



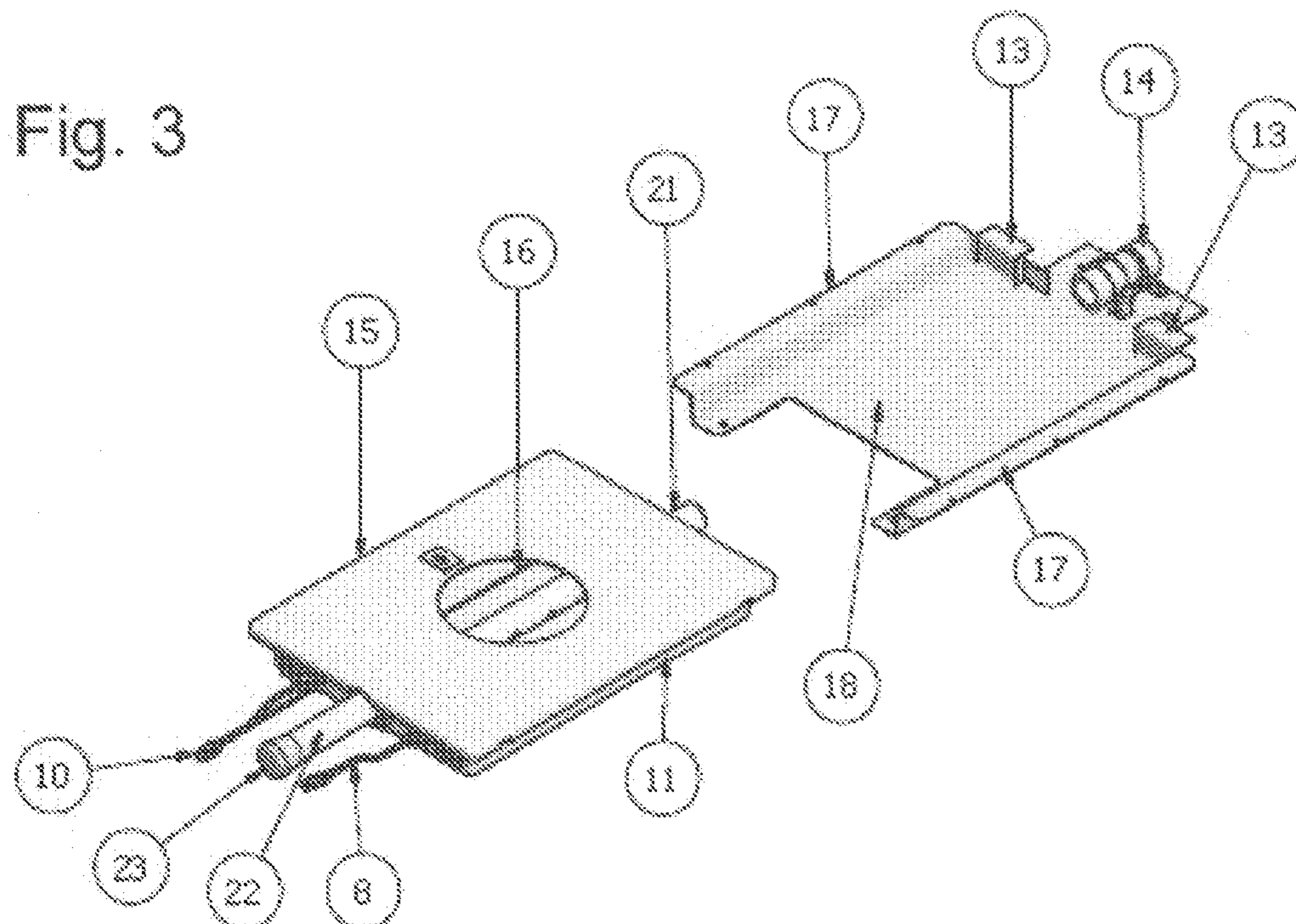
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CONDENSATION PROVENANT D'UNITES DE REFRIGERATION ET DE REFROIDISSEMENT
(54) Title: ARRANGEMENT FOR ACCUMULATION AND EVACUATION OF DEFROSTING AND CONDENSATION
WATER FROM REFRIGERATION AND COOLING UNITS



(57) **Abrégé/Abstract:**

Arrangement for accumulation and evacuation of water such as defrosting and condensation water from refrigeration units (4), the system including a piping arrangement (1) with a vertical pipe section (2) extending from a water evacuation unit (A) provided in conjunction with the respective refrigeration unit; discharge valves (3), one for each unit (A); one or more liquid reservoir (11) for each unit (A); one or more vacuum pumps (5); air inlet nozzles (6); a control unit (7); one or more level switches (8, 10) and air conduit inlet opening (9) for each vertical pipe (2). Each of the water evacuation units (A) includes a docking station (18) and a water collection tray (11) preferably to be slideably provided within the docking station (18), whereby each unit (A) is custom made to fit between the refrigeration unit (4) and floor where the refrigeration units are placed.

