

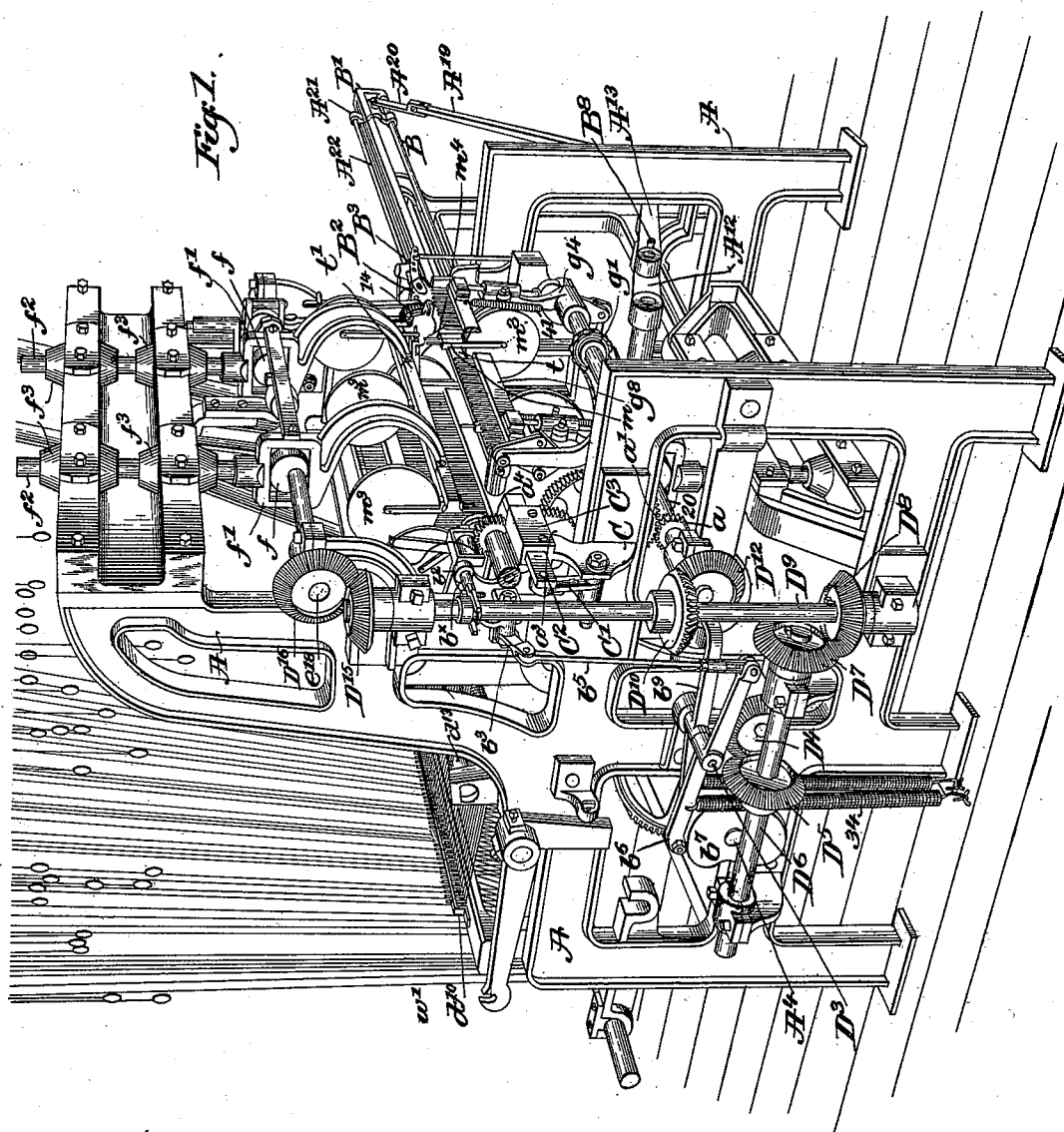
(No Model.)

10 Sheets—Sheet 1.

C. CROMPTON.  
LOOM FOR WEAVING CANE.

No. 550,068.

Patented Nov. 19, 1895.



Witnesses.  
A. Harmon  
Fred S. Guntz.

Inventor.  
Charles Crompton  
by Crosby & Ingham attys.

(No Model.)

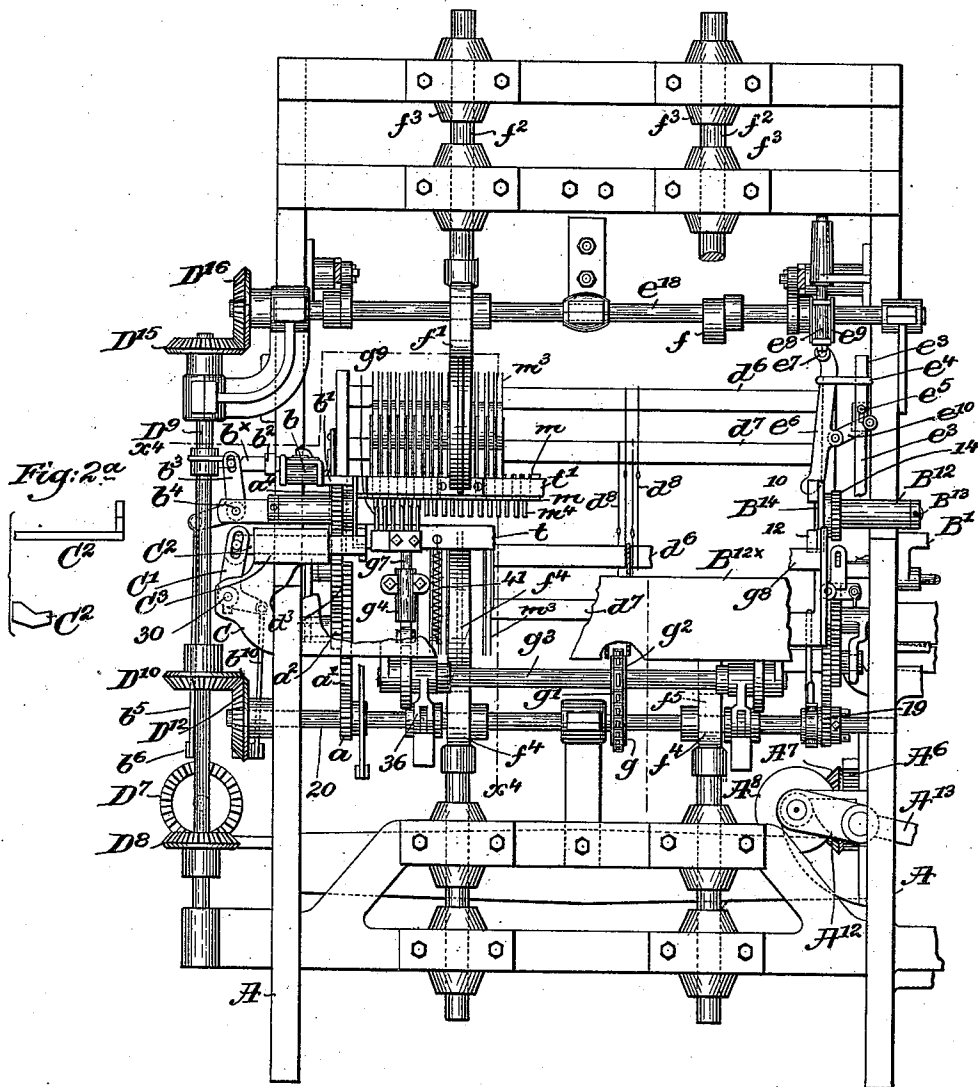
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*Fig: 2.*



*Witnesses.*

W. C. Harmon  
Fred S. Grunke.

*Inventor:*

Charles Crompton  
by Crosby & Gregory attys.

