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(54) Top wire former.

(57) A forming and dewatering mechanism for a twin wire section of a papermaking machine wherein the top wire (10) is brought down over an adjustable roll (18) and both wires (10, 11) are pssed over a curved shoe (14) with a solid or slotted suction board (16) and following blades (15), the twin wires (10, 11) are then passed around a center roll (27) with a reverse wrap relative to the shoe (14). An autoslice (22) is arranged for collecting the water following the shoe (14) and a save-all (28) arranged for collecting the water following the center roll (27), and the twin wires (10, 11) are then passed over a suction transfer box (34) for transferring the web to the lower wire (11).

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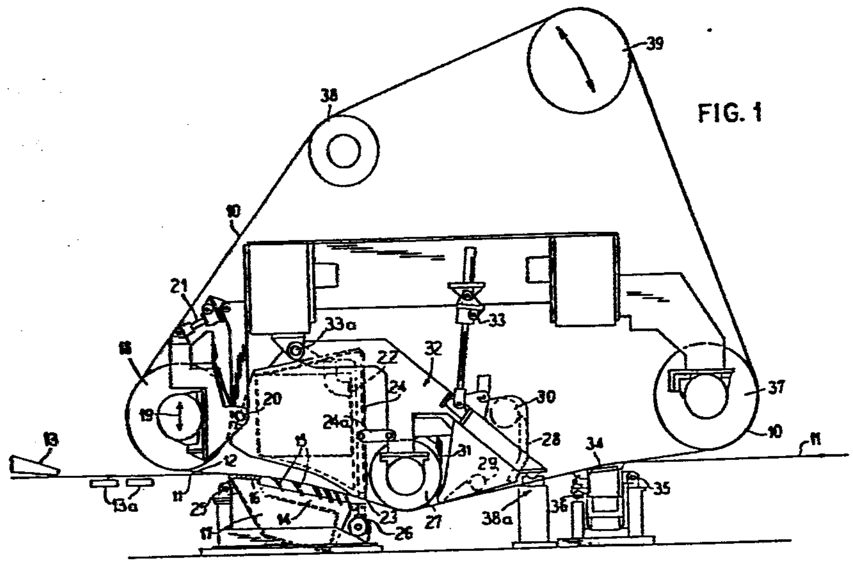
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FIG. 1

The invention relates to improvements in papermaking machines, and more particularly to a web forming a dewatering section of a papermaking machine utilizing twin wires. Since the advent of commercially feasible twin wire machines in the 1950's, the advantages of twin wire machines have been recognized and continuous efforts have been made to improve such machines and circumvent disadvantages in existing machines. The advantages of twin wire machines include the ability to provide a relatively short forming section requiring less machine floor space and less equipment. A substantial advantage of the twin wire machines is the capability of dewatering in both directions which helps avoid the undesirable features of two-sided paper. As is known to those versed in the art, an improved paper machine sheet can be obtained and lighter weight paper provided with the same qualities if the finished sheet has the same quality on both sides. This can be accomplished with a twin wire machine, but provisions for high speed and variances in the type of stock being processed from time to time make attaining continued high quality and avoidance of a two-sided sheet difficult.

Continued efforts have been made to increase the output, upgrade quality and improve the efficiency of a twin wire machine. Secondary considerations, of course, include advantages in installation and wire changing which must be accomplished rapidly, and maintenance and cleaning in a trouble-free manner are other objectives along with maintaining small actual investment costs. An objective is to keep wire wear low so that fine synthetic wires can be used. Uniform distribution of fillers and fines and optimum sheet flatness are also important objectives along with substantial versatility on furnish, speed and basis weight. Low operating power or energy consumption is important, and this is enhanced by fast effective and thorough dewatering of the sheet to obtain optimum dryness as the sheet passes to the

press section.

It is accordingly an objective of the present invention to attain the foregoing designated objectives and to provide an improved twin wire former of a sophisticated construction which provides for improved formation and dewatering.

A further object of the invention is to provide an improved twin wire former wherein the wires are trained through a unique path and handled in a unique manner so that dewatering and formation will occur resulting in an improved sheet. A still further general objective of the invention is to provide an improved twin wire former which is capable of utilizing the improvements and features of a twin wire machine to improve paper quality, is capable of increased productivity and efficiency, is capable of low energy consumption, maintains high retention levels for fines and fillers, has versatility over a wide range of furnishes, and attains low capital and installation costs with minimum down-time.

