

March 14, 1967

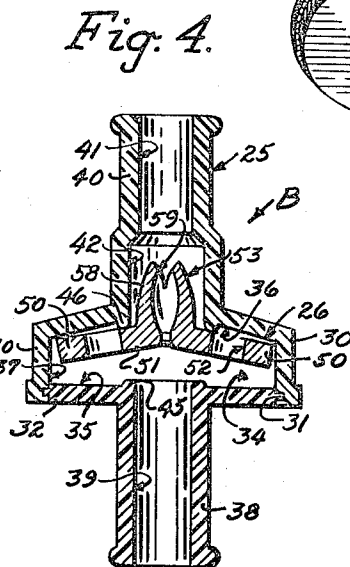
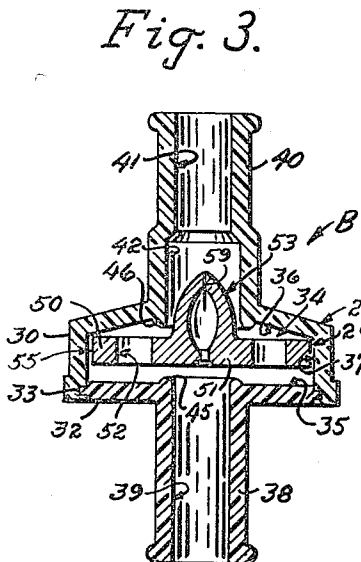
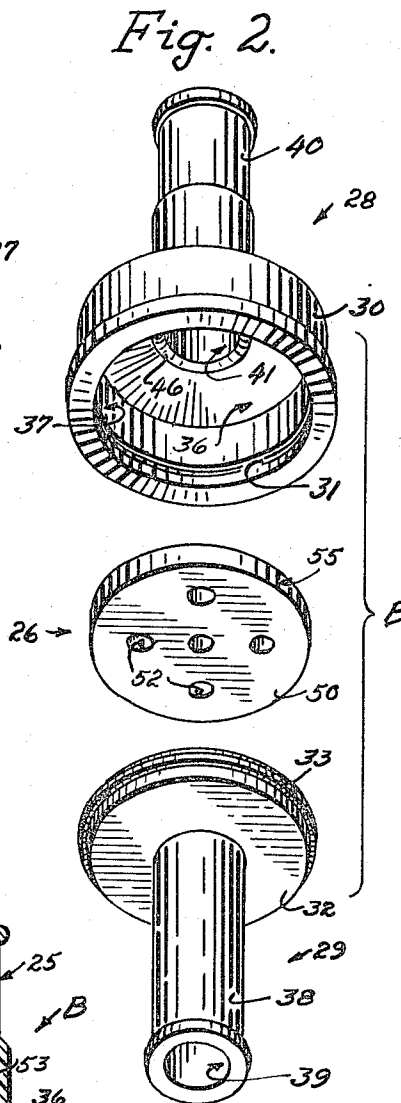
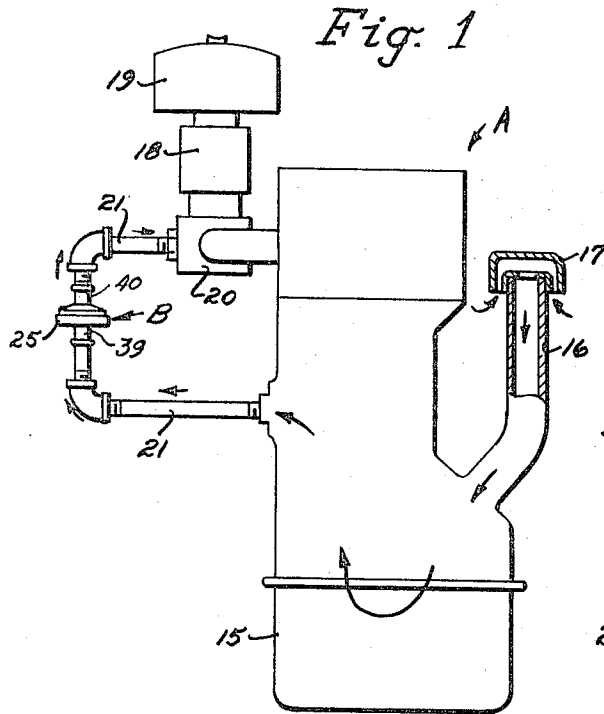
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3,308,798

METERING VALVE FOR CRANKCASE VENTILATION SYSTEMS

Filed May 5, 1965

2 Sheets-Sheet 1



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METERING VALVE FOR CRANKCASE VENTILATION SYSTEMS

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2 Sheets-Sheet 2

Fig. 5.

