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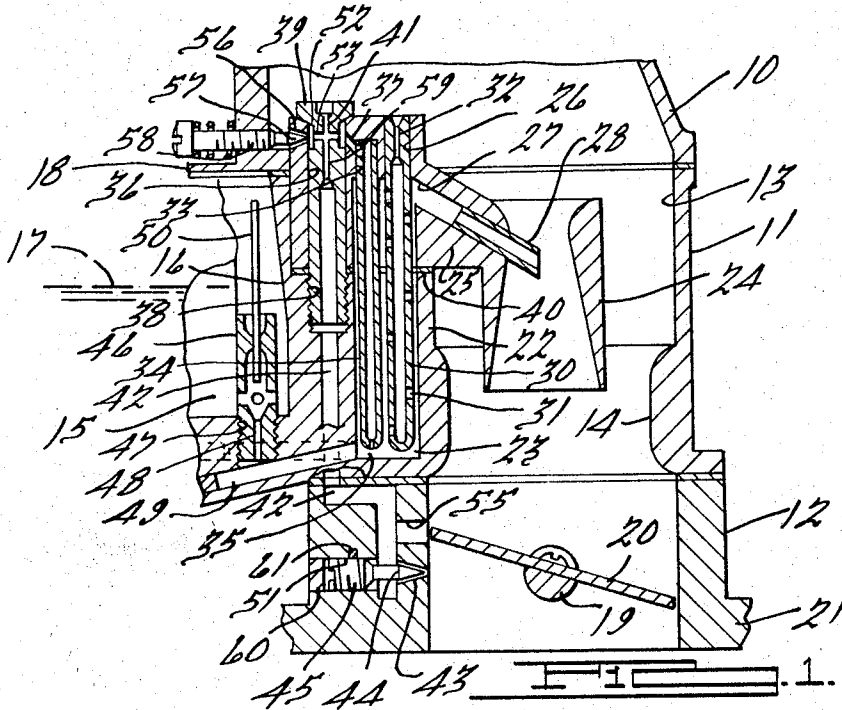
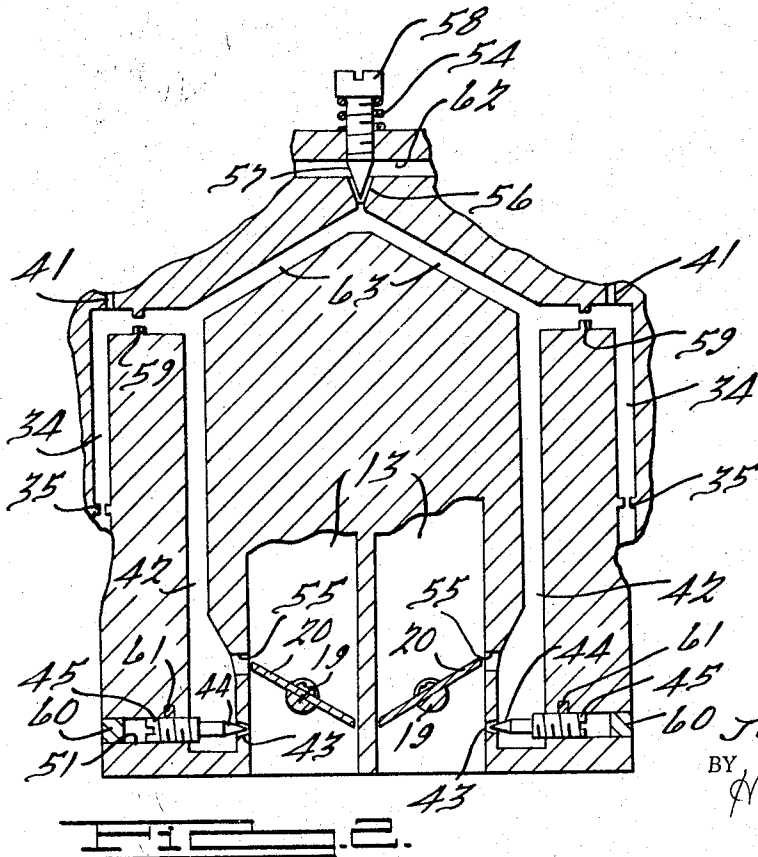
J. O. SARTO

3,454,264

IDLE MIXTURE CONTROL FOR CARBURETORS

Filed April 27, 1967

Sheet 1 of 2



INVENTOR.

Jorma O. Sarto

BY

Harness, Talburt & Bellman

ATTORNEYS.

