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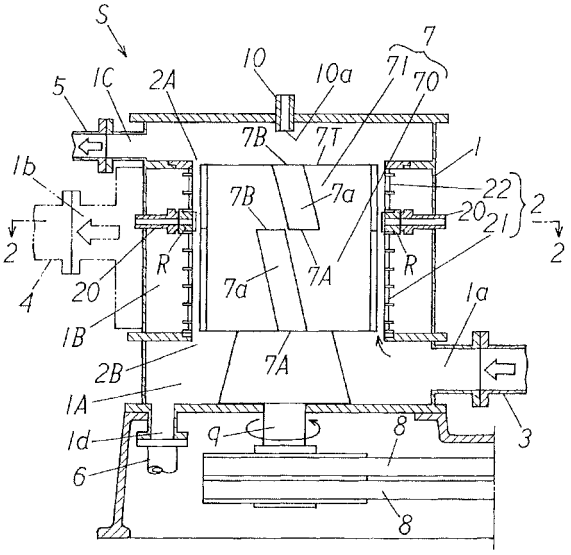
(54) Screen apparatus

(57) This invention provides a screen apparatus having an enhanced capacity for separating foreign matter from fibers of an acceptable quality in paper-making material. The screen apparatus S comprises: a sealed casing 1 having a paper-making material supply port 1a, a refined paper-making material discharge port 1b positioned above the paper-making material supply port 1a and a foreign matter discharge port 1c positioned above the refined paper-making material discharge port 1b; a screen 2 for dividing the interior of the sealed casing 1 into a first chamber 1A and a second chamber 1B and for separating foreign matter in the paper-making material, the screen being of cylindrical shape with end portions both open, the screen having circular holes or slit-like openings on a side face thereof and which screen is stood within the sealed casing 1 in such a way that a direction of height thereof faces a vertical direction;
a rotor 7 disposed inside the screen 2 within the first chamber 1A and having an agitating member 7a for agitating the paper-making material within the sealed casing 1; and a water supply passage 10 mounted onto the sealed casing 1 so that a water spouting port 10a opposes the top end face 7T of the rotor 7.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a screen apparatus for refining a paper-making material by feeding it outward of the screen from the inside thereof, and more particularly to a screen apparatus whose capacity for separating foreign matter from fibers in the paper-making material that are acceptable in the quality has been enhanced.

2 . Description of Related Art

[0002] Conventionally, in a so-called "outward type" screen apparatus (centrifugal type) which refines, for example, paper-making material by feeding it outward of the screen from the inside thereof, a paper-making material loaded within the screen is agitated by means of an agitating member provided on the screen, and then foreign matter in the paper-making material is removed through the screen so as to refine the paper-making material (see, for example, patent document 1).
Patent document 1: Japanese Patent Application Laid-Open No.2004-137621 (FIG. 1)

[0003] However, in such a "screen apparatus having a cylindrical screen whose end portions are both open" , no component exists for obstructing the flow of the paper-making material downstream from an end portion at which the screen is open, and thus the paper-making material is discharged out of the casing. Accordingly, from the viewpoint of enhancing efficiency in separation on the part of the screen there has been room for improvements.

SUMMARY OF THE INVENTION

[0004] The present invention sets out to provide a screen apparatus which eliminates the problem described above.

[0005] To achieve the above object, a first aspect of the present invention provides a screen apparatus comprising :a sealed casing having a paper-making material supply port, a refined paper-making material discharge port positioned above the paper-making material supply port and a foreign matter discharge port positioned above the refined paper-making material discharge port; a screen for dividing the interior of the sealed casing into a first chamber and a second chamber and for separating foreign matter existing in the paper-making material, the screen being of a cylindrical shape and with end portions that are both open, the screen having circular holes or slit-like openings on a side face thereof and stood within the sealed casing in such a way that a direction of height thereof faces a vertical direction, both open end portions of the screen having an upper opening portion and a lower opening portion with the upper opening portion positioned below the foreign matter discharge port and the lower opening portion positioned above the paper-making material supply port; a paper-making material supply passage connected to the paper-making material supply port in order to supply paper-making material to a first chamber from a downward direction; a rotor disposed inside the screen within the first chamber and having an agitating member for agitating the paper-making material within the sealed casing; a refined paper-making material discharge passage connected to the refined paper-making material discharge port and also connected to the second chamber so as to guide paper-making material that has been refined out of the sealed casing via the screen; a foreign matter discharge passage connected to the foreign matter discharge port and also connected to the first chamber so as to guide out of the sealed casing foreign matter existing in the paper-making material and which does not pass through the screen; and a water supply passage mounted onto the sealed casing so that a water spouting port opposes the top end face of the rotor.

[0006] According to a second aspect of the invention in the first aspect , a ring portion provided at a midway position on the screen, the screen being divided by the ring portion into an upstream screen portion and a downstream screen portion, the ring portion being provided with a diluted water introduction port for introducing diluted water into the first chamber; a diluted water passage provided via the sealed casing and connected to the diluted water introduction port; and an uneven portion provided on a side opposing a rotor of the ring portion, wherein a convex portion of the uneven portion is provided so as to project from an inside wall face of the screen, and the uneven portion has a front end portion of the convex portion and a rear end portion of the convex portion that relative to a vertical direction of the casing is positioned lower than the front end portion of the convex portion, and which front end portion is tilted in such a way that relative to a rotational direction of the rotor the front end portion of the convex portion is nearer the rear end portion of the convex portion.

[0007] According to a third aspect of the invention ,in the first aspect , a ring portion provided at a midway position on the screen, the screen being divided by the ring portion into an upstream screen portion and a downstream side screen portion, the ring portion being provided with a diluted water introduction port for introducing diluted water into the first chamber; a diluted water passage provided via the sealed casing and connected to a diluted water introduction port; and an uneven portion provided on a side opposing a rotor of the ring portion, wherein a convex portion of the uneven portion is provided not to project from an inside wall face of the screen and the uneven portion has a front end portion of the convex portion and a rear end portion of the convex portion that relative to a vertical direction of the casing is positioned lower than the front end portion of the convex

portion, and which front end portion is tilted in such a way that relative to a rotational direction of the rotor the front end portion of the convex portion is located nearer than the rear end portion of the convex portion.

