April 7, 1931. C. J. BARNES 1,799,350

METHOD OF AND APPARATUS FOR MAKING PAPER

Filed April 1, 1929

Fig. 1.

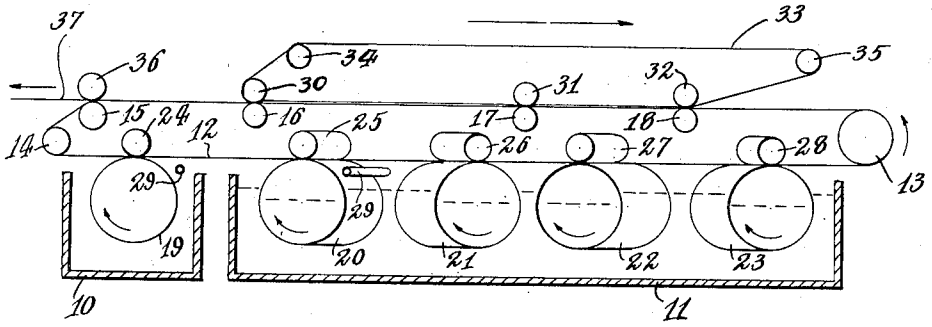


Fig. 2.

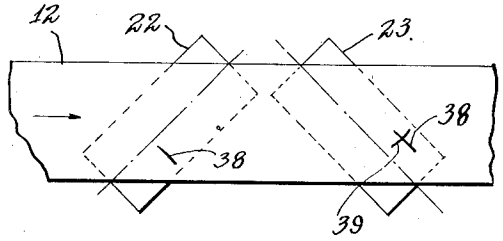
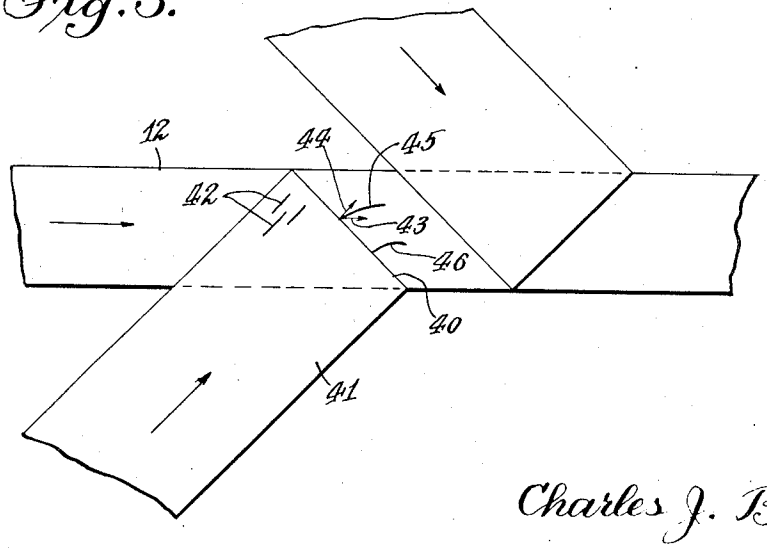


Fig. 3.



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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR MAKING PAPER

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This invention relates to a method of manufacturing various weights and thicknesses of paper, and is particularly directed to a method whereby papers of greater strength may be produced. The invention also relates to an apparatus by means of which the method of this invention may be put into operation.

In the manufacture of various paper products by the use of such well known machines as the Fourdrinier, Yankee or Dowingtown the paper fibres are generally so arranged that the sheet of paper formed contains a large proportion of the fibres lying with their longitudinal axes parallel to the length of the paper made by the machine. In other words, there are substantially no fibres extending transversely to the longitudinal axis of the paper.

A paper produced by any of the now known methods differs greatly in tearing strength in various directions. Most papers show a very high tearing strength transversely of the paper, but exhibit a markedly lower tearing strength longitudinally of the paper. Simultaneously, other properties and characteristics of the paper are affected in a similar manner.