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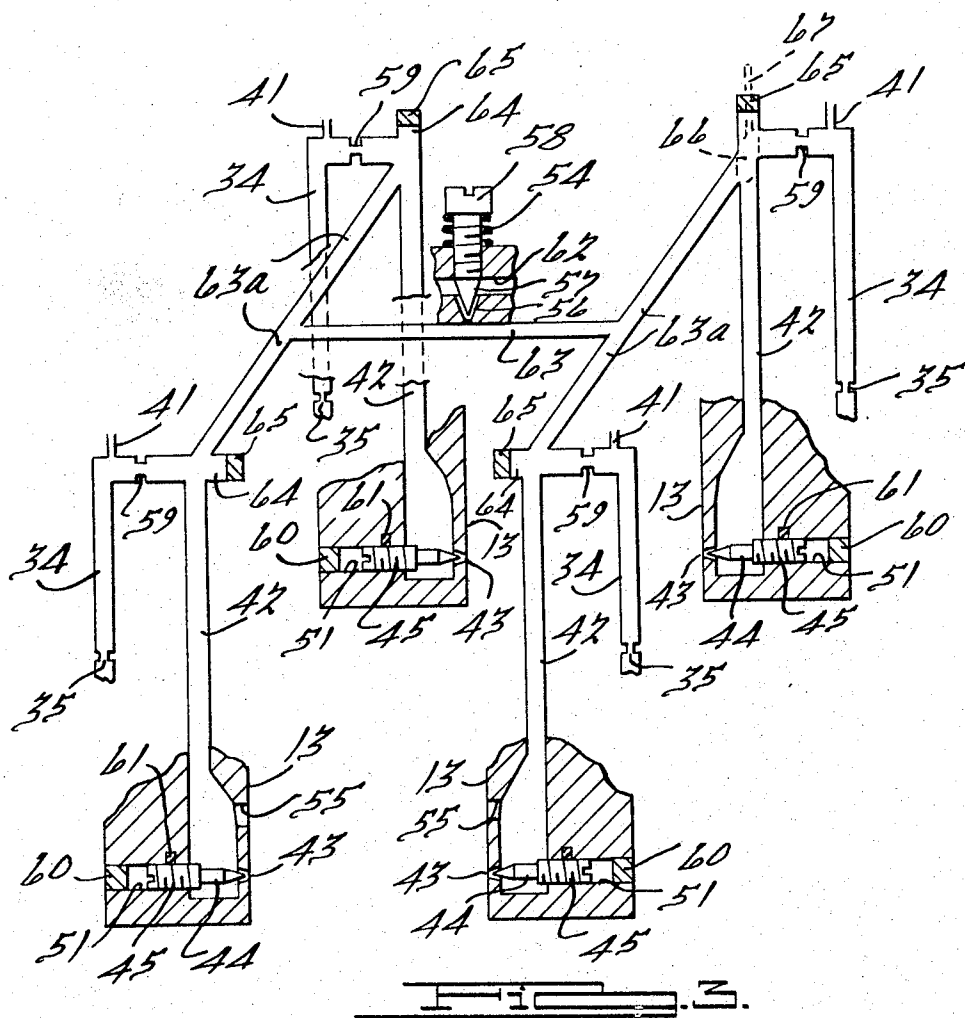
J. O. SARTO

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Sheet 2 of 2



INVENTOR.
Jorma O. Sarto
BY
Harniss Talburt & Baldwin
ATTORNEYS.

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3,454,264

IDLE MIXTURE CONTROL FOR CARBURETORS
Jorma O. Sarto, Orchard Lake, Mich., assignor to
Chrysler Corporation, Highland Park, Mich., a corporation of Delaware

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10 Claims

ABSTRACT OF THE DISCLOSURE

Excess enrichment of the idle fuel-air mixture for a carburetor is avoided by providing an adjustable idle air inlet orifice in communication with the usual idle fuel conduit to supply air thereto upstream of the usual idle fuel port. The latter discharges into the fuel-air induction conduit to the engine and is adjusted to effect the maximum desirable idle fuel enrichment when the adjustable air inlet orifice is closed to the maximum extent of its adjustment and the usual throttle valve is at its idle position. The adjustment means for the idle fuel port is then locked against subsequent adjustment and the leaner fuel-air mixture desired for idle operation is thereafter obtained by opening the adjustable idle air inlet orifice.

Background and summary of the invention

This invention relates to adjustable means in a carburetor for supplying a fuel-air mixture to an internal combustion engine at idle and also part throttle in the range of operation hereinafter called the transfer range, which utilizes the customary transfer port system, and has for an important object the provision of an improved idle mixture adjusting means and a method for utilizing the same to prevent excessive enrichment or leanness of the fuel in the mixture and for assuring a proper distribution of the fuel-air mixture among the various induction conduits of a multiple barrel carburetor during idle and the transfer range of operation.

In conventional carburetors for an internal combustion engine, an idle fuel port located downstream of the throttle valve in the customary fuel-air induction conduit supplies a fuel-air mixture adequate to support engine operation during idling. An idle mixture adjustment screw adjustably screwed into the sidewall of the induction conduit from the latter's exterior terminates inwardly in a conically inwardly tapered valve element aligned with the upstream side of the idle fuel port to adjust its effective opening. By unscrewing the idle mixture screw, the conical valve element is withdrawn outwardly from the idle fuel port to open the latter.

During operation of the engine at the idle condition, the throttle valve is substantially closed and the resulting low pressure in the induction conduit downstream of the throttle valve induces fluid flow through the idle fuel system and into the induction conduit via the idle fuel port. When the latter is substantially closed by virtue of the idle mixture screw being screwed inwardly, the pressure drop across the idle fuel port is at a maximum because the tendency to bleed air into the induction conduit through the idle fuel port and thereby to reduce the pressure in the idle fuel system upstream of the idle fuel port is compensated for by air bleeding into the idle system through the conventional restricted idle transfer and idle air bleed ports. Thus substantially atmospheric air pressure is maintained in the idle fuel system upstream of the idle fuel port.

