March 7, 1944. C. R. SNYDER 2,343,815

CARBURETOR

Filed Nov. 19, 1941 2 Sheets-Sheet 1

FIG. 1.

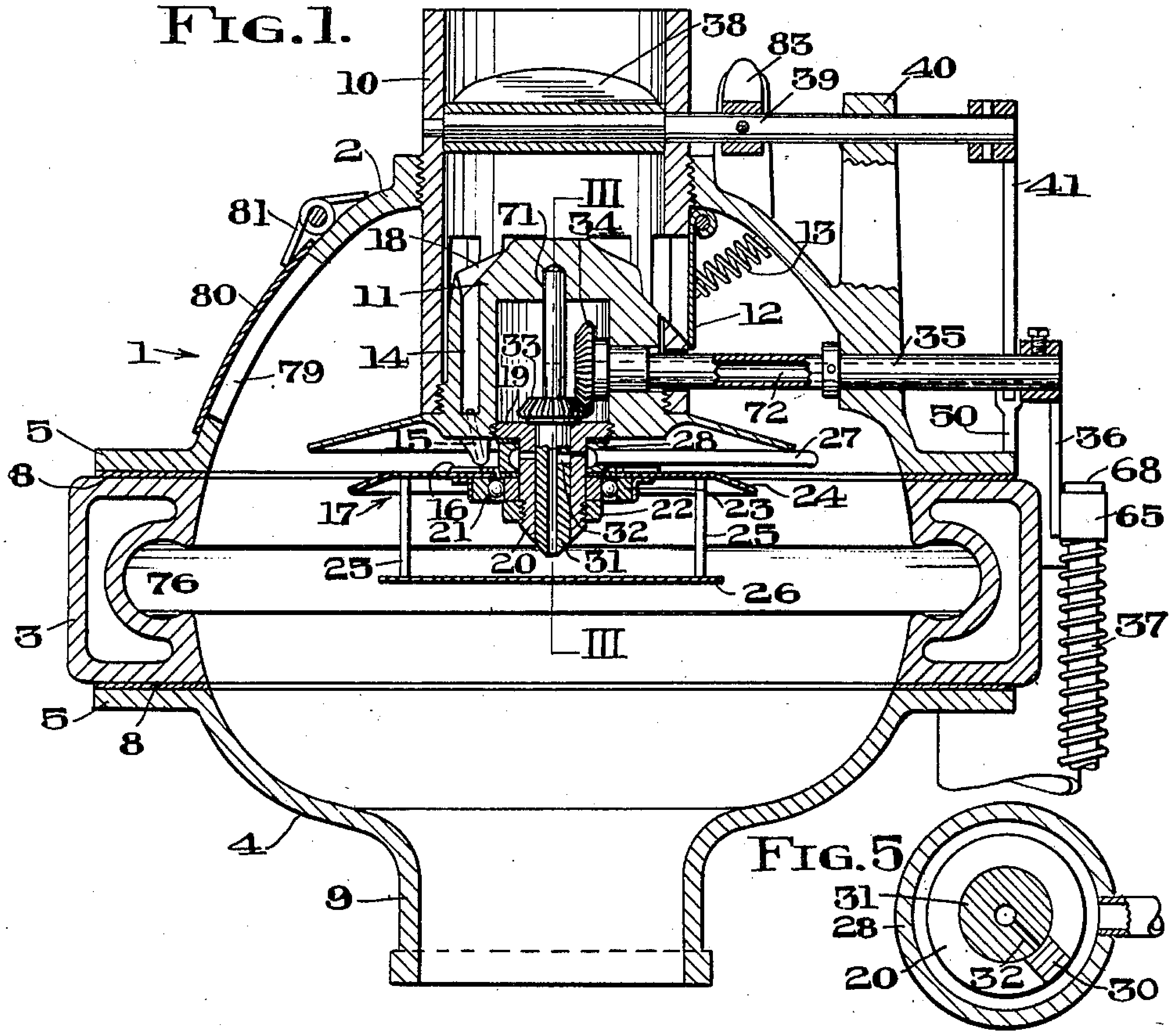


FIG. 5

FIG. 3.

