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(54) **Flat-jet nozzle, especially for use in a high-pressure cleaner**

Flachstrahldüse, insbesondere für Hochdruckreiniger

Buse à jet plat, en particulier pour nettoyeur haute pression

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(56) References cited:
**WO-A-94/17921 DE-A- 4 213 226
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Description

TECHNICAL FIELD

The present invention relates to a liquid-jet nozzle of the kind set forth in the preamble of claim 1.

BACKGROUND ART

A liquid-jet nozzle of the kind referred to above is known from the German published specification No. 4,213,226. In this known nozzle, the recess formed in the upstream side of the end wall has a rather complicated shape, partly comprising spherical surfaces, partly "side walls" in continuation of said spherical surfaces, the transitions between the various surfaces being constituted by sharp edges.

The shape of the recess referred to as known from the above document is the cause of certain disadvantages, both with regard to the flow conditions and with regard to the manufacture of the nozzles. With regard to the flow conditions it is reasonable to believe that the complicated shape of the recess, especially the sharp edges referred to, will create turbulence in the issuing liquid jet and prevent the flattening of the liquid jet from occurring as smoothly as possible. With regard to the manufacture of the nozzle, the complicated shape of the recess makes it impossible to produce it by means of e.g. milling operations, but demands the use of specially designed embossing or stamping tools, that can only be used, if the material of the nozzle lends itself to being shaped by embossing or stamping.

DISCLOSURE OF THE INVENTION

On this background, it is the object of the present invention to provide a nozzle of the kind referred to initially, that both with regard to flow conditions and manufacture represents an improvement of the known nozzle referred to above, and this object is achieved with a nozzle, according to the present invention additionally exhibiting the features set forth in the characterizing clause of claim 1. Since the recess shaped in accordance with the invention does not comprise complicated surfaces with sharp edges as in the known nozzles, the risk of turbulence is considerably reduced, providing improved possibilities for a smooth flattening of the jet. In the nozzle according to the invention, the recess in the upstream side of the end wall may be formed by a simple milling or grinding process using a milling or grinding tool, respectively, with a rounded end, that may be moved back and forth transversely of the longitudinal direction of the nozzle during the machining operation. Practical trials with the nozzle according to the invention have shown that the liquid jet flattens in such a manner, that at a certain distance from the mouth of the nozzle, it becomes extremely thin, almost to resemble a knife edge - this would hardly be possible with a nozzle, with which there is a risk of turbulence being created.

Advantageous embodiments of the nozzle according to the invention, the effects of which will be apparent from the following detailed portion of the present description, are set forth in claims 2-4.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following detailed portion of the present specification, the invention will be explained in more detail with reference to the exemplary embodiment of a liquid-jet nozzle according to the invention shown in the drawings, in which

Figure 1 is a partial sectional view along the line I-I in Figure 2 and illustrates the progressive flattening of the liquid jet,

Figure 2 is a longitudinal sectional view through the complete liquid-jet nozzle and shows symbolically the connection between the nozzle and the remaining components in the high-pressure cleaner, of which the nozzle is a part,

Figures 3 and 4 show the nozzle of Figure 2 as viewed from the right and the left, respectively, in Figure 2, and

Figure 5 at a greatly magnified scale shows a partial sectional view through the nozzle shown in Figure 2, showing the geometrical construction of the nozzle aperture and the region around it.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The liquid-jet nozzle 1 for use in a high-pressure cleaner and shown in the drawing comprises in a manner known per se an inlet chamber 2, the upstream side of which as shown diagrammatically in Figure 2 is adapted to receive liquid under pressure from the liquid pump 3 in a liquid-supply and control unit 4. On the downstream side, the inlet chamber 2 debouches outwardly through a nozzle aperture 5, so that a liquid jet 6 can be ejected as shown in Figure 1.

