Jan. 9, 1940. H. F. SIMON 2,186,214

LIQUID ATOMIZING DEVICE

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Fig.1.

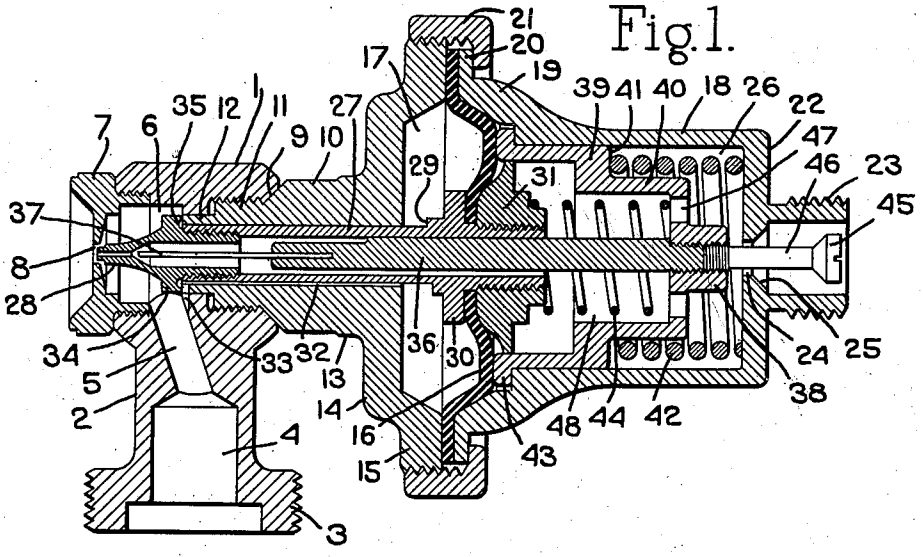


Fig.2.

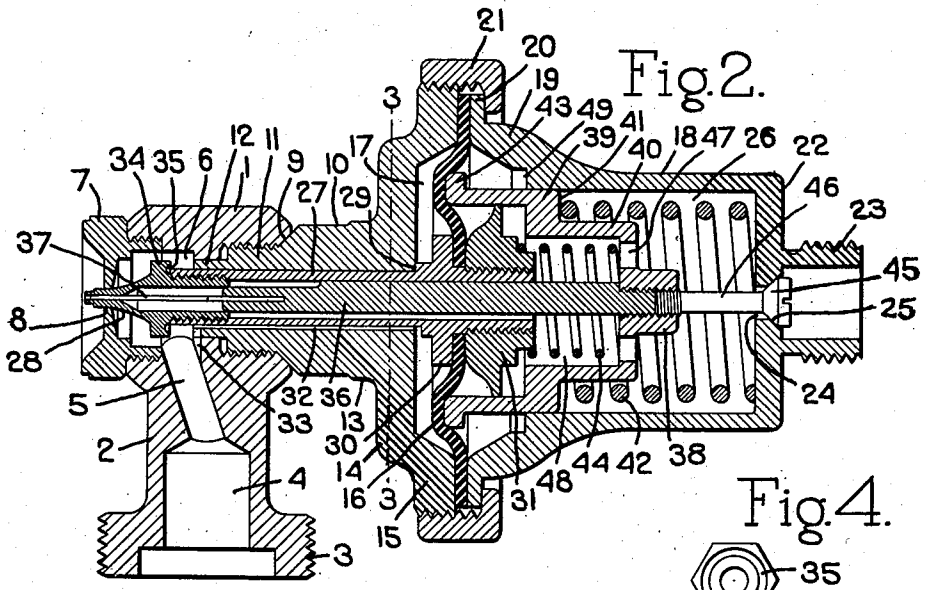
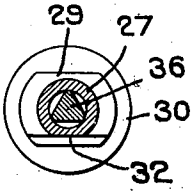


Fig.4.

Fig.3.



Inventor
Herman F. Simon
by Heard Smith & Tennant.
Attys.

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Fig. 5.

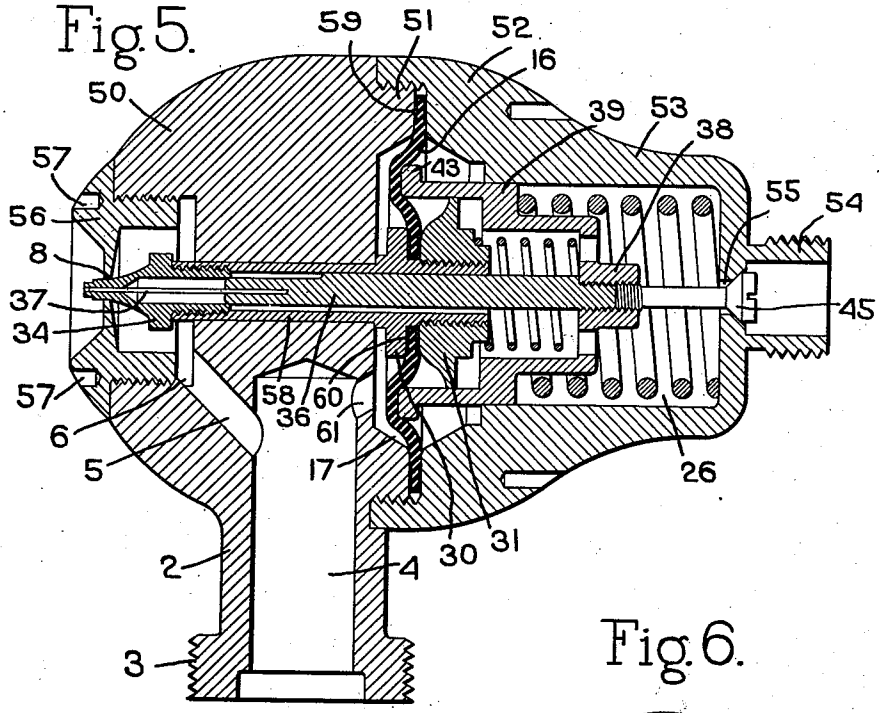


Fig. 6.

