F. C. MOCK.

CARBURETOR.

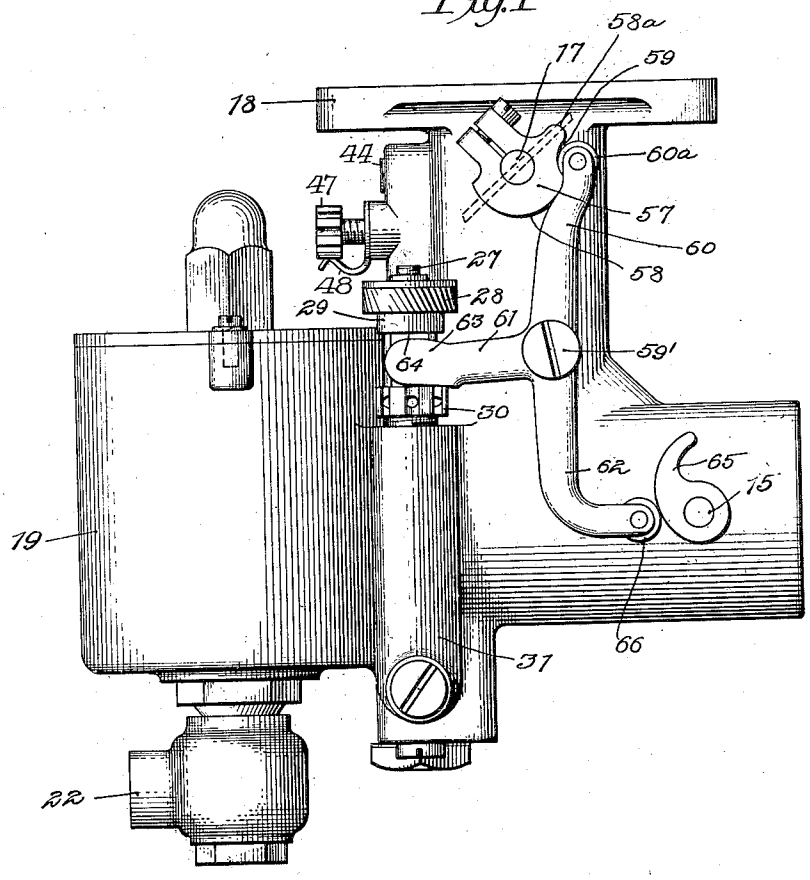
APPLICATION FILED AUG. 25, 1915.

1,404,879.

Patented Jan. 31, 1922.

3 SHEETS—SHEET 1.

Fig. 1



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3 SHEETS—SHEET 2.

