



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : C03B 37/05	A1	(11) International Publication Number: WO 92/06047 (43) International Publication Date: 16 April 1992 (16.04.92)
(21) International Application Number: PCT/EP91/01862 (22) International Filing Date: 30 September 1991 (30.09.91) (30) Priority data: 9021168.1 28 September 1990 (28.09.90) GB 9021169.9 28 September 1990 (28.09.90) GB 9100883.9 16 January 1991 (16.01.91) GB (71) Applicant (for all designated States except US): ROCK- WOOL INTERNATIONAL A/S [DK/DK]; Hovedgad- en 501, DK-2640 Hedehusene (DK). (72) Inventors; and (75) Inventors/Applicants (for US only) : GROVE-RASMUS- SEN, Svend [DK/DK]; Straedet 2, Herslev, DK-4000 Roskilde (DK). LETH MOLLER, Per [DK/DK]; Har- aldsborgvej 1, DK-4000 Roskilde (DK). FRIIS RAS- MUSSEN, Bruno [DK/DK]; Hovedgaden 578, DK-2640 Hedehusene (DK).		(74) Agent: LAWRENCE, Peter, Robin, Broughton; Gill Jen- nings & Every, 53-64 Chancery Lane, London WC2A 1HN (GB). (81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (Eu- ropean patent), GN (OAPI patent), GR (European pa- tent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European pa- tent), NO, PL, RO, SD, SE, SE (European patent), SN (OAPI patent), SU ⁺ , TD (OAPI patent), TG (OAPI pa- tent), US. Published <i>With international search report.</i>
(54) Title: PROCESS AND APPARATUS FOR MAKING MINERAL WOOL FIBRES 		
(57) Abstract Apparatus for the formation of mineral wool fibres comprising a set of rotors (1) mounted on a front face (2) of a housing (3) wherein a rotor (5, 6, 7) has associated with it an air supply slot (8, 9, 10) for discharging an air blast close to the periphery of the rotor with an axial component for carrying off the mineral wool fibres and wherein the air slot has direction means (25) to direct the air at an angle to the axial direction that varies along the length of the slot.		

+ DESIGNATIONS OF "SU"

Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MN	Mongolia
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GN	Guinea	NL	Netherlands
BJ	Benin	GR	Greece	NO	Norway
BR	Brazil	HU	Hungary	PL	Poland
CA	Canada	IT	Italy	RO	Romania
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LI	Liechtenstein	SU+	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark				

**Process and Apparatus for making
Mineral Wool Fibres**

It is known to make mineral wool fibres from a mineral
5 melt using an apparatus comprising
a housing having a front face,
a set of fiberising rotors each mounted on the front
face for rotation about a different substantially
horizontal axis and arranged such that when the rotors are
10 rotating melt poured on to the periphery of the top rotor
in the set is thrown on to the periphery of the subsequent
rotor, or on to the periphery of each subsequent rotor in
sequence, in the set and mineral wool fibres are thrown off
the or each subsequent rotor, and
15 means for collecting the mineral wool fibres
comprising, associated with the or each said subsequent
rotor, an air supply slot extending through the front face
of the housing around and close to the periphery of that
rotor for discharging an air blast close to and
20 substantially parallel to the periphery with an axial
component for carrying the mineral wool fibres axially off
that periphery, and
direction means for selecting the angle of the
discharged air relative to the axial direction.
25 Apparatus of this general type is described in GB
1,559,117. In particular that describes one system in
which the air direction means are blades on the periphery
of the rotor and that rotate with the rotor and thus give
a tangential component to the air supply that is the same
30 as the rotational speed of the rotor. That patent does,
however, also describe that the direction means can be
blades mounted in the slot and that this makes it possible
to vary the flow of air and its direction along the
periphery of the rotor. Thus, instead of the tangential
35 velocity of the air being dictated by the rotational speed
of the rotor, it can be dictated by the choice of the angle
at which the blades are set. Instead of the flow of air

being uniform around the entire rotor, the slot can be closed or reduced in some areas so as to reduce the flow of air in those areas. In particular, it is possible to close the flow of air in the interspace between the rotors where the melt flows from one rotor to the next, so as to reduce the disturbing and cooling effect on the flow of melt. The inference therefore is that the slot containing the blades should extend around most at least of the remainder of the periphery of each of the rotors. As a consequence, the slots will extend between lower adjacent parts of the lowermost pair of rotors.

When manufacturing mineral wool fibres binder is usually sprayed into the fibres as they are carried axially away from the set of rotors, and it is desirable to obtain the best possible distribution of binder with the fibres.

Some shot or coarse fibre is normally thrown off the set of rotors and can be collected in a pit positioned beneath and slightly in front of the set of rotors, just before a conveyor or other suitable carrier for removing the mineral wool from the chamber containing the rotors. The shot and coarse fibres are collected in the pit and recycled to the melt. It is naturally desirable to minimise the amount of good quality fibres that are collected in the pit.

