F. H. & F. O. BALL.

CARBURETER.

APPLICATION FILED OCT. 5, 1910.

1,053,145. Patented Feb. 18, 1913.

3 SHEETS—SHEET 1.

FIG. 1.

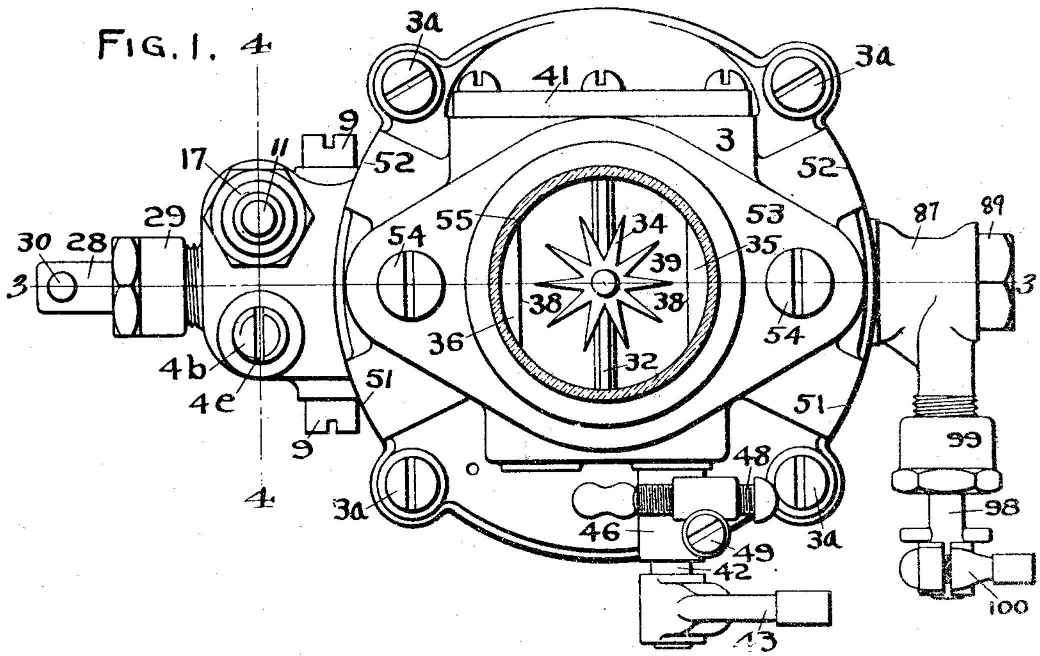
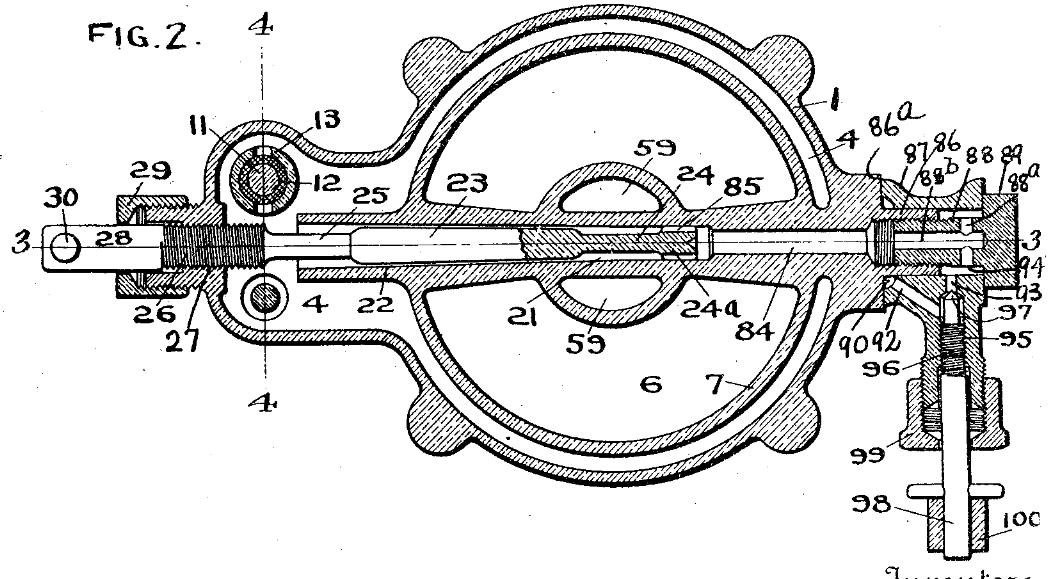


FIG. 2.



Witnesses

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3 SHEETS—SHEET 2.

FIG. 3.

