Aug. 23, 1966 E. J. O'BRIEN ETAL 3,268,176

SPRAY NOZZLE HAVING STABILIZING TUBE AND VANE UNIT

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Fig. 1.

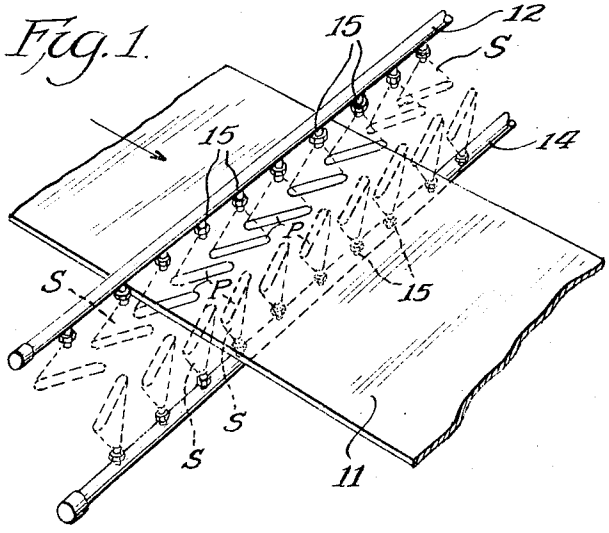
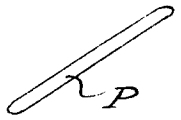


Fig. 2.



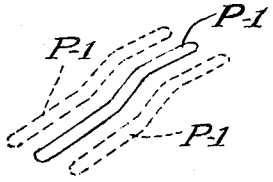
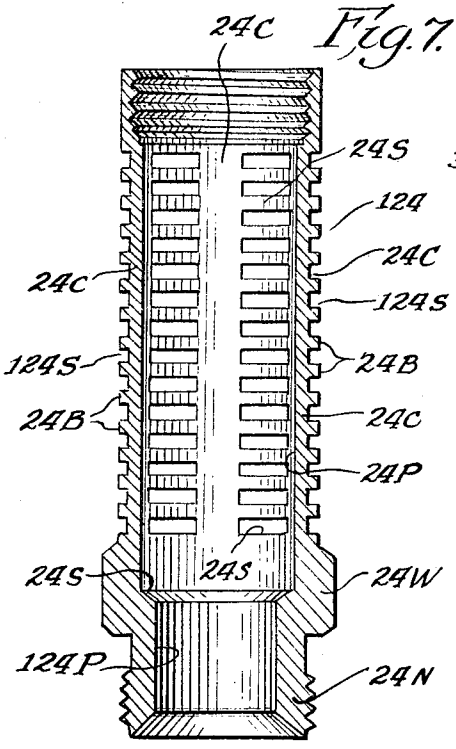


Fig. 3.

Fig. 7.



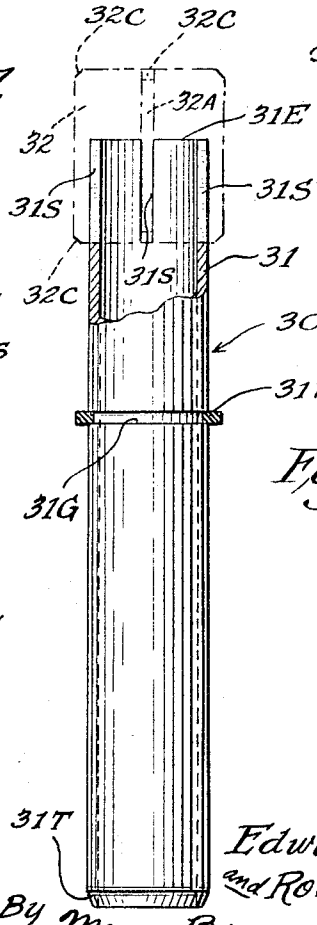


Fig. 8.

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SPRAY NOZZLE HAVING STABILIZING TUBE AND VANE UNIT

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Fig. 4.

