United States Patent

Schott

[15] **3,680,792**

[45] **Aug. 1, 1972**

[54] FLUID DISCHARGE NOZZLE

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[21] Appl. No.: **73,858**

[52] **U.S. Cl.**.....**239/452,** 239/535

[51] **Int. Cl.** **B05b 1/32**

[58] **Field of Search**.....239/451, 452, 456, 459, 519, 239/534, 535, 546, 571

[56] **References Cited**

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1,925,173	9/1933	Chandler	239/452
3,567,125	3/1971	Houghton	239/535 X
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815,174	6/1959	Great Britain	239/535
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Assistant Examiner—Edwin D. Grant
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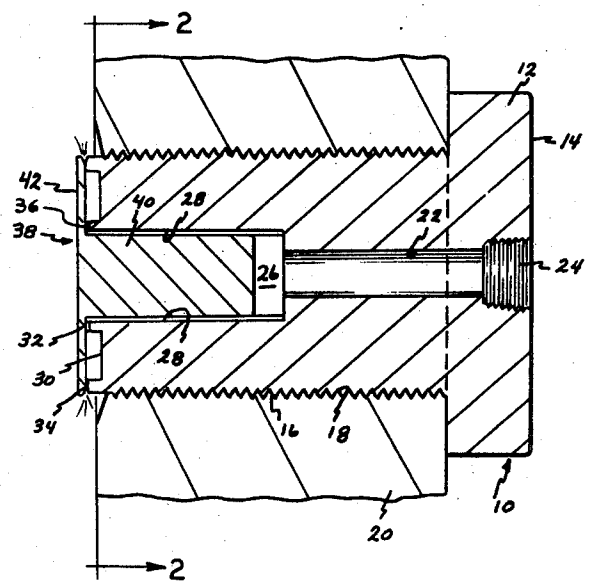
[57] **ABSTRACT**

A fluid discharge nozzle which includes a main body having a fluid inlet passage connected with an annular groove or recess in the end face and located closely adjacent to the peripheral edge thereof, and a cap member substantially coextensive with and overlying the grooved or recessed end of the nozzle body, the cap being secured to the body in a manner to compress its peripheral portion against the outer peripheral edge of the groove or recess in the body with a pressure which will normally close the groove or recess to escape of fluid, with the cap member being slightly flexible such that when fluid pressure reaches a predetermined value, it will open peripherally and produce a substantially fan-shaped spray of fluid between the outer edge of the groove or recess and the outer edge of the cap member.

