July 2, 1935. W. C. UHRI, JR 2,007,029

WASHER GUN

Filed May 2, 1932 2 Sheets-Sheet 1

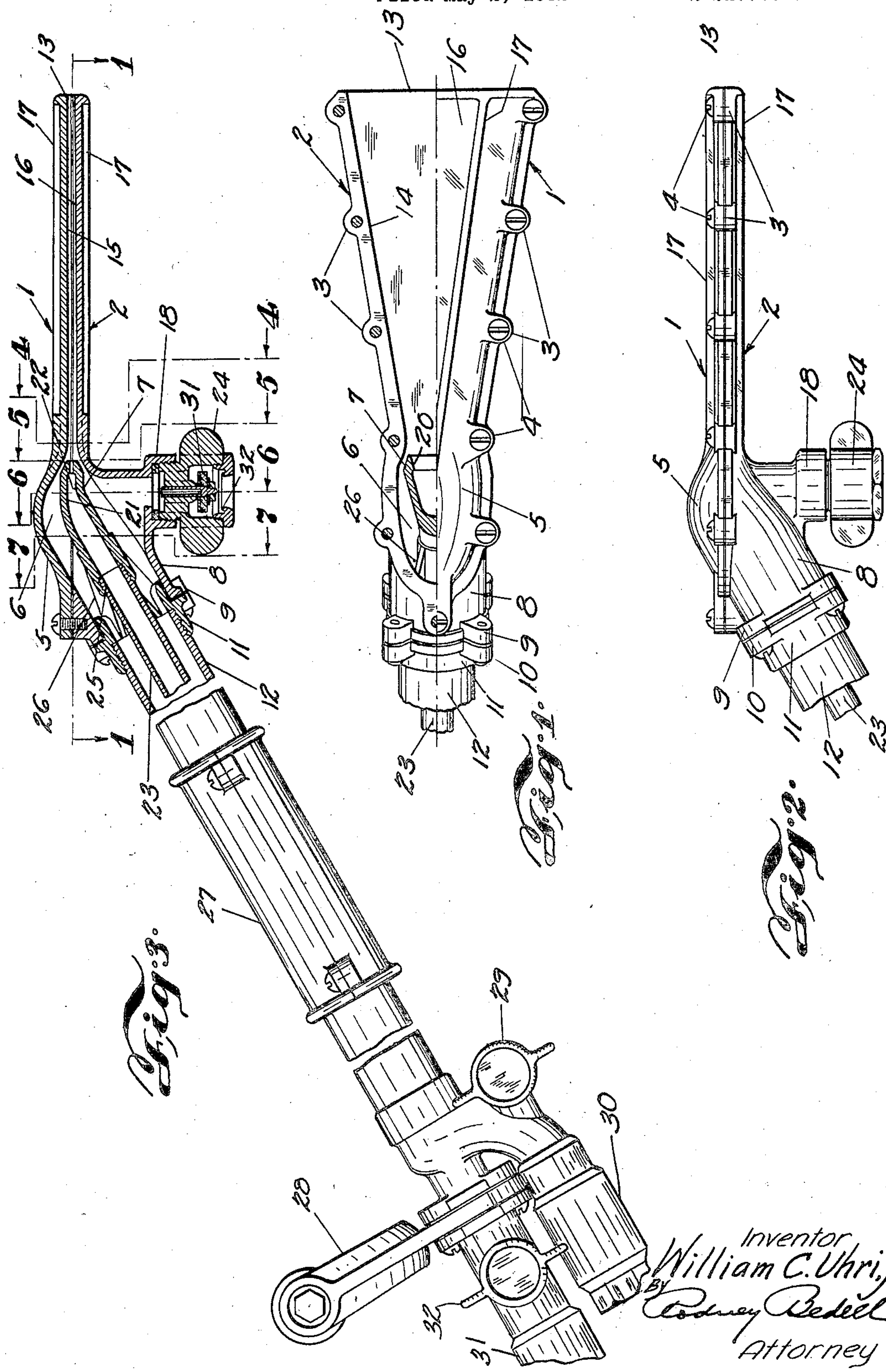

Fig. 3. Fig. 1. Fig. 2.

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Fig. 4.