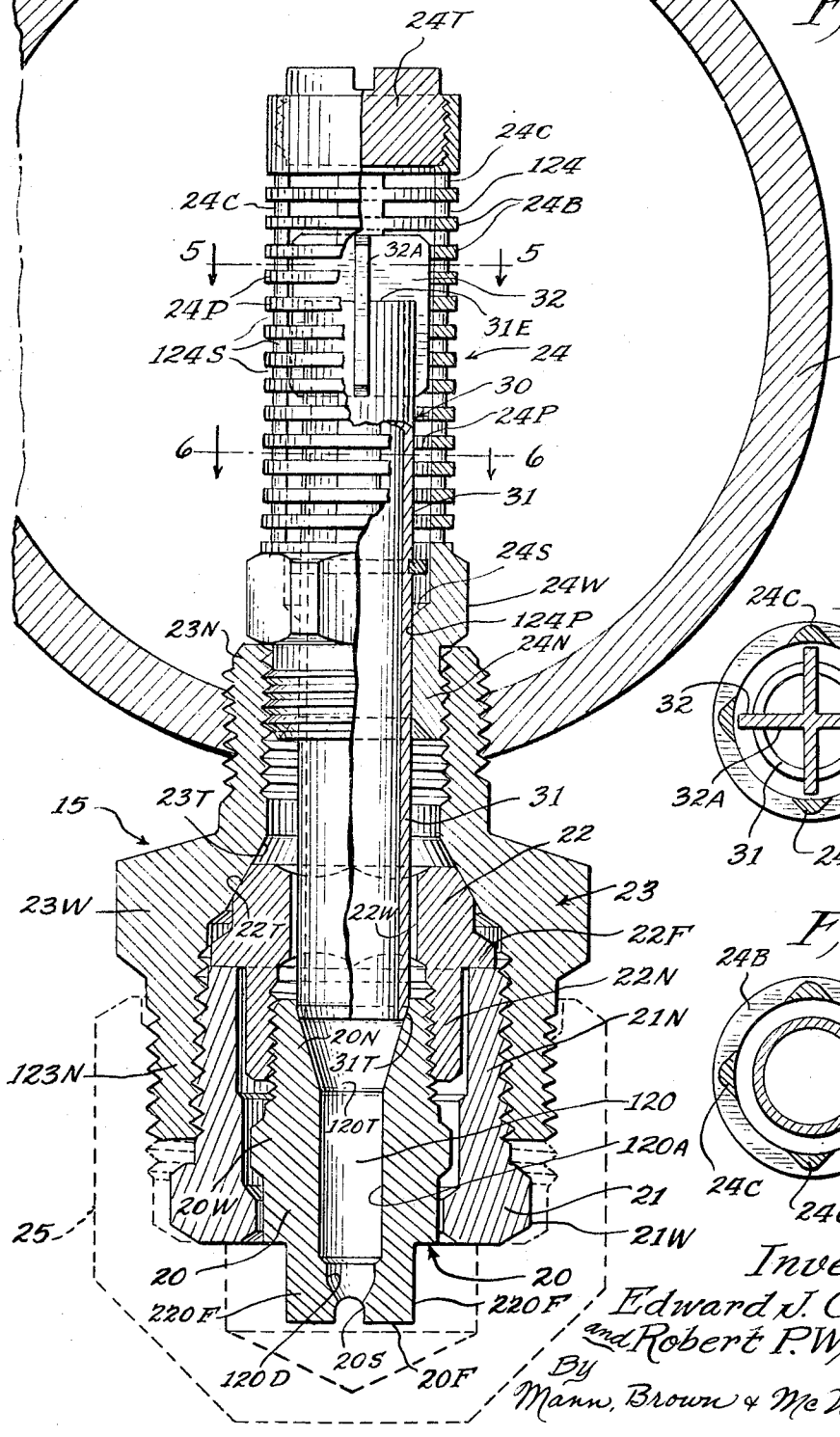

Fig. 5.

Fig. 6.

