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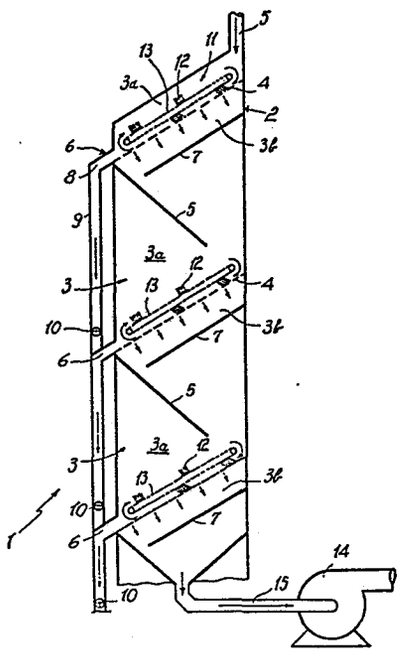
(54)

(57) The invention is related to the technical field of granulated product sorting apparatus, and in particular to the mill grinding field. The technical problem to be solved was that of practically eliminating high inertia moving parts from such apparatus. The solution to the problem is provided by one such apparatus comprising members (14) generating a forced air circulation between the feeding means (5) and discharging means (6) for the product to be sorted so as to create, at each screening layer (4), a forced air flow mixed up with the product to be sorted and capable of determining its sorting in a substantially spontaneous fashion.



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"APPARATUS FOR SORTING GRANULATED PRODUCTS, PARTICULARLY IN THE MILL GRINDING FIELD"

This invention relates to an apparatus for sorting granulated products particularly in the mill grinding field such as incoherent loose products, and in particular flour products from break-up equipment.

As is known, for sifting , sorting, and grading granulated products in general, several types of apparatus have been made available commercially. As an example, known are sifters which comprise essentially a hollow cylinder having its wall perforated with holes of a desired size for product screening, and plansifters comprising freely oscillating flat sifters.

These and other apparatus have the serious disadvantage of being complex and expensive constructions on account of the large masses which are to be set in motion therein for sorting the product being processed.

To obviate such drawbacks affecting prior apparatus, as well as to attenuate their bulkiness, this same Applicant has already disclosed an apparatus for sifting, sorting, and grading granulated products in general, which is fully described in the Italian Patent Application No. 25,387 A/80. Said apparatus marks an improvement over prior apparatus through its decreased bulk and above all reduced moving masses. However, said apparatus still includes moving means, in particular a paddle rotor for moving the product to be sorted onto a screening layer.

Accordingly, the task of this invention is to provide an apparatus which can solve the technical problem of a reduction of the moving members for sorting granulated products in general.

An object of the invention is to provide such an apparatus which is specially versatile, in that it may be constructed in a number of versions to meet varying applicational requirements.

It is a further object to provide such an apparatus which is quite simple construction-wise and can be readily formed from commercially available elements and materials, as well as being highly competitive from a purely economical standpoint.

A not unimportant object of this invention is to provide particular embodiments of the apparatus which are advantageous per se and lead to technical advance, and embodiments which, while using moving parts of greatly reduced mass, can achieve important results even in the presence of such contaminants as paper or the like.

These and other objects, such as will be apparent hereinafter, are achieved by an apparatus according to the invention for sorting granulated products particularly in the mill grinding field, comprising a stationary frame defining on its interior at least

one processing chamber having a screening layer which subdivides said chamber into a first chamber half whereto means for feeding the product to be sorted and first means for discharging the non-screened product are connected, and a second chamber half whereto second means of discharging the screened product are connected, characterized in that it comprises members for generating a forced air circulation between said feeding means and said discharging means, thereby defining, at said at least one screening layer, a forced flow of air mixed with the product being treated, and in that within said forced flow said discharging means and said screening layer are positioned such that sorting of the product being fed is accomplished in a substantially spontaneous fashion.

Further features and advantages will be more clearly understood from the following exemplary description of three embodiments of the inventive apparatus for sorting granulated products, as illustrated by way of example and not of limitation in the accompanying drawings, where:

Figure 1 shows schematically a first embodiment of this apparatus, wherein the product to be sorted is moved in a downward direction;

Figures 2 and 3 show schematically a sectional view and a partly cutaway side elevation view, respectively, of a second embodiment of the inventive apparatus, wherein the product to be sorted is moved in an upward direction;

Figure 4 is a schematical sectional view of a

third embodiment of the apparatus according to the invention; and

Figure 5 is a perspective detail view of the same apparatus of Figure 4.

