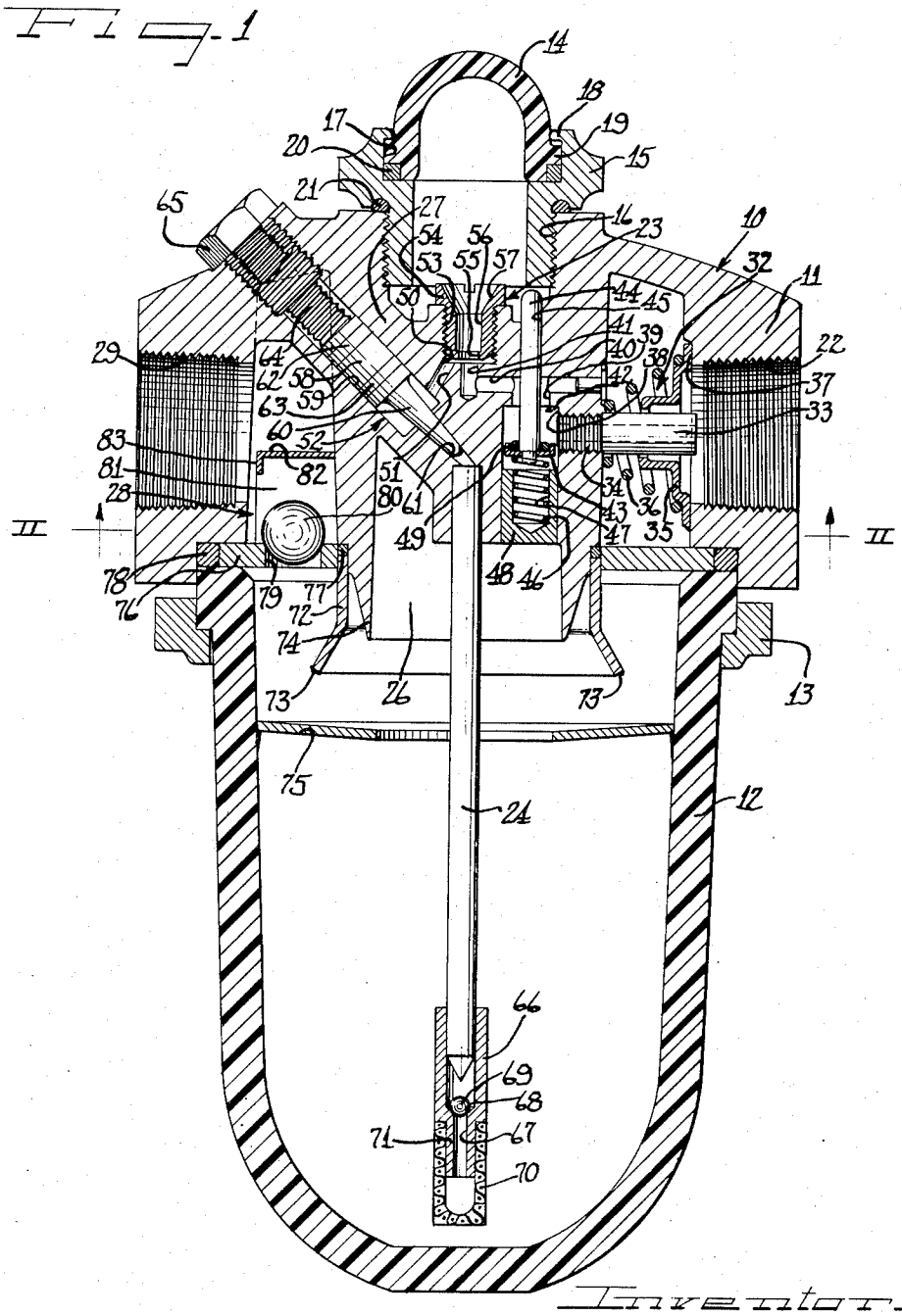
May 20, 1958 H. A. ANDRESEN ET AL 2,835,267

AIR LINE LUBRICATOR

Filed Dec. 31, 1953 3 Sheets-Sheet 1

Fig. 1



Inventors
Hilmar A. Andresen
Raymond H. Andresen
by Hill, Sherman, Meroni, Gross & Simpson Attys