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SPRAY NOZZLE HAVING STABILIZING TUBE AND VANE UNIT

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18 Claims. (Cl. 239—553.5)

This invention relates to liquid spraying equipment and particularly to stabilizing the sprays produced by spray nozzles in such equipment.

In many liquid spraying installations it is found that there is a tendency for the sprays to wobble or to become distorted, and this difficulty is encountered in both high pressure and low pressure installations. An example of such a situation is found in steel mill de-scaling equipment where flat spray nozzles are employed in surface cleaning or de-scaling operations, the liquid such as water is discharged from the nozzles at high pressure and at close range so as to produce the high impact that is desirable for such cleaning or de-scaling. Usually the nozzles are stationary and the material to be cleaned is moved rapidly past the spray impact area, as for example, in de-scaling operations in steel mills where the rolled sheet from a rolling mill passes a plurality of flat spray nozzles arranged in spaced relation along a line that is transverse to the path of movement of the sheet. In such an installation the several nozzles are arranged with their spray patterns at a slight angle to such transverse line so that there is no interference between the spray discharges of the several nozzles and so that there is a small yet effective lateral overlapping of the spray patterns with respect to the line of travel of the sheet that is being de-scaled.

De-scaling installations of the aforesaid character usually involve the mounting of the nozzles on a water supply header which supports the nozzles in the desired array transversely of the path of advancing movement of the sheet that is being de-scaled, and because a certain amount of foreign matter is usually present in the water used in such instances, it is usually considered to be essential that an individual strainer be associated with each nozzle immediately upstream thereof. Thus, in such instances, the strainers must be located within the supply header.

The strainers employed in installations of the aforesaid character have been of the conventional type used in the liquid spraying art where a central passage in an elongated metal body is closed at one end and opens at the other and axially into the approach passage of the nozzle, the body having spaced transverse slots cut therein so that water may enter laterally into the central passage and travel longitudinally thereof to the nozzle for discharge.

It has been found in such installations that at the high pressures and flow rates required for de-scaling and like operations, the close coupling of the nozzles with respect to the header, and the presence of the strainers cause improper and undesirable operations of the spray nozzles that tends to reduce the efficiency and uniformity of the de-scaling operation. Thus, each of the nozzles is intended to produce a straight and relatively narrow spray pattern that remains stationary so as to maintain uniformity of cooperation with adjacent nozzles in accomplishing a uniform de-scaling action, but when conventional strainers are employed in the relationship above described, it is found that there is a marked distortion of the desired straight spray pattern and that this is coupled with an erratic wobbling of the individual sprays so that sporadic interference of adjacent sprays

destroys the desired uniformity of the de-scaling action.

In view of the foregoing, it is the primary object of the present invention to enable the operation of the spray nozzles in such installations to be improved in such a way as to eliminate distortion and wobbling of the spray pattern and thus insure uniformity in the resulting de-scaling action, and an object related to the foregoing is to enable this to be accomplished in a simple and economical manner.

A further important object of this invention is to control the flow of liquid into and through a strainer and into a spray nozzle in such a manner that uniformity and stability of the spray pattern is attained, and a related object is to achieve this objective through the provision of flow controlling means that cooperates with a conventional slotted strainer and a conventional flat spray nozzle in maintaining the desired spray pattern as well as the stability of the spray.

Other and further objects of the present invention will be apparent from the following description and claims, and are illustrated in the accompanying drawings which show structure embodying preferred features of the present invention and the principles thereof, and what is now considered to be the best mode in which to apply these principles.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same:

FIG. 1 is a schematic perspective view showing a conventional descaling installation of the type in which the present invention is used;

FIG. 2 is a schematic view showing the desired flat spray pattern;

FIG. 3 is a schematic view illustrating a distorted spray pattern and the displacement or wobbling thereof;

FIG. 4 is an enlarged cross sectional view showing a spray nozzle-strainer installation embodying the invention;

FIGS. 5 and 6 are cross sectional views taken respectively along the lines 5—5 and 6—6 of FIG. 4;

FIG. 7 is a vertical sectional view of the strainer body; and

FIG. 8 is a side elevational view of the tube element of the flow governing means.