Fig. 2

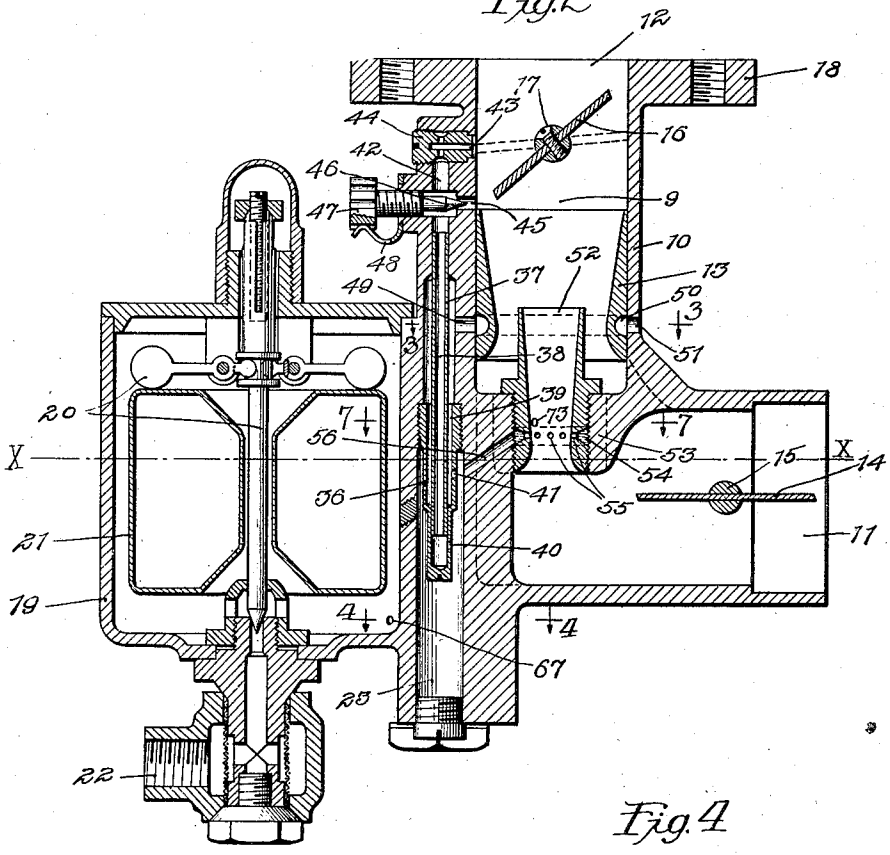


Fig. 3

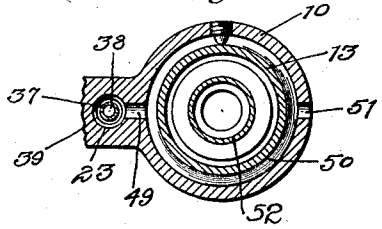
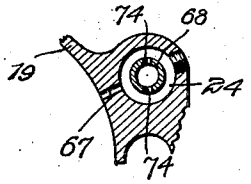


Fig. 4



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3 SHEETS—SHEET 3.

Fig. 5

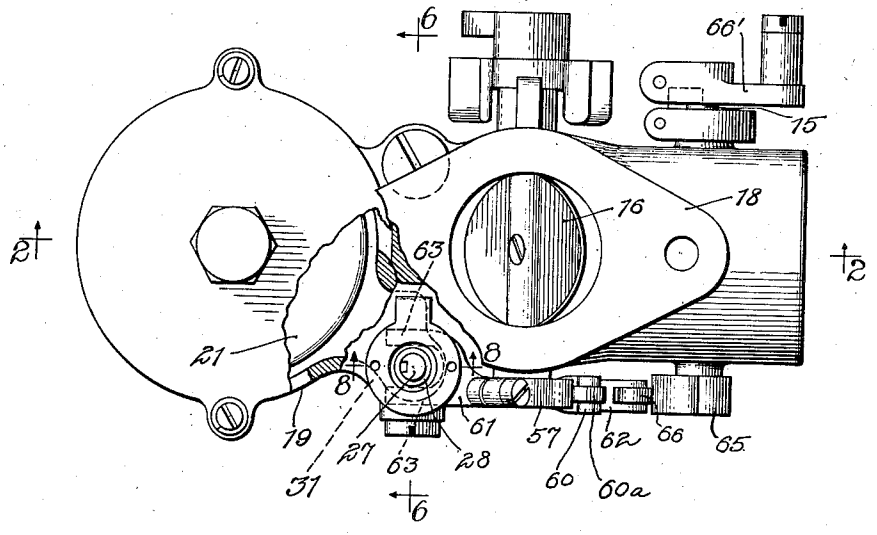


Fig. 6

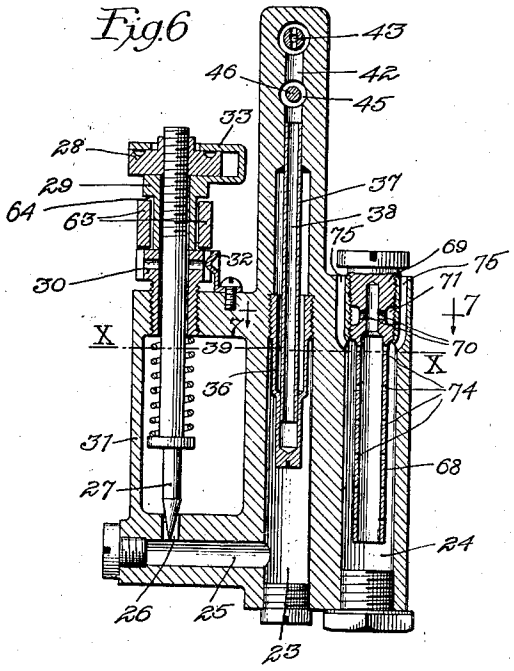


Fig. 7

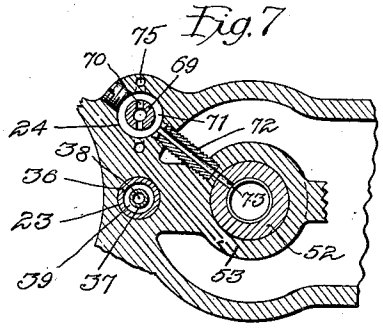
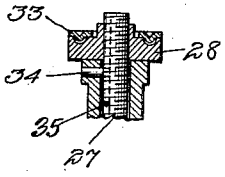


Fig. 8



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UNITED STATES PATENT OFFICE.