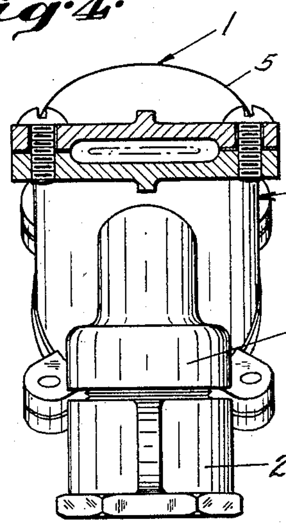


Fig. 5.

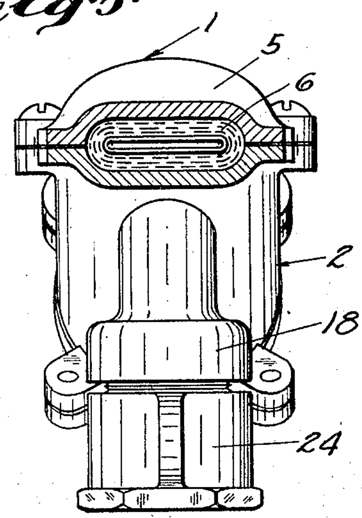


Fig. 6.

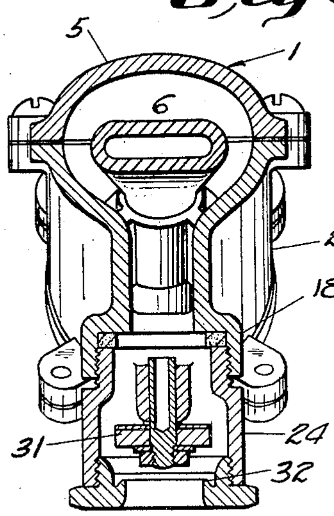


Fig. 7.

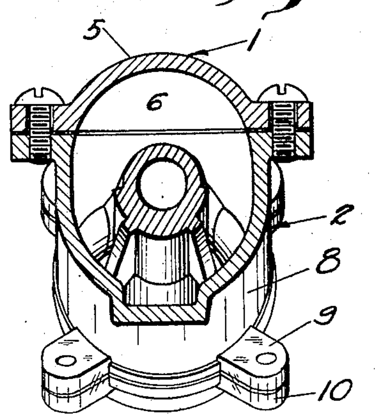
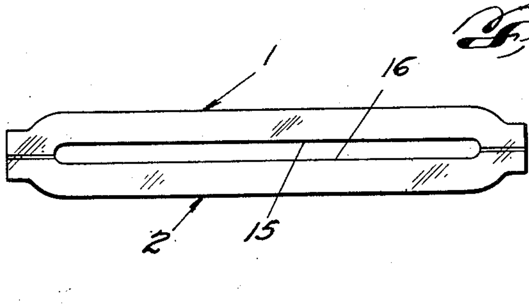


Fig. 8.



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Patented July 2, 1935 2,007,029

UNITED STATES PATENT OFFICE

2,007,029

WASHER GUN

William C. Uhri, Jr., St. Louis, Mo.

Application May 2, 1932, Serial No. 608,577

11 Claims. (Cl. 299—140)

My invention relates to the production of a stream of atomized fluid for use in cleansing articles which have been coated with grease, dirt and other substances which are difficult to remove by ordinary cleaning methods. My invention consists in a novel nozzle or washing gun, and in the method of producing an atomized stream, and utilizes certain general principles disclosed in Patent No. 1,751,719 issued to me March 25, 1930.

The main object of my present invention is to provide a more effective stream by obtaining a higher degree of atomization and higher velocity thereof than has been possible heretofore.

Another object of my present invention is to provide a stream having a wide, flat cross-section of fairly uniform atomization throughout its width. Such a stream is more effective for cleaning large surfaces just as a wide, flat paint brush is better than a round brush for covering flat surfaces.

Another object of my invention is to provide a flat, wide stream of air only for drying purposes.

Another object of my invention is to provide a portable tool which may be connected to any suitable sources of supply of air or water, or like fluids, and will utilize the heat, if present, of one of the fluids to increase the pressure and volume of the other fluid prior to the combination and discharge of the fluids from the tool.

These and other detail objects of my invention are attained by the structure illustrated in the accompanying drawings, in which—

Figure 1 is in part a top view of the gun, and in part a horizontal section on the line 1—1 of Figure 3.

Figure 2 is a side view of the gun.

Figure 3 is a vertical section taken on the longitudinal center line, portions of the handle being in elevation.

