A. REGAL.

ELECTRIC JACQUARD MACHINE FOR FIGURE WEAVING WITHOUT CARDS.

APPLICATION FILED DEC. 20, 1909.

983,862.

Patented Feb. 7, 1911.

4 SHEETS—SHEET 1.

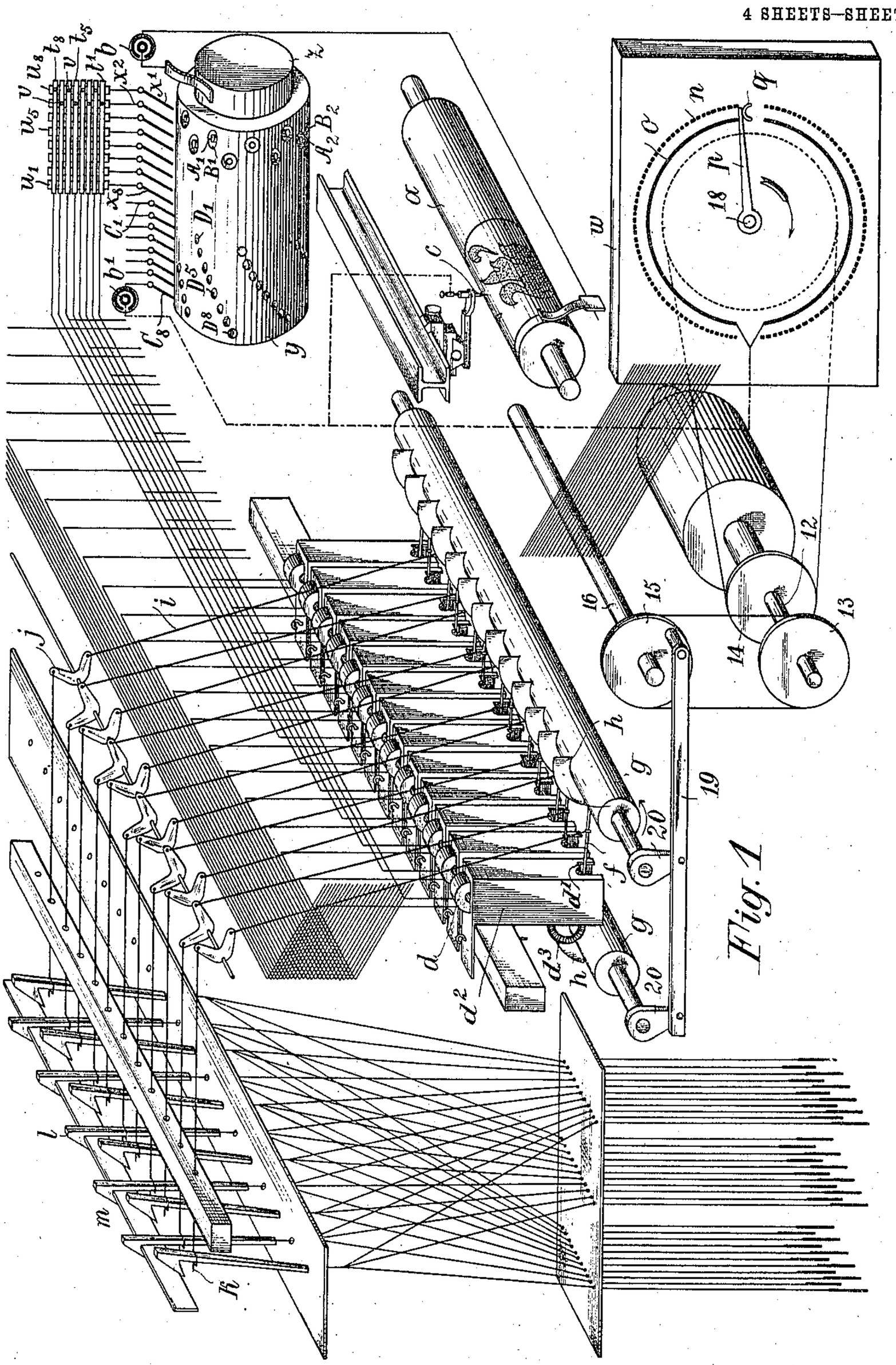

Fig. 1

Witnesses