As will appear from Figure 1, the liquid jet 6 progressively spreads outwardly in the shape of a fan, the jet gradually becoming wider and thinner as indicated with the cross-sectional views 6a-6d. At the distance, in which the cross-sectional view 6d appears, the liquid jet 6 is quite thin, and if it is directed towards a surface to be cleaned in such a manner, that the liquid jet 6 hits the surface at this distance, a very large cleaning effect will be achieved, comparable to what can be achieved by using a metal scraper of the same width. If the liquid jet 6 is allowed to flow past the location corresponding to the cross-sectional view 6d, it will normally disintegrate to form a great number of small droplets. Trials have shown that the liquid jet 6d as shown exhibits a significantly greater cleaning effect than a jet with a circular cross-sectional shape and having the same mass-flow velocity.

In order to achieve the spreading of the liquid jet 6 as shown in Figure 1, it is, of course, necessary to adopt

special measures for influencing the flow of liquid before it leaves the nozzle aperture 5.

The nozzle aperture 5 is situated in an end wall 7 in the nozzle 1, and on the upstream side, this end wall 7 comprises an oval recess 8, the longitudinal axis 9 of which extends parallel to the sectional plane of Figure 2, but at right angles to the sectional plane in Figure 1. As will appear from Figure 5, the recess 8 consists of two spherical surfaces 10 connected to each other through a transition surface 11 forming a transition between the two spherical surfaces 10. Advantageously, the recess 8 may be produced by means of a ball-shaped milling cutter being moved between the two positions corresponding to the two spherical surfaces 10, so that it produces the transition surface 11 when moving between them.

The recess 8 is symmetrical, partly about the longitudinal axis 12 for the nozzle aperture 5, partly about its own longitudinal axis 9, and partly about its own transverse axis (not shown) intersecting the longitudinal axis 12 in the nozzle aperture 5.

In the exemplary embodiment shown, the upstream side of the end wall 7 has the shape of a spherical surface 13, the radius 14 of which is the same as the radius in the remainder of the inlet chamber 2.

A shallow recess 15 is formed on the downstream side of the end wall 7.

Referring to Figures 1, 2 and 4, it should be noted that the liquid jet 6 is flattened out in such a manner that its main plane extends at right angles to the longitudinal axis 9 for the recess 8 shown in Figure 4. The reason for this is presumably that the spherical surfaces 10, cf. Figure 5, add two oppositely and inwardly directed components to the movement of the liquid flow, so that the liquid jet 6 almost immediately after having left the nozzle aperture 5 has a marked ellipsoidal cross-sectional shape as shown by the cross-sectional view 6a. Since at this location, a certain momentum still remains in the components referred to, the liquid jet 6 will continue flattening out as shown in Figure 1.

The function of the recess 15 on the downstream side of the end wall 7 is not to influence the liquid flow, but to make it possible to let the nozzle aperture 5 be sufficiently short for achieving the desired effect, at the same time as the end wall 7 may have the requisite mechanical strength, partly to withstand the high internal liquid pressure, partly to withstand the rough treatment, to which high-pressure cleaners are often subjected, and at the same time protect the outlet side of the nozzle aperture 5.

A number of practical trials with a high-pressure cleaner comprising a liquid-jet nozzle constructed as shown in the drawing have been carried out. During these trials, nozzles have been used, in which the axial length 16 of the nozzle aperture 5 has been between 0.2 and 0.3 times the diameter 17 of the nozzle aperture, and in which the two spherical surfaces 10 have had a radius 18 of between 0.8 and 1.11 times the diameter 17 of the nozzle aperture, said diameter having varied between 1.36 and 1.82 mm, while the centres of curva-

ture 19 for the spherical surfaces 10 have been situated at a distance 20 of between 0.2 and 0.3 times the diameter 17 of the nozzle aperture from the latter's axis 12.

During the trials the spherical surface 13 constituting the upstream side of the end wall 7 has had a radius 14, as mentioned above being the same as the radius of the inlet chamber 2, of between 2 and 3 times the diameter 17 of the nozzle aperture.