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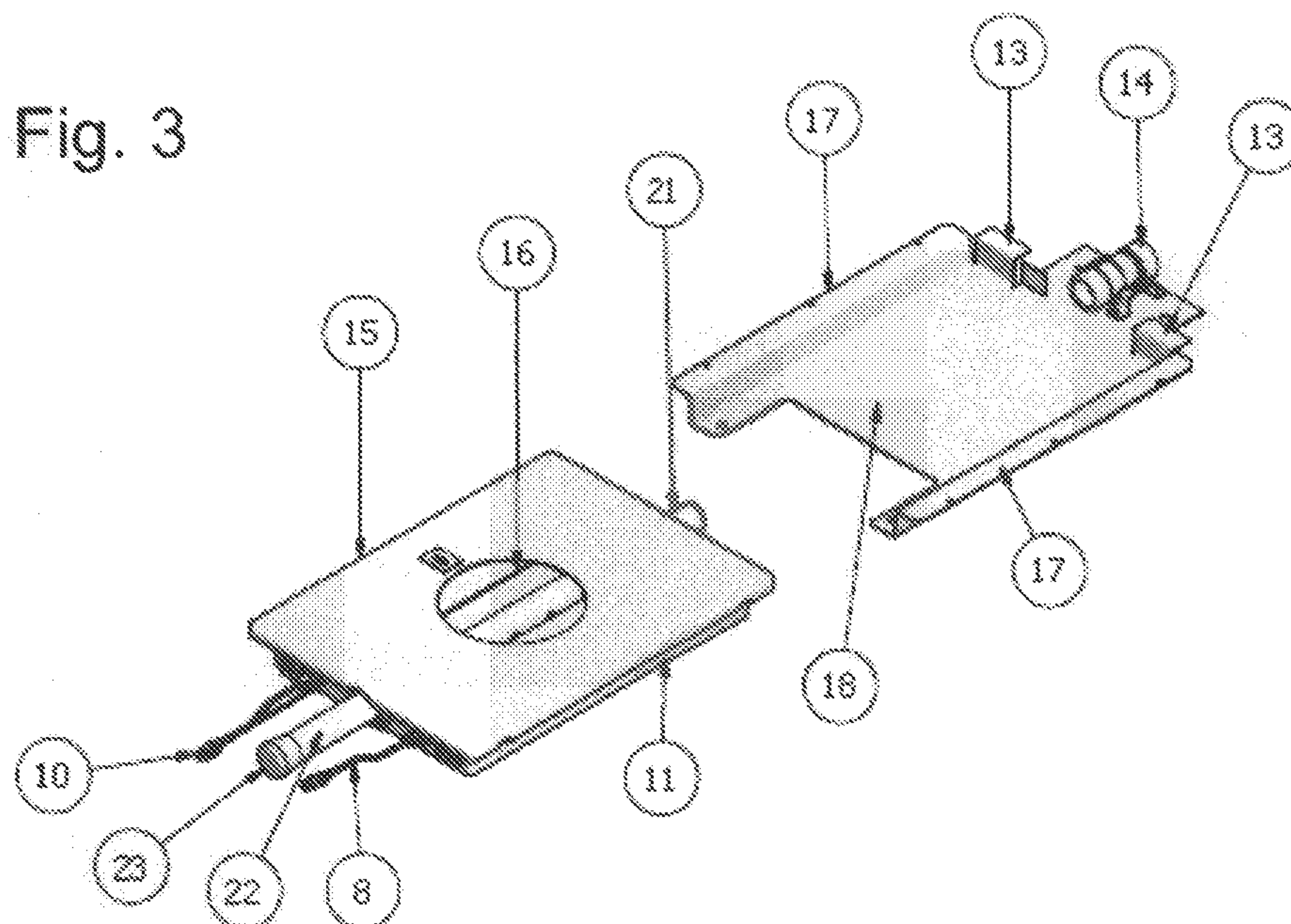
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(54) Title: ARRANGEMENT FOR ACCUMULATION AND EVACUATION OF DEFROSTING AND CONDENSATION WATER FROM REFRIGERATION AND COOLING UNITS

Fig. 3



(57) Abstract: Arrangement for accumulation and evacuation of water such as defrosting and condensation water from refrigeration units (4), the system Including a piping arrangement (1) with a vertical pipe section (2) extending from a water evacuation unit (A) provided in conjunction with the respective refrigeration unit; discharge valves (3), one for each unit (A); one or more liquid reservoir (11) for each unit (A); one or more vacuum pumps (5); air inlet nozzles (6); a control unit (7); one or more level switches (8, 10) and air conduit inlet opening (9) for each vertical pipe (2). Each of the water evacuation units (A) includes a docking station (18) and a water collection tray (11) preferably to be slideably provided within the docking station (18), whereby each unit (A) is custom made to fit between the refrigeration unit (4) and floor where the refrigeration units are placed.

