Oct. 28, 1941. G. G. BUDWIG 2,260,603

METHOD AND APPARATUS FOR FORMING SPRAYS

Filed May 25, 1940

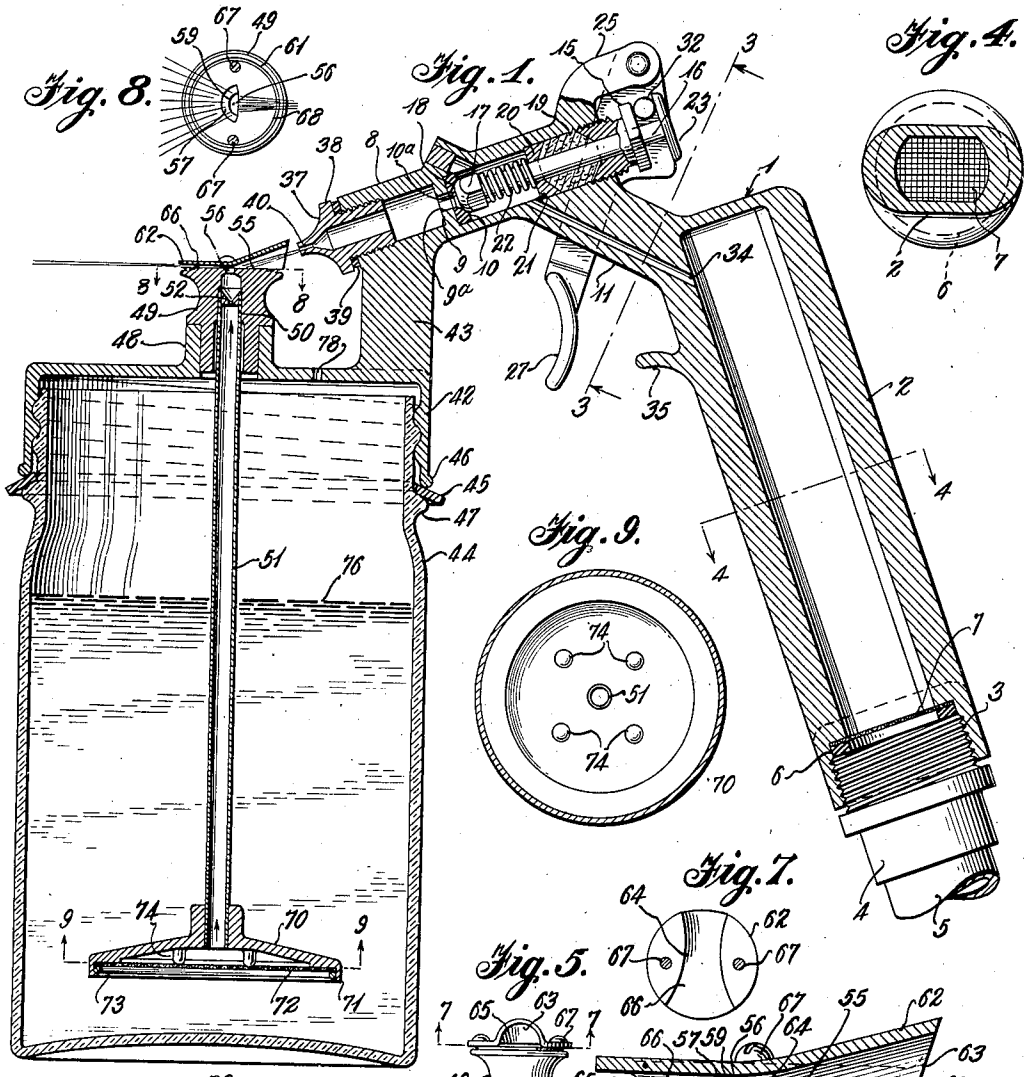


Fig. 8.

Fig. 1.

Fig. 4.

Fig. 9.

Fig. 7.

Fig. 5.

Fig. 3.

Fig. 2.

Fig. 6.

