

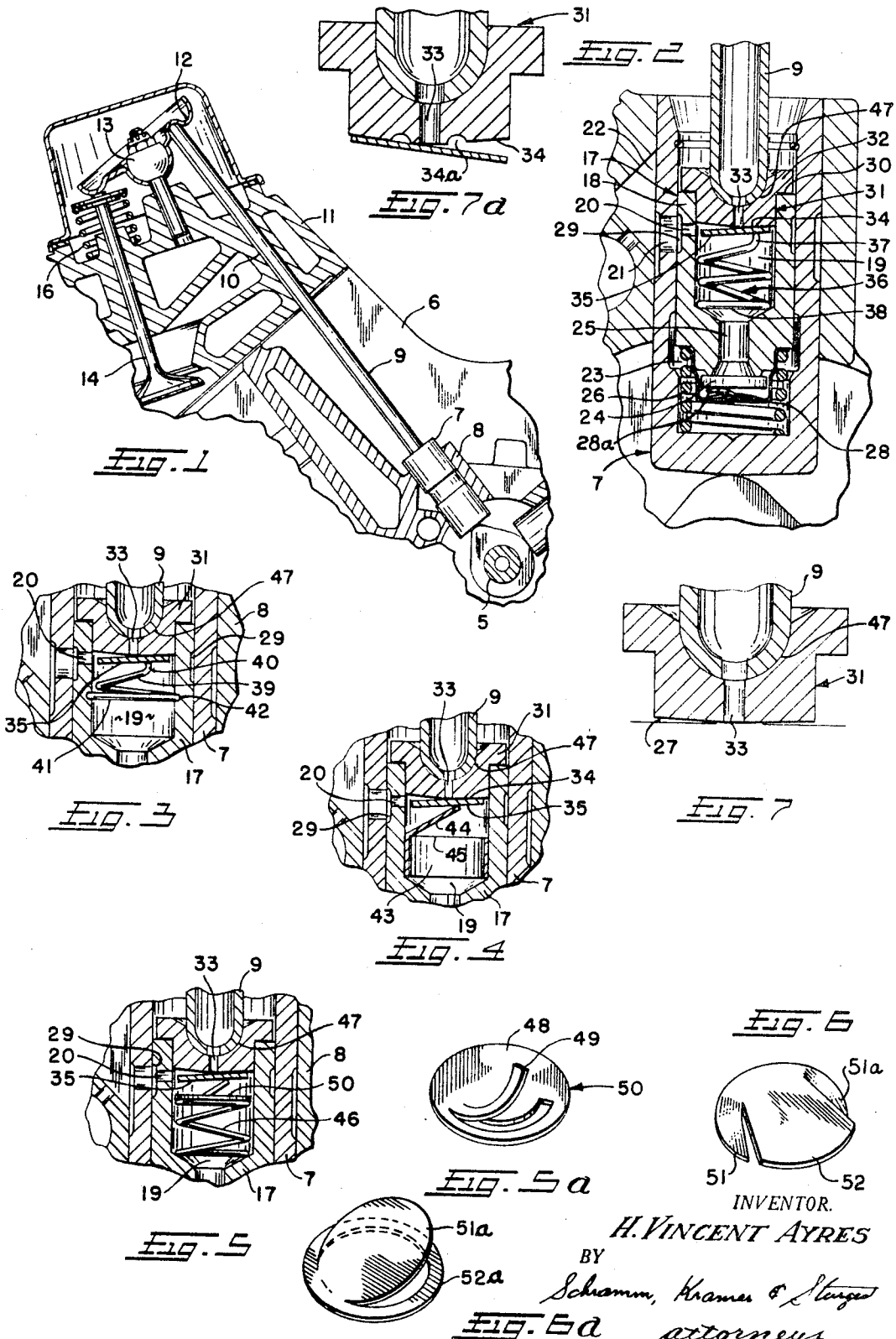
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FLUID METERING VALVE STRUCTURE

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FLUID METERING VALVE STRUCTURE

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This invention relates to fluid metering valve structures, and more particularly to a lubricating fluid metering valve structure in a valve lifter such as a hydraulic tappet in an internal combustion engine valve lubricating system.

