Sept. 22, 1970 H. A. F. VON SELD 3,529,809

CARBURETTOR WITH AUTOMATIC EXCESS AIR ADJUSTMENT

Filed Sept. 5, 1968 6 Sheets-Sheet 1

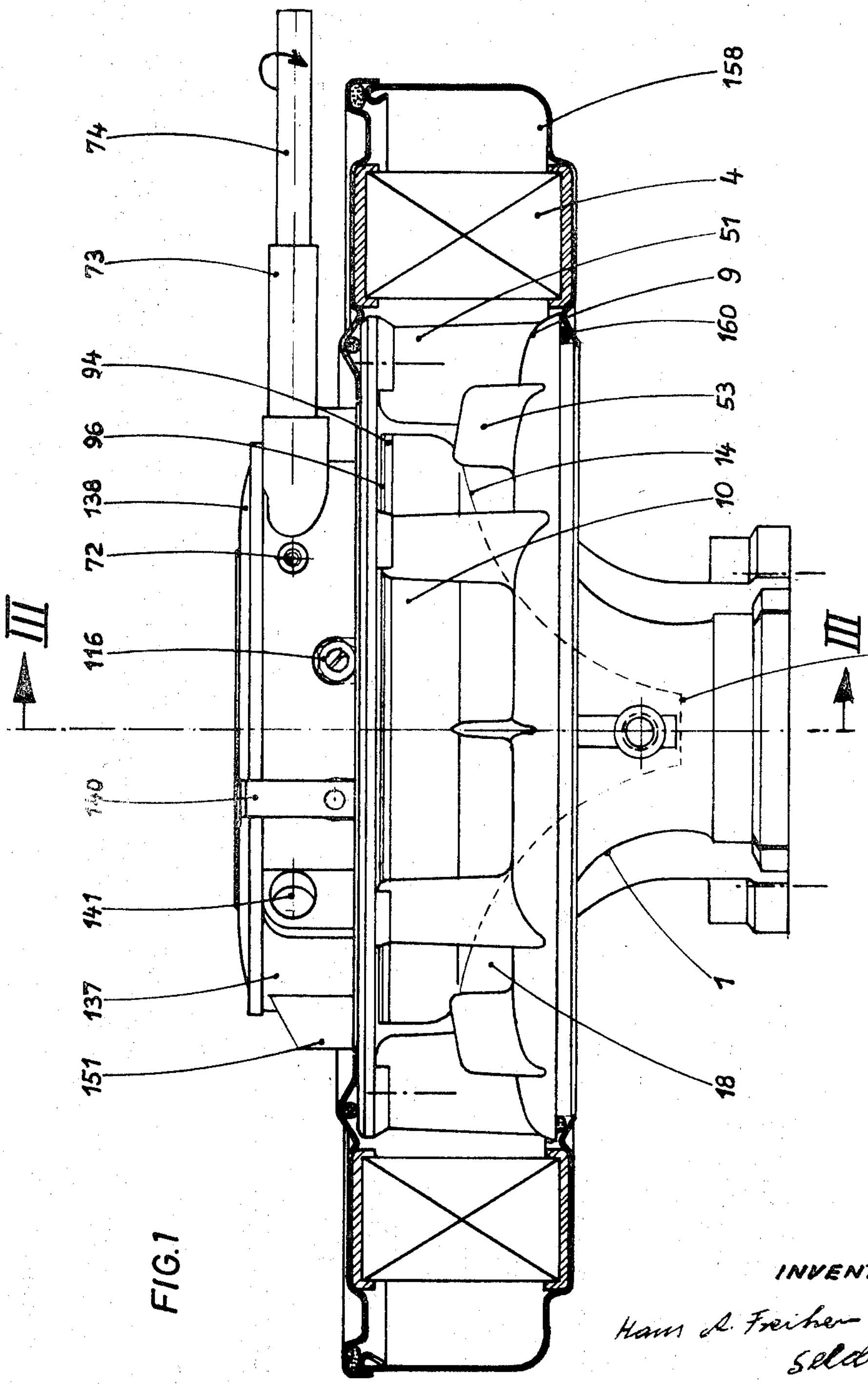

FIG.1

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CARBURETTOR WITH AUTOMATIC EXCESS AIR ADJUSTMENT

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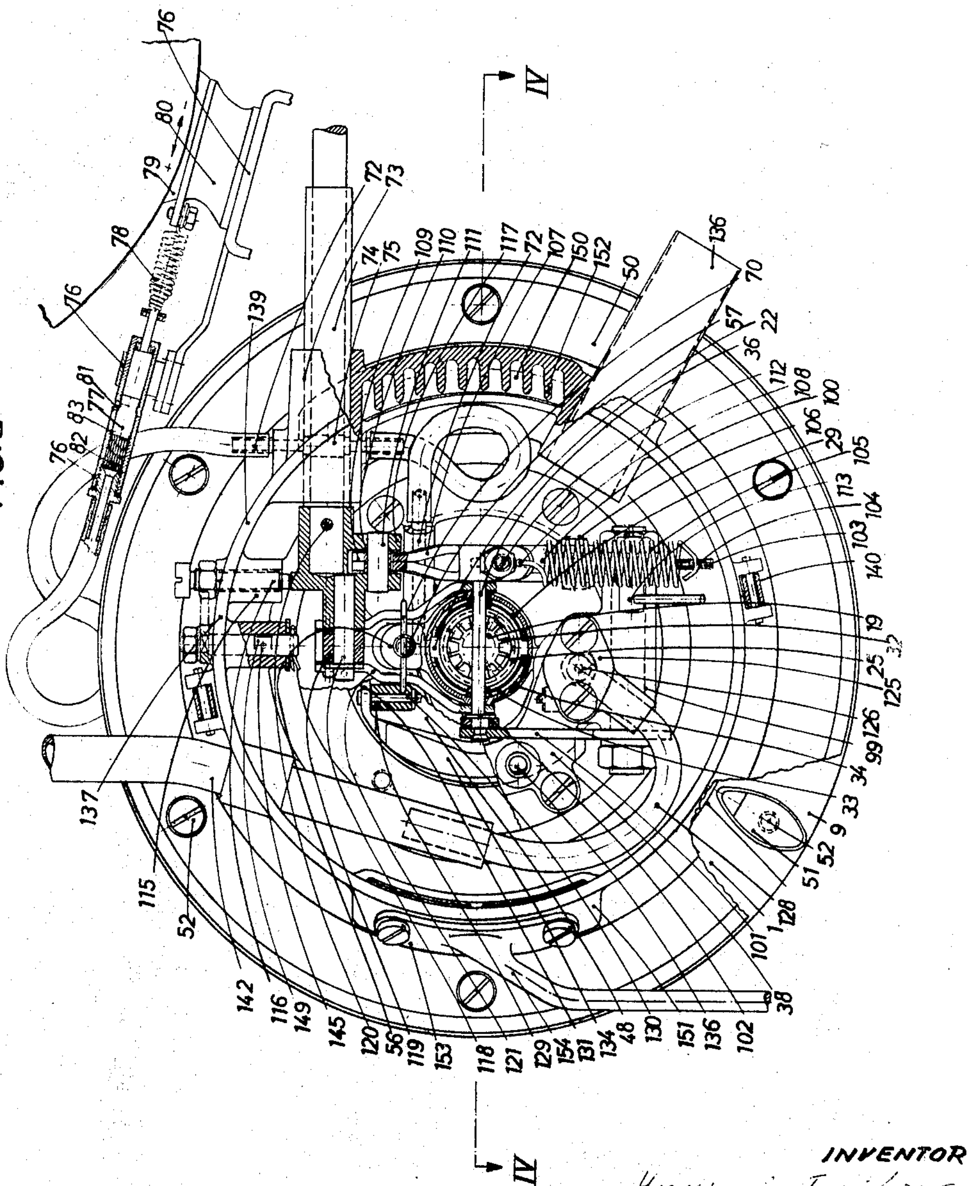
FIG. 2



