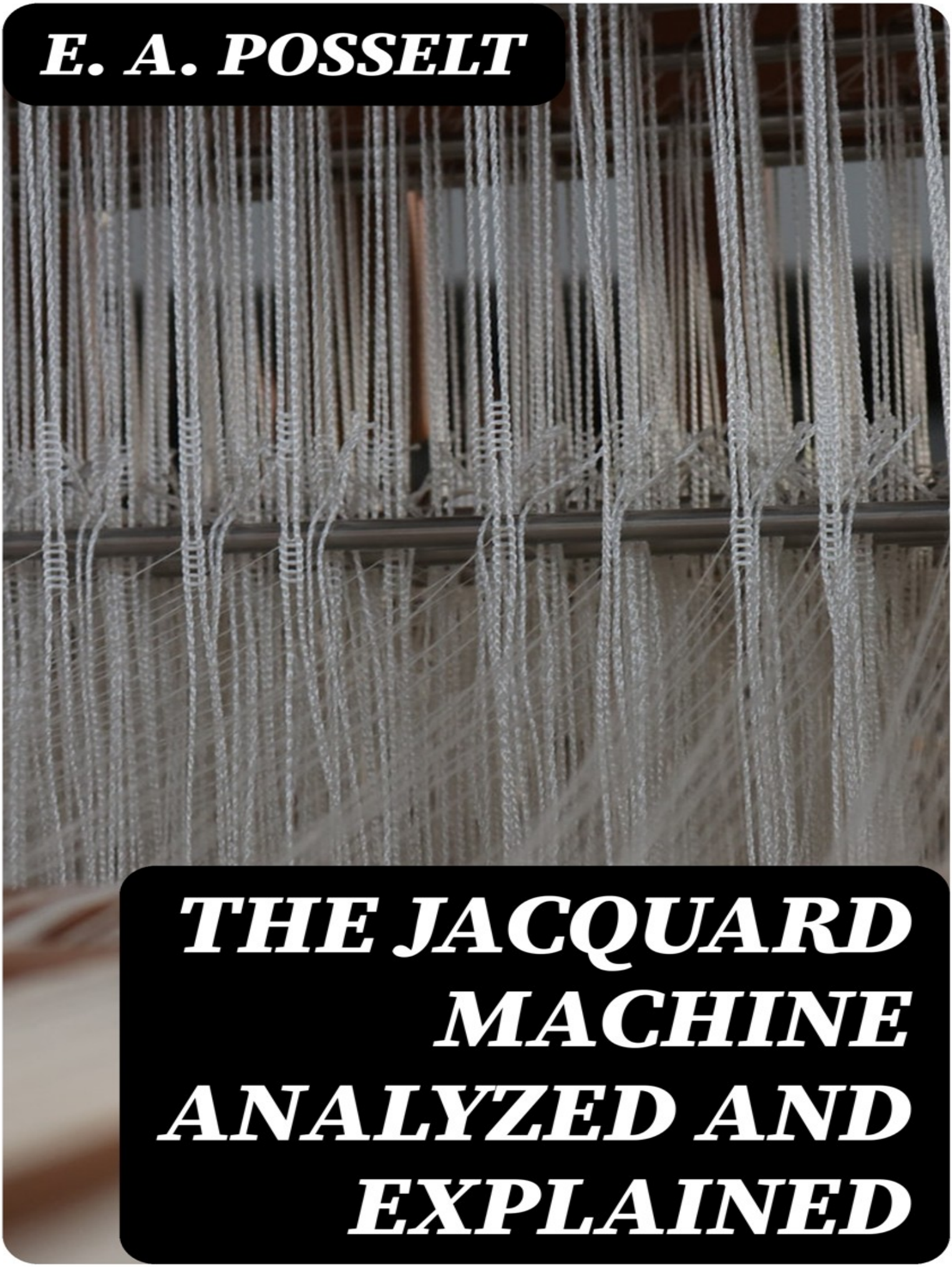
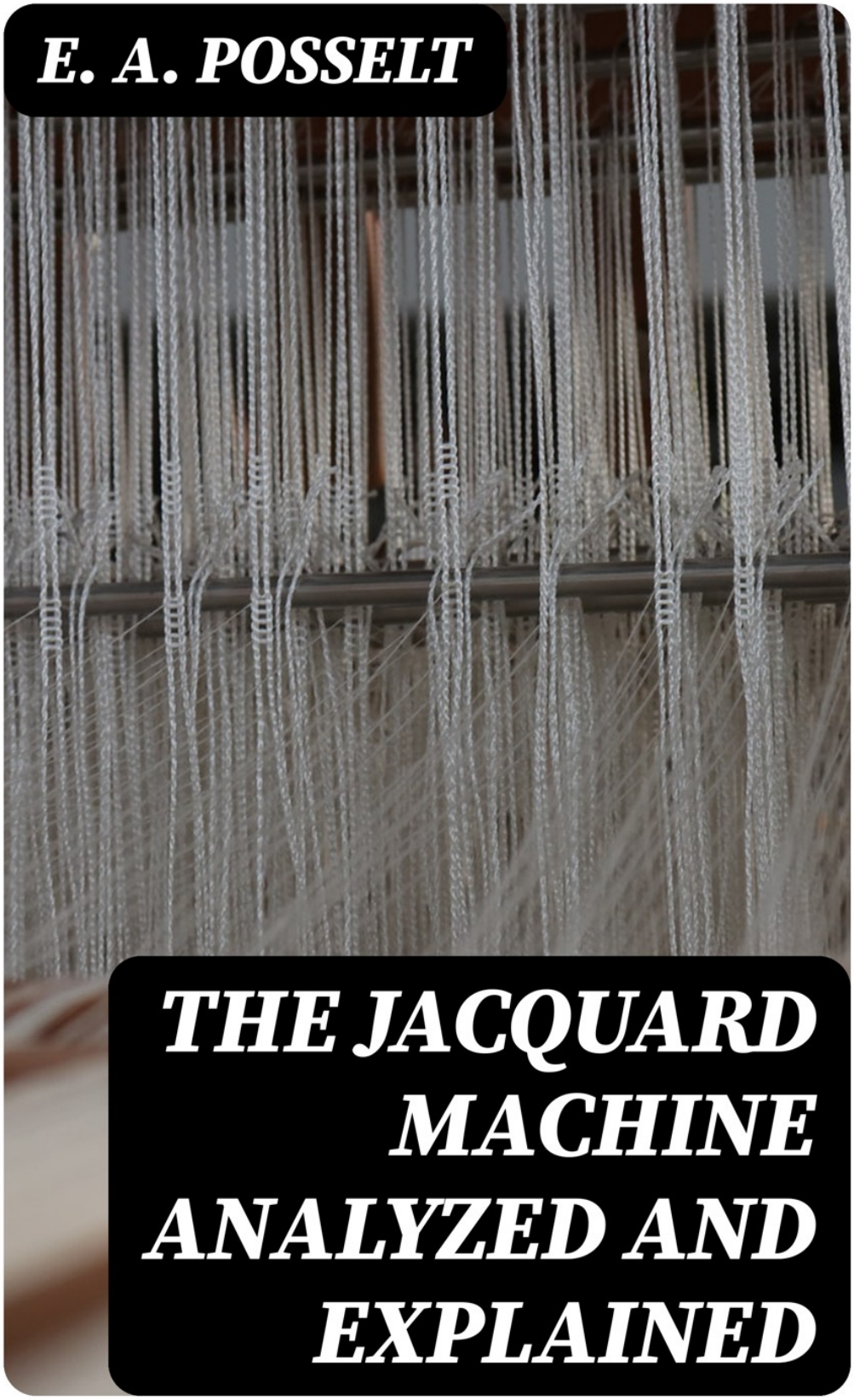


