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(54) **PULP FEEDER FOR USED PAPER RECYCLING APPARATUS**

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(57) **ABSTRACT**

A pulp feeder capable of obtaining recycled paper of uniform texture, stable in the weight of the wet paper made on a mesh belt, in a very narrow used paper processing space of furniture size. A pulp feeding unit (pulp feeder) includes a retention unit disposed slidably on the upper side of an running mesh belt, for retaining a pulp suspension sent from a pulp manufacturing unit, and a paper making frame body for defining the supply width of the pulp suspension on the upper side of the mesh belt, in which the leading end position of this paper making frame body is provided with an overflow unit for keeping constant the water level of the pulp suspension retained in the retention unit. The pulp suspension supplied in the retention unit is retained to the water level defined the overflow unit, and is uniformly dispersed and supplied on the upper side of the mesh belt by cooperative action of this retention action and the running action of the mesh belt.

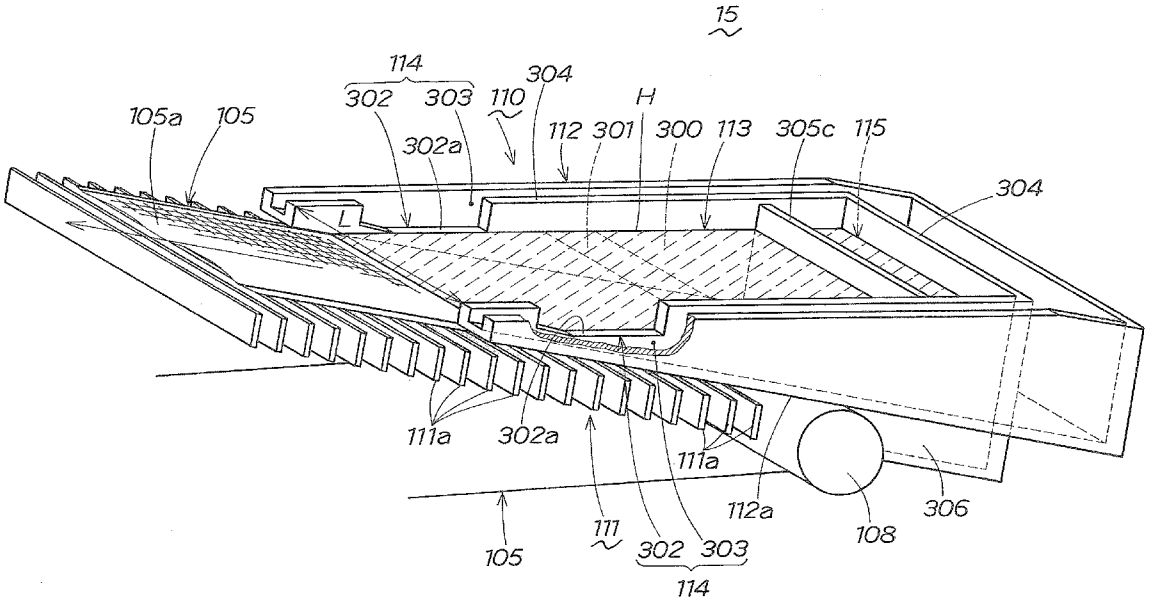


Fig. 1

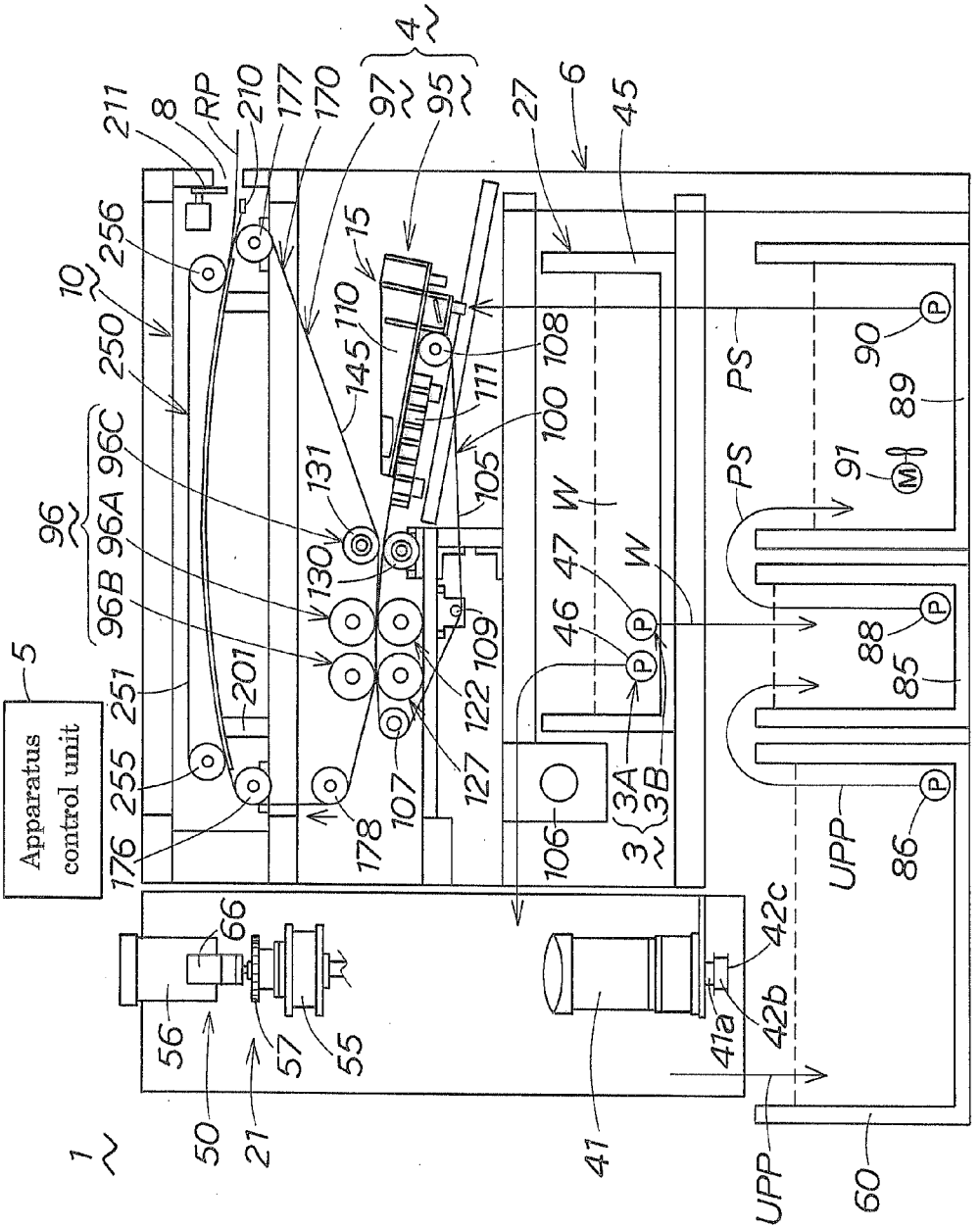

Apparatus control unit
5
1
50
21
56
66
57
55
41
41a
42b
42c
UPP
60
3
3A
3B
106
107
178
176
255
251
201
122
109
127
130
131
96
96A
96B
96C
10
256
250
211
8
RP
210
177
170
97
95
4
15
110
145
111
108
100
105
27
6
45
W
47
46
88
85
90
89
91
86
PS

Fig. 2

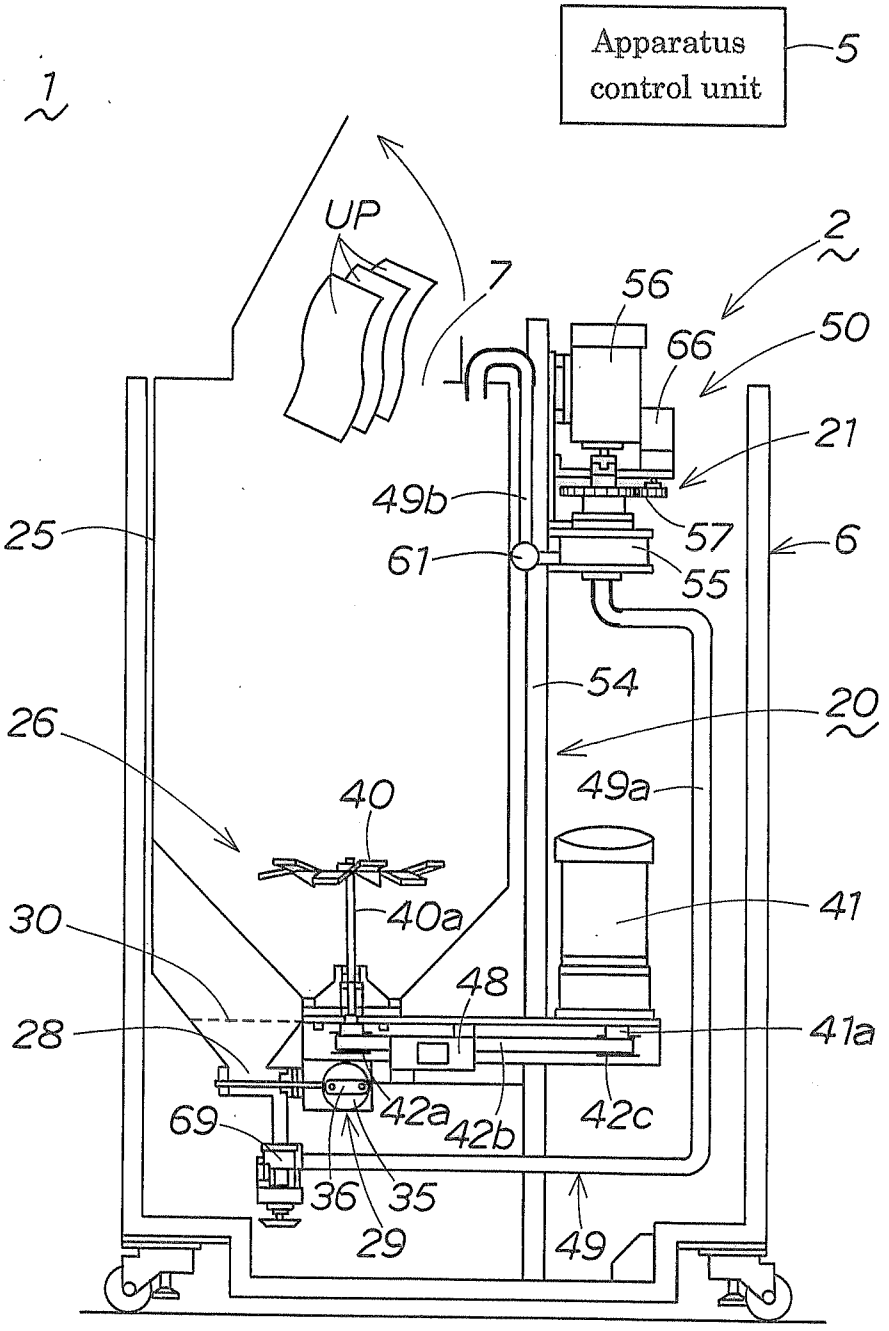

Apparatus control unit
5
1
UP
7
2
56
66
50
21
49b
57
6
25
61
55
54
20
26
49a
40
41
40a
30
48
28
41a
42a
42b
42c
69
36
35
29
49

Fig. 3

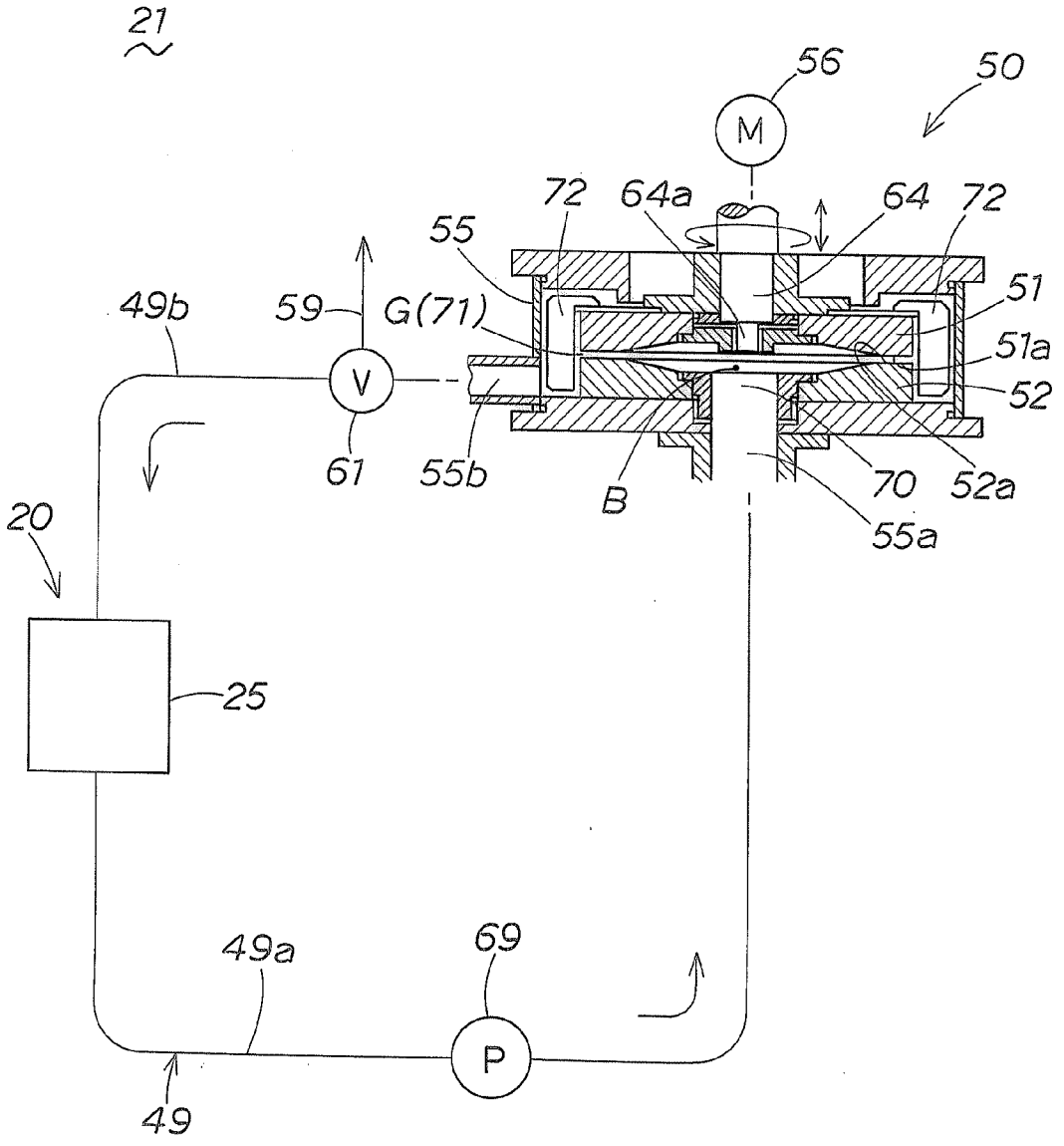
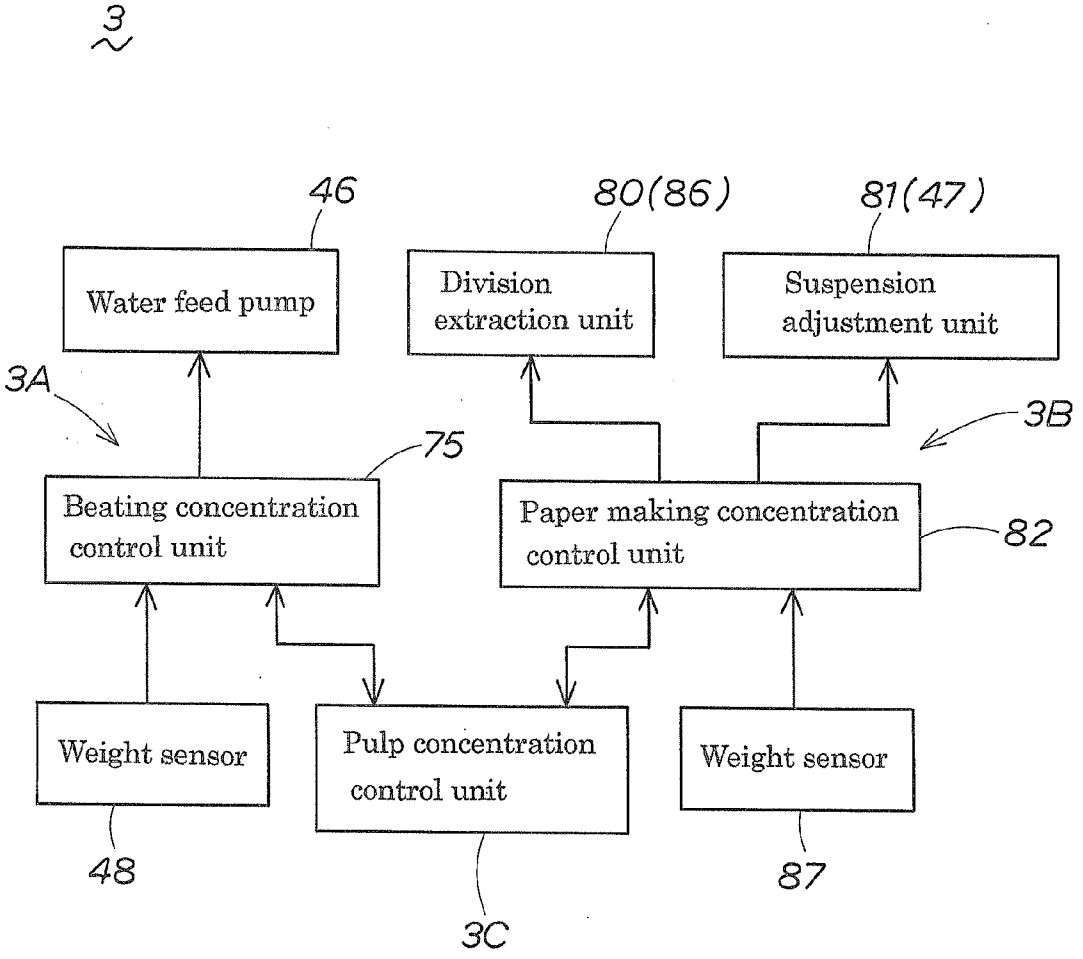