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WO 2018/174719 A1

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"Arrangement for accumulation and evacuation of defrosting and condensation water from refrigeration and cooling units".

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The present invention relates to a. arrangement in a system for accumulation and evacuation of water such as defrosting, condensation and cleaning water from refrigeration and cooling units. The system includes a reservoir, tank or container holding an amount of liquid, a piping arrangement and a vacuum pump and a control device to start and stop the vacuum pump.

Such systems have been increasingly used for the evacuation of condensed water from refrigeration and cooling units in warehouses and stores where drainage in the floor is not available. The condensed water is instead "lifted" in a vertical pipe from a water tank provided in conjunction with the refrigeration or cooling unit to a piping arrangement provided in the ceiling above such unit and further to a vacuum pump provided in an available machine room or other suitable room in the subject warehouse. The pumps commonly used in such systems are liquid ring screw pumps, with or without a macerator as further described below, which can handle liquid containing particles that may be ground to smaller pieces. Pumps of this kind are commonly used in vacuum sewage systems on board ships and on offshore installations. However, such systems are also increasingly being used on land due to reduced water requirement and easy handling and treatment of waste water, as well as its flexibility as regards installation of piping and layout given by such systems.

The applicant of the present application introduced in 1986, cf. EP patent No. 0 287 350, for the first time the novel vacuum sewage system where the vacuum in the system was generated by means of a liquid ring screw pump of this kind and where the pump is used as well to discharge the sewage from a vacuum tank or the like to which it is connected.

EP patent No. 0 454 794, also filed by the applicant, further shows a revolutionary improvement of a vacuum sewage system where the liquid ring screw pump is provided with a grinder or macerator and is connected directly with the suction pipe of the system, whereby vacuum is generated in the sewage suction pipe and sewage is discharged directly from the system by means of the pump.

The present invention may, or may not include such grinder provided at the inlet end of the Archimedes screw rotor.

As stated above, vacuum systems have been increasingly used for the evacuation of condensed water from refrigeration units in warehouses and stores where drainage in the floor is not available. The vacuum in such systems is normally between 60 and 50 kPa (40 and 50 % below atmospheric pressure), implying that the condensed or defrosted water having a density of 1 kg/dm³ is lifted 4 – 5 meters at a maximum. With the present solution, the water may be lifted twice the height, i.e. 8 – 10 meters with the same vacuum by letting air into the suction pipe as explained in a later section. Thus, it is possible to evacuate condensed water in warehouses where the height from the floor to the ceiling is doubled. However, due to the narrow space between the individual refrigeration unit and the floor it has been a challenge to exploit this evacuation principle. The height between the floor and bottom of the modern refrigeration units is just 5 – 7 centimetres and therefore it has been difficult to obtain sufficient space for a container to collect the condensed water. With the present invention is provided an arrangement making it possible to evacuate condensed water and defrosting water effectively using the “floor to ceiling evacuation principle”.

The arrangement according to the invention is characterized by the features as defined in the attached independent claim 1.

Advantageous embodiments of the invention are further defined in the attached
5 dependent claims 2 – 7.

The invention will be further described in the following by way of example and with reference to the enclosed figures, where:

Fig. 1 illustrates an example of a system for removal of water from refrigeration
10 units including the arrangement according to the invention.

Fig. 2 shows a section denoted A in scale 1:5 of a water evacuation unit according to the invention.

Fig. 3 shows the unit in Fig. 2 as such in expanded view and in more detail.

Fig. 4 shows a water tray as part of the unit in Figs. 1 and 2 in more detail.

15 Fig. 1 shows, as stated above, a system according to the invention for removing defrosting water or condensed water from refrigeration or cooling units 4 and/or grey water (cleaning water) from the cleaning of such units 4 in warehouses. The system includes a piping arrangement (a pipe loop) 1 with a vertical pipe section 2 extending
20 from each water evacuation unit A provided in conjunction with the respective refrigeration unit 4; discharge valves 3, one for each unit A; liquid reservoirs 11 (tray, see Fig. 4) for each unit A; a vacuum pump 5; air inlet nozzles 6 (see Fig. 4); a central control unit 7; level sensors or switches 8 and 10 (see Fig. 4), and air conduit inlet opening 9 for each vertical pipe 2. There may be one or more water evacuation unit A
25 for each refrigeration or cooling unit 4.

The main features of the invention are further shown in Figs. 2, 3 and 4 and includes the water evacuation unit A in combination with a water tapping control regime with frequent emptying of water from each evacuation station as described below. Referring to Figs. 2 - 4. Each of the water evacuation units A as shown in Fig. 1 includes a docking station
30 18 and a water collection tray 11 to be slideably provided within the docking station 18.