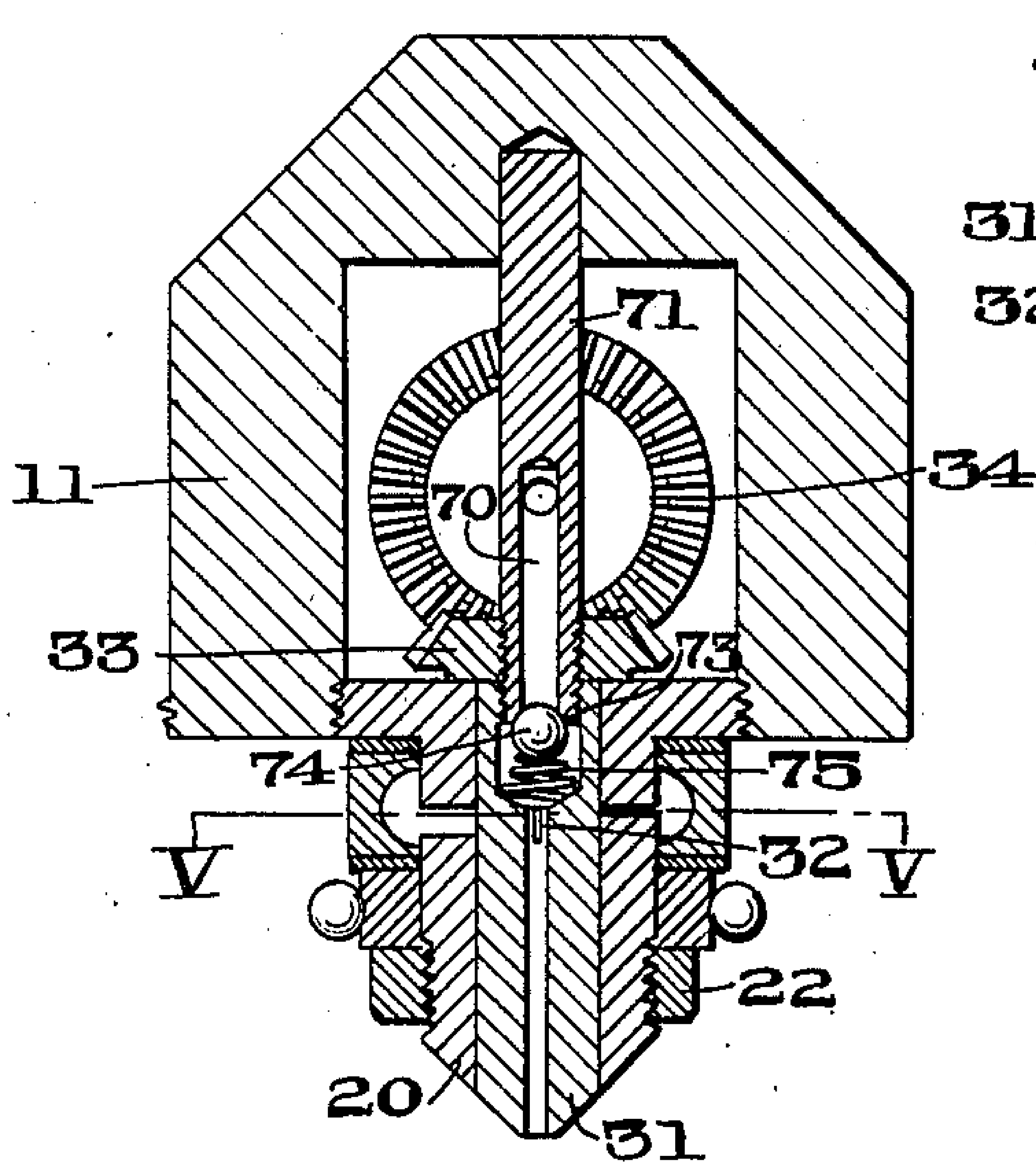
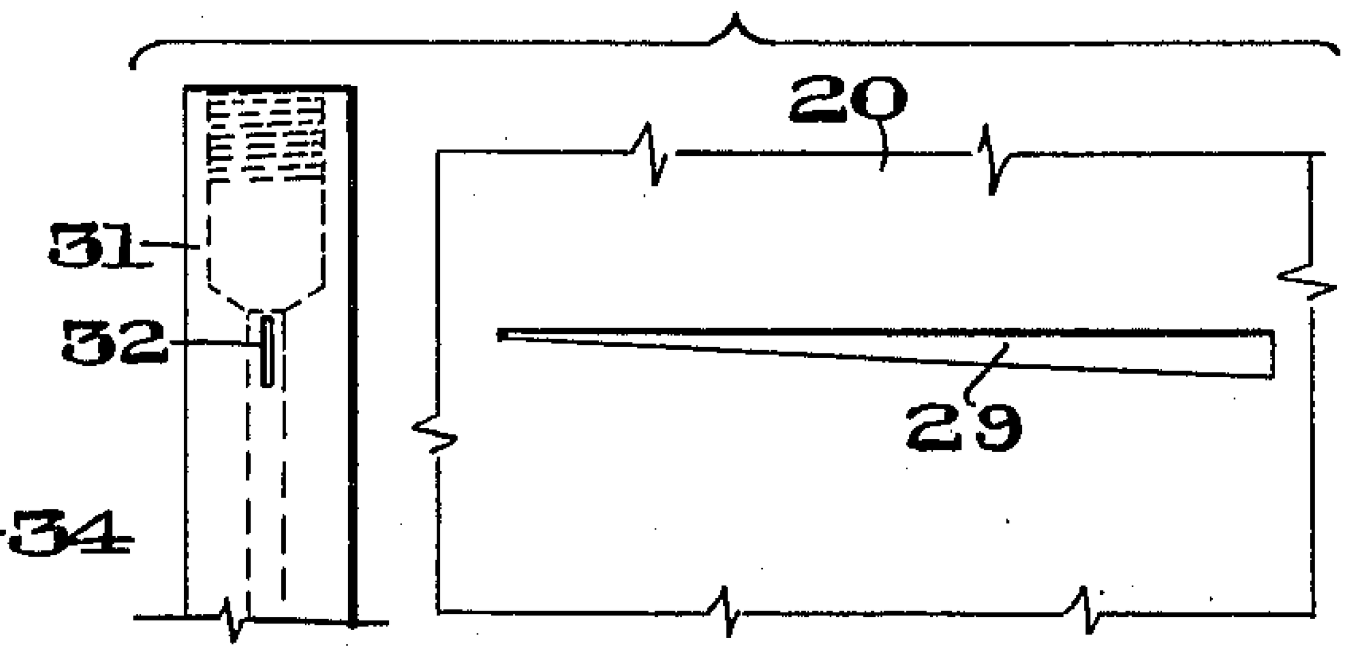


FIG. 4.



Inventor
Charles R. Snyder

By W. S. McDowell

Attorney

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FIG. 2.

