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(54) **ROTARY DRYER**

(57) A rotary dryer, wherein a mechanism having a discharging action in reverse rotation is provided inside a drying drum and the drying drum is rotated reversely in a process where drying substance is discharged, and also the dried object and drying substance are prevent-

ed from being dispersed at the time of charging and discharging them, a plurality of the drums are provided continuously and a specified relation is given between the rotating direction, time, and speed of each drum so as to reduce an operational play of each drum in order to increase the efficiency of the entire dryer.

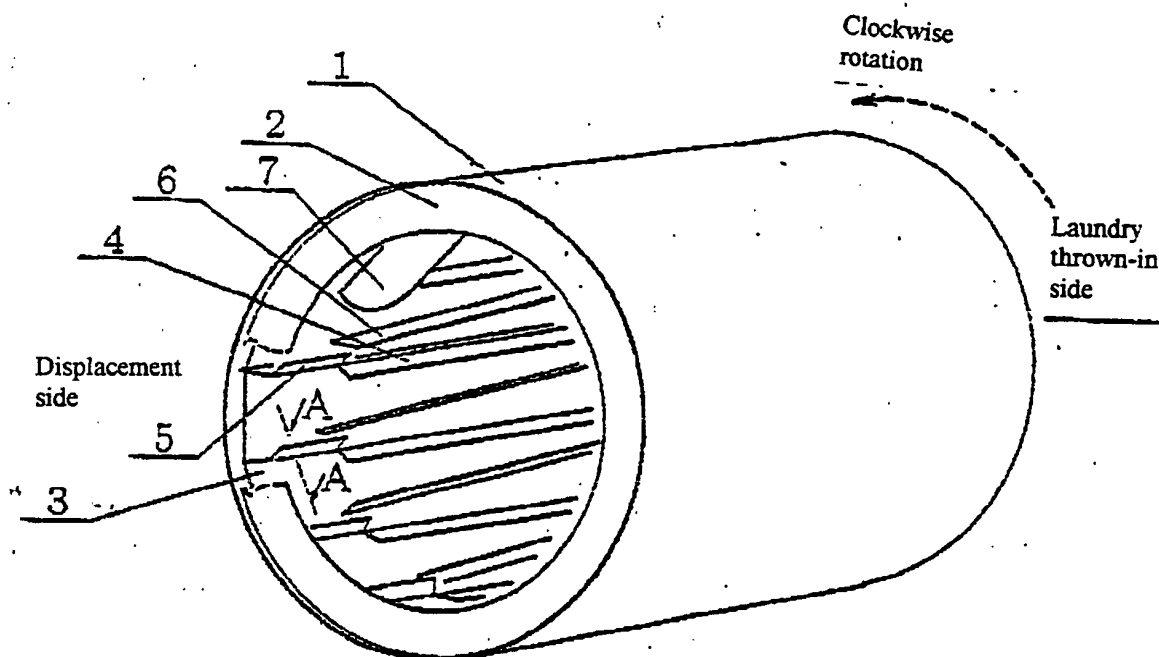


FIG.1

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Description

Scope of technology

[0001] This invention refers to a dryer system that ensures uniform drying effect, accurate sensing system and the easy removal of the laundry.

Technological background

[0002] Laundry can be dried using a drum dryer machine (to be referred as drum below). As the drum rotates and heated air is introduced, the laundry can be dried. The diameter and the length of the drum is designed according to specific characteristics such as nature of the air flow, material, weight, moisture and dampness of the laundry, as well as the speed of the rotation. The current typical structure of a rotating-type dryer machine is as referred in diagram 4, making up of a cylindrical outer drum (1) and transfer reeves (6). There are mainly three existing models of drum dryer system. The first model is the screw-type drum that rotates in a single direction on a horizontal axis. The second model allows the easy removal of the laundry through tilting the drum. The third model is similar to the first model except that the drum may be tilted for the easy removal of the laundry when the laundry job is completed.

[0003] However, there are several problems that will arise for the systems referred above.