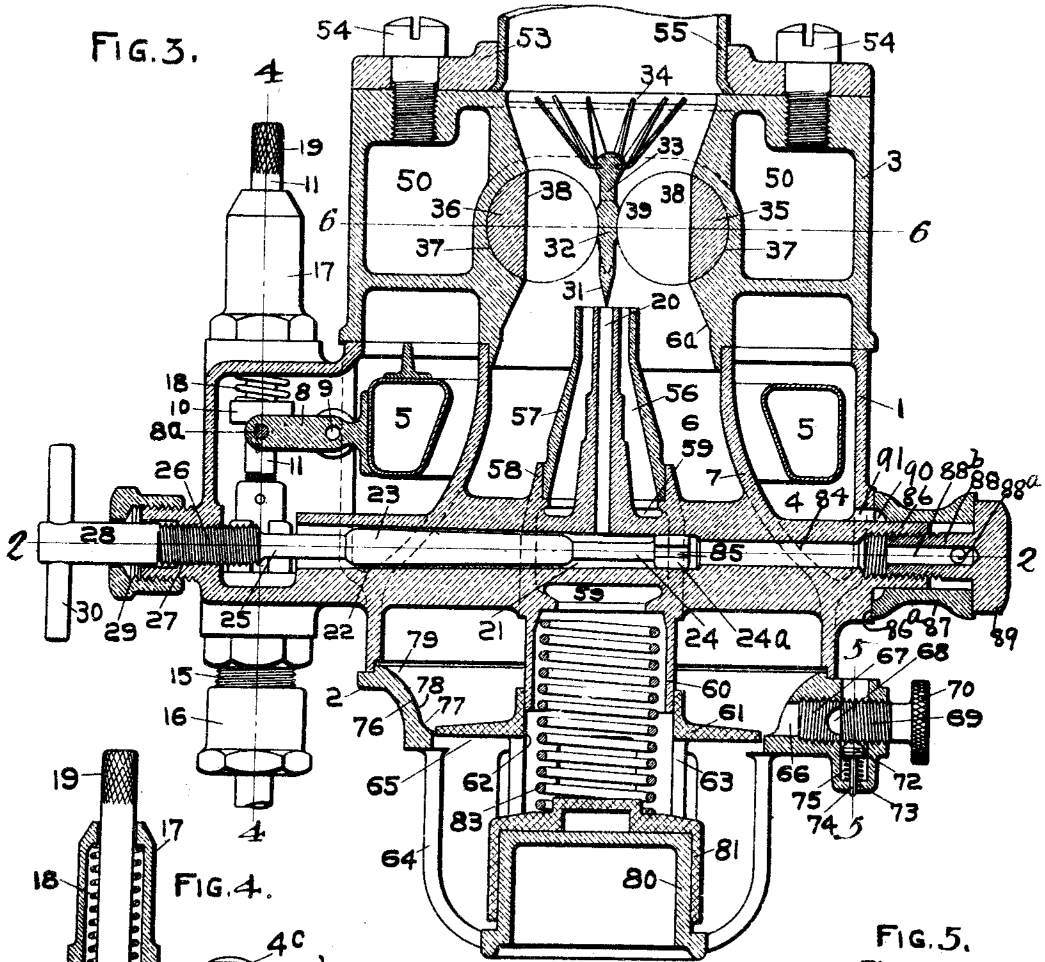


FIG. 4.

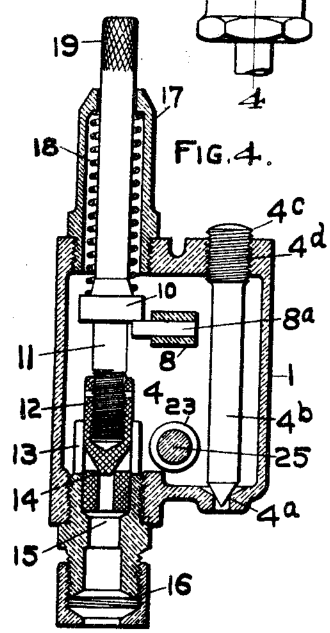
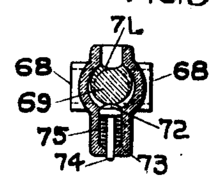


FIG. 5.



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3 SHEETS—SHEET 3.

FIG. 6.

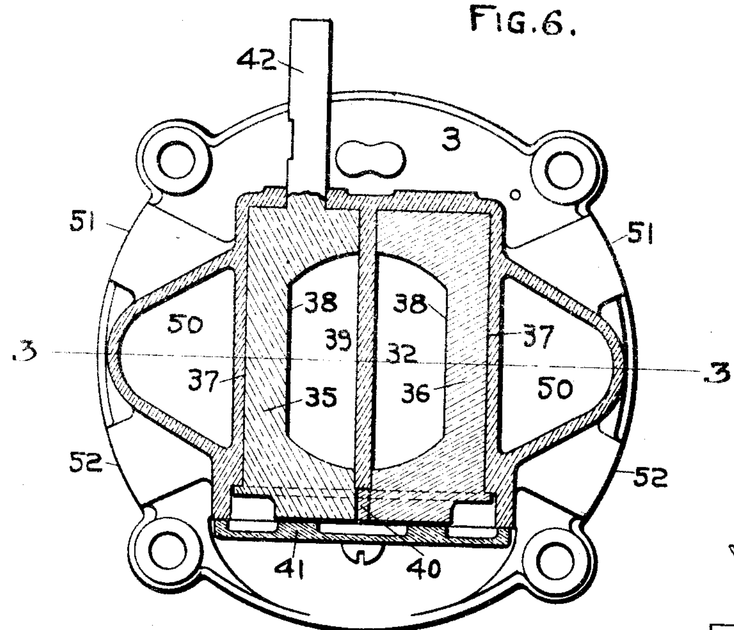
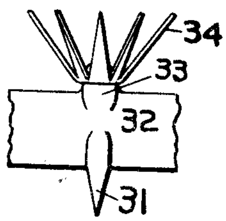


FIG. 8.



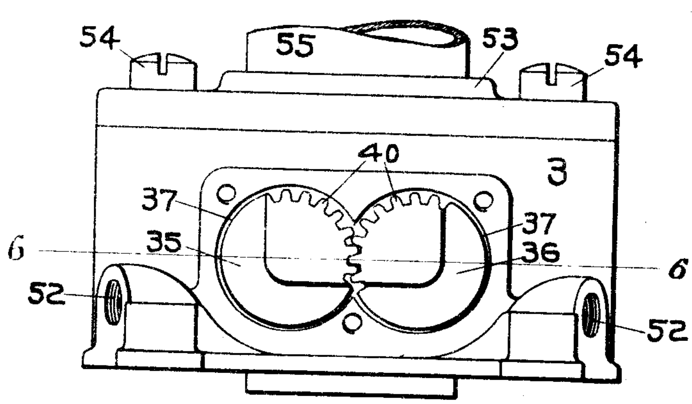


FIG. 7.

