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(54) **FLOCK CONVEYANCE IN A FIBER PREPARATION SYSTEM**

(57) The invention relates to a fiber preparation system with a succession of machines (1 - 6) and conveyor sections (14 - 18) that are arranged between the machines (1 - 6) for pneumatic flock conveyance and an air extraction system for extracting exhaust air from the conveyor sections (14 - 18). The air extraction system has an ID (induced draft) fan (12) that is connected by means of a suction line (13) to at least one of the conveyor sections (14 - 18) via air extraction ducts (34, 37, 45) emanating from the suction line (13) and associated with the respective conveyor section (14 - 18). The air extraction ducts (41, 48) that are not connected to the suction line (13) are brought together in a collecting line (10).

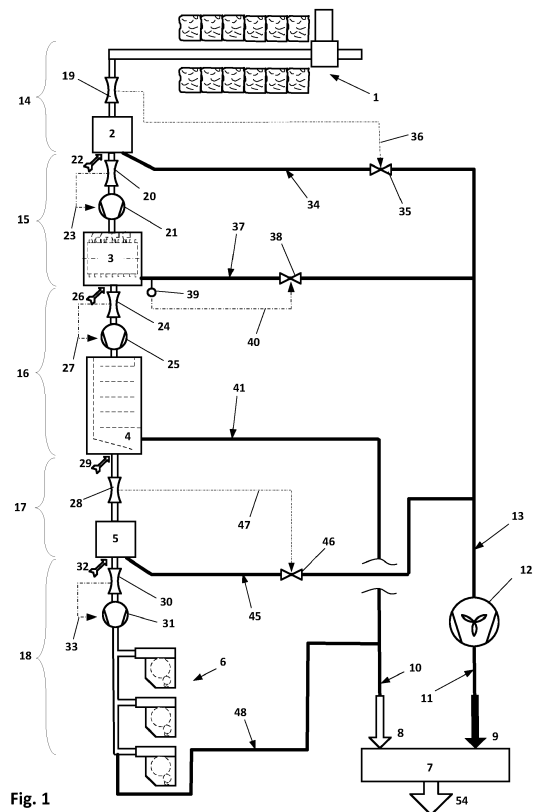


Fig. 1

Description

[0001] The invention relates to a pneumatic flock conveyance, to an air extraction system in a fiber preparation system, and to a method for controlling a volume flow and pressure distribution in a fiber preparation system. The fiber preparation system consists of a succession of machines and conveyor sections that are arranged between the machines for pneumatic flock conveyance and an air extraction system for extracting exhaust air from the conveyor sections.

[0002] Fiber processing machines such as bale openers, cleaners, separators, intermediate storage vessels (so-called "condensers"), mixers, or carding machines are used in fiber preparation and are used for cleaning, mixing, and dissolving the fiber material into individual fibers and parallelizing them. A fundamental distinction can be made between two types of machine. A first type of machine includes condensers or intermediate storage vessels, for example, in which the fiber flocks are not treated but separated from the transport air, whereby as much of the transport air that is introduced into the machine as possible must be discharged as exhaust air. Examples of a second type of machine include the cleaners in which the fibers are treated and a discharge of the transport air is only necessary in some cases, but constant pressure in the transport air flow through the machine is important for proper operation. For conveyance between the machines, on the other hand, a constant volume flow corresponding to a given flow rate is crucial for trouble-free operation.

[0003] During fiber preparation, the fibers to be prepared for spinning undergo several stages of processing. In a first stage, the fibers are dissolved out of fiber bales in the form of fiber flocks. So-called bale openers are usually used for this. Using pneumatic flock conveyance, these fiber flocks are brought out of the bale opener and delivered to a downstream cleaning machine, for example. In order to even out the flock stream before the cleaner, a condenser can be provided as an intermediate storage vessel. In this case, the pneumatic flock conveyor conveys the fiber flocks in a first conveyor section from the bale opener to the condenser, which will be referred to in the following as the first condenser. In the first condenser, the fiber flocks are separated from the transport air and fed to a storage vessel. The transport air is discharged as exhaust air via an air extraction system. From the intermediate storage, the fiber flocks are supplied to the cleaner by means of a fan in a second conveyor section. In a simplified fiber preparation system, the first condenser is not used, and the fiber flocks from the bale opener are fed directly into the cleaner. As a result, the first conveyor section is not present.

[0004] In order to optimize the cleaning of the fiber flocks in the cleaner, a constant pressure in the fiber flock stream is achieved in the cleaner by discharging a portion of the transport air from the cleaner. In a further conveyor section, for example, the cleaned fiber flocks are fed

pneumatically from the cleaner to a mixer with the aid of an additional fan. In the mixer, the fiber flocks are separated from the transport air and stored in various mixing chambers. The separated transport air is discharged from the mixer. In a further conveyor section, the mixed fiber flocks are transported by means of a fan from the mixer to an intermediate storage vessel. The temporary storage vessel serves as a compensating vessel upstream from a further conveyor section, which feeds the fiber flocks to one or more carding machines and is referred to in the following as a card condenser. In the card condenser, the fiber flocks are separated from the transport air and fed to a storage vessel. The transport air from the card condenser as well as from the conveyor section for supplying the cards is discharged as exhaust air. The cards, which break the fiber flocks down into individual fibers and form a card sliver, represent the conclusion of the fiber preparation system. After carding, the fibers are passed on in the form of card slivers for spinning preparation. During spinning preparation, the card slivers are processed by stretching, combers, or flyers for use in final spinning processes.

[0005] The individual conveyor sections are usually operated independently of one another, thereby enabling an optimal configuration of the volume/pressure ratios to the machines adjacent to a conveyor section.

[0006] The arrangement of the individual machines in a fiber preparation system can be set up in different manners; this depends *inter alia* on the raw material to be processed and the product to be obtained. For example, coarse cleaners and fine cleaners can be used as cleaning machines, or additional temporary storage vessels can also be used. For the purposes of this application, a transport path from a delivering machine to a receiving machine is referred to as a conveyor section, with the receiving machine being associated with the corresponding conveyor section in each case. A conveyor section always contains a conveying air supply (usually a fan) for generating a necessary conveying air flow. However, it is not necessary to arrange a fan for generating the conveying air flow between each successive pair of machines. Simple machines such as metal separators, foreign material and foreign fiber detection systems, or simple cleaners that do interrupt the transport line in terms of its shape but do not prevent the actual flow, can be integrated into a conveyor section. In that case, the conveying air flow runs continuously through these devices.

