apparent from the cross sectional view of Figure 1.

An eight cylinder engine of this type is normally formed with an exhaust manifold conduit on either side of the engine, the four cylinders on one side of the engine communicating with one exhaust manifold conduit, and the four cyinders on the other side of the engine communicating with the other exhaust manifold conduit. An exhaust gas crossover passage is normally provided for interconnecting the above-mentioned exhaust manifold conduits to accommodate the flow of exhaust gases therebetween. This exhaust gas crossover passage is identified in Figures 1 and 2 by numeral 138 and it forms a portion of the integrally cast intake manifold structure. Crossover passage 138 includes a central portion which surrounds the above-described intake manifold risers. For the purpose of clarity, the flow of exhaust gases from one side of the crossover passage 138 to the other is represented by means of arrows and it is apparent that the intake risers are engulfed by the hot exhaust gases throughout their entire length. The combustible mixture is thereby heated by the exhaust gases during operation, and in order to provide substantially equal heat distribution between each of the intake risers 134 and 136, a baffle 140 is formed integrally on the bottom of the intake riser 134, said baffle 140 being effective to direct the flow of exhaust gases around the bottom of the intake riser 136 as shown.

As best seen in Figures 1 and 3, I have formed a well 142 in the upper wall of the exhaust gas crossover passage 138 and it extends downwardly into the path of the exhaust gases as they pass from one side of the crossover passage 138 to the other. I have positioned a thermostatic control element 144 within the well 142 and have enclosed the well 142 by a cover plate 146 which may be secured in place by suitable screws or the like. A linkage element 148 is operatively connected to the thermostatic control element 144 at one end thereof and it extends vertically upward through an aperture 150 formed in the cover plate 146. A suitable dust cap or washer 152 may be provided as shown, if desired, to prevent the entry of foreign matter into the well 142 through the aperture 150. The other end of the linkage element 148 is secured to one end of a choke linkage element 154 as best seen in Figure 3, the linkage element 154 being operatively joined to the choke valve shaft 82. The thermostatic control element 144 is adapted to allow the linkage element 148 to move in a downwardly direction, as viewed in Figure 1, as the temperature of the

ambient air within the well **142** becomes heated by the hot exhaust gases flowing through the crossover passage **138**. It will be apparent from Figures 1 and 3 that this downward movement of the linkage element **148** will be accompanied by movement of the choke valve element **80** toward an open position. This choke valve is adapted to move toward an open position by virtue of the offset location of the choke valve shaft **82**.

Referring next to Figures 5 and 6, the thermostatic control element **144** is shown in more particular detail and it includes a bracket **156** extending in a downward direction within the well **142** and is secured at the upper end thereof to the upper surface **158** of the well **142**. The top side of the bracket **156** extends about the periphery of the well **142** and is secured in place by the bolts which retain the cover plate **146** in place. A coil anchor post is shown at **160** and is received within an aperture formed in the lower portion of the bracket **156** and secured therein by a nut **162**. An adjustable plate **164** is interposed between the base of the anchor post **160** and the supporting bracket **156**, said plate being non-rotatable with respect to the anchor post **160**.

As best seen in Figure 3, the plate **164** may be marked with an indicator marking **166** and the lower portion of the bracket **156** may be provided with a series of gradations **168**, the position of the marking **166** with respect to the gradations **168** providing an indication of the arcuate position of the anchor post **160** with respect to the stationary bracket **156**.

A thermostatic coil shell of substantially circular shape is designated by numeral **170** and is rotatably mounted on the relatively stationary anchor pin **160**. A suitable clip or other fastening device may be carried by the end of the anchor pin **160** as shown at **172**, to prevent axial movement of the shell **170** with respect to the anchor pin **160**.

The above-mentioned linkage element **148** is formed at the lower end thereof with a transversely extending portion **174** which may be received through aligned apertures in the end walls of the circular shell **170**, said extension **174** terminating on the exterior of the shell **170**. A suitable locking device **176** may be carried by the terminal end of the linkage element extension **174**.

