(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 611 716 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **94102426.7**

(51) Int. Cl.[5]: **B65H 19/10**

(22) Date of filing: **17.02.94**

(30) Priority: **19.02.93 FI 930765**

(43) Date of publication of application:
24.08.94 Bulletin 94/34

(84) Designated Contracting States:
AT DE FR GB IT SE

(71) Applicant: **VALMET PAPER MACHINERY INC.**
Panuntie 6
SF-00620 Helsinki (FI)

(72) Inventor: **Rautiainen, Pentti**
Kiilakuja 4 D
SF-04400 Järvenpää (FI)
Inventor: **Renvall, Stig**
Mesiheinänkuja 71
SF-Järvenpää (FI)
Inventor: **Bertram, Chris**
22 Bell Street,
Kawerau
Bay of Plenty (NZ)

(74) Representative: **Zipse + Habersack**
Kemnatenstrasse 49
D-80639 München (DE)

(54) Assembly for the unwinder end of an off-machine paper web handling line.

(57) When a new roll is changed in an off-machine coating line into the unwinder (1), problems are encountered in matching the tension of the web (16) received from the expiring roll (13) to that to be paid off from the new roll (12). Differences in web tension cause web breaks during roll change. According to the invention, the web is supported at the unwinder (1), and subsequently, at the following dryer cylinder group (2) by means of a support felt (3) serving to the end of equalizing differences in web tension. The web received from the first roll (13) is spliced to the tail of a second, full roll (12) by pressing the web (16) received from the first roll against the web of the second roll via a support felt (3) by means of a splicing roll. Next, the web is fed supported by the felt (3) to a dryer cylinder group (2) comprising VAC and steam cylinders (20, 21) where the damp web is dried for subsequent coating.

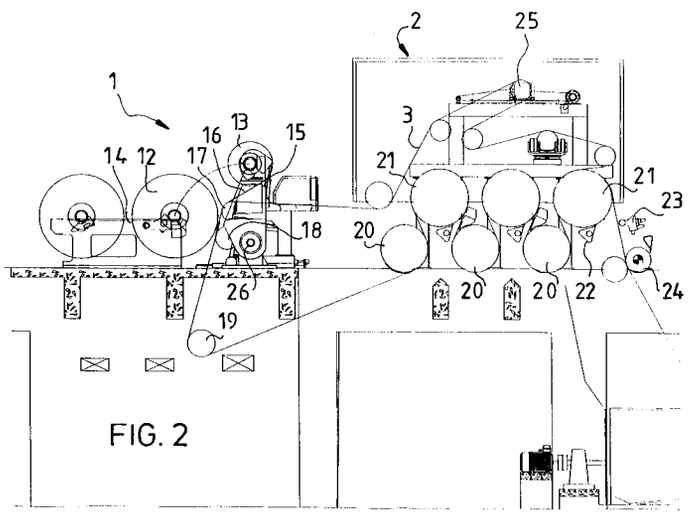


FIG. 2

EP 0 611 716 A2

The present invention relates to an assembly according to the preamble of claim 1 suited for use in an off-machine coating line or other paper web finishing line in the handling of a paper web received from an unwinder and then routing said web to a coating machine.

The paper web manufactured in a paper machine is finished either using on-machine equipment directly following the paper machine, whereby the base sheet outgoing the paper machine is coated and finished with equipment having a width and speed compatible with the those of the paper machine, or alternatively, using off-machine equipment, whereby the output of a single paper machine can be handled by a plurality of finishing equipment. The major benefits of on-machine systems are their high productivity and the possibility of attaining a finished product in a single process. In off-machine equipment the properties of the finished product can be varied in a more flexible manner and often they can give higher quality.

The configuration of an off-machine coating can be widely varied and such equipment is always tailored to customer specifications. Thus, a coating line can include, e.g., an unwinder, several coater stations, dryers and a calender. The last unit in the line is a rewinder.

