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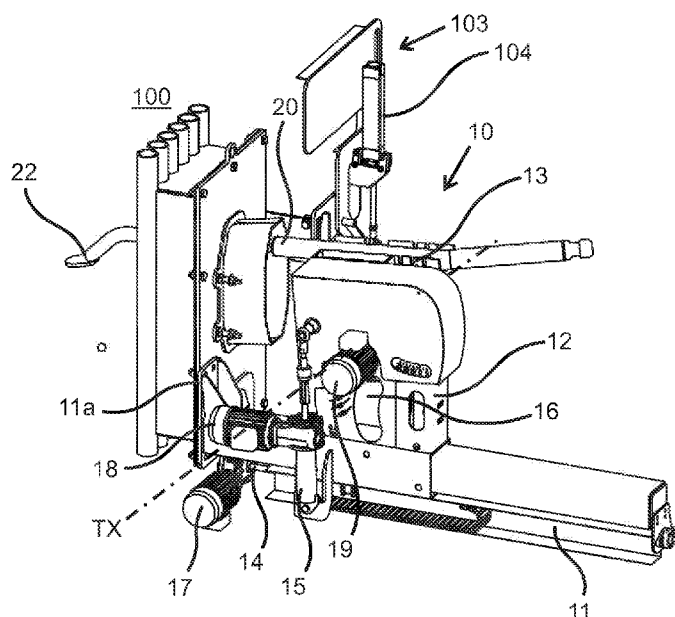


Fig. 1

(57) Abstract: The invention relates to an apparatus for operating a liquor gun (20) of a recovery boiler (100), wherein the apparatus comprises liquor burner rack (10) comprising -a base (11) -a frame (12) attached movably on a base (11) being provided outside a recovery boiler (100) such that the frame (12) is movable back and forth along the base (11) in a direction towards a liquor gun opening (101) at a wall (102) of the recovery boiler (100), -a holder (13) for holding a liquor gun (20) within the frame (12), and attached upwards and downwards movable at the frame (12) and rotatable in respect of a tilting axis (TX) being perpendicular to the directions of the back-and-forth movements of the frame (12) and the holder (13), -an entering element (14) being arranged to move the frame (12) back and forth along the base (11) such that at least part of the liquor gun (20) held by the holder (13) is movable into and out of the recovery boiler (100).



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from the recovery boiler (100) through the liquor gun opening (101), -a lifting element (15) arranged to lift and lower the holder (13) in respect of the frame (12), and -a tilting element (16) arranged to tilt the holder (13) in respect of the tilting axis (TX), and wherein the apparatus further comprises a hatch (103) arranged at the recovery boiler (100) liquor gun opening (101) and arranged to be closed and opened by a hatch actuator (104). In the apparatus according to the invention the hatch actuator (104) is arranged to open and close the hatch (103) automatically according to movements of the frame (12) of the liquor gun rack (10) such that when the frame (12) is moved towards the liquor gun opening (101) the hatch (102) is opened and when the frame (12) is moved away from the liquor gun opening (101) the hatch (103) is closed. The invention relates also to a recovery boiler (100) and a method of operating the apparatus.

**AN APPARATUS FOR OPERATING A LIQUOR GUN OF A RECOVERY BOILER, A RECOVERY BOILER AND A METHOD OF OPERATING THE APPARATUS**

**Field of the invention**

- 5 The present invention relates to an apparatus for operating a liquor gun of a recovery boiler, a recovery boiler, and a method of operating the apparatus.

**Background of the invention**

- Black liquor that is the main fuel of a recovery boiler is sprayed into the furnace of the recovery boiler by using liquor feeding system having several
- 10 liquor guns which spraying nozzles are provided inside the furnace through the respective liquor gun openings at a wall of the recovery boiler. A liquor burner rack is an apparatus that is an important part of such feeding system since it is a device in which a liquor gun is hold, and by means of which the movements of the liquor gun in to and out from the recovery boiler is
- 15 accomplished when the black liquor is fed into the furnace of a recovery boiler. Liquor burner rack is also used for holding the liquor gun during the phases when the liquor gun has been retracted outside from the furnace for maintenance operations such as, for instance, its spraying nozzle cleaning, or a new spraying nozzle replacement.
- 20 Known liquor burner racks or corresponding liquor gun handling/holding devices are described e.g., in publications FI20216129A1, US8444736B1, US7475645B2, EP2199457A and US8443764B2.

- Due to the harsh environment of at the area around the recovery boiler the liquor gun handling/holding arrangements must be very sturdily constructed.
- 25 Regardless of that, physically and chemically attacking conditions at the area where they are operated requires that the liquor guns, and especially their spraying nozzles need be serviced relatively often. For instance, because the spraying nozzle of the liquor gun extends inside the furnace it is constantly exposed to high temperatures and influences of the black

liquor. Therefore, the nozzles of the liquor gun must be cleaned, repaired, or replaced regularly.

