United States Patent

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[33] **Great Britain**
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[54] **CUTTING NOZZLE**
9 Claims, 1 Drawing Fig.

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[50] **Field of Search** ..... 239/589, 601, 590, 593, 594, 597, 602, DIG. 20

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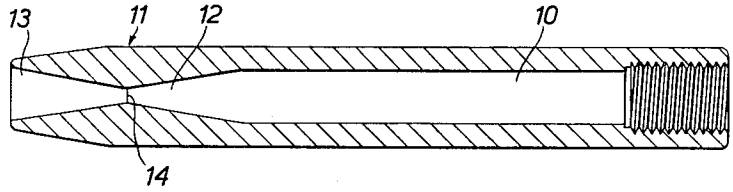
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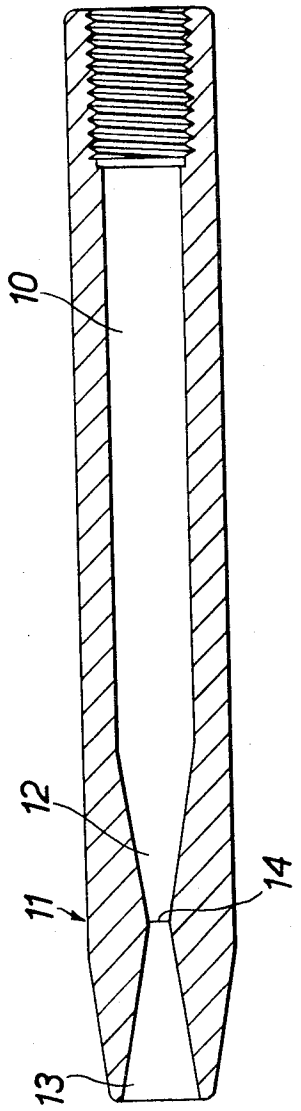
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ABSTRACT: A venturi cutting nozzle whose angles of convergence and divergence are between 7° and 11°, preferably 8° 30′ and 9° 30′.





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CUTTING NOZZLE

This invention relates to a nozzle and in particular to a cutting nozzle.

It is known to use jets of high-pressure water, e.g., water at pressures above 500 atmospheres to cut metal and hard rocks. It is necessary to use a nozzle in order to project such a jet and in this specification the term "cutting nozzle" will be used to denote a nozzle suitable for this purpose.

According to the invention a cutting nozzle comprises a venturi terminal section whose expanding and contracting portions are such that:

a. they create no unacceptable turbulence during use, and

b. the tangent plane at any point of the expanding or contracting portions makes an angle of 7°–11° with the direction of projection.

In order to reduce turbulence it is desirable that the nozzle also comprises an inlet section of constant cross section.

Preferably the nozzle has a circular cross section in any plane perpendicular to the direction of projection and the centers of all said circles lie on a straight line.

Thus according to a preferred embodiment of the invention a cutting nozzle comprises a terminal section whose expanding and contracting portions each have the shape of the frustum of a right-circular cone having a semivertical angle of 7°–11°, preferably 8°30′–9°30′, the two frustums having the same axis and the same cross-sectional area at their intersection.

In order to reduce turbulence this preferred form of the nozzle conveniently includes an inlet section having the shape of a right-circular cylinder which has the same axis as the two frustums and which has the same area of cross section as the frustum with which it intersects at the intersection. Preferably the length of the right circular cylinder is at least 5 times its diameter.

Preferably the semivertical angles of the two cones differ by less than 5′.

The invention will now be described by way of example with reference to the accompanying drawing which is a longitudinal cross section of a nozzle according to the invention.

The nozzle shown in the drawing comprises an inlet section **10** whose shape is that of a right-circular cylinder and a venturi terminal section **11**.

The terminal section comprises a contracting portion **12** and an expanding portion **13** both of which have the shape of the frustum of a right circular cone. The two frustums intersect and define a circular aperture **14**.

The dimensions of the nozzle are:

Inlet Section	
Length	63.4 mm.
Diameter	6.8 mm.
Length divided by diameter	9.3
Terminal Section	
Semivertical angles	9°
Length (portion 12)	16.5 mm.
(portion 13)	16.5 mm.
Aperture	
Diameter	2.5 mm.

The size of the aperture is important in determining the cutting properties of the jet. If the aperture is too large the cross section of the jet will also be too large with the result that the jet will gouge rather than cut. On the other hand if the aperture is too small it will unduly restrict the flow of water so that there will be insufficient flow for satisfactory cutting. We have found that apertures having a diameter of about 2.5 mm. are usually satisfactory.

The other dimensions of the nozzle can be determined from that of the aperture. For example the diameter of the inlet section must be great enough to avoid undue friction losses and the length of the tapered sections is determined by:

a. The difference in size between the aperture and the inlet tube,

and

b. The specified rate of taper.

The sharper the edge at the place where the two conical portions meet (consistent with maintaining the specified rate of taper) the better will be the performance of the nozzle.

Four nozzles as shown in the drawing were used to make an annular hole (90 cm. external diameter and 65 cm. internal diameter) in the sea bed at a place where the underlying stratum was schistose (which is a hard rock).

The four nozzles were unevenly spaced around a circle and rotated so that each nozzle followed a circular path (i.e. around the annulus). The nozzles were supplied with 360 kg./min. (i.e., 90 kg./min. for each nozzle) of water at a pressure of 600 atmospheres. In 18 minutes the hole was cut 23 cm. into the schistose.

I claim:

1. A cutting nozzle which comprises a venturi terminal section whose expanding and contracting portions are such that:

a. they create no unacceptable turbulence during use, and

b. the tangent plane at any point of the expanding or contracting portions makes an angle of 7°–11° with the direction of projection.

2. A cutting nozzle according to claim **1**, which comprises an inlet section of constant cross section.

3. A cutting nozzle according to claim **1**, which has a circular cross section in any plane perpendicular to the direction of projection and the centers of all said circles lie on a straight line.

4. A cutting nozzle which comprises a venturi terminal section whose expanding and contracting portions each have the shape of the frustum of a right-circular cone having a semivertical angle of 7°–11°, the two frustums having the same axis and the same cross-sectional area at their intersection.

5. A cutting nozzle according to claim **4**, in which the semivertical angle of each cone is 8°30′–9°30′.

6. A cutting nozzle according to claim **4**, which includes an inlet section having the shape of a right-circular cylinder which has the same axis as the two frustums and which has the same area of cross section as the frustum with which it intersects at the intersection.

7. A cutting nozzle according to claim **6**, in which the length of the right-circular cylinder is at least five times its diameter.

8. A cutting nozzle according to claim **4**, in which the semivertical vertical angles of the two cones differ by less than 5′.

9. A cutting nozzle according to claim **1**, in which:

c. the expanding and contracting portions intersect and define at their intersection a circular aperture having a diameter of about 2.5 mm.

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