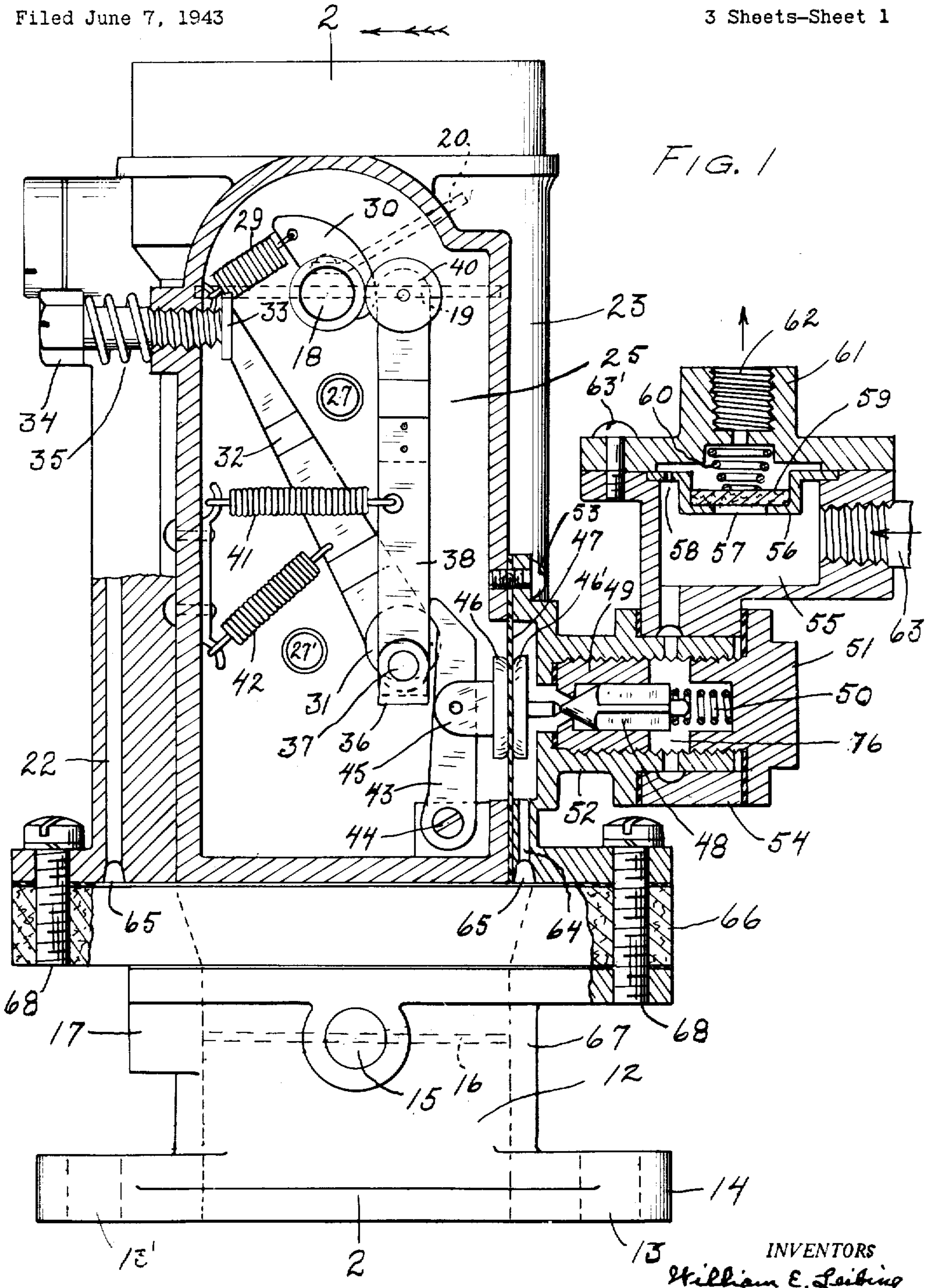
June 15, 1948. W. E. LEIBING ET AL 2,443,464

