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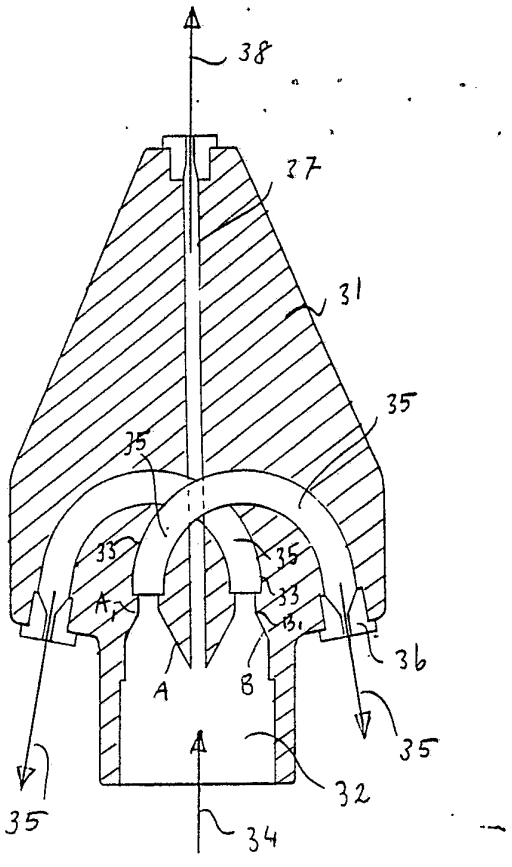
With international search report.
With amended claims.
In English translation (filed in Swedish).

(54) Title: MOVABLE HYDRODYNAMIC NOZZLE FOR PRESSURIZED WATER CLEANING OF WATER, DISCHARGE AND SURFACE WATER PIPES

(57) Abstract

A movable hydrodynamic nozzle (31), which removes deposits of sand, soil, sludge etc. in a pipe system. The nozzle (31) is connected to a pressurized water pipe and pulls the pressurized water pipe into the pipe system. When known movable hydrodynamic nozzles are used, the cleaning efficiency is lower due to strong turbulence and frothing caused thereby and to the fact that the resistance of the nozzle, caused thereby, to the water flow is large. In accordance with the present invention this problem is solved by shaping the channels (33), which guide the pressurized water from the inlet portion (32) of the nozzle (31) to the outer back portion of the nozzle, in such a way that the pressurized water is entering the channels (33) in the same direction as it has when it enters the inlet portion (32). The inlet openings (A_1, B_1, C_1 and D_1) and oulet openings (A_2, B_2, C_2 and D_2 respectively) of every channel (33) are preferably diametrically opposed in order to give the channel an optimally large curve radius.



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Movable hydrodynamic nozzle for pressurized water cleaning of water, discharge and surface water pipes

The present invention relates to a nozzle for hydrodynamic cleaning of pipe systems, particularily discharge and surface water pipe systems. Deposits of sand, soil, sludge etc must be removed, at regular intervals, from a water pipe system in order to prevent insanitary conditions and the clogging of the pipes. The hydrodynamic nozzle according to the present invention is characterized, like nozzles in this technical field, by openings, which are pointed backwards and from which water,due to pumping pressure, is sprayed against deposits in the pipe, dissolves this material and moves it backwards in order to be able to pump it from an well or the like. The nozzle pulls its pressurized water feeding pipe through the water pipe, while working its way in the water pipe, thanks to the pressurized water jets pointed backwards, and freeing deposits at the same time and making this material flow backwards in the pipe.

In fig. 1 is shown, mainly diagrammatically, a longitudinal section in an axial direction of a known nozzle 1 for hydrodynamic cleaning. When nozzle 1 is used, it is connected to a pressurized water pipe (now shown), in which the pressure is generated by a pumping car engine or the like and which said car is able to bring forward increasingly, when the movable nozzle, which is attached to the pressure pipe, increasingly forces its way into the water pipe. The pressurized water flows into the coaxially disposed opening 2 of nozzle 1 and is forced to pass (5) channels 3 in nozzle 1. Nozzle 1 is normally provided with from 6 to 8 such channels 3 and nozzles (not shown) are usually provided in the discharge openings of channels 3. The nozzle certainly works, but its design leads to waste of pumping power, when it is used for cleaning of this kind. Pressurized water

flow 4 in feeding opening 2 partly shuts off partial flows 5, which are forced to pass channels 3. A heavy turbulence with frothing results in feeding opening 2 and thus, the pressurized water flow through nozzle 1 is strongly obstructed and the efficiency of the pipe cleaning is poor.