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UNITED STATES PATENT OFFICE.

FRANK H. BALL AND FREDERICK O. BALL, OF PLAINFIELD, NEW JERSEY.

CARBURETER.

1,053,145. Specification of Letters Patent. Patented Feb. 18, 1913.

Application filed October 5, 1910. Serial No. 585,400.

To all whom it may concern:

Be it known that we, FRANK H. BALL and FREDERICK O. BALL, citizens of the United States, residing at Plainfield, in the county of Union and State of New Jersey, have invented new and useful Improvements in Carbureters, of which the following is a specification.

This invention relates to carbureters, and consists in certain improvements in the construction thereof as will be hereinafter fully described and pointed out in the claims.

In the common form of carbureters using liquid combustible fluids of carbureting volatility with air and fluid at ordinary temperatures such as gasolene, the air and gasolene are drawn into the carbureter by suction, and the quantity of liquid has been controlled by reducing the cross sectional area of the passage through which the liquid is delivered, usually by a needle valve. As the throttle is opened, or the speed of the engine increased, so as to increase the suction and consequently increase the volume of air, this increased suction will also increase the inflow of liquid. It is desirable, in fact necessary, for a perfect performance of the carbureter that the proportions of gasolene and air be maintained within well defined limits through all speeds of the engine, and all throttle openings. With the carbureter as heretofore formed, in order to increase the inflow of gasolene in proportion to the increase in the inflow of air with a greater opening of the throttle or greater speed of the engine, it has been necessary to so impede the inflow of air as to greatly increase the suction so as to maintain the proportions of gasolene and air within workable limits. The difficulty in this arises largely from the method of control of the gasolene. It will be observed that where the control of the gasolene is accomplished by reducing the passage as by a needle valve or by various sized openings in removable plugs that the control of the flow of gasolene is subject, almost wholly, to the laws governing the acceleration of liquids, and, according to these laws, the resistance or retarding effect of the restriction in the passage increases as the square of the velocity, or in other words, increases as the square of the quantity of liquid delivered. By reason of this rapid increase in the resistance to the delivery of gasolene, if the proportion of air and gasolene is maintained within proper limits, the delivery of air must be so impeded as to seriously affect the working of the engine, both by reason of the inability to get a sufficient quantity of mixture and the atmospheric resistance to the movement of the piston when the pressure of the working side is so reduced. Not only this but it is impracticable, using the acceleration of the liquid as the controlling factor, to maintain the proper proportions of gasolene and air with all openings of throttle and all speeds. This difficulty just hereinbefore noted seems to have been recognized in that various means have been employed to augment the liquid passage as the throttle is opened, but the desired effect of this is disturbed by different speeds of the engine with the same throttle opening. This is especially true of automobiles where the load of the engine varies and the speed of the engine does not even remotely follow the throttle openings. Where devices are used for augmenting the liquid discharge with the increase in suction, the law of acceleration is still utilized as the controlling factor of the passage of the liquid, and the throwing in of auxiliary passages or enlarging of a single passage simply makes a fresh starting point. The result is that the mixture is in proper proportions only under certain conditions of throttle opening and engine speed.

The leading object of this invention is to obviate the difficulties incident to this method of controlling the gasolene, and consists, broadly speaking, in substituting the retarding effect of friction on the moving liquid as the dominant factor of control for the control by acceleration as heretofore used. This change in the scheme of controlling the gasolene makes it possible to supply the right quantity of gasolene with very slight resistance to the passage of air and to control the passage of gasolene without moving the parts or varying the adjustments to all conditions of speed and throttle opening. The reason for this is that the resistance to the movement of liquid at low velocities by reason of friction varies directly as the velocity instead of as the square of the velocity, as in the case of the control where acceleration is the dominant factor. In utilizing the friction control a passage of cross sectional area which would flood the carbureter if of slight extent, may be used, and then by extending this passage, and preferably so forming it as to increase the friction area of the moving liquid, the disturbing factor of acceleration may be almost entirely eliminated in the control of the movement of liquid, and the control by the friction of the moving liquid secured.

It will be understood that in the flow of liquids through any orifice, friction will be a factor in the resistance, but with a restricted surface in contact with the moving liquid this is negligible as compared with the resistance incident to a necessary acceleration of the liquid to deliver the desired supply. On the other hand, with a passage having an extended surface in contact with the moving liquid, thus making friction the dominant factor of control, the resistance incident to acceleration is also a factor but inasmuch as the acceleration is slight it is comparatively negligible. In one case, however, the resistance to the flow of the liquid approximates the theoretical resistance to acceleration and in the other case the resistance approximates the theoretical resistance incident to friction alone. This invention is directed to the control of combustible liquids of volatility readily carbureting with the air and liquid at ordinary temperatures, such as gasolene at 60 gravity Baumé scale and at a temperature of 60° Fahrenheit. It will be understood that viscosity changes the fluid characteristics of liquids to a very great extent and varies the factors in the control of the flow of liquid through passages. It will be understood also that practically all liquids at certain temperatures lose their volatility or at least the carbureting volatility with air at ordinary temperature. We have found that a passage giving the liquid a tubular form and extending for a distance approximating the dimensions shown in the drawings and with the cross dimension between the walls of the passage between .005 and .008 of an inch will operate upon a liquid having the fluid characteristics of ordinary gasolene at a carbureting temperature as 60° Fahrenheit when acted upon by ordinary carbureting suction so as to make friction the dominant factor in the control of the flow of liquid through such passage. By so forming the passage as to spread the liquid out in the form of a thin film, the film being engaged on both surfaces by the walls of the passage, such a liquid may be readily subjected to sufficient frictional surface within the structural limits of the ordinary carbureter. The dominant characteristics in the control of the liquid through a passage may be readily ascertained at any time by plotting the quantities delivered under varying pressures and comparing them with the theoretical line indicating a control entirely by friction and a line indicating a control entirely by acceleration. In order to eliminate as far as possible factors disturbing the control by friction of the liquid with the walls of the controlling passage it is desirable to have the entrance to the passage tapered so as to eliminate as far as possible what is commonly known as the entrance head.