21
56
50
M
72
64a
64
72
55
51
49b
59
G(71)
51a
V
52
61
55b
B
70
52a
55a
20
25
49a
69
P
49

Fig. 4


3
46
80(86)
81(47)
Water feed pump
Division extraction unit
Suspension adjustment unit
3A
3B
75
Beating concentration control unit
Paper making concentration control unit
82
Weight sensor
Pulp concentration control unit
Weight sensor
48
3C
87

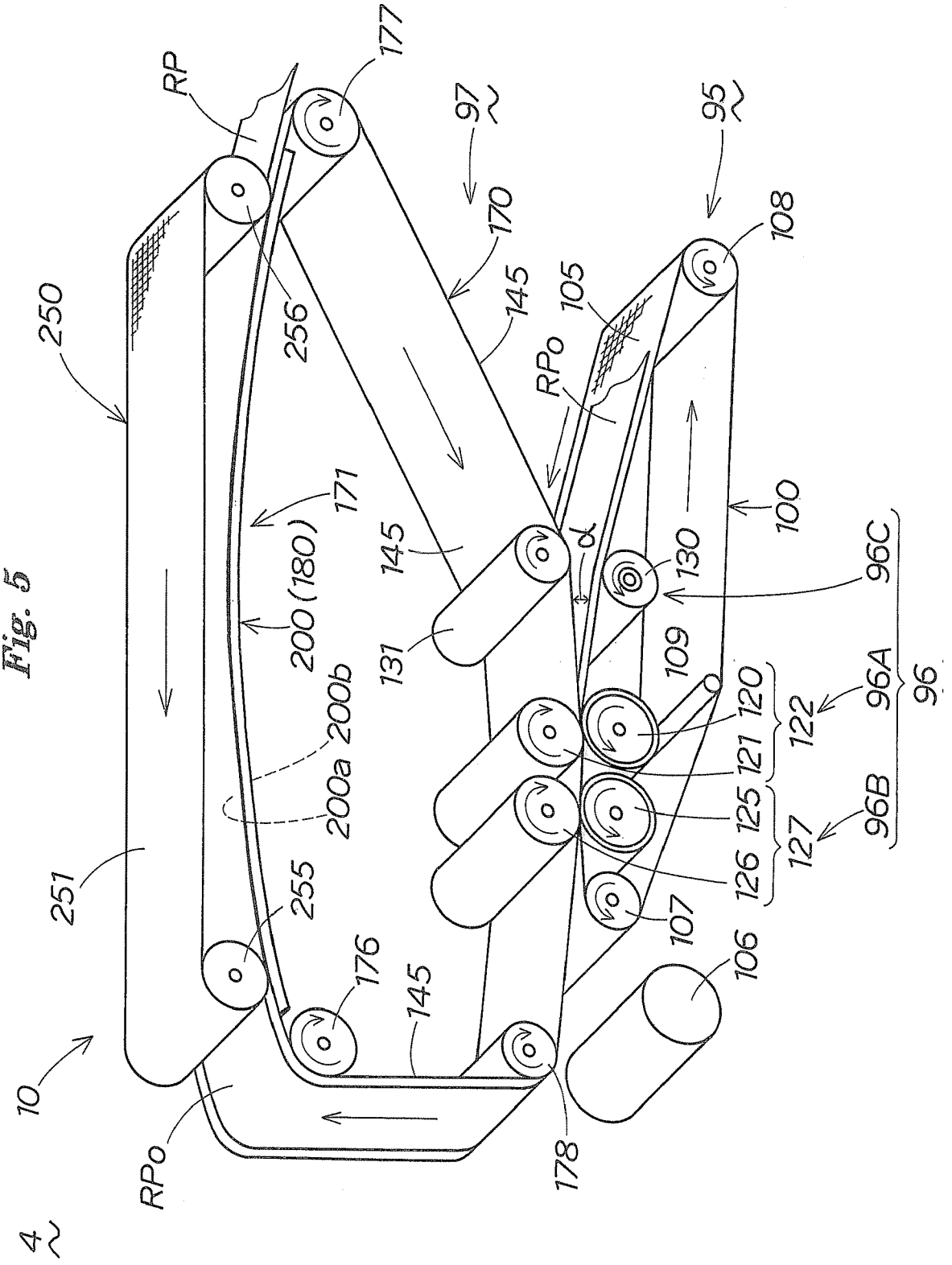

4
10
250
251
RP
RPo
177
97
95
170
145
105
108
256
255
176
178
171
200 (180)
200a
200b
131
109
130
100
96C
96A
96
96B
120
121
122
125
126
127
107
106
d

Fig. 5

Fig. 6

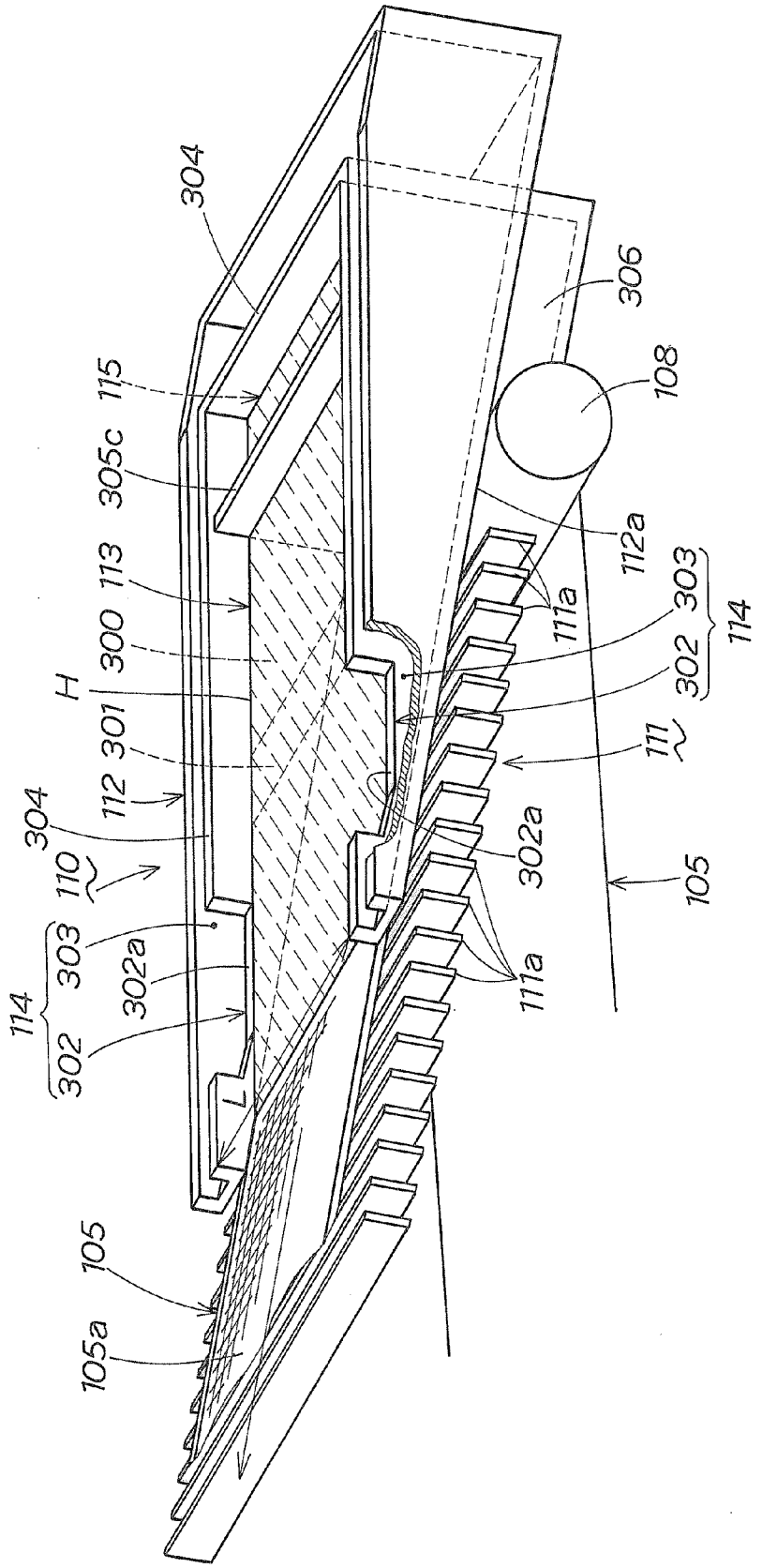

15
304
306
108
115
305c
112a
113
303
114
300
111a
H
302
301
111
112
304
302a
110
105
303
302a
114
111a
302
L
105
105a

Fig. 7

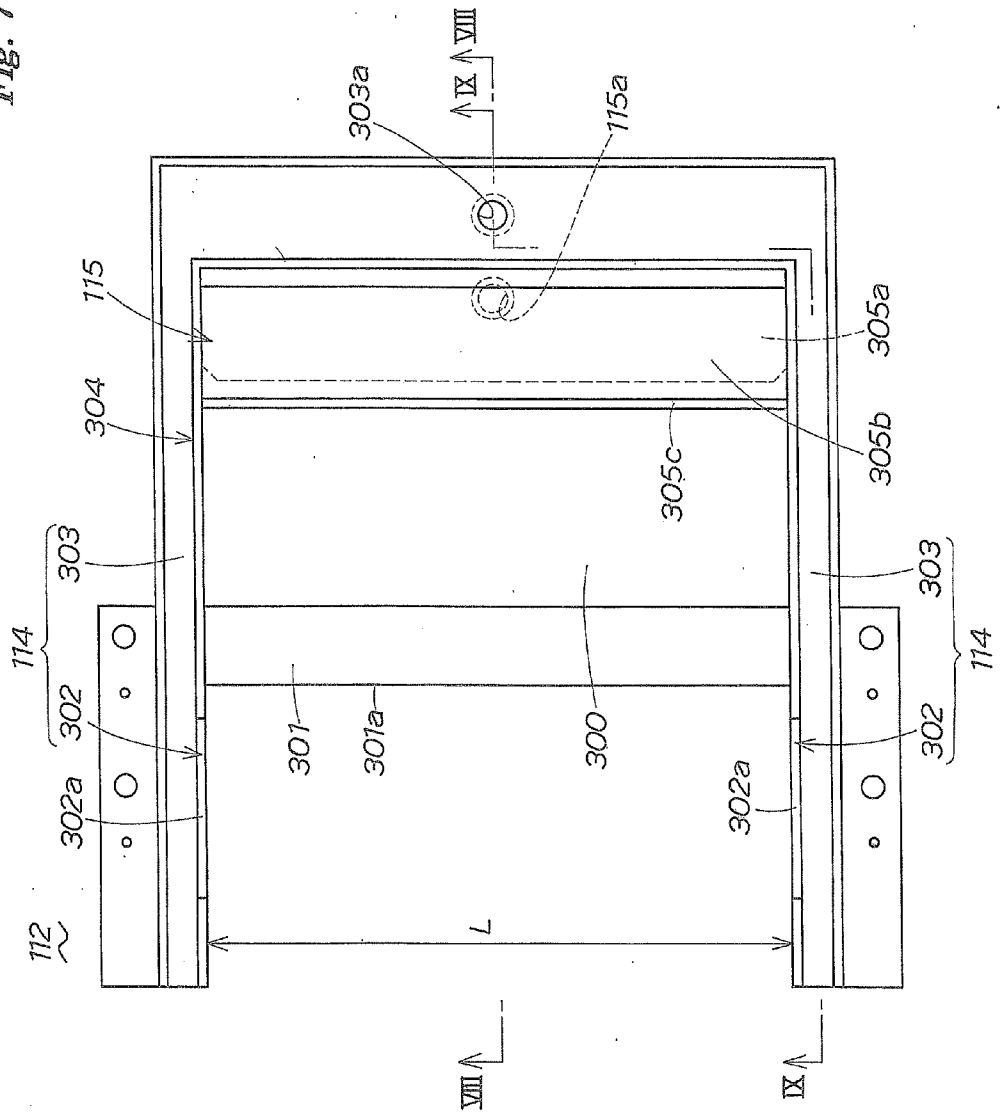
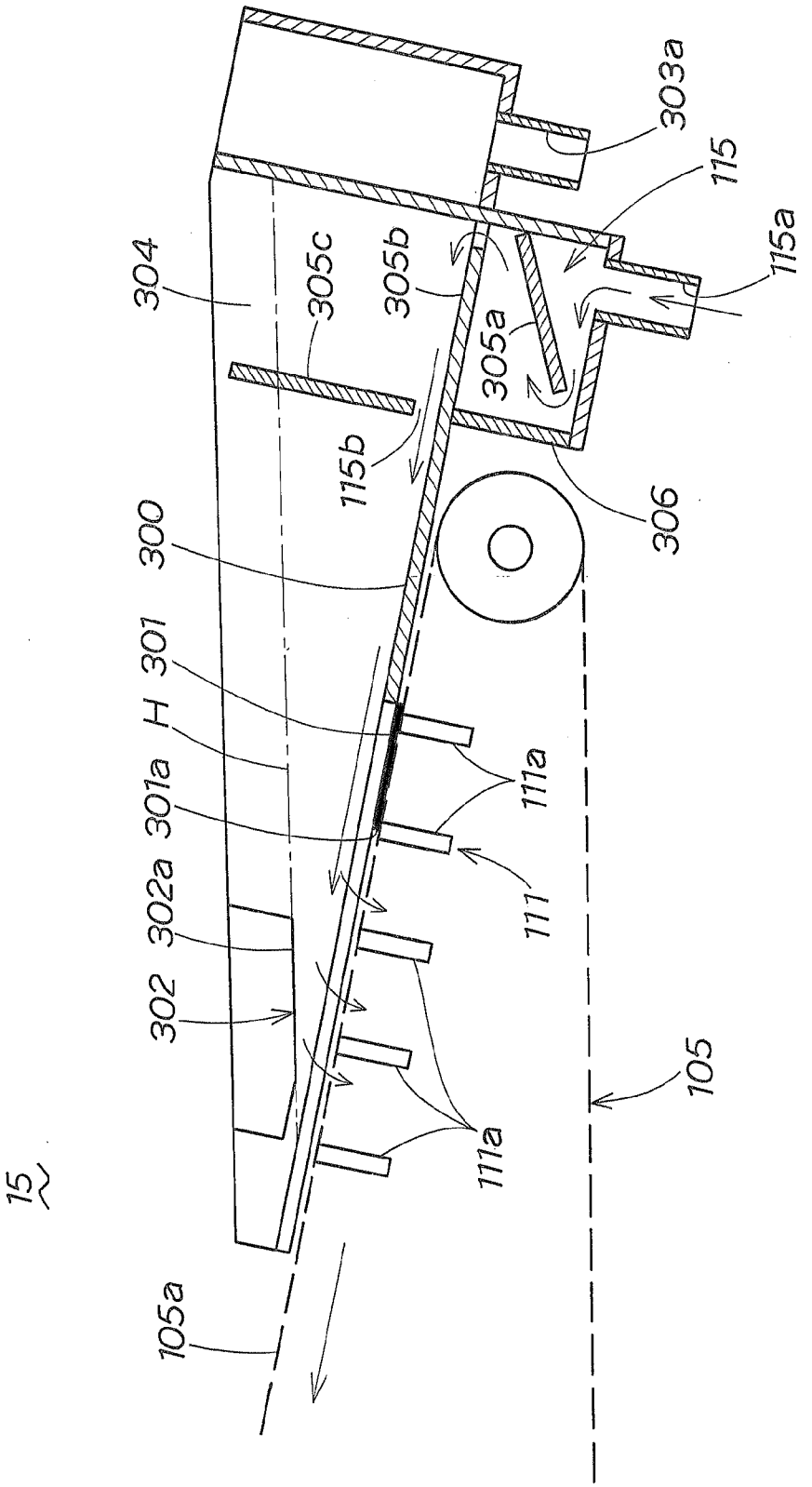

