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HOSE NOZZLE CONSTRUCTION

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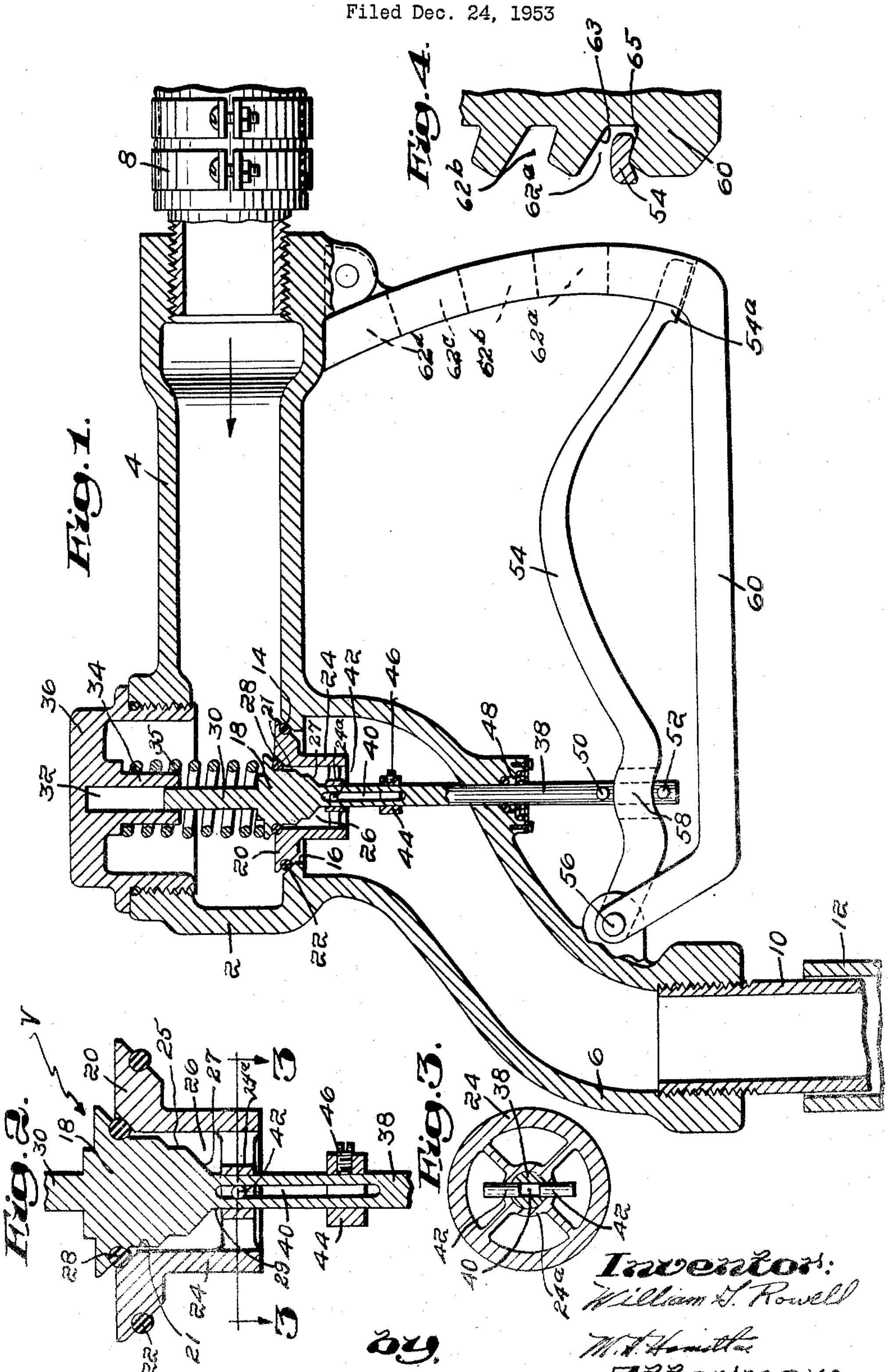

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HOSE NOZZLE CONSTRUCTION

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8 Claims. (Cl. 222—394)

This invention relates to improved fluid delivery nozzles of the type which are commonly employed in tank trucks and which are customarily attached at the discharge end of a flexible hose for controlling delivery of a fluid, such as fuel oil, into a storage tank.

