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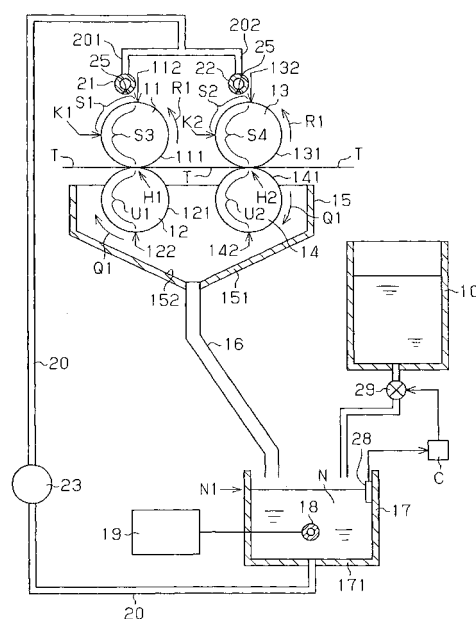
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(54) **Sizing machine**

(57) A sizing machine for sizing warp yarns (T) by drawing warp yarns supplied with size liquid through a pair of squeeze rollers (11,12) and squeezing off excessive size liquid from the warp yarns with the squeeze rollers. A size liquid supply means (21,22) supplies size liquid to the circumferential surface of the roller located at an upper side of the warp yarns or supplies size liquid to an upper surface defined on the warp yarns upstream from the pair of squeeze rollers. A size liquid tray (15) arranged below the squeeze rollers includes a receiving portion for receiving size liquid that falls from the pair of squeeze rollers. The receiving portion is located at a position that is always out of contact with the lower squeeze roller during operation of the sizing machine. Accordingly, an optimal amount of size liquid is easily supplied to the warp yarns.

Fig.1



Description**BACKGROUND OF THE INVENTION**

[0001] The present invention relates to a sizing machine for sizing warp yarns by drawing warp yarns that have been supplied with size liquid through a pair of squeeze rollers and squeezing off excessive size liquid from the warp yarns using the squeeze effect produced by the squeeze rollers.

[0002] A sizing machine (refer to, for example, Japanese Examined Utility Model Publication No. 6-34394) first immerses warp yarns in a size liquid contained in a size liquid tank, and then squeezes off excessive size liquid from the warp yarns by drawing the warp yarns through a pair of squeeze rollers. As the size liquid adheres to the warp yarns, the size liquid contained in the size liquid tank gradually decreases. Thus, the size liquid tank must be replenished. Further, a film of size may be formed on the surface of the size liquid in the size liquid tank. Such a size film would adhere to the warp yarns. If the warp yarns to which the size film is adhered proceeds to a drying process, the size film solidifies and bonds adjacent warp yarns. When separating the warp yarns bonded by the size film, the warp yarns easily break.

[0003] To prevent such a size film from being formed, the sizing machine of the above publication refills the size liquid tank with more size liquid than the amount of size liquid taken away from the size liquid tank by the warp yarns. As a result, the size liquid stored in the size liquid tank overflows from a movable gate of the size liquid tank so as to produce a flow in the surface of the size liquid.

[0004] However, the size liquid tends to be still between a side wall of the size liquid tank and a lower squeeze roller immersed in the size liquid. A film of size is apt to form at such a location where the size liquid has a tendency of being still.

[0005] Japanese Examined Patent Publication No. 1-22380 describes a sizing machine, which supplies size liquid to warp yarns drawn through an upper backup roller and a lower coating roller. To supply the warp yarns with size liquid, this sizing machine discharges the size liquid from a size liquid supply nozzle to the circumferential surface of an applicator roller, which is joined with the circumferential surface of the lower coating roller. The size liquid adhered to the circumferential surface of the applicator roller is transferred to the circumferential surface of the lower coating roller. The size liquid transferred to the circumferential surface of the lower coating roller is adhered to the warp yarns at a nip line defined by the circumferential surface of the lower coating roller and the circumferential surface of the upper backup roller.

[0006] The sizing machine described in Japanese Examined Patent Publication No. 1-22380 eliminates the need for a size liquid tank. Thus, this sizing machine does not have the problems of the sizing machine in Japanese Examined Utility Model Publication No. 6-34394.

[0007] The sizing machine described in Japanese Examined Patent Publication No. 1-22380 is configured to transfer the size liquid adhered to the circumferential surface of the applicator roller to the circumferential surface of the lower coating roller. It is thus difficult for an appropriate amount of size liquid to be supplied from the circumferential surface of the lower coating roller to the warp yarns.

SUMMARY OF THE INVENTION

[0008] It is an object of the present invention to provide a sizing machine that easily supplies warp yarns with an appropriate amount of size liquid.

[0009] One aspect of the present invention is a sizing machine for sizing warp yarns by drawing warp yarns that have been supplied with size liquid through a pair of squeeze rollers and squeezing off excessive size liquid from the warp yarns with the pair of squeeze rollers. The pair of squeeze rollers include an upper squeeze roller and a lower squeeze roller, each having a circumferential surface. The sizing machine includes a size liquid supply means for supplying size liquid to the circumferential surface of the upper squeeze roller located at an upper side of the warp yarns or for supplying size liquid to an upper surface defined on the warp yarns upstream from the pair of squeeze rollers. A size liquid tray is arranged below the pair of squeeze rollers and includes a receiving portion for receiving size liquid that falls from the pair of squeeze rollers. The receiving portion is located at a position that is always out of contact with the lower squeeze roller during operation of the sizing machine.

[0010] Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a schematic diagram showing a sizing machine according to a first embodiment of the present invention;

Fig. 2(a) is an enlarged cross-sectional view of a main part of the sizing machine of Fig. 1;

Fig. 2(b) is a cross-sectional view taken along line A-A of Fig. 2(a);

Fig. 3 is a schematic diagram showing a sizing machine according to a second embodiment of the present invention;

Fig. 4 is a schematic diagram showing a sizing machine according to a third embodiment of the present invention;

Fig. 5 is a schematic diagram showing a main part of a sizing machine according to a fourth embodiment of the present invention;

Fig. 6 is a schematic diagram showing a main part of a sizing machine according to a fifth embodiment of the present invention; and

Fig. 7 is a schematic diagram showing a main part of a sizing machine according to a sixth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] A sizing machine according to a first embodiment of the present invention will now be described with reference to Figs. 1 and 2.

[0013] As shown in Fig. 1, a plurality of warp yarns T, which are arranged in parallel with one another so as to form a sheet, are drawn through two upstream squeeze rollers 11 and 12 and two downstream squeeze rollers 13 and 14. The upstream squeeze rollers 11 and 12 hold the warp yarns T therebetween. The downstream squeeze rollers 13 and 14 hold the warp yarns T therebetween. The upper squeeze rollers 11 and 13 rotate in the direction indicated by arrows R1. The lower squeeze rollers 12 and 14 rotate in the direction indicated by arrows Q1.