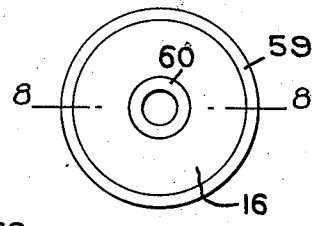


Fig. 7.

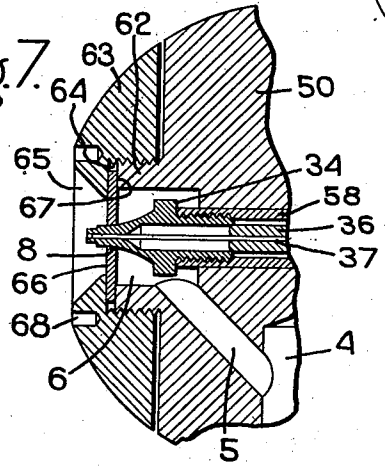
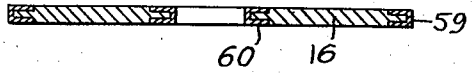


Fig. 8



Inventor.
Herman F. Simon
by Heard Smith & Tennant.
Attys.

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UNITED STATES PATENT OFFICE

2,186,214

LIQUID ATOMIZING DEVICE

Herman F. Simon, Lunenburg, Mass., assignor to Parks-Cramer Company, Fitchburg, Mass., a corporation of Massachusetts

Application September 22, 1936, Serial No. 101,946

14 Claims. (Cl. 299—59)

My invention deals with that type of liquid-atomizing devices in which the energy of compressed air, or of any other suitable elastic fluid under pressure, is used to generate and distribute a fine spray of liquid particles, and in particular, with atomizers in which compressed air is utilized as the agency for atomizing water for the purpose of humidification.

Many efforts have been made to produce an apparatus of this general type provided with special means for conveniently clearing the channels and ports of such atomizers of accumulated deposits without disassembling and reassembling the atomizer, but the resulting increase in mechanical complexity has proved a serious disadvantage.

It is therefore an object of my present invention to provide relatively simple and inexpensive means adapted for automatic penetration of the ports of the atomizer to thoroughly clear them of deposits whenever the supply of actuating fluid is interrupted and also adapted for the automatic withdrawal of the port-cleaning instrumentalities upon the resumption of the supply of fluid so as to maintain continuous operation of the atomizer except when the supply of fluid is purposefully interrupted.

For convenience in description and identification, I hereinafter define the type of atomizer involved in my invention as a self-cleaning atomizer. The elastic fluid under pressure supplied to the atomizer, such as compressed air, is similarly defined as "the atomizing fluid" and the liquid to be atomized as "the liquid." Since atomizing units of this type necessarily possess outlet ports both for the atomizing fluid and for the liquid, such outlet ports are similarly defined as the "fluid port" and the "liquid port."

Self-cleaning atomizers are especially desirable for purposes of humidification, in which art it is common practice to use automatic means responsive to variations in moisture content of the atmosphere to interrupt and resume the supply of atomizing fluid, as occasion requires, in order to regulate the delivery of moisture thereby to control the content of moisture in the atmosphere.

When self-cleaning atomizers are to be used for humidification, it is especially important to prevent the delivery of water at any time other than when the atomizer is subject to the full operating pressure of the compressed air supplied thereto, for any considerable reduction in air pressure causes incomplete atomization and results in the delivery of an objectionably coarse spray or dripping.

It is therefore a further object of my invention to provide automatic port-cleaning means for first penetrating and closing the liquid port effectively in response to the first appreciable fall in pressure following any interruption of the fluid supply and before penetrating the fluid or air port, and, conversely, to provide fluid-actuated means for first opening the air port effectively and only opening the liquid port subsequently in response to resumption of the fluid supply, thereby effectively to prevent the delivery of liquid except when atomizing fluid is being delivered at its full atomizing capacity.

To this important end my invention provides fluid-actuated means adapted for separate and positive motivation of the respective port-cleaning instrumentalities operable to first withdraw the fluid port-cleaning means and subsequently the liquid port-cleaning means from their respective ports in response to the supply of fluid under pressure, thereby to position them for continuous atomization only while atomizing fluid is being supplied.

My invention also provides other means adapted to positively return the port-cleaning instrumentalities to their respective ports independently of each other, the return of the water port-cleaning means preceding the return of the air port-cleaning means. This arrangement for the independent and serially reversed motivation of the port-cleaning instrumentalities is an outstanding characteristic of my invention.

It is desirable to avoid the use of pistons for motivating the port-cleaning means in self-cleaning atomizers because of the friction inherent in piston packing and the inevitable wasteful loss of atomizing fluid by leakage past piston packings during periods when the atomizer is in operation. It is also desirable to avoid the exposure of any part of the liquid supply while passing through the atomizer to the pressure of the atomizer fluid, since any such contact between the fluid and the liquid tends to cause intermittent atomization.

It is therefore a further object of my invention to provide a fluid-actuated means for motivating the port-cleaning instrumentalities for operative atomization of such a nature and so positioned that it will be adapted to perform the two additional functions of effectively separating the supply of atomizing fluid from the supply of liquid and of preventing the wasteful escape of the atomizing fluid while the atom-

izer is in active operation. The use of a single flexibly movable fluid-tight means suitably positioned to perform all of the above functions is another important and outstanding characteristic of my invention.

It is desirable to avoid the use of complex mechanical inter-connections between the port-cleaning instrumentalities for the purpose of controlling their relative movement, and it is therefore a further object of my invention to provide simple means for effecting the desired motivation of these instrumentalities independently of each other and in predetermined sequence as hereinbefore explained.