According to the invention apparatus for the production of mineral wool is provided which comprises a housing having a front face, a set of rotors each mounted on the front face of the housing for rotation about a different substantially horizontal axis and arranged such that when the rotors are rotating mineral melt that is poured on to the periphery of the top rotor in the set is thrown on to the periphery of the subsequent rotor, or each subsequent rotor in sequence, in the set and mineral wool fibres are thrown off the or each subsequent rotor, means for collecting the mineral wool fibres comprising, associated with the or each subsequent rotor, an air supply slot extending through the front face of the housing around

and close to that rotor for discharging an air blast close to and substantially parallel to the periphery of the rotor with an axial component for carrying the mineral wool fibres axially off that periphery, and direction means for
5 selecting the angle of the discharged air relative to the axial direction, characterised in that the direction means in at least the slot associated with the final rotor in the set are arranged to direct the air at an angle to the axial direction that varies along the length of the slot between
10 a higher angle that is corotational with the rotor and a lower angle.

Thus the air stream will emerge from the slot at different angles along the length of the slot. By this means it is possible to optimise the tangential velocity of
15 the air at different positions along the slot, according to the location of each position relative to surrounding apparatus.

The presence of a strong tangential component to the air stream in part at least of each of the slots is
20 desirable because it promotes the formation of a fibrous product having a uniform and light density. Accordingly the direction means should direct the air at an angle over part of the length of the slot that is corotational with the periphery and that is relatively high, namely at least
25 20°, usually at least 30° and often at least 40° to the axial direction. It is generally undesirable for it to be above about 50 or 65° because these higher angles increase the difficulty of providing sufficient axial flow to carry the fibres away from the set of rotors, and generally the
30 maximum angle is below 45°, often around 42°.

However these high angles have proved to be undesirable in some positions around each rotor, in that at these positions a more axial (and less tangential) air flow gives better results. Accordingly at these positions the
35 air stream should emerge at a lower angle. The lower angle will generally be at least 10° less than the higher angle. Suitable results are often obtained when the higher

angle is in the range 30 to 45° and the lower angle is at least 10° less and is in the range 10 to 25°.

In a particularly important and preferred aspect of the invention the lower angle is in the range 0 to 15°, often 0-10° and preferably 0-5°, most preferably 0°, over at least part of the length of at least one of the slots. In some instances the lower angle may be a very small (e.g., 0-5°) counterrotational angle.

One instance where a strong tangential component is undesirable is where the tangent to the rotating surface extends downwardly, for instance at an angle of $\pm 45^\circ$ to the vertical, because the imposition of this tangential air stream tends to blow the fibres downwards so that they may not mix properly with the binder, and may even be blown into the pit. Accordingly, it is desirable in these regions that the direction means should be angled at a lower angle than at other parts of the slot.

In particular, it is often preferred that the lowermost pair of rotors should rotate in opposite directions with the tangents to the adjacent rotating surfaces both being directed downwards, and that there should be air slots around each of these rotors and that these air slots should extend between the adjacent parts of the rotors. If there is a strong tangential component in the air flow from both of these slots, this will provide a very strong downward force to the fibres being thrown off each of the final pair of rotors where they are close to one another, and thus is liable to lead to poor binder distribution and a particularly high loss of good quality fibres into the pit. By reducing the angle of the direction means in these regions, the air flow will have a stronger axial component and so will tend to blow the fibres more strongly on to the collecting surface.

Another position where the use of the higher angle can be disadvantageous is when the tangent from a rotor extends vertically upwards $\pm 45^\circ$, especially at a rotor at the top of the set. This is because the airstream will tend to

throw the fibres upwards. They may strike the roof of the chamber and they may be thrown up away from the binder. Also, the upward air flow could, in some situations, cool the melt stream. Accordingly, at the upper end of the slot of such a rotor, it is preferred that the angle should be a lower angle.

Another situation arises when the spinning chamber is relatively narrow, since the use of a higher angle on the outermost part of the slots, adjacent the walls of the spinning chamber, may then tend to direct the fibres against the walls of the chamber, and so in these positions it would be desirable to have a lower angle.

It is desirable that there should not be a sudden transition from the higher angle to the lower angle and so preferably there is a graduated transition. Usually most of the slot is at one angle and the remainder of the slot, usually at one end, is at the other angle, but if desired the angle may, for instance, start at the lower angle, increase to the higher angle and then reduce to the lower angle.

In any slot where the angle does vary along the length, generally 10 to 90°, often 10 to 40°, is at the lower angle with the remainder being at the higher angle. Several different lower angles may be used. For instance part of the length of the slot, e.g., 10 to 30%, might be at an angle of zero, part at an angle of, for instance, 10 to 20°, and the remainder at an angle of, for instance, 30 to 45°.