12 Claims, 12 Drawing Figures



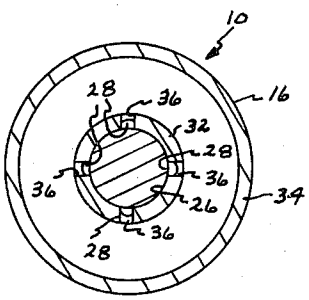


FIG-2

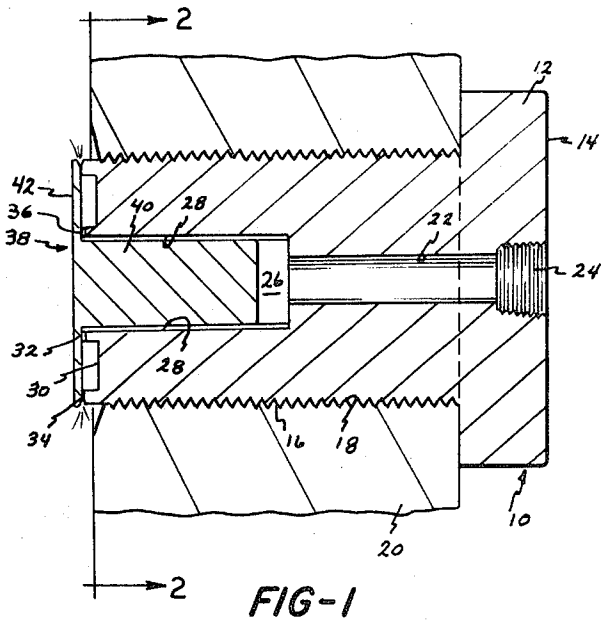


FIG-1

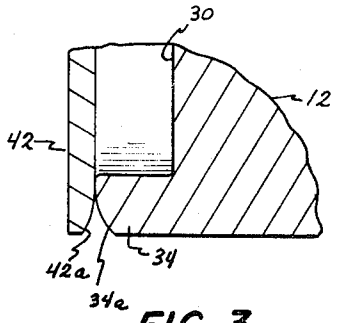


FIG-3

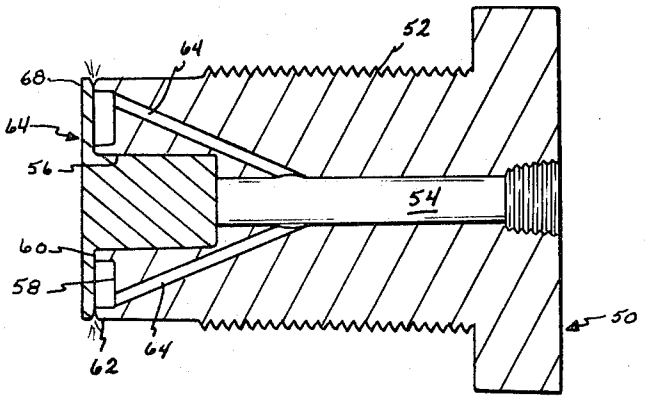


FIG-4

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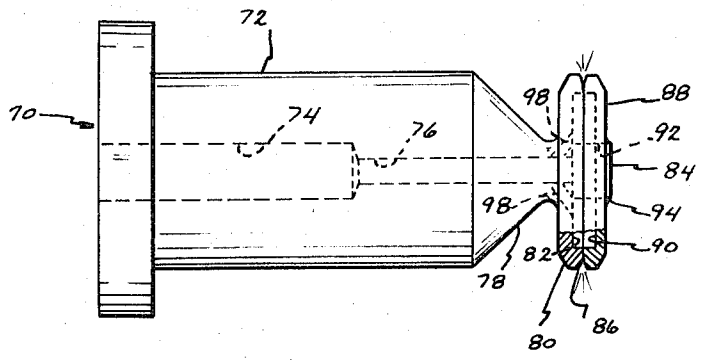