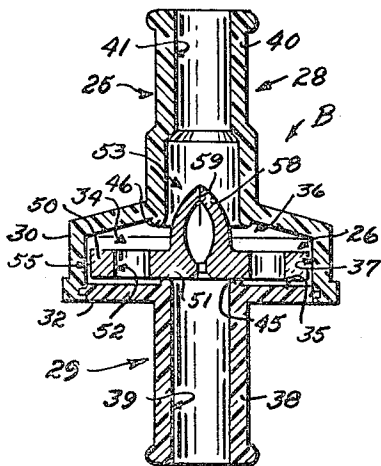


Fig. 6.

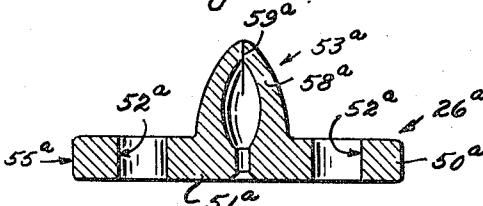


Fig. 7.

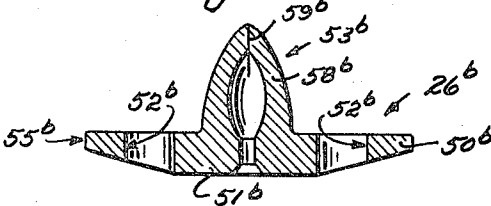


Fig. 8.

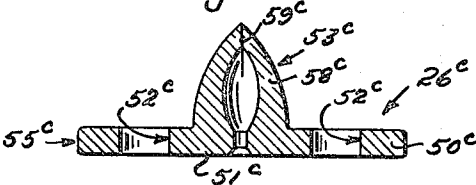


Fig. 9.

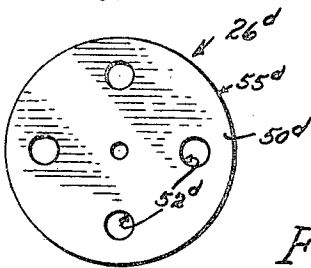


Fig. 10.

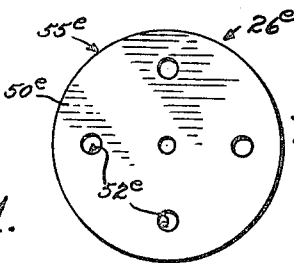


Fig. 11.

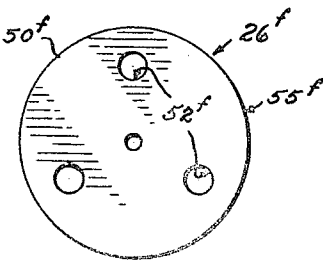
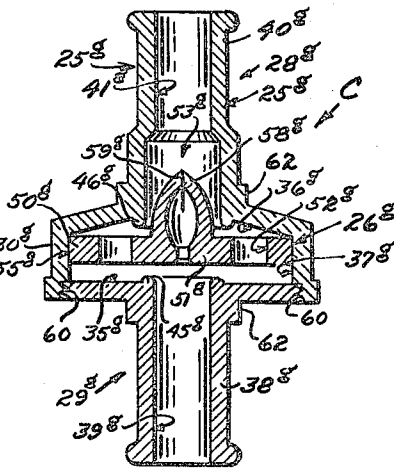


Fig. 12.



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3,308,798

METERING VALVE FOR CRANKCASE VENTILATION SYSTEMS

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7 Claims. (Cl. 123-119)

This invention relates generally to improvements in metering valves and more particularly to metering valves of the type used in the manifold vacuum system of crankcase ventilation of internal combustion engines.