Fluid delivery nozzles as now developed in the art are subject to several disadvantages and are particularly unsatisfactory in view of gradual changes which have taken place in the fuel oil delivery field relating especially to greatly increased pumping speeds. For example, pumping rates of 40 to 50 gallons per minute are now common, as compared with earlier standard pumping rates of 25 gallons per minute. This increase in pumping speeds, although resulting in more efficient oil delivery operations, necessarily, requires that the operator use more care to avoid dangerous overflow or loss of oil. Hence, the operator needs a sharper control of the pumping operation at all times in order to combine efficiency with safety. such a control is not available in present nozzles and, in particular, there is no means provided for regulating flow uniformly over a range of pumping speeds. Various other objections, such as valve sticking, fluid leakage, excessive wear and break down, are also experienced with conventional types of nozzles.

It is an object of the present invention to improve fluid delivery nozzles and especially to deal with the problem of controlling pumping rates so as to provide for uniformly graduated increases or decreases in pumping rates. Another object is to devise a special valve structure particularly suited for use with nozzle triggering mechanisms which are customarily retained in notched handle structures. The invention also aims to provide improved drainage features and valve sealing features in a nozzles structure of the class indicated. Still another object is to provide a nozzles construction that is relatively inexpensive, highly reliable in operation, capable of withstanding a great deal of rough handling, and yet characterized by a relatively simple design.

These and other objects and novel features will be more fully understood and appreciated from the following description of a preferred embodiment of the invention selected for purposes of illustration and shown in the accompanying drawings, in which:

Fig. 1 is a cross-sectional view taken on a line approximately centrally of the improved nozzle construction of the invention and particularly illustrating the control valve mechanism occurring in a normally sealed position;

Fig. 2 is an enlarged detail cross-sectional view of the valve control mechanism;

Fig. 3 is a cross-section taken on the line 3—3 of Fig. 2; and

Fig. 4 is a fragmentary cross-sectional view of a portion of the nozzle handle and trigger mechanism.

The nozzle construction of the invention as illustrated in the above noted figures is based in part upon the novel concept of a special cooperating control valve assembly

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including a pair of valves which are particularly suited for use in an elbow-shaped conduit such as is commonly utilized in fluid delivery nozzle casings. The structure shown in Figs. 1 to 3, inclusive, constitutes one preferred embodiment of the invention which will be described with reference especially to a nozzle casing. It should be understood, however, that the invention is not intended to be limited entirely to nozzle casings and may be embodied in other forms of fluid control devices.

The principal parts of my improved nozzle, therefore, include an elbow-shaped conduit, the control valve assembly noted above located in the conduit, and triggering means for operating the control valve assembly. The basic component of the control valve assembly is a stepped valve element of special design. This element, together with a second cooperating tubular valve element, have been illustrated in Fig. 2 removed from the elbow and generally denoted by the arrow V.

Considering these parts in detail, attention is directed to Fig. 1 in which numeral 2 denotes a casing which is provided with an inlet conduit 4 and a discharge conduit 6. Fuel oil or other fluid body is delivered from a tubular connection 8 and normally the fluid body is discharged through the threaded extension 10 and into a fill pipe 12 of a storage tank not shown in the drawings.

In accordance with the invention I form the casing 2 with a conical seating portion 14. This portion is extended downwardly in the form of a short cylindrical sleeve 16. The control valve assembly of the invention is mounted against this conical seating portion and includes an outer tubular valve element 20, located axially through the cylindrical sleeve 16, and the stepped valve element 18.

The valve member 20 is normally held in sealed relationship with respect to the annular seat 14 by means of a recessed sealing ring 22, and at its lower portion the tubular valve element 20 is provided with a cylindrical extension 24 having an inner cylindrical bore 26 which surrounds the lower part of the valve element 18. This element is also provided with a sealing ring 28 which serves to provide a seal between itself and the movable valve seat member 20, in the manner illustrated in Fig. 1.

