(54) Title: SOAKING VESSEL FOR SOAKING BIOMASSES

(57) Abstract: The present invention relates to a soaking vessel for soaking biomasses, more particularly for soaking biomasses intended for a biofuel refinery or similar facility for producing biofuels. Thanks to the provision of specific measures for advancing the biomasses through the basin and a specific extracting device (11) for extracting them from said basin, the soaking vessel (1) according to the invention allows to soak high flow rates, in the range of 20-50 t/h, of biomasses and extract them for transferring them to the subsequent processing steps. In a preferred embodiment of the invention, the soaking vessel (1) is further provided with means for removing foreign bodies (15, 17, 19) whereby simultaneously with soaking of the biomass a removal of foreign bodies that are initially contained inside said biomass and separate therefrom during its advance movement through the soaking vessel (1) can be effected.
“Soaking vessel for soaking biomasses”

DESCRIPTION

Technical Field

The present invention relates to a soaking vessel for soaking biomasses, more particularly for soaking biomasses intended for a biorefinery or similar facility for producing biofuels.

Prior Art

Biorefineries in which biofuels are obtained from biomasses through a fermentation process are known.

In particular, it is known to produce bioethanol by fermentation starting from biomasses. In current biorefineries, bioethanol is obtained starting from biomasses deriving from sugar-rich agricultural products. For example, sugarcane, corn, sunflower and soy are raw materials widely used for the production of bioethanol.

However, use of said crops for producing biofuels is being increasingly criticized as it subtracts resources from the food industry.

In recent times, attempts have been made at obtaining biofuels, particularly bioethanol, starting from the cellulose contained in non-food masses such as for instance wheat straw or rice straw and other agricultural waste materials.

Furthermore, cellulose is a raw material of great interest non only for producing bioethanol, but more generally for the entire field of the so-called “green chemistry”.

However, at present bioethanol production from cellulose appears to be too expensive and non-competitive from an economic viewpoint when compared with the production starting from agricultural crops.

The main difficulties in producing bioethanol from cellulose lie in the preparatory steps of pre-treatment of raw materials rather than in the process of cellulose fermentation.

Indeed, in order to make cellulose available for the fermentation process and expose it to the microorganisms responsible for such fermentation process, it is necessary to separate cellulose from lignin.

Such separation can take place according to different methods: chemo-physically (for instance by “steam cracking”), thermally (for instance by gasification), enzymatically.

Whatever the separation method may be, the raw materials must be homogenized and purified from possible contaminants such as rocks, stones, soil, metal pieces and so on.

Such preparation process may take place mechanically by cutting, for instance by using a hammer shredder.

However, this solution of the known type involves a series of drawbacks.
First of all, the presence of foreign bodies (stones, rocks, metal scraps and the like) inside the biomasses involves the risk of jamming and failure, thus limiting plant reliability, and also causes quick wear of the used shredding devices.

Secondly, during shredding, an excessive quantity of dusts is created, which is a remarkable problem during the subsequent processing steps.

The aforementioned difficulties related to the pre-treatment of biomasses have heretofore strongly limited the production of bioethanol from cellulose.

Now the Applicant has found that such difficulties may be overcome by providing, upstream of the step of shredding the biomasses, a step of removing foreign bodies from said biomasses, so that dusts and other foreign bodies are not present during shredding.

Advantageously, said step of removing foreign bodies may take place in a wet manner, simultaneously with a step of soaking the treated biomasses, by moving forward said biomasses inside a soaking vessel.

In this way the foreign bodies contained in the biomasses, depending on their different density, would precipitate to the bottom of the soaking vessel or remain in suspension inside said vessel and could thus be removed.

At the same time the biomasses would become soaked with water: soaking of the biomasses with water having a high temperature and possibly mixed with appropriate additives (such as for instance ammonia) is advantageous per se in view of the subsequent working steps, as it allows to separate some substances (such as for instance silica and waxes) that are undesirable for the subsequent processing steps and facilitates destruction of the structure of the biomasses themselves, thus promoting accessibility of the cellulose contained therein.