[0007] The conveying air flow can be guided by the fan, whereby the fiber flocks are also guided by the fan. However, a filter chamber by means of which the conveying air flow is separated from the fiber flocks can also be arranged upstream from the fan. Even if the fan is not part of the transport line, the fan is nevertheless associated with a conveyor section, and the conveying air flow for this particular conveyor section is determined by the fan.

[0008] With a fan, the volume flow generated - i.e., the conveying air flow - is linked to the prevailing pressure

in the transport line or in the conveyor section. At constant fan output, decreases the volume flow in the conveyor section decreases as the pressure increases. The pressure, in turn, is dependent on the flow rate or the amount of fiber flocks present in the conveyor section, the line routing, the machines that are integrated into the conveyor section, the pair of machines delivering and receiving the fiber flocks, and the air discharge from the corresponding conveyor section. The requirements of the individual machines for smooth functioning as well as the need for a certain level of transport performance must be met.

[0009] Various approaches to regulating the conveyance of fiber flocks are known from the prior art. For example, CH 696 909 A5 has the object of providing a largely constant volume flow for conveying the fiber flocks despite different fill pressures when feeding a plurality of cards. CH 696 909 A5 discloses a method in which a family of characteristics of the fan is stored mathematically in the control system, and the associated volume flow at a certain fan speed is calculated from this family of characteristics by means of a pressure difference measurement via the fan. Furthermore, DE 10 2015 106 415 A1 discloses system for controlling of the quantity of fiber flocks that are delivered into an air volume flow by a feeding device.

[0010] One drawback of the known methods is that the proposed control systems produce a constant volume flow in one conveyor section but neglect the pressure conditions in the respective machines. Each of the fiber-processing machines of a fiber preparation system has an optimum operating point at a certain pressure. Depending on the machine, the pressure to be set may also depend on the operating point or on a current production quantity. For example, in order to achieve a constant flock weight in a storage vessel when it is nearly empty, the pressure acting on the flock column in the accumulator is different compared to an almost full storage vessel. This is due to the fact that a height of the flock column also brings about a compression of the fiber flocks as a result of the self-weight of the fiber flocks and thus a change in the weight of the flock at a lower end of the storage vessel. According to the prior art, an optimal control is proposed for each individual machine. Each machine is provided with the necessary transport air supply and exhaust air discharge. Given the interplay of the individual machines in a fiber preparation system, this leads to a high energy demand, since the air systems of the individual machines do not take the needs of subsequent machines into account. Fiber preparation systems are generally also outfitted with a central air extraction system, a so-called "filter house," which provides a certain suction power. The power of a filter house is usually set too high in order to be prepared for the highest demand of a single machine, which also results in a high energy demand. The oftentimes excessive suction power is compensated for at individual transfer points by so-called "open handovers." Open handovers result in the

system being supplied with false air, with the amount of false air compensating for the excess suction power. As a result of this construction, ambient air is moved around in the air extraction system that does not make any contribution to the actual operation, but only compensates for an inadequate system architecture.

[0011] It is therefore the object of the invention to provide a device and a method for controlling a volume flow and pressure distribution in a fiber preparation system that allows for continuous pneumatic conveyance of the fiber flocks between the machines of the fiber preparation system and for a constant pressure that is adapted to the operating requirements of the respective machine while reducing the energy requirement to the lowest possible level.

[0012] The object is achieved by a device and a method with the features of the independent claims.

To achieve the object, a novel fiber preparation system is proposed which comprises a succession of machines and conveyor sections that are arranged between the machines for pneumatic flock conveyance, as well as an air extraction system for extracting exhaust air from the conveyor sections offered. The air extraction system has an ID (induced draft) fan that is connected by means of a suction line to at least one of the conveyor sections via air extraction ducts emanating from the suction line and associated with the respective conveyor section. The air extraction ducts that are not connected to the suction line are brought together in a collecting line.

[0013] Due to the fact that the exhaust air from individual conveyor sections is combined in an air extraction system and actively removed via an ID fan, the system of conveyor sections and the associated control of the volume flow required for the pneumatic fiber flock transport is decoupled from the pressure ratios to be produced in the machine to the greatest possible extent. The ID fan increases the pressure in the air extraction system opposite the filter house. This allows the filter house to be regulated to a lower negative pressure. The machines of the fiber preparation system that do not have an elevated pressure requirement are connected via a collecting line directly to the filter house. However, machines that have an elevated pressure requirement are supplied via the suction line of the ID fan, with the pressure line of the ID fan also leading into the filter house. By virtue of this system, only the necessary portion of the air extraction system is supplied with a high negative pressure. This offers the additional advantage that increases in pressure in individual machines are no longer necessary and, to cite an example, can be dispensed with in a cleaner on an internal fan of the machine for pressure control. The central induced draft in the air extraction system facilitates the regulation of the individual conveyor sections. The elaborate control engineering that was required due to the interaction of central and machine-specific fans is eliminated.

[0014] To complete the decoupling, it is advantageous if an associated conveying fan is provided in the pneu-

matic flock conveyor in the respective conveyor sections. As a result, a delivery volume flow in each individual conveyor section can be determined and regulated independently. If a first condenser is used after the bale opener, the ID fan can be provided in this first conveyor section for the function of the conveying fan. This enables conveying fan for the first conveyor section to be saved. Moreover, it is advantageous if an associated volume flow measuring means is provided in the pneumatic flock conveyor in the respective conveyor sections. A corresponding volume flow measuring means can thus be provided for each conveyor section. Individual control of the flock conveyance in the individual conveyor sections is thus made possible. It is therefore also possible for different conveyed quantities to be transported in the individual conveyor sections, which contributes to an optimization of the operation of the entire fiber preparation system.

