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ATOMIZING INJECTOR NOZZLE

Filed May 15, 1964

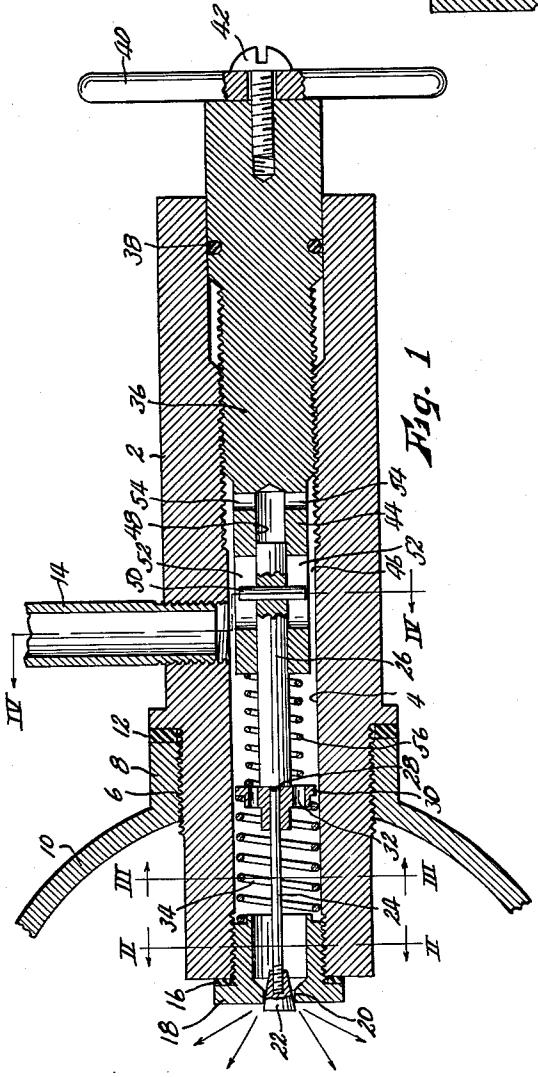


Fig. 1

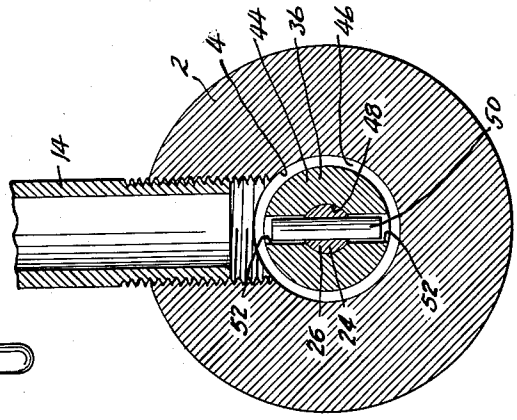


Fig. 4

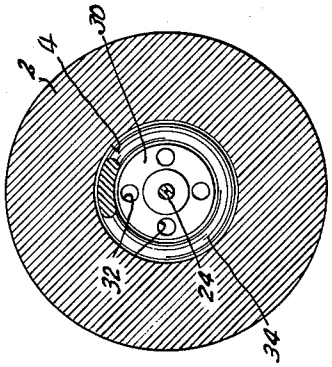


Fig. 3

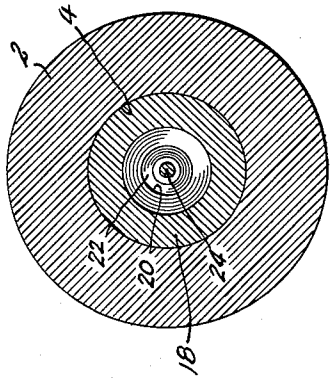


Fig. 2

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ATOMIZING INJECTOR NOZZLE

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This invention relates to new and useful improvements in injector nozzles, and has particular reference to a nozzle adapted to inject a finely divided or atomized spray or mist of a liquid chemical into a pressurized vessel. One practical application is in the injection of an anti-freeze compound into a pipeline or the like to prevent freezing of its contents, although it has many uses and applications.

An object of the present invention is the provision of a nozzle of the character described which is normally closed and held closed by the pressure existing in the vessel into which the injection is to be made, and opened by the pressure of the injection chemical, so that the nozzle cannot open until the pressure of the injection chemical exceeds the pressure in the vessel, whereby to prevent possible reverse flow through the nozzle. Also, this causes the valve elements of the nozzle, which also form the injection orifice for the spray, to be opened and closed as each injection starts and ends. This action tends to keep the nozzle orifice clear and unobstructed by breaking, cutting, or otherwise dislodging minute particles of solid matter which may be entrained in the chemical, and any deposit or scale which might build up on the valve parts.