In fig. 2 is shown, also mainly diagrammatically, a more recent known embodiment of a movable hydrodynamic nozzle 21, by means of which the severest turbulence problems and frothing problems caused have been overcome. Pressurized water 24 from a pumping car engine (not shown) flows through the feeding portion 22 a in the nozzle and reaches a chamber 22 b in the nozzle. A flow separation device or guide 26 and the upper portion of feeding tube 27 cause the pressurized water to circulate in chamber 22 b and it comparatively easy enters the feeding openings of channels 23 in chamber 22 b and comes out of channels 23. The pressurized flow through the movable hydrodynamic nozzle, designed in this manner, is manily doubled,provided the rest of the parameters are constant, and the cleaning efficiency is improved correspondingly.

Applicant has now found, quite surprisingly and in accordance with the present invention, that the movable nozzle in fig. 2, designed to hydrodynamically clean pipe systems, can be further developed and shaped resulting in the mainly complete disappearance of turbulence and frothing in the nozzle caused by the same. The important distinguishing feature of the present invention is that the feeding opening of each channel in the nozzle is situated in that inner wall of the feeding opening in the nozzle, which is perpendicularly disposed in relation to the direction of the pressurized water flow. Thus, when pressurized water is forcing its way into each of said channels, the water has the same direction as the water in the feeding opening,

but the channels are curved to the extent that, when the pressurized water comes out of the channels, it flows obliquely backwards in relation to the nozzle as is known in the art. In this way hardly any turbulence and frothing in the nozzle appears and the feeding of the pressurized water into the channels is obstructed surprisingly little. Thus, the overall pressurized water flow through the nozzle is facilitated and the ratio between the pumping force and the cleaning efficiency is very satisfactory.

In a first preferred embodiment of the present invention means are provided in the feeding opening of the nozzle, which additionally facilitates the admission of the pressurized water in the channels, e.g. cup shaped surfaces around the feeding openings of the channels and/or an coaxially disposed flow separator or guide, preferably shaped as a cone with its top in the upstream direction.

In another preferred embodiment of the present invention the distance between the inlet opening and the outlet opening of each channel is as large as it is possible to make it, considering the outer chape of the nozzle and the direction and the position of the outlet opening in order to maximize the curve radius of the channel and lower the resistance to the pressurized water flow through the nozzle.

In a third embodiment of the present invention is the outlet opening of each channel provided with a set of exchangeable nozzles having outlet openings having different diameters.

The present invention will be described more in detail in the following text, reference being made to the enclosed drawings:

Fig. 3 a and 3 b are mainly diagrammatically bottom views

of a movable hydrodynamic nozzle according to the present invention. The nozzle is viewed in the direction of the pressurized water flow; and

Fig. 4 is a mainly diagrammatical longitudinal section in an axial direction.

Fig. 3 a shows an embodiment of the movable hydrodynamic nozzle according to the present invention. Nozzle 31 is shown in an axial direction and in the downstream direction. Pressurized water, which enters the inlet opening 32 of the nozzle, hits the cup and quadrant shaped surfaces A,C,B and D at the inner end of inlet opening 32 and is guided by these surfaces into inlet openings A_1, C_1, B_1 and D_1 respectively of the four channels 33 in nozzle 31. The pressurized water proceeds in said four channels and is discharged from outlet openings A_2, C_2, B_2 and D_2 respectively of channels 33. Outlet opening A_2 and inlet A_1 are diametrically opposed, outlet opening C_2 and inlet opening C_1 are diametrically opposed etc. and thus, the curve radius of channels 33 from A_1 to A_2, from C_1 to C_2 etc in nozzle 31 is maximized and the overall resistance to the pressurized water flow in the nozzle is low. Also, that is why, the pumping pressure in the pressurized water feeding pipe being constant, the cleaning efficiency is high. This increase is surprisingly large. The efficiency is twice as high as the efficiency of the known nozzle according to fig. 2 and roughly four times as high as the efficiency of the known nozzle according to fig. 1.