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3 Sheets-Sheet 2

Fig. 2

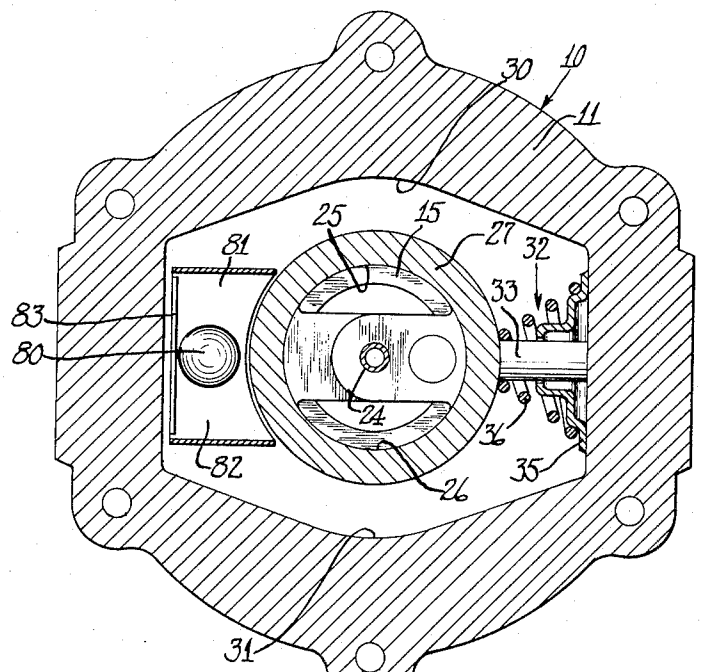
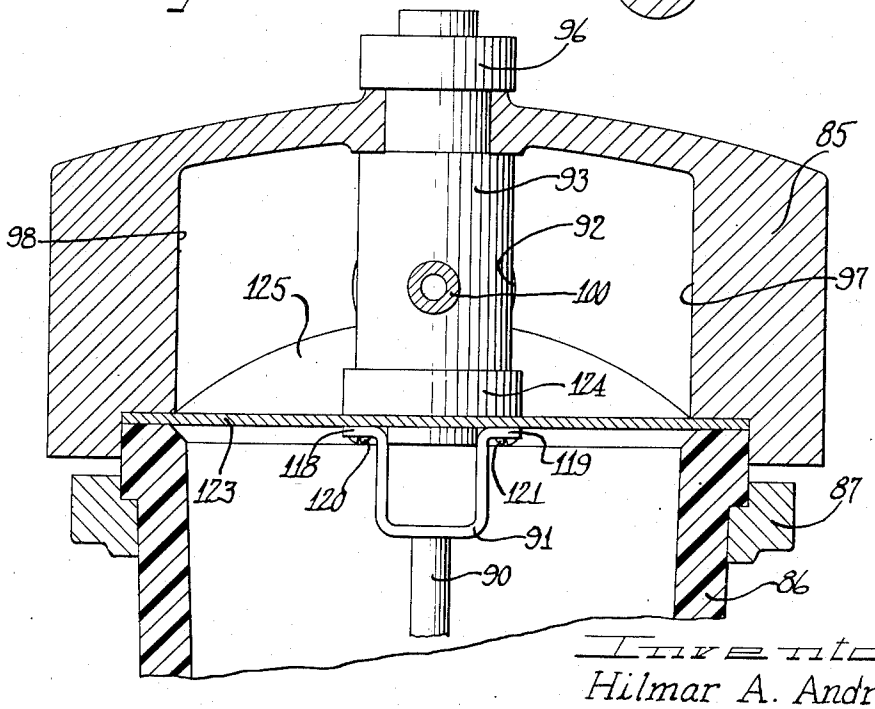


Fig. 4



Inventors

Hilmar A. Andresen

Raymond H. Andresen

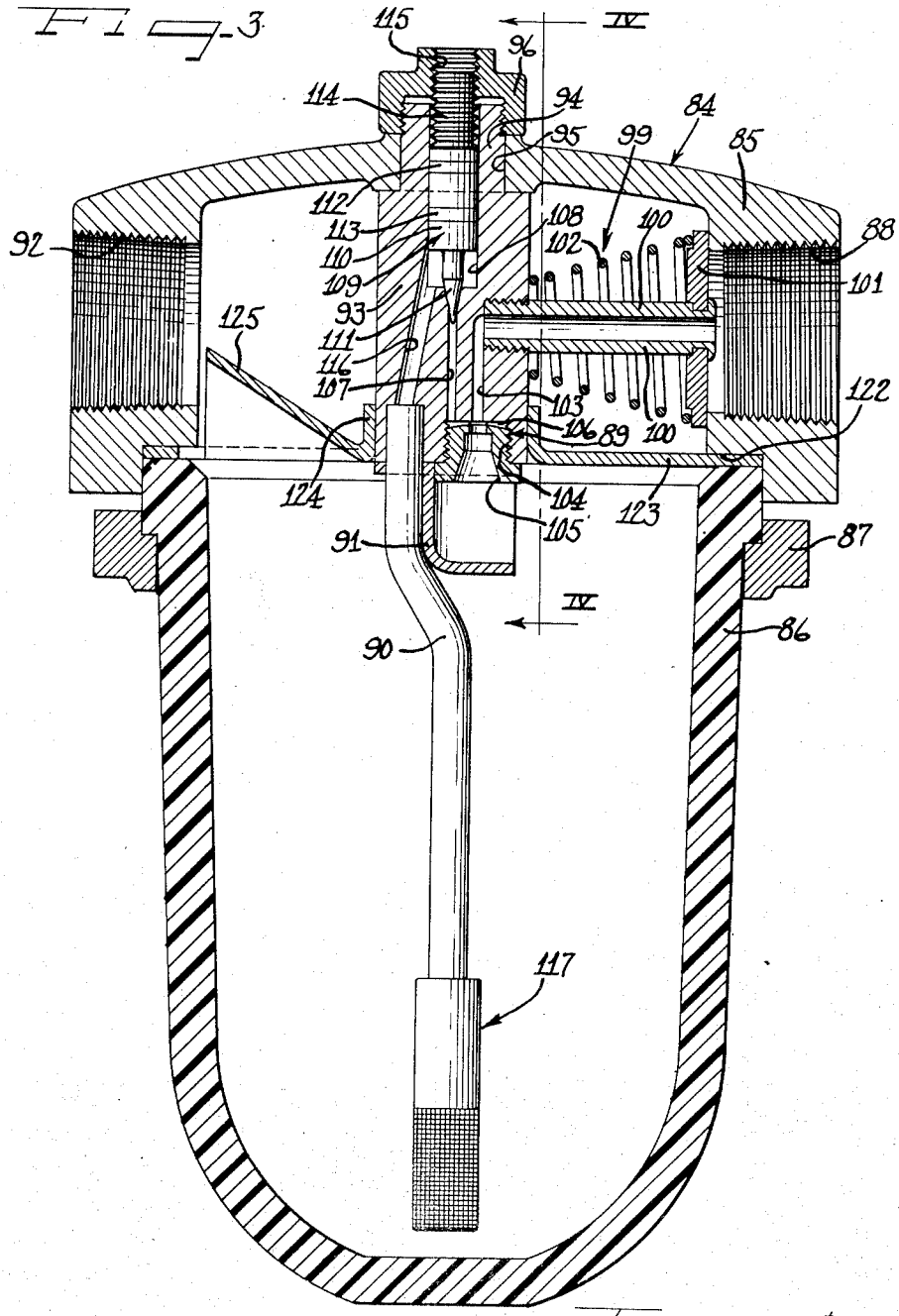
by Kill, Sherman, Merriam, Cross & Simpson Attys