[0015] Advantageously, a constant volume flow is ensured by the volume flow measuring means and corresponding regulation of the fan in the respective conveyor section. The conveying airflow is specified based on the need at the machines adjoining a conveyor section or those which are integrated into a conveyor section. Decisive factors are the production rate at which the conveyor section is operated on the one hand and the conveying air flow required for this production rate on the other hand. Machines such as metal separators or gravity separators that are integrated into a conveyor section usually have an ideal operating point at a specific production rate for a specific speed of the conveying air flow. The machines are adjusted to a certain volume flow of the conveying air flow so that the speed of the conveying air flow corresponds to the ideal operating point. If larger deviations of the volume flow occur due to poor regulation of the volume flow, this leads to a poorer cleaning effect or would have to be compensated for in order to maintain the quality by changing the setting of the machine. Since the volume flow is maintained constant with the proposed decoupling, a complicated adjustment of the individual machines is eliminated. The machines associated with a conveyor section can thus be left in a setting corresponding to the desired production rate. This contributes substantially to trouble-free operation with consistent fiber processing quality.

[0016] Advantageously, an exhaust control element is provided in at least one air extraction duct. Control valves, adjustable apertures, control flaps, or slides can be used as exhaust control elements, for example. The exhaust control element can be manually adjustable or automatically adjustable by means of a corresponding servo controller. An exhaust control element in the air extraction duct makes it possible to have a constant pressure within the machine from which the exhaust air is originating or to control a constant volume flow of the exhaust air. Preferably, the exhaust control element is a control flap. As an alternative to a control flap, a fan can also be used as an exhaust control element. In order to achieve a regu-

lation of the exhaust air flow or of the pressure in the air extraction duct, an exhaust-air measuring element is advantageously provided in at least one air extraction duct. The exhaust-air measuring element can be a volume flow measuring means or a pressure gauge. For example, the volume flow with which the fiber flocks are passed through the cleaner as well as the prevailing pressure in the cleaner inlet are both crucial for the proper operation of a cleaner. Both factors can be maintained within limit values specified for a product by regulating the exhaust air flow that is discharged from the cleaner.

[0017] Preferably, all air extraction ducts of the system are provided with an exhaust-air measuring element and an exhaust control element. As a result, all exhaust air flows can be regulated according to the requirements of the individual machines. The regulation of an exhaust air flow that is not coupled with the suction line of the ID fan also brings advantages in terms of fiber processing, particularly through the use of the minimum required energy.

[0018] It is also advantageous if a pressure gauge is provided upstream from the ID fan in the suction line. The total pressure that is measured upstream from the ID fan is determined by the exhaust air volume flows of the individual conveyor sections that are integrated into the suction line. These individual exhaust air volume flows as well as the required pressures are known for a specific production from the settings of the fiber preparation system. The total volume flow or the total pressure can thus be calculated from the individual exhaust air flows of the integrated conveyor sections and specified as a target value, whereby the induced draft can be regulated to this target value based on the upstream measurement.

[0019] Since the exhaust air conducted away by the ID fan must also be supplied in advance to the overall conveyor system and/or to the individual conveyor sections, an air supply is advantageously provided at the beginning of each conveyor section. Through this introduction of false air into each conveyor section, a controlled regulation of the volume flow can be achieved in a conveyor section by means of the corresponding conveying fan on the basis of the associated volume flow measuring means. The individual conveyor sections can be decoupled from one another. The conveying air of a conveyor section is discharged from the conveyor section through the air extraction duct, and the subsequent conveyor section is operated via the false air inlet at a certain volume flow without the need for an undefined amount of conveying air to be taken over from the preceding conveyor section.

[0020] Preferably, the first conveyor section is delimited by a bale opener and a first condenser, the last conveyor section is delimited by at least one carding machine, and the conveyor sections therebetween are delimited by cleaning machines, mixers, or storage machines, with the respective interposed conveyor section enclosing the machine that is arranged downstream in a direction of conveyance, and with at least the air extrac-

tion ducts of cleaning machines and condensers each having an exhaust control element and an exhaust-air measuring element. As a result, optimal operating conditions are created for the product to be processed and the intended production rate throughout the entire fiber preparation system and, in particular, in the machines operating in a conveying flow without intermediate storage.

[0021] Also proposed is a method for regulating a volume flow distribution and pressure distribution in a pneumatic flock conveyor in a fiber preparation system, the fiber preparation system consisting of a succession of machines and conveyor sections that are arranged between the machines and an air extraction system for extracting exhaust air from the conveyor sections. The exhaust air from at least one conveyor section in an air extraction duct associated with the conveyor section is conducted out of the conveyor section and the air extraction duct is converted into a suction line and removed by an ID fan, and the air extraction ducts that are not connected to the suction line are combined into a collecting line.

[0022] Preferably, at least one volume flow in the flock conveyor in the respective conveyor section is maintained at a constant value by means of a conveying fan that is associated with this conveyor section and an associated volume flow measuring means with a control system. This makes it possible to ensure pneumatic conveyance of the fiber flocks in the various conveyor sections that is adapted to the individual conveyor section and to achieve an individualized supply of the individual machines of the respective conveyor sections.

[0023] In the first conveyor section, which starts from a bale opener, a regulation of the exhaust control element of the first condenser is preferably controlled on the basis of a volume flow measuring means. The volume flow that is required in order to transport the fiber flocks from the bale opener to the condenser must not be less than a minimum amount of air in order to avoid blockages in the lines or in the bale opener itself. To achieve this, the measurement signal of the volume flow measuring means in the first conveyor section is switched to the control system of the exhaust air of the condenser.

[0024] It is also advantageous if a pressure is measured in the air extraction ducts of individual conveyor sections using an exhaust-air measuring element, and the pressure in the machine that is associated with the respective conveyor section is regulated by an exhaust-air measuring element to a constant target value. Using this procedure, an individualized adjustment of the individual machines can be achieved within a conveyor section, and it can be ensured that fiber processing is performed under optimum operating conditions.

[0025] Advantageously, at least the exhaust air of the last conveyor section is guided through an air extraction duct into a collecting line, but the exhaust air is not conducted through the collecting line via the ID fan. The last conveyor section comprises the distribution of flocks onto

the cards. Only the transport air is to be separated off here, which is possible by virtue of a relatively low negative pressure. The supply through the filter house is generally sufficient for this purpose, so that an increase in pressure by means of the ID fan can be omitted, and energy can be saved as well.