Although the slot is preferably an annular, or part annular, duct that extends around the associated rotor and that has blades fitted in it to act as guides, it can alternatively be a series of adjacent orifices, with the walls of each orifice acting as the guides.

Generally each blade is rectilinear and is fitted within the slot at the desired angle, but some or all of the blades can be curved, in which event the angle will be

defined, at least in part, by the angle of the discharge end of the blade.

Because of the capital investment and the labour involved in operating such a plant, it is highly desirable to increase its productivity. Prior art attempts at increasing productivity have included using a pair of fiberising means within the fiberising chamber as exemplified in US 3709670 and US 4119421. In both these patents the fiberising means are necessarily arranged symmetrically to avoid interference between their respective air flows. Neither of these systems is very effective, and both have the additional disadvantage that they require the construction of two opposite types of fiberising means so that the rotors can be arranged in the requisite mirror-image pattern. Replacement of the fiberising means is liable to be required relatively frequently because of the very aggressive conditions to which it is exposed, and so it is very inconvenient that anybody operating a plant as described in either of these patents would have to stock two different types of fiberising means to carry out such a replacement.

There is therefore still an urgent need to be able to increase the productivity of the plant without causing a reduction in product quality, and without making it necessary to stock two different types of fiberising needs.

Also according to the present invention apparatus is provided which comprises a plurality of fiberising means as described above and which are arranged in side by side relationship wherein each set of rotors is substantially identical in each of the fiberising means.

As a result of having the direction means directing the air at different angles within the same set of rotors, it is now possible to optimise the air flow at each part of each set. As a consequence of this, it is for the first time possible to optimise the air flows in one set of rotors in relation to the air flows in the adjacent set, and thus it is possible to obtain very good fiberising

results even though the sets of rotors can be very close to one another and can be identical to one another.

By saying that the sets of rotors are identical to one another it is meant that they are interchangeable with one another without any adverse effect on the performance of the apparatus. Naturally there can be minor and insignificant differences between the sets. However, often the entire fiberising means is identical in this sense, so that a fiberising means comprising the housing, the rotors and the air slots around the rotors, is interchangeable with another fiberising means.

By means of this arrangement of the fiberising means it is possible to avoid interference between the air supplies in adjacent fiberising means.

The spacing between each set of rotors can be very close, for instance the horizontal spacing between the areas of adjacent rotors in the two sets may be 1 to 4, often 1 to 2 times the horizontal spacing of the adjacent rotors in one set.

The set of rotors can consist of just two rotors but generally it consists of three, or more usually four, rotors.

The invention is illustrated by reference to the accompanying drawings in which:

Figure 1 is a front view of a set of rotors;

Figure 2 is a cross-section on the line II-II through the set of rotors in Figure 1 and through the collecting chamber in which they are positioned in use; and

Figure 3 is a detail of the slot around one of the rotors.

Figure 4 is a front view of a pair of a set of rotors (the slots are not shown).

The apparatus consists of a set of rotors 1 mounted on the front face 2 of a housing 3. Each rotor is mounted in conventional manner on a driven axle that allows it to be rotated at high peripheral speed. The illustrated set consists of four rotors, a relatively small feed rotor 4

that rotates anti-clockwise, a first subsequent fiberising rotor 5 that rotates clockwise, a second subsequent fiberising rotor 6 that rotates anti-clockwise, and a third subsequent fiberising rotor 7 that rotates clockwise. The bearings and drive mechanisms are not shown. The bearings and drive mechanisms are not shown. Air slots 8, 9 and 10 are associated with, respectively, the subsequent rotors 5, 6 and 7, each slot extending around part only of the rotor. Generally each slot extends around at least 1/3 of the periphery of its associated rotor, generally around the outer part of the set of rotors. Generally it extends around not more than 2/3 or 3/4 of the periphery.

Each slot leads from an air supply chamber within the housing.

Each slot leads from an air supply chamber within the housing.

Molten mineral melt is poured on to the rotor 4 along path 11 and the majority of it is thrown, along path 12, on to subsequent rotor 5. Some of the melt is fiberised off that rotor whilst the remainder is thrown along path 13 on to subsequent rotor 6. A significant amount of this is fiberised off rotor 6, mainly in the area where there is slot 9, but some is thrown along path 14 on to the subsequent rotor 7. A significant amount is fiberised in the general direction 15 but a large amount is also fiberised around the remainder of the rotor surface included within slot 10.

Since the slots 8, 9 and 10 do not extend around the entire periphery of each rotor, the air flow in the region of paths 12, 13 and 14 can be controlled and, indeed, can be substantially zero.

Within each slot blades 25 are mounted at an angle, relative to the axial direction of the associated rotor, that can be predetermined at a value ranging, typically, from zero to 42°. For instance, in slot 9 the angle in the region A to B can increase from 0° at A to about 20° at B and then the angle of the blades in the region B to C can

be substantially uniform at 42°. Similarly, in slot 10 the angle can increase from about zero at D up to about 20° at E and can then increase and be substantially uniform throughout the region E to F at an angle of about 42°.

