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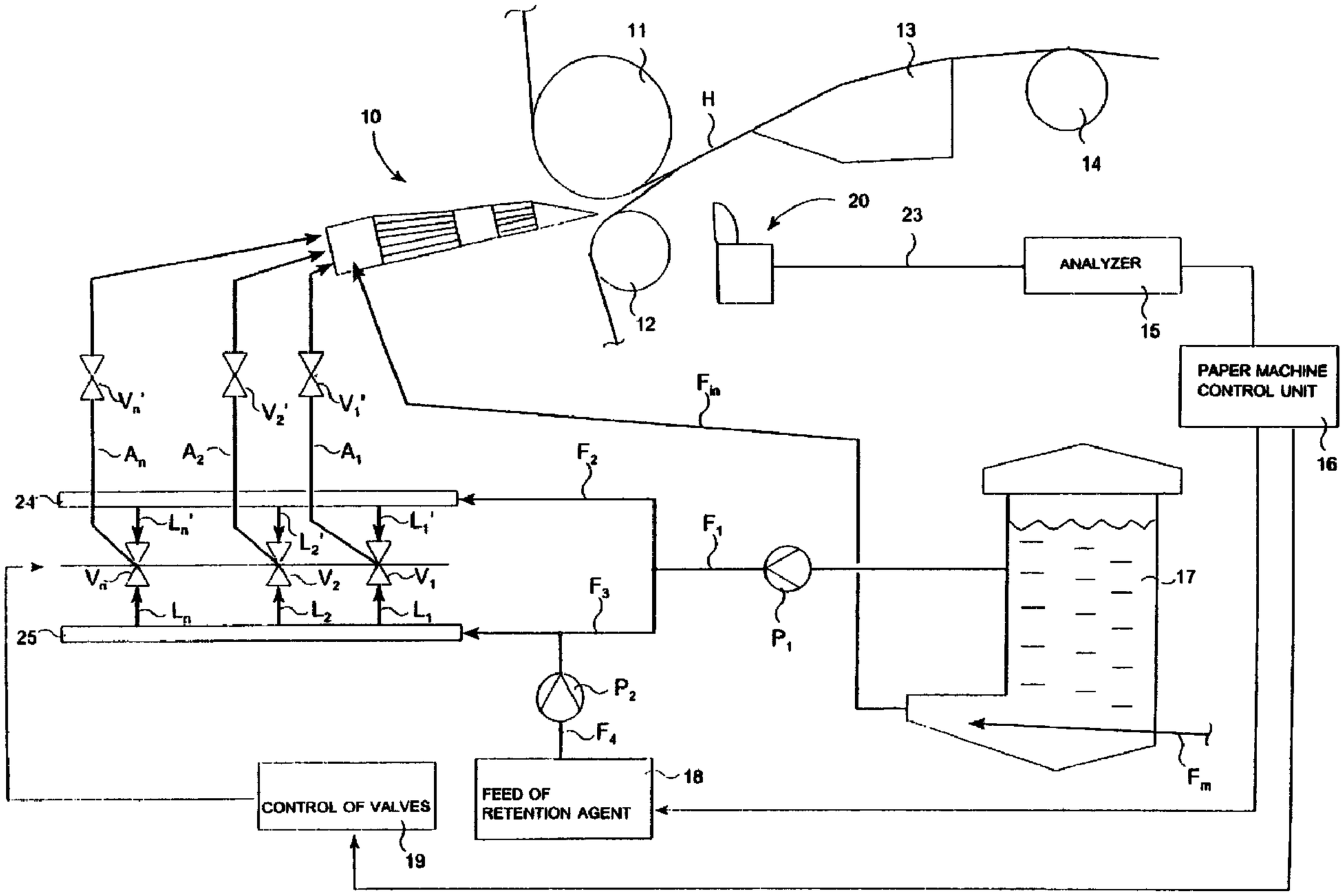
(54) Titre : PROCEDE ET DISPOSITIF DESTINES A MESURER LE PROFIL DE RETENTION ET DE COMMANDER LA RETENTION DANS UNE MACHINE A PAPIER / A CARTON

(54) Title: METHOD AND DEVICE FOR MEASUREMENT OF THE RETENTION PROFILE AND FOR CONTROL OF THE RETENTION IN A PAPER/BOARD MACHINE



(57) Abrégé/Abstract:
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(57) Abrégé(suite)/Abstract(continued):
number of points in the cross direction of the web, preferably at uniform distances, the samples that were taken are analyzed by means of an analyzer, a retention profile is formed out of the measurement results, and the retention profile thus formed is used for controlling the paper machine.

ABSTRACT

In a method and a device for measurement and regulation of the retention profile of the web in a paper/board machine, from the white water drained from the web through the wire in the wire part, samples are taken by means of a sample collecting device a number of points in the cross direction of the web, preferably at uniform distances, the samples that were taken are analyzed by means of an analyzer, a retention profile is formed out of the measurement results, and the retention profile thus formed is used for controlling the paper machine.

Method and device for measurement of the retention profile and for control of the retention in a paper/board machine

The invention concerns a method and a device for measurement and regulation of the retention profile of the web in a paper/board machine.

