



(51) International Patent Classification:

G01N 35/04 (2006.01) B67B 3/18 (2006.01)
B01L 3/00 (2006.01) B67B 7/14 (2006.01)
B67B 3/14 (2006.01) B65B 7/28 (2006.01)
B67B 3/16 (2006.01)

(21) International Application Number:

PCT/EP2017/058751

(22) International Filing Date:

12 April 2017 (12.04.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

16165825.7 18 April 2016 (18.04.2016) EP

(71) Applicant (for DE only): **ROCHE DIAGNOSTICS GMBH** [DE/DE]; Sandhofer Straße 116, 68305 Mannheim (DE).

(71) Applicant (for all designated States except DE, US): **F. HOFFMANN-LA ROCHE AG** [CH/CH]; Grenzacherstraße 124, 4070 Basel (CH).

(71) Applicant (for US only): **ROCHE DIAGNOSTICS OPERATIONS, INC.** [US/US]; 9115 Hague Road, Indianapolis, Indiana 46250 (US).

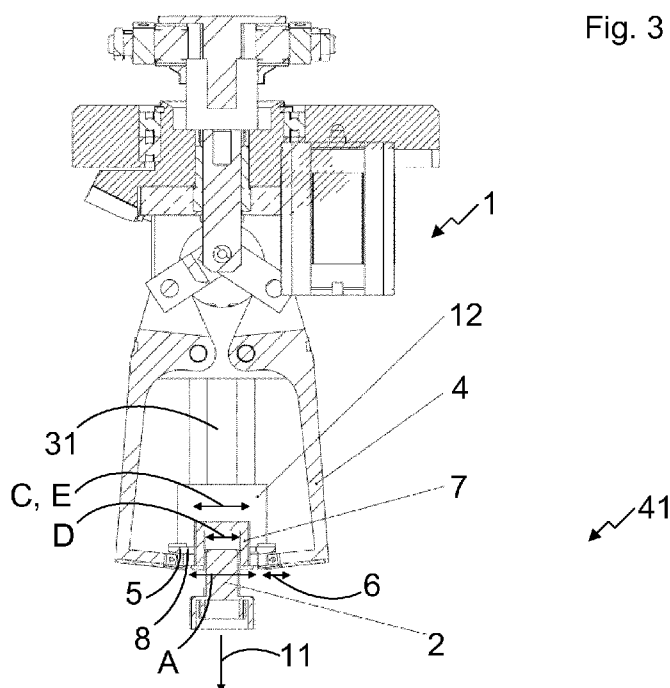
(72) Inventors: **STRZEMPEK, Dominik**; Karlstraße 26, 71394 Kernen (DE). **SÖNTGES, Stefan**; Vogelsangstraße 91, 70197 Stuttgart (DE). **SCHWAB, Gernot**; Marienburg-er Straße 20, 70374 Stuttgart (DE). **DAISLEY, Richard-Paul**; Kissinger Straße 48a, 70372 Stuttgart (DE).

(74) Agent: **PATENTANWÄLTE RUFF, WILHELM, BEIER, DAUSTER & PARTNER MBB**; Kronenstraße 30, 70174 Stuttgart (DE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

(54) Title: DECAPPER AND APPARATUS



(57) Abstract: The invention relates to a decapper for removing a cap from a laboratory sample container, wherein the decapper comprises a guidance. The invention is further directed to an apparatus comprising such a decapper.





GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

Decapper and apparatus

TECHNICAL FIELD AND PRIOR ART

The invention relates to a decapper for removing a cap from a laboratory sample container and to an apparatus comprising such a decapper.

- 5 In laboratories some types of instruments and/or analysis require closed laboratory sample containers such as sample tubes to be opened before laboratory samples are pretreated and/or analyzed. Therefore, such instruments may have a decapper to remove a cap from the container. A device for decapping and recapping sample tubes is shown in document EP 2 538 227 B1.

SUMMARY OF THE INVENTION

- 10 It is the object of the invention to provide a decapper having improved properties than decappers of the prior art. It is a further object of the invention to provide an apparatus comprising such a decapper.

This object is achieved by a decapper according to claim 1 and an apparatus according to claim 12. Preferred embodiments are defined in the dependent claims.

- 15 The invention relates to a decapper for removing a cap from a laboratory sample container. The decapper comprises a cap gripper comprising at least two gripping jaws. At least one of the at least two gripping jaws, in particular each gripping jaw, is displaceable between a holding position and a release position in or along a radial direction. In the holding position the at least two gripping jaws hold or fix the cap. In the release position the cap is released by the at least two
20 gripping jaws. Additionally, the decapper comprises a guidance or mechanical stop. The guidance is adapted to limit or prevent a movement of the cap in the radial direction caused by the displacement of the one gripping jaw from its holding position into its release position.

- The laboratory sample container is typically designed as a tube made of glass or transparent plastic and typically has an opening at an upper end. The container can be used to contain,
25 store and transport a laboratory sample such as a blood sample, an urine sample or a chemical sample. The cap is typically used to close or seal the laboratory sample container, in particular its opening, and is typically embodied separate from the container. Depending on the laboratory sample and the container, the cap may have several functions. One may be to keep the container closed and the sample contained for the specified shelf life until time of opening. Another

one may be to provide a barrier, e.g. to dirt, oxygen and/or moisture. The cap may comprise rubber and/or plastic or may completely consist of rubber and/or plastic. Further, the cap has typically a cylindrical shape, in particular with a circular cross section. Furthermore, the laboratory sample container and/or the cap have/has typically means of attaching to each other with sufficient security, e.g. threads, locks and/or adhesives may be used.

The guidance is embodied separate from the gripping jaws. Furthermore, in the holding position the at least two gripping jaws may be relatively closer to each other in or along the radial direction than in the release position. In the holding position the cap may be held by the at least two gripping jaws in a force-fit manner and/or in a form-fit manner. In particular the gripping jaws may hold the cap at its circumference or periphery. The gripping jaws may be evenly distributed around an axial direction, wherein in particular the axial direction may be perpendicular to the radial direction and/or may be parallel or coincidence with a longitudinal axis of the cap. When the cap is released, it may come off the gripping jaws, in particular it may fall down due to gravity. In particular the decapper with its cap gripper may be oriented in such a way, that the axial direction corresponds to the vertical such that the released cap falls down in or along the axial direction. However, the cap may stick or adhere to at least one of the at least two gripping jaws, which is displaceable between the holding position and the release position in the radial direction. Without the guidance during the displacement of the one gripping jaw from its holding position into its release position the cap may be entrained or dragged by the one gripping jaw and thereby accelerated or moved in the radial direction. This may cause a problem, e.g. when the cap falls due to the movement in the radial direction somewhere down, where it is not supposed to fall down. The cap may be contaminated or polluted with residues of the laboratory sample, e.g. which may be transmitted to other laboratory sample containers, which would cause cross-contamination and interfere with the testing and analysis of other samples. Moreover bio-hazard is also an issue as samples are potentially infectious. Additionally or alternatively, the cap may block moving parts of other laboratory equipment. Such a movement of the cap in the radial direction is limited or prevented by the guidance. Thereby, the cap may come off the cap gripper and/or may fall down, where it is supposed to do so. Thus, the properties of the decapper according to the invention are improved and it may cause fewer problems in a laboratory environment than a decapper without such a guidance.

According to an embodiment of the invention at least one of the at least two gripping jaws of the cap gripper, in particular each gripping jaw, comprises a blade. The blade is adapted to cut or to engrave or to nick into the cap, in particular into the circumference of the cap. Thereby, the cap is held well. In particular the blade may extend around the axial direction and/or along the cir-

cumference of the cap. Furthermore, the blade may comprise a metal or may completely consist of a metal.

According to an embodiment of the invention the guidance comprises at least two guidance elements. The at least two guidance elements are arranged in or along the radial direction opposite to each other such that they surround the held cap on opposite sides. The at least two guidance elements are adapted to limit or prevent a movement of the cap in the radial direction. This is in particular advantageous, when several of the at least two gripping jaws are displaceable between a holding position and a release position in or along the radial direction. In particular the at least two guidance elements may be embodied separate from each other.

- 10 According to an embodiment of the invention the at least two guidance elements form a ring, in particular a closed ring such that the ring extends around the axial direction and/or along the circumference of the cap completely. In particular the ring may have a circular cross section. Furthermore, the ring may be one piece.

- 15 According to an embodiment of the invention a distance of the at least two guidance elements or a distance in between them in the radial direction is smaller than 20 mm, in particular smaller than 12 mm. Most of the caps for laboratory sample containers have a diameter smaller than this distance value, whereby they may be surrounded by the at least two guidance elements, when being held by the cap gripper. In case the at least two guidance elements form a ring, the distance may correspond to a diameter of the ring.

- 20 According to an embodiment of the invention a distance of the at least two guidance elements in the radial direction is smaller than a distance of the at least two gripping jaws or in between them in the release position in the radial direction. In particular the distance of the at least two guidance elements in the radial direction may be larger than the distance of the at least two gripping jaws in the holding position in the radial direction.

- 25 According to an embodiment of the invention the guidance with its at least two guidance elements is movable in the axial direction with respect to the cap gripper with its at least two gripping jaws. A distance of the at least two guidance elements in the radial direction is smaller than a distance of the at least two gripping jaws in the holding position in the radial direction. In particular the axial direction may be perpendicular to the radial direction and/or may correspond to the vertical. This embodiment is in particular advantageous for caps having a shoulder or step in
30 between a relatively axially lower, relatively wider part and a relatively axially higher, relatively narrower part such as for example caps having a form appearance comprising a number of cyl-

inders having different sizes. In particular a first cylinder can be a circular cylinder with a diameter in the range from 13 mm to 18 mm and a height in the range from 7 mm to 20 mm. An optional second cylinder can be a circular cylinder with a diameter of maximum 11 mm and a height of maximum 16 mm. Thereby, the cap may be held in its relatively wider part by the at least two gripping jaws in the holding position while the at least two guidance elements may seat on the shoulder, in particular due to gravity, and surround the relatively narrower part. When the cap is released, it may be pushed in the axial direction by the at least two guidance elements from the cap gripper with its at least two gripping jaws away. Additionally, an outer distance of the at least two guidance elements in or along the radial direction may be smaller than a distance of the at least two gripping jaws in the release position in or along the radial direction, such that the at least two guidance elements may axially move in between the at least two gripping jaws.

According to an embodiment of the invention the decapper comprises a cap push element. The cap push element is movable in the axial direction with respect to the cap gripper with its at least two gripping jaws. Additionally, the cap push element is adapted to expose a pushing force on the cap, in particular on a front side of the cap. In particular the axial direction may be perpendicular to the radial direction and/or may correspond to the vertical. Furthermore, the cap push element may have the form of a disk, in particular extending in the radial direction. This embodiment enables, that the cap may be pushed in the axial direction by the cap push element from the cap gripper with its at least two gripping jaws away, when the cap is released, in particular due to gravity. Additionally, a diameter of the cap push element in or along the radial direction may be smaller than a distance of the at least two gripping jaws in the release position in or along the radial direction, such that the cap push element may axially move in between the at least two gripping jaws.

According to an embodiment of the invention a height of the guidance in the axial direction is in the range from 5 mm to 15 mm. The height of the guidance in the axial direction may be exactly 10 mm.

According to an embodiment of the invention the decapper comprises a container holder. The container holder is adapted to hold the laboratory sample container. Additionally, the container holder and the cap gripper with its at least two gripping jaws are displaceable relatively to each other in the axial direction such that the held cap is removed or pulled away from the laboratory sample container. Thereby, in case the cap has for example a rubber stopper, and is attached to the container by a friction fit, it may be removed from the laboratory sample container. In particular the axial direction may correspond to the vertical and/or the cap gripper may be arranged

vertically above the container gripper such that, after the removal of the cap, the open end of the laboratory sample container is vertically above the rest of the container. Thereby, the laboratory sample may stay in the container and should not spill. In addition, the container holder may be adapted to release the laboratory sample container after the removal of the cap from it.

5 In particular the container holder may comprise a gripper.

According to an embodiment of the invention the container holder and the cap gripper with its at least two gripping jaws are rotatable relatively to each other around the axial direction such that the held cap is unscrewed from the laboratory sample container. Thereby, in case the cap has for example a thread and is screwed on the container, it may be removed from the laboratory
10 sample container by the relative axial and rotational movement of the container holder and the cap gripper.

The invention further relates to an apparatus comprising a decapper as described above and a cap receiver. The cap receiver is rotatable between a receiver position and a storage position around a receiver axis. In the receiver position the decapper and the cap receiver are arranged
15 such that the cap receiver receives the released cap from the decapper. In the storage position the cap receiver allows removing of the cap from the laboratory sample container. In particular the cap receiver may be arranged vertically below the at least two gripping jaws of the cap gripper of the decapper. Thereby, the released cap may fall onto and/or into the cap receiver due to gravity. In particular the receiver axis may correspond to the vertical. Thereby, it may be rotated
20 with relatively low effort. In addition, the apparatus may comprise a cap disposal compartment and the cap receiver may be connected to the cap disposal compartment such that the received cap is passed by the cap receiver into the cap disposal compartment.

According to an embodiment of the invention the apparatus comprises a mounting base. Additionally, the cap receiver is mechanically connected to the mounting base by a key hole coupling system. Thereby, the cap receiver may be reversibly or nondestructively detached from
25 the mounting base in relatively short time. Hence, the detached cap receiver may be cleaned from contaminations caused by the received cap. In addition, the apparatus may comprise an index pin, wherein the index pin may be adapted to secure the cap receiver and the key hole coupling system, respectively, against unintentional detachment.

30 By means of the decapper according to the invention, the advantages of the decapper according to the invention, as discussed above, can be made applicable for the apparatus, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, an embodiment of the invention will be described in detail with reference to the drawings. Throughout the drawings, the same elements will be denoted by the same reference numerals.

- 5 Fig. 1 shows a longitudinal section view of a decapper according to the invention comprising a cap gripper holding a cap, a guidance and a container holder holding a laboratory sample container,
- Fig. 2 shows a longitudinal section of the decapper of Fig. 1 with the cap gripper holding the cap being removed from the laboratory sample container and
- 10 Fig. 3 shows a longitudinal section view of an apparatus according to the invention comprising the decapper of Fig. 1 and a cap receiver with the cap being released, wherein the cap receiver is depicted in perspective view.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

- Figs. 1 to 3 show a decapper 1 for automatically removing a cap 2 from a laboratory sample container 3. The decapper 1 comprises a cap gripper 4 comprising two gripping jaws 5. In a different embodiment the cap gripper may comprise at least three, four, five, six or more gripping jaws. Both gripping jaws 5 are displaceable between a holding position and a release position in or along a radial direction 6. In a different embodiment it may be sufficient that only one of the at least two gripping jaws may be displaceable between the holding position and the release position in the radial direction. In the holding position the gripping jaws 5 hold or fix the cap 2, as can be seen in Figs. 1 and 2. In the release position the cap 2 is released by the gripping jaws 5, as can be seen in Fig. 3. Additionally, the decapper 1 comprises a guidance or mechanical stop 7. The guidance 7 is adapted to limit or prevent a movement of the cap 2 in the radial direction 6 caused by the displacement of one of the gripping jaws 5 from its holding position into its release position.
- 15
- 20
- 25

- In detail the laboratory sample container 3 is designed as a tube having an opening at an in Fig. 1 upper end. In Fig. 1 the cap 2 closes the container 3, in particular its opening. The cap 2 has a thread and is screwed on the container 3. Further, the cap 2 has a cylindrical shape, in particular with a circular cross section. Furthermore, the cap 2 completely consists of rubber and/or plastic.
- 30

The gripping jaws 5 are evenly distributed around an axial direction 11, wherein the axial direction 11 is perpendicular to the radial direction 6. In the holding position the gripping jaws 5 are relatively closer to each other in the radial direction 6 than in the release position. The gripping jaws 5 hold the cap 2 at its circumference or periphery 21 in a force-fit manner and in a form-fit manner; a longitudinal axis of the cylindrical shaped cap 2 coincidences with the axial direction 11. In detail each gripping jaw 5 comprises a blade 8. In Fig. 1 and 2 the blades 8 cut or engrave or nick into the cap 2, in particular into the circumference 21 of the cap 2. The blades 8 completely consist of a metal. The gripping jaws 5 and the blades 8, respectively, extend around the axial direction 11 and thereby along the circumference 21 of the cap 2 almost completely.

Each of the gripping jaws 5 is attached to a finger or an arm of the cap gripper 4. The fingers may be moved by at least one actuator for the displacement of the gripping jaws 5 between their holding position and their release position.

In addition to the cap gripper 4 and the guidance 7 the decapper 1 comprises a container holder 13. The container holder 13 holds the laboratory sample container 3, in particular in such a way that a longitudinal axis of the container 3 in form of the tube coincidences with the axial direction 11. In the shown embodiment the container holder 13 is embodied as a gripper. Further, the container holder 13 and the cap gripper 4 with its gripping jaws 5 are displaceable relatively to each other in the axial direction 11. Additionally, the container holder 13 and the cap gripper 4 with its gripping jaws 5 are rotatable relatively to each other around the axial direction 11. Thereby, the held cap 2 is unscrewed from the laboratory sample container 3 such that the cap 2 is removed from the container 3. In a different embodiment, in particular in case the cap has a rubber stopper and is attached to the container by a friction fit, it may be sufficient that the container holder and the cap gripper with its gripping jaws may be displaceable relatively to each other in the axial direction only such that the held cap is pulled away from the laboratory sample container. In the shown embodiment the cap gripper 4 is arranged vertically above the container holder 13 such that, after the removal of the cap 2, the open end of the container 3 is vertically above the rest of the container. In particular the decapper 1 with its cap gripper 4 and its container holder 13 is oriented in such a way, that the axial direction 11 corresponds to the vertical.

After the removal of the cap 2 from the container 3, the cap 2 may be released by the gripping jaws 5. Then, it may come off the gripping jaws 5, in particular it may fall down due to gravity as can be seen in Fig. 3. However, the cap 2 may stick or adhere to one of the gripping jaws 5. A movement of the cap 2 in the radial direction 6 caused by the displacement of the gripping jaws

5 from their holding position into their release position is limited by the guidance 7, which is embodied separate from the gripping jaws 5.

In detail the guidance 7 comprises two guidance elements 9. The guidance elements 9 are arranged in the radial direction 6 opposite to each other such that they surround the held cap 2 on opposite sides, as can be seen in Figs. 1 and 2. The guidance elements 9 are adapted to limit or prevent a movement of the cap 2 in the radial direction 6. The guidance elements 9 extend around the axial direction 11 and thereby along the circumference 21 of the cap 2, in particular completely. In the shown embodiment the guidance elements 9 form a ring 10, in particular a closed ring. The ring 10 has a circular cross section. Generally, the guidance elements may be embodied separate from each other. Furthermore, in a different embodiment the guidance may comprise at least three, four, five, six or more guidance elements. In particular, the number of guidance elements may correspond to the number of gripping jaws. However, in the shown embodiment the ring 10 is one piece.

In the shown embodiment a height H of the guidance 7, respectively its guidance elements 9, in the axial direction 11 is 10 mm.

A distance D of the at least two guidance elements 9 in the radial direction 6, respectively a diameter of the ring 10, is smaller than a distance A of the gripping jaws 5 in the release position in the radial direction 6, as can be seen in Fig. 3. Thereby, the released cap 2 cannot follow one of the gripping jaws 5 from its holding position into its release position in the radial direction 6. It is stopped before by the guidance 7. In the shown embodiment the distance D may be 11.4 mm +/- 0.6 mm, preferably 11.4 mm +/- 0.2 mm.

Furthermore, the distance D is smaller than a distance B of the gripping jaws 5 in the holding position in the radial direction 6. In addition, the guidance 7 with its guidance elements 9 is movable in the axial direction 11 with respect to the cap gripper 4 with its gripping jaws 5. In detail the decapper 1 comprises a rail 31 extending in or along the axial direction 11. The rail 31 is fixed to the cap gripper 4 with its gripping jaws 5 and the guidance 7 with its guidance elements 9 is displaceable mounted on the rail 31.

This embodiment is in particular advantageous for the cap 2 of the present example, which has a shoulder or step 24 in between a relatively axially lower, relatively wider part 22 and a relatively axially higher, relatively narrower part 23. The cap 2 has a form appearance comprising two cylinders having different sizes. The first cylinder is a circular cylinder with a diameter in the range from 13 mm to 18 mm and a height in the range from 7 mm to 20 mm. The second cylinder

der is a circular cylinder with a diameter of maximum 11 mm and a height of maximum 16 mm. The distance B of the gripping jaws 5 in the holding position in the radial direction 6 corresponds to a diameter of the cap in the relatively wider part 22. Before the cap 2 is held by the gripping jaws 5 in the holding position, they may be in their release position and the cap 2 may be introduced into the cap gripper 4. For example, the closed container 3 may be held by the container holder 13. The container holder 13 and the cap gripper 4 may be relatively moved towards each other in the axial direction 11. Thereby, the cap 2 with its relatively narrower part 23 ahead may be moved in the axial direction 11 towards the cap gripper 4 with its gripping jaws 5. At first the guidance elements 9 may surround the relatively narrower part 23. When the cap 2 with its shoulder 24 is moved against the guidance elements 9, the cap 2 may move the guidance elements 9 in the axial direction 11 with respect to the cap gripper 4 with its gripping jaws 5. Thereafter, the cap 2 may be held in its relatively wider part 22 by the gripping jaws 5 in the holding position while the guidance elements 9 may seat on the shoulder 24, in particular due to gravity, as can be seen in Figs. 1 and 2. When the removed cap 2 is released, it is pushed in the axial direction 11 by the guidance elements 9 from the cap gripper 4 with its gripping jaws 5 away, in Fig. 3 downwards. In the shown embodiment an outer distance C of the at least two guidance elements 9 in the radial direction 6, respectively an outer diameter of the ring 10, is smaller than the distance A of the gripping jaws 5 in the release position in the radial direction 6, such that the guidance elements 9 may axially move in between the gripping jaws 5.

In a different embodiment the distance of the at least two guidance elements in the radial direction may be larger than a distance of the at least two gripping jaws in the holding position in the radial direction. Additionally or alternatively, the guidance may be not movable in the axial direction with respect to the cap gripper with its gripping jaws. It may be axially fixed. In particular the guidance may be positioned above, below or on a level along the axial direction with respect to cap gripper with its gripping jaws.

In the shown embodiment the decapper 1 comprises a cap push element 12 in the form of a disk, in particular extending in the radial direction 6. The cap push element 12 is movable in the axial direction 11 with respect to the cap gripper 4 with its at least two gripping jaws 5. In detail the cap push element 12 is displaceable mounted on the rail 31. Additionally, the cap push element 12 is adapted to expose a pushing force on the cap 2, in particular on a front side 25 of the cap 2. When the cap 2 with its front side 25 ahead is introduced into the cap gripper 4, it is moved against the cap push element 12 and the cap 2 may move the cap push element 12 in the axial direction 11 with respect to the cap gripper 4 with its gripping jaws 5. When the removed cap 2 is released, it is pushed in the axial direction 11 by the cap push element 12 from the cap gripper 4 with its gripping jaws 5 away, in Fig. 3 downwards. In the shown embodiment

a diameter E of the cap push element 12 in form of the disk in the radial direction 6 is smaller than the distance A of the gripping jaws 5 in the release position in the radial direction 6.

The decapper 1 is part of an apparatus 41, as can be seen in Fig. 3. The apparatus 41 comprises a cap receiver 42 in addition to the decapper 1. The cap receiver 42 is rotatable between
5 a receiver position and a storage position around a receiver axis 43, in particular corresponding to the vertical. In the receiver position the decapper 1 and the cap receiver 42 are arranged such that the cap receiver 42 receives the released cap 2 from the decapper 1, as can be seen in Fig. 3. In detail the cap receiver 42 is arranged vertically below the gripping jaws 5 of the cap gripper 4 of the decapper 1. Thereby, the released cap 2 may fall onto and/or into the cap re-
10 ceiver 42 due to gravity. Due to the guidance 7 the cap 2 actually falls down, where it is supposed to do so. In the storage position the cap receiver 42 allows removing of the cap 2 from the laboratory sample container 3, as can be seen in Figs. 1 and 2.

Furthermore, the apparatus 41 comprises a mounting base 47 in form of an adapter plate. The cap receiver 42 is mechanically connected to the mounting base 47 by a key hole coupling sys-
15 tem 45. The mounting base 47 is rotatable around the receiver axis 43 as well. The rotation of the cap receiver 42 between the receiver position and the storage position is performed by a rotational movement of the mounting base 47. In addition the apparatus comprises a lower basis 44 and the mounting base 47 is connected to the lower basis 44 by a rotatable connection. The lower basis 44 is not rotatable. In detail the key hole coupling system 45 comprises guiding
20 screws and corresponding grooves. In addition, the apparatus 41 comprises an index pin 46. The index pin 46 is adapted to secure the cap receiver 42 and the key hole coupling system 45, respectively, against unintentional detachment from the mounting base 47, when being rotated between the receiver position and the storage position. By operating the index pin 46 and rotat-
25 ing the cap receiver 42 relatively to the mounting base 47 and the lower basis 44, respectively, around the receiver axis 43, the cap receiver 42 may be reversibly or nondestructively detached from the mounting base 47.

In addition, the apparatus 41 comprises a not-shown cap disposal compartment and the cap receiver 42 is connected to the cap disposal compartment such that the received cap 2 is passed by the cap receiver 42 into the cap disposal compartment.

30 As the shown and above discussed embodiments reveal, the invention provides a decapper comprising a guidance, whereby the properties of the decapper are improved. Furthermore, the invention provides an apparatus comprising such a decapper.

Claims

1. Decapper (1) for removing a cap (2) from a laboratory sample container (3), wherein the decapper comprises
 - a cap gripper (4) comprising at least two gripping jaws (5), wherein at least one of the at least two gripping jaws is displaceable between a holding position and a release position in a radial direction (6), wherein in the holding position the at least two gripping jaws hold the cap and wherein in the release position the cap is released by the at least two gripping jaws, and
 - a guidance (7), wherein the guidance is adapted to limit a movement of the cap in the radial direction caused by the displacement of the one gripping jaw from its holding position into its release position and wherein the guidance is embodied separate from the gripping jaws.
2. Decapper (1) according to claim 1, wherein at least one of the at least two gripping jaws (5) comprises a blade (8), wherein the blade is adapted to cut into the cap (2).
3. Decapper (1) according to claim 1 or 2, wherein the guidance (7) comprises at least two guidance elements (9), wherein the at least two guidance elements (9) are arranged in the radial direction (6) opposite to each other such that they surround the held cap (2) on opposite sides.
4. Decapper (1) according to claim 3, wherein the at least two guidance elements (9) form a ring (10).
5. Decapper (1) according to claim 3 or 4, wherein a distance (D) of the at least two guidance elements (9) in the radial direction (6) is smaller than 20 mm, in particular smaller than 12 mm.
6. Decapper (1) according to anyone of the claims 3 to 5, wherein a distance (D) of the at least two guidance elements (9) in the radial direction (6) is smaller than a distance (A) of the at least two gripping jaws (5) in the release position in the radial direction.
7. Decapper (1) according to anyone of the claims 3 to 6,
 - wherein the guidance (7) with its at least two guidance elements (9) is movable in an axial direction (11) with respect to the cap gripper (4) with its at least two gripping jaws (5) and

- wherein a distance (D) of the at least two guidance elements in the radial direction (6) is smaller than a distance (B) of the at least two gripping jaws (5) in the holding position in the radial direction.
8. Decapper (1) according to anyone of the preceding claims,
 - wherein the decapper comprises a cap push element (12),
 - wherein the cap push element is movable in an axial direction (11) with respect to the cap gripper (4) with its at least two gripping jaws (5), and
 - wherein the cap push element is adapted to expose a pushing force on the cap (2).
 9. Decapper (1) according to anyone of the preceding claims, wherein a height (H) of the guidance (7) in an axial direction (11) is in the range from 5 mm to 15 mm.
 10. Decapper (1) according to anyone of the preceding claims,
 - wherein the decapper comprises a container holder (13), wherein the container holder is adapted to hold the laboratory sample container (3), and
 - wherein the container holder and the cap gripper (4) with its at least two gripping jaws (5) are displaceable relatively to each other in an axial direction (11) such that the held cap (2) is removed from the laboratory sample container.
 11. Decapper (1) according to claim 10,
 - wherein the container holder (13) and the cap gripper (4) with its at least two gripping jaws (5) are rotatable relatively to each other around the axial direction (11) such that the held cap (2) is unscrewed from the laboratory sample container (3).
 12. Apparatus (41) comprising
 - a decapper (1) according to anyone of the preceding claims and
 - a cap receiver (42), wherein the cap receiver is rotatable between a receiver position and a storage position around a receiver axis (43), wherein in the receiver position the decapper and the cap receiver are arranged such that the cap receiver receives the released cap (2) from the decapper and wherein in the storage position the cap receiver allows removing of the cap from the laboratory sample container (3).
 13. Apparatus (41) according to claim 12, wherein the apparatus comprises a mounting base (47), and wherein the cap receiver (42) is mechanically connected to the mounting base (47) by a key hole coupling system (45).

Fig. 1

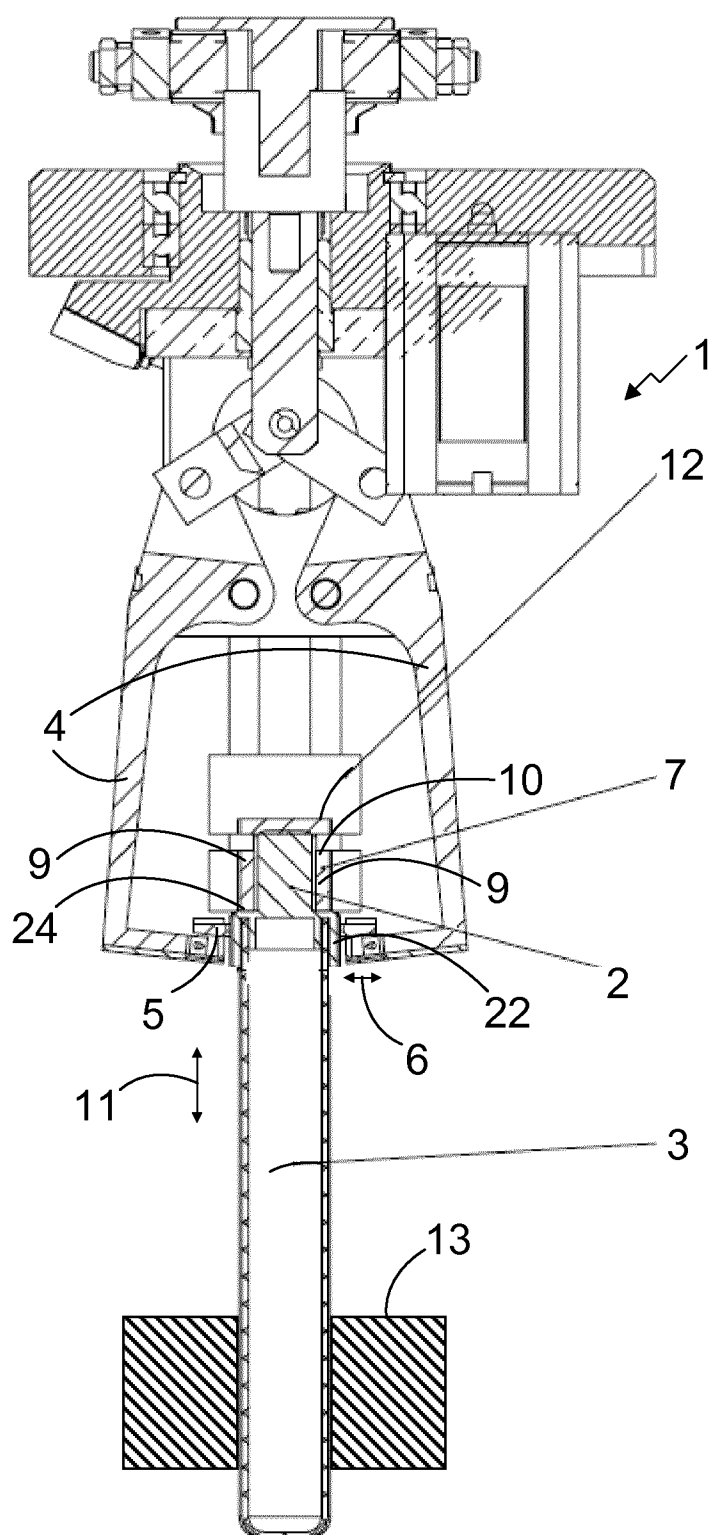


Fig. 2

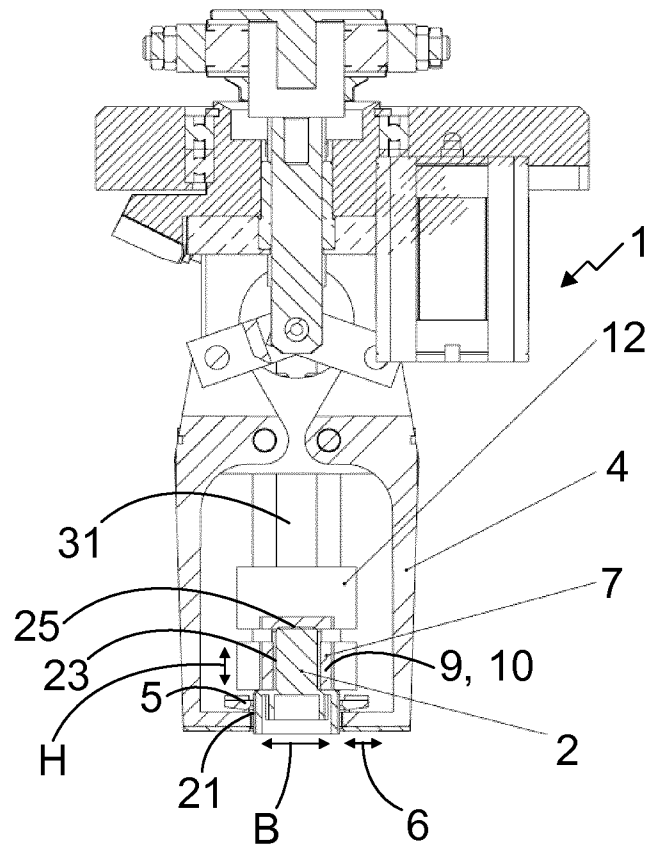
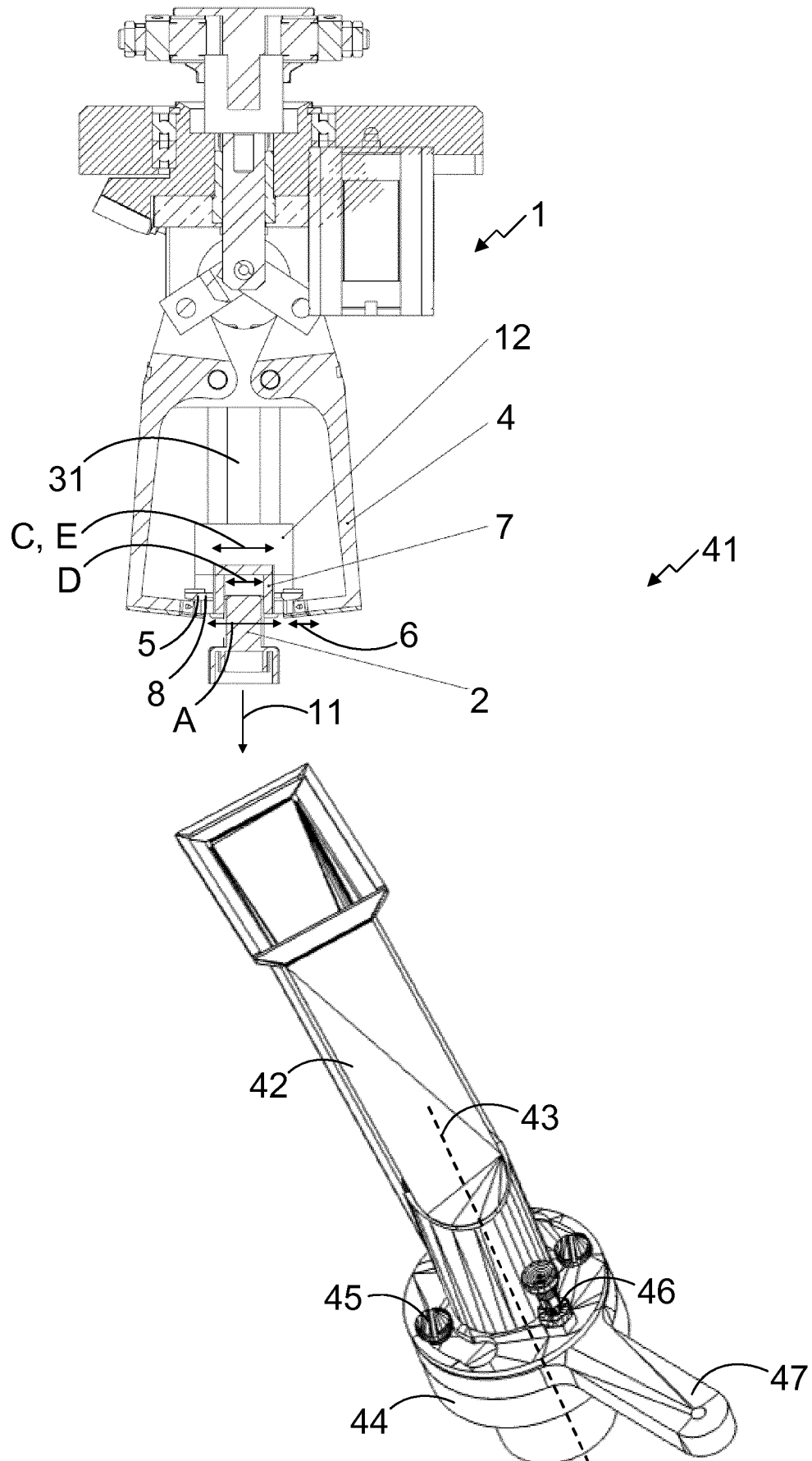


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/058751

A. CLASSIFICATION OF SUBJECT MATTER		
INV. G01N35/04 B67B7/14	B01L3/00 B65B7/28	B67B3/14 B67B3/16 B67B3/18
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) G01N B01L B67B B65B		
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, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 659 091 A1 (KORDIA B V [NL]) 24 May 2006 (2006-05-24) paragraphs [0021] - [0024] -----	1-13
X	US 2007/151212 A1 (MAYER WILLIAM J [US] ET AL) 5 July 2007 (2007-07-05) paragraphs [0190] - [0195]; figures 27-29 -----	1-13
X	EP 0 060 073 A1 (METAL CLOSURES LTD [GB]) 15 September 1982 (1982-09-15) page 8, line 9 - page 9, line 13; figure 5 -----	1-13
X	US 2014/311090 A1 (WEBER RENÉ [CH]) 23 October 2014 (2014-10-23) paragraphs [0033] - [0036] -----	1-13
	-/--	
☒ Further documents are listed in the continuation of Box C. ☒ 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 but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" 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 cited 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 "&" document member of the same patent family		
Date of the actual completion of the international search 7 June 2017		Date of mailing of the international search report 16/06/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Cantalapiedra, Igor

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/058751

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/134769 A1 (FRIEDMAN GLENN M [US] ET AL) 31 May 2012 (2012-05-31)	1-13
Y	figure 1 -----	3-8
X	US 2008/078146 A1 (CIRIO SERGIO [IT]) 3 April 2008 (2008-04-03) paragraph [0030]; figure 3 -----	1-13
Y	US 6 701 692 B1 (NIEHR THOMAS [DE]) 9 March 2004 (2004-03-09) column 2, lines 31-59; figures 2-4 -----	3-8
A	US 2003/103839 A1 (OSBORNE JOEL A [US] ET AL) 5 June 2003 (2003-06-05) figure 6 -----	12,13
A	US 2006/216208 A1 (LI WILLIAM W [US] ET AL) 28 September 2006 (2006-09-28) figure 1 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/058751