By using a docking station 18 and tray 11 as here described, the tray 11 may be positioned under the refrigeration unit 4 in a simple and safe manner and may as well be easily withdrawn for cleaning or maintenance. This is required since the tray and docking station A have a very low building height to fit between the floor and the refrigeration unit 4. Each docking station 18 may be made of a suitable material such as a metal plate material, being bent upwards on each side and end portion, forming upwardly protruding guide members 17 and end stoppers 13 for the tray 11. At the end of the docking station 18, between the end stoppers 13, is provided a suction pipe connection 14 to be sealingly connected at its outer end to the vertical piping 2. The tray 18 may either be fastened to the refrigeration unit via horizontal flanges on the guides 17 or fastened to the floor, preferably by gluing.

The water collection tray 11 is provided with a lid 15 having an opening 16, through which the water enters from the water drainage opening (not shown) of the respective refrigeration unit 4.

Fig. 4 shows the water collection tray 11 in more detail. A water drainage pipe 19 is provided in the longitudinal direction of the tray and is extending through each of the tray ends. The inner end 21 is provided to fit sealingly into the suction pipe connection counterpart 14 when being docked in its docking station 18 underneath the refrigeration unit. The outer end 22 of the pipe 19 is sealed with a cap 23. This outer pipe end 22 may serve two purposes: a) it may be used to interconnect two or more trays 11 in parallel by means of a parallel piping arrangement (not shown in the figures), and b) it may be used as a handle when positioning the tray 11 under or taking it out from the docking station underneath the refrigeration unit 4. This is just a practical design issue. The tray 11 may of course, instead of the pipe end 22, be equipped with a separately provided handle. Along the pipe 19 on the side facing the bottom of the tray 11 and within the length of the tray 11, drainage holes or openings 20 are provided through which the water is drained (under operation of the system). The number of holes 20 along the entire length of the tray ensures complete emptying of the tray 11. To further ensure complete emptying, the bottom of the tray 11 may be tilting downwards from the sides 17 towards the pipe 19. The tray 11 is further, as stated above, provided with a

water level sensor or switch 10 to start and stop the vacuum pump 5. As a preferred embodiment the tray 11 may also be provided with an additional water level sensor or switch 8 which will start the vacuum pump 5 and initiate an alarm (not shown) in case the first sensor 10 fails to work. It is important to understand that the docking station may have a design differing from the one described above where the tray 11 is guided by upwardly protruding guide members 17 and end stoppers 13 to position the tray underneath the refrigeration unit. Thus, the docking station may for instance be formed like V-shaped guide members provided in conjunction with the suction pipe counterpart 14, whereby the end of the suction pipe 21 of the tray 11 may be guided by the V-shaped guides towards the suction pipe connection counterpart 14 when being placed underneath a refrigeration unit.

The system as shown in the figure is normally used and operated in two different modes, intermittently or continuously as described in the following. In small installations, where there is only one or a few number of water or grey water sources, intermittent running of the vacuum pump is normally most suitable. Water from a refrigeration unit (not shown in the figure) is accumulated in the tray 11. Once the water reaches a set level, the sensor 10 in the tray sends a signal to the central control unit 7 to start the pump 5. Electrical wiring is of practical reasons not shown in the figure. The pump generates vacuum in the pipe system thereby lowering the pressure in the pipe system 1. When the vacuum has reached a desired level, the valve 3 for the respective refrigeration unit where the tray 11 needs to be emptied, is opened by the control unit 7 and water is sucked from the tray 11. As formerly stated, water may be lifted twice the height, i.e. 8 – 10 meters with the same vacuum and thus, an air nozzle 6 (Fig. 4) is provided in the drainage pipe 19 at the bottom of the vertical pipe 2, enabling air to enter into the pipe and intermix with the water in the pipe. By such intermixture of air into the pipe, the fluid, i.e. the mixture of water and air, has a density that is much smaller than 1 kg/dm³ making it possible to raise the fluid in the pipe to a higher level. Tests have proved that it is possible with a vacuum of 50 – 60 kPa (40 – 50 % of atmospheric pressure) to raise the fluid in the tank and thereby the water to 8 – 10 meters. The amount of air entering

the pipe can be set manually based on experience/testing, or the nozzle 6 may be controlled by the control unit 7 automatically based on measurement of a density meter in the vertical pipes 2 (not shown) electrically connected to this unit 7. It should, however, be noted that in systems where the tray 11 is small and the amount of accumulated water is additionally small, sufficient air may enter into the pipe 19 through the holes 20 at the end of emptying operation to obtain the required water lifting height. Thus, entering of air through the hole 6 may in such situations not be required.

Once the tray 11 is empty, the water level detector or switch sends a signal to the control unit 7 to stop the pump 5 and close the valve 3. In such small system as described above, the emptying of the tray 11 may even be done by just starting and stopping the pump, without using the valve 3. It is however expedient to use a valve to secure proper working and avoiding return of water from the pressure side of the system.