VIII
IX
303a
115a
115
305a
304
305b
305c
303
303
114
114
302
302
301
301a
300
302a
302a
112
L
VIII
IX

Fig. 8


15
303a
115
115a
304
305c
305b
305a
115b
306
300
301
H
301a
302a
302
111a
111
105
105a

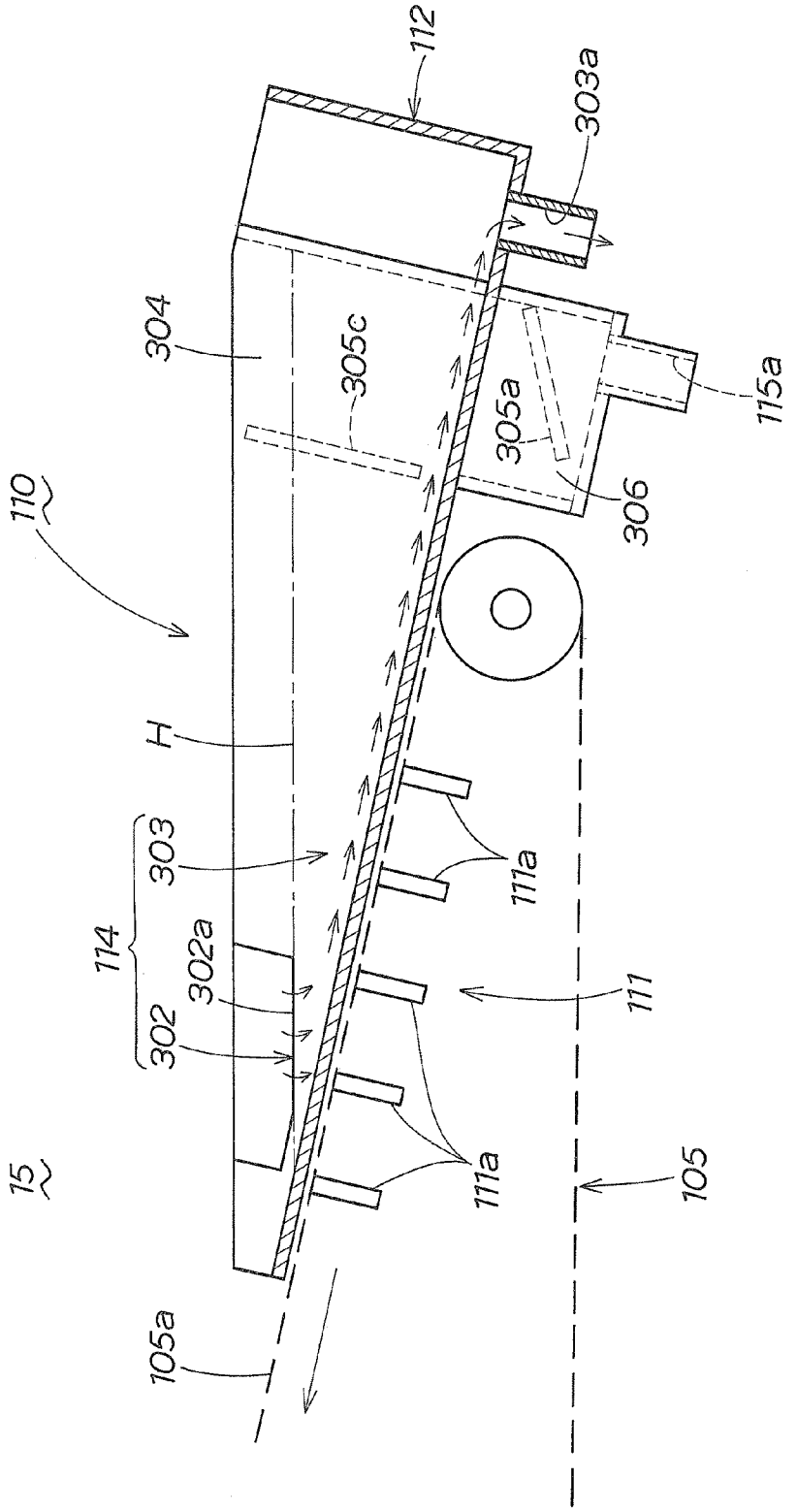

112
303a
304
305c
305a
115a
306
110
H
303
114
302a
302
111a
111
15
105
105a

Fig. 9

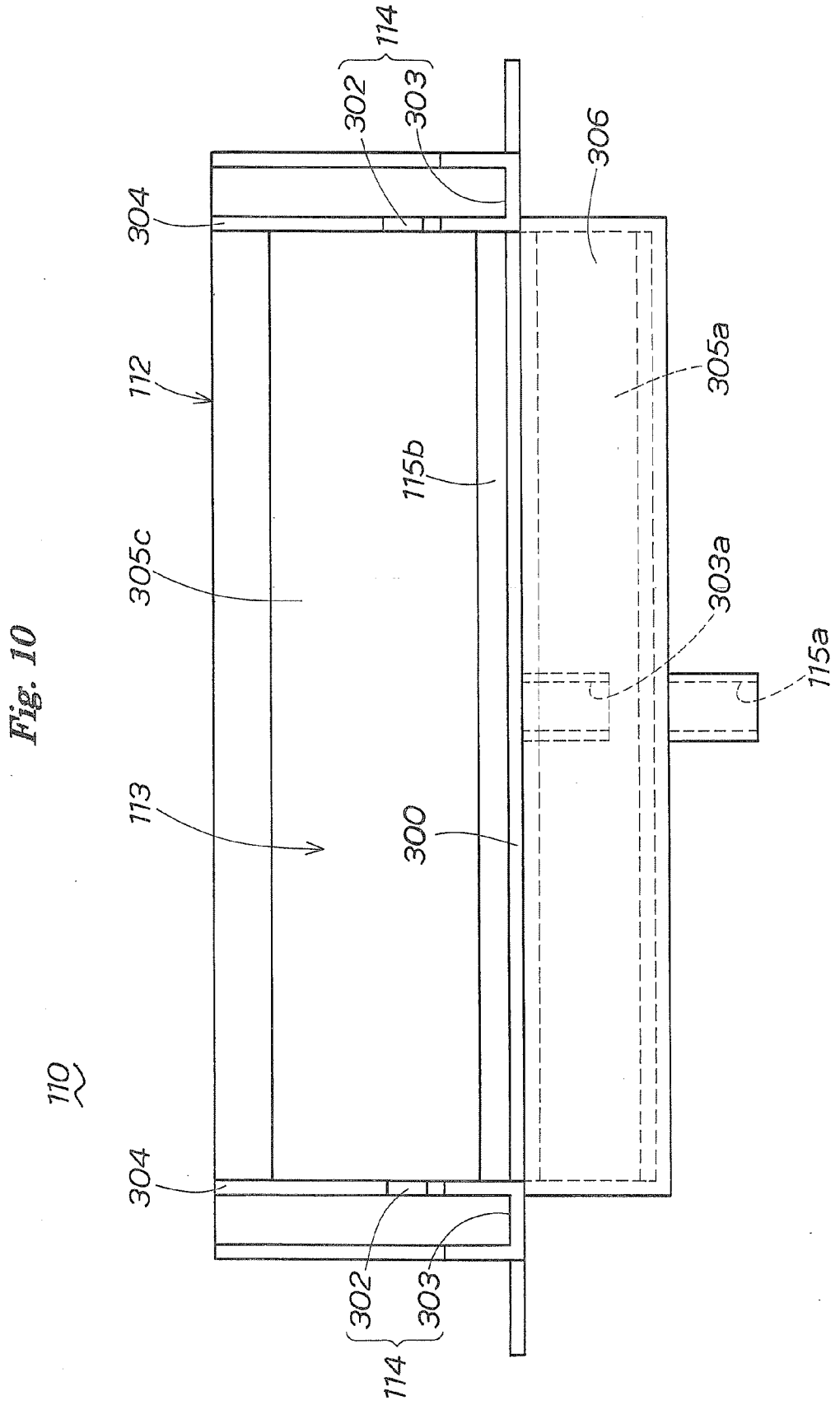
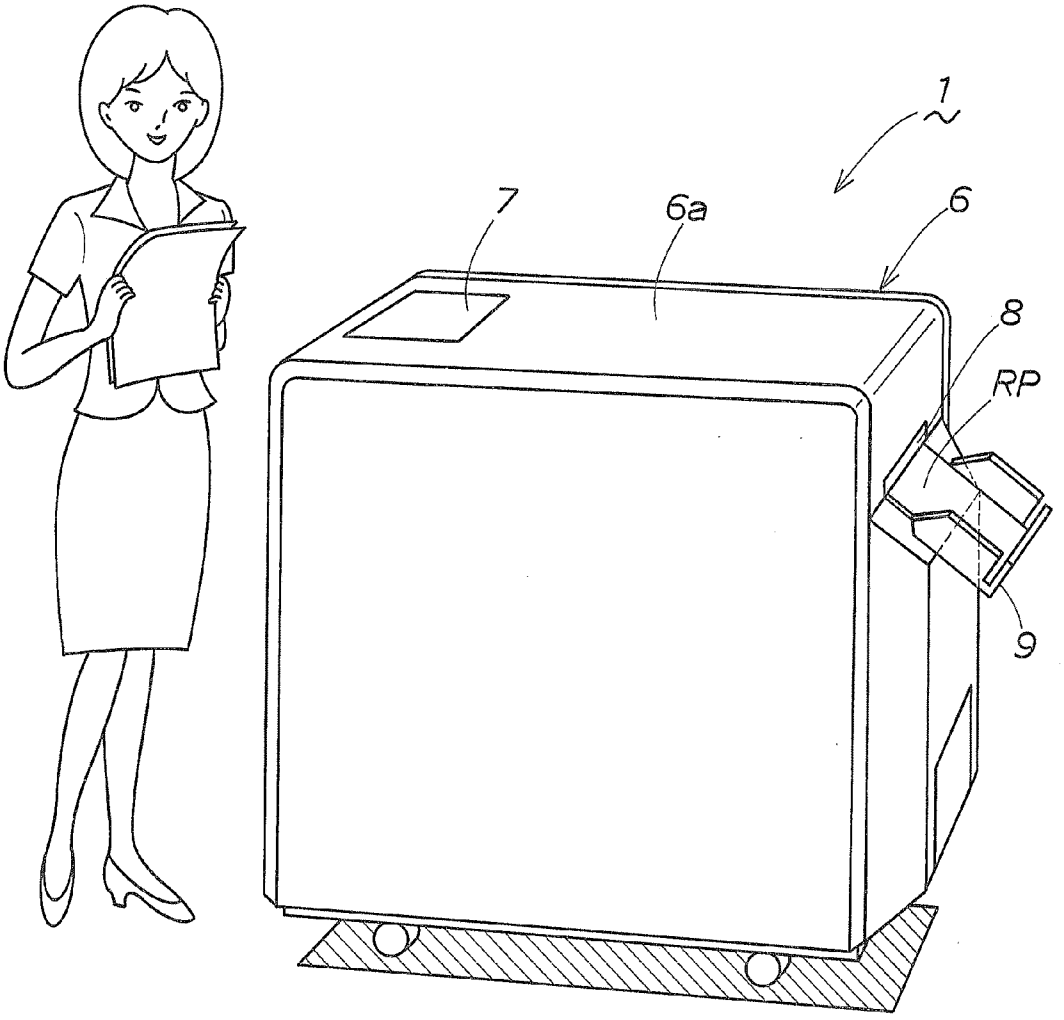


Fig. 10

Fig. 11



PULP FEEDER FOR USED PAPER RECYCLING APPARATUS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a recycled paper smoothing device for used paper recycling apparatus, and more particularly to a pulp feeder for composing a principal component of a paper making unit for manufacturing wet paper by making from a slurry-like pulp suspension, in a used paper recycling apparatus of a small furniture size to be installed at the site of origin of used paper, for regenerating and processing the used paper into a reusable paper at the site without disposing and discarding.

[0003] 2. Description of the Related Art

[0004] Used paper occurs everyday and everywhere, including government offices, companies, and general household, such as used and unnecessary documents. Generally, used paper is disposed as refuse, incinerated, or discarded.

[0005] On the other hand, from the global trend of effective use of limited resources on earth, various technologies have been developed for regenerating and reusing the used paper discarded so far without disposing or discarding.

[0006] These used paper recycling technologies are mostly employed in the paper making industry, and the used paper recycling equipment requires, like an ordinary paper making equipment, a vast land, a tremendous capital investment, and a huge amount of chemicals and water used in paper making, for the purpose of fast and mass production of recycled paper, and enhancement of paper quality.

[0007] Used paper recycling requires manual used paper collection works by many people, and involves various problems, such as mixture of foreign matter, defective sorting due to lack of knowledge about used paper recycling, failure in removal of debris, and many others, and if used paper is collected, in order to regenerate the used paper as recycled paper perfectly by 100%, final sorting by specialists and cleaning or screening should be needed. Moreover, used paper includes confidential documents, and due to the confidential problems, such documents are not collected as general garbage, but may be incinerated and discarded, and recycling is not promoted in certain fields.

[0008] To solve these problems of used paper recycling, it is effective to develop a technology capable of regenerating and utilizing at the site of origin of the used paper, and from such point of view, the present applicant has developed and proposed various used paper recycling apparatus as disclosed, for example, in Japanese Patent Application Laid-Open No. 2007-308837.

[0009] This used paper recycling apparatus relates to a used paper recycling apparatus of a large scale such as used paper recycling plant, realized as an apparatus to be installed indoors in a small shop, a general household, or the like, and the apparatus includes, in an apparatus case of furniture size, a pulp making unit for macerating and beating used paper and manufacturing used paper pulp, a paper making unit for manufacturing recycled paper by making the used paper pulp manufactured in the pulp making unit, and a control unit for driving and controlling the pulp making unit and the paper making unit by interlocking, in which the paper making unit includes a paper making process unit for producing wet paper by making the used paper pulp sent from the pulp making unit, and a drying process unit for produced recycled paper by drying the wet paper made and formed in the paper making process unit, and these two process units are composed in a form of a belt conveyor having a running belt for processing and conveying the used paper pulp.

[0010] The used paper is macerated and beaten in the pulp making unit and becomes used paper pulp, and this used paper pulp is conveyed on the running belt of the belt conveyor in the paper making unit, and is processed in the processes of filtering and dewatering, squeezing and dewatering, and heating and drying, and is recycled paper is obtained. In this process, at the stage of pulp, the used paper is decomposed to fiber level, and written or printed characters and diagrams are completely decomposed and lost, and cannot be restored, so that the confidential information or personal information composed in these characters and diagrams are securely prevented from leaking or disclosing outside.