When atomizers are used for humidification, it is usual to supply them with water from a constant level by taking advantage of the aspirating action of the atomizer. While the preferred embodiment of my invention herein disclosed is intended to be supplied with water by aspiration, I do not limit myself to aspiration, for my invention is equally applicable to atomizers of this class irrespective of whether they are supplied with water under pressure or by aspiration.

The preferred embodiment of my invention herein disclosed is shown in a form adapted to be embodied in an atomizer that is already in wide commercial use and is disclosed in my earlier United States Patent No. 1,476,774 granted December 11, 1923.

In this particular construction air is supplied to the atomizer through an obliquely-disposed port adapted to give a swirling motion to the jet of spray leaving the atomizer, but this is not a feature essential in any way to my present invention.

The essential characteristics and advantages of my present invention are unaffected by such considerations as the path by which the atomizing fluid reaches its outlet port, or whether the mechanism essential to my invention is designed as an integral part of the atomizer as a whole or as an attachment to clean an existing part of a usual type of atomizer as in the embodiment herein disclosed.

It will therefore be clear to those skilled in the art that my invention contemplates its practical application to any suitable type of atomizer in which liquid is atomized by the energy of fluid under pressure and is not in any way limited to the particular embodiments herein disclosed.

Preferred embodiments of the invention are illustrated in the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of an assembled self-cleaning atomizer showing the movable parts thereof in the operative positions which they assume when the atomizer is supplied with an atomizing fluid under pressure, such as compressed air:

Fig. 2 is a similar longitudinal sectional view showing the movable parts in the normal inoperative positions to which they are moved when the supply of atomizing fluid under pressure is interrupted;

Fig. 3 is a transverse sectional view on line 3—3 Fig. 2 of the tubular conduit and the plunger which is mounted therein, showing also the passage for supplying fluid under pressure to the pressure chamber, the casing not being shown in section;

Fig. 4 is an end elevation of the inner end of the nozzle, viewed from the right toward the left;

Fig. 5 is a vertical, longitudinal, sectional view of a modified embodiment of the invention;

Fig. 6 is a plan view of the diaphragm illustrating particularly the metal binding for the periphery of the diaphragm and for the central aperture therethrough; and

Fig. 7 is a fragmentary, vertical, sectional view of a modified form of spray outlet construction particularly adapted to insure accurate alinement of the fluid outlet port and the liquid outlet port in the nozzle.

Fig. 8 is a diametrical sectional view on line 8—8 Fig. 6 on a larger scale.

A suitable embodiment of the invention is illustrated in Figs. 1 to 4 as applied to an atomizing head of the type disclosed in my prior Patent No. 1,476,774 aforesaid. The atomizer illustrated comprises a head 1, which may be of substantially spheroidal form, having a stem 2 provided with an externally screw threaded base 3 adapted to be connected by a suitable union to a pipe for supplying gaseous fluid under pressure thereto. The stem 2 is bored axially to provide a conduit 4 for the atomizing fluid under pressure, such as compressed air, and a relatively small duct or port 5 leads preferably obliquely into a cylindrical atomizing chamber 6 in the head 1 tangentially to the cylindrical wall thereof, the arrangement being such that the fluid under pressure entering the chamber 6 tangentially will impart a whirling motion to the fluid present therein and escaping therefrom.

The wall of the chamber 6 is countersunk and screw threaded to receive a cylindrical extension upon a cap 7 which has an outwardly flanged shoulder adapted to engage the outer end of the head 1 and is provided with a countersunk, relatively thin, centrally apertured wall to provide a positively positioned fluid outlet port 8 from said fluid chamber. The rear portion of the head 1 is bored longitudinally and is provided with an internally screw threaded portion terminating at its rear end in a conical seat 9 adapted to be engaged by a complementary conical shoulder upon a casing 10 which houses the means for supplying liquid to the atomizer head and the cleaning mechanism for the outlet ports for the atomizing fluid and liquid respectively.

The casing is formed in two sections, the front section comprising a cylindrical nipple 11 having an externally screw threaded portion adapted to engage the internally screw threaded rear portion of the head and is provided with a cylindrical extension 12 which passes through and fits within a complementary aperture in a web which forms the rear wall of the atomizing chamber 6. The casing preferably is provided with an hexagonal portion 13 adapted to be engaged by a suitable tool to screw the nipple into the head. The casing is also provided rearwardly of the hexagonal portion with an outwardly extending wall 14 having a rearwardly offset flange 15 adapted, in conjunction with a single flexible member such as a diaphragm 16, which is clamped between the sections of the casing, to form the wall of a pressure chamber 17 for the atomizing fluid under pressure.

One of the important features of the invention consists in providing a diaphragm composed of synthetic gums which when properly compounded may be made of suitable elasticity for the purpose employed and are superior in strength and durability to rubber, while possessing the further important advantage of immunity to deterioration when exposed to contact with oils which would

cause serious deterioration of rubber diaphragms.

The more volatile components of the oils which are used for the lubrication of air compressor cylinders are always present in compressed air and tend to condense in the piping system connected with the air compressor and the terminal devices as a result of the fall in temperature in the compressed air before it reaches the terminal devices, such as the atomizers in a humidifier system. On this account the use of rubber diaphragms in atomizers of the type herein described is undesirable. Careful tests of atomizers of the type herein described having diaphragms composed of synthetic gums have proved that when the diaphragm has been subjected to hundreds of thousands of actuations in the presence of unusual quantities of oil, no perceptible deterioration of the diaphragm is produced, although rubber diaphragms subjected to like conditions would have seriously deteriorated. The use of diaphragms having such characteristics as the motivating mechanism for atomizers is believed to be novel and to form a valuable contribution to the art.