This invention is useful in any fluid metering valve structure; however, it is particularly adapted for use in an internal combustion engine for metering lubricating oil to a conventional rocker arm which connects a valve to a push rod. The cylinder valves in spring biased abutting relation with one side of the rocker arm are caused to open and close by a reciprocating hollow push rod which is in abutting relation with the other extremity of the rocker arm. The push rod engages a valve lifter such as a hydraulic tappet. The valve lifter is caused to reciprocate by a rotating cam journaled in the crank case. The reciprocating valve lifter is supplied lubricating oil under pressure from a source of lubricant through the hydraulic tappet into the hollow push rod and up to the rocker arm. It is desired to provide a continuous flow of lubricating oil to this rocker arm under all operating conditions of speed and temperature, while at the same time, avoiding extremes of excessive lubrication or dryness. These requirements will change among engines. Applicant's invention accomplishes this by providing a novel metering valve structure through which a continuous flow of lubricating oil is metered to the rocker arm.

This invention will be described in reference to hydraulic valve lifters.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means herein-after fully described and particularly pointed out in the appended claims, the following description and annexed drawings setting forth in detail certain illustrative embodiments of the invention, such disclosed means constituting, however, but a few of the various forms in which the principle of this invention may be employed.

In the annexed drawings:

FIG. 1 is a fragmentary sectional view of an internal combustion engine showing a conventional valve lubricating system wherein engine oil is delivered under pressure to a hydraulic valve lifter, through a hollow push rod to a valve rocker mounted in the cylinder head.

FIG. 2 is an enlarged cross-sectional view of a valve lifter embodying applicant's improved metering device.

FIG. 3 is an enlarged fragmentary cross-sectional view showing another embodiment of applicant's invention.

FIG. 4 is an enlarged fragmentary cross-sectional view showing still another embodiment of applicant's invention.

FIG. 5 is an enlarged fragmentary cross-sectional view showing still another embodiment of applicant's invention.

FIG. 5a is a perspective view of a disc member used in the embodiment of the invention seen in FIG. 5.

FIG. 6 is a perspective view of another valve plate used in the embodiment of the invention seen in FIG. 2.

FIG. 6a is a perspective view of still another valve plate used in the embodiment of the invention seen in FIG. 2.

FIG. 7 is an enlarged cross-sectional view of the push rod seat member showing the conical fluid inlet surface in cross section.

FIG. 7a is an enlarged cross-sectional view of the push rod seat member wherein the conical surface of the member is interrupted by an annular recess concentric with the passageway through the seat member.

Briefly stated, this invention is in a reciprocating valve

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lifter having a hollow plunger defining a fluid reservoir having an open end on which is supported a push rod seat member or closure member. In the wall of the reservoir and extending to the exterior wall of the plunger is a fluid inlet. The closure member has a centrally disposed fluid passageway extending therethrough for communication with the reservoir. In accordance herewith the closure member is provided with a conical surface of revolution generated about the longitudinal axis of the fluid passageway. The projected apex of this conical surface extends into the reservoir. A valve plate is disposed in the hollow plunger adjacent this conical surface between the fluid inlet and the closure member. The valve plate meters the flow of fluid through the passageway of the push rod seat member. Resilient means are disposed within the plunger having a free extremity resiliently engaging the valve plate in radially offset relation to the axis of the fluid passageway of the closure member. In this manner the valve plate is maintained in tilted relation to the passageway against the adjacent conical surface of the closure member partially obstructing the opening of the closure member to meter a continuous flow of fluid there-through, without additional restraint on its ability to rotate about its own axis.

Referring more particularly to FIG. 1 of the annexed drawings there is shown a rotating cam 5 journaled for rotation in a crank case 6. A valve lifter in the form of a hydraulic tappet 7 is slidably disposed in a bore 8 in the crank case 6. The tappet 7 reciprocatingly coacts with the rotating cam 5. A hollow push rod 9 engages the other extremity of tappet 7 and extends through a bore 10 in the cylinder head 11 where it pivotally abuts one free extremity of a rocker arm 12. The rocker arm 12 rotates about a spherical fulcrum means generally indicated at 13, which is threadedly secured to the cylinder head 11. A valve 14 communicating with a cylinder 15 pivotally abuts the other extremity of the rocker arm 12. Spring biasing means 16 keeps the valve stem 14 in abutting relation with the rocker arm 12, and in turn maintains the opposite end of rocker arm 12 in contacting relation with the push rod 9, which in turn seats the tappet 7 on the cam 5. This is a conventional valve operating structure in an internal combustion engine.

