

[54] **MULTI-PLY PAPER FORMING MACHINE WITH UPWARD AND DOWNWARD FORMING RUNS**
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[51] Int. Cl. **D21f 1/00**
[58] Field of Search 162/299, 300, 303, 304, 162/306, 317, 351, 352, 123, 132, 133, 203, 208, 211, 212, 213, 214

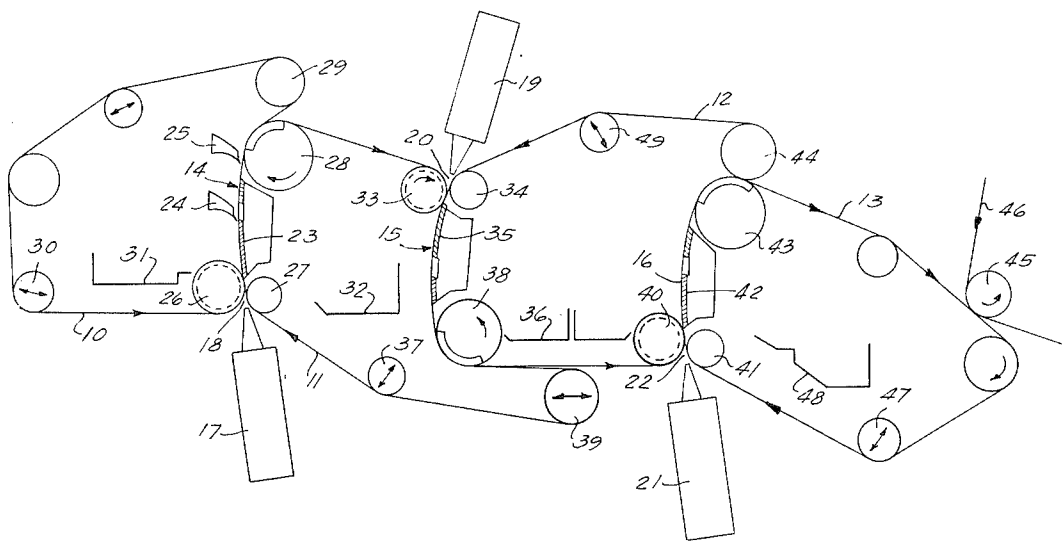
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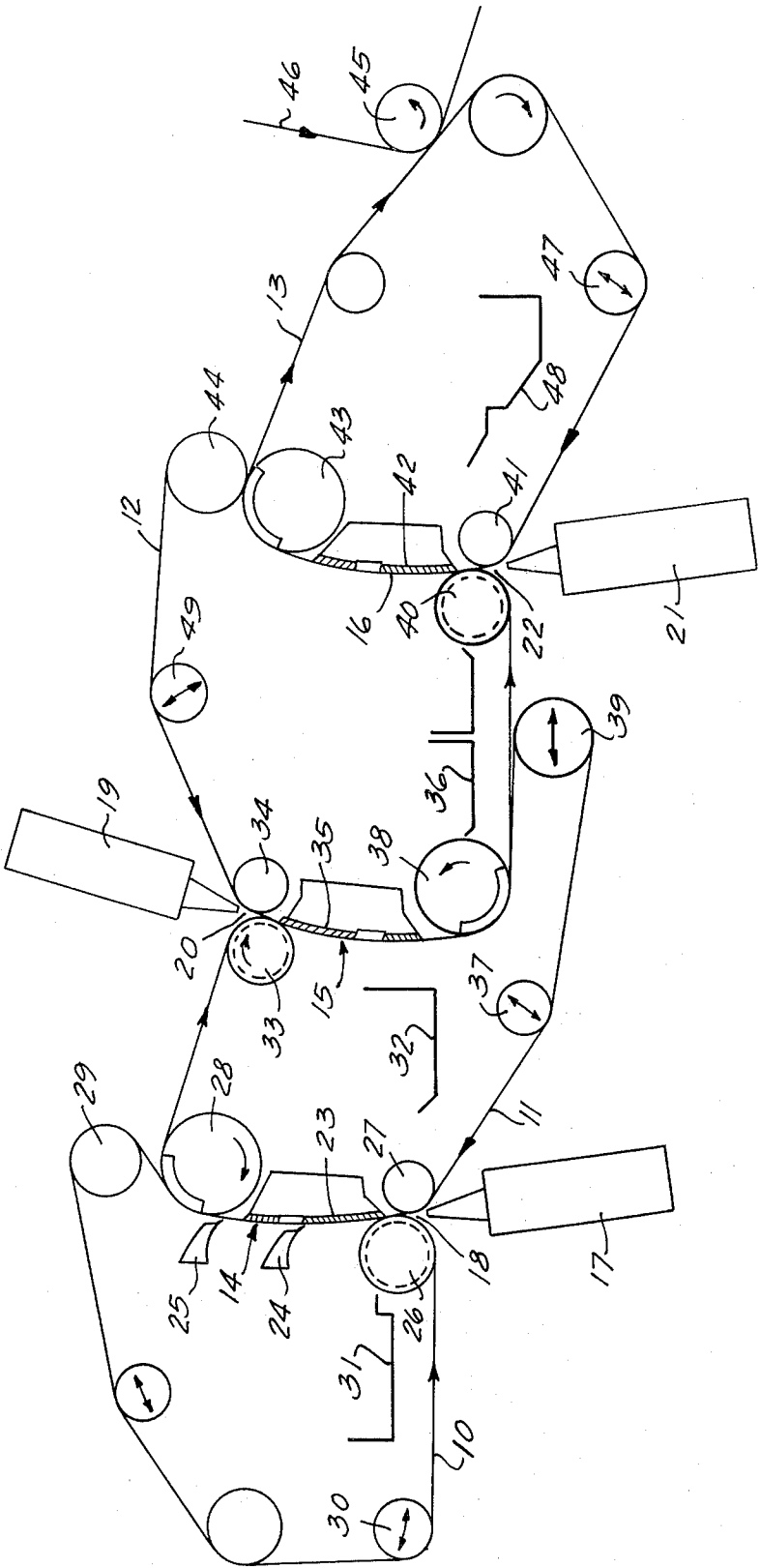
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[57] **ABSTRACT**
A machine for making multi-ply paperboard including first, second, third, and fourth looped forming wires with each of the looped wires having guide means therein to form a first vertical run between the first and second wires dewatering the web formed therebetween in both directions with the wires trained through a generally curved path by engaging the second wire with a series of bars extending in a cross-machine direction and spaced in a machine direction so that the wires inscribe a series of chords through the arc, similar bars within the third and fourth wires with headboxes arranged to deliver stock to the head end of the first forming run and to deliver stock onto one side of the web at the beginning of the second forming run and onto the other side at the end of the third forming run with the outer layers of stock dewatered in their direction and the plies interlocking due to the pressure of the forming wires and arrangement of the runs.

