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SPRAY NOZZLE

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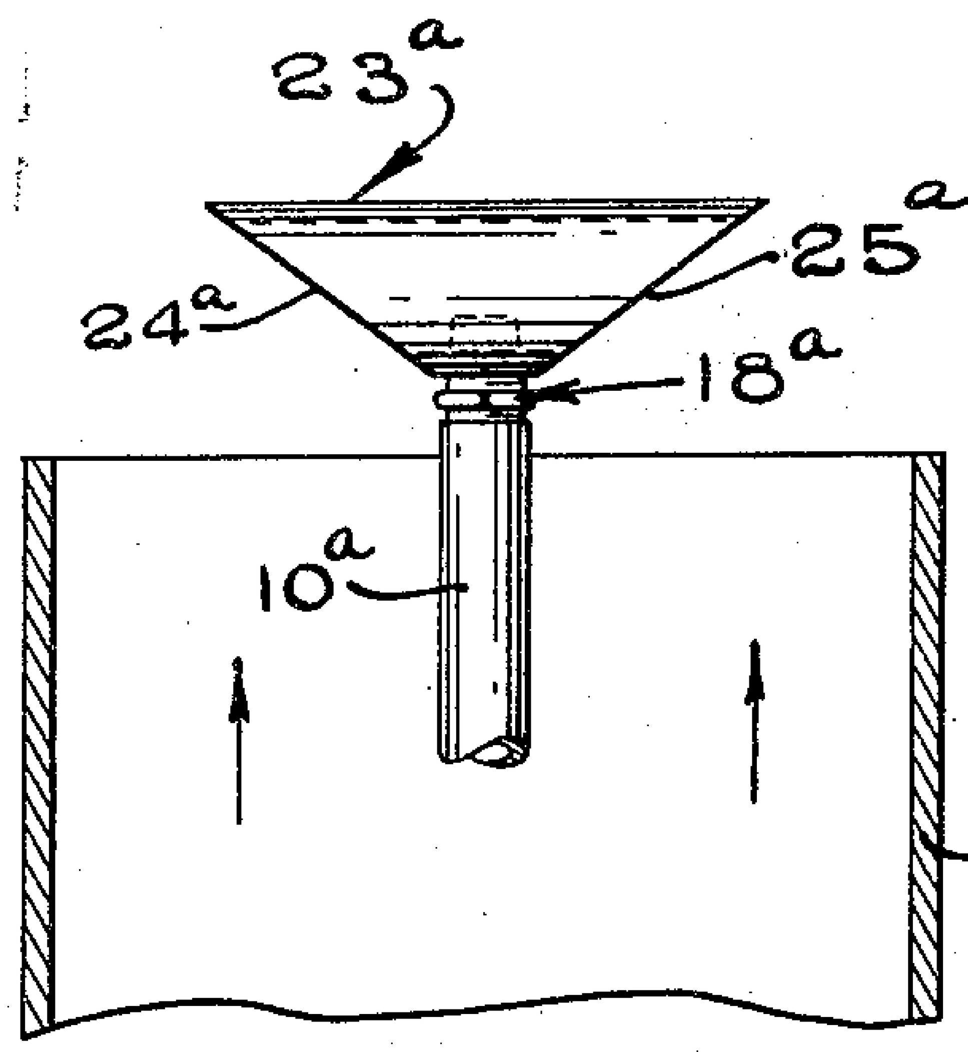