As may be more clearly seen from an inspection of Fig. 2, the stepped valve 18 is formed with a cylindrical surface 21 which normally lies in closely spaced apart relationship with respect to the inner peripheral surface of the valve member 20. This cylindrical surface 21 merges with a conical or inwardly tapered surface 23 which, in turn, terminates in a second smaller cylindrical surface 25. Similarly, a second tapered or conical surface 27 terminates in a third smaller cylindrical surface 29. It will be apparent that when the valve element 18 is raised away from the tubular valve member 20, each one of these cylindrical surfaces 21, 25 and 29, respectively, will move into successive positions of spaced relationship with respect to the inner periphery of the member 20 and will thereby define a series of annular passageways providing for periodic increases in the volume of fluid passing between the two valve members. It will also be observed that the valve member 20 when moved away from its seating surface 22 may also comprise an annular passageway of even greater magnitude through which fluid may pass concurrently with passage between the members 18 and 20.

To carry out displacement of the valve elements 18 and 20 from their respective seats, a valve lifting mechanism is provided. Thus the valve 18 at its upper side is provided with a valve stem 30 which is slidably guided in a recess 32 formed in a neck portion 34 of a cap 36. The latter member is fitted with an O-ring sealing member 36*a* and threaded into a similarly threaded opening at the upper side of the casing **2**. The valve **18** is further provided at its lower side with a valve lifting rod **38** which extends through a spider portion *24a* integral with the cylindrical extension **24**. The rod **38** is provided with a slot **40** through which extend pins **42** slidably mounted in the spider portion *24a*, as best shown in Fig. 3. A second valve lifting member **44** is adjustably secured around the lifting rod **38** by means of an adjusting screw **46**.

The valve lifting rod **38** at its lower end is guided through a bearing **48** and presents an outwardly projecting bottom portion through which are transversely located pins **50** and **52** occurring in spaced relation, one above the other. Arranged to be loosely guided between pins **50** and **52** is a trigger member **54** loosely pivoted at **56** and having an intermediate curved portion **58**. The trigger member **54** is formed with an enlarged end portion *54a* which is retained within a protective guard **60**. The latter member is formed with a series of notches as, for example, *62a*, *62b*, *62c* and *62d*, and these notches are designed to releasably receive and hold an enlarged end *54a* of the trigger member in the manner illustrated in Fig. 4. The loose pivoting of trigger member **54** at **56** permits the trigger member to be shifted laterally in and out of the several notches. The under side of the enlarged portion *54a* of the trigger is preferably hollowed out, as noted in Fig. 4, and the two sides which comprise each of the notches as, for example, the sides **63** and **65** of the notch *62a*, are arranged to extend angularly inwardly and downwardly in a somewhat converging manner so that in the event the trigger member is disengaged from one of the uppermost notches and positioned in a next succeeding notch, it is held against accidental dislodgment and complete shutting off of flow of fluid.

An important feature of the structure described is the manner in which the valve **18** is constructed with annular steps. I am aware that it is old in the art to utilize valve arrangements which provide for varying flow rates depending upon annular stepped valve portions. However, as noted above, these prior art valve steps have heretofore been constructed in such a manner that the stepped sections, although permitting variation in flow rate, fail to provide for uniformly graduated increases or decreases in flow rate. One difficulty with these prior art structures is found to be that they attempt to provide for uniformly graduated increases or decreases in flow based upon the use of stepped portions bearing a definite proportionate relationship to one another. Such a structure fails to take into account the fact that in moving a stepped valve from one position to another where, for example, a stepped portion may provide for a larger passageway, there may occur a drop in pressure and there will result a disproportionate drop in gallonage of fluid actually delivered.

It has also been determined in these trigger type nozzle devices that when the trigger is moved from one notch into another notch position there may occur a momentary surge from pressure change and this surge may cause an undesirable overflow from the fill pipe. Such an occurrence is particularly likely to occur where the operator over-shoots the notch position into which he intended to move the trigger while fluid is flowing in the system.

I have discovered that it is practical to devise a valve with a series of annular steps which are so chosen in their axial and diametric dimensions as to constitute at each position a flow passageway representing a uniformly graduated increase or decrease in flow rate, and these dimensions are so derived as to represent a function of the cross-sectional area of the discharge outlet and the pressure at which fluid is being pumped at any given instant. I have further devised these steps with interconnecting conical or tapered surfaces which prevent an abrupt change in the transition of one flow rate to another, and which thereby tend to avoid a momentary surge in the flow line which might cause overflow at the fill pipe.