As best seen in Figures 5 and 6, a thermostatic coil element **178** is positioned within the shell **170** and the inner end of the coil is received within a slot **180** formed in the anchor pin **160**. The radially outward end of the coil **178** encircles the linkage element extension **174** thereby enabling the coil **178** to impart a turning effort to the shell **170** when the coil **178** becomes stressed. As the shell **170** is caused to rotate in a clockwise direction, as viewed in Figure 6, an upward force will be imparted to the linkage element **148** thereby causing the choke valve element **80** to move toward a closed position.

In operation, a combustible fuel and air mixture is caused to pass through the mixture conduits **16** and **18** into the intake risers **134** and **136** which in turn supply each of the individual intake manifold conduits shown in Figure 2. The throttle valves **26** and **28** control the rate of flow of combustible mixtures to the intake risers in the conventional manner. When the engine is cold the thermostatic element **178** is effective to allow the shell **170** to move in a clockwise direction, as viewed in Figure 6, thereby allowing the choke valve element **80** to assume a closed position. As the exhaust gases continue to pass through the exhaust crossover passage **138** during the warm up period of the engine, the thermostatic element **178** becomes heated which causes the outer end of the thermostatic element **178** to move in a counterclockwise direction about the anchor post **160**. This in turn allows the shell **170** to pivot about anchor post **160** in a counterclockwise direction thereby allowing the choke valve element **80** to move to an open position. It will be apparent that the position of the choke valve element **80** is determined solely by the temperature to which the thermostatic element **178** becomes heated and except for the operation of the choke unloader mechanism, it is in no way influenced by variations in engine intake manifold pressure as in the automatic choke mechanisms of known construction.

During idling operation when the engine is cold, the intake manifold vacuum pressure will be sufficient to cause the vacuum motor unloader piston to be depressed within the cylinder **58** until the transverse passage **90** in the piston element **86** communicates with the cylinder grooves **62**. This is accompanied by a slight opening movement of the choke valve **80** as previously indicated. This movement of the piston element **86** will also cause the cam element **70** to rotate in a clockwise direction, as viewed in Figure 4, and will cause the throttle valve elements **26** and **28** to assume a fast idle position as previously explained.

The thermostatic control element **144** may be conveniently disassembled merely by removing the screws which secure the cover plate **146** to the crossover passage **138**. An adjustment in the initial setting of the thermostatic control element may be conveniently made by loosening the nut **162** and by adjustably positioning the plate **164** with respect to the supporting bracket **156**, and the extent of the adjustment may be measured by means of the graduated markings **168** as shown in Figure 3. This angular movement of the adjustable plate **162** is accompanied by movement of the anchor pin **160** which in turn tends to either wind or unwind the coils of the thermostatic element **178** depending upon the direction of rotation of the plate **162**. This in turn varies the initial tension of the windings for the thermostatic element.

The above-described choke construction will provide a desirable delay in the opening of the choke valve element during the warm up period thus assuring that the fuel and air mixture will be sufficiently rich to maintain steady and smooth engine operation until the engine operating temperature becomes stabilized at its normal operating value.

Similarly, the choke construction of my instant invention provides an inherent delay in the closing of the choke valve while the engine is cooling. This feature prevents an over-rich mixture from being supplied to the engine intake manifold when the engine is started before it has cooled down to the temperature of the ambient air. The shell **170** functions to provide an added "heat dam" which is capable of storing thermal energy to accentuate the above-described time delay feature.

Because of the strategic location of the thermostatic control mechanism of the choke of my instant invention, the choke valve **80** responds directly to variations in the temperature signal existing in the proximate vicinity of the fuel mixing conduits and is sensitive to the actual engine choking requirements whereas the automatic choke mechanisms of known construction employ some other temperature as an operating signal. These conventional mechanisms are therefore not directly sensitive to the engine choking requirements.