Fig. 3 b shows a preferred embodiment of the present invention , which is similar to the embodiment shown in fig. 3 a, but it is provided with an axially disposed pressurized water flow divider 39, which is mainly conically shaped

and the top of which is disposed in an upstream direction. The flow divider 39 is, according to a particular embodiment of the present invention, combined with cup shaped pressurized water flow directing surfaces A,C,B and D around inlet openings A_1, C_1, B_1 and D_1 respectively of channels 33.

Fig. 4 is a longitudinal section of the nozzle according to fig. 3 a, an axial plane through two diametrically opposed channels 33. Pressurized water 34 flows into inlet opening 32 of nozzle 31 towards cup shaped surfaces A and B, in the form of partial flows 35 into inlet openings A_1 and B_1 respectively of channels 33 and out of outlet openings A_2 and B_2 respectively of said channels. Channels 33 suitably are made of metal pipe and nozzle 31 of a plastic material , which surrounds the channels. One of several channels 37 having a downstream direction and a comparatively small inner diameter are also shown in the figure. The cleaning work may be facilitated, if pressurized water jets 38 having a downstream direction start the dissolving of deposits of sand, soil, sludge etc, in the water pipe, which maybe is completely clogged. One small nozzle 36 is shown in outlet opening A_2.

CLAIMS

1. A movable hydrodynamic nozzle (31) for pressurized water cleaning of water, discharge and day water pipes, said nozzle (31) having a pressurized water inlet opening (32) as well as one or more pairs of channels (33) having inlet openings in said inlet opening and outlet opening in the outer surface of said nozzle, said channels transmitting the pressurized water out of said nozzle obliquely backwards in relation to the direction of the pressurized water, which it has, when it flows into said inlet opening of the nozzle, c h a r a c t e r i z e d in that the channels (33) have a curvature, that the pressurized water (34), when it enters said channels (33) from said inlet opening (32), has the same direction as when it enters said inlet opening (32) but is defelcted in said channels (33) having a large curve radius and that the pressurized water, when it comes out of (35) said channels (33) , besides the desired cleaning capacity also has the desired capacity to propel the nozzle (31), the overall resistence of the nozzle to the pressurized water flow being low and the cleaning efficiency, that is the ratio between the cleaning capacity and the pumping force on the pressurized water, being high.

2. The nozzle according to claim 1, c h a r a c t e r i z e d in that the inner wall of said inlet opening (32) is provided with cup shaped surfaces (A,C,B and D) around said inlet openings (A_1, C_1, B_1 and D_1) of said channels (33) and/or a coaxially disposed pressurized water flow divider or guide (39), e.g. conically shaped with its top in an upstream direction, in order to additionally facilitate the entering of the pressurized water in said channels (33) and lessen the overall resistence of said nozzle (31) to the pressurized water flow (34,35).

3. The nozzle according to claim 1 or 2, c h a r a c - t e r i z e d in that the inlet openings (A_1, C_1, B_1 and D_1) and the outlet openings (A_2, C_2, B_2 and D_2 respectively) are diametrically opposed in the nozzle (31) in order to make the curve radius of said channels (33) as large as it is optimally possible as regards the directions of said outlets and their positions in the outer surface of the nozzle (31).

AMENDED CLAIMS

[received by the International Bureau on 27 October 1985 (27.10.85);
original claims 1–3 replaced by new claim 1 (1 page)]

A movable hydrodynamic nozzle (31) for pressurized water cleaning of water, discharge and day water pipes, said nozzle (31) having a pressurized water inlet opening (32) as well as at least two tubular channels (33) having inlet openings in said inlet opening and outlet openings in the outer surface of said nozzle, said channels transmitting the pressurized water out of said nozzle obliquely backwards in relation to the direction of the pressurized water, which it has, when it flows into said inlet opening of the nozzle, c h a r a c t e r i z e d in that said channels (33) mainly are semicircularly shaped, enabling the pressurized water to flow into said channels mainly in the same direction as its flow direction in said inlet opening, and in that the inlet opening (A_1, C_1, E_1, B_1, D_1 or F_1) and the outlet opening (A_2, C_2, E_2, B_2, D_2 and F_2 respectively) of each channel (33) mainly have diametrically opposed positions in relation to the longitudinal axis of the nozzle, so that the curve radii of the channels are optimally large in view of the outlet openings and their positions on the outer surface of the nozzle, by means of which the total resistance of the nozzle to the pressurized water flow is low and the cleaning efficiency high.

