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(54) **Flow guide with integrated valve**

(57) The present invention relates to a flow guide with integrated valve intended for descaling nozzles.

The fundamental object of the flow guide is to uniform the stream line speeds before entering the nozzle, ensuring in this manner a better operation and consequently a better impact pressure.

The fluid-dynamics of the flow guide according to the present invention has been optimized and the flow guide is **characterized in that** it includes a shutter (3a) and a flow straightener (3b) formed by a single element (3).

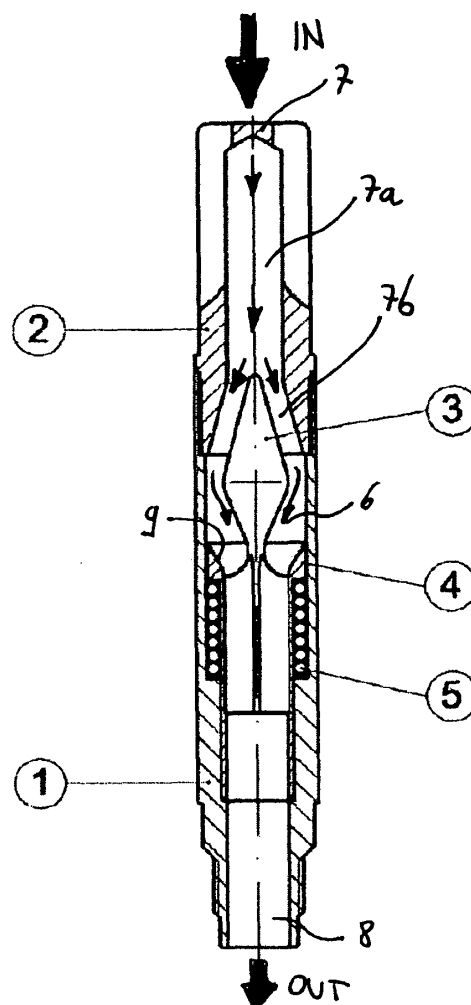


Fig. 3

Description

[0001] The present invention relates to a flow guide for descaling nozzles, provided with a shutter which allows to interrupt the flow of liquid under a given pressure.

[0002] The hydraulic descaling process is performed by means of nozzles which, by operating at very high pressures (in average between 250 bars and 500 bars), generate a very-high speed blade jet which strikes the surface of the steel product (e.g. the slab) at a given angle and causes the mechanical detachment of the scale.

[0003] After the elimination of the scale, the surface is qualitatively higher the more the jet impact pressure profile is uniform.

[0004] Such an uniformity is optimized by inserting a device called flow guide, which minimizes the turbulences in the inner stream, between the manifold (the hydraulic feeding pipe) and the nozzle.

Inside the flow guide, there is indeed a component called flow straightener which impresses a straight trajectory to the stream.

In the constant rate descaling systems, the running pressure is maintained constant during the entire duration of the process and is then reduced and cancelled. Nozzles with simple flow guides or possibly provided with a protective filter to prevent the high-speed collision of small, extraneous parts against the orifice of the nozzle which could cause serious damages are used in this type of systems.

In descaling systems working at intermittent rate, the nozzle is activated during some steps and remains inoperative during the other steps.

The nozzle is controlled by adjusting the pressure. In order to make the nozzle inactive (no flow rate), the pressure should be cancelled but this implies the partial emptying of the hydraulic circuit and causes considerable time for restoring the operation of the nozzle (transient period).

In order to minimize the transient period, it is necessary to leave the circuit at a minimum pressure but in this manner the nozzle continues to operate although in the simple dripping mode.

In order to prevent the dripping (in some cases highly unwelcome), flow guides which combine the function of eliminating the turbulence and of interrupting the flow under a given pressure are used.

In practice, these flow guides are made with an inner valve and are therefore named "flow guides with integrated valve".

Figure 1 shows one of the aforesaid flow guides currently available on the market; they consist of 5 components:

- 1) BODY: allows to accommodate the other components.
- 2) FILTER: in addition to preventing the passage of impurities of given dimensions, offers an appropriate sealing surface to the piston.
- 3) FLOW STRAIGHTENER: imposes a linear trajec-

tory to the flow and thus minimizes the vorticity in the stream.