CARBURETOR

Filed June 7, 1943 3 Sheets-Sheet 1



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CARBURETOR

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FIG. 5

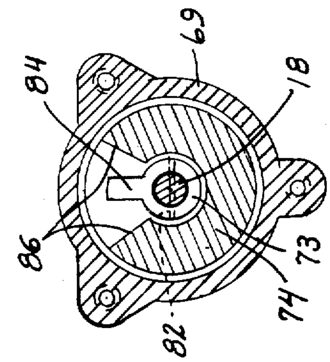
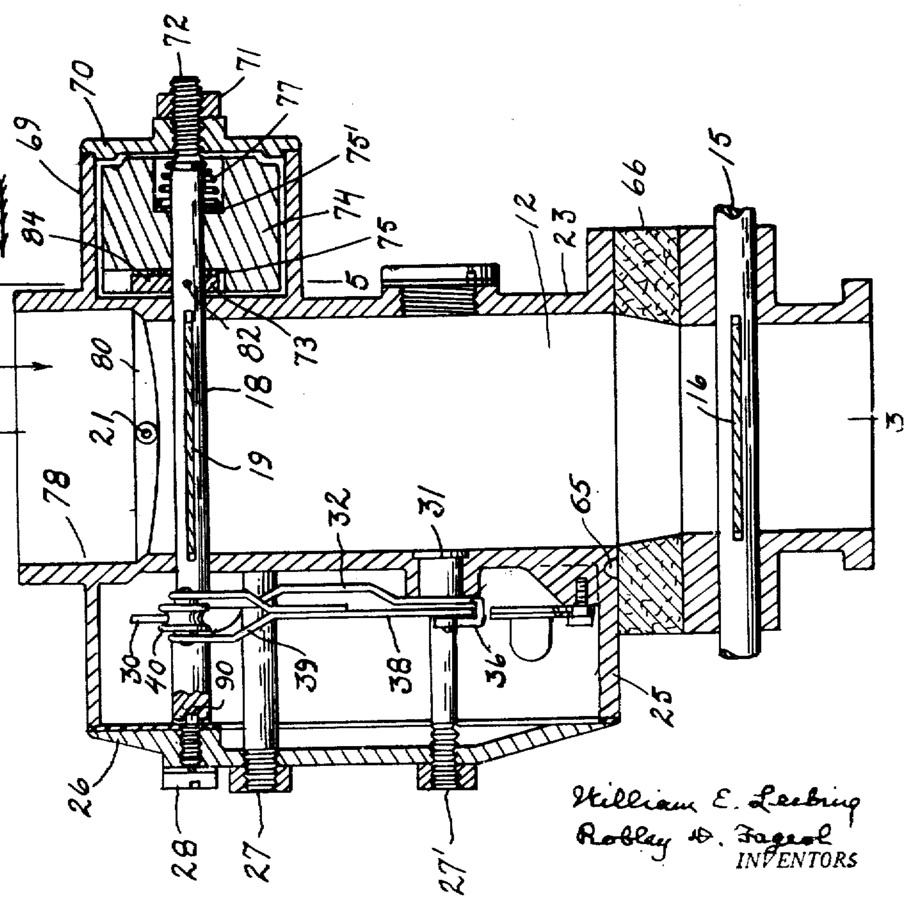


FIG 2



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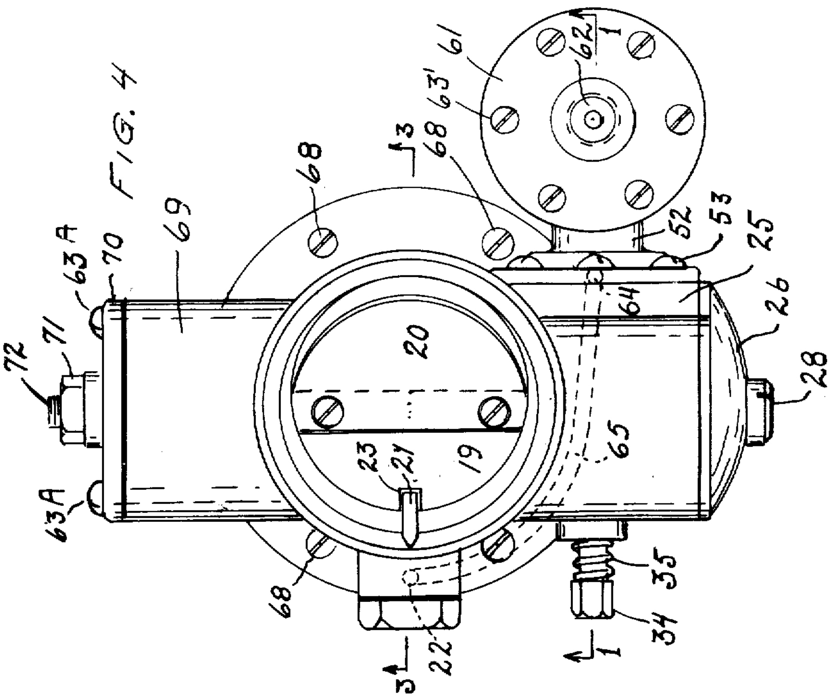
June 15, 1948. **W. E. LEIBING ET AL** **2,443,464**