Crankcase ventilation is of prime importance in controlling of sludge and keeping the lubricating system of an internal combustion engine in good condition. Ineffective or inoperative crankcase ventilators are responsible for lubricating troubles serious enough, in some cases, to cause engine failure. Two methods of crankcase ventilation are presently in use, the road-draft system and the manifold vacuum system.

In the road-draft system of automobile crankcase ventilation, vapors developed in the crankcase are vented exteriorly of the engine, being one of the elements which contribute to the "smog" conditions which have become increasingly prevalent.

In order to control "smog," the road-draft system of automobile crankcase ventilation has been outlawed in some States and the manifold vacuum system of crankcase ventilation has become mandatory. The correct operation of the manifold vacuum system depends upon a free flow of air through the oil filler tube and engine to the control valve mounted on the intake manifold. The system sucks crankcase vapors into the intake manifold to be burned in the combustion chamber. The flow of the vapors is controlled by a ventilator metering valve which must be adjusted so that the high vacuum at engine idle and deceleration provides minimum ventilation, and the low vacuum at conventional road speeds provides maximum ventilation. The valve must also be constructed so that upon backfire of the engine the crankcase is closed so that it will not receive the backfire from the intake manifold.

Previously provided metering valves of this type have relied upon various forms of spring tension for the required operating characteristics and have been susceptible to clogging with carbon or other foreign matter so that the ventilation system does not operate properly. This inoperative condition causes pressure to build up in the crankcase which may cause oil leakage at the rear main bearing or by the piston rings.

The primary object of this invention is the provision of an improved metering valve for use in crankcase ventilation systems of the manifold vacuum type.

A further object is the provision of a metering valve having self cleaning characteristics whereby sludge or residue which may be deposited by the material passing therethrough will be agitated in such a manner as to prevent an accumulation thereof in the metering valve.

A further object is the provision of a metering valve which may be readily calibrated according to the cubic inch displacement of the engine with which the same is to be used, for more efficient operation thereof.

Other objects and advantages of the invention will be apparent during the course of the following detailed description, taken in connection with the accompanying drawings, and in which drawings:

FIG. 1 is a diagrammatic view showing my improved metering valve as a part of the manifold vacuum system of an internal combustion engine.

FIG. 2 is an exploded perspective of my improved metering valve.

FIG. 3 is a transverse sectional view of the metering

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valve, showing the same under normal operating conditions in the manifold vacuum system of crankcase ventilation.

FIG. 4 is a view similar to FIG. 3 showing the valve under operating conditions of idling or deceleration of the internal combustion engine.

FIG. 5 is a view similar to FIG. 3 showing the valve under operating conditions of backfire of the internal combustion engine.

FIGS. 6, 7, and 8 are transverse cross sectional views of the diaphragm of my improved metering valve, showing calibration thereof according to the cubic inch displacement of the internal combustion engine with which the metering valve is to be used.

FIGS. 9, 10, and 11 are bottom plan views of the diaphragm of my improved metering valve, showing calibration of the passageways therethrough which may be made in accordance with the cubic inch displacement of the internal combustion engine with which the metering valve is to be used.

FIG. 12 is a transverse cross sectional view of a modified form of my improved metering valve.

In the drawings, wherein for the purpose of illustration are shown preferred and modified embodiments of the invention, and wherein similar reference characters designate corresponding parts throughout the several views, the letter A may generally designate an internal combustion engine; B my improved metering valve as shown in FIGS. 1-11; and C the modified form of metering valve as shown in FIG. 12.

Internal combustion engine A is shown as including a crankcase 15 having an oil filter tube 16 provided with a ventilated cap 17 which permits substantially free flow of air through the crankcase. The flow of air through the crankcase is illustrated by the arrows in FIG. 1. A carburetor 18 having an air cleaner 19 is mounted on the engine. The carburetor 18 discharges into the intake manifold 20. A manifold suction tube 21 is interconnected at one end to crankcase 15 and at the other end to intake manifold 20, completing the circuit for crankcase ventilation. Metering valve B is mounted at an appropriate location in manifold suction tube 21, depending on space limitation adjacent the engine.

