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APPARATUS FOR THE CONTINUOUS MANUFACTURE OF PATTERNED PAPER

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FIG. 1

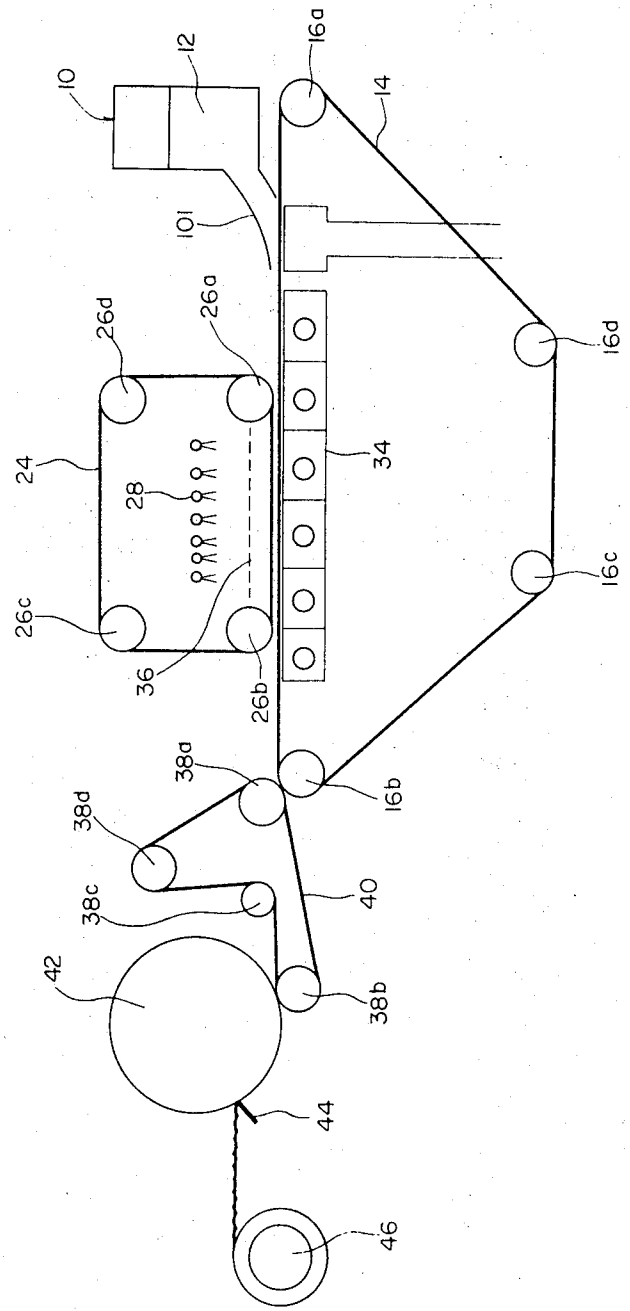

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FIG. 2

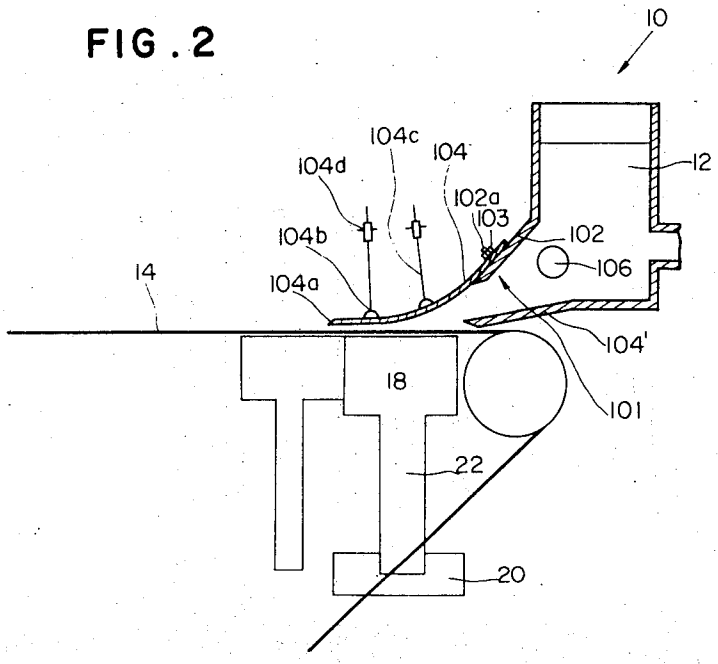
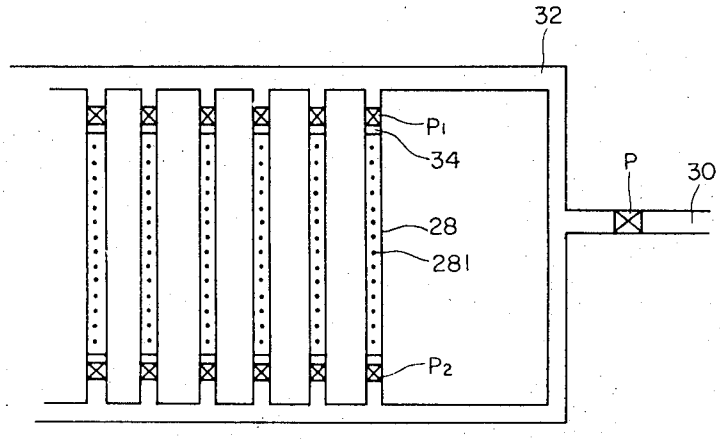


FIG. 3



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3,565,756

APPARATUS FOR THE CONTINUOUS MANUFACTURE OF PATTERNED PAPER

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Int. Cl. B31f *1/12*; D21h *5/06, 5/24*
U.S. Cl. 162—297 3 Claims

ABSTRACT OF THE DISCLOSURE

Liquid stock is uniformly distributed on a machine wire cloth. The thus formed web is conveyed under and in close proximity with a patterning belt. Shower pipes eject a water spray through the patterning belt and formed web. A metallic screen, positioned between the shower pipes and the patterning belt, distributes the water spray uniformly through the patterning belt.

This invention relates to a device for the continuous manufacture of patterned paper, and more particularly, to a device for imparting desired patterns on paper with perforations or cavities formed by means of water jets during paper machining.

Paper with a pattern of perforations or undulations has been manufactured in two steps, i.e. a first step to manufacture the paper per se and a second step to apply a pattern thereon by pressing patterns or boring through holes. This is not only inefficient but also the pattern formed thereby is stiff, crude and not of desirable appearance. In view of the fact that paper is increasingly used as a substitute for textile cloths, such as towels, table cloths, napkins, dresses, sheets, bed covers, etc., there has been a strong demand for an industrial method and device for inexpensively producing paper having a feeling similar to that of conventional textile cloths and with neatly appearing patterns. However, it may be safely said that such need for the industrial method and device has not yet been met successfully, nor has production of the paper having satisfactory feeling for the use in lieu of textile cloths been completed, and hence, no such a paper is on market.