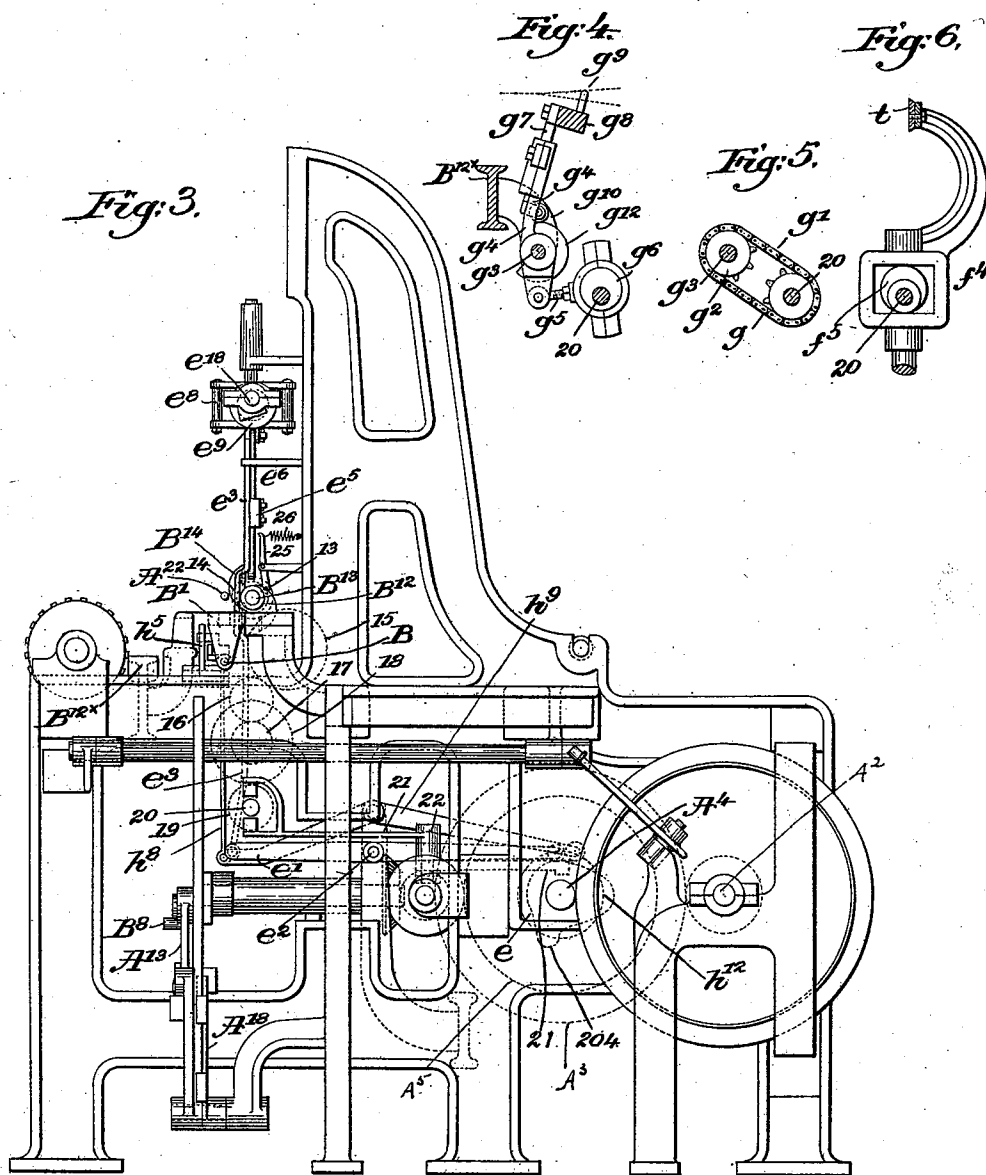
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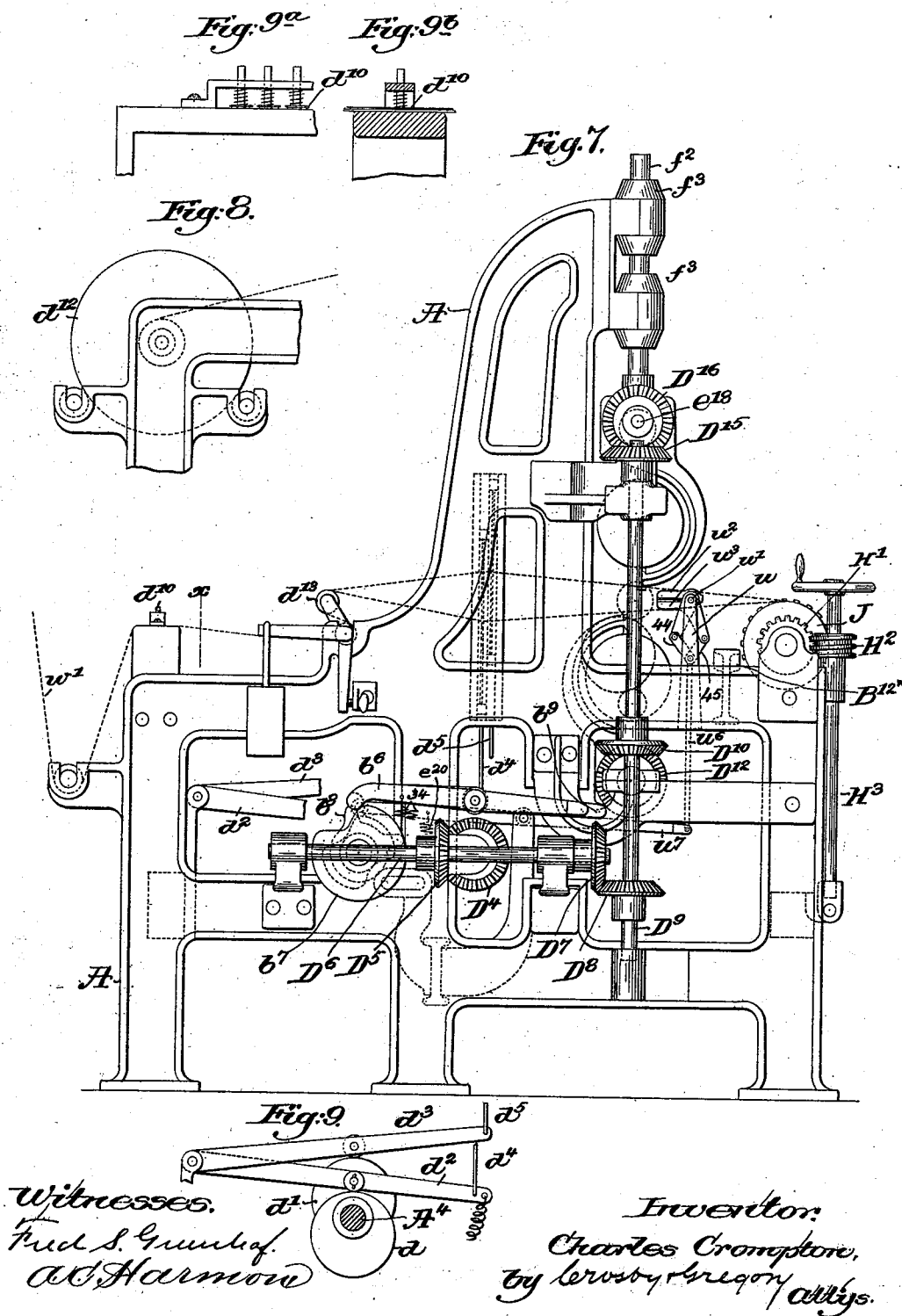
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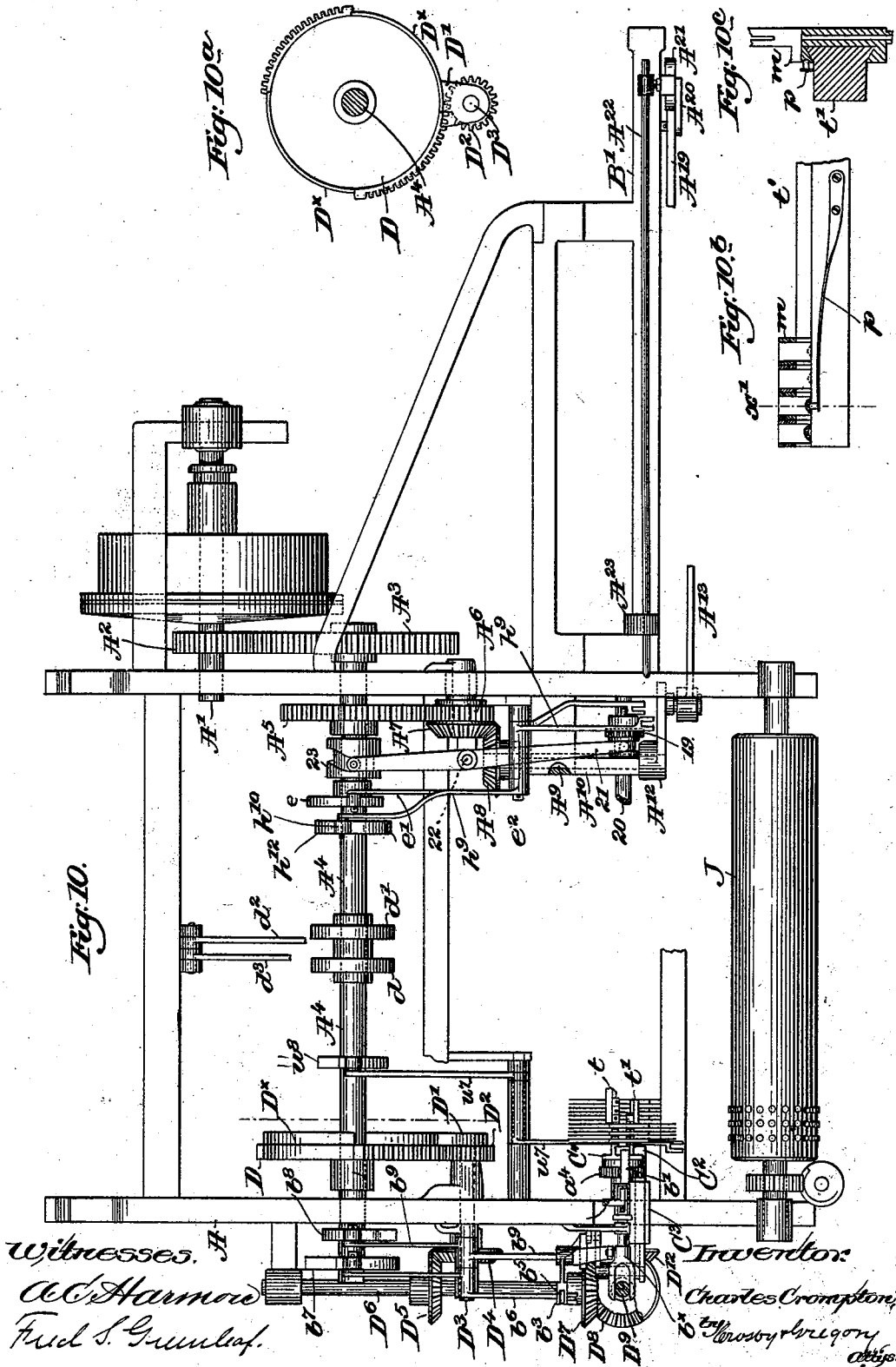
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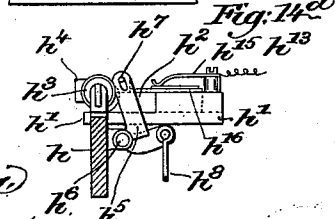
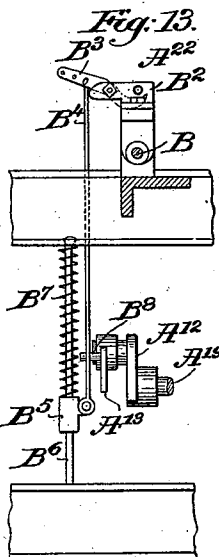
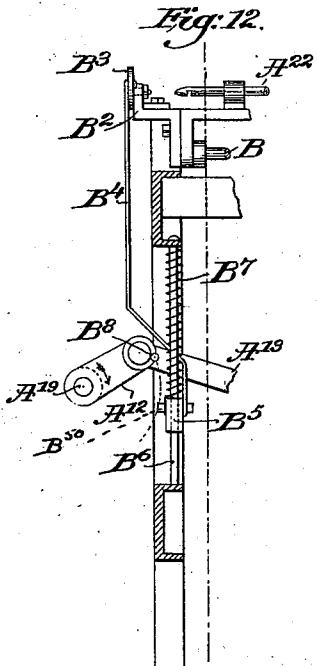
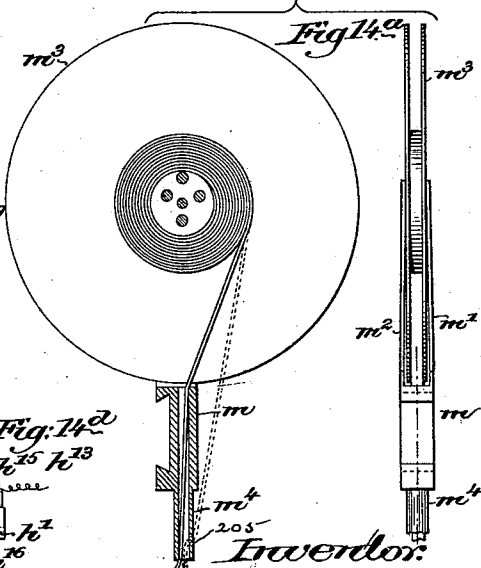
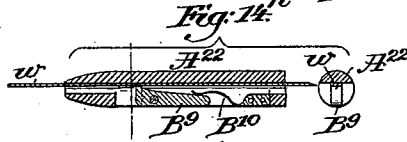
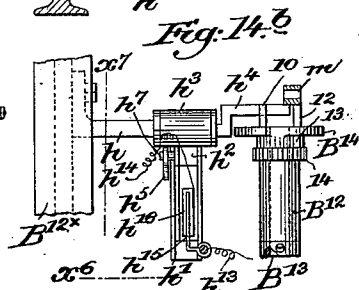
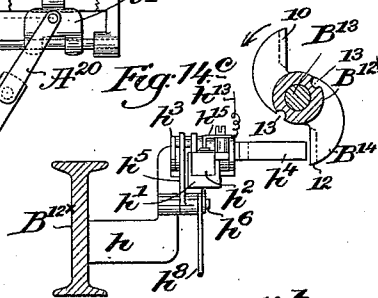
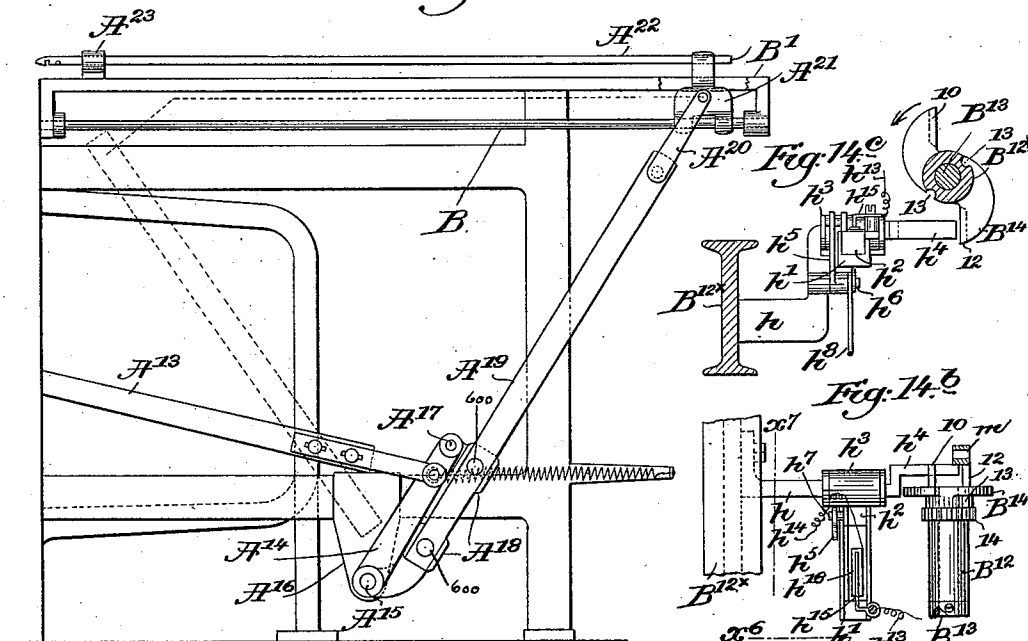