It should be noted that although metering valve B is shown herein as used in association with the manifold vacuum system of crankcase ventilation of an internal combustion engine of the gasoline type such as used in automobiles, the same could likewise be used in crankcase ventilation of virtually any type of internal combustion engine in which it might be desirable to provide crankcase ventilation. Likewise, although the metering valve has been developed primarily for use in connection with crankcase ventilation, it could be used for other purposes, such as the metering of additives to the intake manifold of an internal combustion engine.

Metering valve B preferably includes valve case 25 and diaphragm 26.

Valve case 25 may be of any appropriate material. It may, for instance, be molded from a synthetic resin which is resistant to the material moving through the valve, be a cast or molded metal, or be machine tooled. Valve B, as herein shown, is molded from a synthetic resin having suitable characteristics for resistance to the material to be conveyed through the valve.

Valve case 25 preferably includes an upper section 28 and lower section 29. Upper section 28 includes a substantially bell shaped member 30 at one end thereof having a groove 31 extending about the internal diameter thereof. Lower section 29 includes a disc-like plate 32 at one end thereof having a peripheral flange 33 extending thereabout. As shown in FIGS. 3, 4 and 5, the valve

case is assembled by snapping flange 33 within groove 31 to provide a unitary valve case 25. This construction provides for facile opening of valve case 25 in the event it proves necessary to clean the interior of the same and for facile removal of diaphragm 26 therefrom.

Attachment of disc-like plate 32 to substantially bell shaped member 30 provides a valve case 25 having a chamber 34 including an intake face 35, outlet face 36 opposite intake face 35, and a side wall portion 37 at the outer periphery of and extending between intake face 35 and outlet face 36. Disc-like plate 32 is provided with an intake conduit coupling 38 having a port 39 opening into chamber 34 at the intake face 35 thereof. Substantially bell shaped member 30 is provided with an outlet conduit coupling 40 having a port 41 opening into chamber 34 at the outlet face 36 thereof. Outlet port 41 may have a portion 42 of an enlarged internal diameter adjacent the opening thereof into chamber 34, for cooperation with diaphragm 26, as will be subsequently described. Valve seat 45 is provided in chamber 34 adjacent port 39 and valve seat 46 is provided in chamber 34 adjacent port 41, valve seats 45 and 46 cooperating with diaphragm 26 in sealing of their respective adjacent ports, as will be subsequently described.

Outlet face 36 is preferably substantially concave from side wall portion 37 to an apex at valve seat 46. The purpose of this concavity will be subsequently described.

Diaphragm 26 preferably includes a disc-like body portion 50 having a central body portion 51, a plurality of passageways 52 being provided in body portion 50 about central body portion 51, and central body portion 51 including a normally closed valve means 53.

The term "disc-like" has been used herein in view of the fact that it descriptively portrays the form of body portion illustrated. It is, however, to be understood that body portion 50 may have any appropriate configuration, according to the configuration of chamber 34 within which the same interfits, the descriptive phrase "disc-like," being used merely as a matter of illustrative convenience.

As shown in FIGS. 3, 4 and 5, diaphragm 26 is mounted in chamber 34 with the outer periphery 55 thereof positioned adjacent side wall portion 37 for reciprocable abutment therewith as diaphragm 26 moves between intake face 35 and outlet face 36 of chamber 34. Side wall portion 37 comprises means for guiding reciprocable movement of diaphragm 26 and the abutment of periphery 55 therewith comprises means for wiping residue deposits from side wall portion 37. As shown in FIG. 3, passageways 52 open from intake face 35 to outlet face 36 so that when diaphragm 26 is disposed in chamber 34 as shown in FIG. 3, material may flow through the metering valve through port 39, passageways 52, and out through port 41.

Central body portion 51 is juxtaposed for sealing abutment with valve seat 46 under one condition of flow through the metering valve, as shown in FIG. 4, and for sealing abutment with valve seat 45 in another condition of flow through the metering valve, as shown in FIG. 5. This relationship will be further described in connection with the operation of the metering valve.

Valve means 53 is of the type which includes means opening into port 41 for permitting a substantially restricted flow of material through port 39, valve means 53 and port 41 when the flow through the metering valve is as shown in FIG. 4, as will be subsequently more fully described in connection with the operation of the metering valve. As shown in the drawing, valve means 53 is of the "heart valve" type including a nipple 58 having an elongated slit 59 at the terminal end thereof. Operation of valve means 53 will be subsequently more fully described.

