

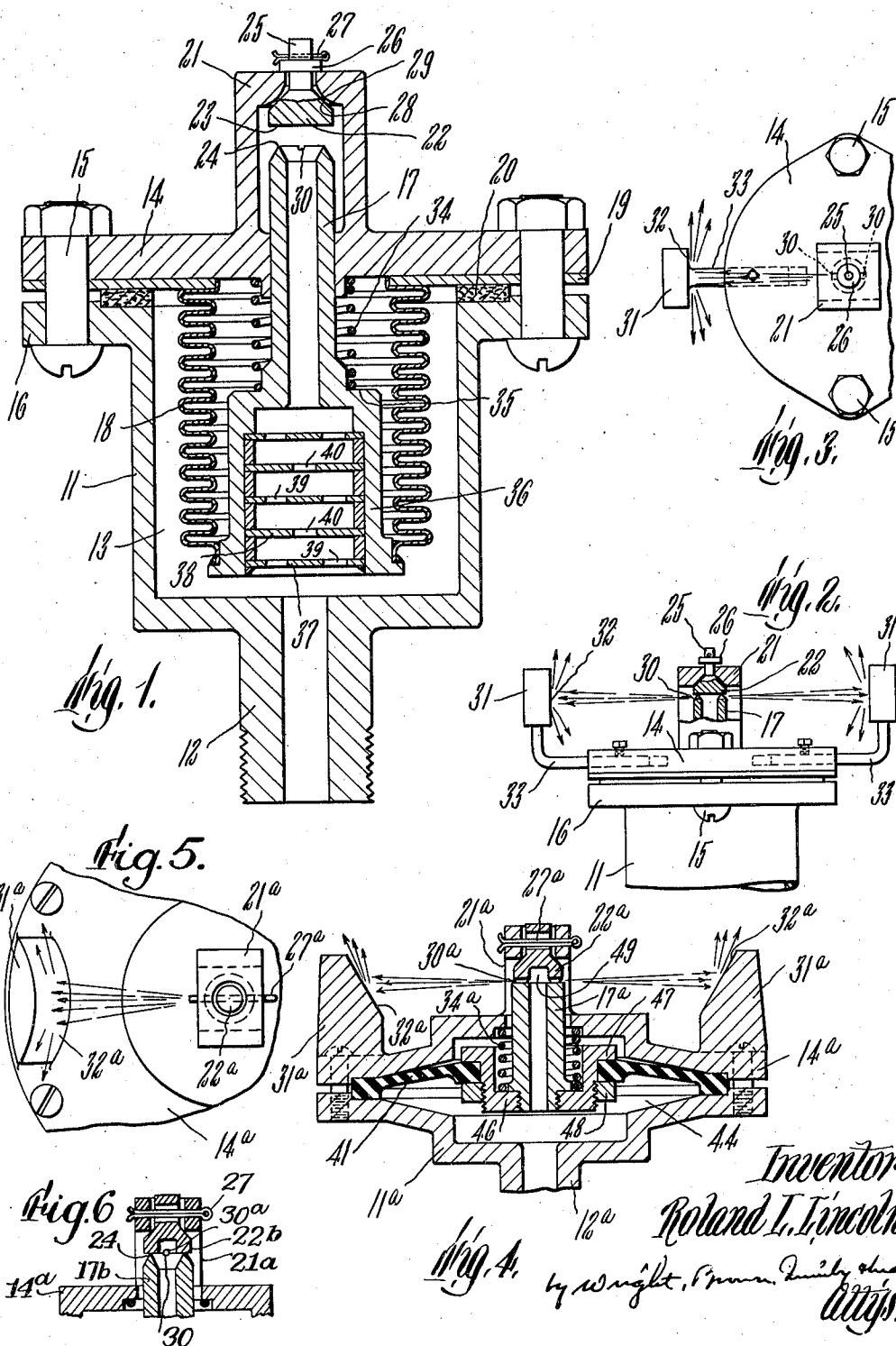
Sept. 6, 1938.