FIG_4

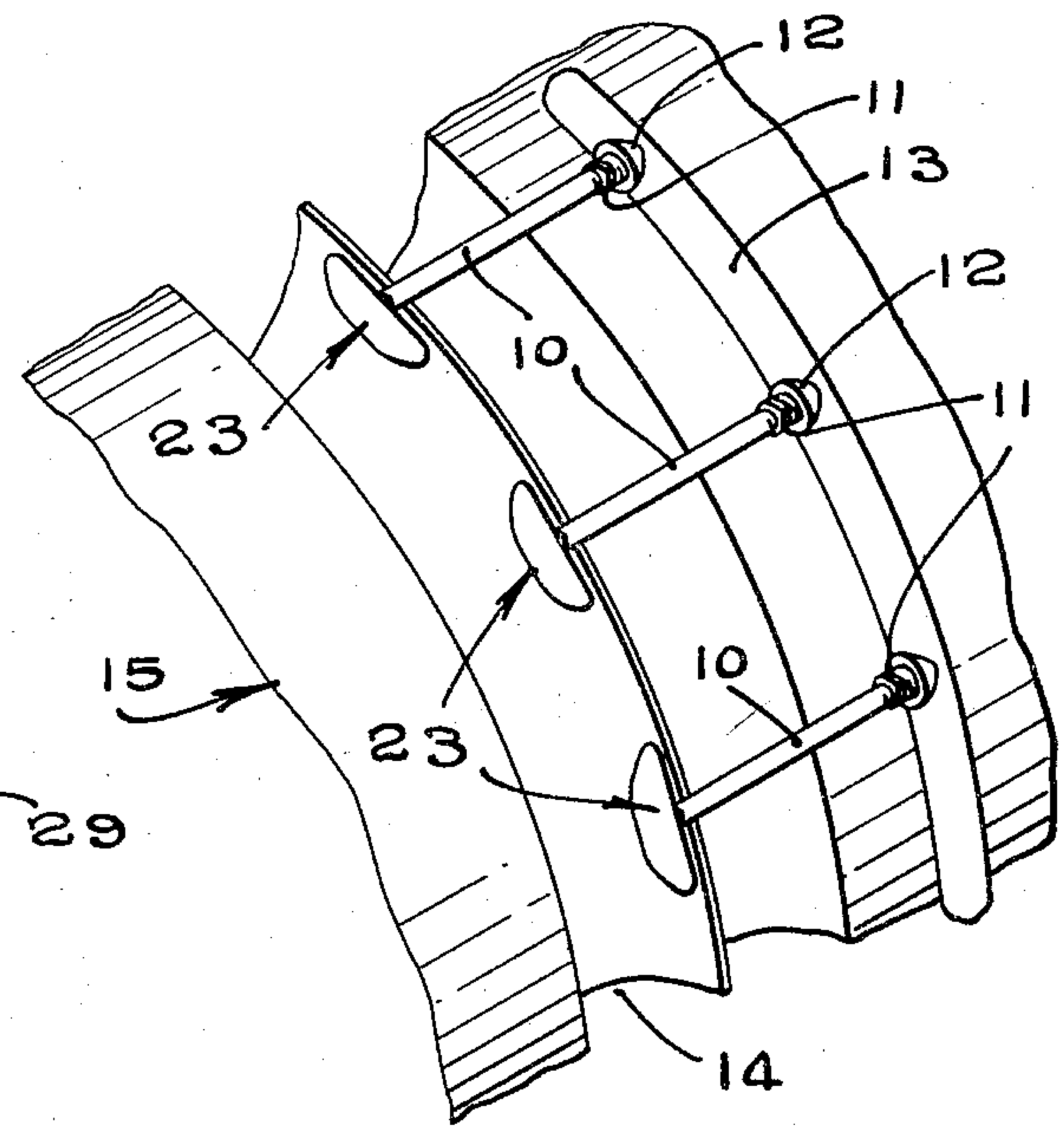

FIG_3

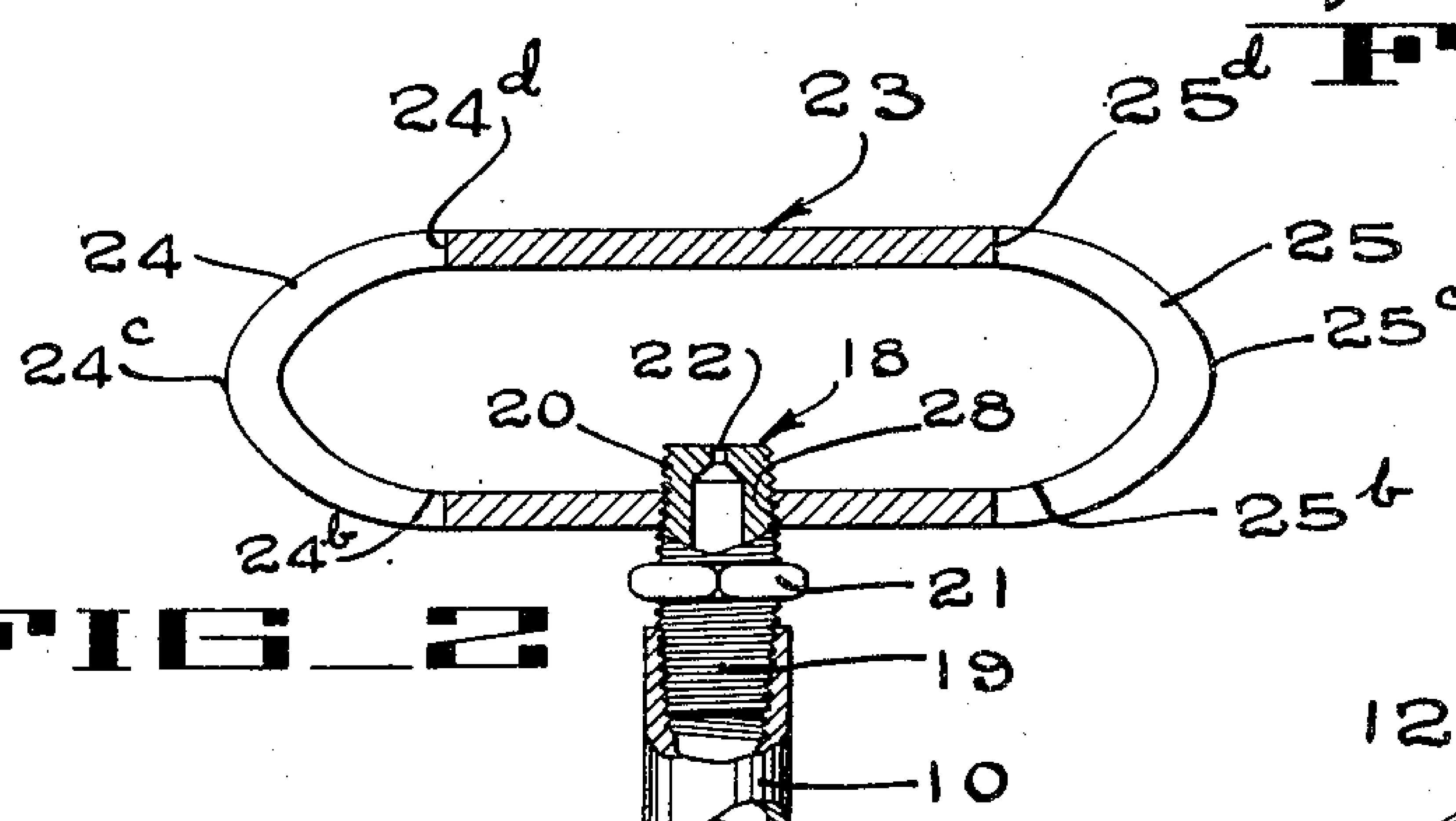

FIG_2

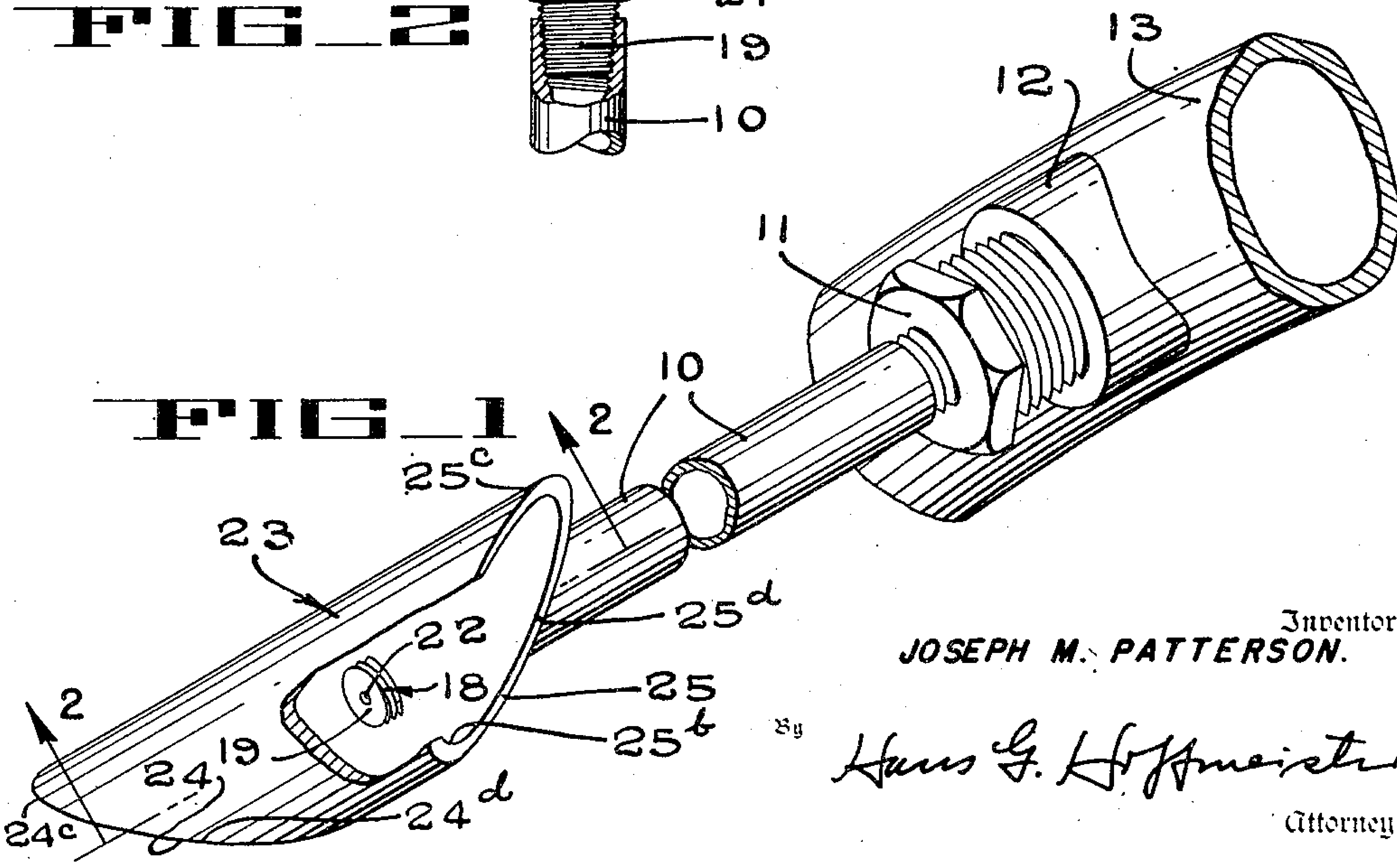

FIG_1

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SPRAY NOZZLE

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The present invention relates to spray nozzles, and more particularly to a shear type spray nozzle for mounting in an air stream for producing air-borne spray.

An object of the present invention is to provide an improved shear nozzle for mounting in a high velocity air stream.

Another object is to provide a simple and effective device for feeding spray particles into an air blast.

Another object is to provide a spray nozzle wherein spraying liquid is supplied to the nozzle at relatively low pressure through a relatively large orifice and the spray particles are created by the shearing action of a high velocity air blast in which the nozzle is located.