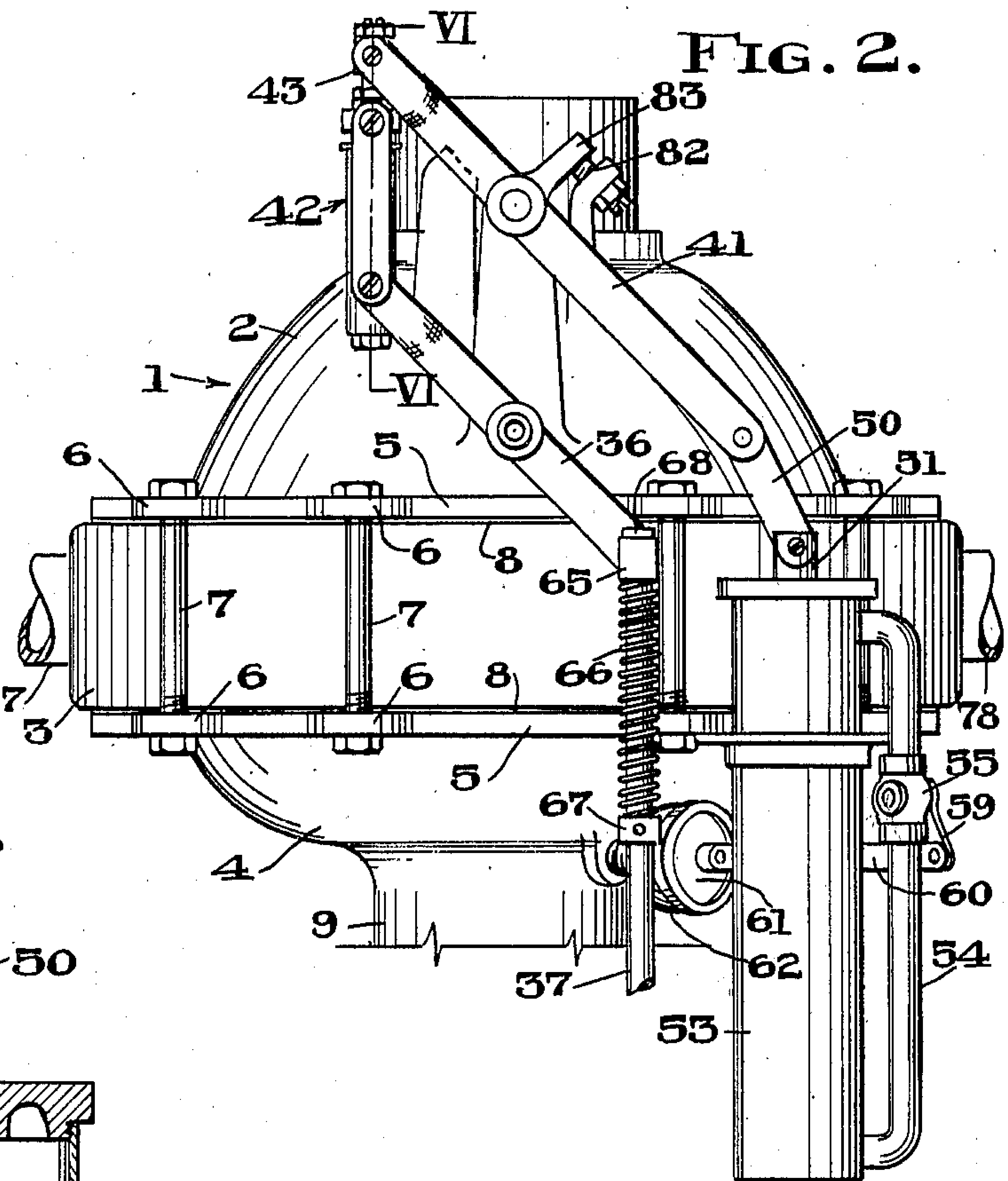


FIG. 6.

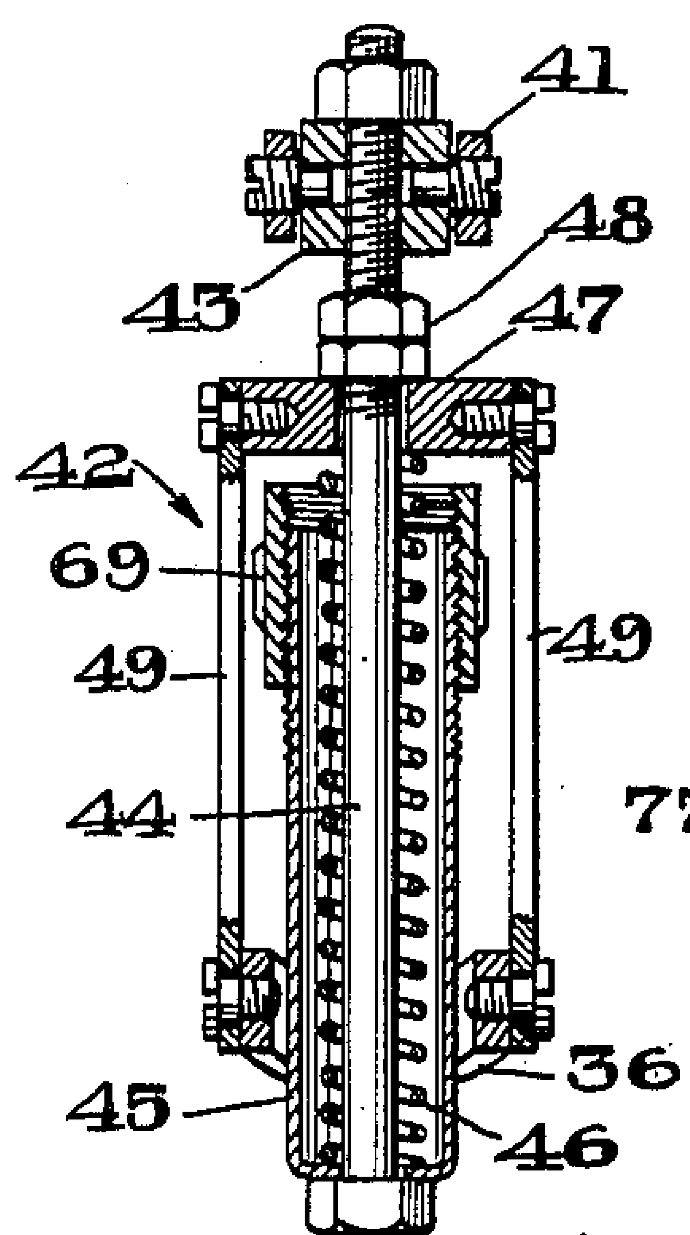


FIG. 7.