[0008] Because the screen apparatus of the first aspect includes a water supply passage that is mounted on the sealed casing in such a way that a water spouting port opposes the top end face of the rotor, water colliding with the top end face of the rotor flows in a substantially horizontal direction, thereby hampering the flow of a paper-making material processing toward the refined paper-making material discharge port from the opening portion at the top of the screen. In other words, this action forces back upstream of the first chamber fibers, which were flowing out to the foreign matter discharge port by reject sealing, thereby enhancing the capacity of the screen apparatus for separating foreign matter from fibers of an acceptable quality contained in the paper-making material.

[0009] In the screen apparatus of the second aspect, in addition to the effects of the invention of the first aspect, diluted water from the diluted water introduction port acts to hamper the flow of a paper-making material flowing downstream, thereby enhancing the capacity of the screen apparatus for separating foreign matter from fibers of an acceptable quality contained in the paper-making material. Further, the paper-making material passes through the screen upstream and a paper-making material whose density has been intensified is diluted with diluted water so as to enhance the capacity of the screen apparatus for separating fibers of an acceptable quality. Further, the convex portion of an uneven portion provided on the side facing the rotor of the ring portion is tilted in such a way that relative to the rotational direction of the rotor a front end portion of the convex portion is positioned closer than the rear end portion of the convex portion. Consequently, pieces in the paper-making material that have not yet melted and that collide with the convex portion are not only separated but also brought back upstream of the paper-making material, thereby further enhancing the capacity of the screen apparatus for separating foreign matter from fibers of an acceptable quality that are contained in the paper-making material.

[0010] In the screen apparatus of the third aspect, in addition to the effects of the invention of the first aspect, diluted water from the diluted water introduction port acts to hamper the flow of a paper-making material flowing downstream, thereby enhancing the capacity of the screen apparatus for separating foreign matter from fibers of an acceptable quality that are contained in paper-making material. Further, the paper-making material passes through the screen upstream and a paper-making material whose density has been intensified is diluted with diluted water so as to enhance the capacity of the screen apparatus for separating fibers of an acceptable quality. Further, the convex portion of the uneven portion provided on the side facing the rotor of the ring portion is tilted in such a way that relative to the rotational direction of the rotor a front end portion of the convex portion is positioned closer than the rear end portion of the convex portion. Consequently, pieces in the paper-making material that have not yet melted and that collide with the convex portion are not only separated but also brought back upstream of the paper-making material, thereby further enhancing the capacity of the screen apparatus for separating foreign matter from fibers of an acceptable quality that are contained in the paper-making material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a schematic sectional view of a screen apparatus according to an embodiment of the present invention;

FIG. 2 is a schematic sectional view taken along the line 2-2 of FIG. 1;

FIG. 3 is a schematic view of a screen in the vicinity of a ring portion as seen from the inside of the screen;

FIG. 4 is a schematic partially enlarged sectional view showing part of FIG. 1 in enlargement;

FIG. 5 is a schematic sectional view taken along the line 5-5 of FIG. 4;

FIG. 6 is a schematic sectional view of a screen apparatus according to another embodiment different from FIG. 1;

FIG. 7 is a schematic plan view of a rotor of FIG. 6;

FIG. 8 is a schematic partially enlarged sectional view showing part of FIG. 6 in an enlarged form;

FIG. 9 is a schematic partial sectional view of a screen apparatus according to another embodiment that is different from FIG. 8;

FIG. 10 is a schematic partial sectional view of a screen apparatus according to another embodiment that is different from FIG. 5;

FIG. 11 is a schematic partial sectional view of a screen apparatus according to another embodiment that is different from FIG. 4; and

FIG. 12(a) is a schematic sectional view taken along the line 12-12 of FIG. 11, and FIG. 2(b) is a view of a ring portion of FIG. 12(a) as seen from the inside of the screen.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] An embodiment of the screen apparatus of the present invention will be described with reference to the accompanying drawings.

With reference to FIGS. 1-5, symbol S denotes a screen apparatus that has a sealed-type casing 1 including a paper-making material supply port la, a refined paper-making material discharge port 1b located above the paper-making material supply port 1a, a foreign matter discharge port 1c located above this refined paper-making material discharge port 1b and a heavy foreign matter discharge port 1d.

This screen apparatus S is a so-called "outward type" screen apparatus (centrifugal type) which refines a paper-making material by feeding it outward from inside of the screen 2 in order to remove foreign matter (for example, plastics) contained in the paper-making material (for example, old newspapers and old corrugated board).

[0013] The interior of the sealed-type casing 1 is divided by a screen 2 into a first chamber 1A and a second chamber 1B.

This screen 2 is intended to separate foreign matter in the paper-making material. The screen 2 is of a cylindrical shape, its end portions are both open, its side face has circular holes or slit-like opening portions and it is stood within the sealed casing 1 in such a way that the direction of its height faces a vertical direction. Both open end portions of the screen 2 include an upper opening portion 2A and a lower opening portion 2B. As shown in FIG. 1, the upper opening portion 2A is located below the foreign matter discharge port 1c and the lower opening portion 2B is located above the paper-making material supply port 1a.

Symbol R shown in FIGS. 1-5 denotes a ring portion provided midway on the screen 2, the screen 2 is divided into an upstream screen portion 21 and a downstream screen portion 22 by this ring portion R and the ring portion R has diluted water introduction ports R1 (for example, a plurality of) for purposes of introducing diluted water into the first chamber 1A.

Reference numeral 20 denotes a diluted water passage for introducing diluted water, a passage which is connected with the diluted water introduction port R1 and is provided via the sealed casing 1. A face of the ring portion R that faces the rotor 7 includes convex portions RT that project from the face of the screen 2 and concave portions RO (see FIGS. 3, 5).