Another object is the provision of an injector nozzle of the character described having spring means further resisting opening thereof, said spring means being adjustable whereby to vary the degree to which the injection chemical pressure must exceed the pressure of the vessel before the nozzle can open.

A further object is the provision of an injector nozzle of the character described wherein the valve elements may be ground or "lapped" at any time to insure a proper mating fit thereof, and to assist in cutting away any foreign matter or deposit which may have accumulated therebetween.

A still further object is the provision of an injector nozzle of the character described wherein the valve members may be opened wide independently of any pressure or spring tension being exerted thereon, whereby to permit flushing away of any foreign matter particles which are too large to pass through the atomizing opening.

Still another object is the provision of an injector nozzle of the character described wherein the above described operations of adjusting the operating pressure, lapping the mating surfaces of the valve members, and opening said valve members wide to flush particles of foreign matter therethrough, may all be performed from the exterior of the structure without disassembly thereof to any degree, and by manipulation of a single handwheel or other handle.

Other objects are simplicity and economy of construction, efficiency and dependability, and adaptability for use in a wide variety of applications.

With these objects in view, as well as other objects which will appear in the course of the specification, reference will be had to the accompanying drawing, wherein:

FIG. 1 is a longitudinal sectional view of an atomizing injector nozzle embodying the present invention, with parts left in elevation and partially broken away,

FIG. 2 is an enlarged sectional view taken on line II—II of FIG. 1,

FIG. 3 is an enlarged sectional view taken on line III—III of FIG. 1, and

FIG. 4 is an enlarged sectional view taken on line IV—IV of FIG. 1.

Like reference numerals apply to similar parts throughout the several views, and the numeral **2** applies to the body member of the nozzle, said body member being essentially tubular, having a bore **4** extending axially throughout the length thereof, and being externally threaded intermediate its ends, as at **6**, for engagement in a boss **8** of a vessel **10** into which a liquid is to be injected, so as to communicate with the interior of said vessel, the joint therebetween being sealed by a gasket **12**. The vessel **10** may for example be a pipeline, and is shown only fragmentarily. The liquid to be injected is fed into bore **4** of the body member, intermediate the ends thereof but exteriorly of vessel **10**, by means of a pipe **14** threaded into the body member and communicating with bore **4** thereof.

Threaded into the inner end if body member **2**, within vessel **10**, and sealed therein by a gasket **16**, is a tubular orifice member **18** defining a circular orifice **20** coaxial with the body member. Said orifice is controlled by a conical valve member **22** disposed coaxially therein, the larger end thereof being disposed externally of the orifice and being of larger diameter than said orifice, whereby to be seated securely in said orifice by inward force exerted thereon. Threaded into the inner end of said valve is a valve stem **24** which extends axially into bore **4** of the body member. The rearward or inner end portion **26** of said stem is of greater diameter, whereby to form a forwardly facing shoulder **28** on said stem intermediate the ends thereof. Carried slidably on the smaller portion of said stem, and seated against shoulder **28**, is a guide washer **30** of a diameter to slide freely in bore **4**, said washer having apertures **32** formed therethrough to permit passage of the liquid to be injected. A helical compression spring **34** is disposed about the stem, bearing at its forward end against orifice insert **18**, and at its rearward end against washer **30**, whereby to urge valve member **22** yieldably into seating relation to orifice **20**.

Threaded into the outer end portion of body member **2** is an operating stem **36**, said stem being sealed in bore **4** by an O-ring **38** or the like, and having a handwheel **40** or other handle whereby it may be manually rotated secured fixedly thereto by a screw **42**. The inner end portion **44** of stem **36** is reduced to a diameter less than the internal diameter of bore **4**, whereby to provide an annular flow passage **46** therebetween. Said operating stem has a bore **48** formed therein from the inner end thereof in which the enlarged portion **26** of valve stem **24** is received for axial sliding movement. A short pin **50** is fixed transversely in portion **26** of valve stem **24**, and extends outwardly therefrom, the extended end portions thereof being engaged slidably in longitudinally elongated slots **52** formed in portion **44** of operating stem **36**. Holes **54** formed through stem **36** and communicating with the inner end of bore **48** serve to equalize pressure in bores **4** and **48**. A helical compression spring **56**, weaker than spring **34**, is disposed about portion **26** of valve stem **24**, bearing at one end against washer **30** and at its opposite end against the inner end of operating stem **36**.