Other objects, advantages and features of the invention will become more apparent with the teaching of the principles of the invention in connection with the disclosure of the preferred embodiments in the specification, claims, and drawings, in which:

Figure 1 is an elevational view shown somewhat schematically illustrating one form of a forming section of a papermaking machine constructed and operating in accordance with the principles of the present invention;

Figure 2 is a fragmentary elevational view of a portion of the machine of Figure 1 showing the primary form of the invention; and

Figure 3 is an elevational view shown in somewhat schematic form of a twin wire paper former constructed and operating in accordance with the principles of the present invention and providing another form of the structure illustrated in Figure 1.

As illustrated in Figure 1, a first or upper looped foraminous forming wire 10 is provided to be brought into dewatering web forming relationship with a second lower looped foraminous forming wire 11. While the mechanism shown preferably operates in the position illustrated so that the wire 10 may be referred to as the top wire and the wire 11 as the bottom wire, it will be understood that in some circumstances, the orientation of the structure may be rotated to a different position so that the operation is not to be limited to one wire being above the other, even though that is the preferred arrangement.

The wires are guided to pass through a forming and dewatering path beginning with a converging forming throat 12 for receiving stock. The term stock as used herein, as is recognized by papermakers will refer to the slurry of water and fibers passing from a headbox into the throat 12 and continuing to be carried between the forming wires and continuing to be dewatered until different degrees of dryness are reached so that the mixture can be continued to be termed stock as long as fiber orientation and transfer of fines and fillers is continuing to occur.

Generally stock is supplied from a headbox through a slice 13 to be deposited on the lower wire 11. The slice is generally at a distance ahead of the throat 12 which allows some predrainage by Fourdrinier elements, not shown. The partially dewatered stock then enters the throat 12 for further dewatering.

For convenience of illustration, the slice 13 is shown essentially at the throat.

A web forming supply of stock is directed into the throat 12 by the slice 13 having a slice opening directed into the throat so that the stock may engage both wires simultaneously within the throat at a location after the wire leaves the upper roll 18. The stock will be directed onto the wires at the speed of

the wires or at a slight difference from the speed of the wire depending upon the objectives of the papermaker. The slight puddle or pool of stock will form in the throat as formation and dewatering begins, and this is controllable by the speed of the machine and the quantity of stock delivered to the throat. If the more usual arrangement is used with the slice further upstream, the stock will enter the throat on the lower wire 11 which may have predewatering devices such as shortened Fourdrinier portions.

The lower wire 11 approaches the throat from previous wire guiding means, not shown, and the upper wire 10 approaches the throat being directed by a lead-in-roll 18. The lead-in roll is constructed to be vertically adjustable relative to the lower wire 11 as shown by the arrowed line 19. Various mechanical devices may be used to attain the adjustment , and as illustrated, the bearing support for the roll 18 is provided on a trunnion 20, and the vertical position of the roll can be adjusted by a jack screw 21.

The curved shoe over which the wires are wrapped is provided with cross-machine blades 15 to cause a pulsation of the stock between the wires in their travel over the shoe to aid in dewatering. The water passes down between the blades 15 of the shoe 14 to suitable collecting means.

In a preferred form the shoe assembly 14 may include a solid or a slotted forming board 16 in advance of the blades 15. The slotted forming board is connected to a suction means 17 therebeneath for initially drawing water down through the lower wire.

The wires are maintained under tension by wire tensioning devices such as shown by the roll 39 for the upper wire 10 and a similar tensioning arrangement is provided for the lower wire 11.

The shoe assembly 14 may be pivotally supported for aiding in adjusting the wrap of the wires over the shoe

and the throat 12, and for this purpose the shoe assembly is shown pivotally mounted at 25 with an adjustable jack 26 at the other side of the shoe assembly for positioning the pivotal location of the shoe asembly 14.