[0014] A convex portion RT provided on a side facing the rotor 7 of the ring portion R in such a way that it projects from the face of the screen 2 has a front end portion X of the convex portion and a rear end portion Y of the convex portion that is positioned at a lower position relative to the vertical direction than the front end portion X of the convex portion, and that is tilted in such a way that relative to the rotational direction of the rotor 7 (see the direction of an arrow in FIG. 3) the front end portion X of the convex portion is positioned closer than the rear end portion Y of the convex portion. The inclination angle is, for example, 3° and 45°.

As a result, pieces contained in a paper-making material that have not yet melted and that collide with the convex portion RT are not only separated but are also made to return upstream of the paper-making material, and in consequence the effect of separation between foreign matter and acceptable fibers in the paper-making material.

The aforementioned convex portion RT and a concave portion RO could also be described as an uneven face provided on a side facing the rotor 7 of the ring portion R. The convex portion RT of this uneven face is provided to project from the inner wall face of the screen 2 and has the front end portion X and a rear end portion Y that is positioned lower than the front end portion relative to the vertical direction of the casing 1. The convex portion RT is tilted in such a way that relative to the rotational direction (see the direction of arrow in FIG. 3) of the rotor 7 the front end portion of the convex portion RT is located nearer the rear end portion Y of the convex portion RT.

[0015] Reference numeral 3 in FIG. 1 denotes a paper-making material supply passage which is connected to the paper-making material supply port 1a in order to supply a paper-making material to the first chamber 1A from a downward direction. Reference numeral 4 denotes a refined paper-making material discharge passage connected to the refined paper-making material discharge port 1b in order to guide the refined paper-making material outside the sealed casing 1 via the screen 2. Reference numeral 5 denotes a foreign matter discharge passage that is connected to the first chamber 1A and that is also connected to the heavy foreign matter discharge port 1c in order to guide foreign matter (for example, relatively light foreign matter) existing in the paper-making material and which does not pass through the screen 2 outside the sealed casing. Reference numeral 6 denotes a heavy foreign matter discharge passage that is connected with the first chamber 1A and that is also connected to the heavy foreign matter discharge port 1d in order to guide relatively heavy foreign matter existing in the paper-making material and which does not pass through the screen 2 outside the sealed casing 1.

[0016] Reference numeral 7 denotes a rotor, which is disposed inside the screen 2 within the first chamber 1A and has on its outer periphery an agitating member 7a for agitating the paper-making material in the sealed casing 1. The rotor 7 has an upstream portion 70 on the upstream side and a downstream portion 71 on the downstream side and agitating members 7a provided on the outer peripheries of the upstream portion 70 and of the downstream portion 71 are tilted. The tilt is set in such a way that a bottom portion 7A of a substantially linear portion of the agitating member 7a advances more in the rotational direction of the rotor 7 than a top portion 7B. A rotation from the motor is transmitted via a belt 8 and a rotating shaft 9 so as to rotate the rotor 7.

Reference numeral 10 in FIG. 1 denotes a water supply passage provided on the sealed casing 1 in such a way that a water spouting port 10a opposes a top end face 7T (more preferably, in such a away that the water spouting port 10a opposes the center of the top end face 7T of the rotor 7).

[0017] Thus, when a paper-making material is supplied into the sealed casing 1 from the paper-making material supply passage 3 and a rotation of a motor (not shown) is transmitted through the belt 8 and the rotating shaft 9 so at to rotate the rotor 7, foreign matter in the paper-making material cannot pass through the screen 2 and is deposited within the first chamber 1A. The paper-making material which passes through the screen 2 is

guided into the sealed casing 1 through the second chamber 1B and the refined paper-making material discharge passage 4.

The flow of paper-making material proceeding downstream is hampered by diluted water supplied from the diluted water introduction port R1 midway on the screen 2, thereby enhancing the capacity of the screen apparatus for separating foreign matter in the paper-making material from fibers of an acceptable quality. Further, paper-making material passes through the screen 2 upstream so that paper-making material whose density has been intensified is diluted by diluted water so as to intensify the effects of separating fibers of an acceptable quality. Further, pieces that have not yet melted and that are contained in the paper-making material collide with the convex portions RT provided on the side facing the rotor 7 of the ring portion R are forced back upstream of the paper-making material, thus enhancing the effects of separating foreign matter from fibers of an acceptable quality in the paper-making material.

Because the water spouting port 10a of the first water supply passage 10 provided on the sealed casing 1 opposes the top end face 7T of the rotor 7 downstream of the screen 2 within the first chamber 1A, water colliding with the center of the top end face 7T of the rotor 7 flows in a substantially horizontal direction so as to hamper the flow of the paper-making material proceeding toward the foreign matter discharge port 1c from the opening portion 2A above the screen 2. In other words, this action forces back upstream of the first chamber 1A fibers, which were flowing out to the foreign matter discharge port 1cby reject sealing, thereby enhancing the capacity of the screen apparatus for separating foreign matter from fibers of an acceptable quality in the paper-making material.

The foreign matter discharge passage 5 and the heavy foreign matter discharge passage 6 are appropriately adjusted in degrees of opening, or are opened or closed, by valves (not shown) for opening and closing the passages so as to guide foreign matter deposited within the first chamber 1A out of the sealed casing 1.

[0018] Although according to the above-described embodiment, an end portion of the lower portion 7A of the agitating member 7a on the downstream side is extended up to a position opposing the diluted water introduction port R1 (see FIG. 1), the present invention need not restricted and, as shown in FIG. 6, it is permissible to eliminate the portion of the agitating member 7a that opposes the diluted water introduction port R1.

Although the top end face 7T of the rotor 7 is formed on a flat surface (see FIG. 1), the present invention need not be restricted to this example, and it is permissible to provide projections (scraping blades) 7Z, as shown in FIGS. 6-8, and change the flow direction of water from the water spouting port 10a to a horizontal direction with the use of centrifugal force by the projections (scraping blades) 7Z, thereby intensifying the effects of reject sealing described above. Further, the arrow shown in FIG. 7 indicates the rotational direction of the rotor 7.

It is permissible to provide a guide G for guiding water from the water spouting port 10a around the water spouting port 10a so as to guide water from the water spouting port 10a to the vicinity of the projections (scraping blades) 7Z so that the face of the guide G opposes the top end face 7T of the rotor 7.