[0026] The invention will be explained in the following on the basis of an exemplary embodiment and elucidated by drawings. In the drawings,

Fig. 1 shows a schematic representation of a fiber preparation system in a first embodiment;

Fig. 2 shows a schematic representation of a fiber preparation system in a second embodiment; and

Fig. 3 shows a schematic representation of a fiber preparation system in a third embodiment.

[0027] Fig. 1 shows a schematic representation of a fiber preparation system with a succession of fiber processing machines in a first embodiment. An air extraction system with a filter house 7, which normally has an exhaust fan and a filter, is common to the entire fiber processing system. The cleaned exhaust air 54 is discharged from the filter house 7 into the environment or otherwise used in the spinning mill. The filter house has at least one first suction port 8 and one second suction port 9. Exhaust air is drawn in at a constant pressure via both suction ports 8 and 9. Starting from the filter house 7, the air extraction system comprises an ID fan 12, which is connected to the second suction port 9 on the filter house 7 via a pressure line 11, and a collecting line 10, which is connected to the first suction port 8. Air extraction ducts emanating from individual machines - in the exemplary embodiment that is illustrated, the air extraction duct 41 emanating from a mixer 4 and the air extraction duct 48 emanating from carding machines 6 - are connected to the collecting line 10.

[0028] In a first conveyor section 14, fiber flocks that are extracted from fiber bales by a bale opener 1 are conveyed via a pneumatic conveyor to an intermediate storage vessel, a so-called "first condenser" 2. A volume flow measuring means 19 is provided for the first conveyor section 14 in the pneumatic conveyor. In the first condenser 2, the fiber flocks are separated from the transport air, and the separated transport air is discharged from the first condenser 2 via an air extraction duct 34. The air extraction duct 34 of the condenser 2 is guided via an exhaust control element 35 into a suction line 13 of the ID fan 12. The pneumatic conveyance of the fiber flocks in the first conveyor section 14 from the bale opener 1 to the first condenser 2 is thus driven by the suction power of the ID fan 12. The volume flow in the first conveyor section 14 is maintained constant, or adapted to the requirements, by a control system 36. The exhaust control element 35 in the air extraction duct 34 is directly influenced by the control system 36 on the basis of the volume flow measuring means 19 in the first con-

veyor section 14.

[0029] In the second conveyor section 15 that follows the first conveyor section 14, the fiber flocks are fed pneumatically from the condenser 2 to a cleaner 3. The conveying fan 21 is provided for the pneumatic conveyance; likewise, a volume flow measuring means 20 is arranged in the second conveyor section 15 upstream from the conveying fan 21, and the volume flow is maintained at a constant value that corresponds to the production specifications by means of a control system 23. The required transport air is sucked in by the conveying fan 21 via an air supply 22 that is arranged at the beginning of the second conveyor section 15. Since a constant volume flow and a certain pressure are required for proper operation of the cleaner 3, the corresponding conditions are ensured by an air extraction duct 37. An exhaust-air measuring element 39 - a pressure sensor, for example - and an exhaust control element 38 - a control valve, for example - are provided in the air extraction duct 37, with a control system 40 acting on the exhaust control element 38 according to the actual values from the exhaust-air measuring element 39 in order to enable the corresponding pressure/volume ratios in the cleaner 3 to be maintained at a predetermined target value. The air extraction duct 37 of the cleaner 3 is connected to the suction line 13 of the ID fan 12.

[0030] In a subsequent third conveyor section 16, the fiber flocks leaving the cleaner 3 are pneumatically fed to a mixer 4. A conveying fan 25 that is connected via a control system 27 to a volume flow measuring means 24 for the pneumatic conveyance. The required transport air is sucked in by the conveying fan 3 partially through the cleaner 3 and supplemented by an air supply 26 that is arranged at the beginning of the third conveyor section 16. Likewise, an air extraction duct 41 for connecting the third conveyor section 16, more particularly the mixer 4, with the collecting line 10 to the filter house 7 is provided in order to separate the fiber flocks from the transport air in the mixer 4.

[0031] In another, fourth conveyor section 17, the fiber flocks leaving the mixer 4 are pneumatically fed to a card condenser 5. A conveying fan 31 that is arranged downstream from the card condenser 5 and has the fourth conveyor section 17 in common with the subsequent conveyor section 18 is provided for the pneumatic conveyance. The volume of exhaust air leaving the card condenser 5 is controlled by means of a control system 47 that is connected to a volume flow measuring means 28 and an exhaust control element 46. The required transport air is sucked in via an air supply 29 at the beginning of the fourth conveyor section 17. Likewise, an air extraction duct 45 for connecting the fourth conveyor section 17, more particularly the mixer 5, with the suction line 13 to the AD fan 12 is provided in order to separate the fiber flocks from the transport air in the card condenser 5.

[0032] Moreover, in a fifth conveyor section 18, the fiber flocks are fed pneumatically from the card condenser

5 to one or more carding machines 6 via a line system. At the carding machines 6, the fiber flocks are separated from the transport air, and the transport air is conducted as exhaust air to the collecting line 10 via an air extraction duct 48. A conveying fan 31 that is connected via a control system 33 to a volume flow measuring means 30 for the pneumatic conveyance. The required transport air is sucked in by the conveying fan 31 via an air supply 32 at the beginning of the fifth conveyor section 18.

[0033] Fig. 2 shows a schematic representation of a fiber preparation system with a succession of fiber processing machines in a second embodiment. The arrangement of the fiber-processing machines, the pneumatic transports in the individual conveyor sections, and the air extraction system are identical to the illustrations according to Fig. 1. In the following, only the elements that have been added to the first embodiment will be described in the second embodiment. For a description of the remaining elements, reference is made to Fig. 1.

[0034] In the air extraction duct 34 of the first conveyor section 14, the exhaust control element 35 is shown as a fan, unlike in the illustration of Fig. 1. The fan performs the same functions as the exhaust control element 35 that is depicted as a flap or valve. Furthermore, an exhaust control element 42 and an exhaust-air measuring element 43 are additionally provided in the air extraction duct 41 of the third conveyor section 16. The exhaust air discharged from the mixer 4 is maintained constant by a control system 44 at a predetermined value. In the embodiment shown, the exhaust-air measuring element 43 takes a pressure measurement, whereby constant pressure conditions can be created in the mixer 4.