[0014] The upstream squeeze rollers 11 and 12 respectively have circumferential surfaces 111 and 121. A yarn holding portion H1 defined between the circumferential surfaces 111 and 121 holds the warp yarns T. The warp yarns T are drawn through the upstream squeeze rollers 11 and 12 along a tangent extending from the yarn holding portion H1. The downstream squeeze rollers 13 and 14 respectively have circumferential surfaces 131 and 141. A yarn holding portion H2 defined between the circumferential surfaces 131 and 141 holds the warp yarns T. The warp yarns T are drawn through the downstream squeeze rollers 13 and 14 along a tangent extending from the yarn holding portion H2.

[0015] A size liquid tray 15 is arranged immediately below the upstream squeeze rollers 11 and 12 and the downstream squeeze rollers 13 and 14. The size liquid tray 15 has a bottom wall 151, which is downwardly tapered. The size liquid tray 15 is arranged so that the bottom wall 151 is not in contact with the lower squeeze rollers 12 and 14. The top end of a recovery pipe 16 is connected to a hole in the lowest part of the bottom wall 151. Accordingly, in this embodiment, the size liquid tray 15 is a container that does not collect size liquid N.

[0016] A size liquid tank 17 is arranged below the size liquid tray 15. The bottom end of the recovery pipe 16 extends to a position immediately above the size liquid tank 17. The size liquid tank 17 contains size liquid N. A heating pipe 18 is arranged in the size liquid tank 17. A vapor supply source 19 sends vapor into the heating pipe 18. The vapor sent into the heating pipe 18 heats the size liquid N stored in the size liquid tank 17. The amount of vapor supplied from the vapor supply source 19 to the heating pipe 18 is adjusted in a manner that the temperature of the size liquid N in the size liquid tank 17 is included within a desired temperature range (e.g., in a range from 90 to 95°C). The size liquid tank 17 functions as a size liquid collector for collecting the size liquid N that falls from the squeeze rollers 11 to 14. The surface N1 of the size liquid N in the size liquid tank 17 is located below the squeeze rollers 12 and 14, which are located under the warp yarns T.

[0017] The size liquid tank 17 has a bottom wall 171 connected to a supply pipe 20. The supply pipe 20 is branched into a branch pipe 201 and a branch pipe 202. A pipe shaped size liquid feeder 21 is connected to the branch pipe 201. A pipe-shaped size liquid feeder 22 is connected to the branch pipe 202. The size liquid feeder 21 is arranged immediately above the squeeze roller 11 and extends in the longitudinal direction of the squeeze roller 11 (the direction orthogonal to the plane of Fig. 1 is shown, that is, the lateral direction in Fig. 2(b)). The size liquid feeder 22 is arranged immediately above the squeeze roller 13 and extends in the longitudinal direction of the squeeze roller 13.

[0018] A pump 23 is arranged in the supply pipe 20. The pump 23 forces the size liquid N from the size liquid tank 17 into tubes of the size liquid feeders 21 and 22 through the supply pipe 20.

[0019] When the amount of size liquid N stored in the size liquid tank 17 becomes less than or equal to a predetermined amount, the size liquid tank 17 is replenished with size liquid from a size liquid supply source 10. A level sensor 28 detects the level of the surface N1 of the size liquid N in the size liquid tank 17. The surface level information obtained by the level sensor 28 is sent to a controller C. The controller C controls a valve 29 based on the surface level information. When the level of the surface N1 of the size liquid N in the size liquid tank 17 becomes less than or equal to a first predetermined level, the controller C opens the valve 29. This causes the size liquid supply source 10 to feed the size liquid to the size liquid tank 17. When the level of the surface N1 of the size liquid N stored in the size liquid tank 17 increases and reaches a second predetermined level, which is greater than the first predetermined level, the controller C closes the valve 29 to stop feeding the size liquid from the size liquid supply source 10. The predetermined level for stopping the flow of size liquid from the size liquid supply source 10 to the size liquid tank 17 is lower than the size liquid

tray 15.

[0020] As shown in Fig. 2(b), a groove 24 is formed in the outer circumferential surface of each of the pipe-shaped size liquid feeders 21 and 22. The groove 24 extends in the longitudinal direction of each of the size liquid feeders 21 and 22. Discharge holes 25 extend from the bottom of the groove 24 at fixed intervals into the tubular space in the size liquid feeder 21 or 22. The size liquid forced into the tubular space of each of the size liquid feeders 21 and 22 is discharged from the discharge holes 25 into the groove 24.

[0021] Referring to Figs. 1 and 2(a), the groove 24 is arranged at a position facing an area located in an upper falling quarter S1 or S2 of the circumferential surface of the upper squeeze roller 11 or 13, as viewed in a direction orthogonal to the direction in which the groove 24 extends. In detail, the groove 24 is arranged at a position facing the upper squeeze roller 11 or 13 between the top 112 (or 132) of the upper squeeze roller 11 (or 13) and the boundary K1 (or K2) of the upper and lower halves of the upper squeeze roller 11 (or 13), which is advanced by one fourth of the circumferential surface from the top 112 (or 132) in the rotation direction R1, as viewed in the direction orthogonal to the axis of the upper squeeze roller 11 (or 13). This range is defined as the upper falling quarter S1 or S2.

[0022] When the squeeze rollers 11 to 14 are rotating, the pump 23 is operated to force the size liquid N from the size liquid tank 17 into the tubular spaces of the size liquid feeders 21 and 22. The amount of size liquid supplied to the size liquid feeders 21 and 22 is easily adjusted by, for example, adjusting the rotation speed of the pump 23.

[0023] The size liquid forced into the size liquid feeders 21 and 22, which function as a size liquid supply means, is discharged from the plurality of discharge holes 25. The size liquid discharged from the plurality of discharge holes 25 are combined in the groove 24 so as to form a film of size liquid that is applied to the upper falling quarters S1 and S2 of the upper squeeze rollers 11 and 13. The film of size liquid travels along falling halves S3 and S4 of the circumferences of the upper squeeze rollers 11 and 13 (Fig. 1) and is adhered to the warp yarns T in the vicinity of each of the yarn holding portions H1 and H2. Part of the size liquid adhered to the warp yarns T in the vicinity of the yarn holding portion H1 is squeezed off from the warp yarns T by the squeezing effect produced by the upstream squeeze rollers 11 and 12. Part of the size liquid that has been adhered to the warp yarns T in the vicinity of the yarn holding portion H2 is squeezed off from the warp yarns T by the squeezing effect produced by the downstream squeeze rollers 13 and 14.