Another object is to provide a shear nozzle for mounting in an air blast, with an end of the nozzle where the shearing action occurs sloped to diverge from the direction of air flow past the nozzle.

Another object is to provide a shear nozzle in which the amount of liquid fed therethrough can be varied between relatively wide limits without materially changing the size range of spray particles produced thereby.

These and other objects and advantages of the present invention will be apparent from the following description and the accompanying drawings, wherein:

Fig. 1 is a perspective view of a shear nozzle embodying the invention mounted on a fragment of manifold pipe, portions being broken away.

Fig. 2 is a section taken along the mid-plane of the nozzle indicated by the line **2—2** of Fig. 1.

Fig. 3 is a fragmentary perspective view showing spray nozzles embodying the invention mounted at the air blast outlet of a radial discharge type of spraying machine.

Fig. 4 is a fragmentary longitudinal section through an air blast tube of an axial discharge type of spraying machine, with a spray nozzle embodying the invention mounted therein.

The shear nozzle of the present invention is adapted to be mounted in any suitable high velocity air stream, but for the purpose of the present specification it will be described as mounted either in the air blast from a radial discharge type of sprayer of the type disclosed in Patent 2,476,960 to George W. Daugherty, issued July 26, 1948, as illustrated in Fig. 3 of the present drawings, or in that from an axial discharge type of sprayer of the type disclosed in patent application of George W. Daugherty, Serial No. 28,317, filed May 21, 1948, now Patent No. 2,667,717, as illustrated in Fig. 4 of the present drawings.