[0004] The first screw-type model in which the drum rotates in a single direction on a horizontal axis has the following problem. When the load of the laundry is high, the length of the drum would be longer and it would require additional mechanism to allow the easy removal of the laundry. The cost for the installation of the removal mechanism can be quite high.

[0005] The second model that allows the easy removal of the laundry through tilting the drum has the following problem. Although it ensures a good working performance for a laundry job for clothes of similar shapes and materials, it may be difficult to ensure the uniform drying effect for a laundry job that has clothes of different type, shapes and materials. The control mechanism can be very complicated and it is difficult to be designed and implemented properly.

[0006] The third model ensures both the uniform drying effect of the laundry job and the easy removal of the clothes. However, there are special devices required to enable the flexibility to tilt the drum for the easy removal of the laundry. There is a need for such tilting-enabling devices to be heat-resistant, especially since they are installed near the path of the flow of the heated air. Such devices will lead to high cost for the mass production of such models of dryer machine.

Details of the invention

[0007] This invention started as a result of the above

observations. The new invention involves the rotation of the drum in one direction (referred to as clockwise direction below), drying the laundry, and rotation in the opposite direction that allows the easy removal of the laundry. It also involves the design of the drum and the control mechanism of the drum rotation to ensure the good efficiency of the dryer machine and the easy removal of the laundry.

[0008] The objective of this invention is the successful development of a dryer machine that can effectively dry the laundry during the clockwise rotation of the drum and the easy removal of the laundry during the anti-clockwise motion.

[0009] This invention successfully ensure the easy removal of the laundry by having a lifter mechanism that lift the laundry to a higher position during the anti-clockwise rotation of the drum as compared to a clockwise motion.

[0010] This patent shall cover the successful invention of a highly effective dryer machine and its required devices, especially the lifter mechanism that lift the laundry to a higher position during the anti-clockwise rotation of the drum as compared to a clockwise motion.

[0011] Also, this patent shall also cover the invention of the device that ensures the laundry job is not scattered during the drying process.

[0012] Lastly, the main objective of the invention is to design several of the drums mentioned above and to build the dryer machine by integrating multiple drums together, ensuring the proper performance of the drying job through developing the control system for the rotation synchronization, timing and speed for each case.

Explanation of the diagram

[0013]

Diagram 1: The dimensional view of the dryer drum;
Diagram 2: The dimensional view of the sectional block, lifters for the clockwise motion, lifters for the anti-clockwise motion, transfer reeves and their respective installation;
Diagram 3: The dimensional view of the anti-scattering device;
Diagram 4: The dimensional view of the traditional system

The most optimal structure (form and shape) for the implementation of the invention

[0014] The most optimal structure (form and shape) for the implementation of the invention

[0015] The development of the dryer machine developed in this invention is as explained below.

[0016] The patent application of this invention is for item 1 to 4 and the description of invention can be shown by diagram 1 to 3. Both ends of the cylindrical drum (1) are welded together with a surface plate (2). The inter-

nal surface of the drum is installed with several sectional-spaced plates (3) securely fixed to the surface plate (2) at the two ends. The lifters for both the clockwise motion (4) and anti-clockwise (5) motion are fixed to the sectional-spaced plates. When required the transfer reeves (6) can also be attached as well. The different parts are securely bonded through riveting, soldering or melted together. The materials are chosen based on heat-resistance and mould-free characteristics.

[0017] The cross-sectional view of the sectional-spaced plate (3) that are bonded to the cylindrical drum (1) are KO-shaped and RE-shaped. There is no requirement for the corner of the sectional-spaced plates to be at right angle and this will allow some flexibility, depending on the shapes and material of the laundry job and the time required. The cross-sectional plates do not need to be bonded in parallel to the shape of the cylindrical drum. It can be tilted to allow more transfer motion.

[0018] The length of the lifters for the clockwise motion (4) and the anti-clockwise motion (5) can be in the range of 60% to 90%, 40% to 10% of the total length of the drum respectively, depending on the characteristics and weight of the laundry.