4) PISTON: is shaped so as to use the front part (Figure 2: 4a) as a shutter so that, by adhering to the sealing surface of the filter, it interrupts the passage of the fluid.

The movement of the piston inside the body occurs by means of the collar (Figure 2: 4b) which at the same time allows to receive the bias of the spring.

The liquid flow crosses the piston through a series of holes (Figure 2: 4c).

5) SPRING: supplies the force required to contrast the acting pressure to the piston.

Figure 1 clearly shows that over a given pressure, the piston retracts allowing the passage of the fluid which after passing through the holes, proceeds inside the piston and thus passes through the straightener.

The geometry of such a type of flow guide with integrated valve generates a non-negligible load loss which reduces the efficiency of the nozzle, the feeding pressure being equal.

A first significant increase of the load loss occurs during the passage of the fluid through the holes 4c on the piston; the low value of the ratio between the total passage area and the total perimeter of the passage section (the higher the number of holes, the lower the value) joined to the sudden variation of the sections of the flow lines, generate turbulences which increase the aforesaid phenomenon.

Furthermore, it is worth considering that with this geometry, the fluid from the passages 4c, strikes the straightener at a random angle causing, in certain conditions, a further increase of the load loss which varies in time. This translates into a non-constant descaling action of the nozzle during the machining of the bar. The main object of the present invention is to provide a flow guide with integrated valve which minimizes the load losses and makes them constant in time, thus solving these issues which are found in the flow guides of the known type.

In order to reach this object, a specific fluid-dynamic study of the flow guide has been conducted, which has led to defining an appropriate architecture and geometry.

[0005] The geometry has been also developed to allow a rapid assembly and disassembly of all the components allowing cleaning and replacement thereof (unlike the known model in which the straightener is not easily extractable and does not allow the access and the cleaning of the inner part of the piston). These objects have been reached by defining a geometry in which the shutter and the straightener consist of a single component.

[0006] Further features and advantages of the present invention will be more apparent from the following detailed description, provided by way of non-limitative example and shown in the accompanying drawings, in

which:

figure 1 shows an example of a known flow guide of the state of the art;

figure 2 shows a detail of the piston (part 4 in figure 1); 5

figure 3 shows a front section view of the nozzle according to the present invention;

figure 4 shows an exploded perspective view of a nozzle according to the present invention;

figure 5 shows a view of the shutter with flow straightener according to the present invention. 10

According to a preferred embodiment of the present invention shown in the mentioned figures by way of non-limitative example, the flow guide with integrated valve includes, according to the present invention, a main body 1 which may appropriately display an essentially cylindrical elongated shape and inside which, in axial position, there is an essentially cylindrical cavity 6 in which a sliding piston element 4 is accommodated, which is adapted to match against a matching element appropriately provided at the inner wall of said cylindrical cavity 6 by means of an elastic spring element 5. Such a matching element, for example, may consist of a variation of diameter, i.e. a narrowing of said cylindrical cavity 6. 15

The elastic element 5 acts so as to oppose to a displacement of the piston 4 in the forward direction of the flow in the nozzle, indicated by the IN (inlet) and the OUT (outlet) arrows, in figure 3. 20

Again with reference to figures 3 and 4, the nozzle according to the present invention further includes a flow adjustment element 3 which is inserted in said piston 4. The piston 4 also displays an essentially cylindrical hollow shape adapted to be inserted, as mentioned, in said cylindrical cavity 6. 25

More specifically, the piston 4 will display a cylindrical body 4b and a collar 4a including an inner surface with inclined walls 9 with respect to the axial direction so as to promote the sliding of the fluid from the inlet 7 of the flow guide. 30

With reference the forward direction of the fluid, the collar 4a is placed at the proximal end of the piston 4, and said elastic element 5, which may for example consist of a helical spring, acts between the lower edge of said collar 4a and said matching element on the inner wall of the cylindrical cavity 5 in a distal position, closer to the outlet 8 of the nozzle. 35

The flow adjustment element 3 includes, in turn, a shutter element 3a, and a flow straightener 3b. The shutter 3a and the flow straightener 3b make a single body. The flow adjustment element 3 may thus be formed in a single piece or may be formed by integrally coupling the two parts, the shutter 3a and the flow straightener 3b. 40

The shutter 3a displays a shape essentially formed by coupling two circular-based cones, one overturned with respect to the other. With specific reference to figure 5, which shows a front view of the flow 45

adjustment element 3, the shutter 3a includes a first divergent profile segment 31 which joins up with a second converging profile segment 33 at a sealing area 32.