R. L. LINCOLN

2,129,145

SELF CLEANING SPRAY NOZZLE

Filed May 6, 1936



UNITED STATES PATENT OFFICE

2,129,145

SELF CLEANING SPRAY NOZZLE

Roland L. Lincoln, Waterbury, Conn., assignor to
Hoffman Specialty Company, Waterbury,
Conn., a corporation of Illinois

Application May 6, 1936, Serial No. 78,156

11 Claims. (Cl. 299—59)

This invention relates to nozzles for creating a mist or a more or less finely divided spray of water or other liquid delivered under pressure, for use particularly in washing or humidifying air, atmospheric cooling, and in systems of various kinds by which the conditioning of air is effected; and also for any other purposes to which it may be adapted in its various forms. Its object is to furnish a nozzle of improved characteristics capable of producing a more uniform and better controlled spray than previously known nozzles and of automatically maintaining the quality of the spray by prevention of clogging. The principles of the invention by which these objects are accomplished comprise new and improved means for the production of spray, means for regulating the fineness of the particles constituting the spray or mist, and means for flushing the discharge orifice of the nozzle when the water is turned on and off.

In the following explanation and description of the invention it will be assumed that the liquid which is converted into mist or spray by means of this nozzle is water, for that is the agent employed in the conditioning of air; but other liquids may be used with embodiments of the invention for other purposes. Hence the references to water, and other specific terms of description used in the specification are to be understood as illustrative and not as limiting the scope of protection herein claimed.

The drawing and following detailed explanation show two of the possible concrete forms in which the principles of the invention may be embodied.

Fig. 1 is a longitudinal sectional view of one of such forms;

Fig. 2 is a side elevation, with parts broken away and shown in section;

Fig. 3 is a partial plan view of the same nozzle shown on a smaller scale than that of Fig. 1;

Fig. 4 is a longitudinal section, and Fig. 5 a partial plan view of another embodiment of the invention.

Fig. 6 is a fragmentary sectional view of a form of the invention in which are combined certain features of the two forms previously mentioned.

Like reference characters designate the same parts wherever they occur in all the figures.

The nozzle shown in Figs. 1, 2 and 3 comprises a casing body 11 having an external threaded, tubular stem or nipple 12 for connection with a pipe line. The body has a (preferably) cylindrical interior 13 which is open throughout its full width at one end, and a detachable cover 14 is provided to close such open end when applied thereover

and secured by bolts 15 passing through a flange 16 on the body. A discharge tube 17 extends through the center of the cover, in which it has a sliding fit permitting it to move endwise. The inner end of this tube is sealed fluid tight to one end of a bellows tube 18, the opposite end of which is sealed fluid tight to a plate 19 which is clamped between the casing body and cover plate and makes a leakage tight joint with the body with the aid of a compressible gasket 20. The bellows tube is preferably or conveniently one of well known character, made from a section of deeply corrugated metal tubing, the wall thickness and characteristics of which are such that the corrugations are flexible, permitting the bellows as a whole to be shortened and lengthened by forces of the magnitude encountered in use.

On the outer side of the cover plate is a rigid yoke 21, of which the standards are at opposite sides of the protruding end of the discharge tube, and the transverse member extends across the end of the tube and supports an abutment block 22 in axial alinement with the tube. Such abutment block is loosely mounted in the yoke in such fashion that its plane face 23 next to the tube end may adjust itself so as to bear squarely on the beveled or knife-edge rim 24 surrounding the outer orifice of the tube. As a convenient means for that purpose, the block is made with a stem 25 which passes through a hole in the cross beam of the yoke and is supported by a collar 26 and cotter pin 27 substantially as shown in the drawing. The block is also formed with a beveled tapered external surface 28 adjacent to the stem, and the yoke with a convex seat 29 near enough to such beveled zone to prevent any substantial displacement of the abutment block away from the discharge tube, but arranged to permit such angular movement of the block as may be necessary to permit self adjustment of the latter to the outer rim of the tube.

In the rim of the tube is a notch or port 30, or there may be two such notches directly opposite to one another, as shown in Fig. 2, or a greater number, suitably located in lines directed between the supporting members of the yoke. When the discharge tube is advanced into contact at its end with the abutment block, such notch or notches provide the only channels through which water may escape; and water admitted under pressure to the nozzle body flows through such channels in streams of which the sectional dimensions are determined by the dimensions of the notches. By suitable design of the notches

streams of any desired fineness or coarseness may be produced.

A target 31 is located across the path in which each such stream flows. In the arrangement shown in Figs. 2 and 3, the targets have plane impingement faces 32 perpendicular to the water streams and are supported by brackets 33 which are adjustably connected with the cover 14 so that the targets may be set at various distances from the outlet ports. The small streams of water flowing at high velocity from the ports 30 impinge on the targets and are broken by impact into a misty spray. By moving the targets toward or away from the discharge orifices, the quality of the spray can be varied from a fine mist to one composed of larger particles of water. Such targets are needed only for uses in which a fine spray or mist is needed. They can be omitted or removed when the nozzle is used for many purposes, such as discharging spray into heated air or spraying hot water into cool air in order to cool the water. Jets discharged under sufficiently heavy pressure from small or narrow orifices normally separate into discrete particles after traveling a greater or less distance, even when not caused to impinge on anything.