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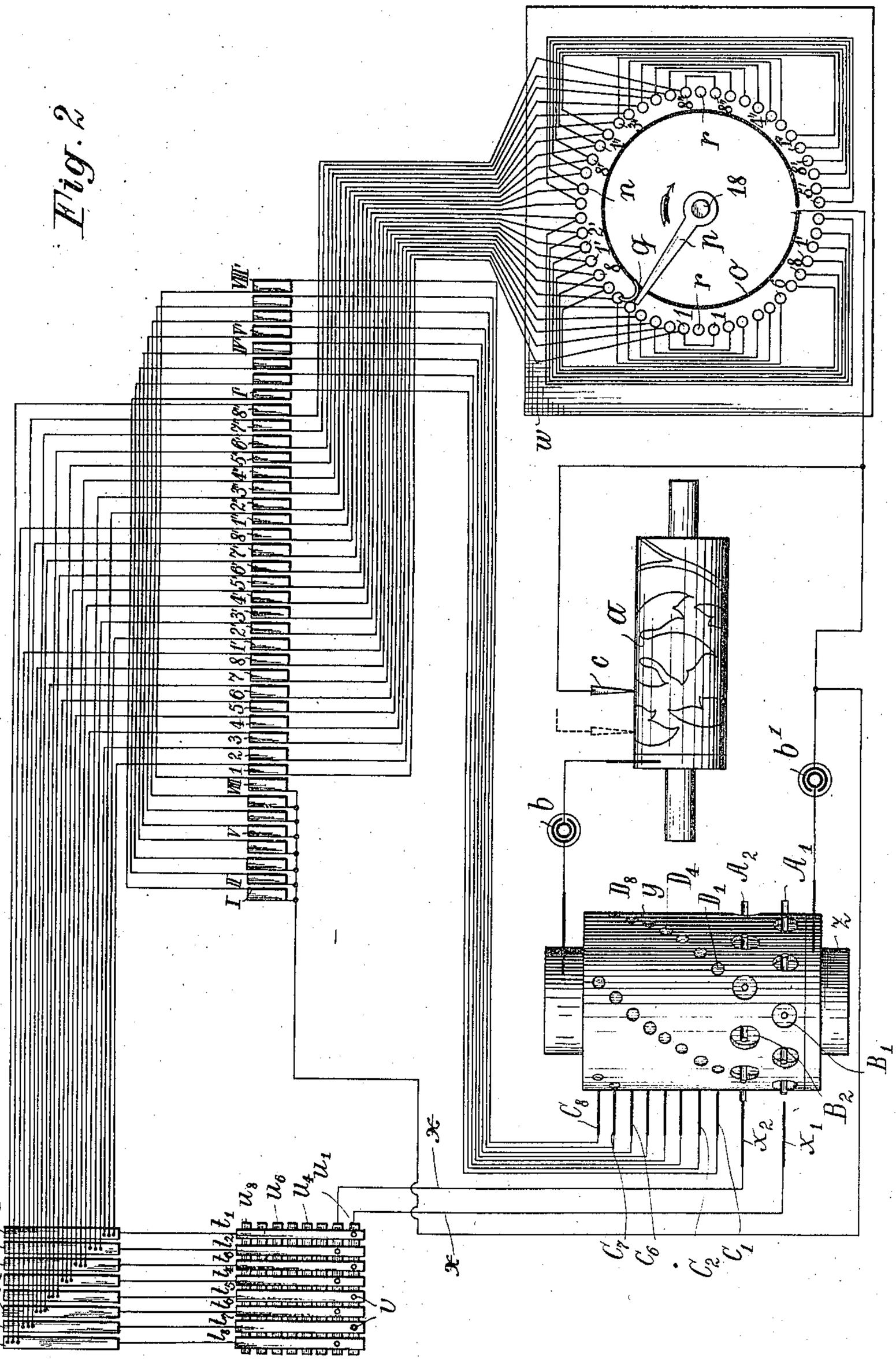
4 SHEETS—SHEET 2.

Fig. 2



WITNESSES

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4 SHEETS—SHEET 3.

Fig. 3.