5 Claims, 1 Drawing Figure





MULTI-PLY PAPER FORMING MACHINE WITH UPWARD AND DOWNWARD FORMING RUNS

BACKGROUND OF THE INVENTION

The invention relates to improvements in paper making machines, and more particularly to improvements in multi-ply paper machine forming sections. In the forming of multi-ply boards, the interlocking or adherence of the layers of the web to each other is very important. This is particularly true when the board is made at higher forming speeds and with different types of stock. It has been discovered that an important factor in the interlocking of the layers of the web to each other is the interspersment or interlocking of the short fibers from one layer to the other. Various mechanisms have been provided to attempt to improve this interlocking between layers, which have limiting factors which incorporate disadvantages.

It is accordingly an object of the present invention to provide an improved multi-ply board forming machine which can operate at relatively high speeds and provides an improved product with the layers more strongly interlocked to each other to increase the quality and strength of the board.

One manner in which multi-layer boards have heretofore been made is to form the layers separately, such as on cylinder machines, and place the layers together after being formed. With the arrangement, the layers tend to be independent of each other and do not adhere to each other with sufficient strength. This lack of strength can cause separation of the layers while the board is being made or when it is used, and results in boards of inferior strength. The more rigidly each layer can be bonded to the adjacent layer, the greater the overall unitary strength of the board, so that with very good bonding, a substantially monolithic board results. This is particularly important where the quality and nature of the different layers of board vary substantially and each layer is formed because of its own inherent properties, i.e., inexpensiveness of the stock, ink receptivity, color and so forth.

A further object of the invention is to provide an improved multiply board forming machine wherein the layers are formed while in contact with a previously formed layer so that an optimum possibility is provided for interlocking of the fibers between layers, and the layers are not merely laid together after being formed.

A still further object of the invention is to provide a multi-ply board forming mechanism wherein the layers are successively formed in a unique manner so that the short fibers from adjacent layers intersperse during the dewatering operation, resulting in a monolithic multiply board of improved strength.

A still further object of the invention is to provide improved structure which more readily accommodates forming the layers of multi-ply board of varying types of stock wherein outer layers of improved quality may be employed to improve the overall quality and appearance of the board.

A still further object of the invention is to provide an improved multi-ply board forming machine which is capable of operating at higher speeds than machines heretofore available and particularly at substantially higher speeds than cylinder machines.

Other objects, advantages and features, as well as equivalent structures which are intended to be covered herein, will become more apparent with the teachings

of the principles of the invention in connection with the disclosure of the preferred embodiment in the specification, claims, and drawings, in which:

DESCRIPTION OF THE DRAWINGS

The single FIGURE of the drawings shows a side elevational view in somewhat schematic form of a multiply web forming section of the paper making machine constructed and operating in accordance with the principles of the present invention.

DESCRIPTION

The structure includes a first forming wire 10 cooperatively arranged with a second forming wire 11. The second forming wire is cooperatively arranged with a third forming wire 12 which is cooperatively arranged with a fourth forming wire 13.

The first and second looped forming wires 10 and 11 are supported by guide means which train the wire into a first forming run 14 which preferably extends vertically upwardly. Ahead of the run is a forming throat 18 which receives the stock directed thereto from a headbox 17 which has a slice opening that delivers the stock in a jet into the forming throat 18. The stock in this case will be of the type to form the intermediate layer of the finished board and will normally be of a lower grade stock to provide the filler and bulk for the center layer.

After the intermediate layer is formed, it is carried on the second wire down into a second forming run 15 which is preferably vertical and extends downwardly. Stock is delivered onto the upper surface of the intermediate layer by the slice opening of a headbox 19 which directs the stock downwardly into a forming throat 20. This second outer layer is dewatered in the second forming run 15 and is then carried on the third wire 12 into a third forming run 16 which is preferably vertically upwardly. Stock is delivered onto the outer and opposite surface of the intermediate layer by a headbox 21 which delivers stock in a spouting jet into a forming throat 22 and leads to a vertical forming run 16. Thus, the finished layers of stock are positioned first on one side and then on the other side of the intermediate layer, and the layers are dewatered while in contact with the intermediate layer with the dewatering occurring through the newly formed layer but in such a manner so as to encourage interspersment of the fine fibers between the layers. This is accomplished by the forming runs being shaped in a general arcuate path, but formed of a series of straightline chords so that a pressure point occurs between the wires at each of the points of engagement with the wire, as will become clear with further description herein. These pressure points will cause a surging back and forth of the water within the stock and an interspersment between fine fibers between the layers. Since the newly formed layers are dewatered outwardly, the fines will tend to collect on the upper surface, that is, the surface next to the intermediate layer where they can perform their best bonding operation. Yet, the structure is such that it encourages continued dewatering through the outer surface of the previously formed web, thus permitting some additional dewatering to occur and further encouraging the forming of a firm bond between layers. The carrying of the web through gentle bending arcs first in one direction and then in the opposite direction

while dewatering also encourages more firm interlocking between the layers.