Figures 4, 5, 6 and 7 are vertical transverse sections through the gun body taken on the corresponding section lines of Figure 3.

Figure 8 is a front end view.

Briefly, my present gun embodies an inner nozzle for discharging a stream of air or other motive fluid, which nozzle has substantially parallel sides and an elongated thin orifice, and a similarly shaped outer nozzle for water or other liquid surrounding the inner nozzle and extending a substantial distance forwardly thereof to confine the combined fluid stream within a restricted but gradually increasing cross sectional area for a sufficient distance or time to effect a high degree of atomization and to eliminate any tendency towards cross currents or spreading of the stream, whereby the stream of air and water, or similar mixture, may be discharged from the end of the device in a flat, wide spray which will maintain its shape for a substantial distance away from the device.

The gun body is illustrated as composed of upper and lower sections 1 and 2, each having a series of lugs 3 along the edges thereof for assembly screws 4. Each of the sections preferably comprises an integral metal unit.

The gun includes a bulged central portion 5 forming a chamber 6 surrounding the inner nozzle 7. The rear end 8 of the gun body has perforated lugs 9 for attachment to the lugs 10 on an internally threaded sleeve 11 into which is screwed the end of the elongated conduit 12. The forward end of the gun body comprises an axially elongated outer nozzle 13 having diverging side walls 14 and substantially parallel top and bottom walls 15 and 16 reinforced by ribs 17. Walls 15 and 16 are preferably slightly converging in order to offset to a degree the tendency of the atomized stream to expand perpendicularly of the wider dimension of the nozzle when released. The outer nozzle should be of sufficient length to insure substantial atomization and shaping of the fluid streams, the length of the nozzle illustrated being several times the width or larger dimension thereof at the inner end. The inner periphery of the orifice of the outer nozzle constitutes a straight line or straight angle extension of the inner periphery of the main walls of the nozzle as distinguished from orifice structures having walls which diverge or converge relative to the walls of the body of the nozzle.

Located within the enlarged chamber 6 is an inner nozzle 7 having a discharge portion including diverging side walls 20 preferably machined at the outer end and substantially paralleling the sides 14 of the outer nozzle, and having top and bottom walls 21 and 22 which at their forward ends substantially parallel each other and the top and bottom walls 15 and 16 of the outer nozzle. The outlet of the inner nozzle is substantially smaller both in depth and width than the throat of the outer nozzle, as indicated by the dot and dash lines in Figure 4, whereby the fluid stream supplied through body 6 to the outer nozzle will substantially envelop the fluid stream emitted from the inner nozzle. Fluid is supplied to the inner nozzle by means of a conduit 23 having threaded attachment to the inner nozzle at 25. The inner nozzle merges with sleeve

11, preferably in a one-piece structure braced by ribs 26. The inner and outer nozzles are so arranged that the water stream will be in dynamic flow or motion equally on all sides of the air orifice. This is produced by coaxial air and water ducts both of substantial length and distinguishes my device from structures wherein water enters a "mixing chamber" at various angles to the air outlet orifice.

Conduit 23 is smaller than conduit 12 and is located inside the same. Both of the conduits extend rearwardly a substantial distance from the body of the gun, and the outer conduit mounts gripping handles 27 and 28 to facilitate manipulation of the gun. Handle 27 may be insulated from the conduits. The conduits at points remote from the gun and adjacent to handle 28 are provided with suitable couplings such as 30 in Figure 3 to which supply hose (not shown) are connected. The couplings are controlled by valves, the handle 29 of one of which is shown, these valves being illustrated and described in my co-pending application Serial #274,548, filed May 2, 1928, now Patent No. 1,903,522, issued April 11, 1933.

Air and water under pressure are supplied to the inner and outer nozzles, respectively, and when warm water is used, the heat therefrom is imparted to the air in the enveloped conduit and serves to increase the pressure and volume thereof and thereby increase the atomization and velocity of the discharged stream. Preferably, the conduits are of copper with thin walls whereby the weight of the entire device is minimized, the transfer of heat from the hot water to the air stream is facilitated, and the radiation of heat from the outer conduit to the atmosphere is reduced. These results are obtained due to the fact that copper has a high value as a conductor of heat and has a low value as a radiator of heat. The desired effects are increased if the inner conduit has a dull or rough finish and if the outer conduit is highly polished as a polished copper pipe radiates heat much less readily than a pipe with a rough finish.