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Fig. 11.



Witnesses.  
A. Harmon  
Fred S. Grant.

Inventor.  
Charles Crompton  
by Crosby & Gregory

(No Model.)

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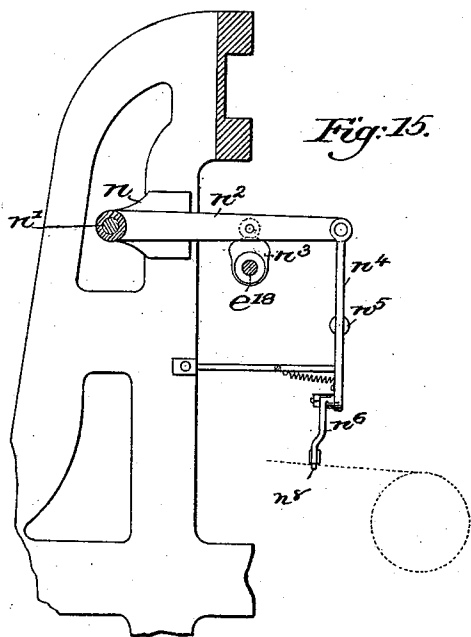


Fig. 15.

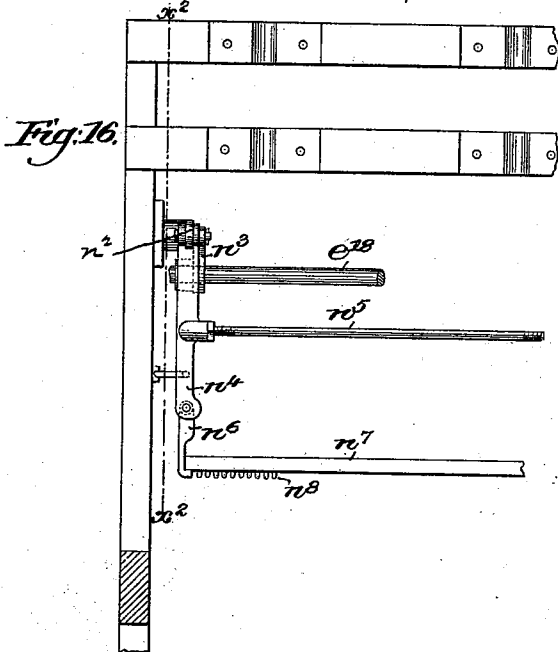


Fig. 16.

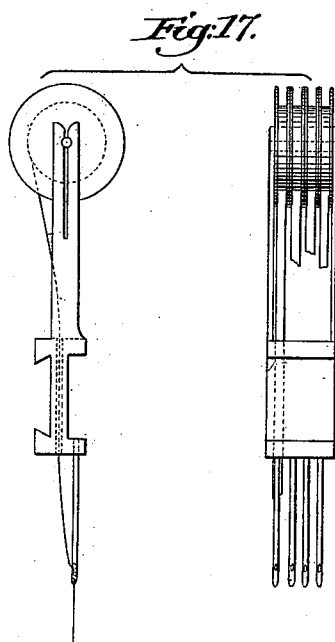


Fig. 17.

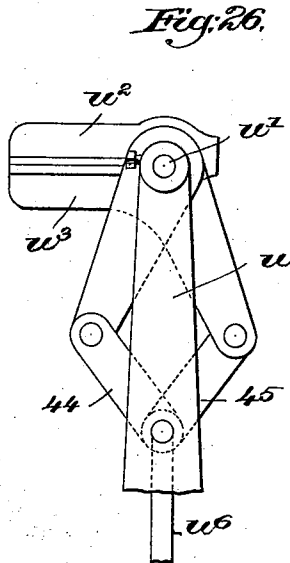


Fig. 26.

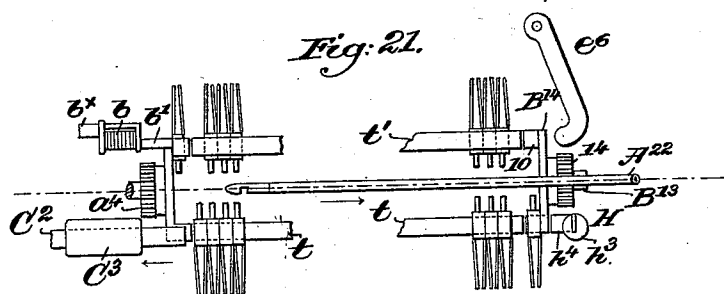
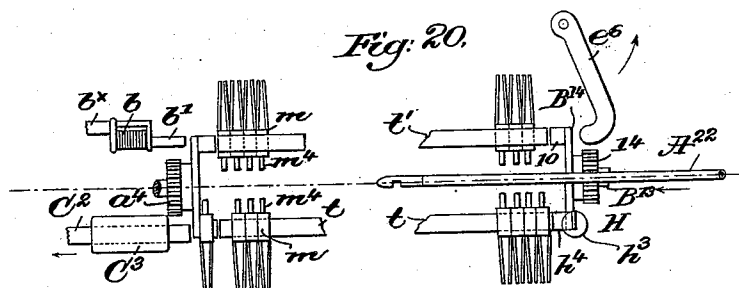
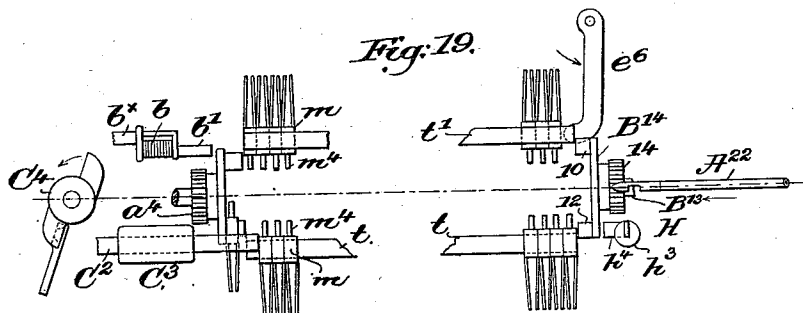
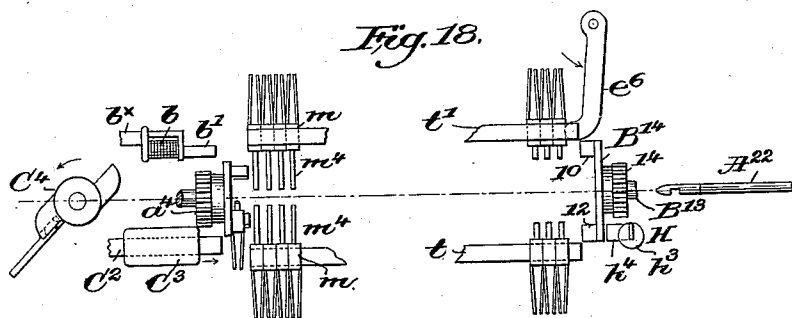
Witnesses.  
A. C. Harmon  
Fred S. Gunkel

Inventor.  
Charles Crompton  
by Crosby & Morgan

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Witnesses.  
ad Harmon  
Fred S. Grunhof.

Inventor.  
Charles Crompton,  
by Crosby & Gregory Attys.



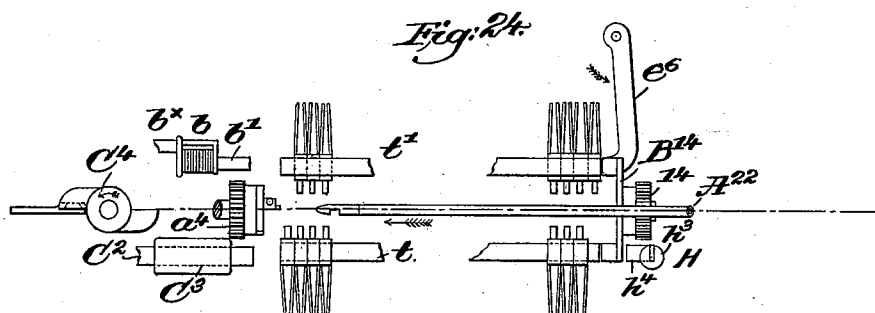
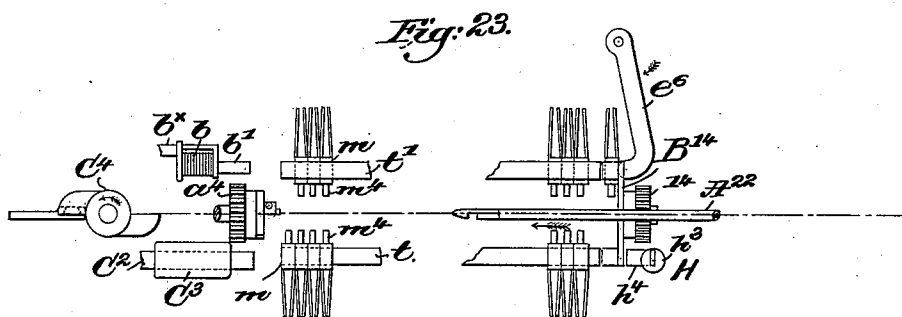
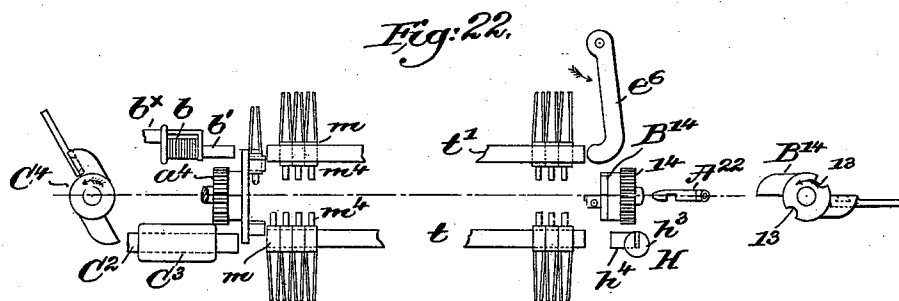
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Witnesses.