In larger systems, where there are several different water accumulation trays 11 working in parallel pipe loops like the one shown in Fig. 1 where each loop is connected to a common vacuum main pipeline 1, continuous running of the pump (or pumps – depending on the system's vacuum requirement) is most common. Then, there is a set vacuum in the main pipeline and the valve opens for each tank and pipe loop when needed. The working principle is, however, the same as described above where the valve opens and closes on the basis of a signal from a water level sensor or switch 10 in the tray 11. Each water drainage system may, as stated above, have a large number of refrigeration units 4 and since each tray 11 has a small volume needing to be emptied frequently and the pump 5 has a maximum capacity, a failsafe control regime is needed to avoid collapse of the system, i.e. that too many discharges of water takes place at the same time. This is obtained by programming the control unit 7 such that only one tray 11 is emptied at a time and within a shortest possible period of time before the emptying of the next tray is started. The size of the trays is custom made for each system, depending on the height or space available between the refrigeration unit and floor where the system is installed. As an example, for a special delivery to a "random" customer, the tray 11 has a volume of 4 litres. The time for emptying is then set to 60

seconds before emptying of the next tray is started. The control unit may be a PLC (Programmable Logic Control) or other suitable control device, but will not be further described.

5 In some situations when the system is running over a period of time, there may be a build-up of liquid in the vertical section 2 of the pipeline as the remaining water after each running of the pump is not returning to the tray 11. To avoid such build-up of water in the pipeline section 2, a small conduit or hole 9 is provided at the upper part of pipe section 2. The hole is so small that a minor amount of air is allowed to enter into the pipe
10 such that the remaining water in the section 2, after each emptying operation, is allowed to return to the tank 4, but the vacuum in the pipe is not influenced when the pump is running.

The dimensioning of the components of a system exploiting the inventive arrangement is dependent on different parameters such as required capacity (number of refrigeration
15 units), pipe diameters, available space and size of trays, the required number vacuum pumps etc.

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Claims

1. Arrangement in a system for accumulation and evacuation of water such as
5 defrosting and condensation water from one or more refrigeration or cooling units
(4), the system including a piping arrangement (1) with a vertical pipe section (2)
extending from a water evacuation unit (A) provided in conjunction with the
respective refrigeration unit; discharge valves (3), one for each unit (A); one or
more liquid reservoir (11) for each unit (A); one or more vacuum pumps (5); air
10 inlet nozzles (6); a control unit (7); one or more water level switches or sensors
(8, 10) and air conduit inlet opening (9) for each vertical pipe (2).

characterised in that

each of the water evacuation units (A) includes a docking station (18) and a water
collection tray (11) to be provided in relation to the docking station (18), whereby
15 each unit (A) is custom made to fit between the refrigeration unit (4) and floor
where the refrigeration unit is placed.

2. Arrangement according to claim 1,

characterised in that

20 each docking station (18) is slideably provided within the docking station,
including upwardly protruding guide members (17) and end stoppers (13) for
guiding and positioning of the tray (11) within the station, whereby at the end of
the docking station (18), between the end stoppers (13), is provided a suction
pipe connection (14) to be sealingly connected at its outer end to the vertical
25 piping (2).

3. Arrangement according to claims 1 and 2,

characterised in that

30 a water drainage pipe (19) is provided in the longitudinal direction of the tray
extending through each of the tray ends such that the inner end (21) of the pipe

is provided to fit sealingly into the suction pipe connection counterpart (14) when being docked in its docking station (18) underneath the refrigeration unit (4), and whereby the pipe (19) on the side facing the bottom of the tray (11) and within the length of the tray (11), is provided with drainage holes (20) through which the water is sucked into the pipe during water evacuation operation.

4. Arrangement according to claims 1 - 3, characterised in that the volume of the individual tray is between 3 – 6 litres.

5. Arrangement according to claims 1 – 4, including several water evacuating units (A), characterised in that the control unit (7) is programmed such that only one tray (11) is emptied at a time and within a shortest possible period of time before the emptying of the next tray is started.

6. Arrangement according to claims 1 – 5, characterised in that the time period from the previous to the next tray (11) is emptied is 60 seconds.

7. Arrangement according to the previous claims 1 – 6, characterized in that an air conduit or inlet opening (9) is provided at the upper part of each vertical pipe (2).