Paper web handling in off-machine equipment occurs in the following manner. Base web rolls manufactured in a paper machine are transferred to the finishing line and lifted onto the unwind stands to wait for their finishing turn. After the preceding roll is finished, a new base web roll can be transferred onto the unwind stand. Roll change is made by stopping the line, then feeding the web tail of the new roll through the line using low speed, and finally accelerating the web to the normal running speed. Because the roll change in this manner is slow, the current practice is to aim at roll changes without stopping the equipment. To accomplish this, the diameter of the roll being unwound is allowed to become sufficiently small, then the web speed is reduced by a suitable amount, the roll being finished is lifted from the unwind stand proper to an secondary stand, and another roll is transferred to the unwind stand proper. To the web tail of the new roll is attached a two-sided adhesive tape or a similar tack splicing means and the tangential speed of the roll is accelerated equal to the actual web speed, whether normal or reduced. The perimeter of the new roll is pressed against the perimeter of the preceding roll, whereby the splicing tape adheres to the running web and the web tail of the new roll is fed with the running web through the entire line. Subsequently, the web of the first, finished roll is cut and the speed of the finishing line is accelerated to normal, unless otherwise desired.

From the unwinder the web passes to a first coater, then to the dryers, to the second coater station, and then further alternately to dryers and coaters, depending on how many coater stations are included in the line and how many coats are being applied to the end product. Subsequent to coating, the web can be calendered in a calender included in the line, or alternatively, in a separate calender. At the end of the finishing line the web is again wound into a roll by means of a rewinder.

One of the problems in off-machine finishing lines of the above-described type is in the roll change. Though the roll change can be made in, e.g., the above manner without stopping the line, web breaks are common during the roll change. The principal cause of web breaks is related to the difference of web tension between the running web of the unwound roll and the web of the new roll. To avoid web breaks, roll change is made using a temporarily reduced web speed. When a web break occurs, the web tail must be guided through the entire line at a reduced threading speed. However, web threading causes a production interrupt during which broke will be produced, particularly if web threading is not successful the first try. If the web is dry or the base web being coated is thin, the probability of web breaks becomes higher and breaks may occur even during normal run.

It is an object of the present invention to achieve an assembly capable of performing roll change in off-machine equipment in a more reliable manner and at higher speed than is possible with conventional means.

A further object of the invention is to achieve an assembly capable of handling webs with a higher initial moisture content than conventional in unwinding with off-machine equipment.

The invention is based on supporting the first web paid off from the first, expiring roll by means of a support felt meanwhile the web of the expiring roll is being spliced to the web of the second, full roll by pressing the web of the first roll backed by the support felt by means of a splicing roll against the perimeter of the second roll.

More specifically, the assembly according to the invention is characterized by what is stated in the characterizing part of claim 1.

The invention offers significant benefits.

The principal benefit of the invention is the reduction of web breaks during roll change. The duration of finishing line shutdown is clearly reduced owing to the lower number of web breaks. Roll change can be made at higher speed than conventional, and with regard of concurrent web speeds, even at the maximum web speed of the finishing line, thus permitting the line to continuously operate at maximum efficiency. As the initial moisture content of the web can be increased, the

probability of web breaks can be reduced, because a base sheet of higher moisture content is less susceptible to web break during a disturbance than a dry base sheet. The proportion of sulfate fibers in the base sheet can be reduced, whereby the price of the base sheet becomes lower and its opacity can be improved. The basis weight of the base sheet can be reduced, in other words, a thinner base sheet can be used, whereby higher coat weight can be used in a finished grade of same final weight. The higher coat weight in turn provides improved printing properties.

The invention is next examined in greater detail with reference to the attached drawings, wherein:

Figure 1 is a general layout of an off-machine coating line in which the unwinder is provided with an assembly according to the invention;

Figure 2 is a detail of the diagram of Fig. 1; and

Figure 3 is a detail of the diagrams of Figs. 1 and 2.