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CARBURETTOR WITH AUTOMATIC EXCESS AIR ADJUSTMENT

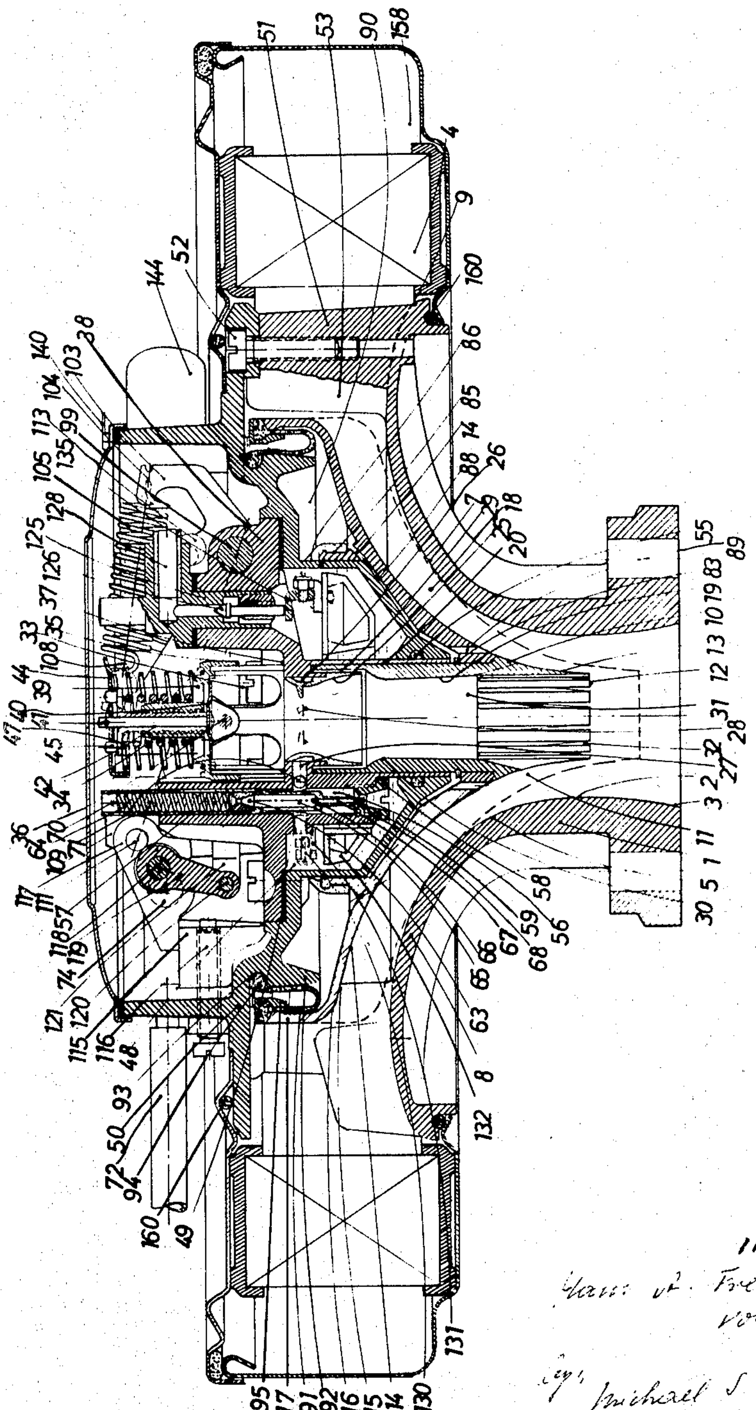

FIG. 3

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CARBURETTOR WITH AUTOMATIC EXCESS AIR ADJUSTMENT

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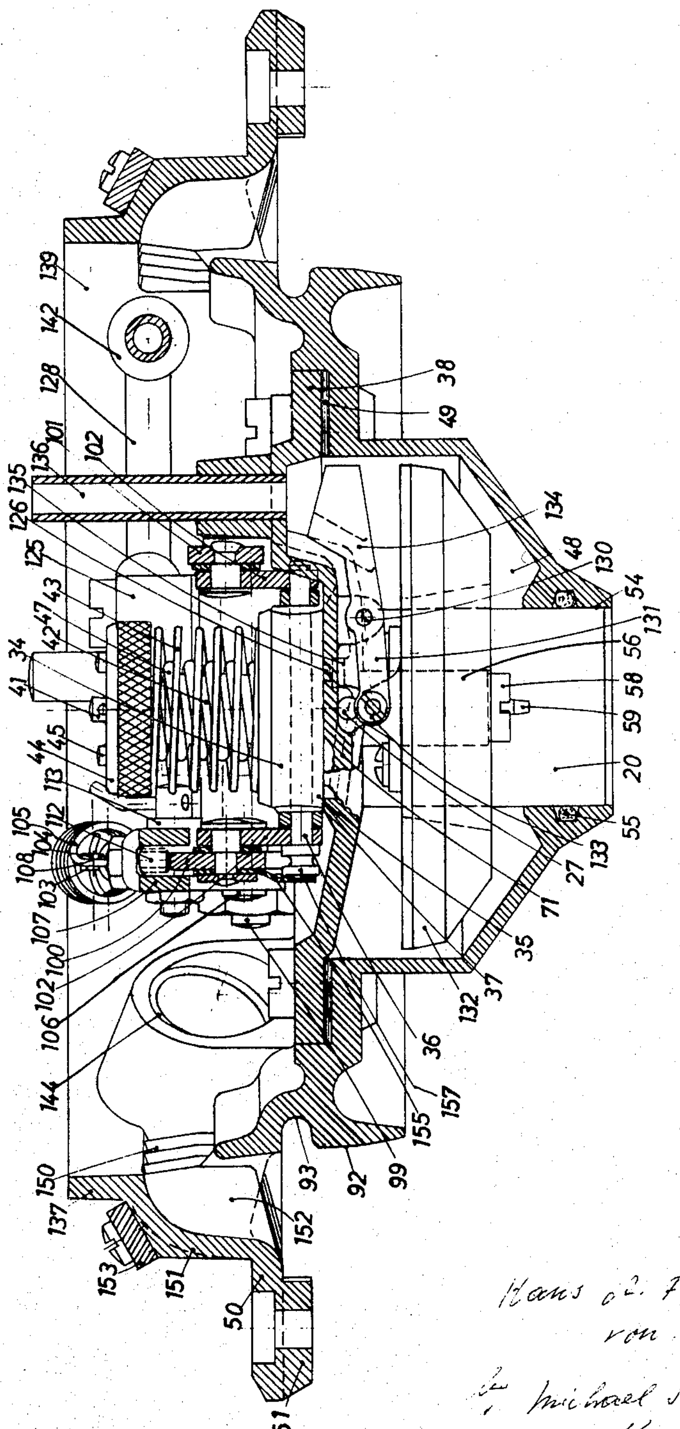
FIG. 4



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CARBURETTOR WITH AUTOMATIC EXCESS AIR ADJUSTMENT

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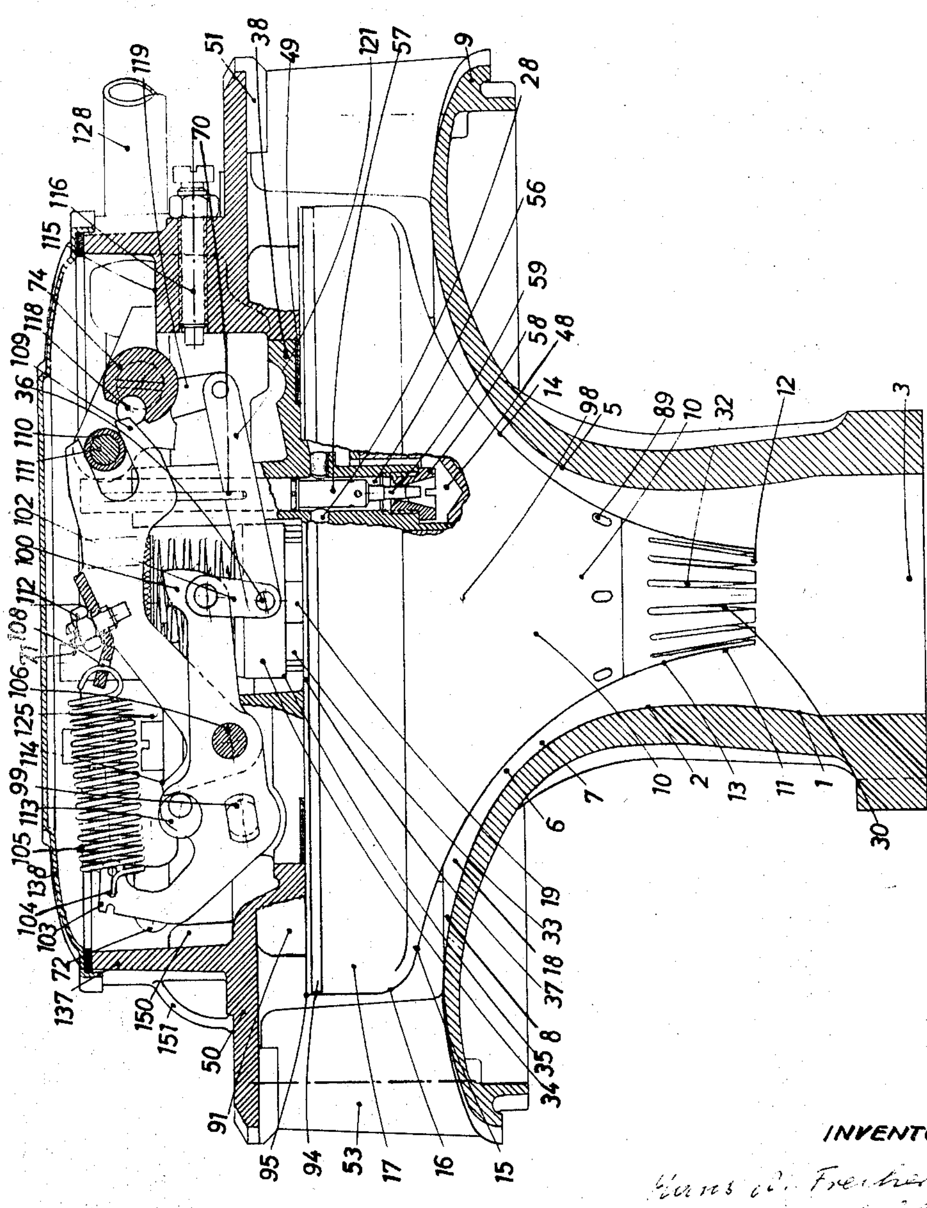
FIG.5