The invention is related to the dilution liquid system in a paper machine and more specifically to measurement and control of the retention profile of the web in the cross direction of the machine. Further, by means of the device in accordance with the invention, it is possible to locate various situations of malfunction in the wire part of a paper machine or equivalent.

A dilution headbox is known from the applicant's *Patent Applications FI-901593, FI-933027 and FI-942780* of earlier dates. In a dilution headbox, the basis weight of the web is regulated so that a dilution flow is passed through a valve to different areas of width of the headbox and so that the quantity of said flow is regulated. The dilution flow is mixed with the stock flow passed from the inlet header of the headbox. As the dilution liquid, it is possible to use pure water or, for example, filtrate water returned from the web. In the applicant's *Patent FI 92,229*, a construction of a three-way dilution valve is described, which is used for regulation of the dilution flow.

As is known from the prior art, a stock suspension jet is discharged out of the slice opening in paper or board machines onto a forming wire or into a gap between wires. The proportion of the solid matter that remains on the wire, i.e. the retention, consists of a fibre retention, whose proportion is about 60...80 %, and of a filler retention, whose proportion is about 20...40 %. The filtrate passing through the wire, i.e. the so-called white water, contains an abundance of fibrous material and fillers, and it is returned back to the process of manufacture. By means of measure-

ment of the properties of the white water, information is obtained, among other things, on the success of the dilution regulation. When the measurement is carried out at a number of points in the cross direction, it is possible to conclude the distribution of fibres and fillers in the cross direction of the web. Attempts are made to regulate the retention of fibres and the retention of fillers so that they are distributed as uniformly as possible in the cross direction of the machine.

Factors that affect the retention include, among other things, headbox consistency, construction of the wire part, and properties of the stock, such as distribution of fibre length, fillers, and added chemicals. Measurement of basis weight does not give a correct picture of the retention profile, for with a uniform basis weight profile, the fibre retention profile and the filler retention profile can, nevertheless, be uneven. This is why determination of the retention profile in the wire part would give a correct idea of the retention profiles.

For regulation of the retention, a retention agent is employed, whose function is to bind fillers and fines to the fibres in order that said agents should not depart from the web through the holes provided in the wire. The particle size of fillers and fines is considerably smaller than the size of the holes provided in the wire.

The present invention is directed towards the provision of a method of measurement for measurement of the retention profile.

The present invention also is directed towards the provision of a method of regulation for regulation of the retention profile in the cross direction.

The present invention additionally is directed towards the provision of a device for measurement of the retention profile.

The present invention further is directed towards the provision of a device for regulation of the retention profile.

The method in accordance with the invention is characterized in that, in the method, from the white water drained from the web through the wire in the wire part, samples are taken by means of a sample collecting device from a number of points in the cross direction of the web, preferably at uniform distances, the samples that were taken are analyzed by means of an analyzer, a retention profile is formed out of the measurement results, and the retention profile thus formed is used for controlling the paper machine.

The device in accordance with the invention is characterized in that the device comprises means for measurement of the retention profile across the web width from different points of width of the web out of the white water drained from the wire part, and that the headbox comprises lines passing to different points of width of the headbox so as to pass a flow of liquid that contains a retention agent in the headbox of the paper or board machine into connection with the stock flow so as to regulate the retention profile across the web width, and that the lines comprise, in their connection, a valve construction for regulation of the amount of retention agent into the flow moving in the line, the regulation of the valves taking place on the basis of the measurement data obtained from measurement of the retention profile.

In the present invention, an arrangement is suggested for measurement and regulation of the retention profile in the cross direction of the machine. A white water sample is collected into a sampling vessel and transferred to an analyzer. The analyzer can also be integrated in a measurement head. After taking of the sample and after its transfer to the analyzer, the measurement head is transferred to the following measurement point. With this procedure, the retention profile can be determined across the width of the whole machine direction. Samples can be taken, for example, at intervals of 10 cm in the machine direction.

The determined retention profile is utilized in the regulation of the dilution liquid system, in which connection each dilution liquid valve can be provided with the necessary regulation of the concentration of retention agent. A measurement arrangement accomplished in this way operates as on-line measurement, and it can be

carried out constantly during the whole run. The measurement also provides information on problem situations, e.g. on blocking or contamination of the wire fabric, on incomplete mixing of retention agent, or on other situations of failure.

Regulation of the retention profile is carried out so that the basis weight profile is not changed. In such a case, a change in the basis weight of the paper arising from a change in the quantity of retention agent is compensated for by means of a change in the dilution quantity. For example, if a local addition of retention agent increases the basis weight, the dilution quantity at said point is increased.

In the following, the invention will be described in more detail with reference to the exemplifying embodiments of the invention illustrated in the figures in the accompanying drawing, the invention being not supposed to be confined to the details of said embodiments alone.

Figure 1 is an illustration in the form of a block diagram of an embodiment of the retention profile measurement and control system in accordance with the present invention as applied to a dilution headbox.

Figure 2 is a general view of an arrangement of collecting of white water samples.

Figure 3 is a detailed illustration of the arrangement of collecting of white water samples.

Figure 4 is an exemplifying illustration of a valve construction that regulates the ratio of the retention agent in the flow.