Attempts have been made to cause a more equal distribution of fibres as respects direction throughout the paper, during various steps of its manufacture. Attempts have been made to rearrange paper fibres in paper stock while the stock is still in a semi-fluid condition, so as to cross and interlace the fibres and destroy the normal parallel formation.

These prior methods necessitated the use of a rather complicated machine, such as for example, large numbers of mechanical fingers or pickers which would agitate the paper stock on a belt so as to interlace the fibres. These prior methods and means have not been successful, however, and as a result it has been necessary to employ carefully graded and selected paper stock in order to produce a strong and durable paper.

An object of this invention is to disclose and provide a method of producing a durable, strong paper containing interlaced fibres. Another object is to disclose and provide a method whereby strong and durable papers having a tearing strength of substantially equal value in all directions, without using expensive or specially prepared paper stock.

A still further object of this invention is to disclose and provide a method whereby papers of various weights may be manufactured, said papers containing interlaced fibres in a plurality of layers.

Another object of this invention is to disclose and provide a mechanism whereby paper having interlaced fibres may be produced.

By the term "paper" as used hereinafter, reference is made to all weights and grades of paper, and the term is not to be limited to light weight papers, but includes press-board, cardboard, bristol board and other varieties of fibrous products.

Furthermore, it is to be understood that the invention is not limited to the use of any particular type of paper pulp or paper fibre, as both soda and sulphite pulp may be employed and waste paper stock and numerous vegetable fibres of suitable length and treatment may be employed.

In describing the invention, reference will be had to the appended drawings which diagrammatically illustrate the preferred form of apparatus by means of which the method embraced by this invention may be placed in operation.

In the drawings:

Fig. 1 is a side elevation of the wet end of a paper making machine, modified in accordance with this invention.

Fig. 2 is a diagrammatic plan view of a portion of the machine illustrated in Fig 1.

Fig. 3 is a diagrammatic representation of one of the effects obtained in accordance with this invention.

In making paper in accordance with this invention the paper stock may be prepared as is customary, and after having passed through the beaters, the Jordans, and through a suitable screen, the stock may be pumped into a pick-up tank or tanks 10 and 11.

The beaters, Jordans and screens are not

illustrated in the drawings, as their construction and mode of operation are well understood in the art.

A continuous belt 12 is preferably positioned above the tanks 10 and 11, the belt 12 being driven by means of the rolls 13 and/or 14, and lapping over additional rolls 15, 16, 17 and 18. It will be understood that the number of rolls 16 to 18 may be varied materially without departing from this invention.

The paper stock is applied to the belt 12 by means of a plurality of rotating screens 19, 20, 21, 22, and 23 and the like. These screens 19 to 23 are rotated upon suitable shafts by means not shown. The speed of the screens 19 to 23 may be varied, but preferably the peripheral speed of the screens 19 to 23 is substantially equal to or slightly in excess of the linear speed of the belt 12, with which the screens 19 to 23 lightly contact.

It will be understood that means for driving the belt 12 are provided, although they are not shown in the drawing, and the means for driving the screens 19 to 23 may be geared to or made a part of the driving means whereby the belt 12 is caused to travel.

The screens 19 to 23 may be of any desired construction and similar screens are employed in the art, notably in the Downingtown type of machine. Screens of varying fineness may be used, depending somewhat upon the fineness of the fibre from which the paper is to be made.

Above each of the screens 19 to 23 a soft cushioned roller may be positioned, such as the rollers 24, 25, 26, 27 and 28. The rollers 24 to 28 may be counter-balanced or weighted as may be desired, so that a predetermined or variable pressure may be imparted to the upper surface of the belt 12 while said belt is in contact with the screens 19 to 23. Furthermore, the rollers 24 to 28 may be provided with yielding thrust bearings adapted to counteract whatever slippage may be set up between the belt 12 and the screens 19 to 23.