The other section 18 of the casing preferably is of substantially cylindrical form having a forward enlarged portion 19 provided with a flange 20 complementary to the flange 15 and secured thereto by a union nut 21 which is preferably knurled on its outer surface for convenience in making up the union. The periphery of the diaphragm 16 is clamped between the complementary flanges 15 and 20. The rear wall 22 of the casing section 18 is provided with a rearwardly extending nipple 23 adapted for convenient connection to a pipe for supplying water or other liquid to the atomizer. The central portion of the wall 22 is provided with a port 24 having a conical wall 25 forming a valve seat. The rear cylindrical portion of the casing section 18 forms a chamber 26 for the liquid which is supplied to the atomizer head. Liquid is supplied from the liquid chamber 26 to the atomizer through a cylindrical tubular conduit 27 which slidably fits an axial bore in the front casing member 10 and is provided with an internally screw threaded front end portion which receives an externally screw threaded extension of a nozzle 28, the end portion of which is tapered and adapted to penetrate and to clean and fit the outlet port 8 for the atomizing fluid. The nozzle is further reduced in diameter at its extreme tip to provide the desired difference in diameter between said tip and the fluid outlet 8 when the parts are in operative position illustrated in Fig. 1. The bore of the nozzle 28 is reduced at a point adjoining its outlet to the preferred minimum diameter which determines the rate of escape of fluid therethrough when the atomizer is in operative position, as shown in Fig. 1.

The rearward portion of the tubular member 27 is enlarged to provide a shoulder 29 adapted to engage the front wall of the pressure chamber 17 and limits the forward movement of the tubular member. This shoulder is cut away at the lower portion to permit communication between a channel leading from the atomizing chamber 6 to the pressure chamber 17. The tubular member has a further cylindrical enlargement 30 providing a shoulder against which the diaphragm 16 is clamped by a nut 31 which is screwed upon the rearward end portion of the tubular member.

Suitable means are provided for conducting atomizing fluid under pressure from the atomizing chamber 6 to the fluid pressure chamber 17. In the particular construction illustrated the lower external portion of the tubular conduit 27 is cut away or slabbed longitudinally to provide a channel 32 through which the fluid under pressure can pass from the atomizing chamber 6 of the head to the pressure chamber 17. Desirably the rear wall of the port 5 is cut away to provide a passage 33 leading to the channel 32 so that fluid under pressure will be continuously delivered to the pressure chamber so long as it is supplied to the atomizing chamber 6.

The nozzle 28 is provided with an hexagonal enlargement 34 presenting a shoulder adapted upon retraction of the tubular conduit 27 to engage the end of the extension 12 of the nipple and thereby limit the position of withdrawal of the tubular conduit for the liquid to a predetermined position. In order to insure a free passage for the fluid under pressure from the port 5 to the channel 32, the rear face of the enlargement 34 of the nozzle is provided with an annular groove 35 through which the fluid under pressure may flow from the passage 33 to the channel 32 irrespective of the rotatable position of the slabbed-off portion of the tubular member when the nipple is screwed into the head.

By reason of the construction above described fluid under pressure will be introduced into the pressure chamber immediately after it is admitted to the vaporizing chamber 6 and will thereupon force the diaphragm rearwardly, thus withdrawing the nozzle from the fluid outlet port until it is arrested by engagement of the shoulder on the enlargement 34 with the end of the nipple extension 12. The nozzle is thus placed in operative position so that the liquid, which passes through the tubular conduit 27 and nozzle 28, will be atomized by the whirling motion of the atomizing fluid as it escapes from the outlet nozzle 8.

The invention further provides automatic mechanism for cleaning the liquid outlet port of the nozzle when the nozzle is restored to inoperative position as illustrated in Fig. 2.

The preferred mechanism shown in the accompanying drawings comprises a non-cylindrical plunger 36, preferably of triangular cross section, as illustrated in Fig. 3, having a forward cylindrical end portion of reduced diameter adapted slidably to fit within the bore of the nozzle 28 and provided with an axial pin 37 adapted to penetrate and clean the liquid outlet of the nozzle when the parts are in normal inoperative position illustrated in Fig. 2. The rear end of the plunger 36 is provided with a reduced screw threaded portion which is engaged by complementary internal screw threads in a boss 38 in the rear wall of a cylindrical slide 39 which is reciprocably mounted in the cylindrical portion 18 of the rear casing section. The slide 39 is provided with a cylindrical reduced portion 40 providing a shoulder 41 adapted to be engaged by one end of a spiral spring 42, the other end of which is seated against the inner face of the end 22 of the casing, the spring acting normally to force the slide forwardly. The front end of the slide 39 desirably is provided with an annular flange 43 which engages the diaphragm 16, so that when the slide is pressed forwardly by the spring 42 the annular portion of the diaphragm is forced forwardly, as illustrated in Fig. 2. A relatively lighter spiral spring 44, which is interposed between the nut 31 and the end wall of the slide 40, permits the tubular conduit to be withdrawn as soon as fluid under pressure enters the pressure

chamber 17 and acts upon the diaphragm so that the nozzle is withdrawn from the fluid outlet port before it is possible for liquid to escape through the fluid outlet in the nozzle 28, thereby avoiding the production of a coarse spray or a dripping from the nozzle during the initial operation of the atomizer.