In each annular step in the series of annular steps I find there is no particular proportionate relationship in the size or shape of successive steps, but each step must give a total cross-sectional area that progresses geometrically and not arithmetically. However, each step can be and has been, in accordance with the invention, so constructed as to represent a predetermined function of cross-sectional area of flow and the pressure at which fluid is being pumped. Therefore, a series of steps may be selected so as to provide for an increase in volume of fluid delivered in each instance by an increment of substantially equal magnitude.

It will be readily observed from Fig. 2 that when the valve element **18** is initially separated from element **20**, the space through which the fluid flows is the first annular area defined by the cylindrical surface **21** of element **18** and the cylindrical interior of the cylindrical extension **24**. When valve element **18** is raised to a point where the controlling annular area is that defined by the cylindrical surface **25** on element **18** and the interior cylindrical surface of extension **24**, such second annular area will be a certain absolute amount greater than the annular area defined by the cylindrical section **21**. Finally, when valve element **18** is opened to maximum position so that the fluid now flows through the space defined by the cylindrical surface **29** of the element **18** and the interior cylindrical surface of the extension **24**, such third annular area will be greater than the second annular area by an absolute amount which is larger than the absolute amount the second annular area exceeds the first annular area. The increase in these annular areas, one over the other, forms an area increase according to a geometrical progression as distinguished from equal area increases which may be called increases according to an arithmetical progression. The geometric increase in the areas is necessary to compensate for the drop in pressure that automatically occurs as the annular area through which the fluid flows is increased: i. e., if at each increased area opening it is desired to have the delivered volume of fluid increase arithmetically, it is necessary to have a geometric increase in the successive annular areas of the valve opening so that the reduced pressure which then prevails will be adequate to deliver the arithmetically increased volume of fluid.

As an aid to further visualize a typical delivery operation the necessary operations involved in filling a fuel tank may be considered. Upon arrival at a delivery stop the driver engages the conventional power take-off lever in the tank truck vehicle. This causes the pump to be engaged with the engine and to start rotating. As soon as the pump is rotating high pressures are built up in the pump and discharge lines extending therefrom. This is due to the fact that the pumps commonly employed for this type of service are of the positive displacement type.

It should be recognized that pressure thus developed would normally build up until the pump destroyed itself. To prevent this a pressure regulating bypass relief valve is employed with the pump rotating at its rated speed. This relief valve is adjusted to relieve pressures at some desired range. A typical situation is to set the relief valve to relieve pressures in excess of between 45 and 50 lbs. per square inch.

With the pump thus exerting pressure and the excess pressure relieved, as described, the driver pulls out the hose and engages the nozzle spout in the fill pipe conduit connected to a customer's oil storage tank. The driver then opens the nozzle valve by lifting the trigger **54** until he gets the maximum flow of oil which may be delivered without oil spilling from around the fill pipe. The driver then pushes the trigger **54** into one of the retaining notches *62a*, *62b*, *62c* or *62d*. This means the driver is now assured of safely filling the tank at a delivery speed just below the maximum rate that the fill pipe will accommodate without spilling.

With a static pressure condition such as the pressure range of from 45 to 50 lbs. per square inch noted above, I find that I may very effectively utilize a relatively small stepped valve, such as the valve **18** shown in the drawings, to provide for three stages of changing flow under this pressure head. By using the small valve **18** within the valve **20** it is extremely easy to carry out the initial opening stage. The pressure within the nozzle is progressively and smoothly decreased with a minimum of shock to the operator, and the whole operation of the trigger is smooth and positive.

As illustrative of one specific arrangement involving three annular steps on the inner valve **18** to provide three passageways and a fourth passageway resulting from separation of the valve **20** from the seat **14** operating, for example, under the 45 to 50 lbs. per square inch pressure range cited, the progressive movement of the trigger and valve assembly may be as follows:

Starting with the trigger **54** in the lowermost position shown in Fig. 1, the end portion **54*a*** is engaged in the notch **62*a*** in the position shown in Fig. 4. When thus moved the trigger engages with the valve stem **38** against the pin **50**, forcing the valve member **18** upward against the valve spring **35**. This lifts the sealing ring **28** from the outer valve **20**. A metered flow of oil then takes place between the cylindrical surface **21** of the valve **18** and the inner peripheral surface of the valve **20**, using proportions such as those shown in Fig. 2, for example. There may thus be obtained a fluid flow of a magnitude representing approximately 25% of the total possible flow through the nozzle.