Conditions at the region of the recovery boiler plant in vicinity of the liquor gun openings are very hazardous due to possible spraying or splashing hot black liquor from the furnace. Thus, for the safety reasons, it is important  
5 that all the operations carried out for the liquor guns by the employees at that area can be accomplished by entering these risky places as rarely as possible and so that it is possible to stay outside the range of the possible hot black liquor splashes/sprays.

10 Even the usability and maintainability of the liquor gun holding arrangements have been improved during the recent years quite a lot due to development made, there are still some issues relating to performance and operational safety of the liquor burner holding arrangements that need to be further improved. For instance, the ways how the position and orientation of the  
15 liquor gun and its spraying nozzle can be moved and adjusted during its use when the spraying nozzle of the liquor gun is extended inside the furnace and during the maintenance operations when whole the liquor gun is fed outside the furnace are still in many cases rather limited. Thus, when considering the matter, for instance from this point of view, the presently  
20 known apparatuses such as liquor burner racks and their usability need to be further improved, in one hand during the spraying phase and in the other hand when service operations for the liquor guns are carried out.

### **Summary of the invention**

An object of the present invention is to provide an apparatus for operating a  
25 liquor gun arranged to feed black liquor into a recovery boiler combustion furnace which further improves the usability and maintainability of a liquor feeding system of a recovery boiler. Furthermore, it is also an aim of the invention to provide a recovery boiler equipped with such a liquor feeding system comprising one or more apparatuses according to the invention as  
30 well as a method of operating such an apparatus.

The aims of the present invention is achieved because according to the invention an apparatus is provided in which a liquor gun is hold in a liquor burner rack by means of which the liquor gun and its spraying nozzle can be moved back and forth in the direction of entering in and exiting out from the furnace and in which it can be lifted or lowered (i.e., moved vertically) as well as tilted freely and independently from the other movements in any desired position either manually or automatically by using respective actuating and/or controlling elements being fitted allow to carry out these movements flexible and effective manner and wherein the liquor gun opening of a recovery boiler furnace is opened and closed by an automatically operated hatch according to the movements of the liquor burner rack. More specifically, the apparatus for operating a liquor gun of a recovery boiler according to the invention is characterized by what is described in the independent claim 1, the recovery boiler according to the invention is characterized by what is described in the independent claim 13, and the method for operating the apparatus according to the invention is characterized by what is described in the independent claim 14. The dependent claims 2-12 describe advantageous embodiments of the apparatus according to the invention, and the dependent claims 15 and 16 describe advantageous embodiments of the method of operating the apparatus according to the invention.

The advantage of the apparatus according the invention is that it makes operation of the liquor gun more safety and flexible for the operators of the recovery boiler because due to the said automatically opening and closing liquor gun opening hatch they do not need to carry out these hazardous work manually, whereas the liquor gun opening is always opened automatically when the liquor gun is moved in to the furnace and closed when the liquor gun is fed out from the furnace. An additional advantage of the apparatus according to the invention is that due to its liquor burner rack having a possibility to accomplish the different adjustments (i.e., horizontal position, vertical position and tilting angle) of the liquor gun independently from each other, the position and orientation of the liquor gun can be adjusted freely in any desired position and orientation within the space at the area of the liquor

spraying openings of the recovery boiler. These features of the apparatus allow set the liquor gun fully according to the burning conditions in the furnace so that highly efficient and complete burning of the black liquor to be introduced into the furnace is achieved. Furthermore, due to such

5 adjustability combined with the automatically operated liquor gun opening hatch the liquor gun can be set quicker and more easily in appropriate position to carry out required maintenance operations during the time when the liquor gun has been taken out from the recovery boiler. This improves the performance of liquor feeding system and makes its serviceability more

10 straightforward and less time consuming. Due to its above-mentioned features the apparatus also enables to carry out all maintenance operations of the liquor feeding system with reduced safety risks because due to the apparatus having such an automatically opening and closing hatch the operators of the recovery boiler need not to spend any time at the hazardous

15 area nearby the liquor gun opening when the hatch is in open position.

Advantage of the recovery boiler according to invention is that its efficiency and operational safety are improved because having the above-mentioned automatically opening and closing liquor gun opening hatches and independently working position adjustments of the liquor gun at its liquor

20 burner racks which enables to position the liquor guns of the liquor spraying system more optimal manner. Also, the maintainability of the recovery boiler is improved because the maintenance operations for the liquor feeding system can be carried out more safely and effectively due to the above-mentioned flexible adjustability and usability of the liquor guns caused by the

25 above-mentioned features of the apparatuses arranged in connection with the furnace in such recovery boiler.

Advantage of the method of operating the liquor burner rack according to the invention is that it provides possibility move the liquor gun into the furnace and out from the furnace as well as to adjust and set the position and

30 orientation of the liquor guns in desired manner quicker and in more safely manner. Also, due to the method according to the invention, the spraying nozzle cleaning and liquor gun exchange operations can be accomplished

faster, safer, and more straightforward manner, and further, in case of fully automated system, in a way where the operators need not to enter the hazardous areas of the recovery boiler plant during its operation at all.