Making reference to the drawing figures 1-3, the apparatus of this invention is generally indicated at 1 in the embodiment of Figure 1, and at 1' in the embodiment illustrated in Figures 2 and 3.

Throughout this specification, the elements of Figure 1 will be designated with plain reference numerals, whereas those of Figures 2 and 3 will be designated with primed (') reference numerals.

The apparatus 1,1' according to this invention comprises a stationary frame 2,2' extending preferably column-like and being provided on its interior with at least one processing chamber 3,3', and preferably three such processing chambers in superimposed relationship as shown in the drawings. Each processing chamber 3,3', hereinafter simply termed chamber, includes at least one screening layer 4 defined by any suitable plate-like element having holes or openings of a desired size, e.g. a perforated piece of sheet metal, or a sifter silk layer. Figures 1 to 3 evidence how the screening layers 4,4' arranged at each chamber 3,3' are formed with holes or openings of different, decreasing sizes from that end of the frame 2 where the product to be screened is fed in, to that end of the frame wherefrom the finest material fraction comes out.

In each chamber 3,3', the screening layer 4,4'

subdivides the chamber space into a first chamber half 3a,3'a and a second chamber half 3b, 3'b.

Feeding means 5,5' for the product to be sorted and first discharging means 6,6' for the non-screened product converge into the first chamber half 3a,3'a.

Connected to the second chamber half 3b,3'b are second discharging means 7,7' for the screened product.

Again with reference to the first two embodiments shown, it should be noted that the first discharging means 6,6' are located at the base of each first chamber half 3a,3'a and comprise, inter alia, a discharge port 8, 8' extending in at least one duct 9,9' wherein valving means, e.g. spider valves, 10,10' are inserted.

Also provided are auxiliary means 11,11' for wiping each screening layer 4,4', as defined for example by brush elements 12,12' driven through a chain drives 13,13'. The auxiliary means 11,11' are each arranged in each first chamber half 3a,3'a.

An essential feature of the apparatus according to this invention is the provision of members effective to generate a forced air circulation between said feeding and said discharging means so as to achieve a substantially spontaneous sorting process of the granulated product being processed, as well as the fact that the entire internal structure of the apparatus is arranged to accommodate the actions of these members.

In detail, making now specific reference to Figure 1 and the first embodiment of the apparatus

according to the invention, said members comprise a suction device 14 located at the base of the frame 2 along a pipe 15 forming the final discharge end for the screened product, that is for the granulated product which has also gone through the last screening layer 4. In a manner obvious per se, the suction device 14 may be extended into further means, known per se, such as one or more cyclones, to collect the last product screened as well.

The internal construction of the apparatus 1 is apparent from the respective figure. It is contemplated that the feeding means 5 be such as to convey the product to be sorted to the top edge of the respective screening layer 4, which is obliquely arranged from the vertical. The discharge port 8 is located at the opposite, bottom end of the screening layer 4, so as to receive the non-screened product, that is not passed through the screening layer 4, by gravity only.

It should be noted that the feeding means 5, which comprise oriented partitions or inlet ducts, create , owing to the provision of the suction device 14, forced flows of air admixed to the product to be screened, which on the one side tend to cause the product to pass through the respective screening layers 4, and on the other side cause, by reflection from the screening layers 4, a component of the forced flow which tends to spontaneously convey the non-screened product toward the respective discharge ports 6.

It should be apparent, moreover, that the auxiliary means 12 act on the respective screening

layers in a direction toward said discharge ports 8, thereby contributing to the conveyance of the non-screened product.

Making reference to Figures 2 and 3, it should be noted that in the second preferred embodiment of the apparatus according to the invention, said members effective to generate a forced air circulation comprise a device 14' operative to deliver pressurized air to the base of the frame 2. As shown more particularly in Figure 2, the device 14' is inserted into a delivery pipe 16' which branches off, for example, in three pipes 17' forming at their ends the feeding means 5' for the chamber 3' located at the base of the frame 2'. The figures evidence that the pipes 17' are inserted into an oblique plate 18' constituting the bottom of a first chamber half 3'a. The oblique plate 18' merges at its base with a discharge port 8', and at the connection holes to the pipes 17', the same plate is formed with vanes 19' partly directing the forced air flow mixed with the product being treated and hindering the return of the non-screened material which slides down across the oblique plate 18'.

In practice, shown in Figures 2 and 3 are apparatus with the first chamber half 3'a in a reversed position with respect to Figure 1, i.e. located below the second chamber half 3'b.

The introduction of the product to be screened into the forced air circulation generated by the device 14' may be accomplished in any of several ways, e.g., as shown in Figure 2, it may be accomplished by

having a supply duct 20' for the product to be screened led into the pipe 15.

Also apparent is that the feeding means for the product to be screened, namely the pipes 17' and holes formed through each oblique plate 18; with their respective vanes, may be variously arranged. Preferably, however, it is contemplated that the forced flow of air mixed with the product being processed, as generated by said feeding means, by the action of the device 14', impinges against each screening layer 4' so as to cause by reflection a flow component directed toward the discharge port 8'.

Figure 2 also shows a sliding pull out support 21' for the screening layers 4'. Figure 3 shows, inter alia, the control members for the auxiliary means 11': e.g. an electric motor 22' actuating chain drives 23'.

The apparatus operation will be apparent from the foregoing description. In practice, the product to be screened is transported and sorted by a forced air circulation which directly or indirectly causes the product to be screened through the screening layers and the non-screened product to be conveyed toward the discharge ports. Contributing to the latter function is also the simple falling action of the non-screened product. The provision of auxiliary means 11,11' is important to the constant cleaning of the screening layers but only ancillary to the granulated material sorting operations.

Thus, said auxiliary means are enabled to only draw very low power.

Referring now to Figures 4-5, the third embodiment of the invention is generally designated with the reference numeral 101 and comprises essentially a casing 102 wherein is mounted a screening member 103 including one, and preferably several substantially cylindrical containers 104a,104b,104c, inserted coaxially within one another and having walls 105a, 105b,105c, respectively, which are partially pervious to the flow of air and granulated material fed thereto bordering corresponding retaining chambers.

The means for feeding air and material to the screening member comprise feeder members 106 of conventional design and provided, for example, with a fan 107 the delivery pipe 108 whereof is connected to a feeder device 109, e.g. of the spider valve type, and, after passing through the casing 102 in sealed relationship therewith, opens to the interior of the first container 104a.

The processing chambers are thus physically separated from the cylindrical containers whose walls define the screening layers, thereby a first chamber half will coincide with the second chamber half of the container directly inside it.

The containers 104a,104b,104c cooperate with a rotary drive 110, e.g. a gear motor, optionally driving each container at a different angular velocity, such as through the use of a gear motor having several coaxial shafts acting each on one of the cited cylindrical containers and being connected to the motor at different drive ratios. On the gear motor side, or

preferably on the remote side from it, the casing 102 is provided with an access door 111 for optionally cleaning the cylindrical containers manually, which are open at the door side end for optional emptying thereof.

At the open ends of the containers discharge ducts are provided which constitute the discharging means for the screened and/or non-screened materials, respectively indicated at 112a,112b,112c along which valving means 113a,113b,113c are inserted, e.g. as comprising spider valves of the same type as previously indicated at 109.

To further clarify the above discussion, the door(s) 111 can be opened to the casing to make for easier inspection of the screening member, and in a preferred embodiment, wiping members 115 are mounted on the latter which comprise, as an example, for all those cylindrical containers which are inserted coaxially within at least another, brushes 116a and 116b which are mounted on the external surfaces of the corresponding containers 104a and 104b in a helical or auger-like arrangement and act on the internal surface of the directly adjacent container whereinto the former is inserted. An additional helical brush 116c is mounted inside the cylinder 104a so as to produce a relative movement between the cited cylinder and brush 116c, e.g. by mounting it onto an open support, not shown and connected to a shaft of the gear motor.

A second wiping member acting on the screening

surface 105c may be formed, for example, from a bank of stationary brushes 117 carried on the interior of the casing 102 and acting on the external surface of the screening cylinder 105c. One possible alternative contemplates the use of perforated tubes, not shown, which are effective to direct compressed air jets onto the screening surface of the cylinder 105c.

This affords the evident advantage of conveying the separated material from each screening surface to the ducts 112 so as to allow it to be discharged from the apparatus 101.

For that reason, and as outlined hereinabove, it is preferable that each cylinder be rotated at a different speed from the cylinders directly adjacent it.

The fan 107 is located upstream of the material infeed by way of example only, as the same machine operation may be implemented by connecting the fan 107 suction side to an inlet duct 120 of the casing 102 wherethrough air and product of a sufficiently fine grain size are flown to pass through the screening surfaces of the member 103, to trigger vacuum operation of the apparatus.

Of preference, the screening surfaces of the various containers are shaped to hold back material in decreasing grain size from the innermost container 104a to the outermost container 104c.

With this third embodiment, the product to be screened is introduced into the container 104a of the sorting machine as fed in by the feeding members 106 such that a mixture of pressurized air and product to

be screened is conducted to the interior of the cited container.

The containers are rotatively driven by the gear motor 110 preferably at different speeds from one another such that the brushes 116a,116b,116 c can effect, in wiping the screening surfaces clean, the discharge of the product which has not been moved through the respective containers via the ducts 112, which are regulated by the valving members 113, said residual product being conveyed toward the cited ducts owing to their motion relatively to the walls on which they act as well as to their auger-like shape.

Thus, the product is passed through the first screening surface 105a to only deposit inside the first container that coarse grain size material which is either picked up by occasionally opening the door 111 or discharged through the ducts 112a, 112b,112c by the combined rotary motion of the brushes and cylinders and owing to the air thrust, since the duct 108 will preferably extend over a significant distance through the container 104a and create a labyrinth passageway.

In going through the screening surfaces, the product leaves behind deposits of materials having different grain sizes, and just the material which has a desired grain size will be able to go through the screening surface 105c to discharge through the duct 120 along with the air forced in by the fan 107.

The provision of doors 111 greatly facilitates the maintenance and occasional cleaning operations

of the containers where the latter are not provided with the members 115.

Thus, any forms of clogging of the screening member are effectively prevented, even where the product is contaminated by substances which are hard to remove with conventional wiping members.

For special application requirements, it would also be possible to serially combine together a number of machines, with one or more containing cylinders.

Thus, the invention fully achieves its objects. It should be pointed out that not only the high inertia moving masses have been virtually removed and volume requirements reduced, but also the screening layers can be fully utilized because they have no dead pockets. Also quite easy is the column arrangement of several screening layers for sorting to a desired grading level.

Lastly, it is important to observe that the apparatus is also advantageous in its specific technical aspects as deductible from the specification and drawings and apparent to a skilled person in the art.

The invention is susceptible of many modifications and variations, without departing from the scope of the instant inventive concept. As an example, it would be possible to provide several processing chambers arranged horizontally side-by-side. Further, all of the technical details, shapes, dimensions, and materials used may be any selected ones to meet individual requirements.

CLAIMS

1. An apparatus for sorting granulated products, particularly in the mill grinding field, comprising a stationary frame (2,2') defining on its interior at least one processing chamber (3,3') having at least a screening layer (4,4') which subdivides said chamber into a first chamber half (3a,3'a) whereto means (5,5') for feeding the product to be sorted and first means (6,6') for discharging the non-screened product are connected, and a second chamber half (3b,3'b) whereto second means (7,7') for discharging the screened product are connected, characterized in that it comprises members (14,14') for generating a forced air circulation between said feeding means (5,5') and said discharging means (6,6' ; 7,7') thereby defining, at said at least one screening layer (4,4'), a forced flow of air mixed with the product being treated, and in that said forced flow, said discharging means (6,6' ; 7,7') and said screening layer (4,4') are positioned such that sorting of the product being fed is accomplished in a substantially spontaneous fashion.

2. An apparatus according to Claim 1, characterized in that each said first chamber half (3a,3'a) is shaped such as to have at its base a discharge port (8,8') adapted for collecting the falling non-screened product, and in that said screening layer (4,4') is arranged with respect to said forced flow such as to produce substantially by reflection of said flow said falling forward movement of the non-screened product toward said port (8,8').

3. An apparatus according to one or more of the preceding claims, characterized in that said first discharge means (6,6') comprise , for each said chamber (3,3'), said discharge port (8,8'), at least one duct (9,9') extending from said discharge port (8,8'), and valving means (10,10') inserted into said at least duct (9,9') and adapted to prevent the non-screened product from flowing toward said port.

4. An apparatus according to one or more of the preceding claims, characterized in that it comprises auxiliary means (11,11') for wiping clean each said screening layers (4,4') defined by brush elements (12,12') movable across the face of said screening layer (4,4') whereon said forced flow impinges directly.

5. An apparatus according to one or more of the preceding claims, characterized in that said brush elements (12) are active on said screening layer (4) with a direct movement so as to contribute to conveying the non-screened product toward said discharge port (8).

6. An apparatus according to one or more of the preceding claims, characterized in that when several processing chambers (3) are stacked together, said second chamber half (3b) is provided with second discharge means (7) for the screened product defining in the following chamber (3) feeding means (5,5') for the product to be screened similar to the feeding means in the adjacent first chamber half (3a).

7. An apparatus according to one or more of the preceding claims, characterized in that said members generating a forced air circulation comprise a

suction device positioned at the end of said frame (2) opposed to the end whereat the granulated product to be screened is introduced.

8. An apparatus according to one or more of the preceding claims, characterized in that said members generating a forced air circulation comprise a device (14') adapted to generate a pressurized air flow and located substantially at the same end of said frame (2') whereat the granulated product to be screened is introduced.

9. A modification of the apparatus according to one or more of the preceding claims, characterized in that it comprises a screening member (103) carried rotatably in a casing (102) and cooperating with a rotary drive (110).

10. An apparatus according to Claim 9, characterized in that said screening member (103) comprises a plurality of containers (104a-104c) mutually associated coaxially with one another and being provided with a screening wall (105a-105c) adapted to hold back particles of the material to be treated with decreasing cross-section from the innermost container (104a) to the outermost container (104c).

11. An apparatus according to Claims 9 and/or 10, characterized in that associated with each said containers (104) is a wiping member (115).

12. An apparatus according to one or more of Claims 9 to 11, characterized in that said containers (104a-104c) have a substantially cylindrical shape and are inserted coaxially within one another, said wiping members including helical brushes (116a-116c) acting on the

screening surfaces (105) of said containers (104).

13. An apparatus according to Claim 9, characterized in that said screening member (103) comprises at least one cylindrical container (104) having a screening surface (105) cooperating with helical brushes (116) to convey the product held back on said screening surface (103) toward discharging ducts (112).

14. An apparatus according to Claim 12, characterized in that adjacent containers (104) are driven rotatively at different angular velocities.

15. An apparatus according to one or more of Claims 9 to 14, characterized in that, at at least one end of said containers (104), inspection doors (111) are provided in said casing (102).

16. An apparatus according to one or more of Claims 9 to 15, characterized in that there are provided, at at least one end of said containers (104), discharge ducts (112) on said casing which are intercepted by valving means (113).

17. An apparatus according to one or more of Claims 9 to 16, characterized in that said wiping members (115) comprise a brush element (117) acting on the screening surface (105c) of the outermost container (104c) and being carried on said casing (102).

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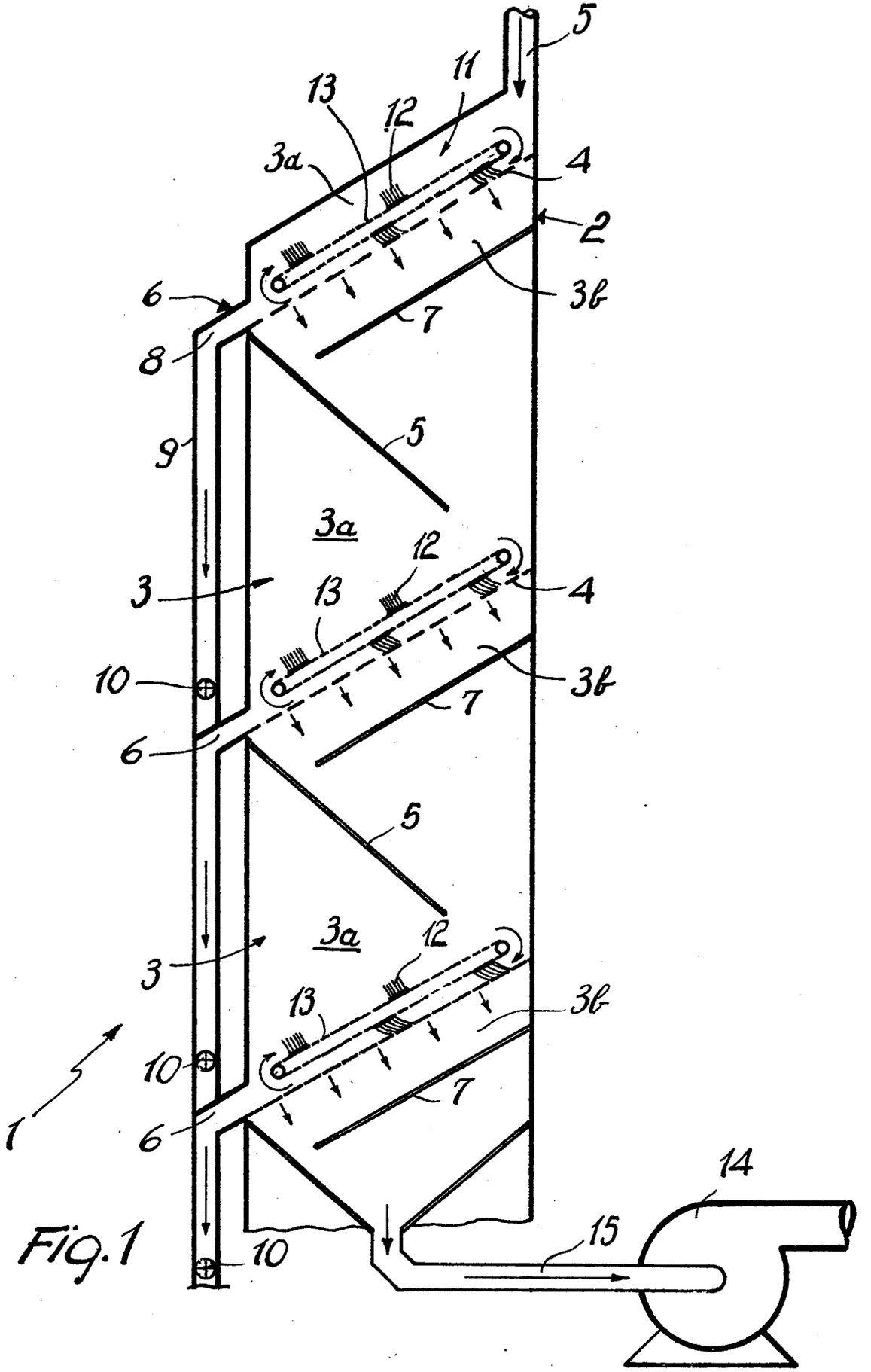

Fig.1

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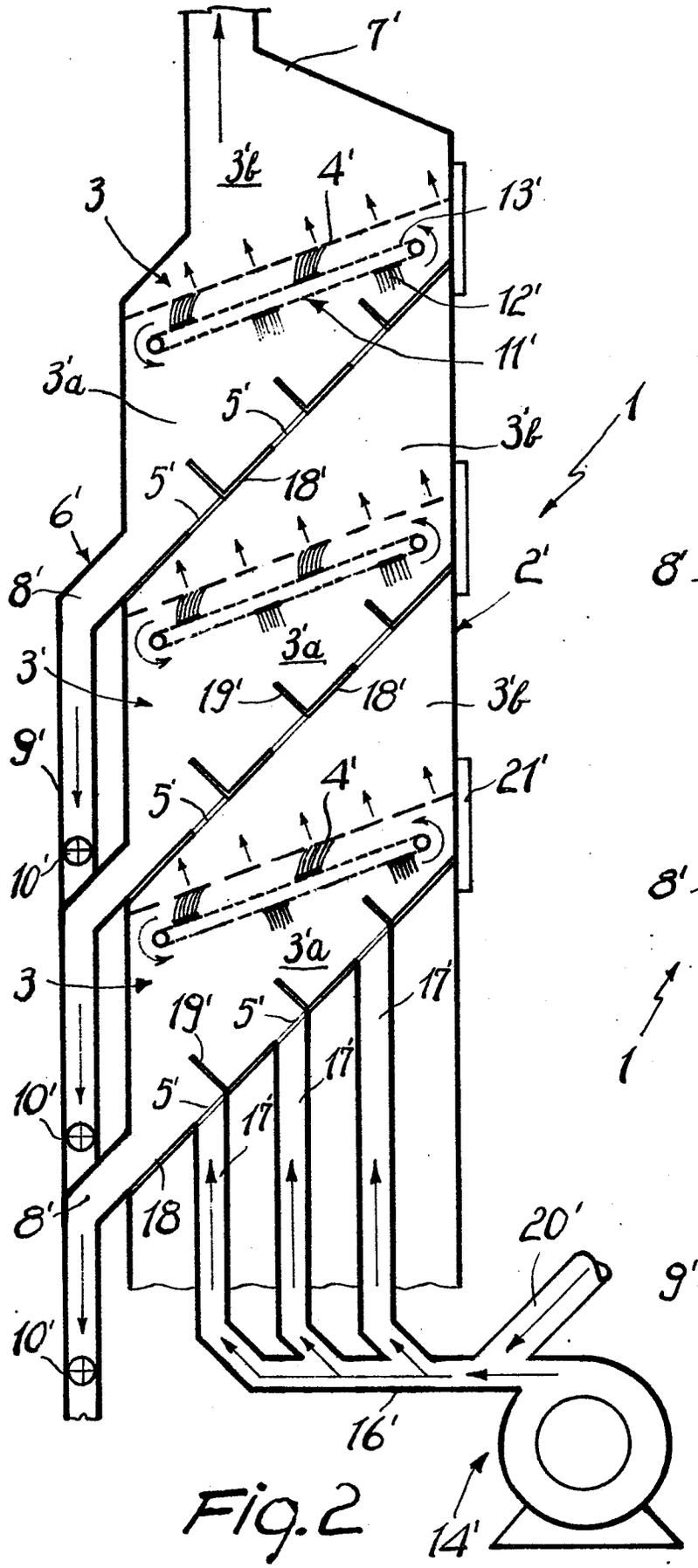


Fig. 2

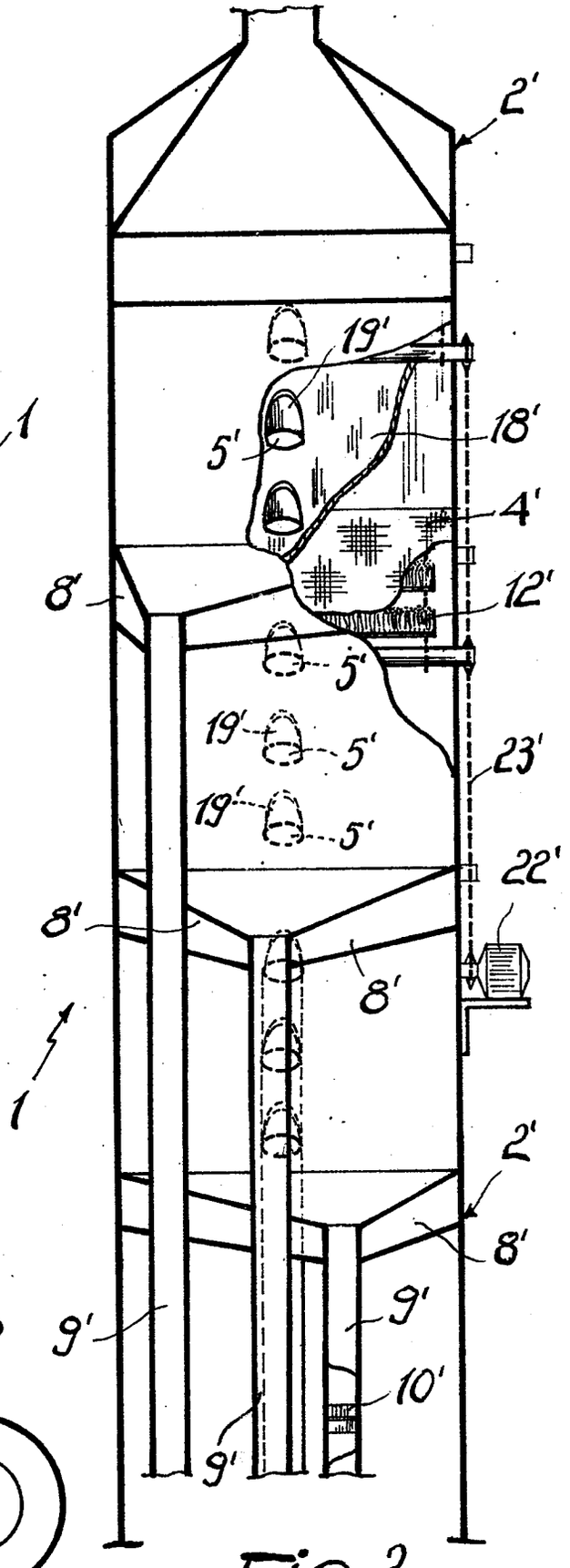
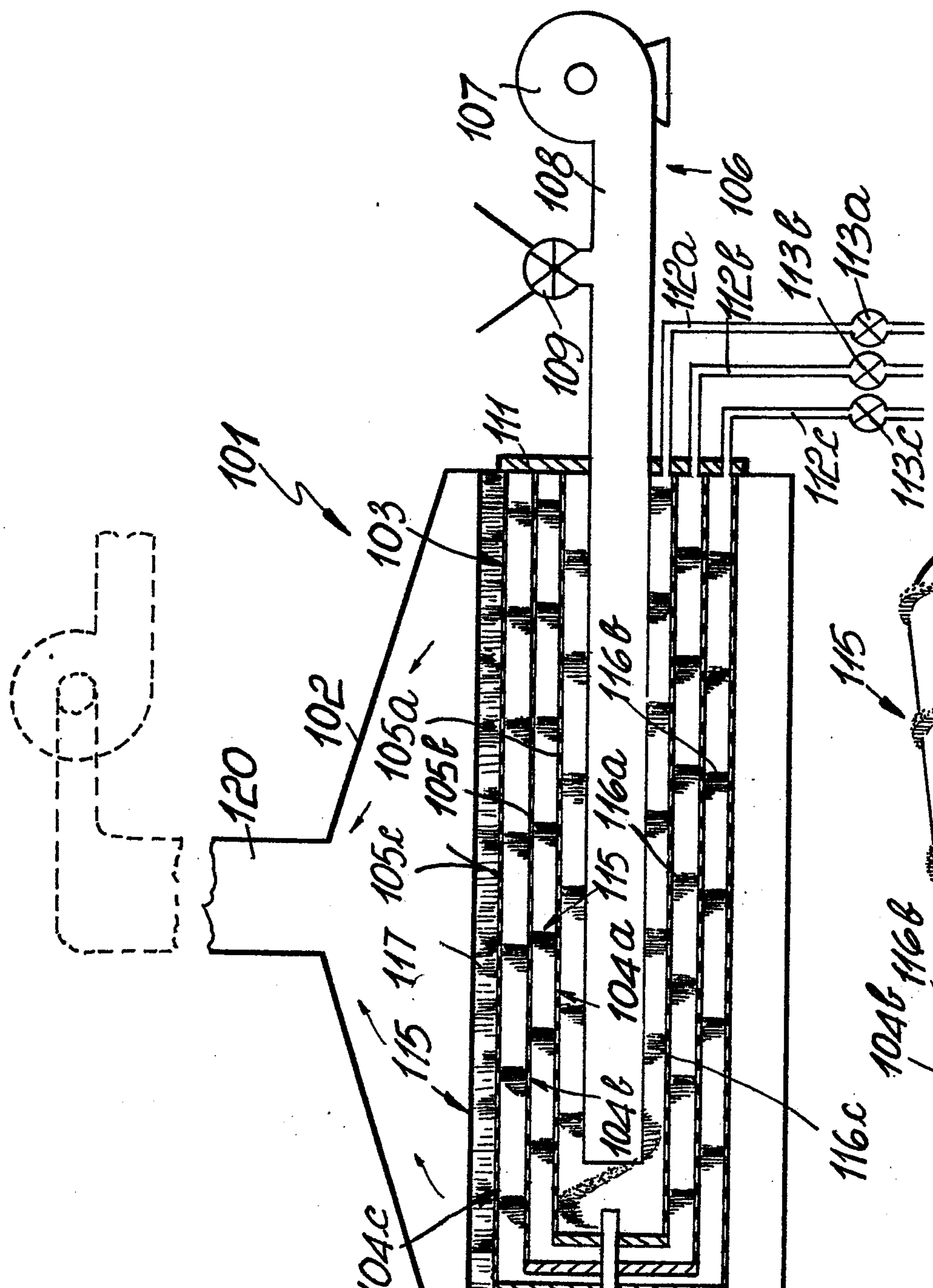


Fig. 3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113c
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116a
116b
116c
117
120

Fig. 4

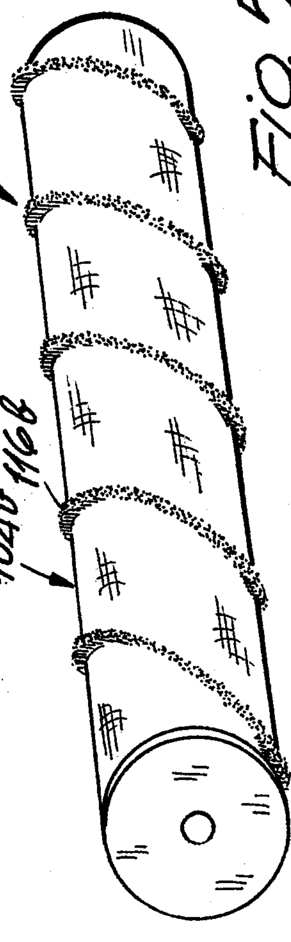
115
104b
116b

Fig. 5