113

Fig. 1

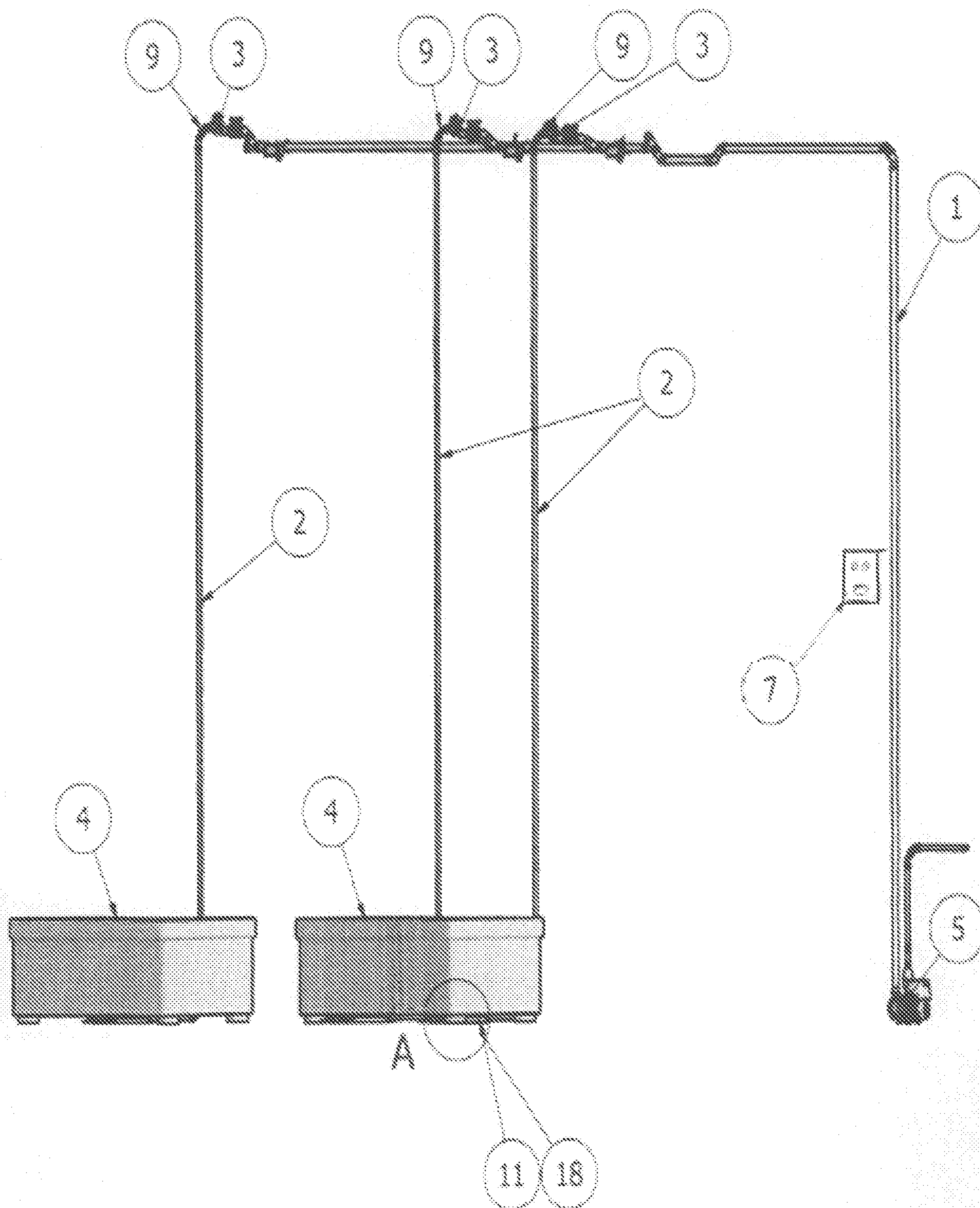


Fig. 2

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A (1:5)