[0035] Furthermore, Fig. 2 also shows a pressure regulator in the air extraction duct 48 in the conveyor section 18. In this case, an exhaust-air measuring element 50 in the form of a pressure gauge and an exhaust control element 49 are provided. By virtue of the control system 51, uniform pressure distributions are created in the air extraction duct 48 and thus in the flock supply to the carding machines.

[0036] A pressure gauge 52 is provided in the suction line 13 to the ID fan 12 upstream from the ID fan 12. The resulting exhaust air flows from the individual conveyor sections 14, 15 and 17 that are connected to the suction line 13 are known based on the specifications for the production of the fiber preparation system and the product to be processed and are extrapolated to a total exhaust volume and the necessary pressure by a control system. By means of a control system 53 of the ID fan 12 that is connected to the pressure gauge 52, the induced draft 12 is regulated to the calculated target value for the total exhaust airflow.

[0037] By virtue of the illustrated regulation of the conveying and exhaust air flows in the fiber preparation system, no open handovers are necessary, so the energy required for the operation is minimized.

[0038] Fig. 3 shows a schematic representation of a fiber preparation system with a succession of fiber

processing machines in a third embodiment. Compared with the embodiments shown in Figs. 1 and 2, the third embodiment is an abbreviated fiber preparation system. Through the precise regulation of the volume flows and pressure conditions in the pneumatic conveyors and the air extraction systems of the individual conveyor sections, the use of condensers, which serve as an intermediate storage between the individual processing steps, can be dispensed with in the fiber preparation system.

[0039] An air extraction system with a filter house 7, which normally has an exhaust fan and a filter, is common to the entire fiber processing system. The cleaned exhaust air 54 is discharged from the filter house 7 into the environment or otherwise used in the spinning mill. The filter house has at least one first suction port 8 and one second suction port 9. Exhaust air is drawn in at a constant pressure via both suction ports 8 and 9. Starting from the filter house 7, the air extraction system comprises an ID fan 12, which is connected to the second suction port 9 on the filter house 7 via a pressure line 11, and a collecting line 10, which is connected to the first suction port 8. Air extraction ducts emanating from individual machines - in the exemplary embodiment that is illustrated, the air extraction duct 41 emanating from a mixer 4 and the air extraction duct 48 emanating from carding machines 6 - are connected to the collecting line 10.

[0040] In a first conveyor section 15 at the beginning of fiber preparation, fiber flocks that are extracted from fiber bales by a bale opener 1 are conveyed via a pneumatic conveyor to a cleaner 3. A volume flow measuring means 20 is provided for the conveyor section 15 in the pneumatic conveyor. In this case, the volume flow is maintained by means of a control system 23 at a constant value that corresponds to the production specifications. The required transport air is sucked in by the conveying fan 21 via the bale opener 1. Since a constant volume flow and a certain pressure are required for proper operation of the cleaner 3, the corresponding conditions are ensured by an air extraction duct 37. An exhaust-air measuring element 39, such as a pressure sensor, for example, is arranged in the air extraction line 37. The ID fan 12, on which the control system 40 acts in accordance with the actual values from the exhaust-air measuring element 39 in order to enable the corresponding pressure/volume ratios in the cleaner 3 to be maintained at a predetermined target value, is used as an exhaust control element. The air extraction duct 37 of the cleaner 3 is connected to the suction line 13 of the ID fan 12. Since only one cleaner 3 is provided in the illustrated embodiment, no further air extraction ducts are connected to the suction line 13 of the ID fan 12. An additional exhaust control element in the air extraction 37 is also dispensed with, since its function is taken over by the ID fan 12.

[0041] In a subsequent, further conveyor section 16, the fiber flocks leaving the cleaner 3 are pneumatically fed to a mixer 4. A conveying fan 25 that is connected via a control system 27 to a volume flow measuring means 24 for the pneumatic conveyance. The required

transport air is sucked in by the conveying fan 3 partially through the cleaner 3 and supplemented by an air supply 26 that is arranged at the beginning of the third conveyor section 16. Likewise, an air extraction duct 41 for connecting the third conveyor section 16, more particularly the mixer 4, with the collecting line 10 to the filter house 7 is provided in order to separate the fiber flocks from the transport air in the mixer 4. Furthermore, an exhaust control element 42 and an exhaust-air measuring element 43 are additionally provided in the air extraction duct 41 of the third conveyor section 16. The exhaust air discharged from the mixer 4 is maintained constant by a control system 44 at a predetermined value. In the embodiment shown, the exhaust-air measuring element 43 takes a pressure measurement, whereby constant pressure conditions can be created in the mixer 4.

[0042] In another, subsequent conveyor section 18, the fiber flocks leaving the mixer 4 are pneumatically fed to one or more carding machines 6. At the carding machines 6, the fiber flocks are separated from the transport air, and the transport air is conducted as exhaust air to the collecting line 10 via an air extraction duct 48. A conveying fan 31 that is connected via a control system 33 to a volume flow measuring means 30 for the pneumatic conveyance. The required transport air is sucked in by the conveying fan 31 via an air supply 29 at the beginning of the conveyor section 18. Furthermore, a pressure regulator is also provided in the air extraction duct 48 in the conveyor section 18. In this case, an exhaust-air measuring element 50 in the form of a pressure gauge and an exhaust control element 49 are provided. By virtue of the control system 51, uniform pressure distributions are created in the air extraction duct 48 and thus in the flock supply to the carding machines.

[0043] The present invention is not limited to the exemplary embodiments that have been illustrated and described. Modifications are also possible within the scope of the claims, as is a combinations of the features, even if these are illustrated and described in different exemplary embodiments.