Although an opening width W in the circumferential direction of the ring portion R of the concave portion R0 shown in FIG. 5 is set so as to be less than the length L of the flat face in the circumferential direction of the ring portion R of the convex portion RT, the present invention is not restricted to this example. As shown in FIG. 10, the opening width W in the circumferential direction of the ring portion R of the concave portion R0 may also be set so as to be greater than the length L of the flat face in the circumferential direction of the ring portion R of the convex portion RT.

[0019] Although in the embodiments described above the convex portion RT is provided so as to project from the face of the screen 2 to the side facing the rotor 7 of the ring portion R, the present invention need not be restricted to this example. As shown in FIGS. 11, 12, the convex portion RT of the uneven face may also be provided on the side facing the rotor 7 of the ring portion R in such a way that it does not project from the inside wall face of the screen 2. Because the type shown in FIGS. 11, 12 is the same as the one described in FIGS. 3-5, except that the convex portion RT is not projected from the face (inside wall) of the screen 2, identical reference numerals have been attached to the same components as those described in FIGS. 3-5, and a description thereof has accordingly partly omitted.

In other words, the convex portion RT has a front end portion X of the uneven portion and a rear end portion Y which relative to the vertical direction of the casing 1 is positioned at a position lower than the front end portion X of the convex portion RT and is tilted in such a way that relative to the rotational direction of the rotor 7 (see the direction of an arrow shown in FIG. 12(b)) the front end portion X of the convex portion RT is nearer than the rear end portion Y of the convex portion RT.

Further, a concave portion RO is located between adjoining convex portions RT and a plurality of each of the convex portions RT and of the concave portions RO are provided on the ring portion R.

The convex portion RT described in FIGS. 11, 12 can enhance the capacity of the screen apparatus for separating foreign matter from fibers of an acceptable quality in paper-making material like the convex portion RT described in FIGS. 3-5, because pieces that have not yet melted and that are in the paper-making material collide with the convex portion RT are not only separated but also brought back upstream of the paper-making material.

Claims

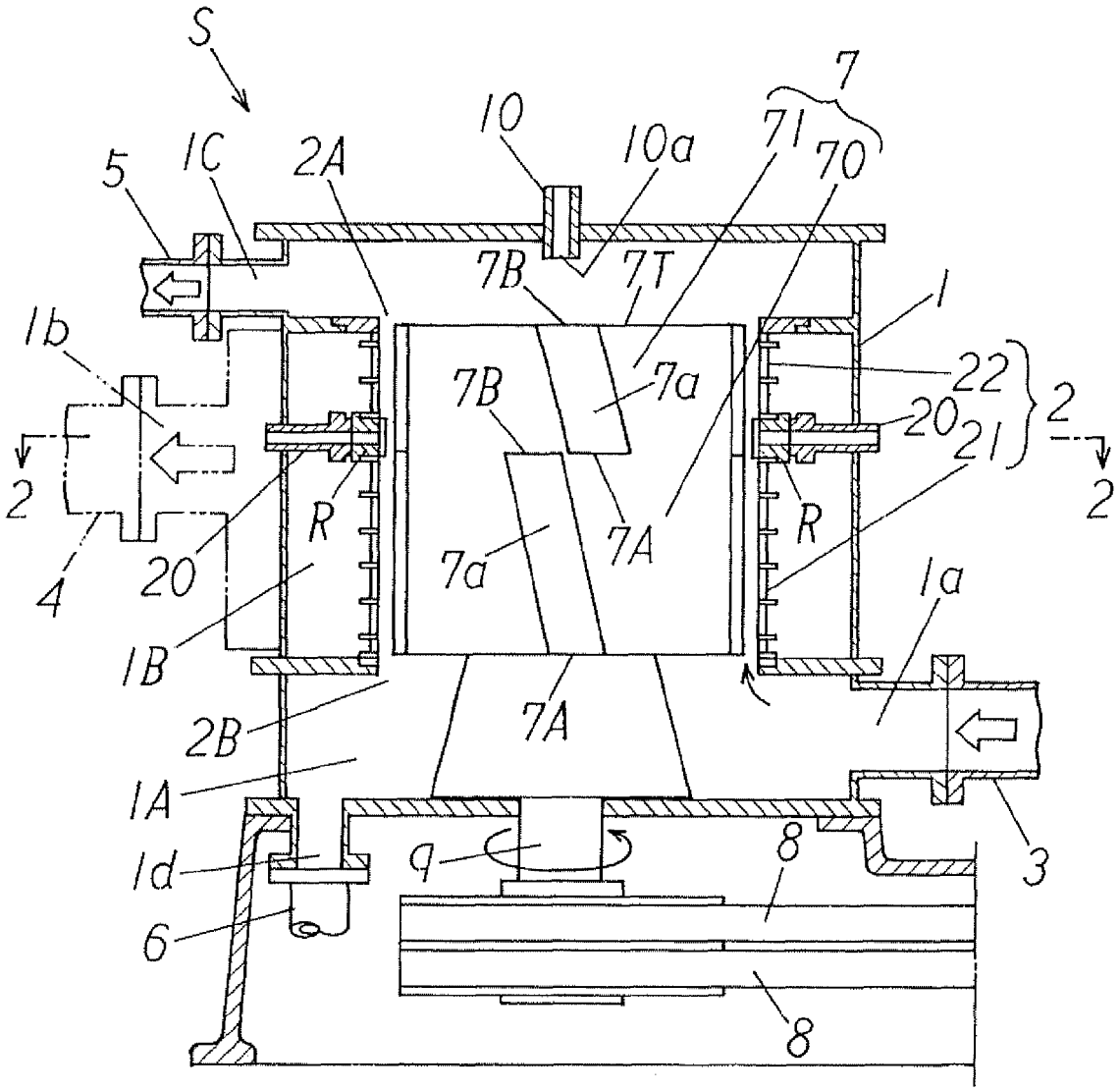
1. A screen apparatus comprising:

a sealed casing having a paper-making material supply port, a refined paper-making material discharge port positioned above the paper-making material supply port and a foreign matter discharge port positioned above the refined paper-making material discharge port;
a screen for dividing the interior of the sealed casing into a first chamber and a second chamber and for separating foreign matter existing in the paper-making material, the screen being of a cylindrical shape and with end portions that are both open, the screen having circular holes or slit-like openings on a side face thereof and stood within the sealed casing in such a way that a direction of height thereof faces a vertical direction, both open end portions of the screen having an upper opening portion and a lower opening portion with the upper opening portion positioned below the foreign matter discharge port and the lower opening portion positioned above the paper-making material supply port;
a paper-making material supply passage connected to the paper-making material supply port in order to supply paper-making material to a first chamber from a downward direction;
a rotor disposed inside the screen within the first chamber and having an agitating member for agitating the paper-making material within the sealed casing;
a refined paper-making material discharge passage connected to the refined paper-making material discharge port and also connected to the second chamber so as to guide paper-making material that has been refined out of the sealed casing via the screen;
a foreign matter discharge passage connected to the foreign matter discharge port and also connected to the first chamber so as to guide out of the sealed casing foreign matter existing in the paper-making material and which does not pass through the screen; and
a water supply passage mounted onto the sealed casing so that a water spouting port opposes the top end face of the rotor.

2. The screen apparatus according to claim 1 further comprising: a ring portion provided at a midway position on the screen, the screen being divided by the ring portion into an upstream screen portion and a downstream screen portion, the ring portion being provided with a diluted water introduction port for introducing diluted water into the first chamber; a diluted water passage provided via the sealed casing and connected to the diluted water introduction port; and an uneven portion provided on a side opposing a rotor of the ring portion,
wherein a convex portion of the uneven portion is provided so as to project from an inside wall face of the screen, and the uneven portion has a front end portion of the convex portion and a rear end portion of the convex portion that relative to a vertical direction of the casing is positioned lower than the front end portion of the convex portion, and which front end portion is tilted in such a way that relative to a rotational direction of the rotor the front end portion of the convex portion is nearer the rear end portion of the convex portion.

3. The screen apparatus according to claim 1 further comprising: a ring portion provided at a midway position on the screen, the screen being divided by the ring portion into an upstream screen portion and a downstream side screen portion, the ring portion being provided with a diluted water introduction port for introducing diluted water into the first chamber; a diluted water passage provided via the sealed casing and connected to a diluted water introduction port; and an uneven portion provided on a side opposing a rotor of the ring portion,
wherein a convex portion of the uneven portion is provided not to project from an inside wall, face of the screen and the uneven portion has a front end portion of the convex portion and a rear end portion of the convex portion that relative to a vertical direction of the casing is positioned lower than the front end portion of the convex portion, and which front end portion is tilted in such a way that relative to a rotational direction of the rotor the front end portion of the convex portion is located nearer than the rear end portion of the convex portion.

FIG. 1


S
7
10
10a
71
70
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1C
2A
7B
7T
1
1b
22
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7B
7a
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2
2
R
R
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7a
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1a
1B
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7A
1A
1d
q
8
3
6
8