5 In slot 8, it may be preferred to have a lesser angle, typically a uniform angle of around 15 to 30°, often around 20 or 25°.

The inner edge 24 of each slot is preferably coaxial with the associated rotor and preferably has a diameter that is substantially the same as the associated rotor. Preferably the diameters are identical but the inner edge of the slot can have a slightly larger diameter but it is desirable that any such increase in diameter should be sufficiently small that a wall jet effect is still achieved as the air flows out of the slot and across the surface of the rotor. Accordingly if the slot has an inner diameter that is more than a few millimetres greater than the outer diameter of the rotor, it is generally desirable for the slot to direct the air stream as a slightly inwardly converging air stream so as to be directed at a small angle on to the surface and form a wall jet with it; WO 88/07980 is an example of such an arrangement.

It is desirable in the invention that the air flow has a wall jet, and this can easily be established by identifying the velocity profile adjacent to the surface. When a wall jet exists, the greatest velocity is close (e.g., within 10mm) to the surface both at the rear edge (16) of the rotor and at the front edge (17) of the rotor.

Binder sprays 18 are mounted as a central nozzle on the front face of each rotor and eject binder into the fibres that are blown off the rotor. Instead of or in addition to this, separate binder sprays may be provided, for instance beneath or above the set of rotors and directed substantially axially.

35 The collecting chamber comprises a pit 20 having a double screw 21 that collects pearls and other fibre that drops into the pit and recycles them to the melt chamber.

A conveyor 22 collects the fibres and carries them away from the spinners. Air is forced through a secondary air ring, for instance a plurality of orifices 23 arranged around the front face of the housing 2 and/or in and/or
5 beneath the front face of the housing 2. The secondary air ring provides an axial air stream to promote the axial transport of the fibres away from the rotors and to control their rate of settlement and the intermixing with binder.

It will be seen from Figure 3 that the inner edge 24
10 of the annular slot has substantially the same diameter as the outer edge of the periphery of rotor 6 and that the blades 25 are arranged substantially radially across the slot. Of course, if desired, they may be arranged at an angle. The leading edge of the blades is shown as 25, and
15 the side face the blades is shown as 26. In Figure 3, position X corresponds approximately to position C in Figure 1, i.e., where the blades are arranged at about 42°, position Y corresponds to position B, i.e., where the blades are arranged at around 20°, and position A
20 corresponds to position Z, i.e., where the blades are at 0° and thus promote truly axial flow of the air.

42°, or thereabouts, is the preferred angle for the blades as, in practice, it provides a tangential air flow through the slot that is at least half of the tangential
25 velocity of the rotor, and so optimises the formation of fibres in the region of, for instance, B to C on rotor 6. For instance a typical peripheral velocity of the rotor 6, is from 80 to 120 metres per second; a typical air velocity through the slot is 80 to 140 or 200 metres per
30 second: a typical axial component of the air velocity is 50 to 130 metres per second; and a typical tangential component of the air velocity is 50 to 120 metres per second. In fact, when the air velocity through the slot is 80 to 140 metres per second and the blades are at about 42°
35 the axial component of the velocity is 60 to 104 metres per second and the tangential component is about 53 to 94 metres per second.

The rotors can all be of conventional size, typically having diameters in the range 180 to 400mm, with rotor 4 generally being smallest, rotor 5 generally being in the range 220 to 300mm and rotors 6 and 7 generally being in the range 300 to 400mm. The width of the slot is generally in the range 5 to 40, generally around 5 to 20, mm.

The described process gives a more uniform product (at both high and low fibre densities) and allows a significant increase in production capacity.

Although only a single air inlet 23 is illustrated in Figure 2, there may be a plurality of individually mounted air slots mounted beneath the rotors that direct air in a generally forward direction.

In Figure 4, the reference numbers indicate the same features of the apparatus as Figures 1-3. Separate air channels 30 are provided for each set of rotors, and lead from the melt furnace.

Although we have referred above to a single air slot, the air slot can consist of inner and outer slots, wherein the inner slot provides an inner blast of air that is sufficiently close to the surface to form a wall jet and the outer slot provides an outer blast of air that merges with the inner blast so as to give a wall jet effect to the combined blasts. Generally the inner surface of the outer slot is not more than 20 or 30 mm radially from the surface of the rotor and generally it is within 10mm. Preferably the inner and outer blasts have different angles of travel at the time of exiting from their slots. For instance the inner blast can be wholly axial and the outer slot can contain the deflection means to cause the outer blast to have the desired tangential component.

The following is an example of the apparatus according to the present invention:

A fiberising chamber has a width of 1.8 -2.0 metres, and mounted therein is a set of four rotors, numbered according to the drawings as 5, 6 and 7. Details of the sizes of the rotors, their velocities, and the velocities

of air used are set out in Table 1. All air velocities are measured by a hot-wire technique.