E. A. POSSELT

THE JACQUARD MACHINE ANALYZED AND EXPLAINED


E. A. POSSELT
THE JACQUARD MACHINE ANALYZED AND EXPLAINED

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The Jacquard Machine Analyzed and Explained

With an appendix on the preparation of jacquard cards, and practical hints to learners of jacquard designing

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PREFACE.

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Very little has been written upon the Jacquard machine, and the fabrics produced by it; and nothing at all has been heretofore published in this country with regard to the machines and systems, as employed here.

Greatly assisted by the guidance, help and advice of Mr. T. C. Search, President of the Philadelphia Textile Association, and Vice-President and Chairman of the Committee of Instruction of the Pennsylvania Museum and School of Industrial Art, the author gives here the results of his practical experience on this subject, with a very detailed description of the methods of procedure with the Jacquard and accompanying machines, in the different branches of Textile Manufacture.

E. A. POSSELT.

Philadelphia, Pa., 1888.

HISTORY OF
THE JACQUARD MACHINE.

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The Jacquard machine was named after Joseph Marie Jacquard. Jacquard was born in Lyons, France, on the 7th of July, 1752. His parents were employed in the manufacture of silk fabrics. The first trade Jacquard learned was book-binding; type-founding and cutlery following successively. He was 20 years of age when his father died, leaving him a

small house and hand-loom in the village of Cauzon, near Lyons. He commenced to invent different improvements in the line of weaving, but without other success than accumulating debt, compelling him to earn the living for himself and family, first in a plaster quarry at Bugey, near Lyons, afterwards by working at cutlery, type-founding and weaving in Lyons.

In 1792 he joined the Revolutionists, and after his return in the following year he and his son assisted in the defence of Lyons against the Army of the Convention, but left when his son was killed near him in battle.

Lyons Council offered him a room, for working on improvements for weaving at the “Palace of the Fine Arts,” with the condition that he should instruct scholars free of charge. During his stay there the Society of Arts, in London, offered a reward for a machine for making fishing nets. Jacquard succeeded in perfecting it, but had to travel under protection to Paris, where he had to show and explain his machine before the “Conservatorium of Arts and Trades.”