In operation, it will be seen that the fluid pressure in vessel **10** tends to seat valve member **22** in orifice **20**, so that said valve cannot open until the pressure of the liquid to be injected, within bore **4** of the nozzle, exceeds the pressure in vessel **10**, so that in no event can there be a reverse flow through the nozzle. Actually, before the valve can open, the pressure in bore **4** must exceed the pressure in vessel **10** by an amount sufficient to overcome the closing bias of spring **34**. Whenever it does so, valve **22** is forced outwardly by fluid pressure, acting through stem **24** and washer **30** to compress spring **34**. Hence the valve opens at the beginning and closes at the end of each injection, and this is helpful in keeping the nozzle orifice clean and unobstructed, in that it tends to

cut away or otherwise dislodge any scale or bits of foreign matter which tend to lodge or be deposited between valve 22 and orifice 20.

It will be seen that spring 56 also tends to push washer 30 in a direction to allow opening of the valve, counteracting the closing bias of spring 34, so that the actual closing bias represents the differential between the tensions of springs 34 and 56. Therefore the operating pressure of the nozzle may be adjusted by turning handwheel 40 to advance or retract operating stem 36 to adjust the compression of spring 56, advancing said stem to compress spring 56 for lower operating pressures, and retracting said stem to relax spring 56 for higher operating pressures. Within limits, advancing or retracting stem 36 has no direct effect on valve stem 24 due to the lost motion therebetween permitted by the engagement of pin 50 in slots 52. Preferably, spring 56 is sufficiently weaker than spring 34 that even when stem 36 is advanced to provide maximum compression of spring 56, so that the rearward ends of slots 52 engage pin 50, the valve is still biased toward its closed position by at least a minimum differential tension of spring 34.

It will be seen, however, that if operating stem 36 is advanced still further after the rearward ends of slots 52 engage pin 50, a direct connection is formed between the stems so that valve 22 may be pushed forwardly to open orifice 20 very widely, and to retain it in this wide-open position. This is useful for flushing through the nozzle any particles of foreign matter which may accumulate in bore 4 and which are too large to pass through the highly restricted annular orifice normally provided around valve member 22. Conversely, if operating stem 36 is retracted until the forward ends of slots 52 engage and press rearwardly on pin 50, valve member 22 is held and locked in its closed position in orifice 20, so that it cannot open regardless of the pressure which may exist in bore 4.

Finally, it will be seen that at any setting of operating stem 36, handwheel 40 thereof may be grasped and oscillated angularly, and that this oscillatory motion will be transmitted through pin 50 and valve stem 24 to valve member 22, causing the latter to oscillate in orifice 20. If performed while the nozzle is closed, this operation will cause the valve member 22 to be ground or "lapped" into orifice 20 to fit very accurately therein. This is useful in grinding or cutting away or otherwise dislodging any foreign matter particles or scale or sludge which may tend to be deposited in the orifice, whereby to better insure efficient atomizing action when the nozzle is open, and also to insure full and accurate closure of the nozzle at the end of each injection.

While I have shown and described a specific embodiment of my invention, it will be readily apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention as defined by the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent is:

1. An atomizing injector nozzle comprising:
   (a) a hollow body member having an internal chamber into which a pressurized fluid to be injected may be introduced, and having an outlet orifice through which said fluid may be exhausted,
   (b) a valve member disposed at said orifice and adapted by movement inwardly of said body member to seat in and seal said orifice,
   (c) a valve stem fixed to said valve member and extending into the interior of said body member,
   (d) a first stronger spring biasing said valve stem inwardly to close said valve,
   (e) a second weaker spring partially counteracting said first spring whereby the residual force tending to close said valve is the difference between the pressures of said springs, and

   (f) means operable from externally of said body member to adjust the pressure of said second spring.

2. An atomizing injector nozzle as recited in claim 1 wherein said body member forms an inwardly facing shoulder surrounding the orifice thereof, and with the addition of a washer member surrounding said valve stem intermediate its ends and secured against movement thereon away from said valve member, said first spring being disposed about said stem and compressed between said shoulder and said washer, and wherein said means for adjusting the pressure of said second spring includes an operating stem carried in said body member coaxially with said valve for movement parallel to the axis thereof, the inner end of said stem being spaced apart from said washer, said second spring being compressed between said washer and the inner end of said operating stem, and means for moving said operating stem longitudinally with respect to said body member.