With choke mechanisms of known construction, previously described, the problem of obtaining clean air for heating the thermostatic element offers considerable difficulty. With the choke construction of my instant invention, this problem is completely eliminated since no air is drawn through the thermostatic element. Also the choke operating air of the conventional choke devices bypasses the throttle and this bypassed air makes it extremely difficult to obtain proper engine idling operation. This problem is greatly aggravated when four barrel carburetors rather than single or dual barrel carburetors are employed since secondary throttle valve leakage as well as primary throttle valve leakage must then be considered. The carburetor choke of my instant invention, however, completely eliminates the bypassing of air around the throttle through the thermostatic element.

It will be apparent from Figures 3, 5, and 6 that the linkage element **154** assumes a substantially horizontal position when the choke valve element **80** is in a closed position. Further, the connection between the linkage element **148** and the rotatable shell **170** approaches a top dead center position when the choke valve element approaches a closed position, and the angle formed by the linkage element **148** and a radial line connecting the axis of rotation of the shell **170** and the point of connection between the shell **170** and the linkage element **148** form an angle which is only slightly less than 180°. By way of contrast it may be observed that the linkage element **154** assumes a downwardly extending position, as shown in Figure 3, when the choke valve element approaches a wide open position. Also, the radial line connecting the axis of the shell **170** with the point of connection between the shell **170** and the linkage element **148** assumes a substantially horizontal position and the angle formed by this line and the linkage element **148** is substantially a right angle. It is thus seen that the closing torque applied to the choke valve element **80** by reason of the tension of the thermostatic coil spring **178** will be at a maximum when the choke valve element assumes a closed position and will be at a minimum when it assumes an open position. In other words, the ratio of the length of the leverage arm between the axis of the throttle valve shaft **82** and the working axis of the linkage element **148** to the length of the leverage arm between the axis of the shell **170** and the working axis of the linkage element **148** will become progressively greater as the choke valve approaches a closed position. As this ratio increases, the closing effort will be correspondingly increased for a given spring tension in the thermostatic coil element **178**.

For the purpose of graphically illustrating the effect of the improved choke construction of my instant invention upon the carburetor performance, a brief reference will be made to Figure 7 wherein the fuel air ratio for a typical automotive type engine is plotted as an ordinate with the air flow rate as an abscissa. During engine cranking it is desirable to provide a rich fuel mixture and this operating condition is represented on the performance chart by point A. As combustion is initiated, the fuel air ratio will rapidly decrease and the variation of the fuel air ratio with respect to the air flow rate during this transient operating condition may be represented by a curve having a large negative slope.

For purposes of illustration, curve **1** in the chart of Figure 7 represents the variation of fuel air ratio with air flow which would be obtained with a conventional type carburetor in which the choke valve closing torque remains substantially constant at all operating positions of the choke. If it is assumed that the optimum closing torque for such a conventional carburetor occurs when the choke valve is partially open thereby providing an optimum fuel mixture ratio during warm-up, the magnitude of the fuel air ratio will be too low to maintain combustion during cold starting and the engine will stall immediately after combustion is initiated. Acceleration of the engine up to the normal operating speed is impossible under these conditions, the variation in fuel-air ratio rapidly diminishing as illustrated by curve **1**.

The minimum fuel air ratios for various air flow rates which are required in order to maintain combustion are represented in the chart of Figure 7 by curve 3, and any fuel air ratio for a given air flow rate should be above curve **3** if the engine is to operate satisfactorily without stalling. It is apparent from the chart of Figure 7 that a portion of curve **1** falls considerably below the operating limit, as represented by curve **3**, and therefore the engine will stall as the air flow rate is increased upon acceleration of the engine since the fuel mixture will be too lean. If the tension of the thermostatic coil element is increased so that the effort applied to the choke valve will be greater throughout the entire choke angular travel, the upper

portion of the performance curve **1** will be raised to a considerably richer fuel air ratio and the lower portion of the curve will fall outside the operating limit represented by curve **3**. However, under such circumstances it is highly probable that the fuel air mixture will be too rich at the higher air flow rates as the engine is accelerated during the warmup period or as the engine is throttled back to an idling speed with the vacuum actuated choke unloader mechanism energized. Such a modified curve has not been represented in Figure 7 but it would be similar in shape to curve **1** except that it would be shifted a substantial distance in a vertical direction.

