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DRIER AND METHOD FOR OPERATING A DRIER

Description

[0001] The invention relates to a dryer with a receptacle for articles to be dried, an air line for routing recirculated air and/or fresh air to the receptacle, a heating device and at least one sensor for determining relative humidity and/or temperature, wherein the air line comprises at least one setting element, such that the proportion of recirculated air to be routed to the receptacle can be changed by way of the setting element. The invention furthermore relates to a method for the open-loop or closed-loop control of a dryer according to the invention.

[0002] Dryers of the type mentioned in the introduction are known from practice and exist in various embodiments. In this regard, reference is made merely by way of example to document WO 2016/184462 A1.

[0003] Generally, after the washing process with mechanical dewatering, the residual water is removed from the textiles under the action of heat. In this regard, depending on the type of laundry, a pre-drying operation is effected in the drum dryer (tumbler) as preparation for the ironing of flat linen or for the finishing of shaped items. Certain items (e.g. terry products) are subjected to "full drying". Pre-drying and full drying are differentiated by the water content (residual moisture) of the laundry items at the end of drying. Depending on the type of laundry and subsequent type of treatment, the textile final residual moisture (water content in relation to the dry laundry mass) lies between 35% and 50% (pre-drying) or 5% and 0% (full drying). A major problem when removing residual water under the action of heat by means of the known dryers is the extremely unfavorable efficiency.

[0004] The desired textile residual moisture determines, by way of the drying time required therefor, the drying energy demand and, by way of textile damage caused by the drying, the service life of the laundry items and thus the economic situation of the mostly small and medium-sized laundry companies.

[0005] For the heating of the vented dryers currently used in laundries, the energy demand values range up to 1.5 kWh/kg of dried textile. This high thermal energy demand, which is considerable compared with the theoretical demand for evaporating the water, is due to the fact that the porous articles to be dried are heated by hot air, which is routed to the textiles by means of blowers and simultaneously serves to transport away the evaporated water. Owing to lower costs for installation work, the easier regulation of the thermal energy supply and the lower energy use, directly gas-heated dryers have prevailed over steam-heated dryers. The electrical heating is used only in small-scale machines or for household appliances.

[0006] The damage caused by the drying concerns, in particular, textile damage such as changes to the textile dimensions, a reduction in the degree of whiteness and in the colour and also chemical damage to the fibre substrate. This textile damage occurs in particular due to "overdrying" of the laundry items (removal of the water contained in textiles at normal humidity, around 10% for cotton) in the case of increased temperature and drying time. A prolonged drying time - even at low temperatures - promotes fibre abrasion owing to intensive "drying mechanisms".

[0007] A dryer and a method for operating a dryer according to the prior art are known from EP 0 503 586 A1.

[0008] The object of the present invention is therefore to design and develop a dryer, and also a method for operating a dryer, in such a way that gentle drying with the lowest possible energy demand is made possible using structurally simple means.

[0009] According to the invention, the above-mentioned object is achieved by the features of claim 1.

[0010] In a manner in accordance with the invention it has firstly been identified that the drying process can be optimized considerably with regard to energy efficiency and textile protection if the proportion of recirculated air and/or the heating power can be controlled in closed-loop or open-loop fashion during operation. Specifically, the proportion of recirculated air and/or the heating power may be able to be changed by an

open-loop or closed-loop control device taking account of the different drying phases, as a result of which the drying overall can be carried out with an extremely high degree of saturation of the process air and very low air temperature. In addition to a high heat quantity utilization, the structural refinement according to the invention has the effect that the drying process proceeds in a manner which is extremely gentle on textiles, since overheating of the articles to be dried is avoided. It is noted that the proportion of recirculated air can be routed within - for example in a hood - and/or outside of - for example in pipes - the apparatus.

[0011] In the context of this invention, the term "fresh air" refers to ambient air which is fed to the dryer, for example to the receptacle or to the burner.

[0012] The term "process air" refers to the air contained in the receptacle during the drying operation. "Exhaust air" should be understood to mean the air discharged from the receptacle. If the exhaust air is fed back to the receptacle and thus forms part of the process air, it is referred to as "recirculated air".

[0013] The "articles to be dried" may be textiles or articles composed of other materials, for example rubber mats or mats composed of polyamide pile.

[0014] In the case of an individual dryer, the "receptacle" may in particular be in the form of a drum. In one refinement comprising a plurality of modules which are arranged, for example, one behind the other or one next to the other, the receptacle of the overall apparatus may be formed for example by the respective drums of the modules, i.e. also be of modular form.

[0015] Advantageously, the setting element may be a ventilation flap and/or a recirculated-air blower. In this case, the ventilation flap may be arranged in an air line in such a way that, in the open position of the ventilation flap, exhaust air is fed back to the receptacle and thus serves as recirculated air. Particularly advantageously, the ventilation flap, and possibly the air line, is designed in such a way that a proportion of recirculated air of 100% can be realized in a fully open ventilation flap position and a proportion of recirculated air of 0% can be realized in a closed ventilation flap position.

As an alternative or in addition, a recirculated-air blower may be arranged in the air line, in order to convey exhaust air as recirculated air to the receptacle.

[0016] In order to be able to set the proportion of recirculated air in a particularly exact manner, it is conceivable for the ventilation flap position and/or the recirculated-air blower power to be able to be set in an at least substantially continuously variable manner. This structural measure makes a particularly energy-efficient open-loop or closed-loop control of the drying process possible. Specifically, it is possible for the ventilation flap to be able to be operated by means of an actuating motor or a cylinder-piston device (for example pneumatic cylinder).

[0017] Further advantageously, it is conceivable for the sensor to serve for determining the relative exhaust air humidity of the exhaust air discharged from the input. The sensor may have a filter element in order to protect the sensor from lint. The filter element used may be, for example, a fabric filter or sintered steel element, in particular with a pore size of 5 µm. It is noted at this point that the term "relative exhaust air humidity" should be understood in the broadest sense, the measurement of the relative humidity can namely also be effected inside the receptacle and thus relate to the process air. As an alternative or in addition, it is also possible to provide for arrangement of a sensor for determining the surface temperature of the articles to be dried. By way of example, this may be an infrared sensor or any other temperature sensor. It is also possible for a combined temperature and moisture sensor to be provided. It is also conceivable to provide for arrangement of a sensor for determining the inlet air temperature and/or the outlet air temperature. The inlet air is the air which is introduced into the receptacle, whereas the outlet air is the air which is discharged from the receptacle. It is thus possible to provide for arrangement of any combination of the above-mentioned sensors. In a modular refinement, the number and functioning of the sensors of the individual modules may differ from one another, and therefore the sensors are provided according to the defined task of the modules. The inlet air temperature and/or the outlet air temperature may be taken into account in the open-loop or closed-loop control of the proportion of recirculated air and/or of the heating power.