### **Brief description of the drawings**

5 In the following, the invention will be described in more detail with reference to the appended drawings wherein

Fig. 1 shows a portion of a recovery boiler wall and an embodiment of an apparatus comprising a liquor burner rack being equipped with actuator-based actuating elements seen obliquely from side when the liquor burner rack being assembled at the recovery boiler is in position where the liquor gun hold by the liquor burner rack is extended into the furnace of the recovery boiler,

10

Fig. 2 shows a portion of a recovery boiler wall as well as another embodiment of an apparatus comprising a liquor burner rack being entrusted manual actuating elements and a spraying nozzle cleaning device seen obliquely from back when the liquor burner rack being assembled at the recovery boiler is in position where the liquor gun hold by the liquor burner rack is retracted outside the furnace of the recovery boiler,

15

Fig. 3 shows the embodiment of the apparatus of figure 2 seen obliquely from side without the portion of recovery boiler wall, and

20

Fig. 4 shows front part of the liquor gun and the spraying nozzle cleaning device of figures 2 and 3 seen obliquely from the direction of the interior of the furnace in a position wherein the liquor gun is extended into the furnace through the liquor gun opening at the recovery boiler wall.

### **25 Detailed description of some advantageous embodiments**

Figures 1-4 show some embodiments of the apparatus according to the invention which many features are identical to each other, but which have also some differences. An embodiment shown in the figure 1 the movements of the liquor burner rack 10 and the movements of the liquor gun 20 in respect of the liquor burner rack 10 are all realized by actuators 17-19

30

whereas in the embodiments shown in the figures 2 and 3 the linear movements and tilting are accomplished by manually operable actuating elements. In the figures 1 and 3 are shown embodiments wherein the liquor burner rack 10 includes a spraying nozzle cleaning device 21.

- 5 The apparatus according to the invention, e.g., such embodiments as it is shown in the figures 1-4 are typically assembled at a recovery boiler plant in front of the liquor gun opening 101 at the recovery boiler 100 wall 102 such that the spraying nozzle 22 of the liquor gun 20 can be moved by applying the functions of the liquor burner rack 10 into the furnace i.e., to the position  
10 shown in the figures 1 and 4 and completely outside the wall of the recovery boiler, i.e., to the position shown in the figure 2. To achieve this the liquor burner rack 10 must have certain functionality since usually the liquor gun 20 itself does not have any means for moving and setting it in respect of the liquor gun opening 101 of the recovery boiler 100. Thus, also these  
15 functionalities of the liquor burner rack 10 are those that plays an important role in respect of those technical problems that the present invention tends to solve.

The liquor burner racks 10 of the embodiments shown in the figures 1 to 4 comprise a base 11 and a frame 12 arranged movable on a base 11. By  
20 means of the base 11 the frame 12 is attachable outside a recovery boiler 100 such that the frame 12 is movable back and forth along the base 11 towards to and away from a liquor gun opening 101 at recovery boiler wall 102. In these liquor burner racks 10 the attachment is accomplished by a bracket 11a at the front end of the base 11. The bracket 11a includes a  
25 flange which has screw holes through which the flange can be attached at the recovery boiler wall 102 by screws or corresponding fastening elements. By means of such attachment the liquor burner rack 10 of the apparatus can be secured to its intended position with minimal amount of additional supporting structures at the area of the liquor gun openings 101.

- 30 In all the embodiments shown in the figures 1-4 the liquor burner racks 10 comprise also a holder 13 for holding a liquor gun 20 within the frame 12. The holder 13 is attached at the frame 12 upwards and downwards movably

and rotatably in respect of a tilting axis TX shown in the figures 1 and 3. The tilting axis TX is preferably perpendicular to the directions of the back-and-forth movements of the frame 12 and the holder 13. Tilting axis TX is formed by providing a pivot joint between the frame 12 and the holder 13 such that  
5 holder 13 can rotate amount of an angle in respect of the frame 12. The rotation angle is limited to avoid liquor gun 20 hitting to the edges of the liquor gun opening 101. However, the allowable range of the tilting angle has been designed so that liquor gun 20 can be tilted maximally within the whole cross-sectional area of the liquor gun opening 101. Thus, in the position  
10 where the spraying nozzle 22 is extended inside the furnace, any of those tilting angles wherein the spraying nozzle 22 or the other portions of the liquor gun 20 does not hit the edges of the liquor gun opening 101 can be freely chosen.

The liquor burner rack 10 of the figures 1-4 comprises further an entering  
15 element 14, a lifting element 15 and a tilting element 16. The entering element 14 is a device that is arranged to move the frame 12 back and forth along the base 11 such that at least part of the liquor gun 20 hold by the holder 13 is movable into and out from the recovery boiler 100 through the liquor gun opening 101. The lifting element 15 is a device that has been  
20 arranged to lift and lower the holder 13 in respect of the frame 12, and the tilting element 16 is a device that has been arranged to tilt the holder 13 in respect of the tilting axis TX. In embodiments wherein these movements are accomplished manually the entering element 14, the lifting element 15 and/or the tilting element 16 have each manually operable mechanism such  
25 as e.g., a manually operable hand wheel, a lever, a handle, or some combination of the latter for accomplishing the respective movements. In embodiments having liquor burner rack with motorized movements, the entering element 14 comprises an entering actuator 17 for moving the frame 12 back and forth along the base 11, the lifting element 15 comprises a lifting  
30 actuator 18 for lifting and lowering the holder 13 and the tilting element 16 comprises a tilting actuator 19 for tilting the holder 13. These actuators can be e.g., electric motors or pneumatically or hydraulically operated motors or actuators having linearly moving end effector (i.e., e.g., cylinders). In

providing linear movements, such as movement of the entering element and lifting element actuators forming linear movement are advantageous since in such cases rotative movements need not to change into linear movements which makes the respective mechanisms simpler.

