No. 789,845. PATENTED MAY 16, 1905.

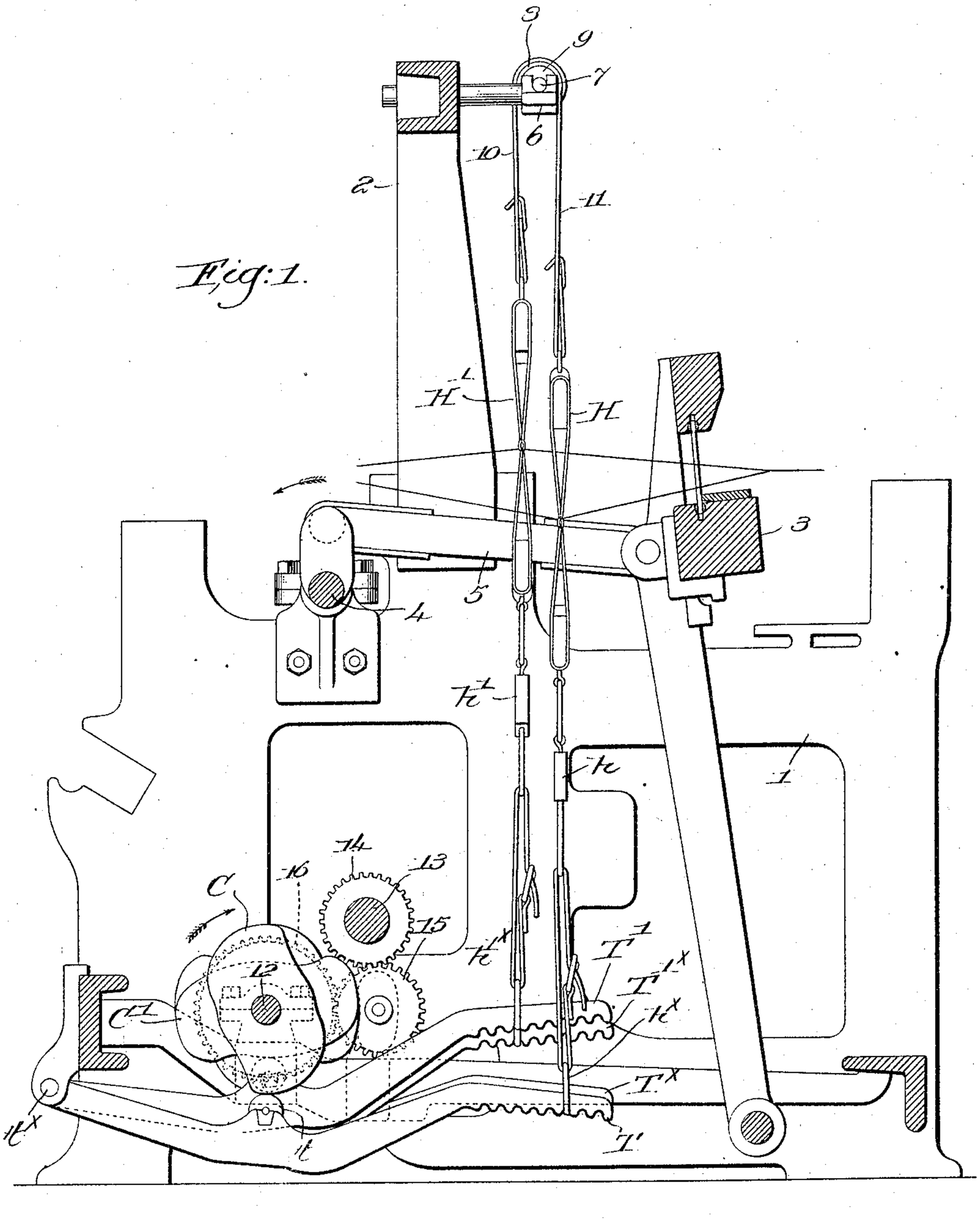
C. H. DRAPER.

LOOM HARNESS OPERATING MECHANISM.

APPLICATION FILED JAN. 9, 1905.

3 SHEETS—SHEET 1.

Fig: 1.



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3 SHEETS—SHEET 2.

Fig: 2.

