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Letter to Editor **Open Access**

Recent Developments in Rapier Weaving Machines in Textiles

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Rapier weaving today exists in diversified forms. During the last two decades the developments in rapier weaving have been carried out in a rapid continuous way. Rapier weaving machine produces top- quality fabrics from spun yarns such as cotton-wool, camel hair, silk, synthetic fibers and fancy yarns. Today's rapier weaving machine has become fast and exceptionally flexible. It offers a choice of various reed widths, shedding motions, selvedges and filling insertion colors. This makes it suitable for weaving an extended range of articles: fashion fabrics, shirting, denim, suiting, industrial or furnishing fabrics, in one to eight or twelve filling colors or yarns, with a maximum weight of 500 g/m2. Today's rapier weaving machine is designed with modern electronics, with total automation of weaving and central microprocessor control system, also ensuring maximum reliability, amazing user-friendliness, ease-of operation, shorter style changing time, excellent fabric quality, low energy consumption, and optimized insertion cycle for unequalled industrial speed.

Rapier looms vary greatly in both the general strategies of their design, such as the choice of method used to transfer the weft between the rapiers and the types of rapier used- rigid, flexible or telescopic- and in details of mechanism used. These machines find preferential use in the production of with fashion-appeal compared to other methods of weft insertion which are mainly suitable for weaving staple items with limited fashion-appeal. Ease of multicolor weft insertion is fully exploited by rapier looms - many can insert up to 12 colors in any pick-at-will patterning sequence, including their ability to deal with a wide range of yarns and fabric types. The positive rapier drives enables heavy or otherwise difficult yarns to be inserted. The rigid rapier system of weft insertion has the advantage of positive thread transfer in the centre of the shed without any need for guiding the rigid rapiers through the shed and without making contact with the warp thread. However this is at the cost of occupying more floor space, which causes reed width of the rigid rapier to be limited. The flexible rapier system of weft insertion has the reputation of being most adaptable and most applicable. The outstanding feature of flexible rapier machine is its significant increase in weft insertion rate, greater reed width (460cm), versatility and adaptability. In the last 15 years or so the design of the rapier machine has been revolutionized by new innovations, engineering walkthroughs, automation in processes, introduction of computer technology, electronics and CAD-CAM systems. The weaving industry on the whole has entered a new era of electronics, microprocessors, information technology and their application to the production of woven fabrics. Incorporation of electronic devices and system to weaving machines has become almost inseparable part of the machine. Developments, particularly of microprocessors, have revolutionized the design of the rapier weaving machines, including the weft propulsion technology. The weft insertion elements have been made smaller and lighter in weight.

The weft color selectors of today's rapier weaving machineare microprocessor controlled, compact sized ones and can be available in 16, 12, 8, 4 or 2 colors. Picanol developed the Quick Step filling presenter, operates with independent module, each consisting of an electronically controlled stepper motor with presenter needle. The color and weave pattern are microprocessor or jacquard controlled. After the left gripper has taken the presented yarns, the Quick Step needle returns to an intermediary position, so the course of the filling yarn is straight and the tension of the yarn is low and remains constant. The Quick Step filling presenter has several advantages. It is monitored by the machine microprocessor, so the timing for the presentation of the filling yarn is perfectly synchronized with the machine speed and the weave pattern. The filling presenter also provides the ideal position for rethreading. The modules of the Quick Step are interchangeable and there are no mechanical drives, so no maintenance or lubrication is required[6,7]. Dornier offers the Electronic Color Selector (ECS), and the electronic filling tension device with integrated filling stop motion (EFC), are based on state-of-the-art stepping motor technology and are controlled by an external CAN-BUS.

A stationary package of yarn is used to supply the weft yarns in the rapier machine. One end of a rapier, a rod or steel tape, carries the weft yarn. The other end of the rapier is connected to the control system. The rapier moves across the width of the fabric, carrying the weft yarn across through the shed to the opposite side. The rapier is then retracted, leaving the new pick in place. In some versions of the loom, two rapiers are used, each half the width of the fabric in size. One rapier carries the yarn to the centre of the shed, where the opposing rapier picks up the yarn and carries it the remainder of the way across the shed.[1] The double rapier is used more frequently than the single rapier due to its increased pick insertion speed and ability to weave wider widths of fabric. The housing for the rapiers must take up as much space as the width of the machine. To overcome this problem, looms with flexible rapiers have been devised. The flexible rapier can be coiled as it is withdrawn, therefore requiring less storage space. If, however, the rapier is too stiff then it will not coil; If it is too flexible, it will buckle. Rigid and flexible rapier machines operate at speeds ranging from about 200 to 260 ppm, using up to 1300 meters of weft yarn every minute. They have a noise level similar to that of modern projectile looms. They can produce a wide variety of fabrics ranging from muslin to drapery and upholstery materials.

Newer rapier machines are built with two distinct weaving areas for two separate fabrics. On such machines, one rapier picks up the yarn from the center, between the two fabrics, and carries it across one weaving area; as it finishes laying that pick, the opposite end of the rapier picks up another yarn from the center, and the rapier moves in the other direction to lay a pick for the second weaving area, on the other half of the machine. The above figure shows the action on a single width of fabric for a single rigid rapier system, a double rigid rapier system, and a double flexible rapier system.