Extensive experimental development work which I have done in connection with the cleaning and washing art indicates that the greater the atomization of the washing stream the more effective work it will do—this being because the finer particles of liquid may penetrate between particles of dirt where thicker particles of the liquid will impinge upon the particles of dirt and rebound without separating and removing the latter from the surface to which they adhere. Also I have found that the degree of atomization of the projected stream depends upon the extent of the contact zone between the fast moving air stream and the surrounding liquid. This contact zone depends in turn upon the cross sectional shape of the outlet orifice of the inner nozzle. Equal distribution of liquid around the inner jet requires that the outer nozzle be shaped similarly to the inner jet.

Clearly, a nozzle having a flat outlet orifice will have a greater circumference than a round nozzle of the same cross-sectional area. I apply this principle to obtain substantially improved results in my novel washer gun due to the increased atomization of the projected stream resulting from the increased area of the contact zone between the inner and outer streams. If the outlet orifice of the inner nozzle 7 in the drawings measures 7/8" by 3/64" in cross section, the area of this orifice will be .04101 square inch and the circumference 1.843". A round inner nozzle with an orifice having the same cross-sectional area would have a circumference of .687 inch, approximately one-third that of a flat nozzle.

A washing gun constructed as described above having an air discharge orifice measuring 3/64" x 7/8" in cross-sectional area at its outer end, an outer nozzle measuring $\frac{5}{32}$" x 1$\frac{1}{8}$" in cross-sectional area at its inner end and flaring to $\frac{1}{8}$" x 3$\frac{3}{16}$" at its outer end and having a length between its inner and outer ends of 6$\frac{1}{8}$", when supplied with air at a working pressure of 87 pounds per square inch and water at 115 pounds per square inch, produces a flat stream of water which at a distance of 12 inches from the gun has a width of 7 inches; 24 inches from the gun has a width of 11 inches; 36 inches from the gun has a width of 15 inches, and similarly increases regularly in width for a distance of about 10 feet from the gun without losing its flat shape. The atomization is so fine that at a distance of 3 feet from the end of the nozzle an object may be readily viewed through the broad side of the stream. Such a stream has thoroughly cleansed such difficult surfaces as a concrete slab in a railway locomotive yard where the dust, crater oil, and other dirt present in such surroundings have been tramped into the pitted surface of the concrete and baked by the sun until washing with an ordinary stream of high pressure water is useless.

Depending from the lower portion of the body of the gun is a threaded inlet 18 for mounting a housing 24 of an air valve which functions to admit atmospheric air when the water supply is cut off and the gun is used for drying purposes. This air valve may be automatic, as shown, or a manually operated valve may be substituted therefor. The valve illustrated is fully described in my copending application, Serial No. 274,548, filed May 2, 1928.

Shutting off the water supplied to the outer nozzle results in the creation of a vacuum in the chamber 6 which causes the valve 33 to lift from its seat 34 permitting atmospheric air to enter chamber 6, thus augmenting the stream of compressed air for drying purposes. The discharged air stream will have the same wide shape as the washing stream and will dry a broad surface more rapidly than a cylindrical stream.

The invention broadly includes the use of wide shallow flaring discharge nozzles, substantially as shown, and the wider top and bottom walls of the outer nozzle may be made parallel, if desired, instead of slightly converging. The advantages of the gun arise from the improved atomization resulting from the novel shaping and arrangement of the parts.

Moreover, the gun may be used with other fluids than those referred to and it is not essential that these be supplied at the pressures indicated.

I contemplate the exclusive use of such modifications as come within the scope of the appended claims.

What is claimed is:

1. In a device of the class described, an outer nozzle having flat substantially parallel sides and flaring edges and a fluid inlet into the restricted end thereof, and a similarly shaped inner nozzle coaxial therewith and spaced therefrom having an elongated thin outlet orifice located immediately adjacent said restricted end of said outer nozzle and having a fluid inlet, the sides and edges of said outer nozzle substantially parallel-

ing the corresponding sides and edges of said inner nozzle and being offset outwardly of the respective planes thereof, the orifice of the outer nozzle forming a straight angle extension of the inner walls of the nozzle adjacent to the orifice.