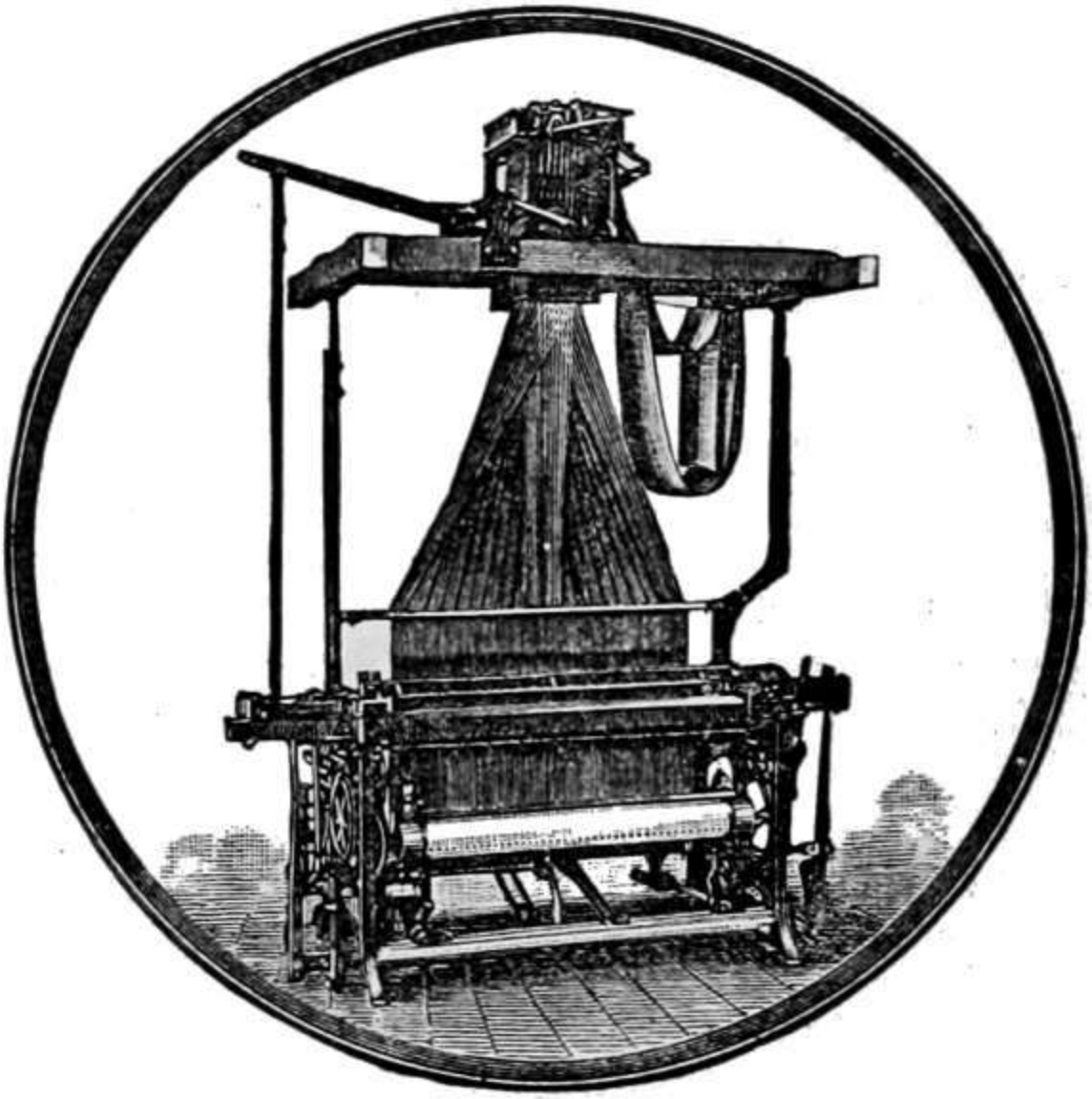
On the 2d of February, 1804, Jacquard received 3000 francs, and the gold medal from the London Society, and also an engagement in the Conservatorium of Arts, in Paris. Here he found opportunity for making improvements on his weaving machine, by the study of the older inventions of Bouchon, Falcon and Vancanson.

M. Bouchon, in 1725, employed a band of pierced paper pressed by a hand-bar against a row of horizontal wires, so as to push forward those which happened to lie opposite the blank spaces, and thus bring loops at the lower extremity of vertical wires in connection with a comb-like rack below. M.

Falcon submitted in 1728 a chain of cards, and a square prism, known as the cylinder, in lieu of the band of paper of Bouchon. In 1745, Jacques de Vancanson suppressed altogether the cumbrous tail-cards of the draw-loom, and made the loom completely self-acting by placing the pierced paper or card upon the surface of a large pierced cylinder, which traveled backwards and forwards at each stroke, and revolved through a small angle by ratchet work. He also invented the rising and falling griffe, and thus made a machine very nearly resembling the actual Jacquard.

