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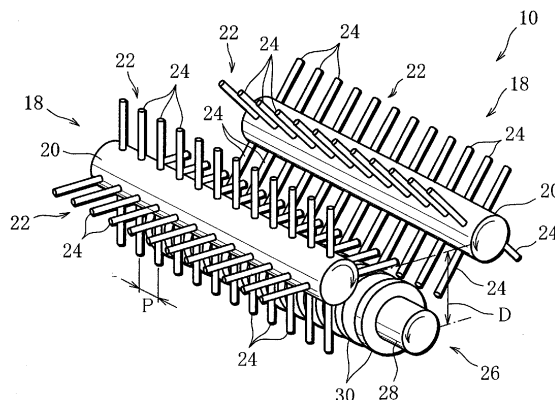
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(54) **TOBACCO CAKE SUBDIVIDING APPARATUS FOR USE IN CUT TOBACCO EXPANDING SYSTEM**

(57) A subdividing apparatus for use in an cut tobacco expanding system comprises a primary de-clumper arranged to receive a tobacco cake of impregnated cut tobacco taken out of an impregnation container and subdivide the received tobacco cake into tobacco loaves, and a secondary de-clumper arranged to receive the to-

bacco loaves from the primary de-clumper, subdivide the received tobacco loaves first into tobacco chunks and then further subdivide the tobacco chunks into tobacco lumps. The secondary de-clumper includes paired rotary rakes and a rotatable drum rake 26 located below the rotary rakes.

FIG. 3



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Description

Technical Field

[0001] This invention relates to a subdividing apparatus used in a cut tobacco expanding system to subdivide a tobacco cake which is a consolidated mass of cut tobacco impregnated with liquid carbon dioxide, into small pieces, before the impregnated cut tobacco is subjected to flash drying.

Background Art

[0002] As one of filling materials for a cigarette, expanded cut tobacco is used. The expanded cut tobacco improves the filling efficiency of the fillers for cigarettes. The expanded cut tobacco is made by an expanding system, and the expanding system includes an impregnation container. Cut tobacco is fed into the impregnation container, and impregnated with liquid carbon dioxide within the impregnation container. Then, the impregnated cut tobacco is taken out of the impregnation container and fed to a flash dryer. The flash dryer rapidly dries the impregnated cut tobacco, and by this drying, solid carbon dioxide contained in the impregnated cut tobacco is vaporized, so that carbon dioxide gas is emitted from the impregnated cut tobacco. The emission of the carbon dioxide gas increases the volume of the cut tobacco. Thus, the impregnated cut tobacco is expanded.

[0003] When the impregnated cut tobacco is taken out of the impregnation container, the impregnated cut tobacco is mostly in the form of a large consolidated mass called a tobacco cake. Such tobacco cake cannot directly be subjected to drying by the flash dryer.

[0004] Hence, a breaking apparatus for breaking a tobacco cake is provided in the expanding system, and such breaking apparatus is disclosed in U.S. Patent No. 4,307,735, for example. The breaking apparatus of this U.S. Patent comprises a plurality of rotary shafts arranged parallel within a horizontal plane, and a large number of blades attached to the rotary shafts. A tobacco cake is fed from above the breaking apparatus toward the blades, and broken by rotation of the blades.

[0005] The breaking device of this U.S. Patent, however, breaks the tobacco cake into fine pieces, so that the impregnated cut tobacco is badly smashed. Even if this impregnated cut tobacco broken into fine pieces is then subjected to drying and thereby made into expanded cut tobacco, the resultant expanded cut tobacco is small in particle size and therefore not suitable to be used as a cigarette filling material.

[0006] In order to break a tobacco cake, use of a common rotary-rake-type subdividing apparatus is thinkable. The rotary-rake-type subdividing apparatus can, however, not perfectly subdivide a tobacco cake into tobacco lumps equal to or smaller than a desired size, so that lots of masses larger in size than the tobacco lumps, namely large masses called tobacco loaves and medium masses

called tobacco chunks are left. If the tobacco loaves and tobacco chunks are directly fed to the flash dryer, the impregnated cut tobacco in the form of the tobacco loaves and tobacco chunks cannot be uniformly dried, which leads to lowering of the quality of the resultant expanded cut tobacco.

Disclosure of the Invention

[0007] The primary object of this invention is to provide a tobacco cake subdividing apparatus capable of subdividing a tobacco cake of impregnated cut tobacco obtained from an impregnation container in an expanding system, in a good manner, and reducing the breakage of the impregnated cut tobacco.

[0008] In order to achieve this object, a tobacco cake subdividing apparatus according to this invention comprises a primary de-clumper arranged to receive a tobacco cake from an impregnation container, subdivide the received tobacco cake into tobacco loaves and deliver the tobacco loaves; and a secondary de-clumper arranged to receive the tobacco loaves from the primary de-clumper and subdivide the received tobacco loaves, wherein the secondary de-clumper includes paired rotary rakes horizontally separated from each other, for subdividing the tobacco loaves into tobacco chunks and delivering the tobacco chunks downward, and a movable rake wall located below the paired rotary rakes, the movable rake wall being moved from one side where one of the rotary rakes is located to the other side where the other of the rotary rakes is located while the movable rake wall vertically overlaps the rotary rakes so that the movable rake wall cooperates with the rotary rakes to subdivide the tobacco chunks into tobacco lumps.

[0009] In the above-described subdividing apparatus, the tobacco cake is first roughly subdivided into tobacco loaves by the primary de-clumper, and then the resultant tobacco loaves are further subdivided by the secondary de-clumper in two stages. Specifically, the primary and secondary de-clumper subdivide the tobacco loaves into tobacco chunks by the paired rotary rakes, and then further subdivide the tobacco chunks into tobacco lumps by cooperation between the paired rotary rakes and the movable rake wall. Since the tobacco cake is subdivided into the tobacco lumps in a plurality of stages, the subdividing power required in each stage is small, so that the breakage of the impregnated cut tobacco is reduced to a great degree.