A cold engine such as is encountered in starting, not only requires a different degree of richness of mixture than a warm engine or an engine at normal temperature, but the quality of the mixture to get the best efficiency varies in a different ratio in a cold engine than in a warm engine. A cold engine, and the slow speed at which it is started requires a very rich mixture, and as the speed increases, the richness of the mixture should be reduced quite rapidly, much more so than with a warm engine. Furthermore most liquid fuels vary greatly in viscosity at different temperatures and this variation in viscosity disturbs the control properly adjusted for a normal temperature, that is, a temperature to which the carbureter and gasolene are subjected from the heat of the engine. The viscosity of the colder fluid is greater than when it is of higher temperature. Consequently with the normal opening of the controlling passage there is a smaller proportion of liquid fuel delivered. For this reason, therefore, it is desirable to augment the normal controlling passage when starting the engine to which the carbureter is attached. It is preferable, therefore, to arrange the normal gasolene control wholly with relation to the normal requirements of the engine and to supply momentarily the added gasolene needed for starting. In this way, the friction control used for the normal operation of the engine may be nicely adjusted to get the greatest possible efficiency for all speeds and throttle openings, leaving out of consideration entirely the requirements incident to starting. Then for starting the engine when cold an auxiliary supply having acceleration as its dominant factor of control operates to advantage because an adequate amount of gasolene can be supplied initially for the cold engine and for the slow speed incident to starting, and as the speed of the engine picks up the increase in resistance incident to the acceleration is so rapid that the added supply of gasolene from this source at the higher speeds of the engine is negligible. In consequence, just the right proportions for starting a cold engine and the proper amounts for the various speeds ordinarily used in warming up the engine can thus be readily supplied. It is preferable to have this auxiliary supply controlled so that it can be thrown in for starting the engine and thrown out after the engine is warmed up.

One of the features of the present invention relates to mechanism combining the two methods of control and utilizing a friction control for the normal operation of the engine and an auxiliary supply controlled by acceleration for starting the engine.

Where the friction control of the liquid is utilized as in the present invention, the reduction of pressure in the carbureter to produce sufficient suction to deliver the requisite amount of liquid at high speeds and full throttle opening is very much less than with carbureters using the ordinary acceleration control. In order that the air pressure at high speeds may not be reduced beyond what is necessary to induce the requisite flow of liquid fuel, it is desirable to vary the size of the air opening as the speed of the engine increases and the pressure in the carbureter is reduced so that there shall be but a comparatively small reduction of pressure of the air in the carbureter at the high speeds of the engine. It will be understood that with a fixed air opening acceleration will be the controlling factor of the resistance to the flow of air and such an opening will not harmonize with a friction control of the liquid where friction is dominant. The control of the air so as to give the greater volume necessary for the high speeds and full throttle opening at such reduction of pressure as will induce a corresponding flow of liquid subjected to friction control can be readily attained by varying the air opening so as to make the resistance to the air conform to the resistance to the flow of liquid. In this way the quality of the mixture can be controlled as desired.

It is desirable in order that the proper proportions of air and gasolene under the varying conditions encountered by different engines may be quickly adjusted, that the initial delivery of air may be varied so as to make the proper mixture for the slow speeds or slight openings of throttle without varying conditions of the maximum throttle openings and engine speeds. Where the carbureter is so arranged the proper proportions of gasolene and air for the maximum opening of throttle and engine speed is provided for by varying the delivery of gasolene. If with this adjustment a slight variation in the mixture is desired for the slow speeds this can be accomplished by adjusting the initial air supply and as this does not affect the proportions with a maximum throttle opening just the right proportions for all openings and speeds may be obtained.

In the present invention the air supply for each carbureter pressure can be regulated and varied as desired, in that it is controlled by a valve, the opening past which is gaged by the distance between the edge of the valve and the walls of the carbureter abreast of the valve. As the pressure in the carbureter varies, the valve assumes different positions varying as the pressure varies. By shaping the walls of that part of the carbureter traversed by the valves, any air opening desired may be had for any carbureter pressure. Inasmuch as the flow of gasolene follows inversely the carbureter pressure, it is only necessary with the present invention to shape these walls so as to get the proper opening for each position of the air valve (the position of the air valve is also controlled by the carbureter pressure) to exactly proportion the air to the gasolene for all carbureter pressures, or in other words, for all throttle openings and engine speeds.

Other objects of the invention will appear from the specification and claims.