2. In a device of the class described, a parallel-sided, diverging edged outer nozzle, a similarly shaped inner nozzle coaxial therewith and spaced therefrom with an elongated shallow outlet orifice disposed to discharge directly into the smaller end of said outer nozzle, and means for supplying fluids under pressure to said inner nozzle and to the smaller end of said outer nozzle, respectively, the orifice of the outer nozzle forming a straight angle extension of the inner walls of the nozzle adjacent to the orifice.

3. The method of producing a flat stream of finely atomized liquid under high pressure which consists in discharging a thin, flat edgewise diverging jet of gaseous material under pressure into a concurrent stream of liquid surrounding the same under comparable pressure, confining the mixture in a relatively thin, flat edgwise diverging form for a distance sufficient to permit substantial atomization of the liquid, and then freeing the atomized mixture.

4. The method of producing a flat stream of atomized mixture which consists in forming a flat fan-shaped jet of gaseous material of restricted thickness, utilizing the entraining force of said jet to increase the velocity of a mass of liquid supplied in flat streams at both wide flat sides of said jet, immediately shaping the resulting mass of air and liquid into a flat stream, the first thickness of which is a little greater than that of said jet, and controlling the width and thickness of the resulting stream so that it diverges uniformly in an edgewise direction while the thickness thereof remains substantially constant, the control being exercised over a length of the stream sufficient to permit substantial atomization of the major portion of the liquid by the air, and then freeing the stream from the control.

5. In a device of the class described, coaxial inner and outer nozzles having closely spaced substantially parallel sides and diverging edges, said outer nozzle having a laterally elongated shallow throat and said inner nozzle having a similarly shaped but slightly smaller outlet orifice immediately adjacent the throat of said outer nozzle, the outlet orifice of the outer nozzle forming a straight angle extension of the inner wall of the nozzle adjacent to the orifice.

6. In a device of the class described, coaxial inner and outer nozzles with corresponding walls spaced apart, each having a fluid inlet and flat substantially parallel sides, said nozzles having substantially coplanar diverging edges, the outlet orifice of said inner nozzle being laterally elongated so as to discharge a flat diverging stream and being positioned immediately adjacent the inlet end of said outer nozzle.

7. A device of the class described including flat coaxial inner and outer fluid nozzles each having substantially parallel wide sides and diverging narrow edges, the sides and edges of one nozzle being spaced from the sides and edges of the other nozzle transversely of the axis of the device and said outer nozzle having an elongated outlet orifice forming a straight angle extension of the inner walls and edges of said outer nozzle, said outer nozzle in its entirety extending a substantial distance forwardly of said inner nozzle.

8. In a device of the class described, an inner nozzle having a fluid inlet, flat substantially parallel sides and diverging edges and an orifice defined by the inner walls thereof, and a similarly shaped outer nozzle coaxial therewith and with its walls spaced from the walls of the inner nozzle transversely of the device, the orifice of the inner nozzle discharging at the throat of the outer nozzle, the orifice of the outer nozzle also defined by the inner walls thereof.

9. The method of obtaining an atomized mixture which consists in confining a stream of gaseous material under pressure into a flat fan-shaped stream, surrounding the same with a thin stream of liquid flowing in the same direction, discharging the gaseous stream into the liquid stream and confining the combined streams in a relatively thin flat fan-shaped stream for a distance sufficient to permit substantial atomization thereof, and then freeing this mixture.

10. In a device of the class described, an axially elongated outer nozzle having an inlet throat and a discharge orifice and an elongated intermediate part, said throat, orifice, and part maintaining a wide flat cross-section substantially from end to end of the nozzle, the width of the nozzle increasing from throat to orifice and the orifice constituting a straight angle extension of the walls of the nozzle, and a relatively short inner nozzle with its sides substantially coplanar with said outer nozzle sides and shaped to discharge a wide flat stream of motive fluid directly into the wide flat throat of said outer nozzle and axially thereof.

11. The method of producing a stream of finely atomized liquid which consists in confining a mass of motive fluid in a flat stream and then discharging the same without changing its general contour or direction of its flow, confining a stream of liquid to be atomized so that it flows in a hollow flat stream coaxially of and substantially surrounding said motive fluid stream and in dynamic flow alongside of and intermingling with the discharged motive fluid stream, confining the combined stream of motive fluid and liquid to be atomized for a substantial distance to a flat cross-sectional contour with diverging edges flowing coaxially with said initial fluid and liquid streams, and then discharging said combined stream without changing its general contour or the direction of its flow.

WM. C. UHRI, JR.