USE OF POLYESTER MONOFILAMENTS IN THE CONNECTING LOCKS OF DRYING SCREENS — "CLOTHING"
FOR PAPER MACHINES

A. N. Mogil’nyi

Different types of frames for joining the ends of drying screens — "clothing" for paper machines were analyzed. A structure for connecting frames for modern fabric drying screens which totally correspond to the technological and service requirements was developed. The optimum types of connecting frames for drying screens include the end segments of the screen fabric forming the sewn flap and the ellipsoidal coil of thick polyester monofilaments mutually connected by a polymer rod.

Drying screens in paper machines are complex multilayer textile cloths used for transporting and simultaneously drying the paper web. The drying felts were originally made of multilayer cotton and wool felts, but as the speeds and paper web output increased, they were totally replaced by multilayer fabric drying screens based on chemical fibres. They are now made of hydrolysis-resistant, high-strength polyester monofilaments and complex fibres with a polymer coating [1-7]. The ends of the screen are joined by special locks both in the primary attachments of the paper equipment and in periodic replacement during use. Elevated requirements are thus imposed on the lock connection, and the basic ones are listed below [2, 8, 9]:

- convenience and technological effectiveness of creating the connection (lock);
- minimum joint thickness no greater than the thickness of the screen;
- smoothness of the seat at the site of the connection so that the lock will not mark the paper web;
- vapor and aerodynamic permeability (air permeability) close to these indexes for the basic screen fabric;
- the weight of the lock connection should not differ significantly from the weight of a screen of the same length, which is especially important for high-speed paper machines due to inertial effects in the roller passage zone;
- flexural rigidity, which differs little from the rigidity of the basic screen fabric;
- high strength (minimum of 50% of the strength of the screen fabric) and resistance to wear during use;
- reliability during the entire time the screen is used.

The design of locks for drying felt has varied as a function of the progress in the design of paper machines and the increase in their production speeds [1-4, 8-12].

The "lap" joint or use of superimposed tapes was the classical method of connection. However, due to the formation of local thicknesses and the low permeability of the site of the joint, as well as the significant marking of the paper web, this joint can only be used in processing coarse types of paper.

Joining with metal brackets with loops on the ends embedded in the edge of the drying felt and attached by hinges with a metal rod is well known. This method was significantly improved for joining woven felts, but it was not very suitable for screens made of synthetic monofilaments. Coupling from additionally attached woven tapes, also joined by metal hooks or brackets forming an unusual hinge, was also insufficiently successful.

Joining by mutual interweaving of the warp fibres of the two ends of the screens with a special loom was very complicated. In addition, this method was only applicable for production of screens previously joined in a ring and in paper mill conditions, it was almost impossible to use.

The loop lock made of warp fibres woven into the screen fabric in the reverse direction is formed by inserting a rod in a combination of loops on the two ends of the screen. The joint region satisfies the requirements for its quality and joining is
Fig. 1. Diagram of the design of the lock of a SK-1M drying screen.

easily done. However, fabrication of the system of loops on the ends of the screen is a very laborious manual operation, and the thickness of the warp fibres in the loops is insufficient for the continuous reliable operation of such a connection.

The ellipsoid spiral lock based on monofilaments formed at the ends of the screen resembled a “zipper” but was complicated to manufacture and unreliable in use. The woven lock formed in fabrication of the screen from the ends of fibres on two sides of the screen by mutually interweaving them do not meet all of the requirements listed above, and it was also relatively complicated to manufacture.

The following type of joint was most reliable and satisfied almost all of the listed requirements. The lock was based on ellipsoid coils of polymeric monofilaments attached to the ends of the screen. Two coils on both ends of the screen are joined by a polymer rod, forming a strong, mobile joint. Eight types of such connecting locks were analyzed in [11, 12], and the causes of marking and the varying quality of the paper during drying were examined in detail. The important advantages of these types of connecting locks, where no metal brackets were used and the thickness of the lock region did not differ from the thickness of the basic screen fabric were demonstrated.

Based on many years of experience in the production and use of screens for paper machines, the lock design with a spiral joint based on ellipsoid coils of monofilaments joined by a polymer rod was selected as optimum [2, 9, 13]. This lock is manufactured during weaving of the screens and allows easily joining the ends of the screen in assembly on the paper machine. A typical lock design used for the SK-1M screens shown in Fig. 1 (including type SK-1M described in [5-7]) is an example.

A polyester monofilament 1.0-1.10 mm in diameter is used for fabricating the connecting coil. A similar monofilament is used as a connecting rod. The hydrolysis-resistant polyester fibre, as in fabrication of the basic screen fabric, was selected due to its reliability and the small changes in mechanical properties during use of the screens [2, 14].

Coils of the monofilaments were fabricated first on a special semiautomatic device developed for this purpose [2, 13]. The finished coil of continuous ribbon was wound on a spool and used for fabrication of the lock as necessary. The sizes of the major and minor axes of the ellipsoid coil were 9 and 5 mm, respectively, and their ratio was equal to 1.8. During installation and use of the screen on the paper machine, the coil is stretched due to the high tension and its dimensions change: the major axis becomes equal to 11 mm, the minor axis is equal to 3 mm, and the ratio of the axes is 3.7.

In fabrication of felt for woven polyester monofilament drying screens, flaps (sections which subsequently bend in fabrication of the lock) which have a more open-weave structure different from the structure of the basic screen fabric are made at the beginning and end of the screen.

As demonstrated previously, the screens can have a two- or three-point structure as a function of the type and application [2, 5-7]. In both cases, the end segments of the screens — the flaps — are manufactured by interweaving the back of the screen. During weaving, the fibres are open over the warp in the length of the lock region so that some of the warp fibres are not interwoven with the face layer of the weft. In connecting the lock, these fibres are cut off. The number of fibres removed is a function of the type of screen: in two-point screens, 1/3 of the warp fibres is removed, and 1/4 is removed in three-point screens. Such thinning of the warp fibres allows placing all construction elements of the fabric in the region of the lock, as well as the connecting coil, without increasing the thickness of the site of the lock and thus preserving high assigned air permeability. The size of the band for the flap (in the direction of production of the screen) is different as a function of the screen width and type of weave:

<table>
<thead>
<tr>
<th>Screen width, m</th>
<th>Width of flap band, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.6</td>
<td>100</td>
</tr>
<tr>
<td>From 4.6 to 7.0</td>
<td>150</td>
</tr>
<tr>
<td>7.0 and greater</td>
<td>200</td>
</tr>
</tbody>
</table>