The invention is illustrated in the accompanying drawings as follows:

Figure 1 is a plan view of the carbureter; Fig. 2 is a section on the line 2—2 in Fig. 3; Fig. 3 is a section on the line 3—3 in Figs. 1, 2 and 6; Fig. 4 is a section on the line 4—4 in Fig. 3; Fig. 5 is a section on the line 5—5 in Fig. 3; Fig. 6 is a section on the line 6—6 in Figs. 3 and 7; Fig. 7 is an elevation of the throttle body; Fig. 8 is a fragment of a gasolene carrying and spreading device.

1 marks the carbureter body; 2 the air valve body; 3 the throttle body. The throttle body is secured to the carbureter by screws 3^a. The air body is similarly secured to the carbureter by screws not shown. The carbureter body 1 has the annular receptacle 4 in which is arranged the annular float 5, the receptacle surrounding the air passage 6, and being separated therefrom by the walls 7.

The float is carried by the lever 8 pivotally mounted on the bearing pins 9 supported by the walls of the body 1. A pin 8^a is arranged in the end of the lever 8, and engages the shoulder 10 on the stem 11, on the supply valve 12. The supply valve operates in the guides 13 and upon a seat 14 and controls the supply passage 15. The usual fitting 16 is arranged for connecting the supply pipe 16^a with the gasolene supply (not shown). A flanged nut 17 is secured to the body 1, and surrounds the upper end of the stem 11. A spring 18 is arranged around the stem 11, and is compressed upon the shoulder 10 and the upper end of the nut 17. The weight of the float is of course sufficient to overcome this spring, so as to open the valve 12 as the level of the gasolene falls; on the other hand the spring is sufficient to close the valve when the float reaches its normal level. The upper end of the stem 11 is knurled at 19 so that the carbureter may be flooded manually if desired.

A convenient means for draining the receptacle 4 is provided by the drain passage

4^a controlled by the needle valve 4^b. The needle valve extends through the upper wall of the receptacle and the stem is screw-threaded at 4^c, and operates in the screw threaded opening 4^d in the top of the receptacle. The top of the valve is provided with a slot 4^e so that it may be conveniently operated by a screw driver or similar implement.

The gasolene is delivered through a vertical passage 20. This communicates with a horizontal passage 21 which opens at one end into the receptacle 4. A portion of this passage 22 is preferably slightly tapered, and a similarly tapered plug 23 is arranged in this tapered passage. The inner end of the passage has a reduced stem or portion 24 which is connected with an enlargement 24^a forming a bearing for the end of the plug, the enlargement operating in the passage 21. The outer end of the plug is provided with a stem 25, the end of which has the screw thread 26 operating in the screw threads 27 in the walls of the body. The outer end of the stem 25 has a smooth surface 28 which operates in the gland 29. A pin 30 is arranged in the end of the stem by means of which the plug 23 may be readily adjusted. This plug 23 presents an extended friction surface to the liquid forming a thin film or layer of liquid between the plug and the walls of the passage. Thus there is resistance on both sides, both the interior and the exterior of this tube of liquid. In this way, a very large surface is provided in a comparatively short distance, and the length of the passage may thus be kept within convenient limits. The proportion of the cross sectional area of the passage formed between the plug 23 and the passage 22 to the surface resisting the movement of liquid may be varied by adjusting the plug 23 in and out by means of screw 26. The cross sectional area of this passage is so great that but for the frictional resistance it would flood the carbureter. While, of course, the liquid is accelerated to some extent in this passage, it is minimized so as to present but little practical influence on the delivery of liquid, the dominant factor in the control of the liquid being the frictional resistance of the walls of the passage to the movement of the liquid. It will be noted that the entrance end of the plug 23 is reduced and the wall of the plug leading to the friction surface is so tapered as to give a nozzle effect to the entrance to the friction annulus. In this way, the entry head to the friction control passage is largely eliminated. In Fig. 7 there is shown an alternative form of adjustment of this frictional control. In this, the plug 23^a is cylindrical, and its effect on the liquid is varied by moving it into and out of passage 21, the portion 22^a of the passage in this instance being cylindrical. In this instance, the extent of the frictional surface may be varied while the cross sectional area remains constant. The variation may also be effected by using various sized plugs with the construction of the passage shown in Fig. 7. This is preferable in some instances, because with it passages of predetermined size may be provided.

As is well known, gasolene has a tendency to adhere to and spread out on a metal surface, from which it can be readily taken up by the passing air. In order to thoroughly disintegrate and break up the gasolene, and insure its perfect mixture with the air, the following scheme of gasolene spreading device and throttle mechanism is used: Immediately above the passage 20 there is arranged a point 31 extending downwardly from the bar 32 extending across the throttle passage 6^a. A projection 33 extends upwardly from this bar opposite the point 31, and a spreader 34 is arranged on this projection, the spreader being preferably formed in the form of a spur wheel, and struck up from sheet metal, and being of conical shape in general outline. Throttle valves 35 and 36 are arranged in openings 37 in the throttle body, portions of the openings 37 being cylindrical, so as to form bearings for the valves, and portions of the valves 35 and 36 being cut away at 38 forming the throttle opening 39. Gear segments 40 are arranged at the ends of the valves 35 and 36 and are in mesh so that the two parts of the valve swing together. The openings 37 are closed by a plate 41 and the valve 35 is provided with a stem 42, on which is arranged an operating lever 43. A sleeve 46 is fixed on the stem 42 and the stop screws 48 and 49 are arranged in this sleeve. By adjusting these screws, the throw of the throttle valves may be adjusted.