Jacquard returned to Lyons in the year 1804 to take charge of the work-house. During his stay at this place he finished his machine. He was an experienced workman, combining together the best parts of the machines of his predecessors in the same line, and succeeded as *the first person* in obtaining an arrangement sufficiently practical to be generally employed. In 1806 Napoleon Buonaparte changed his position, giving him an annuity of 3000 francs, but compelling him to transfer his invention to the city of Lyons, as well as any further inventions. Until 1810 Jacquard had great troubles, as his machine was not understood by the weavers. So violent was the opposition made to its introduction that he was compelled to leave Lyons in order to save his life. The *Conseil des Prudhommes* broke up his machines in the public places, and Jacquard was delivered over to universal ignominy. But after some years had passed the machine proved to be of the greatest value, and on the spot where the model was destroyed a statue to Jacquard now stands. He died August 7th, 1834, in Quillins, near Lyons, at 82 years of age. At the time of his death over

30,000 Jacquard machines were in operation in his native city.



The Jacquard Machine.—General Arrangement and Application.

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If a fabric contains a great number of ends of warp bound differently in the filling, the method of guiding the warp by

harness frames is too cumbrous and inefficient; in such cases it becomes necessary to use the Jacquard machine for raising the warp-threads separately by means of hook and leash.

The hooks as used for raising leash, mail, lingo, and warp-thread, consist of wires 16 to 17 inches long, with a crook on each end. On the lower crook is fastened the leash by means of the neck-cord.

The cords of each leash are threaded through the holes of the comber-board; the latter are separated from each other according to the texture of the warp in reed.

On the harness-cords are adjusted the heddles, (either twine or wire), on which are fastened the lingoes as weights. In the mails of the heddles are drawn the warp-threads.

Now, from the foregoing explanations, it will be apparent that by raising the hook in the Jacquard machine we raise the leash, and the latter raises every warp-thread throughout the fabric for interlacing with the filling.

The next point required to be known is, which hooks are to be raised, and which are to be lowered? To regulate this, a design (pattern) is prepared in which the floating of the warp over the filling is indicated.

For the warp-threads required to be raised holes are punched in the cards. In these holes the points of the needles extending through the needle-board are pushed by a spring fastened on the rear of each needle. The needles are adjusted in rows of different heights. The arrangements most used are 4, 8, and 12 rows high. Each row as to height in the machine contains a bar (knife) in the griffe. When the griffe is down, or the machine at rest, the upper crooks of

the hooks are raised about half an inch above the griffe-bars.

The needles which control the position of the hooks, permitting them to rise or compelling them to remain stationary, are pressed by the springs fastened in the rear towards the cards, which are moved on a quadrilateral and perforated cylinder. This cylinder performs a movement similar to a pendulum towards the points of the needles. Any needle for which a hole was punched in the card will penetrate the cylinder; consequently, the corresponding hook will remain in its natural position, on the crook over the corresponding griffe-bar, and upon lifting the griffe the hook will be raised.

Again, needles for which no holes are punched in the cards will be thrust back by moving the cylinder containing the cards towards the needle-board; this motion forces back the corresponding hooks, pushing them away from the griffe-bars above, and upon raising the griffe they will remain stationary; hence, if a blank card were pressed against all the needles of any machine, the entire number of needles the machine contains would be pushed back, and none of the hooks would come in contact with the griffe-bars, and, consequently, raising the griffe would produce an empty lift. On the other hand, using a card having every hole of the cylinder punched, (or the empty cylinder used), would lift every needle in the machine. Pressing the needles towards the rear compresses the springs; these will again expand as soon as the cylinder leaves the needle-board. The hooks, which were left standing in their position over the griffe-bars are caught by the latter at the raising of the

griffe. The elevation of these hooks raises the leashes fastened to them, thus causing the lifted warp-threads to form a shed with those not lifted.

Jacquard machines are made of different sizes and descriptions, some having only a few hooks and others a large number. The sizes most often used are 100, 200, 400, 600, 900, 1200 hooks. The number or size is always indicated by the number of needles and hooks which it contains, without counting the reserve rows, of which there are generally two. These reserve rows are used for various purposes, such as raising the selvedge; raising the front harness; raising the shuttle-boxes on hand-looms; guiding the take-up motion on hand-looms; indicating a certain card through ringing a bell on hand-looms, etc.

Sometimes a few of the needles and hooks from the reserve are added to the main part of the needles and hooks. For example: Take a design in which the ground weave repeats on 12 ends; working a 400 machine, we find:

$$400 \div 12 = 33 \text{ repeats of the weave, less 4 hooks;}$$

Consequently, if this ground-weave is repeated all over the width of the fabric, we must use either:

> 396 hooks, leaving 4 hooks more to be added to the two rows already used; or 408 hooks, requiring us to call upon the reserve rows for eight extra hooks.