FIG-5

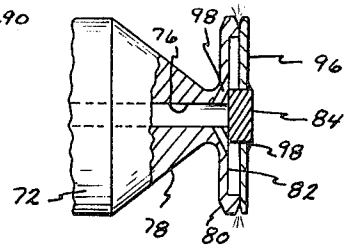

FIG-6

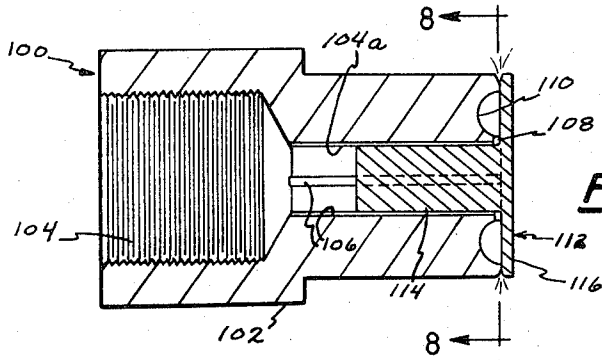

FIG-7

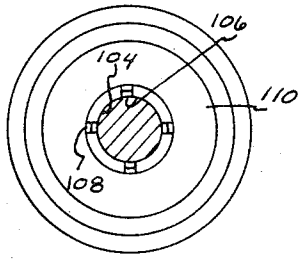

FIG-8

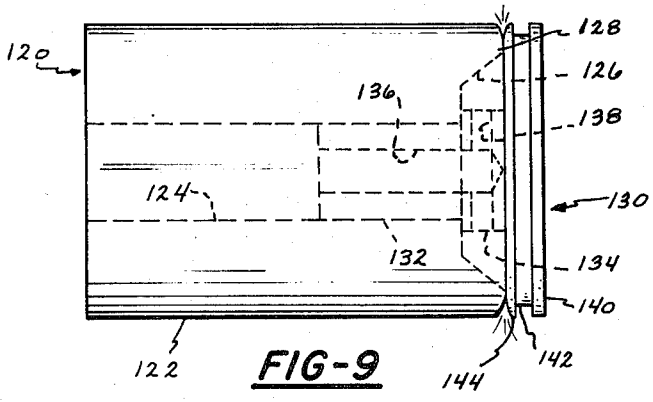

FIG-9

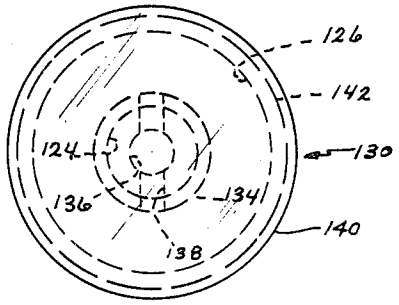

FIG-10

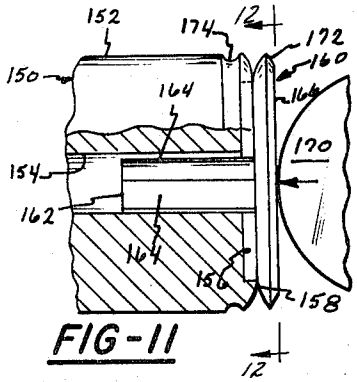

FIG-11

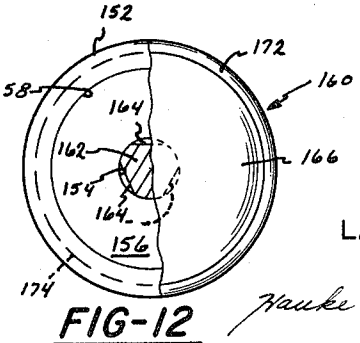

FIG-12

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FLUID DISCHARGE NOZZLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to fluid discharge nozzles, and more particularly to nozzles effecting a peripheral fan-like spray of fluid when the discharge orifice is opened under a predetermined fluid pressure.

2. Description of the Prior Art

Fluid nozzles heretofore in use of the type that effect a peripheral, substantially planar fan-shaped spray of fluid, opening under a predetermined pressure of fluid in the nozzle, generally take the form shown in U.S. Pat. No. 2,088,007. These types of nozzles heretofore have used some form of spring or diaphragm mechanism which acts normally to hold the discharge orifice closed, and which cause it to open against spring or other operating force when fluid pressure in the nozzle increases to a predetermined value. Consequently, such nozzles are of fairly complicated design. Further, the use of moving and sliding parts in such nozzles will produce wear and fatigue, eventually resulting in the nozzle opening at a lesser pressure than desired, or binding to prevent its proper operation, thus periodically requiring either replacement or adjustment of parts.

SUMMARY OF THE INVENTION

The present invention contemplates the use of a simplified two-part fluid discharge nozzle in which a nozzle body is provided with a peripheral discharge groove or recess in one end openly connected to fluid in an inlet passage, and normally closed by a cap affixed to the body and overlying the grooved or recessed end, the cap being compressed thereon with a force sufficient to normally close the discharge groove or recess to escape of fluid therefrom, and being of a thickness and composition such that under a predetermined fluid pressure it will flex peripherally to permit discharge of fluid in a substantially planar peripheral fan-shaped spray from the peripheral slot formed between the outer edge defining the discharge groove or recess in the body and the peripheral edge of the cap. The body and cap peripheral edges outwardly of the discharge groove or recess are preferably of a tapered design to effect an axial outward spreading of the spray of fluid to assure atomization, and atomization may also be enhanced by providing an outer peripheral groove closely adjacent the edge of the tapered surface of the body or cap, or both, to form a knife edge over which the fluid passes. A discharge groove or recess might also or alternatively be provided in the cap itself, and also that the nozzle body may be provided with a peripherally flexible flanged end which will cooperate to open the slot under fluid pressure.