Gasolene entering through the passage 20, engages the point 31 and is carried up by the air along the bar 32 to the projection 33, and follows out on the spreader 34 so as to form a perfect mixture. The initial opening of the throttle is along the bar 32 so that the air with its high velocity due to a partially closed throttle, sweeps along this bar and by the spreader, thus assuring a full taking up of the liquid with a slight throttle opening. As the throttle continues to open, this central location of the passage is maintained, so that with all throttle openings there is a movement of air adjacent to and through the spreader. While it is desirable to take up the gasolene by a retaining surface adjacent to the delivery nozzle, and subject the gasolene to the direct action of the air, at its highest velocity on this surface, the nozzle itself must be within the carbureter or at the opposite side of the throttle from the passage from the carbureter, so that the passage leading to the nozzle will be subjected only to reductions in pressure in the carbureter chamber incident to the variations in the opening of the throttle so as to control the gasolene supply. The carrying point and surface carry the gasolene up through the throttle and still permit of the location of the nozzle sufficiently within the carbureter chamber to subject the nozzle only to the varying pressure of the chamber. By placing the spreader above the throttle, a spreader of ample size and shape may be utilized, and be located with relation to the nozzle so that the gasolene may be readily spread along the surface of the spreader, and thus prevent the gasolene from reaching the engine except in the form of mixture.

The throttle body is provided with a heating chamber 50 having the outlet and inlet passages 51 and 52 through which the chamber may be connected with some supply of heating medium. The usual flanged connection 53 is arranged at the top of the throttle opening by means of screws 54 and the pipe 55 leading to the manifold is arranged in this flanged plate.

It is usual in carbureters of this type to have the initial air delivered through an unobstructed passage of small capacity, and to augment this through an auxiliary passage controlled by a valve, the resistance being determined by the adjustment of this valve. Surrounding the passage 20 is an air passage 56, formed by the fitting 57 set in a socket 58 carried by the walls of the passage 21. The passage 56 is connected with the passage 59 which extends around the walls of the passage 21 and opens into a downwardly extending tube 60. The air valve 61 has a center tube 62 operating on the tube 60 and thus continues the opening from the tube 60. Passages 63 open from the tube 62 to the air, the valve being supported by a spider 64 surrounding the main air passage 65. Thus, the carbureter chamber is at all times in unobstructed connection with the outer air through the passages 56, 59, tubes 60 and 62, and opening 63.

As heretofore stated, the adjustment of the carbureter to different conditions may be more readily accomplished if it is possible to adjust or vary the size of this initial or unobstructed passage, and it is desirable that this variation be accomplished without varying the extreme resistance to the introduction of air. This is accomplished in the present construction by an adjustable initial air valve as follows: An auxiliary initial passage 66 leads to the main air passage 65 above the initial position of the valve 61. This passage has the screw threads 67 with lateral openings 68 leading to it. Screw threaded valve 69 is arranged in the screw threaded passage 67, this valve being provided with a knurled handle 70 by means of which it may be operated. As the valve is screwed in or out, it opens the lateral openings 68 and thus varies the amount of air which will enter through the passage 66. The valve is preferably provided with slots 71. A yielding pawl 72 is arranged to operate in these slots. The pawl is carried in a socket 73 and is provided with a stem 74 which is surrounded by the spring 75, the spring 75 being compressed so as to crowd the yielding pawl into the slots 71. This pawl has sufficient engagement with the valve to lock it in adjustment. On the other hand, the pawl readily yields to permit the valve being turned to adjust the carbureter to the engine for slow speeds, and slight throttle openings. This valve 69 is so adjusted as to give the proper mixture with a maximum supply. The passage 66 opens into the main passage 65 above the initial position of the valve 61. As the valve 61 is lifted it reaches a position above the passage 66 so that in the extreme position of the valve 61 the air from the passage 66 does not affect the maximum amount of air delivered in the least. This is desirable because in adjusting the carbureter the gasolene supply is adjusted to the maximum engine speed and throttle opening, and this is not disturbed by adjustment afterward of the initial supply of air or vice versa.

Carbureters are ordinarily arranged so that there is an inflow of gasolene only with a reduction of pressure in the carbureter chamber. It would be difficult to so perfectly balance an air valve because it is usual to hold some of the air supply by an air valve. The difficulty in so controlling the action of this valve, so that it will deliver air just at the point where gasolene is admitted, makes it expedient to have a small initial supply of air from an unobstructed or practically unobstructed passage, so that the gasolene discharges into a moving column of air. In the present construction, the passage 56 satisfies this requirement. The valve 61 controlling the opening 65 reaches a position opposite the top of the cylindrical part of the opening 65, approximately at the moment the gasolene begins to discharge. The resisting spring 83 is preferably of slightly less length when fully expanded than the distance between its seat on the valve and the seat of the end 60. The valve is preferably formed of aluminum so as to give the least possible resistance to the lift of the valve for a distance equal to the overlap of the valve within the cylindrical part of the opening 65 and the spring being fully expanded, starts at zero in its resisting action.

The main air passage is controlled by the valve and is between the edge of the valve and the walls of the carbureter. By shaping these walls, any intermediate opening may be produced, so as to maintain the proper mixture of air and gas at all the intermediate stages. This relation, that is, the valve traversing adjacent walls shaped to control the flow of air with different valve position to satisfy the different speeds and throttle openings lends itself to any variation desired.

In order to maintain the proper proportions of gasolene and air, it is necessary that the valve starting with the position where it engages the spring 83 should increase the air opening abruptly, the edge of the valve therefore travels over the surface 77. Thus the size of the opening for a short distance increases very abruptly. The continued surface 78 is more nearly parallel to the line of the motion of the valve so that after the initial opening the increase in the area of the passage is less abrupt. In the continued opening of the valve other factors of resistance are effective in creating resistance, so that in the extreme movement of the valve, it is necessary to make the increase in the area of the passage abrupt as at 79. The path over which the valve moves, may be said to describe in general outline an O. G. curve 76 in cross section.