[0018] According to an advantageous refinement, the closed-loop control of the setting element, in particular of the ventilation flap position and/or of the recirculated-air blower, may be effected using the relative exhaust air humidity and/or using the surface temperature of the articles to be dried as measured variable and the proportion of recirculated air as manipulated variable. In the case of such a construction, it is ensured that the proportion of recirculated air can be adapted to the relevant, changeable parameters during operation, as a result of which a considerable improvement in the efficiency also occurs and damage to the articles to be dried is avoided.

[0019] As an alternative or in addition, it is furthermore conceivable for the closed-loop control of the heating device to be effected using the relative exhaust air humidity and/or the surface temperature of the articles to be dried as measured variable and the heating power as manipulated variable. The heating power of the burner can thus be adapted to the essential parameters, which change during the drying process.

[0020] Further advantageously, the receptacle may have a plurality of modules which are arranged one after the other and/or one next to the other and which are designed in a suitable manner for heating, drying or cooling the articles to be dried, in particular each module may have a dedicated heating device. In this case, the receptacle may have two or more modules arranged one behind the other and/or one next to the other. This offers the possibility of carrying out individual process steps in a particularly efficient manner, wherein the proportion of recirculated air and/or the heating power of the heating device of each module may be able to be controlled in open-loop fashion during the drying process. By way of example, a construction comprising one module for heating, one or more modules for drying, one module for checking the moisture content of the articles to be dried and one module for cooling the articles to be dried is particularly efficient. Furthermore, the dryer may have at least one transporting device, assigned to a module, for the onward transport of the articles to be dried from this module to another module. By means of such a transporting device, safe transport or safe transfer of the articles to be dried is made possible during the drying process effected by the modules.

[0021] In an advantageous exemplary embodiment, the air line may be configured in such a way that the recirculated air fed to a module is exhaust air of this module and/or

exhaust air of at least one other module. In particular, it may be the exhaust air of a module arranged upstream thereof as seen in the transport direction of the articles to be dried, preferably of the module arranged directly upstream thereof or of a plurality of modules arranged upstream thereof. Due to the at least partial use of exhaust air as recirculated air, it is possible for the heat contained in the exhaust air to be used in one or more other modules. As an alternative or in addition to such usage of the exhaust air as feed air or recirculated air, the exhaust air may also be used as combustion air of the heating device if the heating device is operated by means of a combustion process. In addition to such a mode of operation of the heating device, the air may also be heated by means of steam or electrical energy - without a combustion process. In this case, exhaust air of a module is not needed for the heating device.

[0022] As an alternative or in addition to the usage of the exhaust air of a module or of a plurality of modules as described above, it is further advantageously possible for heat from exhaust air of a module or of a plurality of modules to be able to be at least partially transferred to feed air and/or recirculated air of a module which is in particular arranged upstream thereof, preferably of the module arranged directly upstream thereof, or of a plurality of modules which are in particular arranged upstream thereof. Such a transfer operation may be effected by means of one or more heat exchangers, preferably air-to-air heat exchangers. This manner of using waste heat from exhaust air differs, owing to a used transfer means - the heat exchanger -, from a direct transfer of heat, as occurs for example in one case if exhaust air of a module at least partially forms feed air of one other or multiple other modules. A heat exchanger may for example be integrated into a module or be assigned directly to a module, in order to for example enable a recirculated-air mode of the module. As an alternative or in addition thereto, it is possible for one heat exchanger or a plurality of heat exchangers to be provided, which are arranged in an air line or are integrated into an air line, in order to, if necessary, for example pre-heat feed air for a module by means of exhaust air of a module.

[0023] To ensure a particularly good drying result and to reliably ensure efficient usage of required energy, a module for checking the moisture content of the articles to be dried may be arranged upstream of a module for cooling the articles to be dried. Such a checking module may form the end of an arrangement of modules for heating and for

drying, in order to check the moisture content prior to cooling of the articles to be dried and to, where necessary, additionally perform a post-drying operation in the checking module.

[0024] With regard to particularly efficient usage of required energy, feed air of a module for checking the moisture content of the articles to be dried may at least partially be air which is heated by means of a heat exchanger, preferably an air-to-air heat exchanger, which acquires thermal energy from the exhaust air of a module for heating the articles to be dried and/or from the exhaust air of another module or of the module for checking the moisture content of the articles to be dried itself. In this case, efficient energy usage can be effected through the supply of preheated feed air. Particularly advantageously, the feed air for this checking module is formed exclusively by air preheated in the described manner.

[0025] Feed air or fresh air from the installation space in which a module or a plurality of modules for cooling the articles to be dried are located, or from outside the building, may be able to be fed to this module or the modules which are usually arranged as a termination of the arrangement of different modules.

[0026] Further advantageously, it is conceivable for the air line, which may for example be formed at least partially corresponding pipes, to have additional blowers or fans. As a result, it is possible to assist the air flow, with the result that reliable functioning of the dryer is ensured in particular in the case of air lines spanning relatively great distances.

[0027] In a particularly advantageous embodiment, a transporting device may be arranged between in each case two modules. In this case, the transporting device may preferably comprise a conveyor belt or a chute or a chute channel. In the case of a chute or chute channel, a suitable height offset between the modules is expedient so that the articles to be dried pass from one module to the next module due to gravity. Where appropriate, a compressed-air assisting means may be provided which ensures reliable onward transport of the articles to be dried. As an alternative to the aforementioned embodiments, the transporting device may be in the form of an internal mechanism of a module or be integrated into a module. Such a transporting device or mechanism can

move the articles to be transported between modules by means of suitable gripping and/or guide elements. When selecting a suitable transporting device, the required amount of articles to be dried to be transported can be taken into account.

[0028] With regard to a reliable feed of the articles to be dried to the receptacle, a feed device for articles to be dried may be arranged upstream of the receptacle, said feed device preferably having a weighing device for the articles to be dried. This ensures that the dryer, and specifically the receptacle, is loaded with a suitable amount of articles to be dried. Overloading of the dryer can be precluded in this way.