[0019] In the direction from the external of the drum to the centre, the lifters for the anti-clockwise motion are curved, taking into consideration the rotating direction.

[0020] The shape of the curve of the lifters for the clockwise motion can be similar as that for the anti-clockwise motion. However, it is desirable for both to correspond oppositely. Ensuring that the laundry objects that can be easily dried to fall down more swiftly than those that are more difficult to dried, it is desirable for the lifters for the clockwise motion and anti-clockwise motion to be curved differently.

[0021] In the case where the dryer machine consists of multiple drums, it is necessary for the angle of the curve for the respective drum to cater to different kind of the laundry jobs.

[0022] At one end (or both end) of the lifters for the clockwise motion (4), there is a portion being removed as seen in diagram 2. This is to prevent excessive accumulation of the laundry near the throw-in end of the surface plate (2). The space resulted from the separation of the lifters for the clockwise and anti-clockwise (5) motion allows the laundry job to be spaced properly.

[0023] The lifters for the clockwise and anti-clockwise motion can be bonded together as seen in diagram 2.

[0024] The laundry at the throw-in end of the drum (as in diagram 1) are dried as the sectional-spaced plates rotate clockwise and thrown up and down by the lifters (for the clockwise motion). The laundry is moved by the transfer reeves (6) during the drying process. The direction and speed of the movement of the laundry is dependent on the angle, height and length of the transfer reeves (diagram 2). Other factors of consideration are the load, texture and shapes of the laundry, diameter & length of the drum and speed of rotation. The mode of installation of the transfer reeves to the sectional spaced

plates as shown in diagram 1 with the angle indicated by the broken lines in diagram 2, is referred to as transfer reeves installation A. The second mode of installation is as referred to as the intermittent line in diagram 2, also known as transfer reeves installation B. The height of the transfer reeves is around half of that of the lifters for the clockwise motion, but the length is identical. The distance of the transfer reeves to the surface plate (2) is determined by the load, characteristic of the laundry and the length of the lifters for the anti-clockwise motion (5).

[0025] In the case of the transfer reeves installation A, the transfer reeves has the effect of moving the laundry towards the laundry thrown-in end of the drum during the clockwise rotation. However, as the height of the transfer reeves is lower than the lifters for the clockwise motion, the laundry is prevented for moving towards to the thrown-in end of the drum. The opposite happens during the anti-clockwise rotation of the drum. The effect of the transfer reeves in moving the laundry towards the thrown-in end is very significant in the implementation of the system.

[0026] In the case of the transfer reeves installation B, the laundry can be moved towards the throw-in end of the drum during the clockwise rotation. In view of the above, the ratio of the transfer reeves installation A and B can be used to achieve optimal performance of the dryer machine. The transfer reeves can be of the similar structure to the lifters for the clockwise motion.

[0027] The transfer reeves (6) has no effect on the laundry at the removal end (diagram 1) of the drum. The laundry can be easily removed at the removal slot (7) through the anti-clockwise rotation of the drum and the effect of the lifters for the clockwise motion.

[0028] The removal slot (7) is similar in structure to the laundry thrown-in end of the drum.

[0029] In the case of transfer reeves installation A, the laundry can be totally moved towards the removal slot during the anti-clockwise rotation of the drum and the effect of the lifters for the clockwise motion.

[0030] In the case of transfer reeves installation B, the laundry can be moved back to the drum for the drying process during the anti-clockwise rotation of the drum. The drying process can be repeated concurrently.

[0031] The lifters for the clockwise motion (5) and anti-clockwise motion (4) are separately installed at the removal slot (7). This will allow laundry job completed to be moved towards the removal slot with the rotating effect of the lifters.

[0032] During the anti-clockwise rotation of the drum, the laundry on top of the lifters for the clockwise motion is thrown lower. As compared to those on top of the lifters for the anti-clockwise motion, the laundry are thrown at a much greater height and moved more effectively towards the removal slot.

[0033] Similarly, during the clockwise rotation of the drum, the laundry on top of the lifters for the clockwise motion are thrown at a much greater height than those on the lifters for the anti-clockwise motion.