Hooks which have no leashes adjusted must be taken out of the machine.

Sometimes two, three, or more, machines are employed on one loom, and may be worked in different manners. In this country Jacquard machines, for power as well as hand-looms, are made of iron, whereas in Europe the machines for hand-looms (comprising the greater part of the Jacquard machines in use) are made of wood; using the iron ones only for power-looms; and even yet, in most cases, the wooden machines are used for the latter.

Illustrations of the Different Parts of the Jacquard Machine.—Method of Operation, etc.

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Every Jacquard machine may be divided into the following parts:

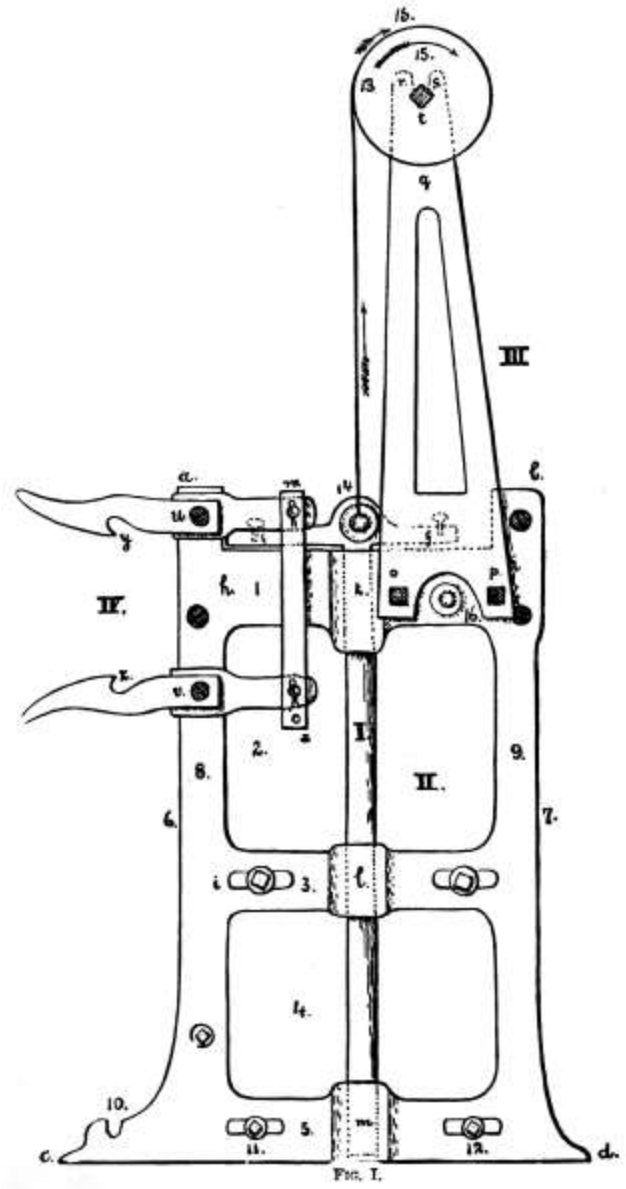

Fig. I.

1. The Frame and the Perforated Board through which the neck-cords are passed.

2. The Griffe and necessary attachments for lifting the same.

3. The Hooks.

4. The Needles.

5. The Springs and Spring Frame.

6. The Needle-board.

7. The Cylinder, Hammer,
and Batten.

8. The Catches.

9. The Cards.

10. The Jacquard Harness.

THE FRAME.

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Fig. I.,[A] represents the side view of the “frame” of a common 200 Jacquard machine by *a*, *b*, *c*, *d*. The width of the frame in its main part [see 6 to 7] is 9-1/2 inches.

1-1/8 inches is the width of the iron casting at the places marked 8 and 9.

2 inches is the height of casting at the place indicated by 1.

1-1/2 inches is the height of casting at the place indicated by 3.

1-3/4 inches is the height of casting at the place indicated by 5.

The open part of the frame, marked 2 in drawing, is 6 inches high.

The open part of the frame, marked 4 in drawing, is 5 inches high. Hence, the main height of the frame is as follows:

1 = 2	inches.
2 = 6	inches.
3 = 1-1/2	inches.
4 = 5	inches.
5 = 1-3/4	inches.

	16-1/4 inches main height.

[A] For illustration of the present article a 200 Jacquard machine is used, illustrated on pages 11-17 by Figs. I. to XI., which contains the same principles of construction as any other size machine. These illustrations are drawn one-fourth of the actual size; hence, any measures, etc., we have omitted may readily be found by any student.

THE PERFORATED BOARD.

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FIG. II.