This type of nozzle has particular utility in internal combustion (particularly Diesel) engine fuel nozzles and injectors, oil furnace nozzles, insecticide or other atomizing spray nozzles, and the like.

DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the invention, reference may be had to the accompanying drawings illustrating preferred embodiments of the invention in which like reference characters refer to like parts throughout the several views, and in which:

FIG. **1** is longitudinal cross-sectional view of a preferred fluid discharge nozzle embodying the present invention and shown as secured into an internal combustion engine cylinder head;

FIG. **2** is a cross-sectional view taken substantially on the line **2—2** of FIG. **1**;

FIG. **3** is a fragmentary enlarged cross-sectional view of a portion of the nozzle shown in FIG. **1**;

FIG. **4** is a longitudinal cross-sectional view of another embodiment of the present invention;

FIG. **5** is an elevational view of another embodiment of the invention with a portion of the nozzle shown in section;

FIG. **6** is a fragmentary partially cross-sectioned longitudinal view of another embodiment of the invention;

FIG. **7** is a longitudinal cross-sectional view of yet another embodiment of the invention;

FIG. **8** is a cross-sectional view taken substantially on the line **8—8** of FIG. **7**;

FIG. **9** is an elevational view of still another embodiment of the invention;

FIG. **10** is an end view of the nozzle of FIG. **9** as seen from the right hand side thereof;

FIG. **11** is a fragmentary longitudinal view, partly cross-sectional, of another embodiment of the invention, and illustrating the use of a preferred assembly tool; and

FIG. **12** is a view, partly in cross-section, as seen from line **12—12** of FIG. **11**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. **1** and **2** illustrate one preferred embodiment of the invention in which a fluid discharge nozzle **10** includes a nozzle body **12** having an outer flange **14** and a shank portion **16** externally threaded as shown for securing the nozzle into an internally threaded bore **18** of an internal combustion engine cylinder head **20** shown here in only fragmentary form.

An axially extending fuel inlet passage **22** in the nozzle body **12** has an outer threaded end **24** adapted for attachment to a fuel supply line (not shown) to which fuel may be supplied under periodic high pressure, timed for desired fuel injection into the engine.

The inner end of the passage **22** ends in an enlarged bore **26** which is provided with a plurality of axially extending and annularly spaced grooves **28**, as shown more clearly in FIG. **2**.

The outer end of the nozzle body **12** is provided with an annular discharge recess **30** defined by an inner annular ridge **32** adjacent the bore **26** and an outer annular ridge **34** at the outer periphery of the nozzle body end. The inner annular ridge **32** has slots **36** annularly spaced to register with the outer ends of the axial grooves **28**. The inner annular ridge **32** is axially recessed below the plane which contains the extremity of the outer annular ridge, for a purpose to be explained.

A cap member **38** has a longitudinal shank **40** sized to be press-fit within the bore **26** of the nozzle body **12** and an outer relatively thin radially extending flange **42** dimensioned to overlie the annular discharge recess **30**, with the outer peripheral edge of the flange **42** substantially coextensive with the outer annular ridge **34** of the nozzle body **12** as shown.

The cap member is installed by press-fitting the shank **40** into the bore **26** with an axial pressure that will cause the flange to be compressed at its outer periphery against the outer annular ridge **34**, the inner annular ridge **32**, as heretofore mentioned, being recessed inwardly to permit the inner portion of the flange **42** to be displaced slightly inwardly of the outer periphery thereof. The inward displacement of the flange **42** is relatively small, and is not readily discernible in the drawing.

