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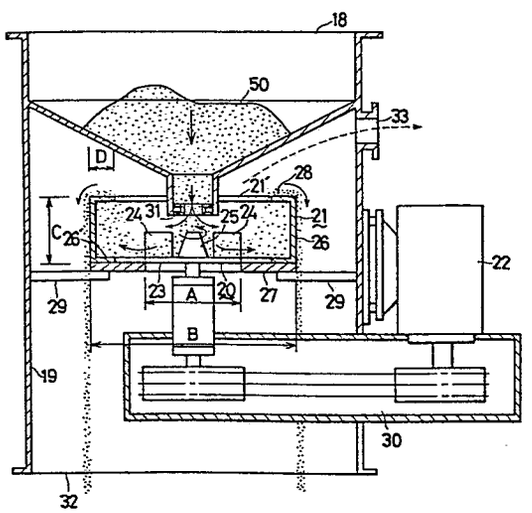
(54) Apparatus for regenerating foundry moulding sand.

(57) An apparatus for removing binder, mould coating agent and fine sand particles from the moulding sand used for casting moulds to regenerate the sand for re-use. The apparatus comprises a rotor (20) for scattering moulding sand falling from a hopper (18), and a friction ring (21) surrounding the rotor and having a flange (28) at its upper end and a seal plate (27) at its lower end. Friction between sand particles in accumulation assures efficient regeneration. This serves to render the apparatus small-sized and imparts improved durability.

FIG.3



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"APPARATUS FOR REGENERATING FOUNDRY MOULDING SAND"

This invention relates to an apparatus for regenerating sand as used for casting moulds to enable the sand to be re-used.

It has been usual practice to regenerate moulding sand and repeatedly to use the sand for shaping casting moulds so as to save time and from the viewpoint of economy. The moulding sand once used contains hardened and scorched portions of binder and mould coating agent and moreover fine particles of moulding sand produced as by thermal impact. The sand can be regenerated by removing such portions and fines from it.

Moulding sand regenerating apparatus of the following two types are chiefly in use.

Fig. 1 shows an apparatus of one type which comprises a hollow cylindrical main body 2 having a hopper 1 in its upper portion. Beneath it there is a rotary drum 3 having a smaller diameter than the main body 2 and disposed in the centre of the main body 2 below the hopper 1 is a shelf-like annular projection 4 extending from the peripheral wall of the main body 2 and surrounding the rotary drum 3. Between the hopper lower end and the rotary drum 3 is a shelf-like annular projection 4.

Fig. 1 further shows a motor 6, a rotary shaft 7 coupled to the motor 6, an outlet 8 for regenerated moulding sand, a suction opening 9 for withdrawing fines and extraneous matter, and moulding sand 40.

Fig. 2 shows an apparatus of the other type comprising a main body 11 having a hopper 10 in its upper portion, a rotor 12 disposed below the hopper 10 for scattering moulding sand, and an annular deflector 13 surrounding the rotor 12 and having a channel-shaped cross section, with its channel portion directed inwardly downwards. A space is formed between the rotor 12 and the deflector 13 for allowing moulding sand to descend. Fig. 2 further shows a motor 14, a rotary shaft 15 coupled to the motor 14, an outlet for regenerated moulding sand, a suction opening 17 for withdrawing fines and extraneous matter, and moulding sand 41.

With the regenerating apparatus of the first type (Fig. 1), the moulding sand falling from the hopper 1 is spread by the distributor 5 and falls into the peripheral portion of the drum 3 whilst it rotates. The sand in the peripheral portion is centrifugally forced against the peripheral wall of the drum 3. Since moulding sand is supplied to the drum 3 continuously, the sand circulates in the form of a surface layer, passes over the peripheral wall of the drum 3 and is centrifugally scattered toward the inner surface of the main body 2. After accumulating on the projection 4, the sand falls off the inner peripheral edge of the projection 4 and is discharged through the outlet 8.

Since the moulding sand continuously falls into the sand layer accumulated in the peripheral portion of the rotary drum 3 and is rapidly accelerated within the sand layer, the sand particles are brought into frictional contact with one another, whereby the extraneous matter adhering to the particles is separated off to regenerate the sand in the first stage. When the sand is subsequently forced outwards against ehe side wall of the main body 2 from the rotary drum 3, the sand particles impinge on those in the sand layer on the projection 4, whereby the sand is regenerated in the second stage.