Referring particularly to FIG. 2 there is shown in cross section a hydraulic tappet 7, improved in accordance with this invention and shows a substantially cylindrical hollow plunger 17, which is centrally disposed within the hydraulic tappet 7. The plunger 17 and the hydraulic tappet 7 move relative to each other along a common axis. The cylindrical wall 18 of the plunger 17 defines a lubricating oil or fluid reservoir 19. A fluid inlet 20 located in the cylindrical wall 18 of the plunger 17 and extending therethrough, communicates with the fluid reservoir 19, and is adapted to coact with a complementary fluid inlet 21 extending through the walls of the hydraulic tappet 7. The inlet 21 in the hydraulic tappet 7 communicates with a lubricating oil or fluid recess 22 in the crank case 6 when the plunger 17 and the hydraulic tappet 7 are in the position shown in FIG. 2. The lower extremity of the plunger 17, and the lower extremity of the hydraulic tappet 7 coact to define an oil or fluid pressure chamber 23. A port 25 communicating with the reservoir 19 at its lowest extremity, extends through the bottom extremity of plunger 17 and communicates with the pressure chamber 23. A check valve 24 in the form of a disc in the pressure chamber 23 adjacent the port 25 is adapted to close the port 25 when the hydraulic tappet 7 is reciprocated in a direction away from the cam 5. A spring 26 in the pressure chamber 23, is designed to force separation of the plunger 17 from the tappet 7 and hold the check valve retaining cup 28 adjacent the bottom of plunger 17. The retaining cup 28

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has a resilient finger 28a which holds the check valve 24 adjacent the port 25.

When the pressure of the oil in the pressure chamber 23 is less than the fluid pressure in chamber 19, the check valve 24 permits a pressure equalizing amount of fluid to pass through the passage 25 into the chamber 23. When the pressure in the pressure chamber 23 exceeds that in the chamber 19, the check valve 24 remains seated under the pressure exerted by the resilient finger 28a of check valve retaining cap 28. Pressure differential under these circumstances is relieved by "leak down" between the adjacent walls of the hollow tappet body 7 and the hollow plunger 17 to the annular recess 29.

The upper extremity 30 of the plunger 17 is open, being adapted to rotatably support a flanged closure member, push rod seat member or valve seat 31. The push rod seat member 31 has a flange 32 which supportingly coacts with the annular extremity 30 of the plunger 17. The push rod seat member 31 at its upper extremity, is provided with a socket 47 adapted to engage and support the push rod 9. Located in the push rod seat member 31 and extending therethrough is a passageway 33 which communicates with the hollow push rod 9 and the reservoir 19. In the preferred embodiment of the invention, the passageway 33 is centrally disposed in the push rod seat member 31. The other extremity or surface 34 of the push rod seat member 31, extends into and closes the reservoir 19. The surface 34 is a surface of revolution generated about the longitudinal axis of the passageway 33. The portion of surface 34 adjacent the axis extends further into the reservoir than the portion of surface 34 remote from the axis and adjacent the periphery of the push rod seat member 31. In the preferred embodiment of the invention, the surface 34 of the push rod seat member 31, is a conical surface of revolution generated about the longitudinal axis of the passageway 33 and has its projected apex extending into the reservoir 19. The conical angle of the surface 34 as seen in FIGS. 2, 3, 4 and 5 is greatly exaggerated for illustrative purposes. Preferably, the conical angle 27 of the surface 34 is approximately 1° to a plane perpendicular to the axis centerline of the push rod seat member 31 as seen in FIG. 7, or the included cone angle is approximately 178° when used in combination with a passageway having a diameter of .086 inch. Further restriction under conditions of high pressure drop may require that the cone angle be as low as ¼° or conversely as high as 5° where the pressure drop is low or more flow is required. Alternately, for a fixed cone angle, a change in the desired flow range may be obtained with a variation of the hole diameter.