Therefore, an object of the present invention is to provide a device for a continuous production of patterned paper to be used for the purposes as referred to. According to the invention, a wet-web prepared by removing approximately 90% of the water content of the liquid stock in the machining process is patterned by jetting water through perforations of a patterning belt means driven proximate thereto and at the same speed, and the wet-web thus patterned is then dried. The patterned paper thus dried, may be subjected further to a mechanical cockling treatment to make the paper shrinkable by means of an embossing roll, dry creping, wet creping, and the like, depending on the use of the product. It is also possible to apply a chemical softening treatment by using a surface activating agent, such as fatty acid amine, alkyl amine, and the like. According to the present invention, it is also permissible to mix non-heat-shrinkable paper fibers with more than 40% of the shrinkable fibers made by heat-stretching thermoplastic fibers, e.g. acrylonitrile and polypropylene fibers. In order to improve the water resistivity of the paper, various resins may be used, such as urea-formaldehyde resin, melamine resin, epoxy resin, polyethylene-imine resin, dialdehyde-starch resin, etc. To improve the water-repellency of the paper,

a suitable water-repellent agent, such as silicone resin, wax, chromestearate chloride, and the like may be used. The aforesaid treatments with various resins and agents can be done either by adding the resins and agents in the liquid stock, or by impregnating the paper with such resins and agents by means of the spray gun after drying the paper. The patterned paper according to the present invention may be laminated with non-patterned paper by superposing the patterned paper on a wet-web and rolling them together under pressure.