For this reason, even if the removal of foreign bodies took place in a dry manner, a step of soaking the biomasses would be in any case favorable in view of the subsequent working steps.

Soaking vessels are known, for instance, from the documents US 3 036 949, US 2 764 289 and WO 01/34901.

However, it is to be noted that the making of a soaking vessel for soaking biomasses, more particularly for soaking whole, unshredded biomasses is not free from drawbacks.

In particular, it must be taken into account that, in order to properly and continuously feed plants for the subsequent processing of the biomasses, it is necessary to treat high flow rates of biomasses, usually comprised between 20 and 50 t/h of dry matter.

In the case of non-food cellulosic biomasses, such as wheat straw and/or rice straw, the
difficulties are further amplified by the heterogeneous nature of the treated biomass, where
the length of the straw stalks to be impregnated may vary from a few millimeters to 150 cm.

For the aforementioned reasons, known solutions for the making of soaking vessels are
not applicable to the present case.

Referring particularly to the extraction of the soaked material from the soaking vessel for
transferring the same to the subsequent processing steps, according to prior art said
material is collected from the free water surface and removed from said vessel by means
of overflow.

Such solution appears impracticable in the case in question, especially because of the
concerned high flow rates of biomasses (which, as anticipated above, usually vary from 20
and 50 t/h of dry matter), as it would involve use of too large quantities of water.

Furthermore, still because of the concerned high flow rates, the advancing means provided
in the soaking vessels of the known kind are not suitable for conveying the treated
biomass through the soaking vessel within the required dwelling time.

The object of the present invention is therefore to provide a soaking vessel for soaking
biomasses which can be advantageously used in pre-treating large quantities of biomasses.

Another object of the present invention is to provide a soaking vessel for soaking
biomasses which allows – simultaneously with the soaking of said biomasses – an
effective separation and removal of the foreign bodies contained in said biomasses.

These and other objects are achieved by the soaking vessel as claimed in the appended
claims.

Summary of the Invention

Thanks to the fact that the soaking vessel according to the invention is provided with a
special extracting device comprising an inclined conveyor belt, of which the lower end is
at an appropriate depth below the free water surface of the soaking vessel and the upper
end is at an appropriate height above the free water surface of said vessel, large quantities
of biomasses can be conveyed through the soaking vessel according to the invention and
extracted therefrom in an effective manner.

Advantageously, said conveyor belt may be provided with teeth that extend from the
surface of the belt itself and can engage the biomasses contained in the soaking vessel
according to the invention and facilitate extraction thereof.

Advantageously, said conveyor belt may further be provided with holes or openings
allowing to discharge excess water.
By virtue of the fact that the soaking vessel according to the invention is provided with means for generating a pressurized water flow inside the vessel itself, directed from the inlet to the outlet of said vessel, it is possible to effectively advance through the vessel itself the biomass to be treated.

In a preferred embodiment of the invention, the soaking vessel comprises means for removing foreign bodies that become separated from the treated biomasses during advance of said biomasses in said vessel.

In a particularly preferred embodiment of the invention, separate means are provided for removing heavy foreign bodies, which precipitate to the bottom of the soaking vessel, and for removing light foreign bodies, which remain in suspension inside said vessel.

Said means for removing heavy foreign bodies may comprise, for instance, an extraction screw arranged at the bottom of the soaking vessel; said one or more extraction screw(s) can cooperate with one or more scraper(s) conveying said heavy foreign bodies towards the bottom of the soaking vessel. Said means for removing light foreign bodies may comprise, for instance, one or more sludge pump(s).

Magnetic removing means may possibly be provided, specifically intended for removing ferrous foreign bodies.

Advantageously, in order to ensure proper soaking of the treated biomasses, the vessel according to the invention includes one or more devices allowing to push said biomasses beneath the water surface so that they are completely submerged during their advancing inside said vessel.

**Brief Description of the Drawings**

Further features and advantages of the invention will become more apparent from the following detailed description of some preferred embodiments of the invention, given by way of non-limiting example with reference to the annexed drawings, in which:

Figure 1 schematically shows a perspective view of a soaking vessel for soaking biomasses according to a preferred embodiment of the invention;

Figure 1a is a diagram illustrating the recirculation circuit of the soaking vessel of Figure 1;

Figure 2 schematically shows a detail of the soaking vessel of Figure 1 regarding the extracting device for extracting the biomass.