With reference to Fig. 1, a coating line is shown incorporating two coater stations 4, 7. The First unit in the line is an unwinder 1. From the unwinder 1 the web being finished passes supported by a felt to a first dryer cylinder group 2. On the dryer cylinder 2 the damp web is dried to a suitable moisture content for applying the coat. Subsequent to drying, the web is routed to a first coater station 4. Next to coating, the web of now higher moisture content and the coat are dried with dryers 5. The layout of Fig. 1 has first a set of three dryers, followed by a second dryer cylinder group 6 comprising three steam cylinders and three vacuum, or VAC, cylinders. The web is passes through the dryer cylinder group 6 supported by a felt. Following the second dryer cylinder group 6 is a second coater station 7, two dryers 8 and a third dryer cylinder group 9 comprising VAC and steam cylinders. At the exit of the web from this cylinder group 9, the web is rewound into a roll with a rewinder 10. To handle the broke, the configuration can be complemented with three pulpers 11. The pulpers 11 are placed under the framework, to the outgoing side end of the dryer cylinder groups 2, 6, 9. At the occurrence of a web break or other disturbance, the web is cut after the dryer cylinder group with the edge trimmer and guided to the pulper 11. The edge strip travelling along with the web edge is guided through the line in a rope nip formed by rope carriers. After the disturbance is rectified, the knife of the edge trimmer is moved obliquely over the web, whereby the web can assume its normal width.

The above-described configuration represents only an exemplifying embodiment of a modern paper web finishing line adapted to incorporate an assembly according to the present invention. Obviously, the number and type of coater stations, dryers and other equipment of the line are selected according to the specific requirements of each paper mill and grades manufactured.

With reference to Fig. 2, an unwinder 1 with associated dryer cylinder unit 2 is shown in greater detail. The unwinder 1 comprises a framework 14 carrying on its upper surface roll feed rails ending at the actual unwinder station, herein referred to as the primary unwinder station. The primary unwinder station is shown in the diagram carrying the first full roll denoted by reference numeral 12. At the side of the framework 14 are situated transfer arms 15 of the unwinder having the expiring roll 13 held by chucks 27 at one ends of the arms. The arms 15 are connected at their other ends to the frame part of arm assembly by means of a pivoting joint 26. To the right side of the unwinder 1 is located a dryer cylinder group 2 comprising three vacuum, or VAC, cylinders 20 and three steam cylinders 21. The web passes through the dryer cylinder group guided by a support felt 3.

The path of the support felt 3 in the system is as follows. In conjunction of the secondary unit of the unwinder 1 is adapted a first guide roll 17 and a splicing roll 18. The felt 3 first passes the guide roll 17, where its direction is diverted to run downward, parallel with the web 16 received from the roll 13. Under the unwinder 1 is located another guide roll 19 which acts to divert the felt toward the dryer cylinder group 2. This dryer cylinder group 2 has a VAC roll 20 as the first cylinder. The structure of the VAC roll is such that permits a vacuum to be applied to its inside, and as the roll surface is either porous or has a plurality of small holes, the vacuum sucks the felt 3 running on the roll 20 and the web 16 running on the felt to adhere to the roll. The purpose of the VAC roll is to assure the adherence of the web to the felt 3, and a further purpose of the vacuum is to assure that the felt 3 travels smoothly rotated by the cylinder group 2 instead of excessively slipping on the rolls.

From the VAC cylinder 20 the felt 3 and the web pass to a steam cylinder 21. On the steam cylinder 21 the web 16 is in intimate contact with the surface of the cylinder 21 pressed by the felt 3. Thus, an effective transfer of heat from the hot cylinder 21 to the web is attained, whereby the web is dried with the applied heat. Next, the felt and the web pass to the next VAC roll, a steam cylinder, and then once more to another VAC roll and a steam cylinder. Adapted to the free sector of the steam cylinders 21 which in this case remains below the cylinders are adapted cleaning doctor blades 22 acting to remove coat debris possibly adhering to the surfaces of the steam cylinders 21.

The web 16 is separated from the felt 3 after the last steam cylinder. The felt 3 is routed back via guide rolls to above the cylinder group onto a

tension roll 25 from which the felt passes to the first guide roll 17, and the felt path thus forms an endless loop. The web in turn is drawn from the steam cylinder 21 via a draw nip 24 to a first coater station 4. The draw nip 24 is required in this embodiment, because a disturbance-free detachment of the web from the felt is desired and the distance of the first coater station 4 from the dryer cylinder group 2 is large. Moreover, the draw roll nip 24 serves to maintain constant web tension. Between the last steam cylinder 21 and the draw roll nip 24 is located a web edge trimmer 23, which in the event of a web break cuts the web, which then passes into a pulper 11.

