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(71) Applicant: **GE.MA.TA. S.p.A.**
36070 Trissino (VI) (IT)

(72) Inventor: **MAITAN, Gianni**
30122 VENEZIA (IT)

(74) Representative: **Bonini, Ercole**
Studio Bonini Srl
Corso Fogazzaro, 8
36100 Vicenza (IT)

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(54) **DRYER FOR FLEXIBLE LAMINAR ELEMENTS AND DRYING PLANT INCLUDING A PLLURALITY OF SAID DRYERS**

(57) A dryer (1) for flexible laminar elements, preferably animal hides (P), comprising a drying tunnel (2) in which a partition wall (13) defines a first drying chamber (14) provided with an intake piping (7) and a second drying chamber (15) provided with a delivery hood (8) and in which a collector duct (9) connects the intake piping (7) with the delivery hood (8). In the drying tunnel (2) there are two lateral extractor hoods (21) housed in the second suction chamber (15) and arranged one on one

side and one on the opposite side of the transport surface (3), each of the suction mouth (21a) arranged in a lower position than the transport surface (3). A suction piping (25) connects each lateral extractor hood (21) to an extractor (23) having the discharge piping (24) communicating with the external environment and connected to an auxiliary piping (28) communicating with the collector duct (9).

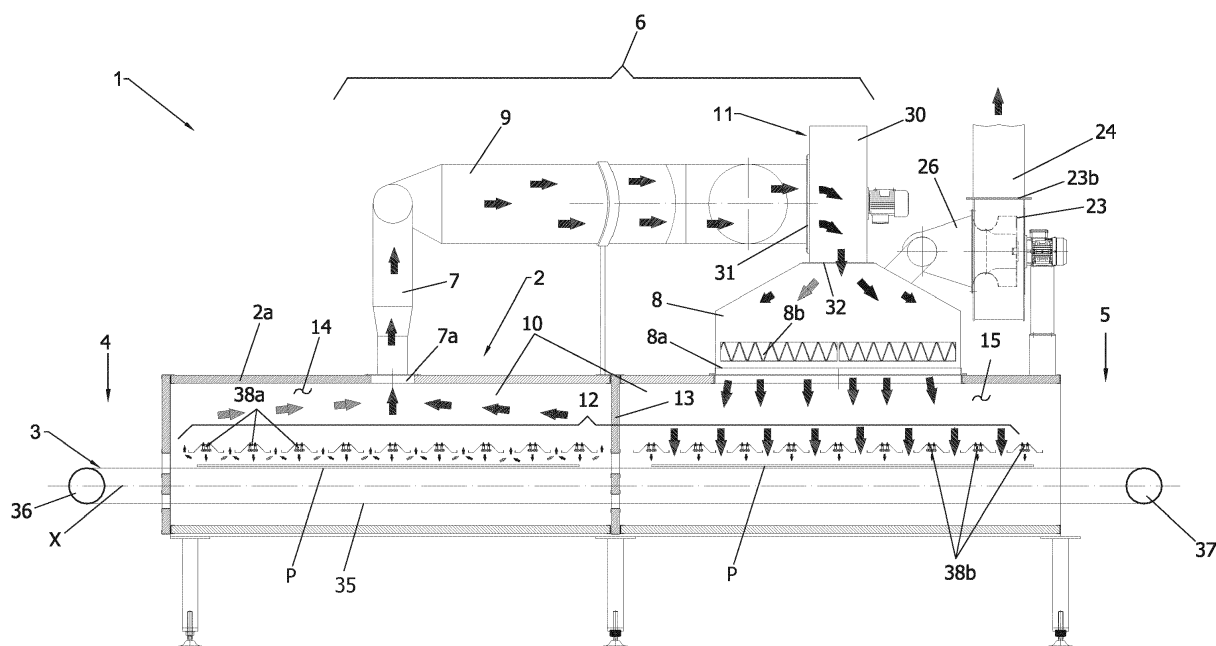


Fig. 1

Description

[0001] The invention relates to a dryer for flexible laminar elements, particularly adapted to dry animal hides.

[0002] The invention also relates to a drying plant comprising a plurality of the aforementioned dryers arranged in line one after the other.

[0003] The dryer and the drying plant of the invention are particularly useful in the tanneries for drying the hides after they have undergone the moist treatments and before proceeding to the subsequent processes that bring them to the state of finished product.

