Oct. 14, 1958 M. J. KITTLER ET AL 2,856,168

TRANSFER SYSTEM

Filed May 9, 1955 2 Sheets-Sheet 1

FIG.1.

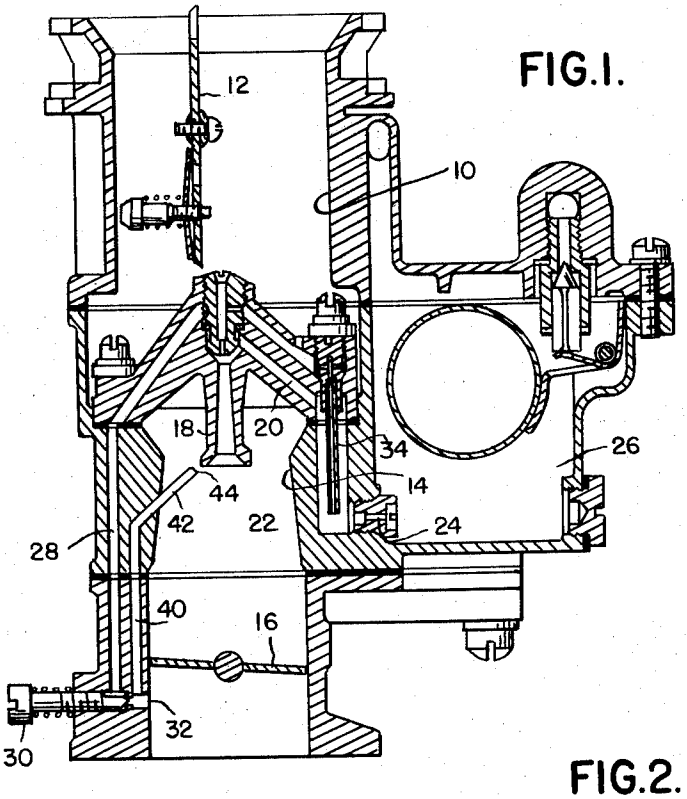
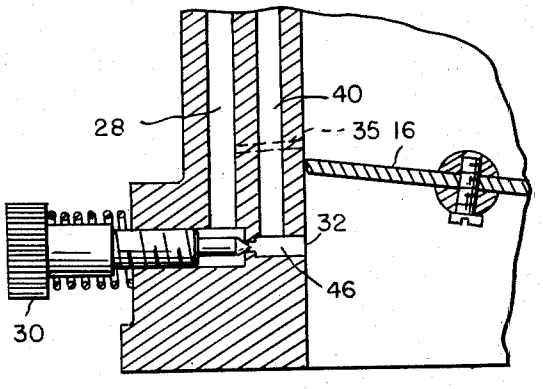


FIG.2.



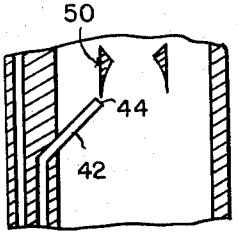


FIG.3.

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FIG.4.

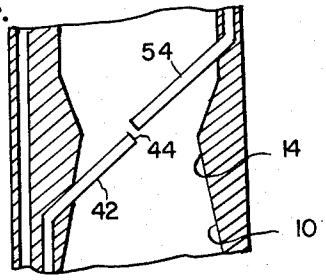


FIG.5.

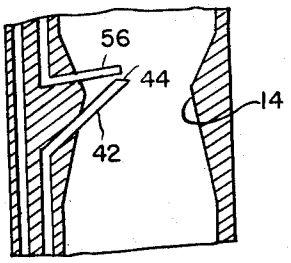


FIG.6.

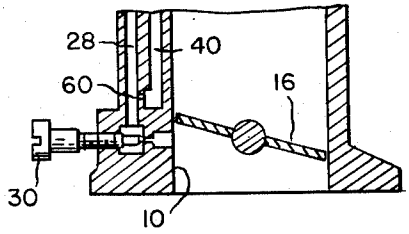
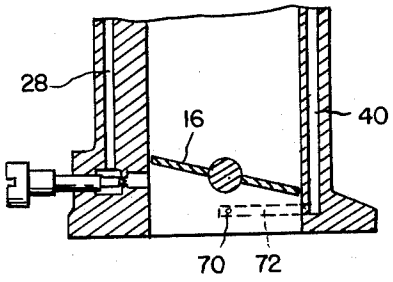


FIG.7.