With reference to Fig. 3, the unwinder 1 and its elements associated with the roll change are shown. It must be noted herein that due to the drafting scale used, not all details shown in Fig. 3 can be found in Figs. 1 and 2. At one ends of transfer arms 15 are mounted chucks 27 to which the expiring roll 13 is clamped for the duration of the roll change. As noted above, the support felt 3 passes to the unwinder 1 and is then diverted by means of a guide roll 17 to run parallel with the web 16 paid off from the expiring roll 13. Next on the path of the felt loop 3 is adapted a splicing roll 18. The splicing roll 18 is mounted supported by a pivoting arm 30 and thus the roll 18 is movable by means of an air bellows 31, which is connected by a link rod to the pivoting arm 30. With reference to Fig. 3, the splicing roll 18 is shown in the position used for splicing the web of the new roll 12 to the web 16 of the expiring roll. Besides these elements, the unwinder 1 further includes a cutting knife 29. The cutting knife 29 is adapted above the support felt 3 passing to the guide roll 17 so that the cutting point of the web 16 falls within that web length which remains between the roll 13 already transferred to the secondary stand and the first guide roll 17. In parallel with the cutting knife 29 is adapted a support roll 28 which tensions the web 16 paid off from the roll in the secondary stand so that the web can be easily cut by a swing of the curved cutting knife 29.

In the above-described system the handling of the paper rolls and the web occurs as follows.

With reference to Fig. 2, the expiring roll 13 is shown lifted with the help of the transfer arms 15 to the secondary roll stand and the following, new roll 12 already lifted in the roll stand of the primary unwinder. According to this diagram, the roll 12 in the primary unwinder is shown still rotating freely. Two-sided splicing tapes are placed on the surface of the roll 12 in the primary unwinder and the roll speed is already accelerated to the speed of the web 16 being unwound from the roll 13 resting on the secondary unwind stand. The web being paid off from the secondary unwind stand meets the support felt 3 at the first guide roll 17 and travels thereafter supported by the felt 3. When the roll 13 in the secondary unwind stand has been paid off to a sufficiently small diameter and the web speed of the roll resting in the primary unwind stand has been accelerated sufficiently high, the web 16 of the roll 13 is spliced to the outer surface of the roll 12 by means of two-sided splicing tape. The splicing takes place so that the edge position of the tape is detected with the help of, e.g., a photocell which gives the actuator 31 of the splicing roll 18 a signal to press the web 16 received from the secondary unwinder via the felt 3 onto the surface of the roll 12 rotating in the primary unwind stand. Immediately after the webs are adhered together, the curved cutting knife 29 severs the web 16 received from the secondary unwinder by a rapid swing from behind the support roll 28 onto the web 16. Subsequently, the web begins to be paid off from the new roll 12 in the primary unwinder.

Web breaks during the above-described phase have formed the majority of web breaks in coating lines. The principal reason for the web breaks has been the large difference in web tension between the running web 16 and the spliced web paid off from the roll 12 starting to rotate in the primary unwinder, whereby a tearing jolt has been imposed on the new web as the web is tensioned after splicing. Here, in contrast, the new web runs according to the invention supported by the felt 3, whereby any excessively rapid tensioning of the web is avoided, since the web is travelling with the felt 3 and the speed of the felt 3 does not change during the splicing nor after it. The adherence of the web to the felt 3 is assured in the preferred, above-described embodiment by means of VAC cylinders 20 which adhere the web by suction to the support felt 3. By virtue of the support felt 3, the incidence of web breaks can be reduced to such a low rate that roll change can be made at full web speed if so desired.