FRANK C. MOCK, OF CHICAGO, ILLINOIS, ASSIGNOR TO STROMBERG MOTOR DEVICES COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

CARBURETOR.

1,404,879. Specification of Letters Patent. Patented Jan. 31, 1922.

Application filed August 25, 1915. Serial No. 47,385.

To all whom it may concern:

Be it known that I, FRANK C. MOCK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Carburetors, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to carburetors for internal-combustion engines and is concerned particularly with that class of carburetors now commonly known as "plain-tube" devices.

It is the object of my invention to provide a carburetor for the purpose referred to which will supply to the engine at the various speeds and various loads, such as are attained and assumed in automobile practice, a mixture with the most efficient proportions of air and fuel. I provide a device whereby thorough vaporization may be had and wherein "loading", that is the improper accumulation of fuel in the carbureting chamber and its subsequent improper supply to the engine, may be avoided.

These and other advantages will become apparent to those skilled in the art as this description proceeds, it being understood that the device which I illustrate in the drawings and which I shall describe is an embodiment of my invention and to which I am not necessarily limited, the scope of my invention being determined by the appended claims.

In the accompanying drawings,

Figure 1 is a side elevational view of the carburetor of my invention;

Figure 2 is a vertical, axial sectional view thereof;

Figure 3 is a cross-sectional view taken on the plane of the line 3—3 of Figure 2 and looking in the direction indicated by the arrows;

Figure 4 is a cross-sectional view of a portion thereof, taken on the plane of the line 4—4 of Figure 2 and looking in the direction indicated by the arrows;

Figure 5 is a plan view of the structure of my invention, parts being broken away and shown in section to clearly reveal the structure thereof;

Figure 6 is a vertical, cross-sectional view taken on the plane of the line 6—6 of Figure 5 and looking in the direction indicated by the arrows;

Figure 7 is a cross-sectional view taken on the plane of the line 7—7 of Figure 6 and looking in the direction indicated by the arrows;

Figure 8 is a detail view which will be referred to.

Referring first to Figure 2, it will be seen that I provide a carbureting chamber 9 suitably formed in the casing 10, which provides a passage from the air-inlet 11 to the mixture-outlet 12. A main Venturi tube 13 is set in this passageway, a butterfly valve 14 being mounted in the air intake upon a rotary shaft 15, and a throttle-valve 16 being mounted in the mixture-outlet upon a rotary shaft 17. A flange 18 surrounds the mixture-outlet and is adapted for attachment to the manifold of an internal-combustion engine.

A float-chamber 19 is formed integrally with the casing 10, and needle-valve mechanism 20, operated by a float 21, controls the entry of liquid fuel, such as gasoline, into the float-chamber 19 by way of the pipe 22, the float thus maintaining a constant level at approximately the dot-and-dash line X—X.

Between the float-chamber and the casing 10 I provide two wells, a primary well 23 and an accelerating well 24, the relative positions being best shown in Figure 6. The primary well 23 is connected with the float-chamber 19 by way of passageways 25 and 26, the latter passageway being controlled by a needle-valve 27, which, at its upper end, screws into and hangs from an adjusting nut 28 which determines the maximum open position of the valve. This adjusting nut rests upon a sleeve 29, through which the needle-valve stem may slide, and the sleeve 29 rests upon an adjusting nut 30, through which the needle-valve stem may slide, this nut 30 threading into an extension 31 of float-chamber 19. It will be seen that the position of the needle-valve 27 determines the flow from the float-chamber into the primary well 23. The nut 30 is held in any adjusted position by means of a snap-spring 32, and the nut 28 is held in any ad-

justed position by means of a snap-spring 33 extending from the sleeve 29, the nature of the contact being shown in Figure 8. Figure 8 also illustrates the pin 34, carried in the sleeve 29, which engages in a longitudinal slot 35 in the needle-valve stem 27, so as to prevent the needle-valve from turning when the screw 28 is turned for adjustment. The passageway 26 is never closed, but it will be seen that the adjustment of the nut 30 determines the lowermost position of the needle-valve, and, thus, the minimum effective size of the passageway which is governs.

From Figures 2 and 6 it will be seen that a nipple 36 is disposed within the primary well 23, and a tube 37 is disposed within this nipple so as to form a central passageway 38 and an annular passageway 39. An aperture 40 admits gasoline, assuming that to be the liquid fuel employed, from the primary well 23 to the central passageway 38, and an aperture 41 admits gasoline from the primary well 23 into the annular passageway 39, both of these apertures lying below the normal level of the fuel, and the latter aperture being mainly adapted for the reverse passage of air for a purpose to be described presently.

The tube 37 passes upwardly and connects exclusively with a passageway 42 near the upper end of the carburetor, which passageway communicates with a nozzle 43 in a plug 44 insertable in the casing 10 at a point in proximity to the closed position of the throttle, as will be pointed out. An air-port 45 connects the carbureting chamber 9, which lies below the throttle, with the passageway 42, and this connection is controlled by means of a needle-valve 46 adjustable from the outside by means of the adjusting screw 47, a snap-spring 48 being provided to hold this adjusting screw in position.

The annular passageway 39 connects with the atmosphere by means of the passageway 49, the annular groove 50 around the Venturi tube 13, and the air-port 51.

A secondary Venturi tube 52 is mounted in the main passageway in such a way that it terminates slightly above the most restricted portion of the main Venturi tube, the most restricted portion of this secondary Venturi tube therefore lying considerably farther down. This secondary Venturi tube is mounted in a spider 53, which spans the air-passage, as clearly shown in Figures 2 and 7, but leaves ample passage for air around it. Slightly above its most restricted portion this secondary Venturi tube is provided with an annular groove 54, from which fuel inlets or nozzles 55, 55 extend inwardly and radially, these nozzles being, preferably, distributed equidistantly upon the inner periphery. It will be seen that air is admissible to the nozzles by way of the air port 51, groove 50, passageway 39 and aperture 41; a nozzle of this nature, wherein air is admitted to it, is known as an "air-bled" nozzle. The annular groove 54 is connected with the primary well 23 by means of the passageway 56, it being noted that the fuel-nozzles 55, 55 lie above the normal level of the gasoline, while the lower end of the passageway 56 lies below it.

Upon the outside of the carburetor, as shown in Figures 1 and 5, the shaft 17, upon which the throttle-valve 16 is mounted, is provided with a cam 57, which has the circular periphery 58 concentric with the axis of the shaft, this cam-surface being complete except for the depression 59, which comes into play at a certain time, as will be described later.

Mounted upon a pivot-pin 59′ upon the outside of the casing is a bell-crank lever having three arms, 60, 61 and 62. The arm 60 extends upwardly and at its upper end is provided with a roller 60^a adapted to ride upon the surface 58. The arm 61 extends horizontally and has its end bifurcated at 63, 63, to embrace the sleeve 29, hereinbefore referred to, below the shoulder 64 thereon.

It will now be seen that when the roller 60^a rides upon the surface 58, which condition exists on the higher speeds, the arm 61 of the bell-crank lever will engage the under side of the shoulder 64 on the sleeve 29 to lift the needle-valve 27 and keep it in its uppermost position. When the roller 60^a drops into the depression 59, as it will due to the location of the center of gravity of the bell-crank lever and the spring of the needle valve, it will be clear that the needle-valve 27 will be allowed to descend to its lowermost position. Again, when the roller 60^a rides upon the portion 58^a of the cam, the needle-valve will be in its uppermost position.

The shaft 15 of the intake-valve 14 is provided with the rising cam 65, which is followed by a roller 66 on the arm 62 of the bell-crank lever. As illustrated in Figure 5, the shaft 15 is provided with an operating lever 66′ at its opposite end, this operating lever being adapted to be connected with adjusting means, usually mounted on the dash of an automobile. This is a temporary dash-adjustment, and under special conditions, the air may be restricted by the valve 14 and simultaneously the flow of gasoline into the primary well 23 may be maximum by reason of the lifting of the needle 27 by the action of the cam 65, regardless of the position of the throttle 16.