- 5 In some embodiments of the apparatus, the functions of the liquor burner rack 10 are fully or partly automatized. In such embodiments the liquor burner rack 10 may comprise control unit (not shown) for controlling the movements of the liquor burner rack 10 and/or the holder 13 realized by the entering actuator 17, the lifting actuator 18 and/or the tilting actuator 19  
10 automatically. Automatization naturally improves further the usability of the apparatus. In addition, it also decreases safety risks for the employees working at the area since it reduces need to carry out manual work at area where above-described safety risks exist.

- In embodiment of the apparatus shown in the figures 2-4 the liquor burner  
15 rack 10 comprises a spraying nozzle cleaning device 21 configured to clean a spraying nozzle 22 of a liquor gun 20 hold by the holder 13. However, also embodiment of figure 1 may be equipped with such a spraying nozzle cleaning device. Typically, the spraying nozzle cleaning device 21 comprises a cleaning blade 23 being movable by a cleaning blade moving element 24  
20 in respect of the spraying nozzle 22 so that scale and deposits formed at the spraying nozzle 22 is removed from the spraying nozzle 22. For that purpose, the cleaning blade moving element 24 has a mechanism for moving the cleaning blade 23 back and forth along the spraying nozzle 22. Also, the spraying nozzle cleaning device 21 may be manually and/or  
25 automatically controlled. Thus, it has a manually and/or automatically controllable actuator 25 for moving the cleaning blade 23. The spraying nozzle cleaning device 21 simplifies maintenance of the liquor gun 20 further and reduces the need to carry out spraying nozzle 22 cleaning manually. It also extends the service life of the liquor gun 20 and its spraying nozzle 22  
30 because cleaning can be carried out more frequently than in case it would be made manually by the operators of the recovery boiler.

During the operation of the recovery boiler deposition and fouling are formed on the spraying nozzles of the liquor guns. It has been found that thickest deposition is formed on the upper part of the nozzle right after a bend that typically locates at the spraying nozzle before the straight part which ends to the tip of the spraying nozzle (as the case is also with the liquor gun 20 shown in the figures 1-4). Furthermore, it has been found that the depositions on the top of the spraying nozzle at the above-mentioned areas on the spraying nozzles are the most harmful because hot and burning depositions at those locations tend to deteriorate the nozzles most likely and usually in worst possible manner. For this this reason the cleaning blade 23 of the spraying nozzle cleaning device 21 in the liquor burner rack 10 shown in the figures 2-4 has been designed so that it primarily detaches deposition formed on these portions of the spraying nozzle 22. This has been achieved so as it can be seen from the figure 4 i.e., that the cleaning blade 23 is disposed on both sides the spraying nozzle 22 such that it extends from below the spraying nozzle 22 at least partly behind the top portion of the spraying nozzle 23. Such configuration is also advantageous because it has been seen in practical tests that such a cleaning blade breaking deposition on the top portion and both sides of the spraying nozzle clean it most completely.

Alternatively, the cleaning device may be realized so that the cleaning blade is arranged to move on the top portion of the spraying nozzle. In such embodiment the cleaning device is placed above the liquor gun which allows to place, e.g., a corresponding cleaning blade to that of shown in the figures 3 and 4 but turned upside down (i.e., 180° around) so that it's horizontal portion scrapes the top portion of the spraying nozzle, and its vertical flanges protrude downwards.

The embodiments of the apparatus shown in the figures 1-4 having liquor burner racks 10 comprise at liquor gun openings 101 of the recovery boiler 100 further a hatch 103. As can be seen from figures 1 and 2 the hatch 103 is, in these cases attached rotatably to the side of the liquor gun opening 101 such that it can be rotated in plane being parallel to the plane of the

recovery boiler wall 102 such that it can be turned in front of the liquor gun opening 101 when it is used to close the liquor gun opening 101, and away from the liquor gun opening 101 when it is used to open the liquor gun opening 101. For the safety reasons it is best if it is arranged to be closed and opened by a hatch actuator 104. Thus, in the apparatus according to the present invention the hatch 103 is always actuated by a hatch actuator such as the hatch actuator 104.

