

**Staple Fibre Spinning Systems
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**Section 5
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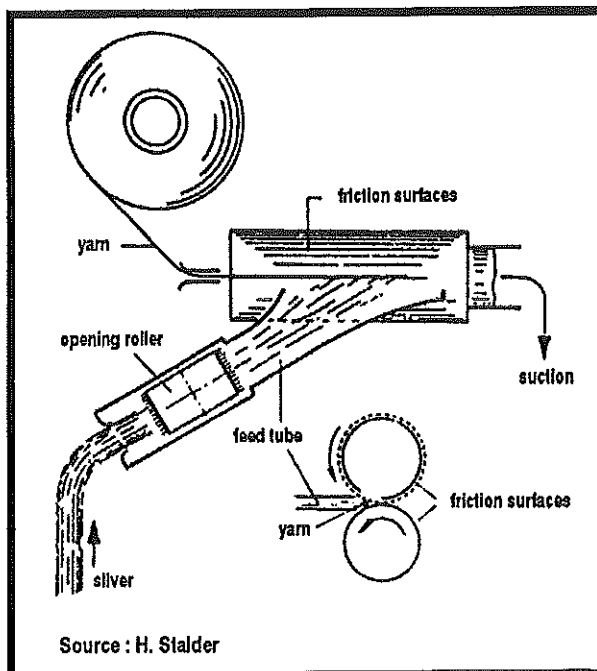
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Friction Spinning

In friction-spinning, where fibres are collected on a moving perforated surface, the speed is not limited by yarn tensional forces, and, since the rotational speed of the mechanical parts can be kept relatively low, potentially very high yarn-delivery speeds are possible. Fehrer first demonstrated with the DREF machine at the 1975 ITMA exhibition the feasibility of using two perforated rotating cylinders as fibre-collecting means while at the same time the spinning-in of the fibres into the open yarn end occurred. From an opening system, the fibres are transported in an air stream towards the spinning cylinders. The yarn formation takes place in the nip of the cylinders, fibres and yarn being pressed against the surfaces by the suction from inside both drums. The finished yarn is pulled off in the direction of the cylinder axis. The amount of twist in the yarn is governed by the ratio of the speed at which the fibres rotate around the yarn tail to the speed of yarn-withdrawal. Obviously, it is the frictional condition that determines the characteristics and properties of the product in the first place. Since the frictional force between fibre and drums, as well as that between yarn and drums, is dependent upon many factors, such as suction power, drum shape and roundness, drum surface, fibre crimp, fibre finish, etc., it would appear that it might be difficult to guarantee an acceptable position-to-position uniformity by this process. It

is probably for this reason that friction-spun yarns have so far found their major applications in the coarse-count and woollen-type sector, where a certain non-uniformity may be a virtue rather than a disadvantage. The tensional forces available for the spinning performance and probably even lower than those in rotor-spinning. The total force created by the differential air pressure around a 30-tex yarn of 20-mm length (the area where fibre contacts the yarn) is of the order of 0.3 cN, which would require supporting forces of 40 cN. Assuming a friction factor of 0.1, the total 'spinning force' amounts to only 4 cN, which is not enough to create a dense yarn structure. Nevertheless, the DREF technique offers great versatility, since virtually any natural or man-made fibre can be processed on it. While the so-called DREF II machine is ideal for creating a sheath around continuous-filament yarns, the DREF III unit is also capable of combining two staple-fibre systems.

DREF III is designed to spin yarns, of somewhat finer counts (N_e 3.5- N_e 18, i.e., 168-33 tex) than DREF II; the major design feature, however, is the additional axial feed of fibres to the yarn-forming zone via a high-draft unit. The fibres fed by this system will acquire a false twist during spinning, and they will form the untwisted fibre core in the finished yarn. The sheath fibres are fed in an air stream in similar manner to that of the DREF II unit. Fibres shorter than 30 mm, particularly cotton, should have a higher content than 50% in blends (with longer fibres). A higher cotton content can only be obtained by incorporating a continuous-filament core. Since the Platt Saco-Lowell (PSL) friction spinner demonstrated at the 1983 ITMA exhibition the feasibility of producing 100% cotton yarns by this technique, worldwide development efforts have been directed towards friction-spinning as a viable alternative for medium-to-fine-count cotton-spinning (Fig. 3). In order to achieve this, it is mandatory to deposit a very uniform fibre stream into the spinning zone (since there exists no backdoubling) and to prevent the fibres from forming loops and hooks as they are spun into the yarn tail. The fibre orientation achieved with mechanical devices as in the DREF machines has only limited applications for long fibres. For short-fibre spinning, the entire fibre transport from opening device to the friction drums is most critical. Herein lies a main feature of the PSL-machine:



through a carefully designed air-flow, it apparently has become possible to obtain a better fibre-straightening effect and therefore improved yarn strength. Another deviation from the DREF concept is the use of one perforated drum only, the other drum having a smooth surface. By this means, besides avoiding patent infringements, a saving in suction energy in spinning and a cost reduction for drum manufacture are realized. Furthermore, by a particular choice of the frictional characteristics of the smooth roll, it becomes possible to obtain an improved spinning performance.

Since the fibre rotational speed around the yarn axis is governed by the ratio of the drum surface speed to the yarn diameter⁴, very high values are theoretically possible. Of particular interest is the fact that this rotational speed increases as the yarn becomes finer in such a way that, independently of yarn count, the production speed can remain constant as long as the twist multiplier is the same.