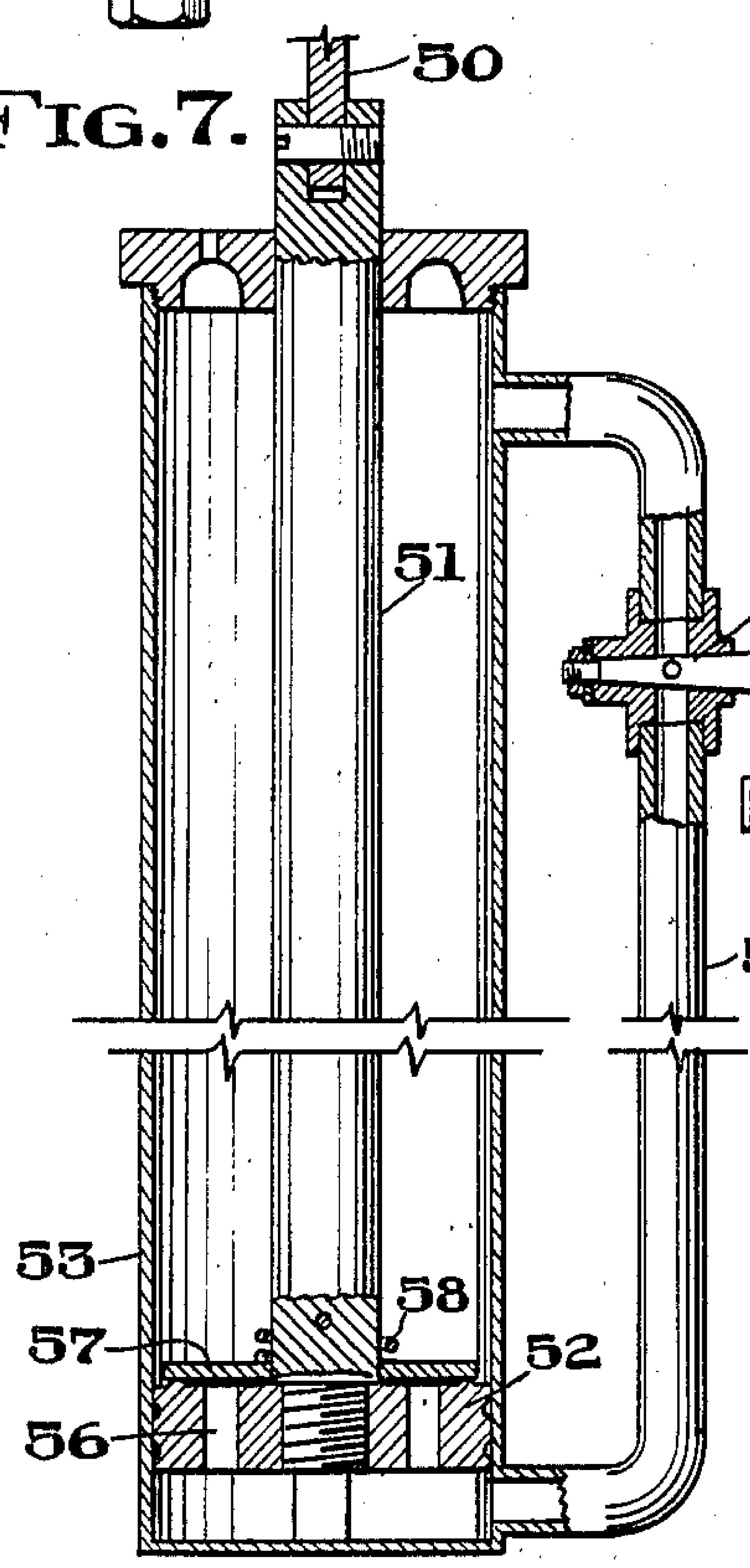
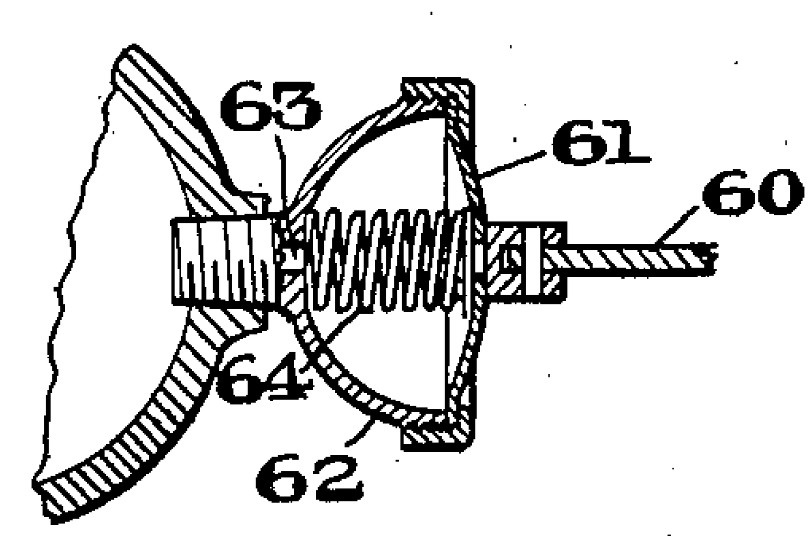


FIG. 8.



Inventor

Charles R. Snyder

By W. S. McDowell

Attorney

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CARBURETOR

Charles R. Snyder, Miami Beach, Fla.

Application November 19, 1941, Serial No. 419,758

3 Claims. (Cl. 261—50)

This invention relates generally to fuel controlling apparatus for internal combustion engines and is particularly directed to means associated with a carburetor for automatically changing the fuel to air ratio in response to varying load conditions imposed on the engine equipped with the carburetor.

This application is directed to the same type of apparatus shown in my copending application, Serial No. 369,417, filed December 10, 1940 patent Serial Number 2,327,675 issued Aug. 24, 1943, of which the present application is a continuation-in-part.