CARBURETOR

Filed June 7, 1943 — 3 Sheets-Sheet 3

FIG. 4



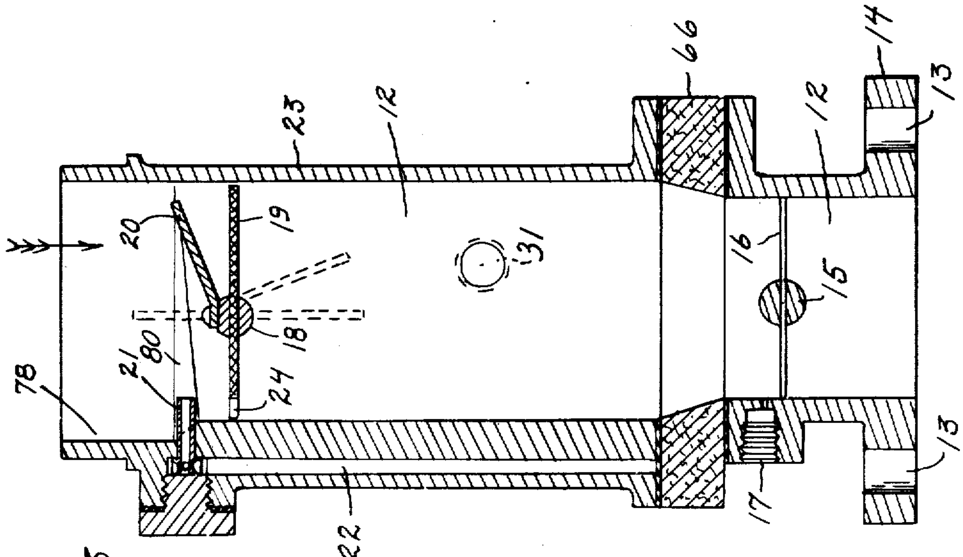


FIG. 3

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UNITED STATES PATENT OFFICE

2,443,464

CARBURETOR

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Application June 7, 1943, Serial No. 489,882

14 Claims. (Cl. 261—50)

1

The present invention relates to carburetors for internal combustion engines and the like, and more particularly to a carburetor of the floatless type.

An object of the present invention is to provide a carburetor of simplified construction and having improved performance and economy.

A further object of the invention is to provide a carburetor having a pressure-responsive air inlet valve of improved operating chracteristics.

A further object is to provide an improved means for damping vibration of the air inlet valve.

Further objects and advantages of the invention will be apparent from the following description, taken in connection with the appended drawings, showing one practical form in which the invention may be embodied, but which are to be taken in an illustrative rather than a limiting sense. In the drawings:

Figure 1 is a partial vertical section taken along the line 1—1 of Figure 4, of a device embodying the invention.

Figure 2 is a vertical section taken along the line 2—2 of Figure 1 and viewed in the direction of arrow.

Figure 3 is a vertical section taken along the line 3—3 of Figure 4.

Figure 4 is a plan view taken from the top.

Figure 5 is a partial section taken on line 5—5 of Figure 2 and viewed in the direction of arrow.

Referring to Figure 1 a perpendicular generally tubular conduit 12 is provided at its lower end with a flange 14 and holes 13 and 13' for attachment in the usual manner to the intake manifold of an internal combustion engine.

Said conduit 12 is further fitted adjacent its outlet or lower end with a shaft 15 (operating between stops not shown and an adjustable stop for closure also not shown) said shaft 15 carrying the butterfly valve 16, said assembly forming the manually controlled throttle whereby flow of fuel mixture to the engine is regulated. Adjacent the left hand edge of butterfly valve 16 is the threaded inlet 17 for control of the spark in the usual well known manner.