[0010] The movable rake wall overlaps the paired rotary rakes in the manner such that the movable rake wall engages with the rotary rakes. Thus, the movable rake and the paired rotary rakes cooperate to subdivide the tobacco chunks. In this case, desirably, the secondary de-clumper further comprises a lap adjustment device for adjusting overlap between the rotary rakes and the movable rake wall. The secondary de-clumper can further comprise a speed adjustment device for adjusting a rotational speed of the rotary rakes and a moving speed

of the movable rake wall.

[0011] By adjusting the overlap, the lap adjustment device reduces the breakage of the impregnated cut tobacco and adjusts the size of the tobacco lumps obtained by subdividing the tobacco chunks.

[0012] The speed adjustment device reduces the breakage of the impregnated cut tobacco and adjusts the subdividing performance of the secondary de-clumper.

[0013] Specifically, each of the rotary rakes can include a rotatable roller and a plurality of rake rows provided on the cylindrical surface of the roller. In this case, the rake rows are disposed in a circumferential direction of the roller with spaces between, and each of the rake rows has a large number of rake pins arranged along the axial direction of the roller with spaces between.

[0014] Desirably, between the paired rotary rakes, there is a positional relation such that the rake pins are at equal positions or in phase with respect to the axial direction of the roller, while the rake rows are at different rotational phase with respect to the circumferential direction of the roller. Thus, at any rotational angle of the rotary rakes, the rake pins in at least one rake row cover the space between the rollers and prevent the tobacco loaves from just passing through between the rollers.

[0015] In one aspect, the movable rake wall is located below the paired rotary rakes and middle between the paired rotary rakes, and includes a rotary shaft extending parallel to the rotary rakes, and a large number of rake discs mounted on the rotary shaft. The rake discs are disposed in the axial direction of the rotary shaft with spaces between, in the manner such that each rake disc is located between the rake pins of each rotary rake. In this case, the rake discs overlap the rake pins of the rotary rakes.

[0016] In another aspect, the movable rake wall is located below the paired rotary rakes, and includes a conveyer extending across the rotary rakes, and a plurality of rake rows provided on the conveyer. The rake rows are disposed in a width direction of the conveyer, and each of the rake rows has a large number of rake pins disposed in the direction of traveling of the conveyer with spaces between. As the conveyer travels, each rake row passes between the rake pins of each rotary rake. In this case, the rake pins on the conveyer overlap the rake pins of the rotary rakes.

Brief Description of the Drawings

[0017]

[FIG. 1] A diagram schematically showing a cut tobacco expanding system.

[FIG. 2] A plan view showing a secondary de-clumper in an embodiment.

[FIG. 3] A perspective view showing part of the secondary de-clumper in FIG. 2.

[FIG. 4] A diagram showing a power transmission system for the secondary de-clumper in FIG. 2.

[FIG. 5] A diagram schematically showing an adjustment device for adjusting the level, or height of a drum rake in FIG. 2.

[FIG. 6] A graph showing relation between the rotational speed of the secondary de-clumper and the proportion of tobacco lumps remaining.

[FIG. 7] A graph showing relation between the rotational speed of the secondary de-clumper and the average particle size of impregnated cut tobacco.

[FIG. 8] A graph showing relation between the distance between rotary rakes and a drum rake and the average particle size of impregnated cut tobacco.

[FIG. 9] A diagram schematically showing a secondary de-clumper in a modified example.

Best Mode of Carrying out the Invention

[0018] A tobacco expanding system in FIG. 1 includes an impregnation container 2. The impregnation container 2 receives cut tobacco and impregnates the received cut tobacco with liquid carbon dioxide. Then, the impregnated cut tobacco is taken out of the impregnation container 2, passed through a subdividing apparatus 4, and then fed to a flash dryer.

[0019] In this embodiment, the subdividing apparatus 4 includes a primary de-clumper 6, a storage container 8 and a secondary de-clumper 10. More specifically, as clear from FIG. 1, the primary de-clumper 6 includes a grid 12. The grid 12 extends horizontally and has a plurality of parallel bars 12a. Immediately above the grid 12, a plurality of rotary rakes 14 are disposed in the longitudinal direction of the grid 12 with specified spaces between. Each rotary rake 14 has a rotatable roller 14a and two rows of rake pins 14b projecting from the cylindrical surface of the roller 14a. The two rows of rake pins 14b are separated in a diametrical direction of the roller 14b, and the individual rake pins 14b have an end bent along the direction of rotation of the roller 14a.

[0020] The impregnated cut tobacco taken out of the impregnation container 2 in the form of a tobacco cake is fed to the primary de-clumper 6 from above the primary de-clumper 6. The primary de-clumper 6 subdivides the tobacco cake into a large number of tobacco loaves by cooperation between the rotary rakes 14 and the grid 12, and feeds the resultant tobacco loaves to the storage container 8. The size of the tobacco loaves is determined primarily by the pitch between the rake pins 14b and the distance between the parallel bars 12a of the grid 12.

[0021] The storage container 8 temporarily stores the tobacco loaves, and then the tobacco loaves are fed from the storage container 8 to the secondary de-clumper 10.

[0022] When the tobacco cake passes through the primary de-clumper 6, the primary de-clumper 6 causes some impregnated cut tobacco particles to separate from the tobacco cake and tobacco loaves. As a matter of course, those separated impregnated cut tobacco particles are also fed to the storage container 8 with the tobacco loaves.

[0023] Next, referring to FIGS. 2 to 5, the secondary de-clumper 10 will be described.

[0024] As shown in FIG. 2, the secondary de-clumper 10 has a housing 16. The housing 16 has an open top and bottom, respectively. Within the housing 16, a pair of rotary rakes 18 is disposed. The rotary rakes 18 are horizontally separated from each other.

[0025] Like the above-described rotary rakes 14, each rotary rake 18 includes a roller 20. The roller 20 includes a roller shaft, and is rotatably fitted to the housing 16 at the opposite ends of the roller shaft. The roller 20 has four rake rows 22 on the cylindrical surface thereof, and the rake rows are disposed in the circumferential direction of the roller 20 at regular intervals. Each rake row 22 has a large number of rake pins 24 projecting from the cylindrical surface of the roller 20. The rake pins 24 are disposed along the axial direction of the roller 20 with the same pitch P and in phase. That is, the rake pins 24 in the four rake rows are at equal positions in the axial direction of the roller 20.