FIG. 1

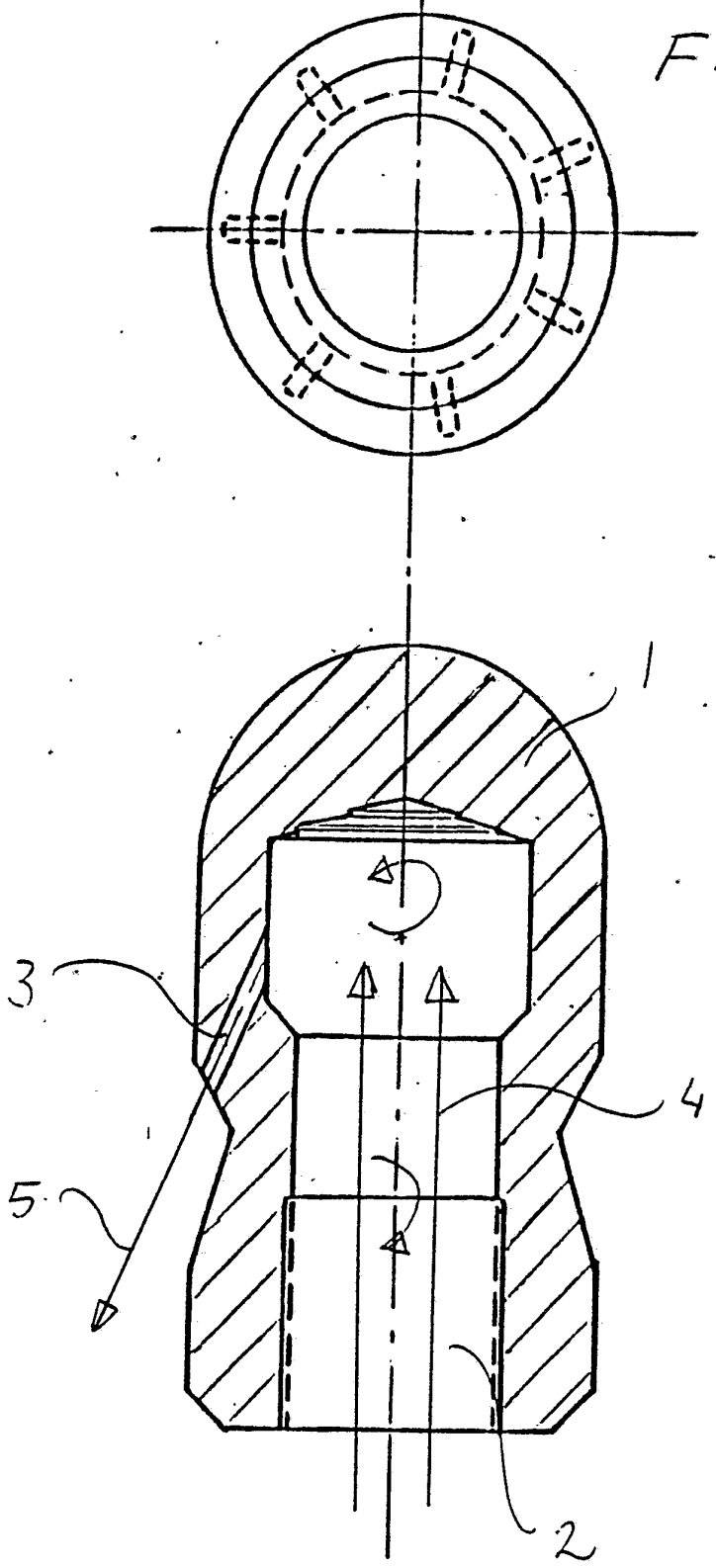


FIG. 2

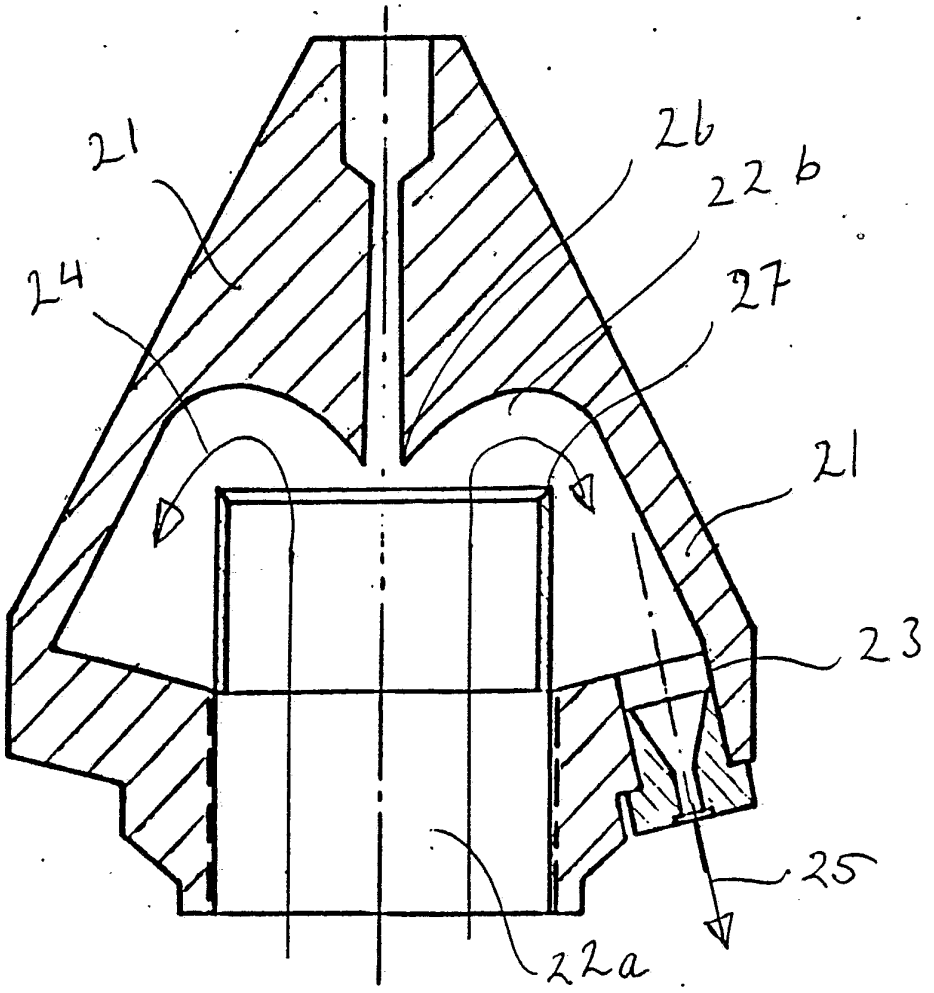


FIG 3A

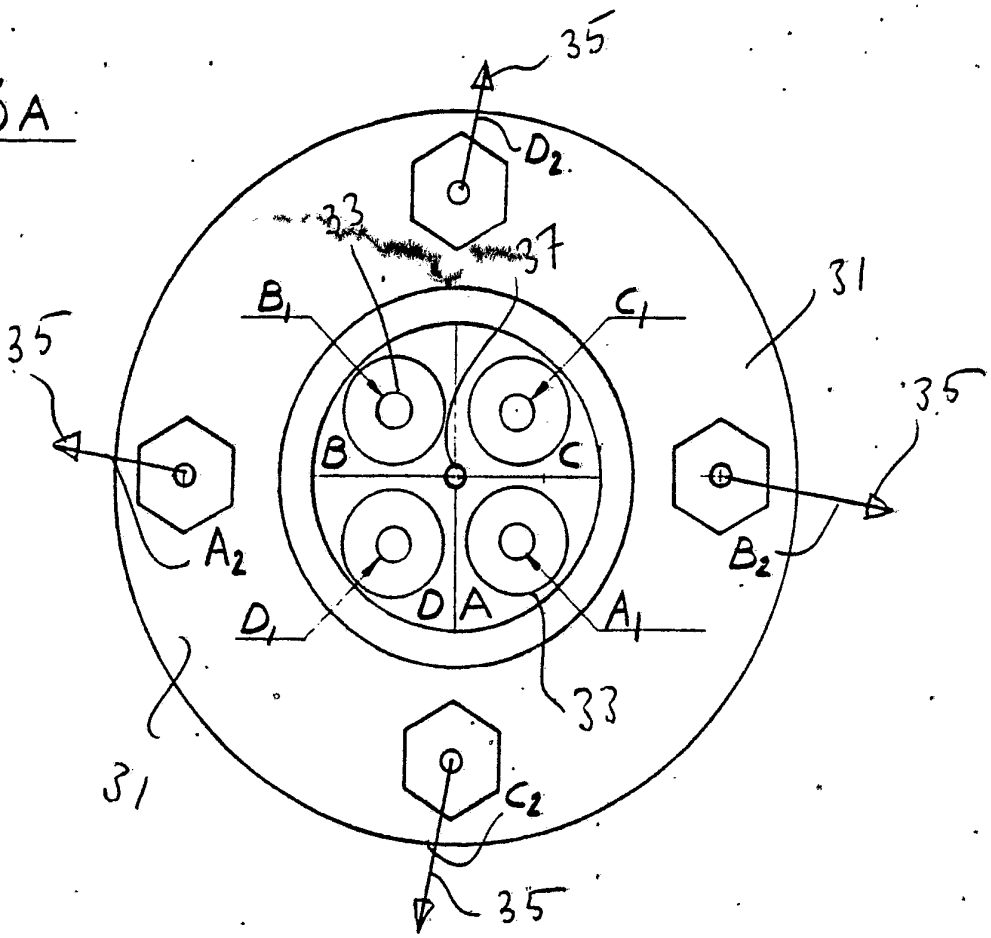

35
D2
33
37
31
B1
C1
35
35
B
C
A2
B2
D1
D
A
A1
33
31
C2
35

FIG 3B

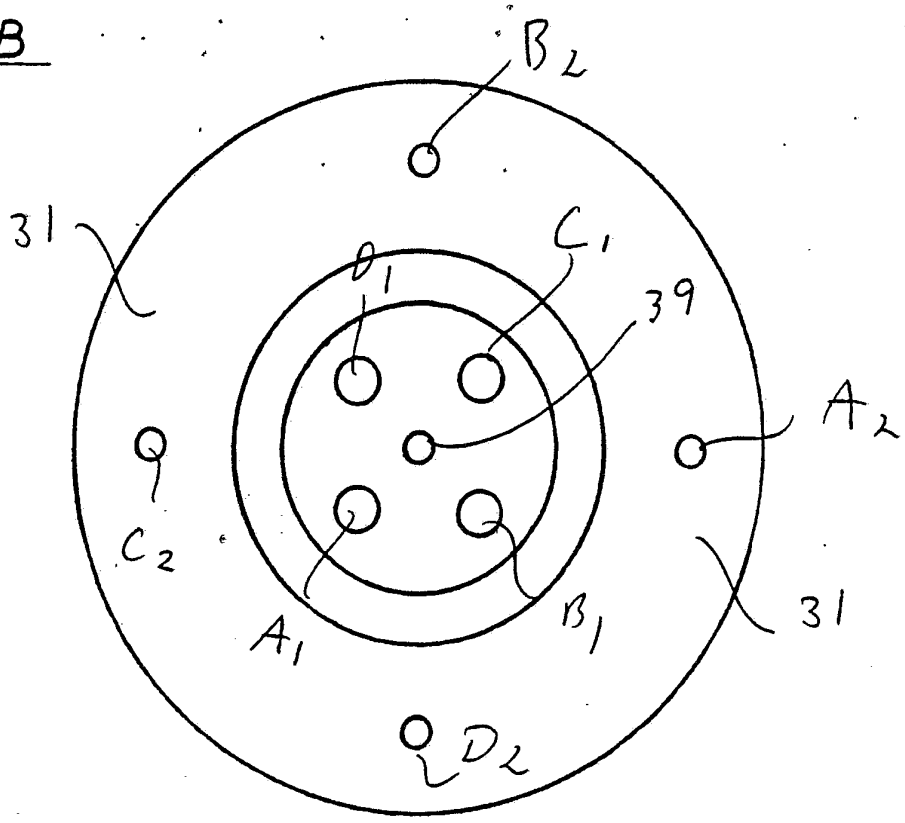
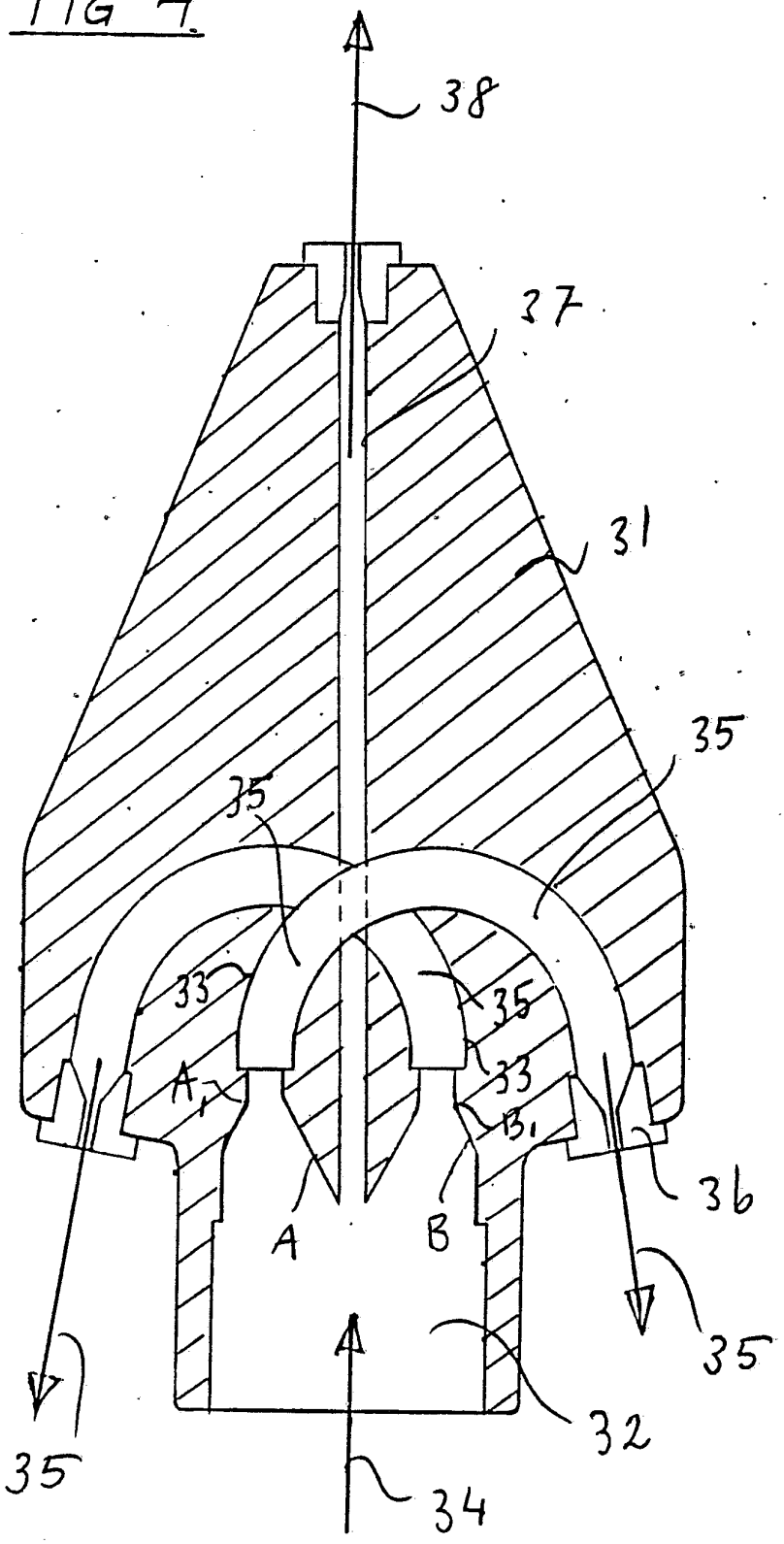

B2
31
D1
C1
39
A2
C2
A1
B1
31
D2

FIG 4



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE85/00186

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

B 08 B 9/04, E 03 F 9/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	B 08 B 3/00-3/04, 9/00-9/04; E 03 F 9/00; E 03 C 1/30-1/308
Nat Cl	85e:18/01, 18/05, 18/20
US Cl	15:104.03, .05, .06, .09, .12, .3, 3.5-3.52; .../...

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	SU, A, 671 883 (V V VOLKOV ET AL) 5 July 1979 see fig. 2	1
A	DE, C, 400 011 (GUSTAV O A LIEBAU) 11 August 1924	1
A	DE, C, 805 209 (OTTO HELM) 10 May 1951	1, 2
A	US, A, 1 587 194 (S C SLADDEN) 1 June 1925	1
A	US, A, 1 628 070 (S C SLADDEN) 12 May 1926	1
A	GB, A, 355 316 (S C SLADDEN) 9 May 1930	1

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1985-07-26	1985 -08- 0 1
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Hans Furhem

VH

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II Fields searched (cont)

138:8,22-8.24, 166-171;
4:255-257

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ..... because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers ....., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers ....., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.