The recess 15 may e.g. have a diameter 21 of between 1 and 1 1/2 times the diameter 17 of the nozzle aperture and a depth 22 of between 1 and 2 times the axial length 16 of the nozzle aperture, possibly a little more, provided that the liquid jet 6 is not influenced.

The liquid-jet nozzle 1 will normally be made from the same material normally used for such nozzles, e.g. steel, so as to be able to withstand the high internal pressures of the order of magnitude 100-200 bars that may occur in high-pressure cleaners.

LIST OF PARTS

1	liquid-jet nozzle
2	inlet chamber
3	liquid pump
4	liquid-supply and control unit
5	nozzle aperture
6	liquid jet
6a-d	cross-sectional view
7	end wall
8	recess
9	longitudinal axis
10	spherical surface
11	transition surface
12	longitudinal axis
13	spherical surface
14	radius
15	recess
16	length
17	diameter
18	radius
19	centre of curvature
20	distance
21	diameter
22	depth

Claims

1. Liquid-jet nozzle (1) for ejecting a progressively flattening jet (6) of cleaning liquid at high pressure, said liquid-jet nozzle being of the kind comprising

a) a nozzle aperture (5) extending through an end wall (7) extending transversely to the main direction of flow of the liquid jet (6),

b) upstream of the nozzle aperture (5) and opening into the latter an inlet chamber (2) connected to the outlet of the liquid pump (3) of a high-pressure cleaner, and

c) in the upstream side of the end wall (7), an elongate recess (8), the longitudinal central axis (9) of which intersects the central axis (12) of the nozzle aperture (5) at right angles,

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characterized in

d) that the recess (8) is oval and consists of ipsilaterally concavely curved surfaces extending smoothly into each other so as to form a continuous surface without sudden transitions or sharp edges.

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2. Nozzle according to claim 1, characterized in that the width of the recess (8) is more than one fifth of and less than five times the diameter (17) of the nozzle aperture (5).

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3. Nozzle according to claim 2, characterized in

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a) that the length (16) of the nozzle aperture (5) is between 0.2 and 0.3 times the diameter (17) of the nozzle aperture (5), and

b) that the recess (8) consists of two spherical surfaces (10) each having a radius (18) of between 0.8 and 1.11 times the diameter (17) of the nozzle aperture (5) and with the centres of curvature (19) situated at a distance (20) of between 0.2 and 0.3 times the diameter (17) of the nozzle aperture (5) from the latter's axis (12), as well as a transition surface (11) situated between the two spherical surfaces (10) and forming a smooth transition between them.

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4. Nozzle according to claim 3 and in which the upstream side of the end walls (7) constitutes a spherical surface (13) with the same radius (14) as that of the inlet chamber (2), characterized in that said radius is between two and three times the diameter (17) of the nozzle aperture (5).

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Patentansprüche

1. Flüssigkeitsstrahldüse (1) zum Ausstossen eines allmählich abflachenden Strahls (6) einer Reinigungsflüssigkeit bei hohem Druck, wobei die genannte Flüssigkeitsstrahldüse von der Art ist, die umfasst

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a) eine Düsenöffnung (5), die durch eine Stirnwand (7) verläuft, die sich quer zur Hauptströmungsrichtung des Flüssigkeitsstrahles (6) erstreckt,

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b) stromaufwärts zur Düsenöffnung (5) und in letztere einmündend eine Einlaufkammer (2), die mit dem Austritt der Flüssigkeitspumpe (3) eines Hochdruckreinigungsgerätes verbunden ist, und

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c) in der Stromaufwärtsseite der Stirnwand (7) eine längliche Vertiefung (8), deren Längsmittelachse (9) die Mittelachse (12) der Düsenöffnung (5) im rechten Winkel schneidet,

dadurch gekennzeichnet,

d) dass die Vertiefung (8) oval ist und aus ipsilateral konkav gekrümmten Oberflächen besteht, die glatt ineinander verlaufen, sodass sie eine zusammenhängende Oberfläche ohne plötzliche Übergänge oder scharfe Kanten bilden.