The upper or inlet end of conduit 12 is fitted with an enlarged bore 78, said enlargement being plainly shown in Figure 3, and it should be noted that said enlargement occurs only on the left side of the conduit as viewed in Figure 3, while the right side of the conduit remains straight. A tapered shoulder 80 connects the bore 78 with the remainder of the conduit 12, for a purpose to be described.

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In spaced relationship with the enlarged bore 78 and off center to the left as viewed in Figure 3, is the shaft 18 carrying the butterfly valve 19, said butterfly valve 19 being eccentric relative to the conduit 12 so that pressure from the top (as viewed in Figure 3) will cause the butterfly and shaft to rotate in a clock-wise direction.

Atttached to shaft 18 is an angular vane 20 of the same general contour as the right half of butterfly 19 (as viewed in Figure 3), said vane 20 functioning to maintain substantial closure along the right hand wall of conduit 12 until the butterfly 19 in going from the fully closed towards the open position has moved through approximately 20 degrees of travel.

Somewhat above the level of butterfly 19, when in the closed position, and on the left side of conduit 12 as viewed in Figure 3, is the fuel jet 21 projecting into the conduit 12, said fuel jet 21 being in communication with vertical hole 22 formed within upper housing 23. A slot 24 is formed in the periphery of left hand edge of butterfly 19 to permit said buttefiy to pass fuel jet 21.

A vertically elongated box 25, Figures 1, 2 and 4, is formed integral with housing 23, said box 25 being sealed on its outer face by cover 26, said cover 26 being attached by means of bolts 27 and 27'.

As viewed in Figure 2 the shaft 18 extends out of conduit 12 and through box 25 to a point adjacent cover 26, at which point the end of shaft 18 is provided with a horizontal bore in which seats the conical head 90 of a stud 28, thus forming a substantially frictionless bearing.

Securely attached to the shaft 18, as viewed in Figure 1, is cam 30; said shaft 18, butterfly 19 and, therefore, cam 30, being held in their farthermost closed position by the extension spring 29, as shown in full lines in Figure 3.

As shown in Figures 1 and 2, a shaft 31 is mounted in a suitable bore within housing 23 at a point considerably below shaft 18. Attached to said shaft 31 is a lever 32 extending angularly upward in box 25 and having a lug 33 formed on its upper end, said lug 33 abutting the adjusting screw 34, said screw 34 being held in adjustment by compression spring 35, the assembly so formed being adapted to rotate the shaft 31 for adjustment purposes by extremely small movement of said shaft 31.

The lower end of arm 32 is securely attached to shaft 31 and is further formed to make a bifurcated end 36.

A pin 37 extends through said bifurcated end 36 and into shaft 31, and it should be noted that said pin 37 is located off center in shaft 31 in a manner whereby, as viewed in Figure 1, adjustment of lever 32 in a clock-wise direction causes pin 37 to move to the left.

Mounted within the bifurcated end 36 and adapted for rotation on pin 37 is the upwardly extending lever 38, the upper end of said lever 38 being bifurcated as at 39, said bifurcation being adapted to receive a cam follower in the form of a wheel 40, grooved to straddle the cam 30.

As viewed in Figure 1 lever 38 is always urged to the left under influence of tension spring 41, while lever 32 is also always urged to the left, under the influence of tension spring 42.

In the lower part of box 25 is mounted lever 43, said lever 43 being adapted for rotation on pin 44, the upper end of lever 43 being in contact with lever 38 at a point adjacent the fulcrum pin 37 of lever 38.

Midway on lever 43 is attached the yoke 45, said yoke 45 being adapted to receive between the collars 46 and 46′ the flexible diaphragm 47 in fluid tight relationship, said diaphragm 47 being formed of any suitable flexible fuel-resisting material such as neoprene, etc.

The right hand end of yoke 45 contacts the needle valve 48, said needle valve 48 operating within the replaceable needle valve seat 49, the valve and seat so formed being adapted for full closure of flows at any time said valve is against said seat.

A compression spring 50 mounted between needle valve 48 and outer cap 51 always urges the valve 48 towards its closed position.

The outer face of diaphragm 47 is sealed by the member 52 attached as by screws 53, said member 52 carrying the above referred to seat 49 and valve 48.