Turning again to the first dewatering run 14, the throat 18 into which the stock is directed from the headbox 17 is formed between an open roll 26 and a solid roll 27. The open roll may be of the suction type, but preferably is a roll with grooves on its outer periphery. As the stock travels upwardly between the two wires in the forming run 14, water is expressed through both the first and second wires. Water expressed through the first wire is skimmed off the surface of the wire by blades 24 and 25, and the water is received in a saveall 31. Another saveall 32 receives water passing through bars or blades 23.

The linear tension in the first wire 10 is adjustable by an adjustable guide roll 30 and with increase or decrease in tension, the amount of lateral pressure applied to the web throughout its forming run 14 is controlled.

Within the second wire 11 throughout the forming run 14, a series of blades or bars 23 which extend in a cross-machine direction, engage the inner surface of the second wire. These bars have spaces in between to receive water expressed from the web and push both the first and second wires laterally of the path between the breast roll 27 and an upper couch roll 28. Thus, the wires which are tensioned between these rolls, will engage the edges of the bars 23 and extend in straightline chords between them with the points of contact generally lying on an arc. At each of the points of contact with the edges of the bars, a pressure point will occur between the wires, and the pressure on the water in the fibers at that location tends to release the water and express it from the web. The upper breast roll 28 has a suction gland therein to urge the web to follow the second wire as it turns toward the second forming run 15. The first wire has a breast roll 29 therein positioned above the breast roll 27 so that the first wire wraps the second wire at the end of the forming run with some water being expressed from the web in the turn around the suction breast roll 27.

In the second vertical forming run 15, the entry throat 20 for receiving the stock from the headbox 19 is formed between breast rolls 33 and 34. Breast roll 33 is an open roll such as a roll with grooves and 34 is a solid roll.

The web with the fresh layer of stock on its outer surface travels downwardly through the second forming run, and the third wire 12 is engaged by a series of cross-machine extending bars 35. These bars are spaced apart in the machine direction to provide spaces therebetween for receiving the water which is caught in a savewall 36. With the intermediate web which was formed in the first forming run, and the outer layer which has now been added to the intermediate web, both traveling in a vertical direction, as the water is expressed from the newly formed layer, it can pass back and forth between the layers without being affected by gravity. A small additional amount of water may be expressed through the intermediate layer, but in the second run primarily dewatering is occurring in the newly added layer.

The second wire wraps a lower suction couch roll 38 within the third wire 12 at the end of the forming run carrying the web therebetween. The web being drawn to the third wire 12 by the suction couch roll 28 will follow the third wire 12 in the horizontal run as the second

wire 11 is separated therefrom and travels down over a turning roll 39.

A tension roll 37 is positioned within the second wire and its lineal tension is controllable to control the pressure between the wires along the second forming run 15.

For entering the third forming run 16, the wires are trained over breast rolls 40 and 41, with 40 being an open roll and 41 being a solid roll. The wires are pressed laterally of their path of travel between the breast roll 41 and an upper suction couch roll 43 by cross-machine extending vertically spaced bars 42. These bars have the same effect on the third forming run 16 by forcing the wires to travel through a general arcuate path, but inscribed by a series of chords because the points of contact are spaced and positioned in a general arcuate path. Water expressed from the outer layer which has been added to the two previously formed layers is received by a saveall 48. Again, the fibers on the newly formed layer are encouraged to move back and forth in the surface of the newer formed layer and the intermediate layer due to the action of the spaced bars forming pressure points between the wires. As the wires travel upwardly, they travel around the suction couch roll 43 and a third wire is wrapped around the turn by a breast roll 44 within the third wire 12. The three-layered web follows the fourth wire 13 in a downwardly inclined path to be picked off the wire by a pickup roll 45 carrying a pickup felt 46.