As the idle mixture adjustment screw is progressively unscrewed to open the idle fuel port during engine idling, the restricted idle transfer and air bleed ports cannot sup-

ply sufficient air to maintain the pressure upstream of the idle fuel port, and said pressure is progressively reduced. In consequence the idle fuel flow into the idle fuel system from the conventional idle fuel supply port is progressively increased, such that the idle fuel-air mixture discharged into the induction conduit is progressively enriched with fuel with respect to the combustion supporting air supplied by controlled leakage around the throttle valve and via the aforesaid idle transfer and air bleed ports. In many carburetor constructions, the idle fuel-air mixture can be enriched excessively by unscrewing or opening the idle mixture screw to the extent that combustion of the mixture in the engine is incomplete and objectionable exhaust emissions such as unburned hydrocarbons and carbon monoxide are exhausted.

It is accordingly another and more specific object of the present invention to provide simple and inexpensive means for limiting the idle fuel enrichment and to prevent accidental over enrichment of the idle fuel-air mixture, comprising an idle adjustment screw of generally conventional construction in combination with an adjustable idle air inlet orifice connecting a source of air upstream of the throttle valve with the idle fuel system to supply air thereto. The idle mixture adjustment screw is adjusted to effect the maximum desirable idle fuel enrichment when the adjustable idle air inlet orifice is closed to the limit of its adjustability and the throttle valve is at its closed or idle position. Suitable means are provided for locking the idle mixture screw against accidental displacement from its adjusted position, as for example friction means engaging the screw to prevent its turning during normal engine operation and means applied after the adjustment to conceal the screw or to render it inaccessible for subsequent adjustment. The adjustable idle air inlet orifice then becomes the means for adjusting the idle fuel-air mixture and is dimensioned so that when adjusted to its fully open condition, it will limit the air supply to the idle fuel system to effect the leanest fuel-air mixture that will satisfactorily support engine idle operation.

Another object is to provide an improved method for adjusting a carburetor of the above character for idle operation comprising first closing the adjustable idle air inlet orifice to its most restricted condition, then adjusting the idle fuel port to obtain the maximum tolerable idle fuel enrichment with the throttle at its closed or idle position, then locking the adjustment means for the idle fuel port in its adjusted position and adjusting the adjustable idle air inlet orifice to obtain the desired fuel-air mixture for idle operation.

Another object is to provide an improved multiple barrel carburetor and method of adjusting the idle fuel-air mixture to the various barrels or induction conduits, wherein a single idle air inlet orifice is connected in parallelism and in predetermined balanced arrangement with the several idle fuel conduits associated respectively with the multiple induction conduits.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Brief description of the drawings

FIG. 1 is a schematic vertical sectional view through a carburetor embodying the present invention, taken through the air induction conduit and idle fuel system.

FIG. 2 is a diagrammatic view similar to FIG. 1, showing a modification adapted for a two-barrel carburetor.

FIG. 3 is a view similar to FIG. 2, but showing a modification adapted for a four-barrel carburetor.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Description of the preferred embodiments

Referring in more particularity to the drawings, a carburetor is illustrated comprising three principal body sections including an upper air inlet and choke valve section 10, an intermediate venturi section 11, and a lower throttle section 12 suitably covered by gaskets and bolted together by means not specifically shown. The three carburetor sections cooperate to define an induction conduit 13 extending completely therethrough and adapted to align with a customary intake header for conducting a combustible fuel and air mixture to the engine.

The intermediate body portion 11 is formed with a large venturi 14 aligned coaxially with the conduit 13 and separated from an integral fuel bowl section 15 by means of a transverse vertical wall 16. The fuel bowl 15 contains a supply of liquid fuel automatically maintained at approximately the level 17 by a float controlled inlet valve connected with a customary fuel pump. The top of the fuel bowl 15 is covered by an extension 18 of the upper body section 10 to provide a comparatively dust free fuel bowl enclosure which is suitably vented to atmospheric pressure, usually within conduit 13.

A throttle valve shaft 19 is pivotally mounted in the conduit portion 13 of the throttle body section 12 and supports a blade type throttle valve 20 operable in a conventional manner by a pedal actuated linkage. The lower body portion 12 is also formed with mounting flanges 21 to facilitate mounting of the carburetors assembly on the intake manifold as aforesaid.

An embossment 22 of the transverse wall 16 extends to the right to define a portion of the venturi 14 and is cored vertically to provide a fuel well 23. A small venturi 24 arranged coaxially upstream of the venturi 14 is provided with an integral extension 25 seated on the upper horizontal surface of the embossment 22.

The fuel well 23 extends upwardly into the extension 25 which in turn is provided with a recess 26, in communication with the fuel well 23, and a downwardly extending passage 27. The latter contains a tubular main fuel nozzle 28 pressed tightly therein and discharging into the throat region of the venturi 24. The upper end of the passage 27 communicates with the upper portion of the well 23 to receive fuel therefrom during operation of the engine under load.