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CARBURETTOR WITH AUTOMATIC EXCESS AIR ADJUSTMENT

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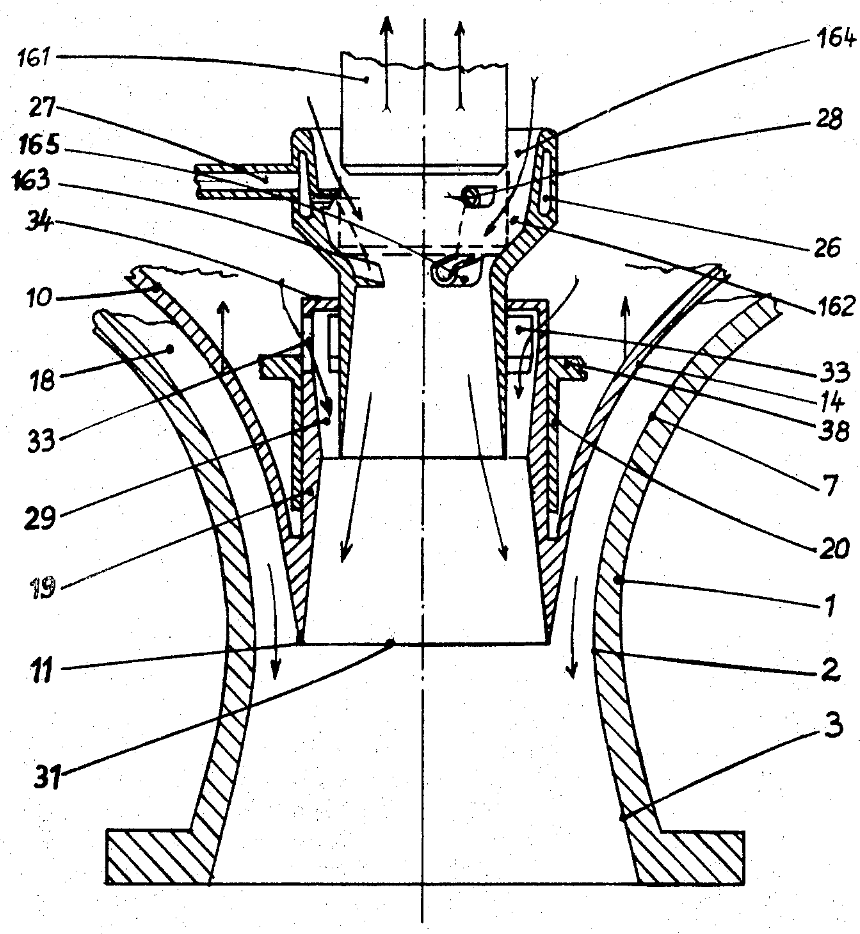
FIG.6



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CARBURETTOR WITH AUTOMATIC EXCESS AIR ADJUSTMENT

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Int. Cl. F02m 7/22, 9/14
U.S. Cl. 261—44 28 Claims

ABSTRACT OF THE DISCLOSURE

A carburettor for producing a fuel-air mixture for internal combustion engines with a suction duct formed by a substantially trumpet-shaped venturi tube, a throttle member coaxially displaceable in the tube, and a fuel chamber arranged above the throttle member with a feed regulator and a regulating needle which engages into a jet area and which is adjustable depending on the movement of the throttle member, to regulate the fuel feed to an atomizer which is in communication with the suction duct in such a manner so as to ensure uniform distribution and laminar flow of the air in the suction duct as well as uniform distribution and complete evaporation of the fuel in the air flow, even with a minimum of excess air, and without condensation of fuel on the walls of the suction duct.

The invention concerns a carburettor for producing a fuel-air mixture for internal combustion engines with a suction duct formed by a substantially trumpet-shaped venturi tube and a throttle member arranged therein which is displaceable coaxially thereto by means of an adjusting device and by the pressure conditions prevailing in the venturi tube, the walls of which suction duct diverge both upstream and also downstream from a restriction point, and with a fuel chamber arranged above the throttle member with a feed regulator and with a regulating needle which engages into a jet area and which is adjustable depending on the movement of the throttle member, to regulate the fuel feed to an atomiser which is in communication with the suction duct. Carburettors are already known in which the throttle member is controlled as a function of the pressure conditions in the venturi tube and the position of which can be influenced from the outside by changing the pressure differences present in the chambers of the carburettor. In this arrangement the fuel feed is regulated in dependence on the position of the throttle member. However, these carburettors suffer from considerable disadvantages. Thus, in the known carburettors, the shape of the throttle member and the venturi tube and the fuel feed into the suction duct in the side regions of the throttle member involves considerable disadvantages as uniform distribution of the air flow over the total area of the suction duct without the flow breaking down is not possible, which results in non-uniform distribution of fuel in the air flow. As a result a considerable portion of the fuel is condensed on the wall of the suction duct and only partly vaporises. In consequence, combustion of the fuel is incomplete and the fuel dilutes the oil which is used to lubricate the pistons and cylinders of the internal combustion engine. Quite apart from the resulting poor efficiency of the internal combustion engine, the oil dilution results in an increased rate of wear of the pistons and cylinders. Furthermore, in the varying running conditions of the internal combustion engine it is not possible with these carburettors to obtain a fuel-air mixture in which the combustion gases are completely or almost completely free from harmful impurities.

It is the problem of the present invention to provide a carburettor of the above described type, in which uniform distribution and laminar flow of the air in the suction duct and uniform distribution of the fuel in the air flow and thereby complete vaporisation even with a minimum excess of air is ensured, without fuel condensing on the walls of the suction duct. According to the invention this is substantially achieved in that at the air inlet point the suction duct extends radially to the suction pipe intake and subsequent thereto passes in a curve into the axial direction thereof, while the position of the throttle point is variable in dependence on the position of the throttle member and with the carburettor open is on the level of a tube-like tip of the throttle member, into which tip opens a mixing duct accommodating the atomiser and being in communication with further air feed orifices and the walls of the suction duct extend here almost parallel to one another. In this manner, in addition to permitting laminar flow conditions and complete vaporisation of the fuel fed to the air flow drawn in, the carburettor is also of a very low structural height, whereby it can be fitted in an advantageous manner into motor vehicles.

With this arrangement the venturi tube is with advantage restricted at the level of the tube-like tip of the throttle member, and flares again downstream thereof. This achieves deceleration of the laminar air flow and an almost complete pressure recovery. By this means the distribution of the fuel-air mixture to the various combustion chambers of an internal combustion engine is considerably improved and optimum filling of the combustion chambers is possible, as the decelerated flow can easily be diverted in the gas manifold at higher pressure.

To adjust the throttle member the adjusting device has two adjustable stops, between which the throttle member can be freely moved in the open position and arrested in the closed position by one of the stops. In this arrangement the adjusting device desirably comprises two interlinked pivotable levers, of which the pivotal movement relative to each other is limited in both directions by the stops, and of which one is connected to the throttle member and the other is connected to a trunnion of an accelerator shaft, while a traction spring is provided between the levers which loads the throttle member in the closing direction. By means of this construction of the adjusting device, a variable force causing the fuel-air mixture to be advantageously adapted to the varying load conditions of the internal combustion engine can be applied from the outside to the throttle member, as the spring loading said throttle member can thereby be moved parallel with respect to the stationary structural parts. The levers holding the spring are also with advantage mounted in such a way that the spring tension degressively increases when they pivot to open the throttle member. As the position of the throttle member is influenced from the outside by means of the spring, this arrangement permits an extremely sensitive control of the throttle member.