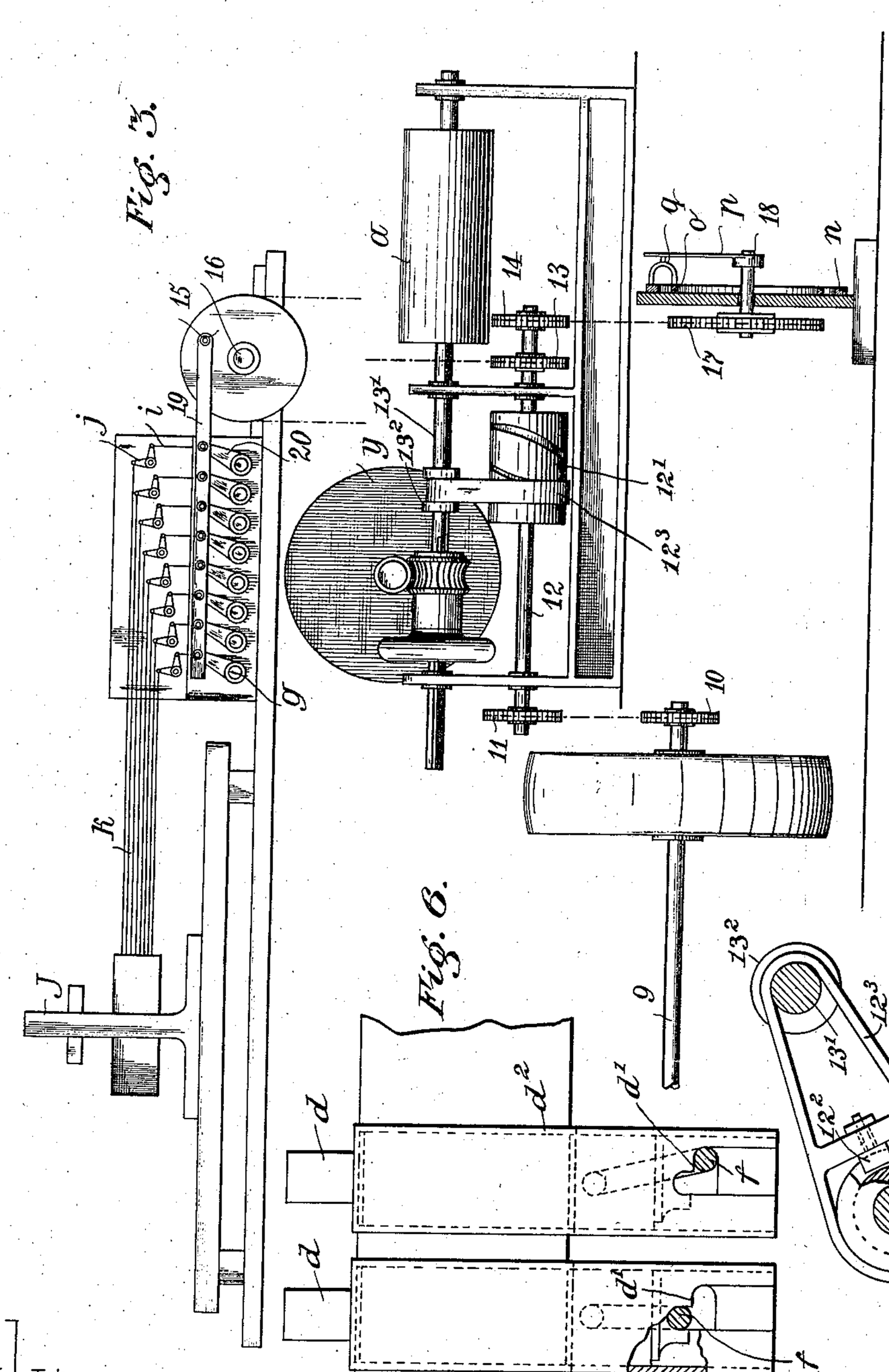

Fig. 6.

Fig. 3a.

Witnesses.

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4 SHEETS—SHEET 4.