[0004] The drying operations are carried out using dryers of various types which operate according to different principles.

[0005] For example, so-called "vacuum" dryers are known in which the hide is dried by evaporation of the water it contains in an environment in which the vacuum is created.

[0006] Dryers in which the hides are dried stretched on panels transiting along a tunnel and to which each hide is bound by means of grippers arranged peripherally along the perimeter edge are also known.

[0007] Dryers which consist of a tunnel along which the hides transit from an inlet station to an outlet station, stretched on the surface of vertical panels, are also known.

[0008] Inside the tunnel, the hides are dried by means of air which is heated using, for example, steam batteries and is then conveyed along the drying tunnel. The hot air in contact with the hides dries them, is charged with moisture and is then extracted when the moisture content it contains exceeds a predefined value.

[0009] To improve the drying process and to reduce energy consumption, dryers are known in which hot air is taken at the initial part of the tunnel located downstream of the station for the inlet of hides and is then introduced at the final part of the tunnel located upstream of the outlet station.

[0010] During the operation of the dryer, the hot air is then repeatedly recycled between the initial part and the final part of the tunnel, obtaining an improvement in thermal efficiency and significant energy savings since the caloric intake in the final part of the tunnel by the air taken in the initial part allows reducing consumption.

[0011] A drawback that is found in the dryers in which the aforementioned recycling of hot air takes place derives from the fact that the drying tunnel comprises a single chamber in which there is no partition between the initial part where the air is taken and the final part where the air is introduced.

[0012] This leads to a loss of efficiency of the heat exchange since the lack of partition between the initial part and the final part of the tunnel favours the establishment of an abnormal circulation so that part of the hot air that is introduced into the final part of the tunnel is immediately sucked in through the suction that takes place in the initial part.

[0013] Furthermore, in the dryers in which the tunnel comprises a single chamber, there is also a significant difficulty in controlling the drying temperature and maintaining it at the value desired by the user along the entire length of the drying tunnel.

[0014] Finally, known heating systems, for example with heat exchange batteries, make it difficult to control the drying temperature and above all make it difficult for the user to modify it quickly to adapt it to his needs.

[0015] The patent document GB 2 043 860 is also known which describes a continuous dryer comprising a plurality of chambers in which between one chamber and the adjacent chambers there are rotating shutters which direct a longitudinal flow of air along the entire row of chambers, in countercurrent to the flow of air of each chamber.

[0016] The present invention has the aim of overcoming the drawbacks listed above. In particular, a first object is to provide a dryer for flexible laminar elements, in particular for animal hides, which has better thermal efficiency compared to known dryers equivalent thereto.

[0017] Another object is that the dryer of the invention allows a more effective and precise control of the drying temperature.

[0018] The listed objects are achieved with the realization of the dryer of the invention according to what is described in the main claim to which reference will be made.

[0019] Further characteristics of the dryer of the invention are described in the dependent claims.

[0020] Advantageously, the dryer of the invention, with respect to the known dryers, has a greater operating flexibility.

[0021] Still advantageously, the dryer of the invention, with respect to known dryers equivalent thereto, allows significant energy savings.

[0022] Finally, the better control of the drying temperature that the dryer of the invention allows also leads to a qualitative improvement of the hides being dried.

[0023] The aims and advantages listed and any other shall be better highlighted below during the description of a preferred but not exclusive embodiment of the invention, which is provided with reference to the appended drawings in which:

- fig. 1 shows a longitudinal section of the dryer of the invention carried out according to the section line I - I of fig. 3;
- fig. 2 shows another longitudinal section of the dryer of the invention carried out according to the section line II - II of fig. 3;
- fig. 3 shows the plan view of the dryer of fig. 2;
- fig. 4 shows the longitudinal section of a drying plant comprising several dryers of the invention arranged in line.

[0024] The dryer of the invention is represented in figures 1 to 3 in which it is indicated as a whole with 1.

[0025] The dryer is used for drying flexible laminar elements, preferably animal hides **P**, and essentially comprises a drying tunnel **2** which develops in a predominantly longitudinal direction **X**.

[0026] Inside the drying tunnel **2** there is a transport surface **3** which develops along the drying tunnel **2** from an inlet station **4** to an outlet station **5** and on which the hides to be dried are stretched.

[0027] In particular, the transport surface **3** belongs to a conveyor belt **35** which is wound like a closed loop between a first cylinder **36**, arranged upstream of the drying tunnel **2** and at the inlet station **4**, and a second cylinder **37** which is arranged downstream of the drying tunnel **2** and at the outlet station **5**.

[0028] In other embodiments, however belonging to the prior art, the transport surface **3**, instead of belonging to a conveyor belt, may belong to a plurality of belts or wires arranged parallel to each other and side by side.

[0029] Motorization means are associated to the first cylinder **36** or to the second cylinder **37** which set them in rotation so as to advance the transport surface **3** with the hides arranged thereon along the drying tunnel **2**.

[0030] It is also observed the presence of means **6** for circulating drying air inside the drying tunnel **2** which comprise at least one intake piping **7** and at least one delivery hood **8** communicating with the internal volume **10** of the drying tunnel **2** and are connected between them by means of at least one collector duct **9** with which means **11** for circulating air from the intake piping **7** to the delivery hood **8** are associated.

[0031] According to the particular but not exclusive embodiment which is described, there are two intake pipings **7** which can be seen in fig. 3 and which are both connected to the collector duct **9** which communicates with the delivery hood **8**.

[0032] The circulation means **11** comprise a fan **30**, having the suction mouth **31** connected to the collector duct **9** and the delivery mouth **32** connected to the delivery hood **8**, which sucks the drying air through the intake pipings **7** and conveys it to the delivery hood **8**.

[0033] Inside the drying tunnel **2** there are heating means indicated as a whole with **12** which comprise a plurality of infrared field emission lamps **38a** and **38b**, commonly indicated by the term infrared lamps, which are arranged above of the transport surface **3** and are powered by an electrical circuit, not represented, connected to an external source of external current.

[0034] In the drying tunnel **2** there is a partition wall **13** which defines a first drying chamber **14** and a second drying chamber **15** which are arranged in succession according to the direction of travel of the hides **P** along the drying tunnel **2** from the inlet station **4** to the outlet station **5**. Both intake pipings **7** communicate with the first drying chamber **14** and the delivery hood **8** communicates with the second drying chamber **15**.

[0035] In particular, the intake mouth **7a** of each intake piping **7** and the delivery mouth **8a** of the delivery hood **8** are made in the ceiling **2a** of the drying tunnel **2** so that

the drying air is taken from the first drying chamber **14** and is conveyed to the second drying chamber **15**.

[0036] According to the invention and as can be seen in particular in figs. 2 and 3, in the second suction chamber **15** there are two lateral extractor hoods **21** which are arranged one on one side and one on the opposite side of the transport surface **3** and each has the suction mouth **21a** arranged laterally and in a lower position than the transport surface **3**.

[0037] Furthermore, a suction piping **25** connects each lateral extractor hood **21** to an extractor **23** having the discharge mouth **23b** connected to a discharge piping **24** which conveys the moist drying air into the external environment to said drying tunnel **2** at the end of the drying cycle.

[0038] Obviously, embodiments are possible in which on each side of the transport surface **3** there is more than one lateral extractor hood **21**.

[0039] For an optimal balance of the suction flows, the lateral extractor hoods **21** are frontally opposite to each other and the respective suction pipings **25** communicate with the extractor **23** by interposition of a suction collector **26**.

[0040] The presence of an auxiliary piping **28** having the inlet mouth **28a** connected to the discharge piping **24** and the outlet mouth **28b** connected to the collector duct **9** is also observed.

[0041] Furthermore, there is also a shutter valve **27** installed in the discharge piping **24** downstream of the inlet mouth **28a** of the auxiliary piping **28**.

[0042] In this way the auxiliary piping **28** and the shutter valve **27** operate synergistically to let at least part of the drying air loaded with moisture recirculate in the second drying chamber **15** before this air is conveyed in the external environment.

[0043] Furthermore, it can be seen in fig. 1 that filtering means **8b** for filtering the air before it enters the second drying chamber **15** are contained in the delivery hood **8**.

[0044] Operatively, when the dryer is in operation, the circulation means **11**, in particular the fan **30**, continuously take air from the first drying chamber **14** through the intake pipings **7** and convey it to the second drying chamber **15** through the delivery hood **8** according to the direction of flow indicated by the arrows in fig. 1.

[0045] In this way in the second drying chamber **15** the hides **P** receive a caloric intake from the hot air coming from the first drying chamber **14** and consequently the infrared lamps **38b** contained in the second drying chamber **15** can be powered in a reduced way compared to the infrared lamps **38a** present in the first drying chamber **14**, with consequent energy savings and therefore a reduction in costs.

[0046] Obviously there will be regulation and control means, not represented and not described as known per se, which are adapted to modulate the electrical power supply of the infrared lamps **38a** and **38b** as a function of the flow rate and, consequently, of the caloric content of the hot air which is transferred from the first drying

chamber **14** to the second drying chamber **15**, as a function of the drying temperature to be maintained.

[0047] The caloric intake in the second drying chamber **15** is also increased by recycling the hot air therein which is sucked laterally and below the transport surface **3** by the extractor **23** by means of the lateral extractor hoods **21** connected to the suction pipings **25**.

[0048] The flow rate of the air that is recycled is regulated by the shutter valve **27**.

[0049] For this purpose there will also be control means of the shutter valve **27** adapted to modify the opening degree to regulate the flow rate of air which is expelled as a function of the moisture it contains and according to the flow indicated by the arrows in fig. 2.

[0050] It is therefore understood that the dryer **1** of the invention achieves the set aims.

[0051] First of all, the presence of the partition wall **13** which divides the internal volume **10** of the drying tunnel **2**, defining a first drying chamber **14** and a second drying chamber **15** separated from each other, prevents the occurrence of a mixing inside the drying tunnel **2** between the air that is introduced into the second drying chamber **15** through the delivery mouth **8** with the air which is taken by the first drying chamber **14** from the intake piping **7**.

[0052] This also avoids energy losses and increases the heat exchange efficiency of the dryer as a whole.

[0053] Furthermore, in a further advantageous way for energy purposes, the dryer of the invention is also provided with lateral extractor hoods **21** which allow a further recirculation of the drying air before the definitive discharge thereof into the environment outside the dryer.

[0054] Furthermore, the aim of reducing consumption is also achieved since the caloric intake due to the hot drying air which is taken from the first drying chamber **14** and which is introduced into the second drying chamber **15** allows reducing the electrical power supply of the infrared lamps **38b** present in the second drying chamber **15** with a consequent reduction in consumption and related costs.

[0055] Fig. 4 shows a drying plant for flexible laminar elements, preferably animal hides, generally indicated with **100**, which comprises a plurality of dryers **1** of the type that is the object of the invention just described which are arranged in line one after the other.

Claims

1. A dryer (1) for flexible laminar elements, preferably animal hides (P), comprising a drying tunnel (2) which develops in a predominantly longitudinal direction (X) and in which it can be identified as follows:

- a transport surface (3) of said hides (P) along said drying tunnel (2) from an inlet station (4) to an outlet station (5);
- motorization means for advancing said transport surface (3) along said drying tunnel (2);

- means (11) for circulating drying air inside said drying tunnel (2) which comprise at least one intake piping (7) and at least one delivery hood (8) communicating with the internal volume (10) of said drying tunnel (2) and connected between them by means of at least one collector duct (9) with which at least one fan (30) is associated;
- means (12) for heating said drying air;
- a partition wall (13) which defines a first drying chamber (14) and a second drying chamber (15) arranged in succession according to the direction of travel of said hides (P) along said drying tunnel (2) from said inlet station (4) to said outlet station (5), said at least one intake piping (7) being in communication with said first drying chamber (14) and said at least one delivery hood (8) being in communication with said second drying chamber (15),

characterised by comprising:

- at least two lateral extractor hoods (21) housed in said second suction chamber (15) and arranged one on one side and one on the opposite side of said transport surface (3), each of said lateral extractor hoods (21) having the suction mouth (21a) arranged laterally and in a lower position than said transport surface (3);
- a suction piping (25) that connects each lateral extractor hood (21) to an extractor (23) having the discharge mouth (23b) connected to a discharge piping (24) which conveys the moist drying air into the external environment to said drying tunnel (2) at the end of the drying cycle.