[0026] As clear from FIG. 2, the rake pins 24 of the paired rotary rakes 18 are in phase in the axial direction of the roller 20. Hence, the paired rotary rakes 18 have four rake pins 24 each, in one vertical plane.

[0027] As clear from FIG. 3, the paired rotary rakes 18 are rotated about their respective axes with a phase difference of 45°. Thus, when the paired rotary rakes 18 are rotated in the opposite directions at the same speed, the rake rows 22 of one of the paired rotary rakes 18 and the rake rows 22 of the other pass through between the rollers 20 of the rotary rakes 18, alternately. Thus, when the paired rotary rakes 18 are viewed from above, the space between the rollers 20, 20 is always covered with any of the rake rows 22 of the paired rotary rakes 18.

[0028] Specifically, each rake pin 24 has a length somewhat shorter than half the distance between the rollers 20 and a diameter of about 9 mm. The pitch P between the rake pins 24 is determined depending on the size of an inlet of the flash dryer, and desirably, smaller than the pitch between the above-mentioned rake pins 14b. In the present embodiment, the pitch P between the rake pins 24 is equal to or less than 100 mm.

[0029] Below the paired rotary rakes 18, a drum rake 26 forming a movable rake wall is disposed. The drum rake 26 includes a rotary shaft 28, and the rotary shaft 28 is located between the rollers 20. The rotary shaft 28 extends parallel to the rollers 20 and is rotatably fitted to the housing 16 at the opposite ends thereof.

[0030] On the rotary shaft 28, a large number of rake discs 30 are mounted. The rake discs 30 are disposed along the axial direction of the rotary shaft 28 at regular intervals, in the manner such that each rake disc 30 is located between the rake pins 24. Hence, the pitch between the rake discs 30 is equal to the pitch P between the rake pins 24, and the distance between the rake disc 30 and the adjacent rake pin 24 in the axial direction of the rotary shaft 28 is P/2.

[0031] In the present embodiment, the rotary shaft 28

has a diameter almost equal to the diameter of the roller 20, and the rake disc has an outside diameter almost equal to the outside diameter of the rotary rake 18.

[0032] The paired rotary rakes 18 and the drum rake 26 are rotated by a common electric motor 32. FIG 4 shows a power transmission path from the electric motor 32 to the rakes 18 and 26.

[0033] The roller shaft of each roller 20 has an end projecting from the housing 16, and as shown in FIG. 4, sprockets 34, 36 are mounted on the respective projecting ends of the roller shafts. Also the rotary shaft 28 has an end projecting from the housing 16, and a sprocket 38 is mounted on this end.

[0034] The sprocket 36 arranged on the electric-motor 32 side in FIG. 4 has a double structure comprising two sprocket members 36a, 36b. The sprocket member 36a and an output sprocket 40 of the electric motor 40 are connected by an endless drive chain 42.

[0035] Further, a tension sprocket 44 is rotatably fitted to the housing 16. The tension sprocket 44 is located on the electric-motor 32 side. An endless linking chain 46 is arranged to pass around the tension sprocket 44, the sprocket member 36b, the sprocket 34 and the sprocket 38. Hence, when the electric motor 32 is driven, drive power is first transmitted by the drive chain 42 to one of the rollers 20, or in other words, the electric-motor-32-side rotary rake 18, so that this rotary rake 18 is rotated counterclockwise in FIG. 4 as indicated by an arrow.

[0036] The traveling of the drive chain 42 rotates the sprocket member 36b, which causes the linking chain 46 to travel. Consequently, also the other rotary rake 18 and the drum rake 30 are rotated, in a manner linked with the electric-motor-side rotary rake 18. Here, the other rotary rake 18 and the drum rake 30 are rotated clockwise in FIG. 4 as indicated by arrows. It is to be noted that in FIG. 4, each rotary rake 18 is represented as the orbit described by the end of the rake pin 24 in rotation.

[0037] As shown in FIG. 2, the electric motor 32 is electrically connected to an inverter-type speed adjustment device 48. The speed adjustment device 48 can adjust the rotational speed of the electric motor 32, and therefore, the rotational speed of the paired rotary rakes 18 and the drum rake 26.

[0038] Further, the drum rake 26 is fitted to the housing 16 using a level adjustment device. The level adjustment device can adjust the level, or height of the drum rake 26 relative to the paired rotary rakes 18, or in other words, the vertical distance D between the drum rake 26 and the paired rotary rakes 18.

[0039] More specifically, as shown in FIG. 5, the level adjustment device 49 includes a pair of slots 50 formed in the housing 16. The slots 50 extend vertically. The rotary shaft 28 of the drum rake 26 has opposite ends extending through both slots 50, respectively. Support plates 52 are fitted to the rotary shaft 28 at the opposite ends thereof, using a bearing. Each support plate 52 is fixed to the housing 16 by four fitting bolts 54 and nuts (not shown) disposed at the four corners of the support

plate.

[0040] For the fitting bolts 54, a large number of through-holes 56 are formed in the housing 16. The through-holes 56 are arranged vertically with specified spaces between, on both sides of the slot 50. Hence, the level, or height of the drum rake 26, namely the distance D can be adjusted by selecting the through-holes 56 into which the fitting bolts 54 should be inserted.

[0041] By adjusting the distance D, the overlap of the rake disc 30 relative to the rake pin 24 can be varied within the range of the length of the rake pin 24. In the present embodiment, the distance D is adjusted within the range of 85 mm (corresponding to the maximum overlap) to 155 mm (corresponding to the minimum overlap).

[0042] It is to be noted that also the tension sprocket 44 is fitted to the housing 16 in a vertically movable manner, and that the level, or height of the tension sprocket 44 can be adjusted in a similar manner to the drum rake 26. Hence, even when the distance D is adjusted, the tension sprocket 44 can impart a desired tension to the linking chain 46.

[0043] When tobacco loaves are fed from the storage container 8 to the secondary de-clumper 10, the tobacco loaves are subdivided into tobacco chunks smaller in size than the tobacco loaves by rotation of the paired rotary rakes 18, or in other words, the rake pins 24 of the paired rotary rakes 18, and the resultant tobacco chunks are fed onto the drum rake 26.