The perforated bottom board, through which the neck-cords are passed, contains one hole for every hook in the machine, and is illustrated in Fig. II. separately. It shows the following measurements:

Entire width of board	=	8 inches.
Entire length of board	=	12 inches.
Thickness of board	=	3/4 inches.
Distance of holes from each centre,	{ *a*, in length of board, 0.27 inch. (See *l* to *b*.)	
	{ *b*, in width of board, 7/8 inch. (See *m* to *w*.)	

Distance of first row from the part of the frame illustrated in Fig. I., 2-3/4 inches.

Distance of first row from the rear part of the frame, 2-1/2 inches.

This board is fastened by screws to the frame at places indicated in Fig. I. by 11 and 12.

THE PLUNGER.

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Besides the frame, Fig. I. illustrates: Under I. the Jacquard plunger, 3/4 inch diameter, for guiding the griffe (attached to its head) when raising. To strengthen the steadiness of this latter movement shoulders are attached to the frame at the three places where the plunger slides.

Height of frame at *k*, = 2-3/4 inches.

Height of frame at *l*, = 2 inches.

Height of frame at *m*, = 2 inches.

Screws, *f*, dotted in drawing, on head of plunger, fasten the griffe to it.

Part III. in Fig. I. illustrates the attachment for providing the lifting of the plunger in a hand-loom, likewise the griffe, etc. This consists of a triangular shaped frame 14-1/4 inches high, or less, according to height of room. This part is fastened to the front part of the frame by bolts at *o* and *p*. In the slot at the top, between *r* and *s*, a wooden cylinder of 3-1/2 inches diameter is fastened to an iron shaft resting in the frame at *t*.

At 13 a leather strap is fastened to this cylinder and to the plunger 14. It will easily be seen that by turning the wooden cylinder in the direction of the arrows, 15, the plunger will be raised with the griffe fastened to its top. By reversing the action of the cylinder, the plunger and griffe will return to their previous positions. The action thus described constitutes a “single lift,” raising and lowering of plunger and griffe for each pick.

THE CATCHES.

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At IV., Fig. I., the “catches” for turning the cylinder at the lantern are illustrated. The distance of the centre of the screws which hold the catches to the frame is 4-3/4 inches. Between these two catches the cylinder is adjusted to the batten, and the direction of its turning is regulated by the catch which is brought in contact with the lantern. If the catch, *y*, turns, the cylinder will turn the card situated on its top towards the needle-board, and if catch, *z*, is brought into contact with the lantern, the card hanging below the needle-board will be the next in turn to be pushed towards the needles.

The entire length of the catches in the present illustration is 8 ins., allowing 5-1/4 ins. for the catch itself and 2-3/4 ins. for the part to which it is fastened. Making this catch in two pieces is preferable to the old style of one piece, because the moment of turning the cylinder can be more easily regulated.

THE GRIFFE.

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FIG. III.

Fig. III. illustrates the top view of the griffe. As mentioned before, the griffe is fastened to the plunger by means of screws. In the drawing the dark shaded places marked *f* are the hollow places in the griffe, through which the screws fasten the latter to the plunger. The griffe, like the other parts explained, is made of cast iron, and the machine is of the following dimensions:

Length of griffe, *a* to *b*,	= 9-3/4 inches.
Depth of griffe, *a* to *c*,	= 6-5/8 inches.
Extension on each side, *e* to *f*,	= 1-1/2 inches.
Distance of griffe-bars, *s* to *s*,	= 7/8 inch.
Length of griffe-bars, *m* to *n*,	= 9-1/4 inches.
Height of griffe-bars, [see Fig. IV., sectional cut of griffe-bars,]	= 7/8 inch. inches.

FIG. IV.

THE HOOK.

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FIG. V.

Fig. V. represents a hook as used in the present machine, made of No. 13-1/4 bright spring wire. Height, *a* to *c*, = 16-5/8 inches. Height of rester, *b* to *c*, = 6-5/8 inches.

THE NEEDLE.

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Fig. VI. illustrates a needle, as used in connection with the hook. Distance from head to loop, 9-1/8 inches, = *a* to *c*.

Length of loop, 1-5/8 inches, = *c* to *d*. 10-3/4 inches entire length.

FIG. VI.

The distance from head to eye (for passing through the hook) is regulated according to the row in which the needle belongs. In the present illustration this is, Head to eye, = 7 inches, = *a* to *b*. The eye, = 3/8 inch, = *b*.

Eight different positions of the distance of the eye from head will be required by an 8-row machine. The needles are made of No. 15-1/2 bright spring wire. The loop on the end, *c* to *d*, permits a pin to be inserted, [see Fig. VII., *o*], and also holds the needle in position.