[0024] The size liquid that has been squeezed off from the warp yarns T falls along rising halves U1 and U2 of the circumferences of the lower squeeze rollers 12 and 14 (ranges between the yarn holding portions H1 and H2 and the corresponding lowest parts 122 and 142 in the circumferential surfaces 121 and 141 of the squeeze rollers 12 and 14 as shown in Fig. 1). Part of the size liquid that falls along the rising halves U1 and U2 of the lower squeeze rollers 12 and 14 is transferred to the yarn holding portions H1 and H2 as the squeeze rollers 12 and 14 rotate and is adhered to the warp yarns T. Part of the size liquid that falls onto the rising halves U1 and U2 of the lower squeeze rollers 12 and 14 falls onto an inner wall surface 152 of the bottom wall 151 of the size liquid tray 15. The size liquid that falls onto the inner wall surface 152 of the bottom wall 151 in the size liquid tray 15 will not be adhered again to the lower squeeze rollers 12 and 14. In other words, the lower squeeze rollers 12 and 14 will not roll up the size liquid that has fallen onto the inner wall surface 152 of the bottom wall 151 in the size liquid tray 15. The inner wall surface 152 of the size liquid tray 15, which is not in contact with the lower squeeze rollers 12 and 14, functions as a collection portion for collecting the size liquid that falls off the squeeze rollers 11 to 14. The inner wall surface 152 functioning as the collection portion is located at a position that is always out of contact from the lower squeeze rollers 12 and 14 during operation of the sizing machine regardless of the operation conditions. More specifically, the inner wall surface 152 is at a position that is always out of contact from the lower squeeze rollers 12 and 14 irrespective of the operation speed of the sizing machine (that is, the circumferential velocity of the squeeze rollers 11 to 14). The size liquid that has fallen into the size liquid tray 15 is recovered in the size liquid tank 17 through the recovery pipe 16.

[0025] The size liquid collected in the size liquid tank 17 is fed to the size liquid feeders 21 and 22 by operating the pump 23. The size liquid tank 17, the supply pipe 20, and the pump 23 form a recirculation means that feeds the size liquid received by the size liquid tray 15 to the size liquid feeders 21 and 22.

[0026] The warp yarns T drawn through the downstream squeeze rollers 13 and 14 are dried by a drier (not shown) and then wound by a winder (not shown).

[0027] The first embodiment has the advantages described below.

(1-1) The size liquid in the size liquid tank 17 is supplied to the circumferential surfaces 111 and 131 of the upper squeeze rollers 11 and 13, which hold the warp yarns T, only from the size liquid feeders 21 and 22. Since the size liquid is supplied only from the size liquid feeders 21 and 22 to the circumferential surfaces 111 and 131 of the upper squeeze rollers 11 and 13, which hold the warp yarns T, it is easy to supply the warp yarns T with an appropriate amount of size liquid.

(1-2) Table 1 shows data taken when inspecting the occurrence of yarn breakage during a process for sizing cotton 40-count single yarns (warp yarns). A total of 5890 cotton 40-count single yarns (warp yarns) were sized. In an example, warp yarns having a length of 14 tan (Japanese unit of length for yarns, 1 tan approximately equals to 10.6 m) were used. The size adhering ratio is the rate (the weight of the dried size liquid relative to the weight of the dry yarns prior to sizing) was 12.1% and the number of broken yarns was 3. In a comparative example, warp yarns having a length of 20 tan were used. In the comparative example, the size adhering ratio was 10.4% and the number of broken yarns was

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11. The average number of broken yarns indicates the number of broken yarns when converted to 5000 warp yarns with a length of 10000 m.

Table 1

	Tan	Size Adhering Ratio	Number of Broken Yarns	Average Number of Broken Yarns
Example	14	12.1	3	14.8
Comparative Example	20	10.4	11	38

Table 2 shows data taken when inspecting the occurrence of yarn breakage and the weaving machine operation rate during weaving performed with the warp yarns of the example shown in Table 1 (cotton 40-count single yarns). Table 2 shows the data for examples 1 to 9. The number of broken yarns indicates the number of warp yarns broken in one hour. The inspection of examples 1 to 9 were conducted on different dates but at the same predetermined time. In examples 1 to 9, cotton 40-count single yarns were used as weft yarns. The weaving density of the warp yarns was 124 yarns/inch. The weaving density of the weft yarns was 65 yarns/inch.

Table 2

	Number of Broken Yarns	Operating Rate (%)
Example 1	0.17	92.7
Example 2	0.38	93.4
Example 3	0.08	96.7
Example 4	0.04	97
Example 5	0.08	97.1
Example 6	0.21	94.6
Example 7	0.13	94.2
Example 8	0.08	93.6
Example 9	0.17	95.9
Average	0.15	95

Table 3 below shows data taken when inspecting the occurrence of yarn breakage and the weaving machine operating rate during weaving performed with the warp yarns of the comparative example shown in Table 1 (cotton 40-count single yarns). Table 3 shows the data of comparative examples 1 to 9. The number of broken yarns indicates the number of warp yarns broken in one hour. The inspection of comparative examples 1 to 9 were conducted on different dates but at the same predetermined time. In comparative examples 1 to 9, cotton 40-count single yarns were used as weft yarns. The weaving density of the warp yarns was 124 yarns/inch. The weaving density of the weft yarns was 65 yarns/inch.

Table 3

	Number of Broken Yarns	Operating Rate (%)
Comparative Example 1	0.13	95.8
Comparative Example 2	0.13	97.3
Comparative Example 3	0.21	94.9
Comparative Example 4	0.25	94.7
Comparative Example 5	0.38	95.3
Comparative Example 6	0.25	95.5
Comparative Example 7	0.29	93.5
Comparative Example 8	0.5	93.1

Table continued

	Number of Broken Yarns	Operating Rate (%)
Comparative Example 9	0.42	91.6
Average	0.28	94.6

As apparent from the test data shown in Tables 1, 2, and 3, less yarn breakages occurred in the warp yarns T that were sized by supplying size liquid to the circumferential surfaces 111 and 131 of the upper squeeze rollers 11 and 13 from the size liquid feeders 21 and 22 than in the warp yarns that were sized by immersing the yarns in the size liquid in the size liquid tank of the prior art. The warp yarns sized by immersing the yarns in the size liquid of the size liquid tank had a poor size adhering ratio. In comparison, the warp yarns sized by supplying the size liquid to the circumferential surfaces 111 and 131 of the upper squeeze rollers 11 and 13 from the size liquid feeders 21 and 22 had an appropriate size adhering ratio. It is believed that the warp yarns immersed in the size liquid of the prior art size liquid tank had a poor size adhering ratio because of the difficulty in appropriately controlling the size adhering ratio. The sizing machine of the present embodiment appropriately adjusts the amount of size liquid adhered to the warp yarns T by adjusting the amount of size liquid supplied to the size liquid feeders 21 and 22 and therefore results in less breakages. The adjustment of the amount of supplied size liquid to optimize the size adhering ratio is easily performed by varying the speed of the rotation produced by the pump 23.