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Patented Oct. 28, 1941 2,260,603

UNITED STATES PATENT OFFICE

2,260,603

METHOD AND APPARATUS FOR FORMING SPRAYS

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Application May 25, 1940, Serial No. 337,273

14 Claims. (Cl. 299—84)

This invention relates to liquid spray apparatus of the general character set forth in my prior Patents Nos. 2,030,853 and 2,061,932, and more particularly to improvements in such apparatus adapting the same for use in forming a cleaning spray and other kinds of sprays in which the presence of air is desired.

It is commonly known that better cleaning can be effected by water containing soap or some other detergent material than by plain water. This may be explained by the fact that the soap or so-called "wetting agent" reduces the surface tension of the dirt film so that the water can more readily loosen and completely flush off the dirt. The ability to break down the dirt film is sometimes referred to as the "cutting effect" of the agent.

Previous attempts have been made to build machines that would apply water and a soap solution to a surface to be cleaned, but most of these machines have been very complicated, requiring auxiliary apparatus such as large storage tanks for city water, or air under pressure, and a tank for a cleaning solution. Such apparatus has proved to be quite expensive and not entirely satisfactory, notwithstanding. In contrast, the present invention is compact, requires no auxiliary apparatus, is quite simple in construction, easy to use, comparatively inexpensive and has proved to be very efficient and effective in actual use.

I have found that in order to get the maximum cleaning efficiency from the so-called "wetting agents," mild soaps and other cleaning agents, a suds should be formed which, in addition to being capable of overcoming the surface tension of the dirt film, tends to keep the dirt particles in suspension until rinsed off the surface being cleaned. I have further found that in order to form a suitable cleaning spray sufficient air must be intermixed with the cleaning agent and water so that the cleaning agent will be caused to foam on the surface to which it is applied.

My aerated spray is particularly well adapted for use in cleaning painted surfaces, for example, the painted surface of an automobile; but, obviously, the spray is not limited in its use to cleaning nor to the cleaning of the surface of any given object.

In general, my invention relates to a method and apparatus for producing a spray of the foregoing character. The apparatus comprises a spray gun having a jar or receptacle for a cleaning agent or other material, a mixing head, a handle member, and means for controlling the flow of a jet of liquid at high velocity to the mixing head.

More specifically, the mixing head comprises a plug member, and a cap member overlying said plug member; the plug member being provided with a flat mixing surface, and having a suction slot or aperture therein and a beveled distributing surface merging with said slot and mixing surface. The suction aperture communicates through an aspirating tube with the interior of the receptacle containing a supply of the agent to be mixed with the air and jet of propelling liquid.

For cleaning purposes, I preferably employ a jet of water and project the same at high velocity from a nozzle against the mixing surface so that it impinges upon an area ahead of the suction slot and beveled distributing surface. The mixing surface deflects the jet over the suction aperture and the beveled distributing surface and causes the same to spread out into the general shape of a fan. The deflected jet, travelling at high velocity, produces a suction effect as it passes over the slot and causes the cleaning material to be sucked upwardly through the aspirating tube and to become well mixed with the jet of water. The distributing surface is beveled on an angle of approximately 10° which has been found to produce a further and intimate mixing of the liquids before they leave the mixing head. Air is introduced and mixed into the spray by directing the propelling jet of liquid into a Venturi-shaped passageway formed in the aforementioned cap member overlying the suction aperture and beveled distributing surface. The design of the Venturi passage is such that the propelling jet induces the entrance of air into the Venturi throat so that the ultimate spray discharged from the mixing head contains an intimate mixture of water, cleaning agent, and air.

The cap member is an important part of the apparatus in that it is primarily responsible for the somewhat "forced" inclusion of air in the spray. The exact manner of formation of the aerated spray is not entirely understood, but at present I am of the opinion that the air is probably entrained in the jet after it is deflected by the mixing surface, and that the cleaning agent is substantially simultaneously inducted with the air. The entrainment of the air, of course, takes place at such velocity as not to affect the maintenance of a low pressure area at the suction aperture, nor to affect the intimate mixing of the water, air, and cleaning agent prior to discharge from the mixing head.

One of the principal objects of my invention

is to provide an efficient and relatively simple and inexpensive spray apparatus.