Thus the moulding sand must be regenerated in two stages because the speed at which the sand is scattered from the rotary drum 3 towards the side wall of the main body 2 is low. The apparatus further has the following drawbacks.

The lowermost portion of the sand accumulation in the peripheral part of the rotary drum 3 is never scattered toward the main body side wall, therefore is not fully regenerated and is in no way withdrawable.

Further, since the moulding sand is caused to impinge on the inner surface of the hollow cylindrical main body so as temporarily to form a sand accumulation on the projection 4, the regenerating apparatus itself must be of large size.

In the operation of the regenerating apparatus of the second type (Fig. 2), the moulding sand falling from the hopper 10 is scattered by the rotor 12 in rotation toward the inner surface of the

deflector 13 of channel-shaped cross section, by which the impinging sand is deflected first vertically upward, then horizontally inward and thereafter vertically downward. Thus sand particles are regenerated when impinging against the deflector 13 and also when colliding with other sand particles scattered by the rotor 12 while falling vertically downwards.

To regenerate moulding sand on an economical scale therefore, the deflecting surfaces on the inner side of the deflector 13 must be of considerable width, with a large space also provided between the rotor 12 and the deflector 13. This renders the apparatus itself of large size. The apparatus further has the drawback of breaking down sand particles or causing marked wear to the deflector 13.

The present invention provides an apparatus for regenerating moulding sand which is smaller than the conventional forms of apparatus described above and in which the moulding sand particles to be regenerated are caused to impinge on one another and further forced into frictional contact with one another for regeneration in order to inhibit the wear on an essential component of the apparatus and also to prevent fracture of the sand particles. The apparatus comprises a rotor for scattering moulding sand, and a friction ring surrounding the rotor, the friction ring having a sealed lower end and an inward flange defining an opening at its upper end for accumulating the scattered sand in the friction ring. Sand particles are continuously fed to the

rotor and thrown thereby into the sand accumulation in striking contact therewith, thus forcing upwardly the preceding portion of sand. Accordingly the spacing between the rotor and the friction ring can be small so as to render the apparatus of small-size, while the moulding sand can be treated with reduced fracture and without causing marked wear on the friction ring.

Figs. 1 and 2, already mentioned, are views showing conventional forms of moulding sand regenerating apparatus in vertical longitudinal section;

Fig. 3 shows a moulding sand regenerating apparatus according to the invention in vertical longitudinal section;

Fig. 4 is a vertical section showing a different form of friction ring useful for the apparatus of the invention and having two upper and lower flanges;

Fig. 5 is a similar view showing another friction ring which has a progressively increasing diameter toward its upper end; and

Fig. 6 is a similar view showing still another friction ring which has a progressively decreasing diameter toward its upper end.

A moulding sand regenerating apparatus according to the present invention as shown in Fig. 3 comprises a hollow cylindrical main body 19 with a hopper 18 fixed in its upper part and having a rotor 20 in its centre. The rotor 20 is surrounded by a friction ring 21.

The rotor 20 has a horizontal disc 23 of small diameter coupled to a motor 22 and rotatable at a specified speed, a plurality of blades 24 extending upward from the upper side of the disc 23 and arranged radially toward the outer peripher of the disc 23, and a frusto-conical distributor 25 located centrally on the upper side of the disc 23. The moulding sand 50 falling from the hopper 18 is uniformly distributed towards the blades 24 by the distributor 25.

The friction ring 21 includes a cylindrical side plate 26 of large diameter and an annular bottom plate 26' at its lower end and has a horizontal annular seal plate 27 disposed beneath the bottom plate 26' and extending towards the disc 23 almost into contact with its outer periphery. A flange 28 of small width extends horizontally inward from the upper end of the side wall 26 to define an overflow opening 21' through which the moulding sand is forced out. The height of the side plate 26 and the width of the flange 28 are suitably determined in accordance with the speed of rotation of the rotor 20. The friction ring 21 is fixedly connected to the main body 19 by support arms 29 extending horizontally from the inner side of the main body 19, or by some other suitable means.

Also shown is a power transmission mechanism 30 comprising a reduction gear, belt, and other components for coupling the motor 22 to the rotor 20.