2. Düse gemäss Anspruch 1, **dadurch gekennzeichnet**, dass die Weite der Vertiefung (8) mehr als ein Fünftel des Durchmessers und weniger als fünfmal dem Durchmesser (17) der Düsenöffnung (5) beträgt.

3. Düse gemäss Anspruch 2, **dadurch gekennzeichnet**,

a) dass die Länge (16) der Düsenöffnung (5) zwischen 0,2 und 0,3 Mal dem Durchmesser (17) der Düsenöffnung (5) beträgt, und

b) dass die Vertiefung (8) aus zwei kugelflächenförmigen Oberflächen (10) besteht, von der jede einen Radius (18) von zwischen 0,8 bis 1,11 Mal dem Durchmesser (17) der Düsenöffnung (5) hat und mit den Krümmungsmittelpunkten (19), die in einem Abstand (20) von zwischen 0,2 bis 0,3 Mal dem Durchmesser (17) der Düsenöffnung (5) von der Achse (12) letzterer gelegen sind, sowie einer Übergangsfläche (11), die zwischen den beiden kugelflächenförmigen Oberflächen (10) gelegen ist und einen glatten Übergang zwischen ihnen bildet.

4. Düse gemäss Anspruch 3 und in der die Stromaufwärtsseite der Stirnwände (7) eine kugelflächenförmige Oberfläche (13) bildet mit dem gleichen Radius (14) wie der der Einlaufkammer (2), **dadurch gekennzeichnet**, dass der genannte Radius zwischen zwei- und dreimal dem Durchmesser (17) der Düsenöffnung (5) beträgt.

Revendications

1. Tuyère à jet liquide (1) pour éjecter, à haute pression, un jet progressivement aplatissant (6) de liquide d'épuration, ladite tuyère à jet liquide étant du genre comprenant

a) un orifice de tuyère (5) s'étendant à travers une paroi frontale (7) qui s'étend transversalement dans la direction principale de l'écoulement du jet liquide (6),

b) en amont de l'orifice de tuyère (5) et entrant dans le dernier, une chambre d'entrée (2) reliée à la sortie de la pompe pour liquides (3) d'un nettoyeur à haute pression, et

c) du côté amont de la paroi frontale (7), un enfoncement allongé (8) dont l'axe longitudinal central (9) croise l'axe central (12) de l'orifice de tuyère (5) à angles droits,

caractérisée en ce que

d) l'enfoncement (8) est ovale et constitué par des surfaces courbées ipsilatéralement concavement qui s'étendent régulièrement les unes dans les autres pour ainsi former une surface continue sans transitions brusques ou arêtes vives.

2. Tuyère selon la revendication 1, caractérisée en ce que la largeur de l'enfoncement (8) est plus qu'un cinquième du diamètre (17) et moins que cinq fois le diamètre (17) de l'orifice de tuyère (5).

3. Tuyère selon la revendication 2, caractérisée en ce que

a) l'orifice de tuyère (5) a une longueur (16) de 0,2 à 0,3 fois le diamètre (17) de l'orifice de tuyère (5), et

b) l'enfoncement (8) est constitué par deux surfaces sphériques (10), le rayon (18) de chacune d'elles a une grandeur de 0,8 à 1,11 fois le diamètre (17) de l'orifice de tuyère (5) et avec les centres de courbure (19) situés à une distance (20) de 0,2 à 0,3 fois le diamètre (17) de l'orifice de tuyère (5) de l'axe (12) de la dernière, ainsi que par une surface de transition (11) située entre les deux surfaces sphériques (10) et formant une transition régulière entre elles.

4. Tuyère selon la revendication 3 et où le côté amont de la paroi frontale (7) est une surface sphérique (13) ayant le même rayon (14) que la chambre d'entrée (2), caractérisée en ce que ledit rayon a une grandeur de deux à trois fois le diamètre (17) de l'orifice de tuyère (5).