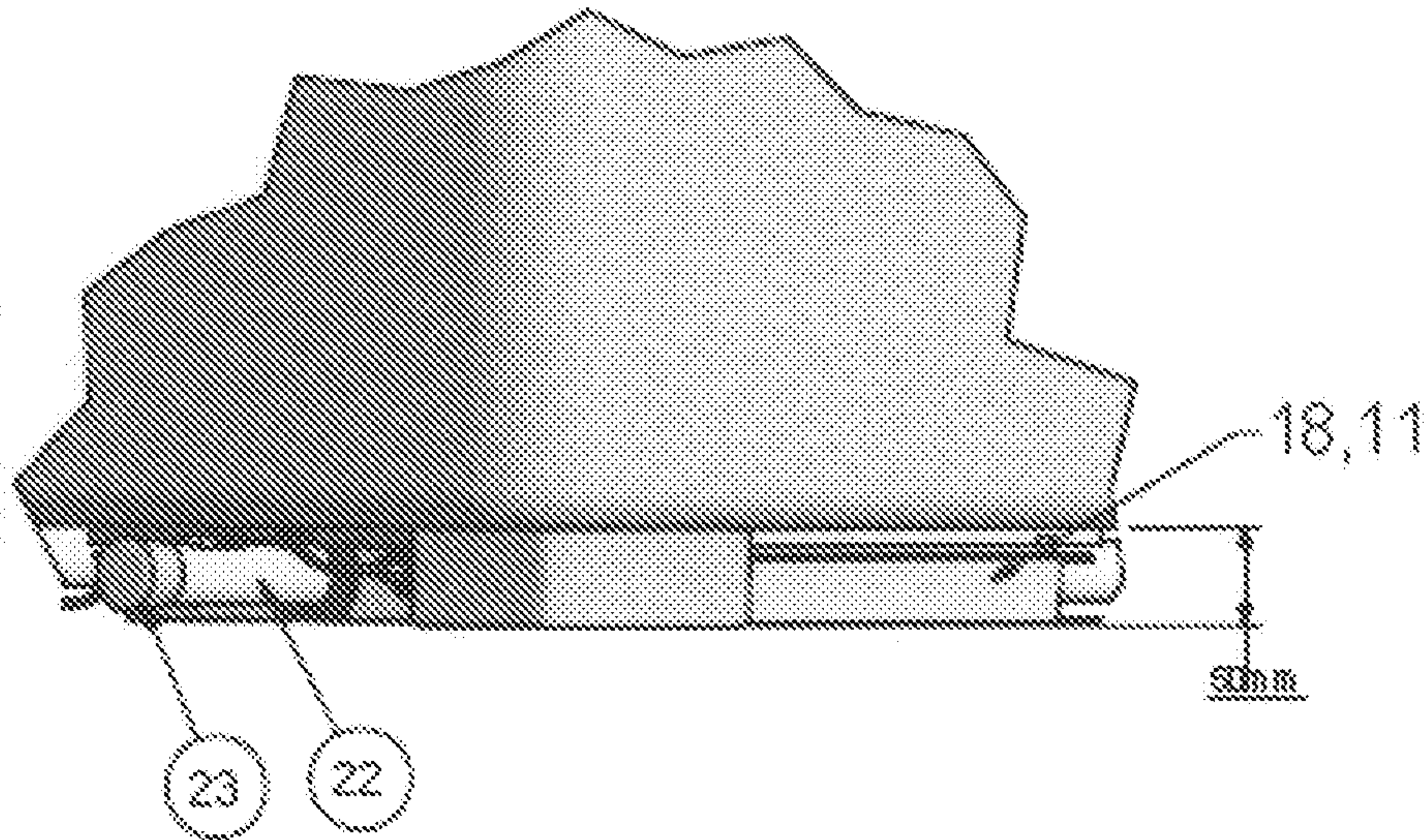
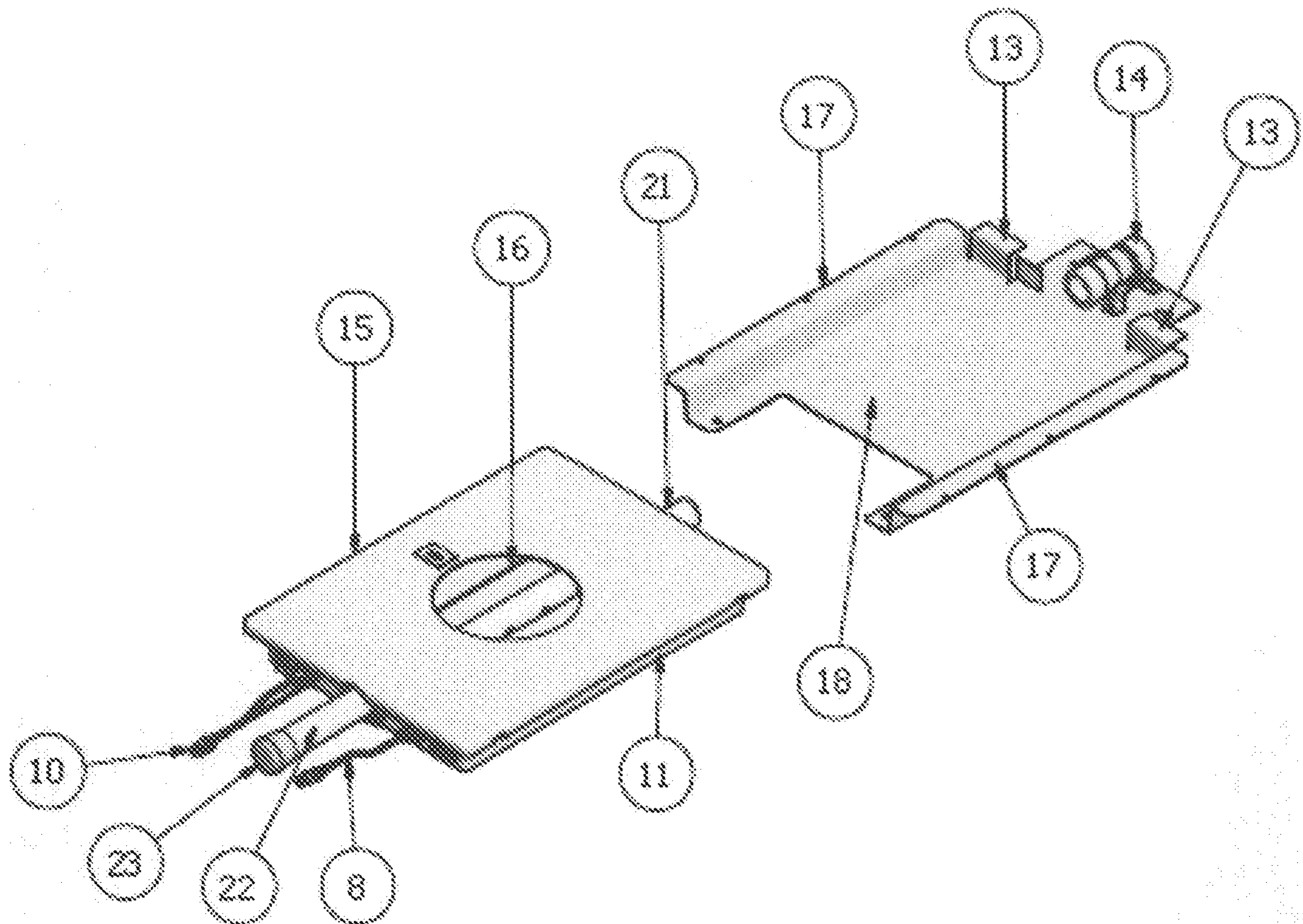