2. The dryer (1) according to claim 1, **characterized by** comprising:

- an auxiliary piping (28) having the inlet mouth (28a) connected to said discharge piping (24) and the outlet mouth (28b) connected to said collector duct (9);
- a shutter valve (27) present in said discharge piping (24) and located downstream of said inlet mouth (28a) of said auxiliary piping (28),

said auxiliary piping (28) and said shutter valve (27) being able to let at least part of said moist drying air recirculate in said second drying chamber (15) before said moist drying air is conveyed to the external environment.

3. The dryer (1) according to claim 1 or 2, **characterized in that** said means (11) for circulating drying air inside said drying tunnel (2) comprise two intake pipings (7) which are both connected to said collector duct (9) which communicates with said delivery hood (8).

4. The dryer (1) according to claim 3, **characterized in that** the intake mouth (7a) of each intake piping (7) and the delivery mouth (8a) of said delivery hood (8) are both made in the ceiling (2a) of said drying tunnel (2). 5

5. The dryer (1) according to any one of the preceding claims, **characterized in that** said at least one fan (30) has the suction mouth (31) connected to said collector duct (9) and the delivery mouth (32) connected to said delivery hood (8). 10

6. The dryer (1) according to any one of the preceding claims, **characterized in that** said transport surface (3) of said hides (P) along said drying tunnel (2) belongs to a conveyor belt (35) which is wound like a closed loop between a first cylinder (36), arranged upstream of said drying tunnel (2) and at said inlet station (4), and a second cylinder (37) arranged downstream of said drying tunnel (2) and at said outlet station (5). 15
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7. The dryer (1) according to any one of the preceding claims, **characterized in that** air filtering means (8b) are contained in said delivery hood (8). 25

8. The dryer (1) according to any one of the preceding claims, **characterized in that** said means (12) for heating said drying air comprise a plurality of infrared field emission lamps (38a, 38b) which are arranged above said transport surface (3). 30

9. A drying plant (100) for flexible laminar elements, preferably animal hides, comprising two or more dryers (1) arranged in line one after the other, **characterized in that** each of said dryers (1) is of the second type according to any of the preceding claims 1 to 8. 35

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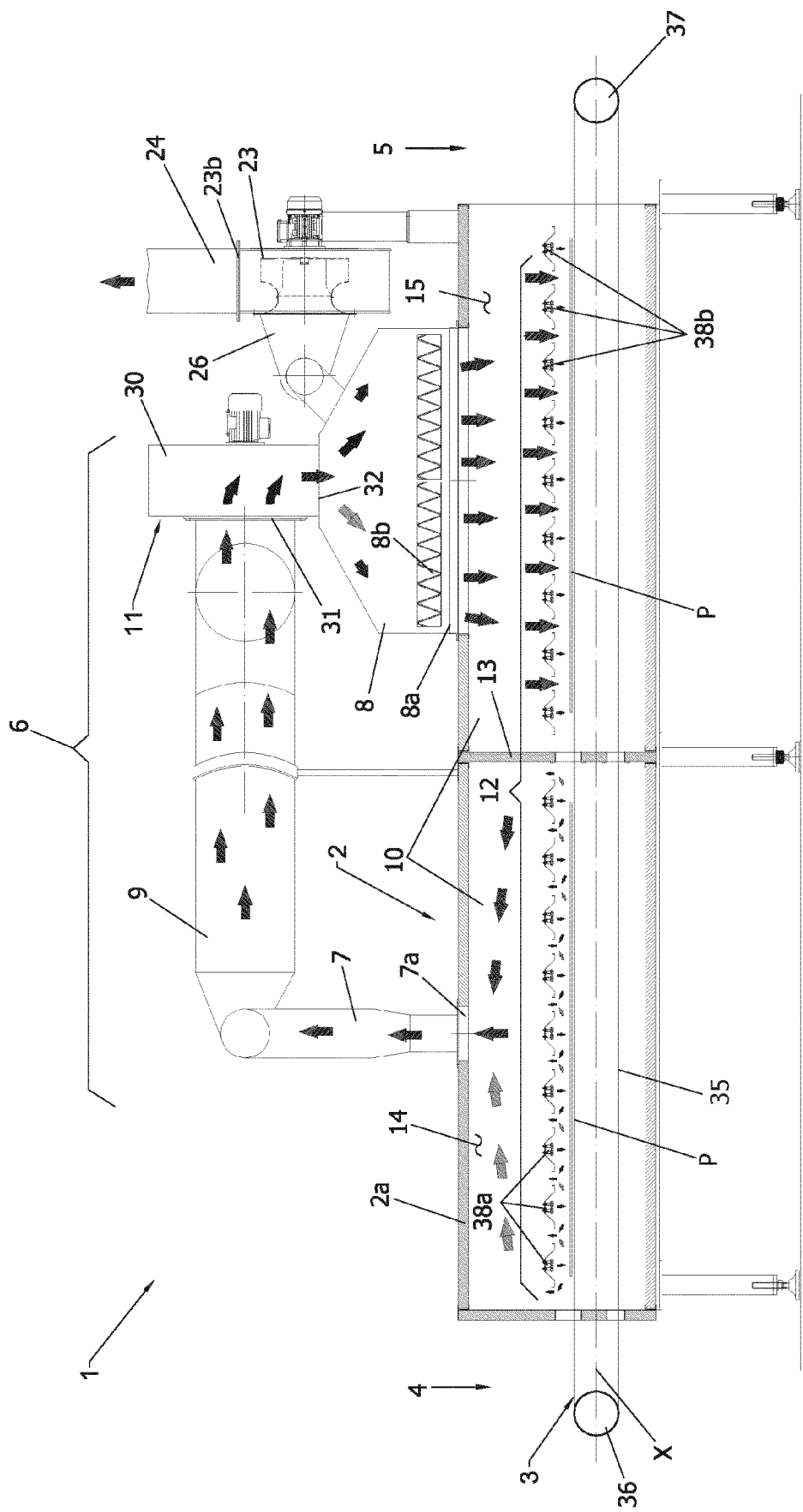


Fig. 1

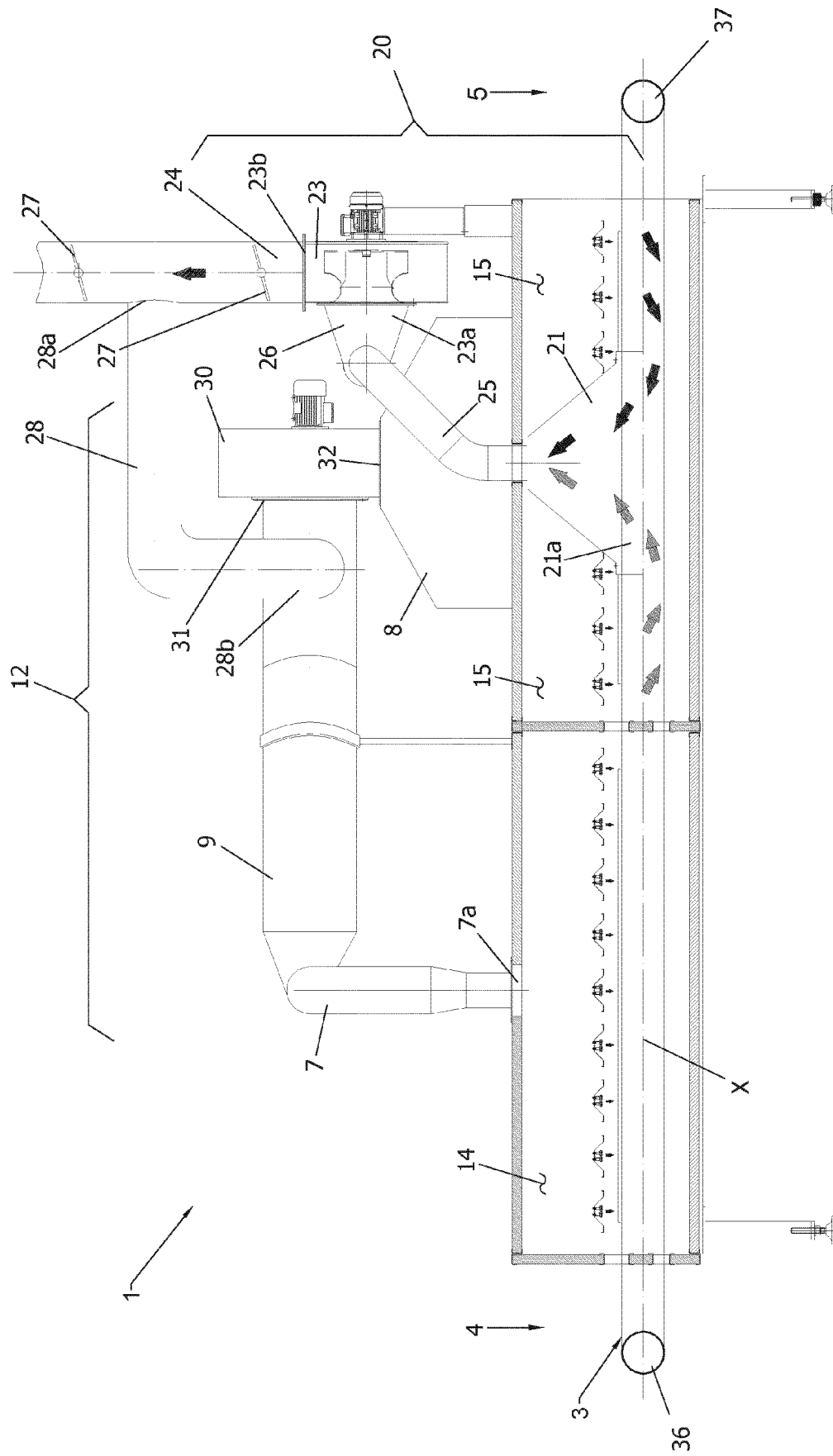


Fig. 2

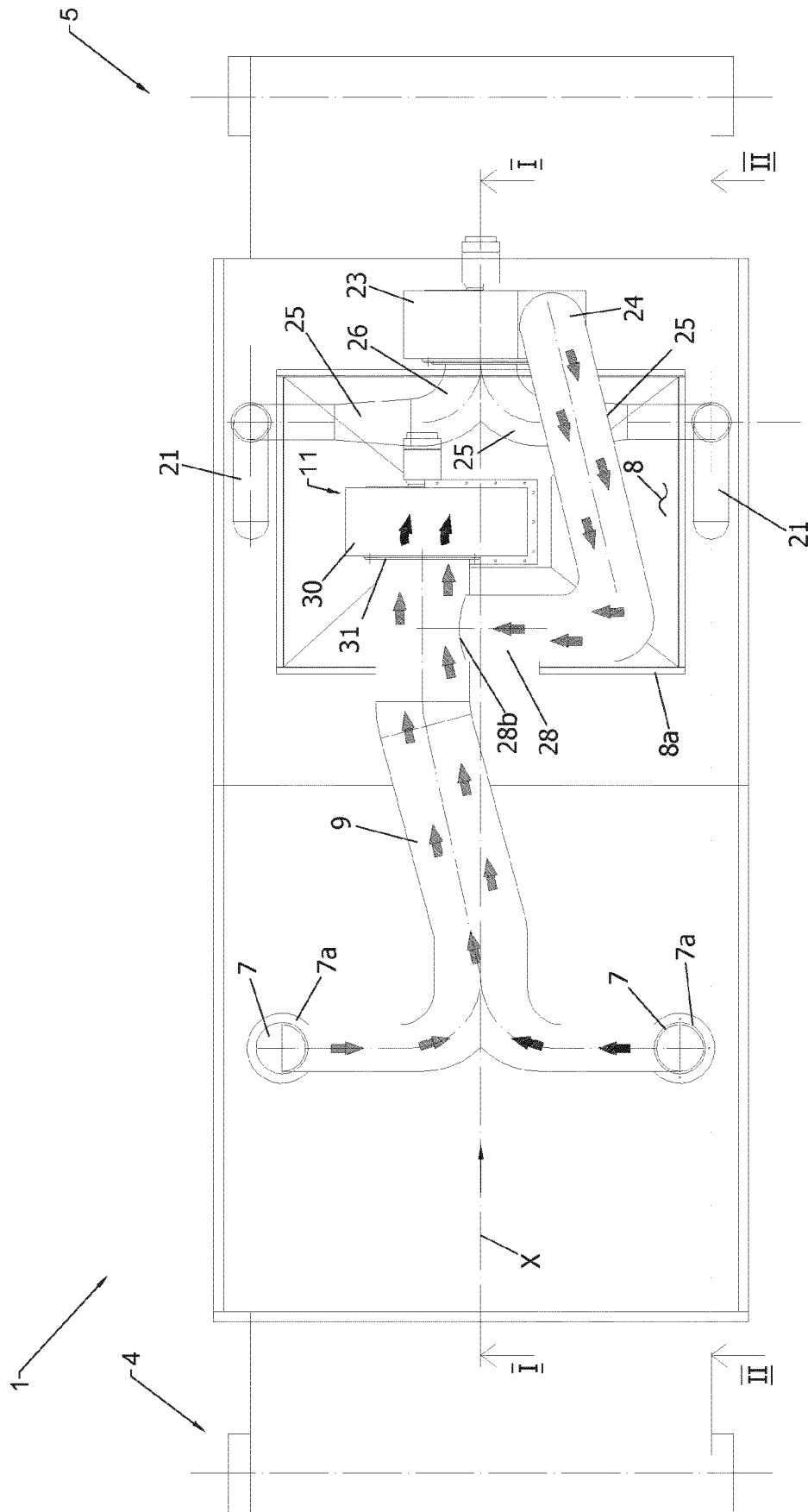