In my aforesaid application, there is disclosed a carburetor having a casing in which is formed a fuel-vaporizing and mixing chamber, there being an air inlet at one end of the chamber and a vaporized fuel outlet at the other end, the air inlet being provided with an adjustable throttle valve for governing the amount of air entering the chamber and there being within the chamber an adjustable fuel-admitting valve for governing under manual control the admittance of varying quantities of liquid fuel into the chamber for vaporizing purposes and admixture with air drawn from the atmosphere through said inlet. Also such a carburetor involves a system of levers by means of which both the air-admitting and fuel-flow regulating valves are operated simultaneously and locked against movement in any position throughout their whole range of adjustment by a mechanism responsive to the degree of partial vacuum present in the mixing chamber.

In my prior construction, the air-admitting and fuel-regulating valves maintain their relative order when held against movement by the vacuum-responsive mechanism. However, I have found it desirable when the air and fuel valves are so locked to provide for a small additional amount of movement on the part of the fuel-regulating valve in order that an increased amount of fuel may be delivered to the mixing chamber of the carburetor to increase the power of the associated engine under conditions of operation in which said valves are held against adjustment.

Therefore, it is a general object of the present invention to specifically improve the carburetor disclosed in my aforesaid application by providing an extensible link mechanism between the actuating controls of the air-admitting and fuel-regulating valves, the said link mechanism being of such nature as to permit of limited relative adjusting movement on the part of the fuel-regulating valve independently of the air-admitting valve when the actuating controls of said valves are restrained against movement by the automatic locking mechanism which is responsive to the degree of partial vacuum present in the mixing chamber of the carburetor.

Other objects and advantages will be apparent from the following description and the accompanying drawings in which a carburetor formed in accordance with the present invention has been disclosed in detail.

In the drawings:

Fig. 1 is a vertical longitudinal sectional view taken through a carburetor formed in accordance with the present invention;

Fig. 2 is a side elevational view of the carburetor shown in Fig. 1;

Fig. 3 is a detail vertical sectional view taken on the plane indicated by the line III—III of Fig. 1 showing, in particular, the fuel control valve;

Fig. 4 is a composite view of the valve parts, the sleeve portion of the valve being disclosed in a developed condition to illustrate the particular shape of a port formed therein;

Fig. 5 is a detail horizontal sectional view taken through the fuel valve mechanism on the plane indicated by the line V—V of Fig. 3;

Fig. 6 is a detail vertical sectional view taken through the connection between the throttle valve and the fuel control valve on the plane indicated by the line VI—VI of Fig. 2;

Fig. 7 is a detail vertical sectional view taken through the check means employed to stop the throttle valve in its movement toward an open position when vacuum disappears from the mixing chamber of the carburetor;

Fig. 8 is a detail sectional view taken through vacuum operated diaphragm means employed to actuate valve means used in the check mechanism shown in Fig. 7.

Referring more particularly to the drawings, the numeral 1 designates the carburetor in its entirety. In this instance, the carburetor is formed from three separate castings 2, 3 and 4, the pieces 2 and 4 being substantially bowl-shaped and having flanges 5 at their larger ends. These flanges are smoothly finished for engagement with the upper and lower surfaces of the intermediate piece 3.

As shown in Fig. 2, the flanges 5 have peripheral lugs 6 through which bolts 7 extend to secure the casting pieces 2, 3 and 4 in assembled relation. Suitable gasket means 8 are positioned between the flanges 5 and the piece 3 to prevent the transmission of heat from the piece 3 to the adjoining sections. Piece 4 has a tubular portion 9 depending therefrom, this portion having a flange at its lower end for connection with the intake manifold of an internal combustion engine. Section 2 has a threaded opening at its upper end to receive a sleeve 10 through which air may enter the carburetor from the atmosphere or through an air cleaner (not shown) which may be secured to the upper end of the sleeve 10. The sections 2, 3 and 4, when assembled, provide a mixing chamber of substantially spherical form, the sleeve 10 projecting into the central portion of the mixing chamber and providing for the entrance of air thereinto.

The inner portion of the sleeve 10 has a plurality of openings formed in its side wall, the inner end of the sleeve being threaded for the reception of a body 11. This body closes the inner end of the sleeve and serves to direct air drawn into the sleeve through ports provided in the side walls. To facilitate this direction of the air, the upper end of the body 11 is made conical, the surfaces of which being in alignment with the lower edges of the ports in the side wall of the sleeve. As shown in Fig. 1, these ports are normally closed by pivoted gate members 12 held in engagement with the exterior surface of the sleeve by light coil springs 13. The body 11 has a plurality of passages 14 formed therein, the inner ends of these passages communicating with jet-like outlets 15 which extend through the bottom wall of the body in angular directions, the outlet ends of the jets being directed toward vanes 16 provided on the upper surface of a rotor member designated generally by the numeral 17.

To insure the flow of air into the passages 14, the upper surface of the body 11 has scoop-like elements 18 formed thereon, these scoops extending around the open upper ends of the passages 14. As air enters the sleeve, it will be caught within the scoops and caused to flow at high speed through the passages 14 for discharge through the jets 15 into engagement with the vanes 16. As this air forcibly engages the vanes, it will cause the rotor to revolve at a high rate of speed. In the event the pressure within the mixing chamber is reduced to such an extent that air will be drawn into the sleeve in greater amounts than can pass with sustained flow through the passages 14, the gates 12 will be moved in opposition to the springs 13 and a portion of the air will by-pass the passages and the rotor. The spring-pressed gates are provided to insure the flow of a sufficient amount of air through the passages at all stages of engine operation to cause the rotor to revolve at a proper rate. It will be seen from the above description that when low engine speed obtains with resulting reduced air flow through the carburetor, the springs 13 close the gates 12, thereby limiting such reduced flow of air for passage through the jets 15, but when the air flow increases sufficiently in volume, gates 12 will open and scoops 18 will then direct the air flow in required degree through the jets 15.