In the arrangement as shown in Figure 2, the forming board 16 may be solid (without a perforated or slotted feature) as shown at 16a with the wires 10a and 11a traveling over the curved shoe 14a. In both arrangements shown in Figure 1 and in Figure 2, the curved shoe following the forming board has cross-machine blades 15a. Water expressed into and through the upper wire 10, with either alternate forming board 16 or 16a is taken off by an autoslice 22. The autoslice has an open bottom for receiving water thrown upwardly and has an autoslice blade 23 in close-running kissing or touching contact with the upper surface of the upper wire 10. The blade 23 may also be utilized to help control unit pressure between the wires, and as an example blade 23 may be 76,2 mm wide with the wire passing over a shoe having a 5080 mm radius for control of unit pressure. Suction means 24 is provided for drawing water away from the autoslice blade 23 as it is skimmed off the top of the traveling wire. Suitable means (i.e. jack 26) are provided in shoe assembly 14 for maintaining the position of the blade 23 to attain the close-running contact.

Following the autoslice is a center roll 27 which in the form illustrated is a solid cylindrical roll. The roll tends to draw water through and off the surface of the upper wire 10 by a pumping action on the off-running side of the roll 27 and into a save-all 28 which follows the forming roll 27. The save-all is provided with a water removal means 29 for drawing water collected and additionally a mist outlet 30 is provided having suitable blower means for removing mist which forms in that location. The save-all is mounted from arm 32 (as is the center roll 27 and the autoslice 22) and the

entire assembly is pivoted at pivot 33a by jack set 33 for wire change. An adjustable mechanical stop 38a establishes the running geometry. A link 24a connects the autoslice and its blade 23 to the arm 32 so that retraction of autoslice 22 occurs with forming roll 27 and save-all 28 during wire change. In some instances, it may be desirable to support the autoslice and its blade 23 separately and make them independently adjustable.

Following the save-all is a web transfer box 34 which has a curved upper surface and is wrapped by both wires 10 and 11. To obtain the desired degree of wrap , the suction transfer box 34 is pivotally mounted at 35 with a vertical adjustment jack 36 at the other side of the box. Following the box 34 is a turning roll 37 for the upper wire which establishes its location relative to the transfer box 34. The web at 34 is transferred onto the lower wire 11, and it is carried onto transfer means to pass to a press section of the machine.

As illustrated in Figure 3, a first upper looped forming wire 40 is brought into dewatering and forming relationship with a second looped foraminous forming wire 41. The two wires form an entry throat at 42 into which stock is delivered such as from a headbox slice 43. The lower wire is led into the throat 42 by suitable guide rolls, not shown, and the upper wire is controlled by a lead-in-roll 65 which is vertically adjustable as indicated by the arrowed line 64. The stock is delivered from a headbox through a slice 43 onto the lower wire 41 . Predewatering devices such as a foreshortened Fourdrinier may be employed illustrated schematically by suction boxes 43a. The stock with some dewatering having occurred enters the throat 42 to be sandwiched between the upper wire 40 and lower wire 41.

Following the throat, the wires are trained over the curved upper surface of a shoe 45. The large radius

forming shoe has a plurality of cross-machine blades and as water drains through the lower wire between the blades, it is collected at the base 44 of the shoe. The wires are under tension by rolls, not shown, so that as they are pressed together over the curved shoe, the pressure of the wires causes the water to pass upwardly and downwardly into and through the wires. The cross blades in the shoe 45 will cause a pulsating effect to help remove the water in the forming stock. If desired, the shoe 45 may take the form shown in Figures 1 or 2 with a forming board in advance of the curved shoe.

On the offrunning side of the shoe is an autoslice 47 brought into close-running contact with the upper wire 40 and removing water which is carried along on the surface of the upper wire. The autoslice has a sufficiently large opening that water present at its entrance as a result of pressure and centrifugal force will be collected. The water is presented at the entrance to the autoslice 47 because of its removal from the stock as a result of pressure between the wires and centrifugal force of the wires passing over the curved face of the shoe 45. The autoslice has a vertical rising passage which is under low level vacuum by a vacuum device 48 to help remove the water and collect water in a collection chamber 49 which is part of the overall autoslice and save-all mechanism 46.