If a compromise between the two above-described conditions is made, the optimum performance of the engine when the choke valve is near the closed position and when it is in a partially open position will be sacrificed in order to permit the engine to operate throughout the entire speed range. By way of contrast with the above, the variable leverage controlled linkage mechanism of the choke of my invention is capable of applying a relatively high closing torque to the choke valve when the operating point is in the region of point A and a low closing torque to the choke valve when the operating point is in the higher air flow region. The variation in fuel air ratio with various air flow rates which is obtained with a carburetor employing the improved choke mechanism of my instant invention is represented in Figure 7 by curve **2**. It may be observed that all of curve **2** is situated above the operating limit of curve **3**.

The locus of the operating points obtained with the improved choke construction of my instant invention and with the choke construction corresponding to curve **1** as the throttle valves are returned to a closed position after the choke unloader mechanism is energized is represented in Figure 7 by curve **4**. However, is would be impossible for the operating point to move along curve **1** from point A to the point of intersection of curve **1** with curve **4** unless the engine is accelerated by means of a push start or unless power is delivered to the engine from an external power source.

What I claim and desire to secure by United States Letters Patent is:

1. In a liquid fuel carburetor for an internal combustion engine having a plurality of cylinders, intake manifold conduits for conducting a combustible fuel and air mixture to said cylinders, an exhaust manifold including portions disposed near opposite sides of said engine, an exhaust gas crossover passage interconnecting said exhaust manifold portions, an intake manifold riser forming a portion of said intake manifold conduits, said intake riser being disposed within said exhaust gas crossover passage; at least one downdraft mixture conduit formed within said carburetor, said carburetor being secured to said intake manifold with said intake riser communicating with said mixture conduit, a throttle valve element disposed within said mixture conduit for controlling the flow of combustible fuel mixture therethrough, said mixture conduit communicating with a carburetor air intake passage, a choke valve element disposed within said intake passage, a well formed in said crossover passage, a thermostatic control element disposed in said well, and linkage means interconnecting said thermostatic control element and said choke valve for adjustiably positioning the latter in response to variations in engine operating temperature.

2. In a liquid fuel carburetor for use with an internal combustion engine having a plurality of cylinders, intake manifold conduits for conducting a combustible fuel and air mixture to said cylinders, an exhaust manifold including portions disposed near opposite sides of said engine, an exhaust gas crossover passage interconnecting said exhaust manifold portions, an intake manifold riser forming a portion of said intake manifold conduit, said intake riser being disposed within said exhaust gas crossover passage; at least one downdraft mixture conduit

formed within said carburetor, said carburetor being secured to said intake manifold with said intake riser communicating with said mixture conduit, throttle valve elements disposed within said mixture conduit for controlling the flow of combustible fuel mixture therethrough, said mixture conduit communicating with a carburetor air intake passage, a choke valve element disposed within said intake passage, a well formed in said crossover passage, a thermostatic control element disposed in said well, said thermostatic control element including a helical bi-metallic coil, means for anchoring the inner end of said coil in a stationary position, and a linkage means including a portion mounted adjacent said coil, the other end of said coil being operatively connected to said portion of said linkage means, said linkage means being operatively connected to said choke valve element for adjustably positioning the same in response to variations in the temperature existing within said well.