The valve plate 35 is disposed in the hollow plunger, preferably between the fluid inlet 20 and the push rod seat member 31 in tilted relation to the passageway 33. The valve plate 35 is adapted to control the flow of fluid or oil through the passageway 33 of the push rod seat member 31. In the preferred embodiment of the invention, the valve plate 35 is a planar disc larger in diameter than the passageway 33, but smaller than the diameter of the reservoir 19. The valve plate 35 may contact the exposed surface of push rod seat member 31 along a direct line extending from the apex to the periphery, or it may contact at least two points on an interrupted surface of the seat member 31, the two points defining a line of contact between the valve plate 35 and the surface 34 of the valve seat 31. For example, the embodiment of the valve seat 31 as shown in FIG. 7a, wherein the conical surface 34 is interrupted by an annular recess 34a, which is provided in the surface 34, and is concentric with the passageway 33. This provides two point contact which defines a line which is in tilted relation to the passageway 33.

A valve plate 35 composed of bimetallic plate material which would be temperature compensating may be used. For example, if the plate were flat at room temperature and became concave at elevated temperatures, it would

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reduce the flow if the concave surface were adjacent the passageway 33 of the valve seat 31. Conversely, when the temperature was low, the excursion of the plate would be away from the passageway 33 and allow more oil to flow.

Resilient means, generally indicated at 36, and disposed in the reservoir 19, has its free extremity 37 resiliently engaging the valve plate 35 in radially offset relation to the axis of the passageway 33 in the push rod seat member 31. The valve plate 35 is thereby maintained in predetermined tilted relation to and adjacent the passageway 33 against the adjacent surface 34 of the push rod seat member 31. The valve plate 35 partially obstructs the passageway 33 and serves to meter a continuous flow of fluid or oil therethrough. The other extremity of resilient means 36 is adapted to abut the plunger 17.

In the embodiment of the invention shown in FIG. 2 the resilient means 36 is a coil spring having its upper extremity 37 resiliently and eccentrically coacting against the valve plate 35 so as to maintain the valve plate 35 in tilted relation to the passageway 33. The lower extremity 38 of the spring 36 abuts the lower extremity of reservoir 19.

In the embodiment of the invention shown in FIG. 3, the resilient means 36 is a short spring 39 having its upper extremity 40 resiliently, and eccentrically coacting against the valve plate 35. The other extremity 41 of the coiled spring 39 is adapted to be seated in a circumferential groove 42 intermediate the fluid inlet 20 and the lower extremity of the plunger 17.

In the embodiment of the invention shown in FIG. 4, the resilient means 36 is a hollow cylinder or sleeve 43 supported within the reservoir 19. A resilient diametrically projecting finger 44 is secured to one extremity 45 of the sleeve 43 and disposed at an obtuse angle with respect to the side wall of sleeve 43. The free extremity of the resilient finger 44 is adapted to hold the valve plate 35 in tilted relation to the passageway 33 of the push rod seat member 31 to meter a continuous flow of fluid or oil therethrough.

In the embodiment of the invention shown in FIG. 5 the resilient means 36 holding the valve plate 35 in tilted relation to the passageway 33 of push rod seat member 31 comprises disc means 50 and resilient support means 46.

In operation, the oil pressure tends to force the plate to cover the opening and this oil pressure must be resisted by the resilient means. It has been determined that there is a minimum spring load that must be maintained in order to overcome the effect of the fluid pressure tending to make the plate seal the opening. This spring load requirement will vary with the oil pressure and hole size as well as finger location.

The disc means 50 seen in FIG. 5a includes a planar disc member 48 having a spiral resilient finger 49 struck out of its plane. The free extremity of the finger 49 is adapted to coact with the valve plate 35 to maintain it in tilted relation to the passageway 33 of the push rod seat member 31. The resilient support means 46 used to support the disc member 50, may be a coil spring supported within the reservoir 19 as seen in FIG. 5, or a coil spring supported in a circumferential groove in the walls of the reservoir 19 as shown in FIG. 3 or supported on a suitable shoulder or ledge formed in the reservoir 19. The disc means 50 is also designed to be used without the resilient means 46. In this case the disc member 48 is supported on a ledge or in a circumferential groove in the reservoir 19, keeping the resilient finger 49 in supporting relationship to the valve plate 35.