For purposes of disclosure the invention is herein illustrated in FIG. 1 as employed in descaling apparatus 10 where a continuous hot metal sheet 11, advancing at a high rate of speed as it leaves the forming rolls in a steel mill, passes between upper and lower supply headers 12 and 14 so that hard hitting sprays S of water discharged from spaced spray nozzles 15 carried on and supplied with water by the respective headers, may be discharged against the upper and lower surfaces of the sheet 11 to loosen and remove scale from such surfaces. The spray nozzles 15, which are of known form and construction as will be described in detail hereinafter, are of the flat spray type designed to produce a long narrow spray pattern P with rounded ends, as shown in FIG. 2, and the nozzles 15 are rotatively set on their supporting headers 12 and 14 so that the individual spray patterns P of the several nozzles will be disposed at a slight angle to the path of movement of the sheet 11 and with respect to this path, will be slightly overlapped, as shown in FIG. 1. This arrangement prevents interference of adjacent sprays S, and promotes uniformity of descaling over the surface of the advancing sheet 11.

To aid in attaining trouble-free spray nozzle performance it is customary to employ individual slotted body strainers associated with the respective nozzles and located within the related water supply header, and experience has shown that such strainers, particularly when the water is fed to the headers at high pressure, tend to

cause distortion or wobbling of the individual sprays S with resultant variations in the descaling action of the apparatus. Thus, as shown in FIG. 3, the desired straight spray pattern may assume various curved or irregular forms such as the modified "Z" shape shown at P–1, and the spray S may wobble back and forth as indicated by the dotted line positions of the spray pattern P–1. Such wobbling and distortion may occur simultaneously, or independently. Wobbling of the sprays S of course results in interference of adjacent sprays, both wobbling and spray pattern distortion have been considered to be objectionable as reducing the uniformity and efficiency of the descaling action.

In accordance with the present invention, such objectionable distortion and wobbling of the spray S has been overcome by the provision of a novel association of flow control means with the strainer and the discharge tip of the nozzle, as shown particularly in FIGS. 4 to 6 of the drawings. Thus, as shown in FIG. 4, a conventional flat spray tip **20** is mounted by means of a retainer **21** and a bushing **22** in the lower end of an adapter **23** that is extended radially through the header **12** and has a slotted body strainer **24** associated therewith within the header so that water from the header **12** feeds through the strainer **24** and the adapter **23** for discharge from the spray tip **20**.

The adapter **23** has a wrench flange **23W** with an upwardly extending nipple **23N** that is threaded externally and screwed radially into the header **12**, and below the wrench flange **23W** an enlarged lower nipple **123N** is provided that is internally threaded to receive the retainer **21**, and is externally threaded to receive a shut-off cap **25** when a particular nozzle is to be disabled.

The spray tip **20** comprises an elongated body **20B** having a wrench flange **20W** intermediate its ends and at its upper end an externally threaded nipple **20N** is provided. The body **20B** extends downwardly beyond the wrench flange **20W** and an internal passage **120** extends downwardly through the nipple **20N**. The passage **120** has a tapered or converging upper portion **120T** that merges with an intermediate cylindrical approach portion **120A** which in turn merges with a reduced domed end portion **120D** that locates the extremity of the dome relatively close to the flat lower end face **20F** of the tip body **20B**. In the face **20F** a transverse slot **20S** is formed so that the rounded bottom of the slot **20S** intersects the domed portion **120D** to form an elongated spray orifice that shapes the discharged water into a flat spray S. The lower end portion of the tip **20** has parallel flat wrench faces **220F** formed thereon parallel to the slot **20S** to aid in rotatively setting the tip **20**, as will be described.