In order to prevent backward escape of the liquid from the fluid chamber 26 when the atomizer is disconnected from its supplies of liquid and atomizing fluid, a valve 45 for the liquid inlet port 24 is connected to and actuated by the slide 39 to which the plunger 36 is connected. In the preferred construction the valve 45 is provided with a stem 46 which is in axial alinement with the plunger and has a screw threaded end which engages the internal screw thread of the boss 38. By reason of this construction the tubular conduit 27 will be withdrawn to open the outlet port 8 for the atomizing fluid under pressure before the valve 45 will be removed from its seat. When, however, the pressure of the atomizing fluid in the pressure chamber 17 is further increased the diaphragm 16 will be forced rearwardly, thereby forcing the slide 39 rearwardly, withdrawing the plunger 36 from the nozzle and the pin 37 from the outlet port of the nozzle, so that liquid may be supplied to the nozzle. At the same time the rearward movement of the slide 39 removes the valve 45 from the valve seat 25, so that liquid can flow from the supply into the liquid chamber 26 of the casing, thence through ports 47 in the rear end wall of the slide into the liquid chamber 48 from which it will flow alongside the non-cylindrical plunger 36 to the nozzle and will be drawn from the nozzle by the aspiration of the fluid under pressure escaping from the outlet nozzle 8 of the atomizing chamber 6. The rearward movement of the slide 47 is limited by the engagement of the annular flange 43 of the slide with a shoulder 49 at the junction of the enlarged portion of the rear section of the casing with the cylindrical portion thereof. The longitudinal dimensions of the casing section 18, the slide 39, the tubular conduit 32, the plunger 36, and the point of connection of the latter to the diaphragm are purposely predetermined to insure complete withdrawal of the pin 37 from the outlet nozzle when the parts are mutually engaged in their extreme rearward positions for operation of the atomizer, as illustrated in Fig. 1.

When the atomizer is operatively connected with sources of fluid under pressure and of liquid, the admission of atomizing fluid under pressure to the atomizing chamber 6 causes the fluid under pressure to flow through the channel 32 and build up pressure in the pressure chamber 17. The first appreciable increase in pressure in the pressure chamber 17 will cause displacement of the inner portion only of the diaphragm against the comparatively light resistance of the spiral spring 44, thus causing the withdrawal of the tubular conduit 27 and the nozzle 28 from its inoperative position and permitting fluid to escape through the opened fluid outlet port 8 before it is possible for liquid to escape through the liquid outlet in the nozzle 28. As the pressure continues to increase in the pressure chamber 17, the enlarged hexagonal portion 34 of the nozzle will be forced into contact with the end of the nipple extension 12, thus predetermining the operative positions of the outlet port 8 and the tip of the liquid nozzle 28 for full atomizing capacity, as illustrated in Fig. 1.

Further increase of the fluid pressure in the pressure chamber 17 upon the diaphragm 16 will overcome the resistance of the relatively strong spiral spring 42 upon which the slide 39 will retreat, carrying with it the plunger 36 and finally reaching its extreme rearward predetermined position in which the flange 43 of the slide contacts with the shoulder 49 of the casing, thereby assuring the final opening of the liquid nozzle by complete withdrawal of the pin 37 from the liquid outlet of the nozzle. At the same time the rearward movement of the slide 40 will remove the valve 45 from the valve seat 25, thereby admitting the liquid from its source of supply to the liquid chambers of the atomizer.

It is to be particularly observed that this serial withdrawal of the moving parts and the complete opening of the fluid outlet prior to opening of the liquid outlet makes it impossible for liquid to escape at the risk of partial atomization before the full atomizing effect of the escaping fluid is available to insure complete atomization, and this separate and predetermined serial motion of the operative parts is an important feature of my invention.

When the supply of fluid under pressure is interrupted or discontinued by any cause whatever, the first material fall in the fluid pressure to which the diaphragm is subject permits the relatively strong spiral spring 42 to move the annular slide 39 and plunger 36 forwardly, thereby causing the pin 37 to penetrate and clean the outlet port of the liquid nozzle and the cylindrical end of the plunger to close the bore of the liquid nozzle, thus cutting off the supply of liquid to the nozzle. At the same time the valve 45, which is secured to the slide 34, is moved forwardly so that its valve 45 seats upon the valve seat 25, thereby shutting off the supply of liquid from the source to the liquid chamber of the atomizer.

Meanwhile the remaining pressure on the central portion of the diaphragm increases the compression of the light spring 44, thereby preventing the forward movement of the tubular conduit 27 and its attached liquid nozzle until after the liquid port of the nozzle has been closed by the prior action of the heavy spiral spring 42.

When the pressure to which the diaphragm 16 is subject has fallen sufficiently to permit the expansion of the light spring 44 against the reduced pressure of the central portion of the diaphragm, the tubular member 27 and its attached nozzle 28 will be moved forward to penetrate, clean and close the fluid outlet port 8, but not until after the escape of liquid from said nozzle has been made impossible. This predetermined serial motion of the operative parts of the atomizer is also an important feature of the invention and it will be observed that by these predetermined serial and independent motions of the movable parts, the escape of liquid under any conditions which might cause incomplete atomization is positively avoided.

It is also to be observed that the position of the diaphragm relatively to the casing and to the moving parts is designed positively to prevent the escape of fluid under pressure either to the outside air with consequent waste during the operation of the atomizer, or to any portion of the mechanism which will expose the liquid passing through the atomizer to the pressure of the atomizing fluid, a circumstance which is highly undesirable, since any such access of fluid under pressure to any part of the water supply will cause highly objectionable intermittent atomizing ac-

tion as a result of intermittent escape of gaseous fluid through the liquid port of the nozzle.

Those skilled in the art will readily perceive that the preferred embodiment of my invention herein disclosed is capable of a modification in detail without departing from the scope of my invention. The smaller of the two spiral springs, for example, is a desirable but not an essential feature and may be omitted altogether without changing substantially the desired operation of the device, for the movable parts of the device have been found to operate serially and in the desired order above described when the spring is omitted, owing to the elasticity of the diaphragm itself and to the relatively high sensitivity of its central portion to the lower fluid pressures.

The spring, however, is a desirable means for attaining more positive control of the motions of the movable parts and for predetermining their desired positions.

The embodiment of the invention shown in Figs. 1 to 4 is such that the self-cleaning mechanism may be produced as an article of manufacture for application to usual commercial atomizer heads of the type disclosed in my prior patent aforesaid.