TABLE 1

5

10

Wheel	RPM	Diameter of rotor (mm)	V periph rotor (m/s)	V tang air (m/s)	V air slot (m/s)	Blade angles
5	5500	250	72	65	140	α 24°
6	6500	330	111	0 - 65 65 - 82	140	α_{AB} 0-24° α_{BC} 24-42°
7	7000	330	120	0 - 65 65 - 82	140	α_{DE} 0-24° α_{EF} 25-42°

V periph rotor = peripheral velocity of rotor

V tang air = tangential velocity of air

V air slot = velocity of air through the slot

15

The amount of melt consumed; the yield of wool produced; and the loss of wool and the amount of unfiberised material on the screw were measured over a eight hour period and the mean-values of each of these are set out below.

20

The amount of melt consumed (or melting capacity):
7000 kg/hour.

Yield of wool: 87%

Loss of wool and amount of unfiberised material on the screw: 910 kg/hour.

25

The following is a Comparative Example detailing spinning apparatus for the production of mineral wool which does not have the graduated angle arrangement of the present invention.

30

A fiberising chamber has a width of 1.8- 2.0 metres and has a set of four rotors mounted therein. Three of these rotors are fiberising rotors, which are denoted as 5, 6 and 7 in Table 2, in compliance with the Example of the invention described above. Table 2 shows details of the

rotors and the air velocities. All air velocities are measured by a hot-wire technique.

TABLE 2

5

10

Rotor	RPM of rotor	Diameter of rotor (mm)	V periph rotor (m/s)	V tang air (m/s)	V air slot (m/s)	Blade angles
5	5500	250	72	65	140	24°
6	6500	330	111	73	140	36°
7	7000	330	120	82	140	42°

The abbreviations for the velocities are the same as for Table 1.

15 Production data was again obtained over an eight hour period, and mean-values calculated; these are set out below. Amount of melt (or melting capacity) 5000 kg/hour.

Yield of wool: 76%

20 Loss of wool and amount of unfiberised material in the screw: 1200 kg/hour.

In summary, the apparatus according to the invention achieves a higher effectivity with a higher capacity, and a results in a lower loss of wool and unfiberised material as compared to the apparatus embodied in the Comparative Example.

25 Both sets of apparatus result in a mineral wool having 29 -33% shot size greater than 63 μ m. However, the product obtained from the apparatus according to the invention is visually more homogeneous, with fewer wool-tufts having no binder in them; this is due to a better distribution of the binder achieved by the apparatus of the invention.

30

CLAIMS

1. Apparatus for the formation of mineral wool fibres comprising
- 5 a housing (3) having a front face (2),
a set of rotors (1) each mounted on the front face of the housing for rotation about a different substantially horizontal axis and arranged such that when the rotors are rotating mineral melt that is poured on to the periphery of
- 10 the top rotor in the set is thrown on to the periphery of the subsequent rotor, or each subsequent rotor in sequence, in the set and mineral wool fibres are thrown off the or each subsequent rotor,
- means for collecting the mineral wool fibres
- 15 comprising, associated with the or each subsequent rotor, an air supply slot (8, 9, 10) extending through the front face of the housing around and close to that rotor (5, 6, 7) for discharging an air blast close to and substantially parallel to the periphery of the rotor with an axial
- 20 component for carrying the mineral wool fibres axially off that periphery, and
- direction means for selecting the angle of the discharged air relative to the axial direction,
- characterised in that
- 25 the direction means (25) in at least the slot associated with the final rotor (7) in the set are arranged to direct the air at an angle to the axial direction that varies along the length of the slot between a higher angle that is corotational with the rotor and a lower angle.
- 30 2. Apparatus according to claim 1 in which each of the said slots (8, 9, 10) extends around part only of the peripheral surface of its associated rotor (5, 6, 7) and does not extend substantially between that rotor and the adjacent subsequent rotor.
- 35 3. Apparatus according to claim 2 in which the final rotors (6, 7) in the set comprise a pair of counter-rotating rotors that rotate in a direction such that the

tangents of rotation of the closest parts of the rotors extend downwardly, and the said lower angle is in the part of each of the slots where the said tangents of rotation extend downwardly.

5 4. Apparatus according to claim 3 in which the set of rotors (1) consists of an initial rotor (4) and three subsequent rotors (5, 6, 7) and the direction means (25) are arranged to direct the air at an angle to the axial direction that varies along the length of the slots (9, 10) associated with each of the third and fourth rotors.

10 5. Apparatus according to any preceding claim including means for spraying a binder on to the fibres as they are carried axially off the or each rotor.

6. Apparatus according to claim 7 in which the means for spraying binder comprise a binder spray (18) mounted coaxially with the rotor.

15 7. Apparatus according to any preceding claim in which the means for collecting the mineral wool fibres comprise a conveyor (22) that carries them away from the set of rotors (1).