Another object of my invention is to provide a spray apparatus particularly useful for cleaning purposes.

An important object of my invention is to provide a method of forming a spray containing air and a mixture of different liquids.

Another object of my invention is to provide an apparatus and method whereby different liquids may be intimately mixed and, in accordance with which, air is introduced into the mixture.

A further object of my invention is to provide an apparatus and method whereby a spray may be formed containing air and a mixture of definite proportions of different liquids.

Still another object of my invention is to provide a spray apparatus adapted to form a cleaning spray, the apparatus being operated by a fluid under pressure which itself becomes a part of the spray.

Other and further objects of my invention will be apparent from the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a vertical sectional view through a spray apparatus constructed in accordance with the principles of the present invention;

Figure 2 is an enlarged sectional view, showing the details of the mixing head;

Figure 3 is a sectional view taken on the line 3—3 of Figure 1 showing certain details of the trigger mechanism for controlling the operation of the spray apparatus;

Figure 4 is a sectional view taken on the line 4—4 of Figure 1 illustrating the cross-sectional shape of the handle or grip member of the spray apparatus;

Figure 5 is a detail view particularly illustrating the inlet end of the Venturi passage formed in the cap member;

Figure 6 is a view somewhat similar to Figure 5 but showing the discharge end of the Venturi passage;

Figure 7 is a sectional plan view taken on the line 7—7 of Figure 5 illustrating the contour of the sides of the Venturi passage;

Figure 8 is a sectional plan view taken on line 8—8 of Figure 1 particularly illustrating the suction aperture or slot in the plug member through which material contained in the jar may be aspirated; and

Figure 9 is a sectional view taken on the line 9—9 of Figure 1 showing a series of pads provided for supporting a screen at the lower end of the aspirating tube.

One form of spray apparatus embracing my invention comprises a body portion 1, preferably a single die casting, formed so as to provide a hollow handle 2 generally oval in cross-section as shown in Figures 1 and 4. The lower end of the handle 2 is provided with threads 3 adapted to receive a conventional coupling 4 secured to one end of a garden hose 5. A conventional hose washer 6 is inserted in the handle adjacent the coupling 4 to prevent leakage at this point. A screen 7 may be positioned inwardly of the washer 6 to preclude the entrance of foreign matter into the handle 2.

The body 1 further comprises a valve housing portion 8 angularly connected with the handle 2 by a neck 11. The housing 8 is hollow as illustrated in Figure 1 and contains a flange 9 against which one side of a rubber valve washer 10 is adapted to rest. The flange 9 surrounds an opening 9a and the washer 10 is provided with an aligned central opening 10a.

The end of the valve housing 8 nearest to the handle 2 is closed by an externally threaded plug 15. A slidable valve stem 16 extends through the plug and terminates at one end in an enlarged convex head 17 adapted to seal against a concave seat 18 formed in one side of the rubber packing 10. Leakage between the valve housing 8, and the plug 15 and the valve stem 17, respectively, is prevented by a body of suitable packing material 19. The packing 19 surrounds the valve stem 16 and is compressed between a metallic washer 20 which seats upon a shoulder 21 in the housing 8, and the plug 15. The head 17 of the valve stem is normally maintained in sealing engagement with the valve washer 10 by a spring 22 interposed between the metallic washer 20 and said head. The opposite end of the valve stem 16 projects outwardly beyond the plug 15 and has a circular head member 23 mounted thereon in axially spaced relation to the adjacent end of the plug 15.

The valve housing 8 has an arm 25 formed integral therewith, and this arm is adapted to provide a mounting for a pivotal support for a trigger member 27. A pin 28 is fixed to the upper end of the trigger 27 and passes through an aperture 29 in the arm 25 as is best shown in Figure 3. The pin 28 is maintained in operative assembled relation with the arm 25 by a split ring 30 seated in a groove in said pin.

The trigger 27 is operatively connected with the valve stem 16 by a projection 32 which extends from said trigger into the space between the nut 15 and the circular stem head 23.