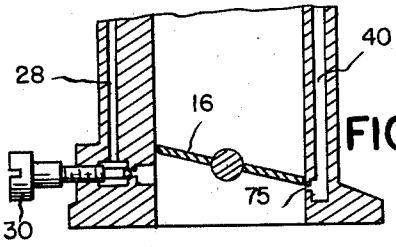
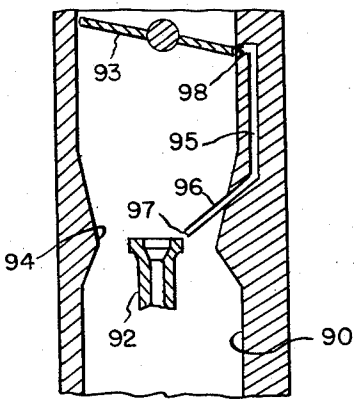


FIG.8.

FIG.10.



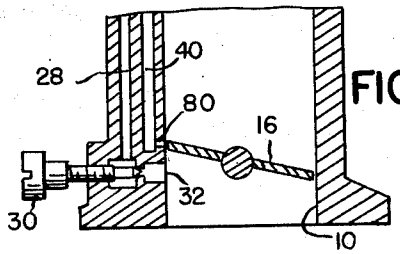


FIG.9.

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2,856,168

TRANSFER SYSTEM

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Application May 9, 1955, Serial No. 506,972

8 Claims. (Cl. 261—41)

The present invention relates to a transfer system designed to insure smooth transition between idle and normal driving ranges.

All present day passenger automobiles are equipped with engines of comparatively very high horsepower output. The power required to drive the car has, on the other hand, not increased substantially over what it was ten or fifteen years ago when the engines were generally of only about one-half the present horsepower. This change in the balance between horsepower available and horsepower required means that all of the engines are regularly operating at a considerably smaller fraction of their maximum capabilities. Translating this into carburetor language, it means that under average city driving conditions the carburetor operates largely in the idle range and in the transfer range between the idle range and the main nozzle range, and a considerably less portion of time in the range where the main nozzle is the principal fuel supply means.

Under such operating conditions it is increasingly important that the carburetor be so designed that the idle fuel system meter with maximum accuracy, and, even more, that the transfer between the idle system and the main system be accomplished with the maximum degree of smoothness. This problem of transfer has been characteristic with all plain tube carburetors, which encompasses all commercial carburetors presently used on automotive vehicles. It is recognized by those skilled in the art that it is difficult to accomplish a smooth transition from the idle fuel system to the main fuel system. As the air flow through the carburetor gradually increases beyond the idling range, the main nozzle gradually begins to feed fuel and at this point it is characteristic of the main nozzle to start to feed in a rather intermittent and unsteady manner. Droplets of fuel will begin to flow through the main nozzle, but the air velocity is not sufficient to keep them moving rapidly nor to spray them smoothly off the end of the main nozzle. The result is that these droplets collect on the main nozzle tip and then drip off in large droplets. The engine of course, requires a homogeneous fuel-air mixture rather than an intermittent dripping of fuel from the nozzle. This dripping of fuel thereby causes the engine to run in a jittery and unsteady manner. It is generally necessary to enrich the mixture ratio beyond the desired point when calibrating the carburetor in order to allow for this poor mixing of fuel and air, with a resulting loss of economy.

As explained previously, this is of particular importance with present day engines where so much of the low speed driving is done in the idle and transfer range. The transfer system disclosed herein was developed for the specific purpose of correcting this problem.

With the foregoing general remarks in mind, it is an object of the present invention to provide a transfer system for improving operation of a carburetor in the transfer range and to facilitate smooth transition from idle range to normal range wherein the fuel is supplied primarily from the main nozzle.

It is a further object of the present invention to provide a transfer system comprising a transfer tube connected to a source of vacuum for drawing off droplets of fuel accumulating on the fuel supply means in the carburetor during the first stages of operation of the main fuel nozzle.

It is a further object of the present invention to provide a transfer system including passage means having an intake port adjacent the main fuel supply means in order to draw droplets of fuel accumulating into the passage, the passage having an outlet port into the barrel of the carburetor below the throttle plate or into the idle fuel feed system.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a vertical sectional view through a carburetor.

Figure 2 is an enlargement of a portion of the structure shown in Figure 1.

Figure 3 is a transverse sectional view showing the intake port of the transfer passage of another embodiment of the present invention.