3. An atomizing injector nozzle comprising:
   (a) a hollow body member having an internal chamber into which a pressurized fluid to be injected may be introduced, and having an outlet orifice through which said fluid may be exhausted,
   (b) a valve member disposed at said orifice and adapted by movement inwardly of said body member to seat in and seal said orifice,
   (c) a valve stem fixed to said valve member and extending into the interior of said body member,
   (d) resilient means biasing said valve stem inwardly whereby to urge said valve member yieldably toward its closed position,
   (e) an operating stem carried by said body member for movement parallel to said valve stem and engaging said valve stem, said valve stem having a free longitudinal movement with respect to said operating stem,
   (f) means operable externally of said body member for moving said operating stem, and
   (g) means limiting free inward movement of said operating stem with respect to said valve stem, whereby when said operating stem is advanced beyond said limit, said limiting means will engage said valve stem and force said valve open against said biasing means.

4. An atomizing injector nozzle comprising:
   (a) a hollow body member having an internal chamber into which a pressurized fluid to be injected may be introduced, and having an outlet orifice through which said fluid may be exhausted,
   (b) a valve member disposed at said orifice and adapted by movement inwardly of said body member to seat in and seal said orifice,
   (c) a valve stem fixed to said valve member and extending into the interior of said body member,
   (d) resilient means biasing said valve stem inwardly whereby to urge said valve member yieldably toward its closed position,
   (e) an operating stem carried by said body member for movement parallel to said valve steam and engaging said valve stem, said valve stem having a free longitudinal movement with respect to said operating stem,
   (f) means operable externally of said body member for moving said operating stem, and
   (g) means limiting the free outward movement of said operating stem with respect to said valve stem, whereby when said operating stem is retracted to cause said limiting means to engage said valve stem, said valve is locked in its closed position.

5. An atomizing injector nozzle as recited in claim 4 wherein said limiting means is operable to limit the inward as well as the outward free movement of said operating stem with respect to said valve stem, whereby when said operating stem is advanced inwardly to and beyond the inward limit, said valve is forced open against said biasing means.

6. An atomizing injector nozzle comprising:
(a) a hollow body member having an internal chamber into which a pressurized fluid to be injected may be introduced, and having an outlet orifice through which said fluid may be exhausted,
(b) a valve member disposed at said orifice and adapted by movement inwardly of said body member to seat in and seal said orifice,
(c) a valve stem fixed to said valve member and extending into the interior of said body member,
(d) resilient means biasing said valve stem inwardly whereby to urge said valve member yieldably toward its closed position,
(e) an operating stem carried by said body member coaxially with said valve stem and for rotation about its axis, said operating stem being connected to said valve stem for free longitudinal movement with respect thereto but secured against rotation with respect thereto, and
(f) means operable externally of said body member to rotate said operating stem, whereby said valve member is rotated in said orifice.

7. An atomizing injector nozzle as recited in claim 6 with the addition of:
(a) means limiting the free longitudinal relative movement of said valve stem and said operating stem.

8. An atomizing injector nozzle as recited in claim 6 with the addition of:
(a) resilient means counteracting the tension of said biasing means, and
(b) means operable by rotation of said operating stem to adjust the tension of said last named resilient means.

9. An atomizing injector nozzle as recited in claim 7 with the addition of:
(a) resilient means counteracting the tension of said biasing means, and
(b) means operable by rotation of said operating stem to adjust the tension of said last named resilient means.

10. An atomizing injector nozzle comprising:
(a) a generally tubular body member having forward and rearward ends, and having a transverse fluid inlet intermediate the ends thereof,
(b) a fitting affixed in the forward end of said body member having a circular orifice formed therein disposed coaxially with said body member, and defining a rearwardly facing shoulder surrounding said orifice within said body member,
(c) a conical valve member disposed in said orifice and adapted to seat rearwardly therein,
(d) a valve stem affixed to said valve member and extending rearwardly within said body member coaxially therewith,
(e) a washer carried on said valve stem intermediate the ends thereof and secured against rearward movement thereon,
(f) a first stronger spring compressed between said shoulder and said washer whereby to bias said valve member toward its seated position,
(g) an operating stem threaded in the rearward end of said body member for rotational and longitudinal movement with respect thereto, the forward end portion of said operating stem having a bore formed therein in which the rearward portion of said valve stem is disposed for axial sliding movement,
(h) a pin fixed transversely in the rearwardly portion of said valve stem and projecting laterally therefrom into longitudinally elongated slots formed therefor in said operating stem, whereby to prevent relative rotation of said stems and to limit relative longitudinal movement thereof, and
(i) a second weaker spring compressed between said washer and the forward end of said operating stem, whereby partially to counteract the tension of said first stronger spring.

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