[0029] For further optimization of the drying operation, it is possible for the open-loop or closed-loop control device to take account, as further parameters, of the articles to be dried (type of articles to be dried), the heating temperature, the drying residual moisture, the drying starting moisture, the load size, the filling ratio, the process air state variables, the blower power (of a recirculated-air blower and/or of a heating blower), the drum movement and/or the burner temperature. By way of example, the user may predefine that the articles to be dried are rubber mats or mats composed of polyamide pile of a certain load size. Corresponding parameters may be input for example by way of an input device and be taken into account by the open-loop or closed-loop control device. In other words, a determined program for an article to be dried may be able to be selected by the user, in order to carry out the drying process. It is also conceivable for the setting element or the setting elements to be able to be controlled in closed-loop fashion in dependence on the pressure prevailing in the air line. To this end, it is possible to provide for arrangement of one or more air pressure sensors.

[0030] The underlying object is achieved with regard to the method by the features of the coordinate Claim 12. According to said claim there is a method for operating a dryer, in particular according to one of Claims 1 to 11, with a receptacle for articles to be dried, an air line for routing recirculated air and/or fresh air to the receptacle, a heating device and at least one sensor for determining relative humidity and/or temperature, wherein the air line comprises at least one setting element, such that the proportion of recirculated air routed to the receptacle is changed by way of the setting element, characterized in that a proportion of recirculated air conducted to the receptacle and/or the heating power

of the heating device is controlled in open-loop or closed-loop fashion during the drying process by way of an open-loop or closed-loop control device.

[0031] In a manner in accordance with the invention it has been identified that a considerable improvement in efficiency can be achieved by virtue of being able to adapt the proportion of recirculated air and/or the heating power during the drying process.

[0032] It is noted that the Apparatus Claims 1 to 9 also have features with a form relating to a method. These may also exclusively represent part of the method according to the invention according to Claim 10. The same applies to the above general description of the dryer according to the invention.

[0033] According to the invention, during a heating phase, a high proportion of recirculated air and a low proportion of fresh air is conducted to the receptacle, wherein, during a drying phase, the proportion of recirculated air is reduced in dependence on the measured relative exhaust air humidity, wherein, during a cooling phase, a low proportion of recirculated air and a high proportion of fresh air is conducted to the receptacle, wherein the duration of the drying phase and/or the reduction in the proportion of recirculated air during the drying phase is adapted taking account of at least one external parameter.

[0034] With regard to gentle and efficient drying, provision may be made for the duration of the drying phase and/or the reduction in the proportion of recirculated air during the drying phase to be adapted taking account of at least one external parameter. The external parameter used may be the type of articles to be dried, the heating temperature, the residual moisture of the articles to be dried, the starting moisture of the articles to be dried, the load size, the filling ratio, process air state variables, the blower power (of a recirculated-air blower and/or of a heating blower), the drum movement and/or the burner temperature. There are then various possibilities of designing and developing the teaching of the present invention in an advantageous manner. In this regard, reference is made, on the one hand, to the claims that are dependent on Claims 1 and 10, and, on the other hand, to the following explanation of preferred exemplary embodiments of the invention on the basis of the drawing. In conjunction with the

explanation of the preferred exemplary embodiments of the invention on the basis of the drawing, generally preferred refinements and developments of the teaching are also explained.

[0035] In the drawing:

Figure 1

shows the typical profile of the fabric temperature in dependence on the drying time in a drying process,

Figure 2

shows a schematic, sectional illustration of a first exemplary embodiment of a dryer according to the invention for carrying out the method according to the invention,

Figure 3

shows a schematic, perspective illustration of a second exemplary embodiment of a dryer according to the invention for carrying out the method according to the invention,

Figure 4

shows a schematic, lateral illustration of the exemplary embodiment according to Figure 3,

Figure 5

shows a schematic, lateral and partially sectional illustration of the exemplary embodiment according to Figure 3,

Figure 6

shows a schematic plan view of the exemplary embodiment according to Figure 3.

[0036] Figure 1 shows the typical temporal temperature profile in the articles to be dried for the duration of the drying, the fabric temperature being plotted in dependence on the drying time. The three phases 1, 2, 3 of the drying operation can be seen. In the first phase 1, the temperature increases rapidly to the value of the evaporation temperature (cooling limit temperature), in order for this to subsequently be held constant in the course of the second phase 2 whilst the moisture is evaporated from the surface of the textile. In the third phase 3, the residual moisture is evaporated from the capillaries of

the textiles, leading to a sharp increase in temperature up to the hot air level. This phase indicates that the drying operation has ended, the heat supply can be stopped and the cool-down can be initiated.

[0037] Figure 2 shows a first exemplary embodiment of a dryer according to the invention. The dryer is in the form of an individual dryer and has a receptacle 4 for the articles to be dried (not illustrated). In this case, the receptacle 4 may be in the form of a drum. Fresh air 5 from outside of the apparatus can be fed to the receptacle 4, said air being routed transversely through the receptacle 4 and there, as process air 6, removing moisture from the articles to be dried. The exhaust air 7 discharged from the receptacle passes through a lint filter 8. As seen in the flow direction of the exhaust air 7, a recirculated-air blower 9 and a moisture sensor 10 are arranged downstream of the lint filter 8. This arrangement avoids the moisture sensor 10 being filled with lint. However, it is also possible for the moisture sensor 10 to be arranged upstream of the lint filter 8 as seen in the flow direction.

[0038] Furthermore, Figure 2 illustrates a ventilation flap 11. If the ventilation flap 11 is closed, the exhaust air 7 is routed out of the dryer. If the ventilation flap 11 is completely or partially open, the exhaust air 7 can be entirely or partially fed as recirculated air 12 to the receptacle 4.

[0039] In the case of the apparatus which is illustrated in Figure 2 and which is suitable for carrying out the method according to the invention, the position of the ventilation flap 11 and/or the power of the recirculated-air blower 9 can be adapted in dependence on the humidity of the exhaust air 7 during operation, said humidity being measured by the moisture sensor 10. Furthermore, it is conceivable for a temperature sensor 13 to be arranged in the receptacle 4 and to serve for determining the surface temperature of the articles to be dried. Provision may also be made of a sensor for determining the inlet air temperature and/or a sensor for determining the outlet air temperature.