The hopper 18 has an outlet 31 whilst the main body 19 has an outlet 32 for regenerated moulding sand, and a suction opening 33 for withdrawing binder, moulding coating agent and finely divided sand particles.

The friction ring 21 need not necessarily have the construction shown in Fig. 3. Fig. 4 shows a friction ring 21 having an upper flange 28" and a lower flange 28' of slightly smaller width than the flange 28".

Fig. 5 shows a friction ring 21 having a progressively increasing diameter toward its upper end.

Fig. 6 shows a friction ring 21 having a progressively decreasing diameter toward its upper end.

While each of the friction rings shown in Figs. 3 to 6 is supported at its lower end by the annular seal plate 27 and thereby sealed, the seal plate may be formed integrally with the friction ring by bending.

Channel bars or angle bars may be used as the arms 29 for supporting the friction ring 21.

The inner surface of the friction ring has a coating for preventing abrasion. A sufficient reinforcement is provided especially for the vertical inner peripheral edge of the upper flange defining the opening of the friction ring and for the corner portion formed with the inner surface continuous with the edge.

The bottom plate 26' of the friction ring may be detachably attached to the seal plate 27.

The moulding sand regenerating apparatus as above described operates as follows.

The motor 22 rotates the rotor 20 at the specified speed through the power transmission mechanism 30. When the old moulding sand 50 to be regenerated is allowed to fall from the hopper 18 in this state, the sand is uniformly spread and supplied to the blades 24 by the distributor 25 and is thereafter centrifugally scattered toward the riction ring 21 by the blades. The sand falls when it impinges against the inner surface of the ring.

In the initial stage of regenerating operation, the moulding sand thus impinges on the inner surface of the side wall 26, and the resulting impact removes from the surfaces of the sand particles, casting binder, mould coating agent and like extraneous matter and the fine particles produced by thermal impact, whereby the sand is regenerated.

Since moulding sand is scattered continuously, the amount of sand accumulation on the seal plate increases, and after the amount of sand accumulation has exceeded a predetermined amount, the part of the sand scattered centrifugally collides with the layer of sand accumulation without impinging directly on the inner surface of the side plate 26. The centrifugal force acting on the sand particles brings the particles into frictional contact with one another, whereby extraneous matter is separated off for the regeneration of the sand. As moulding sand particles are thus thrown into contact with those accumulating on the seal plate 27 one

after another, the sand particles in frictional contact are progressively forced upward to reach the flange 28. The flange 28 restrains the sand which is continuously supplied and pushed upward, thus acting against the sand while it is being progressively forced upward. Consequently the sand is subjected to greater frictional resistance than when it is pushed up free of resistance and then falls. Thus the apparatus achieves a high regeneration efficiency due to repeated collision and friction between the scattered sand particles.

When a further portion of sand is scattered from the rotor 20, the sand accumulation is eventually pushed up beyond the flange 28 and caused by the following ascending portion of sand to fall off the flange 28 inside the main body 19. The falling sand portion is withdrawn from the outlet 32 by a screw conveyor or like suitable means and re-used for shaping casting moulds. The extraneous matter and fines separated from the old sand are withdrawn from the suction opening 33.

When the friction ring shown in Fig. 4 and having the upper and lower flanges 28' and 28" is used for regenerating moulding sand, the sand thrown by the blades 24 against the inner surface of the friction ring chiefly under the lower flange 28' progressively forms an accumulation at a predetermined angle and is temporarily restrained from ascending by the flange 28'. Particles of moulding sand are further thrown into the

accumulation and repeatedly brought into collision and frictional contact with one another while being forced upwards for regeneration. With the increase of the accumulation, the sand readily passes over the lower flange 28' of smaller width, and the sand particles are further forced upward towards the upper flange 28" in repeated frictional contact with one another, whereby extraneous matter is separated off. With a further increase of accumultaion, the sand is forced over the upper flange 28" onto the upper surface of the flange 28" and allowed to fall of the flange outer periphery.

Accordingly the sand is subjected to friction more frequently than in the former case while being forced up due to the provision of the upper and lower flanges.

When the upper and lower flanges 28' and 28" are thus used, the force of the moulding sand being pushed upward can be withstood jointly by the two flanges, so that the wear on the two flanges is smaller than on the single flange 28.