The first segment 31 of said shutter has a conical shape adapted to optimize the sharing of the flow at the nozzle inlet. The vertex of the cone faces towards the flow guide inlet.

The second converging profile segment 33 joins up with said flow straightener 3b.

The flow straightener 3b displays a central rod 34, integrally connected to the end part of said second converging segment 33 of said shutter 3a. The central rod 34 may advantageously display a circular section, and connected to said rod a plurality of fins 35 which protrude outwards is provided. Said fins 35 advantageously display a first oblique segment 36 joining to said central rod 34. In virtue of the arrangement of the flow adjustment element 3 inside the nozzle, the oblique segment 36 of the fins is the first part of the fins which is invested by the flow of fluid through the nozzle.

As specifically shown in figures 3 and 4, the nozzle may further include a filtering element indicated by reference numeral 2 at the inlet area of the fluid into the nozzle. Advantageously, such a filtering element 2 may have an essentially cylindrical shape, axially to said filtering element with the inlet pipe 7 for the fluid being provided at the nozzle inlet. Appropriately, the inlet pipe 7 which is essentially cylindrical in a first segment 7b, displays a diverging segment 7b in a distal position in the area in which the shutter 3a is situated when the nozzle is assembled.

The operation of the nozzle according to the invention is as follows.

Specifically referring to figure 3, the flow guide is shown in a configuration in which the shutter 3a allows the passage of the fluid. The flow guide is thus opened: the pressure of the fluid and the kinetic energy associated to the speed of the jet are sufficient to overcome the resistance of the elastic element 5 which maintains the shutter in the closing position in which the sealing area 32 abuts against the inner wall of the inlet pipe 7, specifically against the inner wall of the pipe 7 at the joining point between the segment 7a and the diverging segment 7b. The broadening of the inlet pipe section 7 at the diverging segment 7b is characterized by an inclination of the walls of the pipe compatible with the inclination of the conical surface of the segment 31 of said shutter, so that when the shutter is in the opening position, the passage port for the fluid displays an essentially uniform cross section. 50

When the circuit which directs the fluid to the nozzles is closed, the flow is interrupted and the elastic element 5, which in the example shown consists of a helical spring which acts between said piston 4 and said main body 1, maintains the sealing area 32 of 55

the shutter 3a abutting against the walls of the inlet pipe 7, as mentioned, effectively preventing in practice any passage of fluid.

When the circuit which directs the fluid to the nozzles is opened, the fluid entering the pipe 7 encounters the vertex of the first conical segment 31 of the shutter 3a and causes the axial displacement of the shutter itself from the initial closing position shown above. The displacement of the shutter 3a consist of an axial translation of the piston 4 in the direction which causes the compression of the spring 5. Since the flow adjustment element 3 to which said shutter 3a belongs is inserted in the axial cavity provided in said piston 4 so that the fins 35 abut, in a distal position, against a matching element appropriately provided in said axial cavity, the displacement of the flow adjustment element 3 implies a similar axial displacement of translation of the piston 4 in the direction which implies the compression of the spring 5.

The displacement of the shutter thus opens a port for the passage of fluid between the walls of the segment 7b of the inlet pipe and the outer surface of the first conical segment 31 of said shutter. The flow rate is thus split as shown by the arrows in figure 3, the flow is forced by the first conical segment 31 of the shutter 3a to split so as to bypass the shutter 3a and is then forced by the flared surface 9 of the collar 4a to flow along the axial cylindrical cavity of the piston 5.