[0044] The diameter of the rake pins 24 is about 9 mm, which is enough to withstand the load required for subdividing the tobacco loaves, but small. Hence, when the tobacco loaves are subdivided by the rake pins 24, the breakage of the impregnated cut tobacco is reduced.

[0045] Then, when the tobacco chunks pass through the drum rake 26, the rake discs 30 cooperate with the rotary rakes 18 to subdivide the tobacco chunks that have passed through between the rotary rakes 18, further into tobacco lumps of a desired size smaller than the size of the tobacco chunks.

[0046] Consequently, from the secondary de-clumper 10, the tobacco lumps are delivered with some impregnated cut tobacco particles. The impregnated cut tobacco particles include not only those separated when the tobacco cake was subdivided but also those separated when the tobacco loaves and tobacco chunks were subdivided.

[0047] The tobacco lumps and impregnated cut tobacco particles delivered from the secondary de-clumper 10 are then fed to the above-mentioned flash dryer, and rapidly dried and thereby expanded within the flash dryer.

[0048] FIG. 6 shows the result of experiment, where examples E1 to E4 of the secondary de-clumper 10, which were different in the distance P/2 between the rake pin 24 and the rake disc 30 and the distance D, were used changing the rotational speed of the rotary rakes 18 and the drum rake 26, and the proportion of the tobacco lumps remaining in the impregnated cut tobacco delivered from the secondary de-clumper 2 and the av-

erage particle size of the impregnated cut tobacco delivered from the secondary de-clumper 2 were measured.

[0049] The distance P/2 and the distance D in examples E1 to E4 are as shown in table 1 below.

Table 1

	P/2(mm)	D(mm)
Example E1	25	85
Example E2	25	135
Example E3	40	85
Example E4	40	135

[0050] The proportion of the remaining tobacco lumps is expressed as a percentage relative to the amount of the tobacco loaves fed from the primary de-clumper 6, which is considered as 100. As clear from FIG. 6, in examples E1 to E4, the proportion of the remaining tobacco lumps was reduced to about 40% or lower.

[0051] As clear from FIG. 7, considering that the initial average particle size of cut tobacco before impregnation was 2.41 mm, in the impregnated cut tobacco obtained by examples E1 to E4 of the secondary de-clumper 10, the average particle size was only reduced to 80 to 93 % of the initial average particle size.

[0052] A broken line in FIG. 7 represents the average particle size (1.66 mm) of impregnated cut tobacco obtained by a comparative example of the secondary de-clumper. The comparative example of the secondary de-clumper includes a rotor and a spiral row of rake pins provided on the cylindrical surface of the rotor. In addition, according to the comparative example of the secondary de-clumper, the proportion of the remaining tobacco lumps was about 80% or higher, and the average particle size of the impregnated cut tobacco was reduced to about 70 % of the initial average particle size.

[0053] Thus, in the subdividing apparatuses 4 having examples E1 to E4 as a second de-clumper 10, the tobacco cake is subdivided into small pieces in a good manner, which allows the impregnated cut tobacco to be thereafter dried uniformly. Further, since the breakage of the impregnated cut tobacco is reduced, high-quality expanded cut tobacco can be produced.

[0054] As clear from FIGS. 6 and 7, in any of examples E1 to E4 of the secondary de-clumper 10, as the rotational speed of the secondary de-clumper 10 increases, the amount of the remaining tobacco lumps decreases and the average particle size of the impregnated cut tobacco decreases.

[0055] Thus, from the result of measurement in FIG. 7, the relation between the rotational speed of the secondary de-clumper and the average particle size of the impregnated cut tobacco as shown in FIG. 8 is drawn. FIG. 8 shows that under a fixed rotational speed of the secondary de-clumper, as the distance D between the rotary rakes 18 and the drum rake 26 increases, the rate

of reduction of the average particle size of the impregnated cut tobacco decreases. Hence, by adjusting the distance D, or in other words, the overlap between the rake disc 30 and the rake pin 24, the average particle size of the impregnated cut tobacco can be controlled to be within a desired range.

[0056] More specifically, the breakage of the impregnated cut tobacco is thought to be reduced for the following reason: As the distance D increases, the overlap decreases, so that the proportion of the tobacco chunks passing through the drum rake 26 without being broken by the rotary rakes 18 and the drum rake 26 increases.

[0057] Thus, the degree to which the tobacco chunks are subdivided, or in other words, the average particle size of the impregnated cut tobacco can be easily maintained at a desired level, in a manner depending on the distance D, namely the distance between the rotary rakes 18 and the drum rake 26.

[0058] The present invention is not limited to the above-described embodiment but can be modified in various ways.

[0059] The rotary rakes 18 and the drum rake 26 of the secondary de-clumper 10 can be rotated by separate electric motors, independently.

[0060] Further, as shown in FIG. 9, the secondary de-clumper can use a conveyer-type movable rake wall in place of the drum rake 26. In this case, the movable rake wall includes a conveyer 58 located below the paired rotary rakes 18, and a plurality of rake rows 60 provided on the conveyer 58. The rake rows 60 are disposed in the width direction of the conveyer 58 with spaces between, and each rake row has a large number of rake pins 62 arranged in the direction of traveling of the conveyor 58 with spaces between.

[0061] As the conveyer 58 travels, each rake row 60 passes between the rake pins 24 of each rotary rake 18. Like the above-described drum rake 26, the level, or height and the traveling speed of the conveyer 58 can be adjusted.

[0062] In the case of this conveyer-type movable rake wall, as the conveyer 58 travels, each rake row 60 passes between the rake pins 24 of each rotary rake 18, where the rake rows 60 and the rake pin rows 22 cooperate to subdivide the tobacco chunks.