According to another feature of the invention, a relief chamber is enclosed between the inner wall of the throttle member and the outer wall of the fuel chamber and is connected to the suction duct by holes opening downstream of the throttle point and is connected by further holes to a controlling chamber formed by the throttle member and the carburettor top which is connected thereto by means of a resilient seal such as a rolling diaphragm. The controlling chamber is in turn in communication with the suction duct via narrower holes opening upstream of the throttle point. This arrangement provides that the throttle member automatically carries out a movement according to the air flow rate of the suction duct, by means of which fine adjustment of the fuel-air mixture is achieved with the adjustment not being altered from the outside.

To ensure that the controlling chamber is sealed off from the outside air and to facilitate assembly, the movable outer bead of the resilient seal such as a rolling diaphragm is embraced from the inside by a loose support and retaining ring which lies with an upper flange on the bead of the seal and presses the bead against the outer edge of the throttle member, while the inner bead of the seal fits resiliently into an upper groove in the fixed carburettor top. In addition the top of the carburettor is provided with a spherical tubular face and the throttle member is provided with a flaring tubular face, against which the bellows portion of the seal rolls during the movement, varying its effective diameter. With this arrangement, to separate the relief chamber from the controlling chamber a cylinder enclosing the cylindrical region of the fuel chamber is desirably formed on the throttle member, the cylinder desirably having holes joining the two chambers and carrying a sliding seal such as a lip seal lying against the outer wall of the fuel chamber.

According to a further feature of the invention, air feed orifices are associated with the mixing duct above the atomiser, and, with the suction duct closed, are also closed by a guide surrounding the mixing duct and are to be opened, depending on the throttle member movement which opens the suction duct, in the manner of a sleeve valve. In addition the mixing duct is closed on the top side by a throttle plate which is held resiliently to a seat lying thereabove. A quantity of air for vaporising the fuel, which is variable depending on the position of the throttle member and thereby the amount of fuel supplied, is fed to the mixing duct through the air feed orifices. At the same time the resilient attachment of the throttle plate below its seat ensures that air is fed into the mixing duct in the idling condition as with the suction duct and mixing duct air feed orifices closed, a high partial vacuum is formed in said mixing duct, whereby the throttle plate of the mixing duct lifts from its seat and the amount of air necessary under idling conditions can flow into the mixing duct. With this arrangement the spring loading the cover in the closing direction is desirably adjustable in order to permit the amount of air flowing into the mixing duct under idling conditions to be varied.

The atomizer for the fuel is desirably fixed in the mixing duct and is in the form of a thin-walled Venturi tube with radial spray holes extending outwardly from an annular channel so that the preliminary vaporisation air flowing through the air feed orifices of the mixing duct is accelerated at this point, with a laminar flow being maintained, thus causing fine atomisation of the fuel issuing from the spray holes. To prevent fuel being condensed on the walls of the mixing duct and the suction pipe intake, the Venturi tube is surrounded by an annular gap and the mixing duct is kept narrower than the suction pipe intake and broader than the tube-like tip of the throttle member. To ensure that the overrich fuel-air mixture issuing from the mixing duct is finely and uniformly distributed, the tube-like tip of the throttle member is provided with substantially radial orifices such as slots or holes.

According to a further feature of the invention, the regulating needle for the fuel feed to the atomiser is hung on a double compound lever, the lift of which is determined on the one hand by an eccentric of the accelerator shaft and on the other hand by the movement of the throttle member. This arrangement provides that the amount of fuel depends both on the movement of the throttle member and also on the external adjustment, whereby particularly when the internal combustion engine is accelerated, the increase in the fuel feed is faster than the increase in the air feed so that the richer fuel-air mixture required in this case for the motor is immediately provided.

The regulating needle for the fuel feed is slidingly arranged in a premixing tube and increases in diameter stepwise in per se known manner, and is provided with cross holes and with a stepped continuous longitudinal bore which is in communication with the outside air. By this arrangement the fuel feed can be advantageously adapted to the varying load ranges of the engine, while the fuel is also prefoamed which facilitates preliminary atomisation. Furthermore, the regulating needle for the fuel feed has an axially apertured conical point, the adjacent step of which sits closingly on the edge of the fuel jet in the idling position. Thus, when the motor is not under load, with the fuel jet closed a certain amount of fuel can pass through the axially apertured point of the regulating needle to the atomiser in order to keep the internal combustion engine running.

It is of advantage for the adjusting device of the throttle member to be arranged in a chamber lying above the fuel chamber and closed by an easily removable cover. The crank-case breather gas can be fed to the said chamber through a pipe and filtered fresh air can be fed through an aperture in the carburettor top. By this means the adjusting device is protected from fouling and at the same time is lubricated and supplied with dust-free air by the crank case breather gas carrying oil mist.

It is of advantage for the bottom of the chamber of the carburettor top and the float chamber cover to be made together in the form of a trough, in the centre of which the oil mist condensing from the crank case breather gas is collected in liquid form and is returned to the internal combustion engine through the air intake arranged at the lowest point in the trough.

In order to improve the preliminary vaporisation of the fuel, air passing through the filter is supplied via an aperture to the upper chamber, while an air preheater is provided which can be heated by means of a heat conductor connected to the exhaust of the internal combustion engine.

Accoring to a further feature of the invention, the feed regulator for the fuel chamber is controlled in per se known manner by a ring float which is suspended on a gimbal frame for swinging movement about pins parallel to the direction of travel, the gimbal frame being mounted in turn on a shaft parallel to the direction of travel and being provided with a counterweight which substantially compensates for the weight of the float. This means that the float is not influenced by outside effects. Moreover, the weight of the float is almost compensated by the counterweight so that the full buoyancy of the float is available for closing the valve needle of the feed regulator. The float can also be kept extremely small in this manner.

According to a further feature of the invention the mixing duct is connected to a breather pipe in which is arranged a filter body and the inlet of which is provided with a closing member such as a spring-loaded valve or slide which is resiliently attached to a part of the internal combustion engine and which opens when the engine leans in the direction of pushing and closes in the direction of pulling. In addition the breather pipe is with advantage passed through the accelerator shaft which at this point is in the form of a rotary slide valve so that with the closing member in the open or partly open position the accelerator shaft closes the breather pipe at the intake. By the venting of the mixing tube being controlled in this way, when the internal combustion engine is on the overrun there occurs a pressure equalisation, consequently there is no intake of fuel. Thereby the fuel delivery is interrupted until the breather pipe is closed either by the rotary slide valve of the accelerator shaft or by the internal combustion engine ceasing to lean in the direction of pushing.

In another embodiment of the invention the carburettor has a second suction duct lying coaxial to the mixing duct, the opening width of which is determined by the position of a second throttle member, the movement of which leads the movement of the first throttle member. This provides a multijet carburettor, the tubes of which are arranged coaxial to each other so that its dimensions can be kept relatively small with a high degree of efficiency. With this arrangement the second throttle member lies within an enlarged section of the mixing duct in which the atomiser is also arranged in such a way that with the throttle member in the closed position it lies outside the static vacuum zone of the second suction duct and with the throttle member in the open position it lies within said zone. To prevent the fuel coming into contact with the inside wall of the mixing duct and to improve fuel distribution, collector grooves projecting into the mixing duct are arranged below the atomiser.

An embodiment of the invention is illustrated in the drawings, in which:

FIG. 1 is a side view of a first embodiment of a carburettor according to the invention,

FIG. 2 shows a plan view of the carburettor shown in FIG. 1,

FIG. 3 shows a side view section of the carburettor taken along the line III—III of FIG. 1,

FIG. 4 shows a side view section of the carburettor taken along the line IV—IV of FIG. 2 but without Venturi tube,

FIG. 5 shows a side view section of the carburettor with the throttle member partly cut-away, and

FIG. 6 shows a side view section of a second embodiment of a carburettor according to the invention.

The carburettor illustrated in the drawings has a Venturi tube **1**, which is slightly restricted by a constriction **2** and which subsequently flares gently to the nominal diameter of the suction pipe intake **3**. Toward the filter **4** the venturi tube **1** flares trumpet-shaped in a gentle curve **5** of increasing curvature and in the vicinity of the throttle gap **6** transforms into a circular arc **7** which has substantially one and a half times the radius of the suction pipe intake **3**. Beyond the throttle gap **6** a larger arc **8** with double the radius follows the arc **7** and extends to shortly before the filter **4** and is convexly overrounded at the rim **9** and terminates in the form of a convex cone. A throttle member **10** is displaceably arranged in the Venturi tube **1**. The tip **11** of the throttle member **10** extends in a long concave arc **14**, the radius of which is equal to that of the arc **8** but which, with the suction duct **18** closed, diverges outwardly by approximately 2° toward the arc **8**. The arc **14** of the throttle member **10** terminates radially outwardly in the form of a truncated cone **15** and at the edge **16** curves round into the cylinder **17**.