[0040] Figures 3 to 6 illustrate, in different schematic illustrations, a further exemplary embodiment of an apparatus according to the invention which is suitable for carrying out the method according to the invention. In this exemplary embodiment, the receptacle

4 is formed by a plurality of modules 14, 14', 14" which are arranged one after the other, for example for heating, drying or cooling the articles to be dried. In this case, the individual modules 14, 14', 14" may be configured according to the exemplary embodiment illustrated in Figure 2, and therefore reference is made to the statements in this regard. In the case of such a refinement, the receptacle 4 of the overall apparatus may be formed by the individual receptacles or drums of the modules 14, 14', 14".

[0041] It furthermore emerges from Figures 3 to 6 that fresh air can be conducted to the individual modules by way of a fresh-air line 15. Furthermore, each module has a recirculated-air line 16 by way of which the receptacle 4, that is to say each module 14, 14', 14", can be fed with recirculated air by virtue specifically of the setting elements (not illustrated) being controlled in closed-loop or open-loop fashion. The exhaust air of the respective module 14, 14', 14" can be discharged by way of an exhaust-air line 21.

[0042] Furthermore, provision is made for arrangement of a heat exchanger 17 by way of which the heat from the exhaust air can be transferred to the feed air.

[0043] To further improve the energy efficiency, the first module 14 has a heating-air feed line 18 by way of which the heating device 19 can be supplied with fresh air which can be preheated by way of the heat exchanger 17. In this case, it is conceivable for all modules 14, 14', 14" to have a corresponding heating-air feed line 18.

[0044] A feed for articles to be dried is arranged upstream of the first module 14 and is used to load the module 14 with the articles to be dried. A respective transporting device 20 for the onward transport of the articles to be dried is arranged between the modules 14 and module 14' and between module 14' and module 14".

[0045] Due to the modular design of the apparatus, it is for example possible for the articles to be dried to be heated in the first module 14, i.e. the heating phase takes place in this module 14. In the second module 14', the actual drying of the articles to be dried can be effected, i.e. the drying phase is effected in this module 14'. In the last module 14", it is for example possible for the articles to be dried to be cooled, i.e. the cooling phase takes place. The proportion of recirculated air fed to the individual modules 14,

14' and 14" can be effected during the drying process in dependence on the measured humidity and/or surface temperature of the articles to be dried. As an alternative or in addition, the heating power of the heating devices of the modules 14, 14' and 14" can be adapted in dependence on these measured values.

[0046] In relation to further advantageous refinements of the apparatus according to the invention and of the method according to the invention, in order to avoid repetitions, reference is made to the general part of the description and to the appended claims.

[0047] Lastly, it should be expressly noted that the above-described exemplary embodiments of the apparatus according to the invention and of the method according to the invention serve merely for discussion of the claimed teaching, but do not restrict said teaching to the exemplary embodiments.

List of reference signs

[0048]

1 First phase

2 Second phase

3 Third phase

4 Receptacle

5 Fresh air

6 Process air

7 Exhaust air

8 Lint filter

9 Recirculated-air blower

10 Moisture sensor

11 Ventilation flap

12 Recirculated air

13 Temperature sensor

14, 14', 14" Module

15 Fresh-air feed line

16 Recirculated-air feed line

17 Heat exchanger

18 Heating-air feed line

19 Heating device

20 Transporting device

21 Exhaust-air line

Patentkrav

1. Tørretumbler med en modtager (4) til tørringsemner, en luftføring til at føre recirkuleret luft (12) og/eller frisk luft (5) til modtageren (4), en varmeanordning (19) og mindst en sensor (13, 17) til fastlæggelse af relativ luftfugtighed og/eller temperatur, hvor luftføringen omfatter mindst et justeringselement (9, 11), således at den andel af recirkuleret luft, der føres til modtageren (4), kan ændres ved hjælp af justeringselementet (9, 11), hvor en styre- eller reguleringsanordning er tilvejebragt, således at den andel af recirkuleret luft, der føres til modtageren og/eller varmeanordningens (19) varmeeffekt kan styres eller reguleres under tørringsprocessen, **kendetegnet ved, at** der under en opvarmningsfase ledes en høj andel af recirkuleret luft og en lav andel af frisk luft til modtageren (4), hvor andelen af recirkuleret luft under en tørringsfase reduceres afhængigt af den målte relative udsugningsluftfugtighed, hvor der under en afkølingsfase ledes en lav andel af recirkuleret luft og en høj andel af frisk luft til modtageren (4), hvor varigheden af tørringsfasen og/eller reduktionen af andelen af recirkuleret luft tilpasses under tørringsfasen under hensyntagen til mindst én ekstern parameter.

2. Tørretumbler ifølge krav 1, **kendetegnet ved, at** justeringselementet er udformet som en ventilationsklap (11) og/eller en cirkulationsventilator (9), hvor ventilationsklappens position og/eller cirkulationsventilatoreffekten kan varieres hovedsageligt trinløst.

3. Tørretumbler ifølge krav 1 eller 2, **kendetegnet ved, at** sensoren (10) tjener til at fastlægge den relative udsugningsluftfugtighed af udsugningsluften (7), der udledes fra indgangen (4).

4. Tørretumbler ifølge et af kravene 1 til 3, **kendetegnet ved, at** sensoren (13) tjener til at fastlægge overfladetemperaturen af tørringsemnet, og/eller til at fastlægge en indgangslufttemperatur og/eller udgangslufttemperatur.

5. Tørretumbler ifølge krav 3 eller 4, **kendetegnet ved, at** styringen af justeringselementet (9, 11) udføres med den relative udsugningsluftfugtighed som målevariabel, og andelen af recirkuleret luft som indstillingsvariabel.

6. Tørretumbler ifølge et af kravene 3 til 5, **kendetegnet ved, at** styringen af justeringselementet (9, 13) udføres med overfladetemperaturen af tørringsemnet som målevariabel og andelen af recirkuleret luft som indstillingsvariabel.

7. Tørretumbler ifølge et af kravene 3 til 6, **kendetegnet ved, at** styringen af varmeanordningen (19) udføres med den relative udsugningsluftfugtighed og/eller overfladetemperaturen af tørringsemnet som målevariabel og varmeeffekten som indstillingsvariabel.

8. Tørretumbler ifølge et af kravene 1 til 7, **kendetegnet ved, at** modtageren(4) har flere moduler (14, 14', 14"), som er anbragt efter hinanden og/eller ved siden af hinanden, til opvarmning, tørring eller afkøling af tørringsemnet, og at mindst et modul (14, 14', 14") er tilvejebragt med en transportanordning (20) til den videre transport af tørringsemnet fra dette modul (14, 14', 14") til et andet modul (14, 14', 14"), hvorved luftføringen kan være konfigureret på en sådan måde, at den recirkulerede luft (12), der tilføres til et modul (14, 14', 14"), kan være udsugningsluft (7) fra dette modul (14, 14', 14") og/eller udsugningsluft (7) fra mindst ét andet modul (14, 14', 14").