The body 11 has a central opening, the lower portion of which is threaded for the reception of a plug 19 having a depending sleeve 20. The rotor 17 is carried by this sleeve through the provision of an antifriction bearing 21, the inner race of which is clamped to the member 20 by a nut 22. The outer race 23 of the bearing is secured to a disk 24 by providing the latter with a ring into which the race 23 is pressed. The disk 24 has formed in its upper surface the vanes 16 which are disposed in registration with the nozzle passages 15, so that upon the issuance of air streams from outlet jets 15, the rotor will revolve at a high rate of speed. A plurality of pins 25 project downwardly from the disk 24 and support a second disk 26 at their lower ends. The fuel, as will hereinafter appear, is deposited on the central portion of the disk 26 and is discharged by centrifugal action in fine particle form from the perimeter of the disk when the latter is revolved.

To provide for the delivery of fuel to the disk 26, a conduit 27 extends through the side wall of the carburetor casing and is connected at its inner end with a recessed ring 28 which is clamped between the inner race of the bearing and the under surface of the plug 19. Suitable gasket means are positioned between these parts to prevent the escape of fuel. The recess in the internal surface of the ring 28 provides an annular chamber around the sleeve member 20, communication between this chamber and the central bore of the member 20 being established by a wedge-shaped port 29 formed in the sleeve 20. This port extends horizontally around the member 20 and is of such length as to substantially encircle the same except for a small portion 30 which serves to retain the bottom portion of the member 20 in connection with the plug 19.

A valve member 31 extends through the central bore of the member 20 and is rotatable therein, the joint between the members 20 and 31 preferably being ground to insure a close fit. The valve 31 has a central passage, one end of which terminates adjacent to the disk 26. At its intermediate portion, the valve has a transversely extending port 32 which is of limited width and extends longitudinally of the valve, the length of the port being at right angles to the length of the port in the member 20. Due to the wedge-shape formation of the port 29, different effective area values of the port 32 will be exposed or opened when the valve 31 is rotated in the sleeve 20. Thus the quantity of fuel which will be permitted to flow from the annular chamber to the central passage in the valve may be closely controlled.

It will be seen that fuel flowing through the conduit 27 will enter the annular chamber and be admitted to the central passage in the valve when the transverse port 32 registers with the port 29. The amount of fuel thus admitted may be varied by rotating the valve 31 relative to the member 20. This rotation is accomplished by providing the valve 31 with a bevel gear 33 which engages with a second bevel gear 34 mounted on the inner end of a shaft 35. This shaft extends through the body 11, the sleeve 10 and the side wall of the carburetor casing, the outer end portion of the shaft having a lever 36 secured thereto. A rod 37 is connected with the outer end of the lever and extends to a suitable manually actuated control by means of which motion is transmitted to the valve.

Entrance of air into the mixing chamber for mixture with the fuel discharged from the disk 26 is controlled by a throttle valve 38 mounted on a shaft 39 extending transversely of the sleeve 10 above the body 11. The shaft 39 is journaled in the side walls of the sleeve and a lug 40 formed with the upper section 2 of the carburetor casing. The outer extremity of the shaft 39 also has a lever 41 secured thereto, one end of this lever being linked to one end of the lever 36 by an extensible link mechanism 42. Through the provision of the connection between the levers 36 and

41, movement of the lever 36 to provide for fuel flow to the vaporizing disk will also provide for rotary movement of the shaft 39, which movement will cause the throttle valve to open whereby air will be admitted to the mixing chamber. Due to the connection between the levers, the relative positions of the throttle and fuel valves will be maintained throughout the full extent of their movement, that is, in normal operations the proportions of fuel and air will be constantly maintained.

In some instances, it will be desirable to enrich the mixture by increasing the quantity of fuel in proportion to the air. To effect this enrichment, the link mechanism 42 is of such type that it may be extended or stretched to permit the shaft which moves the fuel valve to rotate a limited extent while the throttle valve shaft is held stationary. The link mechanism includes a block 43 which is pivotally supported between the forked ends of the lever 41. The block is threaded to receive one end of a bolt 44 which extends downwardly between the forked ends of the lever 36. The head of the bolt serves as a shoulder for engagement by one end of a thimble 45 which surrounds the bolt.

The thimble forms a housing for a compression spring 46, one end of which engages the inner end of the thimble and the other engages a block 47 slidably positioned on the bolt. The block 47 is limited in its movement in response to the expansion of the spring by nut means 48 adjustably carried by the bolt. The block 47 is connected by a pair of links 49 with the forked ends of the lever 36. Thus when the lever 36 is actuated to move the fuel valve to an open position, the block 47 will tend to move downwardly on the bolt 44. The spring 46 is of sufficient strength, however, to cause the throttle valve to open in conjunction with the fuel valve without compressing. But when the throttle valve is locked in position, the spring 46 will compress until the yoke 47 contacts thimble 45, thus allowing the fuel valve to open to this extent beyond the point of lockage of the throttle valve.

To effect a desired control of the carburetor by limiting the degree of movement of the fuel and throttle valves on certain occasions, one end of the lever 41 is connected by a link 50 with the outer end of a piston rod 51, the inner end thereof being connected with a piston 52 mounted for sliding movement within a cylinder 53. The piston closely fits within the cylinder, the peripheral wall of the piston having oil grooves formed therein to provide a better seal between the sides of the piston and the cylinder. The cylinder has a body of oil or other hydraulic fluid placed therein in which the piston moves. The spaces between the opposite sides of the piston and the ends of the cylinder are connected by a by-pass tube 54 in which a valve 55 is positioned. When the valve is fully opened, uninterrupted communication will be established between the lower and upper ends of the cylinder. The piston may then move without obstruction, the fluid being pumped back and forth between opposite sides of the piston. When the piston moves in a downward direction, the fluid will pass through ports 56 extending through the piston. When upward movement is imparted to the piston, the fluid will be forced to flow through the by-pass conduit since the ports 56 will then be closed by a disk valve 57 mounted on the upper side of the piston, a light spring 58 being used to urge the valve to a closed position. When the piston moves upwardly, a vacuum will be produced beneath the piston and the hydraulic fluid will flow through the by-pass conduit to relieve this vacuum. If obstruction to the flow of fluid through the by-pass line is offered, the piston will be stopped in its upward movement. Through the provision of the valve 55, fluid flow through the by-pass line may be controlled. Thus when it is desired to stop the piston from moving upwardly, the valve 55 is closed and since the piston closely fits the cylinder so that no fluid can pass around the side walls of the piston, the suction beneath the piston will effectively restrain it against upward movement.