[0034] Based on the above characteristics, the removal slot and the lifters for the clockwise motion are designed and planned in such a way that only the laundry job completed will be deposited at the removal slot. This system is more reliable than other systems and it ensures uniform heat distribution.

[0035] It is desirable to install anti-scattering device (8) at both the laundry thrown-in end and the laundry removal slot (7) to prevent the dry laundry from being contaminated by the wet laundry placed at the laundry thrown-in end as a result of the rotation of the drum and heated air.

[0036] The structure of the anti-scattering device has to take into consideration the rotation of the drum. It is desirable for it to be conical in shape as indicated by diagram 3. It is important for the device to be secured firmly to the external drum surface (1). The fixture should be resistant to vibration and easily removable. It is suitable for the fixture to be in nuts and bolts.

[0037] The anti-scattering device should take into consideration of the sloping angle of the removal slot.

[0038] The rotation of the respective drum is driven by 3-phase motor. The timing can be determined by clock-timer, while the speed to be determined by the voltage and current of the motor.

[0039] The above can be controlled simultaneously by a sequencer and computer, taking into consideration the characteristics of the laundry, temperature of the heated air and the load.

[0040] In this invention, 4 drum are connected together and controlled as below.

[0041] The drum in the first stage is known as the 1st drum and the drum involved in the last stage known as the fourth stage. When the 4th drum is rotated anti-clockwise during the laundry removal stage, the other three drums will rotate clockwise for the laundry drying process. When the 4th drum is ready for the drying process, the 3rd drums will shift towards the laundry removal mode, similarly for the 2nd and 1st drum. The above system will allow the effective drying and the removal of the laundry process.

[0042] The heated air can be supplied through the external of the drum in the laundry drying process. In the case of multiple-drums system, the volume of the heated air, temperature and circulation at the various stages has to be controlled simultaneously.

Industrial application possibilities

[0043] Let us consider a drying machine that consists of 4 identical drums and the speed of rotation, and timing pre-set for each drum. If we consider the standard capacity to be 100 and the drying process under normal circumstances, the setting for the 1st, 2nd, 3rd and 4th drum is 100 to 40, 40 to 20, 20 to 13 and 13 to 10.

[0044] Based on the above result, we can achieve the optimal performance of the volume ratio of 10 to 1 and the weight ratio of 5 to 1, thus reducing the damage cost

to the laundry.

[0045] At present, there are a few existing models of drum dryer system. The screw-type drum model that rotates in a single direction on a horizontal axis will require additional devices for the easy collection of the laundry and hence, very expensive. Another method that involves tilting the drum requires a complex control system that is very difficult to be implemented. The last method of which the drum can be tilted for the easy removal of the laundry during the completion of the job, also involves additional cost for the installation of expensive devices. In comparison, this invention is able to overcome all the above problems by the anti-clockwise rotation of the drum and has the following advantage as indicated below.

[0046] Firstly, it is cheap and does not require additional devices for the final collection of the laundry job as compared to the screw-model dryer system.

[0047] Secondly, this drum of the dryer system in this invention is also maintained at the horizontal axis and thus it is easy to ensure the even distribution of the heating effect.

[0048] Lastly, the drum that can be tilted for the easy removal of the laundry during the completion of the job involves additional cost for the installation of expensive devices. In this invention, it only involves the installation of an additional device to rotate the drum anti-clockwise or a simple gear which is simple and cheap to be implemented.

[0049] Using the effect that the laundry is thrown at a greater height by the lifters for the anti-clockwise motion (5) compared to the clockwise motion during the anti-clockwise rotation of the drum, this invention involves the simple construction of the lifters to achieve the objective. The cost for the construction of the structure of the lifters (diagram 2) is low.

[0050] The installation of the conical shaped anti-scattering device to the system also helps to ensure that the dried laundry is not contaminated by the wet laundry and not dispersed wildly by the rotation and the heated air.

[0051] Also, making use of the displacement of the laundry during the anti-clockwise rotation, a dryer machine consisting of several drums can also be built to increase the optimal performance of the dryer machine.