**Description of a Preferred Embodiment of the Invention**

A preferred embodiment of the invention will be described in detail hereafter.

Such embodiment should not be intended as limiting the scope of protection of the present
invention.
In particular, although hereafter reference is made to the soaking of non-food cellulosic biomasses, and particularly to wheat straw and/or rice straw, the invention can be equally applied to biomasses of a different nature.

Referring to Figure 1, there is schematically illustrated a soaking vessel 1 for soaking biomasses according to the invention.

Said soaking vessel 1 comprises a structure 3 which has a substantially rectangular base and corresponding side walls equal and parallel in pairs and is mounted on supports 5, said structure 3 defining within itself a basin 7.

Preferably said structure 3 comprises an inner body 3’ and an outer sheath 3’’. In this way the inner body 3’ – when it comes into contact with the water contained in the basin 7 – will be made in a corrosion-resistant material, such as for instance stainless steel, whereas the outer sheath 3’’ can be made of a more inexpensive material, provided that said material has sufficient structural resistance.

In this way the inner body 3’ and the outer sheath 3’’ can be pre-fabricated separately ex works, transported separately and subsequently coupled to each other directly at the installation site, for instance by means of bolts or the like.

The structure 3 of the soaking vessel 1 may advantageously be suitably insulated.
The structure 3, and therefore the basin 7, may be suitably sized for treating the desired quantity of biomasses.

In the case where the soaking vessel 1 is part of a pre-treating plant for pretreating non-food cellulosic biomasses, such as for instance wheat straw and/or rice straw, intended for a biorefinery or similar facility, the flow rates of treated straw may be for instance in the range of 20 – 50 t/h.

In this case, an adequate size for the basin 7 is 10 – 15 meters of length, 2 – 3 meters of width and 2 – 3 meters of depth.

With a basin 7 of this size and the aforementioned straw flow rate, the straw passing through the basin 7 will form a layer having a thickness comprised between 50 and 100 cm.

For advancing said straw layer through the basin 7, the soaking vessel according to the invention provides for means for generating a pressurized water flow having an appropriate flow rate and speed between a first side wall 3a (or inlet wall) of the structure 3 and a second opposite side wall 3b (or outlet wall) of said structure.

Said means comprise at least, at said first side wall 3a of the structure 3, a water inlet 9
through which a water flow having an appropriate flow rate and speed is introduced into the basin 7.

In a preferred embodiment of the invention, the water arriving at the water inlet 9 is not taken from an outer source, but it rather comes from the basin 7 itself, through a recirculation circuit schematically shown in Figure 1a. To this aim there are provided a water outlet 10 at said second side wall 3b of the structure 3, a hydraulic circuit connecting said water outlet 10 to the water inlet 9 and a high flow rate pump 14 that sucks water from the basin 7 through the water outlet 10 and reintroduces it into the basin itself through the water inlet 9.

Flow rate values that can be obtained are for instance comprised between 100 and 200 m³/h.

Upstream of said water inlet 9, the water coming from the recirculation circuit is preferably mixed with clean water, which serves on one hand to balance the quantity of water extracted from the soaked straw and on the other hand to prevent excessive accumulation of impurities in the basin 7. Furthermore, the addition of clean water allows to regulate the overall temperature of the water entering said basin 7. Typically, for a flow rate of approximately 150 m³/h, the recirculated water can constitute two thirds of said flow rate and clean water can constitute the remaining third.

Preferably, the pressurized water flow is provided orientable in order to optimize the function performed by the water jet itself for conveying/advancing the straw layer.

In addition, said pressurized water flow will preferably be introduced into the basin 7 through a plurality of sets of nozzles 9a provided on the first wall 3a of the structure 3, including a set of nozzles 9a arranged above the water surface in said basin 7 in order to ensure that the biomass discharged into the basin 7 is promptly taken away from said first wall 3a.

