No. 717,799. PATENTED JAN. 6, 1903.

E. R. & O. F. BEHREND.

METHOD OF PRODUCING WATER MARKED PAPER.

APPLICATION FILED JUNE 13, 1902.

NO MODEL.

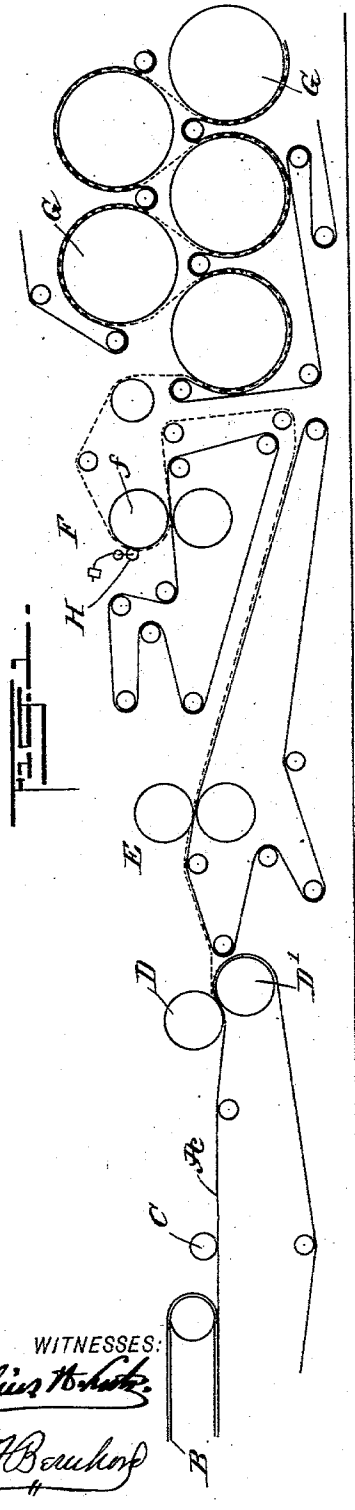


Fig. 1.

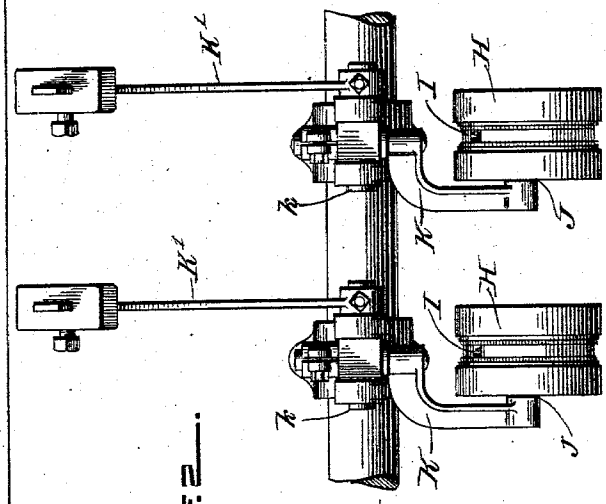


Fig. 2.

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METHOD OF PRODUCING WATERMARKED PAPER.

SPECIFICATION forming part of Letters Patent No. 717,799, dated January 6, 1903.

Application filed June 13, 1902. Serial No. 111,478. (No model.)

To all whom it may concern:

Be it known that we, ERNST RICHARD BEHREND, a citizen of the United States, and OTTO FREDERICK BEHREND, a subject of the Emperor of Germany, both residents of Erie, in the county of Erie and State of Pennsylvania, have invented a new and Improved Method of Producing Watermarked Paper, of which the following is a full, clear, and exact description.

Our invention relates to an improved method of manufacturing watermarked paper, which will be hereinafter fully described, and the actual scope of which will be defined by the claim.

In the present invention we seek to attain two desirable ends in the manufacture of watermarked paper—namely, first, a genuine and indelible watermark which cannot be obliterated or impaired by any test now known to the trade, including the severe action of caustic soda, which is sufficient to efface the mark made by compression of the fibers on many grades of paper, and, secondly, to produce such watermarked paper rapidly and economically.

Prior to our invention the common method of watermarking was to subject the sheet of pulp-stock while it was in the formative state preliminary to conversion into a web of paper to the action of a dandy-roll or other similar device—that is to say, the pressure necessary to secure the watermark is exerted in the pulp fibers while the stock or mass of pulp is in a semifluid condition and spread out in the form of a relatively thin sheet on the endwise "wire" of an ordinary Fourdrinier machine. While a good watermark can be secured on some grades of paper under these conditions, it is impossible on certain other grades of paper to produce a sharp, clear, and distinct mark in the product, and under all circumstances the output or production is decreased and the cost is correspondingly increased because the apparatus or machine must be run at relatively low speed to produce a satisfactory commercial article. Marks produced in paper by the operation of dandy-rolls are thinner than the balance of the sheet because the fibers have been displaced. There is actually less material at the lines of the marks, and consequently all parts of the paper will swell proportionately when subjected to the caustic-soda test, leaving the designs still distinct. Marks which are produced by compression only of the paper fibers when treated with the soda solution simply swell up until the compressed marked portion is on a level with the surrounding surface and of course the mark disappears under this test. The reason for this is that such marks are thinner by compression and contain as much material as the rest of the sheet.

We are also aware that prior to our invention it had been proposed to watermark paper at the stack of calender-rolls; but as the paper had been pressed and completely dried before it reached the calender-rolls it is evident that the web must be again dampened or moistened before it could be treated to secure the desired result. Such method is objectionable and impracticable because the mark is secured by compression, and satisfactory results cannot be obtained, as the mark is not a genuine watermark.