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AIR LINE LUBRICATOR

Filed Dec. 31, 1953 3 Sheets-Sheet 3

Fig. 3



Inventors
Hilmar A. Andresen
Raymond H. Andresen
By Hill, Sherman, Meroni, Gross & Simpson Attys

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2,835,267

AIR LINE LUBRICATOR

Hilmar A. Andresen and Raymond H. Andresen, Barrington, Ill., assignors to Gits Bros. Mfg. Co., Chicago, Ill., a corporation of Illinois

Application December 31, 1953, Serial No. 401,636

1 Claim. (Cl. 137—110)

This invention relates to an air line lubricator in which oil is entrained in finely divided droplet form in the air flowing to a pneumatically-operated device to lubricate the parts of the device.

While the air line lubricator of this invention is designed primarily for such use in conjunction with a pneumatically-operated device, it will be appreciated that the principles of this invention are applicable to devices in which the air is used primarily as a medium for carrying oil to a device to be lubricated, such as, for example, the apparatus disclosed in our copending application entitled "Method and Apparatus for Oil Mist Lubrication," filed March 20, 1952, U. S. Serial No. 277,668, in our Patent No. 2,762,457 issued September 21, 1956, and to any apparatus in which it may be desired to entrain a liquid in finely divided droplet form in a gaseous carrier medium.

This invention may be applied to a unit of the type comprising a casing or body having a liquid reservoir such as a bowl attached thereto and having inlet and outlet passages with means defining a first path or passageway establishing communication between the inlet and the space above the level of liquid in the reservoir and a second path or passageway from such space to the outlet passage. Means are provided in the first path for entraining the liquid in finely divided droplet form in the pressurized gaseous medium flowing from the inlet to the outlet. With such a unit, the larger droplets that are too heavy to be carried by the gaseous medium may flow back into the reservoir.

According to an important feature of this invention, a by-pass passageway is provided right in the unit between the inlet passage and the outlet passage with a pressure-actuated valve in this by-pass passageway. The valve is arranged to open when the differential in pressure between the pressure at the inlet and the pressure at the outlet exceeds a predetermined value. This value is determined by the operation of the means for entraining the liquid in the gaseous medium, which means operates efficiently at flows up to a predetermined flow rate but does not operate efficiently above that flow rate. Accordingly, the predetermined differential in pressure required to open the valve is adjusted so that the flow through the path in which the liquid is entrained in the gaseous medium does not exceed the value above which such operation is inefficient.

It may be noted that in most prior art constructions, a straight venturi arrangement is used to create pressure to pick up and atomize oil and such constructions operate efficiently only over a very limited range of flow rates.

It has been found that by the provision of the by-pass passageway and the by-pass valve arrangement right in the lubricator unit, highly advantageous results are achieved from a practical standpoint because a single unit may be adjusted for use in applications involving extremes in pressure and flow requirements and such a unit may be cheaply mass-produced while otherwise a multitude of

custom designed units, each sized and designed for a particular type of service, would be required.

A more specific feature of the present invention is concerned with the structure for dividing the flow between the path in which the liquid is entrained in the gaseous medium and the by-pass passageway. According to this feature, a tubular member is disposed centrally in the inlet passage in alignment with the flow of fluid therein for communication with the path in which the liquid is entrained in the gaseous medium, the inlet passage being in communication with the by-pass passageway about the outside of the tubular member.

The advantage of this arrangement is that the tubular member receives high velocity flow and a smooth flow is maintained through the entrainment path irrespective of variations in the flow through the by-pass path. If the intake to the entrainment path were at an angle to the direction of flow from the inlet, the flow of the gaseous medium thereacross when the by-pass passageway is open might tend to produce a venturi effect or undue turbulence preventing proper flow through the entrainment path.

Further, this arrangement permits a simple and easily and economically manufacturable valve construction forming a further specific feature of this invention. In particular, the tubular member is arranged to project from a wall facing the inlet passage and a valve member is provided having a central aperture receiving the tubular member with a helical compression spring between the valve member and the wall arranged to seat the valve member against a valve seat around the inlet passage in facing relation to the wall.

In one preferred arrangement, the valve member may be movable relative to the tubular member and in another preferred arrangement, the valve member may be secured to the tubular member but may flex toward and away from the valve seat. In either case, it will be appreciated that the tubular member, in addition to serving as a highly advantageous intake for the entrainment path, also serves as a guide and support means for the valve member.