[0052] During the transfer reeves installation A, the laundry objects in the drum can be effectively removed to the removal slot until the drum is almost empty. This can be applicable to the food and pharmaceutical industry in which the quality of the food and medicine can be affected by exposing to excessive dehydration.

[0053] During the transfer reeves installation B, the wet laundry that has yet to be displaced at the removal slot, will be returned to the drying process even when the drum is rotating anti-clockwise. Also, through the effective control of the clockwise and anti-clockwise rotation of the drum, the length of the drum may also be reduced. In this case, the degree of the drying process

can also be controlled by the time of the clockwise rotation of the drum.

[0054] The lifters for the clockwise motion (4) and the anti-clockwise motion (5) are installed separately in the removal slot (7), ensuring that the laundry is displaced at the removal slot only when it reaches its pre-set dryness requirement.

[0055] Based on the height that the wet and dried laundry is thrown upwards during the anti-clockwise drum rotation, and through harnessing the effect of the lifters for the anti-clockwise motion (5) and clockwise motion (4), the laundry can be transferred to the removal slot (in diagram 1) based on the relative dryness of the laundry.

[0056] We can develop a multiple-drum dryer machine with optimal performance by controlling the drying process of the laundry at the different drums

[0057] The heated air can be supplied through the external of the drum in the laundry drying process. In the case of multiple-drum system, the volume of the heated air, temperature and circulation at the various stages has to be controlled simultaneously.

[0058] The ratio of the length of the lifters for the clockwise-motion (4) and the anti-clockwise motion (5) can be set to suit different kind of laundry objects, the load and the desired dryness requirement.

[0059] In the case that the length of the transfer reeves (6) can not be determined and keeping the length of the lifters for the anti-clockwise motion (5) constant, we can pre-determine the displaced load of the completed laundry job effectively.

[0060] At one or both end of the lifters for the clockwise motion (4), there is a portion being removed as seen in diagram 2. This is to prevent excessive accumulation of the laundry near the throw-in end of the surface plate (2). The space resulted from the separation of the lifters for the clockwise and anti-clockwise (5) motion allows the laundry job to be spaced properly.

Area of application

[0061]

1. The design of the drum dryer machine in this invention involves the drying of the laundry in the rotating drum and effective displacement of the finished laundry job through the reversed rotation of the drum.

2. During the anti-clockwise rotation of the drum, the laundry on top of the lifters for the anti-clockwise motion is thrown higher as compared to those on top of the lifters for the clockwise motion. This mechanism allows more effective displacement of the finished laundry towards the removal slot.

3. The mechanism of the drum that is able to displace the finished laundry making using of its anti-

clockwise rotation is as described by item 1 and item 2 of this application.

4. Anti-scattering device is installed at the thrown-in and the finished laundry displaced ends of the drum as described in item 3.

5. Making use of the displacement mechanism during the anti-clockwise rotation of the drum, a dryer machine has been invented making use of multiple drum and effective control of the rotating phase, timing and speed of the respective drum.

Claims

1. Laundry dryer system comprising a rotatably mounted drum dryer including a displacement mechanism for displacing laundry in the drum in one direction as the drum is rotated in one sense; and a system of lifters arranged such that during rotation of the drum dryer in an opposite sense, the system of lifters causes laundry on top of the lifters to be thrown higher compared with laundry on top of the lifters during rotation in the one sense.
2. A system according to claim 1, wherein the drum includes a removal slot towards which laundry is displaced during rotation of the drum in the one sense.
3. A system according to claim 1 or claim 2, further comprising a removal anti-scattering device installed at each end of the drum.
4. A dryer machine comprising a plurality of laundry dryer systems according to any of the preceding claims, the drums of the dryer systems being connected end to end.
5. A method of operating a dryer machine according to claim 4, the method including controlling the rotating phase, timing and speed of each drum.

Amended claims under Art.19.1 PCT

(With reference to application dated 18 September 2000 to the international administration office, we would like to seek the removal of item 1, amendment to item 2, 4 and 5 and insertion of additional clause to item 3.)