In the embodiment of the invention illustrated in Figs. 1, 2 and 3 a combined nozzle-support and liquid-supply tube **10** has one end thereof screwed into an adapter bushing **11** which in turn is screwed into a side outlet **12** of a liquid supply manifold **13**. The assembled length of the tube **10** and bushing **11** should be such as to locate the nozzle in a desired part of the air stream. The manifold **13** is arranged adjacent the air blast outlet **14** (Fig. 3) of a radial discharge sprayer **15** of the type disclosed in Daugherty Patent 2,476,960 mentioned previously herein.

Each tube **10** is internally threaded on its free end, and an orificed fitting **18**, with threaded end portions **19** and **20** (Fig. 2) and an intermediate nut portion **21** formed integrally therewith, is screwed into the free end of the tube **10**. The fitting **18**, which may be considered as part of the nozzle, has a jet orifice **22** therein of a predetermined but relatively large diameter, for example, in the range between three sixty-fourths and one-eighth of an inch. Liquid discharged through this orifice is directed axially of the fitting toward the opposite wall of a nozzle head **23**.

The head **23** is tubular, and is herein illustrated as being substantially circular in cross sectional shape, although the use of other shapes, such as rectangular, triangular, oval and so-called streamlined section, is contemplated. One or both ends **24** and **25** of the tubular head portion are exposed to the air stream and are sloped to diverge from the direction of flow of the air stream in which the nozzle is mounted. The head **23** has a threaded hole **28** therethrough midway of the length of a side thereof, into which is screwed the threaded outer end of the fitting **18**.

The amount of divergence of the end faces **24** and **25** of the head portion **23** from the direction of air flow materially affects the performance of the nozzle. For example, it has been found by experiment that with a jet orifice having a diameter within the range from three sixty-fourths to one-eighth of an inch, a pressure of sixty pounds per square inch on the spraying liquid supplied to the nozzle, an air blast velocity at the nozzle of approximately ninety miles per hour, and the planes of the sloping ends **24** and **25** of the head **23** disposed to diverge at angles of fifty-five degrees in the direction of air flow past the nozzle, the spray particle size will be between 30 and 125 microns.

Since such a wide variation in orifice sizes at the above specified constant pressure would produce a wide variation in volume output of spraying liquid, it is important to note that the spray particle size range remains quite constant throughout such variation. Further experments indicate that best nozzle performance results are obtained when the end faces **24** and **25** of the head diverge from the direction of air flow past the nozzle at angles within the range between fifty and seventy degrees.

The threaded hole **28** in the tubular head portion **23** to receive the jet fitting **18** is so located that the longer side of the head portion will be on the downstream side of the nozzle. Therefore, when, as shown in Fig. 4, a support and liquid supply tube **10***a* and jet fitting **18***a* are mounted in a tubular air tunnel **29** with their common axis extending in the direction of flow of the air stream, the jet fitting will be screwed into a threaded hole provided therefor in the short or upstream side of the head **23***a*. This disposes the sloping end faces **24***a* and **25***a* of the head **23***a* at divergent angles to the direction of air flow past the nozzle.

All threads in the form of the invention illustrated are of the tapered or iron pipe type so that the parts can be drawn down into frictionally secured relation to each other, and still be capable of being removed and replaced as required.

Briefly, the operation of the device is as follows: The shear nozzle is mounted with the longer side of the head **23** on the downstream side of the air blast on a fitting **18** having an orifice **22** of predetermined size therein. The volume of liquid supplied by the nozzle can be varied either by changing the orifice size, or by varying the pressure on the liquid supplied to the nozzles. Usual air blast generating means, not shown, such as a suitable motor driven blower or fan, is then placed in operation to discharge a high velocity air blast past the nozzle, and the spraying liquid is discharged under predetermined pressure into the head 23 through the jet orifice 22.