Fig. 1 is an illustration in the form of a block diagram of the parts of a paper machine and of a system of measurement included in the system of regulation and control of the retention profile in an embodiment in accordance with the present invention. The stock suspension jet is discharged out of the slice opening of the headbox 10 into the forming gap between the forming rolls 11 and 12 and from the

gap further onto the forming wire H. Fig. 1 also shows a suction box 13 and a guide roll 14. Below the forming wire H, a sample collecting equipment 20 is placed, by whose means samples are taken out of the white water departing from the wire H. The white water is recovered into the wire pit 17, from which it is passed back into the papermaking process, mainly to be used as dilution water for the headbox.

The high-consistency stock is fed into the wire pit 17 as a flow F_m, and from the wire pit 17 the high-consistency stock is passed to the headbox 10 as a flow F_{in}. From the wire pit 17, a flow F_1 is passed through a pump P_1, which flow is divided into flows F_2 and F_3. The white-water flow F_2 is passed into a dilution header 24. A retention agent feed unit 18 supplies a retention agent flow F_4 through a pump P_2 to be added to the flow F_3, which is passed further into a retention agent header 25.

From the dilution header 24 the flow F_2 is distributed to the valves $V_1 \ldots V_n$ through the respective lines $L_1' \ldots L_n'$. From the retention agent header 25 the flow is distributed to the valves $V_1 \ldots V_n$ through the respective lines $L_1 \ldots L_n$. The valves $V_1 \ldots V_n$ are three-way valves, by whose means the retention profile and the dilution profile are regulated. The regulation of said profiles is carried out independently from one another. For example, if a recess is noticed in the retention profile, retention agent is added to that location. Owing to the improved retention, more fibres, fines and fillers remain on the wire, in which connection the basis weight is increased in this area. In such a case, dilution water is added to said area in order that the basis weight profile should remain uniform. The control for the valves $V_1 \ldots V_n$ is obtained from the valve control unit 19.

From the valves $V_1 \ldots V_n$ the stock flow is passed through the respective lines $A_1 \ldots A_n$ to the different positions of width in the headbox across the whole width of the headbox. The lines $A_1 \ldots A_n$ include ordinary throttle valves $V_1' \ldots V_n'$ for regulation of the flow quantities. In the embodiment shown, the valves $V_1 \ldots V_n$ are favourably valves to which it is possible to pass the flow portion Q_1 comprising the retention agent from the retention agent header 25 and the flow portion Q_2 comprising the dilution water alone from the dilution water header 24. The combined flow

$Q_1 + Q_2$ is passed further into the lines $A_1 \ldots A_n$ and further, through the valve $V_1' \ldots V_n'$ placed in each line, to the different positions of width in the headbox. By means of the valves $V_1 \ldots V_n$, the mixing ratio of the dilution flow passed from the dilution water header 24 to the flow containing retention agent and passed from the retention agent header 25, i.e. the retention ratio, is regulated. When the flow Q_1 is increased, the flow Q_2 is reduced by a corresponding amount, and the other way round. Thus, the sum flow $Q_1 + Q_2$ remains invariable, and said combined flow is passed through the ordinary throttle valves $V_1' \ldots V_n'$ to the different positions of width in the headbox. By means of regulation of the valves $V_1' \ldots V_n'$, it is possible to regulate the flow quantity of the sum flow $Q_1 + Q_2$ and, thereby, the basis weight of the web at different positions of width with the retention ratio regulated by means of each particular valve $V_1 \ldots V_n$. A joint operation of the valves V_1 and V_1' can also be accomplished, for example, by means of one valve, which is described in the *FI Patent No. 92,229*.

The device 20 for taking samples from the white water is favourably traversing, and by its means samples are taken from the white water preferably with uniform spacing across the entire width of the wire H. The sample collected from each cross-direction location is carried through a transfer pipe 23 to the white water analyzer 15, which determines the concentrations of solid matter and fillers present in the sample. The device for 20 taking samples can also be stationary (e.g. a pipe) so that it comprises sampling compartments opened one at a time for taking samples in the cross direction.

As a white water analyzer 15, it is possible to use, for example, a "Kajaani RM-200" analyzer, whose operation is based on optical on-line measurement from a constant flow of samples. The detector of the analyzer measures the depolarization, attenuation and backscattering and absorption at different wave lengths from laser light passing through the sample. In analyzing of the sample, it is also possible to use some other analyzer for determination of the properties of the white water.

The white water analyzer 15 transmits the data analyzed from the sample to the paper machine control unit 16, which uses the analyzed data for the control of the paper machine.

In the embodiment in accordance with the invention, the paper machine control unit 16 controls the retention agent feed unit 18 and the valve control unit 19.

Fig. 2 illustrates the location of the traversing sampling unit 20 in the vicinity of the forming wire H and of the forming rolls 11 and 12. The stock M is fed in the direction indicated by the arrow between the forming rolls 11 and 12 and a ribbed shoe L. The carrier 21 of the traversing sampling head remains stationary at each sampling point for the time of collecting of the sample. Typically, the taking of a sample takes about 30 seconds, and samples are taken at intervals of 10 cm. The movement of the carrier 21 of the traversing sampling head is preferably synchronized, so that the sample is always taken from the same position of width in each series of measurement of the retention profile.