BRIEF SUMMARY OF THE INVENTION

[0011] It is a primary object of the present invention to present a novel pulp feeder of a used paper recycling apparatus further improved from the conventional used paper recycling apparatus.

[0012] It is other object of the present invention to present a pulp feeder capable of obtaining a recycled paper of uniform texture, stable in the weight of the wet paper made on an endless mesh belt, in a very narrow used paper processing space of a used paper recycling apparatus of furniture size to be installed indoors in a small shop, a general household, or the like, not limited to a large office or the like, in particular, by improving the configuration of the pulp feeder for supplying pulp on the endless mesh belt running in the paper making process unit, by processing the used paper pulp sent from a proceeding process of pulp making unit, at a start end of the paper making process unit of the paper making unit of the used paper recycling apparatus.

[0013] To achieve the object, the pulp feeder of the used paper recycling apparatus of the present invention is a device for composing a pulp feeder of a paper making device in a used paper recycling apparatus of furniture size to be installed at the site of origin of used paper, the paper making device being for manufacturing recycled paper by making from used paper pulp manufactured in a proceeding process of pulp manufacturing unit, including a paper making frame body disposed slidably on the upper side of an endless mesh belt running in a paper making process unit, having a retention unit for retaining a slurry-like pulp suspension mixing the water and used paper pulp sent from the pulp manufacturing unit, and for defining the supply width of the pulp suspension on the upper side of the endless mesh belt, in which the leading end position of this paper making frame body is provided with overflow means for keeping constant the water level of the pulp suspension retained in the retention unit, and the pulp suspension supplied in the paper making frame body is retained in the retention unit to the water level defined the overflow means, and is uniformly dispersed and supplied on the upper side of the endless mesh belt by cooperative action of this retention action and the running action of the endless mesh belt.

[0014] A preferred embodiment is composed as follows.

[0015] (1) The paper making frame body has its frame inside width dimension set at the width dimension of the recycled paper to be manufactured, and the supply width of the pulp suspension on the upper side of the endless mesh belt is defined.

[0016] (2) The overflow means is provided at both side walls of the retention unit at the leading end position of the paper making frame body, and includes an overflow gate for overflowing the pulp suspension when the water level of the pulp suspension retained in the paper making frame body exceeds a specific level, and a collection route passing to a collection port by way of the periphery of the paper making frame body from the outside of this overflow gate.

[0017] (3) The upper edge of the overflow gate is set to be horizontal and straight in a state of the paper making frame body installed on the endless mesh belt.

[0018] (4) The bottom of the paper making frame body is provided with a flat plate member for covering the mesh of the mesh belt in a closed state from the upper side, and the bottom of the retention unit is formed by this flat plate member and the running endless mesh belt, the pulp suspension supplied in the paper making frame body is retained in the retention unit to a water level defined by the overflow means, and is uniformly dispersed and supplied on the upper side of the endless mesh belt by cooperative action of this retention action and the running action of the endless mesh belt.

[0019] (5) The leading end edge of the flat plate member of the paper making frame body is provided with a thin guide sheet for assuring a smooth flow of the pulp suspension on the mesh belt.

[0020] (6) The upstream side of the retention unit in the paper making frame body is provided with a meandering flow passage for promoting uniform dispersion of the supplied pulp suspension, and preventing disturbance of the pulp suspension.

[0021] (7) The meandering flow passage is provided in a zigzag form in a vertical direction between the supply port of the pulp suspension of the paper making frame body and the retention unit.

[0022] (8) The meandering flow passage is provided in a zigzag form in a vertical direction between the supply port of the pulp suspension of the paper making frame body and the retention unit.

[0023] (9) The lower side of the running endless mesh belt is provided with a partition plate member disposed slidably.

[0024] (10) The partition plate member is formed in a louver structure for slidably supporting the lower side of the endless mesh belt.

[0025] (11) The endless mesh belt is disposed upward and obliquely toward the running direction.

[0026] The paper making device of the used paper recycling apparatus of the present invention is a paper making device for composing a used paper recycling apparatus of furniture size to be installed at the site of origin of used paper, for manufacturing recycled paper by making from used paper pulp manufactured in a proceeding process of a pulp making device, comprising a paper making process unit for producing wet paper by making from a slurry-like pulp suspension mixing water and used paper pulp sent from the pulp making device, in which this paper making process unit has a paper making conveyor for conveying while making the pulp suspension, and a pulp feeding unit for feeding the pulp suspension from the pulp making device to the paper making conveyor, being installed at a paper making process start end position of this paper making conveyor, and this pulp feeding unit is composed of the pulp feeder.

[0027] The used paper recycling apparatus of the present invention includes, in an apparatus case of furniture size, a pulp making unit for manufacturing used paper pulp by macerating and beating used paper, a paper making unit for manufacturing recycled paper by making from the used paper pulp manufactured in this pulp making unit, and a control unit for driving and controlling the pulp making unit and the paper making unit by interlock, in which the paper making unit is composed of the paper making device.

[0028] The pulp feeder of the present invention includes a retention unit disposed slidably on the upper side of an endless mesh belt running in a paper making process unit, for retaining a slurry-like pulp suspension mixing the water and used paper pulp sent from the pulp manufacturing unit, and a paper making frame body for defining the supply width of the pulp suspension on the upper side of the endless mesh belt, in which the leading end position of this paper making frame body is provided with overflow means for keeping constant the water level of the pulp suspension retained in the retention unit, and the pulp suspension supplied in the paper making frame body is retained in the retention unit to the water level defined the overflow means, and is uniformly dispersed and supplied on the upper side of the endless mesh belt by cooperative action of this retention action and the running action of the endless mesh belt, and therefore if variation occurs in the supply water amount of the pulp suspension sent into the paper making frame body, the water level of the pulp suspension retained in the paper making frame body is always maintained constant, so that the weight of the wet paper making on the endless mesh belt is stably, and that recycled paper of uniform texture will be obtained.

[0029] Moreover, in the paper making device of the present invention having such pulp feeder, it can be installed not only in a large office, but also in a small shop or general household, and it is friendly to the environment, and low in running cost, and leak or disclosure of confidential information, personal information, and various items of information can be prevented securely, and a used paper recycling apparatus of high confidentiality can be presented.

[0030] These and other objects and features of the present invention will be appreciated by reading the detailed description made in conjunction with the accompanying drawings, and novel facts pointed out in the claims thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] FIG. **1** is a front sectional view showing an overall outline configuration of a used paper recycling apparatus in a preferred embodiment of the present invention.

[0032] FIG. **2** is a side sectional view showing an overall outline configuration of the used paper recycling apparatus of the same.

[0033] FIG. **3** is a circuit diagram showing a configuration of a used paper pulp circulation route of a beating unit of the used paper recycling apparatus of the same.

[0034] FIG. **4** is a block diagram showing a configuration of a pulp concentration adjustment unit of the used paper recycling apparatus of the same.

[0035] FIG. **5** is a perspective view showing an overall outline configuration of a paper making unit of the used paper recycling apparatus of the same.

[0036] FIG. **6** is a perspective view showing a configuration of a pulp feeding unit in the paper making unit.

[0037] FIG. **7** is a plan view showing a configuration of the pulp feeding unit of the same.

[0038] FIG. **8** is a sectional view along line VIII-VIII of FIG. **7** showing the configuration of the pulp feeding unit of the same.

[0039] FIG. **9** is a plan view showing a sectional view along line IX-IX of FIG. **7** showing the configuration of the pulp feeding unit of the same.

[0040] FIG. **10** is a front view showing a configuration of the pulp feeding unit of the same.

[0041] FIG. **11** is a perspective view showing an outline configuration of the used paper recycling apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0042] Preferred embodiments of the present invention are described specifically below while referring to the accompanying drawings. Throughout the drawings, same reference numerals refer to same or similar constituent components or elements.

[0043] A used paper recycling apparatus of the present invention is shown in FIG. **1** to FIG. **11**, and this used paper recycling apparatus **1** is specifically installed at the site of origin of used paper, and is an apparatus for regenerating into a reusable paper at the same site, without disposing or discarding the used paper UP, and the used paper UP includes confidential documents from government offices and general corporate offices, personal letters from general household, and other used and unnecessary documents.

[0044] The used paper recycling apparatus **1** is as small as furniture size shown in FIG. **11**, that is, small and compact similar to document rack, locker, desk, copier, personal computer, and other equipment installed in an office, and includes, as shown in FIG. **1**, main units, specifically a pulp making unit **2**, a pulp concentration adjustment unit **3**, a paper making unit (paper making device) **4**, and a device control unit (control unit) **5**, and the paper making unit **4** includes a pulp feeding unit (pulp feeder) **15** which is a feature mechanism of the present invention.

[0045] These apparatus components **2** to **5** are compact in design to be incorporated and installed in an apparatus case **6**. This apparatus case **6** is a furniture size as mentioned above, and the specific shape and size may be designed appropriately depending on the purpose or application. The apparatus case **6** of the illustrated preferred embodiment is formed like a box of shape and size similar to a copier installed and used in an office, and the top plate of the apparatus case **6** is provided with an inlet port **7** opening and closing for putting in used paper UP, an the side part is provided with an outlet port **8** for discharging recycled paper RP, RP, ... At the lower edge position of this outlet port **8**, a recycled paper receiving tray **9** is detachably provided for receiving the recycled paper RP, RP, . . . discharged from the outlet port **8**.

[0046] The pulp making unit **2** is a process unit for manufacturing used paper pulp by macerating and beating the used paper UP, and consists of a macerating unit **20** for agitating, crushing, and macerating the used paper UP, and a beating unit **21** for beating the used paper UP macerated in this macerating unit **20**.

[0047] The macerating unit **20** is a process unit for agitating, crushing, and macerating the used paper UP, and mainly consists of a macerating tank **25**, an agitating device **26**, and a water feed device **27**.

[0048] The macerating tank **25** is, as shown in FIG. **2**, provided with the inlet port **7** for feeding and supplying the used paper UP in its ceiling wall, and its bottom wall is provided with a discharge port **28** for discharging the macerated used paper pulp UPP to the downstream side. The inner volume of the macerating tank **25** is set depending on the number of used paper UP to be agitated and processed in batch. In the illustrated preferred embodiment, the macerating tank **25** has a capacity of agitating and processing (in batch process) about 500 sheets (about 2000 g) of used paper UP of A4 format PPC (plain paper copier) by adding about 98 liters of water. In this case, the concentration of the used paper pulp UPP to be macerated is about 2%. This concentration adjustment is conducted by water supplied from the water feed device **27**, and this water feed device **27** forms a part of the pulp concentration adjustment unit as described below.

[0049] The inlet port **7** is designed to be opened and closed with respect to the outside of the case cover **6***a* as apparatus case **6**. The discharge port **28** is opened and closed by a switch valve **29**, and is connected to a used paper circulation route **49** mentioned below. The position of the discharge port **28** is provided with a debris filter **30** for removing debris harmful for the subsequent process of the beating process, such as clips, staples, and others binding the used paper UP, UP, ...

[0050] The switch valve **29** is opened and closed specifically by crank motion of a crank mechanism **36** by a driving motor **35**. The driving motor **35** is specifically an electric motor, and this driving motor **35** is electrically connected to the device control unit **5**.

[0051] An agitating device **26** is provided inside of the macerating tank **25**, and includes an agitating impeller **40** and a driving motor **41**.

[0052] The agitating impeller **40** has its rotation shaft **40***a* rotatably supported in an upright position in the bottom center of the macerating tank **25**, and the lower end of the rotation shaft **40***a* is driven and coupled to a rotation shaft **41***a* of the driving motor **41** by way of transmission means **42** composed of a transmission pulley **42***a*, a transmission belt **42***b*, and a transmission pulley **42***c*.

[0053] The water feed device **27** is to supply water W into the macerating tank **25**, and composes a beating concentration adjustment unit **3**A of the pulp concentration adjustment unit **3** as described below.

[0054] The water feed device **27** of the illustrated preferred embodiment includes, as shown in FIG. **1**, a white water collection tank **45**, a water feed pump **46** for beating concentration adjustment, and a water feed pump **47** for paper making concentration adjustment. The white water collection tank **45** is, as described below, designed to collect white water W filtered and dewatered in the paper making unit **4** (that is, pulp water of ultra-low concentration filtered by the paper making mesh in the paper making process), and the white water W collected in the white water collection tank **45** is supplied into the macerating tank **25** through the water feed pump **46**, and into a concentration adjustment tank **85** through the water feed pump **47** mentioned below.

[0055] In this relation, in the bottom of the macerating tank **25**, a weight sensor **48** is provided, and the used paper UP, UP, . . . and the amount of water processed in batch in the macerating tank **25** are weighed and controlled, and the weight sensor **48** is electrically connected to the device control unit **5**.

[0056] The weight sensor **48** of the illustrated preferred embodiment is composed of a load cell, and is designed to sense and measure the total weight of the used paper UP, UP, and the water charged and supplied in the macerating tank **25**.

[0057] In a specific control configuration of the macerating unit **20**, first the operator opens the inlet port **7**, and charges used paper UP, UP, . . . into the macerating tank **25**, and its weight is sensed and measured by the weight sensor **48**, and when reaching the specified weight (number of sheets), it is

noticed to the operator by sound and/or display. Corresponding to this display, the operator closes the inlet port **7**, and the water feed device **27** is driven, and the feed water pump **46** supplies the water W in the white water collection tank **45** into the macerating tank **25** by the amount corresponding to the charged weight (number of sheets) of the used paper UP, UP, ...

[0058] When the operator closes the inlet port **7** after feeding an arbitrary amount (smaller than the specified weight (number of sheets)) of used paper UP, UP, . . . into the macerating tank **25** from the inlet port **7**, the weight is sensed and measured by the weight sensor **48**, and the water feed device **27** is driven, and a proper amount of water W corresponding to the result of measurement is supplied into the macerating tank **25** from the white water collection tank **45**.

[0059] In the illustrated preferred embodiment, as mentioned above, when a maximum of about 500 sheets (about 2000 g) of A4 format PPC used paper UP is charged into the macerating tank **25**, at this moment, it is noticed to the operator by sound and/or display, and by the closing action of the inlet port **7**, about 98 liters of water is supplied from the water feed device **27**, or when an arbitrary amount (smaller than the specified weight (number of sheets)) of used paper UP, UP, . . . is supplied, a proper amount of water corresponding to the supplied amount of the used paper is added from the water feed device **27**, and the concentration of the used paper pulp UPP to be macerated is controlled and adjusted to be about 2%.

[0060] In the agitating device **26**, the used paper UP, UP, . . . charged into the macerating tank **25** from the supply opening of the apparatus case **6**, that is, the inlet port **7**, are operated by normal and reverse rotation of the agitating impeller **40** by the driving motor **41**, and agitated and mixed for a specified time (10 to 20 minutes in the illustrated preferred embodiment) in the water supplied from the water feed device **27**, so that the used paper UP, UP, . . . are macerated and beaten, and used paper pulp UPP is obtained.

[0061] The discharge port **28** of the macerating tank **25** is closed by the switch valve **29** during operation of the macerating unit **20**, and flow of used paper UP or used paper pulp UPP from the macerating tank **25** into the used paper pulp circulation route **49** is prevented, and the discharge port **28** is opened by the switch valve **49** during operation of the beating unit **21** described below, and the flow of used paper pulp UPP from the macerating tank **25** into the used paper pulp circulation route **49** and the circulation flow are allowed.

[0062] The beating unit **21** is a process unit for beating the used paper UP macerated in the macerating unit **20**, and specifically the used paper UP macerated in the macerating unit **20** is pressurized and beaten, and the inks for forming characters and patterns on the used paper UP (printing ink forming characters and patterns on the used paper UP by various printing technologies, characters and patterns formed on the used paper UP by pencil, ball-point pen, fountain pen, or the like, and other inks) are ground and pulverized (to be micro-fibers).

[0063] The beating unit **21** has a grinder **50** as a principal component. This grinder **50** mainly includes a pair of beating disks **51**, **52** rotated and driven relatively, and the pair of beating disks **51**, **52** are disposed oppositely and concentrically across a tiny beating gap G between beating action faces **51***a*, **52***a*.

