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(54) **Multistage fans**

(57) A multistage fan for heating or drying purposes comprises two or more fan rotors 2 axially spaced from each other along a shaft 1 within a tubular housing 3. The shaft may comprise a number of portions each provided with a respective fan rotor and connected together to form the multistage assembly. The assembly may contain fan rotors of different designs. An upstream fan 11 may be provided.

Fig. 3

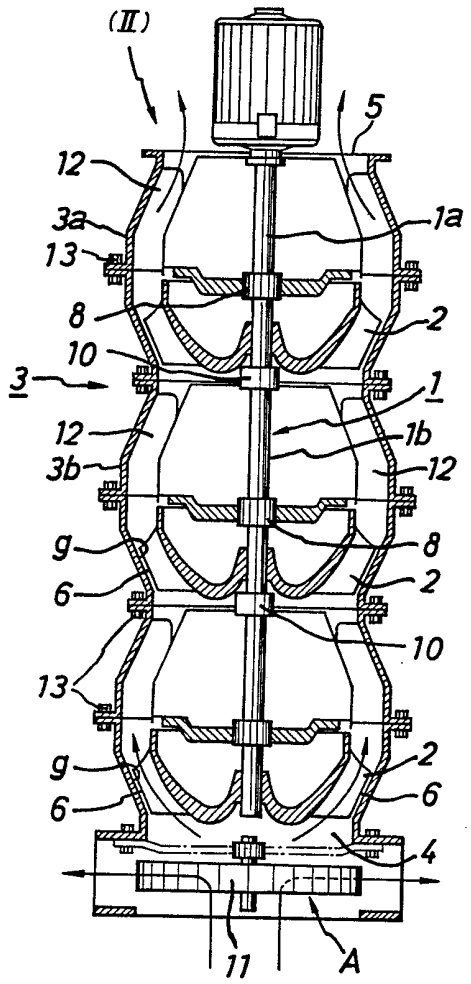

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Fig. 1

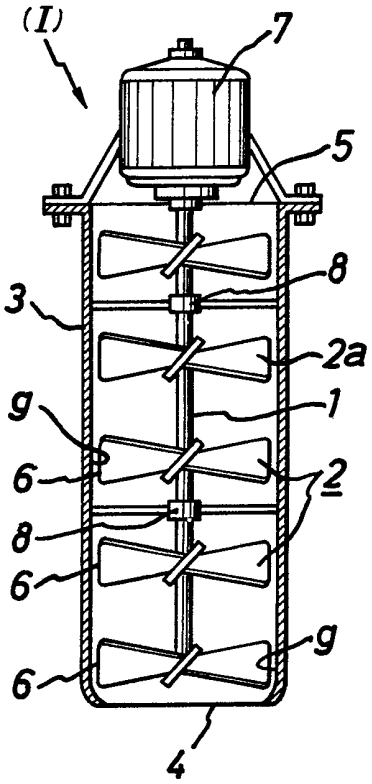


Fig. 2

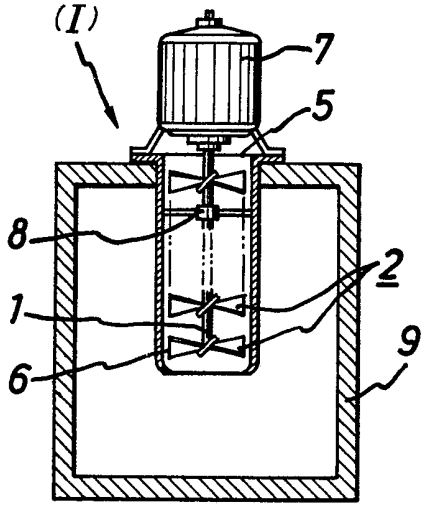
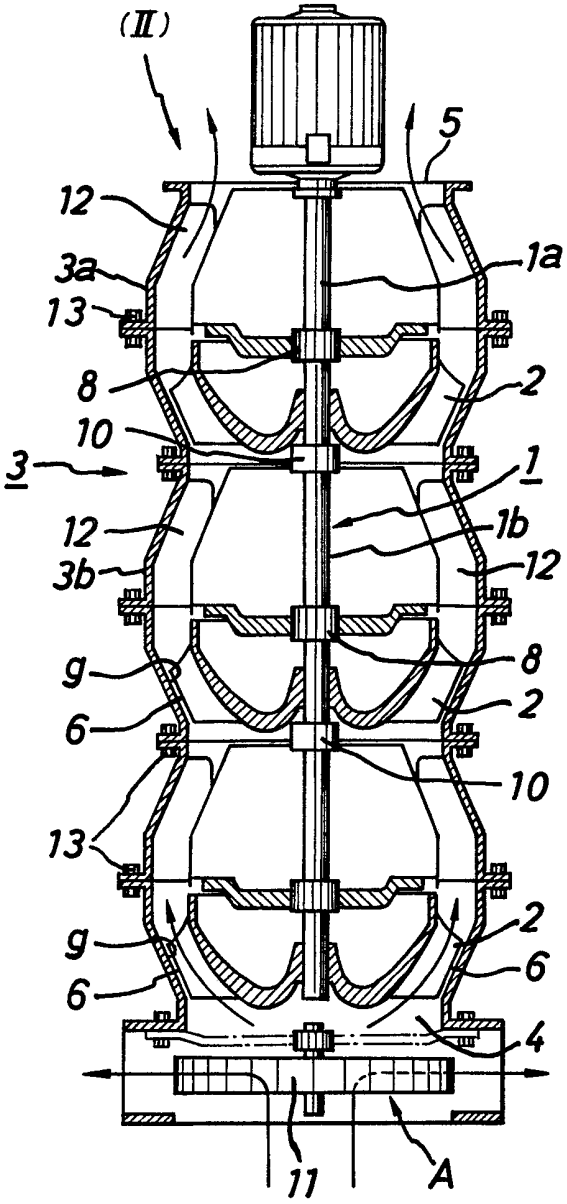