Legend

[0044]

| | |
|----|---------------------|
| 1 | bale opener |
| 2 | initial condenser |
| 3 | cleaner |
| 4 | mixer |
| 5 | card condenser |
| 6 | carding machine |
| 7 | filter house |
| 8 | first suction port |
| 9 | second suction port |
| 10 | collecting line |
| 11 | pressure line |
| 12 | ID fan |
| 13 | suction line |

| | | |
|----|---|----|
| 14 | first conveyor section | |
| 15 | second conveyor section | |
| 16 | third conveyor section | |
| 17 | fourth conveyor section | |
| 18 | fifth conveyor section | 5 |
| 19 | volume flow measuring means, first conveyor section | |
| 20 | volume flow measuring means, second conveyor section | |
| 21 | conveying fan, second conveyor section | 10 |
| 22 | air supply, second conveyor section | |
| 23 | control for conveying fan, second conveyor section | |
| 24 | volume flow measuring means, third conveyor section | |
| 25 | conveying fan, third conveyor section | 15 |
| 26 | air supply, third conveyor section | |
| 27 | control for conveying fan, third conveyor section | |
| 28 | volume flow measuring means, fourth conveyor section | |
| 29 | air supply, fourth conveyor section | 20 |
| 30 | volume flow measuring means, fifth conveyor section | |
| 31 | conveying fan, fifth conveyor section | |
| 32 | air supply, fifth conveyor section | |
| 33 | control for conveying fan, fifth conveyor section | 25 |
| 34 | air extraction duct, first conveyor section | |
| 35 | exhaust control element, first conveyor section | |
| 36 | control system for exhaust control element, first conveyor section | |
| 37 | air extraction duct, second conveyor section | 30 |
| 38 | exhaust control element, second conveyor section | |
| 39 | exhaust-air measuring element, second conveyor section | |
| 40 | control system for exhaust control element, second conveyor section | 35 |
| 41 | air extraction duct, third conveyor section | |
| 42 | exhaust control element, third conveyor section | |
| 43 | exhaust-air measuring element, third conveyor section | |
| 44 | control system for exhaust control element, third conveyor section | 40 |
| 45 | air extraction duct, fourth conveyor section | |
| 46 | exhaust control element, fourth conveyor section | |
| 47 | control system for exhaust control element, fourth conveyor section | 45 |
| 48 | air extraction duct, fifth conveyor section | |
| 49 | exhaust control element, fifth conveyor section | |
| 50 | exhaust-air measuring element, fifth conveyor section | |
| 51 | control system for exhaust control element, fifth conveyor section | 50 |
| 52 | pressure gauge, suction line | |
| 53 | control system for ID fan | |
| 54 | filter house outlet | 55 |

Claims

1. A fiber preparation system, with a succession of machines (1 - 6) and conveyor sections (14 - 18) that are respectively arranged between the machines (1 - 6) for pneumatic flock conveyance, and with an air extraction system for extracting exhaust air from the conveyor sections (14 - 18), **characterized in that** the air extraction system has an ID fan (12) that is connected with a suction line (13) to at least one of the conveyor sections (14 - 18) via air extraction ducts (34, 37, 45) emanating from the suction line (13) and associated with the respective conveyor section (14 - 18), and that the air extraction ducts (41, 48) that are not connected to the suction line (13) are combined in a collecting line (10).
2. The fiber preparation system as set forth in claim 1, **characterized in that** an associated conveying fan (21, 25, 31) is provided in the pneumatic flock conveyor in the respective conveyor sections (14 - 18).
3. The fiber preparation system as set forth in claim 1 or 2, **characterized in that** a volume flow measuring means (19, 20, 24, 28, 30) associated with the conveyor sections (14 - 18) is provided in the pneumatic flock conveyor in the respective conveyor section (14 - 18).
4. The fiber preparation system as set forth in claim 3, **characterized in that** a constant volume flow is ensured by the volume flow measuring means (20, 24, 30) and corresponding regulation of the conveying fan (21, 25, 31) in the respective conveyor section (15, 16, 18).
5. The fiber preparation system as set forth in any one of the preceding claims, **characterized in that** an exhaust control element (35, 38, 42, 46, 49) is provided in at least one air extraction duct (34, 37, 41, 45, 48).
6. The fiber preparation system as set forth in claim 5, **characterized in that** the exhaust control element (35, 38, 42, 46, 49) is a control flap or a fan.
7. The fiber preparation system as set forth in any one of the preceding claims, **characterized in that** an exhaust-air measuring element (39, 43, 50) is provided in at least one air extraction duct (37, 41, 48).
8. The fiber preparation system as set forth in claim 7, **characterized in that** the exhaust-air measuring element (39, 43, 50) in the air extraction duct (37, 41, 48) is a volume flow measuring means or a pressure gauge.
9. The fiber preparation system as set forth in any one

of the preceding claims, **characterized in that** a pressure gauge (52) is provided upstream from the ID fan (12) in the suction line (13).

10. The fiber preparation system as set forth in any one of the preceding claims, **characterized in that** an air supply (22, 26, 29, 32) is provided at the beginning of each conveyor section (14 - 18).
11. The fiber preparation system as set forth in any one of the preceding claims, **characterized in that** the first conveyor section (14) is delimited by a bale opener (1) and a first condenser (2), the last conveyor section (18) is delimited by at least one carding machine (6), and the conveyor sections therebetween are delimited by cleaning machines (3), mixers (4), or storage machines, with the respective interposed conveyor section (15, 16, 17) enclosing the machine (3, 4, 5) that is arranged downstream in a direction of conveyance, and with at least the air extraction ducts (37, 41) of cleaning machines (6) and condensers (2, 5) each having an exhaust control element (38, 42) and an exhaust-air measuring element (39, 43).
12. A method for method for regulating a volume flow distribution and pressure distribution in a pneumatic flock conveyance in a fiber preparation system, wherein the fiber preparation system consists of a succession of machines (1 - 6) and conveyor sections (14 - 18) that are arranged between the machines (1 - 6) and an air extraction system for extracting exhaust air from the conveyor sections (14 - 18), **characterized in that** the exhaust air from at least one conveyor section (14 - 18) in an air extraction duct (34, 37, 45) associated with the conveyor section (14 - 18) is conducted out of the conveyor section (14 - 18) and the air extraction duct (34, 37, 45) is converted into a suction line (13) and removed by an ID fan (12), and that the air extraction ducts (34, 37, 45) that are not connected to the suction line (13) are combined into a collecting line (10).
13. The method as set forth in claim 12, **characterized in that** at least one volume flow in the flock conveyor in the respective conveyor section (15, 16, 18) is maintained at a constant value by means of a conveying fan (21, 25, 31) that is associated with this conveyor section (15, 16, 18) and an associated volume flow measuring means (20, 24, 30) with a control system (23, 27, 33).
14. The method as set forth in claim 12 or 13, **characterized in that** a pressure is measured in the air extraction ducts (37, 41, 48) of individual conveyor sections (15, 16, 18) using an exhaust-air measuring element (39, 43, 50), and the pressure in the machine (3, 4, 6) that is associated with the respective con-

veyor section (15, 16, 18) is regulated by an exhaust-air measuring element (38, 42, 49) to a constant target value.