The neck 11 is provided with a passageway 34 for establishing communication between the hollow handle 2 and the hollow portion of the valve housing 8. The handle 2 is provided with a projection 35 adapted to serve as a stop for the trigger 27.

The end of the valve housing 8 opposite the plug 15 is adapted to threadedly receive a nozzle element 37. This element has a flange 38, and a gasket 39 is adapted to be compressed by said flange into leakproof engagement with the adjacent end of said valve housing. The nozzle element 37 is also provided with an orifice 40 arranged to angularly direct a spray against a flat mixing surface 55, which will be more fully described later.

The body portion 1 still further comprises a cover member 42 which is connected to the valve housing 8 by a leg 43. The cover 42 is internally threaded so that it may be screwed upon the upper end of a conventional pint-size receptacle or jar. A conventional jar rubber 45 may be interposed between the beaded flange 46 of the cover and a circumferential rib 47 on said jar to provide a seal between said cover and jar.

The cover 42 is provided with a central annular boss 48 adapted to receive a mixing head comprising a circular plug 49 and a cap 62. The plug 49 is provided with an internal bore 50 for the reception of one end of an aspirating tube 51. A metering element 52 is adapted to be carried by the upper end of the tube 51 and to be received in the bore 50, as best shown in Figure 2. The element 52 has a metering hole 53 at the lower end thereof and converging and conical walls 54 which merge into said metering hole.

The upper face of the plug 49 provides a flat mixing surface 55 which functions in a manner which will be more fully pointed out hereinafter.

The mixing surface 55 is interrupted by a suction aperture 56 and a generally fan-shaped distributing surface 57 cut away or beveled on an angle of approximately 10 degrees (see Figures 2 and 8). The juncture of the suction aperture 56 and the beveled cut away portion is rounded as indicated at 59. The peripheral edge of the flat mixing surface 55 is undercut as indicated at 60 to provide a sharp edge 61 adapted to reduce drip.

The cap 62 overlies the mixing surface 55 and may consist of a suitably shaped copper stamping. The cap 62 is generally circular and is provided at one side thereof with a semi-conical inlet opening 63 which merges into a restricted throat 64. The walls defining the inlet opening 63 converge at a point approximately directly above the suction aperture 56. The cap 62' is further provided with a narrow, flared outlet portion 65 shaped so that it is widest at the edge of said cap opposite the inlet opening. The outlet portion 65 merges into said throat and cooperates with said inlet opening to provide a Venturi-shaped passageway 66 overlying the mixing surface of the plug 49.

The cap 62 is secured to the plug 49 by a pair of machine screws 67. The upper face of the plug 49, adjacent the sharp edge 61, is provided with an annular groove 68 adapted to cooperate with the lower surface of the copper cap and to form a seal therewith when the machine screws 67 are tightened, whereby to preclude any side leakage between the cap 62 and the mixing surface 55.

The lower end of the aspirating tube 51 carries a circular member 70 provided with an internally undercut flange 71. A relatively large screen 72 is received in the circular member 70 and retained in place by a split ring 73 cooperating with the flange 71. A plurality of pads 74 depend from the inner surface of the member 70 and serve as spaced supports for the screen 72.

The jar or receptacle 44 is adapted to receive a quantity of liquid soap or other material 76, the level of which is normally kept well above that of the member 70 at the lower end of the aspirating tube 51. The cover member 42 is provided with a vent 78 for admitting atmospheric pressure into the jar 44 above the level of the liquid 76.

It will be apparent from the foregoing description that when the trigger 27 is moved toward the stop 35, the projection 32 carried by said trigger will engage the head 23 of the valve stem 16 and cause the end 17 of said valve stem to be moved away from its seat 10, thus permitting water or other liquid under pressure to flow from the hose 5 into the handle 2, through passageway 34 in the neck 11, through the openings 10a and 9a in the seat 10 and the flange 9, respectively, and out through the orifice 40 of the nozzle 37.