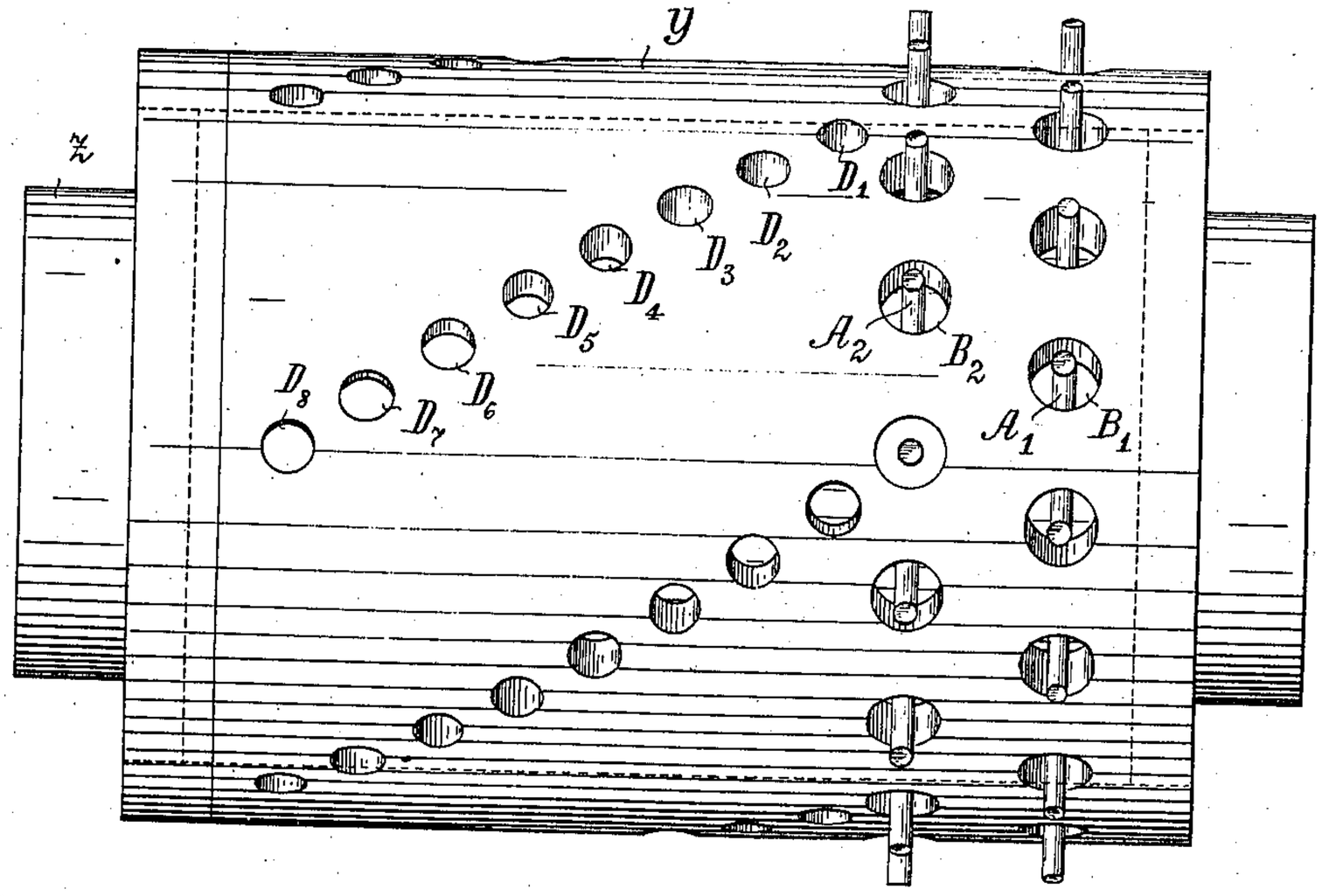

Fig. 4

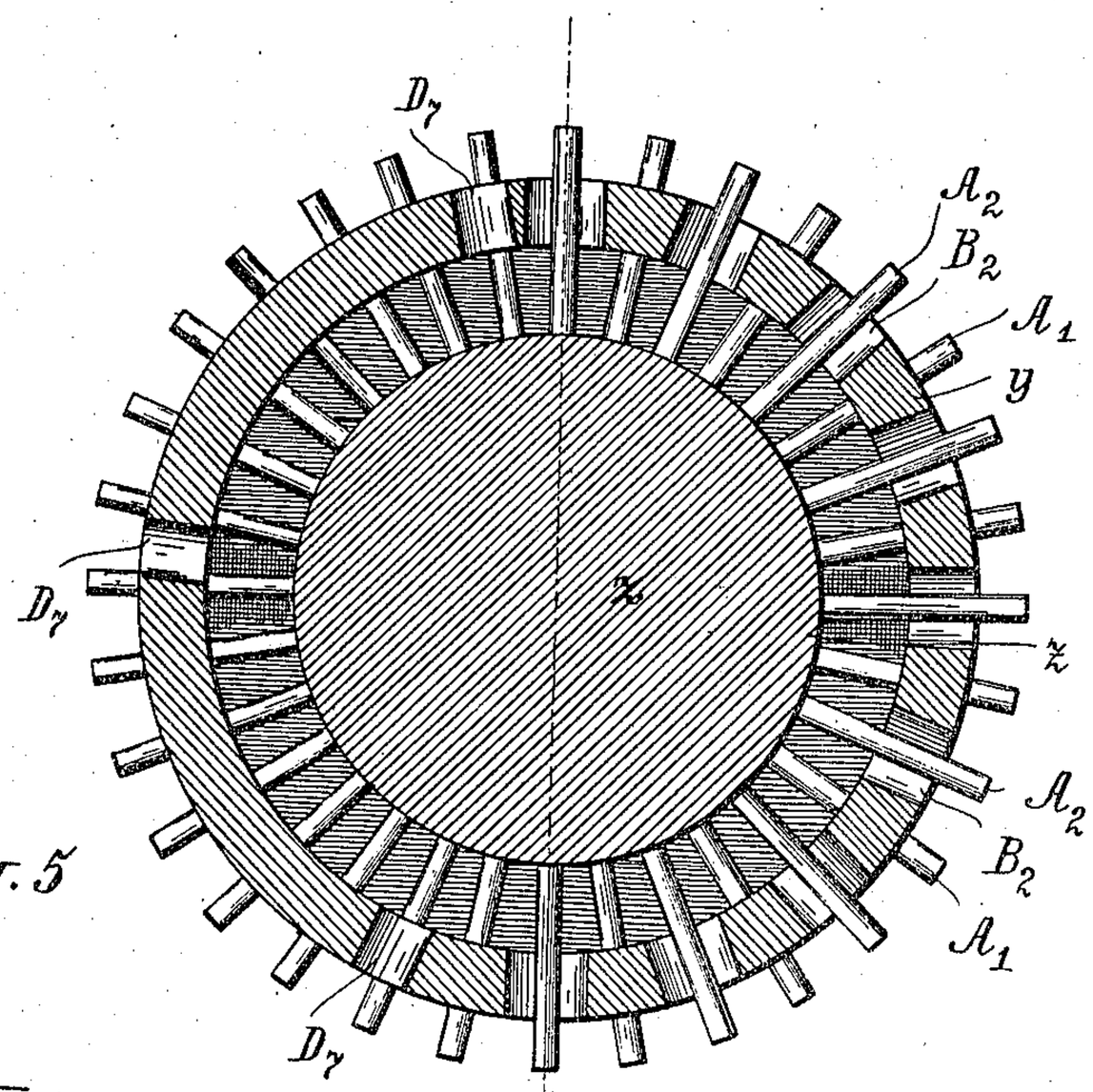

Fig. 5

Witnesses.

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UNITED STATES PATENT OFFICE.

AUGUST REGAL, OF JÄGERNDORF, AUSTRIA-HUNGARY.

ELECTRIC JACQUARD-MACHINE FOR FIGURE-WEAVING WITHOUT CARDS.

983,862. Specification of Letters Patent. Patented Feb. 7, 1911.

Application filed December 20, 1909. Serial No. 534,140.

To all whom it may concern:

Be it known that I, AUGUST REGAL, professor, a subject of the Emperor of Austria-Hungary, and resident of Jägerndorf, in the Crownland of Silesia, Empire of Austria-Hungary, have invented a new and useful Improvement in and Relating to Electric Jacquard-Machines for Figure-Weaving Without Cards, of which the following is a specification.

This invention relates to an electric jacquard machine for figure weaving without cards, of the kind in which the electromagnets which control the hooked wires of the harness leashes are operated by means of a pattern card on which the figure is drawn, without taking into consideration the binding of the fabric, in such manner that either the said figure is an electric conductor, and the background is not electrically conducting, or vice versa, while the binding for the background of the fabric, and also that for the figure, is produced by a special background-and figure-binding device.

According to this invention, the background-and figure-binding device of the jacquard machine works in such manner that, as long as the contact pin or stud is in contact with the background of the pattern, a background-binding pattern card effects the selecting of the hooked wire magnets, while when the said pin is in contact with the surface of the figure of the pattern card all the selecting points of the background binding card are rendered conducting, so that the binding effect of the card is annulled.

This invention relates to a special construction of the binding card with its canceling or annulling device.

A construction according to this invention is illustrated by way of example in the accompanying drawing, in which—

Figure 1 shows the most important parts of the jacquard machine in diagrammatic perspective; Fig. 2 is a diagram illustrating principally the electric wiring; Fig. 3 shows diagrammatically the arrangement of the apparatus in operative relation to the weaving loom, and Fig. 3ª illustrates a detail of Fig. 3 in side elevation; Figs. 4 and 5 show the binding device respectively in elevation and in cross-section; Fig. 6 is a detail illustrating the magnets and their accessories.