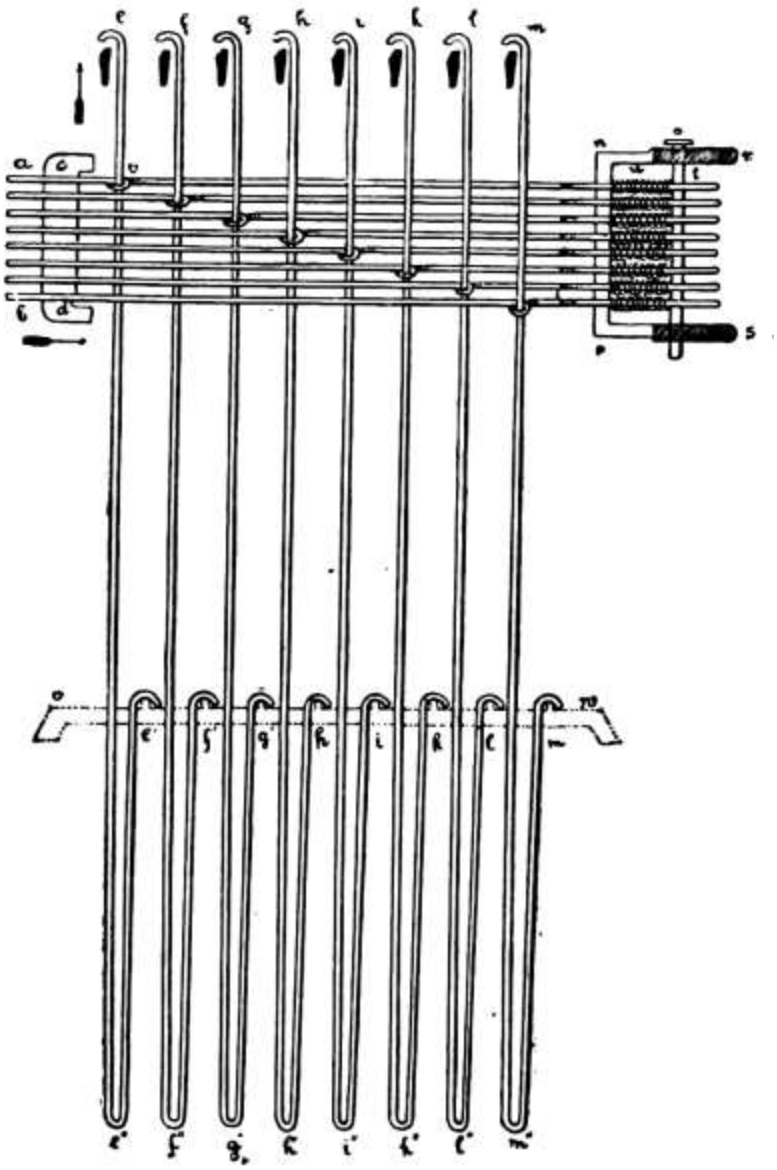

FIG. VII.

Fig. VII. gives a clear understanding of the arrangement of hooks, needles, griffe-bars, springs, frame for holding the latter, and the needle-board. This drawing is in accordance with the preceding ones, executed one-fourth of the actual size, and represents the sectional cut of one cross-row in the Jacquard machine containing 8 hooks, (as it is an 8-row deep machine which we explain): *e* to *e´*, 1st hook; *f* to *f´*, 2d hook; *g* to *g´*, 3d hook; *h* to *h´*, 4th hook; *i* to *i´*, 5th

hook; *k* to *k´*, 6th hook; *l* to *l´*, 7th hook; *m* to *m´*, 8th hook. These hooks are held in their required places by the eyes of the needles [see place *v* at hook 1], through which the former are passed.

The needles rest with their heads in the needle-board, *a* to *b*, extending outside, towards the cylinder, for about 1/2 inch. The rear part of the needle—the loop—is passed between two bars of the spring frame, *n*, *p*, and held by the latter firmly, but with sufficient play for a longitudinal motion for pressing towards their springs. The pin, *o*, is inserted for holding the springs in their places. One pin is required for each vertical row of needles. The part of the spring frame, *r*, *n*, *p*, *s*, unshaded, is made of cast iron; the shaded part (extension) is constructed of wood. Below the upper crook of the hooks, the black sections represent a sectional cut of the griffe-bars; *v* to *w* indicates the rester for the lower hooks, which keeps the latter in their required position.

A study of this illustration will show that when the heads of the needles, *a*-*b*, are pushed backwards, in the direction of arrows, the hooks are also moved. If the needles are not pushed, the upper crooks of the hooks will remain in position, as in drawing, over the griffe-bar; and raising the latter will consequently raise every one of these hooks. Therefore, if a blank card is pressed against the 208 needles of the machine, all the needles and hooks will be pushed back, out of the way of contact with the griffe-bars, thus causing an empty lift when they are raised; whereas, by pressing with an empty cylinder, or with a card, containing as many holes as the machine has needles, and so placed

that the holes are exactly opposite the needles, none of them would be moved, and each hook would remain vertical over its griffe-bar; and raising the griffe will lift every hook.