Fig. 3 illustrates the area of the rectangle drawn with a dashed line in Fig. 2, which figure shows a detail of the sample collecting trough 22. The collecting trough 22 is placed at a point which represents about 40 per cent of the water that is drained. The water sample passes from the collecting trough into a transfer pipe 23, along which it is passed to the analyzer 15.

The system of measurement of the retention profile is connected to each particular valve $V_1 \ldots V_n$ that regulates the mixing ratio (mixing ratio of retention agent) as a feedback connection so that from each point of width the measurement data are passed to the valve $V_1 \ldots V_n$ that regulates the retention profile at said point of width. After the valves $V_1 \ldots V_n$, in the discharge line $A_1 \ldots A_n$ departing from the valves, there can be a separate throttle valve $V_1' \ldots V_n'$ which regulates the flow quantity and by whose means the basis weight of the web can be regulated additionally across the web width. Joint operation of the valves V_1, V_1'; V_2, V_2' can also be accomplished by means of a single-valve solution in accordance with the *FI Patent No. 92,229*. By

means of the regulation in accordance with the present invention, it is possible to provide a retention profile as straight as possible across the web width. Moreover, it is separately possible to regulate the filler profile. The device is also suitable for clearing up situations of problems, for example, in a situation in which the retention agent has been mixed incompletely or in which there are blocked portions or contaminations in the wire fabric.

Fig. 4 illustrates an exemplifying embodiment of a solution of a three-way valve as described in the *FI Patent 92,229*, which valve is suited for regulation of the retention agent in the present invention. The retention agent is passed, for example, into the liquid flow Q_1, and the flow Q_2, which may consist of pure water, is passed into the valve V while the covering part 101 pivoting on the spindle 100 regulates the coverages of the inlet openings E_1 and E_2. When one inlet opening E_1 is being opened, the other opening E_2 is being closed, or the other way round. In this way the flow quantity remains invariable, but the mixing ratio of the retention agent in the combined flow $Q_1 + Q_2$ is regulated. Further, the valve V shown in the figure can be such that the covering part 101 and the spindle 100 can be shifted axially in the direction X, in which case, with a certain mixing ratio, it is also possible to regulate the flow quantity. Said property can be substituted for by means of the construction described above, in which separate throttle valves are employed after the three-way valve $V_1 \ldots V_n$.

In the following, the patent claims will be given, and the different details of the invention can show variation within the scope of the inventive idea defined in said patent claims and differ even to a considerable extent from what has been stated above by way of example only.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for measurement and regulation of a retention profile of a web in a paper/board machine, wherein, in the method, from white water drained from the web through a wire in a wire part, samples are taken by means of a sample collecting device from a number of points in the cross direction of the web, the samples that were taken are analyzed by means of an analyzer, a retention profile is formed out of the measurement results, and the retention profile thus formed is used for controlling the paper machine.

2. A method as claimed in claim 1, wherein said measurement results are used for regulation of the retention profile of the paper web.

3. A method as claimed in claim 1 or 2, wherein a successive series of white water samples is taken from the same cross-direction measurement points of the web.

4. A method as claimed in any one of claims 1 to 3, wherein the retention profile is used for regulation of the contents of fibres, fines and fillers in the papermaking pulp.

5. A method as claimed in any one of claims 1 to 4, wherein the retention profile is regulated so that the feed of retention agent to different points of width in a headbox is regulated.

6. A method as claimed in any one of claims 1 to 5, wherein retention agent is metered together with dilution water by means of valves.

7. A method as claimed in any one of claims 1 to 6, wherein the sample of white water is taken from the water departing from a former roll.

8. A device for measurement and regulation of a retention profile of a web in a paper/board machine, wherein the device comprises means for measurement of the retention profile across the web width from different points of width of the web out of the white water drained from the wire part, and wherein a headbox comprises lines passing to different points of width of the headhox so as to pass a flow of liquid that contains a retention agent in the headbox of the paper or board machine into connection

with stock flow so as to regulate the retention profile across the web width, and wherein the lines comprise, in their connection, a valve construction for regulation of the amount of retention agent into the flow moving in the line, the regulation of the valves taking place on the basis of the measurement data obtained from measurement of the retention profile.

9. A device as claimed in claim 8, wherein the valve construction is composed of a two-way valve, in which connection the mixing ratio of two inlet flows is regulated by means of the valve, of which flows one flow includes the retention agent, and that the mixing ratio is regulated so that, when the one flow is increased, the other flow is reduced by a corresponding amount, and the other way round, and wherein the combined flow is passed into the line after the valve.

10. A device as claimed in claim 8 or 9, wherein the valve construction is such that, besides regulating the mixing ratio, by its means it is also possible to regulate the amount of flow of material passing into the line which passes to a certain position of width in a headbox.

11. A device as claimed in any one of claims 8 to 10, wherein, after the valves, the valve construction comprises a separate valve, by whose means the flow quantity can be regulated in the line.

12. A device as claimed in any one of claims 8 to 11, wherein the device comprises an analyzer, a sample collecting device for taking a sample from the water that has departed from the wire, a carrier for the sample collecting device, and a sample transfer duct for transferring the sample to the analyzer for the purpose of determination of the retention profile.