Claims

1. A tobacco cake subdividing apparatus for use in an cut tobacco expanding system, the expanding system being arranged such that cut tobacco is impregnated with liquid carbon dioxide within an impregnation container and a tobacco cake of the impregnated cut tobacco taken out of the impregnation container is fed to said subdividing apparatus, the dividing apparatus comprising:

a primary de-clumper arranged to receive the

tobacco cake, for subdividing the received tobacco cake into tobacco loaves and delivering the tobacco loaves; and

a secondary de-clumper arranged to receive the tobacco loaves from said primary de-clumper, for subdividing the received tobacco loaves, said secondary de-clumper including paired rotary rakes located horizontally with a space between, for subdividing the tobacco loaves into tobacco chunks and delivering the tobacco chunks downward, and a movable rake wall located below the paired rotary rakes, the movable rake wall being moved from one side where one of the rotary rakes is located to the other side where the other of the rotary rakes is located while the movable rake wall vertically overlaps the rotary rakes so that the movable rake wall cooperates with the rotary rakes to subdivide the tobacco chunks into tobacco lumps.

2. The apparatus according to claim 1, wherein said paired rotary rakes overlap said movable rake wall in the manner such that the rotary rakes engage with said movable rake wall.
3. The apparatus according to claim 2, wherein said secondary de-clumper further comprises a lap adjustment device for adjusting overlap between said rotary rakes and said movable rake wall.
4. The apparatus according to claim 2, wherein said secondary de-clumper further comprises a speed adjustment device for adjusting a rotational speed of said rotary rakes and a moving speed of said movable rake wall.
5. The apparatus according to claim 2, wherein each of said rotary rakes includes a rotatable roller and a plurality of rake rows provided on a cylindrical surface of the roller.
6. The apparatus according to claim 5, wherein the rake rows are disposed in a circumferential direction of the roller with spaces between, and each of the rake rows has a large number of rake pins arranged along an axial direction of the roller with space between,.
7. The apparatus according to claim 6, wherein between said paired rotary rakes, the rake pins are in phase with respect to the axial direction of the roller, while the rake rows are different phase in the circumferential direction of the roller.
8. The apparatus according to claim 7, wherein said movable rake wall is located below said paired rotary rakes and middle between said paired rotary

rakes, and includes a rotary shaft extending parallel to said rotary rakes, and a large number of rake discs provided on the rotary shaft, and the rake discs are arranged along the axial direction of the rotary shaft with spaces between, in the manner such that each rake disc is located between the rake pins of each rotary rake. 5

9. The apparatus according to claim 7, wherein said movable rake wall is located below said paired rotary rakes, and includes a conveyer extending across said rotary rakes, and a plurality of rake rows provided on the conveyer. 10

10. The apparatus according to claim 9, wherein the rake rows are disposed in a width direction of the conveyer with spaces between, and each of the rake rows has a large number of rake pins arranged in the direction of traveling of the conveyer with spaces between, so that as the conveyer travels, each of the rake rows passes between the rake pins of each rotary rake. 15 20