Other objects and a fuller understanding of the present invention may be had by referring to the following description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a diagrammatic illustration of a device for producing patterned paper, according to the present invention, shown in a schematic longitudinal section;

FIG. 2 is a schematic perspective view of a dewatering means usable in the device of FIG. 1, shown in an enlarged view; and

FIG. 3 is a schematic bottom view of a nozzle means for producing water jets.

Like parts are shown by like numerals and symbols throughout the drawings.

Referring to FIG. 1, a head box, generally represented by a reference numeral **10**, stores liquid stock **12** supplied from a source (not shown). The stock **12** can be prepared by any known method, and it can be any mixture of suitable fibers, including one or more of wooden pulp, cotton fibers, linen fibers, other natural fibers, acryl fibers, polyamide fibers, polyester fibers, polyurethane fibers, and other synthetic fibers. It is possible to add binder fibers in the stock, and polyvinyl alcohol fibers are preferable as such binders. An outlet or nozzle **101** of the head box **10** is gradually sloped downwards, so that the stock **12** can be disposed on a machining wire cloth **14** at a uniform thickness. The wire cloth **14** is driven by wire rolls **16***a*, **16***b*, **16***c*, and **16***d*.

As clearly depicted in FIG. 2, the lower edge **102** of the front wall of the head box **10** is bent forward by 40 to 60 degrees with respect to the vertical upper portion of the wall. A threaded bolt **102***a* is secured to the edge **102**, and a lip or slidable plate **104** is mounted on the edge **102** by fitting the threaded bolt **102***a* in a slot (not shown) of the plate **104** and fastening with a nut **103**, in an adjustable manner. The thickness of the paper to be machined can be adjusted by controlling the spacing between the free end **104***a* of the lip plate **104** and the endless support or machining wire cloth **14** by sliding the plate **104** on the lower edge **102**. It is preferable to mount at least one eye-ring **104***b* in the proximity of the free end **104***a* of the plate **104**, so that the free end **104***a* can be resiliently suspended by a flexible wire **104***c* extending between the eye ring **104***b* and a pulley **104***d*.

The flow of the stock **12** fed into the head box **10** through an inlet opening **105** is controlled by a rectifier roll **106**, so as to flow at a controlled rate towards a bottom lip plate **104'**, which is mounted on the bottom of the head box **10** and directed towards the lower front side of the box. The bottom lip plate **104'** is somewhat shorter than the other lip plate **104**, and cooperates with the latter to guide the stock onto the machining wire cloth **14**.

At least one drainage box **18** is disposed underneath that portion of the machine wire cloth **14** where the stock is delivered from the head box. The upper surface of the drainage box **18** is substantially in contact with the machine wire **14**, while the lower end of the box **18** communicates with a draft or suction means **20** through a tube **22**.

With the dewatering means of the aforesaid structure, the water in the stock liquor is eliminated very efficiently, up to about 90% of the moisture while the machine wire cloth travels a relatively short distance, e.g. 250 to 500

mm. More particularly, a test was made by using a machine wire to be run at 100 m./min. with a dehydrating span of 250 mm., in conjunction with a drainage box having a dehydrating pressure of 0.1 kg./cm.^{2}; a stock having a concentration of 0.1 to 0.2% was prepared from a standard coniferous draft pulp (freeness 500 cc.); and the stock was treated by the machine wire cloth to prove the dehydrating efficiency of about 90%. The quality of the paper thus machined was excellent, as shown below.