13. A device as claimed in any one of claims 8 to 12, wherein the sample collecting device has been fitted to be displaced by means of the carrier of the sample collecting device in the cross direction of the web.

14. A device as claimed in any one of claims 8 to 13, wherein the content of fibres and fillers is analyzed by means of the analyzer from the water that has drained from the wire.

15. A device as claimed in any one of claims 8 to 14, wherein the device includes a first flow connection for passing of dilution water from a wire pit to the dilution header and lines for passing of the flow of dilution water to the valves.

16. A device as claimed in any one of claims 8 to 15, wherein the device comprises a second flow connection for passing of dilution water from a wire pit to the retention agent header and a second flow connection for passing of retention agent from the retention agent supply unit to the retention agent header.

17. A device as claimed in any one of claims 8 to 16, wherein the valves are controlled by means of a valve control unit.

18. A device as claimed in any one of claims 8 to 17, wherein the paper machine control unit controls the retention agent supply unit and the valve control unit.

19. A device as claimed in any one of claims 8 to 18, wherein the lines comprise valves for regulation of the flow quantity of dilution water.

20. A method as claimed in any one of claims 1 to 7, wherein the samples are taken by means of a sample collecting device from a number of uniformly-distanced points in the cross direction of the web.

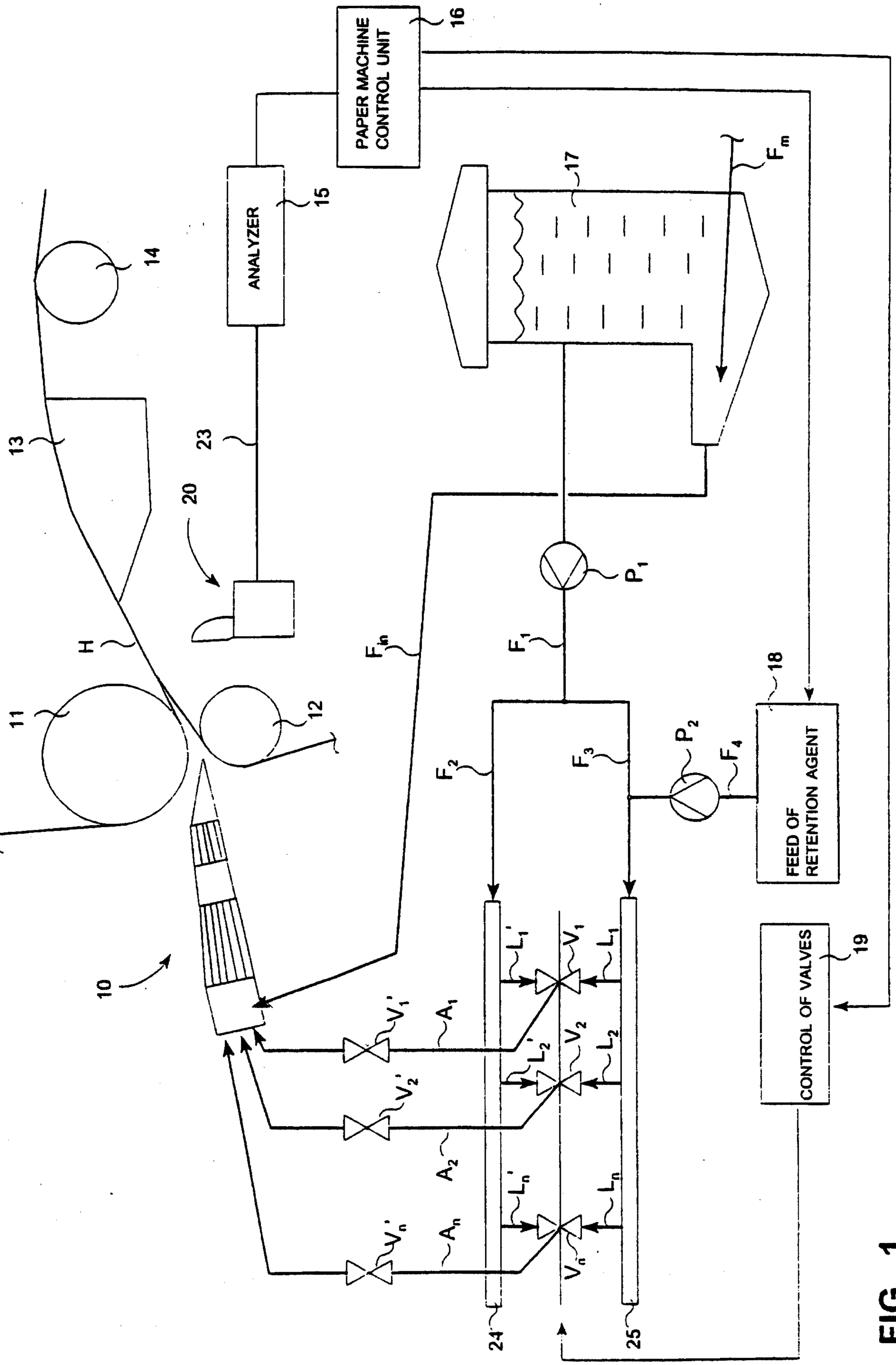

PAPER MACHINE CONTROL UNIT
16
ANALYZER
15
14
13
23
20
H
11
12
10
17
F_m
P_1
F_{in}
F_1
18
F_2
F_3
P_2
F_4
FEED OF RETENTION AGENT
CONTROL OF VALVES
19
V_1'
A_1
L_1'
V_1
L_1
V_2'
L_2'
V_2
L_2
V_n'
A_2
A_n
L_n'
L_n
V_n
24
25