1. To be removed.

2. (After amendment) With reference to the laundry displacement mechanism of the drum dryer during reversed rotation, the lifters system causes the laundry on top of the lifters for the anti-clockwise

motion to be thrown higher than compared to those on top of the lifters for the clockwise motion during reversed drum rotation.

3. (Insertion) Equipped with the displacement mechanism during the reversed drum rotation, it involves the design of the lifters system that cause the laundry on top of the lifters for the anti-clockwise motion to be thrown higher than those on top of the lifters for the clockwise motion during reversed drum rotation. This dryer machine allows the finished laundry to be effectively displaced at the removal slot for collection. 5 10

4. (After amendment) Removable anti-scattering device is installed at the thrown-in and the finished laundry displaced ends of the drum as described in item 3. 15

5. (After amendment) Making use of the displacement mechanism during the anti-clockwise rotation of the drum as referred in the dryer machine in item 2 to 4, a dryer machine can be assembled by joining the individual machines together. Laundry can be transferred accordingly from one machine to another on a horizontal axis and effectively dried by controlling the rotating phase, timing and speed of the respective drum. 20 25

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Statement under Art. 19.1 PCT

Item 2 of the amendment request are the combination of item 1 to 3 of the old application. The difference is clearly explained by examples quoted in JP 38-23001, JP 11-44485, JP 55-119499, JP 6-147755. 35

The objective of the item 3 of the amendment request is to make clear an important component of invention, which is the finished laundry removal (or collection) slot. 40

The objective of the item 4 is to show the change as a result to the amendment of item 2 and inclusion of item 3 above.

Item 5 is different from JP 38-23001. It refers to multiple machines installed on the same horizontal plain. 45

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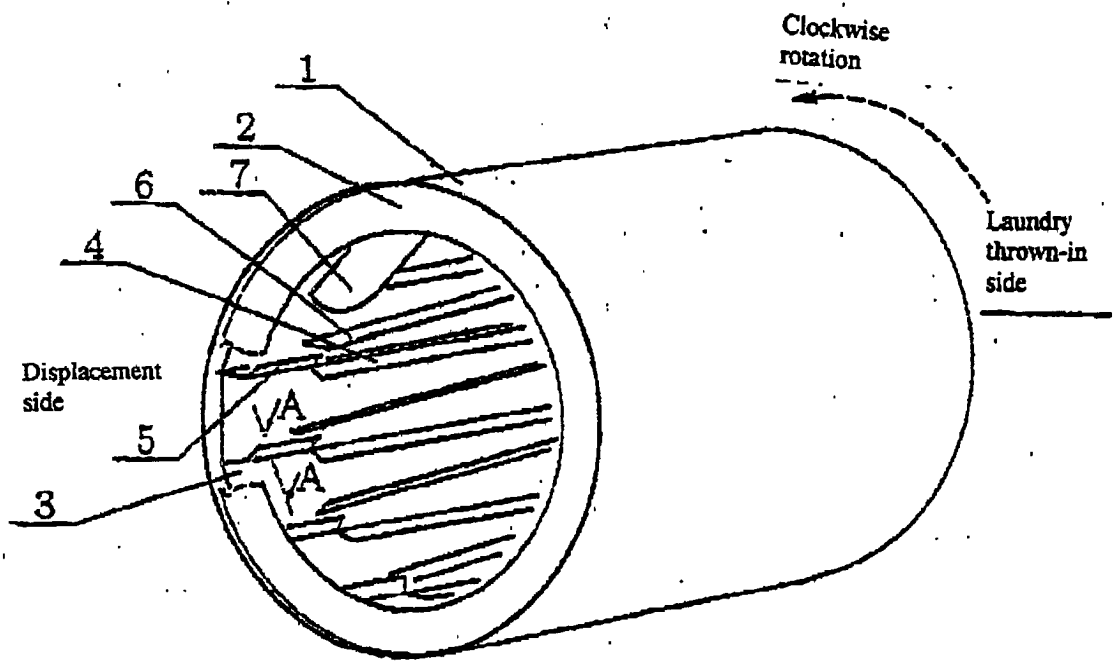
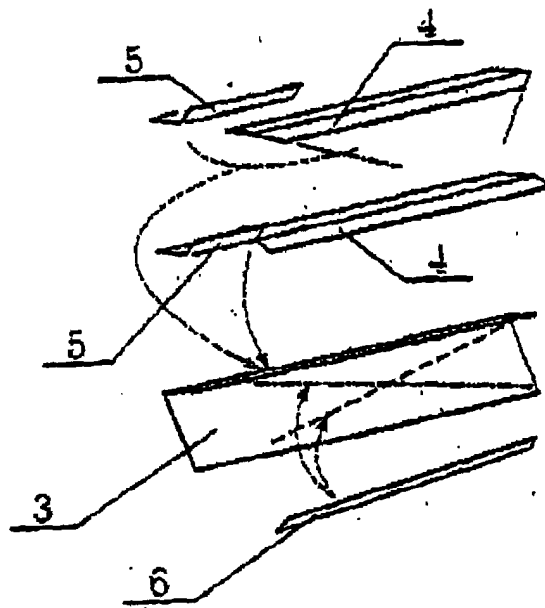