Clamped between outer cap 51 and a flange formed on member 52 and in fluid-tight relation therewith is the extension 54 of container 55, said container 55 being in unrestricted communication with the chamber 76 formed between needle seat 49 and outer cap 51, and as needle valve 48 is longitudinally fluted it should be noted that chamber 55 is therefore in unrestricted communication with the outlet end of needle valve 48.

The upper end of container 55 is sealed by a cup shaped member 56 having a large central aperture 57 and a small off center aperture 58.

A cover member 61, securely attached to container 55 as by screws 63′, has a central bore adapted to receive the compression spring 60, said spring 60 urging the fibre disc 59 downwards as viewed in Figure 1 and sealing the large aperture 57 in member 56, the assembly so formed acting as a relief valve by which excessive pressure within container 55 will lift fibre disc 59 against the predetermined pressure of spring 60, and permit such excessive pressure to relieve itself from container 55.

It should be noted that aperture 58 is at all times a leak from container 55 for a purpose yet to be described.

The internally threaded bore 62 is adapted to receive an outlet line for the return to the fuel supply of such fuel as may be passed by aperture 58 and aperture 57, while the threaded bore 63 is adapted to receive the fuel inlet line, and in practice bore 63 is connected to the pressure pump of the engine to which the device is attached.

From the chamber formed between the diaphragm 47 and the member 52 a downwardly extending hole 64 connects with a groove 65, said groove 65 extending around the conduit 12 and connecting hole 64 and hole 22, the bottom of said groove 65 being sealed by a gasket 66 of fibre or other heat-resisting material interdisposed between upper housing 23 and the throttle body 67, the assembly so formed being securely attached as by screws 68.

Formed integral with housing 23 and on the right hand side of conduit 12, as viewed in Figure 2, is a cylindrical housing 69 sealed at its outer end with a cap 70, said cap 70 being centrally threaded to receive a threaded member 72 and adapted for endwise adjustment and locked in said adjustment by nut 71.

The inner end of member 72 is provided with a pin of reduced diameter which seats rotatably in a bore in the right hand (Figure 2) end of shaft 18, which extends out of conduit 12 and through the housing 69 to a point adjacent the cap 70. The opposite end of shaft 18 may be provided with a similar bearing, or both bearings may be of other types, so long as they are of substantially frictionless type.

Adjacent the inner end of housing 69, but not in contact therewith, and securely attached to shaft 18 by a pin 82, is collar 73, said collar 73 having an upwardly extending lug 84 as clearly shown in Figure 5.

Surrounding collar 73 and mounted for oscillation on shaft 18 is an inertia member 74, and that portion of inertia member which surrounds collar 73 is cut away to form abutments 86 against which the lug of collar 73 contacts in a manner whereby the inertia member is free to travel between abutments 86 for approximately 50° of rotation from one abutment to the other, while the total travel of collar 73 attached to shaft 18 will be 90° as the butterfly 19 goes from its fully closed to its fully open position.

Inertia member 74 is centrally bored out to receive a fibre washer 75′ and abutting washer 75′ is a compression spring 77, the outer end of spring 77 being snapped in a groove formed adjacent the end of shaft 18, while a second fibre washer 75 is interposed between inertia member 74 and collar 73, the assembly so formed acting to resist by the friction of washers 75 and 75′ any sudden movement of shaft 18, said resisting or braking action being caused by the lag behind of inertia member 74 during the rapid travel of lug 84 between abutments 86. Movement of lug 84 into contact with either of abutments 86 causes such impact between the lug and the abutment as to arrest the movement of shaft 18 whenever such movement is of sufficient rapidity and extent as to bring about such impact. Further, the assembly so formed is adaptable to frictionless rotation whenever gradual or relatively slow movement of the shaft 18 occurs, as the assembly of parts 84, 75, 75′, 74 and 77 are entirely carried by shaft 18 and offer no resistance to easy or gradual changes of position or rotation.

In practice the device is attached to the intake manifold of an internal combustion engine, the fuel inlet 63 is connected to the pressure pump of the engine, the fuel return line 62 is connected back to the fuel tank supplying the engine, and the shaft 15 is connected in the usual manner to the accelerator pedal.

With the engine at rest regardless of the position of the manual throttle 16, the air valve 19 will be in position as shown in Figure 3, the parts associated with shaft 18 will be at the positions shown in Figure 1, and the needle valve 48 will be completely shut off.