[0064] The beating gap G of the beating action faces **51***a*, **52***a* of the grinder **50** is set to be narrower gradually from the grinder **50** for initial period to the grinder **50** for terminal period of the beating process, as described below.

[0065] In the beating unit **21** of the present preferred embodiment, as shown in FIG. **3**, the used paper pulp circulation route **49** comprising one grinder **50** is formed, and the used paper UP is beaten and processed while being circulated for a specified time by way of the grinder **50** in a circulation system.

[0066] By the execution of the beating process by the used paper pulp circulation route **49**, in spite of a very small and narrow process space of the apparatus case **6** of furniture size, a used paper pulp beating process route of limitless length basically not limited in length, a beating process space practically equal to the beating process in a large-scale plant can be assured, and an optimum beating effect can be obtained depending on the purpose.

[0067] In relation to one grinder **50** for executing the beating process throughout the whole process of the beating process, this one grinder **50** plays the function of a plurality of grinders from the grinder for initial period to the grinder for terminal period of the beating process. Specifically, the beating gap G of the beating action faces **51***a*, **52***a* of this grinder **50** is controlled and adjusted to be narrower gradually from the initial period to the terminal period of the beating process.

[0068] The grinder **50** of the illustrated preferred embodiment as shown in FIG. **2** is installed adjacently to the macerating tank **25** of the macerating unit **20**, in an apparatus machine body **54** for composing the apparatus case **6**, and as shown in FIG. **3**, it includes a beating tank **55** communicating with the macerating tank **25** of the macerating unit **20**, the pair of beating disks **51**, **52** rotatably provided relatively in this beating tank **55**, a rotation drive source **56** for rotating the pair of beating disks **51**, **52** relatively, and gap adjusting means **57** for adjusting the beating gap G of the pair of beating disks **51**, **52**.

[0069] The beating tank **55** is formed in a closed cylindrical shape capable of accommodating the pair of beating disks **51**, **52**, and has a supply port **55***a* for supplying the used paper pulp UPP from the upstream side, and a discharge port **55***b* for discharging the beaten used paper pulp UPP to the downstream side.

[0070] Specifically, the supply port **55***a* is opened toward the vertical direction in the center of the bottom of the beating tank **55**, and the discharge port **55***b* opened toward the horizontal direction at the cylindrical side of the beating tank **55**. The supply port **55***a* and the discharge port **55***b* are connected, as shown in FIG. **3**, to communicate with the macerating tank **25** of the macerating unit **20**, respectively by way of circulation pipings **49***a*, **49***b*, and the discharge port **55***b* further communicates with a used paper pulp collection tank **60** by way of a discharge piping **59**.

[0071] Reference numeral **61** is a direction changeover valve, and by the switching action of this direction changeover valve **61**, the used paper pulp UPP discharged from the discharge port **55***b* is selectively returned to the macerating tank **25**, or collected in the used paper pulp collection tank **60**. The direction changeover valve **61** is specifically an electromagnetic valve, and it is electrically connected to the device control unit **5**.

[0072] One of the pair of beating disks **51**, **52** is a fixed side beating disk fixed and provided in the rotating direction, and the other is a rotating side beating disk capable of rotating. In the illustrated preferred embodiment, the upper side beating disk **51** is the rotating side, and the lower side beating disk **52**

is the fixed side, and with respect to the lower side fixed side beating disk **52**, the upper side rotating side beating disk **51** is disposed oppositely concentrically and rotatably across a tiny beating gap G. This rotating side beating disk **51** is coupled and driven to a driving motor **56** by way of a rotation main shaft **64** supported rotatably at the fixed side of the apparatus machine body **54** and movably in the axial direction.

[0073] The rotation main shaft **64** is rotatably supported on an elevating member of the gap adjusting means **57** although not shown specifically, and the rotating side beating disk **51** is fitted to its leading end concentrically and integrally, and its base end part is driven and coupled to the rotation shaft of the driving motor **56** integrally in the rotating direction, and relatively movably in the axial direction.

[0074] The driving motor **56** is a rotation drive source, and it relatively rotates the pair of beating disks **51**, **52**, and an electric motor is used specifically, and this driving motor **56** as the drive source is electrically connected to the device control unit **5**.

[0075] Opposite faces **51***a*, **52***a* of the both beating disks **51**, **52** forming the tiny beating gap G cooperate with each other, and form beating action faces. These opposite beating action faces **51***a*, **52***a* are grinding wheel surfaces formed of multiple abrasive grains bonded by a bonding material. The both beating action faces **51***a*, **52***a* are formed in a taper shape, as shown in FIG. **3**, so that the diameter dimension may be larger continuously in the mutually opposite directions, and the outermost peripheral edges are mutually parallel annular flat surfaces, and these annular flat surfaces form the beating gap G.

[0076] In other words, in the pair of beating disks **51**, **52**, at the central position of the beating action face **52***a* of the fixed side beating disk **52**, an inlet **70** is formed so as to communicate coaxially with the supply port **55***a* of the beating tank, and two annular flat surfaces formed on the outer peripheral edges of the beating action faces **51***a*, **52***a* of the pair of beating disks **51**, **52** communicate with the discharge port **55***b* of the beating tank **55**, and form a outlet **71** having the beating gap G.

[0077] On the outer circumference of the rotating side beating disk **51**, a plurality of blades **72**, **72**, . . . are provided at specified intervals in the circumferential direction, and these blades **72**, **72**, . . . are rotated by the rotating side beating disk **51**, and the used paper pulp UPP discharged from the outlet **71** is forced out by pumping action toward the discharge port **55***b* of the beating tank **55** by a centrifugal force.

[0078] In this way, by the driving motor **56** as the drive source, when the rotating side beating disk **51** is rotated and driven with respect to the fixed side beating disk **52**, the used paper pulp UPP supplied in the beating space B from the macerating tank **25** of the macerating unit **20** by way of the supply port **55***a* and the inlet **70** of the beating tank **55** flows into the beating space B from the inlet **70**, and passes through this beating space B, and is pressurized and beaten by the relatively rotating beating action faces **51***a*, **52***a*, and the inks forming characters and patterns on the used paper UP are ground and pulverized, and the used paper UP is discharged through the discharge port **55***b* of the beating tank **55** from the outlet **71**.

[0079] When being discharged from the outlet **71**, the used paper pulp UPP further receives the pressurizing and beating actions at the location of the outlet **71** having the beating gap G, and is pulverized to a micron size (to be micro fibers) specified by the beating gap G.

[0080] In this regard, in the present preferred embodiment, as mentioned above, since the used paper pulp circulation route **49** is provided with the circulation beating process (see FIG. **3**) having one grinder **50**, that is, the one grinder **50** functions as a plurality of grinders from the grinder for initial period to the grinder for terminal period of the beating process, and the beating gap G of this grinder **50** is controlled and adjusted so as to be gradually narrower from the initial period to the terminal period of the beating process by the gap adjusting means **57**.

[0081] The gap adjusting means **57** is composed to control and adjust the beating gap G of the beating disks **51**, **52**, although not shown specifically, by moving the pair of beating disks **51**, **52** relatively in the rotation axial direction, and is mainly composed of moving means (not shown) for moving the rotating side beating disk **51** in the rotation axial direction, that is, in the axial direction of the rotation main shaft **64**, and a drive source **66** for driving this moving means. The drive source is specifically an electric motor, and this driving motor **66** is electrically connected to the apparatus control unit **5**.

[0082] By rotation of this electric motor **66**, the rotation main shaft **64** is moved up and down by way of the moving means, and the rotating side beating disk **51** integral with the rotation main shaft **64** is moved in the vertical direction to the fixed side beating disk **52**, that is, in the rotation axial direction, and the beating gap G of the both beating disks **51**, **52** is controlled and adjusted.

[0083] For this purpose, a position detection sensor (not shown) is provided for detecting the elevating position of the rotating side beating disk **51**, and by the detection result of the position detection sensor, the driving motor **66** is controlled and driven. The position detection sensor is electrically connected to the device control unit **5**.

[0084] The beating gap G of the beating disks **51**, **52** by the gap adjusting means **57** is controlled and adjusted in mutual cooperation with a circulation pump **69** as circulation means, in the circulation beating process in the used paper pulp circulation route **49** shown in FIG. **3**.

[0085] That is, in FIG. **3**, the used paper pulp UPP macerated and processed in the macerating unit **20** is circulated in the used paper circulation route **49** by means of the circulation pump **69**, and the beating process is executed by the grinder **50**, and at this time the beating gap G of the beating action faces **51***a*, **52***a* of the grinder **50** is adjusted to be narrower gradually from the initial period to the terminal period of the beating process by the gap adjusting means **57**.

[0086] In this manner, one grinder **50** is disposed in the used paper pulp circulation route **49**, and the beating gap G of this grinder **50** is controlled and adjusted to be narrower gradually from the initial period to the terminal period of the beating process in the circulation system, and therefore in a very narrow process space of furniture size, the used paper pulp UPP is repeatedly and sequentially processed by the pressurizing and beating action and the ink grinding and pulverizing action by the beating action faces **51***a*, **52***a* of grinder **50** becoming gradually narrower in the beating gap G, and further the beating and the ink grinding and pulverizing actions are executed uniformly on the entire used paper pulp UPP circulating in the used paper pulp circulation route **49**. As a result, an optimum paper tenacity is obtained for the recycled paper RP made and regenerated in the paper making unit **4** described below, and the recycled paper RP of high degree of whiteness (equal to de-inked quality) will be obtained.

[0087] The used paper pulp circulation route **49** includes the macerating tank **25** of the macerating unit **20**, and in this relation, in the beating process, the agitating device **26** of the macerating unit **20** is driven and controlled, and the macerating unit **20** and the beating unit **21** are driven at the same time. That is, in the circulation type beating process, while the used paper pulp UPP flows out from the macerating tank **25** into the used paper pulp circulation route **49**, the used paper pulp UPP after beaten by the grinder **50** flows into the macerating tank **25**, and therefore in the macerating tank **25**, the used paper pulp UPP different in the beating degree is mixed, and by the agitating action by the agitating device **26**, the beating degree of the used paper pulp UPP in the macerating tank **25** is made uniform, and the beating process is promoted.

[0088] The used paper pulp collection tank **60** is a location for collecting the used paper pulp UPP beaten and pulverized to a specified size by the beating unit **21**, and the used paper pulp UPP collected herein is sent into the pulp concentration adjustment unit **3** to be processed into a pulp suspension PS mixed and adjusted to a paper making concentration corresponding to the finished paper quality of the recycled paper RP to be regenerated before being sent into the paper making unit **4** of the next process of paper making process.

[0089] The pulp concentration adjustment unit **3** is a weight type device for adjusting the mixing rate of the used paper UP and the water W to be charged into the apparatus, and adjusting the concentration of the used paper pulp UPP to be supplied in the paper making unit **4**, and specifically as shown in FIG. **4**, it includes a beating concentration adjustment unit **3**A, a paper making concentration adjustment unit **313**, and a pulp concentration control unit **3**C,

[0090] The beating concentration adjustment unit **3**A is intended to adjust the beating concentration of the used paper pulp UPP in the pulp making unit **2**, corresponding to the beating efficiency by the beating unit **21**, and mainly includes the water feed pump **46** for beating concentration adjustment of the water feed device **27**, as mentioned above, and a beating concentration control unit **75**.

[0091] The supply amount of white water W by the water feed pump **46** of the beating concentration adjustment unit **3**A is preferably set so that the beating concentration of the used paper pulp UPP macerated and beaten by the agitating device **26** may be the maximum concentration allowable for the beating capacity of the grinder **50** of the beating unit **21** for executing the next process of beating process, and in the illustrated preferred embodiment, it is set to be a beating concentration of about 2% as mentioned above.

[0092] The beating concentration control unit **75** drives and controls, as mentioned above, the water feed pump **46** so as to supply a necessary amount of water W into the macerating tank **25**, depending on the measurement result from the weight sensor **48**. This beating concentration control unit **75** forms a part of the device control unit **5** as described below.

[0093] The paper making concentration adjustment unit **3**B is for adjusting the paper making concentration of the used paper pulp UPP in the paper making unit **4** to an appropriate concentration corresponding to the finished paper quality of the recycled paper RP for regenerating, and is specifically designed to adjust the concentration of the used paper pulp UPP manufactured in the pulp making unit **2** in division type, and it mainly includes a division extraction unit **80**, a suspension adjustment unit **81**, and a paper making concentration control unit **82**.

[0094] The division extraction unit **80** is for dividing and extracting a specified small amount from the whole volume of the used paper pulp UPP manufactured in the pulp making unit **2** in the proceeding process, and includes a used paper pulp supply pump **86** for division extraction for extracting the used paper pulp UPP of the used paper pulp collection tank **60** and sending into a concentration adjustment tank **85**.

[0095] The suspension adjustment unit **81** is for preparing the pulp suspension PS of a specified concentration by adding a specified amount of water W for concentration adjustment to a specified small amount of used paper pulp UPP divided and extracted by the division extraction unit **80**, and mainly includes the water feed pump **47** of the water feed device **27** as mentioned above.

[0096] Specifically, although not shown in the drawing, in the bottom of the concentration adjustment tank **85**, same as in the macerating tank **25** stated above, a weight sensor **87** formed of a load cell is provided, and it is designed to measure and control the amount of used paper pulp UPP and water W for concentration adjustment supplied into the concentration adjustment tank **85**, and the weight sensor **87** is connected electrically to the device control unit **5**.

[0097] The paper making concentration control unit **82** is for controlling by interlocking the division extraction unit **80** and the suspension adjustment unit **81**, and forms a part of the device control unit **5**, and interlocks and controls pumps **86**, **47** of the division extraction unit **80** and the suspension adjustment unit **81** so as to execute the paper making concentration adjustment process as described below.

[0098] First of all, from the whole volume of used paper pulp UPP collected in the used paper pulp collection tank **60** from the beating unit **21** (in the illustrated preferred embodiment, about 2000 g of used paper UP+100 liters of water W), a specified portion (1 liter in the illustrated preferred embodiment) of used paper pulp UPP is divided by the used paper pulp feed pump **86**, and is transferred and contained in the concentration adjustment tank **85**. As a result, the weight is sensed and measured by the weight sensor **87**, and the result is transmitted to the device control unit **5**.

[0099] In succession, corresponding to the specified portion of the divided used paper pulp UPP, the water feed pump **47** supplies a specified amount of water W for dilution into the concentration adjustment tank **85** from the white water collection tank **45** (9 liters in the illustrated preferred embodiment (actually as measured by the weight sensor **87**)).

[0100] In consequence, in the concentration adjustment tank **85**, the used paper pulp UPP of beating concentration (2% in the illustrated preferred embodiment) and the water W are mixed and diluted, and pulp suspension PS of specified concentration (in the illustrated preferred embodiment, about 0.2% concentration (target concentration)) is prepared.

[0101] Meanwhile, the target concentration of the pulp suspension PS to be prepared is set in consideration of the paper making capacity in the paper making unit **4** as described below on the basis of the preliminary experiment, and it is set at about 0.2% as mentioned above in the case of the illustrated preferred embodiment.

[0102] In this manner, the pulp suspension PS adjusted to the target concentration of paper making concentration (0.2%) in the concentration adjustment tank **85** is transferred and supplied into a pulp supply tank **89** from the concentration adjustment tank **85** by way of a first suspension supply pump **88**, and is temporarily stored in wait for the next process of the paper making unit **4**. Hereinafter, this paper making

concentration adjustment process is repeatedly executed similarly for the whole amount of the used paper pulp UPP in the used paper pulp collection tank **60**. In the pulp supply tank **89**, a second suspension supply pump **90** is provided for sending the pulp suspension PS to a paper making belt conveyor unit **95** of the paper making unit **4**.

[0103] An agitating device **91** is provided in the pulp supply tank **89**, and by the agitating action of this agitating device **87** (**91**?), the entire paper making concentration of the temporarily stored pulp suspension PS is maintained uniformly at a specific value.

[0104] Thus, since the concentration adjustment by the paper making concentration adjustment unit **3** is not executed in batch of whole volume, but in small divided portions or dispensed portions, not only the water consumption is saved substantially, but also the shape and size of the concentration adjustment tank **85** can be reduced substantially, and the entire structure of the used paper recycling apparatus **1** is realized in a compact design.