Furthermore, in the apparatuses shown in the figures 1-4 the hatch 103 is operated fully automatically such that the hatch actuator 104 has been arranged to open and close the hatch 103 according to movements of the frame 12 of the liquor gun rack 10. Most preferably this would happen so that when the frame 12 of the liquor burner rack 10 is moved toward the liquor gun opening 101 the hatch 102 is opened and when the frame 12 is moved away from the liquor gun opening 101 the hatch 103 is closed. Thus, opening and closing of the hatch 103 in this manner automatically according to the movements of the frame 13 of the liquor burner rack 10 causes that operator of the recovery boiler need not to enter hazardous area close to the recovery boiler furnace during its operation which remarkably improves operational safety of the recovery boiler. Of course, this may be arranged to happen independently on the way how the liquor burner rack is controlled or moved (i.e., to work also with fully or partly a manually controlled and actuated liquor burner rack).

When operating the apparatus shown in the figures 1 to 4 according to the method of the invention it comprises at least following phases:

-the frame 12 of the liquor burner rack 10 is moved along the base 11 towards to the liquor gun opening 101 at the recovery boiler wall 102

-right before the moment when the frame 12 with the liquor gun 20 arrives close to the liquor gun opening 101 the hatch 103 is automatically opened (i.e., moved away from the liquor gun opening 101) by the hatch actuator 104. Alternatively, the hatch 103 can be opened e.g., just before the start of the movement of the frame 12 of the liquor burner rack 10.

-the frame 12 of the liquor burner rack 10 is moved along the base 11 further towards the recovery boiler (100) such that at least part of the liquor gun 20 moves into and/or out from the recovery boiler 100 through the liquor gun opening 101,

- 5    -the liquor gun 20 is lifted and/or lowered in respect of the frame 12 of the liquor gun rack 10 by lifting and/or lowering the holder 13 in some chosen elevation with the lifting element 15,

-the liquor gun 20 is tilted in respect of the tilting axis TX of the holder 13 by tilting the holder 13 in a desired orientation with the tilting element 16.

- 10   Due to the design of the liquor burner rack 10 the latter two phases can be carried out at least partly simultaneously or totally independently from each other. Such adjustments of the liquor gun 10 vertical position and orientation is a matter which makes the liquor burner rack 10 very flexible and easily adaptable with the other functions of the recovery boiler 100. For instance,  
15   this allows tilting and lifting or lowering the holder 13 simultaneously so that liquor gun 20 tilts in respect of a virtual rotation axis at a desired position e.g., in respect of the spraying nozzle 22.

- Furthermore, in such embodiments where the liquor burner rack includes the spraying nozzle cleaning device 21, cleaning of the spraying nozzle 22 with  
20   the spraying nozzle cleaning device 21 may be accomplished during, after or before any of the above-mentioned phases. Thus, the spraying nozzle 22 cleaning by using the spraying nozzle cleaning device 21 is possible when the spraying nozzle 22 is extended inside the furnace (as shown in the figure 4) or when the liquor burner rack 10 is moved in the position wherein the  
25   liquor gun 20 is outside the furnace.

In case, when the liquor gun is moved out from the recovery boiler the hatch 103 is automatically closed after the frame 12 has been moved far enough so that the liquor gun 20 is at least outside the liquor gun opening 101 and preferably completely outside the recovery boiler wall 102.

It should be notified that the apparatus, the recovery boiler, and the method of operating the apparatus according to the invention may be accomplished in many ways departing from the above-described embodiments. For instance, in some embodiments only the entering element of the liquor burner rack has actuator for realizing movements of the frame along the base but the lifting and lowering as well as the tilting movements may be accomplished by means of manually operated lifting and tilting elements. Alternatively, any other of the entering element, the lifting element or the tilting element may include actuator in case one or two of the others have manually operated actuating means. However, in a recovery boiler equipped with an apparatus according to the invention there is always an automatically operating hatch for closing the liquor gun opening, In the different embodiments of the apparatus the hatch may be such that it is turned or placed on the liquor gun opening in a way that differs that of the above-described embodiments. For instance, instead of turning the hatch it may have been arranged to move horizontally to either of the sides of the liquor gun opening or vertically above or below the liquor gun opening. Furthermore, the method of operating liquor burner rack of the apparatus may include one or more further method steps. For instance, there may be a phase where the liquor burner rack is moved further backwards from the position where it is when the spraying nozzle is cleaned or exchanged, i.e., to a position where the whole liquor gun can be detached from the holder or where some maintenance operations for the liquor burner racks other portions can be carried out more safely because of the position being further away from the furnace of the recovery boiler.

Thus, the invention is not limited to the above-described embodiments but can vary within scope of the appended claims.

## Claims

1. An apparatus for operating a liquor gun (20) of a recovery boiler (100), wherein the apparatus comprises a liquor burner rack (10) comprising

-a base (11)

5        -a frame (12) attached movably on a base (11) being provided outside a recovery boiler (100) such that the frame (12) is movable back and forth along the base (11) in a direction towards a liquor gun opening (101) at a wall (102) of the recovery boiler (100),

10        -a holder (13) for holding a liquor gun (20) within the frame (12), and attached upwards and downwards movable at the frame (12) and rotatable in respect of a tilting axis (TX) being perpendicular to the directions of the back-and-forth movements of the frame (12) and the holder (13),

15        -an entering element (14) being arranged to move the frame (12) back and forth along the base (11) such that at least part of the liquor gun (20) held by the holder (13) is movable into and out from the recovery boiler (100) through the liquor gun opening (101),

-a lifting element (15) arranged to lift and lower the holder (13) in respect of the frame (12), and

20        -a tilting element (16) arranged to tilt the holder (13) in respect of the tilting axis (TX),

and wherein the apparatus further comprises a hatch (103) disposed at the liquor gun opening (101) and arranged to be opened and closed by a hatch actuator (104), **characterized** in that the hatch actuator (104) is arranged to  
25        open and close the hatch (103) automatically according to movements of the frame (12) of the liquor burner rack (10) such that when the frame (12) is moved towards the liquor gun opening (101) the hatch (103) is opened and when the frame (12) is moved away from the liquor gun opening (101) the hatch (103) is closed.