A hollow vent or partitioning tube 30 is secured within the recess 26 by means of a press fit and extends downwardly into the well 23. The tube 30 is formed with a plurality of ports 31 spaced along its length to permit the transfer of air from its interior into the adjacent portions of the well 23 for emulsifying the fuel. Air is admitted into the hollow interior of the tube 30 at its upper end through a restricted port 32, which communicates with the upper portion of the air induction passage 13.

A second and upwardly closed recess 33 is formed in the upper portion of the extension 25 to receive the upper end of an idle tube 34 pressed tightly therein. The idle tube 34 communicates with the bottom of the well 23 through a restricted idle fuel inlet port 35 and communicates with a third recess or opening 36 in the upper end of extension 25 by means of an upper transverse passage 37, the latter being defined in part by a radial port in the upper end of tube 34. The opening 36 extends vertically through the extension 25 in alignment with a lower threaded opening 38 in the wall 16. A tubular clamping bolt 39 is received snugly within the opening 36 and is screwed tightly into the opening 38 to clamp

the projection 25 securely in place on the embossment 22. A fibrous gasket 40 is preferably disposed between the extension 25 and embossment 22.

An annular exterior recess 52 and diametrical bore 53 in the upper end of bolt 39 conduct idle fuel into its central bore from passage 37. The central bore of bolt 39 also communicates upwardly through an idle air bleed restriction 41 with the air induction passage 13 to receive air for mixing with the idle fuel to provide a combustible fuel and air mixture for the engine during idling. This idle fuel-air mixture is conducted through the bolt 39 comprising part of an idle fuel passage 42 which extends downwardly into the throttle body section 12 and opens into the induction conduit 13 through an inwardly tapered conical idle port 43 located downstream of the throttle valve 20. The degree of restriction of the idle port 43 may be varied by a mating conical valve element 44 having an integral coaxial outer idle mixture screw body 45 adjustable by screw action within a mating threaded bore 51 which extends to the exterior of the throttle body 12.

The interior of the fuel bowl section 15 contains a main metering element 46 screwed into the base of the fuel bowl at 47. The metering element 46 is situated substantially on the plane of symmetry of the fuel bowl and is formed with a main metering orifice 48 communicating with a fuel supply passage 49 which discharges into the bottom of the fuel well 23. The upper portion of the metering element 46 slidably receives and guides a metering pin 50 carried by a vertically movable and resiliently biased piston reciprocable in response to pressure changes downstream of the throttle valve 20, so that the restriction of the metering orifice 48 decreases with increasing opening of the valve 20.

Cooperating with the idle fuel system is a vertically slotted idle transfer port 55 in the throttle body section 12 connecting the idle conduit 42 with the conduit 13. Preferably the transfer slot 55 extends upwardly from its lower end, located slightly below an edge portion of the throttle blade 20 when the latter is in the closed or idle position shown, to its upper end slightly above the aforesaid edge. Thus when the throttle valve 20 is in its closed or idle position shown, air from conduit 13 will flow into the idle fuel conduit 42 via port 55 above the blade 20 and a fuel-air mixture will flow from conduit 42 into the conduit 13 via port 55 below the blade 20. The transfer port 55 is dimensioned to cooperate with the port 43 and supply approximately ten percent of the total fuel for idle operation. As the throttle valve 20 progressively opens, the proportion of the slot 55 downstream of the throttle 20 and correspondingly the proportion of fuel supplied to the conduit 13 via slot 55 will increase with respect to the fuel supplied by idle port 43, in accordance with customary practice.

The structure described thus far may relate to either a single or multiple barrel carburetor and may be conventional, reference being had to Ball Patent No. 2,966,344 and to Sarto copending application Ser. No. 571,506, now Patent No. 3,391,909 as if the same were incorporated herein, for a more complete discussion of the structure and operation of the conventional details shown.

In order to adapt the idle fuel system to prevent in-expert adjustment resulting in a fuel-air mixture that is either too lean or excessively rich, an adjustable idle air inlet port 56 opens in parallelism with restricted port 41 into the idle fuel conduit 42 via annular recess 52 in tubular bolt 39. The port 56 in the present instance comprises an outwardly tapering valve seating portion in extension 25 adapted to receive a mating tapered idle air adjusting valve 57. The latter is integral with a screw body 58 adjustably screwed through the sidewall of the upper carburetor section 10 and accessible from its exterior for manual adjustment to restrict or completely close port 56 as desired. Spring 54 frictionally holds screw 58 in its adjusted position.

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Port 56 is dimensioned so that when it is at its maximum opening, i.e. when valve 57 is completely removed, the idle air supplied to conduit 42 via port 56 in cooperation with the idle air supplied from other sources, including the fixed air inlet port 41, transfer port 55, and controlled flow around throttle valve 20 at its closed or idle position shown, will result in an idle fuel-air mixture of minimum fuel to air ratio which will operate the engine smoothly without an objectionable level of undesirable exhaust emissions. Downstream of the ports 41 and 56, the idle fuel conduit 42 is preferably provided with a restriction 59 to facilitate mixing of the idle fuel and air as it flows toward port 43. Where desired, port 56 may open into conduit 42 downstream of restriction 59 as in FIG. 2.