The jet of liquid discharged through the orifice 22 strikes the head opposite the fitting 18, where the driving force of the jet causes the liquid to spread radially in all directions from the point of impact as a center with a force much greater than the force of gravity, with the result that the liquid is spread over the inner wall of the head 23, and is caused to flow toward the diagonally diverging head ends 24 and 25. Here the air blast shears off particles of liquid both on the short or upstream edge portions *24b* and *25b* of the sloping ends of the head, and also on the longer downstream edges *24c* and *25c* thereof. The diagonal slope of the ends of the head 23 provides an offsetting of the upstream and downstream edges thereof to expose both of them to the shearing action of the air blast. It also provides a sharpened or chisel-like edge on the downstream sides of both of said edge portions. This sharpened, chisel-like edge structure insures that the film of liquid flowing thereto will be sheared off in droplets of relatively uniform size.

Since the intermediate edge portions *24d* and *25d* of the nozzle ends are curved to extend generally longitudinally of the direction of air flow past the nozzle, little or no shearing action occurs along these edge portions, but the liquid flowing thereto will mostly be blown by the air blast around toward the projecting downstream edges *24c* and *25c*, where such liquids will be sheared or taken off in droplets by the action of the air blast flowing across these transversely extending sharpened edge portions. It is obvious that since the longer downstream edges *24c* and *25c* of the head project out into unobstructed portions of the air stream, the most effective air flow will be across such projecting downstream edges, and therefore the normal flow of most of the liquid toward this downstream edge is a fortunate but inherent characteristic of the nozzle. This flow of a major portion of the liquid toward the downstream edges of the head, is not materially affected by the position of the nozzle with respect to the vertical, since the previously mentioned spreading action of jet impact plus the strong eddy currents within the head affect the flow of the liquid film toward the ends of the head much more than does gravity. Therefore, the liquid is sheared off in a relatively uniform manner from all of the nozzles regardless of whether they are upright, on end, or inverted.

The fact that the spray particle size range remains relatively constant throughout a considerable range of volume output of liquid as set forth previously herein, is extremely important in a nozzle of this character, since it allows the operator considerable latitude in his selection of spray density while retaining optimum particle size. This avoids the creation of an excessive amount of either excessively small droplets which tend to drift away or evaporate, or excessively large droplets which cause wasteful run-off.

While in the illustrated embodiment of the invention the nozzle head 23 is of circular cross sectional shape and the jet fitting 18 is separable therefrom, it will be obvious that the head can be of other cross sectional shapes, as mentioned previously herein, and that the body of the jet fitting can be formed, for example by well known die casting methods, as a part of the head. Also, while illustrated as being mounted in the air stream of ordinary types of sprayers, the nozzle

is capable of use in any air stream of suitable velocity, for example on an airplane for aerial spraying of crops or orchards.

It will be understood therefore that these and other changes and modifications in the details of the nozzle and its mounting arrangement may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is as follows:

1. A shear nozzle comprising a conduit having an open end thereof sloped at an acute angle relative to its axis, means for directing a high velocity air stream past said open end, and means for supplying liquid, in sufficient quantity to form a film, to the interior wall of said conduit for flow along the wall to the marginal edge portion of the open end of the conduit for shear take-off by said air stream.

2. A shear nozzle comprising a tubular head having an end thereof sloped at a divergent angle relative to a transverse plane normal to the tubular axis of said head, means directing an air stream past said head and a liquid supply passage opening through an orifice into the interior of said head to discharge liquid interiorly of said head, for spreading in the form of a film over the interior thereof to said sloping end for shear take-off by said air stream.

3. A liquid distributing device comprising means for creating a high velocity air stream, a support having a liquid supply passage extending lengthwise therein and adapted to be connected at one end thereof to a liquid supply pipe, a short length of tubing mounted on the other end of said support to lie within the air stream with the tubing axis disposed at right angles to the direction of air flow past the tubing, the ends of the tubing being open, and disposed in planes diagonal to the tubing axis which form an angle divergent in the direction of air flow past the tubing, and an opening from the supply passage into the interior of the tubing through an orifice positioned to direct the liquid discharged therethrough toward the interior of the tubing wall for spreading thereover in the form of a film flowing to the diagonal tubing ends, there to be sheared off by the passing air stream.

4. A spray device comprising means for directing a high velocity air stream in a predetermined direction a portion of tubing having a sloping open end and mounted to extend transversely to the direction of flow of said air stream with the sloping open end of the tubing being directly exposed to said air stream, and means for supplying a film of water to the edge of the tubing surrounding the sloping open end of said tubing to be sheared off in droplets by the passing air stream.

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