FIG. 2

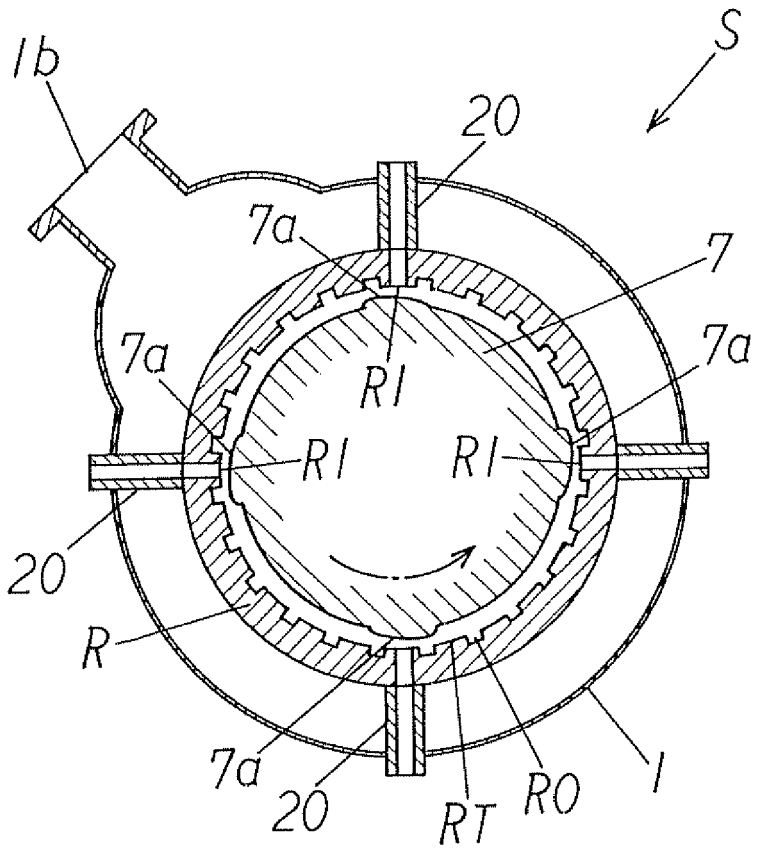


FIG. 3

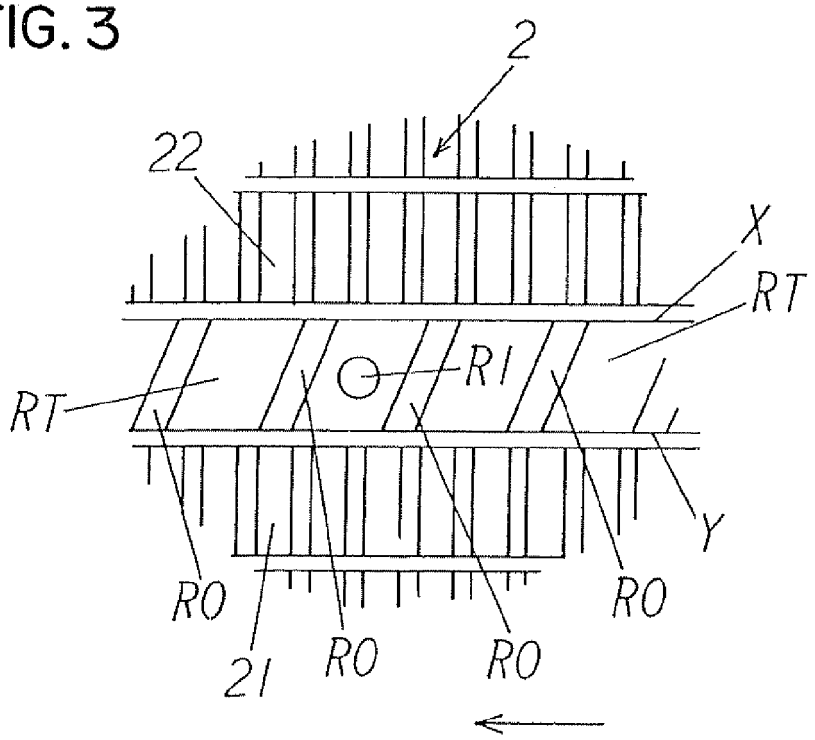


FIG. 4

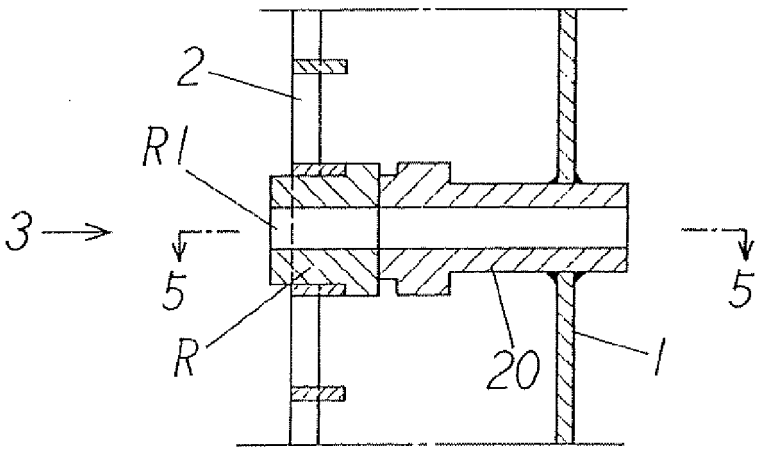


FIG. 5