(1-3) The falling quarters S1 and S2 of the upper squeeze rollers 11 and 13 are defined in the area extending in the falling direction toward the warp yarns T as the squeeze rollers 11 and 13 rotate. The size liquid discharged from the size liquid feeders 21 and 22 falls on the surfaces of the falling quarters S1 and S2. The size liquid that has fallen on the falling quarters S1 and S2 reach the warp yarns T in the vicinity of the yarn holding portions H1 and H2. The falling quarters S1 and S2 are located at desirable areas for guiding an appropriate amount of the size liquid discharged from the size liquid feeder 21 onto the warp yarns T.

(1-4) The warp yarns T are drawn through the upstream squeeze rollers 11 and 12 along the tangent extending from the yarn holding portion H1, which holds the warp yarns T between the circumferential surfaces 111 and 121 of the upstream squeeze rollers 11 and 12. Further, the warp yarns T drawn through the downstream squeeze rollers 13 and 14 along the tangent extending from the yarn holding portion H2, which holds the warp yarns T between the circumferential surfaces 131 and 141 of the downstream squeeze rollers 13 and 14. In other words, the warp yarns T are drawn through the yarn holding portions H1 and H2 without being bent. This reduces bent portions of the warp yarns T and decreases damage to the warp yarns T that would otherwise be inflicted by bending the warp yarns T.

(1-5) The size liquid that has fallen into the size liquid tray 15 is sent to the size liquid tank 17 without being collected in the size liquid tray 15. The size liquid tray 15 has a simpler structure than the size liquid tank of the prior art since it does not have to collect the size liquid. Further, the size liquid tray 15 is more compact than the size liquid tank of the prior art.

(1-6) In the sizing machine of the prior art that immerses the warp yarns in the size liquid tank, the size liquid may solidify near the yarn holding portions of the squeeze rollers when the sizing machine is stopped (that is, when the rotation of the squeeze rollers is stopped to stop the movement of the warp yarns). A stop mark may be produced if such solidification of the size liquid occurs. In this embodiment, even if the sizing machine is stopped, by continuously supplying the size liquid from the size liquid feeders 21 and 22, the size liquid is prevented from solidifying near the yarn holding portions H1 and H2. This is because the yarn holding portions H1 and H2 are washed by the size liquid that continuously falls from the size liquid feeders 21 and 22.

[0028] A sizing machine according to a second embodiment of the present invention will now be described with reference to Fig. 3. To avoid redundancy, like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment.

[0029] A size liquid tray 26 for collecting size liquid is arranged immediately below squeeze rollers 11 to 14. The size liquid tray 26 contains size liquid N. Size liquid falls from the squeeze rollers 11 to 14 onto surface N1 of the size liquid N in the size liquid tray 26. When the amount of the size liquid N in the size liquid tray 26 becomes less than or equal to a predetermined amount, the size liquid tray 26 is replenished with size liquid supplied from a size liquid supply source 10 through a valve 29. The level of the surface of the size liquid in the size liquid tray 26 at which the supply of the size liquid from the size liquid supply source 10 is stopped is set at a predetermined level that is below the lower squeeze rollers 12 and 14. In other words, the surface N1 of the size liquid N stored in the size liquid tray 26 is positioned below the lower squeeze rollers 12 and 14. Thus, the squeeze rollers 12 and 14 will not roll up the size liquid stored in the size liquid tray 26. In this embodiment, the size liquid tray 26 functions as a size liquid collector for collecting the size liquid N that drops from the squeeze rollers 11 to 14. The surface N1 of the size liquid N in the size liquid tray 26 is located below the squeeze rollers 12 and 14, which are arranged at the lower side of the warp yarns T.

[0030] The surface N1 receiving the size liquid that falls from the squeeze rollers 11 to 14 functions as a collection portion arranged in the size liquid tray 26 at a position that is out of contact with the lower squeeze rollers 12 and 14. In

this embodiment, the size liquid tray 26 is a container that collects the size liquid. Thus, the surface N1 of the size liquid N in the size liquid tray 26 functions as the collection portion. The surface N1 functioning as the collection portion is located at a position that is always out of contact with the lower squeeze rollers 12 and 14 during operation of the sizing machine regardless of the operation conditions. More specifically, the surface N1 is located at a position that is always out of contact with the lower squeeze rollers 12 and 14 irrespective of the operation speed of the sizing machine (that is, the circumferential velocity of the squeeze rollers 11 to 14).

[0031] The size liquid N stored in the size liquid tray 26 is fed to the size liquid feeders 21 and 22 by operating the pump 23. A heating pipe 18 is arranged in the size liquid tray 26. A vapor supply source 19 supplies vapor into the heating pipe 18. The vapor supplied into the heating pipe 18 heats the size liquid N in the size liquid tray 26.

[0032] The second embodiment has advantages that are the same as advantages (1-1), (1-3), (1-4), and (1-6) of the first embodiment.

[0033] The size liquid tray 26 is optimal for reusing the size liquid N since it collects the size liquid N, heats the collected size liquid N, and feeds the size liquid N to the size liquid tray 26.

[0034] The size liquid is contained in the size liquid tray 26. However, the warp yarns T do not have to be immersed in the size liquid contained in the size liquid tray 26. Thus, the size liquid tray 26 has a simpler and more compact structure than the size liquid tank of the prior art.

[0035] A sizing machine according to a third embodiment of the present invention will now be described with reference to Fig. 4. To avoid redundancy, like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment.

[0036] A pump 23A is operated to supply size liquid N from a size liquid tank 17 to a size liquid feeder 21 through a supply pipe 20A. Further, a pump 23B is operated to supply size liquid N from the size liquid tank 17 to a size liquid feeder 22 through a supply pipe 20B.

[0037] The third embodiment has advantages that are the same as advantages (1-1) and (1-3) to (1-6) of the first embodiment.

[0038] Further, the speed of the rotation generated by the pump 23B may differ from that of the pump 23A so that the flow amount of the size liquid from the size liquid feeder 21 differs from that of the size liquid feeder 22. When the warp yarns T sized by the squeeze effect of the upstream squeeze rollers 11 and 12 are further sized by the squeeze effect of the downstream squeeze rollers 13 and 14, the size adhering ratio is further optimized by setting a difference in the flow amount of the size liquid between the size liquid feeder 21 and the size liquid feeder 22.

[0039] A sizing machine according to a fourth embodiment of the present invention will now be described with reference to Fig. 5. To avoid redundancy, like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment.

[0040] A size liquid feeder 21 is located immediately above a size liquid tray 15 and the part of warp yarns T that is upstream from a yarn holding portion H1 of upstream squeeze rollers 11 and 12. A size liquid feeder 22 is located immediately above the size liquid tray 15 and the part of the warp yarns T that is upstream from a yarn holding portion H2 of downstream squeeze rollers 13 and 14.