8. Apparatus according to claim 7 in which there is a pit (20) in front of the set of rotors (1) and before the conveyor (22), and there are means for recycling (21) to a melting furnace the shot and wool that collects in the pit.

25 9. Apparatus according to any preceding claim in which the higher angle is from 30 to 50° and the lower angle is at least 10° less.

10. Apparatus according to claim 9 in which the lower angle is 10 to 25° and is corotational with the rotor.

30 11. Apparatus according to claim 9 in which the lower angle is from 0 to 10° and is corotational with the rotor.

12. Apparatus according to any preceding claim wherein the air slot (8,9,10) comprises an inner slot close to the surface of the rotor and an outer slot which is no greater

35 than 30 mm radially outwards from the surface of the rotor.

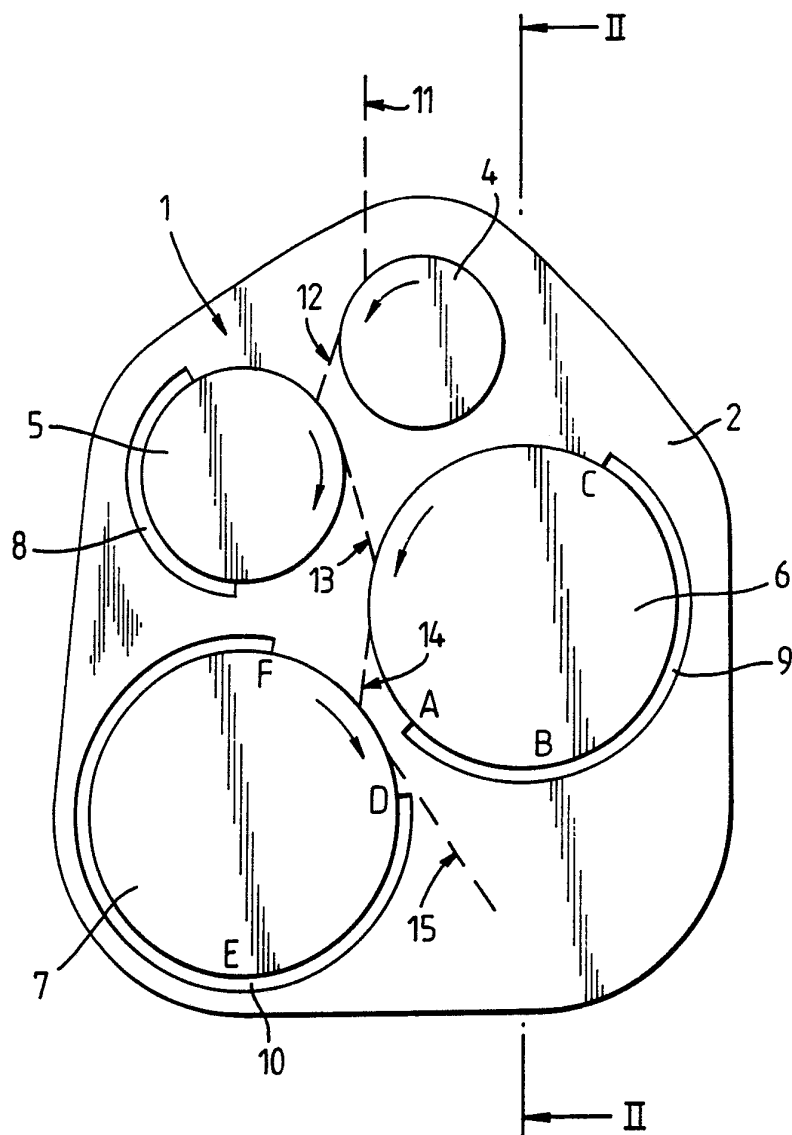
13. Apparatus for the formation of mineral wool fibres comprising a plurality of fiberising means as defined in

any preceding claim and which are arranged in side by side relationship characterised in that each set of rotors is substantially identical in each of the fiberising means.

14. A process for the formation of mineral wool fibres
5 characterised in that it comprises use of apparatus according to any preceding claim and comprises pouring melt on to the top rotor in a set of rotors (1) while all the rotors (4, 5, 6, 7) are rotating and air is being forced through the slots (8,9,10) and collecting the mineral wool
10 fibres.

1/3

Fig. 1.



2/3

Fig. 2.