9. Tørretumbler ifølge et af kravene 1 til 8, **kendetegnet ved, at** styre- eller reguleringsanordningen som en yderligere parameter tager hensyn til tørringsemnet, og/eller opvarmningstemperaturen og/eller restfugtigheden af tørringsemnet, og/eller startfugtigheden af tørringsemnet, og/eller belastningsmængden og/eller fyldningsforholdet og/eller proceslufttilstandsvariabler og/eller blæsereffekten og/eller tromlebevægelsen og/eller brændertemperaturen.

10. Fremgangsmåde til drift af en tørretumbler, især ifølge et af kravene 1 til 9, med en modtager (4) til tørringsemne, en luftføring til at føre recirkuleret luft (12) og/eller frisk luft (5) til modtageren (4), en varmeanordning (19) og mindst én sensor (10, 13) til fastlæggelse af relativ luftfugtighed og/eller temperatur, hvor luftføringen omfatter mindst ét justeringselement (9, 11), således at andelen af recirkuleret luft, der tilføres modtageren (4), ændres ved hjælp af justeringselementet (9, 11), hvor en andel af recirkuleret luft, der føres til modtageren (4) og/eller varmeeffekten af varmeanordningen (19) styres eller reguleres under tørringsprocessen ved hjælp af en styre- og/eller reguleringsanordning,
kendetegnet ved, at der under en opvarmningsfase ledes en høj andel af recirkuleret luft og en lav andel af frisk luft til modtageren (4), hvor andelen af recirkuleret luft under en tørringsfase reduceres afhængigt af den målte relative udsugningsluftfugtighed, hvor der under en afkølingsfase føres en lav andel af recirkuleret luft og en høj andel af frisk luft til modtageren (4), hvorved varigheden af tørringsfasen og/eller reduktionen af andelen af den recirkulerede luft under tørringsfasen tilpasses under hensyntagen til mindst én ekstern parameter.

11. Fremgangsmåde ifølge krav 10, **kendetegnet ved, at** der under en opvarmningsfase ledes en høj andel af recirkuleret luft imellem 90 % og 100 % recirkuleret luft og en lav andel af frisk luft mellem 0 % og 10 % frisk luft til modtageren (4).

12. Fremgangsmåde ifølge krav 10 eller 11, **kendetegnet ved, at** varmeanordningens (19) varmeeffekt reduceres under en tørringsfase.

13. Fremgangsmåde ifølge et af kravene 10 til 12, **kendetegnet ved, at** en lav andel af recirkuleret luft på 0 % til 10 % og en høj andel af frisk luft på 90 % til 100 % føres til modtageren (4) under en afkølingsfase.

14. Fremgangsmåde ifølge krav 10, **kendetegnet ved, at** tørringsemnet, og/eller opvarmningstemperaturen og/eller restfugtigheden af tørringsemnet, og/eller startfugtigheden af tørringsemnet, og/eller belastningsmængden og/eller fyldningsforholdet og/eller proceslufttilstandsvariabler og/eller blæsereffekten og/eller tromlebevægelsen og/eller brændertemperaturen anvendes som ekstern parameter.