2. The apparatus according to claim 1, wherein the entering element (14), the lifting element (15) and/or the tilting element (16) comprise a manually operable hand wheel, a lever, a handle, or combination of the latter for accomplishing the respective movement.

5 3. The apparatus according to claim 1 or 2, wherein the entering element (14) comprises an entering actuator (17) for moving the frame (12) back and forth along the base (11).

4. The apparatus according to any of preceding claims, wherein the lifting element (15) comprises a lifting actuator (18) for lifting and lowering the  
10 holder (13).

5. The apparatus according to any of preceding claims, wherein the tilting element (16) comprises a tilting actuator (19) for tilting the holder (13).

6. The apparatus according to any of claims 3-5, wherein the entering actuator (17), lifting actuator (18) and/or tilting actuator (19) are manually  
15 controllable.

7. The apparatus according to any of claims 3-6, wherein the liquor burner rack (10) comprises a control unit for controlling the movements of the liquor burner rack (10) and/or the holder (13) realized by the entering actuator (17), the lifting actuator (18) and/or the tilting actuator (19) automatically.

20 8. The apparatus according to any of preceding claims, wherein the liquor burner rack (10) comprises a spraying nozzle cleaning device (21) arranged to clean a spraying nozzle (22) of a liquor gun (20) hold by the holder (13).

9. The apparatus according to claim 8, wherein the spraying nozzle cleaning device (21) comprises a cleaning blade (23) being movable by a cleaning  
25 blade moving element (24) in respect of the spraying nozzle (22) so that at least deposits formed at the top portion of the spraying nozzle (22) is removed from the spraying nozzle (22).

10. The apparatus according to claim 8 or 9, wherein the cleaning blade (23) is disposed on both sides the spraying nozzle (22) such that it extends from below the spraying nozzle (22) at least partly behind the top portion of the spraying nozzle (23).

5 11. The apparatus according to claim 9 or 10, wherein the cleaning blade moving element (24) comprises a mechanism for moving the cleaning blade (23) back and forth along the spraying nozzle (22).

12. The apparatus according to any of claims claim 9 to 11, wherein the spraying nozzle cleaning device (21) comprises a manually and/or  
10 automatically controllable actuator (25) for moving the cleaning blade (23).

13. A recovery boiler (100), comprising the apparatus according to any of claims 1 to 12.

14. A method of operating the apparatus according to any of claims 1-12 comprising method steps of

15 -moving the frame (12) of the liquor gun rack (10) along the base (11) towards to the liquor gun opening (101) at the recovery boiler wall (102),

-automatically opening the hatch (103) of the apparatus by moving the hatch (103) away from the liquor gun opening (101),

-moving the frame (12) of the liquor gun rack (10) along the base (11) further  
20 towards the recovery boiler (100) such that at least part of the liquor gun (20) moves into the recovery boiler (100) through the liquor gun opening (101),

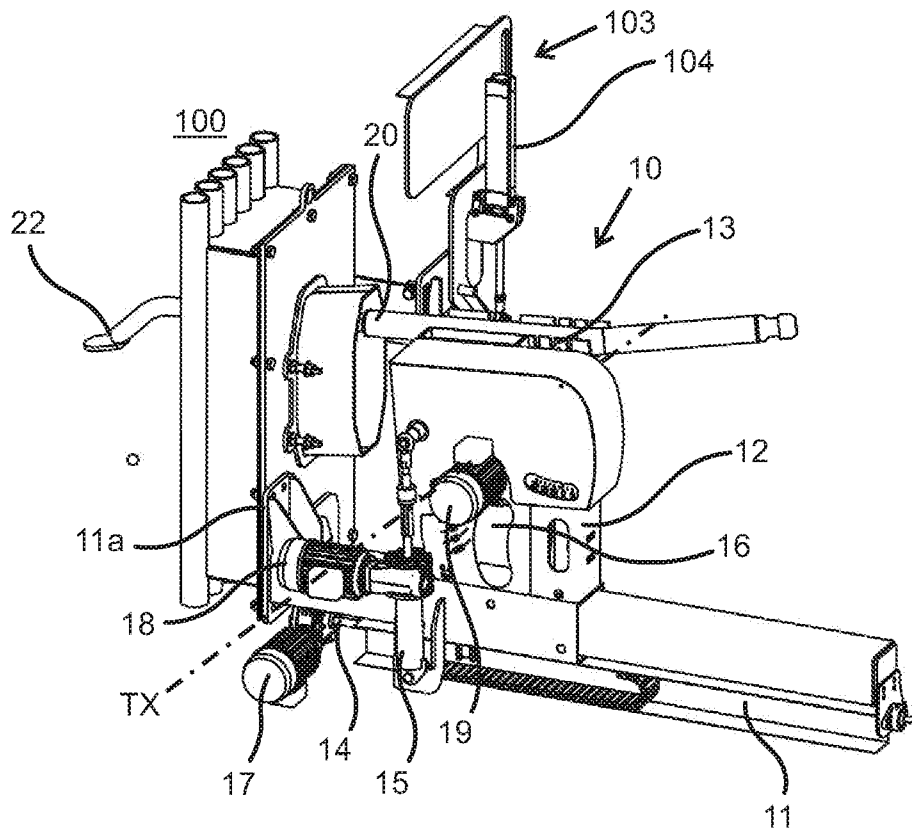
-lifting and/or lowering the liquor gun (20) in respect of the frame (12) of the liquor gun rack (10) by lifting and/or lowering the holder (13) with the lifting element (15).