In order to promote soaking of the treated straw and simultaneous removal of undesired substances, such as wax-like substance and silica, the water flow entering the basin 7 has a high temperature.

It may possibly be provided that suitable additives are added to water; indeed, some experimental experiences show that the addition of convenient chemical substances (such as for instance ammonia) contributes to promote the subsequent production process.

Above the basin 7 of the soaking vessel 1, a feeding device for feeding the biomass (straw) to be treated is arranged at said first side wall 3a of the structure 3. Said feeding device (not shown) may comprise, for instance, a hopper from which the straw is made to
fall down into the basin 7 arranged thereunder with a desired flow rate comprised, as indicated above, between 20 and 50 t/h.

Owing to the water flow circulating in the basin 7 between the water inlet 9 in the first side wall 3a and the water outlet in the second side wall 3b, the straw is pushed throughout the entire length of the basin 7, from said first side wall 3a to said second side wall 3b.

At said second side wall 3b, the soaking vessel 1 is provided with an extracting device for extracting the straw that has been soaked in the basin 7 and transferring it to the subsequent working stations.

As mentioned above, the straw to be extracted forms, inside the basin 7, a layer having a thickness comprised between 50 and 100 cm: it is evident that with a layer of such thickness an extraction by means of overflow would involve excessive water consumption and is therefore impracticable.

According to the invention the extracting device for extracting the soaked biomass comprises an inclined conveyor belt 11, of which the lower end 11a is immersed in said basin 7 and the upper end 11b is arranged above the water surface of said basin 7.

In particular, the length and inclination of said conveyor belt 11 will be chosen so that said lower end 11a is at an appropriate depth below the water surface of said basin 7 and said upper end is at an appropriate height above the water surface of said basin 7.

In a preferred embodiment of the invention, at least the inclination of said conveyor belt 11 is adjustable, so as to vary, as needed, the position of its ends 11a, 11b relative to the water surface of the basin 7.

Preferably, as shown in Figure 1, the conveyor belt 11 is located at the second side wall 3b of the structure 3 of the vessel 1, and extends in a direction substantially parallel to the straw advance direction through the basin 7, i.e. in a direction substantially perpendicular to said second side wall 3b. However, it is evident that said conveyor belt may also be arranged and/or oriented in a different way relative to the soaking vessel 1 without departing from the scope of protection of the invention.

As illustrated in detail in Figure 2, in a preferred embodiment of the invention, said conveyor belt 11 is provided with teeth 21 that extend from the surface of the conveyor belt itself, in a direction inclined and preferably substantially perpendicular to said surface, and can engage the straw in the soaking vessel 1, thus facilitating extraction thereof.

Preferably said teeth 21 are arranged in parallel rows extending in a direction substantially transverse to the advance movement of the conveyor belt 11 and are mutually spaced
apart.
In addition, said conveyor belt 11 may advantageously be provided with holes or openings 23 allowing to discharge excess water into the basin 7 arranged thereunder.
The conveyor belt 11 and its support structure 12 are preferably made of corrosion-resistant materials, for instance of corrosion-resistant plastic materials and stainless steel, respectively.
In order to ensure quick and proper soaking of the straw passing through the basin 7, the soaking vessel 1 according to the invention is provided with one or more devices for pushing said straw beneath the water surface, so that it is entirely immersed during the advance movement through said basin.
In the illustrated embodiment, said devices consist of a plurality of rotating vaned wheels 13 partially immersed in the basin 7.
In particular, in the shown example, three vaned wheels 13 are provided, with their axes arranged mutually parallel and perpendicular to the straw advance direction inside the basin 7. However, it is evident that the number and arrangement of said vaned wheels – or similar devices – is not to be taken in a limiting sense.
Said vaned wheels not only allow to push the straw beneath the water surface of said basin 7 in order to promote soaking thereof, but they also contribute to advance said straw through the extracting device.
In this respect, the rotating speed of the vaned wheels 13 can be provided adjustable, so that it can contribute to determine the straw advancing speed through the basin 7 and, in the end, the straw dwelling time inside said basin.
Generally, a dwelling time comprised between 30 seconds and 3 minutes is deemed to be sufficient to ensure proper soaking of the straw.
As anticipated above, in the soaking vessel 1 according to the invention a step of soaking the biomass and a step of removing foreign bodies from said biomass are carried out simultaneously.
During advance of the straw through the basin 7 of the vessel 1, the foreign bodies contained in said straw will tend to separate from the straw because of the different density.
In particular, heavier foreign bodies will tend to precipitate and deposit on the bottom of the basin 7, whereas lighter foreign bodies will tend to remain in suspension inside said basin.
Correspondingly, the soaking vessel 1 according to the invention may advantageously be
provided with suitable means for removing foreign bodies, and even more advantageously with separate means for removing heavier foreign bodies and lighter foreign bodies.