As mentioned before, the springs, *u*, are attached to the needles between the needle-frame, *n*-*p*, and the pin, *o*. Fig. VI., the distance *e* to *f* indicates the part of the loop around which the spring is adjusted, and where it rests against the expansion of the loop. *f*, in Fig. VI., represents the place where pin, *o*, (as shown in Fig. VII.) passes through the loop and is fastened to the needle-frame on top and bottom. Pressing the needle at the head compresses the spring, as the latter is securely fastened on one end by the wider part of the loop, and on the other end by a pin inserted in the loop and fastened to the frame. Remove the pressure at the head of the needle, and the spring will return to its natural position, pushing the needle into its old place. These springs are made of thin brass wire.

It is necessary to keep the needle-eyes in the proper place, otherwise it would result in bending the hook out of its perpendicular position, and by lowering the griffe its bars would possibly come in contact with the head of the hook, crushing the latter, or doing more damage if not detected at once. Each needle or hook, if worn out, can be replaced by pulling out the pin, *o*, thus loosening the needle and giving a chance to work the required hook out of the needle-eye.

THE BATTEN MOTION.

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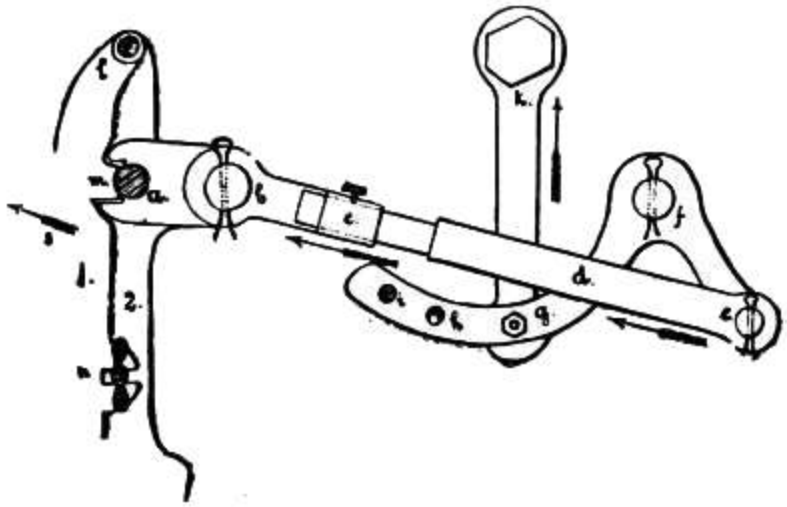

FIG. VIII.

Fig. VIII. represents the batten motion to be attached to the guiding-rod, [see No. 14, in Fig. I.], and the frame, [see No. 16, in Fig. I.] The batten, 2, is connected to a triangular lever by means of lever, *d*. Another vertical lever connects the lower part of this triangular lever to a projecting bolt, *k*, fixed to the guiding-rod of the griffe. By raising the guiding-rod, thus raising lever, *k*, in the direction of the arrow, the batten is thrown outwards, [see direction of arrow below *c*], returning again to its former position at the lowering of the griffe. *f* indicates the place where the triangular lever is fastened (movable) to the projecting bolt, extending out of the frame. *a* indicates the place for the cylinder. Part 1 of the batten is movable at *l* in the direction of arrow, *s*, allowing the cylinder to be inserted. Part 1 is fastened (after putting the cylinder in at *a*), to 2 by means of the screw, *n*.

THE CYLINDER.

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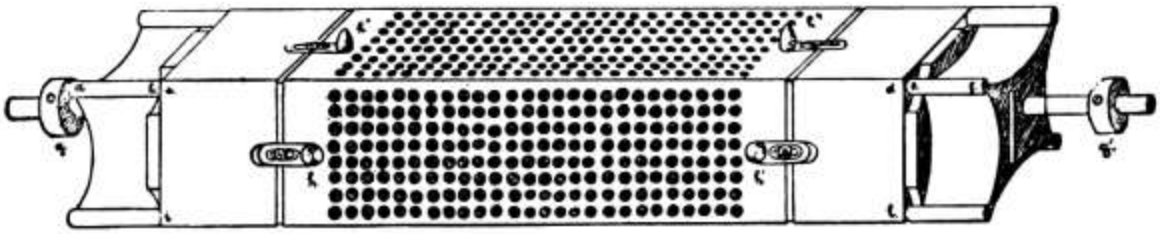

FIG. IX.

Fig. IX. represents the cylinder, with the lantern for turning the same by means of the catches. The dimensions for the cylinder in the present machine are as follows:

Height of cylinder,	=	2-7/16	inches.
Width of cylinder,	=	13	inches.
Width of lantern,	=	1-1/2	inches.
Average length of spindle,	=	2	inches.

This cylinder is carried in the batten, the latter moving in the groove provided for it under 10, Fig. I. This batten has sufficient vibratory motion to enable it to move the required distance away from the needle-board. After coming in contact with the catch it still moves until the cylinder has performed a complete turn. The cylinder is steadied in the required position by the hammer pressing by the means of a spring towards the lantern from below.

THE HAMMER.

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