After the wires wrap over the shoe 45, they are wrapped in an opposite direction over a center or forming roll 50. The center roll 50 is preferably an open roll such as by being constructed with grooves 51 covered by a fine mesh wire or screen over the outer surface of the roll. As the wires wrap over the center roll 50, an amount of water is pressed through the lower wire 41 to pass downwardly and be directed by a stabilizing deflector 52. Additional water is pressed from the upper wire 40, and this removal of water

in an upward direction is augmented by the pumping action of the roll 50. This water which passes upwardly through the upper wire is thrown off on the offrunning side of the center roll 50 and is caught by a save-all collecting chamber 60. The chamber has a save-all blade 57 running close to the upper wire 40, and the water passes upwardly into a collector 60 and a low level vacuum removal means 59 is provided to remove water from the collector 60.

A needle jet shower 55 is positioned to clean the offrunning side of the upper forming roll 50, and the excess water generated by the shower is also caught by the save-all mechanism 57.

Following the center roll 50, the wires are wrapped again in an opposite direction over a wire wrap roll 56. Some water is pressed in an upward direction which is caught by the save-all 60.

If desired, a stabilizing deflector blade 53 is positioned on the offrunning side of the open center roll 50 to support the wires and prevent the disadvantageous effects of an open run of wires. While the blade 53 is optional, its omission in certain operating circumstances can cause vibration or chattering of the wires. Following the blade, the water which tends to be carried on the upper wire 40 will tend to travel in a straightline and be thrown off to be caught by the save-all blade 57.

Following the wire wrapped roll 56, the wires are passed over a web transfer vacuum box 62. The box has a curved upper surface 61 which is porous, and the vacuum within the box 62 transfers the web to the lower wire 41 so that it is carried on the lower wire to the couch roll and a press section. The upper wire is positioned and is separated from the lower wire by a nondriven turning roll 63.

In operation, with reference to Figure 1, stock is deposited on the lower wire and some dewatering occurs.

The twin wires 10 and 11 are brought together into a forming throat 12 to receive the stock on the lower wire and then together pass over a large radius curved shoe 14 so that the pressure between the tensioned wires presses water from the web in an upward and downward direction. Additionally, a certain amount of centrifugal force aids in carrying the water upward, and the water which passes downward moves in between blades of the forming shoe. The water which passes upward through the upper wire is caught by an autoslice mechanism 22. The wires are then wrapped in a reverse direction about a center roll 27, and the water expressed by a pumping action is caught by a save-all 28 following the forming roll 27. The wires then wrap a curved suction transfer box 34 so that the web will follow the lower wire 11.

The apparatus mainly utilizes rolling elements as illustrated by the rolls 18 and 27, or low vacuum elements such as the forming board 16 and autoslice 22 and web transfer box 34. There are few stationary elements, such as the blades in the drainage shoe 14. This construction permits a very economical operation. It is expected that such a roll former as disclosed may use only about 75% or less of the energy of a conventional Fourdrinier. The savings essentially reside in the fact that a conventional Fourdrinier may utilize on the order of 45 foil blades and on the order of 6 vacuum boxes which create a large drag force on the forming wire as it is driven and these quantities are substantially reduced by this twin wire apparatus.

The present design is flexible and easily modified to accommodate a wide range of paper and board grades. This is due to the fact that the blades in the lower drainage unit or shoe 14 can be added or removed quickly and easily, sometimes while the machine is actually in operation. Further, a solid forming roll such as at 27 can be replaced with an open forming roll as shown in Figure 3 without undue modification of the structure.

Further, the lead-in-roll can be raised or lowered to create and control the desired pond of water in the entrance throat between the forming wires as well as the pressure over the lower drainage unit 14 which is an important feature.

CLAIMS:

1. A paper machine web forming and dewatering section, comprising in combination:

first and second looped continuous forming wires;

means guiding said wires through a forming and dewatering path beginning with a converging throat for receiving stock;

a large radius open shoe over which the second wire is directed for forming said throat;

a lead-in roll directing the first wire into an approach to said throat with the first wire wrapping over the second wire over said shoe and with said wires being under tension for dewatering stock through both wires over the shoe;

an autoslice in close-running relation with the first wire following the shoe for receiving water expressed into and through the first wire;

a center roll positioned after the shoe with the wires wrapping in a curvature opposite that of the shoe;

a save-all following the forming roll for collecting water drawn from the first wire by the center roll;

and a suction transfer box against the second wire following the save-all for transferring the web to the second wire.