These contours of the venturi tube **1** and the throttle member **10** together form a suction duct **19** for the indraft, which is defined by revolution surfaces which come closer together up to the throttle gap **6** and which again diverge further downstream, wherein the main portion of the intake air is firstly drawn in radially and then, being simultaneously accelerated, is diverted in a laminar flow into the axial direction. The central mixing duct **19** forms one piece with the tube-like tip **14**. It has substantially half the inside diameter of the suction pipe intake **3** of the venturi tube **1** and slides in a stationary guide tube **20**. Its orifices **21** have holders **22** and **23** passing through them which join the carrier ring **24** of an atomiser **25** to the guide tube **20**. Formed in the outside of the atomiser is an annular channel **26** which is closed by the carrier ring **24** which is pressed thereon, and to which the filtered fuel is fed through the hole **27** of the holder **22**. The inside width of the atomiser **25** substantially corresponds to that of the tip **11** of the throttle member **10**. The foam mixture passes through a circle of fine holes **28** in the wall of the atomiser **25** into the mixing duct **19**. These holes are located half way up the annular channel **26** so that before issuing, the fuel can flow around the atomiser **25** in the annular channel **26** and mixes in the holes **28** with the partially re-separated air on the upper portion of the annular channel **26**. A narrow annular clearance **29** between the carrier ring **24** and the inside cylindrical surface of the mixing duct **19** serves for the induction of an air screen which prevents enriched mixture condensing on the wall.

Radial slots or steep holes **32** which join the mixing duct **19** to the suction duct, are formed in the tube-like tip of the throttle member **10**. These slots or holes act as a main atomiser, at the sharp edges of which the droplets which have not yet vaporised are broken up into still smaller parts, and they also act as a mixer, out of which rich mixture passes in the form of radial sprays into the stream of fresh air delivered via the suction duct **18** and is uniformly distributed over the area of the Venturi-like constriction **2**. The slight flaring of the Venturi-like constriction **2** to the nominal diameter of the suction pipe intake **3** prevents the fuel droplets coming into contact with the wall of the Venturi tube **1**.

The top end of the mixing duct **19** has other large orifices **33** through which the preliminary air for the preliminary vaporisation process can enter. It is closed at the top by the cover **34**, the outside rim **35** of which embraces it above the orifices **21**, **23** and is pinned to it by means of the shaft **36**. When the throttle member is closed, the orifices **21**, **33** descend into the guide tube **20** and the rim **35** of the cover **34** lies against the annular face **37** of the fuel chamber cover **38** which is in one piece with the guide tube **20**.

The idling air passes through apertures **39** in the cover **34** into the preliminary vaporisation tube **19**. It is regulated by a small throttle plate **40**, through the central stem **41** of which passes the adjusting screw **42** and which is lifted by the spring **43**. The spring **43** is applied against the upper spring plate **44** to which the stem **41** is rotatably anchored. The adjusting screw **42** is provided at the top with two gripping pins **45** which pass through the spring plate **44**, so that it is turned by the spring plate **44** being rotated. Depending on the extend to which the adjusting screw **42** is screwed into the cover **34**, the air gap between the edge of the throttle plate **40** and the inside face **46** of the cover **34** varies. A stronger inner spring **47** prevents the adjusting screw **42** being unintentionally moved by vibration.

The fuel chamber cover **38** is sealed against the fuel chamber **48** by a laminated seal. By removing or inserting laminations of the seal **49**, any manufacturing differences in respect of height can easily be compensated. Smaller differences in height of the air seal are compensated by adjustment of the idling adjustment screw **42**.

The fuel chamber **48** is let into the disc-shaped top **50** of the carburettor which is centered and lies on a cluster of supporting radial guide ribs **51** which project up from the rim **9** of the Venturi tube **1**. Countersunk bolts **52** join the two parts together. Between the supporting ribs **51** the rim **9** carries other radial guide ribs **53** of lesser height and thickness.

The guide tube **20** passes through the bottom of the fuel chamber **48**, in the hole **54** in which it is sealed by the sealing ring **55**.

A premixing tube **56** is let into the locally thickened portion of the wall of the guide tube **20** parallel to the mixing duct **19**. The fuel regulating needle **57** slides sealingly in the premixing tube **56** which is closed at the bottom by the main jet **58**, through the whole of which passes the conical point **59** of the fuel regulating needle **57**. The fuel regulating needle **57** has two external steps. The lower step **60** lies on the edge of the main jet **59** under idling conditions. The upper step **59** is located at the level of the mixture feed hole **27**, when the engine is idling. The fuel regulating needle **57** is bored over its whole length in steps. The air correction jet **63** which is held on its seat by the covered spring **64** lies against the upper internal step **62**. The bore is continued below the step **62** in the form of a correction air duct

65, at the lower end of which the correction air passes into the premixing tube 56 through cross holes 66 in the tapered stem of the needle 57. Further cross holes 66 for the correction air are located above the external step 61 in the thicker portion of the needle 57 and are only open with the needle in the lowered condition. The bore of the needle 57 is continued, substantially tapered, below the correction air duct 65 in the form of a fuel duct 67 and is terminated by the idling hole 68 with a sharp edge, which is still further reduced at the end of the point 59. The point 59 of the needle 57 has a triple stepped taper with angles firstly of 2½°, then about 1½° and finally something more than 3°. It is longer than the needle lift and forms with the main jet 58 a variable cross section for metering the fuel.

At its upper end the needle 57 has a continuous cross hole 69 which is flared in its longitudinal direction and into which the spring wire clip 70 is inserted, against which the smaller inner spring 64 bears.

The inclined breather hole 71 is bored in the fuel chamber cover 38, opens into the mixture feed duct 27 and the cross section of which is greater than the sum of the spray holes 28. The breather hole 71 is continued on the outside in the form of a pipe 72 which is passed transversely through the mounting 73 for the accelerator shaft 74 and its cross hole 75, which acts as a rotary slide valve. Beyond the rotary slide valve 75 the flexible pipe 72 passes into the tubular housing 76 fixed to the chassis, in which slides the slide valve 77 which is attached to a part of the motor 79 by means of a spring 78. When the motor is uncoupled in the rest position or leans when pulling positively in its resilient mounting 80, the cross holes 81 of the housing 76 are closed by the slide valve 77. When the moment of reaction on the overrun is negative, the motor 79 leans in the opposite direction and the slide valve 77 is drawn out of the housing 76 by the spring 78 to such an extent that the cross holes 81 are exposed. The rotary slide valve 75 is open when the accelerator shaft 74 is in the idling position. A filter body 82 cleans the breather air. The outer portion of the throttle member 10 is pressed onto the mixing duct 19 and is additionally secured by the circlip 83. On its top side it has a short cylinder 84 which surrounds the cylindrical part of the float chamber 48 with ample clearance. The bellows portion 85 of a lipped seal 86 is inverted onto the cylinder 84 and prevented from slipping off by the bead 87. The lip 86 seals the cylinder 84 against the circumference of the fuel chamber 48 so that there is formed below the bottom thereof a closed chamber, the base area of which corresponds to the outer suction area at the throttle member 10 in the Venturi tube 1, which extends up to the periphery of the throttle gap 6. This relief chamber 88 is in communication via vertical holes 89 with the interior of the Venturi tube 1 and relieves the throttle member 10 of suction forces.

The fuel chamber 48 is surrounded by an annular controlling chamber 90, the volume of which varies with the lift of the throttle member 10, It is defined at the top by the disc-like top 50 of the carburettor. The rising and falling throttle member 10 is movably sealed on the outside against the fixed top 50 by means of a rolling diaphragm 91 which is pushed onto a collar 92 of the top 50 with a slot 93 and lies with the moved bead 94 against the rim of the outer cylindrical portion of the throttle member 10. Sealing contact is ensured by the support ring 95 which embraces the head 94 from the inside and lies against it with the upper flange 96.

The controlling chamber 90 is in communication with the inner relief chamber 88 by means of two holes 97 and with the suction duct 18 by means of two smaller holes 98 which lie beyond the throttle gap 6. The reduced pressure in the suction duct 18 which is continued by the vertical holes 89 and the radial holes 97, and the speed of the fresh air in the suction duct 18 in front of the holes 98 determine the pressure difference between the outer part of the suction duct 18 and the controlling chamber 90, said pressure difference tending to lift the throttle member 10.