The tip **20** is assembled with respect to the adapter bushing **22** by threading the nipple **20N** of the tip into an internally threaded nipple **22N** that forms the lower portion of the bushing. The bushing **22** has a hexagonal central passage **22W** extended downwardly therethrough and this serves as a wrench socket for assembly purposes. Intermediate its ends the bushing **22** has an outward annular flange **22F** which, in mounting of the bushing-tip assembly, is engaged by the upper end of the retainer **21**, as will become evident as the description proceeds. Thus, the retainer **21** is in the form of a nipple **21N** with a wrench flange **21W** at its lower end, and the bushing-tip assembly **22–20** is fitted into the retainer **21** with the flange **22F** of the bushing **22** resting on the upper end of the nipple **21N**. In this relationship the flat sides **220F** of the tip are disposed below the lower end of the retainer **21**. The retainer **21** is then screwed into the internally threaded nipple **123N** of the adapter **23** to engage a tapered surface **22R** of the bushing **22** with a complemental tapered seat **23T**. The flat wrench surfaces **220F** are used to hold the spray tip **20** in the desired position of rotative adjustment.

The strainer **24** has a conventionally formed body **124**

made from metal bar stock centrally bored from its upper end to form a central passage **24P** that is reduced near the lower end of the body to form a smaller passage **124P**, and the two passages meet at an upwardly sloping shoulder **24S**. The lower end portion of the body **124** is formed as an external nipple **24N** that is threaded into the nipple **23N** of the adapter **23**, and a wrench flange **24W** formed on the strainer body **124** just above the nipple **24N** and is of a smaller dimension than the nipple **23N** so that the strainer **24** may be carried by the adapter **23** when the adapter is put in place on the header **12**. The upper end of the passage **24P** is closed by a screw plug **24T**, and in the space between the screw plug **24T** and the wrench flange **24W** the wall of the strainer body **124** has a series of transverse slots **124S** milled therein to define parallel, closely spaced strainer bars **24B**. The slots **124S** are milled in the cylindrical surface of the strainer body **124**, as shown in FIGS. 5, 6 and 7 so that the bars **24B** are joined at spaced points by integral connectors **24C**.

With the nozzle and strainer formed and mounted as thus far described, the resulting spray S tends to distort and wobble, but under the present invention this is overcome through the provision of a flow control assembly **30**, FIGS. 4 and 8, that is located partially within the strainer body **124** and which acts on and controls the flowing water until such water enters the converging approach throat **120T** of the spray tip. The flow control assembly **30** comprises an elongated tube **31** with a vane unit **32** associated with one end of the tube. The tube **31** has a diameter such that the tube may be slideably extended through the passage **124P**, and at its other or lower end the tube **31** has a tapered surface **31T** adapted to seat on the tapered surface **120T** of the spray tip **20**. When the tapered lower end surface **31T** is thus seated in the tapered approach passage **120T**, a snap ring **31R** seated in an external annular groove **31G** in the tube **31** is located in upwardly spaced relation to the shoulder **24S**, FIG. 4, but in this location the snap ring **31R** is nevertheless disposed below the lowermost slot **24S**. The snap ring **31R** has a slight clearance with respect to the passage **24P**, and when the bushing tip assembly **22–20** is removed, the tube **31** is held against undue downward displacement by engagement of the snap ring **31R** with the shoulder **24S**.

The vane unit **32** is provided by short length of a cruciform metal extrusion, the flat, plate-like vanes or arms **32A** of which are relatively thin and chamferred at their corners at **32C**, and the maximum transverse dimension of the vane unit is slightly less than the diameter of the central passage **24P**. The length of the vane unit is preferably somewhat less than one-half the length of the slotted portion of the strainer body **124**, and the unit **32** is mounted on the upper end of the tube **31** so that when the tube is in its normal position, the upper end of the vane unit **32** is spaced downwardly from the lower face of the plug **24T**. For mounting the vane unit **32**, the upper end **31E** of the tube **31** has diametric slots **31S** cut therein to receive the respective arms **32A** in a press fit relation, and the depth of the slots is such that slightly more than one-half of the length of the arms **32A** is disposed in the slots while the balance projects upwardly beyond the upper end **31E** of the tube **31**. With the vane unit **32** positioned as described and properly centered with respect to the tube **31**, the end **31E** of the tube is staked adjacent the arms **32A** so as to hold the vane unit **32** and the tube **31** in assembled relation.