Fred S. Grumbaf.  
A. C. Harmon

Inventor

Charles Crompton,  
by Crosby & Gregory attys.

(No Model.)

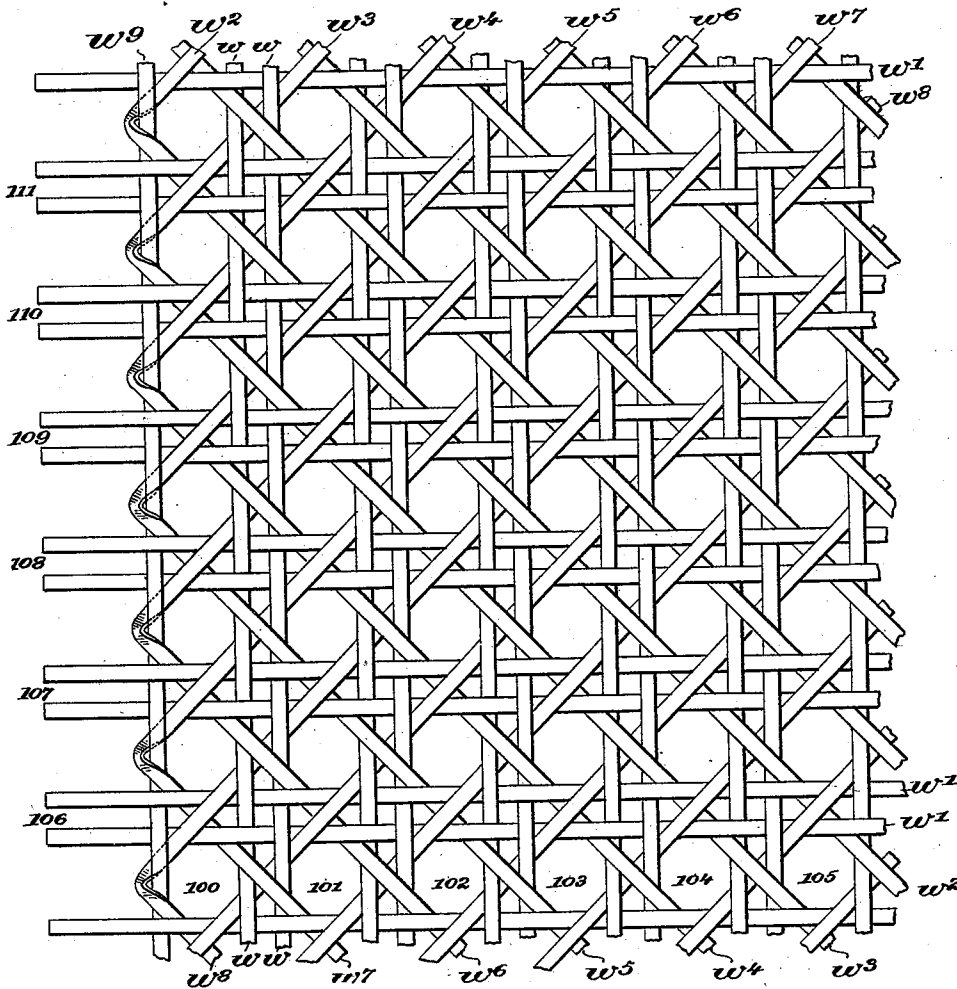
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*Fig. 25.*



*Witnesses.*

*W. H. Harnow*  
*Fred L. Grunke*

*Inventor.*

*Charles Crompton*  
*by Crosby Gregory* *attys.*

# UNITED STATES PATENT OFFICE.

CHARLES CROMPTON, OF WORCESTER, MASSACHUSETTS.

## LOOM FOR WEAVING CANE.

SPECIFICATION forming part of Letters Patent No. 550,068, dated November 19, 1895.

Application filed June 8, 1894. Serial No. 513,870. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES CROMPTON, of Worcester, county of Worcester, State of Massachusetts, have invented an Improvement in Looms for Weaving Cane, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention has for its object the production of a loom for the automatic manufacture of fabric having warp and weft crossing one the other and also having diagonal warp, my novel loom being adapted, among other things, to the weaving of that class of fabric employed for chair and other seats wherein cane and similar stiff material is used, the construction and operation of the parts being such that the natural hardened shell of the cane may be presented always at one side of the fabric being produced; but it will be understood that I may, in my novel loom, use warp and weft and diagonal warp of any usual or suitable materials, that depending upon the fabric which it is desired to produce.

My improved loom contains a plurality of tracks, one or more of them, preferably all of them, having an up-and-down movement and having loosely mounted upon them a series of diagonal warp-carriers, represented as spools or disks provided with needles or tubes through which the diagonal warps are led independently into the fabric. These diagonal warp-carriers are free to be slid along said tracks step by step from one to the other side of the loom or the fabric being woven therein, the movement being effected by suitable pushers to be described, so that a diagonal warp wound upon a warp-carrier may be inserted at one pick at or near one selvage and then be moved laterally to insert its thread at a subsequent pick at a point farther from the selvage of the fabric, and so on across the fabric.

It will be understood that the carriers having the diagonal warp which are moved across the loom in one direction in weaving must, in order to make a uniform fabric, travel back across the loom in the opposite direction, and to do this the carriers are made to travel in one direction on one track and back on another track, and in the form in which I have chosen

to illustrate my invention one of the tracks is above and another track below the main or body warp of the fabric; but my invention would be useful and practical for the production of some classes of fabric if the tracks were all in substantially the same horizontal plane rather than in different horizontal planes.

To enable me to take the carriers intermittently from one to the other track, however relatively located, I have devised a transferer upon which said carriers may be placed one after another at the proper times or in an established order, by a pick-off to be described, and said transferer—it having received a carrier—is then moved to place the carrier just deposited upon it, opposite the end of the other track upon which the carrier is to be applied preparatory to traversing the loom or fabric in the opposite direction, the carrier being removed from the transferer by a pusher, there being a pick-off and a pusher for each transferer, as will be hereinafter described.

In the form in which I have chosen to illustrate my invention—it being supposed that the spool of the carrier is supplied with a diagonal warp having a glazed face, as is the case when cane is used—it is obvious that the said face must be presented always at the same side of the fabric—as, for instance, the face of the fabric—and to provide for this I have devised mechanism whereby the carrier, in moving from above the body-warps into position below the body-warps, is made to travel through an arc of about one hundred and eighty degrees, and when the carrier goes from the lower to the upper track it is moved back in the same arc, but at the opposite edge of the fabric, instead of rotating in a complete circle.

To insure the most compact arrangement of the working parts and to enable the weft-inserter or needle employed to introduce the filling or weft to work closely into the shed and close to the tubes of the carriers, I have devised means whereby the transferer used to take a carrier from the upper and put it opposite the lower track is moved for about ninety degrees at each step, while the transferer at that side of the loom where the needle referred to enters the shed is moved twice

as fast and through an arc of one hundred and eighty degrees substantially at each step. The carriers are mounted loosely side by side on the track and are more or less in number, according to the width or character of the fabric; and to provide for sliding the entire series of carriers along the track, in order that the strands contained by the carriers may be laid diagonally, I have devised means for imparting such movement to the pusher that it acts not only to move a carrier from a transferer onto a track, but also to move the entire series of carriers on the track when the tubes or needles thereof are unobstructed by body-warps, thus shifting the entire series of carriers for a suitable distance, according to the fabric being woven, and, as I have herein illustrated my invention, the lateral shifting of the carriers is effected on the uppermost track while the latter is in or about in its elevated position, said pusher leaving the endmost carrier acted directly upon by it sufficiently distant from the receiving end of said track to afford ample space for the reception of the next carrier which it is desired to put onto said track, said carrier being brought by a transferer opposite the receiving end of said track.

In the form in which I have herein illustrated my invention I have utilized one and the same pusher, as stated, to not only shift the entire series of carriers on the track, but also to put a carrier from a transferer onto said track; but my invention is not in this particular necessarily limited to the use of one and the same pusher, as it will be obvious to one skilled in the art that other pusher contrivances might be devised for pushing a carrier from a transferer onto a track and for pushing the entire series of carriers on the track with but the exercise of mechanical rather than inventive skill.

In the loom to be herein described the transferer located at that side of the loom opposite where the weft-inserter or needle enters the shed has, as stated, a movement substantially one-half slower than the transferer at the other side, and I have chosen to divide its movement into two steps, there being a dwell at about ninety degrees, and during the first of said steps the transferer at that side of the loom where the weft-needle enters the shed has imparted to it a movement over its one hundred and eighty degrees, it then remaining stationary while the other carrier completes its second step.

The peculiar but not absolutely necessary timing referred to enables me to use the pusher not only to shift laterally the series of carriers, as described, but also to put a carrier onto the track and the auxiliary pusher at the other side of the loom is also made to perform a like duty in connection with the other track, not only to move the series of carriers bodily on the other track, but also to push a carrier from the auxiliary transferer onto said track. The movements of the pushers to push a carrier from a transferer onto a

track will preferably be of such extent as to put the carrier on the track without necessarily displacing any of the carriers already on the track. To certainly take the carriers, one after another, from one end of the track and put them onto the transferers, I have devised a pick-off which, in this present form of my invention, is made as a magnet, said pick-off being made at the proper times to engage one of the carriers and, having engaged the same, be moved away from the track to thus pick or pull off therefrom a carrier and put it onto a transferer, by which it is moved next the end of another track. These magnets will preferably be of soft iron connected in electric circuit so as to be excited when they are to engage a carrier and put it onto a transferer. I have also devised what I may designate as a "mesh-gage," it serving to gage the size of the open spaces or meshes of the fabric, said mesh-gage consisting, essentially, of a bar having a series of pins to enter the spaces between the warps vacated by the reed, and remain there while the shed is formed and for one or more picks, preferably two picks, or while the filling is being laid to make the other side of a row of meshes or openings.

The reed employed by me consists, essentially, of a bar having a series of strong upright pins, the free ends of which, as the reed goes forward to beat in the filling or weft, rises between the warps, both the body-warps and the diagonal warps.

During alternate forward movements of the lay to beat in the filling or weft the carriers are shifted laterally upon their tracks and the next shed is formed, the lateral movement of the carriers causing the diagonal warps carried by them to be laid or placed diagonally across the spaces between the adjacent body-warps, thus closing the path through which the pins of the reed moved when the latter was driven forward to the breast-beam. Owing to this diagonal position of some of the warps, as above stated, it will be obvious that the pins of the reed cannot be moved back in exactly the same path, so I have devised means whereby the reed, it having beaten in the filling or weft, may be dropped or lowered at alternate picks, so that the upper ends of its pins may be withdrawn completely from between the warps preparatory to and while the reed is being moved backward or away from the fell, it being raised again between the warps, as it is again to go forward to beat the filling or weft into the fabric.