In order to steady the valve it is preferable to have the valve provided with the dash pot, and this is conveniently done by the following means which not only serve as a dash pot, but also as a guide for the valve: The plunger of the dash pot 80 extends upwardly from the spider 64 and the cylinder 81 operating on it is arranged in the lower end of the tube 62. This is made an easy fit so that through the leakage of air through the joint thus formed the pressure within the cylinder 81 gradually assumes atmospheric pressure at whatever position the valve may take. This, while permitting the valve to readily yield to different conditions, stops the vibration which would otherwise be incident to each pulsation of the engine.

As heretofore indicated, a supply of liquid suitable for slow speeds under ordinary running conditions is not sufficient for starting at low temperature. With the friction control the frictional resistance to the flow increases in direct ratio to the decrease in velocity—in other words the resistance decreases in direct ratio to the quantity of liquid delivered, whereas in the control having acceleration as the dominant factor, the resistance due to acceleration decreases as the square of the decrease in velocity of the liquid, so that with such reductions in pressure in the carbureter chamber as will properly supply the liquid for the higher speeds can not practically be controlled at the slower speeds so as to result otherwise than in an excess of gasolene. As this is just what is desired for starting at low temperatures, such a means of control is supplied in connection with the friction control by means, manually operated, for throwing it in and out of action.

The passage 21 is continued through the wall of the carbureter and the enlargement 24ª on the stem 24 has the grooves 85 as a means of connection between the extension 84 on the carbureter and the main passage of the passage 21 and the central portion of the said passage. The walls of the outer end of the extension 84 extend outwardly beyond the walls of the carbureter forming a cylindrical projection 86. A swiveled needle valve fitting 87 is journaled on the projection 86. The fitting is held in place by a screw 88 which is screwed into the projection 86, the interior of the projection 86 being screw threaded for this purpose. The screw has an enlarged head 89 which engages the outer end of the swiveled fitting and clamps the same, against a finished surface 86ª on the carbureter surrounding the projection 86, and thus makes a close joint. The inner end of the fitting has an annular groove 90 which extends from and connects with a passage 91 extending from the chamber 4 through the walls of the carbureter. A passage 92 (see Fig. 3) connects the groove 90 with a valve passage 93. The passage 93 opens into an annular chamber 94 between the walls of the swiveled fitting 87 and the screw 88, the swiveled fitting being somewhat longer than the projection 86. The annular chamber 94 is connected through passages 88ª and 88ᵇ and a screw 89 with the extension 84. The swiveled needle valve fitting has the screw threaded extension 95 on the valve passage 93 in which the screw threaded portion 96 of the needle valve 97 operates. The needle valve controls the passage 93. The needle valve is provided with the stem 98 which extends outwardly through the gland 99 and the stem is provided with the handle 100 by means of which the needle valve may be operated from any convenient position. It will be noted that by the use of the swiveled needle valve fitting, the stem of the needle valve and its controlling lever may be swung around to any angle that may be most convenient for operating the controlling lever. The gasolene for this control by acceleration passes through the chamber 4 through the passage 91, to the annular groove 90, and from this annular groove by the passages 92 and 93 past the needle valve 97 to the chamber 94, and from the chamber 94 through the passages within the screw to the extension 84, and from the extension by way of the grooves 85 to the passage 21, and thence to the passage 20. In this control the dominant factor resisting the flow of liquid occurs in the restricted portion of the passage directly at the needle valve. Here, the resistance to acceleration, (a manifestation of inertia), increases as the square of the velocity, and friction has but slight influence upon this resistance. When, therefore, it is desired to increase the flow to the carbureter under the conditions named, the needle valve 97 is manually operated connecting the gasolene receptacle by way of this valve with the passage 21, the passage having the restricted opening at the needle valve. With the starting of the engine, the velocity even of such a quantity of gasolene as will flood the carbureter is very slight, and consequently the resistance to movement of the gasolene through the passage is very slight. The result is that the amount of gasolene delivered past the needle valve 97 is greatly in excess of that which is desirable in the normal operation of the engine, or which will be delivered through the passage 22, although the cross sectional area of the passage 21 is larger than that of the restricted opening controlled by the valve 97. It is often desirable to leave this auxiliary passage open until the engine gets warmed up or normally operating, and this means of increasing the flow of fluid to the carbureter initially is very desirable in this respect because so long as there is slow speed or a small throttle opening, it will continue to flush the carbureter, but when the engine reaches its normal speed, so that a large quantity of mixture is being received, this increase in resistance is so rapid that the quantity of the mixture is not proportionally enriched as the quantity increases. In other words, the proportionate effect is automatically reduced as the speed increases. It can be entirely thrown out manually as soon as desired.

What is claimed as new is:

1. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the delivery of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the friction of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the said walls the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber.

2. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; mechanism controlling the suction in approximately direct ratio to the quantity of air delivered; and means for controlling the delivery of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of said passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber and essentially in direct ratio with the velocity of the combustible liquid in the passage.

3. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the flow of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of the passage making the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of combustible liquid through the passage and to the carbureting chamber; and mechanism for varying the cross sectional area of the passage.

4. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; mechanism controlling the suction in approximately direct ratio to the quantity of air delivered; means for controlling the delivery of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through it and to the carbureting chamber and essentially in direct ratio with the velocity of the combustible liquid in the passage; and mechanism for varying the proportions of the friction surface area of the walls relatively to the cross sectional area of the passage.

5. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; and means for controlling the flow of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber, said passage having interior and exterior friction surfaces extending the liquid in a thin film between said surfaces.

6. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the delivery of combustible liquid compris-

ing a passage the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber; and an adjustable plug arranged in the passage and forming the interior wall of the passage.

7. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the delivery of combustible liquid comprising a tapering passage, the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber: and an adjustable tapered plug arranged in the tapered passage and forming the interior wall of the passage.

8. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; and means for controlling the delivery of combustible liquid comprising a passage having its walls in close proximity between which the liquid is extended in a thin layer and subjected to frictional engagement with the walls of the passage, the walls of said passage being extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber.

9. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber: means for controlling the delivery of combustible liquid comprising a passage having its walls in close proximity between which the liquid is extended in a thin layer and subjected to frictional engagement with the walls of the passage, the walls of said passage being extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber: and means for adjusting the adjacent walls relatively to each other.

10. In a carbureter, the combination of a carbureting chamber: devices for delivering by suction air and combustible liquid to the carbureting chamber: means for controlling the delivery of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber: and mechanism adapted to be manually thrown into action for augmenting the flow of said liquid.

11. In a carbureter, the combination of a carbureting chamber: devices for delivering by suction air and combustible liquid to the carbureting chamber; mechanism for controlling the delivery of combustible liquid comprising two controlling means, first, a passage the walls of which are extended relatively to its cross sectional area to make the friction of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber, said passage supplying the greater portion of the normal supply of combustible liquid to the carbureting chamber, and the second passage having a reduced opening making the resistance to the acceleration of the liquid the dominant factor in resisting the movement of the liquid by way of said second passage to the carbureting chamber.

12. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the delivery of combustible liquid to the carbureter comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber; means controlling the introduction of air comprising a passage leading to the carbureter: and devices for varying said passage as the pressure in the carbureter varies.

13. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the delivery of combustible liquid to the carbureter comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60

gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber; and an air valve opening to the carbureter with a reduction of pressure in the carbureter.

14. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the delivery of combustible liquid to the carbureter comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber; and devices controlling the delivery of air comprising a passage and an air valve operating in said air passage, the area of the opening of the valve through a part of its travel being controlled by the distance between the edges of the valve and the walls of the passage traversed by the valve.

15. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber, said devices comprising an initial air opening and a main air opening; means for controlling the delivery of combustible liquid comprising a combustible liquid passage, the walls of which are extended relatively to the cross sectional area of said combustible liquid passage to make the friction of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber; and an air valve controlling the main air passage.

16. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber, said devices comprising an initial air opening and a main air passage; means for controlling the delivery of combustible liquid comprising a combustible liquid passage, the walls of which are extended relatively to the cross sectional area of said combustible liquid passage to make the friction of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through said combustible liquid passage and to the carbureting chamber; an air valve controlling the main air passage; and means for varying the initial air opening.

17. In a carbureter, the combination of devices for delivering air and combustible liquid thereto, the devices for delivering combustible liquid comprising a nozzle; and carrying surfaces terminating adjacent to the nozzle, and extending into the discharge passage of the carbureter; a spreader on the carrying surface; and a throttle valve between the spreader and the nozzle.

18. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; and means for controlling the delivery of combustible liquid comprising a passage through which the combustible liquid is supplied to the carbureter, the walls of said passage being extended relatively to the cross sectional area of the passage to make the friction of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the said walls the dominant factor in resisting the flow of liquid through it and to the carbureting chamber, the delivery to and from said passage being of at least as great cross sectional area as the extended passage.

19. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the delivery of combustible liquid comprising a passage through which the combustible liquid is supplied to the carbureter, the walls of said passage being extended relatively to the cross sectional area of the passage to make the friction of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the said walls the dominant factor in resisting the flow of liquid through it and to the carbureting chamber, the delivery to and from said passage being of at least as great cross sectional area as the extended passage; and mechanism controlling said devices for varying the air opening to the carbureting chamber to vary the air opening to the carbureting chamber to vary the quantity of air delivered as the delivery of combustible liquid varies.

20. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; a receptacle from which the combustible liquid is drawn; and means for controlling the delivery of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the friction of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the said walls the dominant factor in resisting the flow of liquid to the passage and to the carbureting chamber, said passage having a direction

permitting the free escape of gas as the passage is filled with liquid from the receptacle.

21. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; means for controlling the delivery of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the friction of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the said walls the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber, the entrance of said passage being tapered.

22. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; mechanism controlling the suction in approximately direct ratio to the quantity of air delivered; and means for controlling the delivery of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of the passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber and essentially in direct ratio with the velocity of the combustible liquid in the passage, the entrance of said passage being tapered.

23. In a carbureter, the combination of a carbureting chamber; devices for delivering by suction air and combustible liquid to the carbureting chamber; mechanism controlling the suction in approximately direct ratio to the quantity of air delivered; means for controlling the delivery of combustible liquid comprising a passage the walls of which are extended relatively to the cross sectional area of said passage to make the frictional engagement of a combustible liquid of the fluid characteristics of 60 gravity gasolene at 60° Fahrenheit with the walls of the passage the dominant factor in resisting the flow of liquid through the passage and to the carbureting chamber and essentially in direct ratio with the velocity of the combustible liquid in the passage, the entrance of said passage being tapered; and an air valve opening to the carbureting chamber through the suction in the carbureting chamber.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

FRANK H. BALL.
FREDERICK O. BALL.

Witnesses:
CHAS. S. PARRY,
E. N. BOWEN.