In operation, fluid, which in the case of the internal combustion engine would be fuel from a fuel supply source (not shown), is admitted through the inlet passage **22** to the enlarged bore **26** from which it passes axially through the grooves **28** and radially outwardly through the slots **36** into the annular discharge recess **30**. At the timed moment when fuel pressure is increased to its injection value, it will force the outer peripheral edge of the cap member flange **42** to flex away from the outer annular ridge **34** so that the fuel will be sprayed in an annular substantially planar fan through the peripheral slot formed between the flange **42** and the outer annular ridge **34**.

In certain embodiments of the invention, it may be desirable to increase the atomizing and dispersing of the fluid, which can readily be done by tapering the facing edges of the abutting outer edge of the flange **42** and the outer annular ridge **34**, as shown as **42***a* and **34***a* respectively in FIG. **3**, providing an air-foil or annular bell-mouth effect which produces the desired dispersion of the fluid.

FIG. **4** illustrates another embodiment of a fluid discharge nozzle **50** comprising a nozzle body **52** having an axial inlet passage **54** provided with an enlarged outer bore **56** and an annular discharge recess **58** provided on the inner end face of the nozzle body, similar to the discharge recess **30** of the embodiment of FIG. **1**, and defined by similar inner and outer annular ridges **60** and **62** respectively. The difference between the embodiments of FIG. **4** and FIG. **1** is that the inlet passage **54** is connected with the annular discharge recess **58** by means of separate bored passages **64** instead of the grooves **28** of FIG. **1**, there being no communication through the enlarged bore **56** to the discharge recess **58**. A cap member **64** is provided with a shank portion **66** press-fit into the bore **56** of the nozzle body **52** and has an outer flange **68** overlying the discharge recess **58** and substantially coextensive with the outer ridge **62**, similar to the construction shown in FIG. **1** and operating in the same fashion.

In the embodiment shown in FIGS. **5** and **6**, a fluid discharge nozzle **70** comprises a nozzle body **72** having an inlet passage **74** ending in a reduced portion **76** which extends axially almost to the end of the body **72**, which end is formed with a reduced diameter portion **78** subtended by a radially extending flange **80**. The outer end face of the flange **80** has an annular discharge recess **82** defined by the periphery of an inner axially extending boss **84** and an outer annular ridge **86**.

FIGS. **5** and **6** differ slightly to indicate alternative embodiments of the construction in which an end cap **88**, shown in FIG. **5**, consists of a washer member having a formation similar to the radially extending flange **80** of the nozzle body **72**, with a discharge recess **90** registering with the discharge recess **82** in the flange **80**. The end cap **88** is retained against the flange **80** by means of the boss **84** extending through a central hole **92** and being silver-soldered or otherwise secured at its outer edge **94** to the boss **84**.

In FIG. **6**, an end cap **96** consists merely of a flat washer element similarly secured to the boss **84**, but having no discharge recess as does the end cap **88** of FIG. **5**. It will be seen that the thickness of the cap members **88** and **96** are substantially the same as the thickness of the flange **80** in their recessed portions.

In operation, fluid under pressure entering the inlet passage and its reduced portion **76** communicates with the discharge recess **82** through angularly extending passages **98**, and the fluid pressure will cause the flexing of both the flange **80** and the cap member **88** or **96** away from each other to permit fluid to be discharged from the peripheral slot therebetween.