With the friction ring shown in Fig. 5 in which the ring side plate has a progressively increasing diameter toward its upper end, the particles of moulding sand in frictional contact in the narrow lower portion of the ring are forced upward smoothly along the side plate 26, with the result that abrasion of the flange 28 can be reduced.

With the frusto-conical friction ring shown in Fig. 6 wherein the side plate 26 has a progressively increasing diameter toward its

lower end, particles of moulding sand are brought into frictional contact with one another while beinf forced upward from the wide lower portion of the ring toward the small upper opening. The flange 28 of this ring can be of a reduced width.

The regenerating apparatus of the foregoing construction achieved good results when the diameter A of the rotor 20 and the diameter B of the friction ring 21 are in the ratio of 1:1.6. While the height C of the friction ring shown in Fig. 3 must be such that the ring 21 will confine therein the moulding sand falling from the hopper and scattered by the rotor, experiments have revealed that good results are available when the height C is 150 mm and the width D of the flange is 50 mm when the rotor 20 is driven at 2,000 r.p.m.

The present invention makes it possible to reduce the spacing between the rotor 20 and the friction ring 21 and therefore to reduce the diameter of the cylindrical main body 19 to about 1/3 the diameter of the known main body of Fig. 2 to provide a very compact apparatus.

When the moulding sand cannot be fully regenerated by one apparatus, a desired number of regenerating apparatus may be used in stages.

According to the present invention, a rotatable rotor is surrounded by a stationary friction ring having a sealed bottom portion and an inward flange projecting from its upper end, whereby the particles of moulding sand continuously falling from a hopper and scattered are brought into collision

and frictional contact with one another within the friction ring and are forced upward while being restrained by the upper end flange. Before the sand is pushed up beyong the flange, binder, mould coating agent and fine sand particles can be separated off and removed effectively.

Although achieving a high regeneration efficiency, the present apparatus is very small in its entirety and yet has the unique advantage of being capable of treating the moulding sand without causing break of sand particles and with reduced abrasion of the friction ring side plate.

CLAIMS

1. Apparatus for regenerating foundry moulding sand comprising a hollow cylindrical main body (19), a hopper (18) in the upper part of the main body for supplying the moulding sand to be regenerated and having an outlet at its lower end for regenerated sand, a rotor (25) rotatably disposed within the main body immediately below a downwardly extending charging outlet in the centre of the hopper, characterised by a distributor (25) at the upper end of the rotor (25), and a friction ring (21) surrounding the charging outlet and the upper end of the rotor, the space between the lower end of the friction ring (21) and the outer periphery of the rotor (25) being closed, and the friction ring (21) having an inward flange (28, 28', 28") of specified width at its upper end.

2. Apparatus as defined in claim 1 wherein the friction ring has a diameter larger than the diameter of the rotor but not larger than twice the diameter of the rotor.

3. Apparatus as defined in claim 1 wherein the friction ring has a second flange on the inner side of its side plate below the upper end flange.

4. Apparatus as defined in claim 1 wherein the friction ring includes a frusto-conical side plate having a progressively increasing diameter toward its upper or lower end.

5. Apparatus as defined in claim 1 wherein the rotor has upright blades arranged radially outside and adjacent the distributor.

6. Apparatus as defined in claim 1 wherein the friction ring is fixed to the inner side of the cylindrical main body by support arms.

7. Apparatus for regenerating foundry moulding sand substantially as hereinbefore described with reference to, and as shown in, Fig. 3 or Fig. 3. as modified by any of Figs. 4, 5 or 6 of the accompanying drawings.