FIG.1

Fig 2 A-A cross section installation diagram



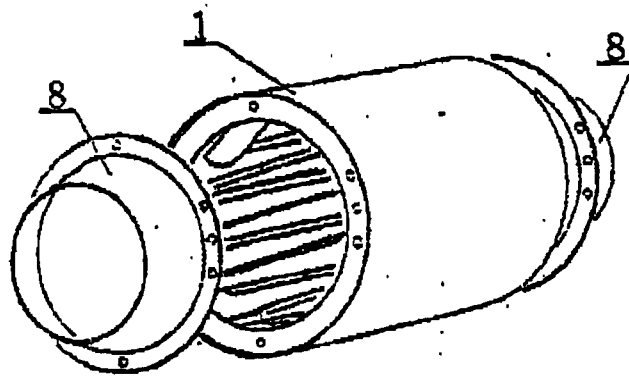


FIG.3

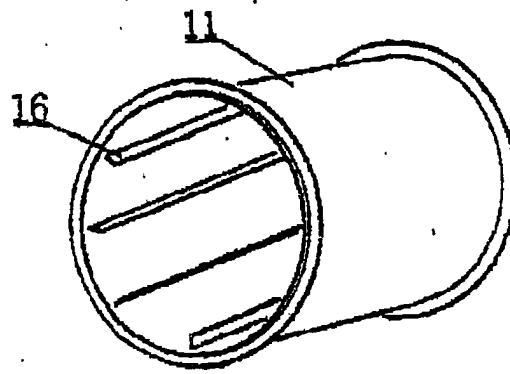


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/03630

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ F26B 11/04, 17/32		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) Int.Cl ⁷ F26B 11/04, 17/32		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1971-1996 Toroku Jitsuyo Shinan Koho 1994-2000 Kokai Jitsuyo Shinan Koho 1971-1996 Jitsuyo Shinan Toroku Koho 1996-2000		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 38-23001, B (Yokoyama Kogyo K.K.), 29 October, 1963 (29.10.63) (Family: none)	1, 5
Y		2-4
X	JP, 11-44485, A (NGK INSULATORS, LTD.), 16 February, 1999 (16.02.99) (Family: none)	1
A		2-5
Y	JP, 55-119499, A (Riken Corporation), 13 September, 1980 (13.09.80), page 2, lower right column, the last 3 lines to page 3, lower left column, line 7 (Family: none)	1-4
Y	JP, 57-104886, U (Kabushiki Kaisha Akitsu Seisakusho), 28 June, 1982 (28.06.82) (Family: none)	4
A	JP, 6-147755, A (Kyokuto International Corporation), 27 May, 1994 (27.05.94) (Family: none)	1-5
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 11 July, 2000 (11.07.00)		Date of mailing of the international search report 18 July, 2000 (18.07.00)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)