Fig. 3



SPECIFICATION

Rotary means for multistage fans

This invention relates to rotary means equipped with multistage fans having the excellent effect of an air suction and discharge.

The origin of this invention is based on U.K. Patent Application No. 8041291 entitled "Heating process and its apparatus in reducing air pressure within a chamber at a balanced level" which was invented by the present Applicant. The corresponding U.S. Patent Application was assigned U.S. Patent No. 4,319,408. Further, the Applicant has filed the corresponding U.K. Patent Applications Serial Nos. 8204757 and 8209113 and has so far developed various related inventions including the heating process and its apparatus in reducing or pressurizing air pressure within a chamber at a balanced level.

The aforesaid inventions comprise a rotary means for reducing or pressurizing air pressure within the chamber and a suction opening in which the rotary means is disposed, wherein a difference between the reduced or pressurized air pressure and the air pressure outside the chamber is maintained at a balanced level, and air friction heat is generated in a gap between the suction opening and the rotary means by rotation thereof, thereby the chamber can be used for drying or heating purposes.

That is to say, means for suctioning and discharging air within the chamber as well as means for generating air friction heat is formed by the rotary means having the suction opening, so that the drying or heating effect is greatly dependent upon whether or not the operational efficiency of the rotary means is high. From this point of view, this invention has been accomplished.

Accordingly, this invention provides novel rotary means equipped with multistage fans having the excellent air suction and discharge effect as well as the excellent heat generation effect, wherein a plurality of fans are disposed perpendicularly with each other in a multistage manner.

Further, this invention provides novel rotary means equipped with multistage fans, wherein trailing rotary means is disposed right below the lowest fan of the multistage fans and driven by rotation of the lowest one thereof, thereby the aforesaid effects are enhanced further.

Still further, this invention provides rotary means equipped with multistage fans which can bring a preferred air suction and discharge effect by modifying optionally each fan's size, number of vanes, their inclination and a distance between adjacent fans, etc.

This invention will be further described, by way of examples, with reference to the accompanying drawings, in which:—

Fig. 1 is a section view of an example of rotary means equipped with multistage fans according to this invention;

Fig. 2 is a section view of a use condition of the above rotary means;

Fig. 3 is a section view of another example of the rotary means equipped with multistage fans according to this invention.

Preferred examples of this invention will now be described.

Numeral 1 denotes a rotary shaft on which a plurality of fans 2 spaced with each other are fixed. Numeral 3 denotes a tubular body in which the plurality of fans 2 are incorporated. The tubular body 3 is provided with a suction opening 4 at the bottom thereof and a discharge opening 5 at the top thereof.

Numeral 6 denotes air friction heat generating means A which is formed in a small gap *g* between an interior of the tubular body 3 and an edge of the fan's vane 2a. The air can be retained within the gap *g*, thereby the air friction effect can be increased.

In Fig. 1, a plurality of fans 2 are disposed with an equal distance, and each fan has the same size, the same number of vanes 2a and the same inclination. If necessary, it is optional to modify a distance between adjacent fans, each fan's size, number of vanes 2a and their inclination. If the plurality of fans 2 are of a deformed size, it is suitable to change the profile of the tubular body 3 so as to meet the profile of the corresponding fans.

In Fig. 1, the rotary shaft 1 is connected directly to a motor 7. Its speed is variable by way of a transmission gear connected to the motor 7.

Numeral 8 is a bearing mounted on the rotary shaft 1, so that it is smoothly rotatable with the tubular cylinder 3.

Fig. 2 is a section view in which rotary means (I) equipped with multistage fans is fixed with a chamber 9.