The outer end of the idle mixture screw 45 is recessed within bore 51 and the latter is preferably permanently sealed at the factory by a plug 60 to prevent access to screw 45. In this regard, prior to sealing bore 51 by a lead plug 60, screw 45 is adjusted to effect an idle fuel-air mixture of maximum permissible fuel enrichment when port 56 is completely closed by valve 57 and throttle valve 20 is at its idle position shown. Suitable means such as a plastic insert 61 is deformed between the sidewall of bore 51 and screw 45 to frictionally engage the latter and prevent its inadvertent movement out of its adjusted position, whereupon after plug 60 is applied, the idle fuel system is comparatively tamperproof and cannot be adjusted to effect an excessively rich idle mixture which would result in objectionable exhaust emissions. It is apparent that since screw 45 is adjusted to effect maximum idle fuel enrichment while port 56 is closed, the subsequent adjustment of screw 58 to open port 56 will only add more air and reduce the richness of the idle fuel-air mixture.

The desired adjustment of screw 45 can be accomplished with the engine running at idle by analyzing the exhaust emission from the engine cylinder or group of cylinders supplied by conduit 13, corresponding to different adjusted positions of the screw 45, until the maximum tolerable level of unburned exhaust is attained, which level will also determine the maximum tolerable idle fuel enrichment. A preferred method for adjusting the screw 45 suitable for mass production of carburetors is to predetermine the dimensions and geometry of the screw 45 and the related elements controlling the idle fuel and air supply including valve 44, tapered port 43, transfer port 55, and throttle valve 20, within prescribed tolerances with respect to the idle operating characteristics of the carburetor and engine, so that when the screw 45 is unscrewed a predetermined number of turns from its seated position closing port 43, the desired maximum idle fuel enrichment will result. The foregoing is accomplished by manufacturing all of the production carburetors according to the prescribed tolerances as aforesaid, then adjusting screw 45 for each of a sampling of the carburetors in turn, while the engine is idling with port 56 closed and throttle 20 at its idle position, until analysis of the exhaust as aforesaid determines that the maximum desirable idle fuel enrichment is obtained. The number of turns of screw 45 required to effect the adjustment is noted and averaged with the corresponding adjustment turns required for the other carburetors in the sampling. The resulting average number of adjustment turns is then employed with each production carburetor thereafter.

In FIGS. 2 and 3, the idle fuel systems for two and four barrel carburetors are shown schematically. These idle fuel systems are substantially the same as described with regard to FIG. 1 and corresponding parts are similarly numbered in all views. In FIG. 2, a single adjustable air inlet port 56 is symmetrically connected in parallelism with the two idle fuel conduits 42 associated respectively with the two fuel-air induction conduits 13, each adapted to supply a combustible fuel-air mixture

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primarily to one of two separate inlet headers operably connected with a separate bank or group of engine cylinders, although a certain amount of interchange between the two separate inlet headers downstream of the throttle valves 20 may take place, depending upon the type of engine and the operating condition desired.

In FIG. 3, the single adjustable air inlet port 56 is symmetrically connected in parallelism with four idle fuel conduits 42 associated with four fuel-air induction conduits 13, each again being adapted to supply the fuel-air mixture primarily to a specific inlet header connected with a separate group of engine cylinders. The two lower conduits 13 may be considered to be primary conduits for supplying fuel during all operating conditions and are shown with the idle ports 43 and transfer ports 55, whereas the two upper conduits 13 may be considered to be secondary conduits for supplying supplemental fuel primarily during high load conditions. Such conduits frequently supply a portion of the idle fuel and are shown with idle ports 43, but the transfer ports 55 are not required with the secondary conduits 13 because the primary conduits 13 are adequate to supply fuel during low load engine operation in the transfer range. In all other respects, the remaining features of the fuel system of FIGS. 1, 2 and 3 are the same. In fact, except for the specific arrangement of the idle inlet port 56, FIG. 1 could be an illustration of a fuel system associated with any one of induction conduits 13 in either FIG. 2 or FIG. 3.

In accordance with the arrangements illustrated in FIGS. 2 and 3, not only can the maximum and minimum idle fuel enrichment for each induction conduit 13 be predetermined in the manner described above, but a balancing of idle fuel to the various induction conduits can be readily achieved. The adjustable port 56 in FIG. 2 for example opens upstream into an air supply conduit 62 in communication with the atmosphere to receive air, preferably from the upper portion of conduit 13 within the carburetor section 10 and below the usual air filter. The port 56 discharges downstream into a bifurcated connecting conduit 63, each branch of the bifurcation 63 opening respectively into one of the idle fuel conduits 42 at locations downstream of the restrictions 59, although the connections between conduits 42 and 63 could be upstream of the restrictions 59 if desired, as in FIG. 1. The two branches of the conduit 63 have equal resistances to air flow, so that other factors being equal, the idle air supplied through port 56 is automatically proportioned equally between the two conduits 42 for any adjusted position of the single screw 58. It is also apparent that either port 41 or 56 may be adapted to supply any proportion of the desired idle air to the associated duct 42, including a negligible quantity or none, in which event the other port 56 or 41 respectively would supply a preponderant amount or all of the required idle air.

