The pieces *A* are less than one-half inch in thickness, so that from two to forty harnesses can be used in the wide range fancy worsted loom. The threads of the warp are drawn into the "eyes" *D*, as shown in the sketch. This is done by two hands, who draw in from 5,000 to 6,000 ends per day. Great skill is needed to do this work, as every pattern, unless it be a straight draw, is more or less complicated.

The jacquard machine is in reality an attachment, and is used in the weaving of figured worsted goods. The mechanism for throwing the shuttle, the movement of the lay, and the general arrangement of the loom is such that the resemblance is very close to the common kind. Although the loom itself does not differ in construction from the regular loom, the head-motion is entirely different. Fig. XIII. illustrates the head motion of the Jacquard loom. *A* in the above view shows the upright wires, the top portions of which are formed in the shape of hooks. The lower ends of these wires are furnished with small holes, through which the harness strings *F* are put and secured. The hook ends of these wires rest above the knives *C*, the ends of which may be seen in the figure. A crank contrivance, which is operated from the loom, is attached to these knives, and an up-and-down motion is given to them. They make this motion once for each revolution of the loom. Should the knives rise when the hooks are in the position shown in the sketch, each of the wires would be lifted, carrying the harness strings with him. Whatever warp yarns are in these strings will rise too, and the shuttle will pass below them. Only a single series of hooks are shown in the illustration, but there are from 200 to 1,000 used in practice. If, however, the hooks were to remain in the one position, nothing would result. It is here that the ingenuity of the Jacquard attachment is displayed. The cylinder *K* is a square-shaped arrangement, extending the full length of the head-motion, and comes in contact with each of the cross-wires *B*, the technical name of which is "needles." A series of cards *L*, securely fastened together, is the agency by which the needles are made to adjust the upright wires, according to the requirement of the pattern. The cards are made the same size as the cylinder sides, so that they can work well together. These cards are about one-half holes and one-half blanks. They manipulate the needles. A mechanical device causes the cylinder *K* to move forward against the heads of the needles *B*, which it does at every pick of the loom. All the blank spaces in the card causes the needles to move forward, thus bringing the hooks of the upright wires over the knives. The needles and upright wires are connected at the points *D*. The holes produce the opposite effect, for the ends of the needles slip through and the hooks are not brought into contact with the knives and so remain depressed. The above plan represents the relative position of the part when all blank spaces are presented on the card. The moment the cylinder returns the springs *H*, which are held in position by the pin *I* in the frame, cause the needles to move back and clear the knives. The piece *E* is a support.

(To be concluded in our next issue.)

ROPE AND TWINE MAKING.

The manufacture of rope and twine has been carried on in all ages, since primitive man first felt the need of raising a weight or securing the parts of a weapon. The old-fashioned process of manufacture as carried on in the rope walks is a thing of the past; machinery and centralization have produced numerous changes in this as in most other industries. The demand for rope has not grown very rapidly in recent years, owing, no doubt, to falling off in the number of sailing ships, but the demand for twine has enormously increased. The self-binding harvesting machinery in the United States in 1895 took up 150,000,000 lbs. twine, which serves to show to what proportions this industry has grown. The demand for a number of different cords is constant, as that for fishing-lines, nets, etc.

The fibre which is used is hemp of various kinds, and is derived from a number of plants. Manilla is obtained from a wild plaintain, and the fibre is of great length and strength, although somewhat intractable. Sisal hemp is obtained from the aloe, while Russian and Italian is the product of an annual which is specially cultivated. Italian hemp has the finest and best fibre. There are a large number of fibres which it is clear will ere long be brought commercially into use, and New Zealand flax and coir are already employed in the manufacture of ropes. It is, perhaps, the most notable feature of the present day that the efforts to utilize all available materials are persistent, and do not slacken even in the face of enormous difficulties. At the same time, in an industry such as this, there are certain well-defined sources of supply, which are drawn upon so long as it is not clearly proved that others are available. This is obviously the prudent course to take. There is just one point to which attention may be directed. Rope making is essentially the art of utilizing the fibre in its full dimensions, it being necessary to obtain the whole advantage from the great strength of the unbroken fibre. This is also the case in producing binder twine. Twine making, on the other hand, utilizes the tow or short fibre, being much more of the character of spinning, it being obvious that the necessarily great reduction of the diameter of the slivers naturally modifies the character of the operation. It may thus be said that, in one sense, the process is either one direct from the fibre, or an indirect one by the utilization of the short fibre.

The length of the fibres which are used in the direct process of making either rope or twine demands that the method of reducing them to order shall be the work of successive combs or heckles. Carding is quite out of the question for some kinds of hemp, and the machines which are used are therefore constructed on the moving gill principle, which also finds employment in woolen spinning.

In preparing the manilla for rope it is first gilled