[0105] The pulp concentration control unit **3**C is to drive and control the beating concentration adjustment unit **3**A and the paper making concentration adjustment unit **3**B in cooperation, and specifically by receiving the pulp concentration control information (the charged amount of used paper UP, water supply amount to the macerating tank **25**, beating concentration of used paper pulp UPP, and others) from the beating concentration control unit **75** of the beating concentration adjustment unit **3**A, depending on this control information, the paper making concentration control information (the target paper making concentration of the used paper pulp UPP, the division extraction amount of the used paper pulp UPP from the used paper pulp collection tank **60**, the water supply amount to the concentration adjustment tank **85**, and others) for controlling the concentration of the used paper pulp UPP manufactured in the pulp making unit **2** to the target value (paper making concentration) is sent to the paper making concentration control unit **82** of the paper making concentration adjustment unit **3**B, so that the paper making concentration adjustment process mentioned above can be executed.

[0106] The paper making unit **4** is a process unit for manufacturing recycled paper RP by making from the used paper pulp UPP manufactured in the proceeding process of the pulp making unit **2**, and as shown in FIG. **1** and FIG. **5**, it mainly includes a paper making belt conveyor unit (paper making process unit) **95**, a dewatering roll unit **96**, and a drying belt conveyor unit **97**, and the paper making belt conveyor unit **95** is provided with a pulp feeding unit (pulp feeder) **15** which is a feature mechanism of the present invention as mentioned above.

[0107] The paper making belt conveyor unit **95** is a location functioning as the paper making process unit for manufacturing wet paper by making from a slurry-like pulp suspension mixing the water W and used paper pulp UPP sent from a pulp feeding tank **89** in the pulp manufacturing unit **2**, and mainly includes a paper making net conveyor (paper making conveyor) **100**, and the pulp feeding unit **15**.

[0108] The paper making net conveyor **100** is for conveying the pulp suspension while making paper, and has a mesh belt **105** of paper making mesh structure composed of numerous mesh cells for filtering and dewatering the pulp suspension PS disposed to run straightly toward its running direction.

[0109] Specifically, the paper making net conveyor **100** includes the mesh belt (endless mesh belt) **105** formed as an endless belt conveying and running while making paper from the pulp suspension PS, and a drive motor **106** for driving this mesh belt **105**.

[0110] The plate material of the paper making mesh structure for composing the mesh belt **105** is a material capable of filtering and dewatering the pulp suspension PS appropriately through numerous mesh cells of the paper making mesh structure, and preferable examples are polypropylene (PP), polyethylene terephthalate (PET), polyamide (PA) (generally known as Nylon, a registered trademark), stainless steel (SUS), and other corrosion resistant materials, and in the illustrated preferred embodiment, a PET mesh belt **105** excellent in heat resistance is used.

[0111] The paper making mesh structure for composing the mesh belt **105** is preferably fine in mesh size, and fine and smooth in weaving mesh, and may be specifically selected depending on the characteristic of the desired paper, and for example, the following points are taken into consideration.

[0112] (1) Mesh Size of Mesh Belt **105**

[0113] The mesh size of the mesh belt **105** is preferably set at 25 mesh cells to 80 mesh cells, and in the illustrated preferred embodiment, the mesh belt **105** of 50 mesh cells is used.

[0114] (2) Wire Diameter of Mesh of Mesh Belt **105**

[0115] The mesh of the mesh belt **105** is determined not only by the number of mesh cells (size), but also by the wire diameter of the mesh. If the number of mesh cells is the same, the mesh size is smaller when the wire diameter is larger, or larger when the diameter is smaller, and this relation is expressed by the porosity of mesh, or the ventilation degree of airiness ($cm^3/cm^2/sec$).

[0116] For example, when the mesh is fine and the ventilation is poor, the water filtering rate is low, and the shape and dimension of the pulp supply unit **101** described below may be longer in the running direction of the mesh belt **105**, and the apparatus is increased in size. To the contrary, when the mesh is coarse and the ventilation is good, the pulp supply unit **101** is short and the apparatus is small, but the paper quality of the recycled paper RP is coarse, and the difference of smoothness of the face and back sides is larger, and the paper is poor in smoothness.

[0117] Considering these conditions comprehensively, the mesh belt **105** is desired to be small in the wire diameter of mesh, large in the number of mesh cells, and reticular in structure not lowering in the degree of ventilation, in order to prevent the used paper pulp UPP from slipping out of the mesh cells of the mesh belt **105** in the paper making process, and the mesh belt **105** in the illustrated preferred embodiment is a plain-woven PET mesh belt **105** of 50 mesh cells. By using this mesh belt **105**, it has been experimentally proved that a favorable paper quality suited to writing is obtained.

[0118] The width dimension of the mesh belt **105** is set at a specified width dimension slightly larger than the width dimension of the recycled paper RP to be manufactured by making from the pulp suspension PS.

[0119] The mesh belt **105** is supported and suspended so as to be rotatable by way of a drive roller **107**, a dewatering roll unit **96**, a driven roller **108**, and a support roller **109** as shown in FIG. **1** and FIG. **5**, and it is driven and coupled to the drive motor **106** by way of the drive roller **107**.

[0120] The paper making process length in the mesh belt **105** is set in a range of the upper side running direction length of the mesh belt **105** in the apparatus case **6** of furniture size

(in the shown case, the lateral direction length from the pulp supply unit **101** to the dewatering roll unit **96** in FIG. **1**).

[0121] The running speed of the mesh belt **105** is set in consideration of the various conditions in the paper making process, and it is preferably set at 0.1 m/min to 1 m/min, and in the illustrated preferred embodiment, it is set at 0.2 m/min. Incidentally, in the conventional used paper recycling plant of a large scale, the running speed of the paper making belt of this type was set at least at more than 100 m/min, or more than 1000 m/min in a faster version.

[0122] The mesh belt **105** disposed so as to run upward obliquely and straightly toward its running direction as shown in FIG. **1** and FIG. **5**, and the paper making process length is extended considerably in a limited space of installation, and the filtering and dewatering efficiency is enhanced in relation to the paper making mesh structure of the mesh belt **105**.

[0123] The drive motor **106** for driving the mesh belt **105** is specifically an electric motor, and is electrically connected to the device control unit **5**. This drive motor **106** is also used as the drive source of the dewatering roll unit **96** and the drying belt conveyor unit **97** described below.

[0124] The pulp feeding unit (pulp feeder) **15** is a location for supplying the pulp suspension PS on the mesh belt **105** from the pulp making unit **2**, and is disposed at the paper making process start end position of the paper making net conveyor **100**, and from this pulp feeding unit **15**, the pulp suspension PS is uniformly dispersed and supplied on the upper side of the mesh belt **105**.

[0125] A specific structure of the pulp feeding unit **15** shown in the drawing is shown in FIG. **6** to FIG. **10**. That is, in this pulp feeding unit **15**, the mesh belt **105** is disposed upward and obliquely toward the running direction as described above, and a paper making frame body **110** and a partition member **111** are disposed at the upper and lower positions of this mesh belt **105**.

[0126] The paper making frame body **110** is disposed slidably on the upper side of the mesh belt **105**, and is to define the supply width L of the pulp suspension PS sent from the pulp making unit **2** onto the upper side of the mesh belt **105**, and mainly includes a main body frame **112**, a retention unit **113**, an overflow unit (overflow means) **114**, and a flow passage **115**.

[0127] The main body frame **112** is formed in flat U-shape opened at the leading end part, that is, the running direction side end part of the mesh belt **105**, and its lower end side **112***a* is disposed to slide and contact with the upper side **105***a* of the mesh belt **105** running obliquely, and the frame inside width dimension of the main body frame **112**, that is, the frame inside width dimension L of the paper making frame body **110** is set corresponding to the width dimension of the recycled paper RP to be manufactured, and the supply width L of the pulp suspension PS on the upper side **105***a* of the mesh belt **105** is defined (see FIG. **6**, FIG. **7**, and FIG. **10**)

[0128] The retention unit **113** is a location for retaining the slurry-like pulp suspension PS mixing the water W and used paper pulp UPP sent from the pulp making unit **2**, and is specifically disposed in a form of covering the mesh of the mesh belt **105** by a flat plate member **300** in a closed state from the upper side, in the bottom of the main body frame **112**, and the bottom part of the retention unit **113** is formed by this flat plate member **300** and the running mesh belt **105**.

[0129] In this relation, the leading edge of the flat plate member **300** is provided with a thin guide sheet **301** for assuring a smooth flow of the pulp suspension PS to the mesh belt **105**.

[0130] The overflow unit (overflow means) **114** is for keeping constant the water level of the pulp suspension PS retained in the retention unit **113**, and is provided at the leading position of the paper making frame body **110**.

[0131] This overflow unit **114** specifically includes an overflow gate **302** and a collection route **303** as principal component, and in the illustrated preferred embodiment, they are provided at both sides of the retention unit **113** respectively.

[0132] The overflow gate **302** is provided at an inner wall **304** for composing both walls of the retention unit **113** at the leading end position of the main body frame **112**, and causes the pulp suspension PS to overflow when the water level H of the pulp suspension PS retained in the retention unit **113** exceeds a specified level. The inner wall **304** forms the retention unit **113** together with the flat plate member **300** forming the bottom part and the running mesh belt **105** mentioned above.

[0133] An upper edge **302***a* of the overflow gate **302** is set to be horizontal and straight in a state of the paper making frame body **110** disposed on the mesh belt **105**. The height position of the upper edge **302***a* of this overflow gate **302** is set corresponding to various conditions of the mesh belt **105** as mentioned above, so as to maintain the weight of the wet paper RP_0 made on the mesh belt **105** and the recycled paper RP stably at a desired value.

[0134] That is, in order to stably maintain the weight of the wet paper RP_0 made on the mesh belt **105**, the retention action of the pulp suspension PS in the retention unit **113** of the paper making frame body **110** is an important element, and this retention action varies significantly depending on the water volume (retention water amount) of the pulp suspension PS in the retention unit **113**. Accordingly, it is extremely important to stabilize the water amount or the water level H of this pulp suspension PS.

[0135] In this pulp feeding unit **15**, since the overflow gates **302**, **302** are provided, the water level H of the pulp suspension PS in the retention unit **113** is stably maintained at a specified value.

[0136] Moreover, since the overflow gates **302** are provided at both side walls **304**, **304** of the retention unit **113** at the leading end position of the main body frame **112**, that is, closely to the mesh belt **105** for making paper by filtering the pulp suspension PS, the water volume of the pulp suspension PS, that is, the water level H can be maintained stably, and hence the weight of the wet paper RP_0 made on the mesh belt **105** can be always assured stably.

[0137] The collection route **303** is a passage for collecting the pulp suspension PS overflowing from the overflow gate **302**, and communicates with the collection port **303***a* from the outside of the overflow gate **302** through the surrounding of the main body frame **112**.

[0138] The pulp suspension PS overflowing from the overflow gate **302** flows down and is collected in this collection route **303**, and is further collected into the pulp supply tank **89** from the collection port **303***a*, and is re-used.

[0139] The flow passage **115** encourages a uniform dispersion of the pulp suspension PS supplied into the retention unit **113**, and prevents disturbance of the pulp suspension PS, and is formed as a meandering flow passage, and is provided at the upstream side of the retention unit **113**.

[0140] The flow passage **115** is specifically provided in a form curved and bent in a vertical direction between the supply port **115***a* and the retention unit **113** of the pulp suspension PS of the paper making frame body **110**.

[0141] The flow passage **115** in the illustrated preferred embodiment is mainly formed of a plurality of partition plates **305**, **305**, . . . provided in the main body frame **112**, and more specifically the flow passage **115** is formed in bent and curved form, consisting of a partition plate **305***a* provided in the supply unit **306** of the main body frame **112**, a rear part (partition plate) **305***b* of the flat plate member **300** for forming the bottom of the main body frame **112**, and a partition plate **305***c* provided upright in the main body frame **112**. The running direction of the flow passage **115** is formed in an upward direction from its inlet, that is, the supply port **115***a* opened in the bottom of the supply unit **306**, turning around the partition plate **305***a*, further turning around the partition plate **305***b*, and extending toward the outlet **115***b* opened at the lower side of the partition plate **305***c* (see arrow in FIG. **8**). The supply port **115***a* can communicate with the pulp supply tank **89** for supplying the pulp suspension PS.

[0142] The upper edge of the partition plate **305***c* provided upright in the main body frame **112** is provided so as to be positioned at the water level of the pulp suspension PS flowing and stagnant on the flat plate member **116**, that is, at a lower level than the water level H defined by the overflow gate **302**.

[0143] The assembly structure of the partition plates **305***a*, **305***b*, **305***c* for forming the flow passage **115** and the main body frame **112** is not specified, and for example, the partition plates **305***a*, **305***b*, **305***c* may be formed independently, and connected and assembled integrally with the main body frame **112**, or they may be formed integrally when made of injection molding plastic material or integral forming material.

[0144] The partition member **111** is composed of a plurality of framework members **111***a*, **111***a*, . . . , having a louver structure capable of draining, and has a shape and size capable of sliding and supporting the entire width of the lower side of the mesh belt **105**.

[0145] In this relation, at the leading end of the flat plate member **116** of the paper making frame body **110**, as mentioned above, a thin guide sheet **301** is provided for assuring a smooth flow of the pulp suspension PS on the mesh belt **105**, and the leading edge **88***a* of this guide sheet **88** is set at a position corresponding to the beams for composing the louver structure of the partition member **111**, that is, one of the framework members **111***a*, **111***a*, . . . , and is more specifically disposed slidably on the upper position of the mesh belt **105** supported by this beam **111***a*.

[0146] The action and effect of the flow passage structure of the pulp suspension PS in the pulp feeding unit **15** are estimated as follows.

[0147] (i) Meandering Route of Flow Passage **115**

[0148] The flow passage **115** divided and formed by the partition plates **305** (**305***a*, **305***b*, **305***c*) is meandering and long, and the pulp suspension PS passes through this flow passage **115**, and is dispersed uniformly, and disturbance of the pulp suspension PS is prevented effectively.

[0149] (ii) Overflow Gate **302**

[0150] By the presence of the overflow gates **302**, **302**, if the supply amount of the pulp suspension PS in the paper making frame body **110** varies, the water level H of the pulp suspension PS retained in the paper making frame body **110** is always maintained at a specific level, so that the weight (paper thickness) of the wet paper RP_0 made on the mesh belt **105** may be stabilized.

[0151] That is, in the paper making process, in order to keep constant the weight (paper thickness), it is necessary to keep constant the supply amount of the pulp suspension PS onto the mesh belt **105**. In the supply amount adjustment by the second suspension supply pump **90** mentioned above, since the pump rotation=supply amount of pulp suspension PS is not constant, the variation of the weight is significant.

[0152] By contrast, when the water level H of the pulp suspension PS retained in the paper making frame body **110** is constant, the supply water volume of the pulp suspension PS is constant, and by noticing this phenomenon, the pulp suspension PS is allowed to overflow from the leading end of the paper making frame body **110**, and the water level H of the pulp suspension PS retaining in the paper making frame body **110** is kept constant. As a result, if the discharge amount of the second suspension supply pump **90** varies, the water level is constant, and a stable weight is obtained. In addition, precise pump control is not necessary.

[0153] (iii) Thin Guide Sheet **301** at the Leading Edge of Flat Plate Member **300**

[0154] Since the leading edge **301***a* of the guide sheet **301** is disposed slidably on the upper side position of the mesh belt **105** supported by the assembly member **111***a* for forming the louver structure of the partition member **111**, uniform water filtering by the net of the mesh belt **105** is assured.

[0155] Between the assembly members **111***a*, **111***a* of the partition member **111**, the pulp suspension PS tends to flow freely also in the direction of the driven roller **108** when being filtered through the paper making mesh structure of the mesh belt **105**, and hence uniform water filtering by the mesh cells is difficult, and uneven water filtering may occur locally. When the water filtering is not uniform, the recycled paper RP may have longitudinal patterns.

[0156] By contrast, as in the illustrated preferred embodiment, since the leading edge **301***a* of the guide sheet **301** is set at the upper side position of the assembly member **111***a* for forming the louver structure of the partition member **111**, such inconvenience can be avoided effectively.