In FIG. 3, each of the two branches of the connecting conduit 63 bifurcates into connecting conduits 63a, which in turn open into the four idle fuel conduits 42 in the manner aforesaid in regard to FIG. 2, so that idle inlet air supplied via port 56 is automatically proportioned to each of the four idle fuel conduits 42 at all adjusted positions of the single adjusting screw 58. In both FIGS. 2 and 3, if more or less idle air is desired for any one of the conduits 42, the resistance of the associated connection with port 56 will be predetermined accordingly.

Instead of adjusting the idle enrichment for any of the conduits 13 shown and balancing the fuel flow to the multiple barrels or conduits 13 when the carburetor is mounted on an engine operating at idle, the carburetor can be adjusted and balanced on a flow stand, whereby a vacuum is induced downstream of the throttle 20 in a simulated idle operation, with throttle valve 20 at its idle position and port 56 closed. In such a procedure, fuel is supplied to the fuel bowl to simulate operating conditions and idle fuel and air are forced through the idle

fuel system and into the induction conduit 13 via ports 55 and 43 as described above except that the amount of fuel enrichment at the conduit 13 will usually not be the same as the fuel enrichment under actual operating conditions. In fact, for a multiple barrel carburetor as illustrated in FIGS. 2 and 3, the fuel enrichment under flow stand conditions will usually be different for each conduit 13 when the associated idle fuel system including the screw 45 is adjusted to effect maximum idle fuel enrichment during actual engine idling. The foregoing is well known to the art and follows in consequence of differences in the geometry, temperature, resonance characteristics, and other factors of the various conduits 13 and associated inlet manifolding affecting fluid flow therein during idle operation. However during actual engine operation, the idle fuel flow will be the same to each engine cylinder. In any event, the quantity of fuel discharged from each conduit 13 on the flow stand is compared with the quality of the exhaust gases from the cylinder or group of cylinders supplied by that conduit 13 during actual engine idle operation at various settings of the screw 45, so that by interpolation an accurate setting of the screw 45 for maximum fuel enrichment during idle operation can be predetermined on the flow stand.

Where a multiple barrel carburetor is involved, as in FIGS. 2 and 3, all but one of the conduits 13 can be plugged, preferably above and below the ports 43 and 55 so as to render the latter inoperative. The carburetor is then mounted on the flow stand and vacuum is applied downstream of the throttle valve for the one remaining unblocked conduit 13 in a simulated idle operation, whereupon the screw 45 associated with the one unblocked conduit 13 under observation is adjusted under the conditions described until analysis of the fuel exhausted from the latter conduit 13 indicates that the maximum desirable idle fuel enrichment from that conduit 13 would result when the carburetor is mounted on an engine running at idle. During this flow stand adjustment, some air and fuel will be supplied by the ports 41 and 35 associated with the blocked conduits 13, but this factor will have been taken into consideration by the aforesaid calibration or comparison of the flow stand enrichment with the actual idle operating condition at the various settings of the screw 45.

A somewhat more accurate measurement of the idle fuel-air mixture within each conduit 13 of a multiple barrel carburetor can be made in turn on the flow stand if the idle fuel-air systems associated with the other conduits 13 are rendered inoperative and completely isolated from the one conduit 13 under observation. Thus as illustrated in FIG. 3, valve means may be provided for selectively blocking fuel and air flow from the ports 35 and 41 (associated with the conduits 13 not under observation) to any of the conduits 13, whether under observation or not. Also preferably cross flow is prevented from the ports 43 (and 55 where such exists) associated with any conduit 13 to the corresponding ports of any other conduit 13.

Specifically in FIG. 3 by way of example, a port 64 is provided in the idle system adjacent each juncture between the conduits 42 and 63a and is normally sealed by a lead plug 65. Each port 64 is arranged to receive a valve or plug element 66, as for example of deformable rubber-like material on the end of a tool 67 as shown by dotted lines at the upper right-hand port 64, and adapted when inserted by the tool to close the port 64 and, if desired, to close the connection between the adjacent conduit 63a and each of the associated ports 35, 41, 43 and 55 (where the latter exists) and also to close the ports 43 and 55 (where the latter exists) associated with the adjacent conduit 42 from the associated ports 35 and 41.