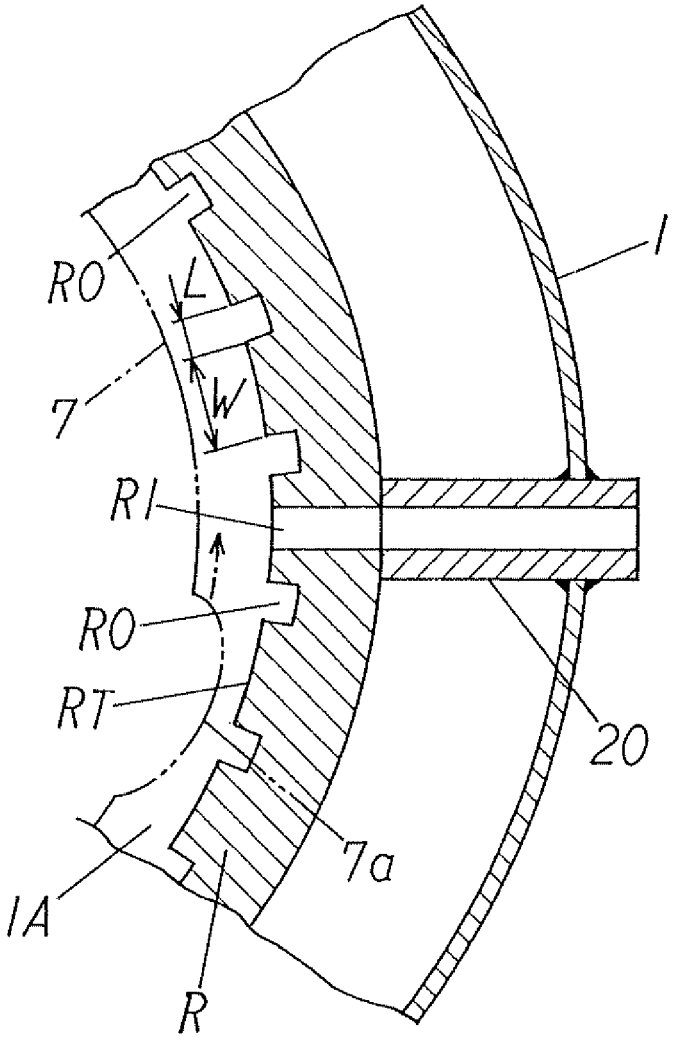


FIG. 6

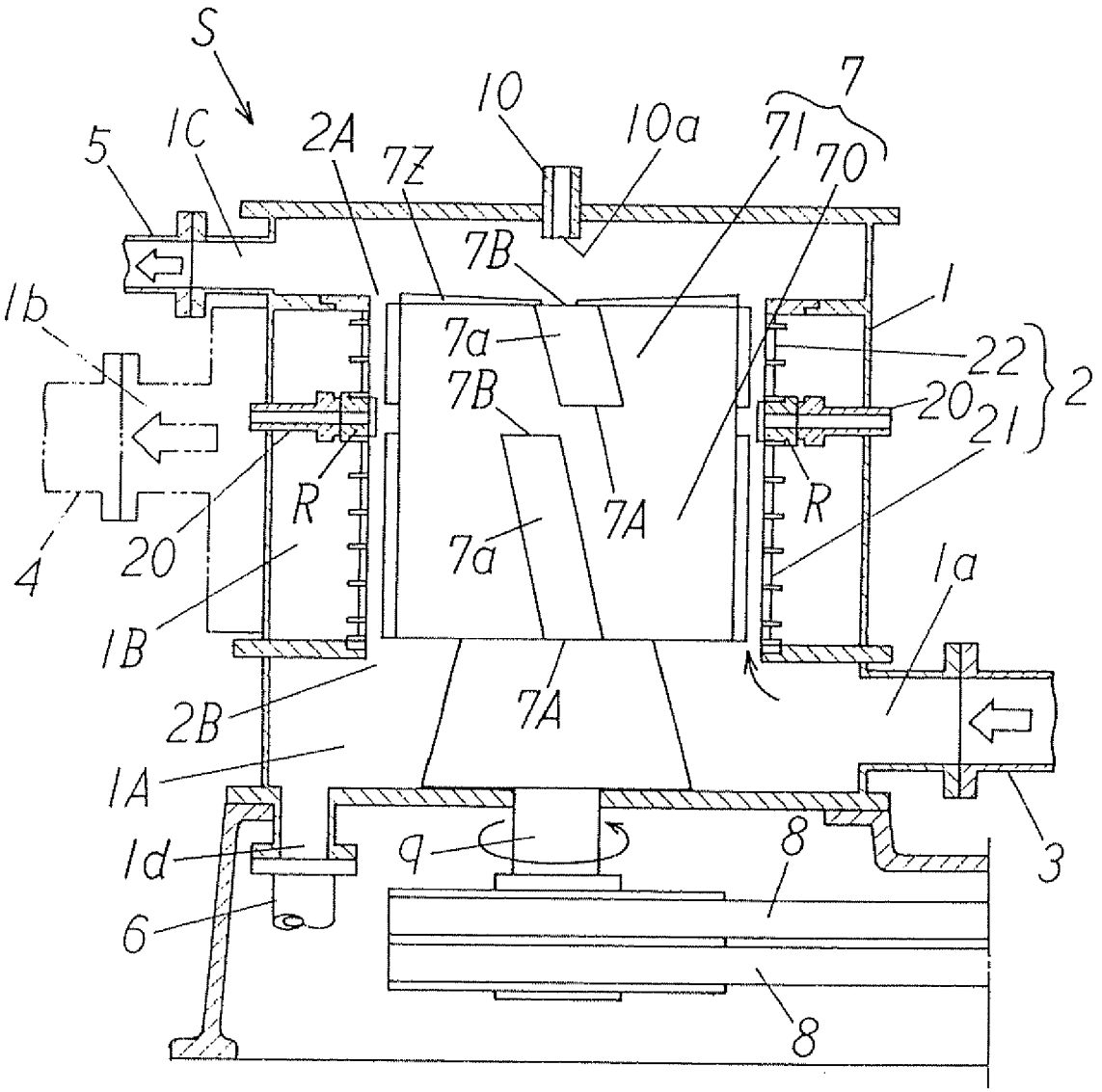

S
1C
2A
7Z
10
10a
7
71
70
5
7B
1
1b
7a
22
2
7B
20
21
R
7A
R
4
20
7a
1a
1B
2B
7A
1A
1d
9
8
3
6
8