A modified embodiment of the invention is illustrated in Figs. 5, 6 and 7, which is particularly adapted for an article of manufacture. In this construction substantially the same port cleaning and closing mechanism is used as that heretofore described, and the same numerals are employed to designate parts similar to those illustrated in Figs. 1 to 4.

In this construction the atomizer comprises a head 50 having an annular screw threaded extension 51 and a casing 52 screwed upon said extension and presenting with said head a spheroidal form and extending rearwardly therefrom in such manner as to present a stream lined contour over which air flowing by the inductive effect of the atomizer will minimize the accumulation of lint, dust or other foreign material upon the atomizer head, thereby preventing such an accumulation of an excess of foreign material of this character as would cause it to drop upon the machinery beneath the head, which in textile mills is likely to engage and be carried into the fabric or other material being processed. The rear end 53 of the casing 52 is provided with a screw threaded nipple 54 adapted to be connected to a suitable supply of liquid. A valve port 55 is provided centrally of the nipple and has a conically inclined wall forming the valve seat.

The head 50, as in the construction previously described, is provided with a stem 2 having an externally screw threaded base 3 adapted to be connected by a suitable union to a pipe for supplying gaseous fluid under pressure and is bored axially to provide a conduit 4 for the atomizing fluid under pressure with a relatively small duct 5 leading preferably obliquely into an atomizing chamber 6 so that the fluid under pressure entering the chamber will impart a whirling motion to the fluid present therein and escaping therefrom. The wall of the chamber 6 is countersunk to receive a cap 56, which differs from the cap 7 in the previously described construction in that instead of being of cylindrical exterior contour, it is of a spheroidal contour merging into the contour of the head, and is provided with sockets 57 to receive a socket wrench, by means of which it can be screwed into the head.

The liquid is supplied to the atomizer by a tubular member 58, which is in all respects similar to that illustrated and described in the preceding embodiment except that it is not slabbed off for providing a passage for the atomizing fluid under pressure to the pressure chamber. The tubular member 58 is provided with a nozzle 34 which normally penetrates the fluid outlet 8 of the cap 56.

The means for cleaning the nozzle may be, and desirably is, identical with the plunger 36 and the rod 37, forming an extension thereof as heretofore described.

In the construction disclosed in Fig. 5, the diaphragm 16 is clamped between the casing 52 and the extension 51 of the head, as the forward casing member heretofore disclosed is omitted in this construction. In order more effectively to secure the diaphragm in place and to prevent tearing of the same, the periphery of the diaphragm desirably is provided with a thin sheet metal binding 59 and a similar binding 60 is provided for the wall of the aperture in the central portion of the diaphragm which is clamped by the nut 31 against the cylindrical enlargement 30 of the tubular member.

The diaphragm 16 in this construction, as in that previously described, provides the rear wall of the pressure chamber 17 and air is introduced into the pressure chamber in this construction directly through the port 61 which communicates with the conduit 4 and the pressure chamber 17. The rear end of the plunger 36 in this construction, as in that previously described, is provided with a screw threaded end portion which is engaged by complementary internal screw threads in a boss 38 in the rear wall of the cylindrical slide 39 which, like that previously described, is reciprocably mounted in the cylindrical portion of the casing 53. The front end of the slide 39 has a similar flange 43 which engages the diaphragm. The liquid inlet port 55 to the fluid chamber 26 is controlled by the valve 45, which is connected to and actuated by the slide 39 to which the plunger is connected in the manner heretofore described.

The operation of the mechanism illustrated in Fig. 5 is in all respects similar to that heretofore described, but the construction is one which can be manufactured more economically for sale as an article of manufacture, whereas the previous construction is so designed as to be capable of embodiment in atomizers of the type disclosed in my prior patent which have been previously installed.

A further modification of the invention is illustrated in Fig. 7 which enables the outlet port for the atomizing fluid to be readily positioned with accuracy in axial alinement with the port of the nozzle through which the liquid is discharged.

In this construction the front end of the head is partially faced off at right angles to the longitudinal axis of the atomizer and provided with an externally threaded extension 62 presenting a flat end. A cap 63, which presents a spheroidal external contour adapted to merge into the spheroidal contour of the head, is provided with a flat face complementary to the flat face of the head. The cap 63 has a central recess 64 of somewhat greater depth than the length of the extension 62 and its wall is provided with internal screw threads complementary to the threads on the extension 62. The cap is provided with a

relatively large outwardly diverging conical central opening 65 in axial alinement with and communicating with the recess 64.

In the construction shown in Fig. 7 the outlet port instead of being bored through the cap is bored centrally through a relatively thin flat disk 66 of somewhat smaller diameter than that of the recess 64 and the disk 66 is adapted to be clamped by the cap against the flat end 67 of the extension 62. The cap is provided with suitable sockets 68 to receive a spanner wrench.

By reason of this construction the nozzle may be placed in its normal position to penetrate and close the outlet port and the disk applied to the nozzle and the cap then screwed up to clamp the disk firmly against the shoulder 67, thus causing the disk to assume a position accurately concentric with the nozzle outlet. This construction has the advantage of reducing the degree of accuracy of manufacture that otherwise would be necessary to insure concentric alinement of the atomizing fluid outlet with the liquid outlet.

It will be understood that the particular embodiments of the invention disclosed herein are of an illustrative character and not restrictive of the meaning and scope of the following claims.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is:

1. A self-cleaning atomizer having an outlet port for an atomizing fluid under pressure, a relatively movable cleaning member for said fluid port forming a conduit for the liquid and having a liquid outlet port positioned in cooperative relation to said fluid outlet port, an independently movable cleaning member for the liquid outlet port, resilient means causing said cleaning members respectively normally to penetrate and clean, one, the said fluid outlet port and the other said liquid outlet port, and means including a single diaphragm operating only in response to pressure of said atomizing fluid to withdraw and position the respective port cleaning means for atomizing operation.