The movement of a reed into the warp spaces and then completely out from said warp spaces, whether at alternate or at every pick, is an important element of my invention.

The upward and downward movement of the tracks on which the carriers are made to slide laterally enables the ends of the tubes or needles of the carriers to place the diagonal warps above or below the plane of the

body-warps at the proper times, so as to form between the said diagonal warps and body-warps proper sheds for the passage of the weft inserter or needle employed to insert the filling or weft in the shed. I have also combined with the weft-inserter, when made as a needle, a cutting mechanism, which severs the weft-strand, which may be of cane, between the edge of the fabric and the end of the needle after the latter has been retracted from the shed, the said needle during its retraction from the shed sliding along the weft-strand held at the opposite edge of the fabric by a suitable clamp. If the weft should not be cut off, as stated, it would have to be inserted double into the shed, which is not desirable with cane and the like stiff weft-strand. Cutting the weft-strand off uniformly distant from the end of the needle also enables just the proper amount of weft-strand protruding from the end of the needle to be grasped by the weft clamp or catcher at the edge of the fabric opposite that at which the needle enters the shed; but in case a spun filling should be used this cutting mechanism would be omitted, and the catcher might be of any known kind, such as usually employed in connection with looms using a needle for the insertion of filling or weft—as, for instance, as in looms for weaving tufted carpets and the like.

This invention is not limited to any particular number of sets of tracks and carriers mounted thereon or the number of tubes or guides connected with each carrier, as that may depend upon the particular pattern or class of fabric to be woven. Nor is the invention to be hereinafter described limited to the particular devices herein to be shown for actuating the essential parts hereinbefore briefly defined, as said actuating means may be varied within the skill of a mechanic and without the exercise of invention.

Different patterns of open-meshed and other fabrics may be woven by the employment of carriers having the capacity of supplying diagonal warps of different character, or by locking the differing diagonal warps into the fabric at desired distances apart and in desired orders.

Prior to my invention I am not aware that a loom has ever been provided with a series of warp-carrying spools which are adapted to be moved across the fabric being woven step by step along one track and then returned automatically along another track, or returned in any manner along a track.

Having described the position occupied by my invention with relation to the state of the art and believing my invention to be a broad one, the particular features claimed by me will be hereinafter more fully described in the specification to follow, and in the claims at the end thereof.

Figure 1, in perspective, shows a loom embodying my invention, the breast or feeding roll and some of the parts at the front of the

loom, together with most of the diagonal warp-carriers and needles, being omitted. Fig. 2 is a partial front elevation of the loom, the breast or feeding roll being omitted and some of the parts which are duplicates being left off, other parts being omitted to show parts at the rear, said figure showing the reed and tracks *t t'* broken mostly away, the part left of the upper track having on it a series of carriers arranged closely together as they will in practice be arranged on each track. Fig. 2<sup>a</sup> shows a top view and an inner end view of the auxiliary pusher co-operating with the lower track. Fig. 3 is an elevation showing some of the parts at the right-hand side of the loom and some of the levers and devices just inside the said framework, as shown in Fig. 10; Fig. 4, a detail as to the mechanism for actuating the lathe; Fig. 5, a detail of the driving mechanism for the lathe-shaft. Fig. 6 shows part of the track *t*, its support, and actuating-cam. Fig. 7 is a left-hand elevation of the loom, the transferrer, pick-off, and their actuating parts shown in Figs. 1 and 2 being omitted; Fig. 8, a modification to be referred to to enable the loom to be provided with textile body-warps; Fig. 9, a detail of the harness levers and cams; Fig. 9<sup>a</sup>, a view looking to the left of the section line *x*, Fig. 7; Fig. 9<sup>b</sup>, a section of the parts shown in Fig. 9<sup>a</sup>. Fig. 10 is a detail view in plan of parts of the loom below the irregular dotted line *x'*, Fig. 2. Fig. 10<sup>a</sup> shows the dwell-gear in side elevation, together with the shaft actuated by it; Fig. 10<sup>b</sup>, a detail showing part of track *t'* with some diagonal warp or strand carriers thereon in section and a locking device to hold one of the carriers; Fig. 10<sup>c</sup>, a section on the line *x'*, Fig. 10<sup>b</sup>. Figs. 11, 12, 13, and 14 are details showing the weft-inserting needle or device and its actuating means. Fig. 14<sup>a</sup>, on a larger scale, shows in elevation and in section a diagonal warp-carrier and its spool detached; Fig. 14<sup>b</sup>, a top or plan view of the pick-off at the right-hand side of the loom; Fig. 14<sup>c</sup>, a view looking from the dotted line *x''*, Fig. 14<sup>b</sup>; Fig. 14<sup>d</sup>, a section at one side the dotted line *x'*, Fig. 14<sup>b</sup>. Fig. 15 is a sectional detail on line *x''*, Fig. 16, showing the mesh-gage and its actuating devices omitted from Figs. 1, 2, 3, and 4; Fig. 16, a front end view of the devices shown in Fig. 15. Fig. 17 shows a modified form of diagonal warp-carrier having a plurality of needles. Figs. 18 to 24, inclusive, show parts of the tracks with some diagonal warp-carriers thereon, the spools or bobbins of the carriers being omitted, the transferrers, the two pushers, the pick-offs, and the weft-inserting needle, said figures showing different positions of said carriers throughout a round or cycle of their operation, some of said figures also showing alongside of them the positions of the transferrers at one or the other ends of the tracks when the diagonal warp-carriers are in the positions shown in the particular figures, Fig. 18 showing some of the tubes of their full length,

most of the tubes on said figures being, however, shortened to avoid crowding the drawing. Fig. 25 shows a few body and diagonal warp-threads united by a weft to make a cane fabric. Fig. 26 is an enlarged detail of the weft-detainer or clamp.

The loom-frame A is and may be of suitable shape to sustain the working parts. The frame has bearings for a suitable power-shaft A', (see Fig. 10,) provided with any usual or suitable driving-pulley under the control of a suitable shipper or device, whereby the loom may be started or stopped, as desired. The power-shaft has a pinion A<sup>2</sup>, which engages a tooth-gear A<sup>3</sup>, fast on the main or cam shaft A<sup>4</sup>, said cam-shaft being provided as represented, with a tooth-gear A<sup>5</sup>, which acts upon an intermediate pinion A<sup>6</sup> and rotates a bevel-bear A<sup>7</sup>, which in turn engages a bevel-gear A<sup>8</sup>, mounted on a short shaft A<sup>9</sup>, supported in suitable bearings in a stand A<sup>10</sup>, connected with the loom-frame, said shaft having an arm A<sup>12</sup>, to which is suitably connected a link A<sup>13</sup>, in turn jointed (see Fig. 11) to an arm A<sup>14</sup>, pivoted at A<sup>15</sup> on a stand A<sup>16</sup>, said arm A<sup>14</sup> having a bearing at its upper end for the reception of a stud A<sup>17</sup>, on which is mounted to turn a hub connected to the upper end of a casting A<sup>18</sup>, mounted to turn on the pivot A<sup>15</sup>, and shaped to have bolted to it by bolts 600, and thus constitute a holder for the lower end of the lever A<sup>19</sup>, the upper end of said lever being attached by a link A<sup>20</sup> to a carriage A<sup>21</sup>, to which, in this instance of my invention, is attached one end of the weft inserter or needle A<sup>22</sup>, used to introduce the weft, said inserter or needle being represented as hollow and as adapted to slide in a guide A<sup>23</sup>. The carriage A<sup>21</sup> runs freely on a rod B, fixed with relation to the framework, the carriage being prevented from overturning by entering a slot (shown best in Fig. 1) in guide B'. The inner end of the weft-inserter is also, in this instance of my invention, made to work through a hole in a block B<sup>2</sup>, (see Figs. 1, 12, and 13), said block also forming one member of a weft-cutting mechanism, the other member thereof consisting of a blade or device B<sup>3</sup>, represented as pivoted and as connected by a rod B<sup>4</sup> with a slide B<sup>5</sup>, mounted on a guide B<sup>6</sup>, said slide being normally elevated, in this instance of my invention, by a contractile spring B<sup>7</sup>, the said slide being adapted to be depressed at the proper time to actuate the cutter and cut off the filling, as will be described, by the action of a pin B<sup>8</sup>, which may be carried by the link A<sup>13</sup> before described, said pin acting on a projecting part or shelf B<sup>50</sup> of the slide B<sup>5</sup>. The weft inserter or needle herein shown has at its inner end (see Fig. 14) a pivoted dog B<sup>9</sup>, which is acted upon by a suitable spring B<sup>10</sup>, so that said dog engages the weft or filling led through said needle, and acts to carry the same positively with it into the shed, such dog or some equivalent device being necessary, especially when the filling is of a stiff

or slippery material like cane or wire. This invention is not, however, limited to the particular construction shown for the filling-inserter, nor to the means for actuating it, as it may derive its motion in various ways and produce the same result, and instead of the particular filling-inserter I may use any other usual or suitable filling-inserter adapted, for instance, to insert a textile or spun filling, as in weaving of textile fabrics.

Suitably supported upon the loom above and back beyond the guide B', (see Figs. 1, 2, 3, 14<sup>b</sup>, and 14<sup>c</sup>,) is a bearing B<sup>12</sup>, which receives the shaft B<sup>13</sup> of the transferrer B<sup>14</sup>, said transferrer having two arms from which project wings 10 and 12. The head of the transferrer B<sup>14</sup> (see Figs. 3 and 14<sup>c</sup>) has two notches 13, and the shaft of the transferrer has fast upon it a tooth-gear 14, (see Figs. 1, 2, 14<sup>b</sup>, and 18,) which is engaged and rotated at proper times by a train of gears (see dotted lines, Fig. 3) composed of a gear 15, a pinion 16, engaged by a pinion 17, fast on a gear 18, driven by a pinion 19, splined on a shaft 20, and having an annularly-grooved hub embraced by the forked end of a lever 21, mounted on a stud 22, and having at its rear end a suitable roller or other stud which enters the groove in the cam-hub 23, fast on shaft A<sup>4</sup>, so as to slide gear 19 into and out of engagement at regular intervals with relation to gear 18. The shaft of the transferrer B<sup>14</sup> is thus rotated intermittently by the gears referred to at the proper times, and its wings 10 12 must be made to stand evenly and squarely with relation to the tracks *t t'* to be described, and to aid in positioning these wings accurately I have provided the loom with a locking device 25, (see Fig. 3,) composed, as herein represented, of a lever having a roll, a spring 26 acting on the lever causing said roll to ride on a hub of the transferrer and enter one of the two notches 13 thereof (see Fig. 14<sup>c</sup>) as soon as the wings of said transferrer arrive in alignment with the tracks.

Each transferrer will in practice have a like locking device. Instead of the particular locking device shown, I may employ any other equivalent device.