Areal weight (gr./m.^{2})	19.65
Burst factor	1.577
Percent Elmendorf	111.95
Breading length (km.)	
M.D.	1.356
M.C.	1.067
Bulk density	0.243

The wet-web thus formed on the wire cloth **14** is fed under a patterning belt **24**, which is driven by rolls **26***a*, **26***b*, **26***c*, and **26***d*, at the same travelling speed with the wire cloth **14**. The patterning belt **24** is made of any suitable material such as metal, plastic, or rubber, and having a number of perforations for forming a desired pattern. When the wet-web travels between the belt **24** and the wire cloth **14**, pressurized water is uniformly jetted from a plurality of holes of shower pipes **28**, through said perforations of the belt **24** onto the wet-web.

In the embodiment illustrated in FIG. 3, the shower pipes **28** are connected to a pair of manifolds **32** through rubber, or other flexible hoses **34**, at each end thereof, and the manifolds **32** are in turn connected to a main pipe **30** through a main valve P. Regulating valves P_1, P_2 . . . are provided, one for each connection between the shower pipe and the manifold. The pressure of water to be ejected from a plurality of jet-holes **281** bored on the shower tubes **28** can be regulated by controlling the degree of opening of the valve P and regulating valves P_1, P_2 . . . . The details of the water jet means, such as the number and size of shower pipes, the arrangement of such shower pipes, the number and dimension of holes to be bored on the shower pipes, the distance between the shower pipes parallelly arranged, and the pressure of water ejected from the holes can be determined experimentally, depending on the thickness of the wet-web to be treated, the composition of the stock, the feeding rate of the stock, and the like, so that the wet-web may not be eroded by the pressure of the injected water and that the desired perforations or cavities may be effectively formed. In a preferred embodiment of the present invention, there are 3 to 10 shower pipes at intervals between 10 to 100 cm., each having a diameter of 25 to 50 mm. and 200 to 500 jet-hole perimeter of pipe length of 0.5 to 1 mm. dia. to keep the water pressure inside the shower tube at 0.1 to 3 kg./cm.^{2}.

The pressurized water thus ejected from the belt **24** penetrates through the wet-web while forming holes or recesses corresponding to the perforations of the belt on the wet-web. There are a plurality of suction boxes **34** disposed across that span of the patterning belt **24** where the pressurized water injected, so that the water passes through the wet-web quickly to accelerate the exact transfer of the pattern preformed on the patterning belt **24** onto the wet-web. The section pressure of the suction box **34** is determined depending on the thickness of the wet-web and the rate of pressurized water ejection. When the wet-web is quite thin there is no need for using the suction box **34**.

It is preferable to provide a metallic screen **36** of about 10 to 15 mesh between the shower pipes **28** and the patterning belt **24**, in order to achieve uniform water pressure distribution over the entire span of the wet-web of the ejected water spray issuing from the pipes **28**.

The wet-web thus patterned is then moved from the wire **14** to an endless belt of felt **40** driven by rolls **38***a*, **38***b*, **38***c*, and **38***d*. The web then proceeds to a drying

section, because its water content is about 85 to 88% when it is moved to the felt **40**. For instance, a roll type dryer **42** is used to dry the web. If it is desired to crepe the product, a crepe doctor **44** can be used when the patterned paper thus dried leaves the dryer **42**. According to a test carried out, a sample having an areal weight of 30 gr./m.^{2} and a softness of 32.5, as determined by the Clark method prior to creping, was converted into a crepe tissue having the softness of 133, by treating the former at a creping rate of 20% by using a dryer roll **42** rotating at a surface speed 100 m./sec. in conjunction with a pope reel roll **46** rotating at a surface speed 80 mm./sec.

If a wet-web is prepared by mixing non-shrinkable fibers with shrinkable fibers, which shrinkable fibers are made of thermoplastic fibers, such as acrylonitrile and polypropylene fibers, by applying heat stretch treatment thereto, such web can be easily converted into soft cloth-like paper by heating it to a temperature between 100 and 150° C. When such web is thus heated, the shrinkable fibers therein shrink by about 20 to 30%, while the non-shrinkable fibers contained therein substantially do not shrink. The difference in the shrinkage between the shrinkable and non-shrinkable fibers contained in the web results in softening the product. In other words, with such mixed paper stock, the dryer roll or drum **42** works only as a heater, and the crepe doctor **44**, as shown in FIG. 1, can be dispensed with, so that the paper dried by the dryer roll **42** is directly wound on the pope reel roll **46**.