As shown in the drawings, port 41 has been provided with an enlarged portion 42 into which is received nipple 58 of normally closed valve means 53 of diaphragm 26. It is, of course, to be understood that the entire length of port 41 could be such as to operably receive nipple 58 of valve means 53.

FIGS. 3, 4 and 5 show various operating positions of metering valve B in the intake manifold line of an internal combustion engine. The metering valve is mounted in the intake manifold line with port 39 opening to that portion of the line leading to the crankcase to be ventilated, and port 41 opening to that part of the line leading to the intake manifold. A vacuum is thus created by the intake manifold through port 41 to chamber 34. Under normal operating conditions of the internal combustion engine of an automobile, a relatively low vacuum, usually of from 6 to 8 inches of mercury, will be created through port 41. Under such low vacuum conditions, diaphragm 26 is maintained at an intermediate range of reciprocable movement between intake face 35 and outlet face 36 of chamber 34, as shown in FIG. 3. Under these operating conditions, vapors from the crankcase will flow through port 39, through passageways 52, and out through port 41 to the intake manifold. When the internal combustion engine is idling, or under conditions of deceleration of the internal combustion engine, a relatively high vacuum, usually of from 12 to 16 inches of mercury, will be created in the intake manifold, exerting this higher vacuum through port 41 to chamber 34. When this condition of high vacuum occurs, diaphragm 26 will be sucked up so that the central body portion 51 thereof is in sealing abutment with valve seat 46, as shown in FIG. 4. When port 41 is thus sealed at valve seat 46, increased pressure is exerted on normally closed valve means 53, which acts to open slit 59 of nipple 58 of valve means 53, permitting a relatively restricted flow from the crankcase through port 39, through valve 53, and out through port 41 to the intake manifold.

In the event that the internal combustion engine backfires, flame or sparks are likely to occur in the intake manifold. If such combustion is permitted to reach the crankcase, the crankcase might blow up. Accordingly, under such conditions of backfire, as shown in FIG. 5, the force of the backfire entering port 41 will force diaphragm 26 down toward intake face 35 so that central body portion 51 thereof abuts against valve seat 45, sealing off communication with the crankcase.

In the use of the manifold vacuum system of crankcase ventilation, the mixture of the intake manifold must be adjusted to receive the crankcase vapors. Since my improved metering valve is designed to be used on internal combustion engines of various cubic inch displacement, diaphragm 26 thereof is preferably calibrated to provide optimum performance in connection with the cubic inch displacement of the internal combustion engine with which it is being used.

As shown in FIG. 3, under normal operating conditions, the diaphragm 26 is at an intermediate range of reciprocable movement between intake face 35 and outlet face 36.

Disc-like body portion 50 must therefore have sufficient rigidity to remain in juxtaposition, as shown in FIG. 3, for flow of vapors through passageways 52 thereof under normal operating conditions. If disc-like body portion 50 is too flexible, the normally low vacuum under normal operating conditions would be likely to cause diaphragm 26 to be sucked to a position as shown in FIG. 4. On the other hand, body portion 50 must be sufficiently flexible so that under increased vacuum, as under idling or decelerating conditions, the same will flex so that central body portion 51 thereof may abut with valve seat 46, as shown in FIG. 4. The shaped concavity of outlet face 36 and the relative rigidity of diaphragm 26 thus comprise means for maintaining diaphragm 26 at an intermediate range of reciprocable movement under normal operating conditions and the relative flexibility of diaphragm 26 comprises means for permitting seating thereof on valve seat 46 under idling and decelerating operating conditions.

FIG. 6 shows a diaphragm which is of relatively low flexibility such as would be used in connection with an

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internal combustion engine having a high cubic inch displacement. The parts of the diaphragm of FIG. 6 which correspond to parts of diaphragm 26 have been indicated by identical reference characters, with the exponent *a*.

The diaphragm of FIG. 7 is of medium flexibility, such as would be utilized in connection with internal combustion engines having an average cubic inch displacement. Identical reference characters having the exponent *b* have been applied to the parts of the diaphragm of FIG. 7 which correspond to parts of diaphragm 26.