Upon cranking the engine, however, a depression will be created below the valve 19 causing it, due to its off center mounting, to rotate in a clockwise direction as viewed in Figure 3, such rotation of shaft 18 as viewed in Figure 1 will also rotate the cam 30 in a clockwise direction and thereby move wheel 40, levers 38 and 43, yoke 45, diaphragm 47 and finally needle valve 48 all to the right as viewed in Figure 1, but it should be noted that a vast reduction occurs as regards the movement of the wheel 40 to the movement imparted to the needle valve 48.

However, if the leverages involved plus the contour of cam have been properly selected, the movement imparted to butterfly valve 19 by the act of cranking will displace the needle valve 48 sufficiently far from its seat to permit the correct amount of fuel to pass the needle and via hole 64, groove 65, hole 22 and jet 21 to be delivered at the point of greatest velocity and the engine will immediately start, whereupon, due to the increased flow caused by the difference between cranking R. P. M. and idling R. P. M., will cause butterfly 19 to open still further and of course move still farther the needle valve 48 from its seat.

Assuming the engine to be at idling speed and the fuel mixture too rich, the adjustment screw 34 is advanced, the arm 32 is thereby rotated in a clock-wise direction, the pin 37 is moved to the left (Figure 1) and the needle valve 48 thus brought closer to its seat, as plainly shown in Figure 1, while if the fuel mixture were too lean the opposite adjustment will effect the opposite result.

The above description of operation has been limited to cranking and idling or the farthermost closed position of throttle valve 16 only, and it should be noted that at this idling position the butterfly 19 will have moved in a clock-wise direction to a point where its leading or up-stream edge is approximately about to enter the enlarged bore 78, and that vane 20 has moved into close proximity to the right hand wall (Figure 3) of conduit 12.

Further opening of the throttle 16 will result in increased air flow through conduit 12. The increased air flow results in an increased movement of valve 19 and shaft 18 and thereby a greater opening of the needle valve 48. This results in an increased amount of fuel delivered to jet 21 in direct accordance with the increased air flow.

At this point we consider it necessary to fully describe the action of the offset bore 78 and the vane 20.

All butterfly valves have the characteristic of a decided closing torque when the valve is at an angle of between 10 and 60 degrees from their closed position, due primarily to their leading edge developing a vacuum pocket immediately behind the edge and thus tending to close the valve. With an on center valve this results in a considerable closing torque anywhere within the above range, while in an off center valve it results in loss of torque through the same range, and when such an off center valve is opposed by a straight line spring this loss of torque renders the valve useless as an air metering means, for increased air flows will not in all positions cause increased motion of the valve due to the above described counter-torque.

Therefore in the described device at a position coincident with the normal appearance of this loss of torque, the conduit opens out and permits an abnormal amount of air to enter immediately under the leading edge of the butterfly 19, thus breaking down the vacuum pocket that would otherwise exist at this point. Such an abnormal amount of air, however, upsets the true valving action of the valve, to correct which the vane 20 is added, which delays the opening of the following vane, in the same ratio as the leading vane is abnormally supplied due to the offset bore 78. Thus, the vacuum pocket is effectively eliminated without upsetting the flow characteristics of the valve and the slightest change of air flow will respond in a change of position of the valve when the valve is opposed by a straight line spring. (By a straight line spring is meant one with uniform build-up characteristics.)

An off center butterfly such as 19 (but without vane 20) will under high rates of flow rapidly lose torque as it approaches a position parallel with the bore and, therefore, a further function of vane 20 is to assist butterfly 19 as it approaches a parallel position with the bore against such loss of torque (see dotted outline Figure 3), so that any change in air flow, whether caused by a change of throttle position or of load on the engine, will result in a change of position of the fuel needle valve, to cause it to discharge the correct amount of fuel for that amount of air which so positioned the air valve.

Such an off center valve, when operating under wide open throttle at low engine speeds, has a tendency to flutter and if the opening torque of such a valve is resisted with a spring light enough to permit full air flows, it will under the above conditions travel from the fully open to the fully closed position as each piston of the engine completes its intake stroke. In other words, under these conditions the valve flutters, which results in excessive wear, etc., besides which the engine suffers a considerable loss of torque during this period.

We have found the inertia member 74 together with parts 73, 75, 75′ and 77 to be highly efficient in completely curing this fluttering trouble and further will operate at all periods of vibration, as small high speed impulses are completely eliminated by the braking action, while strong somewhat slower impulses are completely eliminated by the combined braking and hammer action.