[0157] The upstream side of the pulp feeding unit **15** is provided with the pulp supply tank **89** for supplying the pulp suspension PS to the pulp feeding unit **15**.

[0158] The pulp suspension PS retained in the pulp supply tank **89** is supplied by the second suspension supply pump **90**, and supplied into the flow passage **115** in the paper making frame body **110** from the supply port **115***a*, and passes slowly in this meandering flow passage **115** as indicated by arrow in FIG. **8**, and flows into the retention unit **113** from the outlet **115***b*, and is retained to the water level H defined by the overflow gates **302**, **302**, and is uniformly dispersed and supplied on the upper side of the mesh belt **105** running being disposed upward and obliquely toward the running direction, by the cooperative action of this retention action and the running action of the mesh belt **105**.

[0159] On the other hand, the pulp suspension PS flowing down and collected in the collection route **303** by overflowing from the overflow gate **302** is collected in the pulp supply tank **89** as mentioned above.

[0160] The pulp suspension PS uniformly dispersed on the upper side of the mesh belt **105** is conveyed together with the mesh belt **105**, by the running action off the mesh belt **105** in the arrow direction, and is dewatered by the self-weight fil-

tering action by the mesh of the mesh belt **105**, and wet paper RP_0 (water content 90 to 85% in the illustrated preferred embodiment) is obtained.

[0161] The white paper W filtered and dewatered by the mesh belt **105** (the pulp water of an ultra-low concentration filtered by the paper making mesh in the paper making process) is collected in the white water collection tank **45** of the water feed device **27** as mentioned above.

[0162] The dewatering roll unit **96** composes a location for squeezing and dewatering the wet paper RP_0 on the mesh belt **105** at the linkage position of the paper making belt conveyor unit **95** mentioned above and the drying belt conveyor unit **97** described below.

[0163] More specifically, the smooth surface belt **145** described below of the drying belt conveyor unit **97** at the downstream side, and the mesh belt **105** of the paper making belt conveyor unit **95** at the upstream side are stacked up in upper and lower layers as shown in FIG. **1** and FIG. **5**, and the upper and lower adjacent portions of the smooth surface belt **145** and the mesh belt **105** are the linkage location, and at this linkage location, the dewatering roll unit **96** rolls and squeezes the mesh belt **105** and the smooth surface belt **145** by squeezing from upper and lower sides, thereby dewatering.

[0164] The dewatering roll unit **96** includes at least a preliminary dewatering roll unit **96**A, and a final dewatering roll unit **96**B.

[0165] The illustrated dewatering roll unit **96** is, as specifically shown in FIG. **1**, mainly composed of the preliminary dewatering roll unit **96**A, the final dewatering roll unit **96**B, and an angle defining roll unit **96**C as auxiliary means.

[0166] The preliminary dewatering roll unit **96**A is for squeezing and dewatering the wet paper RP_0 on the mesh belt **105** preliminarily, and more specifically it includes a preliminary squeezing roll pair **122** consisting of a preliminary dewatering roll **120** for rolling on the mesh belt **105** from the lower side, and a preliminary press roll **121** for rolling and pressing on the smooth surface belt **145** from the upper side in relation to this preliminary dewatering roll **120**.

[0167] By the preliminary squeezing roll pair **122** consisting of the preliminary dewatering roll **120** and the preliminary press roll **121**, the mesh belt **105** and the smooth surface belt **145** are rolled and squeezed in a pressed form by a specified preliminary pressure from the upper and lower sides, and the moisture contained in the wet paper RP_0 on the mesh belt **105** is preliminarily dewatered and removed.

[0168] In this case, the preliminary pressure, that is, the preliminary squeezing force of the preliminary dewatering roll unit **96**A for preliminarily squeezing and dewatering the wet paper RP_0 on the mesh belt **105** is set in a range not to destroy the wet paper RP_0 having a large water content, and in the illustrated preferred embodiment, the preliminary squeezing force is set in a range so that the water content of the wet paper on the mesh belt **105** may be 80 to 75% after the preliminary dewatering process.

[0169] The final dewatering roll unit **96**B is a location for finally squeezing and dewatering the wet paper RP_0 on the mesh belt **105** after preliminary dewatering in the preliminary dewatering roll unit **96**A to obtain dried paper (recycled paper) RP of a specified water content, and more specifically includes at least one set of final squeezing roll pair **127** consisting of a final dewatering roll **125** for rolling on the mesh belt **105** from the lower side, and a final press roll **126** for rolling and pressing on the smooth surface belt **145** from the upper side in relation to this final dewatering roll **125**.

[0170] By the final squeezing roll pair **127** consisting of the final dewatering roll **125** and the final press roll **126**, the mesh belt **105** and the smooth surface belt **145** are rolled and squeezed in a pressed form by a specified final pressure from the upper and lower sides, and the moisture contained in the wet paper RP_0 on the mesh belt **105** is finally dewatered and removed, and a dried paper of specified water content, that is, a recycled paper RP is obtained.

[0171] In this case, the final pressure, that is, the final squeezing force of the final dewatering roll unit **96**B for finally squeezing and dewatering the wet paper RP_0 on the mesh belt **105** is set to such a degree as to be capable of obtaining a specified dewatering effect securely on the preliminarily dewatered wet paper RP_0, and in the illustrated preferred embodiment, it is set in a range of water content of 70 to 85% in the dried paper (recycled paper) RP on the mesh belt **105** after final dewatering.

[0172] The rolls **120**, **121**, **125**, **126** in the dewatering roll unit **96** are not specifically shown in the drawing, but are driven and coupled to a single drive motor **106** by means of driving and coupling means composed of a gearing mechanism, and all rolls **120**, **121**, **125**, **126** are rotated and driven in mutual cooperation.

[0173] In this case, these rolls **120**, **121**, **125**, **126** are rotated and controlled so that the outer circumference of the upper and lower rolls **120**, **125**, and the outer circumference of the rolls **121**, **126** may mutually roll and contact with each other and a slight rotating speed difference each other, with respect to the contact surface of the mesh belt **105** and the smooth surface belt **145** (the lower side of the mesh belt **105** and the upper side of the smooth surface belt **145**) being rolled and squeezed in a pressed state, between their outer circumferential surfaces.

[0174] More specifically, the rotating speed of the preliminary and final press rolls **121**,**126** of the upper side is set slightly larger than the rotating speed of the preliminary and final press rolls **120**,**125** of the lower side, and hence the running speed of the smooth surface belt **145** is set lightly larger than the running speed of the mesh belt **105**. In this constitution, as described below, when the wet paper RP_0 squeezed and dewatered by the dewatering roll **96** is transferred and moved to the lower side of the smooth surface belt **145** of the upper side from the upper side of the mesh belt **105** of the lower side, a tension is applied to the wet paper RP_0, and wrinkling of the wet paper RP_0 may be prevented effectively.

[0175] The angle defining roll unit (angle defining means) **96**C is a location for assisting and validating the squeezing and dewatering action by the preliminary dewatering roll unit **96**A and the final dewatering roll unit **96**B, and it is provided at the upstream side of the preliminary dewatering roll unit **96**A, and defines the inclination angle between the mesh belt **105** and the smooth surface belt **145** inserted in the preliminary dewatering roll unit **96**A.

[0176] The angle defining roll unit **96**C specifically defines the inclination angle between the mesh belt **105** and the smooth surface belt **145** inserted in the preliminary dewatering roll unit **96**A, and more specifically it includes a mesh belt guide roll **130** for defining the insertion angle of the mesh belt **105** into the preliminary dewatering roll unit **96**A by rolling on the mesh belt **105** from the lower side, and a smooth surface belt guide roll **131** for defining the insertion angle of

the smooth surface belt **145** into the preliminary dewatering roll unit **96**A by rolling on the smooth surface belt **145** from the upper side.

[0177] The insertion angle of the mesh belt **105** into the preliminary dewatering roll unit **96**A is defined by the mesh belt guide roll **130**, and the insertion angle of the smooth surface belt **145** into the preliminary dewatering roll unit **96**A is defined by the smooth surface belt guide roll **131**, and therefore the inclination angle between the mesh belt **105** and the smooth surface belt **145** is determined indirectly in a specified range.

[0178] The inclination angle between the mesh belt **105** and the smooth surface belt **145** is set so as to prevent the wet paper RP_0 from becoming slurry again by the preliminary dewatering action by the preliminary dewatering roll unit **96**A, as the moisture contained in the wet paper RP_0 is massively squeezed out to the upstream side of the preliminary dewatering roll unit **96**A, and the large amount of water thus squeezed is absorbed again in the wet paper RP_0.

[0179] In other words, by the preliminary dewatering roll **120** and the preliminary press roll **121** of the preliminary dewatering roll unit **96**A, when the mesh belt **105** mounting the wet paper RP_0 on the upper side and the smooth surface belt **145** are rolled and squeezed in a pressed state from the upper and lower sides, the moisture contained in the wet paper RP_0 is squeezed out to the upstream side of the both rolls **120**, **121**.

[0180] In this case, if the inclination angle α formed between the mesh belt **105** and the smooth surface belt **145** is large, at a position near the upstream side of the both rolls **120**, **121**, the smooth surface belt **145** of the upper side is departed from the wet paper RP_0 on the mesh belt **105** at the lower side, and a part of the massive squeezed moisture contained in the wet paper RP_0 is absorbed again in the wet paper RP_0 and the wet paper RP_0 may become slurry again.

[0181] By contrast, when the inclination angle α formed between the mesh belt **105** and the smooth surface belt **145** is small, at a position near the upstream side of the both rolls **120**, **121**, the smooth surface belt **145** of the upper side is pressed to the wet paper RP_0 on the mesh belt **105** at the lower side, and all of the massive squeezed moisture contained in the wet paper RP_0 falls down through the mesh belt **105**, and is not absorbed again in the wet paper RP_0 and the wet paper RP_0 may be prevented from becoming slurry again.

[0182] The inclination angle α formed between the mesh belt **105** and the smooth surface belt **145** is preferably set at 1 to 20 degrees as a result of experiments, and more preferably set at 3 to 7 degrees, and it is set at 5 degrees in the illustrated preferred embodiment.

[0183] Thus, by driving of the drive motor **106**, the rolls **120**, **121**, **125**, **126** of the preliminary dewatering roll unit **96**A and the final dewatering roll unit **96**B in the dewatering roll unit **96** are put in rotation, and first by the preliminary squeezing roll pair **122** in the preliminary dewatering roll unit **96**A, the mesh belt **105** and the smooth surface belt **145** are rolled and squeezed in a pressed state from both upper and lower sides with a specified preliminary pressure, and the moisture contained in the wet paper RP_0 on the mesh belt **105** is preliminarily dewatered and removed (in the illustrated preferred embodiment, the water content of the wet paper RP_0 is reduced from 90 to 85% to 80 to 75%).

[0184] In succession, by the final squeezing roll pair **127** in the final dewatering roll unit **96**B, the mesh belt **105** and the smooth surface belt **145** are rolled and squeezed in a pressed state from both upper and lower sides with a specified final pressure, and the moisture contained in the wet paper RP_0 on the mesh belt **105** is finally dewatered and removed, and dry paper of specified water content, that is, recycled paper RP is obtained (in the illustrated preferred embodiment, the water content of the wet paper RP_0 is reduced from 80 to 75% to 70 to 65%). In this series of processes, the white water W squeezed and dewatered from the wet paper RP_0 is collected in the white water collection tank **45** of the water feed unit **27**.

[0185] The wet paper RP_0 squeezed and dewatered in the dewatering roll unit **96** is transferred and conveyed to the lower side of the smooth surface belt **145** at the upper side from the upper side of the mesh belt **105** of the lower side at the downstream side location of the dewatering roll unit **96**, and is conveyed together with the smooth surface belt **145**, and the drying process by the drying belt conveyor unit **97** is executed.

[0186] This transfer action is considered to be caused by the smooth surface structure of the smooth surface belt **145**. That is, the surface of the mesh belt **105** at the lower side is a fine undulated surface forming multiple fine continuous pores, while the surface of the smooth surface belt **145** at the upper side is a smooth surface without pores, and the wet paper RP_0 containing a slight moisture seems to be attracted by the surface tension against the surface of the smooth surface belt **145**.

[0187] The drying belt conveyor unit **97** is a location for obtaining recycled paper RP by further heating and drying the dried paper RP squeezed and dewatered in the dewatering roll unit **96** after the paper making process in the paper making belt conveyor unit **95**, and mainly includes a drying conveyor **170**, a heating and drying unit **171**, and the recycled paper smoothing unit (recycled paper smoothing device, recycled paper smoothing means) **10** mentioned above.

[0188] The drying conveyor **170** smoothes and conveys the wet paper RP_0 squeezed and dewatered in the dewatering roll unit **96**, and mainly includes the smooth surface belt **145**, and the drive motor **106** for driving the smooth surface belt **145**.

[0189] The smooth surface belt **145** is for conveying the wet paper RP_0 while heating and drying, and specifically it is an endless belt of plate materials of smooth surface structure having a specified width connected and formed like a ring of a specified length. The plate material of the smooth surface structure is any material capable of finishing the one side surface of the wet paper RP_0 to a proper smoothness, and withstanding the heating action by the heating and drying unit **171** described below, and preferably fluoroplastic, stainless steel, or other flexible heat-resistant material may be used, and a fluoroplastic belt is used in the illustrated preferred embodiment.

[0190] This smooth surface belt **145** is, as shown in FIG. **1** and FIG. **5**, rotatably suspended and supported by way of a drive roller **176**, a driven roller **177**, the dewatering roll unit **96**, and a driven roller **178**, and is driven and coupled to the drive motor **106** by way of the drive roller **176**.

[0191] The drive motor **106** for driving the smooth surface belt **145**, as described above, is used commonly as the driving source of the paper making net conveyor **100** and the dewatering roll unit **96**.

[0192] The heating and drying unit **171** is a location for heating and drying the wet paper RP_0 transferred, rolled and conveyed on the smooth surface belt **145** from the mesh belt **105** of the paper making net conveyor **100**, and specifically the smooth surface belt **145** for conveying and supporting the

lower side of the wet paper RP_0 is heated from the lower side by a heater **180** disposed in an intermediate position of the running route thereof.

[0193] This heater **180** is a heater plate sliding and contacting with the opposite side of the conveying and supporting side of the wet paper RP_0 on the smooth surface belt **145**, and is provided in a horizontal direction running portion in the running route of the smooth surface belt **145**, and is provided in slide and contact with the opposite side of the upper side of the holding side of the wet paper RP_0 in the smooth surface belt **145**, that is, at the lower side. As a result, the wet paper RP_0 on the smooth surface belt **145** is heated indirectly and dried by the smooth surface belt **145** heated by the heater plate **180**.

[0194] The specific structure of the heater **180** in the illustrated preferred embodiment is shown in FIG. **5**, and it is designed to function also as the recycled paper smoothing unit **10**.

[0195] That is, the recycled paper smoothing unit **10** of the present preferred embodiment mainly includes the smooth surface belt **145**, and a belt guide unit (belt guide means) **200** for sliding and supporting this smooth surface belt **145** from the lower side, and guiding the smooth surface belt **145** in a running state being curved upward toward the running direction, and the belt guide unit **200** is provided with the heater **180**.

[0196] More specifically, the belt guide unit **200** is a plate material curved upward toward the running direction of the smooth surface belt **145**, and having a horizontal and straight contour in the width direction, and this component material has a sufficient strength and wear resistance for sliding and supporting the smooth surface belt **145** from the lower side, and in particular a material excellent in heat transfer property is preferred as a base material for the heater plate.

[0197] The belt guide unit **200** in the illustrated preferred embodiment is made of a stainless steel plate (SUS), and is mounted and supported on the apparatus machine body **54** by means of support base plates **201**, **201**, and its upper surface is the curved guide surface **200***a*. Although not shown specifically in the drawing, the lower side **200***b* of the belt guide unit **200** is integrally provided with a flat heater of a thin plate, and it is formed as a heater plate of the heater **180**.

[0198] On the curved guide surface **200***a* of the belt guide unit **200** having such configuration, the smooth surface belt **145** is slidably disposed with a specified tension. As a result, the smooth surface belt **145** is guided slidably on the curved guide surface **200***a* of the belt guide unit **200** so as to run in an upward curved state (see FIG. **5**)

[0199] The recycled paper smoothing unit **10** of the present preferred embodiment has a pressing unit **250** for pressing the entire wet paper RP_0 conveyed on the smooth surface belt **145** with a uniform pressure from the upper side, in addition to the configuration described above.