[0041] The size liquid discharged from discharge holes 25 of the size liquid feeder 21 falls onto the upper surface of the part of the warp yarns T that is upstream from the yarn holding portion H1. The size liquid discharged from discharge holes 25 of the size liquid feeder 22 falls onto the upper surface of the part of the warp yarns T that is upstream from the yarn holding portion H2. Some of the size liquid that has fallen on the warp yarns T falls into the size liquid tray 15. The remaining size liquid that has fallen onto the warp yarns T is transferred to the yarn holding portions H1 and H2 as the warp yarns T move. The size liquid transferred to the yarn holding portion H1 by the movement of the warp yarns T is partially squeezed off from the warp yarns T by the squeeze effect of the upstream squeeze rollers 11 and 12. The size liquid transferred to the yarn holding portion H2 by the movement of the warp yarns T is partially squeezed off from the warp yarns T by the squeeze effect of the downstream squeeze rollers 13 and 14.

[0042] The size liquid squeezed off from the warp yarns T falls along rising halves U1 and U2 of the lower squeeze rollers 12 and 14. Some of the size liquid that falls along the rising halves U1 and U2 of the lower squeeze rollers 12 and 14 rises as the squeeze rollers 12 and 14 rotate. As a result, the size liquid is transferred to the yarn holding portions H1 and H2 and adhered to the warp yarns T. The remaining size liquid that falls along the rising halves U1 and U2 of the lower squeeze rollers 12 and 14 falls into the size liquid tray 15.

[0043] The size liquid in the size liquid tank 17 (refer to Fig. 1) is fed to the upper surface of the part of the warp yarns T that is upstream from the yarn holding portions H1 and H2 only from the size liquid feeders 21 and 22 through a supply pipe 20 and a pump 23. This facilitates the supply of an appropriate amount of size liquid to the warp yarns T.

[0044] The fourth embodiment has the same advantages as advantages (1-4) and (1-5) of the first embodiment.

[0045] A sizing machine according to a fifth embodiment of the present invention will now be described with reference to Fig. 6. To avoid redundancy, like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment.

[0046] A downstream squeeze roller 13 rotates in the direction of arrow R2. A downstream squeeze roller 14 rotates

in the direction of arrow Q2. Warp yarns T drawn through upstream squeeze rollers 11 and 12 are first wind onto about half of the squeeze roller 14 and then drawn through the squeeze rollers 14 and 13. The warp yarns T drawn through the squeeze rollers 14 and 13 are wind onto about half of the squeeze roller 13. The size liquid discharged from discharge holes 25 of a size liquid feeder 22 forms a film of size liquid that is supplied to a falling quarter S5 in the upper half of the squeeze roller 13. The film of size liquid then falls along the falling half round S6 of the squeeze roller 13 and adheres to the warp yarns T in the vicinity of the yarn holding portion H2. Some of the size liquid adhered to the warp yarns T in the vicinity of the yarn holding portion H2 is squeezed off from the warp yarns T by the squeezing effect of the downstream squeeze rollers 13 and 14.

[0047] The size liquid squeezed off from the warp yarns T falls along the rising half U3 of the lower squeeze roller 14. Some of the size liquid that falls along the surface of the rising half U3 of the squeeze roller 14 rises as the squeeze roller 14 rotates. Such size liquid is transferred to the yarn holding portion H2. The remaining size liquid that falls along the warp yarns T on the rising half U3 of the squeeze roller 14 falls into a size liquid tray 15.

[0048] The fifth embodiment has the same advantages as advantages (1-1), (1-3), (1-5), and (1-6) of the first embodiment.

[0049] A sizing machine according to a sixth embodiment of the present invention will now be described with reference to Fig. 7. To avoid redundancy, like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment.

[0050] A size liquid tank 17 is arranged above upper squeeze rollers 11 and 13. When the amount of size liquid in the size liquid tank 17 becomes less than or equal to a predetermined amount, the size liquid tank 17 is replenished with size liquid supplied from a size liquid supply source 10. A recovery pipe 16 is connected to a size liquid tray 15 and extended to a position immediately above the size liquid tank 17. A pump 23 is arranged in the recovery pipe 16. A flow amount adjustment valve 27, which is manually operated, is arranged in a supply pipe 20. The supply pipe 20 is connected to the bottom wall 171 of the size liquid tank 17.

[0051] The size liquid N in the size liquid tank 17 is supplied to size liquid feeders 21 and 22 through the supply pipe 20 and the flow amount adjustment valve 27. The size liquid supplied to the size liquid feeders 21 and 22 is supplied from the discharge holes 25 to each of the upper squeeze rollers 11 and 13. The size liquid that falls into the size liquid tray 15 from the lower squeeze rollers 12 and 14 is sent into the recovery pipe 16. The pump 23 operates to discharge the size liquid out of the recovery pipe 16 and into the size liquid tank 17.

[0052] The amount of size liquid supplied to the size liquid feeders 21 and 22 is easily adjusted by adjusting the opening degree (cross-sectional passage area) of the flow amount adjustment valve 27.

[0053] The sixth embodiment has the same advantages as advantages (1-1) and (1-3) to (1-6) of the first embodiment.

[0054] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the present invention may be embodied in the following forms.

(1) In the first embodiment, the warp yarns T may be bent when drawn through the yarn holding portions H1 and H2.

(2) In the first embodiment, the size liquid may be directly fed to the yarn holding portions H1 and H2 from the size liquid feeders 21 and 22.

(3) In the first embodiment, a size liquid supply means may be employed to apply size liquid to the circumferential surfaces 111 and 131 of the upper squeeze rollers 11 and 13 while contacting the circumferential surfaces 111 and 131.

(4) In the first embodiment, either one of the pair of upstream squeeze rollers 11 and 12 or the pair of downstream squeeze rollers 13 and 14 may be eliminated.

[0055] The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

Claims

1. A sizing machine for sizing warp yarns by drawing warp yarns that have been supplied with size liquid through a pair of squeeze rollers and squeezing off excessive size liquid from the warp yarns with the pair of squeeze rollers, wherein the pair of squeeze rollers include an upper squeeze roller and a lower squeeze roller, each having a circumferential surface, the sizing machine being **characterized by:**

a size liquid supply means for supplying size liquid to the circumferential surface of the upper squeeze roller located at an upper side of the warp yarns or for supplying size liquid to an upper surface defined on the warp yarns upstream from the pair of squeeze rollers; and
a size liquid tray arranged below the pair of squeeze rollers and including a receiving portion for receiving size liquid that falls from the pair of squeeze rollers, wherein the receiving portion is located at a position that is always out of contact with the lower squeeze roller during operation of the sizing machine.

2. The sizing machine according to claim 1, **characterized in that**:

the size liquid supply means supplies size liquid to the circumferential surface of the upper squeeze roller in an area defined between the top of the circumferential surface and a location advanced by one fourth of the circumferential surface in a rotation direction of the upper squeeze roller.