FIGS. **7** and **8** illustrate yet a further modification of the invention in which a fluid discharge nozzle **100** comprises a nozzle body **102** having a fluid inlet passage **104** provided with an inner reduced diameter portion **104***a* with grooves **106** extending axially to the inner or discharge end of the nozzle body **102**, as shown, and communicating through slots **108** with an annular semi-circular cross-sectioned discharge recess **110**. A cap member **112** has a shank portion **114** which is press-fit within the reduced diameter portion **104***a* of the inlet passage **104**, and a radially extending flange **116** overlying the discharge recess **110** and substantially coextensive with the outer end of the nozzle body **102**. The inner annular edge of the discharge recess **110** through which the slots **108** are formed is displaced axially inward of the plane containing the outer annular edge, so the flange **116** of the cap member **112** when assembled will be deflected to compress against the outer peripheral edge of the discharge recess **110**. Operation of this modification is substantially similar to that of the modification shown in FIG. **1**.

FIGS. **9** and **10** illustrate yet another modification of the invention in which a fluid discharge nozzle **120** comprises a nozzle body **122** having a straight fluid inlet passage **124** open at its inner end to a discharge recess **126** provided in the inner end of the nozzle body **122** and defined simply by an outer annular ridge **128**. A cap member **130** has a stepped shank **132** formed to have an enlarged portion **134** which, when the shank **132** is press-fit into the inlet passage **124**, will abut the inner surface of the recess **126** as shown. A fluid passage **136** extends through the shank **132** into the portion **134** and communicates with the discharge recess **126** through radially extending passages **138**. A flange **140** of the cap member **130** overlies the discharge recess **126** and is compressed, when the portion **134** is assembled to abut the recess inner surface, against the outer annular ridge **128**. The flange **140** has around its outer periphery an annular groove **142** which provides a substantially sharp annular knife-edge, as at **144**, which contributes to the dispersion and atomization of fuel when discharged through the peripheral slot formed between the flange **140** and the outer annular ridge **148**, which are tapered as indicated in a fashion similar to that shown in FIG. **3**.

In the modification of the invention shown in FIGS. **11** and **12**, a fluid discharge nozzle **150** comprises a

nozzle body **152** having a straight fluid inlet passage **154** open at its inner end to a discharge recess **156** defined by an outer annular ridge **158**. A cap member **160** has a straight shank **162** sized to be press-fit into the inlet passage **154** and having annularly spaced flats **164** to permit fluid flow to the discharge recess **156**. A flange **166** of the cap member **160** overlies the discharge recess **156** and is compressed, when the shank **162** is assembled within the passage **154**, against the outer annular ridge **158**. Assembly is accomplished by means of a tool **170** which is forced, as indicated by the arrow, against the end cap **160** to press-fit the shank **162** in the passage **154** with a predetermined pressure, effecting a slight deflection of the flange **166** in compressing against the outer annular ridge **158** of the body **152**. The outer surfaces of the ridge **158** and the flange **156** adjacent the peripheral slot formed therebetween are tapered as in the modifications previously described to provide for dispersion and atomization of the fluid which is discharged through the slot when fluid pressure flexes the flange **156** outward. The atomization effect is enhanced by the provision of an annular bevel **172** around the flange **166** and an annular groove **174** around the end of the body member **152** closely adjacent the tapered surfaces to provide knife-edges as shown.

It will be seen that the basic idea of the invention is achieved in all the modifications shown, the concept being that of effecting, with no moving or wear producing parts, the discharge of fluid from a nozzle under a predetermined pressure. In the modifications shown, the compression under which the cap member is held against the outer annular ridge of the nozzle body discharge recess will predetermine the pressure at which fluid can be discharged between the peripheral slot formed between the cap member flange and the nozzle body.

It will be apparent that the annular recess to which fluid is directed may readily be formed in the cap member rather than in the nozzle body without varying the concept of the invention, and various other changes and modifications may be made in the structure without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A fluid discharge nozzle comprising:

a nozzle body having an inlet adapted for connection to a source of pressure fluid and an end face having an annular recess defined at least in part by a peripheral outer annular ridge, said recess being openly connected with said inlet;

an end cap secured to the nozzle body and having a radially extending flange overlying said recess and peripherally engagingly compressed against said annular ridge, said flange being flexible to part from said ridge under the pressure of fluid in said recess to effect a radial ejection of

the annular surfaces of said ridge and flange outwardly of their annular engagement being formed on curved diverging radii.