Fig. 3



3/3

Fig. 4

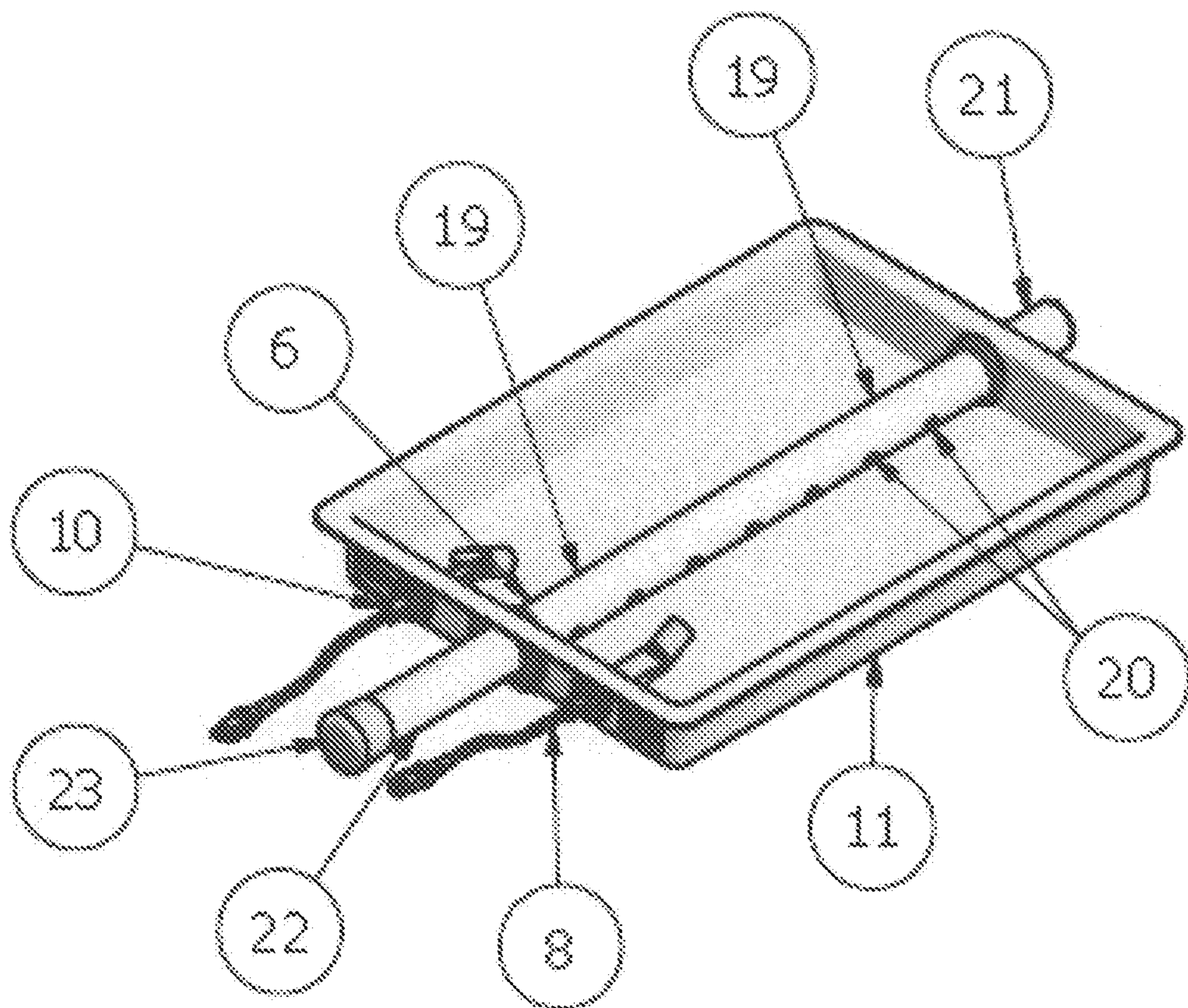


Fig. 3