25 -tilting the liquor gun (20) in respect of the tilting axis (TX) of the holder (13) by tilting the holder (13) with the tilting element (16).

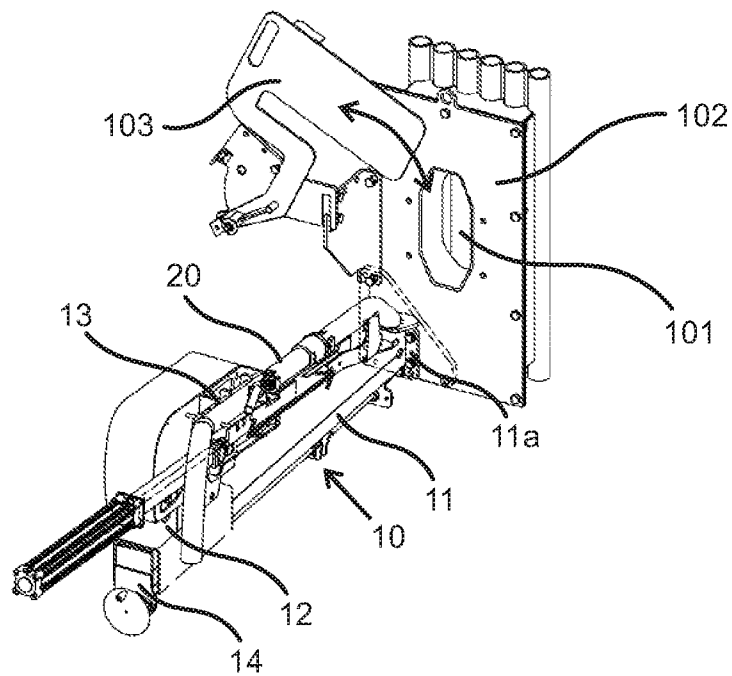
15. The method according to claim 14 wherein the method comprises a method step of cleaning the spraying nozzle (22) with the spraying nozzle cleaning device (21).

- 5 16. The method according to claim 14 or 15 wherein the method comprises a method step of moving the frame (12) of the liquor gun rack (10) along the base (11) out from the recovery boiler (100) into a position where the liquor gun (20) is at least outside the liquor gun opening (101) and automatically closing the hatch (103) by moving the hatch (103) on the liquor gun opening (101).

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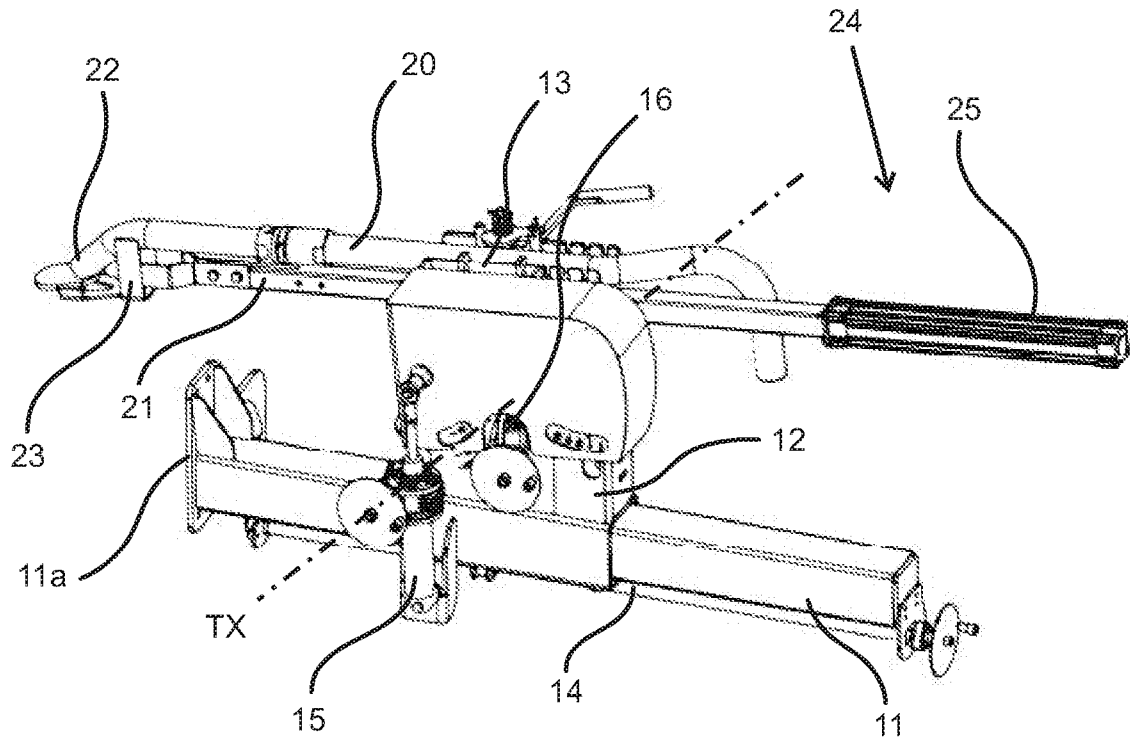


