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H. HARDWICK.

JACQUARD MECHANISM FOR LOOMS.

No. 497,277. Patented May 9, 1893.

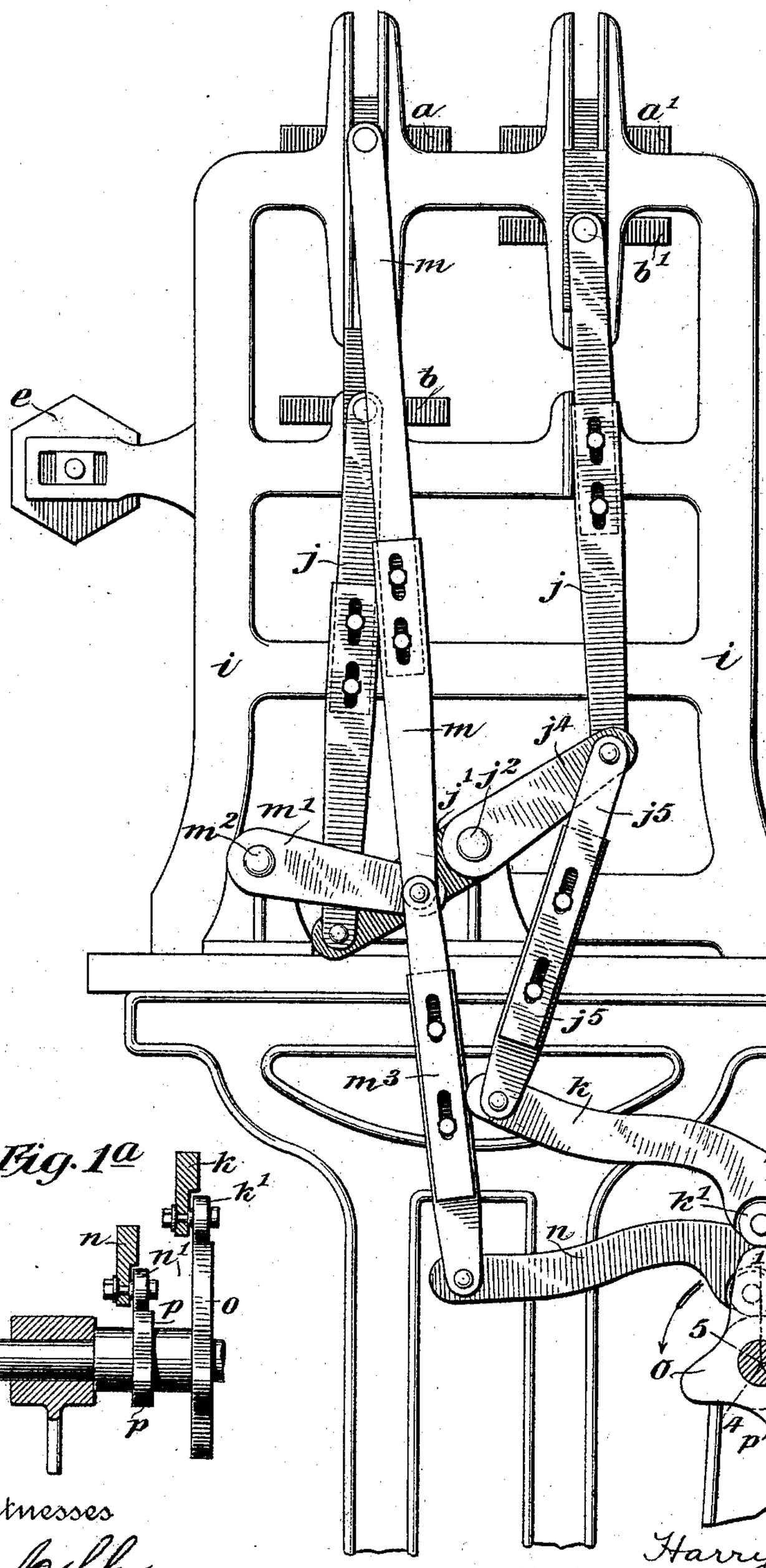

Fig. 1.

Fig. 1a

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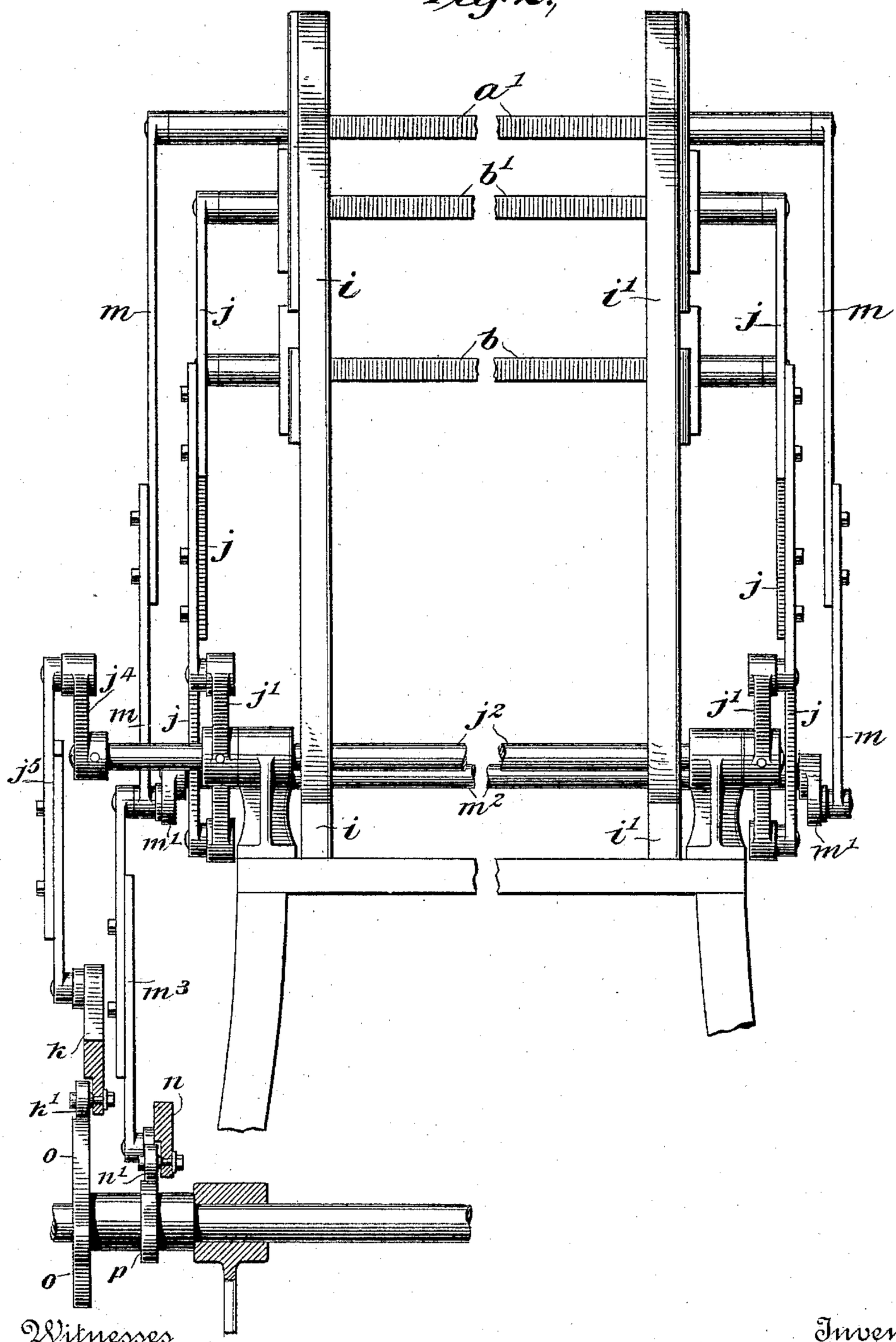
Fig. 2.



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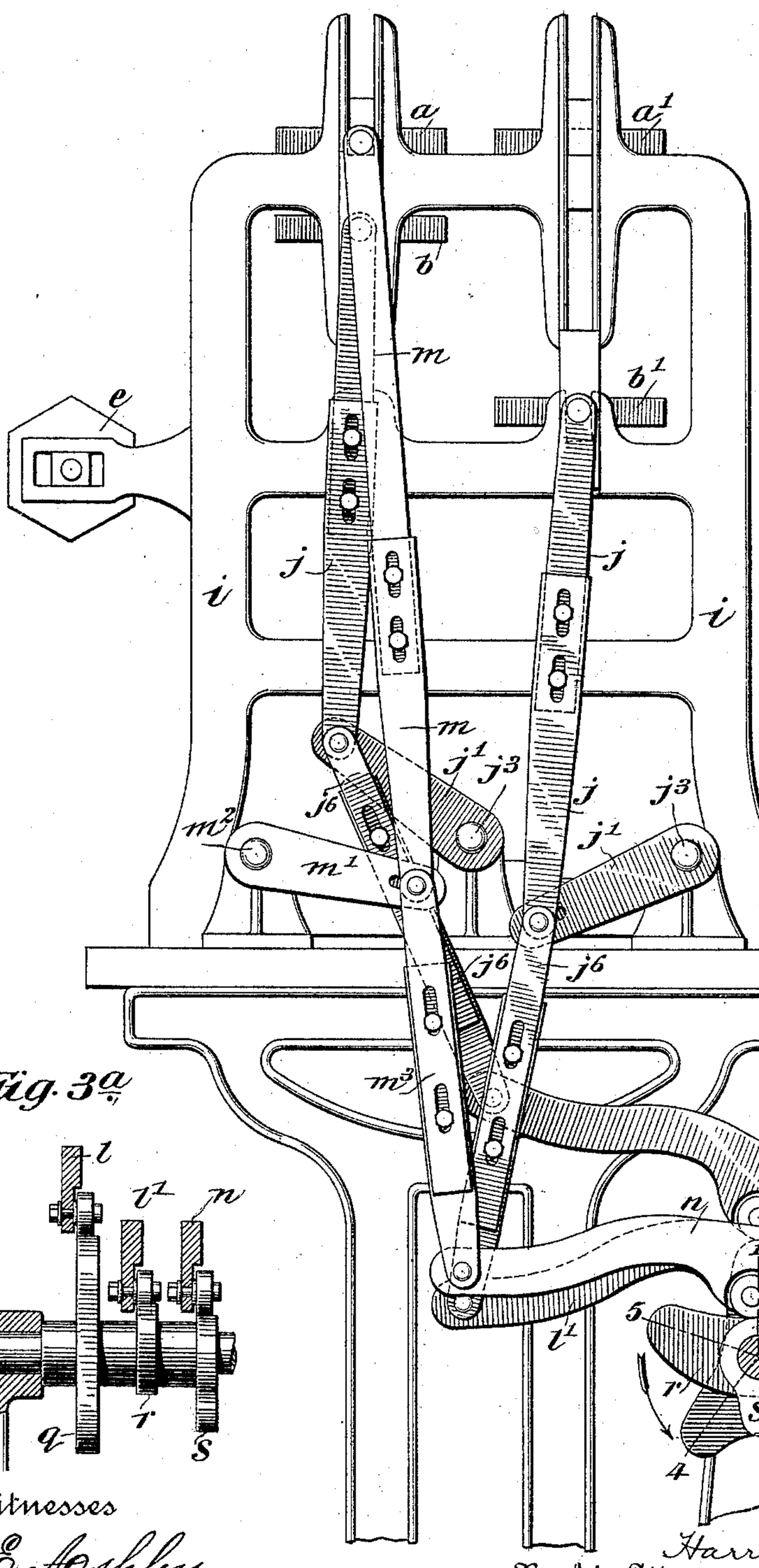

Fig. 3.

Fig. 3a.

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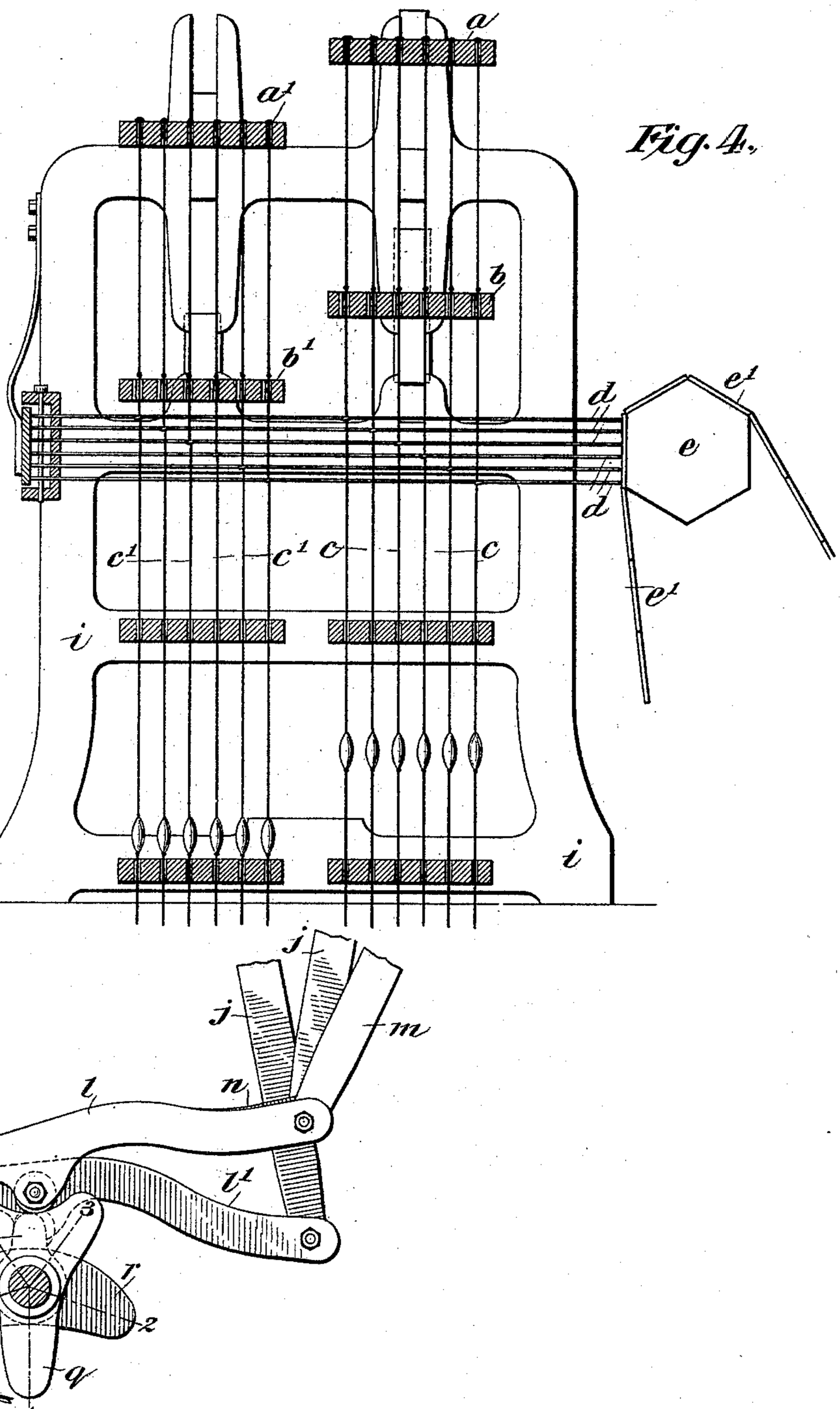

Fig. 4.

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Fig. 5.

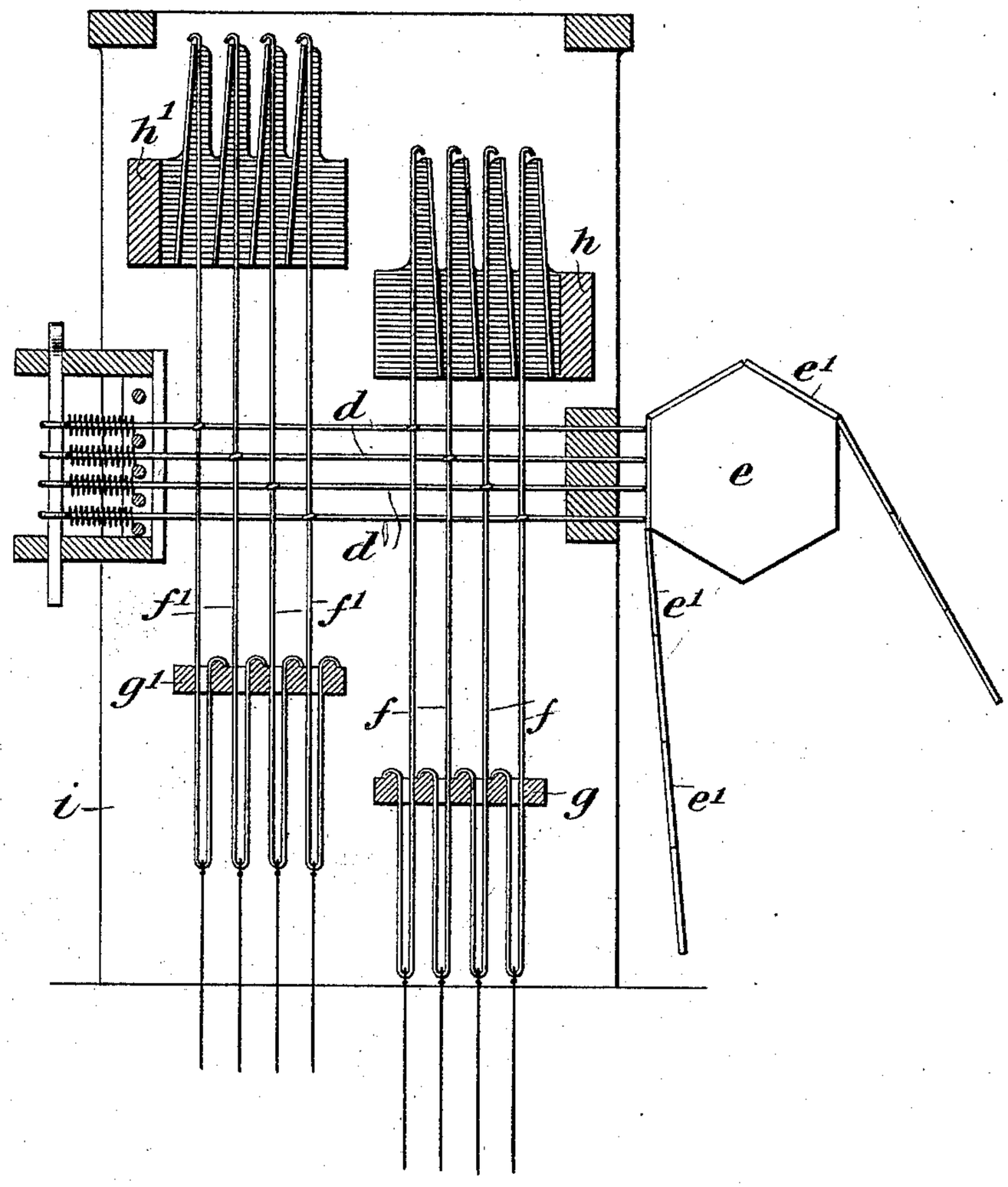

Fig. 6.

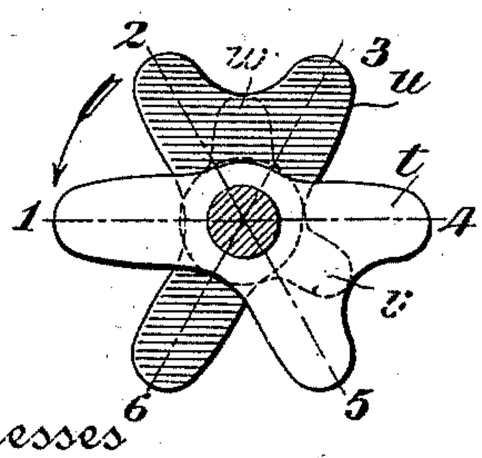

Fig. 7.

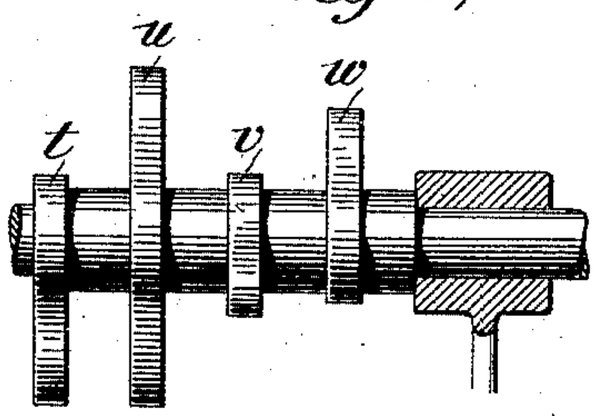

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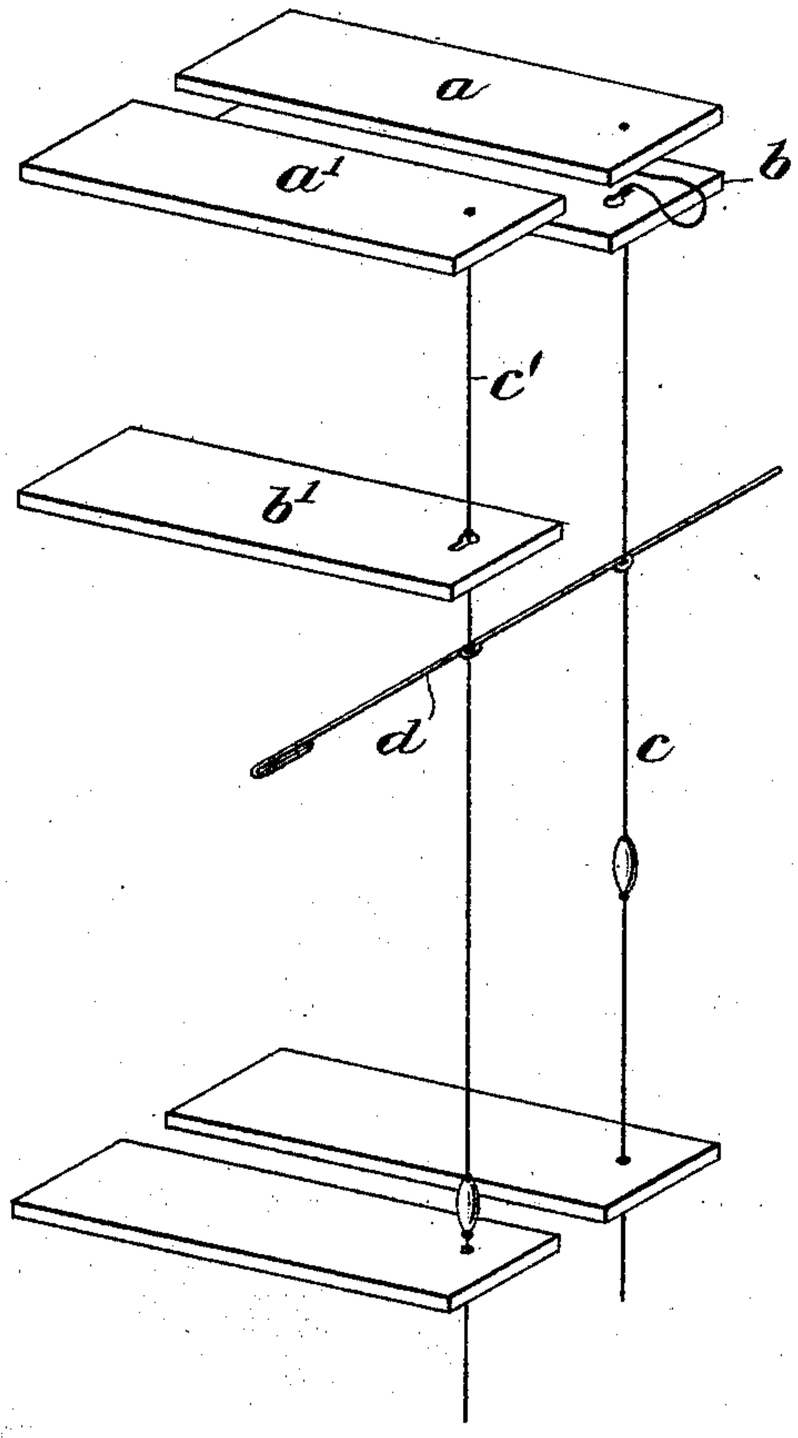
Fig. 8.



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UNITED STATES PATENT OFFICE.

HARRY HARDWICK, OF THOMPSONVILLE, CONNECTICUT.

JACQUARD MECHANISM FOR LOOMS.

SPECIFICATION forming part of Letters Patent No. 497,277, dated May 9, 1893.

Application filed December 2, 1891. Serial No. 413,770. (No model.)

To all whom it may concern:

Be it known that I, HARRY HARDWICK, a citizen of the United States, and a resident of Thompsonville, county of Hartford, State of Connecticut, have invented certain new and useful Improvements in Jacquard Mechanism for Looms, of which the following is a specification, reference being had to the accompanying drawings, forming part hereof.

My invention relates to looms for weaving ingrain carpets and similar fabrics, and particularly to that part of the loom called the Jacquard mechanism.

The object of my invention is to utilize a double acting jacquard, with all its advantages both in construction and in rapidity and uniformity of operation, in the weaving of fabrics having the weft threads arranged in sets of more than four in a set.

My invention may be employed in looms provided with tail cords controlled by Jacquard needles and carried by top boards and manipulated by lifter boards, or it may be employed in looms provided with hooks controlled by Jacquard needles and carried by hook boards and manipulated by griffs. I therefore in this specification couple the terms tail cords and hooks, the terms top boards and hook boards, and the terms lifter boards and griffs, respectively, to describe these analogous devices designated in the art by these different names.

Double acting Jacquard mechanisms are at present employed in the weaving of fabrics having the weft threads arranged in sets of four in a set, the tail cords or hooks being divided into two sets, and two lifter boards or griffs being provided, one set of tail cords or hooks being arranged to be lifted by one lifter board or griff, and the other set by the other lifter board or griff, and the two lifter boards or griffs being operated alternately so that when one lifter board or griff is in its highest position, the other lifter board or griff is in its lowest position, and while one lifter board or griff is moving downward and permitting the downward movement of the cords or hooks carried thereby and moving into position to make a new engagement of the cords or hooks as may be dictated to the needles by the cards, the other lifter board or griff is moving upward and lifting those cords or hooks of the other set which had been put in position by the cards and needles for engagement with the lifter board or griff. In the operation of such double acting jacquards no time is lost in the formation of the shed, as immediately after the shot of the weft shuttle, the lifter boards or griffs commence the movements, the one upward and the other downward, which movements form the next shed. Again the number of needles may be reduced to one half the number of warp threads in each repeat of the pattern throughout the width of the fabric, as each needle may have two eyes, each eye controlling one tail cord or hook, that is to say, each needle controlling by one eye a certain number, depending upon the number of repeats in the width, of warp threads, called ground threads, and controlling by the other eye a corresponding number of warp threads called figure threads.

According to my invention the double acting Jacquard mechanism can be employed in the weaving of fabrics having the weft threads arranged in sets of five, six, or more in a set with the same rapidity of operation (the formation of the shed commencing immediately after one weft shot and terminating before the next weft shot) and with the same economy of needles (one half as many needles as there are warp threads in each repeat of the pattern throughout the width) as has heretofore been attained in weaving fabrics having the weft threads arranged in sets of four in a set.

I shall describe my invention as it would be applied in the weaving with a double acting Jacquard of a fabric such as is known in the trade as the "Agra" ingrain carpet fabric, patented to me May 1, 1888, numbered 382,157, having the weft threads arranged in sets of five in a set, and of a fabric having the weft threads arranged in sets of six in a set. It will be obvious, however, that my invention may be applied to the weaving of many other fabrics.

In weaving the "Agra" carpet it is necessary when using the economical arrangement of needles having two eyes each, one eye controlling figure warp threads and one eye controlling ground warp threads, at some time during the weaving of each set of weft threads,

usually when forming the shed for the third and fourth shots of weft to cause one set of tail cords or hooks to be operated twice in succession, and each of these two operations is of the full extent of one lift for the formation of a shed. Heretofore this has not been accomplished except by one full downward movement of the lifter board or griff, which movement occupied the full time usually required for the formation of a shed and accomplished nothing but the bringing of the tail cords or hooks into position for rearrangement under the dictation of the needles, and one full upward movement which also occupied the full time usually required for the formation of a shed and which actually effected such formation. Thus in the weaving of every set of weft threads there has been a lost motion and a waste of time amounting to one sixth of the time actually consumed in weaving.

According to my present invention successive operations of the tail cords or hooks of either set may be effected without any waste of time or lost motion. This I accomplish by operating one of the top boards or hook boards of the jacquard simultaneously with the operating of the corresponding lifter board or griff but in the opposite direction to that of the movement of the lifter board or griff, continuing these movements through approximately one half of the distance necessary to form a complete shed, and then operating both top board or hook board and lifter board or griff in directions opposite to their former movement, and continuing such movement until they have returned to their original positions. The total extent of these movements in both directions will thus be the distance necessary to form a complete shed. During the first half movement, all the tail-cords or hooks of one set that were not engaged by the lifter-board or griff in forming the preceding shed, and therefore were not moved by said movement of the lifter-board or griff, are now moved by the top board or hook board; and the lifter-board, or griff, is moved into position to engage with the tail-cords or hooks, and thereby carries with it the tail-cords or hooks that were engaged by it during its preceding movement. Thus at the completion of these movements, all of the tail-cords or hooks of this set are in position to be engaged (if the needles so dictate) with the lifter-board or griff. At about the completion of the first half movement there is, therefore, a rearrangement of the tail cords or hooks under the dictation of the cards and needles, and at the beginning of the second half movement the engagement of some or all of the tail cords or hooks as determined by the needles will take place. During the last half movement the tail cords or hooks that were engaged by the lifter board or griff will be caused by the lifter board or griff to continue and complete their movement to form the shed, while those tail cords or hooks not engaged will be returned by the top board or hook board to their original positions.

My invention consists of certain improvements in loom mechanism whereby the above described economical and efficient operations may be performed, such improvements being hereinafter particularly described and claimed.

In the accompanying drawings Figure 1 is a side elevation of the Jacquard mechanism of a loom (the tail cords and needles being omitted) embodying my invention. Fig. 1ª is a detached end view of the cams of Fig. 1. Fig. 2 is a rear elevation of the mechanism shown in Fig. 1. Fig. 3 is a side elevation similar to Fig. 1, but showing a modification in the construction of the cams and levers. Fig. 3ª is a detached end view of the cams of Fig. 3. Fig. 4 is a vertical longitudinal section of the Jacquard mechanism with cams and levers corresponding to those shown in Fig. 3, but with the levers broken away to more clearly show the tail cords, boards and needles. Fig. 5 is a longitudinal vertical section of a Jacquard mechanism embodying my invention differing from that shown in Fig. 4 in that hooks are employed in place of the tail cords, griffs in place of the lifter-boards, and hook-boards in place of the top boards. Fig. 6 is a detached end view of a set of cams for operating the loom according to my invention to produce a fabric with the weft threads arranged in sets of six in a set, and Fig. 7 is a rear elevation of the same. Fig. 8 is a detached perspective view of the lifter boards, top boards and guide boards and but one needle and two tail cords, one tail cord of each set.

My invention may be employed in any looms that are provided with double acting Jacquard mechanism and I have therefore not shown in the drawings the complete loom but only those parts of the loom the construction of which is in any way modified by my invention. The drawings show the upper part of a power loom and the Jacquard mechanism including the operating cams of the Jacquard mechanism.

When my invention is used in a hand loom it is of course evident that the successive shed forming operations may be accomplished by the ordinary treadles and additional treadles and connecting mechanism to manipulate the top-boards or hook-boards.

In Figs. 1, 2, 3, 4 and 8 are shown the top-boards a a', and the lifter-boards b b' of an arrangement such as is most usually employed in ingrain carpet looms wherein the tail cords and lifter boards operate in conjunction with the Jacquard needles to effect the necessary manipulation of the warp threads for the purpose of producing the desired pattern in the fabric. The tail cords c c and c' c' are shown in Figs. 4 and 8. The front top-board, lifter-board and tail cords are lettered a, b and c, respectively, and the back top-board, lifter-board and tail-cords are lettered a', b' and c', respectively. The Jacquard needles d d are

each provided with two eyes, a front tail-cord *c* passing through one eye of each Jacquard needle and a back tail-cord *c'* passing through the other eye of the same Jacquard needle. *e* is the Jacquard cylinder and *e'* the cards. Thus each Jacquard needle controls two tail-cords, one of such tail-cords being connected to one or more warp threads designated ground warp threads, and the other tail-cord being connected to one or more warp threads designated figure warp threads.

The construction of the Jacquard needles, lifter-boards and tail-cords is illustrated in Fig. 8, such figure showing but one needle, one front tail-cord and one back tail-cord. The tail-cords *c c'* are suspended from the top-boards *a a'* and pass through slots in the lifter boards *b b'* and through eyes in the Jacquard needles *d*. Each slot in the lifter boards is so shaped that when the tail-cord is in one position a knot upon the tail cord will pass freely through such slot and when the tail-cord is in another position the knot upon the tail-cord will prevent the tail-cord from passing through such slot. The change of position of each needle by means of the Jacquard cards shifts the tail-cords to one or the other position in the slots, so that the needle determines whether a tail-cord shall be lifted by the lifter-board or shall allow the lifter-board to move upward without engaging the tail-cord. The slots upon the front lifter-board are arranged oppositely to those on the back lifter board, so that the position of the Jacquard needle which will put the front tail-cord in a position to be lifted by the front lifter-board will put the back tail-cord controlled by the same needle in a position in which it will not be engaged or lifted by the back lifter-board. The knots upon the tail-cords *c c'* are so placed that when the top-board is in normal position and the lifter-board in lower position the knots will be just above the lifter-board.

Heretofore in the operation of double acting Jacquard mechanisms in looms for ingrain carpets and similar fabrics the lifter-boards have been operated alternately, that is to say the front lifter-board has moved upward to higher position and lifted the warp threads to form one shed, while the back lifter-board was returned to lower position bringing down the warp threads that had previously been lifted by it. This is illustrated in Fig. 8 in which the front lifter-board *b* is shown in higher position and has lifted the one tail-cord shown in such drawing to that position while the back lifter-board *b'* is in lower position. In the next operation of the lifter-boards the front lifter-boards *b* will descend and carry down any of its tail cords that it has lifted, while the back lifter-board *b'* will ascend and lift any of its tail cords that have been put in position by the Jacquard needles for engagement with such lifter-board.

According to my present invention either of the top-boards *b* or *b'* is, during the formation of one or more of the sheds of warp threads in the weaving of each set of weft threads, caused to ascend and, of course, to carry upward with it all of the tail cords suspended from it that have not already been lifted by the lifter-board. This upward movement of the top-board continues for about one-half the distance necessary to form a shed. Simultaneously with this upward movement of the top-boards there is a downward movement of the corresponding lifter board from its upper position downward to about one-half the extent of its usual full movement. At the completion of these two simultaneous movements the tail cords have been lifted half way upward and the lifter board has moved half way downward and thus the distance between the top-board and the lifter board will be the same as when the top-board is in normal position and the lifter-board in lower position and the knots upon the tail cords will be just above the lifter-board. At about this point in the operation a rearrangement of the tail-cords will take place under the dictation of the needles as the tail cords are now all freely suspended and may be placed by the needles in the desired positions. The time consumed in the operation just described has been about one-half that that necessary to form a shed. Fig. 4 shows the front top-board *a* and the front lifter-board *b* in the position just described. The next movement is a downward one of the top-board and an upward one of the lifter-board simultaneously, and these movements are continued until both boards have returned to their original positions. The time occupied by the last described movement will be one-half that necessary for the formation of a shed. Thus the two half movements above described will occupy the same time and be of the same total extent of one ordinary shed forming operation. All tail-cords that were not engaged by the lifter-board in middle position will be carried by the downward movement of the top-board to lower position. All tail-cords that were engaged by the lifter-board in middle position will be lifted by the lifter-board to the full distance necessary to form a shed. Any tail-cords that were lifted by the lifter-board in the preceding operation but were not engaged by the lifter-board at the middle position of this operation will be returned to lower position.

It will be noted that at the beginning of the above described operation the lifter-board is in upper position having just completed one full upward movement, and that at the end of such operation the lifter-board is in the same position as at the beginning of the operation, that is to say, in upper position. Thus the lifter-board has been operated twice successively and during each operation the tail-cords have been lifted the full distance necessary to form a shed of warp threads and each operation of lifting the tail-cords has been of the same extent and in the same time

and there has been no lost motion and no time wasted in getting into position.

In Fig. 5 are shown Jacquard hooks $f\,f'$, hook-boards $g\,g'$ and griffs $h\,h'$; the front hooks, hook board and griff being lettered f, g and h respectively, and the rear hooks, hook board and griff being lettered f', g' and h' respectively. The Jacquard needles are lettered d, the Jacquard cylinder e and the cards e' as in the other drawings. The operation of this hook jacquard is identically the same as that of the tail-board jacquard. The hook-boards $g\,g'$ perform the same function as the top-boards $a\,a'$. The griffs $h\,h'$ perform the same function as the lifter-boards $b\,b'$, and the hooks $f\,f'$ perform the same function as the tail-cords $c\,c'$. In this drawing Fig. 5, the rear hook-board g' has moved upward a distance equal to one-half the lift of a griff to form a shed and the rear griff h' has moved downward from upper position one-half its full stroke and the rear hooks f' are in position to engage or not to engage with the griff as may be dictated by the needles. The next movement will be a downward one of the hook-board g' to its original position and an upward one of the griff h' to its original position, both movements taking place simultaneously. As the operations in this hook jacquard are identically the same as in the tail-cord jacquard no further description thereof is necessary.

In a power loom the movements of the top boards or hook-boards and of the lifter-boards or griffs are, when my entire invention is employed, effected by the improved cams and connecting mechanism which I will now describe, referring to Figs. 1 to 4 inclusive. Each of the lifter-boards b and b' slides in guides in the side frames $i\,i'$ and is connected by the rods $j\,j$ to operating arms $j'\,j'$. These operating arms $j'\,j'$ are preferably mounted upon a single rock-shaft j^2 as shown in Figs. 1 and 2, but may be mounted upon separate rock-shafts or studs $j^3\,j^3$ as shown in Fig. 3. When the construction employing a single rock-shaft j^2 is used, this rock-shaft is fitted in bearings and extends through to the other side of the machine and the arms j' and connecting rods j are there duplicated; and an arm j^4 is mounted upon the rock-shaft j^2 and connected by a rod j^5 to the cam lever k. When the construction shown in Fig. 3 is employed, each of the arms j' is directly connected by a rod j^6, one for each arm, to cam levers, and two cam levers are used, the one cam lever l being connected to the arm j' of the front lifter-board b and the other cam lever l' being connected to the arm j' of the back lifter-board b'. The front top-board a is also fitted to slide in bearings in the side frames $i\,i'$ and is connected at each side of the frame of the machine by a rod m to a rock-arm m'. Both rock-arms m' are mounted upon the rock-arm m^2 having suitable bearings in the machine and passing from one side of the machine through to the other. One of the arms is directly connected by the connecting rod m^3 to the cam lever n.

Instead of the rock-shafts passing through the machine from one side to the other, short studs may be employed at each side of the machine upon which the various rock-arms are mounted. This will necessitate a duplication on each side of the machine of the cams, cam levers, and connecting rods. I therefore prefer to use rock-shafts. When the arms $j'\,j'$ connected to the front lifter-board b and to the back lifter-board b' are all mounted on the same rock-shaft, the operations of both lifter-boards may be effected by a single cam, cam lever and connecting rod. When these arms j' are mounted upon separate shafts or studs, two cams, cam levers and connecting rods are required, one for the front lifter-board and one for the back lifter-board. I will first describe the preferred construction of a single rock-shaft. This construction is shown in Figs. 1 and 1^a. The cam o is shaped to cause five shed forming operations during each revolution of the cam. In the position shown in Fig. 1 the cam roller k' which is mounted upon the cam lever k has been lifted by the cam to its highest position, and this has caused the back lifter-board b' to be raised to its highest position and the front lifter-board b to be moved downward into its lowest position. At this point in the operation of the loom a shed has been formed and the weft shuttle is thrown. During the next one-fifth revolution of the cam o the cam roller k' will be moved down into lower position and at the end of this one-fifth revolution the cam roller k' will rest upon the point marked 2 of the cam o. The back lifter-board b' will now be in the lowest position and the front lifter-board b in the highest position, another shed will have been formed and the second shot of the weft shuttle will take place. During the second one-fifth revolution of the cam o, the cam roller k' will be lifted back into highest position and at the end of this one-fifth revolution the cam roller k' will rest upon the point marked 3 of the cam o. The back lifter-board b' will now be in highest position and the front lifter-board b in lowest position, another shed will have been formed and the third shot of the weft shuttle will now take place. During the third one-fifth revolution of the cam o, the cam roller k' will be moved back into lowest position and at the end of this one fifth revolution it will rest upon the point marked 4 of the cam o. The back lifter-board b' will now be in lowest position and the front lifter-board b in highest position, another shed will have been formed and the fourth shot of the weft shuttle will now take place. During the next (fourth) one-fifth revolution of the cam o the cam-roller k' will be moved upward half way and then downward again into lowest position, and at the end of this one-fifth revolution it will rest upon the point marked 5 of the cam o. During this one-fifth revolution the back

lifter-board b' will be moved upward half way and then down again to lower position and this movement of the back lifter-board will accomplish nothing and disarrange no part of the weaving mechanism. It will be simply a harmless extra movement necessitated by its connection through the rock-shaft j^2 of the two lifter-boards. The front lifter-board will be, during this fourth one-fifth revolution of the cam, moved downward half way and then moved back again and into upper position. Simultaneously with this upward movement of the front lifter-board b there will be an upward movement of the front top-board a caused by the cam p operating upon the cam lever n' of cam roller n, and this upward movement of the top-board a will be continued for one half of the stroke so that when the front lifter-board b is half way down, the front top-board a will be half way up, and the tail cords will be in position for rearrangement and engagement by the lifter-board. The projection of the cam p which causes this upward movement of the top-board a is of precisely the same shape as the projection of the cam o which causes this downward movement of the lifter-board b. At the end of this one-fifth revolution the top-board a has been returned to its lower and normal position and the lifter-board b has, as above described, been returned to its highest position, another shed has been formed, and the fifth shot of the weft shuttle now takes place. During the next one-fifth revolution of the cam o the operating devices are moved into the position first described, that is, the position shown in Fig. 1.

The construction and operation of cams and connecting mechanism shown in Figs. 3, 3^a, and 4 will be readily understood without specific description. The cam q operates the front lifter-board, the cam r operates the back lifter-board, and the cam s operates the front top board. The sequence of operations of the lifter-boards and top-board is exactly the same as that just described in connection with Figs. 1 and 1^a. In Figs. 3 and 3^a the cams are in the position which I have just described as at the end of the second one-fifth revolution of the cam shown in Fig. 1, that is to say, the back lifter-board b' is down and the front lifter-board b is up. It will be noted that the arrangement of connecting mechanism in Fig. 3 permits the back lifter-board to be held at rest in lower position throughout the one-half downward and one-half upward movement of the front lifter-board b. In Fig. 4 the cams and cam levers are shown at the middle of that movement which I have formerly described as the fourth one-fifth revolution of the cam, that is to say, the cam lever and its connected front lifter-board b have been moved one-half way down, the cam lever m and its connected front top-board a have been moved half way up, and the cam lever l' and its connected back lifter-board b' are in lower position.

In Figs. 6 and 7 I have shown a construction of cams for producing a six shot fabric, that is to say, a fabric in which the weft threads are arranged in sets of six in a set, according to my invention. In this construction each of the two top boards is independently operated in the manner hereinafter described. Four cams are employed, the cam t operating the front lifter-board or griff, the cam u operating the back lifter-board or griff, the cam v operating the front top-board or hook-board, and the cam w operating the back top-board or hook-board. A shed is formed during each one-sixth revolution of this cam. I will now describe the sequence of operations commencing with the cam in such position that the cam rollers are in the radial line marked 1. The positions of the lifter-boards at the termination of each shed forming operation are shown by the following table:—

	Front lifter board.	Back lifter board.
1	Up	Down
2	Down	Up
3	Down	Up
4	Up	Down
5	Up	Down
6	Down	Up

The movements of the lifter-boards and top-boards are as follows:—Between 1 and 2 the front lifter-board moves downward to lower position and the back lifter-board moves upward to higher position. Between 2 and 3 the front lifter-board remains at rest in lower position; the back lifter-board moves down half way from upper position and then back again to upper position; and the back top-board moves up a distance equal to a half lift of the lifter-boards and then moves down again to lower position. Between 3 and 4 the front lifter-board moves upward to higher position and the back lifter board moves downward to lower position. Between 4 and 5 the front lifter board moves down half way from upper position and then back again to upper position; the back lifter-board remains at rest in lower position; and the front top-board moves up a distance equal to a half lift of the lifter-boards and then moves down again to lower position. Between 5 and 6 the front lifter-board moves down to lower position and the back lifter board up to higher position. Between 6 and 1 the front lifter-board moves up to higher position and the back lifter board moves down to lower position.

What I claim, and desire to secure by Letters Patent, is—

1. A double acting Jacquard mechanism for looms consisting of suitable needles, each needle having two eyes and each eye controlling a tail-cord or hook cards and card operating mechanism, tail-cords or hooks divided into two sets, each needle controlling tail-cords or hooks of both sets two reciprocating lifter-

boards or griffs, one lifter-board or griff controlling each set of cords or hooks, means for operating the lifter-boards or griffs, and a top-board or hook-board carrying one set of the tail-cords or hooks and another top-board or hook-board carrying the other set of tail-cords or hooks and means for operating one of such top-boards or hook-boards while the other top-board or hook-board is at rest, substantially as and for the purpose set forth.

2. A double acting Jacquard mechanism for looms consisting of suitable needles, each needle having two eyes and each eye cotrolling a tail-cord or hook cards and card operating mechanism, tail-cords or hooks divided into two sets, each needle controlling tail-cords or hooks of both sets two lifter-boards or griffs, one lifter-board or griff controlling each set of cords or hooks, a cam or cams and connecting mechanism for imparting full and half strokes to the lifter-boards or griffs, and a top-board or hook-board carrying one set of the tail cords or hooks and another top-board or hook-board carrying the other set of the tail cords or hooks, and a cam and connecting mechanism for operating a top-board or hook-board simultaneously with a half movement of the corresponding lifter-board or griff, substantially as and for the purpose set forth.

3. A double acting Jacquard mechanism for looms, consisting of suitable needles, each needle having two eyes and each eye controlling a tail-cord or hook cards and card operating mechanism, tail-cords or hooks divided into two sets, each needle controlling tail-cords or hooks of both sets two reciprocating lifter-boards or griffs, one lifter-board or griff controlling each set of cords or hooks, a cam or cams and connecting mechanism for imparting full and half strokes to the lifter-boards or griffs, and the cam p and connecting mechanism for operating a top-board or hook-board, substantially as and for the purpose set forth.

4. A double acting Jacquard mechanism for looms, consisting of suitable needles, cards and card operating mechanism, tail-cords or hooks divided into two sets, two top boards or hook boards supporting said tail-cords or hooks two reciprocating lifter-boards or griffs, one lifter-board or griff controlling each set of cords or hooks, the cam o, the rock-shaft j^2 and connecting mechanism for operating both of the lifter boards or griffs, and the cam p and connecting mechanism for operating a top-board or hook-board, substantially as and for the purpose set forth.

HARRY HARDWICK.

Witnesses:
WILLIS GOWDY,
TUDOR GOWDY.