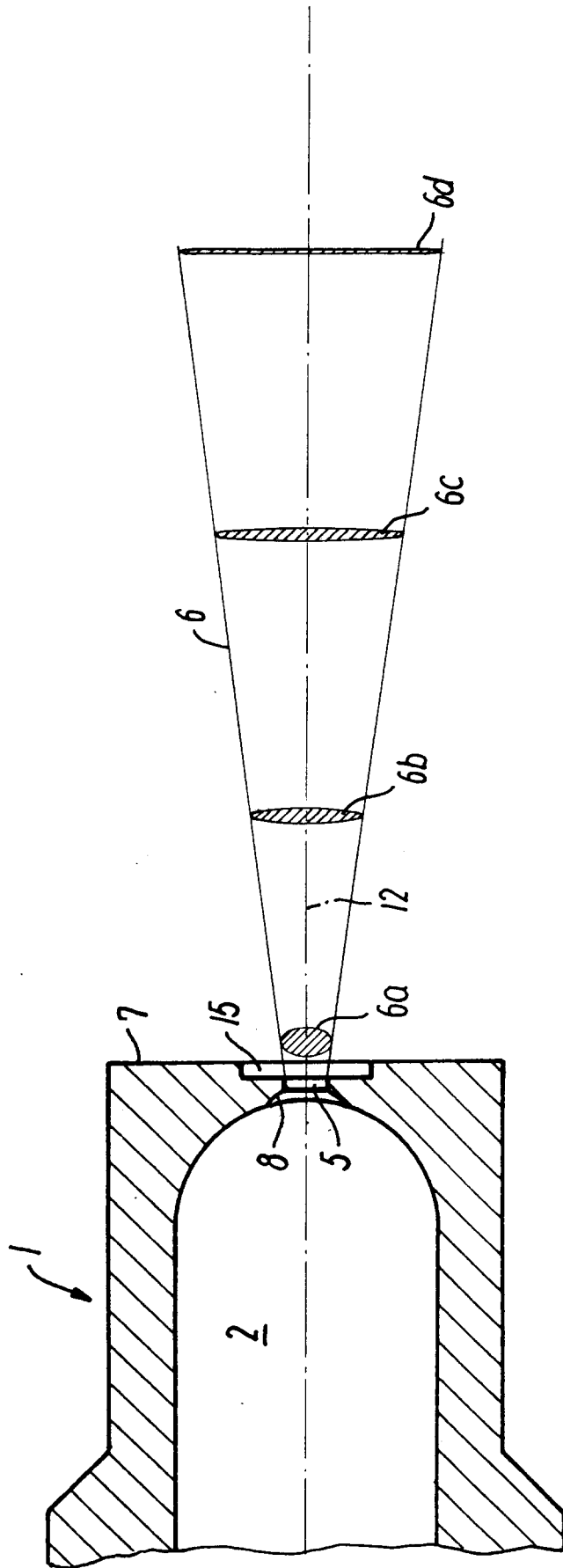


FIG. 1

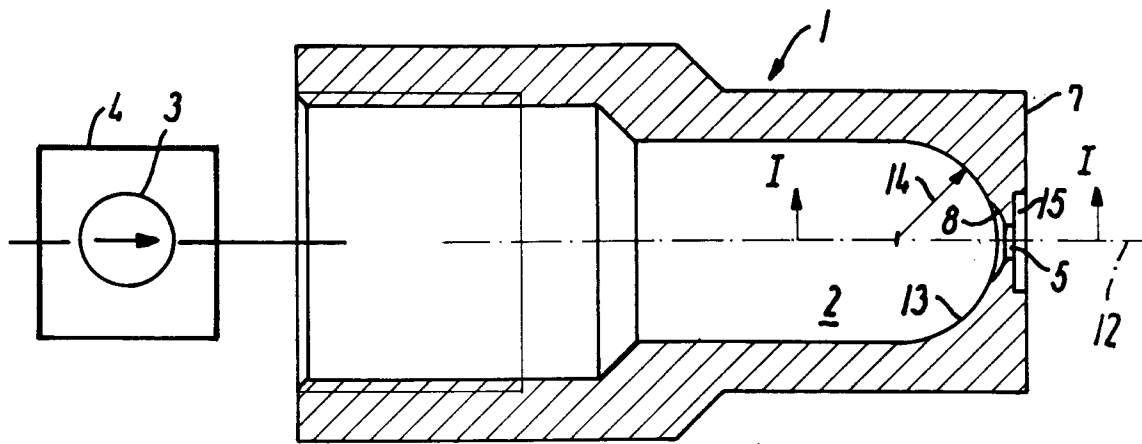


FIG. 2

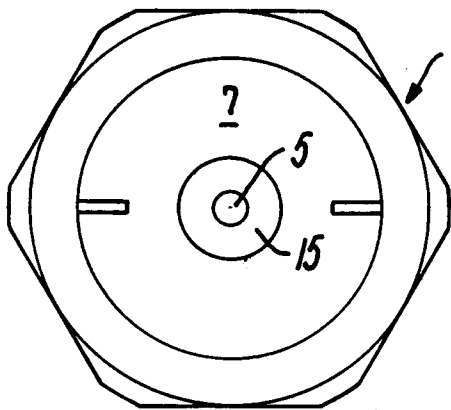