The accelerating well 24, which has hereinbefore been referred to, is fed directly from the float-chamber 19 by means of the restricted passageway 67, shown in Figures 2 and 4. A tube 68, which depends from a screw-plug 69, threaded in the top of this

well, is placed concentrically in the well, the interior of this tube being connected by means of ports 70 with an annular groove 71 in the plug 69. This annular groove 71, as illustrated in Figure 7, connects, by means of a small tube 72, with a fuel-nozzle 73, terminating within the secondary Venturi tube 52 slightly above the fuel-nozzles 55, 55, as illustrated in Figure 2 and also in Figure 7. This fuel-nozzle I refer to as the accelerating nozzle and I shall describe its operation presently.

The tube 68 is provided with a series of ports 74, arranged in vertical succession along the length of the tube, and, preferably, equidistantly spaced apart, as shown in Figure 6. In this figure the dot-and-dash line indicates the fuel level in the float-chamber, and, under ordinary conditions, the uppermost of these apertures lies above this fuel-level. Openings 75, 75 permit the entry of air into the space surrounding the tube 68.

The operation of the device is as follows: When there is no suction the gasoline stands at a common level in the float-chamber, the two wells, and the associated passageways. In starting, the response of the fuel depends upon the position in which the throttle is maintained when the engine is cranked, but it will suffice as a general statement to say that gasoline goes to the engine from the nozzle 43 and also from the fuel-jets 55, 55. Since, at starting, collected fuel stands in the passageways leading to these nozzles, there will be a desirable excess of fuel to compensate for the coolness of the engine-cylinders, the lag in response of the gasoline, since the gasoline is heavier than air, and the excess of air.

In assuming now a condition of idling or very low running, the throttle is closed as far as it can be, in which position, as shown in dotted line in Figure 2, the nozzle 43 may feed over the throttle. Under these conditions air entering the main air-inlet passes upwardly through the Venturi tubes and into the passageway 45, where it goes into the passageway 42, mixing with the rising gasoline and going on to the engine. It will be seen that the outlet of the nozzle 43 is in a slight recess and the result is that there is a slight shunt path for air past the nozzle. This air, of course, goes to the engine with the mixture which comes from the nozzle 43. Under these conditions the reduction in pressure below the throttle is so slight that no feed effect is had upon the jets in the secondary Venturi tube. The adjusting screw 46 is set for the proper admission of air in order to secure the best mixture for idling and low running, it being evident that this mixture may be determined independently of consideration as to higher running. When the throttle is in this idling or low-running position the roller 60[a] on the bell-crank lever on the outside of the carburetor rests upon the portion 58[a] of the cam-surface and consequently, as before described, the needle-valve 27 is in its uppermost position, giving a full supply of gasoline. If, as for instance in colder weather, a somewhat richer mixture is desired under the circumstances, the dash-adjustment may be manipulated to slightly close off the air in the main air inlet 11.

If it be now assumed that the throttle is gradually opened, it will be seen that the first effect, which will be of very short duration, however, will be a temporary restriction of the lower branch of the slight shunt which has been referred to, and a slight enlargement of the upper branch thereof, this resulting in a momentary increase in the suction on the nozzle 43, with a slight reduction in the amount of air passing thereby, thus slightly enriching the mixture, in accordance with the slightly-advanced position of the throttle.

As the throttle is opened wider, the suction at 43 decreases and the issue therefrom decreases correspondingly, but at the same time the suction is increased below the throttle and the nozzles 55, 55 come into play. It will be remembered that up to this time the nozzles 55 have been practically inert, for not only has there not been sufficient influence to raise the level of the gasoline in the passageway 56 toward the nozzles 55, 55, but the level has actually been lowered by the withdrawal of fuel through the aperture 40 and upwardly through the central passageway 38 and tube 37. As the throttle is opened, however, and suction becomes effective in the Venturi tube 52, a reverse action takes place and the gasoline rises in the passageway 56 to the point of issue from the nozzles 55, 55. Thus, as nozzle 43 gradually recedes in action with the opening movement of the throttle, the nozzles 55, 55 increase in action.