Figure 4 is a transverse sectional view showing the intake port of the transfer passage of another embodiment of the present invention.

Figure 5 is a transverse sectional view showing the intake port of the transfer passage of another embodiment of the present invention.

Figure 6 is a fragmentary sectional view showing the connection of the transfer passage to suction in yet another embodiment of the present invention.

Figure 7 is a fragmentary sectional view showing the connection of the transfer passage to suction in yet another embodiment of the present invention.

Figure 8 is a fragmentary sectional view showing the connection of the transfer passage to suction in yet another embodiment of the present invention.

Figure 9 is a fragmentary sectional view showing the connection of the transfer passage to suction in yet another embodiment of the present invention.

Figure 10 is a fragmentary sectional view illustrating the application of the invention to an updraft carburetor.

The present invention is applicable to any type of carburetor as for example, the conventional type of four barrel downdraft carburetor having two primary barrels for low speed operation and two secondary barrels for high speed operation. This is the type of carburetor commonly used on present day V type eight cylinder engines. However, in order to simplify the disclosure, the invention is illustrated and described in conjunction with a single barrel, which may be considered a primary barrel of a two stage, four barrel carburetor. On the other hand, the invention is equally useful in conjunction with a single barrel carburetor or a carburetor having any number of barrels.

Referring now to Figures 1 and 2 there is shown a carburetor having a barrel **10** provided with the usual choke valve **12**, Venturi **14**, and throttle plate **16**. Mounted in the barrel of the carburetor is a main fuel supply means including the main fuel supply nozzle **18** adapted to draw fuel through passage **20**, well **22**, and jet **24** from float chamber **26**.

In conventional downdraft carburetors of the type indicated in Figure 1 the region above throttle plate **16** is substantially at atmospheric pressure or slightly below atmospheric pressure and is normally the "high pressure" part of the carburetor air system. The area below throttle plate **16** is always at a higher vacuum than the area above the throttle plate and may be called the low pressure side of the carburetor air passage system. In the following paragraphs the high pressure area will be under-

stood to be that area above throttle plate **16** and the high vacuum or low pressure area will be understood to be that area below throttle plate **16**. Where an updraft carburetor is discussed rather than a downdraft carburetor, the relationship of the high pressure and low pressure area is obviously reversed since the flow is in an upward direction rather than in a downward direction.

The carburetor includes an idle air bleed supply system including a passage **28**, adjustable needle valve **30**, and outlet port **32** located in the barrel below the throttle plate **16**. As is well understood in the art, when the throttle plate is closed or substantially closed, vacuum below the throttle plate **16** operates through the passage **28** to draw sufficient fuel for idling operation of the engine through tubular member **34**. Passage **35** connects passage **28** to the barrel **10** above throttle plate **16**, as shown in Figure 2. While not illustrated in the other figures, this second idle discharge passage is conventional, and will ordinarily be provided.

During idle operation of the engine, air pressure at the main nozzle **18** is substantially atmospheric and no fuel is drawn through the nozzle **18**. However, as the throttle plate **16** is gradually opened, the pressure at the main nozzle **18** decreases gradually and the vacuum applied thereby to the fuel in the well **22** eventually draws fuel up into the nozzle where it commences to discharge into the barrel. During the initial operation of the nozzle **18** while vacuum is increasing, the fuel is not drawn smoothly from the nozzle in a spray, nor is it atomized as is desirable. Instead, it tends to accumulate in small droplets which run together and eventually drops of fuel drop off the nozzle and are drawn into the manifold and thence into the cylinders of the internal combustion engine in an intermittent and improperly mixed or atomized condition.

In accordance with the present invention a transfer system including a transfer passage **40** is provided. The transfer passage **40** communicates with a transfer tube **42** having an intake port **44** located in close proximity to the fuel supply means in the Venturi **14** and in position to draw off droplets of liquid fuel before they gather into large drops and accumulate on the nozzle **18**. The other end of the transfer passage communicates with a source of vacuum. As illustrated in Figures 1 and 2, the lower end of the transfer passage **40** communicates with the end portion **46** of the passage **28** which terminates in the outlet port **32** of the idle fuel supply system previously described. Accordingly, as the throttle plate **16** moves toward open position so as to cause fuel to commence to flow through the main nozzle **18**, vacuum is applied at the intake port **44** and causes droplets of fuel to be drawn through the transfer passage and discharged into the barrel below the throttle. In this case, the fuel is utilized in the most efficient manner and most important, intermittent supply of relatively large drops of unatomized fuel to the engine is effectively prevented.