The diaphragm of FIG. 8 is extremely flexible, and would be used in connection with internal combustion engines having a low cubic inch displacement. Identical reference characters having an exponent *c* have been applied to the parts of the diaphragm of FIG. 7 which correspond to parts of diaphragm 26.

As previously noted, in the manifold system of crankcase ventilation, the mixture flowing through the intake manifold must be adjusted to receive vapors from the crankcase. Under normal operating conditions, an internal combustion engine having a high cubic inch displacement will be able to ingest a greater flow of crankcase vapors than would be internal combustion engine of relatively low cubic inch displacement. Accordingly, it is within the scope of my invention to provide for passageways 52 through diaphragm 26 of various size and at various locations, as indicated in diaphragms 26^a, 26^b, and 26^c of respective FIGS. 9, 10 and 11. Identical reference characters with exponents *d*, *e* and *f* have been respectively applied to the parts of diaphragms of FIGS. 9, 10 and 11 which correspond to similar parts of diaphragm 26.

In normal operating conditions, the intake manifold of the internal combustion engine with which the metering valve is used will be able to ingest a greater supply of crankcase vapors than it will be able to ingest during conditions of idle and deceleration. Accordingly, in order that deceleration may be evenly accomplished and in order to secure proper idling of the internal combustion engine, means must be provided for restricting the flow of crankcase vapors to the intake manifold under conditions of idling and deceleration of the internal combustion engine.

Such restricted flow of vapors is attained by movement of diaphragm 26 of my improved metering valve into position as shown in FIG. 4 in which the only flow from the crankcase to the intake manifold will be regulated by that amount of vapors which are permitted to flow through valve means 53.

Metering valve C is generally the same as metering valve B, and identical reference characters with the exponent *g* have been applied to the parts thereof corresponding to parts of metering valve B. In some vehicles, such as trucks, which may be subjected to shock loads, etc., which are not normally encountered by the usual automobile, it may be desirable to assemble the metering valve other than by a mere snap-fit of one part to another. It may thus be desirable to provide plate 32^g and the lowermost end of bell shaped member 30^g with mating screw threads 60, intake conduit coupling 38^g and and outlet conduit coupling 40^g being provided with wrench receiving faces 62 for tightening of the parts together and unloosening of the same. Otherwise, construction of metering valve C is identical to that of metering valve B.

Various changes may be made to the forms of the invention herein shown and described without departing from the spirit of the invention or scope of the following claims.

I claim:

1. In a metering valve, the combination of a valve case including a chamber having an intake face, an outlet face opposite said intake face, and a side wall portion at the outer periphery of and extending between said intake face and said outlet face, an intake conduit

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coupling having a port opening into said chamber at the intake face thereof, an outlet conduit coupling having a port opening into said chamber at the outlet face thereof, and a valve seat in said chamber at each said port; and a diaphragm mounted in said chamber for substantially free reciprocable movement between said intake and said outlet faces of said chamber according to flow conditions through said metering valve, said diaphragm having a disc-like body portion extending substantially transversely across said chamber with the outer periphery thereof adjacent said side wall portion of said chamber, said disc-like body portion including a central body portion juxtaposed for sealing abutment with each said valve seat of said chamber for sealing of said port of said intake conduit coupling at one extreme of reciprocable movement of said diaphragm and sealing of said port of said outlet conduit coupling at the other extreme of reciprocable movement of said diaphragm, and a plurality of passageways about said central body portion opening from said intake face of said chamber to said outlet face thereof and permitting relatively free flow through said metering valve at intermediate ranges of reciprocable movement of said diaphragm, said passageways being closed to flow there-through by abutment of said diaphragm with said outlet face and said valve seat of said port opening thereinto when said diaphragm is at its extreme position toward said outlet face, said central body portion of said diaphragm including a normally closed valve and said normally closed valve including means opening to permit substantially restricted flow of material through said metering valve under flow conditions which cause said central body portion of said diaphragm to abut said valve seat of said chamber at said port of said outlet conduit coupling.