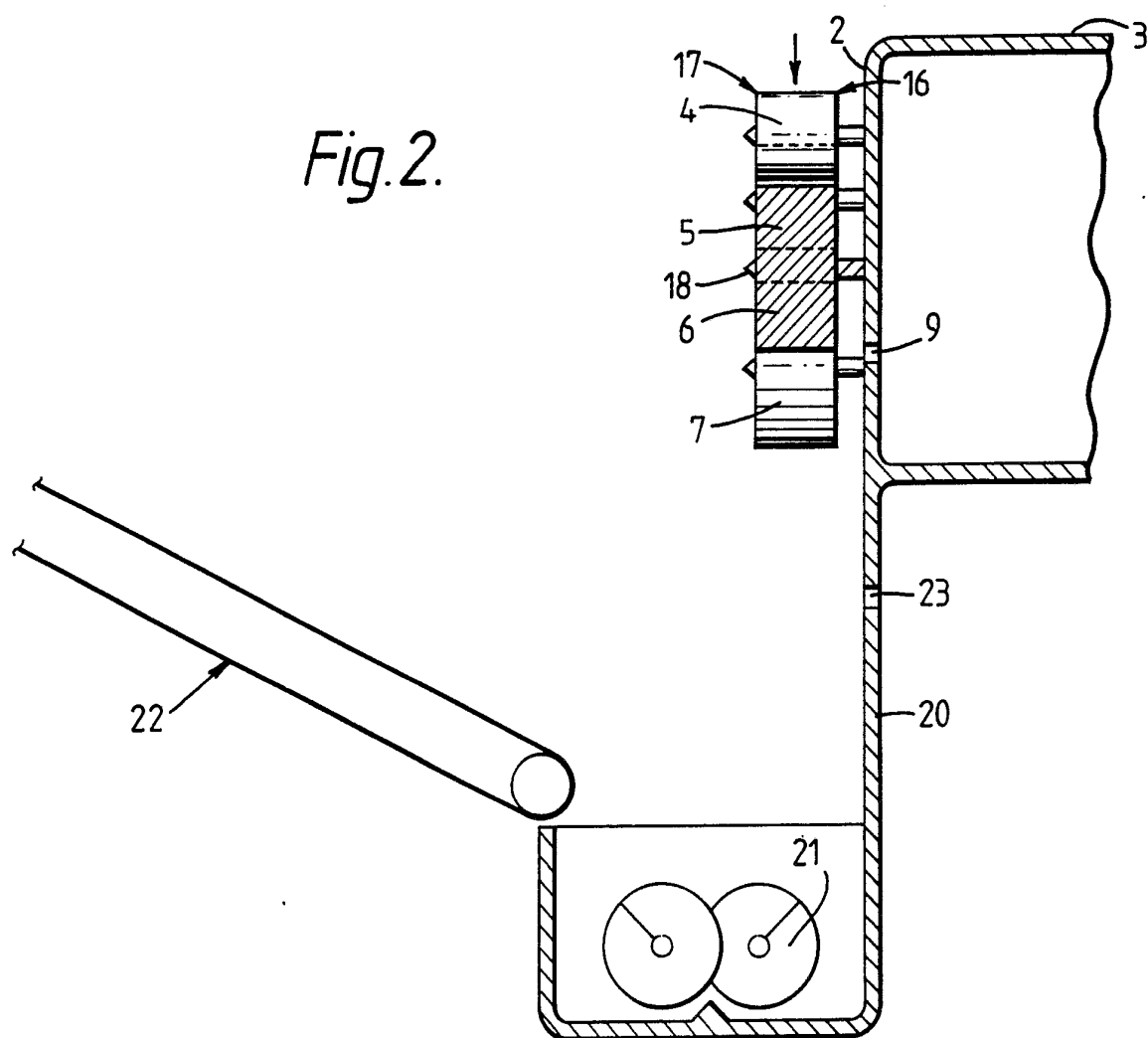
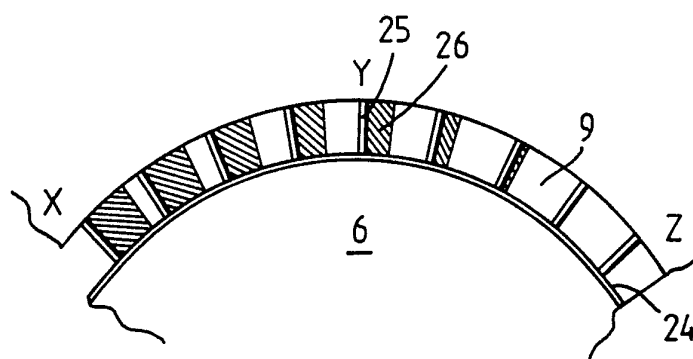
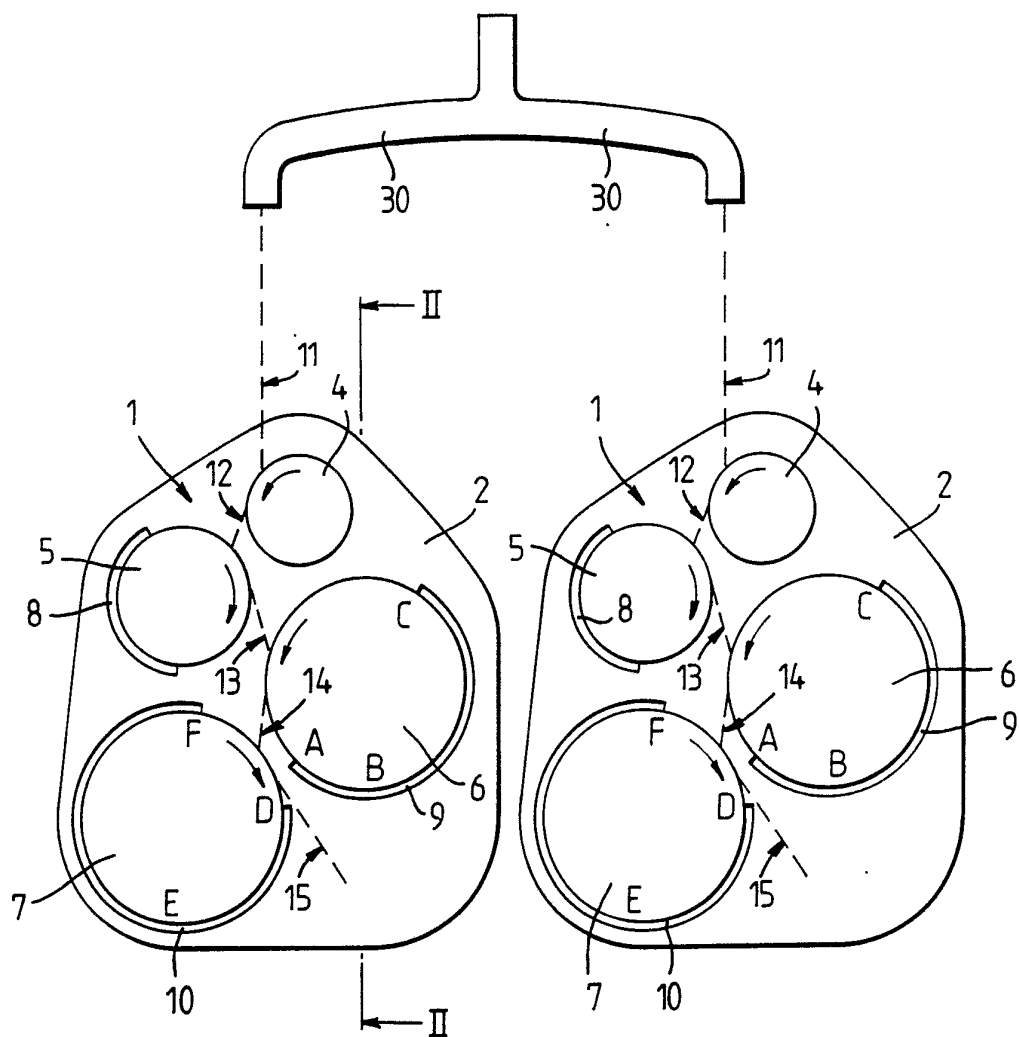