FIG. 1

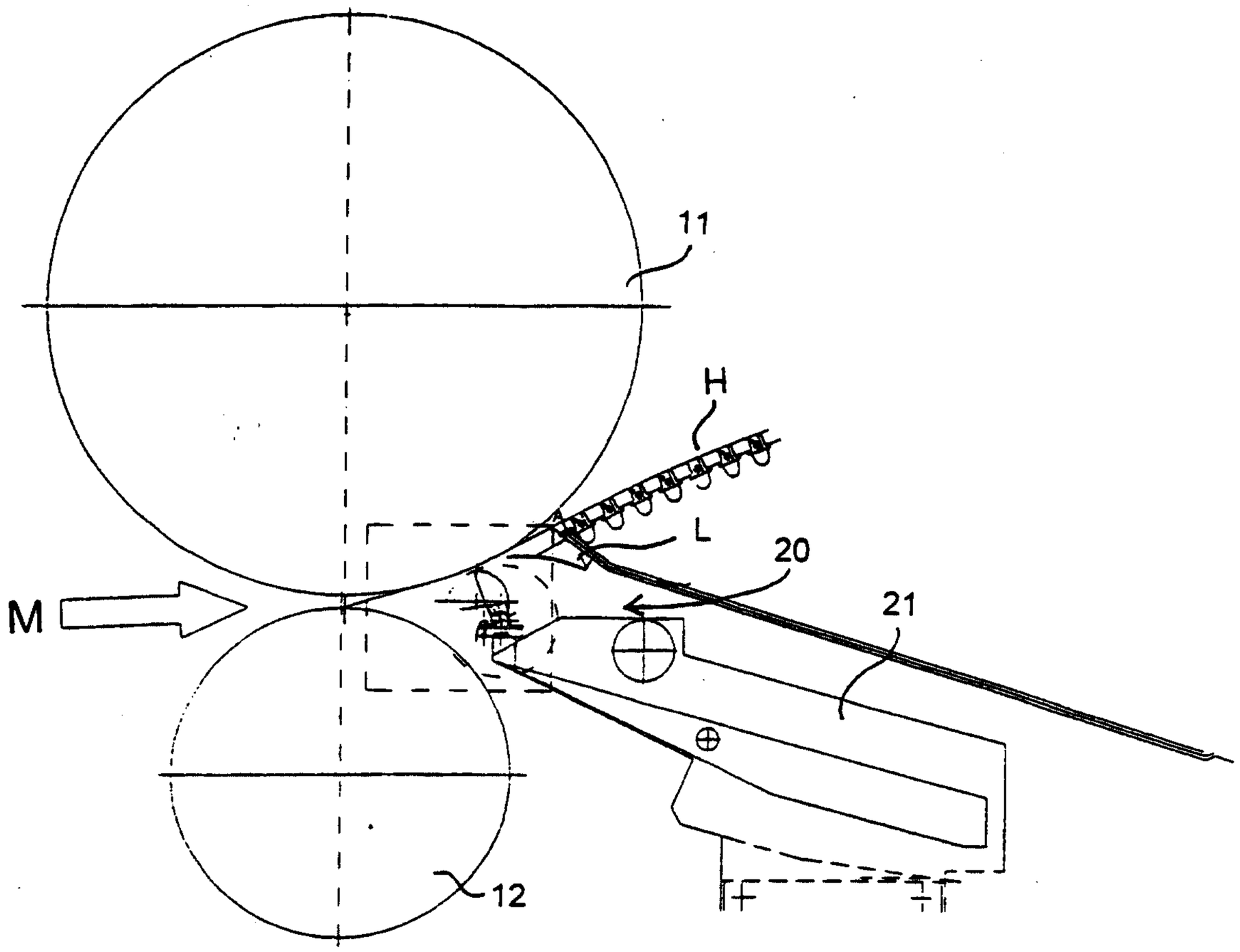


FIG. 2

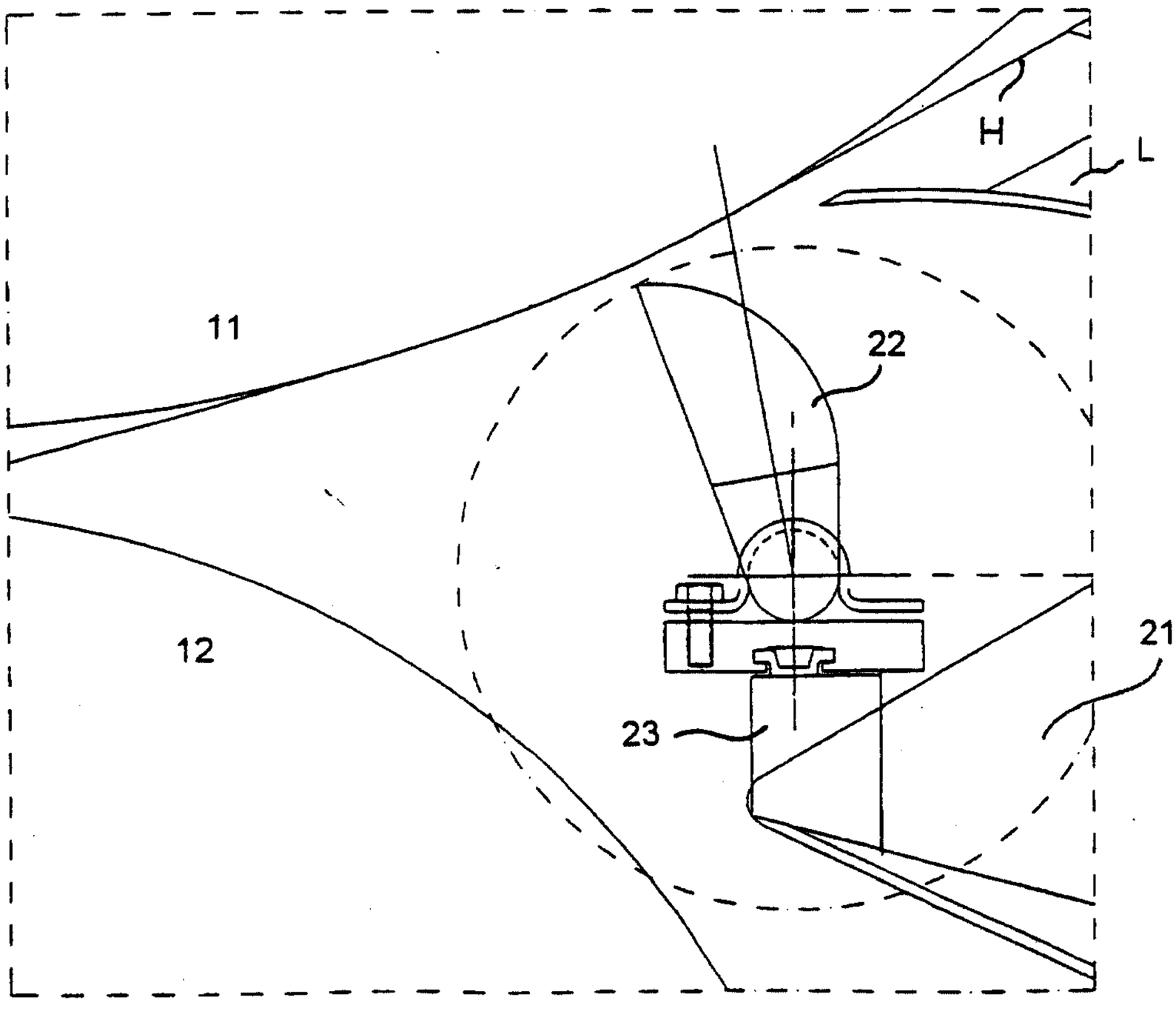


FIG. 3