2. The combination as specified in claim 1 wherein the outer periphery of said disc-like body portion of said diaphragm abuts said side wall portion of said chamber during reciprocable movement of said diaphragm, said side wall portion of said chamber comprising means for guiding reciprocable movement of said diaphragm, and said abutment of the outer periphery of said disc-like body portion of said diaphragm comprises means for wiping residue deposits from said side wall portion of said chamber.

3. The combination as specified in claim 1 wherein said metering valve is disposed in a pipe line for venting the crankcase of a vehicle to the intake manifold of an internal combustion engine and said passageways of said disc-like body portion of said diaphragm are calibrated according to the cubic inch displacement of the internal combustion engine.

4. The combination as specified in claim 1 wherein said outlet face of said chamber is concave from said side wall portion to an apex at said valve seat of said port of said outlet conduit coupling.

5. The combination as specified in claim 4 wherein said disc-like body portion of said diaphragm is of a flexibility whereby to substantially conform to the concavity of said outlet face of said chamber in the seating of said central body portion of said diaphragm on said valve seat of said port of said outlet conduit coupling.

6. The combination as specified in claim 5 wherein said metering valve is juxtaposed in a pipe line for venting the crankcase of a vehicle to the intake manifold of an internal combustion engine and said flexibility of said disc-like body portion of said diaphragm is calibrated according to the cubic inch displacement of the internal combustion engine whereby said diaphragm is maintained at an intermediate range of reciprocable movement under normal operating conditions of the internal combustion engine and said diaphragm flexes to seat the central body portion thereof on said valve seat of said port of said outlet conduit under idling and deaccel-

eration operating conditions of the internal combustion engine.

7. In a metering valve for use in a pipe line for venting the crankcase of a vehicle to the intake manifold of an internal combustion engine, the combination of a valve case having an intake face, an outlet face opposite said intake face, and a side wall portion at the outer periphery of and extending between said intake and said outlet face, an intake conduit coupling for attachment thereto of a conduit leading to the crankcase, said intake conduit coupling having a port opening into said chamber at the intake face thereof, an outlet conduit coupling for attachment thereto of a conduit leading to the intake manifold, said outlet conduit having a port opening into said outlet face of said chamber in juxtaposition whereby vacuum of the intake manifold acts through said outlet conduit, chamber and intake conduit in drawing fumes from the crankcase to the intake manifold, and a valve seat in said chamber at each said port; and a diaphragm mounted in said chamber for substantially free reciprocable movement between said intake and outlet face of said chamber, said diaphragm having a disc-like body portion extending substantially transversely across said chamber with the outer periphery thereof adjacent said side wall portion of said chamber and juxtaposed in said chamber to substantially freely float in said chamber at intermediate ranges of reciprocable movement thereof under normal operating conditions of the internal combustion engine, to be drawn to an extreme of reciprocable movement toward said outlet face under idling and deceleration operating conditions of the internal combustion engine, and to be forced to an extreme of reciprocable movement toward said intake face when said internal combustion engine backfires, said disc-like body portion including a central

body portion juxtaposed for sealing abutment with each said valve seat of said chamber for sealing of said port of said intake conduit coupling at the extreme of reciprocable movement of said diaphragm toward said intake face of said chamber and sealing of said port of said outlet coupling at the extreme of reciprocable movement of said diaphragm toward said outlet face of said chamber, and a plurality of passageways about said central body portion opening from said intake face of said chamber to said outlet face thereof and permitting relatively free flow through said metering valve at intermediate ranges of reciprocable movement of said diaphragm, said passageways being closed to flow there-through by abutment of said diaphragm with said outlet face and said valve seat of said port opening thereinto when said diaphragm is at its extreme position toward said outlet face, and said central body portion of said diaphragm includes a normally closed valve, said normally closed valve including means opening to permit restricted flow of material through said metering valve at the extreme of reciprocable movement of said diaphragm toward said outlet face of said chamber.

References Cited by the Examiner

UNITED STATES PATENTS

3,034,731	5/1962	Chapin	137—525.1	X
3,105,477	10/1963	Lowther	123—119	
3,111,138	11/1963	Humphreys	123—119	X
3,122,161	2/1964	Pfeifer	137—525.1	X
3,198,208	8/1965	Tramontini	123—119	X
3,241,537	3/1966	Jones	123—119	

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