Assuming now that it is desired to increase the rate of flow by an increment of equal magnitude, the trigger is lifted upwardly and engaged in the notch **62*b***. As the trigger leaves notch **62*a*** an abrupt change in the transition in one flow rate to another is prevented by the tapered or conical surface **23**, thus preventing a momentary surge from causing overflow at the fill pipe. When moved into this second notch position **62*b***, the cylindrical surface **25** and inner peripheral surface of valve element **20**, constitute an enlarged annular passageway which can be chosen to comprise approximately 50% of the maximum flow through the nozzle.

A third position is arrived at by lifting the trigger and engaging it with notch **62*c***, and in this case the cylindrical surface **29** of the valve **18** cooperates with the inner peripheral surface of valve element **20** to comprise still another annular passageway so chosen that the flow resulting therethrough will be approximately 75% of the total possible flow.

A fourth and final stage is then arrived at by lifting the trigger and engaging it in the notch **62*d***. When thus moved the lifter element **44** raises the entire valve assembly, including the valve element **20**, away from the seat **22**, and there is then comprised a fourth annular passageway which allows flow of fluid concurrently between the valve **20** and the casing sides, as well as between the valve elements **18** and **20**. This constitutes 100% of the maximum flow through the nozzle.

The invention includes several other desirable features resulting from the construction and arrangement of the parts described. Thus the trigger **54** by means of its arcuate section normally engaged between the pins **50** and **52** on the valve lifting rod **38** permits a positive manual closure of the valve should the spring **35** fail or should the valve seat become temporarily dislocated. It will readily be apparent that by forcing the trigger **54** downwardly against the pin **52** it is possible to draw both of the valve elements **18** and **20** downwardly against the seat **14** and thus prevent accidental discharge of fuel oil or other inflammable fluid.

Another desirable feature is the arrangement of the valve mechanism in the elbow portion of the conduit so that oil retained at any point in the structure may have an opportunity to drain down through the end of the conduit **10**, thus avoiding any objectionable spilling of fluid after the nozzle has been withdrawn from a fill pipe.

Still another feature resides in the special means for preventing the valve **18** and the valve **20** from rotating about their respective seats. Extensive tests of nozzles of conventional sealing construction has revealed that wear does not occur evenly around the annular valve seats of conventional structures for one reason or another, and thus non-uniform wear occurs. If a valve is permitted to rotate unmatched contours come into contact with one another and leakage devolops. There has thus been present for a period of years intermittent and uncontrolled nozzle leakage of a serious and annoying nature. In the present invention this has been completely eliminated by providing the trigger **54** with an intermediate arcuate or curved section **58** so that the pin **52** acts as a stop for preventing the valve lifting rod **38** from rotating. Similarly, by providing the anti-rotation pins **42** in the spider portion of the valve **20** and extending these pins through the slot **40** of the valve lifting rod, rotation of valve **20** is also prevented and the entire valve assembly is necessarily held in a constant seating position.

It will be evident from the foregoing description that I have provided an improved nozzle construction which not only provides for uniformly graduated increases or decreases, but also deals with a number of minor difficulties, such as failure to check leaking, failure to drain, and failure to properly hold the trigger in an engaged position.

While I have shown a preferred embodiment of the invention, it should be understood that various changes and modifications may be resorted to in keeping with the scope of the appended claims.

Having thus described my invention, what I desire to claim as new is:

1. A fluid delivery nozzle for use under conditions presented by pumping mechanism of the type in which the fluid pressure drops as the nozzle is opened and the flow increases, comprising a fluid conduit having an inlet for receiving a fluid body under varying pressures automatically determined by the available valve opening from said nozzle and an outlet for discharging said fluid body, valve means for controlling the flow of fluid through said conduit, said valve means including a valve seat member formed wth a cylindrical surface and a cylindrical bore extending away from the seating surface, a valve element constructed and arranged to be moved in to sealing relationship with the said valve seat member, said valve element being formed with a series of successively smaller cylindrical sections projecting in to the said cylindrical bore, and means for varying the position of the valve element and the cylindrical sections in relation to the cylindrical bore to provide a series of annular fluid delivery passageways each of which provides a cross-sectional area greater than the preceding smaller cross-sectional area according to a generally geometric progression and which results in progressive drops in fluid pressure as each successive, larger cross-sectional area is reached, thereby to cause the fluid delivered by the said nozzle when at each successive, increasing, cross-sectional area to increase substantially arithmetically.