When the roll 12 in the primary unwinder is being unwound, the roll diameter becomes smaller and the support felt with its guide roll 17 and splicing roll 18 must be transferred closer to the roll 12 in order to prevent the web being paid off from the roll 12 from detaching from the support felt 3. To facilitate this transfer, the felt 3 is provided with a tension roll 25 permitting the control of the felt 3 tenser or slacker. The movement of the tension roll 25 can also accommodate the tension change caused by the action of the splicing roll 18 on path of the felt 3.

When the diameter of the roll 12 in the primary unwind stand is reduced to a preset minimum, the roll is lifted by means of the transfer arms 15 to the secondary unwind stand and the first guide roll 17 and the splicing roll 18 are transferred so much

backward that the next new roll can be received into the primary unwinder. The next actual roll change is then effected again in the above-described manner.

One detail essentially characterizing to the invention is the draw roll nip 24. This nip assembly comprises two rolls, of which one is the draw roll and the other is a backing roll, and a doctor blade. The draw roll nip 24 is located in the above-described embodiment after the dryer cylinder group 2, and its position in the machine direction is invariably located so that the nip is after the point where the web is detached from the support felt 3 but before the first coater station 4.

Between the draw roll nip 24 and the detachment point of the web from the felt 3 is further placed an edge trimmer 23. The draw roll nip 24 and the edge trimmer 23 perform several functions in the assembly. As the web is received from the unwinder 1 travelling on the support felt 3, it does not attain its normal web tension in the same manner as a web drawn unsupportedly in the conventional manner by means of draw rolls directly from a roll in a stand. Therefore, the web tension is advantageously controlled by means of the draw nip to make the web enter the subsequent process stages correctly tensioned. Further, the draw roll nip 24 assures that the web is positively detached from the support felt 3. The edge trimmer 23 serves for the purpose of cutting the web if a disturbance should occur on the coating line. The web is cut by transferring the trimmer knife obliquely across the web close to the other edge of the web and stopping the knife there before the web is entirely cut. In this marginal position the knife separates a narrow edge strip from the web that is then threaded forward in the line in a rope carrier nip. During this time, a major part of the web is routed to a pulper 11 and the winding of the web tail about the draw roll is prevented by virtue of the doctor blade. As soon as the disturbance is rectified, the knife of the edge trimmer 23 is moved back to its home edge, whereby the web assumes its full width threaded with the help of the rope carrier nip. In this manner, a rapid tail feed after web breaks is attained and the down times due to web breaks and other disturbances remains shorter.

Besides those described above, the present invention can have alternative embodiments.

In its simplest form the invention comprises only the support felt 3, the first guide roll 17, the splicing roll 18, elements 25 for tensioning the felt and guide rolls for guiding the path of the felt 3. In principle, even the first guide roll can be omitted as the felt can be directly routed to the splicing roll 18. In this case the web need be taken without the help of the draw roll nip to the first coater station or other finishing equipment. Such an assembly would find applications in feeding the web directly from an unwinder to some kind of a calender, whereby the calender provides the draw nip capable of detaching the web from the felt 3. In practice, the equipment most typically comprises the draw roll nip 24 and at last one cylinder pair capable of assuring the adherence of the web to the felt. Such cylinders are advantageously VAC cylinders and dryer cylinders, whereby the drying of the web can be performed prior to the entry of the web into a coater station or similar equipment. The number and type of the cylinders are selected according to the required drying capacity and mechanical construction. Obviously, multiple different embodiments are possible for the guiding, tensioning and mechanical construction of the assembly.

Claims

1. An assembly for a web finishing line comprising at least

a continuously operating unwinder (1) incorporating at least a primary unwinder in which the web is unwound from a roll (12) and a secondary unwinder to which the expiring roll can be transferred after its diameter has become smaller, whereby a sequence can be performed in which a new roll is transferred to the primary unwinder, the web on the new roll is spliced with the web (16) being paid off from the secondary unwinder and then the web (16) from the secondary unwinder is cut,

at least one piece (4) of finishing equipment, and

a rewinder (10),

characterized by

a support felt (3),

rolls (17 21, 25) over which the support felt (3) is adapted to pass as an endless loop so that

at least one of said rolls is a transferrable roll (18) which is adapted to cooperate with the web (16) received from the secondary unit of the unwinder station (1) in such a manner that said web (16) travels on the support felt at said roll (18) and said roll (18) is movable toward the roll (12) resting in the primary unwinder unit to the end of pressing the web (16) received from the secondary unwinder unit via the felt (3) against the surface of the roll (12), and

at least one of said rolls is a movable tension roll suited to the control of the felt tension.