As shown in the drawings, the screen 19 is positioned in a tank 10 transversely to the belt 12. This is the normal position of screens of this character. The screens 20 to 23, however, have their axes inclined to the belt as is more specifically shown in Fig. 2. The screens 19 to 23 are partly submerged in the paper stock with which the tanks 10 and 11 are supplied, through means not shown.

It is to be understood that the paper stock in the tanks 10 and 11 is very fluid, and a filtering action takes place through the walls of the screens 19 to 23 during which a film of paper stock is formed on the outer surface of the screens. Suitable means may be provided for removing a quantity of liquid from the interior of the screens 19 to 23 so as to maintain a head of liquid between the outside and the interior of these screens.

The film of paper stock picked up by the screens 19 to 23 is applied to the under side of the belt 12. The screen 19 first applies a thin layer of fibres to the belt and a second film is applied thereon by the screen 20. The screens 21, 22, and 23 apply further layers of paper pulp to the belt, so that when the belt 12 passes over the roll 13 it carries as many layers of paper pulp thereon as there are screens, or as illustrated, it carries five layers of paper stock.

Rolls 24 to 28 exert a slight pressing action, thereby draining a large proportion of water from the paper stock. Sprays such as the spray 29 may be pushed beneath the belt 12 so as to wash the screens before they again enter the paper stock in the tanks.

The belt 12 carrying the paper stock then passes over the roll 13 and while passing over the rolls 16, 17, 18 or the like is squeezed by pressure rolls 30, 31, 32 and the like. Preferably, said squeezing action is applied through a second belt 33 which is driven at the same linear speed as that of the belt 12, by means not shown, and passes over suitable rolls 34 and 35. During the passage of the paper stock on belt 12 between the bolt 33, large quantities of water are drained therefrom.

The paper on the belt 12 may then pass under a cold metal roll 36 and be discharged as at 37 to pass through the subsequent drying and calendering operations. The arrangement of driving and calendering rolls is not shown, as it does not pertain to this invention, and furthermore the arrangement, construction and operation of such rolls is well understood in the art.

By having the rolls 20, 21, 22 and 23 inclined to the longitudinal axis of the belt 12, the fibres picked up by the screens may be applied to the belt with the longitudinal axes of the fibres at an angle to the longitudinal axis of the belt. Furthermore, by staggering the screens 20 to 23 or by alternately inclining said screens at complementary angles to the longitudinal axis of the belt 12, the adjoining layers of paper stock applied thereto may be composed of fibres oppositely inclined to each other.

As shown in Fig. 2, the screen 22 may be inclined at a positive angle of say 45 degrees to the belt 12, whereas the screen 23 may be inclined at a positive angle of 315 degrees to the belt 12. The fibres applied by the roll 22 will therefore assume a position roughly indicated at 38, whereas the fibres applied by the screen 23 will assume the position roughly indicated at 39.

In Fig. 3 the action which takes place is diagrammatically illustrated. Contact between the screens 20 to 23 and the belt 12 may be said to take place along a line of contact indicated at 40. The surface of the screen in developed form is indicated at 41,

and it bears fibres such as the fibre 42 (here shown in an exaggerated size for purposes of illustration).

If the belt 12 and the surface 41 of a screen are moving at the same linear speed, the velocity of the belt 12 may be illustrated by the line 43 and the velocity of the screen 41 illustrated by the line 44. The fibre 42 will therefore assume a position on the belt 12 as indicated at 45, the slight curvature of the fibre as shown at 45 being due to a small amount of slippage between the belt 12 and the screen 41. This slippage is compensated for by using the screens 20 to 23 in pairs, adjoining screens being oppositely inclined to the axis of the belt, thereby neutralizing any tendency to slip in one direction (set up by one screen) by the opposed tendency set up by the adjoining screen. Special slipping-preventing or compensating devices may be employed however; for example, the surfaces of the rolls 25, to 28 may be spirally indented so as to exert a longitudinal pull on the belt in a direction opposed to that in which there is a tendency to slip.