3. In a liquid fuel carburetor for use with an internal combustion engine having a plurality of cylinders, intake manifold conduits for conducting a combustible fuel and air mixture to said cylinders, an exhaust manifold including portions disposed near opposite sides of said engine, an exhaust gas crossover passage interconnecting said exhaust manifold portions, an intake manifold riser forming a portion of said intake manifold conduits, said intake riser being disposed within said exhaust gas crossover passage; at least one downdraft mixture conduit formed within said carburetor, said carburetor being secured to said intake manifold with said intake riser communicating with said mixture conduit, throttle valve elements disposed within said mixture conduit for controlling the flow of combustible fuel mixture therethrough, said mixture conduit communicating with a carburetor air intake passage, a choke valve element disposed within said intake passage, a well formed in said crossover passage, said thermostatic control element including a bi-metallic helical coil, an anchor pin, one end of said coil being secured to said anchor pin, means for supporting said anchor pin within said well, linkage means interconnecting said choke valve element and the other end of said coil, said anchor pin being movable to any of a plurality of fixed angular positions to vary the initial tension of said coil.

4. The combination as set forth in claim 3 wherein said means for supporting said anchor pin includes a plate member extending into said well, said anchor pin being rotatably secured to said plate member, and an indicator element secured to said anchor pin adjacent said plate member, said indicator element being movable with said anchor pin thereby providing an indication of the angular position of said anchor pin.

5. In a liquid fuel carburetor for use with an internal combustion engine, said engine including an intake manifold and an exhaust gas manifold; at least one downdraft carburetor mixture conduit, an air intake passage communicating with said mixture conduit, a choke valve element movably mounted in said air intake passage for providing a controlled restriction to the flow of intake air through said intake air passage, an exhaust gas crossover passage formed in the vicinity of said intake manifold and interconnecting portions of said exhaust gas manifold, a well formed in said crossover passage, said well defining a pocket which is adapted to be surrounded by engine exhaust gases during operation of the engine, a thermostatic control element disposed in said pocket, and a linkage means operatively connected to said choke valve and extending therefrom into said pocket, said thermostatic control element including a portion operatively connected to said linkage means, said choke valve being movable into and out of an intake air passage closing position in response to variations in the temperature existing within said pocket.

6. In a liquid fuel carburetor for use with an internal combustion engine, said engine including an intake manifold and an exhaust gas manifold; at least one downdraft carburetor mixture conduit, an air intake passage communicating with said mixture conduit, said carburetor being mounted upon said intake manifold with said mixture conduit communicating with said intake passage, a choke valve element movably mounted in said air intake passage for providing a controlled restriction to the flow of intake air through said intake passage, a throttle valve means including a throttle valve element movably mounted in said mixture conduit for controlling the flow of combustible fuel and air mixture therethrough, an exhaust gas crossover passage formed in the vicinity of said intake manifold and interconnecting portions of said exhaust gas manifold, a well formed in said crossover passage, said well defining a pocket which is adapted to be surrounded by engine exhaust gases during operation of the engine, a thermostatic control element disposed in said pocket, a linkage means operatively connected to said choke valve and extending therefrom into said pocket, said thermostatic control element including a portion operatively connected to said linkage means, said choke valve element being movable into and out of an intake air passage closing position in response to variations in the temperature existing within said pocket, a cam element rotatably mounted on a portion of said carburetor, other linkage means operatively connecting said choke valve and said cam element, said cam element being adapted to contact a portion of said throttle valve means and to crack open said throttle valve element to provide a fast idle when said choke valve approaches a fully closed position, and means for cracking open said choke valve during engine warm up operation to provide an adequate intake air capacity.

7. The combination as set forth in claim 5 wherein said thermostatic control element comprises a helical, bi-metallic coil with the outer end thereof operatively connected to said linkage means, an anchor element and bracket means for supporting said anchor element in said pocket, the inner end of said helical coil being secured to said anchor element.

8. The combination as set forth in claim 7 wherein said bracket means is removably attached to a portion of said crossover passage and wherein said anchor element may be rotatably adjusted to a preselected position to vary the initial tension of said helical coil as desired.