[0200] This pressing unit **250** is composed in a form of a covering belt conveyor specifically as shown in FIG. **5**.

[0201] The covering belt conveyor **250** includes a covering belt **251** disposed and composed to run in a same horizontal direction in a state overlaid with the smooth surface belt **145**, and the drive motor **106** for driving this covering belt **251**. This drive motor **106** is used commonly as the drive source of the paper making net conveyor **100** and the dewatering roll unit **96** as explained in preferred embodiment 1.

[0202] The covering belt **251** is an endless belt running while covering the entire wet paper RP_0 on the smooth surface belt **145** while tightly holding together with the smooth surface belt **145**, and its lower side, that is, the side covering the entire wet paper RP_0 together with the smooth surface belt **145** cooperates with the upper side of the smooth surface belt **145**, and a flat smoothing action surface is formed for smoothing the entire wet paper RP_0. The covering range of the wet paper RP_0 (recycled paper RP) by the covering belt **251** is set in a range nearly opposite to the belt guide unit **200** (that is, the heater plate **180**) in the running route of the smooth surface belt **145**.

[0203] The covering belt **251** is specifically a mesh belt, and has a ventilation mesh structure composed of numerous mesh cells for passing and releasing the steam heated and evaporated from the wet paper RP_0.

[0204] The plate material of the ventilation mesh structure for composing the mesh belt **251** is a material capable of passing and releasing the moisture heated and evaporated from the wet paper RP_0 on the smooth surface belt **145** smoothly to the upper side from the numerous mesh cells, and preferably, same as in the mesh belt **105** of the paper making unit **4** mentioned above, desired examples are polypropylene (PP), polyethylene terephthalate (PET), polyamide (PA) (generally known as Nylon, a registered trademark), stainless steel (SUS), and other corrosion resistant materials, and in the illustrated preferred embodiment, a PET mesh belt **251** excellent in heat resistance is used.

[0205] The ventilation mesh structure of the mesh belt **251** is preferred to be fine in mesh size, and fine and smooth in weaving, and same as the mesh belt **105** of the paper making unit **4** described above, a specific material is selected in consideration of the characteristic of the desired paper.

[0206] As far as the mesh belt **251** satisfies the requirements of heat resistance of withstanding high heat in the heating and drying process, and the ventilation for passing the steam heated and evaporated from the wet paper RP_0, strict design conditions as required in the mesh belt **105** forming the core of the paper making unit **4** are not needed, but the mesh belt **251** in the illustrated preferred embodiment is a plain-woven PET-made mesh belt of 25 mesh cells.

[0207] The width dimension of the mesh belt **251** is set same as the width dimension of the smooth surface belt **145** as shown in FIG. **5** so as to overlap with the smooth surface belt **145** and hold the wet paper RP_0 in a sandwich state.

[0208] The mesh belt **251** is rotatably suspended and supported by way of a drive roller **255**, and a driven roller **256**, and the drive roller **255** is driven and coupled to the drive motor **106**.

[0209] The mesh belt **251** is slidably disposed on a curved guide surface **200***a* of a belt guide unit **200** with a specified tension by way of the smooth surface belt **145**. As a result, in a state overlaid with the smooth surface belt **145**, the mesh belt **251** is guided slidably in a same direction on the curved guide surface **200***a* of the belt guide unit **200**, and runs in an upward curved state (see FIG. **9** and FIG. **10** (*a*)).

[0210] By such disposition and configuration of the mesh belt **251**, the mesh belt **251** pressed the wet paper RP_0 on the smooth surface belt **145** with a uniform pressure in the overall length of the covering range, and without causing warp or wrinkle in the wet paper RP_0 (recycled paper RP), the one-side surface of the wet paper RP_0 (recycled paper RP) contacting with the surface of the smooth surface belt **145** and the opposite-side surface are finished to an appropriate smooth surface.

[0211] After the wet paper RP_0 squeezed and dewatered by the dewatering roll unit **96** is transferred and roll on the lower side of the smooth surface belt **145** at the upper side from the upper side of the mesh belt **105** of the lower side, the smooth surface belt **145** is inverted to run by way of the rollers **178**, **176**, and the wet paper RP_0 on the smooth surface belt **145** conveyed from the smooth surface belt **145** is provided with a uniform tension in the conveying and running direction by means of the running action of the smooth surface belt **145**, and the curved shape of the smooth surface belt **145** by the belt guide unit **200** (**180**), and by the pressing force by covering with the mesh belt **251** of the covering belt conveyor **250** from the upper side, the wet paper is heated and dried while being held in a sandwich state by uniform pressures from the upper and lower side. As a result, the wrinkle and the warp of the wet paper RP_0 caused in the proceeding process of paper making process are effectively eliminated, and occurrence of wrinkle or warp of the wet paper by the heating and drying process by the heater plate **180** can be effectively prevented, and the entire wet paper RP_0 is uniformly dried by an appropriate ventilation of the mesh belt **251** of the upper side, so that the wet paper RP_0 is regenerated into a smooth recycled paper (dry paper) RP on the whole.

[0212] In other words, the wet paper RP_0 (recycled paper RP) is heated and dried while being held in a flat state, by the cooperative action of the sandwich structure of a specified pressure by the smooth surface belt **145** and the covering belt **251**, together with the uniform tension applied in the conveying and running direction, and the wrinkle and warp caused on the wet paper RP_0 in the proceeding process of paper making process is effectively lost and removed, and occurrence of wrinkle and warp of the wet paper RP_0 (recycled paper RP) by the heating and drying action by the heater plate **180** can be effective prevented further, and therefore in the very narrow used paper processing space of a furniture size, a smooth recycled paper RP free from wrinkle can be regenerated securely.

[0213] Moreover, the covering belt **251** of the covering belt conveyor **250** is formed of a mesh belt composed of numerous mesh cells capable of passing and releasing the steam heated and evaporated from the wet paper RP_0 on the smooth surface belt **145** to the upper side, in spite of the presence of the covering belt **251**, the steam generated by heating of the wet paper RP_0 can be effectively elevated and dissipated, and the drying process is smoothly promoted.

[0214] At the downstream side of the heating and drying unit **171** on the smooth surface belt **145**, a stripping member **210** is provided, and the dry paper or the recycled paper RP (water content 10 to 7%) being dried and conveyed on the smooth surface belt **145** is sequentially stripped off from the holding side of the smooth surface belt **145**.

[0215] In this relation, at the running route terminal end position of the smooth surface belt **145** at the downstream side of the stripping member **210**, a fixed size cutter unit **211** is provided, and the recycled paper RP stripped from the smooth surface belt **145** is cut to a specified size (in the illustrated preferred embodiment, an A4 size format), and is discharged from the outlet port **8** of the apparatus case **6**.

[0216] The device control unit **5** is to control the driving parts of the pulp making unit **2**, the pulp concentration adjustment unit **3**, and the paper making unit **4** automatically by mutual cooperation, and is specifically composed of a microcomputer having CPU, ROM, RAM, and I/O port.

[0217] This device control unit **5** stores programs for executing the pulp making process of the pulp making unit **2**, the concentration adjustment process of the concentration adjustment unit **3**, and the paper making process of the paper making unit **4** by mutual cooperation, and various items of information necessary for driving of the component units **2** (**20**, **21**), **3** (**3**A, **33**), and **4** (**95**, **96**, **97**) are preliminarily entered as data through keyboard or other input means appropriately, including, for example, the driving time and rotating speed of the agitating device **26** in the macerating unit **20**, the water feed timing and the water feed amount of the water feed device **27**, the driving time and the agitation amount of the circulation pump **69** in the beating unit **21**, the driving time and the rotating speed of the grinder **50**, the adjustment timing and the beating gap G adjustment amount of the gap adjusting means **57**, the running speed of the conveyors **100**, **170** in the paper making unit **4**, the driving time of the heating and drying unit **171**, and the operation timing of the fixed size cutter unit **211**.

[0218] The device control unit **5** electrically connected with the weight sensors **48**, **87**, and the drive units **35**, **41**, **56**, **61**, **66**, and **106** as mentioned above, and the drive control unit **5** controls these drive units **35**, **41**, **56**, **61**, **66**, and **106**, according to these measured values and control data.

[0219] The used paper recycling apparatus **1** having such configuration is started when the power source is turned on, and the component units **2** (**20**, **21**), **3** (**3**A, **3**B), and **4** (**95**, **96**, **97**) are controlled automatically by mutual cooperation, and the used paper UP, UP, . . . charged into the inlet port **7** of the apparatus case **6** are macerated and beaten by the macerating unit **20** and the beating unit **21** of the pulp making unit **2**, and the used paper pulp UPP is manufactured, and the pulp suspension PS of paper making concentration is prepared in the pulp concentration adjustment unit **3**, and this pulp suspension PS is manufactured in the paper making belt conveyor unit **95** of the paper making unit **4**, the dewatering roll unit **96**, and the drying belt conveyor unit **97**, and is regenerated as recycled paper RP, and is discharged onto the recycled paper receiving tray **9** from the outlet port **8** of the apparatus case **6**.

[0220] In the used paper recycling apparatus **1** having such configuration, the pulp feeding unit (pulp feeder) **15** of the paper making unit **4** is disposed slidably on the upper side **105***a* of the mesh belt **105***a* running in the paper making belt conveyor unit (paper making process unit) **95**, and includes the retention unit **113** for retaining a slurry-like pulp suspension PS mixing the water W and used paper pulp UPP sent from the pulp manufacturing unit **2**, and the paper making frame body **110** for defining the supply width L of the pulp suspension PS on the upper side of the mesh belt **105**, in which the leading endposition of this paper making frame body **110** is provided with the overflow unit **114** for keeping constant the water level H of the pulp suspension PS retained in the retention unit **113**, and the pulp suspension PS supplied in the paper making frame body **110** is retained in the retention unit **113** to the water level H defined the overflow unit **114**, and is uniformly dispersed and supplied on the upper side of the mesh belt **105** by cooperative action of this retention action and the running action of the mesh belt **105**, and therefore if the supply amount of the pulp suspension PS sent into the paper making frame body **110** varies, the water level H of the pulp suspension PS retained in the paper making frame body **110** is always kept constant, and the weight of the used paper RP_0 made on the mesh belt **105** is stable, so that recycled paper RP of uniform texture will be obtained.

[0221] The foregoing preferred embodiment may be modified and changed in design as described below.

[0222] For example, the specific configuration of the pulp feeding unit (pulp feeder) **15** of the present invention is not limited to the illustrated preferred embodiments alone, but other configurations having similar functions may be employed.

[0223] For example, in the used paper recycling apparatus in the illustrated preferred embodiments, the grinder **50** for composing the beating unit **21** of the pulp making unit **2** is used for pressurizing and beating the used paper by the beating action surfaces **51***a*, **52***a*, and for grinding and pulverizing the inks forming the characters and patterns on the used paper, and by using only the tap water such as drinking water obtained from the general water services, the configuration requires no paper making chemicals such as used paper de-inking chemicals conventionally essential in large-scale used paper recycling equipment in the paper making plant or used paper recycling plant, and moreover the present invention is applicable, as a matter of course, not only in the used paper recycling apparatus capable of realizing used paper recycling by ordinary water alone, but also in the used paper recycling apparatus using paper making chemicals such as used paper de-inking chemicals.

[0224] As the present invention may be embodied in several forms without departing from the spirit of essential characteristics thereof, the present preferred embodiment is therefore illustrative and not restrictive, since the scope of the present invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalence of such metes and bounds thereof are therefore intended to be embraced by the claims.

1. A pulp feeder of a used paper recycling apparatus, being a device for composing a pulp feeding unit of a paper making device in a used paper recycling apparatus of furniture size to be installed at the site of origin of used paper, the paper making device being for manufacturing recycled paper by making from used paper pulp manufactured in a proceeding process of pulp manufacturing unit, comprising:

a paper making frame body disposed slidably on the upper side of an endless mesh belt running in a paper making process unit, having a retention unit for retaining a slurry-like pulp suspension mixing the water and used paper pulp sent from the pulp manufacturing unit, and for defining the supply width of the pulp suspension on the upper side of the endless mesh belt,

wherein the leading end position of this paper making frame body is provided with overflow means for keeping constant the water level of the pulp suspension retained in the retention unit, and

the pulp suspension supplied in the paper making frame body is retained in the retention unit to the water level defined the overflow means, and is uniformly dispersed and supplied on the upper side of the endless mesh belt by cooperative action of this retention action and the running action of the endless mesh belt.

2. The pulp feeder of a used paper recycling apparatus according to claim **1**,

wherein the paper making frame body has its frame inside width dimension set at the width dimension of the recycled paper to be manufactured, and the supply width of the pulp suspension on the upper side of the endless mesh belt is defined.

3. The pulp feeder of a used paper recycling apparatus according to claim **1**,

wherein the overflow means is provided at both side walls of the retention unit at the leading end position of the paper making frame body, and includes an overflow gate for overflowing the pulp suspension when the water level of the pulp suspension retained in the paper making frame body exceeds a specific level, and a collection route passing to a collection port by way of the periphery of the paper making frame body from the outside of this overflow gate.

4. The pulp feeder of a used paper recycling apparatus according to claim **3**,

wherein the upper edge of the overflow gate is set to be horizontal and straight in a state of the paper making frame body installed on the endless mesh belt.

5. The pulp feeder of a used paper recycling apparatus according to claim **1**,

wherein the bottom of the paper making frame body is provided with a flat plate member for covering the mesh of the mesh belt in a closed state from the upper side, and the bottom of the retention unit is formed by this flat plate member and the running endless mesh belt,

and the pulp suspension supplied in the paper making frame body is retained in the retention unit to a water level defined by the overflow means, and is uniformly dispersed and supplied on the upper side of the endless mesh belt by cooperative action of this retention action and the running action of the endless mesh belt.

6. The pulp feeder of a used paper recycling apparatus according to claim **5**,

wherein the leading end edge of the flat plate member of the paper making frame body is provided with a thin guide sheet for assuring a smooth flow of the pulp suspension on the mesh belt.

7. The pulp feeder of a used paper recycling apparatus according to claim **1**,

wherein the upstream side of the retention unit in the paper making frame body is provided with a meandering flow passage for promoting uniform dispersion of the supplied pulp suspension, and preventing disturbance of the pulp suspension.

8. The pulp feeder of a used paper recycling apparatus according to claim **7**,

wherein the meandering flow passage is provided in a zigzag form in a vertical direction between the supply port of the pulp suspension of the paper making frame body and the retention unit.

9. (canceled)

10. The pulp feeder of a used paper recycling apparatus according to claim **1**,

wherein the lower side of the running endless mesh belt is provided with a partition plate member disposed slidably.

11. The pulp feeder of a used paper recycling apparatus according to claim **10**,

wherein the partition plate member is formed in a louver structure for slidably supporting the lower side of the endless mesh belt.

12. The pulp feeder of a used paper recycling apparatus according to claim **1**,

wherein the endless mesh belt is disposed upward and obliquely toward the running direction.

13. A paper making device of a used paper recycling apparatus, being a paper making device for composing a used paper recycling apparatus of furniture size to be installed at the site of origin of used paper, for manufacturing recycled paper by making from used paper pulp manufactured in a proceeding process of a pulp making device, comprising:

a paper making process unit for producing wet paper by making from a slurry-like pulp suspension mixing water and used paper pulp sent from the pulp making device,

wherein this paper making process unit has a paper making conveyor for conveying while making the pulp suspension, and a pulp feeding unit being installed at a paper making process start end position of the paper making conveyor, for feeding the pulp suspension from the pulp making device to the paper making conveyor, and

this pulp feeding unit is composed of the pulp feeder of any one of claims **1** to **5** and **10** to **12**.

14. A used paper recycling apparatus, comprising:

in an apparatus case of furniture size, a pulp making unit for manufacturing used paper pulp by macerating and beating used paper, a paper making unit for manufacturing recycled paper by making from the used paper pulp manufactured in the pulp making unit, and a control unit for driving and controlling the pulp making unit and the paper making unit by interlock,

wherein the paper making unit is composed of the paper making device of claim **13**.

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