The diagonal warp-carrier (see Fig. 14<sup>a</sup>) is composed, essentially, of a body part *m*, grooved to fit and slide on a track *t* or *t'*, said body having arms *m'* *m''*, between which is mounted a spool or disk-bobbin *m'''*, on which is wound the diagonal weft, said weft being either cane, wire, or fibrous material, and a needle or tube *m<sup>4</sup>*, having a suitable delivery-eye *m<sup>40</sup>* for the diagonal warp. As shown in Figs. 1, 2, and 14<sup>a</sup>, the spool or bobbin is very thin and its side walls are separated about the width of the cane, and the journals of the spool projected from each end thereof enter notches in the arms *m'* *m''*, as shown in Fig. 17, they being preferably spring-arms to bear against the spool and by their friction prevent the too rapid or easy rotation thereof. The notches in the bodies of the carriers are shown as of

dovetail shape in cross-section, and the tracks embraced by said bodies are of like shape, so that said carriers may be slid along said tracks from end to end and be transferred from one to the other track.

The loom near its front has a cross-brace or girth  $B^{12x}$ . (Shown partially in Figs. 2, 14<sup>b</sup>, and 14<sup>c</sup> and represented by dotted lines in Figs. 3 and 7.) To the inner side of the girth is suitably bolted a stand  $h$ , (see Figs. 14<sup>b</sup> and 14<sup>c</sup>,) having a guideway  $h'$ , in which is placed the shank  $h^2$  of a pick-off device having, as herein shown, an electromagnet  $h^3$ , provided with an extended pole-piece  $h^4$ , which is adapted to engage a portion of one of the diagonal warp-carriers  $m$ , preferably its body, the magnet, it having been excited, engaging and pulling the carrier from the lowermost track  $t$  and putting it upon that wing of the transferrer  $B^{14}$ , then opposite it, the pick-off during such operation being moved positively by suitable actuating mechanism, herein represented as a lever  $h^5$ , mounted on a stud  $h^6$  of the stand  $h$ , said lever at its upper end being slotted to embrace a stud  $h^7$ , projected from the shank  $h^2$ , the opposite end of said lever having jointed to it a rod  $h^8$ , in turn attached to one arm of a rocker-shaft  $h^9$ , having its rearwardly-extended arm provided with a roller or other stud  $h^{10}$ , which bears upon a cam  $h^{12}$ , (see Fig. 10,) fast on the main shaft  $A^4$ . The magnet referred to is in an electric circuit on wires  $h^{13}$   $h^{14}$ , the finger  $h^{15}$  connected with the wire  $h^{13}$  making electrical connection with the metal plate  $h^{16}$ , carried by the shank of the magnet, so that when the magnet is thrown back out of working position the circuit will be broken, and when in position to engage a part of a diagonal warp-carrier and pull it off a track the circuit will be closed.

Going now to the opposite side of the loom, the loom side has a stand  $C$ , (see Fig. 2,) which receives a stud 30, upon which is mounted an elbow-lever  $C'$ , one arm of which is slotted to embrace a pin on the auxiliary pusher  $C^2$ , represented as a bar adapted to slide in a bearing  $C^3$ , fixed to said stand, the inner end of said pusher being shaped substantially as shown in Figs. 2 and 2<sup>a</sup>, to act upon a part of one of the diagonal warp-carriers, as in Figs. 20 and 21, and push it from the lowermost wing of the transferrer  $C^4$ , located at that side of the loom, and put the said carrier onto the lowermost track  $t$  at the desired time, and also to act a second time, as represented in Figs. 18 and 19, where the tracks  $t$   $t'$  are separated to meet the endmost carrier on the track  $t$ , and push or feed the entire series of carriers along on the said track in order that at the next shed the said carriers may put the diagonal warps carried by them into the fabric a little farther distant from the edge of the fabric from which the said carrier is traveling.

The transferrer  $C^4$  at the left-hand side of the loom is just like the transferrer  $B^{14}$  at the

right-hand side of the loom and before described, so I have omitted it from Fig. 1, but I have shown in place the pinion  $a^4$  on its shaft, which pinion is rotated by a train of gearing slightly different from that for moving pinion 14 on transferrer  $B^{14}$ , there being one less gear in the train for driving transferrer  $C^4$ , said gears being also of a different size, so that said transferrer  $C^4$  has imparted to it not only a slower motion, but a motion in the opposite direction from that of the transferrer  $B^{14}$ .

The direction of rotation of the transferrer  $C^4$  is such as to take a carrier from the upper track  $t'$  and carry it back and down to the lower track in substantially two steps of about ninety degrees each; but the direction of rotation of the transferrer  $B^{14}$  is such as to take a carrier from the lower track  $t$  and move backwardly and upwardly to the upper track, and the transferrer  $B^{14}$  turns through an arc of substantially one hundred and eighty degrees, while the transferrer  $C^4$  travels through an arc of substantially ninety degrees.

The transferrer  $B^{14}$  takes a carrier from the lower track and carries it by a quick motion to the upper track and then rests while the weft-inserter enters and retires from the shed, and when the transferrer  $B^{14}$  rests the transferrer  $C^4$  is completing the second half of its movement.

Referring to Fig. 2, the shaft 20 has fast on it a pinion  $a$ , which engages a toothed gear  $a'$ , the hub of which has a pinion  $a^2$ , which engages a gear  $a^3$ , which in turn engages the gear  $a^4$ , fast on the shaft of the transferrer  $C^4$ . By working the transferers in opposite directions, as stated, or down in the rear half of a circle and up again in the same half of the circle at the opposite ends of the tracks it is possible to keep the same natural hard-coated face of a strand of diagonal warp uppermost whether the same is being introduced into the fabric from the upper side or from the lower side of the body or standing warps.

The shaft  $A^4$  has fast upon it a dwell-gear  $D$ , it being herein represented as provided with two segmental series or sets of teeth, (see Figs. 10 and 10<sup>a</sup>,) each extended for about ninety degrees about its periphery and about ninety degrees apart, the said gear having extended laterally from it opposite its blank spaces segmental flanges  $D^x$ , which are acted upon intermittently by a locking projection  $D'$ , connected to a pinion  $D^2$ , having preferably one of its teeth removed, so that said dwell-gear may rotate said pinion intermittently, said pinion in the present embodiment of my invention being rotated once and then left at rest until again to be rotated. The pinion  $D^2$  is fast on a short shaft  $D^3$ , having a bevel-gear  $D^4$ , which engages a bevel-gear  $D^5$  on a shaft  $D^6$ , having a second bevel-gear  $D^7$ , engaging a bevel-gear  $D^8$  on a shaft  $D^9$ , said shaft having a bevel-gear  $D^{10}$ , which

engages a bevel-gear  $D^{12}$ , fast on and to rotate the shaft 20, before described, the said shaft being thus rotated intermittingly twice with a dwell between each rotation, while the gear  $D$  on shaft  $A^4$  is rotated once.

The pick-off  $b$ , (see Fig. 2,) located at the left-hand side of the loom is also, as I have herein chosen to represent my invention, made as a magnet having a pole-piece  $b'$ , which in the reciprocation of that pick-off is adapted to engage part of a diagonal warp-carrier and pull the same from the upper track  $t'$ , as described, of the pick-off at the right-hand side of the loom upon that wing of the transferrer  $C^4$  then opposite the end of that track, both transferrers being stationary during the operation of the pick-off. The shank  $b^x$  of the pick-off extended through a suitable guide  $b^2$ , (see Figs. 1 and 2,) is provided with a suitable pin or projection, which is engaged by a bell-crank lever  $b^3$ , pivoted at  $b^4$ , said bell-crank lever being joined by a rod  $b^5$  (see Fig. 1) with a lever  $b^6$ , (see Figs. 1, 7, and 10,) adapted to be actuated by a cam  $b^7$ , fast on the main shaft  $A^4$ , a suitable spring 34 (see Fig. 1) serving to keep a roller or other stud of the said lever in contact with the said cam, the outer end of the shank  $b^x$  being shown in Fig. 10 as slotted to straddle the shaft  $D^9$ , the latter preventing the said shank from rotation. Immediately behind the cam  $b^7$  is a cam  $b^8$ , (see Fig. 10,) which actuates a lever  $b^9$ , joined to a link  $b^{10}$ , (see Fig. 2,) which link is connected to and moves the elbow-lever  $C'$ , which actuates the pusher  $C^2$ , before described. The main shaft has two suitable cams  $d$   $d'$ , (shown best in Figs. 9 and 10,) which actuate harness or treadle levers  $d^2$   $d^3$ , joined in usual manner at their forward ends by rods or other suitable connections  $d^4$   $d^5$  with the under sides of heddle-frames  $d^6$   $d^7$ , (shown best in Fig. 2,) each frame being provided with suitable heddles  $d^8$ , having eyes for the reception of the main longitudinal or body warp-threads  $w'$ , which may come into said heddle-eyes from any suitable source, according to the material being used for the main or body warp—as, for instance, if cane is being woven and that material is used for the body-warp, it will be taken into the loom under suitable tension devices  $d^{10}$ , which may be as represented in Fig. 1 and in the detail Figs. 9<sup>a</sup> and 9<sup>b</sup>, where they are shown as plates acted upon by springs, one plate for each warp-strand, so that the tension may be kept uniform thereon. In case the body-warp is of spun or textile material it may come to the eyes of the heddles from a suitable warp-beam, as  $d^{12}$ . (See Fig. 8.) In either instance I prefer to pass the body-warps over a suitable whip-roll, as  $d^{13}$ , which may be of any usual construction, it being properly weighted.

The shaft  $A^4$  has fast on it (see Fig. 10) a cam  $e$ , which acts on a lever  $e'$ , having its fulcrum at  $e^2$ , said lever having connected to it a link  $e^3$ , (shown by dotted lines, Fig. 3, and

partially broken off in Fig. 2,) said link at its upper end entering a guide  $e^4$ , the link having a block  $e^5$  attached to it in an adjustable manner by a bolt, said block having connected to it a link  $e^{10}$ , which is jointed to what I have chosen to call the "main pusher"  $e^6$ , mounted on a pivot  $e^7$  at the lower end of a yoke  $e^8$ , the latter having arranged within it an eccentric  $e^9$ , fast on a shaft  $e^{18}$ . A roll at the end of the lever  $e'$  is held in contact with the cam  $e$  by a suitable spring  $e^{20}$ , Fig. 7, and when the link  $e^3$  is pulled down the said pusher—the shaft  $e^{18}$  being then at rest with the eccentric down—will throw the lower end of the pusher  $e^6$  toward the center of the loom or in the direction of the arrow thereon, (see Fig. 23,) and at that time the pusher will act on a carrier, then on a transferrer  $B^{11}$ , and will push it onto the track  $t'$ , and thereafter, as the loom continues to run, the shaft  $e^{18}$  in its rotation will lift the yoke and the link  $e^{10}$  being then stationary the said pusher will be given a second movement toward the center of the loom, said movement being preferably, however, increased somewhat by the cam  $e$ , which continues in rotation, it having an extra projection 204 to act at that time, it at that time acting against the endmost carrier  $m$  of the series of carriers already on the track  $t'$ , (see Figs. 24 and 18,) and pushing the entire series of carriers along said track, leaving a space (see Figs. 20 and 21) for the next carrier to come onto the track from the transferrer  $B^{11}$  at another operation of the pusher. The shaft  $e^{18}$ , rotated through the attached bevel-gear  $D^{16}$ , engaged by bevel-gear  $D^{15}$  on shaft  $D^9$ , has two like cams  $f$ , which enter openings in the track-carrying yokes  $f'$ , having shanks fitted to slide in suitable guides  $f^3$ , the lower ends of said yokes carrying the upper track  $t'$  for the diagonal strand or warp-carriers, the lower track  $t$  being carried by the upper ends of two like track-carrying yokes  $f^4$ , (shown in Figs. 2 and 6,) they being raised and lowered at the proper times by cams  $f^5$  on the shaft 20. As these yokes are made to approach each other, they carry the needles or tubes of the diagonal warp or strand carriers past each other vertically in such manner as to cross said warps to form between them a shed for the weft-inserter, and they also carry the diagonal warp or strands above and below the plane of the body-warps being used. The wings at the opposite ends of each transferrer are distant from each other just the distance between the tracks  $t$   $t'$ . When the filling-inserter with its filling  $w$  is working in the shed and when the tracks are nearest together, the pick-offs will be moved to engage the diagonal warp-carriers nearest them, and then occupying a position at the extreme ends of the track will pull said carriers from the tracks onto a wing of the transferrer.

The shaft 20 (see Figs. 2 and 5) has an attached sprocket-wheel  $g$ , which by a sprocket-chain  $g'$ , passed over a sprocket-wheel on a shaft  $g^3$ , rotates said shaft whenever shaft



20 is rotated through the dwell-gear D. The shaft  $g^3$  has mounted on it, loosely, levers  $g^4$ , having the lower sides of their hubs (see Figs. 2 and 4) connected by an eccentric-strap  $g^5$ , encircling an eccentric  $g^6$  on shaft 20, said eccentric-strap vibrating said levers about shaft  $g^3$ . The levers have guides in which are inserted the legs  $g^7$ , carrying the lay-bar  $g^8$ , having erected on it the pins or studs  $g^9$ , constituting the dents of the reed, the lower ends of said legs having rolls  $g^{10}$ , which run on cams  $g^{12}$  fast on the shaft  $g^3$ . The rocking of the levers  $g^4$  effect the backward and forward movement of the lay, while the cams  $g^{12}$  effect the up-and-down movement thereof to enable the reed-dents to be in proper position to beat up the filling as the lay is moved forward and to enable the lay to be dropped on its backward movement sufficiently to lower the reed from the spaces between the body-warps to enable it to pass under the diagonal warps when laid across said spaces. Suitable springs 41, (see Figs. 1 and 2,) shown as connected to said lay and the hub of lever  $g^4$ , act normally to keep the rolls  $g^{10}$  on the cams  $g^{12}$ . The cross-girth  $B^{12x}$  in this instance, sustains a stand  $u$ , provided with a stud  $u'$ , on which is pivoted the filling-clamp, (shown in Figs. 1 and 7 and enlarged in Fig. 26,) composed, as herein represented, essentially of two elbow-levers  $u^2$   $u^3$ , faced preferably with india-rubber, said elbow-levers having jointed to them links 44 45, attached, preferably, by one pin to a rod  $u^6$ , attached to one arm of a rocker-lever  $u^7$ , acted upon by cam  $u^8$ , said clamp being opened at the proper time to let the end of the filling inserter or needle pass between them, the clamp being then closed to clasp the end of the filling  $w'$  projected from the end of the inserter, thus holding said filling while the carrier is retracted.

I will designate in Figs. 18 to 24 the right-hand pick-off by the letter H.

In order to illustrate the operation of my improved loom in weaving, I will refer to the diagrams, Figs. 18 to 24, inclusive, wherein I have shown portions of the two tracks, the uppermost track being supposed to be nearest the breast-beam, and in said figures I have shown parts of the transferers, and parts of the pull-offs, and in connection with Figs. 18, 19, 22, 23, and 24 I have shown in detached views the relative positions of the transferers.

Referring now to Fig. 18, where the tracks are fully separated, it will be seen that the two wings of the transferer  $B^{14}$  occupy positions one above and the other below the line of travel of the weft-inserter, and that the pusher  $e^6$  has acted to push the series of carriers along upon the upper track to provide for inserting the diagonal warps supposed to be carried thereby each in its proper place in the warps, for it will be remembered that these carriers travel intermittingly from one to the other end of the tracks and are to in-

sert the warps carried by them into different portions of the fabric being woven from selvage to selvage diagonally. The pusher  $e^6$ , in addition to moving all these carriers simultaneously along the track, also acts to push the endmost carrier next to it far enough on the track  $t'$  to leave a space sufficient so that when the next carrier comes onto the track it will find an ample space for its reception, and so that at that time the pusher shall not have a double duty to perform—that is, the duty of removing a carrier from a transferer onto the track and also at the same time moving all the carriers—but this might be done if desired, and yet be with the scope of my invention. In Fig. 18 the pusher  $e^6$  is supposed to have finished its movement to the left and as just starting in its movement to the right in the direction of the arrow thereon. Going to the right-hand side of the figure, the pick-off H is supposed to be standing still, and the pusher  $C^3$  as just starting to move in the direction of the arrow near it, and the transferer  $C^2$  is supposed to be coming down in the direction of the arrow, it having upon one of its wings a carrier previously taken from the track  $t'$ .

In Fig. 19 the tracks have, it will be supposed, been started toward each other, the pick-off H remains stationary, and the carrier  $m$  has moved yet a little farther, but the pusher  $C^3$  has moved quickly forward, has struck the endmost carrier of the track  $t'$ , and has moved the entire series of carriers along said track from the position Fig. 18 into the position Fig. 19, and has left a space at the left-hand end of the lower track for the reception of the carrier then hanging on the transferer  $C^4$  at the next operation of the said pusher, while at the right-hand side of the track  $t$  the endmost carrier is substantially flush with the end of the track. During the change of position from Figs. 18 to 19 the weft-inserter has started forward.

In Fig. 20 the tracks  $t$   $t'$  have been moved into their closest working position, the pusher  $e^6$  has completed its movement to the right, the weft-inserter has got substantially halfway into the shed, the pusher  $C^3$  has been moved backwardly in the direction of the arrow, the transferer  $C^4$  has continued to move in the direction indicated in Fig. 19 until the carrier on one of its wings has come opposite the end of the track  $t$ , and at the same time the pick-off H at the right-hand end of the track  $t$  has moved to the left and come into engagement with the carrier at the right-hand end of the track.

In Fig. 21 the tracks remain in the same position as in Fig. 20, the pusher  $e^6$  is in about its same position, the pick-off H has taken the carrier engaged by it in Fig. 20 and pulled it onto the then lowermost wing of the transferer  $B^{14}$ , the pick-off  $b$  at the left-hand end of the track  $t$  has been moved forward from the position Fig. 20, has engaged a carrier and pulled it off the track  $t'$  onto the wing of

the transferer  $C^4$ , then opposite it, and the pusher  $C^2$  has been moved quickly forward from its position, Fig. 20, has struck the carrier then held on a wing of the transferer  $C^4$ , has moved the same from the transferer onto the end of the track  $t$  and onto the space left (see Fig. 20) after the operation of the pusher (represented in Fig. 19) and has started back to the left or into its outward position, and the weft inserted has completed its stroke and is on its way back out of the shed, the weft having been suitably clamped or secured in the shed.

In Fig. 21 it will be seen that each transferer has been provided with a carrier and each transferer must take the carrier on it and place it opposite the other track in order that the carrier may be removed from the transferer to the track.

In Fig. 22 both transferers have started, and the faster-moving transferer  $B^{14}$  is shown as having completed about one-quarter of a rotation, and the slower-moving transferer  $C^4$  about one-eighth of a rotation.

Between the positions Figs. 21 and 22 the pusher  $e^6$ , owing to the peculiar construction of its devices, has a slight movement, but not an effective one, and it has come back into the position Fig. 22 about as the transferers reach the positions therein designated.

In Fig. 23 the transferer  $B^{14}$  is shown as having completed its stroke of one hundred and eighty degrees, and the weft-inserter has come quickly into the shed, but the transferer  $C^4$ , the slower-moving one, has completed about one-half of its stroke.

While the parts occupy the position in Fig. 23, the movement of the pusher  $e^6$  is made in the direction of the arrow thereon in that figure to cause it to push the carrier then on the transferer  $B^{14}$  quickly onto the upper track  $t'$ , as represented in Fig. 24. The pusher  $e^6$ , having removed the carrier from the transferer  $B^{14}$  onto the upper track  $t'$ , as in Fig. 24, the tracks are separated into the position Fig. 18, and the shaft  $e^{18}$  is rotated, lifting the yoke carrying the pusher, so that the pusher gets its second movement, acting on the endmost carrier on the track  $t'$  next it, and pushes or feeds the entire series of carriers along said track, and in the meantime, between the positions Figs. 24 and 18, the weft-inserter makes its full stroke and retires from the shed and the transferer  $C^4$  starts on its way down toward the lower track  $t$ .

From the foregoing description and an examination of the diagrams referred to it will be readily apparent how the different carriers are made to travel across the fabric from selvage to selvage and present the warp-threads carried by them to different pairs of body-warps, so that the warps or strands wound on the spools of the carriers are interlocked diagonally across the fabric.

Fig. 25 shows a piece of cane fabric woven on my novel loom,  $w$  representing the body or longitudinal warps,  $w'$  the weft-strands

and  $w^2, w^3, w^4, w^5, w^6, w^7$ , and  $w^8$  the diagonal strands. In that figure it will be seen that the weft-strands  $w'$  cross the body-warp  $w$  over and under in pairs with a shed known as "one-and-one" or "plain" weaving, and that the diagonal warps are laid diagonally throughout said fabric, they running from one toward the other edge of the fabric and then back again in the opposite direction, turning about a suitable warp, as  $w^9$ , (shown at the left in Fig. 25,) which may be considered a selvage-warp. The drawings show a series of longitudinal meshes 100, 101, 102, 103, 104, and 105, and in said figure it will be seen that the diagonal warp  $w^2$  is first locked into the fabric by the pair of weft-strands 106 in the row 105 and that diagonal warp is again locked into the fabric next by the pair of weft-strands 107 in the row 104, and so on with each one, and, finally, the said diagonal warp is locked by the pair of weft-strands 111, it being supposed that the carrier  $m$  has completed its movement at that point on the track  $t'$  and that it goes then down under the selvage  $w^9$  onto the track  $t$  and starts across the under side of the fabric, the laying of the diagonal warp on its return course being best represented by diagonal warps  $w^6$  and  $w^7$ .

As cane fabric has heretofore been made, the warp and weft are first united into a fabric and thereafter the diagonal warp-strands are inserted singly through the meshes left between the warp and weft, this operation being performed by means of a needle actuated chiefly by hand, and each run of diagonal warp is a separate short piece. In my invention, however, the diagonal warp may be made in a long piece and wound each on its own spool, it being of a length to extend back and forth from edge to edge of the fabric, and these diagonal warps are caught in each shed and locked by the weft-strands at each crossing thereof together with the body-warp, all being united into the fabric at the same time pick after pick; or in other words, the diagonal warp-threads are inserted and made a part of the fabric as the fabric is being built up or woven by the weft crossing the body-warp, and the diagonal warp is made to follow diagonally across the fabric, each carrier working in proper order or sequence with different warp-threads in successive sheds. If textile filling is used the clamp will be omitted, and instead I shall use a shuttle or other usual device to catch the doubled filling.

