Oct. 22, 1957 A. BIBER 2,810,608

NOZZLE FOR APPLYING CUTTING FLUID IN A FLAT STREAM

Filed July 7, 1953

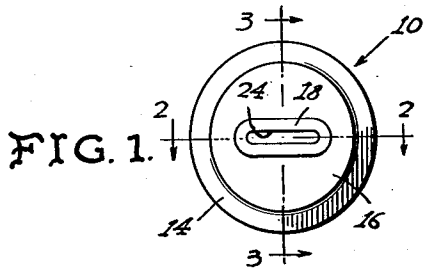

FIG. 1.

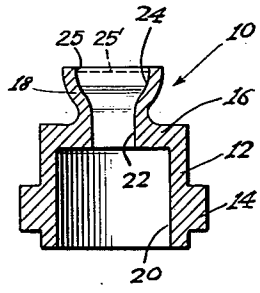

FIG. 2.

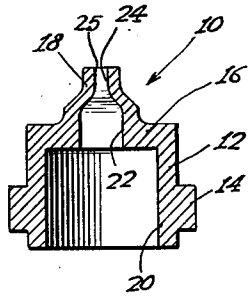

FIG. 3.

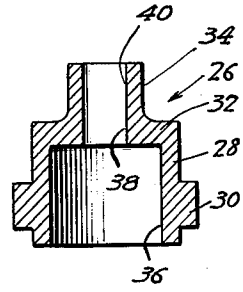

FIG. 5.

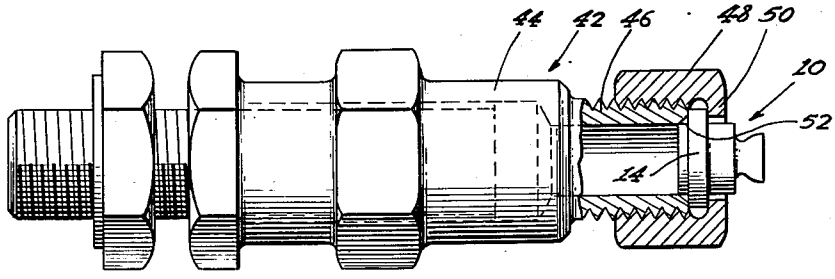

FIG. 4.

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United States Patent Office 2,810,608 Patented Oct. 22, 1957

2,810,608

NOZZLE FOR APPLYING CUTTING FLUID IN A FLAT STREAM

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Application July 7, 1953, Serial No. 366,438

3 Claims. (Cl. 299—154)

The present invention relates to a nozzle assembly, and more particularly pertains to a nozzle for emitting a flat non-spreading stream that may be adjusted angularly about its longitudinal axis.

Generally, the invention resides in the structure and method of making a nozzle having a passageway therethrough which for at least a portion of its axial extent changes progressively in its transverse configuration from being circular to being substantially flat, the rate of such progressive changes in configuration being at a maximum intermediate the axial extent of such portion and approaching zero adjacent the opposite ends of such portion. In the preferred form of the invention, the aforementioned progressive changes in the transverse configuration of the passageway are also accompanied by a progressive decrease in the cross-sectional area of the passageway. The invention also resides in an angular mounting rib on the nozzle and means engaging such mounting rib for securing the nozzle in adjusted angular relationship about its longitudinal axis to a feed conduit.

The invention is fully described hereinafter with reference being made to the accompanying drawings, wherein:

Figure 1 is an elevational view of the discharge end of the nozzle of this invention;

Figure 2 is a horizontal sectional view taken upon the plane of section line 2—2 of Figure 1;

Figure 3 is a vertical sectional view taken upon the plane of section line 3—3 of Figure 1;

Figure 4 is a side elevational view, on a reduced scale, of the nozzle assembly with portions thereof being cut away and shown in section to illustrate the manner in which the nozzle of Figure 1 is secured to the feed conduit; and,

Figure 5 is a longitudinal central sectional view of the nozzle of this invention at an intermediate stage of manufacture.