**Fig. 1**

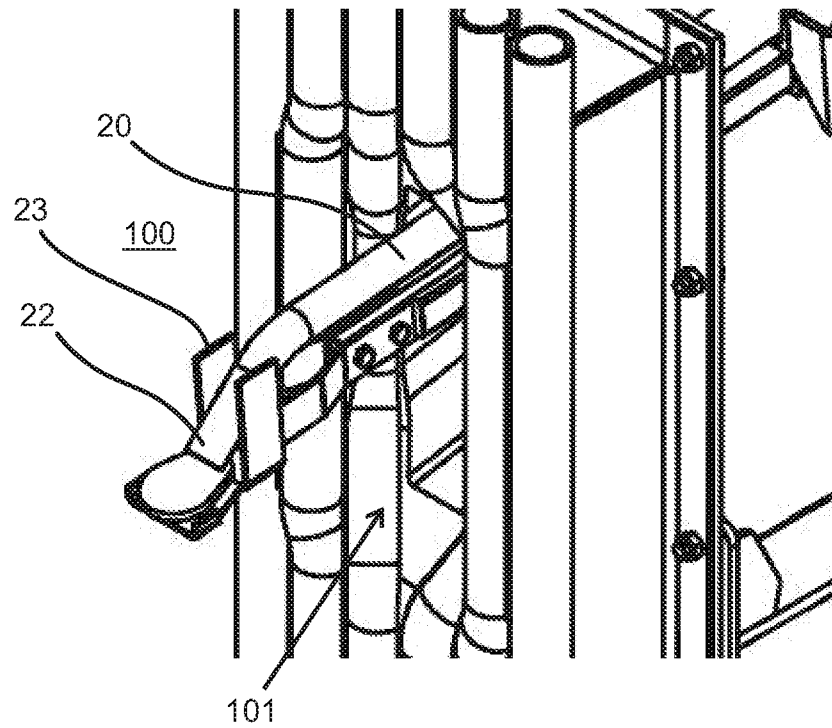


**Fig. 2**

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**Fig. 3**



**Fig. 4**

## INTERNATIONAL SEARCH REPORT

International application No

PCT/FI2024/050027

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                              |                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br><b>INV. F23C5/06 F23D11/02 F23G7/04</b><br><b>ADD.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                              |                                                                         |
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                              |                                                                         |
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br><b>F23C F23D F23G</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                              |                                                                         |
| 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)<br><b>EPO-Internal, WPI Data</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                              |                                                                         |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                              |                                                                         |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                           | Relevant to claim No.                                                   |
| <b>A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>WO 2015/199597 A1 (SUPPLY Ö VIK AB [SE])</b><br><b>30 December 2015 (2015-12-30)</b><br><b>page 1, lines 6,7; claims 1,2; figures 2-7</b><br><b>page 4, line 2 - line 10</b><br><b>page 4, line 15 - page 5, line 10</b><br><b>page 5, line 30 - page 6, line 12</b><br><b>page 6, line 27 - page 7, line 24</b><br>----- | <b>1-16</b>                                                             |
| <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                              |                                                                         |
| <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"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</p> <p>"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</p> <p>"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</p> <p>"&amp;" document member of the same patent family</p> |                                                                                                                                                                                                                                                                                                                              |                                                                         |
| Date of the actual completion of the international search<br><b>2 April 2024</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                              | Date of mailing of the international search report<br><b>10/04/2024</b> |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                              | Authorized officer<br><b>Hauck, Gunther</b>                             |

## INTERNATIONAL SEARCH REPORT

### Information on patent family members

International application No

PCT/FI2024/050027

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| <b>WO 2015199597 A1</b>                   | <b>30-12-2015</b>   | <b>SE 1400320 A1</b>       | <b>25-12-2015</b>   |
|                                           |                     | <b>WO 2015199597 A1</b>    | <b>30-12-2015</b>   |
| -----                                     |                     |                            |                     |