The invention describes a process for the continuous production of paper which facilitates the drying thereof and device for the realisation of said process. It is based on the introduction of a pre-drying phase leading to a compression of the paper between a forming wire (12) and a felt (11).
PROCESS FOR THE CONTINUOUS PRODUCTION OF TISSUE PAPER AND DEVICE USED IN SAID PROCESS

Field of the invention
The present invention refers to the field of processes and devices for the continuous production of tissue paper.

State of the art
As is known, systems for the manufacture of tissue paper comprise large very complex machines for continuous production, starting from preparation of the suspension of fibres (normally cellulose) right through to the finished sheet.

After preparation of the suspension of fibres, the main machine, i.e. the continuous paper machine, takes over the process.

The work of the continuous machine consists basically of two phases: formation of the sheet and drying of the sheet formed.

In the sheet formation phase two technologies are adopted: crescent former (the method most commonly used today) or twin wire.

In the first case, in the formation phase the suspension of fibres (normally suspensions of cellulose in water with density below 1% in weight) is uniformly distributed on a forming wire belt; this consists of a loop of very strong synthetic material which is kept constantly tightly tensioned and rotates at the set speed on steel cylinders which keep it tensioned and move or guide it.

The forming wire has a filtering surface which permits the drainage of large amounts of water and therefore the formation of a paper sheet containing 10 - 20% in weight of paper, depending on the particular method used.

In the subsequent drying phase, the paper sheet thus obtained is transferred onto a belt made of felt.

If the twin-wire method is used, an additional wire belt called transport belt is positioned between the forming wire belt and the felt (below, the generic definition "wire belt" will be used for the sake of simplicity to indicate both types of wire belt specified above).

In this case the sheet is formed on the forming cylinder, as described previously, between the two wire belts, i.e. the forming and the transport belt; the second one conveys the sheet formed over a short distance, passing it on to the felt.
The felt that conveys the paper sheet (received from the forming belt or transport belt depending on the method used as described above) along its path is then pressed by a rubber-coated cylinder (called suction or press cylinder, which normally has a surface provided with holes and is connected to one or more suction pumps) against a second metal cylinder, much bigger and heated, called Yankee cylinder, so as to remove a further quantity of water, leaving the sheet adhering to the hot metal surface of the metal cylinder which then transfers it to the cylinders for winding in large rolls.

The contact of the sheet with the hot surface of the Yankee cylinder (normally with the further action of blasts of hot air) allows it to reach the final degree of dryness which is around 95%.

Analogously to the forming belt and transport belt, also the felt is a loop made of very strong synthetic material which is a very heavy woven fabric kept constantly tightly tensioned and rotating at the set speed on steel guide cylinders.

As has been seen in the known processes, independently of the various specific technologies used for formation of the sheet, the forming belt in the case of the crescent former method or the sheet transport belt in the case of the twin-wire method and the felt are in contact for a certain length and as soon as the sheet is transferred to the felt, the belts separate and the sheet proceeds towards the drying phase.

The process has the disadvantage, however, that the paper sheet arrives at the drying phase on the Yankee cylinder still containing a fairly large amount of water and therefore requires, for drying, the application of a considerable pressure by the rubber-coated cylinder against the Yankee cylinder which negatively affects the softness and absorption capacity of the fibres in the finished sheet.

Furthermore said considerable presence of water before the drying phase requires the use of a considerable amount of energy to reach the required degree of dryness which, as said, is normally around 95% in weight of paper out of the total weight of the sheet.

The advantage of preliminarily reducing part of the water retained in the sheet during the formation phase in order to overcome the above-mentioned drawbacks is therefore obvious.
Brief description of the figures

Figures 1 (a) and (b) show schematically a particular embodiment of the process according to the invention;

figure 2 shows schematically a further particular embodiment of the process according to the invention;

figure 3 shows schematically, for comparison, the process of Figure 1 according to the state of the art in which the crescent former technology is used;

figure 4 shows schematically, for comparison, the process of Figure 2 according to the state of the art in which the twin-wire technology is used.