It will be seen that in the annular passageway 39 there is a certain amount of fuel above the aperture 41 when the suction is not present to draw it out; but as soon as suction does become effective this fuel is drawn out and thereafter air, entering by way of passageways 51, 50 and 49, bleeds into the gasoline supply to the jets 55, 55. This action is called "compensation," being for the purpose of compensating for the tendency of the mixture to grow richer as the suction increases.

During this description of the operation of the nozzles 55, 55, it is opportune to refer to the double Venturi construction whereby the usual Venturi effect is secured within the secondary venturi 52, while the primary Venturi tube 13 has a similar super-effect upon the secondary Venturi tube as a nozzle.

By this means the depression at the nozzles is multiplied in large proportions, it being noted that the secondary venturi terminates at the point of maximum depression in the primary venturi.

In the design of any carburetor there are two essential requirements, which to a certain extent oppose one another;—to deliver a maximum charge of air to the engine, and to exert the maximum atomizing effect upon the fuel, which atomizing effect is more or less a function of the suction or force by which the fuel is drawn from the nozzle. A strong suction on the nozzle usually involves a high air velocity past it, and to obtain a high air velocity in an ordinary single Venturi carburetor generally involves a considerable vacuum or depression in the intake manifold of the engine. This means that the air charge delivered to the engine is rarefied and of less density than would be the case if the air velocity were less, thus preventing maximum air charge if the suction on the nozzle is to be sufficient, and if the single venturi is made of such size as to operate properly at low air velocities it will not be adequate for the demand at high air velocities. By applicant's arrangement only a small part of the air taken in by the motor is raised to high velocity, and the maximum charge of air is most efficiently secured on both low and high suctions simultaneously with a maximum suction upon the nozzle. This result is secured basically by the use of two Venturi tubes, with the secondary Venturi outlet disposed at the point of greatest depression in the large venturi, a most important point since improper relation of the tubes makes the desired action impossible; then improved by the radial nozzles, since an axial nozzle in such a small tube creates eddy currents, and the carbureting action as a whole being then further improved by "air bleeding" the nozzles. This last-named point is important for this reason: It is an accepted fact that in an ordinary uncompensated carburetor the mixture tends to grow richer as the suction increases. The double venturi partly counteracts this tendency by reason of the easy passage of air only between the two venturis and the bleeding of air into the jet also partly counteracts this tendency, together counteracting it entirely or practically so. If either of these devices were designed to do all the compensating, their purposes would be defeated. If the bleed were made large enough to do so the liquid fuel would go out in slugs, and if the outer venturi were made too large it would not produce the desired effect upon the inner one. Thus, these two devices, working together and in harmony, have been found to produce the desired result.

As an example of correct relative sizes it may be said that with an internal diameter of three-eights of an inch for the most restricted part of the secondary venturi, an external diameter of nine-sixteenths of an inch for the upper cylindrical portion thereof and an internal diameter of fifteen-sixteenths of an inch for the most restricted part of the primary venturi are proper.

During this period of intermediate running less fuel than the suction would draw is entirely sufficient for the engine and the natural flow may be restricted for the sake of economy since power at this time is not the main consideration. On the other hand it would be detrimental to permanently restrict the flow since then power would not be available. In other words, power and economy can not be secured with the same mixture and I therefore change the mixture to correspond to changed conditions. It is during this temporary period that the depression 59 in the cam 57 comes into play, so that, as before described, the needle-valve 27 may drop to its lowermost position and restrict the flow of gasoline from the float-chamber into the primary well 23. At the same time, the air which enters the fuel passageway by way of the aperture 41, as has been described, displaces gasoline to a small extent to keep down the supply.

As higher running takes place, however, the needle-valve 27 must again be raised to return to the position of maximum power, and this, as has been described is provided for by the riding of the roller 60^a upon the surface 58 of the cam 57, maintaining the needle-valve 27 in its uppermost position throughout the remainder of the range. It is important, however, in this connection, to point out that, as the higher suctions are attained, more and more air is bled in through the aperture 41 and proportionately gasoline is displaced, so that, although more gasoline is necessary on the higher running, the provision of more in proportion is prevented and, as a matter of fact, overbalanced, so as to make the mixture somewhat leaner on the high speeds.