As is best shown in Figure 1, the nozzle 37 is positioned at an angle relative to the mixing surface 55 so that the jet of water issuing from the orifice 40 impinges against said mixing surface on an area ahead of the suction aperture 56. The mixing surface 55 deflects the jet across the suction aperture 56 and over the beveled distributing surface 57 causing the spray to assume a flat, fan shape as diagrammatically illustrated in Figure 8. The suction created by the deflected jet in passing over the slot 56 causes aspiration of the liquid 76 from the jar 44 into said jet.

A suction aperture or slot of the type shown is highly effective in that the liquid to be aspirated is subjected to a comparatively increased suction due to the lateral extent of the slot, and the liquid after rising in the aspirator tube 51 mixes with the water along the entire extent of the slot, thus producing a more thorough and complete mixing of the liquids. Furthermore, by rounding the juncture of the beveled distributing surface 57 and the wall of the slot 56, as indicated at 59, and then merging the surface 57 with the plain mixing surface 55 of the suction plug, a still further and more intimate mix is produced.

As has been previously stated, a jet issuing from the orifice 40 induces air to enter the Venturi passage 66 in the cap 62 and to be mixed and entrained in the spray. The size of the orifice, the throat of the Venturi passage, and the size of the metering hole in the element 52, respectively, are so proportioned as to preclude any "choking" of the spray and, therefore, a sufficient suction effect is maintained at all times to withdraw the proper proportion of liquid from the jar and to form an aerated spray of the desired composition.

It will be apparent that satisfactory sprays may be produced within reasonable limits by the substitution of a nozzle having an orifice of a different size from the orifice 40 and, further, that metering elements similar to the element 52 but with a metering hole of a size different from the hole 53 may be substituted in the upper end of the aspirating tube 51 to vary the rate of withdrawal of liquid from the receptacle 44. Thus, it will be obvious that the volume of water in the spray is determined by the size of the nozzle orifice 40 while the volume of aspirated liquid is controlled by the size of the metering hole 53. The Venturi passage 66 in the cap 62 is designed to afford a reasonable variation in these proportions but, of course, a cap with any other suitable Venturi passage may be used if necesary to produce the character of spray desired. In any event, it is important that the passage be such as to cause the mixing of substantial air into the spray.

While the drawing herein illustrates one embodiment of the invention, it will be understood that various changes and modifications may be made therein without departing from the spirit of the present invention and the scope of the annexed claims.

I claim:

1. A spray device for forming and applying a spray to a surface comprising mixing means having a deflecting surface provided with a suction aperture and a Venturi passageway overlying said suction aperture; and a nozzle for directing a jet of liquid into said Venturi passageway and upon said deflecting surface.

2. A spray device for forming and applying a cleaning spray containing water, a cleaning agent and air to a surface to be cleaned, comprising mixing means including a suction aperture communicating with a source of cleaning agent and a passageway overlying said suction aperture; and a nozzle for angularly directing a jet of water downwardly into said passageway toward said suction aperture so that it impinges adjacent said suction aperture.

3. A device for forming and applying liquids to a surface in the form of a liquid spray containing air comprising a mixing head having a suction aperture opening onto an upper surface thereof; a cap mounted upon said mixing head, said cap having a passageway extending there-

across and having a restricted portion adjacent to said suction aperture; and a nozzle for directing a jet of liquid into said passageway.

4. A device for forming a spray containing a mixture of a plurality of liquids and air, comprising a mixing head having a substantially flat surface formed thereon and a suction aperture opening onto said surface; a cap mounted upon said mixing head in overlying relation to said surface, said cap having a portion thereof spaced from the adjacent surface of said mixing head, said spaced portion being of the general shape of a Venturi passageway; and a nozzle for directing a stream of liquid into said passageway and onto said flat surface.

5. A device for forming and applying liquids to a surface in the form of a liquid spray containing air, comprising a mixing head having a mixing surface and a suction aperture opening onto said mixing surface; a cap mounted upon said mixing surface, said cap having a Venturi passageway overlying said suction aperture; and a nozzle for directing a jet of liquid into said passageway at an angle onto said mixing surface.