3. The sizing machine according to claim 1, **characterized in that**:

the warp yarns are drawn through the pair of squeeze rollers along a tangent extending from where the warp yarns are held between the circumferential surfaces of the squeeze rollers.

4. The sizing machine according to any one of claims 1 to 3, **characterized in that** the size liquid tray is a container that does not collect size liquid.

5. The sizing machine according to claim 4, **characterized in that** the size liquid tray includes an inner wall surface functioning as the receiving portion, and a size liquid collector for collecting size liquid received by the size liquid tray is arranged below the size liquid tray.

6. The sizing machine according to any one of claims 1 to 3, **characterized in that** the size liquid tray is a container for collecting size liquid.

7. The sizing machine according to any one of claims 1 to 3, further being **characterized by**:

a recirculation means for sending the size liquid received by the size liquid tray to the size liquid supply means.

8. The sizing machine according to any one of claims 1 to 3, **characterized in that** the sizing machine includes plural pairs of squeeze rollers including the pair of squeeze rollers, the size liquid supply means includes a plurality of size liquid feeders for respectively supplying size liquid to the plural pairs of squeeze rollers, and the sizing machine includes a plurality of flow amount adjusting means for respectively adjusting amounts of size liquid supplied from the plurality of size liquid feeders.

Fig.1

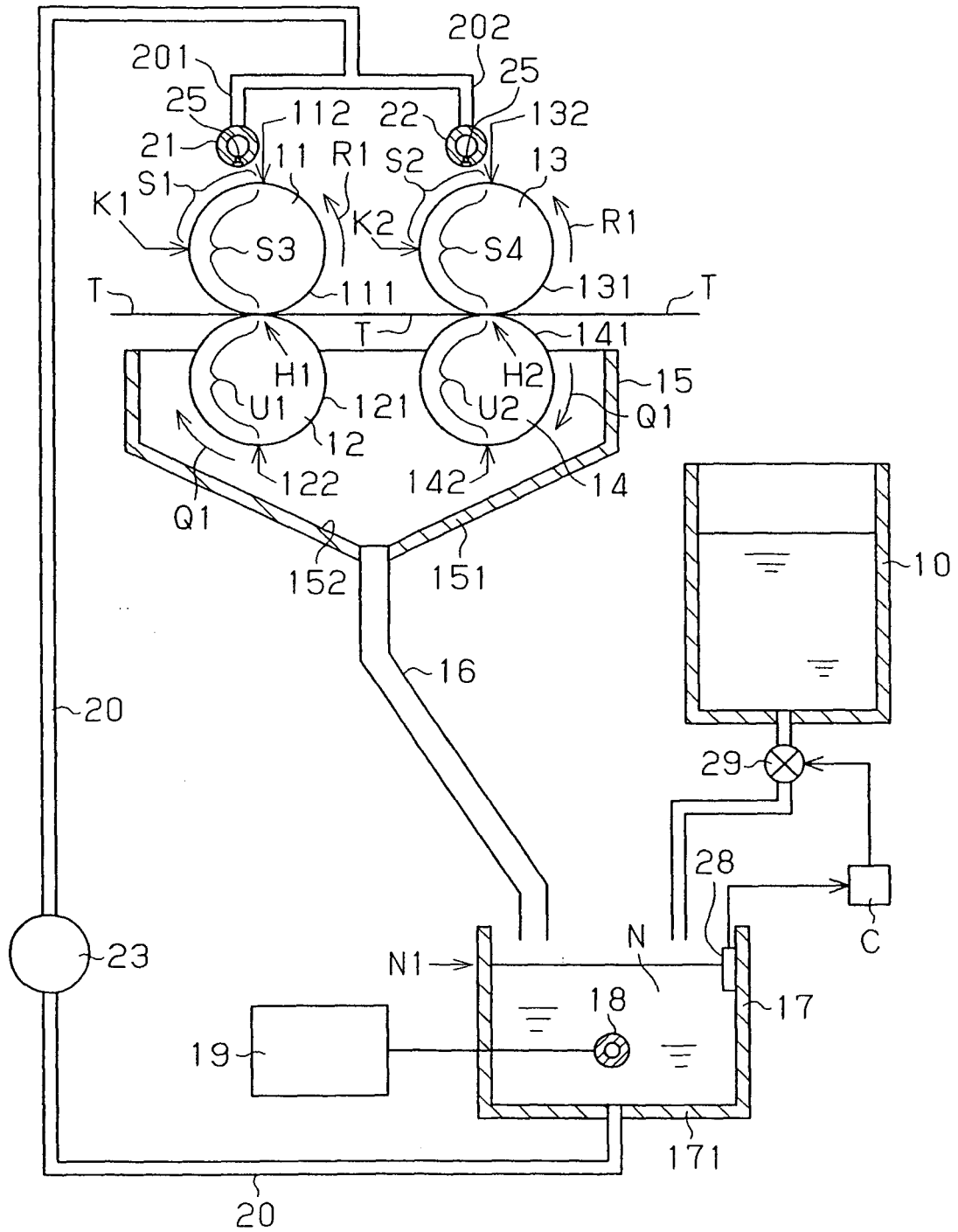


Fig. 2(a)

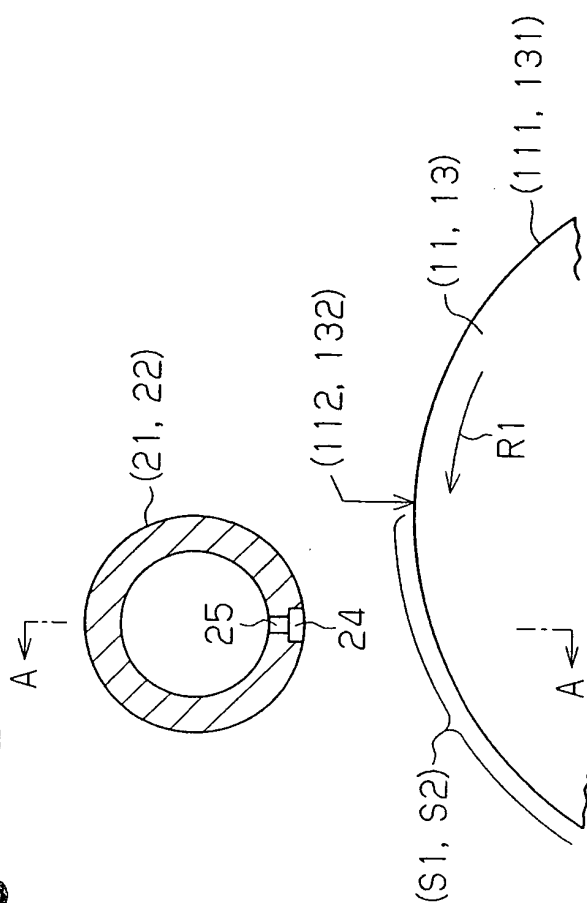


Fig. 2(b)