Fig. 3.



3/3

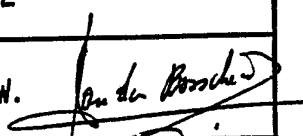
Fig. 4.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 91/01862

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 C03B37/05		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	C03B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	WO,A,8 807 980 (OYPARTEK) 20 October 1988 see the whole document ---	14
X	FR,A,2 322 114 (ROCKWOOL INTERNATIONAL) 25 March 1977 see the whole document ---	14
A	FR,A,2 106 430 (ERIKSEN) 5 May 1972 see the whole document ---	1
A	GB,A,867 299 (HENDRIKSEN) 3 May 1961 see the whole document ---	1
P,X	EP,A,0 439 385 (ISOVER SAINT-GOBAIN) 31 July 1991 see the whole document ---	1,14
¹⁰ 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 "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		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
02 JANUARY 1992	21. 01. 92	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	VAN DEN BOSSCHE W. 	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. EP 9101862
SA 51621**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 02/01/92

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
WO-A-8807980	20-10-88	AU-B-	610163	16-05-91
		AU-A-	1576888	04-11-88
		EP-A-	0354913	21-02-90
		JP-T-	2502904	13-09-90

FR-A-2322114	25-03-77	AT-B-	371082	25-05-83
		AU-A-	1737776	09-03-78
		BE-A-	845718	16-12-76
		CA-A-	1079069	10-06-80
		CH-A-	610871	15-05-79
		DE-A,C	2638412	10-03-77
		GB-A-	1559117	16-01-80
		JP-A-	52031174	09-03-77
		NL-A-	7609744	03-03-77
		SE-B-	416295	15-12-80
		SE-A-	7604304	02-03-77
		US-A-	4105425	08-08-78

FR-A-2106430	05-05-72	CA-A-	972158	05-08-75
		DE-A-	2144682	02-08-73
		NL-A-	7112338	14-03-72
		US-A-	3709670	09-01-73

GB-A-867299		DE-B-	1089522	

EP-A-0439385	31-07-91	FR-A-	2657077	19-07-91
		AU-A-	6934091	18-07-91