2. The nozzle as defined in claim **1** wherein said flange has an annular recess facing said nozzle body annular recess and defined by an outer annular ridge coextensive with and engaging the nozzle body outer annular ridge.

3. The nozzle as defined in claim **1** wherein the end face of said nozzle body has a central recess separated from said annular recess by an inner annular ridge whose outer surface is disposed in a plane parallel to and spaced inwardly from a plane containing the edge surface of said outer annular ridge which engages said end cap flange; and said end cap having a central boss pressfit into said central recess to retain said end cap with said flange being urged inwardly to engage said inner annular ridge to apply pressure engagement of said flange on said outer annular ridge.

4. The nozzle as defined in claim **3** wherein said inlet comprises an axial bore extending through said body member to the inner end of said central recess; and said central recess being defined by a substantially cylindrical sidewall having an axial groove therein; said inner annular ridge having a slot openly connecting said axial groove with said annular recess to provide fluid passage from said inlet through said groove and slot to said annular recess.

5. The nozzle as defined in claim **3** wherein said inlet comprises an axial bore extending through said nozzle body to the inner end of said central recess; and said nozzle body having passages openly connecting said bore directly with said annular recess.

6. The nozzle as defined in claim **3** wherein said inlet comprises an axial bore through said nozzle body axially coextending with said central recess; said bore and recess being defined by a cylindrical sidewall; said boss being substantially cylindrical to engage with said sidewall and having an axially extending flat to provide an axial passage from the inner end of said recess outwardly and communicating with said annular recess.

7. The nozzle as defined in claim **6** wherein said inlet comprises an axial bore through said nozzle body axially coextending with said central recess; said bore and recess being defined by a cylindrical sidewall; said boss being substantially cylindrical to engage with said sidewall and having an axially extending flat to provide an axial passage from the inner end of said recess outwardly and communicating with said annular recess.

8. A fluid discharge nozzle comprising:

a nozzle body having an inlet adapted for connection to a source of pressure fluid, an end face having an annular recess defined at least in part by a peripheral outer annular ridge and a central recess extending inwardly from said end face, said annular recess being openly connected with said inlet;

an end cap comprising a boss portion and a radially extending flange, said flange overlying said nozzle body annular recess and peripherally engaged with said annular ridge, said boss portion being pressfit retained in said nozzle body central recess to an extent compressing said flange against said annular ridge, said flange being flexible to part from said ridge under the pressure of fluid in said annular recess to effect a radial ejection of fluid therefrom between said ridge and said flange.

9. The nozzle as defined in claim **8** wherein said inlet comprises an axial bore extending through said body member to the inner end of said central recess; and said central recess being defined by a substantially cylindrical sidewall having an axial groove therein; said inner annular ridge having a slot openly connecting said axial groove with said annular recess to provide fluid passage

from said inlet through said groove and slot to said annular recess.

10. The nozzle as defined in claim **8** wherein said inlet comprises an axial bore extending through said nozzle body to the inner end of said central recess; and said nozzle body having passages openly connecting said bore directly with said annular recess.

11. The nozzle as defined in claim **8** wherein said central and annular recesses are separated by an inner annular ridge on said nozzle body end face and whose outer surface is disposed in a plane parallel to and spaced inwardly from a plane containing the edge surface of said outer annular plane, said end cap boss being pressfit into said central recess to an extent flexing said flange toward said inner annular ridge to provide compression of said flange against said outer annular ridge.

12. The nozzle as defined in claim **11** wherein an inner annular surface of said flange engages said inner annular ridge.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,680,792 Dated August 1, 1972

Inventor(s) Lawrence A. Schott

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

IN THE CLAIMS

Claim 1, col. 5, line 59, add --fluid therefrom between said ridge and said flange; and--.

Signed and sealed this 23rd day of January 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents