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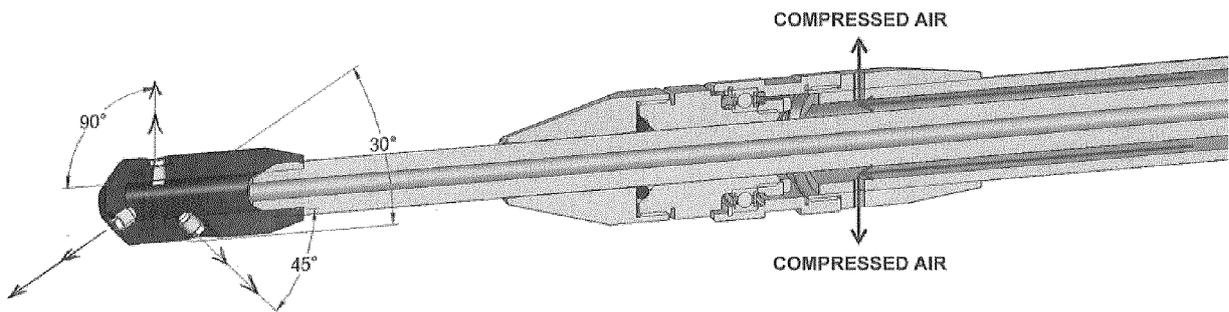
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(54) **APPARATUS AND METHOD FOR SANITISATION OF BREWERY CONTAINERS**

(57) Apparatus and method for the sanitisation of brewery containers, the apparatus comprising a high-pressure spray lance (14) for application of a washing liquid (20) against internal surfaces (18) of a brewery container. The spray lance (14) is elongate to allow it to be introduced into an opening (12, 22) of a brewery container. A spray lance head (16) is provided with a plurality of washing liquid ejection orifices (26, 28, 30); and a compressed air ejection orifice (32) is located upstream of

the spray lance head (16). The ejected compressed air forces excess washing liquid from the internal surfaces (18) during the cleaning process. Furthermore, the positioning of the compressed air ejection orifice (32) proximate the point of connection between the spray lance (14) and its disengageable head (16) prevents ingress of the washing liquid into the interior of the spray lance (14).



**Fig. 3**

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## Description

**[0001]** The present invention relates to apparatus for the sanitisation of brewery containers and particularly, though not exclusively, to an apparatus for applying ultra-high pressure water jets to sanitise the internal surfaces of beer casks or kegs.

**[0002]** In the United Kingdom alone the number of beer containers in circulation is of the order of eight million, most of which are wholly owned by brewing companies. Two basic types of container are used: (i) unpressurised casks, which are gravity-filled with finished fermented beer and clarified in situ with finings; and (ii) pressurised kegs, which are quiet-filled (usually upside-down) under back -pressure with stabilised, filtered, and usually pasteurised beer. Cask beer has a shelf life of between 4 and 6 weeks, whereas the keg product can last from 10 to 16 weeks.

**[0003]** The cost of a stainless steel beer container in the United Kingdom (in 2019) is typically in excess of £40. Therefore, the container population held by larger brewing companies may be among its most valuable financial assets, with a value running to several million pounds. Despite this, the nature of the industry is such that beer containers are inevitably subjected to significant impact damage during handling, storage and transportation, thereby eroding the value of these assets and, sometimes, putting strain on a brewing company's cash flow.

**[0004]** In order to address the above problem, a business model has evolved within the industry whereby larger container handling companies have bulk-purchased container populations from brewing company customers and rented those containers back to the customer on a "fee-per-fill" basis. This model allows brewing company customers to release capital tied up in their container assets and reinvest it in other parts of their business.

**[0005]** Each container supplied for rental must to be internally washed to remove any beer residues, soiling, inorganic scale, and protein. Furthermore, those internal surfaces must be sanitised to substantially eliminate microorganisms that could otherwise spoil the contained beer product.

**[0006]** Hitherto, this internal cleaning process has relied on the following combination of energy sources for effective cleaning and sanitisation:

- (i) Mechanical energy: water jets impinging on the internal surfaces;
- (ii) Chemical energy: mineral acid to de-scale, and alkali to dissolve and disperse protein; and
- (iii) Heat energy: hot water for casks, high-pressure wet steam for kegs.

**[0007]** The devisor of the present invention has developed a new apparatus for the sanitisation of internal surfaces of brewery containers which, advantageously, obviates the need for any chemical cleaning media or heat

energy, and reduces waste effluent. The resultant environmental and cost benefits are derived without any compromise in the quality or effectiveness of the cleaning process.

**[0008]** According to a first aspect of the present invention there is provided an apparatus for cleaning the internal surfaces of brewery containers, comprising a high-pressure spray lance for application of a washing liquid against internal surfaces of a brewery container; the spray lance comprising:

- (i) an elongate spray lance body having a longitudinal axis, and being shaped and dimensioned to facilitate its at least partial introduction into a brewery container;
- (ii) a spray lance head provided at a downstream distal end of the spray lance body, the spray lance head comprising a plurality of washing liquid ejection orifices; and
- (iii) at least one compressed air ejection orifice provided upstream of said plurality of washing liquid ejection orifices.

**[0009]** Optionally, the elongate spray lance body is rotatable about its longitudinal axis.

**[0010]** Optionally, the elongate spray lance body is translatable back and forth along its longitudinal axis.

**[0011]** Optionally, said rotation and/or translation movements of the elongate spray lance body are implemented by a robotic arm which is connectable thereto at a position upstream of said at least one compressed air ejection orifice.

**[0012]** Optionally, the washing liquid ejection orifices are distributed circumferentially on the spray lance head relative to said longitudinal axis of the elongate spray lance body.

**[0013]** Optionally, the washing liquid ejection orifices are arranged so as to each eject liquid at differing angles relative to said longitudinal axis of the elongate spray lance body.

**[0014]** Optionally, three washing liquid ejection orifices are provided on the spray lance head.

**[0015]** In some embodiments, one of the washing liquid ejection orifices has a diameter of 0.7 mm, and two of the washing liquid ejection orifices has a diameter of 0.6 mm.

**[0016]** Optionally, at least one of the washing liquid ejection orifices is arranged so as to eject liquid substantially radially relative to said longitudinal axis of the elongate spray lance body.

**[0017]** Optionally, at least one of the washing liquid ejection orifices is arranged so as to eject liquid in a generally forward direction whereby its ejection angle relative to said longitudinal axis of the elongate spray lance body is less than 90 degrees.

**[0018]** For example, in some embodiments the forward ejection angle relative to said longitudinal axis is 30 degrees.

**[0019]** Optionally, at least one of the washing liquid ejection orifices is arranged so as to eject liquid in a generally rearward direction whereby its ejection angle relative to said longitudinal axis of the elongate spray lance body is more than 90 degrees.

**[0020]** For example, in some embodiments the rearward ejection angle relative to said longitudinal axis is 150 degrees.

**[0021]** Optionally, a washing liquid conduit extends longitudinally along the longitudinal axis of the elongate spray lance body from the spray lance head and is connectable to a washing liquid source.

**[0022]** Optionally, a compressed air conduit extends longitudinally along the elongate spray lance body from the said at least one compressed air ejection orifice and is connectable to a compressed air source.

**[0023]** Optionally, the compressed air conduit is annular and extends coaxially relative to the washing liquid conduit.

**[0024]** Optionally, the at least one compressed air ejection orifice is arranged so as to eject compressed air substantially radially relative to said longitudinal axis of the elongate spray lance body.

**[0025]** Optionally, the spray lance head is selectively disengageable from the spray lance body at a longitudinal position lying upstream of said plurality of washing liquid ejection orifices, and downstream of said at least one compressed air ejection orifice.

**[0026]** It will be appreciated that the ejected compressed air provides two advantages. Firstly, it forces excess washing liquid from the interior surfaces of the beer keg or cask during the cleaning process. Secondly, the positioning of the compressed air ejection orifices proximate the point of connection between the spray lance body and the disengageable head prevents ingress of the washing liquid into the interior of the spray lance body.

**[0027]** According to a second aspect of the present invention there is provided a method for cleaning the internal surfaces of brewery containers, the method comprising:

- (i) providing an apparatus according to the first aspect and connecting same to a pump for pumping a washing liquid;
- (ii) moving the spray lance head into a brewery container via an access opening;
- (iii) ejecting a washing liquid from said plurality of washing liquid ejection orifices against the interior surfaces of a brewery container; and
- (iv) ejecting compressed air from the at least one compressed air ejection orifice.

**[0028]** Optionally, the step of ejecting a washing liquid from said plurality of washing liquid ejection orifices is initiated once the spray lance head is in a predetermined internal position within a brewery container.

**[0029]** In some embodiments, the predetermined in-

ternal position within a brewery container is proximate its access opening. In other embodiments, the predetermined internal position may be a point which is remote from its access opening; or at an intermediate position between the two.

**[0030]** Optionally, the step of ejecting compressed air from the at least one compressed air ejection orifice is performed contemporaneously with the step of ejecting a washing liquid from said plurality of washing liquid ejection orifices.

**[0031]** Optionally, the washing liquid is ejected from the plurality of washing liquid ejection orifices at a pressure in the range of 200,000 to 300,000 kPa.

**[0032]** In an exemplary embodiment, the washing liquid is ejected at a pressure of 250,000 kPa (2500 Barg). It will be appreciated that this pressure is sufficiently high to not only remove all scale and debris from the interior walls of a brewery container, but also to kill any microorganisms present within a brewery container by rupturing their cell walls.

**[0033]** Optionally, the compressed air is ejected from the at least one compressed air ejection orifice at a pressure in the range of 250 to 350 kPa.

**[0034]** In an exemplary embodiment, the compressed air is ejected at a pressure of 300 kPa (3 Barg).

**[0035]** Optionally, the method comprises rotating the spray lance head at a rate in the range of 500 to 1,000 RPM.

**[0036]** In an exemplary embodiment, the rate of rotation of the spray head is 750 RPM.

**[0037]** Optionally, the method comprises translating the spray lance head longitudinally within a brewery container at a speed in the range of 25 to 75 mm/s.

**[0038]** In an exemplary embodiment, the translation speed of the spray head is 50 mm/s such that a single wash cycle may last for approximately 15 seconds. It will be appreciated that a combined translation and rotation movement of the spray head ensures that only three washing liquid ejection orifices directed at different angles can nevertheless provide complete internal coverage against the internal surfaces of a brewery container.

**[0039]** Optionally, the washing liquid is water.

**[0040]** Advantageously, the use of town water alone as the washing liquid eliminates any environmental issues relating to the disposal of harmful effluent which is otherwise required when using chemical additives.

**[0041]** Further features and advantages of the first and second aspects of the present invention will become apparent from the claims and the following description.

**[0042]** Embodiments of the present invention will now be described by way of example only, with reference to the following diagrams, in which:-

Fig. 1 shows a spray lance head within the interior of a beer cask and ejecting a washing liquid against its internal surfaces;

Fig. 2 shows a spray lance head entering the interior

of a beer keg;

Fig. 3 is a sectional view through the longitudinal axis of a spray lance head and body, and showing the ejection positions and directions for the washing liquid and compressed air, respectively;

Fig. 4 is a part-sectional view through the longitudinal axis of the spray lance body showing the manner of its connection with the interchangeable spray lance head, and its coupling for connection to a robotic controlling arm (not shown);

Fig. 5 shows a beer cask being having been transported, via a conveyor system, to a cleaning zone where it is clamped in position whilst interior cleaning is performed; and

Fig. 6 is a flow chart summarising how the cleaning method of the present invention forms part of a wider brewery container processing system.

**[0043]** As shown in Fig. 1, a beer cask 10 is provided with an opening in the form of a shive hole 12. Once opened, the shive hole 12 allows an elongate spray lance body 14 to be inserted (horizontally or vertically dependent on the cask's orientation) into the interior of the cask 10 such that its associated spray lance head 16 is spaced from the interior surfaces 18 of the cask 10. A washing liquid is ejected from orifices 20 distributed around the spray lance head 16 in the form of jets 20 of ultra-high pressure water. Those jets 20 of water impact against all internal surfaces 18 of the cask 10 to clean and sanitise those surfaces 18 as will be described in further detail below.

**[0044]** Fig. 2 shows a beer keg 100 provided with an opening 22 formed following removal of its spear. The opening allows the elongate spray lance body 14 to be inserted (horizontally or vertically dependent on the keg's orientation) into the interior of the keg 100 such that the spray lance head 16 will be spaced from the interior surfaces 18 of the keg 100. Ultra-high pressure water jets are then used to clean and sanitise those surfaces 18 in like manner to that described briefly above, and in further detail below. Also shown in Fig. 2 is an end of the elongate spray lance body 14 most distal to the spray lance head 16 to which, in use, is connected to a robotic controlling arm (not shown).

**[0045]** Fig. 3 shows a more detailed view of the internal structure of the spray lance body 14 and its detachable spray lance head 16. A washing liquid conduit 24 extends longitudinally along the internal central longitudinal axis X-X of the spray lance body 14. Water is pumped through the conduit 24 to the spray lance head 16 from a water source and pump (neither shown).

**[0046]** Three water ejection orifices 26, 28, 30 are distributed around the spray lance head 16, each orifice being orientated to eject water at a different angular di-

rection relative to the central longitudinal axis X-X. A first water ejection orifice 26 is orientated to eject water substantially radially with respect to the central longitudinal axis X-X. A second water ejection orifice 28 is orientated to eject water in a generally forward direction whereby the ejection angle relative to the central longitudinal axis X-X is substantially 30 degrees. A third water ejection orifice 30 is orientated to eject water in a generally rearward direction whereby the ejection angle relative to the central longitudinal axis X-X is substantially 150 degrees. All three water ejection orifices 26, 28, 30 are spaced apart both longitudinally and circumferentially. The circumferential spacing may be equal, i.e. whereby each orifices 26, 28, 30 is spaced from both of its neighbouring orifices by an angle of 120 degrees. In one embodiment, a satisfactory degree of cleaning has been achieved by means of three water ejection orifices 26, 28, 30 having round (Type S) stainless nozzles having diameters of 0.6mm and/or 0.7mm, and wherein water is ejected at a pressure of 250,000 kPa (2,500 Barg).

**[0047]** However, alternative spray pressure, total numbers of water ejection orifices, and differing spacings and angular orientations thereof are all possible dependent on factors such as the container's internal volume, its surface profile, its degree of soiling, or other considerations.

**[0048]** Also shown in Fig. 3 is two diametrically opposed compressed air ejection orifices 32 formed in the spray lance body 14, and extending radially with respect to its central longitudinal axis X-X. An annular compressed air conduit 34 extends coaxially around the washing liquid conduit 24. Compressed air is pumped through the conduit 34 to the orifices 32 from an air source and pump (neither shown).

**[0049]** Four compressed air ejection orifices 32 are equally distributed at 90 degree intervals around the spray lance body 14, each orifice 32 being orientated to eject compressed air generally radially with respect to the central longitudinal axis X-X. The compressed air ejection orifices 32 are located on the spray lance body 14 proximate the point of connection (see circled part of Fig. 4) between spray lance body 14 and the spray lance head 16.

**[0050]** The combined length of the spray lance body 14 and spray lance head 16 may be of the order of 750mm. A coupling member 40 is shown in Fig. 4 for connecting the spray lance body 14 to a robotic controlling arm (not shown).

**[0051]** In use, a brewery container - such as a beer cask 10 as shown in Fig. 5 - is transported, via a conveyor system 50, to a cleaning zone 60 where its opening is located automatically and, if necessary, the cask 10 is re-orientated to present its shive hole opening 12 toward the robotic controlling arm and its associated spray lance body 14. The shive hole opening 12 of the cask 10 to be cleaned is located optically (e.g. by a laser beam) and once the correct position is verified, the cask 10 is then secured against movement by a horizontal and vertical

clamps of a clamping apparatus 70 ready for commencement of the cleaning process.

**[0052]** The robotic arm (not shown) advances the spray lance body 14 towards the shive hole opening 12 until its spray lance head 16 reaches a desired position within the interior of the cask 10. A Hammelmann® HDP 174 series pump is used to generate ultra-high pressure water jets 20. These are ejected from the spray nozzles 26, 28, 30 of the spray lance head 16 (e.g. at a pressure of 250,000 kPa, and flow rate of 30 litres/minute) whilst the spray lance head 16 is simultaneously rotated (e.g. at 750 RPM) or oscillated, and translated longitudinally towards and/or away from the shive hole opening 12 (e.g. at a speed of 50mm/s).

**[0053]** As the ultra-high pressure water jets 20 are ejected from the spray lance head 16, compressed air is simultaneously ejected from the compressed air ejection orifices 32 located on the spray lance body 14. The ejected compressed air forces excess water away from the interior surfaces of the cask 10 during the cleaning process. Advantageously, the ejected compressed air also forces water away from the interface between the spray lance body 14 and the spray lance head 16 to avoid ingress of water and debris into the interior of the spray lance itself.

**[0054]** The total time taken to complete cleaning cycle will vary dependent on the type and size of brewery container being cleaned. For example, the travel distance for the spray lance head 16 within a 30 litre keg will be approximately 325mm, increasing to 580mm for a 100 litre keg. Meanwhile, the travel distance for the spray lance head 16 within a 9 gallon cask will be approximately 392mm. In some cases - e.g. dependent on the degree of soiling - multiple cleaning passes/cycles may be required.

**[0055]** It will be appreciated that the linear and rotational speeds of the spray lance head 16, its nozzle characteristics, and the water pressures are all variables which can be empirically derived to provide optimal cleaning and sanitisation performance for any given brewery container.

**[0056]** Although particular embodiments of the invention have been disclosed herein in detail, this has been done by way of example and for the purposes of illustration only. The aforementioned embodiments are not intended to be limiting with respect to the scope of appended claims. Indeed, it is contemplated by the inventor that various substitutions, alterations, and modifications may be made to the invention without departing from the scope of the invention as defined by the claims.

## Claims

1. An apparatus for cleaning the internal surfaces of brewery containers, comprising a high-pressure spray lance for application of a washing liquid against internal surfaces of a brewery container; the spray

lance comprising:

- (i) an elongate spray lance body having a longitudinal axis, and being shaped and dimensioned to facilitate its at least partial introduction into a brewery container;
- (ii) a spray lance head provided at a downstream distal end of the spray lance body, the spray lance head comprising a plurality of washing liquid ejection orifices; and
- (iii) at least one compressed air ejection orifice provided upstream of said plurality of washing liquid ejection orifices.

2. An apparatus according to claim 1, wherein the elongate spray lance body is rotatable about its longitudinal axis.

3. An apparatus according to claim 1 or 2, wherein the elongate spray lance body is translatable back and forth along its longitudinal axis.

4. An apparatus according to claim 3, wherein said rotation and/or translation movements of the elongate spray lance body are implemented by a robotic arm which is connectable thereto at a position upstream of said at least one compressed air ejection orifice.

5. An apparatus according to any preceding claim, wherein the washing liquid ejection orifices are arranged so as to each eject liquid at differing angles relative to said longitudinal axis of the elongate spray lance body.

6. An apparatus according to any preceding claim, wherein

(i) at least one of the washing liquid ejection orifices is arranged so as to eject liquid substantially radially relative to said longitudinal axis of the elongate spray lance body; and/or;

(ii) at least one of the washing liquid ejection orifices is arranged so as to eject liquid in a generally forward direction whereby its ejection angle relative to said longitudinal axis of the elongate spray lance body is less than 90 degrees; and/or

(iii) at least one of the washing liquid ejection orifices is arranged so as to eject liquid in a generally rearward direction whereby its ejection angle relative to said longitudinal axis of the elongate spray lance body is more than 90 degrees.

7. An apparatus according to any preceding claim, wherein a washing liquid conduit extends longitudinally along the longitudinal axis of the elongate spray lance body from the spray lance head and is connectable to a washing liquid source.

8. An apparatus according to any preceding claim, wherein a compressed air conduit extends longitudinally along the elongate spray lance body from the said at least one compressed air ejection orifice and is connectable to a compressed air source. 5
9. An apparatus according to claim 8, wherein the compressed air conduit is annular and extends coaxially relative to the washing liquid conduit. 10
10. An apparatus according to claim 9, wherein the at least one compressed air ejection orifice is arranged so as to eject compressed air substantially radially relative to said longitudinal axis of the elongate spray lance body. 15
11. An apparatus according to any preceding claim, wherein the spray lance head is selectively disengageable from the spray lance body at a longitudinal position lying upstream of said plurality of washing liquid ejection orifices, and downstream of said at least one compressed air ejection orifice. 20
12. A method for cleaning the internal surfaces of brewery containers, the method comprising: 25
- (i) providing an apparatus according to any of claims 1 to 11 and connecting same to a pump for pumping a washing liquid;
  - (ii) moving the spray lance head into a brewery container via an access opening; 30
  - (iii) ejecting a washing liquid from said plurality of washing liquid ejection orifices against the interior surfaces of a brewery container; and
  - (iv) ejecting compressed air from the at least one compressed air ejection orifice. 35
13. A method according to claim 12, wherein the step of ejecting a washing liquid from said plurality of washing liquid ejection orifices is initiated once the spray lance head is in a predetermined internal position within a brewery container. 40
14. A method according to claim 12 or 13, wherein the step of ejecting compressed air from the at least one compressed air ejection orifice is performed contemporaneously with the step of ejecting a washing liquid from said plurality of washing liquid ejection orifices. 45
15. A method according to any of claims 12 or 14, wherein the washing liquid is ejected from the plurality of washing liquid ejection orifices at a pressure in the range of 200,000 to 300,000 kPa. 50

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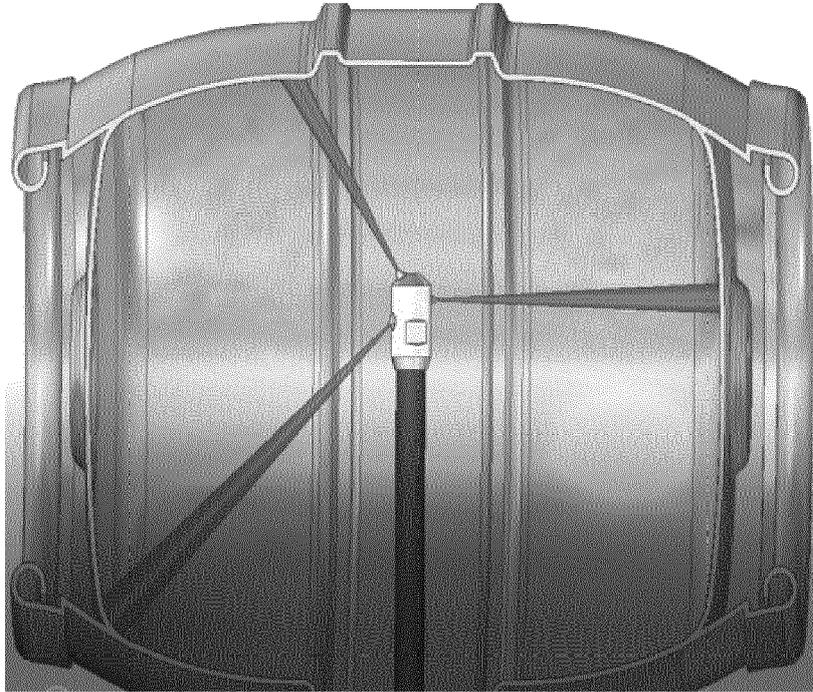


Fig. 1

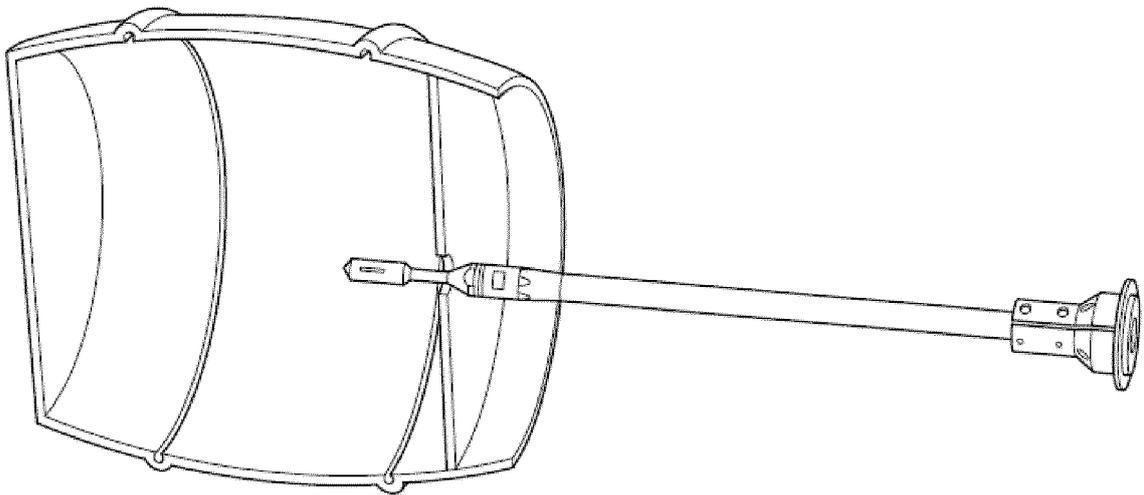


Fig. 2

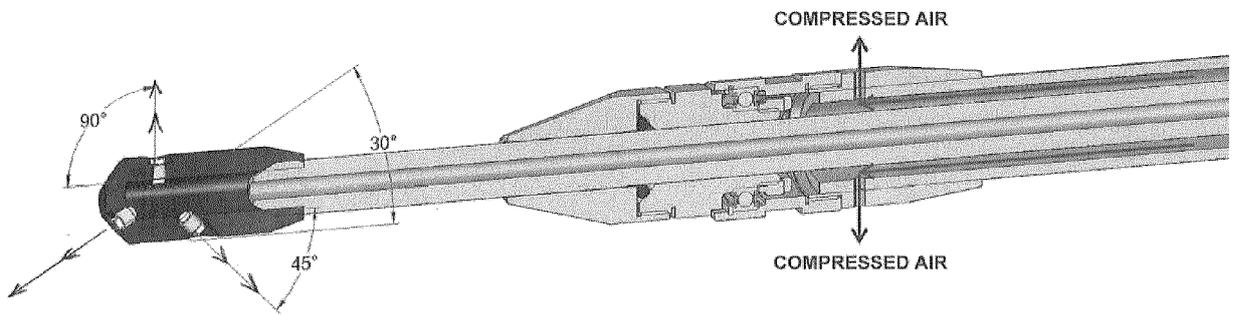


Fig. 3

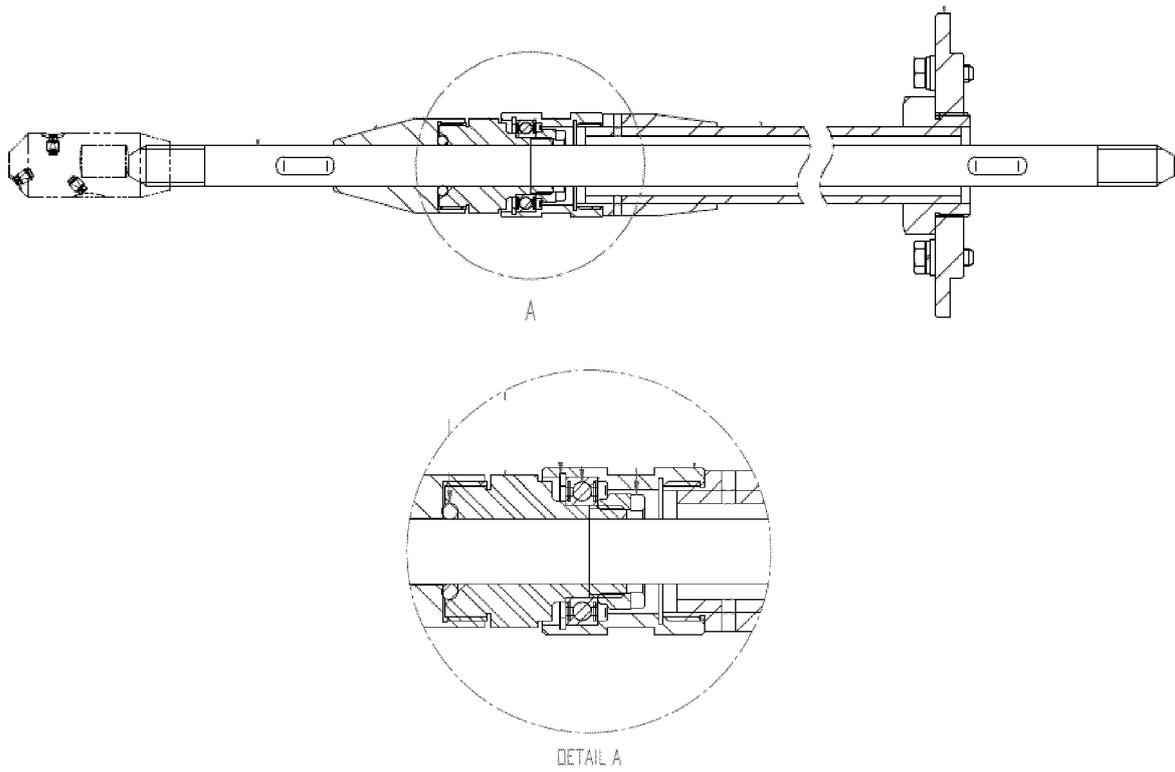


Fig. 4

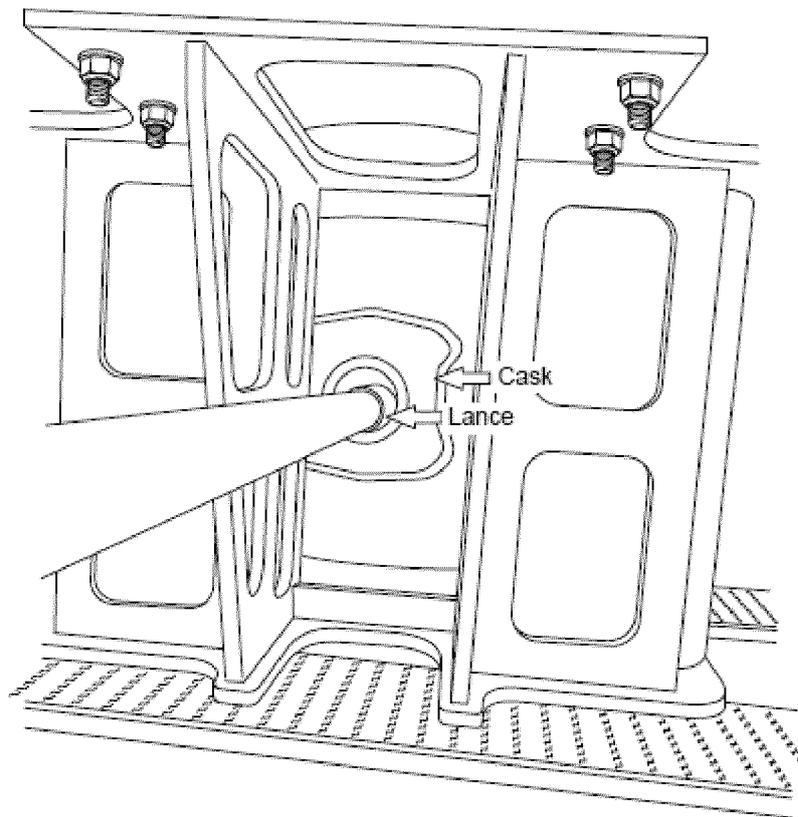


Fig. 5

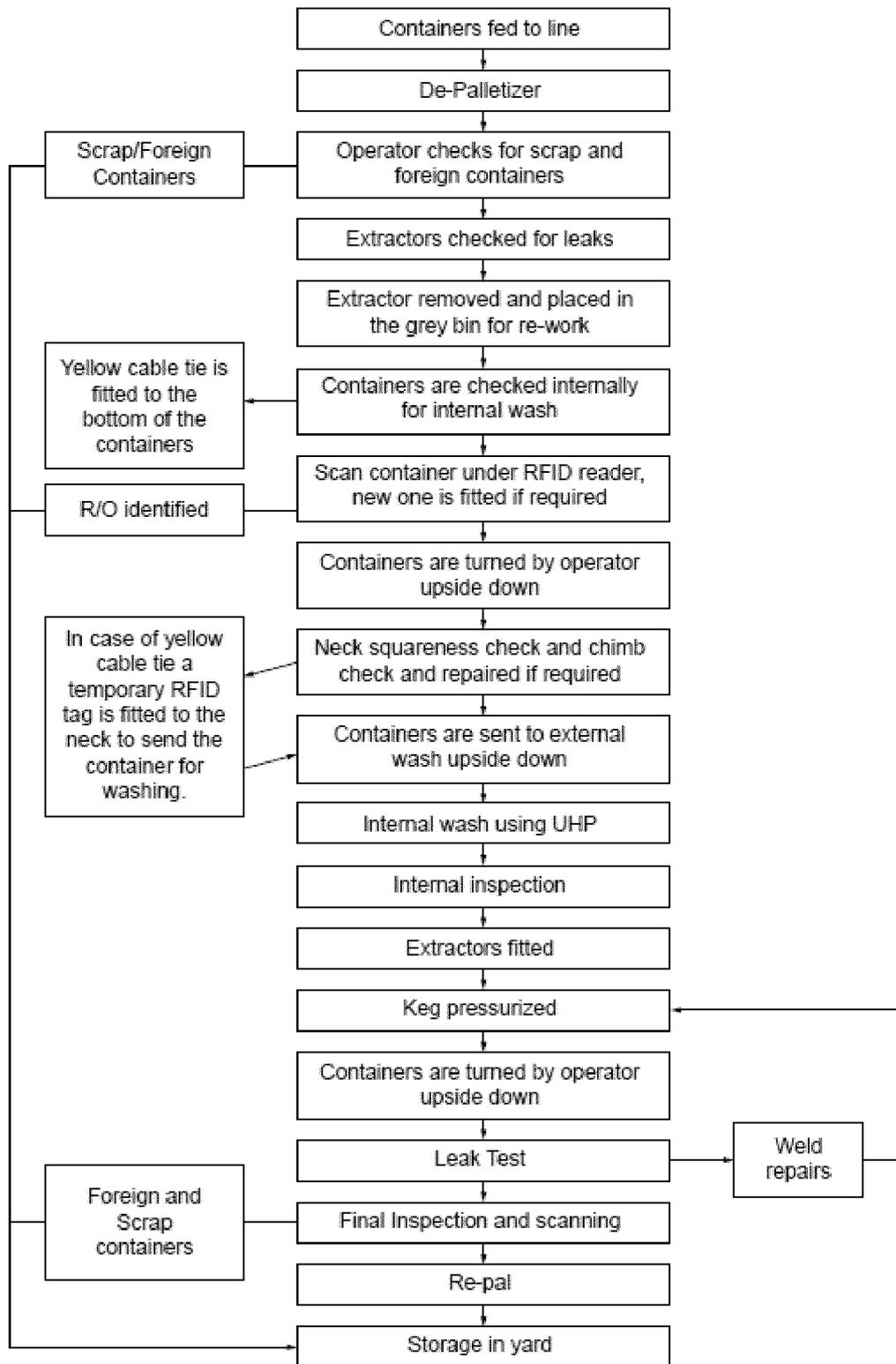


Fig. 6



EUROPEAN SEARCH REPORT

Application Number  
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 August 2020	Examiner van der Zee, Willem
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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Place of search The Hague		Date of completion of the search 14 August 2020	Examiner van der Zee, Willem
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The members are as contained in the European Patent Office EDP file on  
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