By causing the screen surface 41 to move at a higher lineal speed than the belt 12, the fibres 42 may be caused to assume a curved position, as shown at 46, this being due to the fact that the end last to leave the screen is actually hammered into the belt 12.

The invention therefore comprises a method of applying fibres to a moving belt and at an angle to the direction of movement of said belt, the fibres being placed in alternative layers and at varying angles.

It is to be understood that screens extending transversely of the belt as the screen 19, may be employed either for the production of outer layers or intermediate layers throughout the paper. Separate tanks may be employed for the various screens. For example, the tank 10 may be supplied with a paper stock to which sizing materials have been added or to which a coloring material or filler has been added, whereas succeeding tanks such as the tank 11 may be supplied with a paper stock free of sizzing, coloring, etc.

It will be readily understood that a paper composed of fibres which cross and interlock each other is of much greater strength than a paper composed of fibres in substantially parallel relation. Paper made in accordance with the method hereinabove described is particularly effective and useful for wrapping purposes, the manufacture of bags, cartons, covers and other purposes necessitating the use of a strong non-tearable paper.

Numerous changes and modifications may be made both in the arrangement and location of the various elements described hereinabove and in the method, and all the changes and modifications which come within the scope of the appended claims are embraced thereby.

I claim:

1. In a method of making paper the step of applying layers of paper stock composed of fibres in substantially parallel relation to a belt moving in a direction at an angle to said fibres at the time of application, successive layers of paper stock applied to said belt being composed of fibres at opposed angles with respect to said belt.

2. In a method of making paper having fibres angularly disposed to each other, the steps of continuously forming a film of paper stock composed of fibres in substantially parallel relation but at an angle to the longitudinal axis of a moving belt, continuously applying said film to the said belt while said fibres are at an angle to the axis of said belt, continuously forming a separate film of paper stock composed of fibres in substantially parallel relation but at an opposed angle to the longitudinal axis of said belt, and continuously applying said separate film to said belt and to fibres carried thereby.

3. In an apparatus for making paper containing fibres angularly disposed to each other, the combination of a tank for paper stock, a continuous belt rotatably suspended over said tank, and cylindrical rotating means partially immersed in said tank, said last named means being in operative contact with said belt and rotating on axes at an angle with the longitudinal axis of said belt.

4. In an apparatus for making paper having fibres angularly disposed to each other, a tank for paper stock, a continuous belt rotatably suspended over said tank, and rotatably mounted cylindrical screens partly immersed in said tank, said screens rotating on axes opposed to each other and at opposed angles to the longitudinal axis of said belt.

5. In an apparatus for making paper composed of fibres angularly disposed to each other, the combination of a tank for paper stock, a continuous belt rotatably suspended over said tank, rotatably mounted cylindrical screens partially immersed in said tank and paper stock therein, said screens rotating on axes opposed to each other and at opposed angles to the longitudinal axis of said belt, and means for bringing said belt and screens into operative relation.

6. In an apparatus for making paper containing fibres angularly disposed to one another, the combination of a tank for paper stock, a continuous belt adapted to receive paper stock rotatably suspended over said tank, a plurality of rotatably mounted cylindrical screens partly immersed in said tank and paper stock therein, said screens rotating on axes opposed to each other and at opposed angles to the longitudinal axis of said belt, means for driving said belt at a predetermined linear speed, means for driving said

screens at a peripheral speed substantially equivalent to the linear speed of said belt, and means for bringing said belt and screens into operative relation with each other.

7. In a method of making paper, the steps of applying films of paper stock composed of fibres in substantially parallel relation to each other and to the film of paper stock of which the fibres are a part, to a belt moving in a direction at an angle to said fibres at the time of application, successive films of paper applied to said belt being composed of fibres at opposed angles with respect to said belt.

Signed at Los Angeles, Calif., this 20th day of March, 1929.

CHARLES J. BARNES.