2. A self-cleaning atomizer having an outlet port for an atomizing fluid under pressure, a relatively movable cleaning member for said fluid port forming a conduit for the liquid and having a liquid outlet port positioned in cooperative relation to said fluid outlet port, an independently movable cleaning member for the liquid outlet port, resilient means of different strength causing said cleaning members respectively normally to penetrate and clean, one the said fluid outlet port and the other said liquid outlet port, and means operated by the pressure of the atomizing fluid in opposition to the respective resilient means first to withdraw the cleaning means from the fluid outlet port and thereafter to withdraw the cleaning means from the liquid outlet port, to positions adapted for effective operation of the atomizer.

3. A self-cleaning atomizer comprising an outlet for atomizing fluid, a slidably movable tubular conduit for liquid operatively connected with a supply thereof and having an outlet nozzle adapted to clean said fluid outlet by penetration thereof, a plunger slidably movable within said tubular liquid conduit having means to close and clean said liquid nozzle by penetration thereof, a flexibly movable fluid-tight diaphragm interposed between said atomizing fluid and said liquid operating in response to the pressure of said atomizing fluid to maintain said plunger, said liquid outlet and said fluid outlet in relative positions adapted for effective operation of the atomizer, and resilient means operating upon interruption of the supply of atomizing fluid first to cause said plunger to penetrate and close said liquid nozzle and subsequently to cause said liquid nozzle to penetrate and close said fluid outlet.

4. A self-cleaning atomizer comprising an outlet for atomizing fluid, a slidably movable tubular conduit for liquid having an outlet nozzle coaxial with said fluid outlet adapted to clean said fluid outlet by penetration thereof, a non-cylindrical plunger slidably movable within and coaxially of said liquid conduit and having an extension adapted to clean said liquid nozzle by penetration thereof, means for supplying liquid to said liquid conduit, a flexible diaphragm connected to said tubular conduit and separating said atomizing fluid from the liquid supplied to said conduit and operating only in response to the pressure of said atomizing fluid to position independently said plunger and said liquid nozzle with respect to said fluid outlet for effective atomization, and resilient means operating respectively upon interruption of the supply of atomizing fluid to move said tubular conduit and said plunger independently of each other first to cause said plunger to close said liquid nozzle and thereafter to cause said liquid nozzle of said tubular conduit to penetrate said fluid outlet.

5. A self-cleaning atomizer comprising a head having an atomizing chamber provided with an outlet port, and having a pressure chamber communicating with said atomizing chamber, means for supplying liquid to said head comprising a casing connected to said head, a tubular conduit slidably mounted in said head having a nozzle concentric with and adapted to penetrate and clean said fluid outlet port, a plunger within said tubular conduit having means to penetrate and clean the outlet of said nozzle, resilient means acting respectively upon said tubular conduit and said plunger to effect penetration and cleaning of the respective outlet ports, means for withdrawing said conduit and said plunger from port-cleaning positions including a diaphragm having a thin metallic binding clamped between said casing and said head and connected to said tubular conduit and operated by the pressure of the atomizing fluid first to withdraw the nozzle from the fluid outlet and subsequently to withdraw said plunger from the liquid outlet and thereafter to maintain said nozzle and plunger in predetermined positions adapted for effective operation of the atomizer while supplied with atomizing fluid.

6. A self-cleaning atomizer comprising a head having an atomizing chamber provided with an outlet port, and having a pressure chamber communicating with said atomizing chamber, means for supplying liquid to said head comprising a casing connected to said head, a tubular conduit slidably mounted in said head having a nozzle concentric with and adapted to penetrate and clean said fluid outlet port, a plunger within said tubular conduit having means to penetrate and clean the outlet of said nozzle, resilient means acting respectively upon said tubular conduit and said plunger to effect penetration and cleaning of the respective outlet ports, means for withdrawing said conduit and said plunger from port-cleaning positions including a diaphragm having a thin metallic binding clamped between said casing and said head, and having a central opening the wall of which is provided with a thin metallic binding embracing said tubular mem-

ber and clamped thereupon and operated by the pressure of the atomizing fluid first to withdraw the nozzle from the fluid outlet and subsequently to withdraw said plunger from the liquid outlet and thereafter to maintain said nozzle and plunger in predetermined positions adapted for effective operation of the atomizer while supplied with atomizing fluid.

7. A self-cleaning atomizer comprising a head having an outlet for atomizing fluid, a relatively movable conduit for liquid having an outlet nozzle adapted to clean said fluid outlet by penetration thereof, a plunger for cleaning said liquid outlet, means for withdrawing said tubular conduit from the fluid outlet and said plunger from the liquid outlet including an elastic diaphragm composed of synthetic gums of greater strength and durability than rubber and resistant to deterioration in the presence of oils, operating in response to the pressure of the atomizing fluid to position the respective port-cleaning means for atomizing operation, and means operating upon discontinuance of the pressure of the atomizing fluid to cause said tubular conduit to penetrate said fluid outlet and to cause said plunger to penetrate said liquid outlet.

8. A self-cleaning atomizer comprising a head having an atomizing chamber and an outlet for atomizing fluid, means for supplying atomizing fluid under pressure thereto, a slidably movable tubular conduit for liquid operably connected with the supply thereof and having a nozzle adapted to penetrate and clean said fluid outlet, a plunger slidably movable within said tubular liquid conduit having means to close and clean said liquid nozzle by penetration thereof, an elastic diaphragm composed of synthetic gums of greater strength and durability than rubber and resistant to deterioration in the presence of oils connected to said tubular conduit and acting upon said plunger operating in response to the operating pressure of said atomizing fluid to maintain said plunger, said liquid outlet and said fluid outlet in relative positions adapted for effective operation of the atomizer, and means operating upon interruption of the supply of atomizing fluid first to cause the plunger to penetrate and close said liquid nozzle and subsequently to cause said liquid nozzle to penetrate and close said fluid outlet.