Referring now to Figure 3 there is illustrated a similar arrangement in which the upper end of the transfer tube **42** is located with its intake port **44** in position adjacent the lower or downstream edge of a booster Venturi indicated generally at **50**. It may be mentioned at this time that the exact placement of the intake port will be determined by the particular means for supplying the main fuel feed to the barrel, and in a proper case where a main nozzle and booster Venturi are both provided, it may be desirable to provide a transfer system including branched tubes or passages having intake ports adjacent both the nozzle and booster Venturi or any other element in the carburetor where fuel tends to collect in droplets during transition from idle to normal range.

Referring now to Figure 4, the main fuel supply means in the Venturi **14** of the barrel **10** is illustrated as a downwardly inclined tube **54**, and in this case the upper end of the transfer tube **42** is shown as having its intake port **44** downstream from and closely adjacent to the port at the end of the fuel nozzle **54**.

Referring now to Figure 5 there is shown a main fuel supply nozzle in the form of an upwardly inclined tube **56** and the transfer tube **42** is shown as having its intake port **44** at the downstream side of and closely adjacent to the port at the end of the fuel nozzle **56**.

It will be appreciated that the specific variations of the invention illustrated in Figures 3, 4 and 5 relate only to the upper end of the transfer passage, and particularly to the relationship between the intake port **44** at the end of the transfer tube **42** with the particular main fuel supply means in the carburetor.

Referring now to Figure 6 there is illustrated another embodiment of the present invention in which the passage **40** of the transfer system has a restricted connection **60** with the passage **28** of the idle fuel supply system. The restricted connection **60** between the passages **28** and **40** is located above the needle valve **30** which is used to adjust the flow of fuel under idling conditions into the barrel **10** of the carburetor below the throttle plate **16** thereof.

Referring now to Figure 7 there is illustrated another embodiment of the present invention wherein the discharge end of the transfer system includes a port **70** connected by a passage **72** communicating with the vertically extending transfer passage **40**. It will be observed that the outlet or discharge port **70** is located below the throttle plate **16** and hence, at a zone of relatively low pressure or high vacuum in the transfer system during idle and transfer range. This embodiment of the invention differs specifically from that illustrated in Figure 1 in that the source of vacuum to which the transfer system is connected is in this case independent of the idle fuel supply system.

Referring now to Figure 8 there is illustrated yet another embodiment of the present invention in which the lower end of the transfer passage **40** is provided with an outlet port **75** located just below or at the downstream side of the throttle plate **16** in position to be traversed by an edge of the throttle plate during initial opening movement of the throttle. In this case vacuum in the transfer tube is under the control of the throttle **16** as will be readily apparent. With the throttle fully closed as illustrated in Figure 8, vacuum is applied to the passage **40** and hence produces a low pressure at the intake end of the transfer tube. However, the applied vacuum will be diminished or cut off upon predetermined opening movement of the throttle. Placement of the port **75** is such that operation of the transfer system is terminated when the throttle is opened an amount sufficient to produce efficient flow of fuel through the main nozzle and efficient mixture of fuel supplied from the main nozzle by means of the normal air velocity alone.

Referring now to Figure 9 there is illustrated yet another embodiment of the present invention in which the transfer passage **40** has an outlet port **80** located in position to be substantially closed by an edge of the throttle plate **16** when the throttle plate is in a fully closed position. At this time fuel is supplied to the barrel **10** of the carburetor through the idle fuel supply system including the passage **28** and the port **32**. During this idle operation vacuum is not applied to the transfer system. However, initial opening movement of the throttle plate **16** will move the adjacent edge of the throttle plate upstream from the port **80** and will in effect connect the transfer passage **40** to the downstream or low pressure side of the throttle plate. Thus, at a predetermined point in the opening movement of the throttle plate, vacuum is applied to the transfer system and to the intake port **44** located adjacent the main fuel supply means. In this way, vacuum is applied to the transfer system only when it is required to prevent the disadvantages occurring as a result of the inefficient initial stages of operation of the main fuel supply nozzle.

It will of course be understood that in the embodiments of the invention illustrated in Figures 6–9 the transfer passages **40** are as shown in Figure 1 and may be connected with transfer tubes **42** having intake ports **44**. It will further be understood that the transfer tube **42** and intake ports **44** may be arranged in conjunction with main fuel supply means such as specifically illustrated in Figures 1, 3, 4 or 5.