Another specific feature of the invention resides in a particular form of mixing for inducing flow of the liquid into the path of the pressurized gaseous medium and for providing a fine spray. According to this feature, the entrainment path includes a passage having a portion of limited length and of greatly enlarged cross-sectional area with means for supplying liquid into the side of that portion. The gaseous medium flowing past the portion will produce a negative pressure or suction sufficient to draw the liquid into the path of the medium.

It has been found that the best results are achieved when the cross-sectional area of the passage on the downstream side of such portion is slightly greater than the cross-sectional area of the passage on the upstream side of such portion, and the mixing structure is preferably so constructed.

According to a still further feature of the invention, a member is arranged at the junction between the by-pass passageway and the outlet passage which is arranged to restrict the flow from the by-pass passageway to provide a venturi effect by which flow from the by-pass passageway induces flow through the entrainment path. This structure has been found to be highly advantageous in promoting a smooth flow through the entrainment path irrespective of variations in the flow through the by-pass passageway.

According to a further specific feature of the invention, a liquid delivery tube which extends upwardly from the lower end of the reservoir to the entraining means carries a check valve therein adjacent the lower end thereof to prevent backflow of the liquid and insure quick operation of the device after periods of inoperation. It may be

noted that this novel feature is advantageous over that disclosed in our above-identified copending application in which a check valve is located at the upper end of the delivery tube because in the arrangement of this invention, the check valve has a column of liquid thereabove and a more effective seal is likely to result. This check valve is preferably in the form of a ball carried in a sleeve which also serves the function of carrying a filter on the lower end of the delivery tube.

In accordance with still other features of the invention, the droplet-carrying gaseous stream from the mixing structure is impinged against a barrier surface to reduce the droplet sizes and to remove larger droplets by adhesion to the barrier surface. In one preferred embodiment of the invention, the droplet-carrying gaseous stream may be directed upwardly with a barrier member secured to the top side of the main body or casing of the unit, as is the case in the apparatus disclosed in our above-identified copending application. In another preferred embodiment, the droplet-carrying gaseous stream from the mixing structure may be directed downwardly toward the liquid in the reservoir with a barrier surface mounted on the underside of the body or casing of the unit in the path of the droplet-carrying medium to prevent the same from impinging on the liquid in the reservoir and to break up larger droplets or remove the same by adhesion thereto. The first embodiment has certain advantages in that the barrier member may be of a transparent material so that the entraining action is visible and it may be removable from the casing for ready access to the mixing or entraining structure. The second embodiment is advantageous in that it is more compact and it may be manufactured with less expense.

A still further feature of the invention, applicable to either of the above-described two preferred embodiments resides in the provision of a manually operable valve means between the inlet and the mixing or entraining structure together with check valve means between the space above the liquid in the reservoir and the outlet such that flow into the reservoir from either the inlet or the outlet is prevented, and the reservoir may be removed for refilling, cleaning, etc. without disconnecting the unit or shutting off the pressure. The apparatus used in conjunction with the unit can still be operated through the by-pass path of the unit or through a by-pass path outside the unit.

Another specific feature of the invention is in the construction of the check valve means. According to this feature, a restricted orifice is provided between the outlet and the space above the liquid in the reservoir and a ball on the downstream side of this orifice is urged toward the orifice with a plate on the downstream side of the ball for limiting movement thereof away from the orifice, this plate also serving to restrict the by-pass passageway to provide a venturi effect inducing flow through the entrainment path in response to flow through the by-pass passageway.

Still another specific feature of the invention is particularly applicable to the first embodiment described above in which the barrier member may be removably secured to the outside of the body or casing of the unit. According to this feature, means are provided for automatically blocking flow in the entrainment path between the mixing or entraining structure and the inlet passage when the barrier member is removed. Accordingly, the barrier member may be removed for cleaning the same and for cleaning and adjusting of the nozzle structure, or for removing and filling the supply bowl without disconnecting the unit from the air supply or without shutting off the air supply.

The means for blocking this path may preferably take the form of a spring-actuated valve which is held in open position by the barrier member mounted on the unit.

Yet another feature of this invention is in the provision of a baffle member extending inwardly from the sides of the liquid reservoir above the level of liquid therein. It has been found that with the provision of such a baffle member, a much more uniform entrainment of liquid in the gaseous medium is achieved irrespective of changes in the level of the liquid in the reservoir, particularly when there is a pulsating flow of the gaseous medium through the unit. It is believed that this advantageous effect is achieved partly from elimination of a pumping effect which might result when the flow through the unit is pulsating, but primarily from the elimination of picking up of liquid droplets from the foam which is usually induced above the surface of the liquid in the reservoir.

A still further feature of this invention relates primarily to the first embodiment described above in which the droplet-carrying stream is directed upwardly against a barrier surface. In this embodiment of the invention, the stream is directed downwardly through openings in the main body or casing of the unit into the space above the level of the liquid in the reservoir. Liquid dripping off of the barrier member will accumulate on the sides of the opening or openings through the main body of the unit and from the sides of such opening or openings will drop down into the reservoir. The gaseous stream flows outwardly past the lower edges of such opening or openings to the outlet and it has been discovered that some of the droplets which would otherwise fall down into the reservoir will be carried by this gaseous stream directly into the outlet. This is highly undesirable since such droplets are ordinarily of large size and furthermore this operation is quite erratic.

According to this invention, a skirt is provided about the lower end of such opening or openings and has a lower edge spaced outwardly from the lower edge of such opening or openings, and also preferably downwardly therefrom. This skirt prevents a high velocity flow outwardly past the lower edge of such openings and it has been discovered that a much finer mist is achieved together with a much more uniform operation.

An object of this invention, accordingly, is to provide an improved device for entraining a liquid in finely divided droplet form in a gaseous carrier medium.

Another object of this invention is to provide an improved unit for entraining a liquid in finely divided droplet form in a gaseous carrier medium in which a by-pass passageway and a pressure-operated valve are incorporated.

A further object of this invention is to provide improved structure for dividing flow between two paths.

Still another object of this invention is to provide improved valve structure for use in a device in which flow is divided between two separate paths.

Still another object of this invention is to provide improved means for inducing flow of liquid into the path of a gaseous medium and entraining the liquid in droplet form therein.

A specific object of this invention is to provide an improved unit for entraining a liquid in finely divided droplet form in a gaseous carrier medium in which a delivery tube extending upwardly from the lower end of a liquid reservoir has a check valve in the lower end thereof to prevent backflow of the liquid.

Another specific object of this invention is to provide an improved unit for entraining a liquid in finely divided droplet form in a gaseous carrier medium in which the flow of the gaseous medium is through the space above the level of the liquid in a liquid supply bowl and in which valve means are provided for preventing flow into the bowl when it is desired to remove and fill or clean the same.

Still another specific object of this invention is to provide an improved unit for entraining liquid in finely divided droplet form in a gaseous carrier medium in which a by-pass passageway is provided and in which means are provided whereby flow through the by-pass passage-

way provides a venturi effect inducing flow through the entrainment path.

A still further specific object of this invention is to provide an improved unit having a barrier member removably secured thereto in the path of a droplet-carrying gaseous medium, with means for blocking flow automatically on removal of the barrier member.

Still further objects of this invention reside in improved baffle members for promoting more efficient and more uniform entrainment of liquid in finely divided droplet form in a gaseous carrier medium.

This invention contemplates other objects, features and advantages which will become more fully apparent from the following detailed description taken in conjunction with the accompanying drawings which illustrate preferred embodiments and in which:

Figure 1 is a vertical sectional view through one preferred form of air line lubricator constructed according to the principles of this invention;

Figure 2 is a sectional view taken substantially along lines II—II of Figure 1;

Figure 3 is a vertical sectional view through another preferred form of air line lubricator constructed according to the principles of this invention; and

Figure 4 is a sectional view taken substantially along lines IV—IV of Figure 3.

In Figures 1 and 2 reference numeral **10** generally designates one preferred form of air line lubricator constructed according to the principles of this invention and which includes a main body or casing **11**, a generally cup-shaped oil bowl or reservoir **12** secured to the bottom face of the body **11** by a retaining ring **13** which is secured to the body **11** by screws or the like, and an inverted cup-shaped member or dome **14** carried by a sleeve **15** which is threaded into a bore **16** in the top face of the body **11**. The lower end of the dome **14** may be disposed in an annular recess **17** in the support **15** and the upper edge **18** of the support **15** may be turned inwardly in locking relation to an annular rib **19** on the dome **14**. Suitable gaskets **20** and **21** respectively between the dome **14** and member **15** and between the member **15** and the body **11** provide a seal between the dome **14** and the body **11**.

The body **11** may preferably be a metal casting while the bowl **12** and dome **14** are preferably of a translucent material such as, for example, a clear plastic to permit visibility of the oil level and the droplet-entraining action.

The body **11** has an air inlet **22** communicating through structure to be described hereinafter with an air-oil mixing structure generally designated by reference numeral **23** which receives oil from the reservoir **12** through a delivery tube **24**. The air-oil mixture is directed upwardly and impinged against the internal surface of the dome **14** and from there travels through a pair of openings **25** and **26** (Figure 2) in a central generally cylindrical integral portion **27** of the body **11**. The air-oil mixture travels through the openings **25** and **26** into the space in the oil reservoir **12** above the level of oil therein and from that space past a check valve structure generally designated by reference numeral **28** out through an outlet opening **29** in the body **11**. The inlet and outlet openings **22** and **29** may, of course, be internally threaded for suitable connection to conduits or the like.

According to an important feature of this invention, a by-pass passageway is provided between the inlet passage **22** and the outlet passage **29**. In this instance, the passageway is in two parts defined by internal surface portions **30** and **31** of the body **11** (Figure 2) and the opposed surface portions of the generally cylindrical integral internal portion **27** of the body **11**. A pressure-actuated valve structure generally designated by reference numeral **32** is disposed between the inlet **22** and the two parts of the by-pass passageway, and is arranged to open in response to a predetermined differential in pressure between the pressure at the inlet **22** and the pressure at the outlet **29**.

This structure is highly advantageous. In particular, a predetermined pressure differential between the pressure at the inlet **22** and the pressure at the outlet **29** is required for maximum efficiency in the operation of the oil-air mixing structure and with high pressure differentials between the pressure at the inlet **22** and the pressure at the outlet **29**, the pressure-actuated valve **32** may open to automatically maintain a pressure differential very nearly equal to that required for optimum efficiency of operation.

A further feature of the invention is in the provision of novel inlet structure for flow of air to the oil-air mixing structure. According to this feature, a tubular member **33** is disposed centrally in alignment with the air flow into the inlet **22** with the downstream end of the member **33** in communication with the oil-air mixing structure **23**. The advantage of this arrangement is that the tubular member receives high velocity air flow from the inlet and a smooth flow is maintained through the oil-air mixing structure irrespective of the opening or closing of the by-pass valve **32**. If the intake to the air-oil mixing path were at an angle to the direction of flow from the inlet, the flow of air thereacross, when the valve **32** is open, might produce a venturi effect or undue turbulence preventing proper flow through the entrainment path.

In accordance with a more specific feature of the invention, the tubular member **33** is a part of the valve structure **32**. According to this feature, the tubular member **33** is rigidly supported preferably by means of a reduced diameter threaded end portion **34** threaded into a bore in the external surface of the cylindrical portion **27** which faces the inlet passage **22**. A valve member **35** has a central aperture receiving the tubular member **33** and is urged by a helical compression spring **36** toward a valve seat **37** about the inlet passage **22**. With this arrangement, the tubular member **33**, in addition to serving as an inlet for the entrainment path, also provides support for the valve member **35**. In addition, an extremely compact structural arrangement of parts is accomplished.

The terminal end of the reduced diameter portion **34** of the tubular member **35** extends to a cylindrical vertical chamber **38** eccentrically disposed within the cylindrical portion **27** of the body **11**. This chamber **38** communicates with the oil-air mixing or entrainment structure **23** through a vertical passage **39** above the chamber **38**, a transverse passage **40** and a vertical passage **41**.

According to a specific feature of this invention, means are provided for blocking the path between the inlet tubular member **33** and the entrainment structure **23** when the dome **14** is manually removed from the top of the casing or body **11**. According to this feature, the passage **39** above the chamber **38** has a diameter less than the diameter of the chamber **38** to define a downwardly facing annular shoulder **42** which provides a valve seat against which a valve member **43** may seat. The valve member **43** is carried by a pin **44** which projects vertically through a bore **45** into the path of the lower edge of the support **15** which carries the dome **14**, the valve member **43** being held downwardly out of engagement with the valve seat **42** when the support **15** is in the position illustrated, threaded into the upper face of the body **11**. To engage the valve member **43** with the valve seat **42** when the support **15** together with the dome **14** are removed from the body **11**, a helical compression spring **46** acts against the lower surface of the valve member **43**. This helical compression spring **46** is preferably supported within a central bore **47** in a plug member **48**

forming a closure for the lower end of the chamber 38. The valve member 43 may preferably be generally cup-shaped as illustrated to carry an O-ring packing gasket 49.

With this structure, the passage between the inlet 22 and the entrainment structure 23 may be readily closed so that the oil reservoir bowl 12 may be removed for cleaning and filling without shutting off the air pressure to the unit. The air flow can continue through a by-pass passageway either separate from the unit or preferably embodied in the unit in the manner as illustrated. It may be noted that the check valve generally designated by reference numeral 28 prevents reverse flow of air from the outlet into the space above the level of oil in the oil reservoir 12. It may further be noted that when the support 15 for the dome 14 is removed, the oil reservoir bowl 12 may be filled from the top of the body 11 and, accordingly, it is not necessary to provide a separate filler plug for filling the oil reservoir. Still further, since the path between the inlet and the entrainment structure is automatically blocked when the dome 14 is removed, it is not necessary to provide separate means for actuating the valve.

A highly important feature of the present invention is in the construction of the oil-air mixing or entrainment structure 23. According to this feature, the vertical passage 41, which communicates with the inlet 22 through the passage 40, the passage 39, the chamber 38 and the tubular member 33, is provided with a portion 50 of limited length and of greatly enlarged cross-sectional area with the oil supplied into the side of the portion 50 through a passage 51 which is in communication with the oil delivery tube 24 through a valve structure generally designated by reference numeral 52 which will be described in detail hereinafter. When the pressurized air stream from the inlet passes this portion 50 of enlarged cross-sectional area and limited length, the flow of oil will be induced into the path of the air stream and the oil will be broken up into droplet form.

The portion 50 is preferably defined, in part, by the lower end of an internally threaded bore 53 and a plug 54 threaded into the bore 53 and having a lower end spaced from the lower end of the bore 53, thereby to define the portion 50. The plug 54 has an internal passage aligned with the passage 41 and defined by a lower portion 55, an intermediate portion 56 of slightly enlarged cross-sectional area and an upper outwardly flared portion 57. It has been found that best results are achieved when the portion 55 adjacent the portion 50 on the upstream side thereof is slightly greater than the cross-sectional area of the passage 41 on the downstream side of the portion 50 of enlarged cross-sectional area.

It will be appreciated that the droplet-carrying air stream from the entrainment structure 23 is directed upwardly into the concave inner surface of the dome 14. This air stream will build up pressure within this concave surface and develop an air cushion. The smaller oil droplets will not penetrate this air cushion but will be turned back and downwardly in a generally umbrella-like path, while the larger droplets, having a higher inertia, will penetrate this air cushion and strike the inner concave surface of the dome 14 and will either be broken up into smaller particles or will adhere to the surface so as to be removed from the droplet-carrying air stream. As the larger droplets accumulate on the surface they will flow downwardly and drop off of the lower edge of the support 15 through the openings 25 and 26 into the oil reservoir bowl 12.

The oil-control valve structure 52 comprises a member having a generally cylindrical body 58 movable in a cylindrical bore 59 extending angularly within the body 11, the member having a tapered end portion 60 movable into a tapered passage 61 between the chamber 59 and the upper end of the delivery tube 24. Thus axial movement of the member 58 will control the amount of oil flowing into the entrainment structure 23. The member 58 preferably carries a pair of O-ring packing gaskets 62 and 63 and, for axial adjustment of the position of the member 58, the member 58 has an upwardly and outwardly extending reduced diameter threaded end portion 64 which is threaded into an internally threaded bore in a plug 65 which has an externally threaded portion threaded into an internally threaded upper end portion of the bore 59. The axial position of the member 58 may be adjusted by rotating the same relative to the plug 65. However, if it is desired to remove the member 58 for cleaning purposes or the like, this can be accomplished by removing the plug 65.