On a pattern card *a* (Fig. 1) made of an electrically conducting material the repeat or pattern to be woven is drawn direct or transferred to it by a photo-chemical process without taking into consideration the binding of the pattern or of the ground for the pattern. The ground of the pattern is made non-conducting, so that only the figure remains conducting, or the converse process may be adopted. The pattern card *a* is connected to a source of current *b* (Figs. 1 and 2) into the circuit of which are inserted contact pins or studs *c* traveling over the pattern card, which, according as they touch the conducting or the non-conducting portions of the pattern card, close or open the circuit of the source of current *b*. In the said circuit moreover, are inserted electro-magnets *d* the number of which corresponds to the number of the hooked wires to be controlled. The electro-magnets *d* act on armatures which, on the electromagnets being excited, are attracted, and moving laterally out of engagement with the notches *d'* in the magnet housings d^2, are thereby brought into a position in which they come with their ends into the path of lifting fingers *h* secured to rollers *g*. The said lifting fingers *h* are of such shape that, on the rollers *g* rotating, they press downward armature levers in opposition to the action of springs d^3 which automatically return the armature levers to their normal positions *i. e.*, engaged in the notches *d'* after the action of the said fingers has ceased. To the armature levers are connected cords *i* attached to the ends of bell crank levers *j*, the second ends of which are connected to the cross-wires or needles *k* controlling the hooked wires. The cords *i* secured to the armature levers *f*, could also be connected direct to the harness leashes of the warp threads, so that the electromagnet armatures *d* and the lifting fingers *h* could act direct on the warp threads.

When a conducting point of the pattern card *a* touches a contact stud *c*, the corresponding electromagnet *d* is excited, and its armature lever attracted, so that the latter comes into the path of a lifting finger *h* of a roller *g*, and on the latter rotating, is depressed. At the same time the cord *i* is pulled down, and the cross wire or needle *k* connected to the same, moved. The corresponding hooked wire *l* is thus disengaged from the griff, so that the former is not moved during the upward movement of the griff *m*, and the corresponding warp thread is not raised.