2. An assembly as defined in claim 1, **characterized** in that at least one of said rolls is adapted

to act as a guide roll (17) cooperating with the web (16) received from the secondary unwinder unit in such a manner that the felt (3) passing over said roll (17) and the web intended to travel on the felt meet at said roll.

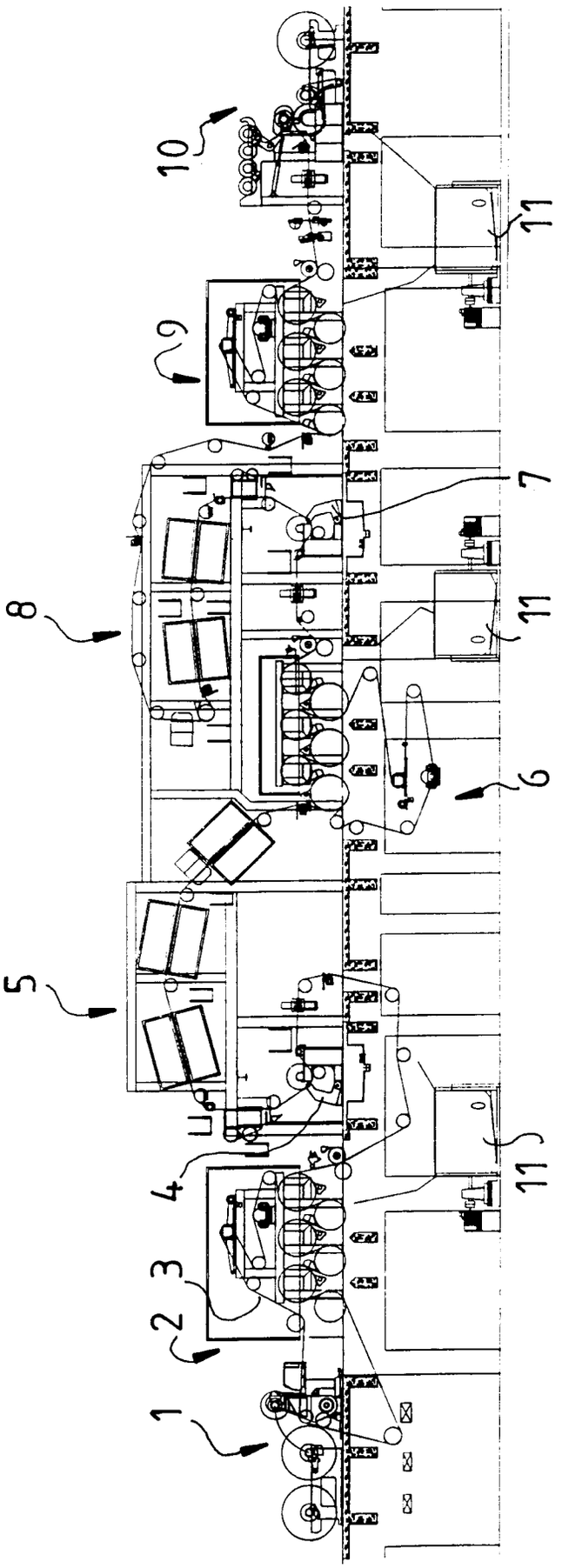
3. An assembly as defined in claim 1 or 2, **characterized** in that at least one of said rolls is a vacuum cylinder (20).

4. An assembly as defined in claim 2, **characterized** in that at least one of said cylinders is a heatable dryer cylinder (21).