I come now to a consideration of the accelerating well. What I desire is a temporary surcharging of the mixture with gasoline upon acceleration, that is, at the beginning of a period of increased suction. This desirability follows from the natural inertia of the fuel from the main source, and the lag with which the feed of fuel, being heavier than air, follows the position of the throttle; it is also due to the increased effort of the engine at that particular time. It is obvious that this extra feed of gasoline should be merely temporary, since, once the increased suction has become effective on the main source, the conditions are steady and further additional gasoline would be excessive. It will be seen that suction at the accelerating

nozzle 73 is transmitted back through the passageways 72, 71 and 70 to the interior of the tube 68. This accelerating well does not feed on the lower suctions for two reasons: first, because the nozzle 73 is at a higher plane than the main nozzles, and also because the uppermost apertures 74 in the tube 68 partly satisfy the suction, and it is not until this suction is not satisfied by the open apertures that gasoline responds.

In assuming an act of acceleration, it will be clear that an increase in suction will be attended by an additional charge of gasoline from the nozzle 73, the size of this additional charge depending upon the amount of the increase. This regulation of the charge is due to the successive openings 74. For instance, when the suction reaches a point where it is not satisfied by the first bleeders 74, there will be a response of gasoline to the extent of the fuel above the second bleeders. This uncovers the second bleeders, and, if the two bleeders together satisfy the suction which has thus been attained, no further gasoline will issue from the accelerating well except that which is drawn out to maintain the level where is has been brought. In other words then gasoline flows out as fast as it flows in. On the other hand, if these two bleeders do not satisfy the suction, more gasoline will go to the carbureting chamber until the third bleeder is uncovered, and then again the test as to whether more gasoline is to go to the carbureting chamber is whether or not the three bleeders, or three sets of bleeders, satisfy the suction.

It will also be clear that, if the increased range of suction is maintained, the level in the accelerating well will be maintained at the point which was assumed when acceleration took place. Further acceleration to a still higher range is merely a matter of further similar action, as has been explained. If the suction is decreased, obviously the gasoline will rise by gravity head from the float-chamber to balance the decreased suction, and a repeated acceleration means merely a repetition of the operation which has been set forth.

Under any circumstances, the temporary dash adjustment is available to cut down the air and give maximum gasoline for any condition of the throttle. It will be understood, of course, that this adjustment is utilized, as is common in automobile practice, to correct temporary conditions. The proper amount of gasoline for high speed is determined by the proper setting of the screw 28. The proper amount of gasoline for intermediate running is determined by the proper setting of the adjusting nut 30. The adjustment for idling is determined by the adjusting screw 46. Once determined for a particular engine, these adjustments need no attention except for a marked change in climate or in the quality of the gasoline. As before stated, for temporary conditions, such as starting in cold weather, the dash-adjustment is utilized to correct the action.

Other features of novelty in the structure disclosed herein are claimed in my two copending divisional applications, Serial Nos. 316,308 and 316,309, filed August 9th, 1919.

I claim:

1. In a carburetor, a carbureting chamber having a mixture outlet, a Venturi tube leading to said carbureting chamber, a second Venturi tube leading into and terminating slightly beyond the most restricted zone of said first named Venturi tube, said Venturi tubes having their axes substantially co-incident and having air inlets thereto, and a fuel inlet leading into said second Venturi tube.

2. In a carburetor, a carbureting chamber having a mixture outlet, a Venturi tube leading into said carbureting chamber, a second Venturi tube leading into and terminating slightly beyond the most restricted zone of said first named Venturi tube, said Venturi tubes having their axes substantially co-incident and having air inlets thereto, and a fuel inlet slightly beyond its most restricted zone leading into said second Venturi tube.

3. In a carburetor, a carbureting chamber having a mixture outlet, a Venturi tube leading to said carbureting chamber, a second Venturi tube leading into said first named Venturi tube, said Venturi tubes having their axes substantially co-incident and having air inlets thereto, and a fuel inlet leading laterally to and terminating flush with the inner surface of said second Venturi tube.

4. In a carburetor, a carbureting chamber having a mixture outlet, a Venturi tube leading to said carbureting chamber, a second Venturi tube leading into said first named Venturi tube, said Venturi tubes having their axes substantially co-incident and having air inlets thereto, a fuel inlet leading into said second Venturi tube, and means for admitting air to said fuel inlet anterior to its point of discharge into second Venturi tube.

In witness whereof, I hereunto subscribe my name this 19th day of August A. D. 1915.

FRANK C. MOCK.

Witnesses.

LESLIE W. FRICKE,

ERNEST W. RAPALIE.