A serious trouble encountered in existing spray nozzles, especially those in which the production of a fine spray necessitates employing a discharge orifice of very small dimensions, is clogging of the orifice by solid matter, such as scale or dirt carried by the water or salts in solution which gradually are precipitated on the sides of the orifice. Such troubles are substantially eliminated in my nozzle by the provisions for automatically flushing it, which I have already described in part and will now explain further.

The manner in which the discharge tube 17 is mounted permits it to be moved up to and away from the abutment block 22. It is acted on by a spring 34, confined between the cover and an external shoulder 35 on the tube, with tendency to withdraw it from the abutment. The equilibrium of forces between the pressure of the spring, and the resilience of the bellows, normally holds the discharge tube withdrawn a short distance from the abutment block when there is no water pressure in the casing; substantially as shown in Fig. 1.

The portion 36 of the discharge tube, adjacent to the end joined to the bellows, is enlarged to make an interior space wider than the bore through the balance of the tube, and in this enlarged space are baffle plates 37, 38, separated by spacing rings and having staggered openings 39 and 40 respectively. The number of baffle plates and the areas of their openings are designed to exert such resistance to flow of water when first admitted to the nozzle as to cause a quick displacement of the tube toward the abutment but to permit discharge of a small quantity of water before the tube makes contact with the abutment. The amount of water thus permitted to escape is enough to flush the contact surface of the abutment and the knife edge surrounding the tube orifice, whereby any sediment which may have lodged on either of these parts is washed away, and the knife edge is enabled to seat squarely on the abutment.

Thus when water under pressure is admitted to the nozzle after having been excluded, the discharge tube is quickly forced against the abutment, but not until after the flushing escape of a small amount of water has occurred, and therefore after the only escape possible for the water is

through the notches or ports 30. The total area of such ports is so small in proportion to that of the passageway through the tube and baffles that substantially the full available pressure of the water supply is exerted at the ports without appreciable impedance due to the baffles; and a force substantially equal to the transverse area of the bellows multiplied by the unit pressure of the water is exerted to hold the rim of the discharge tube tightly against the abutment. The small streams issuing at high velocity from the ports strike the targets and are thereby broken up into a mist, the fineness of which may be regulated by adjustment of the targets toward or away from the discharge tube, as previously described. When the water supply to the nozzle is shut off, the pressure within the casing soon subsides enough to permit withdrawal of the tube by the spring 34; and the water then displaced by the expansion of the bellows flows across the edge of the tube and the surface of the abutment, causing another flushing action.

The phase of this invention which resides in the automatic flushing of the nozzle is useful in many situations and environments, not only those hereinbefore named or suggested, but others as well, and independent of the presence or absence of targets in the paths of the emitted jets.

Numerous variations from the particulars of the nozzle herein described may be made without departure from the invention; some of which are illustrated in Figs. 4 and 6. Thus a diaphragm, as 41, may be provided to perform the functions of the bellows 18. The outer circumference of the diaphragm is clamped between plates 11a and 14a which correspond with the body and cover respectively of the form first described, and the member 11a is recessed to provide a pressure chamber 44, and has a tubular nipple 12a, like the nipple 12 of Fig. 1, for connection with a supply pipe. A discharge tube 17a, equivalent to the tube 17, passes through a central opening in the diaphragm and is connected thereto by a coupling sleeve 46 having a flange 47 and a clamp nut 48 between which the inner circumference of the diaphragm is gripped. The base of the nozzle tube is screwed into an internal flange of the coupling sleeve. A spring 34a is confined between the last named flange and the central part of the plate 14a.

Discharge orifices or ports equivalent to the notches 30 may be formed in the abutment member rather than in the extremity of the discharge tube. Such a variation is shown in Fig. 4, where an abutment block 22a, equivalent to the block 22, is formed with a central chamber or recess 49 in its bottom and with radial ports 30a leading therefrom. Block 22a is coupled with a yoke 21a, rising from the central part of plate 14a, by a cotter pin 27a which passes through holes in separated parts of the yoke and through a vertical slot in an intermediate stem on the block. The chamber 49 is in line with the passageway through the tube 17a, and the rim of the block surrounding the chamber is tapered to a relatively narrow annular area, and may be brought to a knife edge like the edge 24 of Fig. 1, if desired. Otherwise the block 22a is formed substantially like the block 22 and its loose coupling with the yoke enables it to be brought into even bearing on the end of the tube and into centralized reactive bearing with the edges of the hole in the yoke through which its stem protrudes. In this case the end of the tube is formed with an annular surface sufficiently wide to insure con-

tinuous bearing with the beveled edge of the abutment block.