To control the valve 55, its operating lever 59 is connected by a link 60 with a diaphragm 61 which is stretched across the enlarged open end of a cup-shaped fitting 62 supported by the casing section 4. The interior of the cup-shaped fitting is in open communication with the interior of the carburetor casing through a port 63 formed in the member 62. Normally, the diaphragm is held in an outwardly flexed direction by a coil spring 64 positioned between the diaphragm and the inner surface of the member 62. When the diaphragm is in this position, the valve 55 will be closed. Upon the presence of negative pressure within the interior of the member 62, the diaphragm 61 will be moved in opposition to the spring 64 and through the medium of the link 60, this motion will be transmitted to the valve 55 to cause it to assume an open position wherein fluid flow through the by-pass line 54 will be unobstructed.

As long as the engine to which the carburetor is applied is operating in a normal manner, vacuum will be present in the mixing chamber of the carburetor and the diaphragm will be held in opposition to the spring 64. In the event such a load is placed on the engine as to prevent it from accelerating when the throttle valve is opened to a greater extent, the vacuum in the mixing chamber will be destroyed and the diaphragm 61 will then be moved by the spring 64 to a position wherein valve 55 will be closed. The throttle valve will then be stopped in its movement toward an open position through its lever and link connection with the piston 52. As the accelerator control is connected directly with the fuel valve, this member will continue to move until the link mechanism 42 has been extended the full amount for which it has been set. This continued movement of the fuel valve will provide for a greater flow of fuel, thus enriching the carbureted mixture to provide for increased power which will overcome the additional load imposed on the engine. As the speed of the engine increases, due to the decrease in load, vacuum will be built up within the carburetor casing and the diaphragm 61 will again be moved in opposition to the spring 64, the valve 55 in turn being moved to an open position which will permit the piston 52 to move and the throttle valve will be freed.

The connection between the rod 37 and the lever 36 is such as to permit the rod to continue to move after the lever has been stopped. The lever carries a block 65 through which the rod may slide. A coil spring 66 is positioned between this block and a collar 67 rigidly secured to the rod. Thus when the rod is actuated to move the lever in an upward direction, the spring 66 will transmit the force from the rod to the lever. If the lever is held against movement, the spring will be compressed and no injury will result to the mechanism. After the piston in the cylinder has been released, and the levers are permitted to move, the spring 66 will expand until the block 65 engages the head 68 at the upper end of the rod 37. It is, of course, to be understood that the valve 55 may open slowly depending upon the speed at which the vacuum is built up in the carburetor casing. When the valve 55 opens slowly, the piston will be permitted to move slowly and similar slow movement will take place on the part of the throttle and fuel valves. As the spring 46 is weaker than the spring 66, the latter will fully expand before the former expands and thus the rich mixture will be maintained until the spring 46 has fully expanded. The enriched mixture will be fed to the engine until the normal conditions of operation have been restored. The degree of extension of the link mechanism 42 may be controlled by an adjustable nut 69 threadedly carried by the upper end of the thimble 45. Through the adjustment of the nuts 48 on the bolt, the relative positions of the fuel and throttle valves may be varied when it is desired to change the fuel to air ratio in the initial setting of the carburetor. After this adjustment has been performed, the nuts 48 are locked to prevent undesirable movement thereof.

It is highly desirable in a carburetor of the type wherein fuel is fed to the vaporizing means under pressures to maintain the rate of fuel flow uniform for any particular setting of the fuel valve. Inasmuch as the pressures within the carburetor may be varied, due to the creation of suction and the relief thereof, the effective pressure on the fuel will vary and when a vacuum is present in the mixing chamber, there will be a tendency for the fuel to flow at a more rapid rate even through the fuel valve position remains unchanged.

To offset this tendency, there has been provided a means for maintaining the pressure in the vicinity of the fuel outlet equal to atmospheric pressure. As illustrated in Figs. 1 and 3, the valve 31 has a chamber formed in the upper end which communicates with a passage 70 formed in the valve stem extension 71. The passage 70 is of greater cross sectional dimension than the passage in the valve proper and is connected with the chamber formed in the body 11 by transverse ports provided in the stem 71. Air at atmospheric pressure is introduced to the chamber in the body 11 through a passage 72 formed axially of the shaft 35, such passage also being of greater cross sectional dimension than the passage in the valve proper.

It will be seen that when a vacuum is created within the mixing chamber, air will be drawn through passages 70 and 72 into the chamber formed in the upper end of the valve. This air will pass downwardly through the valve and into the mixing chamber. The air within the valve passage will thus be at substantially the same pressure as the atmosphere and since the fuel flows into this passage through the port 32, it will be unaffected by the reduced pressure within the mixing chamber.

In certain instances, the pressure within the mixing chamber will be approximately the same as atmospheric pressure. To avoid at these times the tendency of the fuel to flow in the wrong direction through the valve passage and the passages 70 and 72, a check valve 73 is provided between the chamber in the valve stem and the passage 70. This check valve comprises a ball member 74 which is resiliently held against a seat formed on the stem 71 by a spring 75. When the pressures on opposite sides of the ball 74 are equal, the ball will be in engagement with its seat to close the passage. As soon as the pressure within the mixing chamber is reduced, the ball will be unseated to permit air to flow into the mixing chamber through this passage. It will be seen that under this arrangement, low pressure cannot build up in the valve passage proper due to the smaller diameter thereof when compared to the passages communicating with the outside atmosphere. The metered fuel under pressure is fed into this valve passage and when low pressures are present in the mixing chamber, the suction carries the fuel from such entrance point in the valve passage to the mixing chamber without affecting the metering. When low pressures in the mixing chamber are not present, then the outside pressure on the fuel supply will carry on through the valve passage to the mixing chamber with the check valve 74 preventing its passage in the opposite direction.