9. In a liquid fuel carburetor for use with an internal combustion engine, said engine including an intake manifold and an exhaust gas manifold, at least one downdraft carburetor mixture conduit, an air intake passage, said carburetor being mounted upon said intake manifold with said mixture conduit communicating with said intake passage, a choke valve element movably mounted in said air intake passage for providing a controlled restriction to the flow of intake air through said intake air passage, an exhaust gas crossover passage in the immediate vicinity of a portion of said intake manifold and interconnecting portions of said exhaust gas manifold, a well formed in said crossover passage, said well defining a pocket which is adapted to be surrounded by engine exhaust gases during operation of the engine, a thermostatic control element disposed in said pocket, and linkage means operatively connected to said choke valve and extending therefrom to said thermostatic control element, said thermostatic control element including a helical, bi-metallic coil, an anchor element, a cover plate removably secured over said pocket, a bracket means for supporting said anchor element, the inner end of said helical coil being secured to said anchor element, a member rotatably mounted on said anchor element adjacent said helical coil, the other end of said helical coil being operatively connected to said member, said member forming a portion of said linkage means and rotatable about said anchor element in response to variations in the ambient temperature in the vicinity of said helical coil within said pocket.

10. In a liquid fuel carburetor for an internal combustion engine having a plurality of cylinders, an intake manifold having conduits for conducting a combustible fuel and air mixture to said cylinders, an exhaust manifold including portions disposed on opposite sides of said engine, an exhaust gas crossover passage interconnecting said exhaust manifold portions, an intake manifold riser forming a portion of said intake manifold conduits, said exhaust gas crossover passage at least partially surrounding said riser; at least one downdraft mixture conduit formed within said carburetor, said carburetor being secured to said intake manifold with said intake riser communicating with said mixture conduit, a throttle valve element disposed within said mixture conduit for controlling the flow of combustible fuel mixture therethrough, said mixture conduit communicating with a carburetor air intake passage, a choke valve element dispose within said intake passage, a well formed in said crossover passage in the proximate vicinity of said intake riser, a thermostatic control element disposed in said well, and linkage means interconnecting said thermostatic control element and said choke valve for adjustably positioning the latter, said thermostatic control element responding to variations in the engine operating temperature in the immediate vicinity of said intake manifold riser to effect an adjustment of said choke valve, the magnitude of said adjustment being directly responsive to the engine choking requirements.

11. In a liquid fuel carburetor for an internal combustion engine having an intake manifold and an exhaust manifold, at least one downdraft mixture conduit communicating with said intake manifold with a portion of the latter being defined by said mixture conduit, an air intake passage communicating with said mixture conduit, a choke valve element movably mounted in

said intake passage, an exhaust gas passage connected to said exhaust manifold, a recess formed in said exhaust gas passage in close proximity to said mixture conduit portion, a thermostatic control element disposed in said recess, and a linkage means operatively connecting said choke valve element with said thermostatic control element for controlling the movement of the former in response to engine operating temperature.

12. In a liquid fuel carburetor for an internal combustion engine having an intake manifold and an exhaust gas manifold, at least one fuel mixture conduit communicating with a portion of the said intake manifold, an air intake passage formed on the upstream side of said mixture conduit, a choke valve element movably mounted in said air intake passage, an exhaust gas passage communicating with said exhaust gas manifold, a recess formed in said exhaust gas passage in the proximate vicinity of said intake manifold portion, and a temperature responsive control means situated at least in part within said recess with a portion thereof being operatively connected to said choke valve element, said control means being adapted to adjustably position said choke valve element in response to the choking requirements.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,871,843 February 3, 1959

Francis W. Hamilton

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 74, for "downwardly" read -- downward --; column 10, line 36, for "is would" read -- it would --; column 13, line 18, for "dispose read -- disposed --; column 14, line 8, for "temperature" read -- temperature

Signed and sealed this 2nd day of June 1959.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON

Commissioner of Patents