2. A fluid-delivery nozzle as set forth in claim 1 and including a trigger for manually moving said valve element section by section with respect to said cylindrical bore, and latching means for holding said trigger and said valve element positioned with any selected section cooperating with said bore whereby any proportionate volume of the maximum delivery rate may be selected and delivered from said nozzle.

3. A fluid delivery nozzle for use under conditions presented by pumping mechanism of the type in which the fluid pressure drops as the nozzle is opened and the flow increases, comprising a fluid conduit having an inlet for

receiving a fluid body under pressure and an outlet for discharging said fluid body, valve means for controlling the flow of fluid through said conduit, a valve seat member formed with a sealing surface and a cylindrical bore extending away from the sealing surface, a valve element, spring means for normally urging the valve element in to sealing relationship with the said sealing surface, said valve element being formed with a reduced end portion which projects in to the said cylindrical bore, said reduced end portion comprising a series of cylindrical sections which cooperate with the said cylindrical bore, and means for selectively locating the cylindrical sections in predetermined positions in the cylindrical bore thereby to provide a series of annular fluid delivery passageways which increase successively in cross-sectional area by increments of unequal and increasing magnitude, each successive, larger, annular fluid-delivery passageway acting to cause a further drop in the pressure of the fluid body received by said nozzle, the relationship of each of the series of annular cross-sectional areas presented by said valve element to said cylindrical bore and the pressure resulting therefrom being such that the volume of fluid discharged from said nozzle per unit of time will increase substantially arithmetically in approximately whole units as said valve element is progressively moved section by section from closed to maximum open position.

4. A fluid-delivery nozzle as set forth in claim 3 and including a trigger for manually moving said valve element section by section with respect to said cylindrical bore, and latching means for holding said trigger and said valve element positioned with any selected section cooperating with said bore whereby any proportionate volume of the maximum delivery rate may be selected and delivered from said nozzle.

5. A structure according to claim 3, in which the valve seat member is mounted in sealing relationship with respect to an adjacent supporting portion of the said nozzle casing, and means for moving the said valve seat member out of sealed relationship with respect to the supporting portion of the casing to define an annular passageway acting in addition to the maximum passageway obtainable between the valve element and said cylindrical bore and thereby to cause a further drop in the pressure of the fluid body received by said nozzle, the combined areas of the passageways between said valve element and said cylindrical bore and the valve seat member and supporting portion of the casing in relation to the further reduced pressure acting to cause a further increase in fluid delivery of approximately one whole unit according to the said arithmetical progression.

6. A fluid-delivery nozzle as set forth in claim 5 and including a trigger for manually moving said valve element section by section with respect to said cylindrical

bore and for thereafter moving said valve seat member to open position, and latching means for holding said trigger at any selected position corresponding to a known degree of discharge opening of said nozzle, whereby any proportionate volume of the maximum delivery rate may be selected and delivered from said nozzle.

7. A fluid delivery nozzle for use under conditions presented by pumping mechanism of the type in which the fluid pressure drops as the nozzle is opened and the flow increases, comprising a fluid conduit having an inlet for receiving a fluid body under pressure and an outlet for discharging said fluid body, valve means for controlling the flow of fluid through said conduit, a valve seat formed internally of the casing, valve means cooperating with the valve seat to control the flow of fluid through said conduit, the valve means including a plurality of cooperating valve members arranged in concentric sealed relationship with a series of reduced cylindrical sections on the innermost valve member cooperating with the immediately adjacent surfaces of the next outer valve member to define fluid passageways which increase in cross-sectional area in unequal and increasing amounts, and said outermost valve member being movable away from the said casing seat to define an additional of cross-sectional area such as to provide a total passageway area of a further increased amount.

8. A fluid-delivery nozzle as set forth in claim 7 and including a trigger for manually moving said valve members successively to positions of increased degree of opening, and latching means for holding said trigger and the valve members positioned at any selected degree of opening whereby any proportionate volume of the maximum delivery rate may be selected and delivered from said nozzle.

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