This invention is not limited to the particular construction shown for the pick-offs or to making them as magnets, as I consider as within the scope of my invention in that particular any pick-off which will take one carrier at a time from a track and enable it to be put onto a proper part of a transferer to take it to another track.

This invention, as stated, is not limited to inserting the weft by only a needle, and my

invention comprehends inserting the weft in the shed in any usual manner.

The loom-frame has suitable stands  $n$  (see Fig. 15) with pivots  $n'$  for levers  $n^2$ , having suitable rolls to rest on cams  $n^3$  on the shaft  $e^{18}$ . The levers  $n^2$  (see Fig. 15) carry arms  $n^4$ , connected rigidly by cross-bar  $n^5$ , the lower ends of the arms having brackets  $n^6$ , which support the mesh-gage  $n^7$ , it consisting of a bar having a series of pins  $n^8$ , which stand between the warps when the filling is being introduced back of said pins toward the center of the loom, the pins thus gaging the size of the meshes. The pins  $n^8$  rest against one edge of the cane or other weft, while the reed-dents  $g^9$  act against the other edge thereof.

I have herein illustrated the tracks  $t t'$  as located in different horizontal and also different vertical planes and the transferers as rotatable; but this invention is not limited to the exact form of transferer shown or to the devices for actuating the transferer, and believing myself to be the first to use a plurality of tracks on which diagonal warp-carriers may be slid, and from one to the other of which the said carriers may be automatically transferred, I consider within the scope of this invention any transferer capable of taking a carrier from one to another track, and also any form of pusher to co-operate with the carriers on the transferers of whatever form to put them onto a track, and also any form of pick-off to put a carrier from a track onto a transferer to be taken to another track.

The diagonal warp-carriers may each be so shaped as to be engaged by a locking device  $p$ , which may be made as a spring, (see Figs. 10<sup>b</sup> and 10<sup>c</sup>;) said spring having a projection to enter a notch in the carrier, the locking device holding under slight friction preferably the next to the endmost carrier, so that as the series of carriers are slid on a track by a pusher, said locking device will substantially position that carrier or not let the series of carriers be moved farther than actually pushed by the pusher while in contact with the carrier at the other end of the track, and, further, this locking device prevents the pick-off from taking more than one carrier.

In the modification, Fig. 17, I have shown a warp-carrier provided with a plurality of needles, so that said carrier may deliver several warp-threads rather than one, and said carrier may, as therein shown, have a plurality of spools. A carrier of this kind, if provided with threads of different colors, may form a diagonal band across the fabric from selvage to selvage. The woven fabric, after having passed the mesh-gage, is passed over the breast or feed-roll  $J$ , which may be rotated at the proper speed in any usual or suitable manner, I having herein shown said roll as having its shaft provided with a worm-gear  $H'$ , which is engaged by a worm  $H^2$  on a vertical shaft  $H^3$ .

In the drawings, Fig. 14<sup>a</sup> showing the diagonal warp-carrier on a larger scale, it will be seen that the needle is hollow and has a hole at its end from which the warp passes into the shed, and the said warp may be led through the needle from end to end or the warp may be led from the bobbin outside the body  $m$  and into an inlet 205, as shown by dotted lines, Fig. 14<sup>a</sup>, or as in Fig. 17.

In this present instance of my invention, wherein I have illustrated my invention as applied to weaving cane fabric, the carriers are moved from track to track and back again in the same half of a circle; but it will be understood that this invention is not limited to moving the transferers only, as stated, and movement of the transferers in any direction to take a carrier from one to another track is within the scope of my invention, and while in this present embodiment of my invention I shift the carriers from the tracks onto the transferers and vice versa while the shed is closed, yet with but slight changes in some of the parts, the shifting referred to might be effected when the shed is open, so my invention is not limited to shifting the carriers at any exact position of the warps in the shed.

It will be understood in practice that the needles will be of sufficient length that when the tracks are in their closest positions the ends of one series of tubes will pass beyond the ends of the other series, so as to cross the diagonal warp-threads and leave a space for the reception of the filling.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a loom, the following instrumentalities, viz:—a plurality of tracks, a series of diagonal warp-carriers mounted thereon side by side and adapted to be slid thereon, and transferers to transfer the said carriers intermittently from one to the other of said tracks, substantially as described.

2. In a loom, the following instrumentalities, viz:—a plurality of tracks, a series of warp carriers mounted thereon and provided each with its own warp, and a pusher for each track, said pusher acting to move said series of warp carriers along said tracks, whereby the warps contained by said carriers may be laid diagonally into the fabric being woven, substantially as described.

3. In a loom, the following instrumentalities, viz:—a plurality of tracks, a series of warp carriers mounted thereon loosely side by side, transferers co-operating with the ends of said tracks, pick-offs, and actuating devices for said transferers and pick-offs, whereby the pick-offs are made to engage a carrier at the end of a track and put it onto a transferer, the latter placing said carrier opposite the end of another track, substantially as described.

4. In a loom, the following instrumentalities,

ties, viz:—a plurality of tracks; a series of warp carriers mounted loosely thereon side by side and each carrying a wound-up supply of warp thread; movable transferers having wings adapted to be placed opposite the ends of said tracks; pick-offs to automatically take said carriers from the ends of said tracks and put them one by one on said transferers, and pushers to push said carriers from said transferers onto said tracks, the said parts co-operating substantially as described to enable the said carriers to be moved intermittently along one of said tracks from one to the other side of the fabric being woven, and then to be moved back along another of said tracks to the starting point, for the purposes set forth.

5. In a loom, a plurality of tracks; a series of warp carriers mounted thereon, each provided with a spool containing a warp strand, and also having a tube or needle to control said warp thread in the formation of a shed, combined with devices to move said carriers intermittently along said tracks, and to raise and lower said tracks to cross the threads of the warp carriers mounted on said tracks, and aid in forming sheds, substantially as described.

6. In a loom, the following instrumentalities, viz:—a plurality of tracks, a series of warp carriers mounted loosely on said tracks side by side, transferers located at the ends of said tracks, each transferer co-operating with two tracks, means to move said carriers intermittently from said tracks onto said transferers, means to take said carriers from said tracks and put them on said transferers, and to remove the carriers from the transferers onto said tracks, and devices to rotate said transferers in opposite directions in order that a carrier taken from one track to the other may thereafter be returned from the latter track to the first track by the oppositely moving transferer but in the same arc, whereby the same side or face of the warp strand being laid diagonally across the fabric being woven may be kept with the same side uppermost in both directions of travel of the warp strand across the fabric, substantially as described.

7. In a loom, a plurality of tracks, a series of warp carriers mounted thereon loosely and movable longitudinally thereon, combined with a transferer and pick-off made as a magnet to engage a part of each of said carriers at the proper time and pull them from the ends of the tracks and put them onto the transferer, substantially as described.

8. In a loom, the following instrumentalities, viz:—a plurality of tracks, a series of independently movable warp carriers mounted thereon, devices to move said carriers along said tracks, devices to move said carriers from one to the other of said tracks, means to move said tracks toward and from each other in the formation of sheds into the planes of which the wound-up warps on said

carriers enter, and a weft inserting device, to operate, substantially as described.

9. In a loom, the following instrumentalities, viz:—a plurality of tracks, a series of independently movable warp carriers mounted thereon, devices to move said carriers along said tracks, devices to move said carriers from one to the other of said tracks, means to move said tracks toward and from each other in the formation of sheds into the planes of which the wound-up warps on said carriers enter, a weft inserting device, and shed forming mechanism to open and close sheds in body warps mounted in said loom, substantially as described.

10. In a loom, a track, combined with a warp carrier composed of a block having its body fitted to slide on and be guided by said track, a tube or needle, and fingers having bearings and spools having journals to enter said bearings, substantially as described.

11. In a loom, the following instrumentalities, viz:—a plurality of tracks; a series of warp carriers mounted thereon, means to move said carriers along said tracks, shed forming mechanism to form sheds in body warps, a filling inserter, a lay having a reed, and means to vibrate said lay and raise and lower the same whereby the reed may be withdrawn from between the body warps to enable it on its back stroke to pass under the diagonally laid warps of the carriers, for the purposes set forth.

12. In a loom, the following instrumentalities, viz:—a series of warp carriers, means to support them above and below the planes of the warp shed, means to move said warp carriers intermittently across the body warps at their upper and then at their lower side, a weft inserter, and a device to engage and hold the weft at the selvage opposite that at which the weft was inserted into the shed, substantially as described.

13. In a loom, a weft inserting needle, and a spring controlled rocking dog carried thereby to engage the weft and carry it through the shed, combined with a cutting mechanism to cut off the end of the weft protruding beyond the delivery end of the said needle, substantially as described.

14. In a loom, the following instrumentalities, viz:—harness mechanism to form sheds in body warps; a series of independent warp carriers each adapted to contain a wound up diagonal warp strand, means to support said carriers and move them intermittently across the said body warps from selvage to selvage, and then back again whereby each of said diagonal warps is introduced into the fabric being woven at different distances from its selvage shed after shed, and a weft inserter to insert a weft to unite said body and diagonal warps into a fabric, substantially as described.

15. In a loom, a track, a series of diagonal warp-carriers mounted thereon, devices to move said warp-carriers longitudinally on

said track step by step, the levers  $g^4$ , the lay provided with a series of pins to constitute reed dents, and having legs, the shaft 20, and connections between it and said levers to vibrate the latter, combined with cams to act on said legs and to reciprocate said lay vertically to lower said dents while in its backward position and the diagonal warp-carriers are being moved across the body warps, substantially as described.

16. In a loom, the following instrumentalities, viz:—harness mechanism to form sheds in body warps, weft inserting mechanism, a lay having a reed, a take-up beam, and a mesh gage located between the lay and the take-up beam and made as a bar having a series of pins and means to raise and lower said bar to cause said pins to occupy a position in the fabric between those picks where the fabric is to have open meshes to thus gage said meshes, substantially as described.

17. In a loom, the following instrumentalities, viz:—a track, and a movable series of diagonal warp carriers mounted thereon, and containing bobbins on which said diagonal warps are wound, and devices to slide said carriers on said track across the loom, for the purposes set forth.

18. In a loom, a track extended across the loom, a series of independent diagonal warp carriers mounted loosely thereon, a series of bobbins mounted on said carriers and having wound on them the diagonal warps, and a device to act on said carriers to move them in-

termittingly along said track across the loom, substantially as described.

19. In a loom, a track, a series of independent diagonal warp carriers mounted loosely thereon side by side and having tubes or eyes to deliver said diagonal warps into the fabric, and a pusher to slide said carriers on said track across the loom, combined with devices to raise and lower said track to enable the said tubes to be put into spaces between the body warps and place the diagonal warp threads to form part of a shed to be entered by the weft, substantially as described.

20. In a loom, a track, a series of carriers adapted to be slid thereon and having each a tube open at its extremity to enable the diagonal warp to be led out of the extremity of the tube, and means to slide said carriers upon the track, substantially as described.

21. In a loom, a track, a series of carriers adapted to be slid thereon and having each a tube open at its extremity to enable the diagonal warp to be led out of the extremity of the tube, and having an inlet just above said extremity, and means to slide said carriers upon the track, substantially as described.

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

CHARLES CROMPTON.

Witnesses:

SAMUEL B. SCHOFIELD,  
JOHN B. SYME.