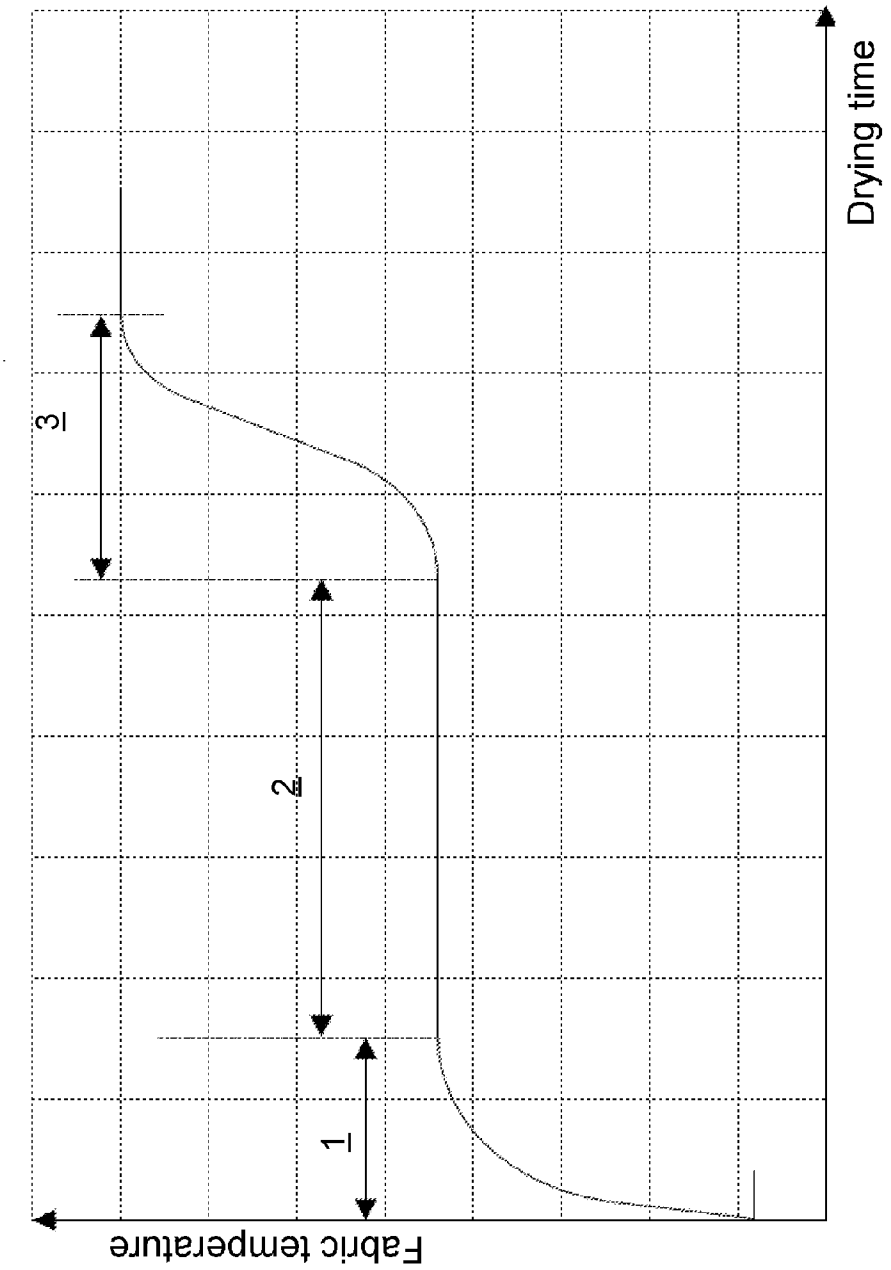

Fig. 1

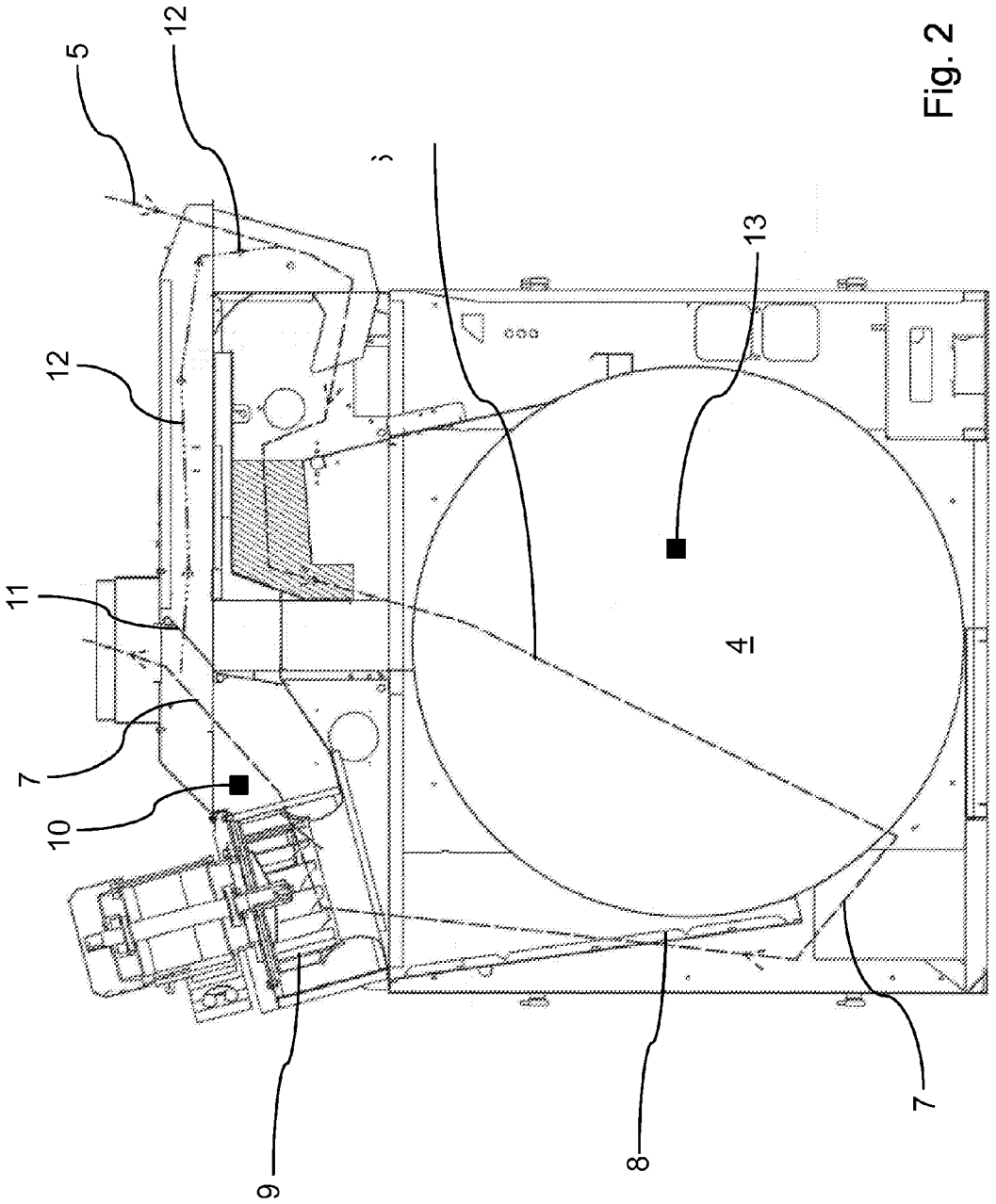

Fig. 2