The ports 64 are utilized as follows: Prior to insertion of the lead plugs 65, a separate plug or valve element

66 is inserted into each of the ports 64 to close the same. The plug 66 in each of three of the ports 64 is also inserted so as to close the upper end of the adjacent conduit 42 from the adjacent conduit 63a, as well as from the associated ports 41 and 35, and also to close the latter two ports from the adjacent end of conduit 63a. Thereafter fuel is supplied to well 23 and vacuum is applied to the induction conduits 13 downstream of the throttle valves 20 in a simulated idle operation with port 56 closed, whereupon the screw 45 associated with the conduit 13 under observation is adjusted until measurement of the fuel and air flow from the latter conduit, either by measuring the fuel and air input or by analyzing the discharged fuel-air mixture, indicates that maximum idle enrichment for that conduit would result under actual engine idling conditions. The flow stand measurement will have been previously calibrated against actual operating conditions in the manner above described, so that the flow stand measurements can be read directly either in terms of idle fuel enrichment or in terms of incomplete fuel combustion during actual idle operation. After adjustment of one screw 45 is complete, the above procedure is repeated until all of the screws 45 are adjusted to effect the desired maximum fuel enrichment. With the procedure just described, it is usually unnecessary to block the induction conduits 13 not under observation during the flow stand adjustment of the screws 45, because the conduit 13 under observation is isolated as described from the possibility of fuel and air being supplied from the idle fuel systems associated with the other conduits 13. However, blocking of the latter conduits can also be done where this procedure would facilitate analysis of the fluid emissions from the conduit 13 under observation. When all the screws 45 are adjusted, the ports 64 and threaded bores 51 are sealed by the lead plugs 65 and 60 respectively. If a subsequent adjustment is ever required, the plugs 60 and 65 can be readily drilled out by a skilled mechanic. Otherwise the adjusted screws 45 are comparatively tamper-proof.

The foregoing methods of adjusting the screws 45 are briefly summarized as follows:

(A) Operate the engine at idle with adjustable idle air port 56 closed and, for various adjusted positions of each idle mixture screw 45 in turn, analyze and record the exhaust emissions from the engine cylinders supplied primarily by the conduit 13 associated with the screw 45 being adjusted, whereby the adjusted position of the screw 45 within its threaded bore 51 (as for example the number of turns that the screw 45 is backed off of the tapered valve seat of port 43) for the maximum tolerable idle fuel enrichment, as well as for other exhaust conditions, is determined. This procedure will usually be too slow and costly for production adjustment, but is accurate and useful for spot checking and enables accurate calibration or comparison of flow stand characteristics at various adjusted positions of the screw 45 with actual engine operating conditions.

(B) Measure the input of air and fuel to the conduit 13 under observation at various adjusted positions of screw 45 while the carburetor is on a flow stand under simulated idle conditions and port 56 is closed, while

- (a) each of the conduits 13 except the one under observation is blocked, as explained above, or
- (b) the idle fuel system associated with one conduit 13 under observation is isolated from all the other conduits 13, and each of the other idle fuel systems is isolated from all of the conduits 13, as explained above, or
- (c) the conditions of paragraphs (b) and (c) above are combined.

(C) Measure the output of fuel and air from each conduit 13 under observation at various adjusted positions of screw 45 while the carburetor is on the flow

stand under simulated idle conditions and port 56 is closed. In accordance with this latter procedure, it will be unnecessary to block the conduits 13 not under observation. Also the flow stand characteristics in accordance with each of the procedures summarized in paragraphs B and C above will first be calibrated with respect to actual operating conditions at the same adjustment of screw 45, as for example in accordance with the procedure of paragraph A above.

In operation of any one of the idle fuel systems shown, after the screws 45 and 58 are adjusted, the fuel well 23 is partially filled with fuel to the level 17 by means of the metering orifice 48 and conduit 49. When the throttle valve 20 is at the closed or idle position shown, the opening 48 will be partially restricted by plunger 50. The low pressure downstream of throttle valve 20 induces fluid flow via idle conduit 42 and port 43 into the induction conduit, whereupon fuel in the well 23 is forced upwardly through the idle tube 34 via idle inlet port 35 to the duct 37 and thence through the hollow bolt 39 and downwardly through conduit 42. Similarly, air for supporting idle combustion will be supplied by controlled leakage around the throttle valve 20, through the restricted port 41, adjustable port 56, and transfer port 55.

As the throttle is initially opened progressively in accordance with increased engine load during the transfer range, the portion of the transfer port 55 downstream of the adjacent edge of the throttle blade 20 will progressively increase, thereby to decrease the pressure in idle conduit 42 and increase the fuel flow therethrough from idle tube 34 and into conduit 13 via both ports 55 and 43. As the throttle 20 continues to open to increase the air flow in conduit 13, the pressure within conduit 13 at ports 43 and 55 will increase and the fuel flow therethrough will decrease and the main fuel system will take over. Low pressure will be induced at the lower end of nozzle 28 by reason of the venturi system 14, 24 and fuel will be forced upwardly in well 23 to passage 27 and discharged via nozzle 28. Simultaneously, emulsifying air for the main fuel supply will be admitted into tube 30 via restriction 32 and admixed with the fuel in well 23 by means of the ports 31. Also, as the pressure downstream of throttle 20 progressively increases, the metering rod 50 will be withdrawn from metering port 48 to progressively open the latter and increase the fuel flow into well 23.