The resilient means 36 is included in the embodiment of the valve plate 35 shown in FIG. 6. In this embodiment, a pair of resilient finger portions 51 and 51a are struck from the planar disc portion 52. The disc portion 52 is adapted to coact as a valve plate against the surface 34 in tilted relation to and adjacent the passageway 33 of the push rod seat member 31 to meter a continuous flow of fluid or oil therethrough. The finger portions 51 and 51a

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are supported on a ledge or in a circumferential groove in the walls of the reservoir 19 and, hold the disc portion 52 in metering relation to the aperture 33. Another embodiment of the combined valve plate 35 and the resilient means 36 is shown in FIG. 6a. An annular rim 52a is struck from the planar disc 51a. The rim 52a similarly rests on a ledge or in a circumferential groove in the reservoir 19 holding the disc 51a in metering relation to the aperture 33.

During operation, while the hydraulic valve lifter is rapidly reciprocating and effecting an opening and closing of the valve 14, and oil is supplied under pressure to the recess 22 from the oil gallery, the flow restricting valve plate 35 is urged by the eccentric resilient means 36 into abutment with the conical oil chamber extremity 34 adjacent the passageway 33 of the push rod seat member 31 thereby restricting delivery of oil under pressure to the push rod 9 and the rocker 12. During reciprocating, rotation is imparted to the valve plate 35 through the frictional interconnection of the tappet 7, spring 26, plunger 17 and spring 37 (FIG. 2), upon the rotation of tappet 7 as induced by actuating cam 5 engageable therewith. As such the valve plate 35 tends to rotate within the bore or chamber 19 relative to the conical face 34 by reason of the fact that the push rod seat member is resisted from rotating with the valve plate, through the frictional engagement of socket 47 thereof with push rod 9. As previously indicated, the valve plate 35 contacts the conical surface 34 along a line or at least two points where the surface 34 is purposely interrupted by grooves placed in the surface 34 concentric with the passageway 33. Because of this contact along the conical surface 34 and the effect of the relative rotation of the normally contacting parts, there is a wiping action between the valve plate 35 and the surface 34 which maintains the interface free of foreign matter. In devices where only one point contact is established between the valve plate and the push rod seat member, the cleaning action is absent or far less noticeable, and clogging frequently results. When the valve plate and the surface of revolution against which it bears are so interrelated that this aforementioned contact between the two is established, the normally occurring relative rotation between these parts effects a cleaning action on the valve plate 35.

There has thus been provided an improved valve lifter which is particularly adapted for use in an internal combustion engine. Also provided is a self-cleaning filtering metering valve for controlling the flow of fluid or lubricating oil through a passageway. The valve plate is held in such tilted obstructing relation to the passageway as to filter out any sludge particles which might produce clogging. The relative rotation of the valve plate further breaks down such particles to prevent clogging of the passageway. The metering valve is particularly adapted for coaction with a hydraulic tappet valve used in an internal combustion engine. The volume of fluid or oil flow can be predetermined by the combination of cone angle, fluid or oil passageway diameter, and oil pressure inside the lifter valve. The above described metering structure may be used in mechanical tappets as well as hydraulic tappets.

Other modes of applying the principle of this invention may be employed instead of those specifically set forth above, changes being made as regards the details herein disclosed, provided the elements set forth in any of the following claims, or the equivalent of such be employed.

It is, therefore, particularly pointed out and distinctly claimed as the invention:

1. In a valve lifter including a hollow plunger having an open end and defining a fluid reservoir, a closure member fitted on the open end having a centrally disposed passageway extending therethrough communicating with the reservoir, and a fluid inlet extending through the wall of the plunger, the improvement which comprises:

(a) a closure member, the inwardly facing surface of which is a surface of revolution generated about the

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longitudinal axis of the passageway, the portion of the surface adjacent the axis of generation extending farther into the reservoir than the portion of the surface remote from the axis and adjacent the periphery thereof;

(b) a valve plate disposed in the hollow plunger adjacent said surface in tilted partially obstructing relation to the passageway for metering and filtering the flow of fluid therethrough; and

(c) resilient means supported in the hollow plunger engaging the valve plate for resiliently holding the valve plate in contact with said surface in tilted relation to the passageway.