The means for removing heavy foreign bodies may comprise an extraction screw 15. Advantageously, using an extraction screw – instead of, for instance, a conveyor belt – allows a remarkable reduction of the space requirement of said removing means. Said means for removing heavy foreign bodies may further comprise one or more scraper(s) conveying the foreign bodies towards said extraction screw 15.

The means for removing light foreign bodies may comprise one or more sludge pump(s) 17: said sludge pumps allow to remove those foreign bodies that are too light for precipitating on the bottom of said basin 7 and remain in suspension inside the basin itself, whereby it would be impossible to remove them by means of the extraction screw 15.

Magnetic means for separately removing ferrous foreign bodies may possibly be also provided.

In addition, under the biomass feeding device, at the first side wall 3a of the structure 3, a shielding grate 19 is preferably provided, arranged above the scraper(s) 15, for retaining particularly heavy foreign bodies (such as for instance large stones), which otherwise may damage said scraper(s).

It is evident that the extraction screw 15, the scrapers that may be provided, the shielding grate 19 and other means for removing foreign bodies immersed in the basin 7 will preferably be made of corrosion-resistant materials.

It is evident from the above description that the soaking vessel for soaking biomasses according to the invention allows to attain the objects set forth above.

Indeed, as required for instance in the case of the pre-treatment of biomasses – particularly of non-food cellulosic biomasses – intended for biorefineries and similar facilities, said vessel allows to properly soak high flow rates of biomasses and to extract them for transferring them to the subsequent processing steps, which would be impossible by applying prior art solutions.

In addition, where required, it allows, simultaneously with the carrying out of the biomass soaking step, to carry out an effective separation and removal of foreign bodies that may be contained in said biomass.

It is further evident that what has been described above with respect to a preferred embodiment of the invention has been given merely by way of example and that several variants and modifications can be made on the basis of the common knowledges of the person skilled in the art without departing from the scope of protection as defined in the
appended claims.
CLAIMS

1. Soaking vessel (1) for soaking biomasses, comprising a structure (3) having a substantially rectangular base and corresponding side walls and defining within itself a basin (7), an inlet for a water flow (9) provided at a first side wall (3a) of said structure, a device adapted for feeding the biomasses to be treated and provided at said first side wall (3a) of said structure, and an extracting device provided at a second side wall (3b) of said structure (3) for extracting said biomasses from said basin (7), characterized in that said extracting device comprises an inclined conveyor belt (11), of which the lower end (11a) is immersed in said basin (7) and the upper end (11b) is arranged above the water surface of said basin (7).

2. Soaking vessel (1) according to claim 1, wherein said conveyor belt (11) is provided with teeth (21) extending from the surface of said conveyor belt (11), in a direction inclined, and preferably substantially perpendicular, with respect to said surface.

3. Soaking vessel (1) according to claim 2, wherein said teeth (21) are arranged in parallel rows that extend in a direction substantially transverse to the advance movement of said conveyor belt (11) and are mutually spaced apart.

4. Soaking vessel (1) according to claim 1 or 2, wherein said conveyor belt (11) is provided with holes or openings (23) for discharging excess water.

5. Soaking vessel (1) according to any one of the preceding claims, wherein the inclination of said conveyor belt (11) is adjustable.