A wire tension roll 47 within the fourth wire 13 adjusts its tension. Primarily, the tension between the wires in the fourth forming run 16 and consequently the pressure between the wires is controlled by a tensioning roll 49 within the third wire 12.

The present machine is capable of forming a multiply web within a much shorter shop space than was possible with structures heretofore which had to be stretched out in a horizontal direction across the shop floor. The vertical formation also contributes to the control of the dewatering and control of the location of the fines to enhance the bond between the various plies. The mechanism could be used to form a two-ply web or three-ply as shown, or additional forming runs may be provided to form additional layers in certain circumstances.

I claim as my invention:

1. A multi-ply board making machine comprising in combination:

first and second looped forming wires;

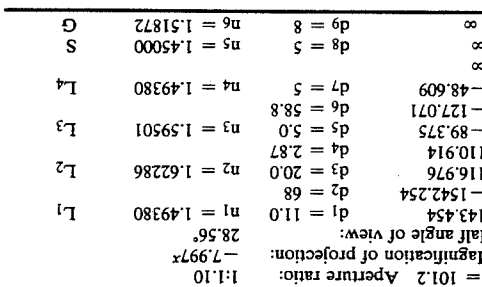
first and second wire guide means training the wires into a first vertically upwardly extending forming throat leading to a first vertically upwardly extending dewatering run with the wires applying a pressure against a web through said run;

a first headbox positioned to direct a pressure jet of first stock into the first throat;

first and second water receiving means within said first and second loops respectively receiving water expressed from the web in said first run;

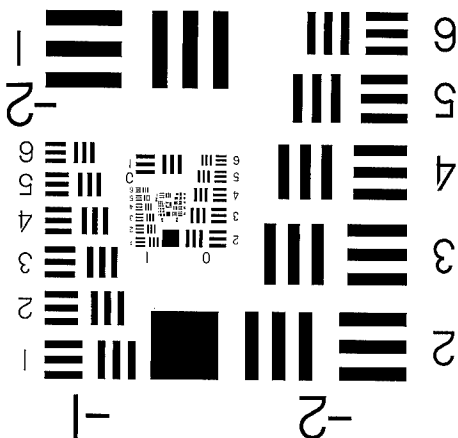
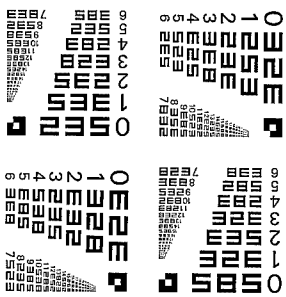
a third looped forming wire;

a third wire guide means within the third wire positioned to guide the wire into a vertically downwardly extending second forming throat leading to a vertically downwardly extending second dewatering run with the second wire and the second and third wire applying pressure to the web through said second run;



Carboxyyl derivative or pharmaceutically acceptable acid addition salt thereof, having excellent platelet aggregation inhibitory effect, calcium antagonism, hypotensive effect and phosphodiesterase inhibitory effect, are useful as prophylactic or treating agents for thrombosis, circulation improving agents for coronary blood flow such as coronary vasodilators, hypotensive agents and phosphodiesterase inhibitors. Furthermore, the carboxyyl derivatives are weak in heart rate increasing activity and also in cardiac muscle contraction increasing activity, and the carboxyyl derivatives are useful