Rotatably mounted on the fuel chamber cover 38 is the shaft 99 of the combined forked lever 100, 101, at the ends of which are pivoted plates 102 which engage the shaft 36 of the mixing duct 19. The arm 100 of the forked lever is extended beyond the shaft 99 to form an upwardly projecting lever arm 103 which has a plurality of attachment holes 104 in a row for the traction spring 105. Near the shaft 99 there is pressed into the arm 100 of the forked lever a pin 106 about which the control lever 107, the eye 108 of which is engaged by the other end of the traction spring 105, pivots in the same plane. The control lever 107 embraces with its end fork 109 a roller 110 which is mounted on a trunnion 111 of the accelerator shaft 74. When the trunnion 111 is pivoted, the control lever 107 is raised or lowered, while the traction spring 105 is tensed or partly relieved and a variable force is exerted on the forked lever 100, 101 in the direction of lowering the throttle member 10. This force is opposed by the pressure difference between the outer suction duct 18 and the controlling chamber 90. As the attachment points 104, 108 of the traction spring 105 pivot on circular arcs and both lie on levers 103, 107 which move relative to each other, the spring 105 has a degressively rising characteristic curve which is displaceable in parallel with respect to the fixed structural parts.

The pivotal travel of the forked lever 100, 101 relative to the control lever 107 is limited in the direction of opening of the throttle member 10 by the adjustable stop screw 112 thereon and is limited in the direction of closing by an adjustable eccentric stop means 113 which is located on the arm 100 of the forked lever and which is contacted by the lug 114 of the control lever 107. The pivotal travel of the trunnion 111 of the accelerator shaft 74 is limited in the opening position by the fixed stop 115 and in the closing position by the adjustable stop screw 116 which serves to synchronise the beginning of the fuel regulating needle lift with that of the throttle lift.

An eccentric 118 to which is attached the connecting rod 119, is pressed into the side plate 117 of the trunnion 111. The connecting rod 119 is joined by means of the pin 120 to the symmetrical compound levers 121 lying on the same level, the other ends of which are pivoted to the shaft 36 of the mixing duct 19. Approximately in the middle of the compound levers 121 are holes 122 into which engage the two hook portions 123 of the spring wire clip 70 which transmits the lift movement of the compound levers 121 to the fuel regulating needle 57. The lift of the fuel regulating needle 57 is controlled by means of the compound levers 121, both by the degree of pivotal movement of the eccentric 118 and also by the respective lift position of the throttle member 10.

The valve housing 125 of the needle valve 126 is inserted and screwed into the hole 124 in the fuel chamber cover 38 from the outside. The valve housing 125 is provided with the pipe connection 128. The fuel chamber cover 38 has on its underside mounting lugs 129 lying parallel to the longitudinal axis of the vehicle, into which pins 130 are inserted and secured by wire springs. The gimbal frame 131 on the arms of which the ring float 132 is swung by means of screw bolts 133, is hung on a lifting face 135 offset from the arm of the gimbal frame carries the counterweight 134 which almost compensates the weight of the float 132 so that the full buoyancy of the float 132 is available for the closing lift of the needle valve 126. The needle valve 126 is in contact with a lifting face 35 offset from the arm of the gimbal frame 131. This construction spares structural height and permits the size of the float 132 and the circumference of the fuel chamber 48 to be kept within the limits which are set by the diameter of the throttle gap 6 and the compensation of the suction forces on the throttle member **10**. The fuel chamber **48** is vented by the vertical tube **136** pressed into the cover **38**.

On the top side of the carburettor top **50** there is formed a cylindrical collar **137** which is closed at the top by a sheet metal cover **138** and which forms a chamber **139** in which the control mechanism of the throttle member **10** is mounted in dust-proof manner. The catch springs **140** hold the sheet metal cover **138** firmly on the collar **137** so that the cover can be easily removed and replaced for checking. The collar **137** has the accelerator shaft **74** passing through it. It has a tightly fitting opening **141** for the fuel pipe **142** and a larger hole **143** into which the pipe connection **144** for the crank case breather is pressed. The calibrated bore **145** opens into the chamber **139**. The shaft **146** is introduced transversely to the bore **145** into the wall of the collar **137**, which is thickened at this point, and is secured on the inside by the washer **147** and a pin. On the outside the lever **148** is keyed onto the shaft **146** and in the region of the bore **145** the shaft is turned down to two thirds of its diameter to form an eccentric **149**. Depending on the extent to which the shaft **146** is rotated, the breather bore **145** which supplies air to the annular chamber **90**, is either closed or more or less throttled. A manually operated traction means or a thermostat (not shown) heated by the exhaust can be connected to the lever **148**, closing the bore **145** when it warms up. The breather gases are drawn off through the aperture **33** into the mixing duct **19**. The oil mist in the gases lubricates the bearings of the control mechanism and the guide tube **20**. Condensed oil running off of the control members and the wall when the engine stops collects in the trough of the fuel chamber cover **38** and when the engine is subsequently started, passes into the machine to provide extra lubrication.

The disc of the top **50** of the carburettor has at least one vertical orifice **150** which forms a passage for air purified in the filter **4** into the upper chamber **139**. The wall **151** of the collar **137** which is bulged out at this point is provided on its inside with heating ribs **152** which project into the air passage **150** while screwed onto its outside is the end plate **153** of a thick copper wire **154**, the other end of which is connected to the exhaust pipe where it picks up heat to convey it to the heating ribs **152**.

A small leaf spring **155** is connected parallel to the side plate **102** of the forked lever arm **100**, the lug **156** of which spring presses against the curved head **157** of the shaft **36**. When the leaf spring **155** is pivoted, the shaft **36** can be withdrawn from the mixing duct **19**, whereupon the throttle member **10** can be disassembled.

The filter **4** concentrically surrounds the suction duct **18** and is fitted in a sound-damping filter casing **158** which is clamped onto the outer marginal face of the top **50** and the bottom external step **159** of the Venturi tube **1**, with rubber sealing rings **160** being inserted.

The method of operation of the carburettor according to the invention is described hereinafter:

Under idling conditions the throttle member **10** is pressed onto its seat in the venturi tube **1** by the control lever **107** which is lowered by the trunnion **111**, the stop screw **112** of the control lever **107** and the forked lever **100, 101**. The fuel regulating needle **57**, which is protected from excess pressure by the spring **64**, lies in closing contact with its shoulder **60** against the main jet **58**. The venturi tube **1** only receives fuel through the idling jet **68**, the fuel being made into foam primarily in the correction air duct **65** and secondarily in the premixing tube **56**, the foam passing the duct **27** and passing out of the atomiser **25** into the mixing duct **19**. Here it vaporises in the idling air which enters the mixing duct **19** through the apertures **39** and the adjustable gap formed by the throttle plate **40** with the inner annular face **46**. As a result of the high partial vacuum prevailing in the suction duct **18** vaporisation is complete and all the cylinders receive an equally fine mixture which eliminates misfiring and the accompanying emission of carbon monoxide. In this case there prevails in the relief chamber **88** a high partial pressure and in the controlling chamber **90** a somewhat lower partial pressure, as the air sucked via the hole **97** is replaced under partial throttling by the intake of fresh air via the smaller holes **98**.

When the trunnion **111** is pivoted with the accelerator shaft **74** when the engine is accelerated, the stop screw **112** of the control lever **107** frees the way for the lever **100, 101** and the spring **105** is partly relieved.

The air pressure in the outer part of the suction duct **18** exerts on the throttle member **10** as a result of the partial vacuum in the controlling chamber **90** a lifting force which overcomes the reduced force of the spring **105**. When the trunnion **111** is pivoted, at the same time the main jet **58** is partly opened by lifting the fuel regulating needle **57** by means of the eccentric **118** which is also pivoted, via the compound lever **121**. As soon as the throttle member **10** begins to lift, the orifices **33** of the mixing duct **19** slide out of the guide tube **20** and provide the air with a large cross section for access to the atomiser **25**. As the fuel regulating needle **57** has a lead, the engine accelerates spontaneously with enriched mixture so that there is no need for an injection device. As long as the throttle gap **6** is still very narrow, there is formed therein a high speed of flow which sucks air via the holes **98** out of the controlling chamber **90**, the partial vacuum in which is increased and firstly accelerates the lift of the throttle member **10**. When the speed of flow in the throttle gap **6** decreases when the throttle member **10** is opened further, the suction through the holes **98** gradually falls off and finally air again passes through them into the controlling chamber **90**, whereby the suction of air via the holes **97** and the relief chamber **88** is partially compensated. As there is an increase in tension by the spring **105** with the lift of the throttle member **10** and the pivotal movement of the levers **100, 103**, the throttle member **10** can in future only open simultaneously with an increase in the speed of rotation of the engine, in which the partial pressure in the suction duct **18** is steadily reformed. Synchronously with the lift of the throttle member **10**, the end of the compound lever **121** which is pivoted to the shaft **36**, and therewith the fuel regulating needle **57**, is lifted and the fuel feed increased in accordance with the increasing feed of fresh air. In this case the lead in the opening of the main jet which enriched the mixture, is compensated to an increasing degree so that finally, when the arm **100** of the forked lever meets the stop screw **112**, the mixture has a slight excess of air.