6. Soaking vessel (1) according to any one of the preceding claims, wherein said second side wall (3b) of said structure (3) is opposite to said first side wall (3a) and said conveyor belt (11) extends in a direction substantially perpendicular to said second side wall (3b).

7. Soaking vessel (1) according to claim 1, wherein said vessel (1) is provided with one or more device(s) for pushing said biomasses beneath the water surface of said basin (7).

8. Soaking vessel (1) according to claim 7, wherein said devices for pushing the biomasses beneath the water surface of said basin (7) comprise one or more rotating vaned wheel(s) (13) partially immersed in said basin (7).

9. Soaking vessel (1) according to claim 1, wherein said vessel (1) is provided with means for generating a pressurized water flow from said first side wall (3a) of said structure (3) and said second side wall (3b) of said structure (3).

10. Soaking vessel (1) according to claim 9, wherein said means for generating a
pressurized water flow comprise a water inlet (9) arranged at said first side wall (3a) of said structure (3).

11. Soaking vessel (1) according to claim 10, wherein said means for generating a pressurized water flow further comprise a water outlet (10) provided at said second side wall (3b) of said structure (3), a recirculation circuit connecting said water outlet to said water inlet, and a high flow pump (14) provided along said recirculation circuit.

12. Soaking vessel (1) according to claim 10 or 11, wherein said water inlet (9) comprises one or more set(s) of nozzles (9a), of which at least one set is arranged above the water surface of said basin (7).

13. Soaking vessel (1) according to claim 1, wherein said vessel (1) is provided with means for removing foreign bodies contained in said biomasses.

14. Soaking vessel (1) according to claim 1, wherein said vessel (1) is provided with separate means for removing heavy foreign bodies and for removing light foreign bodies.

15. Soaking vessel (1) according to claim 14, wherein said means for removing heavy foreign bodies comprise at least one extraction screw (15) arranged near the bottom of said basin (7).

16. Soaking vessel (1) according to claim 15, wherein said means for removing heavy foreign bodies further comprise one or more scraper(s) adapted to convey said heavy foreign bodies towards said at least one extraction screw (15).

17. Soaking vessel (1) according to claim 14, wherein means for removing light foreign bodies comprise one or more sludge pump(s) (17).

18. Soaking vessel (1) according to any one of the claims 13 - 17, wherein said means for removing foreign bodies further comprise magnetic means for removing ferrous foreign bodies.

19. Soaking vessel (1) according to any one of the preceding claims, wherein said vessel is adequately insulated.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

**INV.** D21B1/02 D21B1/06 D21B1/12

**ADD.**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

D21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 3 036 949 A (CHA SUNG H.) 29 May 1962 (1962-05-29) column 3, line 3 - column 4, line 6; figure 1</td>
<td>1, 4-8, 13, 19</td>
</tr>
<tr>
<td>X</td>
<td>US 2 764 289 A (CHA SUNG H.) 25 September 1956 (1956-09-25) column 2, line 69 - column 3, line 5; column 2, line 59 - column 3, line 70; figures</td>
<td>1-7, 13, 19</td>
</tr>
<tr>
<td>X</td>
<td>WO 01/34901 A1 (EXPORTATION DE MATERIEL IND [FR]; CHERBIT MAURICE [FR]) 17 May 2001 (2001-05-17)</td>
<td>1-3, 5, 6, 13</td>
</tr>
<tr>
<td>A</td>
<td>page 7, line 8 - page 8, line 11; figures</td>
<td>7, 8, 17, 19</td>
</tr>
</tbody>
</table>

[ ] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent published on or after the international filing date
- "L" document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" of document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but other to understand the principle or theory underlying the invention
- "X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "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
- "M" document member of the same patent family

**Data of the actual completion of the international search**

9 December 2015

**Data of mailing of the international search report**

17/12/2015

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentiaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax (+31-70) 340-3016

Authorized officer

Pregetter, Mario
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 3036949 A</td>
<td>29-05-1962</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 2764289 A</td>
<td>25-09-1956</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>FR 280165 A1</td>
<td>18-05-2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 0134901 A1</td>
<td>17-05-2001</td>
</tr>
</tbody>
</table>