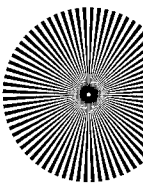
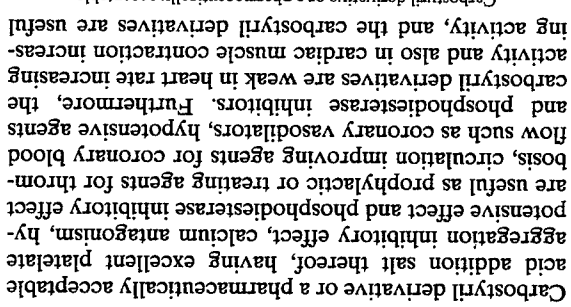
Cardiotonic derivative or a pharmacologically acceptable acid addition salt thereof, having excellent platelet aggregation inhibitory effect, calcium antagonism, hypotensive effect and phosphodiesterase inhibitory effects, are useful as prophylactic or treating agents for thrombosis, circulation improving agents for coronary blood flow such as coronary vasodilators, hypotensive agents and phosphodiesterase inhibitors. Furthermore, the cardiotonic derivatives are weak in heart rate increasing activity and also in cardiac muscle contraction increasing activity, and the cardiotonic derivatives are useful



$$(K_1x + K_2y + K_3z + L) + n(K_1'x + K_2'y + K_3'z + L') = 0$$

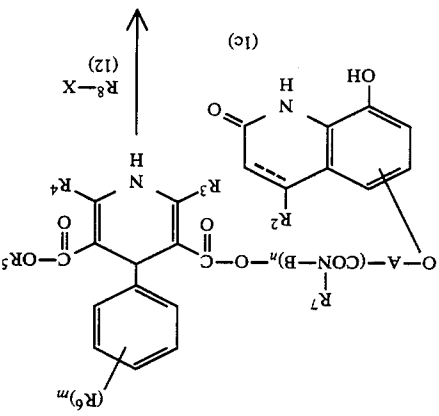
ing activity, and the carboxyl derivatives are useful in cardiac muscle contraction increase. The carboxyl derivatives are weak in heart rate increasing. Furthermore, the carboxyl derivatives are weak in heart rate increasing. Furthermore, the carboxyl derivatives are weak in heart rate increasing.

$$\cos \beta^* = \frac{K_2 - n \frac{T'}{V'}}{\sqrt{K_1^2 + \left(K_2 - n \frac{T'}{V'}\right)^2 + K_3^2}}$$



carboxymethyl derivatives are weak at heart rate increases in cardiac muscle contraction. Furthermore, the carboxymethyl derivatives are weak as coronary vasodilators, hypotensive agents and phosphodiesterase inhibitors. In contrast, the carboxymethyl derivatives are useful in increasing activity, and the carboxymethyl derivatives are useful

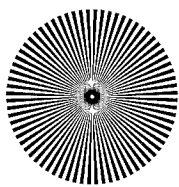
$$K' f(t) = K \left(1 - \frac{v_m}{2L} \right) e^{-\lambda t} + K (1 - e^{-\lambda t})$$



U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE



IMAGE SYSTEM
TEST TARGET



$r_1 (L_1)$	$r_6 (L_3)$	$r_7 (L_4)$
$K = 1.0$	$K = 1.0$	$K = 0.0$
$C_2 = 0.0$	$C_2 = 0.0$	$C_2 = 0.0$
$C_4 = -0.15691 \times 10^{-6}$	$C_4 = +0.95381 \times 10^{-7}$	$C_4 = -0.22891 \times 10^{-5}$
$C_6 = -0.40068 \times 10^{-10}$	$C_6 = -0.73871 \times 10^{-10}$	$C_6 = +0.12283 \times 10^{-9}$
$C_8 = +0.21016 \times 10^{-13}$	$C_8 = +0.12280 \times 10^{-13}$	$C_8 = +0.84230 \times 10^{-13}$
$C_{10} = -0.37685 \times 10^{-17}$	$C_{10} = -0.33177 \times 10^{-17}$	$C_{10} = -0.20592 \times 10^{-16}$
$f_1 = 314.6$		
$f_2 = 86.0$		
$f_3 = -481.2$		
$f_4 = -99.6$		