The electromagnets *d* are connected to the contact studs of a contact arranged in a circle on a switch (Fig. 2) provided with a ring *o*. A rotatable arm or lever *p* is provided at the end with a contact bridge *q* with contact brushes or contact wheels, which, on the rotation of the arm *p*, closes the circuit into which the electromagnets are switched, by connecting the ring *o* to one of the contacts of the contact series *n*, and in that way consecutively switches in all the electromagnets *d* into the circuit of the source of current. Into the said circuit containing the pattern card *a*, the electromagnets *d* and the switch *n*, *o*, *p*, is also switched in a binding device, for enabling the binding to be effected in the background and in the figure of the pattern to be woven.

The pattern card makes both a longitudinal reciprocating movement and an intermittent rotation. After each longitudinal movement in one or in the other direction an intermittent rotation of the pattern card takes place, so that the contact pins come into contact with the next series of the pattern card. If during the longitudinal movement of the pattern card *a*, one of the contact studs or pins *c* comes on to a conducting point of the pattern card, and at the same time a connection is made between a contact of the series *n* and the ring *o* by the contact bridge *q* during the rotation of the arm *p*, and the circuit thus closed, the armature lever of the corresponding electromagnet *d* switched by the contact bridge *q* into the circuit of the source of current *b*, comes into the position of operation in which, as already stated, the armature is moved, whereby the corresponding hooked wire *l* is disengaged from its griff *m* so that the corresponding warp thread in the fabric remains undisturbed.

In order to enable the required binding or weaving to be given to the background, as well as to the figure of the fabric, a special device is provided, the substance of which will be seen from Figs. 1 and 2. As an example, it has been assumed, for explaining the device, that the background of the fabric is to be woven in "linen binding" while the figure in a binding corresponding to eight leaf twill. The pattern card is made in such manner that the background is electrically non-conducting, while the figure is conducting. The electromagnets *d* are consecutively connected to the contacts of the switch board *w* (Fig. 2), arranged in a circle, the said switch board being provided with so many contacts *n* that half of the same corresponds to the number of the electromagnets *d* used. Moreover, there are provided two resting points *r* arranged between the upper and the bottom half of the contacts. The sequence of the contacts of the bottom half is exactly the opposite of that of the contacts of the upper half, so that, when for instance the last contact 8″ of the upper half of the contact series *n* is connected to the last (counting from the left) electromagnet 8″ for the warp threads of the background the first contact of the bottom half of the contact series *n*, following the resting point *r*, is connected to the last contact 8″ of the upper half of the contact series, and therefore, also to the last electromagnet 8″ of the electromagnet series for the warp threads of the background. In that way, a continuous rotation of the arm *p* is rendered possible with the reciprocation of the pattern card. While the bridge *q* connects the contacts of the upper half of the contact series *n*, one after another, to the bar *o*, the longitudinal movement of the pattern card *a* takes place in one direction and, therefore, one series of contact points is touched by the contact studs or pins *c*. While the contact bridge *q* is moving from the contact 8″ over the rest contact *r* to the next contact 8″ of the bottom half of the contacts *n*, the intermittent rotation of the pattern card *a* takes place, so that the contact studs *c* can engage with the next weft line of the pattern. While the pattern card moves back in the direction opposite to the first movement, the contact bridge *q* slides over the contacts of the bottom half of the contact series *n* of the switch board *w*, connected to the electromagnets consecutively, but in the reverse sequence to that of the contacts of the upper half, as shown in Fig. 2. The electromagnets *d* are connected to the bars s'—s^8 (Fig. 2) provided with a series of binding screws, so that the connection can be altered at will. When it is desired to effect the binding of the figure in eight leaf twill, the electromagnets *d* are divided into groups of eight magnets each. To the first bar s' are then connected the first electromagnets 1, 1′, 1″ etc. of each group, to the bar s^2 the electromagnets 2, 2′, 2″, etc. up to the last bar s^8 to which are connected the electromagnets 8, 8′, 8″. For suitably switching in the electromagnets for the binding of the ground, is provided a reversing switch of well known construction consisting of two systems t'—t^8 and u^1—u^8 completely insulated from each other, of intersecting current conducting bars which are perforated at the points of intersection, so that an electric connection can be effected at these points by means of contact studs *v* or the like. As the pattern ground in the example selected is to be bound in linen binding or twill, all the electromagnets *d* which are to be marked with even figures in their sequence, are connected to one bar, and the magnets marked with uneven or odd figures, to a second bar. In that way, all the bars t' t^3 t^5 t^7 which would be marked in their sequence with odd numbers are con-

nected to the bar u', and the remaining bars t^2 t^4 t^6 t^8 to the bar u^2. Each of the bars u' and u^2 is connected by one of two conductors x to a sliding contact x' or x^2 which slide on a binding cylinder y. The latter is mounted on and insulated from the spindle z connected to the source of current b, while the binding cylinder y is connected to the source of current b.