Further specific features of the invention reside in the provision of a check valve at the lower end of the oil delivery tube and in the provision of a combination check valve and filter support structure. According to these features, a sleeve 66 is press-fitted onto the lower end of the delivery tube 24. This sleeve 66 has a reduced diameter internal passage 67 at its lower end thereof which provides an upwardly facing shoulder 68 spaced downwardly from the lower end of the delivery tube 24. A ball check valve member 69 is disposed within the sleeve 66 between the lower end of the delivery tube 24 and the shoulder 68, the shoulder 68 thereby providing a valve seat which is preferably tapered for this purpose. It may here be noted that the location of the check valve defined by the ball check valve member 69 and the valve seat 68 at the lower end of the delivery tube 24 is highly advantageous since the entire column of oil in the delivery tube thereabove can press against the ball member 69 and insure an effective seal preventing back-flow. Accordingly, the level of the oil will be right up to the portion 50 of the entrainment structure 23 and the unit will always be ready for operation even after long periods of inoperation.

The sleeve 66 also receives a filter member 70 of generally cup-shaped configuration which has an upper tubular portion press-fitted onto the outer surface of the sleeve 66. For this purpose, the sleeve 66 may preferably have a reduced diameter portion 71 at its lower end with the outer surface of the filter 70 flush with the outer surface of the upper end of the sleeve 66.

Still another feature of the present invention resides in the provision of a skirt member 72 having a lower edge 73 which is spaced downwardly and outwardly from the lower edge of the openings 25 and 26. The purpose of this arrangement is to prevent the air stream from flow at high velocity outwardly past the lower edge of the openings 25 and 26 and carrying with it oil droplets of large sizes. With this arrangement, the velocity of the air stream outwardly past the lower edge of the openings 25 and 26 is greatly reduced so that the oil droplets may fall from the lower edge downwardly toward the reservoir with sufficient inertia so as not to be carried by the air stream to the outlet. Most preferably, an integral depending barrier portion 74 of the central cylindrical portion 27 of the body 11 is disposed around the downwardly extending passages or openings 25 and 26, and this depending barrier portion may have an inwardly tapered outer surface so that the skirt member 72 is in outwardly spaced relation to the lower edge of the depending barrier portion 74. With this spacing, oil droplets cannot flow from the lower edge of the openings 25 and 26 onto the skirt 72.

For ease of manufacture, the skirt 72 preferably extends all the way around the openings 25 and 26. However, this is not absolutely essential but it is important that the skirt should be disposed between the lower edge of the openings and the outlet from the space above the reservoir.

According to still another feature of the invention, a baffle member 75 extends inwardly from the internal sur-

face of the reservoir bowl 12 above the level of the oil therein. It has been discovered that without this baffle, the amount of oil entrained in the air passing through the outlet of the unit is dependent to a considerable extent upon the level of the oil in the reservoir, especially when the rate of flow of air through the unit is pulsating, while with the provision of the baffle member 75, the amount of oil entrained in the air passing through the outlet of the unit is substantially independent of the level of the oil in the reservoir. It is believed that this effect is achieved primarily because in the normal operation of the unit, a foam is developed on the surface of the oil in the reservoir and some of such foam may be carried by the air stream into the outlet and any such foam rising above the baffle member 75 must be disposed centrally out of the high velocity path of the air stream. Further, with a pulsating flow of air through the unit, a pumping effect may be achieved which it is believed is substantially eliminated by the provision of the baffle member 75. It may be noted that the baffle member 75 is inclined downwardly a slight amount so that oil may drain therefrom into the reservoir.

To separate the two parts of the by-pass passageway from the space above the level of oil in the reservoir 12, an annular plate 76 is disposed between the upper edge of the oil reservoir bowl 12 and the body 11 and also between the central cylindrical portion 27 of the body 11 and the outer portion of the body 11 with a first O-ring gasket 77 between the member 76 and the portion 11 and a second O-ring gasket 78 between the member 76 and the outer portion of the body 11.

This plate 76 is provided with an aperture 79 for communication between the space above the level of oil in the reservoir and the outlet passage 29. To prevent back-flow through the aperture 79, a ball check valve member 80, which may preferably be of nylon or a like material, is disposed above the aperture 79 and gravity-urged toward sealing engagement therewith. In normal operation, the ball member 80 will be lifted out of engagement with the aperture 79 by the pressurized air stream. To limit upward movement of the ball member 80, a member 81 of inverted U-shaped configuration attached to the plate 76 has a bight portion 82 spaced above the aperture 79 and this bight portion 82 may preferably have a downturned flange portion 83.

As well as limiting movement of the ball member 80, this member 81 also serves a very important function which would warrant its inclusion in the unit, even if the ball check valve member 80 were not provided. In particular, the bight portion 82 projects into the end of the by-pass passageway and restricts the by-pass passageway to provide a venturi effect to aid in inducing flow from the space above the level of the oil in the reservoir 12 through the aperture 79 into the outlet passage 29, in response to air flow through the by-pass passageway.