As the idling jet always lies below the level of fuel in the fuel chamber **48** and the premixing tube **46** is partly below said level, when the engine is started there is already a small amount of fuel in the premixing tube **56** and in the correction air duct **65** of the needle **57**, which is firstly drawn in and enriches the starting mixture.

In the case of a cold start, the accelerator pedal has only to be depressed somewhat further when cranking the engine, whereby the primary lead of the fuel regulating needle **57** is increased and a richer starting mixture is provided which compensates the condensate in the suction tube. As the throttle lift upon starting is controlled by the partial vacuum in the suction duct **18** and this vacuum depends on the part of the mixture which actually passes into the cylinders and determines the speed of rotation, even a cold engine keeps running smoothly after being started.

Under extreme cold start conditions the mixture can be enriched in that the bore **145** is partly opened by rotating the small shaft **146**. This additional air feed to the controlling chamber **90** reduces the partial vacuum prevailing therein, whereby the throttle member **10** opens less far and follows the lift of the fuel regulating needle **57** later, thus providing a rich mixture.

Reliable starting is already provided with this carburetor for the reason that the atomiser **25** lies within the choke of the carburetor and is exposed to a high partial vacuum which leads to a high degree of activation of the fuel flow out of the main jet **58**.

When the vehicle is started rapidly from the idling condition, the accelerator shaft **74** is pressed right up to the stop **115**. In this case the eccentric **118** lifts the fuel regulating needle **57** by a large part of its lift and provides an abundant supply of fuel. The lug **114** of the lifted control lever **107** lies against the eccentric stop means **113** of the forked lever arm **100** which is entrained so that the worked lever **100, 101** positively lifts the throttle member **10** by an adjustable part of its lift. In this case the engine receives a large amount of fresh air and, in spite of low suction efficiency, an overabundant amount of which mixture which mixes homogeneously with the fresh air, and reacts with spontaneous acceleration, while further lift of the throttle member with simultaneous delivery of fuel, as a result of the reformation of a sufficient partial vacuum, occurs, automatically.

In the course of the automatic throttle lift, the mixture again runs weak, passes the stoichiometric ratio at approximately two thirds of the lift and when the arm **100** of the forked lever **100, 101** comes into contact with the stop screw **112**, therefore at the maximum throttle lift and a good 90% of the maximum speed of the engine, has approximately 10% excess air. If the accelerator is left fully open, when the engine approaches its maximum speed, the ratio is stoichiometric. If the accelerator is closed at maximum speed by from 10 to 20%, nothing is changed in the filling of the cylinders and the speed of rotation as the Bernoulli effect is operative in the accelerating section **18**. Only the fuel-air ratio is changed as the carburetor now operates with from 10 to 15% excess air due to the fuel regulating needle **57** descending. If the throttle member **10** is lowered further, the engine is operating under throttled part-load conditions in which the same excess of air of a good 10% is still found due to the lead, now reversed, of the fuel regulating needle **57**. This excess of air in no way hinders combustion as, due to the fine separation and repeated atomisation and the good distribution over the suction tube area, the mixture is so homogeneous that it has the best ignitiability and speed of combustion. If the engine is slowed by overloading to a lower speed of rotation, for example when travelling up a hill, the partial vacuum in the throttle gap **6**, the suction duct **18** and the controlling chamber **90** is reduced. The throttle member **10** now sinks on its free lift until the tension of the spring **105** is predominating. The flow in the throttle gap **6** is again accelerated by the constriction thereof and draws a richer mixture out of the mixing duct **19** with greater kinetic energy, whereby the ratio of the mixture is adjusted to a slight excess off uel and the engine delivers its maximum torque. When the engine is slowed to below half its normal speed the lug **114** of the control lever **107** comes into contact with the eccentric stop means **113** of the forked lever **100, 101** and prevents further constriction of the throttle member **10**. If the speed of rotation of the engine is still further reduced by heavy loading, the flow in the throttle gap **6** is reduced in speed and the mixture becomes leaner until it reaches a stoichiometric ratio at approximately one sixth of the maximum speed of the engine. If the loading on the engine is reduced, the engine accelerates spontaneously, the increase in speed of the engine leading the progressive opening of the throttle member **10** so that acceleration begins stoichiometrically and ends with a slight excess of air.

Upon sudden transition from full load to part load, the mixture firstly becomes very lean due to the fuel regulating needle descending and secondly due to the fact that the throttle member **10** which is forcibly lowered by the contact of the stop screw **112** with the arm **100** of the forked lever, initially throttles relatively little the supply of air to the engine, as the result of a sharp increase in speed in the throttle gap **6** and the high pressure recovery of the laminar flow in the venturi tube **1**. The excess of air which is at first high, reduces to approximately 10% with the subsequent decrease in speed of rotation of the engine.

If the accelerator lever and the throttle are suddenly closed at full speed, a particularly high partial vacuum is formed in the venturi tube **1**, which lasts as long as the deceleration of the rotating masses. This shock partial vacuum serves to vaporise the film of fuel creeping on the wall of the suction ducts. The associated emission of carbon monoxide is countered in that with a high partial pressure, the spring **43** of the throttle plate **40** flexes so that the plate descends and allows a corresponding proportion of air to enter the mixing duct **19**, which compensates the momentary excess of fuel. When the speed of the engine decreases as a result of the throttling, the partial vacuum in the suction tube also falls to a normal degree and the spring **43** is in a condition to lift the throttle plate **40** to the idling position.

When the vehicle runs down a hill or is on the overrun with the throttle member **10** closed, the engine leans negatively in its resilient mounting **80** and thereby opens the slide valve **77** of the breather **71** of the mixing tube **56** in which no more fuel is sucked up due to the lack of a sufficient partial vacuum. The engine now rotates without fuel being delivered until either the rotary slide valve **75** of the accelerator shaft **74** is rotated by acceleration and is closed or the negative lean of the engine is interrupted by declutching, e.g., at a red traffic light, whereby the slide valve **77** closes. As the float does not go down with this type of fuel cutoff but a small amount of fuel is to be found in the lower part of the premixing tube **56**, the engine immediately restarts when the overrun condition comes to an end.

The independent adjustment described of the throttle lift within the free distance between the stops **112** and **113** controls the fuel-air mixture correctly according to loading, speed and operating condition of the engine. This correct fuel-air ratio is achieved with the accelerator lever in any position. It fluctuates between the stoichiometric ratio and operation with a slight excess of air and is the necessary condition for complete combustion of the gas mixture in the cylinders, the exhaust gas of which only contains traces of poisonous carbon monoxide gas, which are far below the allowed limit.

The double consecutive vaporisation produces a very fine gas with no proportion of larger droplets of fuel, so that all the cylinders of the engine are supplied with gas of an equal fuel-air ratio, less ignition advance is required and combustion is rapid and thorough.

Vaporisation is already at its optimum in the throttling conditions of the carburettor for the reason that atomisation takes place in the suction duct **18** within the throttle gap **6** and under a high partial vacuum.

The variable area of the throttle gap **6** and the internal width of the venturi-like constriction **2** and the ideal contours for guiding the flow in the suction duct **18** provide high-percentage filling of the cylinders of the engine under full load and even at high speeds keep the compression pressure constant.

The higher rate of air flow has a cooling effect on the engine while the unreduced compression pressure accelerates and intensifies combustion and permits the engine to run with an excess of air.

In the embodiment illustrated in FIG. 6 of the carburettor according to the invention a piston **161** which leads the throttle member **10** by a certain degree when it is opened, is associated with the parts regulating the idling condition. The atomiser **25** is arranged in this case outside a throttle point **162**. The throttle point **162** lies in the region of a seat **163** for the piston **161**. At the beginning of the upward lift of the piston **161** the suction force of the indrawn air in the region of the atomiser **25** is only low as the annular area **104** of the intake is larger than the internal area in the region of the throttle point **162**. The throttle member **10** is freed after the piston **161** has lifted to a certain extent. The piston **161** and the throttle member **10** now rise together at equal speed. When the piston **161** has been lifted by a certain amount, the area of the throttle point **162** is larger than the annular area in the region of the atomiser **25**. Thereby the speed of flow of the air in the region of the atomiser **25** increases considerably, producing a considerable suction. Collector ribs **165** are arranged on the wall of the mixing duct below the seat **163** and the holes of the atomiser **25**, by means of which the fuel is prevented from running down the inside wall of the mixing duct and is distributed in the air flow to a considerably better degree.