The spindle z carries, in the case of the binding selected, two series of contact studs A′ and A² (Figs. 4 and 5) which are insulated by the bores B¹ and B² of the binding cylinder y and project from the same. The binding cylinder y and the spindle z with the contact studs A′ and A² are made of electrically conducting material. The contact studs A′ in the bores B′ are arranged in a staggered order relatively to the contact studs A² and bores B² in accordance with the binding, so that, when a sliding contact x' slides over one of the contact studs, the sliding contact x^2 is situated between two consecutive studs A² or bores B² on a conducting point of the binding cylinder y. In that way, during the rotation of the binding cylinder at one time all the electromagnets marked in their sequence with even numbers and another time all the electromagnets marked with the odd numbers are alternately switched into the circuit of the source of current b' and excited when the contact stud c is on a non-conducting point of the pattern card a, and thus the source of current b is switched out. Accordingly all the even, and all the odd warp threads, remain alternately without change, whereby the warp threads forming the background are bound in the linen twill fashion. If, on the contrary, the contact stud c is on a conducting point of the pattern card, then, in the case specified, the sliding contact x' which slides on one of the contact studs A′ will be switched into the circuit of the source of current b connected to the spindle z, and the sliding contact x^2 which touches the conducting surface of the binding cylinder, into the circuit of the source of current b'. In that way the electromagnets of the even and of the odd warp threads of the pattern, will be excited, and consquently all the threads of the background will be left unlifted, while the lifting of the figure threads will be effected by operating a rod which controls several heddles or leashes so that they may be simultaneously operated as will be hereinafter explained.

Fig. 2 shows the binding of warp threads of the background, as the contact stud c on the pattern card a touches a point of the ground, that is to say, a non-conducting point. The source of current b is, therefore, switched out of the circuit, but the source of current b' is switched in. The current passes from that source of current b' to the ring o of the switch board w, and on the arm p being moved, through the bridge q and the consecutive contacts n to the electromagnets d through the bars s'—s^8, and through the bars t'—t^8 into the bars u' and u^2. As at the moment in which the single parts are in the position shown in Fig. 2, the sliding contact x^2 touches a pin A², the bar u^2 and therefore, all the even electromagnets are switched out from the circuit of both sources of current b and b'. Consequently none of the electro-magnets marked with even figures, is affected. The corresponding hooked wires remain within reach of their griffs, so that all the even warp threads are lifted. The sliding contact x' which touches the conducting surface of the binding cylinder, is switched into the circuit of the source of current b'. Thus all the odd electromagnets are excited and bring the corresponding hooked wires out of reach of their griffs, so that the corresponding warp threads are not lifted, while at the next moment, after the intermittent rotation of the binding cylinder has taken place, the contrary process takes place.

The lifting out of the warp threads forming the figure, is effected by means of the electromagnets I—VIII and I′—VIII′ which, for the sake of clearness, are shown in the drawing next to each other, while in reality, they are arranged at the points where the reserve hooked wires are arranged in each series of hooked wires. As it is intended to bind the pattern in a manner corresponding to the eight leaf weft twill, one eighth of the threads must always remain in the background, and one eighth of the threads must be raised into the upper shed. In order to avoid the necessity of making the rods too heavy, each pair of rods contains one-eighth of the threads, that is to say, one rod which is operated by an electromagnet, carries one-sixteenth of the threads. Each two of these electromagnets I′ I′ etc. to VIII VIII′ are switched in series, so that a pair of rods, that is to say, one-eighth of the warp threads, are operated simultaneously. The electromagnet pairs I I′—VIII VIII′ are connected to the sliding contacts C′—C⁸ which slide along the binding cylinder y. In the latter there are provided eight series of bores D′—D⁸ which are arranged alternately, in such manner that the sliding contacts C′—C⁸ on the binding cylinder rotating, slide consecutively over each bore D′—D⁸. The distance between the bores in the single series is calculated in such manner that each sliding contact first comes again to rest above the next bore of the same series, until each bore in all the consecutive series has been consecutively passed by the corresponding sliding contacts. Owing to this construction, seven slide contacts can touch at times the con-

ducting binding cylinder, while one sliding contact slides over a bore of the same, that is to say, over a non-conducting portion. At the moment to which the position of the single parts shown in Fig. 2 correspond, the contact stud C touches, as already stated, a non-conducting portion of the pattern card. The circuit of the source of current *b* is broken, but the source of current *b'* is switched in by means of the conducting binding cylinder *y*. The electromagnets of the rods, connected to the sliding contacts C^2—C^8 are excited, and accordingly the corresponding reserve hooked wires of the rods are not affected. The sliding contact C' which comes over a perforation or bore D', is switched out of the circuit of the source of current *b'*. The corresponding electromagnets of the rods are not excited, and therefore the reserve hooked wires with the rods are raised by the griffs and thus the eighth of the pattern warp threads corresponding to the binding, is lifted out for binding the ground. If, on the contrary, the contact stud *c* were in the position shown dotted in Fig. 2, the figure warp threads would have to be lifted out, so as to bind one-eighth of the pattern warp threads for producing the pattern. The binding device regulates which one-eighth of the pattern warp threads is to be lifted out.