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1659091	A1	24-05-2006	NONE

US 2007151212	A1	05-07-2007	AT 365312 T 15-07-2007
			AT 365909 T 15-07-2007
			AT 365910 T 15-07-2007
		AU 2002365134 A1	09-07-2003
		AU 2006235861 A1	30-11-2006
		AU 2006235918 A1	30-11-2006
		AU 2006246492 A1	04-01-2007
		AU 2006249272 A1	04-01-2007
		CA 2452797 A1	24-04-2003
		CA 2452800 A1	24-04-2003
		CA 2453252 A1	24-04-2003
		CA 2461734 A1	24-04-2003
		CA 2462238 A1	01-05-2003
		CA 2462447 A1	24-04-2003
		CA 2463573 A1	24-04-2003
		CA 2463673 A1	01-05-2003
		CA 2463940 A1	03-07-2003
		CA 2464219 A1	24-04-2003
		CA 2643133 A1	03-07-2003
		CN 1571921 A	26-01-2005
		CN 1571922 A	26-01-2005
		CN 1605023 A	06-04-2005
		CN 1605028 A	06-04-2005
		CN 1606518 A	13-04-2005
		CN 1606696 A	13-04-2005
		CN 1608025 A	20-04-2005
		CN 1678897 A	05-10-2005
		DE 60220813 T2	06-03-2008
		DE 60220932 T2	06-03-2008
		DE 60220937 T2	28-02-2008
		EP 1436199 A1	14-07-2004
		EP 1436585 A1	14-07-2004
		EP 1436586 A2	14-07-2004
		EP 1436629 A1	14-07-2004
		EP 1436630 A2	14-07-2004
		EP 1438252 A1	21-07-2004
		EP 1438559 A2	21-07-2004
		EP 1438561 A2	21-07-2004
		EP 1438562 A2	21-07-2004
		EP 1438590 A1	21-07-2004
		ES 2289152 T3	01-02-2008
		JP 2005506253 A	03-03-2005
		JP 2005506531 A	03-03-2005
		JP 2005506533 A	03-03-2005
		JP 2005506534 A	03-03-2005
		JP 2005506535 A	03-03-2005
		JP 2005506537 A	03-03-2005
		JP 2005506538 A	03-03-2005
		JP 2005506933 A	10-03-2005
		JP 2005507079 A	10-03-2005
		JP 2005514594 A	19-05-2005
		KR 20040045827 A	02-06-2004
		KR 20040045828 A	02-06-2004
		KR 20040045829 A	02-06-2004
		KR 20040047910 A	05-06-2004
		KR 20040047911 A	05-06-2004

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/058751

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
		KR 20040047912 A	05-06-2004	
		KR 20040047926 A	05-06-2004	
		KR 20040047928 A	05-06-2004	
		KR 20040054716 A	25-06-2004	
		KR 20050038577 A	27-04-2005	
		US 2003087443 A1	08-05-2003	
		US 2003088963 A1	15-05-2003	
		US 2003089731 A1	15-05-2003	
		US 2003090959 A1	15-05-2003	
		US 2003092170 A1	15-05-2003	
		US 2003092186 A1	15-05-2003	
		US 2003097824 A1	29-05-2003	
		US 2003099580 A1	29-05-2003	
		US 2003100125 A1	29-05-2003	
		US 2003118487 A1	26-06-2003	
		US 2005195684 A1	08-09-2005	
		US 2006120834 A1	08-06-2006	
		US 2006120835 A1	08-06-2006	
		US 2007151212 A1	05-07-2007	
		US 2008164200 A1	10-07-2008	
		US 2008166801 A1	10-07-2008	
		US 2008209709 A1	04-09-2008	
		WO 03033394 A1	24-04-2003	
		WO 03034034 A2	24-04-2003	
		WO 03034036 A1	24-04-2003	
		WO 03034037 A2	24-04-2003	
		WO 03034038 A2	24-04-2003	
		WO 03034075 A1	24-04-2003	
		WO 03034076 A1	24-04-2003	
		WO 03035477 A1	01-05-2003	
		WO 03036267 A2	01-05-2003	
		WO 03054552 A2	03-07-2003	

EP 0060073	A1	15-09-1982	AR 230245 A1	01-03-1984
			AU 8100082 A	09-09-1982
			DK 489582 A	04-11-1982
			EP 0060073 A1	15-09-1982
			ES 8306675 A1	16-09-1983
			JP S58500364 A	10-03-1983
			NO 823541 A	25-10-1982
			PT 74542 A	01-04-1982
			WO 8203059 A1	16-09-1982
			ZA 8201437 B	27-04-1983

US 2014311090	A1	23-10-2014	CN 104108671 A	22-10-2014
			EP 2792598 A1	22-10-2014
			JP 2014210338 A	13-11-2014
			US 2014311090 A1	23-10-2014

US 2012134769	A1	31-05-2012	CN 102576032 A	11-07-2012
			EP 2462455 A1	13-06-2012
			JP 2013501633 A	17-01-2013
			US 2012134769 A1	31-05-2012
			WO 2011017586 A1	10-02-2011

US 2008078146	A1	03-04-2008	AT 453601 T	15-01-2010
			CN 101157432 A	09-04-2008
			EP 1908725 A1	09-04-2008

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/058751

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
		ES 2336839 T3	16-04-2010	
		HK 1118792 A1	14-10-2011	
		PT 1908725 E	22-02-2010	
		TW 200817275 A	16-04-2008	
		US 2008078146 A1	03-04-2008	

US 6701692	B1	09-03-2004	AT 229450 T	15-12-2002
			BR 0010336 A	13-02-2002
			DE 29908075 U1	14-09-2000
			DK 1175343 T3	07-04-2003
			EP 1175343 A1	30-01-2002
			ES 2187474 T3	16-06-2003
			JP 2002544069 A	24-12-2002
			US 6701692 B1	09-03-2004
			WO 0068079 A1	16-11-2000

US 2003103839	A1	05-06-2003	AT 349400 T	15-01-2007
			AU 2002352935 A1	17-06-2003
			CA 2466735 A1	12-06-2003
			DE 60217177 T2	18-10-2007
			EP 1461282 A1	29-09-2004
			US 2003103839 A1	05-06-2003
			WO 03048025 A1	12-06-2003

US 2006216208	A1	28-09-2006	EP 1883473 A2	06-02-2008
			EP 2754498 A1	16-07-2014
			JP 4969564 B2	04-07-2012
			JP 2008537775 A	25-09-2008
			US 2006216208 A1	28-09-2006
			WO 2006101833 A2	28-09-2006