Or if desired, the ports may be formed partly in the end of the tube and partly in the abutment, arranged to register when the tube is brought against the abutment; although exact registry is not essential. Fig. 6 shows such an arrangement where a tube 17b, (like the tube 17a except that its end is brought to a sharp edge 24 and is provided with a port 30 as in Fig. 1), cooperates with an abutment block 22b like block 22a except that its rim is not beveled and that it contains one or more ports 30a. Registry between the ports 30 and 30a where required is maintained by the cotter pin 27 which prevents rotation of the abutment block and by the connection of the tube with the casing through the diaphragm 41 or its equivalent, which prevents any rotation of the tube.

Another variation shown in Figs. 4 and 5 is in the disposition of the targets, illustrating that the impingement surfaces of the targets may be otherwise located than at right angles to the streams of water. In this instance the targets 31a are fixed nonadjustably to the plate 14a and their impingement faces 32a are conical. Such surfaces may also be arranged in other relationships to the impinging streams.

Fig. 4 also shows how, by providing a diaphragm or its equivalent of sufficiently large area in proportion to the bore of the discharge tube, a sufficiently rapid closing of the tube against the abutment when the water supply is turned on may be obtained without the aid of baffles.

It will be apparent that the mode of operation of the nozzle construction last described is essentially the same as that of the one first described. Normally when water under pressure is excluded from the nozzle, the discharge tube is withdrawn from the abutment by the retracting spring. When water is turned on, the pressure exerted on the diaphragm quickly presses the tube against the abutment, but not until after a flushing discharge of water has occurred across all parts of the contact faces of these members; streams of water flow at high velocity through the ports 30a after such faces have been brought together, and impinge on the targets; and when the supply is shut off the spring 34a withdraws the discharge tube and causes another flushing flow of the water then displaced from the pressure chamber 44.

Such variations as a diaphragm instead of the bellows, emission ports in the tube or in the abutment, or partly in both, and impingement surfaces perpendicular or variously inclined to the direction of the emitted streams, may be combined with one another in various arrangements other than the specific arrangements here illustrated, all within the scope of the protection herein claimed. For convenience of descriptive definition, the bellows may be considered as a special form of diaphragm, and the term "diaphragm" as used in the claims is to be construed generically as including comprehensively the bellows species as well as the substantially flat species shown in Fig. 4, and other equivalent species except where the context requires otherwise. The term "diaphragm" as so understood embraces all flexible members which are secured at one boundary to a fixed structure and at the opposite boundary to a movable member and prevent passage of fluid under pressure while permitting or causing displacement of such movable member under the influence of fluid pressure.

What I claim and desire to secure by Letters Patent is:

1. A spray nozzle comprising a casing having an inlet, a discharge tube having a passage adapted to conduct liquid admitted to the casing, a diaphragm connected to the casing and discharge tube in such manner as to prevent escape of fluid from the casing except through the tube and to permit displacement of the tube under the pressure of such admitted fluid, an abutment located across the end of the tube in position to close the latter when displaced by fluid pressure, there being a port between such abutment member and the rim of the tube when in contact with one another through which liquid can escape, a target arranged to be impinged upon by such escaping liquid, and means for automatically effecting a separation between the tube and abutment when fluid pressure is excluded from the casing.

2. A spray nozzle comprising a casing having an inlet, a tube protruding from said casing adapted to conduct liquid therefrom, an abutment supported by the casing across the end of the tube, the tube being movable endwise into and out of contact at its outer end with the abutment, there being between the tube and abutment an emission port to which the outflow of liquid is restricted when the tube and abutment are in contact with one another, a target in the path of the liquid stream emitted from such port, and cooperating resilient means for causing advance of the tube toward the abutment when fluid pressure is exerted within the casing and for separating the tube from the abutment when such pressure does not exist.