According to our invention we produce paper with an indelible distinct watermark by and according to a new method, comprising the following steps—*i. e.*, converting a sheet of paper fibers and water in a pulpy condition into a continuous wet web of paper, thereafter attenuating the wet paper-web on certain predetermined lines, forming a desired watermark by displacing the paper fibers in the web through pressure in excess of the mere inertia of the fiber-displacing means, and finally drying and finishing the watermarked paper-web, such step of subjecting the paper-web to excessive pressure for the attenuation of the web on the watermark-lines taking place subsequent to its conversion from a sheet of pulp-stock into a wet web and previous to drying the web.

Our method of manufacturing paper enables perfectly and sharply defined watermarks of any figure or pattern to be indelibly produced, so as to successfully withstand all known tests, including the test of caustic soda, which is recognized as quite a severe one among paper manufacturers, and at the same

time the article can be produced economically and rapidly, which is a matter of great importance in the trade.

To enable others to understand our invention, we have illustrated by the accompanying drawings a form of apparatus suitable for carrying the invention into practice, but it will be understood that many other kinds of machines may be used.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresonding parts in both the figures.

Figure 1 is a sectional elevation of a part of a paper-making machine of the well-known Fourdrinier type, and Fig. 2 is a detail view of a gang of watermarking-rolls which may be used.

A designates the endless "wire;" B, a part of one of the deckle-straps.

C is a dandy-roll, and D D' are the coacting couch-rolls. In the rear of the couch-rolls is situated a press E, or a series of two or more presses may be used, such series being indicated at E F. From the press or presses the paper-web is adapted to pass to the driers, the latter being indicated by Fig. 1 in the form of heatable cylinders or drums G, and from the driers the paper-web is adapted to pass to the usual stack of calenders or equivalent apparatus for finishing the paper.

One embodiment of means for watermarking paper is disclosed in detail by a copending application filed in the United States Patent Office by ourselves on February 19, 1902, Serial No. 94,852, and for convenience of disclosure we have shown said watermarking device in the present application, although it will be understood that many different kinds of marking devices may be adopted. Said watermarking device is necessarily placed in a position to operate on the wet web of paper after it shall have been converted from a mass spread out in sheet form and consisting of a mechanical admixture of paper fibers and water in a pulpy condition into a wet web and before it is thoroughly dried by the action of the driers. The watermarking device is in the form of a roll H, or a gang of such rolls, as shown by Fig. 2, each roll having designs, figures, letters, &c., of any suitable or preferred character, as indicated at I. The design-carrying roll of each gang is mounted to rotate on a spindle or arbor J under the influence or control of a pressure or tension device, the latter being shown in the form of a hanger K, suspended or hung at *k* and having a weighted arm K', although the tension device may be modified in construction within wide limits.

The watermarking device is shown by Fig. 1 as being disposed in a position opposite one of the presses, as F, for the purpose of having the design-carrying roll H coöperate with one of the press-rolls, as *f;* but the position of the watermarking mechanism opposite to a press-roll is not material, because it may be positioned in coöperative relation to the first press E, or to one of the drying-rolls, or to any other convenient part of the machine, so long as said marking device is arranged to act on a wet web of paper after it leaves the couch-rolls and before it is dried.

The paper-stock is delivered from the "flow-box" to the endless wire A, where it is uniformly distributed into a thin pulpy layer consisting of paper fibers and water, which is neither a web of paper, nor is it in the same condition it was before it entered the wire. The pulpy layer is carried by the wire between the couch-rolls, the water escaping freely from the stock or sheet at this period. The sheet of pulp is converted by the couch-rolls into a wet web of paper, and the latter then passes through the presses and now is subjected to the action of the watermarking mechanism, or the paper-web may be subjected to the action of the marking-roll after it leaves the couch-roll and before it enters the first press, after which the web of marked paper passes on to the driers and is finally finished by the calenders. The water-marking mechanism is disposed to act on the web of paper while the latter is in a wet condition, and the roll of said mechanism is held under yielding pressure in excess of that exerted by the inertia of the marking-roll alone, said roll being in engagement with the wet paper-web, the pressure being sufficient to cause the design, character, or letters on the roll to crowd or displace the fibers of the wet web in such manner as to attenuate the paper at the lines of the contact, and thereby produce a genuine and ineffaceable water-mark.

To secure a satisfactory commercial article of watermarked paper, it is essential that the wet web after its conversion from a mass of pulp shall be subjected to pressure in excess of that exerted by the mere inertia of the working roll. Owing to the pressure exerted on this roll by the tension device, the roll is liable to drag when in contact with a wet web of paper, and to overcome this the marking-roll is mounted by ball-bearings in its support, so that the roll will turn with great freedom and be capable of a peripheral speed equal substantially to the speed of the paper-web. By holding the freely-turning working roll under strong pressure in contact with the wet web it is possible to displace the paper fibers in the wet web, and thereby attenuate the web along the lines of the desired watermark, the whole being accomplished without tearing the paper and producing an indelible article the mark of which cannot be effaced by any known means or substance.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

The improvement in the art of making watermarked paper, which consists in attenuating a wet paper-web along the lines of a desired water-mark at a period subsequent to the conversion from a sheet of wet pulp-stock into a wet web and before drying the latter.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ERNST RICHARD BEHREND.
OTTO FREDERICK BEHREND.

Witnesses:
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