2. A paper machine web forming and dewatering section constructed in accordance with claim 1:

including suction means connected to said autoslice whereby the water collected by the autoslice is forcibly withdrawn therefrom.

3. A paper machine web forming and dewatering section constructed in accordance with claim 1 :

wherein said center roll is a smooth solid cylindrical roll.

4. A paper machine web forming and dewatering section

constructed in accordance with claim 1:

wherein said suction transfer box is curved and wrapped by both wires.

5. A paper machine web forming and dewatering section constructed in accordance with claim 1:

including means for adjusting the position of the lead-in roll relative to the second wire to change the convergence of the throat.

6. A paper machine web forming and dewatering section constructed in accordance with claim 1:
wherein said lead-in roll is a solid imperforate cylindrical roll.

7. A paper machine web forming and dewatering section constructed in accordance with claim 1:

wherein said shoe is preceded by a flat open suction board in close-running relation with the second wire for the initial removal of quantities of water through the second wire.

8. A paper machine web forming and dewatering section constructed in accordance with claim 1:

wherein said shoe has a plurality of cross-machine blades causing pulsations in the stock between the wires for aiding in the removal of water from the stock.

9. A paper machine web forming and dewatering section constructed in accordance with claim 1 :

wherein said save-all includes a vacuum mist outlet for pumping mist from the area following the center roll.

10. A paper machine web forming and dewatering section constructed in accordance with claim 1:
wherein said autoslice has a wide lip in contact with the first wire following the shoe.

11. A paper machine web forming and dewatering section constructed in accordance with claim 1:
wherein the position of said autoslice is adjustable relative to the surface of the first wire.

12. A paper machine web forming and dewatering section, comprising in combination :
first and second looped continuous forming wires; means directing said wires through a forming and dewatering path beginning with a converging forming throat for receiving stock; a large radius shoe over which the second wire is directed for forming said throat with the first wire wrapping said shoe over the second wire; means directing said wires toward said throat under tension; means for collecting water expressed through the first wire during its wrap of the shoe; a center roll positioned after the shoe with the wires wrapping in a curvature opposite that of the shoe; and means collecting water drawn through the first wire by the wrap over the center roll so that the wires pass over the shoe in a first large arcuate path and follow the center roll in a second path of smaller radius in a reverse wrap.

13. A paper machine web forming and dewatering section constructed in accordance with claim 12: including a suction board positioned in advance of the shoe in engagement with the second wire for drawing initial water through the second wire.

14. A paper machine web forming and dewatering section constructed in accordance with claim 12: wherein said shoe has a plurality of cross-machine blades causing pulsations in the stock carried between the wires as the wires wrap the shoe.

15. A paper machine web forming and dewatering section constructed in accordance with claim 12: wherein means is provided for adjusting the position of said center roll relative to the first wire so as to change the angle of wrap by the wires .

16. A paper machine web forming and dewatering section constructed in accordance with claim 15: including means for simultaneously adjusting the

position of said water collecting means.

17. A paper machine web forming and dewatering section, comprising in combination : first and second looped continuous forming wires; means directing said wires through a forming and dewatering path beginning with a converging forming throat for receiving stock; a large radius open shoe over which the second wire is trained for forming said throat;

means directing the first wire into an approach through said throat with the first wire wrapping over the second wire over said shoe and with said wires being under tension for dewatering through both wires over the shoe;

means for collecting water from the first wire which is expressed through the first wire in its travel over said shoe;

a center roll positioned after said shoe with the wires wrapping in a curvature opposite that of the shoe;

a wire wrap roll positioned after said center roll with the wires wrapping the wire wrapped roll in a direction opposite that of the center roll;

and means for collecting water from the first wire following the wire wrapped and the center roll.

18. A paper machine web forming and dewatering section constructed in accordance with claim 17: wherein said center roll is an open roll.

19. A paper machine web forming and dewatering section constructed in accordance with claim 18 :

wherein said open roll has a fine wire mesh wrapped thereover so as to present the mesh to the first wire.

20. A paper machine web forming and dewatering section constructed in accordance with claim 17: including a foil following the center roll in close-running contact with the second wire preventing flutter of the wires between the center roll and the wire wrapped

roll.