In order to produce a laminated paper with pattern, a sheet of patterned paper thus dried, through the processes described hereinbefore, is superimposed on a wet-web delivered on the wire **14** from the head box **10**, and both the wet-web and the patterned paper laminated thereon are forwarded between the patterning belt **24** and the machine wire **14**, to bond them together by pressure without ejecting the pressurized water thereto.

In order to illustrate an embodiment of the present invention in further detail, essential dimensions thereof are described below. It should be noted that the following data are not intended to limit the scope of the invention but to facilitate a better understanding thereof.

(1) Continuous production of patterned paper
Composition of stock,
Rayon—50%.
Pulp—40%.
Polyvinyl alcohol fibers (binder fibers)—10%.
Concentration of liquid stock—0.1%.
Areal weight—20 gr./m.^{2}.
Width of machined paper—1 meter.
Travelling speed of machine wire—100 m./min.
Travelling speed of patterning belt—100 m./min.
Water pressure of shower—1.5 atm.

(2) Manufacture of laminated paper with pattern
Patterned paper—according to the item 1.
Wet-web, stock—100% pulp.
Liquid stock concentration—0.1%.
Moisture content of wet-web—88%.
The above-mentioned patterned paper and the wet-web, which are laminated to each other, are processes between the machining wire cloth and the patterning belt at a travelling speed of 100 m./min.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that various modifications in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A device for continuously manufacturing patterned paper, said device comprising a running machine wire means, means for distributing liquid stock onto said machine wire means at a uniform thickness, first dewatering means for removing most of the moisture in said liquid

stock thus distributed on the machine wire means to form a continuous wet-web, a patterning belt positioned above said machine wire means and means having perforations and being moved in close proximity to and at the same velocity as said running machine wire means, means for ejecting water under pressure through said perforations onto the wet-web, a screening means disposed below said water ejecting means and above a portion of said patterning belt means for spraying water uniformly onto said wet-web, second dewatering means for removing the water ejected through said perforations and through corresponding portions of the wet-web and said machine wire, and means for heating the wet-web to thereby dry said wet-web into said patterned paper.

2. The device for continuously manufacturing patterned paper, as claimed in claim 1, wherein said means for distributing said liquid stock is a head box comprising a hollow body member in which liquid stock is supplied from a source and stored therein, said head box including an outlet portion, a stationary lower lip which extends from said outlet portion and is spaced proximate the machine wire to distribute the liquid stock on the latter, and an upper lip plate including a first lip plate having one end which is secured to the wall of said hollow body and an opposite end which is slanted downwardly toward the machine wire and a second lip plate having one end secured to said first lip plate and a further free end adjustably suspended so as to leave a controllable space, corresponding to the desired thickness of the wet-web to be formed, between the free end of said second lip plate and the machine wire surface, and wherein said first dewatering means includes a main suction box spaced just

below said second lip plate so as to eliminate most of the water contained in the distributed liquid stock, and a complemental suction box, whereby the liquid stock is substantially converted into the complete continuous wet-web when it appears from the underside of said second lip plate.

3. A device for continuously manufacturing patterned paper, as claimed in claim 1, wherein said screening means for spraying water uniformly is a screen of about 10 to 15 mesh.

References Cited

UNITED STATES PATENTS

3,350,260	10/1967	Johnson	162—299X
3,471,368	10/1969	Reitzel	162—336X
1,957,913	5/1934	Smith	162—111X
2,862,251	12/1958	Kalwaites	162—114X
3,014,832	12/1961	Donnelly	162—111
3,042,576	7/1962	Harmon et al.	162—114
3,129,466	4/1964	L'Hommedieu	162—114X

OTHER REFERENCES

Sushereba, J. A.: Broad Selection of Headboxes—Considerations for Fine Papers, Paper Trade Journal, Aug. 3, 1964, pp. 22–25.

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U.S. Cl. X.R.

162—111, 115, 281, 308, 347