5. An assembly as defined in any foregoing claim, **characterized** by a draw roll nip (24) which is adapted to cooperate with the endless loop formed by the support felt (3) and is suited to receive the web paid off from the unwinder (1) and travelling supported by the felt (3) to the end of detaching the web from the felt (3)

6. An assembly as defined in claim 5, **characterized** by an edge trimmer (23) which is adapted after the detachment point of the web from the support felt (3) but before the draw pull nip (24).

FIG. 1



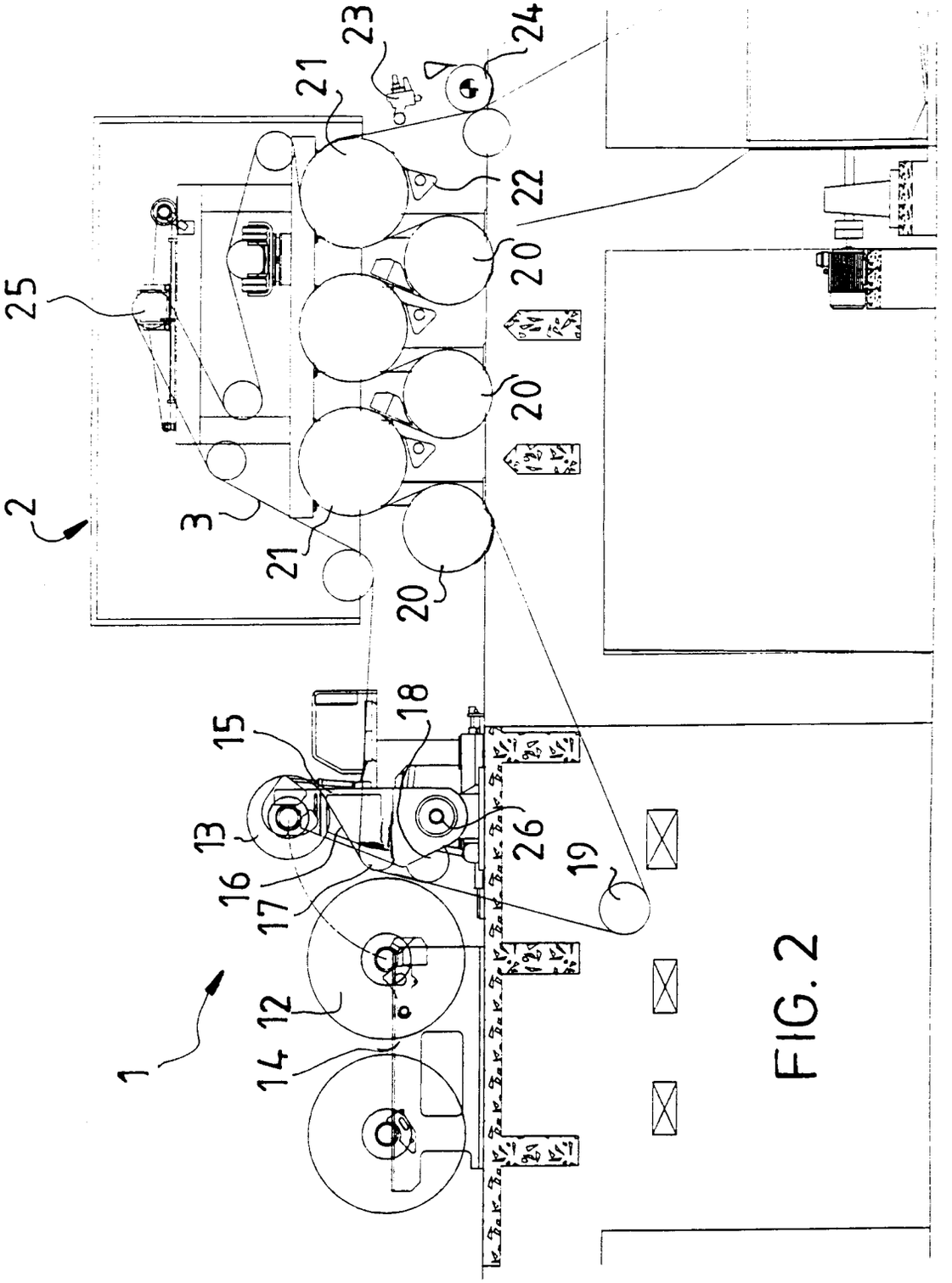


FIG. 2

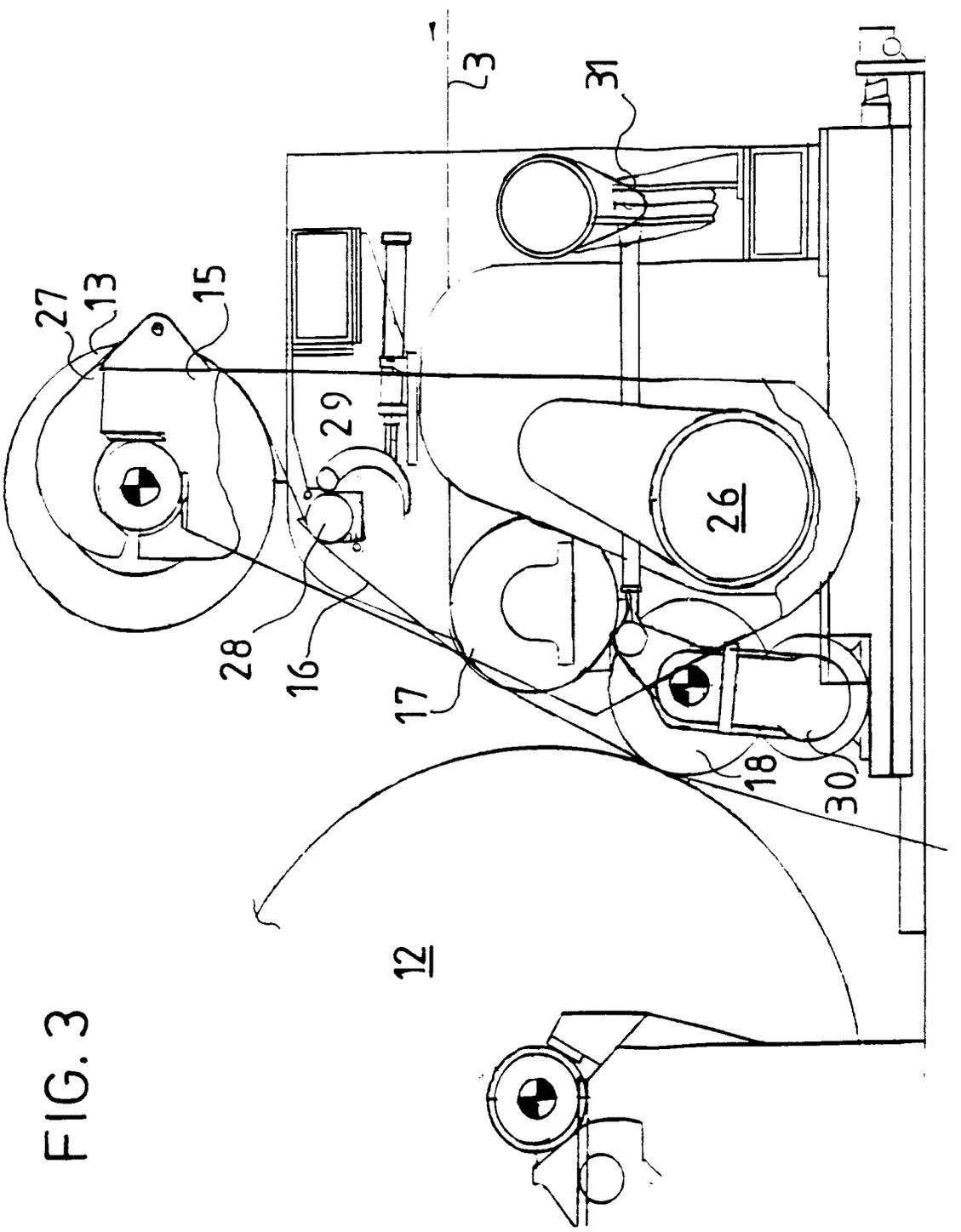


FIG. 3