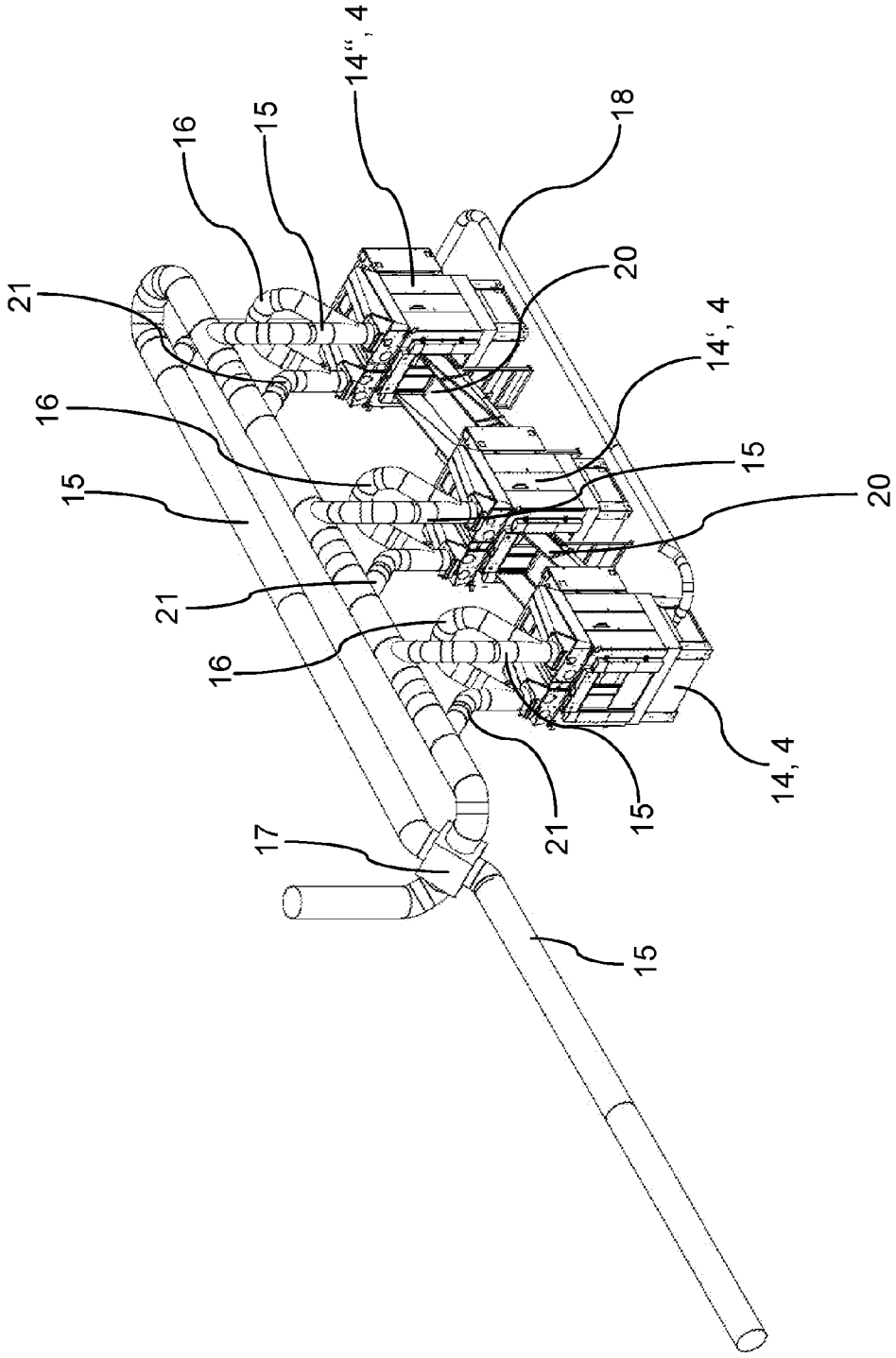

Fig. 3

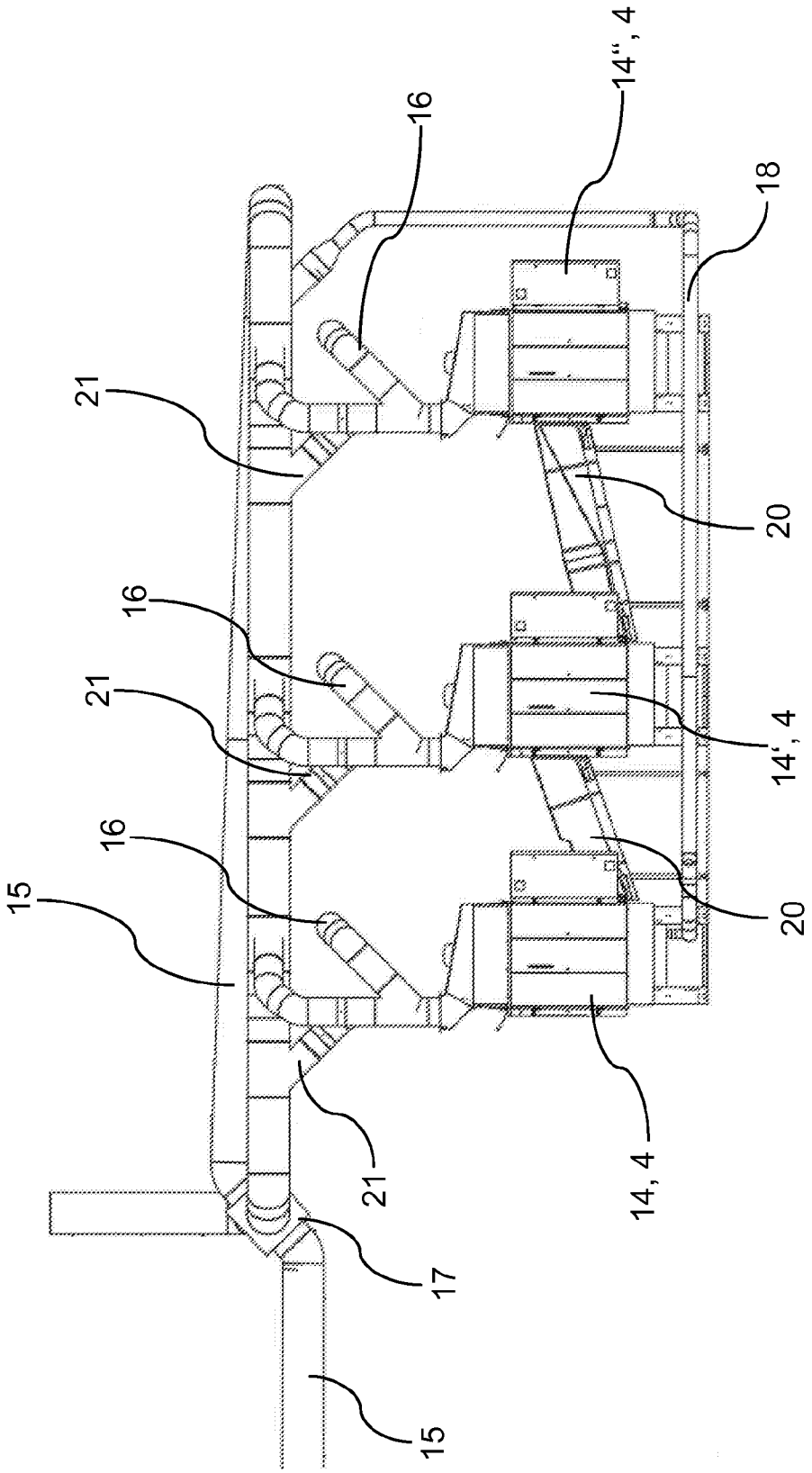

Fig. 4