3. A spray nozzle comprising as the emission portion thereof a tube and an abutment supported across the end of the tube, there being a restricted opening between the abutting faces of the tube and abutment through which discharge of liquid is permitted, and a target in the path of the stream emitted from such opening, the tube and abutment being mounted with provision for separation one from the other for cleaning, combined with automatic means for effecting such separation when flow of the liquid to the nozzle is shut off, and causing relative approach of one to the other when liquid under pressure is supplied to the nozzle.

4. A spray nozzle comprising a recessed body having a liquid inlet and a separable cover over the interior recess of the body, a flexible diaphragm member in fluid tight connection between the body and cover, a tube in fluid tight connection with the diaphragm protruding and being movable endwise through the cover, the tube being displaceable outward by fluid pressure within the casing acting on the inner end of the tube and the diaphragm, an abutment supported by the cover in line with the outer end of the tube and in position to receive pressure contact of such tube end when the tube is thus advanced, the tube having a notch in its rim for restricted emission of liquid when such rim is pressed against the abutment, and a target in the path of liquid flowing from the notch.

5. A spray nozzle comprising a recessed body having a liquid inlet and a separable cover over the interior recess of the body, a flexible diaphragm member in fluid tight connection between the body and cover, a tube in fluid tight connection with the diaphragm protruding and being movable endwise through the cover, the tube being displaceable outward by fluid pressure within the casing acting on the inner end of the tube

- and the diaphragm, an abutment supported by the cover in line with the outer end of the tube and in position to receive pressure contact of such tube end when the tube is thus advanced, the abutment having a notch in its face against which the tube thus abuts, through which liquid may flow in a stream when the tube is thus closed against the abutment, and a target in the path of such stream.
6. A spray nozzle including a casing having an inlet, a tube protruding from the casing adapted to conduct liquid from the casing, a flexible diaphragm member in fluid tight connection with the casing and tube arranged to prevent discharge from the casing except through the tube, baffle means in the tube arranged to impede flow through the tube and to build up a pressure causing outward movement of the tube when liquid under pressure is admitted to the casing, an abutment arranged to obstruct the tube when so moved outward, there being an emission outlet between the tube and abutment, and a target in the path of the liquid stream issuing under pressure from such outlet.
7. A spray nozzle comprising a casing having an inlet, a tube protruding from the casing adapted to conduct liquid from the casing and having an enlarged inner end, a bellows surrounding the tube in fluid tight connection at one end with the enlarged end of the tube and at its other end with the casing, baffles in the enlarged part of the tube arranged to impede flow through the tube and to build up a pressure causing outward movement of the tube when liquid under pressure is admitted to the casing, an abutment arranged to obstruct the tube when so moved outward, there being an emission outlet between the tube and abutment.
8. A spray nozzle comprising a casing having an inlet for liquid, a tube opening from, and being movable endwise relatively to the casing, an abutment located across the end of the tube, there being a restricted opening between the abutting faces of the tube and abutment through which discharge of liquid is permitted, and means whereby the pressure of liquid admitted to the casing causes the tube to move endwise into bearing engagement with the abutment.

9. A spray nozzle comprising a casing having an inlet, an emission tube leading from the casing and being mounted with provision for endwise movement, a liquid tight seal between the tube and casing preventing emission of liquid otherwise than through the tube and being yieldable to permit outward movement of the tube under the pressure of liquid entering the casing, and an abutment mounted across the end of the tube in position to be forcibly engaged by the latter when so moved by fluid pressure, there being an outlet of restricted area between the abutting portions of the tube and the abutment.

10. A spray nozzle comprising a casing having an inlet for liquid, an emission tube leading from said casing and being movable endwise relatively thereto, means connected with and reacting between the tube and casing for causing the tube to be advanced when liquid under pressure is admitted to the casing and for retracing the tube when such pressure subsides, an abutment for engagement with the end of the tube, and rigid supporting means for the abutment holding the latter with provision for self-adjustment into squarely abutting contact with the rim of the tube, there being a restricted opening between the contact portions of the tube and abutment through which discharge of liquid is permitted.

11. A spray nozzle comprising a recessed body having a liquid inlet and a separable cover over its recess, a flexible diaphragm member in fluid tight connection between the body and cover, a tube in fluid tight connection with the diaphragm protruding, and being movable endwise, through the cover, the tube being displaceable outward by fluid pressure within the casing acting on the inner end of the tube and the diaphragm, and an abutment supported by the cover in line with the outer end of the tube and in position to receive pressure contact of such tube end when the tube is thus advanced, one of the members constituted by the tube and the abutment having a notch in its portion next to the other member through which liquid may flow when the tube is thus closed against the abutment.

ROLAND L. LINCOLN.