Summary of the invention

Process for the continuous production of tissue paper in which between the sheet formation phase and the drying phase a pre-drying phase is scheduled by compression of the paper sheet between the wire belt (forming or transport according to the technology used) and the felt.

Detailed disclosure of the invention

The present invention overcomes the above-mentioned problems permitting a reduction in the concentration of water in the sheet prior to the drying phase by means of a process for the continuous production of tissue paper in which before said phase, the paper sheet, positioned between wire belt (forming or transport according to the technology used) and felt is passed over one or more cylinders so that the belt positioned outside the cylinder(s) is able to exert a uniform pressure against the other belt and against the cylinder itself with which it is in contact, so that the paper sheet, positioned between the two belts, releases to the felt a part of the water contained up to that point in its component fibres.

Figure 3 illustrates the known process applied to a continuous machine with crescent former technology (the most widespread method used today for the continuous production of tissue paper) but it can obviously be applied in the same way to the other technologies used for continuous production of paper sheets (such as the already mentioned twin-wire technology).

As can be seen in figure 3, the paper sheet forms on the forming cylinder 10 which is wrapped by an angle of approximately 150° - 180° by the felt 11 and, outside
the latter, by approximately 120° - 150° by the forming wire 12 hence the forming wire adheres to the felt in the part where the latter rests on the forming cylinder.

The jet 14 of suspension of fibres (normally below 1% in weight of fibres) which comes out (at approximately the speed of the forming wire and the felt) of the headbox 15 is directed into the slice 13, located between the forming wire 12 and the felt 11.

The pressure exerted by the forming wire against the felt (and therefore against the forming cylinder) in the part in which they are in contact with each other, together with the centrifugal rotation force of the forming cylinder, permit the drainage of a large part of the water, while the fibres are regularly distributed thus forming the paper sheet 16 with a density of approximately 10 - 13% in weight of fibre.

When the felt leaves the surface of the forming cylinder, the forming wire separates, in point A, from the paper sheet which continues its route, adhering to the felt until it meets the press cylinder 17.

Here the felt runs outside the press cylinder, pressing the paper sheet against the hot Yankee cylinder 18 and, under the strong pressure created, absorbing a further considerable percentage of water from the sheet which thus reaches a density of approximately 38 - 40% and adheres to the surface of the hot Yankee cylinder; the latter performs the final drying, with the help of the hood 19 which blows hot air, bringing the density of the sheet to 95% in weight.

Lastly a steel blade 20 detaches the sheet from the Yankee cylinder for final winding in reels 21.

Analogously to the above, Figure 4 shows the known process applied to a continuous machine with double-wire technology.

As can be seen, in this case the forming cylinder 10 is wrapped, in a substantially analogous manner to that illustrated previously, by two wires, one of which acts as a forming belt 12 and the other as a transport belt 12' which conveys the sheet formed over a short distance, transferring it from the forming belt 12 to the felt 11 on which the process continues as described for the preceding technology.

In the process according to the invention, as illustrated in Figures 1 (a) and (b), the forming belt, the felt and the paper sheet positioned between them pass over the
forming cylinder and proceed together as far as one or more cylinders 22 (the figure shows two) positioned between the forming cylinder and the press cylinder, so that the forming belt or the felt are positioned in contact with the first cylinder (if there are more than one) (and vice versa when the belt passes over the second cylinder and so on if further cylinders are provided) and the belt on the outside of each cylinder exerts a uniform pressure on the fibres of the sheet; in this way there is a further release of water to the felt, thus increasing the degree of dryness (density of the fibres) of the paper being formed and improving the characteristics of the paper sheet.

The two figures show, for maximum clarity, two possible arrangements of the cylinder such that in one case (Figure 1 (a)) it is the wire that rests on the first cylinder while in the other (Figure 1 (b)) it is the felt that rests on the first cylinder (obviously in both cases the positions of wire and felt are inverted on the second cylinder and so on if there are other cylinders); other positions of the cylinder(s) according to the invention are obviously possible, on condition that they are intermediate, between forming and drying, according to the geometry of the machines used and the relative paths of the belts.