6. A spray device comprising a receptace for a liquid to be sprayed; a cover member for said receptacle; mixing and spray forming means carried by said cover member, said mixing and spray forming means including a surface having a suction aperture communicating with said receptacle and a Venturi passageway overlying and extending across said suction aperture in direct communication therewith; and a nozzle for directing a jet of liquid into said passageway so that it impinges upon said surface at a point adjacent said suction aperture.

7. A spray device comprising a receptacle for a liquid to be sprayed; a cover member for said receptacle; a mixing head carried by said cover member; a cap mounted upon said mixing head, said mixing head having a suction aperture formed therein and said cap member having portions thereof spaced from the adjacent surface of said mixing head and shaped to provide a Venturi passageway overlying said suction aperture; and a nozzle for angularly directing a jet of fluid into said passageway.

8. A spray gun comprising a grip member; a cover member connected wtih said grip member; a receptacle adapted to contain an agent to be sprayed, said receptacle being secured to said cover member; a mixing head mounted upon said cover member, said mixing head having a suction aperture and having a depending aspirating tube extending into said receptacle; a cap carried by said mixing head, said cap having portions thereof spaced from the adjacent surface of said mixing head to provide a passageway overlying said suction aperture; a nozzle mounted upon said cover member and positioned to direct a jet of liquid into said passageway; and valve means for controlling the flow of liquid to said nozzle.

9. A spray forming apparatus comprising a handle member; a cover member connected with said handle member; a receptacle adapted to contain a liquid to be sprayed, said receptacle being detachably secured to said cover member; a mixing head mounted upon said cover member, said mixing head having a suction aperture; an aspirating tube below said suction aperture and extending into said receptacle; a cap overlying said mixing head, said cap having portions thereof spaced from the adjacent surface of said mixing head to provide a passageway overlying said suction aperture; a nozzle arranged to direct a jet of fluid into said passageway; and a valve for controlling the flow of fluid to said nozzle.

10. A spray gun comprising a grip member; a cover member connected with said grip member; a receptacle adapted to contain a material to be sprayed, said receptacle being detachably secured to said cover member; a mixing head mounted upon said cover member, said mixing head having a suction aperture; an aspirating tube below said suction aperture and extending into said receptacle; means below said suction aperture providing a metering orifice; a cap overlying said mixing head, said cap having portions thereof spaced from the adjacent surface of said mixing head to provide a Venturi passageway overlying said suction aperture; a nozzle mounted upon said cover member arranged to direct a jet of fluid into said Venturi passageway; and valve means for controlling the flow of fluid to said nozzle.

11. A spray gun comprising a hollow handle member having an opening through which fluid may be introduced into said handle member; a cover member connected with said handle member; a receptacle adapted to contain a cleaning agent, said receptacle being secured to said cover member; a mixing head mounted upon said cover member, said mixing head having a suction aperture; an aspirating tube below said suction aperture and extending into said receptacle; a metering orifice at the upper end of said aspirating tube; means overlying said mixing head having portions thereof spaced from the adjacent surface of said mixing head to provide a passageway overlying said suction aperture; a nozzle mounted upon said cover member arranged to direct a jet of fluid into said passageway; a valve chamber adjacent said nozzle adapted to be placed in communication with said hollow handle member; a valve stem in said chamber for controlling the flow of liquid from said hollow handle to said nozzle; and means including a trigger for moving said valve stem to open position.

12. The method of forming a spray containing water, air and another liquid which comprises angularly projecting a jet of water at a substantially high velocity against an apertured mixing and distributing surface within a Venturi passageway and creating suction in said passageway to simultaneously draw air into the inlet end of said passageway and to aspirate said other liquid into said passageway through the aperture in said mixing and distributing surface.

13. The method of forming a spray containing a mixture of liquids and air which comprises angularly directing a jet of water against a covered, apertured mixing and distributing surface so that said jet is caused to entrain air and to create suction in said aperture thereby aspirating another liquid into the jet of water and air before it is discharged from said surface.

14. The method of forming a spray containing a plurality of liquids and air which comprises angularly directing a stream of one liquid at a deflecting surface, aerating said stream while it is moving at a high velocity with respect to said surface, and introducing a second liquid into the moving stream of the first mentioned liquid before it has traveled across said surface.

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