When the flow runs along the inner cylindrical cavity of the piston, it encounters the fins 35 of the flow straightener 3b. The tangential components of the flow speeds are cancelled by the impact against the fins 35 which force the flow to exit the nozzle in an axial direction.

The fluid-dynamics of the flow guide according to the present invention has been appropriately studied to reduce the load losses at the shutter and the flow straightener.

We have thus shown how the flow guide according to the present invention reaches the proposed objects.

Specifically, we have shown how the fluid guide according to the present invention allows to optimize the fluid-dynamics, by minimizing the load losses associated, in particular, to the shape of the shutter and to the optimized action of the flow straightener. With respect to the fluid guides of the known type, the construction of the shutter and the flow straightener in a single piece as described herein allows to further reduce the load losses deriving from the untidy impact of the fluid flow rate against the surfaces of the straightener.

Furthermore, the fluid guide according to the present invention allows to eliminate the turbulences and to considerably reduce the load losses which affect the operation of the nozzles of the known type.

Furthermore, an object reached by the flow guide

according to the present invention consists in that the jet exiting the flow guide is axial-symmetric in all conditions of use.

Many changes may be made by a person skilled in the art without departing from the scope of protection of the present invention.

The scope of protection of the claims, therefore, must not be limited to the disclosures or preferred embodiments described by way of example, but rather the claims must include all the features of patentable novelty inferable from the present invention, including all the features which would be treated as equivalent by a person skilled in the art.

Claims

1. A flow guide of the type including a main body (1), an inlet pipe (7) and an outlet (8) for the fluid rate, a shutter (3a) and a flow straightener (3b), **characterized in that** said shutter (3a) and said flow straightener (3b) are integrated in a single flow adjustment element (3).
2. A flow guide according to the preceding claim, **characterized in that** said shutter (3a) includes at least one first segment (31) having an essentially conical shape adapted to optimize the splitting of the fluid flow rate entering the nozzle and a sealing area (32) having a diameter adapted to abut against the walls of said inlet pipe (7).
3. A flow guide according the preceding claim, **characterized in that** said inlet pipe includes a first constant-section cylindrical segment (7a) and a second diverging segment (7b), and **in that** said sealing area (32) of said shutter (3a) has a suitable diameter to abut and close said inlet pipe (7) at the variation of section of said pipe (7).
4. A flow guide according to the preceding claim, **characterized in that** said shutter (3a) includes, joined to said first segment (31), at least one second segment (33) also having a cylindrical shape and distally converging for joining to said flow straightener (3b).
5. A flow guide according to one or more of the preceding claims, **characterized in that** said flow straightener (3b) includes a central rod (34) which supports a plurality of externally protruding fins (35).
6. A flow guide according to any one of the preceding claims, **characterized in that** said flow adjustment element (3) is arranged in an axial position to said nozzle and is inserted in an axial cylindrical cavity of a piston (4) adapted to axially slide within the main body (1) of said nozzle.