The arrangement of the jacquard machine on the weaving loom is illustrated in Fig. 3 of the accompanying drawing. The driving of the jacquard machine is effected from the crank shaft 9 of the weaving loom, on which next to the belt pulley is mounted a chain wheel 10. The latter transmits the movement of the crank shaft 9 by means of chain and chain wheel 11, to the spindle 12 driving the pattern card *a* and carrying two chain wheels 13 and 14.

The longitudinal movements of the pattern cylinder *a* are accomplished by the means shown in Figs. 3 and 3^a, where 12' is a spirally grooved cylinder receiving a projection 12^2 of a yoke 12^3 which is penetrated by the shaft 13' carrying the pattern cylinder and which is confined for movement in the longitudinal direction with said shaft by a collar 13^2 which is fixed on said shaft and receives the yoke.

The chain wheel 13 is positively connected to a chain wheel 15 mounted on a spindle 16, which operates the rollers *g* for the electromagnets *d* by means of a connecting rod 19 and cranks 20. The chain wheel 14 is connected by means of a chain to a chain wheel 17 mounted on the spindle 18 of the switch lever *p*. The ratio between the chain wheels 14 and 17 is 1:2 as at one revolution of the spindle 12 the pattern card makes a longitudinal movement in one direction, but the arm *p* must make during the same time only half a revolution, that is to say, slide only over half of the contacts *n*. During the next revolution of the spindle 12, during which the pattern card is longitudinally moved in the opposite direction, the arm *p* makes the second half of its revolution and slides over the bottom half of the contacts *n* of the switch *w*. The electromagnets *d* which control the hooked wires, are arranged in a casing mounted on the frame for the jacquard device J. The device for operating the pattern card and the binding cylinder is arranged at the side slightly above the crank shaft 9 of the weaving loom and below the said device is arranged the switch board *w*.

In the construction of the electric jacquard machine illustrated only one series of hooked wires are shown, and therefore, only one contact stud *c* for the pattern card. In practical construction of the device there is for each series of hooked wires, a series of electromagnets with a corresponding switch *w* and contact pin *c*, while only one binding cylinder, one pattern card and one reversing switch coöperates with the said parts of the device.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:

1. The combination, with a series of electro-magnets to be controlled corresponding in number to the warp threads to be actuated, of a series of conductors electrically including said magnets, two other conductors *x* electrically connected the one with alternates of the magnet-including conductors and the other with the remainder thereof, said magnet-including conductors terminating in a series of separate contacts, a single contact adjoining the first-named contacts, a switch movable over the single contact and simultaneously over the series of contacts in succession, electro-conductive means, comprising a source of electric energy and a movable switch-member, for alternately connecting said conductors *x* with the single contact, other electro-conductive means comprising another source of electric-energy, a movable pattern cylinder having electro-conductive and electro-non-conductive surface portions, and a contact piece engageable with said portions of the pattern member, for electrically connecting either of the conductors *x* with said single contact when the other of the said conductors *x* is not connected with the single contact by the first-named electro-conductive means, and means for effecting the movement of the pattern cylinder and the switch and switch-member, substantially as described.

2. The combination, with a series of electro-magnets to be controlled corresponding in number to the warp threads to be actu-

ated, of a series of conductors electrically including said magnets, two other conductors *x* electrically connected the one with alternates of the magnet-including conductors and the other with the remainder thereof, said magnet-including conductors terminating in a series of separate contacts, a single contact adjoining the first-named contacts, a switch movable over the single contact and simultaneously over the series of contacts in succession, electro-conductive means, comprising a source of electric energy and a movable switch-member, for alternately connecting said conductors *x* with the single contact, other electro-conductive means comprising another source of electric-energy, a movable pattern cylinder having electro-conductive and electro-non-conductive surface portions, a contact piece engageable with said portions of the pattern member and another switch-member movable with the first switch-member, said other switch-member having interruptions in its surface portions, for electrically connecting either of the conductors *x* with said single contact when the other of the said conductors *x* is not connected with the single contact by the first-named electro-conductive means, means for effecting the movement of the pattern cylinder and the switch and switch-members, other electro-magnets to be controlled corresponding to other warp threads to be actuated, other conductors each electrically including one of said other magnets and electrically connected at one end with the first-named means between the source of energy therein and the single contact and engaging at their other ends the interrupted surface portion of said other switch-member, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

AUGUST REGAL.

Witnesses:
JULIUS FISCHER,
GERSON WOLFF.