Referring to the drawings, the numeral **10** designates generally the nozzle of this invention. The nozzle **10** is best shown in Figures 1, 2 and 3 wherein the same will be seen to be of integral construction and comprised of a hollow cylindrical section **12** provided with an annular mounting rib **14**. The hollow cylindrical section **12** is partially closed at one end by a wall **16** through which the interior of the hollow cylindrical section **12** opens into the lip section **18** of the nozzle.

The cylindrical section **12**, the wall **16**, and the lip section **18** of the nozzle define a passageway having a longitudinally straight axis comprised of four contiguous portions, namely, a portion **20** of circular cylindrical configuration, a portion **22** of circular cylindrical configuration and of lesser diameter than the passageway portion **20**, a portion **24** of progressively varying transverse dimensions, and a portion **25** of short axial extent that is of constant transverse dimensions and which opens through the outer extremity of lip section **18**. The juncture of passageway portions **24** and **25** is indicated in Figure 2 by the dashed line **25'**.

The passageway portion **24** at its end adjacent the passageway portion **22** has a cross section identical with that of the passageway portion **22**; however, as best shown in Figures 2 and 3, the cross section of the passageway portion **24** at the end thereof adjacent the passageway portion **25** is of an elongated configuration having substantially parallel sides and semicircular ends. As will be noted upon comparing Figures 2 and 3, the cross-sectional configuration of the passageway portion **24** progressively and smoothly changes throughout its axial extent from the cross-sectional configuration at one extremity to that of its other extremity.

Inspection of Figures 2 and 3 will also show that the passageway portion **24** progressively increases in one transverse dimension, while progressively decreasing in a transverse dimension perpendicular thereto, it being especially noteworthy that the rate of such progressive changes is at a maximum intermediate the axial extent of the passageway portion **24** and that such rate of progressive changes is equal to or at least approaches zero adjacent the opposite axial extremities of the passageway portion **24**.

In the preferred form of the invention shown in the drawings, the progressive changes in the transverse dimensions of the passageway portion **24** are also accompanied by a progressive decrease in the cross-sectional area of the passageway portion **24**, such progressive decrease in cross sectional area having a maximum rate intermediate the axial extent of the passageway portion **24** and at least approaching zero adjacent the opposite axial extremities thereof. The advantages stemming from the unique configuration of the passageway portion **24** described in this and the preceding paragraph will be subsequently set forth. It will also be noted that the rate of the progressive dimensional changes varies smoothly and continuously.

The shape of the lip section **18** and the unique configuration of the passageway portions **24** and **25** therethrough will perhaps be more clearly understood upon description of the preferred method of fabricating the same. Referring to Figure 5, there is designated generally at **26** a work piece representing an intermediate stage of manufacture of the nozzle **10** according to the preferred method.

The similarity between the shape of the work piece **26** and the shape of the nozzle **10** will be apparent, the former differing from the latter only with respect to the lip section **18**, such work piece **26** comprising a hollow circular cylindrical section **28** having an annular rib **30** thereon, a wall **32** partially closing one end of the cylindrical section **28**, and a hollow, circular, cylindrical section **34** integral with the wall **32**.

The passageway through the work piece **26** is composed of three portions, namely, passageway portion **36** corresponding to passageway portion **20** of nozzle **10**, passageway portion **38** corresponding to passageway portion **22** of nozzle **10**, and a passageway portion **40** extending through the cylindrical section **34**. The passageway portions **36**, **38** and **40** are axially aligned and each is of circular cross section, the passageway portions **38** and **40** being of equal and uniform diameter throughout their axial extents. The shape of the work piece **26** can be obtained by various methods, such as casting following by machining, die casting, molding, or by turning on a lathe from solid stock, the latter method being preferred. The work piece **26** may be fashioned from materials such as various metals, their alloys, and plastics. In fabricating the nozzle **10** according to the preferred method, it is essential that the material forming the work piece **26** be of such character as to withstand the hereinafter described flattening operation. Among such ma-

terials may be mentioned copper, malleable alloys such as brass, and thermo plastic resins.