9. A self-cleaning atomizer comprising a head having an atomizing chamber provided with an outlet port, means for supplying atomizing fluid under pressure thereto, means for supplying liquid to said head comprising a casing connected to said head provided with a bore in axial alinement with said fluid outlet port and an enlarged portion divided by a flexible fluid-tight diaphragm into a pressure chamber and a liquid chamber having an inlet port, means for conducting atomizing fluid to said pressure chamber, a tubular conduit communicating with said liquid chamber reciprocably mounted in said bore and having a liquid outlet nozzle adapted to penetrate and clean said fluid outlet, a plunger within said tubular conduit having at its front end means to penetrate and clean said nozzle outlet and at its rear end a valve for the inlet port of said liquid chamber, means operated by said diaphragm in response to the pressure of the atomizing fluid in said pressure chamber to withdraw said tubular conduit to a predetermined position, and means operated thereafter by pressure in said pressure chamber to withdraw said plunger from said liquid outlet and simultaneously to open the inlet port to said liquid chamber.

10. A self-cleaning atomizer comprising a head having an atomizing chamber provided with an outlet port, means for supplying atomizing fluid under pressure thereto, means for supplying liquid to said head comprising a casing connected to said head provided with a bore in axial alinement with said fluid outlet port and an enlarged portion divided by a flexible fluid-tight diaphragm into a pressure chamber and a liquid chamber having in its rear wall an inlet port for the liquid, means for conducting atomizing fluid to said pressure chamber, a tubular conduit communicating with said liquid chamber reciprocably mounted in said bore having a liquid outlet nozzle adapted to penetrate and clean said fluid outlet, means connecting said tubular conduit to said diaphragm, a plunger slidably mounted in said tubular conduit having at its rear end a valve to engage said inlet port and at its forward end a plunger adapted to penetrate and clean said liquid outlet, means mounted on said plunger operatively engaging said diaphragm, means for limiting the rearward movement of said tubular conduit whereby further actuation of said diaphragm by said atomizing fluid will withdraw said plunger from said nozzle and remove said valve from said inlet port, and means for successively restoring said plunger and said tubular conduit to outlet-port-closing positions upon release of pressure in said pressure chamber.

11. As an article of manufacture a liquid supplying and port cleaning device for atomizers having a head provided with an outlet port for atomizing fluid under pressure comprising a hollow casing having a nipple for attachment to the atomizer head and provided with a bore in axial alinement with the fluid outlet port of said head, a diaphragm dividing said casing into a pressure chamber and a liquid chamber, a tubular conduit reciprocably mounted in said bore communicating with said liquid chamber and connected to said diaphragm and having a nozzle adapted, when assembled upon said head to penetrate and clean said fluid outlet port, a plunger reciprocably mounted in said tubular conduit having means to clean and close said nozzle, means for admitting atomizing fluid under pressure into said pressure chamber to cause said diaphragm to withdraw said nozzle from the fluid outlet, means for arresting the withdrawal of said nozzle at a predetermined distance from said fluid outlet, means operated by further pressure of the atomizing fluid upon said diaphragm to withdraw said plunger from said nozzle, thereby to permit effective operation of the atomizer and resilient means in said casing acting respectively on said tubular conduit and said plunger to return said nozzle and plunger respectively to outlet port cleaning position upon release of pressure in said pressure chamber.

12. A self-cleaning atomizer comprising a spheroidal head having an atomizing chamber provided with an outlet port and a pressure chamber rearwardly of said atomizing chamber, a rearwardly extending casing detachably connected to said head forming with said head an assembly presenting a stream lined contour and providing a chamber for the liquid having at its rear end an inlet port, a diaphragm clamped between said casing and said head forming the rear wall of said pressure chamber, means for supplying atomizing fluid under pressure to said at-

omizing chamber and said pressure chamber, a movable tubular member communicating with said liquid chamber extending through and connected to said diaphragm and having a nozzle normally penetrating and closing said fluid outlet port and moved by said diaphragm upon introduction of fluid under pressure into said fluid chamber to withdraw said nozzle from said fluid outlet port to a predetermined position permitting effective operation of the atomizer and means operating upon discontinuance of said fluid pressure to return said nozzle to fluid outlet penetrating and cleaning positions.

13. A self-cleaning atomizer comprising a casing containing a cylindrical terminal chamber having a central outlet port and an inlet port for admitting atomizing fluid under pressure to said chamber in a direction substantially tangential to the cylindrical wall thereof, thereby to impart a whirling motion to said fluid when escaping from said outlet, a liquid supplying member slidably movable to penetrate and clean said outlet port and containing a passageway for said liquid terminating in a nozzle positioned in cooperative relation to said fluid port, an independently movable member for cleaning said liquid nozzle, resilient means for causing said movable members normally to penetrate and clean the one said fluid port and the other the nozzle outlet port, and means operable by the pressure of said atomizing fluid to withdraw and position said port-cleaning members for atomizing operation.

14. A self-cleaning atomizer comprising an outlet for atomizing fluid, a slidably movable tubular conduit for liquid operatively connected with the supply thereof and having an outlet nozzle adapted normally to clean and close said fluid outlet by penetration thereof, means for normally closing and cleaning said liquid outlet, and flexible means operating in response to the pressure of said atomizing fluid, first to open said fluid outlet by withdrawal of said nozzle therefrom and subsequently to open said liquid outlet by withdrawing said means for cleaning and closing the same, and resilient means acting only upon interruption of said fluid pressure to restore said nozzle and said liquid outlet cleaning means to normal positions.

HERMAN F. SIMON.