FIG.1

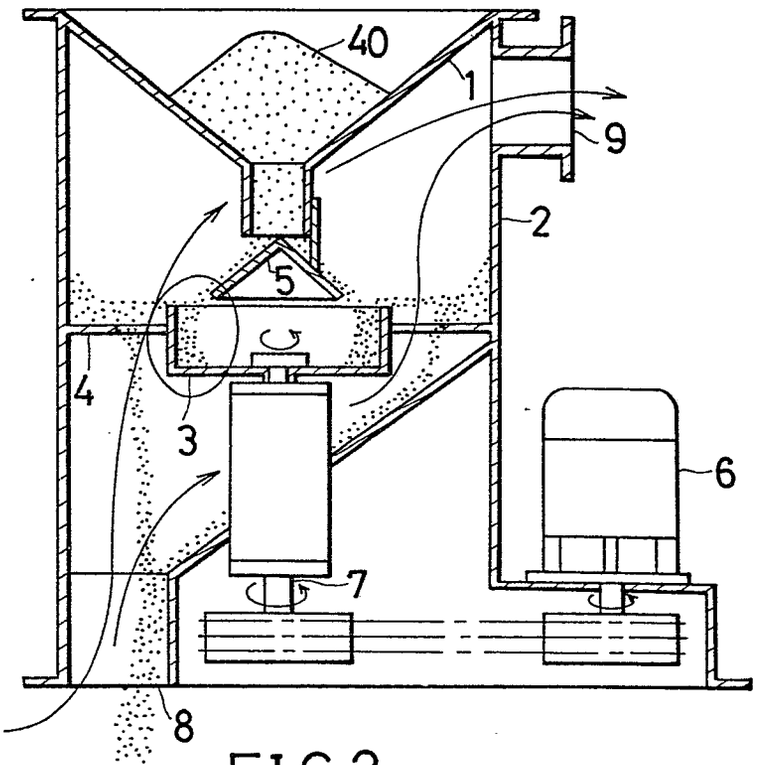


FIG.2

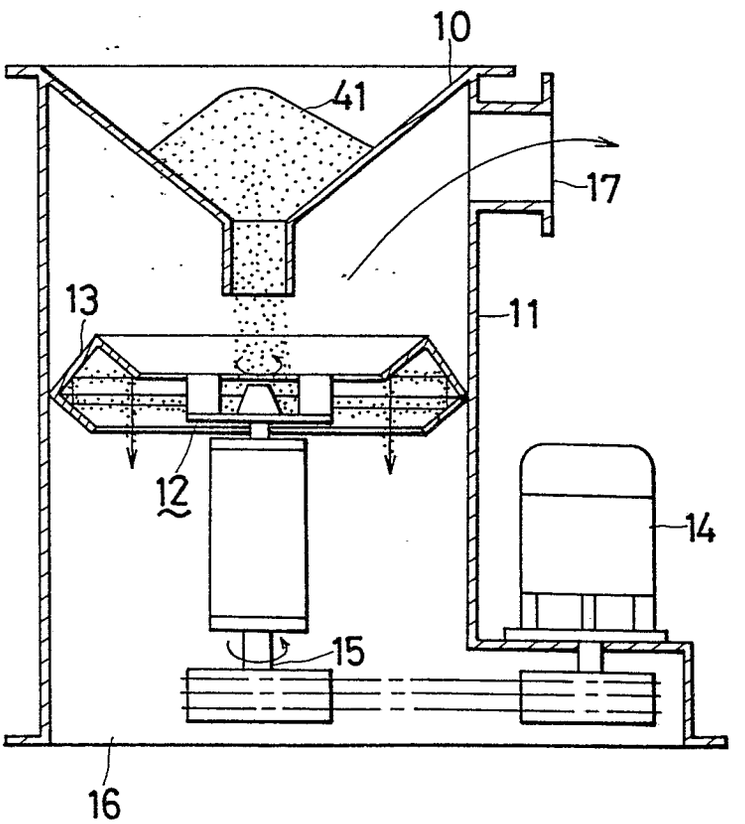


FIG.3

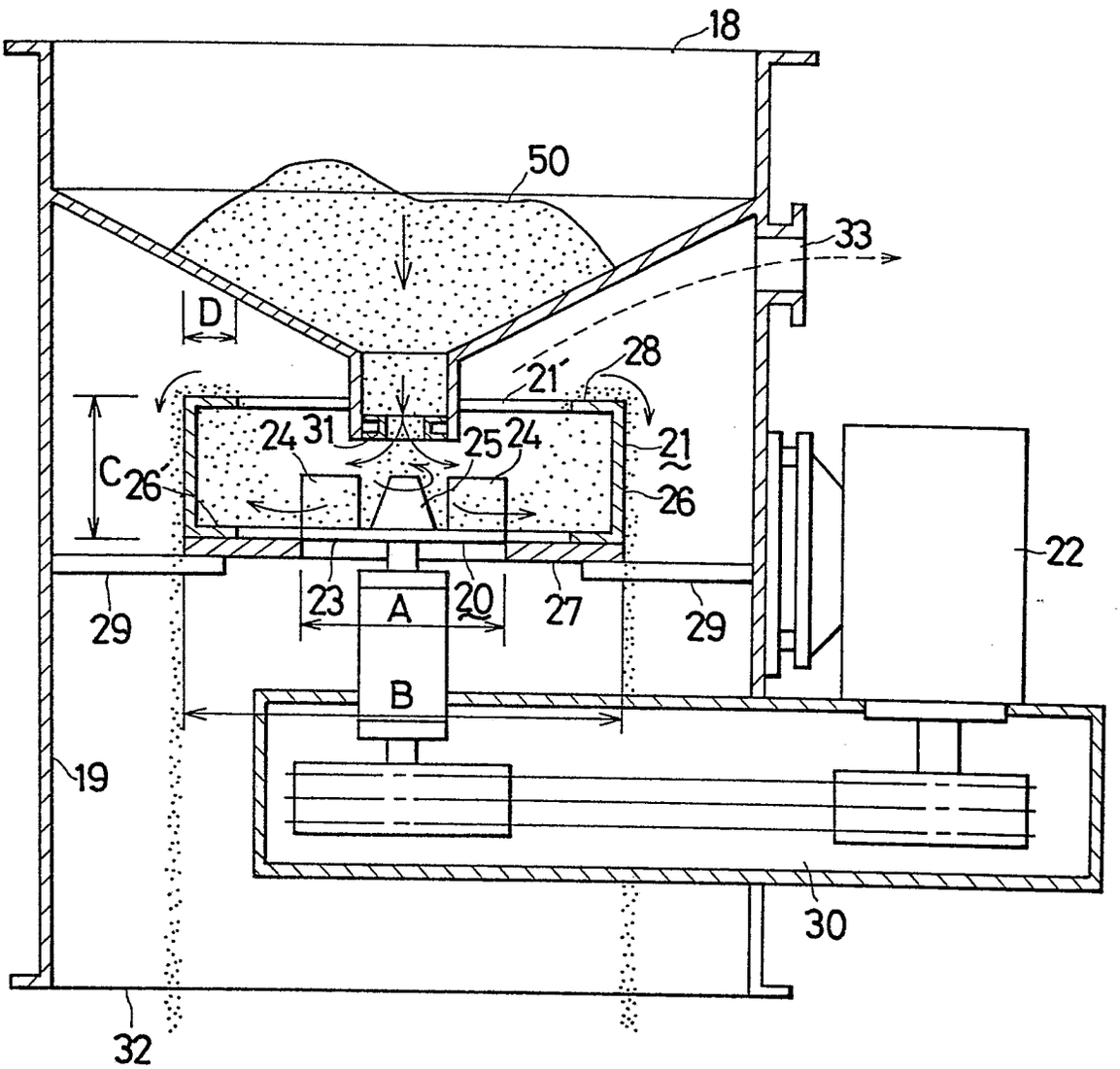


FIG.4

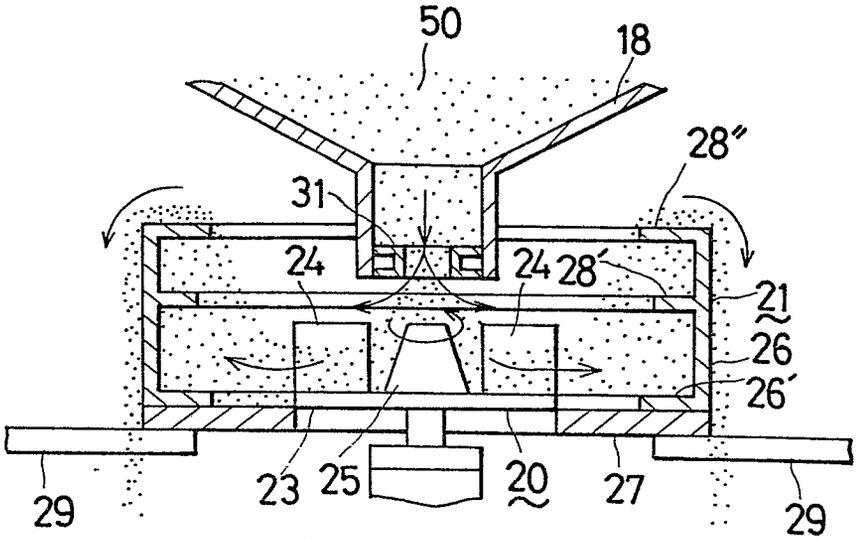


FIG.5

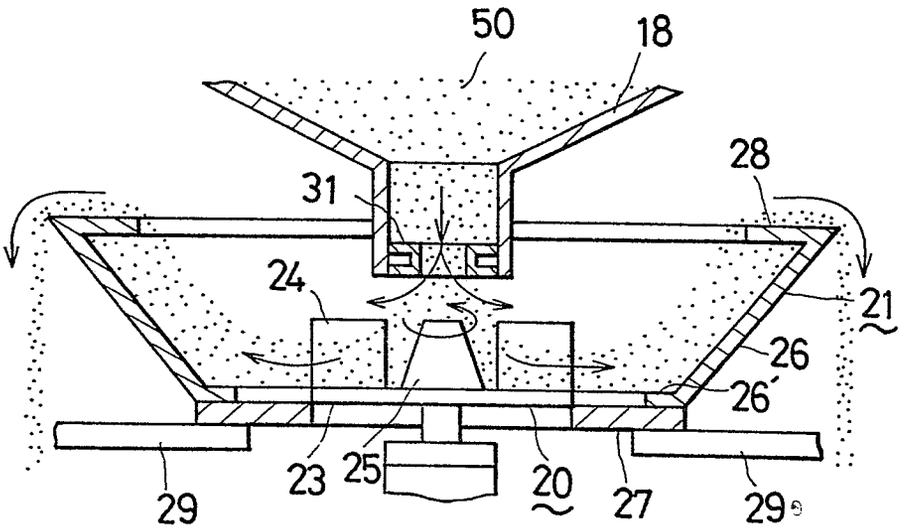
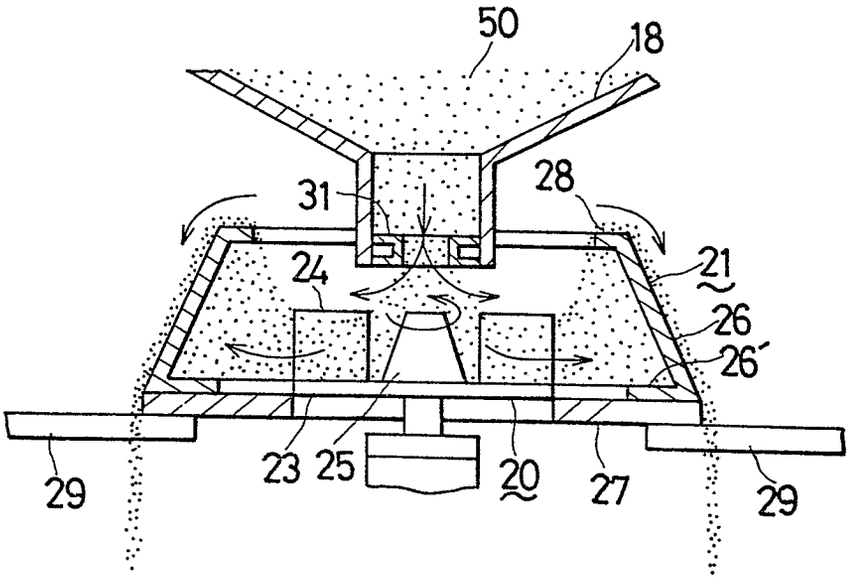


FIG.6



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EUROPEAN SEARCH REPORT

Application number EP 81 30 5399

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
Y	US - A - 3 782 643 (CARPENTER) * abstract; figure 1 *	1
Y	US - A - 3 995 784 (IZQUIERDO) * abstract; figure 2 *	1
Y	US - A - 3 180 582 (O. DANYLUKE) * figures 1,2; column 2, lines 48-72; column 3, lines 1-10 *	2,4
Y	GB - A - 376 760 (E. FEUERHEERD) * figures 1-4 *	5
Y	US - A - 2 985 391 (B.J. PARMELE) * figure 2 *	3
Y	US - A - 3 544 015 (M. GULIC) * figures 1,2; column 2, lines 20-61 *	1,2

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

B 22 C 5/02
5/10

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

B 22 C
B 02 C
B 07 B

CATEGORY OF CITED DOCUMENTS

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	05-03-1982	MAILLIARD