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FIG. 1

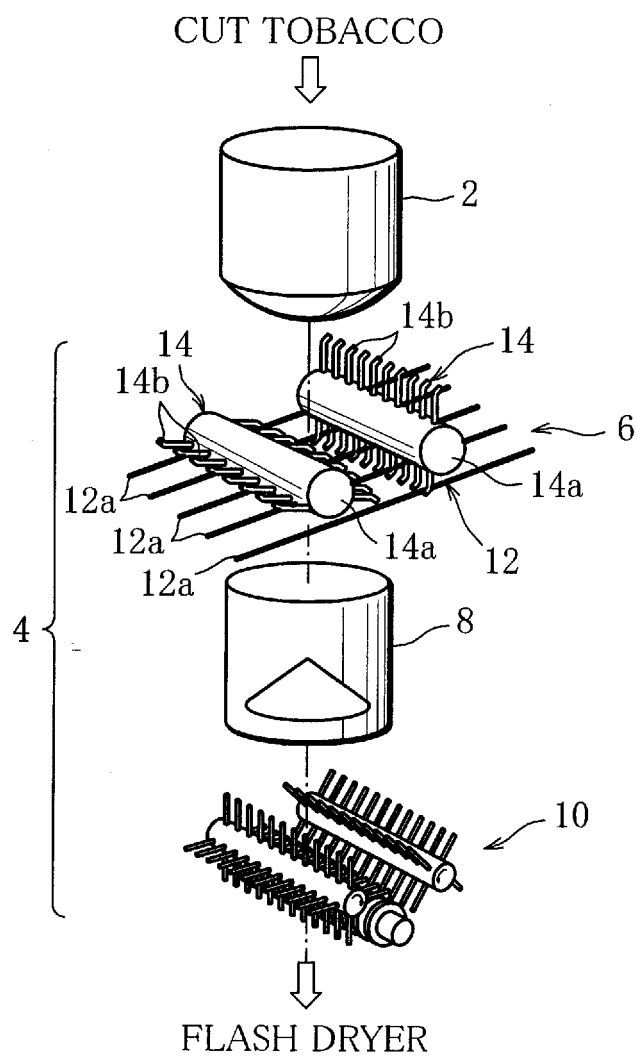


FIG. 2

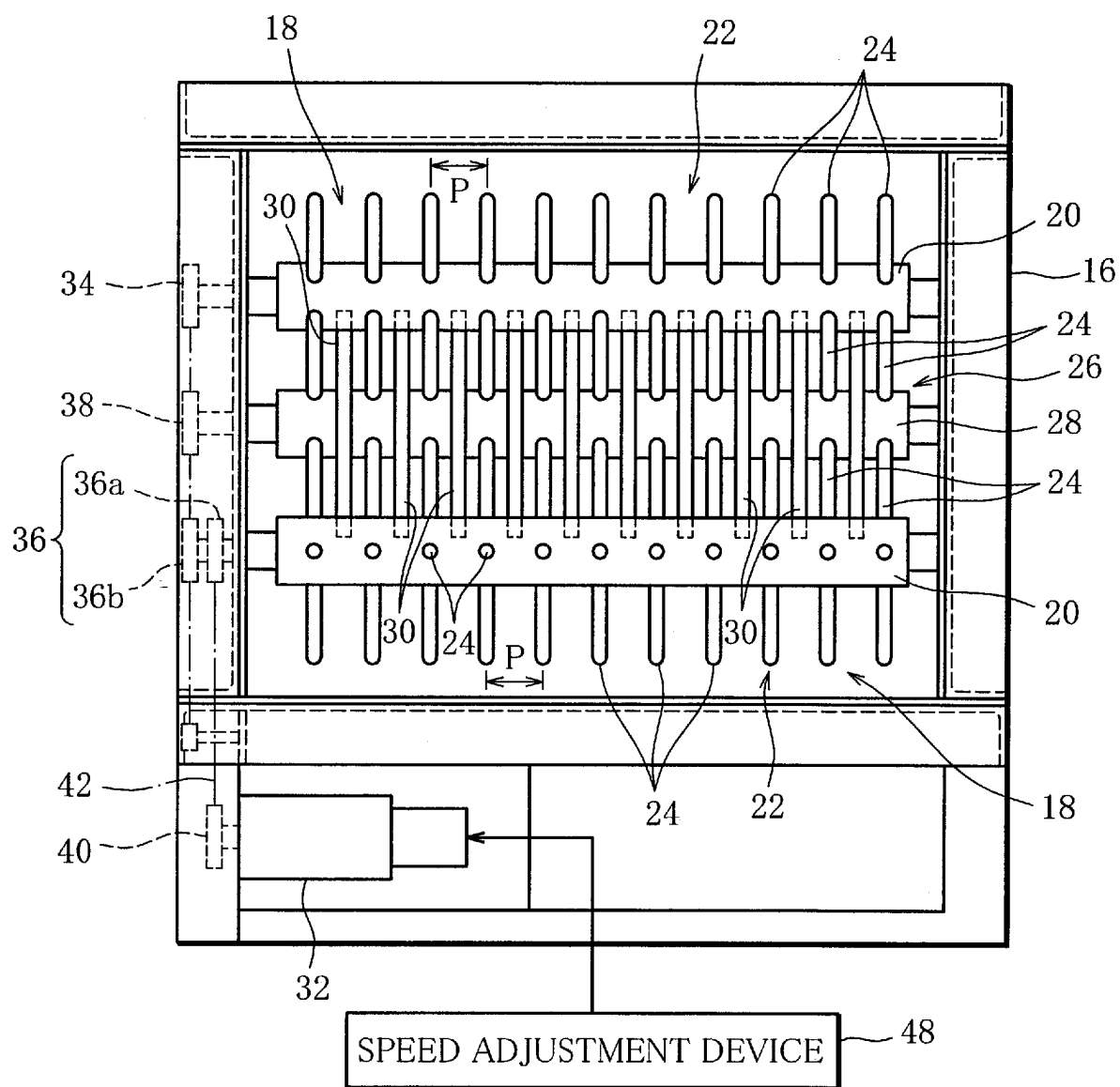


FIG. 3

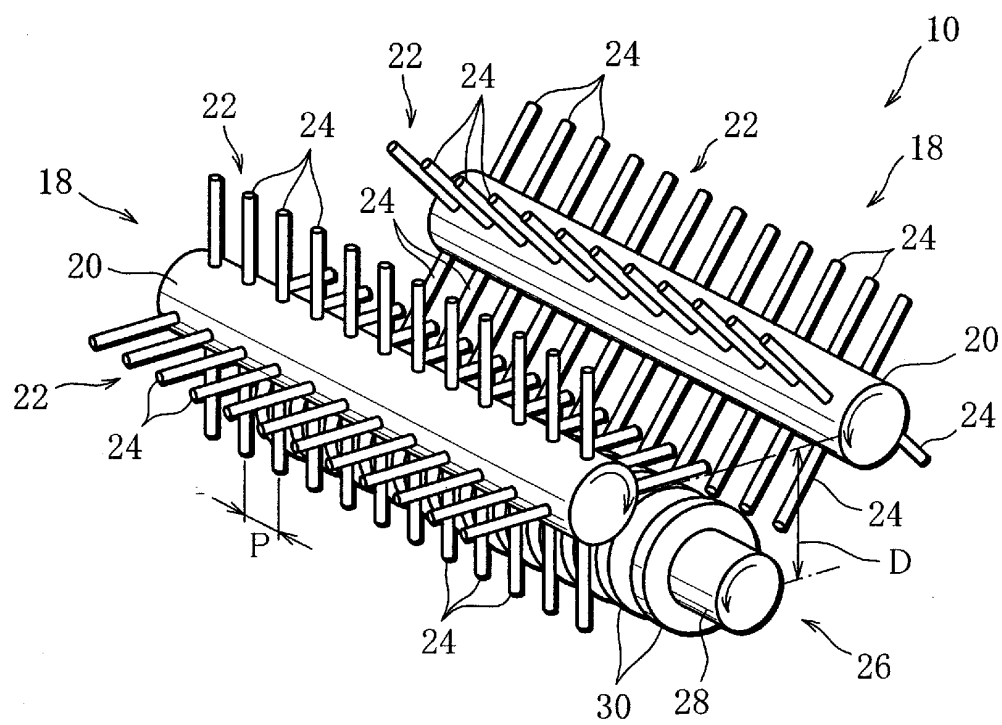


FIG. 4

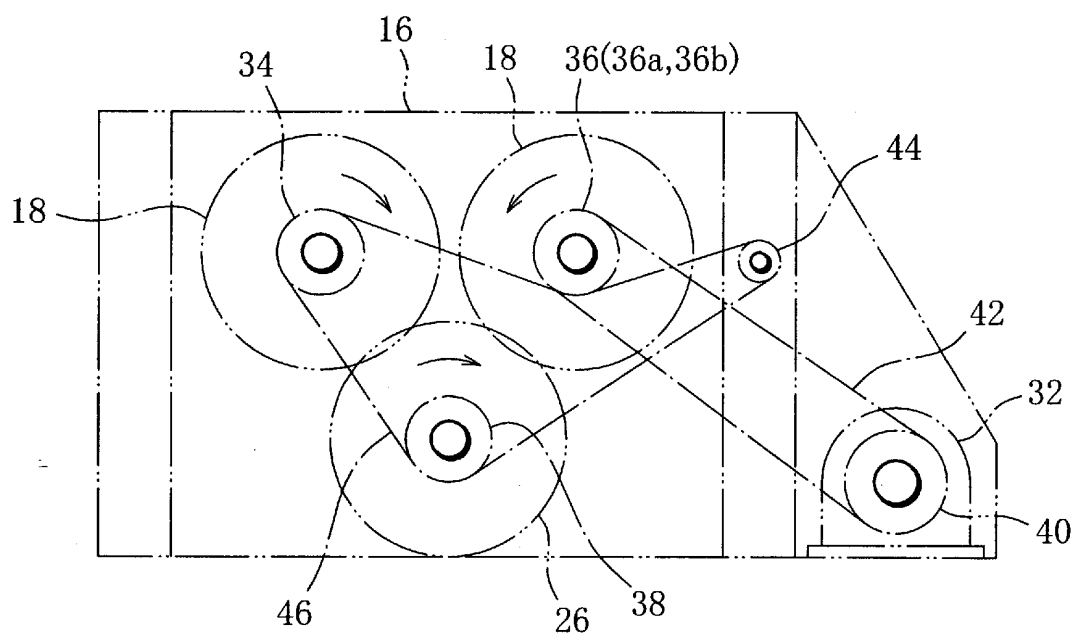


FIG. 5

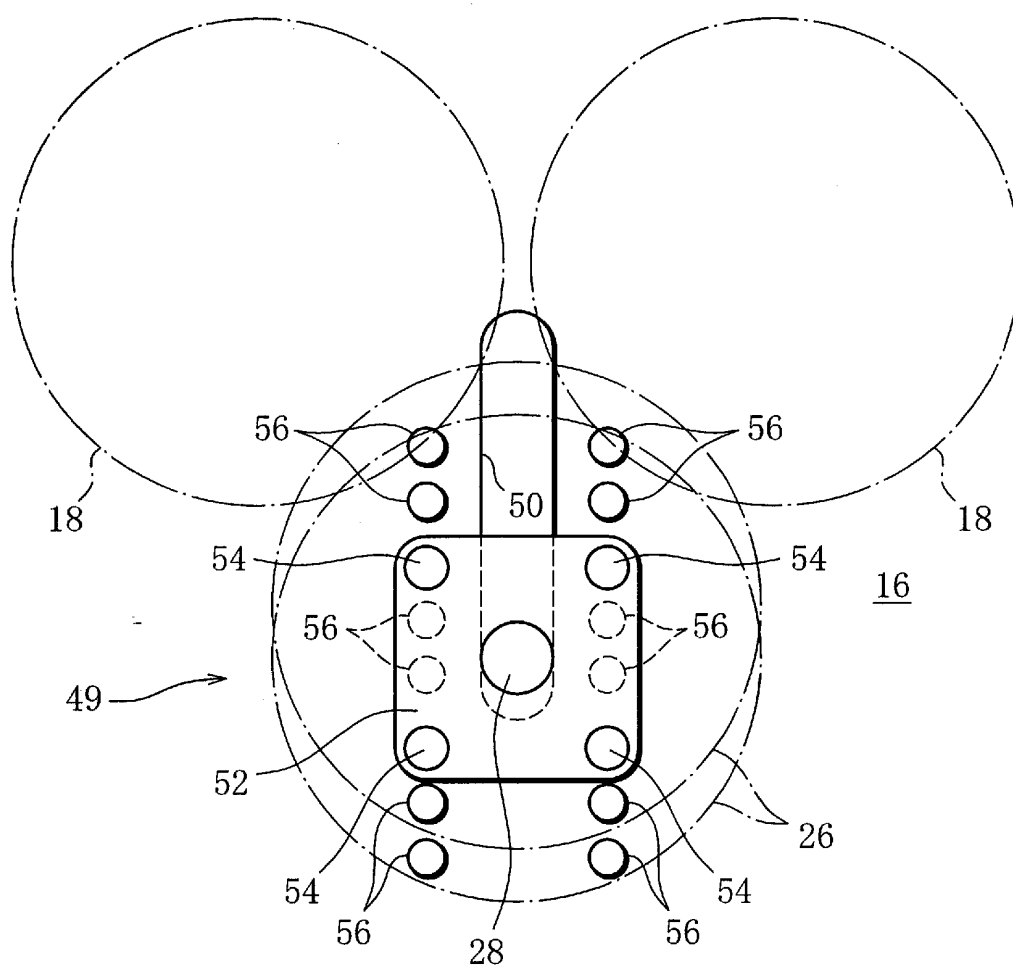


FIG. 6

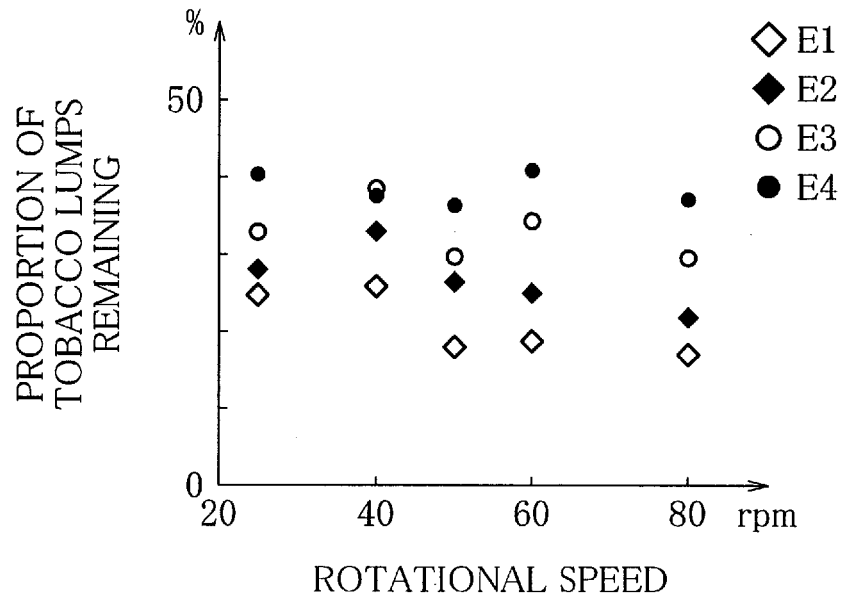


FIG. 7

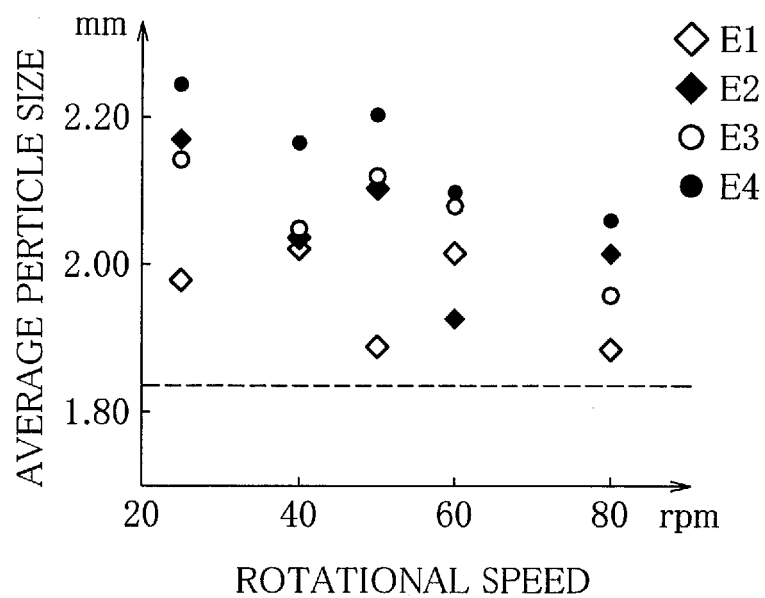


FIG. 8

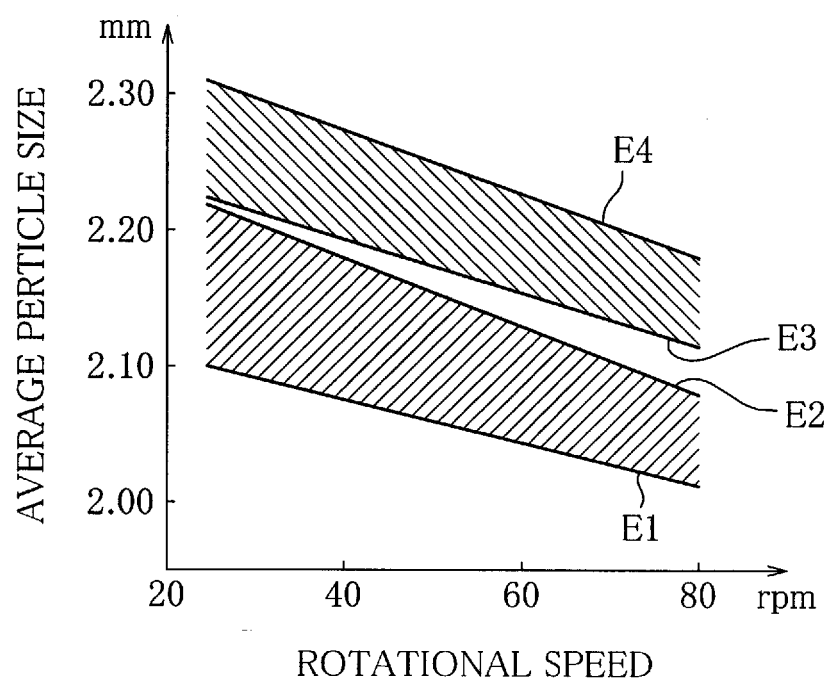