With the flow control assembly **30** in place as shown in FIG. 4, water, of course, enters the central passage **24P** of the strainer through all of the entry slots **24S**, but after such entry, the water from most of the slots **24S**, in order to enter the upper end of the tube **31**, must travel upwardly between the projecting edge portions of the vanes where it merges with water that has entered the slots **24S** located above the upper end **31E**

of the tube **31**. At the level just above the upper end **31E** of the tube **31** where the water flowing in from different directions is merged, the vane unit **32** is effective to guide and control the water flow as it enters the tube **31**. The water then has a long straight flow path through the tube **31** before it enters the converging throat **120T**, the approach passage and the domed end **120D**, so that the resulting spray S is flat and remains stable. Thus distortion and wobbling of the spray S are eliminated.

From the foregoing description it will be apparent that the present invention enables the operation of descaling spray installation to be improved so as to eliminate distortion and wobbling of the sprays, and further that this has been accomplished in a simple and economical manner.

It will also be evident that by maintaining the desired spray pattern as well as the stability of the sprays, the present invention assures uniformity in the descaling action of the spray apparatus.

Thus, while preferred constructional features of the invention are embodied in the structure illustrated herein, it is to be understood that changes and variations may be made by those skilled in the art without departing from the spirit and scope of the appending claims.

We claim:

1. In a flow control assembly for association with a spray tip-strainer installation, an elongated tube having an annular tapered edge at one end and an elongated vane unit mounted at the other end of the tube and providing flat plate-like arms, the flat faces of which extend longitudinally of the tube with portions of the arms located within said other end of said tube.

2. A flow control assembly defined in claim **1** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube.

3. A flow control assembly as defined in claim **1** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube, and wherein said other end of the said tube has radial slots therein and said unit comprises an elongated cruciform extrusion, the arms of which are press fitted into said slots so as to project equally beyond the outside of the tube.

4. A flow control assembly as defined in claim **1** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube, wherein said other end of said tube has radial slots therein and said same unit comprises an elongated cruciform extrusion that has a length greater than the depth of the slots with the arms press fitted into said slots so as to project equally beyond the outside of the tube.

5. In spray apparatus having a supply header, an adapter fitting opening radially into said header and having a spray tip mounted therein exteriorly of said header, a slotted body strainer carried by said fitting within the header, and a flow control assembly mounted in part with said fitting and in part within said strainer and comprising an elongated tube having an annular tapered edge engaging and opening into the spray tip at one end, and an elongated vane unit mounted at the other end of the tube within the strainer and providing flat plate-like arms, the flat faces of which extend longitudinally of the tube and with portions of the arms located within said other end of said tube.

6. Spray apparatus as defined in claim **5** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube.

7. Spray apparatus as defined in claim **5** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube, and wherein said other end of said tube has radial slots therein and said unit comprises an elongated cruciform extrusion, the arms of which are press fitted into said slots so as to project equally beyond the outside of the tube.

8. Spray apparatus as defined in claim **5** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube, wherein said other end of said tube has radial slots therein and said same unit comprises an elongated cruciform extrusion that has a length greater than the depth of the slots with the arms press fitted into said slots so as to project equally beyond the outside of the tube.

9. In spray apparatus for association with a supply header, an adapter fitting having an inlet nipple adapted to be threaded radially into such a header and having a spray tip mounted therein at its other end where it will be located exteriorly of such a header, a slotted body strainer carried by said nipple of said fitting in position to be located within such a header, and a flow control assembly mounted in part within said fitting and in part within said strainer and comprising an elongated tube having an annular tapered edge engaging and opening into the spray tip at one end, and an elongated vane unit mounted at the other end of the tube within the strainer and providing flat plate-like arms, the flat faces of which extend longitudinally of the tube and with portions of the arms located within said other end of said tube.