The present type of automotive diaphragm pump we consider too well known to require discription, but in practice we find that different units vary between 4 and 6 pounds of pressure.

Obviously if the carburetor is calibrated for 4 pounds pressure and then attached to an engine having a pump delivering 6 pounds pressure, the calibration is wrong and too much fuel will be delivered through the carburetor.

Therefore, the chamber 55 is equipped with a pressure relief valve. This valve limits the pressure in chamber 55 to that desired, and the excess fuel is returned to the fuel storage tank through the outlet 62, thus permitting the carburetor to operate on the fuel pressure for which it was calibrated.

A further characteristic of the present type of automotive fuel pump is that they are invariably mounted directly on the engine and, therefore, in a very warm if not hot location. Such an amount of heat generates a considerable amount of bubbles or free gas which if they pass the needle valve 48 will unfavorably effect the fuel metering of the carbureter which of course has been calibrated for liquid fuel.

We find, therefore, that such pumps, to be reliable for use with the described carburetor, must have sufficient circulation to keep them cool. Therefore, the small aperture 58, which as previously described amounts to a permanent leakage out of chamber 55 and back to the supply tank, results in a sufficient circulation of fuel to keep the pump cool. As an illustration, the engine at idling may be using only one-half gallon per hour, which would result in very little cooling of the pump. Under such a condition we permit at least 5 gallons of fuel per hour to return to the tank via apertures 57 and 58, which extra amount of circulation we find the pumps well fitted to deliver, and under which flows they will remain sufficiently cool to eliminate the formation of bubbles or free gas.

What we claim is:

1. In a carburetor, an induction passage comprising an anterior portion and a posterior portion of smaller cross-sectional area than the anterior portion and joined thereto by a tapered portion, a disk valve mounted off-center in the passage adjacent the tapered portion, a fuel conduit having its outlet in the induction passage adjacent the tapered portion, and a valve controlled by the position of the disk valve for controlling the flow through said conduit.

2. In a charge forming device, an induction passage comprising an anterior portion and a posterior portion of smaller cross-sectional area than the anterior portion and joined thereto by a tapered portion, a pressure responsive butterfly valve mounted eccentrically in the posterior portion and movable by air flow to an intermediate position where its leading edge overlies the tapered portion and air currents deflected by the tapered portion pass to the posterior face of the valve, a fuel conduit having an outlet in the induction passage adjacent the valve, and a fuel valve controlled by movement of the butterfly valve for controlling the flow through said conduit.

3. The invention defined in claim 2, wherein the outlet of the fuel conduit is located slightly anterior to the leading edge of the valve, and said leading edge is recessed to admit fuel discharged from said outlet.

4. The invention defined in claim 2, wherein the valve is provided with an angularly disposed vane fixed thereto and positioned to obturate one side of the induction passage when the valve is in partially opened position.

5. In a charge forming device, an induction passage comprising an anterior portion and a posterior portion eccentric relative to each other and joined by an eccentric tapered portion, a butterfly valve mounted in the posterior portion and movable by air flow to an intermediate position where its leading edge overlies the tapered portion and air currents deflected by the tapered portion pass to the posterior face of the valve, an aperture in the leading edge of the valve, a fuel conduit having its outlet slightly anterior to said aperture when the valve is in closed position but aligned with said aperture, and a fuel valve controlled by movement of the butterfly valve for controlling flow through said conduit.

6. In a charge forming device, an induction passage comprising an anterior portion and a posterior portion of smaller cross-sectional area, said portions being connected end-to-end, a butterfly valve rotatably mounted in the smaller portion in such position that the leading edge of the valve sweeps past the juncture between the two portions during part of the opening movement of the valve, said valve being provided with a vane fixed thereto and restricting flow past the trailing edge of the valve during such movement, and a fuel conduit discharging into said passage, a fuel valve in said conduit controlled by the position of said air valve.

7. In a carburetor, an induction passage, a member responsive to air flow through the induction passage rotatably mounted in the induction passage, a vibration damping means comprising a member of high moment of inertia mounted to rotate with said flow responsive member, a frictional overrunning connection between the flow responsive member and the inertia member permitting relative rotary movement therebetween, and means limiting the extent of such movement.