7. A flow guide according to the preceding claim, **characterized in that** it further includes an elastic element (5) which acts between said piston (4) and said main body (1), opposing to a translation of said piston (4) which causes an opening of the shutter (3a). 5
8. A flow guide according to any one of the preceding claims, **characterized in that** it includes an inlet pipe (7) displaying a first essentially straight segment (7a) with circular section and a second diverging segment (7b), said diverging segment (7b) having an inclination of the wall of the pipe adapted to mate with the inclination of the outer surface of the first conical segment (31) of said shutter (3a). 10
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9. A flow guide according to one or more of the preceding claims, **characterized in that** said piston (4) includes a cylindrical body (4b) and a collar (4a) having an inclined inner surface (9) with respect to the axial direction, so as to convey the flow entering the inner cavity of the piston (4). 20
10. A flow guide according to one or more of the preceding claims, **characterized in that** said flow adjustment element (3) is adapted to move between a first closing position in which said sealing area (32) of said shutter (3a) abuts against the inner surface of said inlet pipe (7), and a second opening position in which between said shutter (3a) and the inner surface of said inlet pipe there is a passage port. 25
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11. A flow guide according to the preceding claim, **characterized in that** said elastic element (5) acts between said piston (4) and said main body (1) so as to maintain said shutter (3a) in the closing position. 35
12. A flow guide according to any one of the preceding claims, **characterized in that** it further includes a filtering element (2). 40
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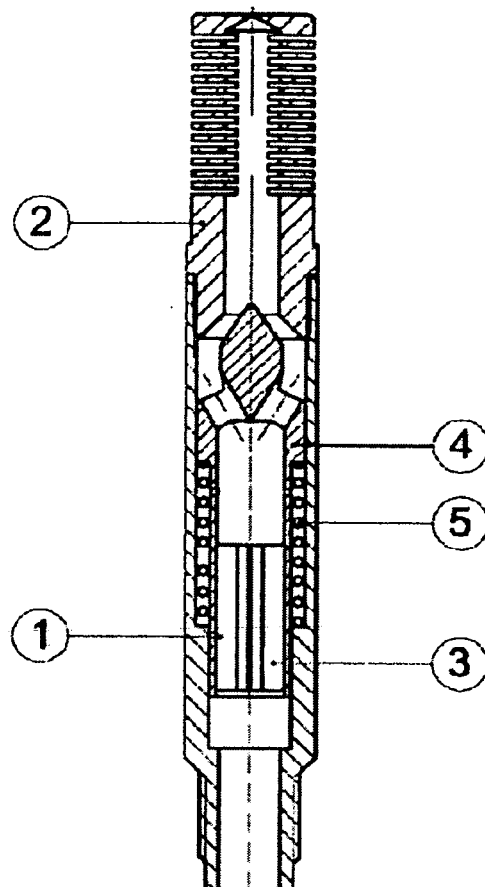