Only after this pressing does the forming wire separate (in point A) from the felt which continues its loop towards the press cylinder and the Yankee cylinder as previously illustrated.

Analogously Figure 2 shows the process according to the invention in the case of application of the double-wire technology.

In this case it is the transport belt 12' which, transporting the sheet 16, rests on the felt 11 on the cylinders 22 where the compression takes place which causes the pre-drying as described above.

In both cases, operating as described, a thicker sheet of paper is obtained and the paper is softer and more absorbent. Furthermore it is possible to achieve considerable savings in energy in the subsequent heating phase which brings the sheet to its optimal density (95%).

The present invention furthermore refers to a device for machines for the continuous production of tissue paper, consisting of one or more cylinders arranged in succession, in any position between the forming cylinder and the
press cylinder, so that said one or more cylinders are able to receive the wire belt, the felt and the paper sheet between them, allowing the outermost belt to exert a uniform pressure against the other belt and against the cylinder with which the latter is in contact, thus compressing the fibres of the paper sheet between the two belts.

The invention also refers to machines for the continuous production of tissue paper equipped with the above-mentioned device and the sheet of tissue paper continuously produced according to the process described above.
CLAIMS

1. Process for the continuous production of tissue paper wherein between the sheet formation phase and the drying phase a pre-drying phase is scheduled by compression of the paper sheet between the wire belt and the felt.

2. Process as claimed in claim 1 wherein said drying phase consists in passing the paper sheet, located between the wire belt and the felt, over one or more cylinders so that the wire or felt are positioned in contact with said cylinder(s) and the belt on the outside of the cylinder(s) is able to exert a uniform pressure on the fibres of the paper sheet located, as said, between wire and felt.

3. Process as claimed in claim 2 wherein said wire belt is the forming belt as used in the crescent former technology.

4. Process as claimed in claim 2 wherein said wire belt is the transport belt as used in the double-wire technology.

5. Process as claimed in claims 1—3 wherein:

- the paper sheet (16) forms on the forming cylinder (10) between the felt (11) and the forming wire (12);
- the forming belt (12), the felt (11) and the paper sheet (16) positioned between them proceed together as far as one or more cylinders (22), located between the forming cylinder and the press cylinder, so that the wire belt or the felt come into contact with the cylinder(s) and the outer belt is able to exert a uniform pressure on the fibres of the sheet;
- the forming wire (12) separates from the paper sheet (16);
- the felt (11) continues its route, conveying the paper sheet to the press cylinder (17) and pressing it against the hot Yankee cylinder (18) on which it adheres for the final drying;
- a steel blade (20) detaches the sheet from the Yankee cylinder for final winding on reels (21).

6. Process as claimed in claims 1—2 and 4 wherein:

- the paper sheet (16) forms on the forming cylinder (10) between the forming belt 12 and the transport belt (12');
- the transport belt (12'), the felt (11) and the paper sheet (16) positioned between them meet one or more cylinders (22), located between the forming
cylinder and the press cylinder, so that the transport belt or the felt come into contact with the cylinder(s) and the outer belt is able to exert a uniform pressure on the fibres of the sheet;
- the transport belt (12') separates from the paper sheet (16);
- the felt (11) continues its route, conveying the paper sheet to the press cylinder (17) and pressing the paper sheet against the hot Yankee cylinder (18) on which it adheres for final drying;
- a steel blade (20) detaches the sheet from the Yankee cylinder for final winding on reels (21).

7. Device for machines for the continuous production of tissue paper consisting of one or more cylinders, arranged in any succession, between the forming cylinder and the press cylinder so that said one or more cylinders are able to receive the wire belt, the felt and the paper sheet positioned between them allowing the outermost belt to exert a uniform pressure against the other belt and against the cylinder with which it is in contact, thus compressing the fibres of the paper sheet positioned between the two belts.

8. Machines for the continuous production of tissue paper provided with the device as claimed in claim 7.

9. Paper sheet produced continuously according to the process claimed in claims 1 - 6.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. D21F9/00 D21F11/14

According to International Patent Classification (IPC) onto both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Pregetter, Mario

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