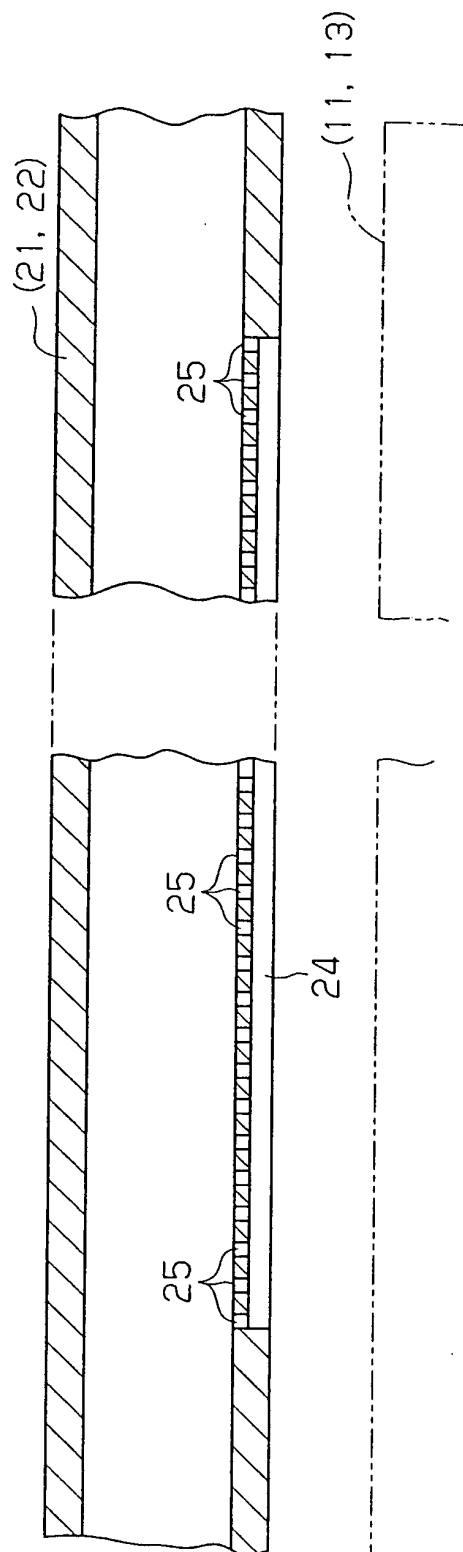


Fig.3

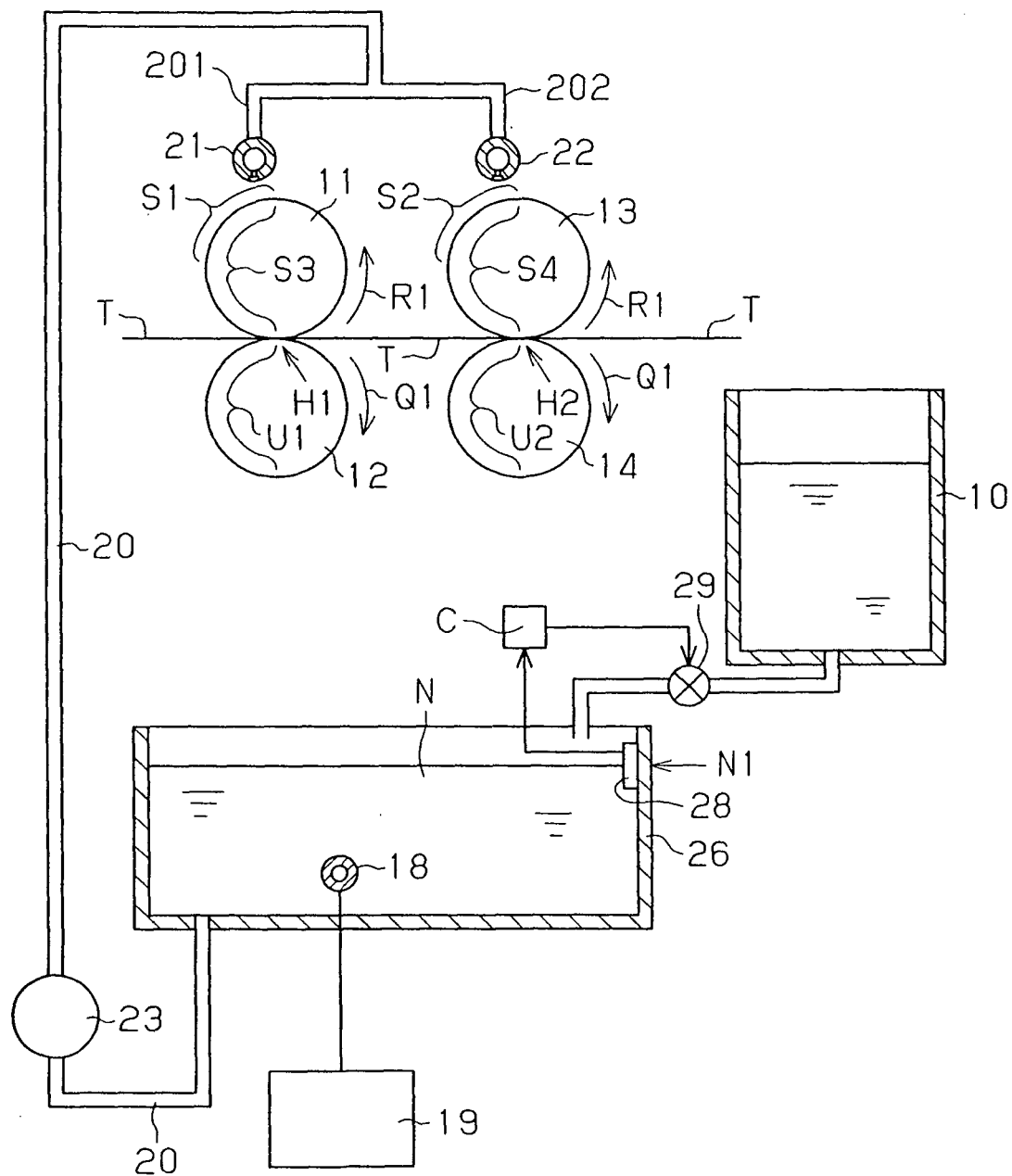


Fig.4

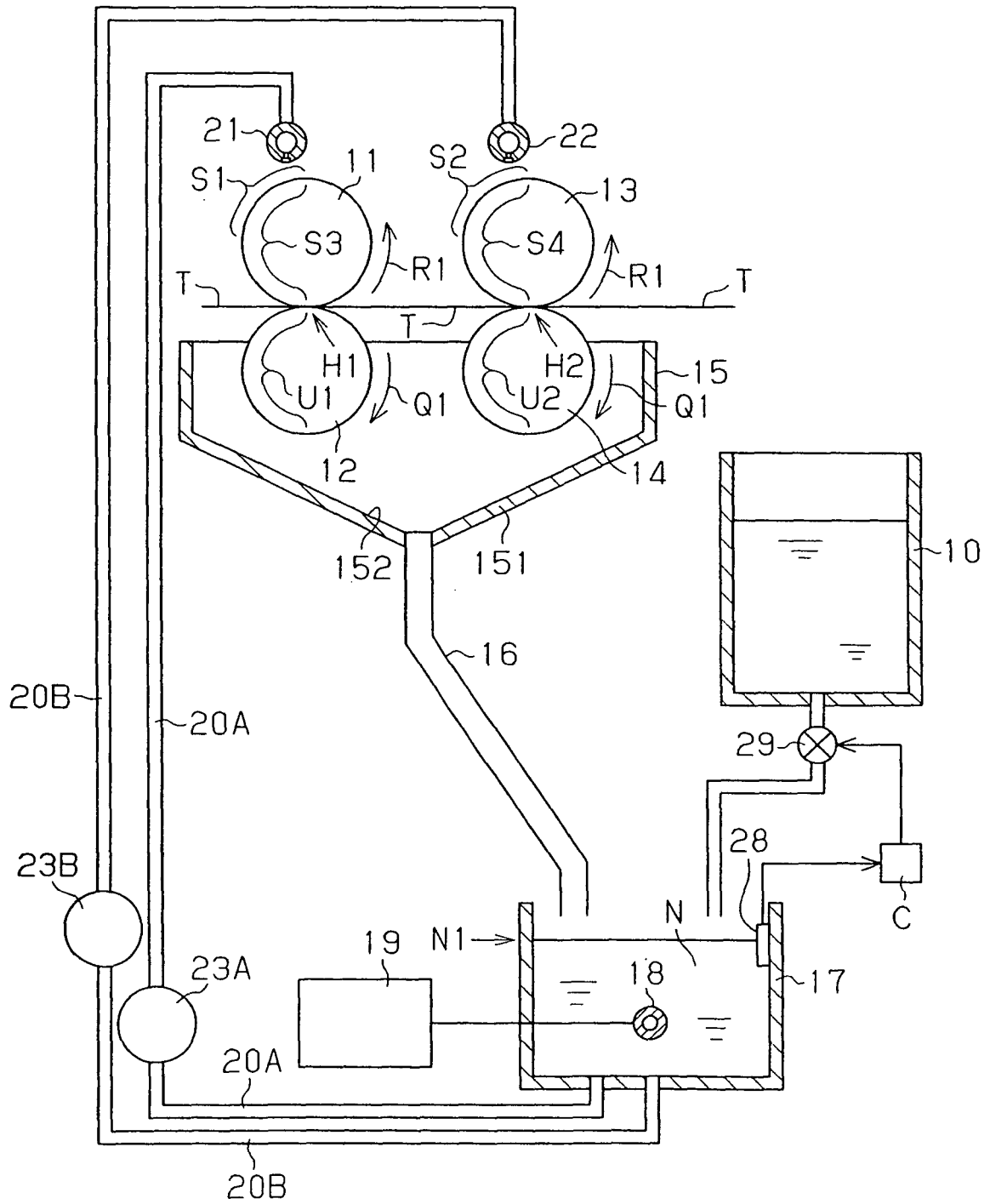