Fig. 3

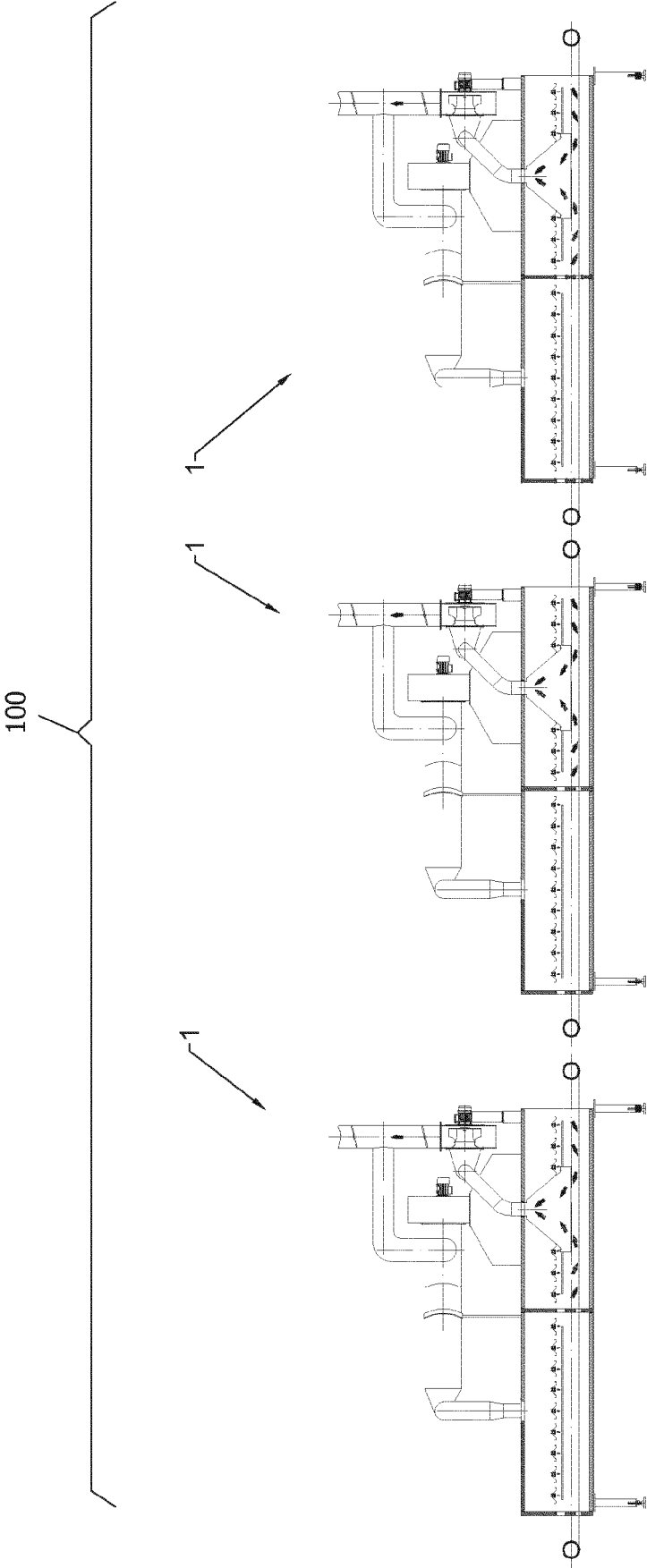


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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