To adapt the carburetor for use with fuels which volatilize at higher temperatures, the intermediate section of the carburetor casing has an annular recess 76 formed in edgewise registration with the disk 26. Section 3 has a double wall to provide a chamber around the outwardly bulged portion of the inner wall, the chamber being provided for the reception of heated fluids whereby the wall separating the chamber and the recess 76 will be maintained at an elevated temperature. In the event fuels discharged from the rotating disk 26 are not absorbed by the air passing through the carburetor, the centrifugal force will cause these fuel particles to pass into the recess where they will be vaporized by the heat and picked up by the air passing the open side of the recess. Suitable conduits 77 and 78 are connected with the section 3 to provide for the introduction of the heated fluids.

Sometimes during the operation of internal combustion engines, improper firing occurs, causing the gases to flow in a reverse direction, or toward the carburetor. To prevent injury when such a condition occurs, the upper section of the carburetor casing has one or more openings 78 formed therein. Pivoted shutters 80 are carried exteriorly of the casing to close these openings, spring means 81 serving to normally hold the shutters in closed positions. When pressures within the casing are unduly elevated, the shutters are free to swing open and relieve these pressures, the springs returning the shutters to their normal closed position when the pressures are reduced.

The swinging movement of the levers 36 and 41 may be limited in any desired manner, the conventional adjustable stop being illustrated at 82. This stop engages a projection 83 carried by the shaft 39. By adjusting the screw portion of the stop, the degree of swinging movement of the lever 41 may be varied.

In view of the foregoing, it will be evident that the present invention provides a carburetor in which the separate fuel-regulating and air-admitting valves are linked together for simultaneous and interdependent movement by means of a common actuating element. The valves thus maintain their relative positions throughout their full ranges of adjustment, maintaining a fuel to air ratio which may be efficiently employed for combustion purposes in the cylinders of an associated engine. Also, the carburetor provides means for locking the air and fuel regulating valves in any of their various positions of adjustment, and maintaining their relative order, through the operation of the vacuum-responsive diaphragm 61 and its associated parts. However, through the extensible link mechanism, disclosed in Fig. 6 of the drawings, limited additional movement of the fuel regulating valve is provided when the air-regulating valve is locked against movement, such additional movement of the fuel valve permitting added quantities of fuel to enter the mixing chamber of the carburetor in order to provide an enriched mixture during stages of engine operation, as when the engine is laboring under heavy load conditions. Whenever normal vacuum conditions prevail in the mixing chamber of the carburetor, the movement of both valves follows a fixed relative order.

What I claim is:

1. In a carburetor of the type having a mixing chamber with air inlet and carbureted fuel outlet ports and fuel vaporizing means, a throttle valve disposed between the fuel vaporizing means and said air inlet port, means for conducting fuel under pump pressure to said vaporizing means, valve means in said fuel conducting means for governing the flow of fuel therethrough, an extensible link connecting said fuel and throttle valves, resilient means cooperating with said link to normally maintain the same in its shortest condition, said link providing for simultaneous movement of said fuel and throttle valves, a piston connected for movement with said throttle valve, a fluid-receiving cylinder surrounding said piston and in which the same is slidably positioned, conduit means connecting the spaces on opposite sides of said piston, valve means in said conduit means, and means controlled by suction in the mixing chamber of the carburetor for actuating said valve, the presence of suction within said mixing chamber serving to open said valve to permit fluid flow through said conduit means.

2. In a carburetor, a casing formed with the internal mixing and vaporizing chamber having an air inlet and a carbureted fuel outlet, a movable throttle valve for governing the inflow of air into said chamber through said inlet, conducting means for conveying liquid fuel under positive flow into said chamber, an adjustable fuel-flow metering valve cooperative with said fuel-conveying means, a pivotally movable operating arm connected with the fuel-metering valve and disposed externally of said casing, a complemental operating arm connected with said throttle valve, a link mechanism uniting the arms of said throttle and fuel valves and causing normally proportionate movement of said valves throughout their full range of adjustment, means responsive to the degree of partial vacuum present in the mixing chamber for arresting automatically adjusting movements of said valves when the vacuum in said chamber attains a definite minimal value, said adjustment arresting means providing for automatic release of said valves upon restoration of vacuum values in said chamber in excess of said minimal values, and yieldable means provided in said link mechanism admitting of limited additional movement of the fuel valve toward a fuel flow increasing position when said throttle valve is held in an arrested position of operation.

3. In a carburetor, a casing formed with the internal mixing and vaporizing chamber having an air inlet and a carbureted fuel outlet, a movable throttle valve for governing the inflow of air into said chamber through said inlet, conducting means for conveying liquid fuel under positive flow into said chamber, an adjustable fuel-flow metering valve cooperative with said fuel-conveying means, a pivotally movable operating arm connected with the fuel-metering valve and disposed externally of said casing, a complemental operating arm connected with said throttle valve, a link mechanism uniting the arms of said throttle and fuel valves and causing normally proportionate movement of said valves throughout their full range of adjustment, means responsive to the degree of partial vacuum present in the mixing chamber for arresting automatically adjusting movements of said valves when the vacuum in said chamber attains a definite minimal value, said adjustment arresting means providing for automatic release of said valves upon restoration of vacuum values in said chamber in excess of said minimal values, yieldable means provided in said link mechanism admitting of limited additional movement of the fuel valve toward a fuel flow increasing position when said throttle valve is held in an arrested position of operation, and manually operated means connected with one of said arms for effecting valve-operating oscillation thereof.

CHARLES R. SNYDER.