I claim:

1. In a carburetor

(A) a fuel-air induction conduit,

(B) a throttle valve in said conduit,

(C) means for supplying an idle fuel and air mixture to said conduit comprising

(1) an idle fuel metering port opening into said conduit at a location downstream of said throttle valve,

(2) an idle fuel duct in communication with said idle fuel metering port to deliver said idle fuel and air mixture thereto and thence through said port into said conduit at said location,

(3) selectively adjustable idle air metering means in communication with a source of air upstream of said throttle valve and opening into said idle fuel duct upstream of said idle fuel metering port to adjustably increase the supply of air thereto from said source,

(4) a recess in the wall of said induction conduit opening from the exterior thereof into said idle fuel duct at the region of said idle fuel metering port,

(5) manually adjustable idle mixture adjusting means within said recess for adjustably restricting said fuel metering port, and

(1) an idle fuel metering port opening into said

idle mixture adjusting means to prevent access to the latter in its adjusted position.

2. In the combination according to claim 1, a plurality of fuel-air induction conduits including the first-named induction conduit, a separate throttle valve, idle fuel metering port, idle fuel duct, idle mixture adjusting means, recess, and means for closing the latter associated with each induction conduit as aforesaid in regard to said first-named induction conduit, and said adjustable idle air metering means comprising a single adjustable air metering port connecting said source of air in parallelism with each idle fuel duct at a location upstream of the associated idle fuel metering port.

3. In the combination according to either claim 1 or claim 2, a fuel bowl containing a supply of liquid fuel and communicating with each idle fuel duct to supply fuel thereto, the opening of said adjustable idle air metering means into each idle fuel duct being above the fuel level in said bowl.

4. In the method of adjusting a carburetor having the structure of claim 2, the steps of closing said adjustable idle air metering means to its minimum opening, thereafter and prior to installing said means for closing said recess, adjusting each idle mixture adjusting means within its recess to obtain the maximum idle fuel enrichment compatible with exhaust emission requirements, thereafter installing said means for closing said recess exteriorly of said idle mixture adjusting means, and then adjusting said idle air metering means to obtain the desired idle fuel and air mixture.

5. In the method according to claim 4, the idle mixture adjusting means associated with each induction conduit being adjusted in turn for maximum idle enrichment by temporarily isolating the associated induction conduit from the idle fuel supply means associated with the remainder of said induction conduits, supplying fuel to the idle fuel port associated with the idle mixture adjusting means to be adjusted and applying a partial vacuum to the associated induction conduit downstream of the throttle valve therein in a simulated idle operation while said carburetor is mounted on a flow stand, analyzing the fuel and air mixture discharged from the latter induction conduit at various adjusted conditions for the latter idle fuel port, and thereafter while said adjustable idle air metering means is closed to its minimum opening, repeating the above procedure with the remaining idle mixture adjusting means in turn.

6. In the combination according to claim 1, said idle mixture adjusting means comprising means adjusted to obtain a maximum idle fuel to air ratio compatible with exhaust emission requirements when said idle air metering means is adjusted to supply the minimum quantity of air from said source to said idle fuel duct.

7. In the combination according to claim 6, said means for closing said recess comprising means that must be destroyed to be removed from said recess.

8. In the combination according to claim 1, said throttle valve comprising a pivotal throttle blade within said induction conduit, said idle air metering means including a transfer port connecting said idle fuel duct and induction conduit, the opening of said transfer port into said induction conduit being elongated in the direction of flow within said induction conduit and being arranged with respect to an edge of said throttle blade at its idle position to provide a first predetermined portion of said opening upstream of said edge to conduct air from said induction conduit into said idle fuel duct and to provide a second predetermined portion downstream of said edge to conduct idle operating fuel and air from said idle fuel duct into said induction conduit.

9. In the method of manufacturing a carburetor having a fuel-air induction conduit, a throttle valve in said conduit, an idle fuel duct opening into said conduit at an idle fuel port downstream of said throttle valve, a bore extending from the exterior of the sidewall of said induction

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conduit into said idle fuel duct to register with said idle fuel port and having a screw threaded portion, an idle mixture screw within said threaded portion of said bore and adjustable axially of said bore by screw action, said screw having a metering valve portion registering with said idle fuel port to adjustably restrict the opening of said fuel port upon said screw action, and a plurality of air bleed metering orifices in communication with a source of air upstream of said throttle valve and opening in parallelism with each other into said idle fuel duct upstream of said idle fuel port, the steps of dimensioning certain of said orifices to supply a predetermined minimum quantity of air from said source to said idle fuel duct when the remainder of said orifices are closed and said throttle valve is at its idle position, thereafter closing said remainder of said orifices and adjusting said throttle valve to said idle position, adjusting said screw by said screw action to restrict said opening of said idle fuel port to obtain maximum idle fuel enrichment when said remainder of said orifices are closed and said throttle valve is at its idle position, and locking said adjustable means against displacement from said working position by sealing said bore exteriorly of said screw to prevent access thereto.

10. In the method according to claim 9, the steps of dimensioning said bore, threaded portion thereof, screw, metering valve portion, and idle fuel port within predetermined tolerances such that the screwing of said screw

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a predetermined number of turns within said threaded portion will adjust said valve portion with respect to said idle fuel port to effect said maximum idle fuel enrichment under the conditions aforesaid, and wherein the step of adjusting said screw comprises the step of screwing said screw said predetermined number of turns within said threaded portion.

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TIM R. MILES, *Primary Examiner.*

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