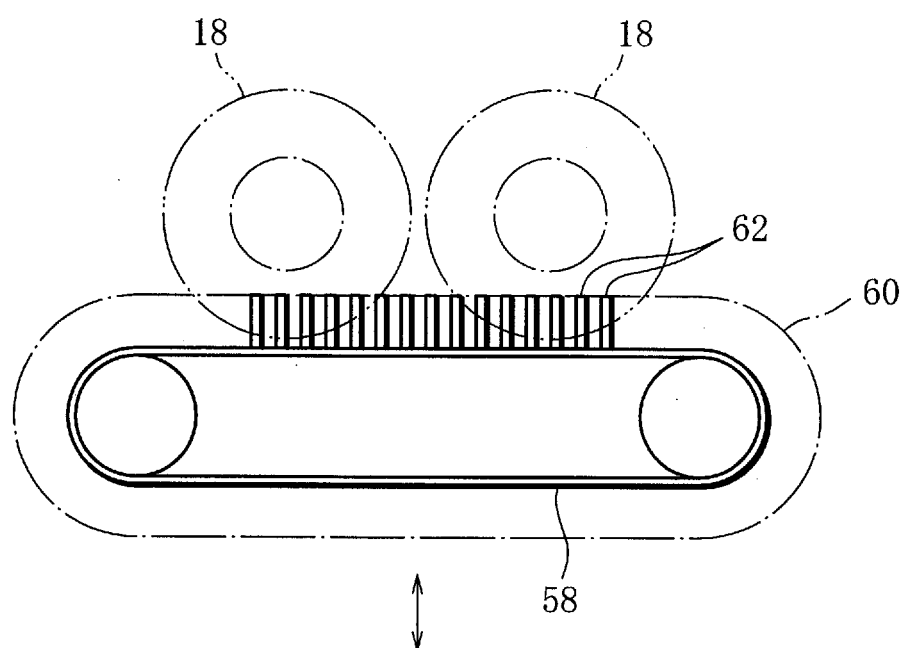


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/006779

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ A24B3/06, 3/18 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int.Cl. ⁷ A24B3/06, 3/14, 3/18 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 4-293476 A (Japan Tobacco Inc.), 19 October, 1992 (19.10.92), (Family: none)	1-10
A	JP 2001-95550 A (Japan Tobacco Inc.), 10 April, 2001 (10.04.01), (Family: none)	1-10
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 144999/1989 (Laid-open No. 85328/1991) (Japan Tobacco Inc.), 29 August, 1991 (29.08.91), (Family: none)	1-10
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 29 June, 2005 (29.06.05)		Date of mailing of the international search report 12 July, 2005 (12.07.05)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4307735 A [0004]