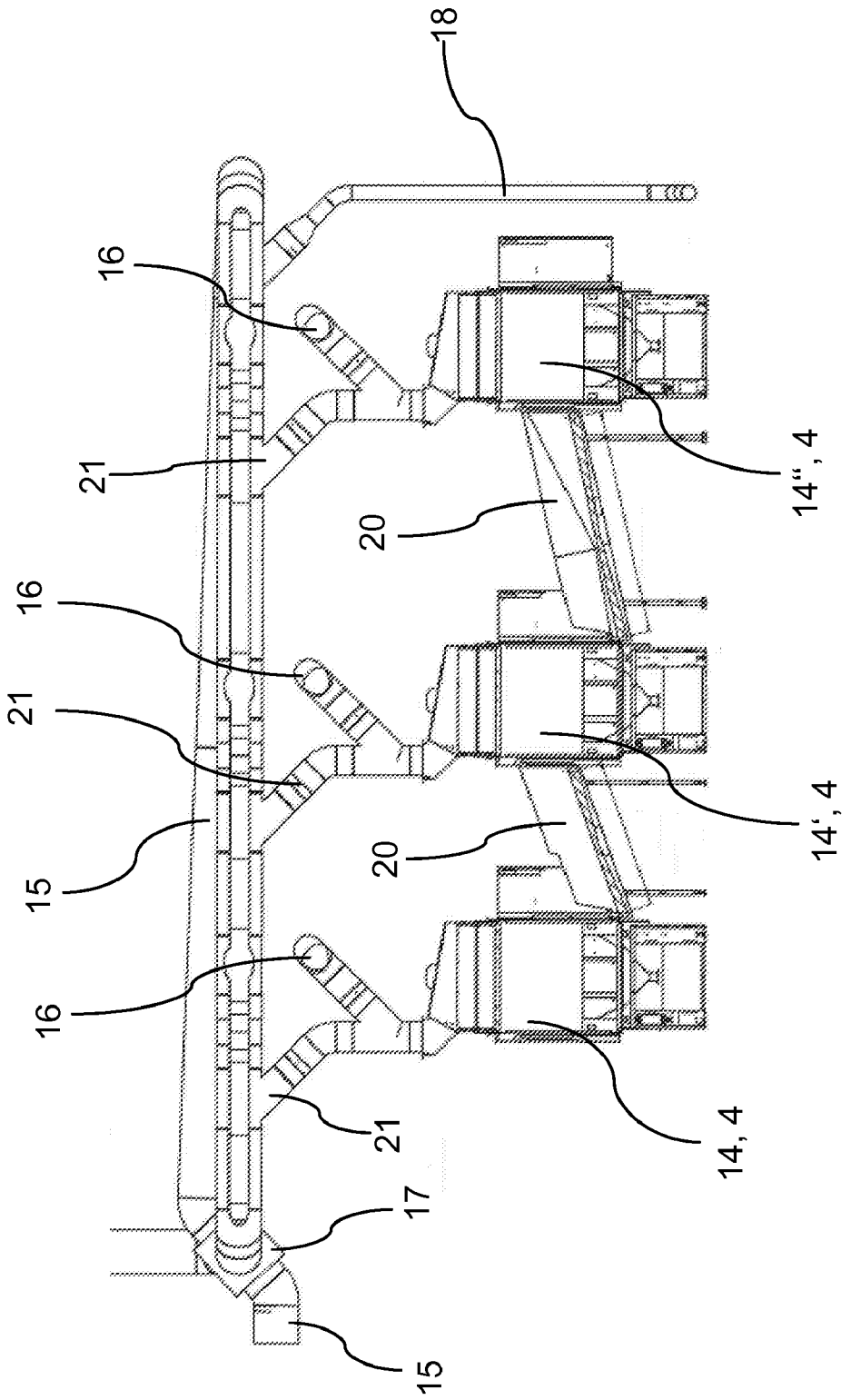

Fig. 5

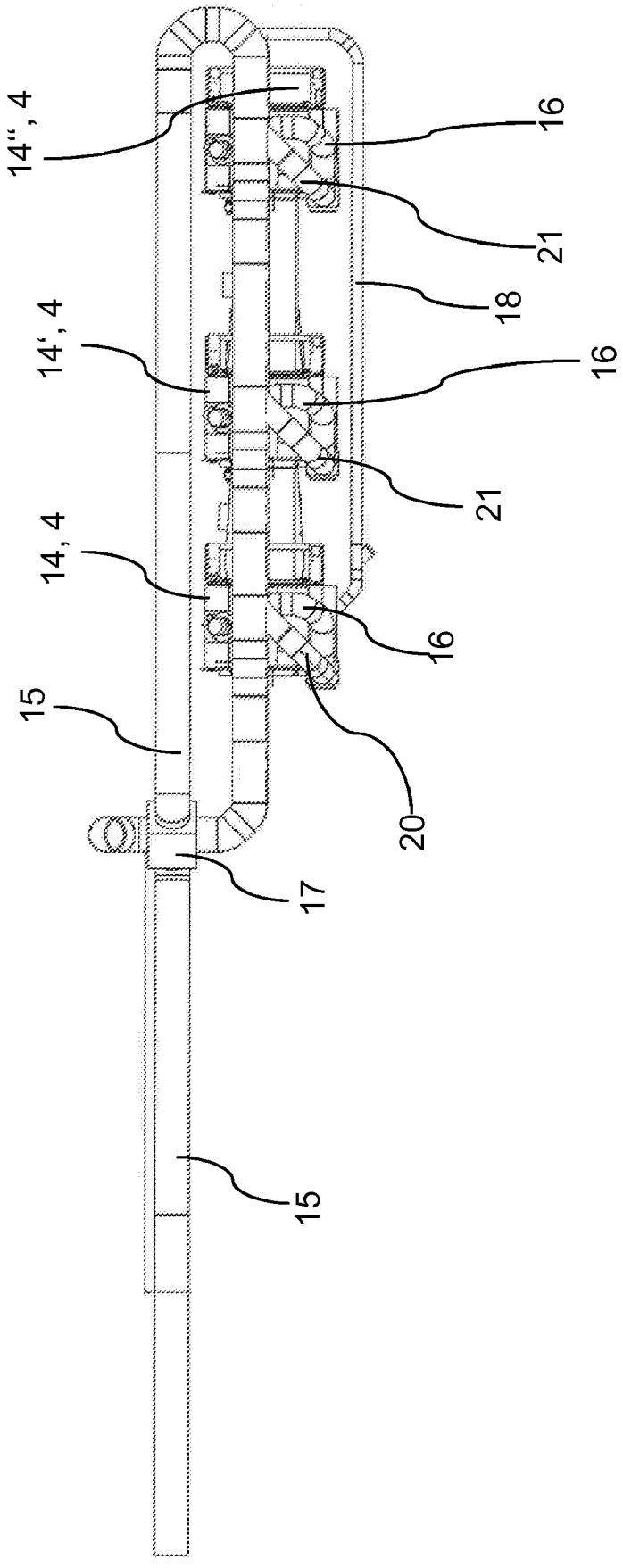

Fig. 6