Referring now to Figure 10, there is more or less diagrammatically illustrated a carburetor of the updraft type having a barrel **90** in which is located a main fuel supply nozzle **92** and a pivoted throttle plate **93**. The main fuel supply nozzle is located in a Venturi **94** as is customary. In this case the transfer system comprises a passage **95** connected to a transfer tube **96** having an intake port **97** adjacent the upstream end of the main fuel supply nozzle **92** in position to collect by vacuum any droplets of liquid fuel collecting thereon before these droplets can be carried in the air stream into the manifold and thence to the cylinders of the internal combustion engine. In this case the transfer passage **95** is illustrated as connected to a source of vacuum by a port **98**. The port **98** for convenience, is illustrated as similar to the port **80** shown in Figure 9, which is closed by the edge of the throttle plate **93** when the throttle is fully closed. Obviously of course, the outlet port connecting the transfer passage **95** to a low pressure source to apply vacuum to the system may be as disclosed in Figures 1, 2, 6, 7, 8 or 9.

Referring again to the embodiment of the invention illustrated in Figures 1 and 2, the operation will be described in some detail. It will be appreciated that the operation of the different embodiments of the invention illustrated in the remaining figures is generally similar and the details of difference are apparent from the description previously given. At the minimum idle speed at which the engine is set to run there is a continuous flow of air entering the intake port **44** of transfer tube **42**, proceeding through transfer passage **40** and opening into the end portion **46** of the idle passage. This flow of air serves to improve the atomization of the idle fuel as disclosed in Kittler's copending application, Serial No. 503,468, filed April 25, 1955. When the throttle is gradually opened to a point where sufficient air flow is induced through the Venturi **14** so that fuel is just beginning to issue from the main discharge nozzle **18**, there is encountered the undesirable condition described in the foregoing. It has been observed under test conditions that this fuel will accumulate at the end of the main discharge nozzle **18** or at the lower end of the booster Venturi such as illustrated at **50** in Figure 3, instead of discharging continuously and smoothly into a finely atomized pattern. With the incorporation of the transfer system there is induced an additional air flow of substantially higher velocity right at the lower edge of the main nozzle **18**. This additional flow of air exerts a scavenging effect on any particles or droplets of fuel that may collect at the lower edge of the nozzle or booster Venturi. As a result, a fuel-air mixture is drawn through the intake port **44** and thence through the transfer tube **42** and passage **40** where it is admitted into the idle system to blend with the mixture regularly flowing to the idle discharge port **32** from the idle fuel supply passage **28**.

It will of course be understood that under the idling and low speed operating conditions herein referred to, there is always a high vacuum existing below the throttle plate **16** so that as a result there will always be a brisk flow of air through the transfer system. Careful observation under test conditions has confirmed that the addition of the transfer tube **40** keeps the lower edge of the main fuel supply or booster Venturi or both, completely free from accumulated drops of fuel and causes this fuel to be aspirated into the transfer system in a smooth continuous fashion, thereby insuring a smooth

flow and a homogeneous fuel-air mixture during the transfer condition.

When the throttle is opened further there is finally a sufficiently high air velocity through the Venturi and/or booster Venturi so that the normal spray pattern of fuel issuing from the main nozzle **18** becomes established and the transfer tube automatically diminishes in its effectiveness as the wide open throttle condition is approached. Extensive tests of engines and vehicles equipped with carburetors incorporating this improvement confirm that much leaner mixtures can be used in the transfer range with a resulting improvement in economy. The transfer range on present day automobiles is roughly in the region of 15 miles per hour up to approximately 40 miles per hour for the average passenger vehicle. It can be seen that the present invention contributes substantially to the economy and smooth running under these conditions, which encompass a major part of the speed range employed in ordinary city driving.

It is of interest to observe that in a very simple check, the effectiveness of the transfer system has been easily demonstrated. When the air silencer of a carburetor not equipped with the transfer system is removed and the throttle opened very slowly, the point at which the main nozzle drips fuel can be very easily determined by the intermittent hissing, frying sound made as the droplets of fuel are intermittently drawn past the edge of the throttle plate **16**. In contrast to this, a carburetor equipped with the transfer system and subjected to the same test will simply give forth a continuous hissing sound without the frying, crackling noises which are a direct symptom of the intermittent main nozzle fuel discharge.