FIG. 3

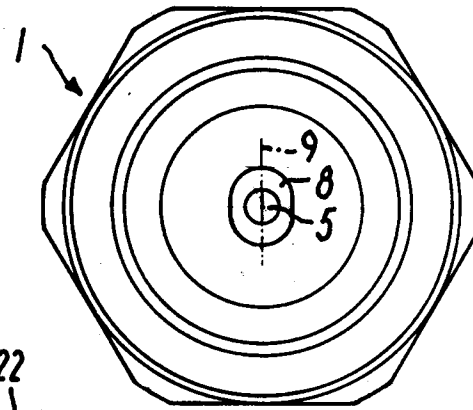


FIG. 4

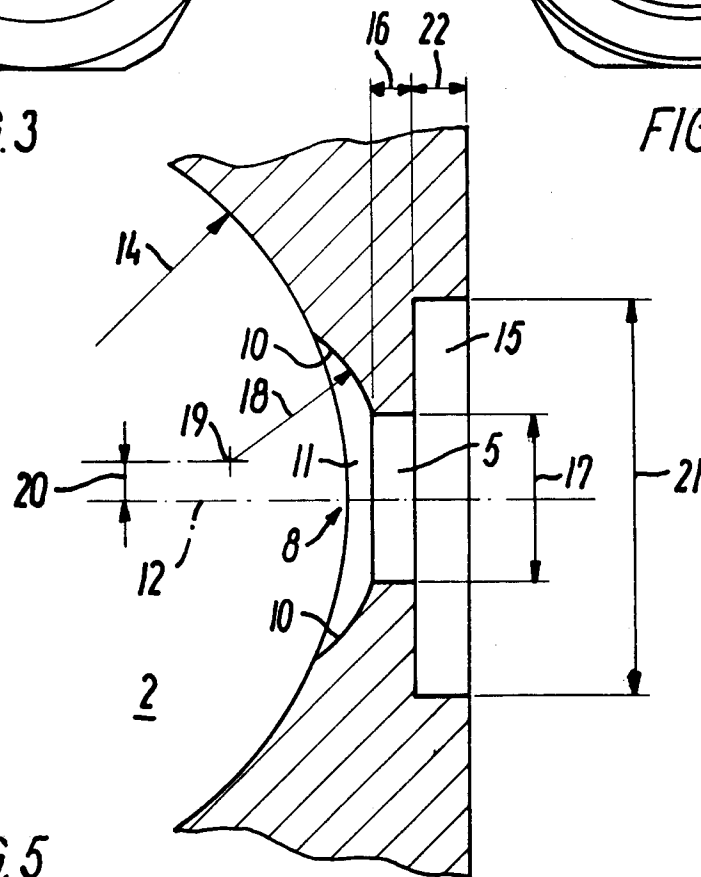


FIG. 5