Fig 1

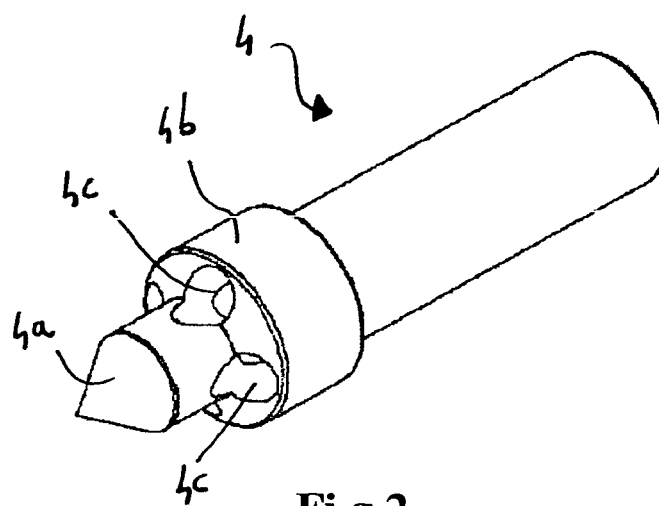


Fig 2

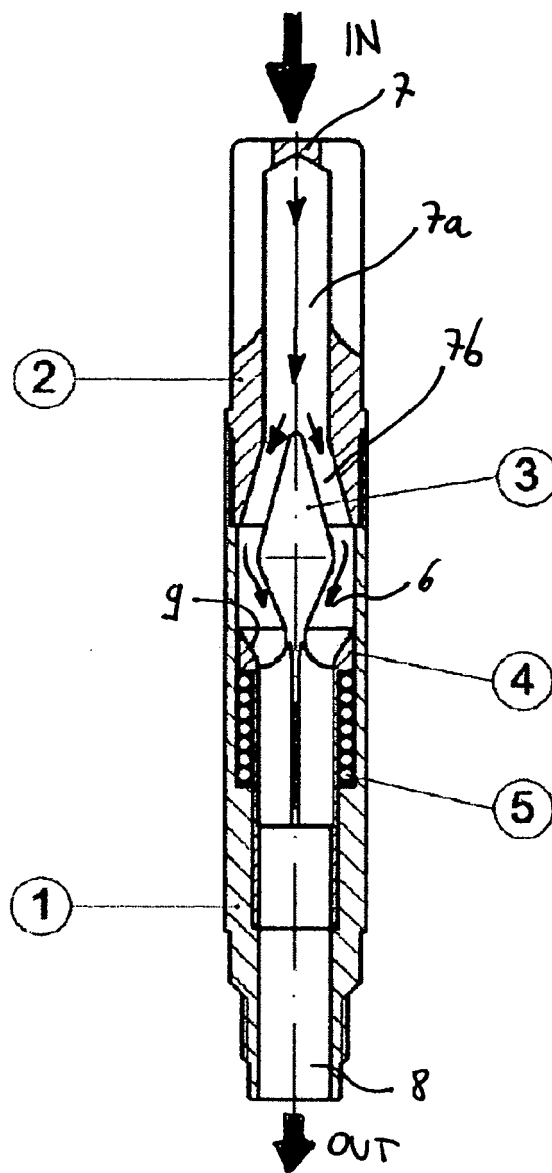


Fig. 3

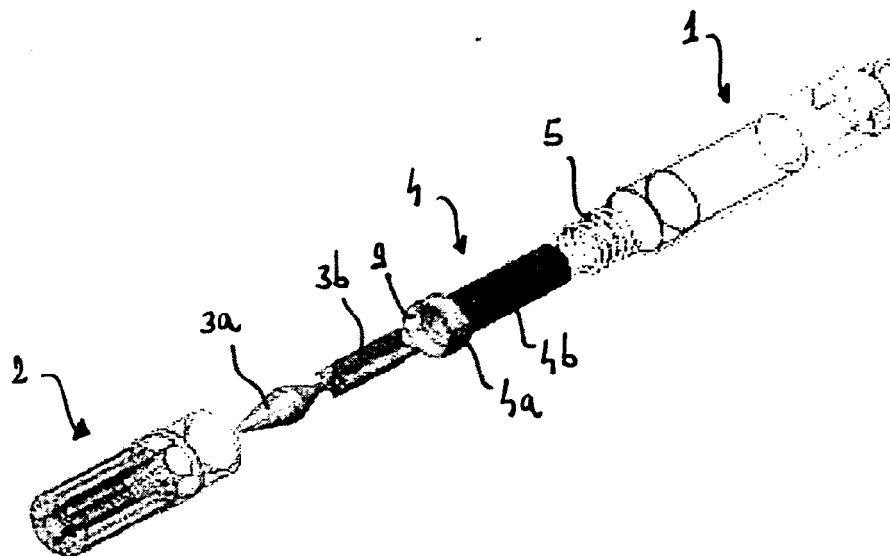


Fig. 4

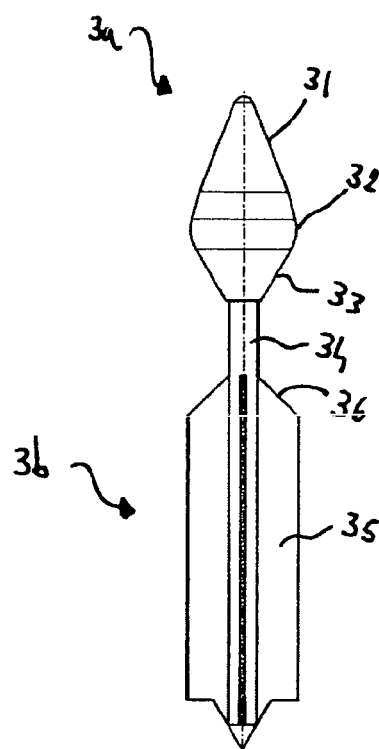


Fig. 5



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5330

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 06 079339 A (NIPPON STEEL CORP; SPRAYING SYST JAPAN KK) 22 March 1994 (1994-03-22) * the whole document *	1	INV. B05B1/04 B21B45/02 B21B45/08
A	JP 62 061715 A (SUPUREEING SYST JAPAN KK) 18 March 1987 (1987-03-18) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B05B B21B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 19 August 2008	Examiner Eberwein, Michael
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 08 42 5330

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The members are as contained in the European Patent Office EDP file on
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19-08-2008

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 6079339	A	22-03-1994	JP 2717757 B2	25-02-1998

JP 62061715	A	18-03-1987	NONE	

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