FIG. 7

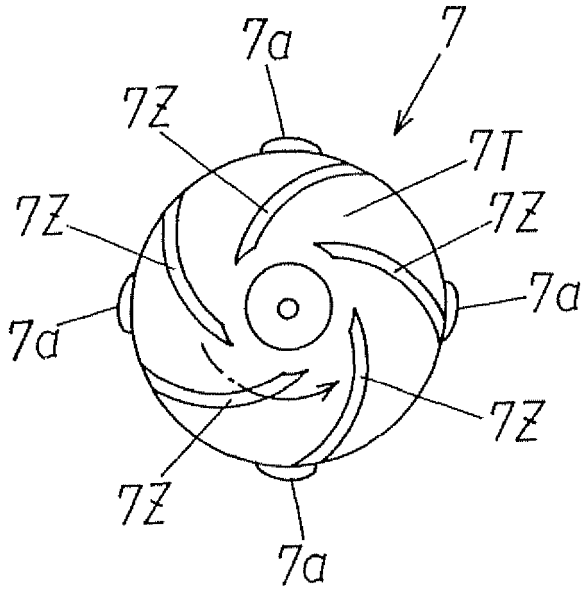


FIG. 8

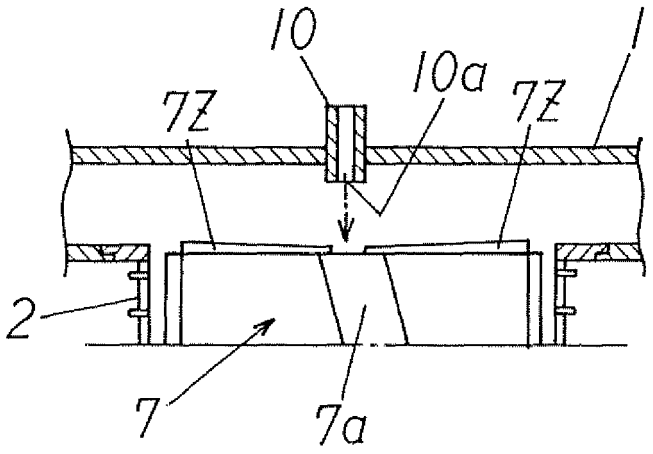


FIG. 9

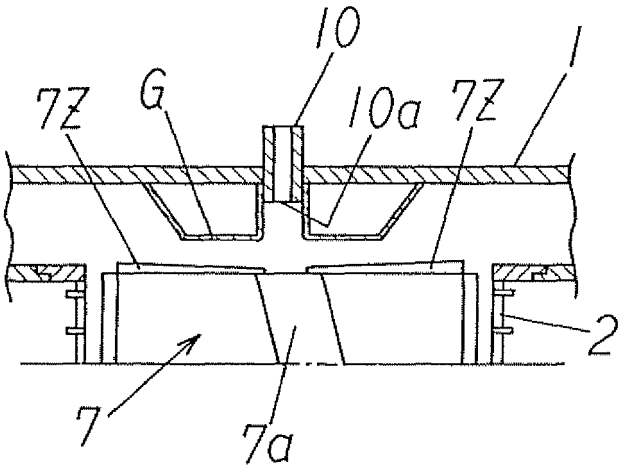


FIG. 10

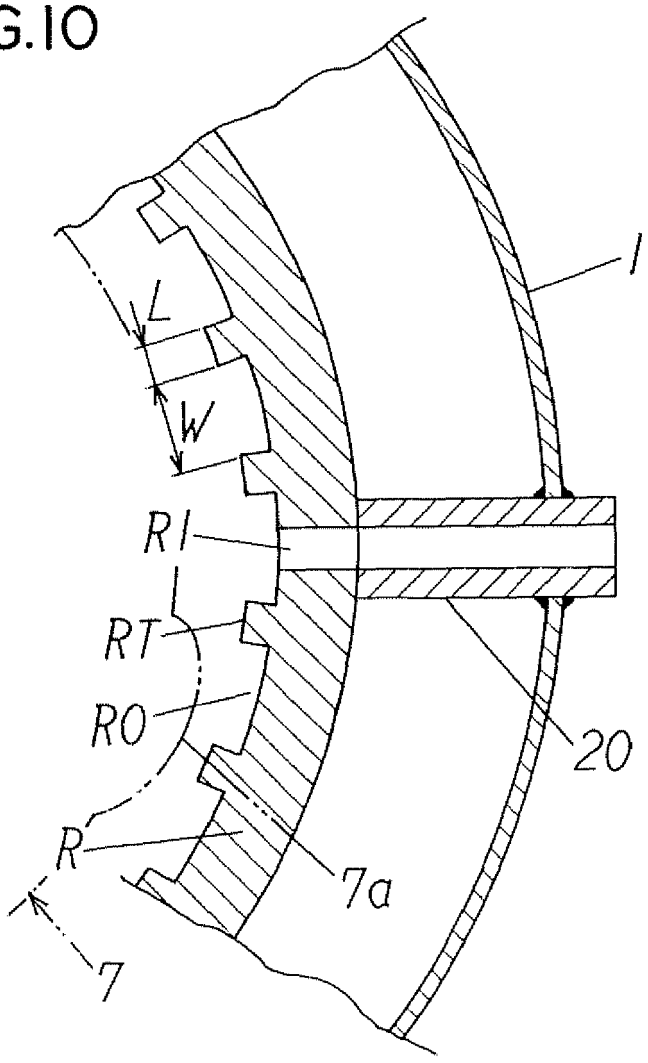


FIG. 11

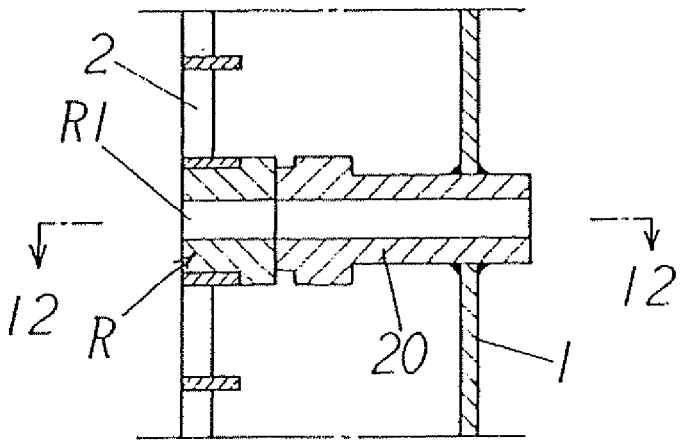
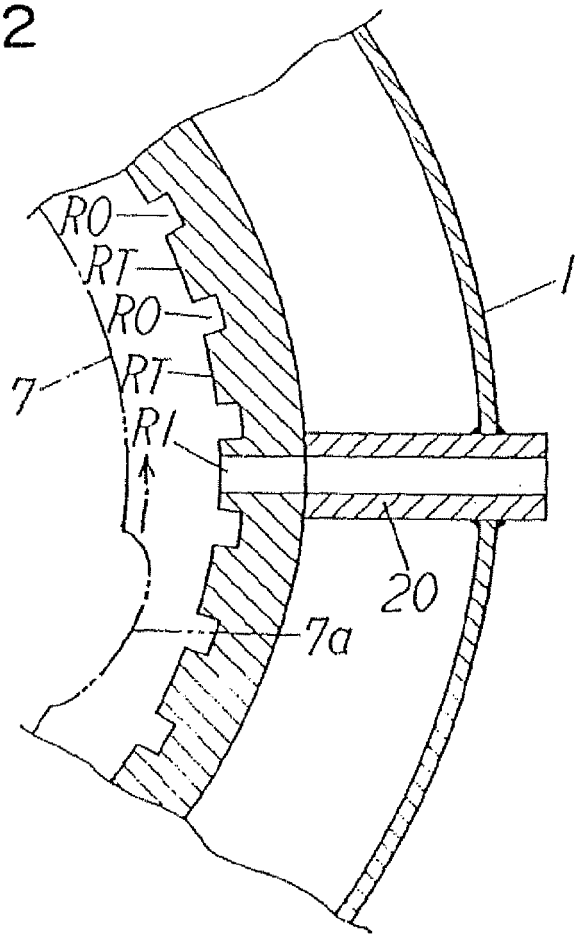
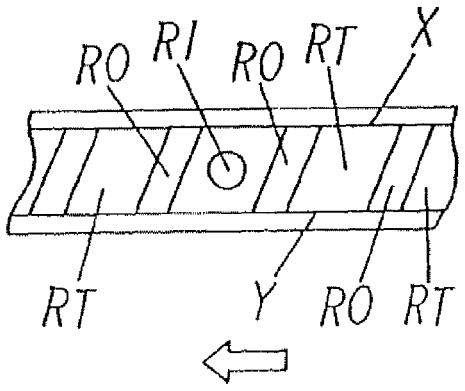


FIG. 12



(a)



(b)

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EUROPEAN SEARCH REPORT

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Place of search	Date of completion of the search	Examiner
Munich	12 November 2007	Beckman, Anja

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