8. In a carburetor, an induction passage, a shaft traversing said passage, a member fixed to said shaft and rotatable therewith in response to airflow through the induction passage, an inertia member rotatable on said shaft, means positively limiting the extent of such rotation, and a frictional connection between the shaft and the inertia member for damping vibration of said shaft.

9. In a charge forming device, an induction passage, a rotatable shaft mounted eccentrically in said passage, a pressure responsive butterfly valve fixed to said shaft, and vibration damping means for said valve comprising an inertia member rotatably mounted on said shaft and having an overrunning frictional connection therewith.

10. In a carburetor, an induction passage comprising two clindrical portions of different diameter connected at one side only of the passage by a frusto-conical portion, means for measuring the rate of air flow through said passage comprising a pressure-responsive butterfly valve rotatably mounted in said passage adjacent said frusto-conical portion in such relation thereto that the leading edge of the valve sweeps past it in its opening movement, a vane fixed to the valve for restricting flow past the trailing edge of the valve during such movement, and a fuel conduit discharging into said passage and controlled by the position of said valve.

11. In a charge forming device, an induction passage comprising two portions of different cross-sectional area joined end-to-end, means for measuring the rate of air flow through said passage comprising an air valve rotatably mounted in the smaller passage in such position that one edge of the valve sweeps past the juncture between the two portions during the opening movement of the valve, a fuel conduit, a valve in said conduit controlled by the position of said air valve, and a vane fixed to the anterior face of the air valve and projecting therefrom at an angle for restricting flow of air past the other edge of the air valve during such movement.

12. In a carburetor, an induction passage, a rotatable shaft extending eccentrically across said passage, an unbalanced butterfly valve fixed to said shaft and rotatable therewith toward open position in response to air flow through the induction passage, a spiral spring connected to said valve and uring the same toward closed position, an inertia member mounted on said shaft outside of said induction passage and rotatable relative to said shaft, positive means limiting the extent of rotation of the inertia member relative to the shaft in either direction, and friction means between the shaft and the

inertia member for damping vibration of the shaft.

13. The invention defined in claim 12, wherein the inertia member is a cylindrical member having a higher moment of inertia than the valve and having a sector cut away to form a slot, and the limiting means comprises a stop member fixed to the shaft and positioned to contact the walls of the slot upon movement of the valve relative to the inertia member through a predetermined angle.

14. In a carburetor, an induction passage, a rotatable shaft extending across said passage, a pressure responsive air valve mounted on said shaft and rotatable therewith toward open position in response to air flow through the induction passage, a fuel conduit discharging in said induction passage and controlled by the position of said valve, yielding means urging the valve toward closed position, an inertia member mounted on said shaft and rotatable relative thereto, means positively limiting the extent of rotation of the inertia member relative to the shaft in either direction, and friction means between the shaft and the inertia member for damping vibration of the shaft.

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The following references are of record in the file of this patent:

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1,928,829	Dickerson	Oct. 3, 1933
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2,082,293	Linga	June 1, 1937
2,182,580	Bracke	Dec. 5, 1939
2,238,333	McCain	Apr. 15, 1941
2,261,490	Weber	Nov. 4, 1941
2,327,903	Jorgenson	Aug. 24, 1943

FOREIGN PATENTS

Number	Country	Date
275,820	Great Britain	1927
838,242	France	1938

Certificate of Correction

Patent No. 2,443,464.

June 15, 1948.

WILLIAM E. LEIBING ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Column 8, line 36, claim 10, for "clindrical" read *cylindrical*; line 69, claim 12, for "uring" read *urging*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of September, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

inertia member for damping vibration of the shaft.

13. The invention defined in claim 12, wherein the inertia member is a cylindrical member having a higher moment of inertia than the valve and having a sector cut away to form a slot, and the limiting means comprises a stop member fixed to the shaft and positioned to contact the walls of the slot upon movement of the valve relative to the inertia member through a predetermined angle.

14. In a carburetor, an induction passage, a rotatable shaft extending across said passage, a pressure responsive air valve mounted on said shaft and rotatable therewith toward open position in response to air flow through the induction passage, a fuel conduit discharging in said induction passage and controlled by the position of said valve, yielding means urging the valve toward closed position, an inertia member mounted on said shaft and rotatable relative thereto, means positively limiting the extent of rotation of the inertia member relative to the shaft in either direction, and friction means between the shaft and the inertia member for damping vibration of the shaft.

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