When the rotary shaft 1 is rotated by the motor 7, and the plurality of fans 2 are rotated in air discharge direction, the air within the chamber 9 is suctioned forcibly from the suction opening 4, migrated from the lowest fan to the upper fans by rotation of the rotary fans 2 and finally discharged outside the chamber by way of the discharge opening 5. Thus, the air pressure within the chamber 1 is suctioned gradually.

When a difference between a reduced air pressure within the chamber 9 and a normal air pressure thereoutside is maintained at a balanced level, the air is retaining in the air friction heat generating area 6, thereby the air friction effect is enhanced rapidly and heat is generated by the temperature rise of the retaining air.

When the plurality of fans 2 each having the same profile as shown in Fig. 1 are used, the distribution of the air friction heat is such that the temperature of the air friction heat in the innermost fan faced to the suction opening 4 is the highest, while that in the upper fans becomes lower gradually. That is, the air friction heat is most actively generated in the gap *g* of the innermost fan 2, because the air pressure reduction effect is very large in this area, and no heat loss occurs.

Particularly, as the number of fans 2 is additionally increased more, the test result proves that the effect of the air pressure reduction is accelerated more effectively.

Accordingly, when the chamber 2 is used as a shielded structure for the purpose of generating heat, it becomes a heat source. Further, outer air induction means (not illustrated) may be disposed in the chamber 9 to introduce the outer air thereinto automatically or manually. Further, when wet articles are incorporated in the chamber 9, it becomes a drying apparatus.

Another example of this invention will now be described with reference to Fig. 3. Since the same component as shown in Fig. 1 is indicated by the same numeral, its description will be omitted.

In this example, rotary means (II) equipped with multistage fans is made of a combination of a plurality of tubular bodies 3a, 3b, . . . individually separable from each other. Namely, each tubular body (made of two members) is a single unit type, wherein each fan is fixed with individual rotary shafts 1a, 1b, ... In this way, the rotary means (II) equipped with multistage fans is obtained by mounting one single unit type tubular body upon another. The individual rotary shafts are connected with each other by couplings 10. Further, the individual tubular bodies of single unit type are jointed with each other by nuts 13.

Likewise in the example of Fig. 1, the second rotary means (II) is provided with the suction opening 4 at the bottom thereof and the discharge opening 5 at the top thereof.

Further, a trailing rotary means A which is driven by rotation of the lowest fan 2 is disposed right below the suction opening 4. The trailing rotary means A is provided with a driven fan 11.

In case the second rotary means II having the trailing rotary means A is mounted in the chamber 9, the trailing rotary means A causes a forcible air circulation within the chamber, and a further temperature rise, thereby the drying effect is enhanced further.

The aforesaid rotary means II which is disposed in the chamber 9 performs the same function as the first rotary means (I), that is, performs the heating and drying function in reducing air pressure within the chamber 9 at a balanced level. Further, it is optional to pressurize air within the chamber 9 at a balanced level by rotating the plurality of fans 2 in a reverse direction.

Numeral 12 is a guide blade disposed within each tubular body.

According to one aspect of this invention, since a plurality of fans are disposed in a multistage form in a tubular body, the air reducing effect as well as the air pressurizing effect is increased effectively. Further, by adding a trailing rotary means to the rotary means equipped with multistage fans, the air suction and discharge function is increased much more.

According to another aspect of this invention, the multistage fans can be separated individually in a unit type, thereby enabling easy assembling at a working site as well as easy transportation.

Still further, by modifying selectively each fan's size, number of vanes, their inclination and a distance between adjacent fans, a very unique rotary means equipped with multistage fans may be obtained and applied for various purposes.

CLAIMS

1. Rotary means equipped with multistage fans comprising: a tubular body having an air suction opening and an air discharge opening, a rotary shaft disposed in said tubular body, and two or more fans fixed with said rotary shaft in a multistage manner.

2. The rotary means equipped with multistage fans as claimed in claim 1, wherein said rotary shaft is divided into a number of shafts and each shaft is provided with a single fan, subsequently said plurality of shafts each having said single fan being connected with each other by means of bearings.

3. The rotary means equipped with multistage fans as claimed in claim 1, wherein it is optional to modify each fan's size, number of vanes, their inclination and a distance between adjacent fans.

4. Rotary means equipped with multistage fans comprising: a tubular body having an air suction opening and an air discharge opening, a rotary shaft disposed in said tubular body, two fans or more fixed with said rotary shaft in a multistage manner, and a trailing rotary means disposed right below said discharge opening.

5. The rotary means equipped with multistage fans as claimed in claim 4, wherein said rotary shaft is divided into a number of shafts and each shaft is provided with a single fan, subsequently said plurality of shafts each having said single fan being connected with each other by means of bearings.

6. The rotary means equipped with multistage fans as claimed in claim 4, wherein it is optional to modify each fan's size, number of vanes, their inclination and a distance between adjacent fans.

7. A rotary means equipped with multistage fans, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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