21. A paper machine web forming and dewatering section constructed in accordance with claim 17:

including a transfer box with a suction therein in engagement with the second wire with a large radius of curvature for transferring the web to the second wire following the wire wrapped roll and both wires wrapping the suction box.

22. A paper machine web forming and dewatering section constructed in accordance with claim 21:

including training the wires through a third radius of curvature opposite the second radius of curvature for dewatering through the first wire.

23. A paper machine web forming and dewatering section constructed in accordance with claim 17:

including an autoslice blade in close running relationship with the first wire following the shoe; and means for adjusting the position of said autoslice blade relative to the first wire.

24. The method of forming and dewatering a web between a pair of looped continuous foraminous forming wires, comprising the steps :

directing said wires through a forming and dewatering path beginning with a converging forming throat for receiving the stock;

first wrapping the wires over an open large radius forming shoe in a first curvature dewatering the stock through both wires;

second wrapping the wires over a roll in an opposite second direction of curvature dewatering the stock between the wires in both directions.

25. The method of forming and dewatering a web between a pair of looped continuous foraminous forming wires in accordance with the steps of claim 24:

including adjusting the angle of convergence of the two wires at the throat for entry into the first radius of curvature.

FIG. 1

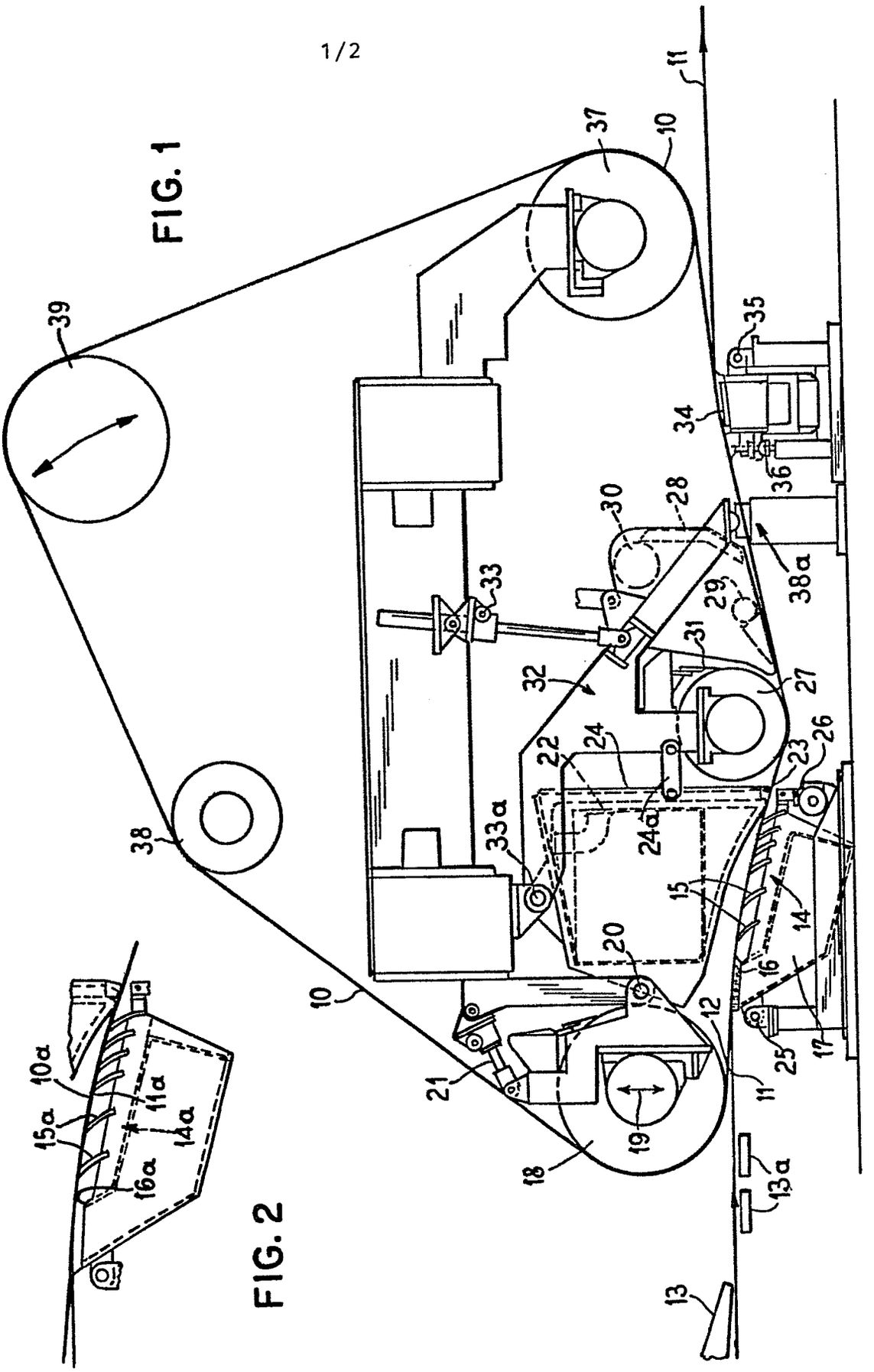
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FIG. 2