Figures 3 and 4 illustrate another preferred embodiment of air line lubricator, which is generally designated by reference numeral 84. This lubricator comprises a main body 85, which may preferably be a metal casting, and a generally cup-shaped oil bowl or reservoir 86 secured to the bottom face of the body 85 by a retaining ring 87 which may be secured to the body 85 by screws or in any desired manner. The body 85 has an air inlet 88 which supplies air to an air-oil mixing structure generally designated by reference numeral 89 which receives oil through a delivery tube 90, entrains the oil in the air stream and directs the droplet-carrying air stream downwardly against a baffle member 91 from which the air stream travels through the space above the level of oil in the reservoir 86 out through an outlet passage 92 in the body 85. The entrainment structure 89 is carried by a cylindrical member 93 mounted centrally within the body 85 and having a reduced diameter upper end portion 94 projecting through an opening 95 in the upper end of the body 85 with a cap member 96 threaded onto the portion 94 to secure the member 93 within the body 85.

As in the unit 10 described above, the unit 84 has a two-part by-pass passageway between the inlet passage 88 and the outlet passage 92 which is defined by internal surface portions 97 and 98 of the body 85 and the opposed surface portions of the cylindrical member 93.

The unit 84 also has a pressure-activated valve generally designated by reference numeral 99 for admitting air into the by-pass passageway in response to a predetermined differential in pressure between the air inlet passage 88 and the air outlet passage 92. The valve 99 is constructed somewhat similarly to the valve 32 in the unit 10 above described and includes a tubular member 100 which forms an air inlet for the entrainment path and also carries a valve member 101 which may be of a flexible resilient material such as rubber and which has a central portion securely fastened to the tubular member 100 adjacent the terminal end thereof. A helical compression spring 102 is disposed between the member 93 and the outer periphery of the valve member 101 to urge such outer periphery into engagement with a valve seat surface about the inlet passage 88.

The valve 99, of course, functions generally in the same manner as the valve 32 in the unit 10 above described. The tubular member 100 also functions in the same manner as the tubular member 33 in the unit 10 above described and has the same inherent advantages.

The tubular member 100 may be secured to the cylindrical member 93 in any desired manner preferably by a threaded engagement as illustrated and the inner or down-stream end of the tubular member 100 communicates with the upper end of a generally vertical passage 103 in the member 93. The lower end of the passage 103 is enlarged at an internally threaded bore 104 into which a plug 105 is threaded, this plug having the same general construction as the plug 54 in the unit 10 as above described and cooperating with the upper end of the bore 104 to provide a portion 106 of enlarged cross-sectional area and of limited length in the air flow passage. Oil is supplied into the side of the portion 106 from the lower end of a vertical passage 107 in the cylindrical member 93 which passage 107 is flared outwardly at its upper end into communication with the lower end of a cylindrical bore 108 of enlarged diameter. Disposed in the bore 108 is a valve member 109 having an intermediate cylindrical portion 110 slidable in the bore 108 and a lower tapered end portion 111 cooperating with the flared upper end portion of the passage 107 to define a metering valve. The intermediate cylindrical portion 110 of the valve member 109 may carry a pair of O-ring sealing gaskets 112 and 113 and the plunger valve member 109 has a reduced diameter upper end portion 114 threaded into an internally threaded bore 115 in the cap member 96 for vertical adjustment of the plunger valve member 109 to control the amount of flow of oil. The chamber 108 adjacent its lower end is in communication with the upper end of the delivery tube 90 through a passage 116.

The delivery tube 90 at its lower end carries a combination check valve and filter structure 117 which is preferably constructed substantially the same as the combination check valve and filter structure 66—71 as described in detail above in connection with the unit 10, and for that reason will not be again described in detail.

As will be clear from the drawings, the baffle member 91 is of generally cup-shaped configuration with the side thereof facing away from the outlet being open. The member 91 is preferably secured to the lower end face of the cylindrical member 93 and for this purpose it may have out-turned flange portions 118 and 119 secured against the lower end face of the member 93 by screws 120 and 121, respectively. The member 91 functions generally in the same manner as the dome 14 in the unit 10 as described above to reduce droplet sizes and remove larger droplets by adhesion thereto. Such larger

droplets will drip off from the member **91** onto the surface of the oil in the reservoir **86**.

Disposed between the upper end of the oil bowl **86** and a lower recessed annular face of the body **85** is an annular plate **123** which has an upturned central annular flange portion **124** in sealing engagement with the outer surface of the lower end portion of the cylindrical member **93**. The plate **123** thus separates the two-part by-pass passageway from the space above the level of the oil in the reservoir **86**.

For flow of the droplet-carrying air stream from the space above the oil in the reservoir to the outlet **92**, the plate **123** has an upwardly struck-out portion **125** adjacent the outlet passage **92**. This upwardly struck-out portion **125** functions generally in the same advantageous manner as the member **81** in the unit **10** above described. In particular, it restricts the by-pass passageway in such a manner as to produce a venturi effect inducing flow from the space above the level of the oil in the reservoir **86** out through the outlet passage **92** in response to flow through the by-pass passageway.

It will, of course, be understood that while the various features of the invention have been described in detail in order that those skilled in the art might most readily apply the invention in practice, various modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

We claim as our invention:

In a dual path fluid flow unit, a body having an inlet passage, a wall facing said inlet passage and a valve seat about said inlet passage facing said wall, a tubular member projecting from said wall centrally into said inlet passage, a valve member having a central aperture receiving said tubular member, and a helical compression spring disposed between said wall and said valve member, said tubular member providing communication with one of the fluid flow paths with the valve member movable away from said seat to establish communication between the inlet and the other of the fluid flow paths.

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