Fig.5

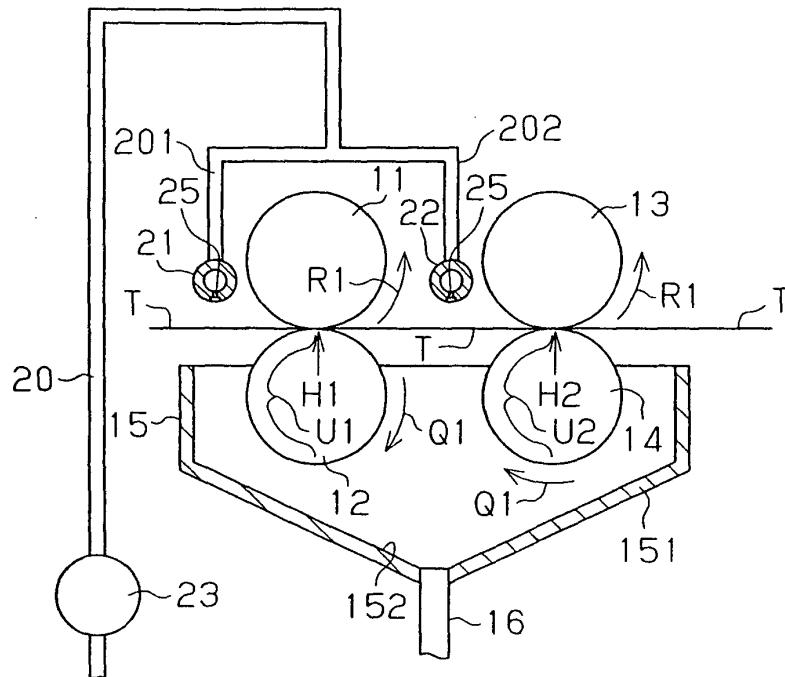


Fig.6

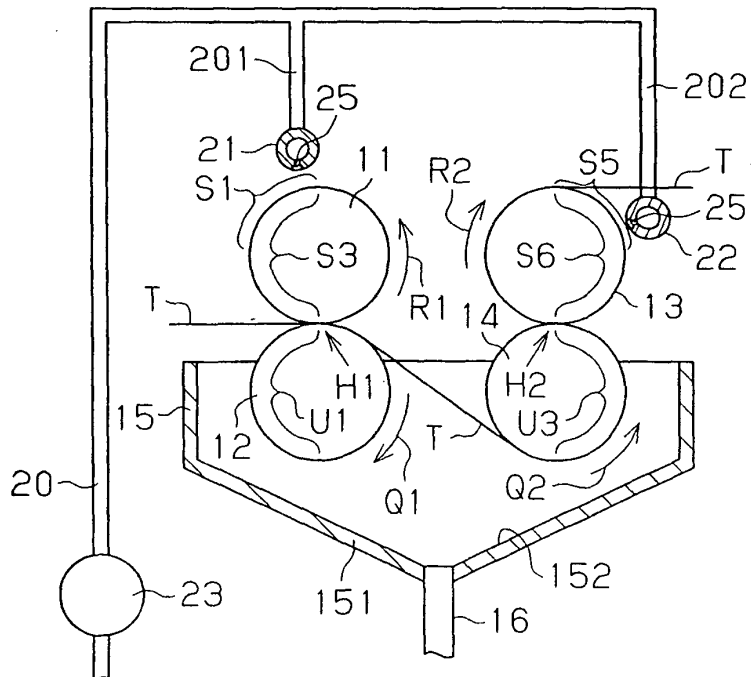


Fig.7