- 5 15. The method as set forth in claim 12 to 14, **characterized in that** at least the exhaust air of the last conveyor section (18) is guided through an air extraction duct (48) into a collecting line (10), but the exhaust air is not conducted through the collecting line (10) via the ID fan (12).

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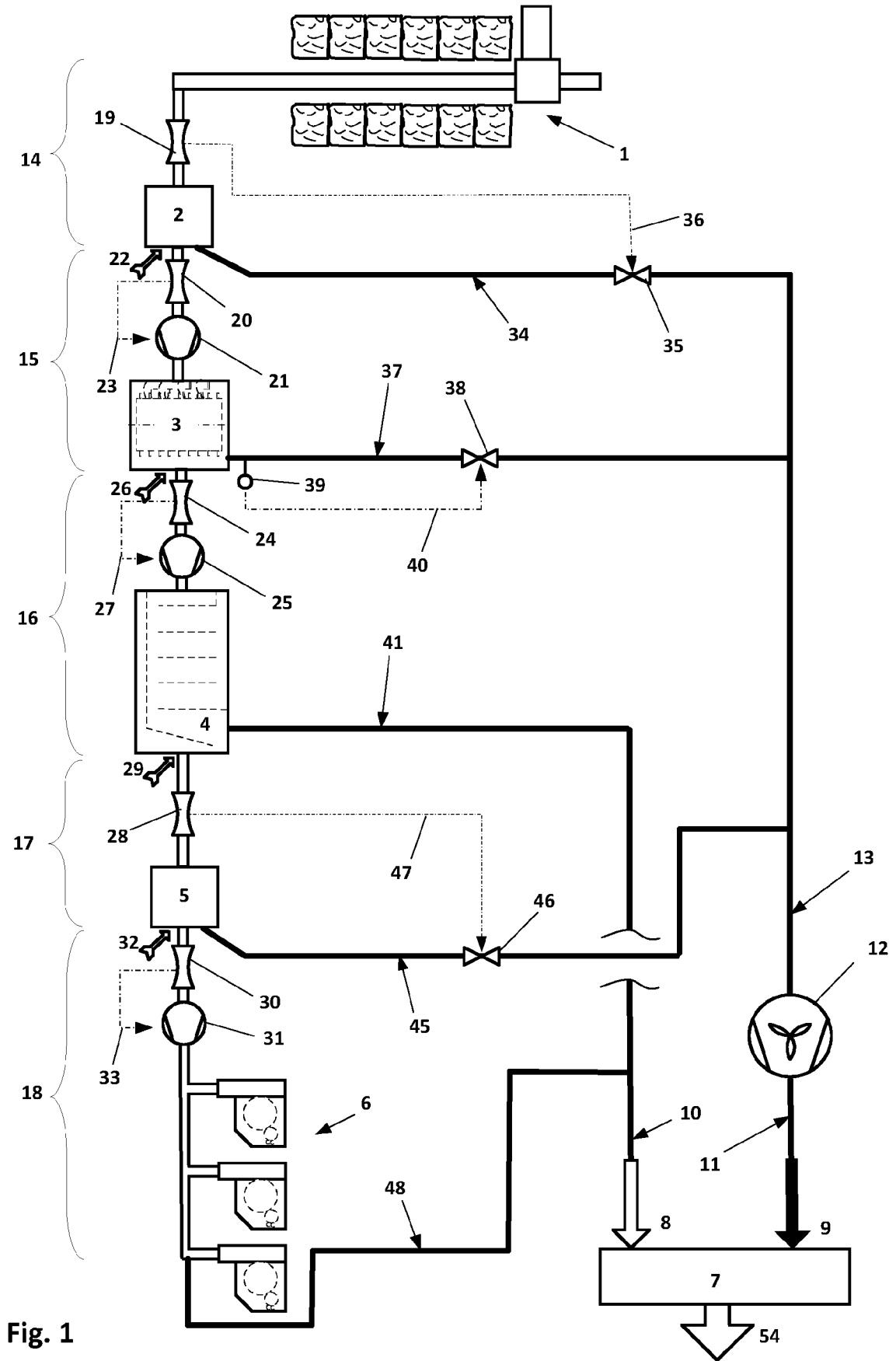