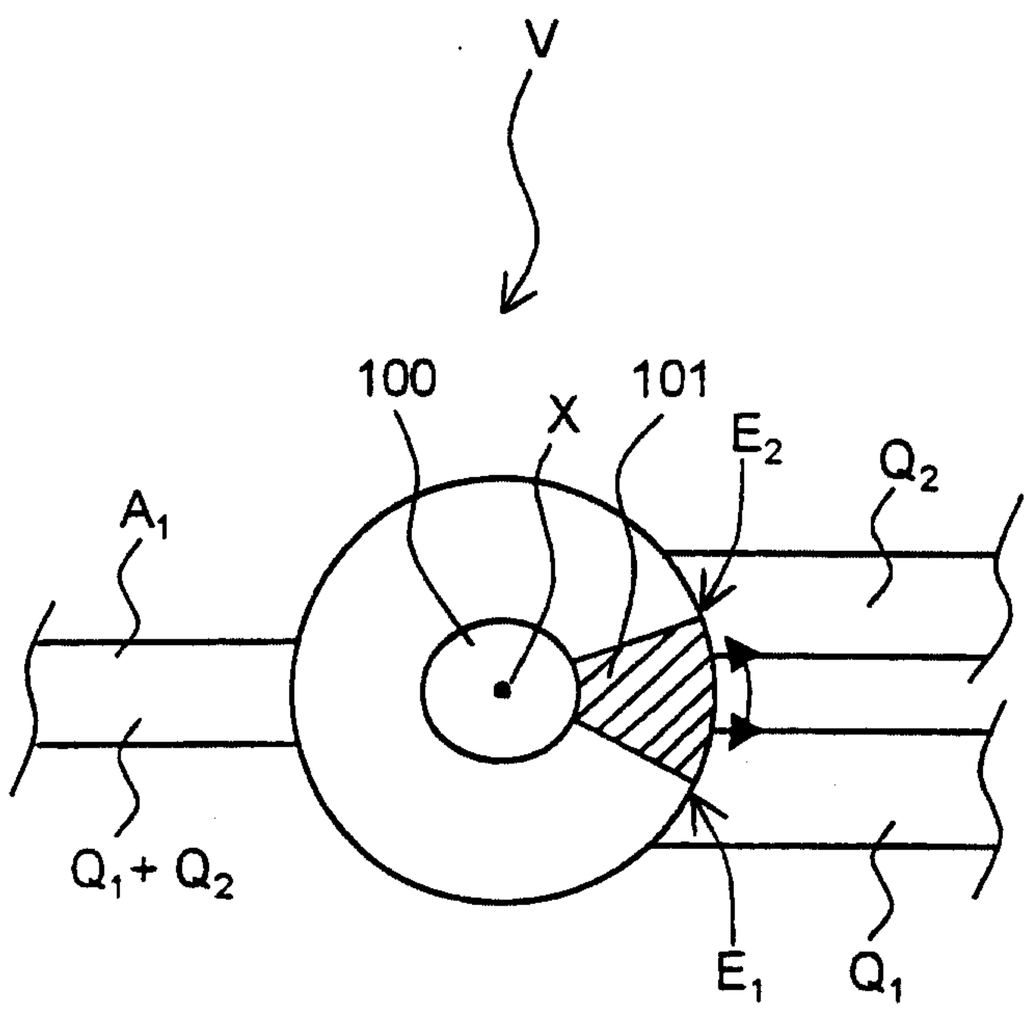
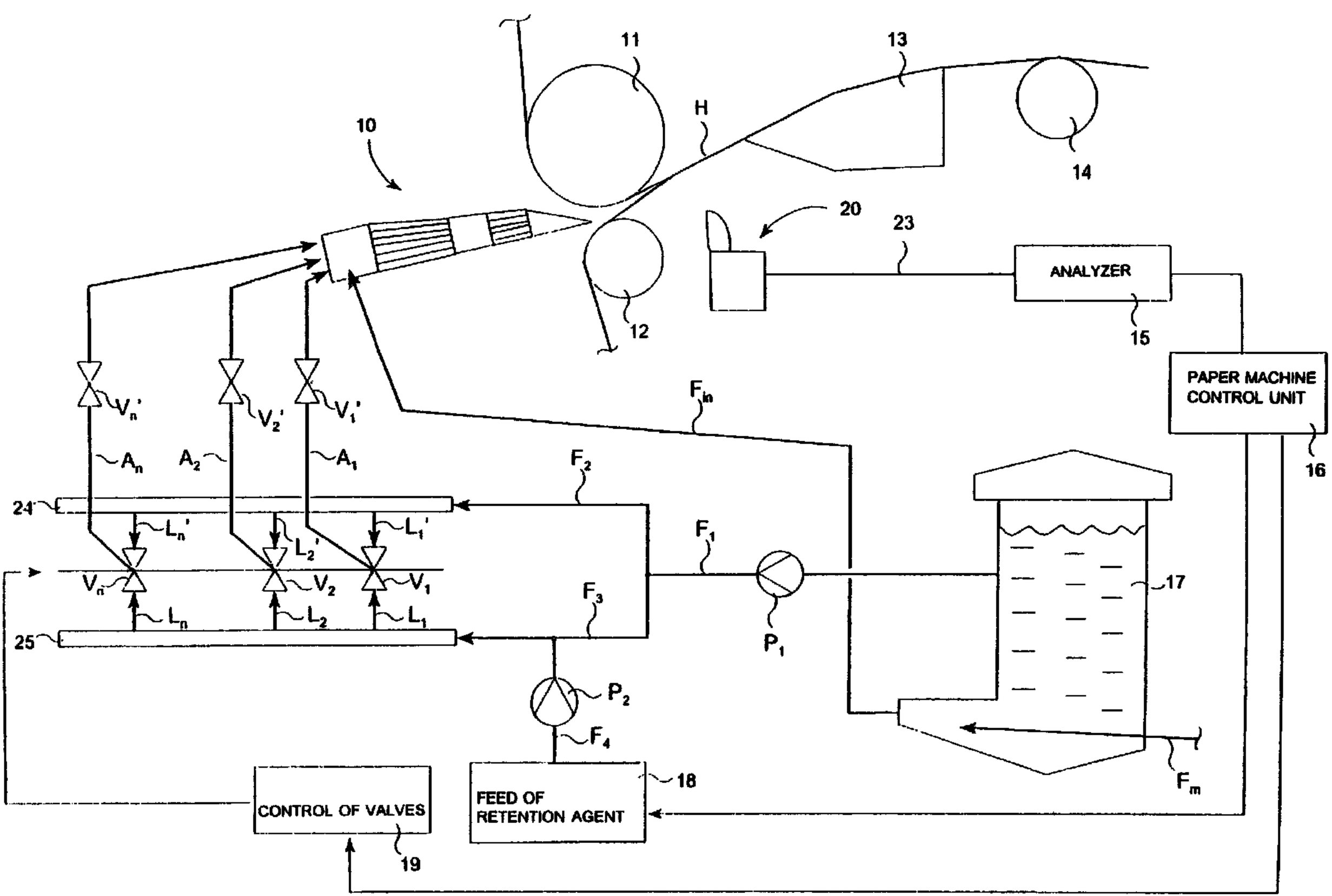


FIG. 4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CONTROL OF VALVES
FEED OF RETENTION AGENT
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