2. The improved valve lifter of claim 1, wherein the surface of revolution is conical having its projected apex extending into the reservoir.

3. The improved valve lifter of claim 2, wherein the valve plate is a planar disc having a diameter larger than the diameter of the passageway and smaller than the diameter of the reservoir.

4. The improved valve lifter of claim 3, wherein the resilient means engages the valve plate in radially offset relation to the axis of the passageway.

5. The improved valve lifter of claim 4, wherein the included angle of the conical surface is 178°, and the passageway has a diameter of .086 inch.

6. A flow metering assembly for metering fluid under pressure through a passageway in a valve seat comprising:

(a) a valve seat having a centrally disposed passageway extending therethrough, through which the fluid passes, the extremity of the valve seat exposed to the source of fluid being a surface of revolution generated about the axis of the passage and diverging in a direction away from said source of fluid;

(b) a valve plate larger in diameter than the passageway disposed adjacent and in tilted relation to the passageway, and partially obstructing the passageway for metering and filtering fluid therethrough; and

(c) means for resiliently holding the valve plate in fluid metering relation to the passageway.

7. The assembly of claim 6 which includes means for rotating the valve plate relative to the valve seat.

8. A fluid metering assembly comprising:

(a) a reciprocating body having an open end and defining a fluid reservoir;

(b) a closure member supported on the open end of the reservoir, having a centrally disposed passageway extending therethrough communicating with the reservoir, a surface of the member adjacent the reservoir being a surface of revolution generated about the longitudinal axis of the passageway, the portion of the surface adjacent the axis of generation extending farther into the reservoir than the portion of the surface remote from the axis and adjacent the periphery thereof;

(c) a valve plate disposed in the reservoir adjacent to and in tilted partially obstructing relation to the passageway for metering and filtering the flow of fluid therethrough; and

(d) resilient means for holding the valve plate in fluid metering relation to the passageway.

9. The fluid metering assembly of claim 8, wherein the resilient means comprises:

(a) a body portion having means for seating against an abutment in the reservoir; and

(b) means for resiliently engaging the valve plate in radially offset relation to the longitudinal axis of the passageway.

10. The fluid metering assembly of claim 8, wherein the resilient means comprises:

(a) a hollow cylinder disposed in the reservoir; and

(b) a finger portion secured to one extremity of the cylinder resiliently engaging the valve plate in radially offset relation to the longitudinal axis of the passageway.

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11. The fluid metering assembly of claim 8, wherein the resilient means comprises:

(a) a planar disc having a finger portion struck from its plane, resiliently engaging the valve plate in radially offset relation to the longitudinal axis of the passageway; and

(b) biasing means disposed in the reservoir supporting the planar disc with its finger portion.

12. The fluid metering assembly of claim 8, wherein the surface is a conical surface of revolution having its projected apex extending into the reservoir toward the valve plate.

13. The fluid metering assembly of claim 12, wherein the valve plate is a planar disc having a diameter larger than the diameter of the passageway and smaller than the diameter of the reservoir.

14. The fluid metering assembly of claim 13, wherein the resilient means engages the valve plate in radially offset relation to the axis of the passageway.

15. The fluid metering assembly of claim 14, wherein the included angle of the conical surfaces is 178° and the passageway has a diameter of .086 inch.

16. A fluid metering assembly having a valve seat with

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a passageway extending therethrough and a valve plate resiliently held adjacent the seat in tilted, partially obstructing relation to the passageway, the valve plate and valve seat having adjacent surfaces coacting to partially obstruct the passageway for metering and filtering the flow of fluid therethrough, one of the adjacent surfaces being planar and the other being conical in configuration, the conically configured surface having its apex projecting towards the other adjacent surface.

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