A further incidental advantage obtained by the present construction is the substantial reduction in carburetor icing characteristics. This is due to the fact that the vaporization of fuel takes place to a great extent at the point where the transfer passage **40** communicates with the idle fuel supply passage instead of at the edge of the throttle plate. Reduction of temperature resulting from vaporization at the juncture between transfer passage **40** and the idle fuel supply passage may be compensated for by proximity to a warm manifold. On the other hand, the loss of heat due to vaporization at the edge of the throttle plate **16** is not so readily overcome by manifold heating at this point and may produce icing.

The drawings and the foregoing specification constitute a description of the improved transfer system in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What we claim as our invention is:

1. In a carburetor comprising a barrel, a main fuel nozzle in said barrel, a main venturi in said barrel, a booster venturi in said barrel surrounding said nozzle and having a downstream annular edge on which droplets of fuel collect and tend to drip off, and a throttle plate in said barrel downstream from said nozzle and venturis, the improvement which comprises a passage having a restricted intake port adjacent the downstream edge of said booster venturi, said passage having an outlet port in said barrel in position to be covered by the edge of said throttle plate when it is in closed position but to be exposed to vacuum at the downstream side of said throttle plate whenever said throttle plate is moved away from its closed position, said intake port being in position to suck off droplets of fuel as they accumulate on the edge of said booster venturi.

2. A carburetor comprising a barrel, fuel supply means in said barrel including a member having an annular lip extending transversely of said barrel and facing downstream thereof on which droplets of fuel accumulate during transition from idle engine operation, a throttle in said barrel downstream from said fuel supply means,

and means for preventing drops of fuel from dripping off said lip into the air stream through said barrel comprising a passage having an outlet port in said barrel in position to be covered by an edge of said throttle when in fully closed position and exposed at the downstream side of said throttle upon initial opening movement of said throttle, said passage having an intake port in immediate proximity to said lip to draw off droplets of fuel therefrom by suction.

3. In a carburetor comprising a barrel, a main fuel supply means comprising a venturi and nozzle and including means having a downstream annular edge on which droplets of fuel tend to collect and drop off during transition from idle engine operation, and a throttle plate in said barrel downstream from said fuel supply means, the improvement which comprises passage means having a discharge and connected to said barrel in a location such that it is exposed to engine manifold vacuum during transition from engine idle operation, said passage means extending into said barrel and having an inlet port of small area such that engine manifold vacuum is effective to establish a strong suction action at said port, said port being located at the downstream side of said annular edge and in close proximity thereto, said inlet port being wholly removed from the center and major portion of the path of fluid flowing from said nozzle whereby suction in said port is adapted to suck off unvaporized fuel droplets directly from said edge.

4. In a carburetor as defined in claim 3, a main venturi and a booster venturi, said annular edge forming the downstream end of the booster venturi.

5. In a carburetor as defined in claim 3, the said annular edge extending transversely of said barrel.

6. In a carburetor as defined in claim 3, the discharge end of the passage means being connected to the barrel downstream from said throttle plate.

7. A carburetor having a barrel, vacuum operated main fuel supply means therein, a throttle plate therein operable in fully closed position to prevent application of vacuum to said main fuel supply means, said throttle plate being movable from fully closed position toward

open position to provide a gradually increasing vacuum to said main fuel supply means, and transfer means connected to a source of vacuum and having an intake port adjacent said main fuel supply means to draw off by suction droplets of fuel gathering thereon during transfer from non-operating to operating condition of said main fuel supply means, said transfer means being connected to a port in said barrel in position to be closed when said throttle plate is fully closed and to be opened at the downstream side of said throttle plate upon initial opening movement thereof.

8. A carburetor for use with an internal combustion engine having an intake manifold, said carburetor comprising a barrel, a main fuel supply means comprising a venturi and nozzle and including means having a downstream annular edge on which droplets of fuel tend to collect and drop off during transition from idle engine operation, a throttle plate in said barrel downstream from said fuel supply means, a passage having a discharge end located such that it is exposed to engine manifold vacuum during transition from engine idle operation, said passage extending into said barrel and having an inlet port of small area such that engine manifold vacuum is effective to establish a strong suction action at said port, said port being located at the downstream side of said annular edge and in close proximity thereto, said inlet port being wholly removed from the center and major portion of the path of fluid flowing from said nozzle whereby suction in said port is adapted to suck off unvaporized fuel droplets directly from said edge.

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