The hereinbefore mentioned flattening operation consists of partially flattening the outer extremity of the cylindrical section **34** until the outer extremity has the transverse configuration of the lip section **18** as shown in Figure 1, that is, until the cross section of the outer extremity of the passageway portion **40** assumes an elongated configuration of closely-spaced parallel sides and generally semicircular ends. It is essential that the flattening operation be so conducted that the cylindrical portion **34** is flattened to a uniform extent for a minor part of the axial extent of the cylindrical portion **34** that is immediately adjacent the outer extremity of the cylindrical portion **34**. Flattening the cylindrical portion **34** in such a manner insures the rate of change of the transverse dimensions of the passageway therethrough approaching zero adjacent the outer extremity of the cylindrical portion **34**. Inasmuch as the transverse dimensions of the cylindrical portion **34** are effectively reinforced at the juncture of cylindrical portion **34** with the wall **32**, and since the forces applied to the cylindrical portion **34** during the flattening operation are applied primarily to the part of the cylindrical portion **34** immediately adjacent the outer extremity thereof, the substantially uniform wall thickness of the cylindrical portion **34** results in the smoothly varying distortion of the cylindrical portion **34** intermediate its ends possessed by the lip section **18** of the finished nozzle **10**.

The aforementioned flattening operation may be accomplished by any of various known methods for deforming bodies, such as forging, or by simply placing that part of the outer extremity of the cylindrical portion **34** to be uniformly flattened within a vise and, with such vise, applying the necessary transverse forces. Depending upon the character of the material forming the cylindrical portion **34**, the flattening operation may be facilitated by heating the same, the possible necessity for such heating or the desirability thereof being deemed well within the scope of the skill of the art.

In some instances, the cross section of the passageway **40** at the outer extremity thereof may tend towards having concaved sides during the flattening operation; in which event such deformation will be easily recognized and prevented by inserting a flat spacer within the outer extremity of the passageway **40** having a thickness equal to the desired ultimate breadth of the passageway **40**.

It is preferred that the uniformly flattened extremity of the cylindrical portion **34** be of very short axial extent, it only being necessary that the rate of change of the transverse dimensions of the passageway be equal to, or very closely approach zero immediately adjacent the discharge end thereof. Accordingly, after completion of the flattening operation, the axial extent of the uniformly flattened cylindrical portion **34** may be reduced, if desired, by sawing, grinding or otherwise removing a part or substantially all of the axial extent of the uniformly flattened part of the cylindrical portion **34**.

For example, nozzles constructed in accordance with the principles of this invention in which the width of the cross section of the discharge end of the passageway has varied from 0.006 inch to 0.020 inch and the length from 0.075 inch to 0.300 inch and having a uniformly flattened axial extent of about $\frac{1}{32}$ of an inch have been found to be quite satisfactory. Of course, uniformly flattened axial extents defining the length of the passageway portion **25** can be substantially longer with otherwise larger nozzles, but preferably should not be as long as the progressively varying passageway portion **24**.

Referring now to Figure 4, wherein there is shown a nozzle assembly designated generally at **42**, such nozzle assembly **42** comprising an adaptor or feed conduit **44** having an externally threaded end portion **46**. The nozzle **10** abuts the outer extremity of the threaded portion **46** of the feed conduit **44** and is in axial alignment therewith; the nozzle **10** being secured in position by a gland nut or coupling member **48** threaded upon the threaded portion **46** of the feed conduit **34** and having an inturned flange **50** engaging the mounting rib **14**. In the preferred construction, the internal surface of the outer extremity of the threaded portion **46** of the feed conduit **44** is tapered as at **52**. The relation between the feed conduit **44**, the coupling **48**, and the nozzle **10** is such that the coupling **48** can be removed from the feed conduit **44** for convenient replacement of the nozzle **10** and, in addition, the coupling **48** can be unscrewed slightly from the position shown thereof in Figure 4 and the nozzle **10** then rotated about its longitudinal axis relative to the feed conduit **44** and the coupling **48** again tightened to fixedly secure the nozzle **10** in adjusted position.