10. Spray apparatus as defined in claim **9** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube.

11. Spray apparatus as defined in claim **9** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube, and wherein said outer end of said tube has radial slots therein and said unit comprises an elongated cruciform extrusion, the arms of which are press fitted into said slots so as to project equally beyond the outside of the tube.

12. Spray apparatus as defined in claim **5** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube, wherein said other end of said tube has radial slots therein and said same unit comprises an elongated cruciform extrusion that has a length greater than the depth of the slots with the arms press fitted into said slots so as to project equally beyond the outside of the tube.

13. In spray apparatus for association with a liquid supply header, an elongated adapter fitting having a longitudinal passage therethrough with an annular seat intermediate its ends facing toward one end, a bushing adapted to fit within said end of said passage and having a shoulder adapted to engage said seat, a spray tip threaded axially into and carried by said bushing, a retainer collar threaded onto said end of said adapter fitting and holding said bushing and said spray tip in a fixed axial and rotative relation with respect to the fitting with said shoulder engaging said seat, said fitting having a nipple at its other end adapted to be threaded through such a header, a slotted body strainer carried by said nipple of said fitting in position to be located within such a header, and a flow control assembly mounted in part within said fitting and in part within said strainer and comprising an elongated tube having an annular tapered edge engaging and opening into the spray tip at one end, an elongated vane unit mounted at the other end of the tube within the strainer and providing flat plate-like arms, the flat faces of which extend longitudinally of the tube and with portions of the arms located within the other end of said

tube, and cooperating means on the the tube and said strainer for supporting said flow control unit in position when said bushing and spray tip are removed from the fitting.

14. In a flow control assembly for association with a spray tip installation, an elongated tube having an annular tapered edge at one end adapted to be seated against the inlet of a spray tip and an elongated vane unit mounted at the other end of the tube and providing flat plate-like arms, the flat faces of which extend longitudinally of the tube with portions of the arms located within said other end of said tube.

15. A flow control assembly defined in claim **14** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube.

16. A flow control assembly as defined in claim **14** wherein said vane unit has the radial arms thereof disposed in planes passing through the axis of the tube and in which the arms project uniformly beyond the outer side of the tube, and wherein said other end of the said tube has radial slots therein and said unit comprises an elongated cruciform extrusion, the arms of which are press fitted into said slots so as to project equally beyond the outside of the tube.

17. In spray apparatus having a supply header, an adapter fitting opening radially into said header and having a spray tip mounted therein exteriorly of said header, a holder carried by said fitting within the header, and a flow control assembly mounted in part with said fitting and in part within said holder and comprising an elongated tube having an annular tapered edge engaging and opening into the spray tip at one end, and an elongated vane unit mounted at the other end of the tube within the strainer and providing flat plate-like arms, the flat faces of which extend longitudinally of the tube and with portions of the arms located within said other end of said tube.

18. In spray appartus for association with a liquid supply header, an elongated adapter fitting having a longitudinal passage therethrough with an annular seat intermediate its ends facing toward one end, a bushing adapted to fit within said end of said passage and having a shoulder adapted to engage said seat, a spray tip threaded axially into and carried by said bushing, a retainer collar threaded onto said end of said adapter fitting and holding said bushing and said spray tip in a fixed axial and rotative relation with respect to the fitting with said shoulder engaging said seat, said fitting having a nipple at its other end adapted to be threaded through such a header, a holder carried by said nipple of said fitting in position to be located within such a header, and a flow control assembly mounted in part within said fitting and in part within said holder and comprising an elongated tube having an annular tapered edge engaging and opening into the spray tip at one end, an elongated vane unit mounted at the other end of the tube within the holder and providing flat plate-like arms, the flat faces of which extend longitudinally of the tube and with portions of the arms located within the other end of said tube, and cooperating means on the tube and said strainer for supporting said flow control unit in position when said bushing and spray tip are removed from the fitting.

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