As already mentioned, the embodiment illustrated is only given by way of example of the invention which is not restricted thereto. On the contrary many alterations and other embodiments are also possible. In particular the carburettor can readily be in the form of a flat flow carburettor.

I claim:

1. Carburettor for producing a fuel-air mixture for internal combustion engines with a suction duct formed by a substantially trumpet-shaped venturi tube and a throttle member arranged therein which is displaceable coaxially thereto by means of an adjusting device and by the pressure conditions prevailing in the venturi tube, the walls of which suction duct diverge both upstream and also downstream from a restriction point, and with a fuel chamber arranged above the throttle member with a feed regulator and with a regulating needle which engages into a jet area and which is adjustable depending on the movement of the throttle member, to regulate the fuel feed to an atomiser which is in communication with the suction duct, characterised in that at the air inlet point the suction duct (**18**) extends radially to the suction pipe intake (**3**) and subsequent thereto passes in a curve into the axial direction thereof, while the position of the throttle point (**6**) is variable in dependence on the position of the throttle member (**10**) and with the carburettor open is on the level of a tube-like tip (**11**) of the throttle member (**10**), into which tip opens a mixing duct (**19**) accommodating the atomiser (**25**) and being in communication with further air feed orifices (**33, 39**) and the walls of the suction duct (**18**) extend here almost parallel to one another.

2. A carburettor according to claim **1**, characterised in that the venturi tube (**1**) is restricted at the level of the tube-like tip (**11**) of the throttle member (**10**) and flares again downstream thereof.

3. A carburettor according to claim **1**, characterised in that the adjusting device has two adjustable stops (**112, 113**), between which the throttle member (**10**) can be freely moved in the open position and arrested in the closed position by one of the stops (**113**).

4. A carburettor according to claim **3**, characterized in that the adjusing device comprises two interlinked pivotable levers (**100, 107**), of which the pivotal movement relative to each other is limited in both directions by the stops (**112, 113**), and of which one is connected to the throttle member (**10**) and the other is connected to a trunnion (**111**) of an accelerator shaft (**74**), while a traction spring (**105**) is provided between the levers (**100, 107**), which loads the throttle member (**10**) in the closing direction.

5. A carburettor according to claim **4**, characterised in that the levers (**100, 107**) holding the spring (**105**) are mounted in such a way that the spring tension to a gradually decreasing extent when they pivot to open the throttle member (**10**).

6. A carburettor according to claim **1**, characterised in that a relief chamber (**88**) is enclosed between the inner wall of the throttle member (**10**) and the outer wall of the fuel chamber (**48**) and is connected to the suction duct (**18**) by holes (**89**) opening downstream of the throttle point (**6**) and is connected by further holds (**97**) to a controlling chamber (**90**) formed by the throttle member (**10**) and the carburettor top (**50**) which is connected thereto by means of a resilient seal such as a rolling diaphragm (**91**), the controlling chamber in turn being in communication with the suction duct (**18**) via narrower holes (**98**) opening upstream of the throttle point (**6**).

7. A carburettor according to claim **6**, characterised in that a loose support and retaining ring (**95**) embraces from the inside a movable outer bead (**94**) of the resilient seal (**91**) and lies with an upper flange (**96**) on the outer bead (**94**) of the seal (**91**) and presses the bead against the outer edge of the throttle member (**10**), while the inner bead of the seal (**91**) fits resiliently into an upper groove (**93**) of the carburettor top (**50**).

8. A carburettor according to claim **6**, characterised in that the carburettor top (**50**) is provided with a spherical tubular face and the throttle member (**10**) is provided with a flaring tubular face, against which the seal (**91**) rolls during the movement of the throttle member (**10**), varying its effective diameter.

9. A carburettor according to claim **6**, characterised in that a cylinder (**84**) enclosing the cylindrical region of the fuel chamber (**48**) is formed on the throttle member (**10**) to separate the relief chamber (**88**) from the controlling chamber (**90**), which cylinder (**84**) has holes (**97**) joining the two chambers (**88, 90**) and carries a sliding seal such as a lipped seal (**86**) lying against the outer wall of the fuel chamber (**48**).

10. A carburettor according to claim **1**, characterised in that air feed orifices (**33**) are associated with the mixing duct (**19**) above the atomiser (**25**), and, with the suction duct (**18**) closed, are also closed by a guide (**20**) surrounding the mixing duct and are to be opened, depending on the throttle member movement which opens the suction duct (**18**), in the manner of a sleeve valve.

11. A carburettor according to claim **10**, characterised in that the mixing duct is closed on the top side by a throttle plate (**40**) which is held resiliently to a seat lying thereabove.

12. A carburettor according to claim **11**, characterised in that the spring (**43**) loading the throttle plate (**40**) in the direction of closing is adjustable.

13. A carburettor according to claim **1**, characterised in that the atomiser (**25**) is fixed in the mixing duct (**19**) and is in the form of a thin-walled Venturi tube with radial spray holes (**28**) extending outwardly from an annular channel (**26**).

14. A carburettor according to claim **13**, characterised in that the atomiser (**25**) is surrounded by an annular gap (**29**).

15. A carburettor according to claim **1**, characterised in that the mixing duct (**19**) is kept narrower than the suction pipe intake (**3**) and broader than the tube-like tip (**11**) of the throttle member (**10**).

16. A carburettor according to claim **15**, characterised in that the tube-like tip (**11**) of the throttle member (**10**) has substantially radial openings (**32**) such as slots or holes to the suction duct (**18**).

17. A carburettor according to claim **1**, characterised in that the regulating needle (**57**) for the fuel feed to the atomiser (**25**) is hung on a double compound lever (**121**), the lift of which is determined on the one hand by an eccentric (**118**) of the accelerator shaft (**74**) and on the other hand by the movement of the throttle member (**10**).

18. A carburettor according to claim **17**, characterised in that the regulating needle (**57**) for the fuel feed is slidingly arranged in a premixing tube (**56**) and increases in diameter stepwise in per se known manner and is provided with cross holds (**66, 69**) and with a stepped continuous longitudinal bore which is in communication with the outside air.

19. A carburettor according to claim **18**, characterised in that the regulating needle (**57**) for the fuel feed has an axially apertured conical point (**59**), the adjacent step (**60**) of which sits closingly on the edge of the fuel jet (**58**) in the idling position.

20. A carburettor according to claim **3** characterised in that the adjusting device for the throttle member (**10**) is arranged in a chamber (**139**) lying above the fuel chamber (**48**) and closed by an easily removable cover (**138**), to which chamber (**139**) the crank case breather gas can be fed through a pipe (**144**) and filtered fresh air through an aperture (**150**) in the carburettor top.

21. A carburettor according to claim **20**, characterised in that the bottom of the chamber (**139**) of the carburettor top (**50**) and the float chamber cover (**38**) are made together in the form of a trough, an air intake being arranged at the lowest point in the trough.

22. A carburettor according to claim **20**, characterised in that a preheater (**152**) is provided in the region of the aperture (**150**) for supplying air to the chamber (**139**), and can be heated by means of a heat conductor connected to the exhaust.

23. A carburettor according to claim **1**, characterised in that the feed regulator (**126**) is controllable in per se known manner by a ring float (**132**) which is suspended on a gimbal frame (**131**) for swinging movement about pins (**133**) parallel to the direction of travel, the gimbal frame (**131**) being mounted in turn on a shaft parallel to the direction of travel and being provided with a counterweight (**134**) which substantially compensates for the weight of the float (**132**).

24. A carburettor according to claim **10**, characterised in that the mixing duct (**19**) is conected to a breather pipe (**72**) in which is arranged a filter (**82**) and the inlet of which is provided with a closing member (**77**) such as a spring-loaded valve or slide which is resiliently attached to a part (**79**) of the internal combustion engine and which opens when the engine leans in the pushing direction and closes in the pulling direction.

25. A carburettor according to claim **24**, characterised in that the breather pipe (**72**) is passed through the accelerator shaft (**74**) which at this point is in the form of a rotary slide valve, so that with the closing member (**77**) in the open or partly open position the accelerator shaft closes the breather pipe.

26. A carburettor according to claim **1**, characterised in that it has a second suction duct (**162**) lying coaxial to the mixing duct (**19**), the opening width of which is determined by the position of a second throttle member (**161**), the movement of which leads the movement of the first throttle member (**10**).

27. A carburettor according to claim **26**, characterised in that the second throttle member (**161**) lies within an enlarged section of the mixing duct (**19**), while the atomiser (**25**) is arranged in such a way that with the second throttle member (**161**) in the closed position it lies outside the static partial vacuum zone of the second suction duct (**162**) and with the throttle member (**161**) in the open position it lies within said zone.

28. A carburettor according to claim **27**, characterised in that collector grooves (**165**) projecting into the mixing duct (**19**) are arranged below the atomiser (**25**).

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