The chief advantages of the instant invention reside in the economical manner in which the nozzle **10** may be manufactured, and especially in the unique configuration of the passageway portions **24** and **25** which are such that a liquid directed through the nozzle **10** will be emitted in a stream flat in cross section, and which stream will retain its transverse dimensions for a substantial distance from the nozzle. The stream velocity is accelerated during transit through the passageway portion **24**, with the axial extent of the passageway portion **25** having the least hydraulic radius being extremely short, whereby high stream velocities may be realized in relation to the fluid pressure applied at the nozzle inlet.

The nozzle of the present invention is of particular value in directing a stream of cutting oil upon a cutting tool during machining operations, since the substantial non-flaring characteristics of the discharge stream permits considerable freedom in adjusting the nozzle towards and away from the work.

The hereinbefore described angular adjustability of the nozzle **10** about its longitudinal axis, with respect to its feed conduit **44**, enables proper orientation of the plane of the flat liquid stream emitted from the nozzle **10** without adversely affecting the seal between the nozzle **10** and the feed conduit **44**.

The instant invention is subject to numerous variations without departing from the scope thereof, particularly with respect to the transverse dimensions of the passageway portions **20** and **22**. For example, either or both of the passageway portions **20** and **22** may be tapered towards the passageway portion **24**.

The invention has been described in considerable detail for the purpose of conveying a full and complete understanding thereof and not for the purpose of limiting its scope. The scope of the invention is to be ascertained by reference to the appended claims.

I claim:

1. In a nozzle, a passageway having a longitudinally straight axis, said passageway including first and second portions and an intermediate portion disposed between and contiguous to said first and second portions, said first portion being of circular cross section, said second portion having an elongated cross section with substantially parallel sides and being of constant cross sectional area and configuration throughout its length, said intermediate portion of the passageway having mutually perpendicular transverse dimensions that progressively change throughout the axial length of the intermediate portion, with the rate of each of said dimensional changes smoothly and continuously varying throughout the axial length of said intermediate portion of the passageway so that the progressive changes as well as the rates thereof equal zero at the opposite extremities of said intermediate portion, said second portion of the passageway being of lesser cross sectional area than the first portion of the passageway and constituting the nozzle exit, said second portion of the passageway having an axial length that is a minor fraction of the axial length of the intermediate portion.

2. The combination of claim 1, wherein the length of

the transverse periphery of the intermediate portion of the passageway is substantially constant throughout the axial length of said intermediate portion of the passageway.

3. A nozzle assembly comprising a nozzle provided with a passageway therethrough having a longitudinally straight axis, said passageway including first and second portions and an intermediate portion disposed between and contiguous to said first and second portions, said first portion being of circular cross section, said second portion having an elongated cross section with substantially parallel sides and being of constant cross sectional area and configuration throughout its length, said intermediate portion of the passageway having mutually perpendicular transverse dimensions that progressively change throughout the axial length of the intermediate portion, with the rate of each of said dimensional changes smoothly and continuously varying throughout the axial length of said intermediate portion of the passageway so that the progressive changes as well as the rates thereof equal zero at the opposite extremities of said intermediate portion, said second portion of the passageway being of lesser cross sectional area than the first portion of the passageway and constituting the nozzle exit, said second portion of the passageway having an axial length that is a minor fraction of the axial length of the intermediate portion, said nozzle including intermediate its ends a radially extending annular mounting rib, an externally threaded feed conduit of greater external diameter than the mounting

rib in longitudinal alignment with said nozzle, said feed conduit receiving the inlet end of the nozzle and abutting said rib, and means for securing the nozzle and the feed conduit in relative angular adjustment, said means including an internally threaded coupling member threaded on the feed conduit, said means also including an inwardly extending securing flange carried by the coupling member in engagement with the mounting rib.

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