Fig. 1

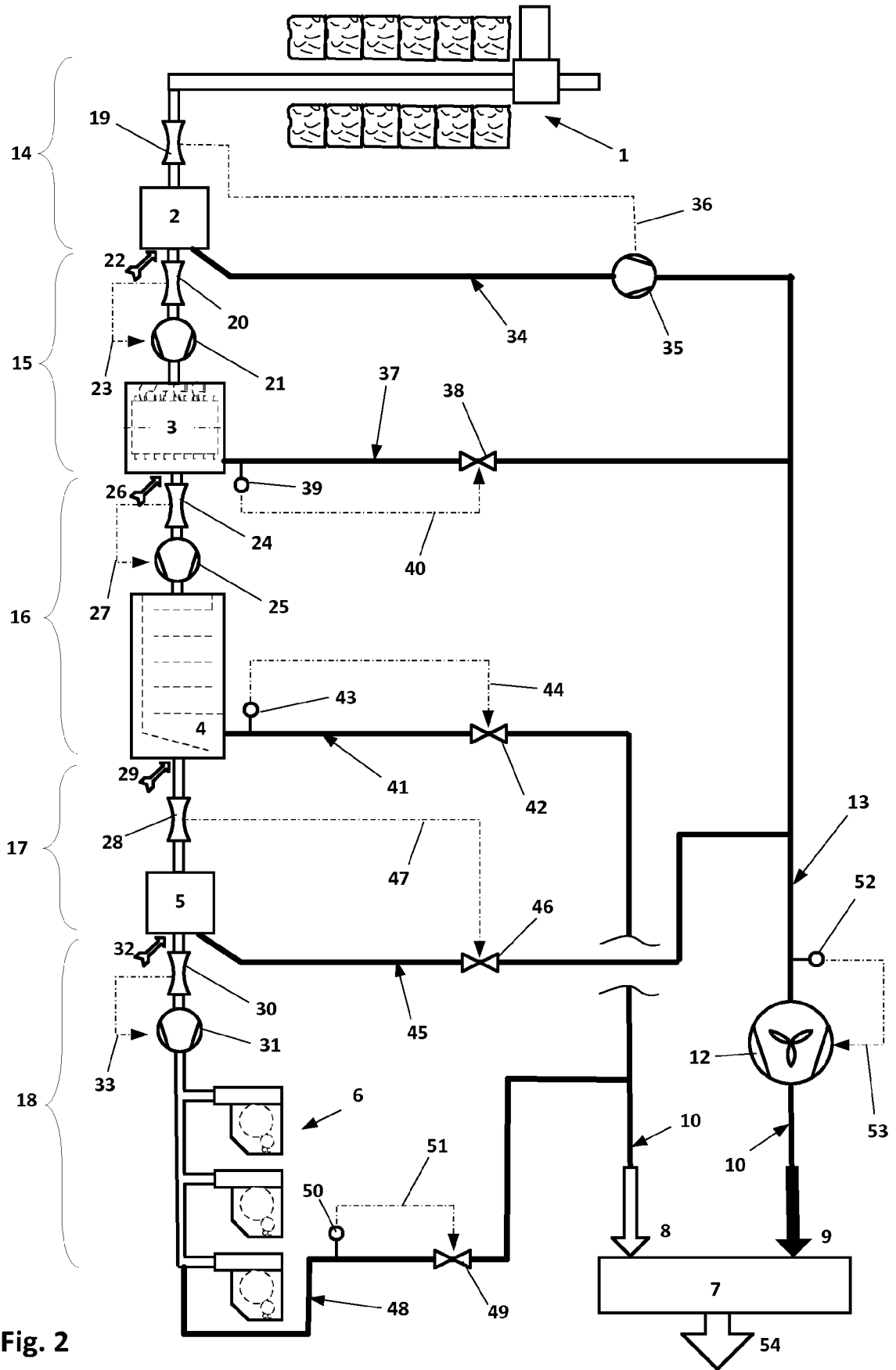


Fig. 2

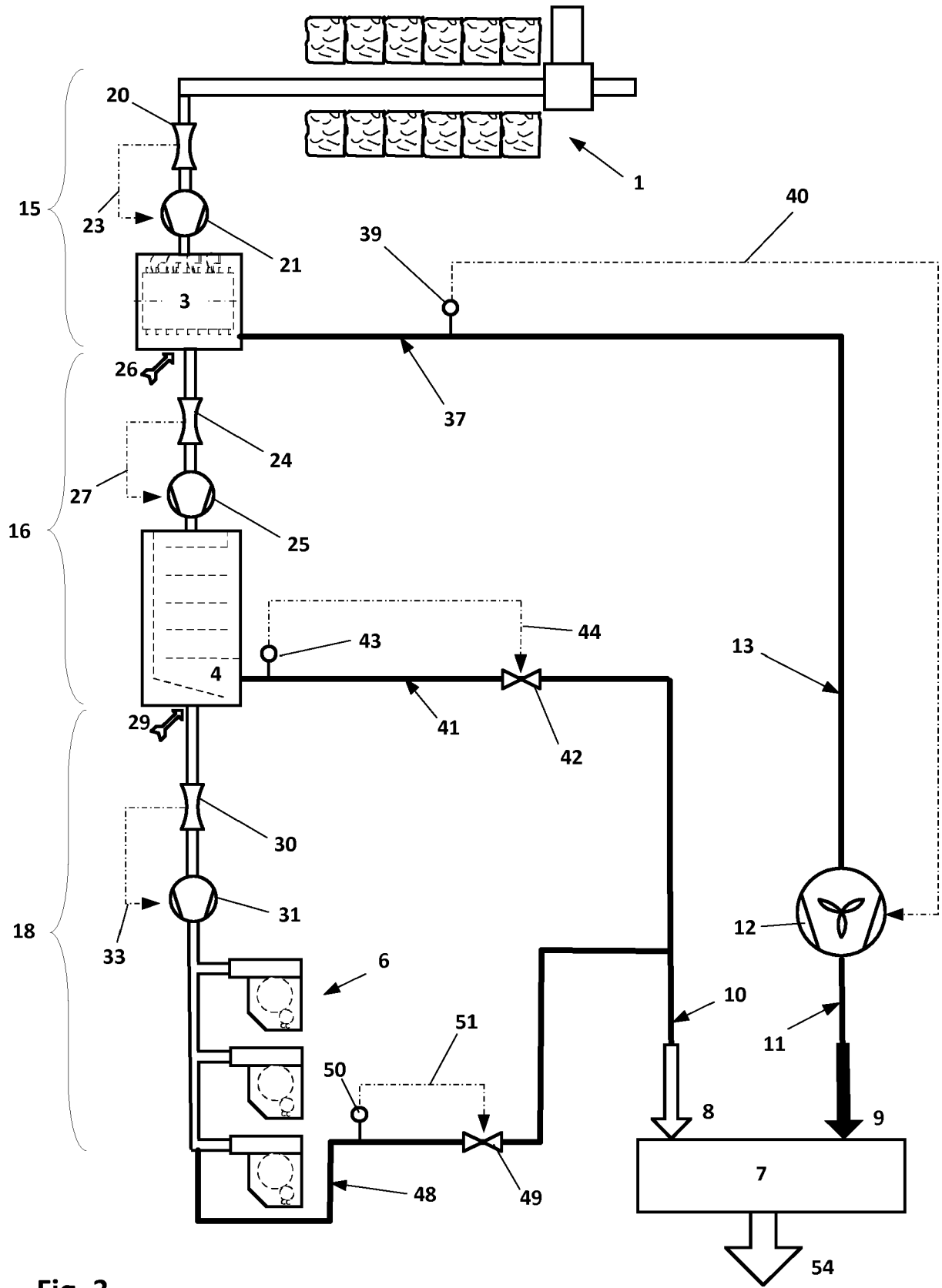


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
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| The present search report has been drawn up for all claims | | | |
| Place of search Munich | | Date of completion of the search 23 January 2020 | Examiner Clivio, Eugenio |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p> | | | |

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23-01-2020

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REFERENCES CITED IN THE DESCRIPTION

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