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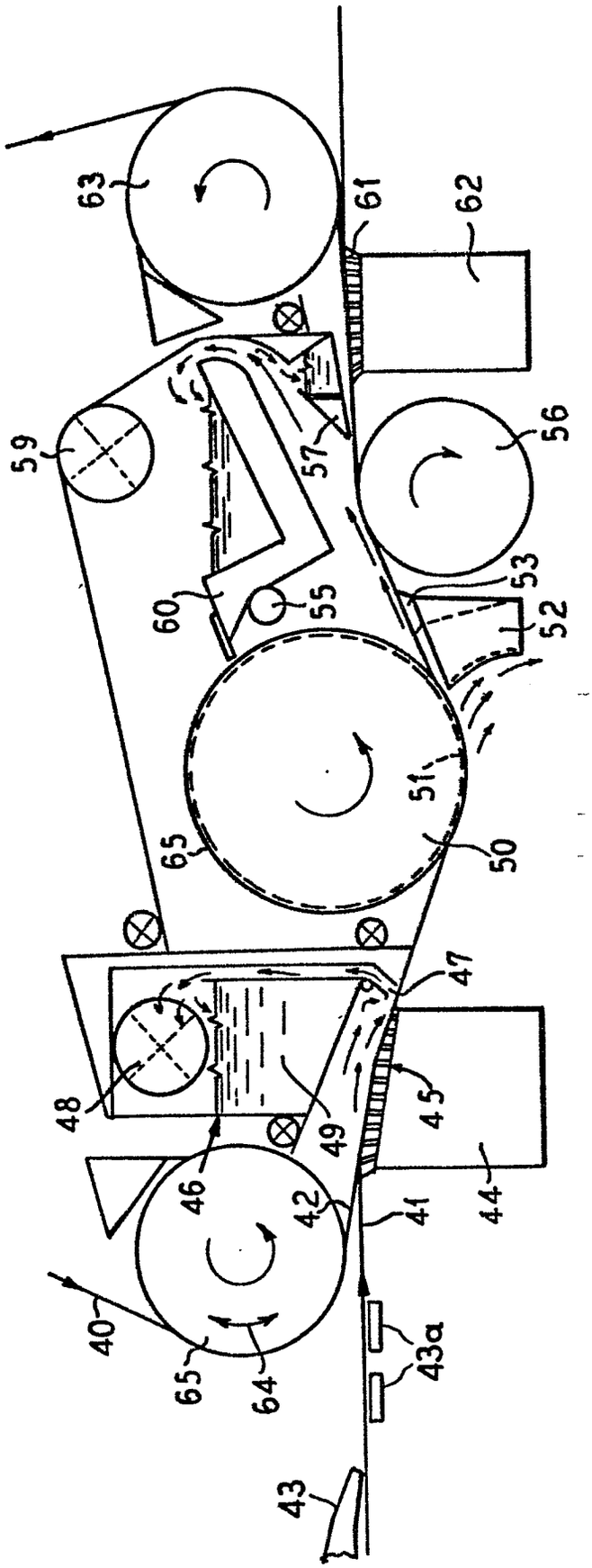

FIG. 3