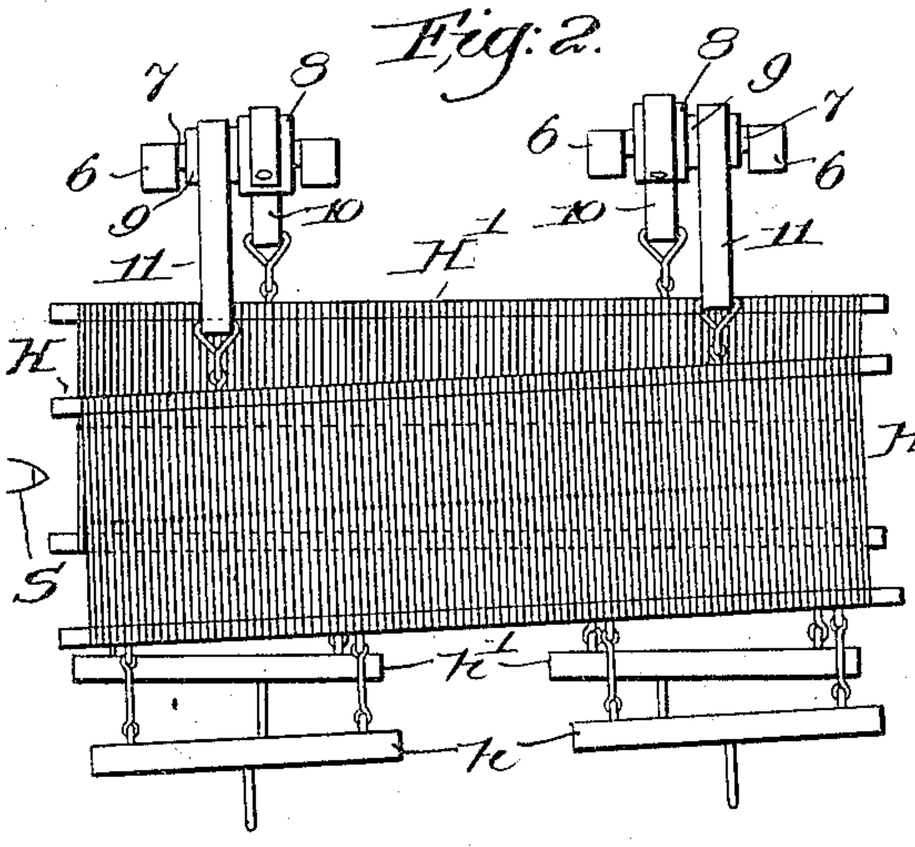


Fig: 3.

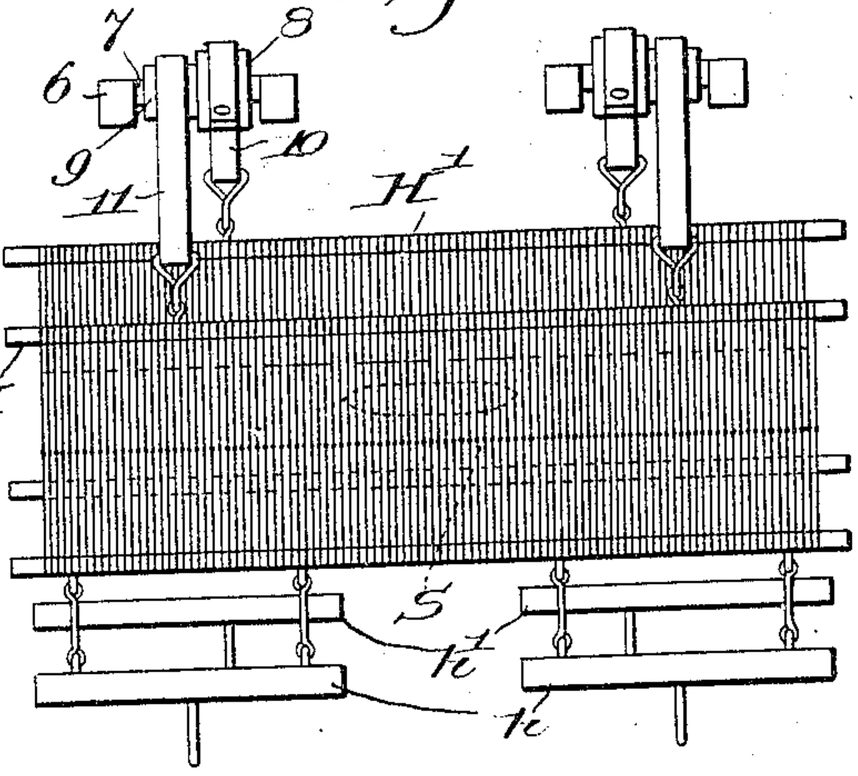


Fig: 4.

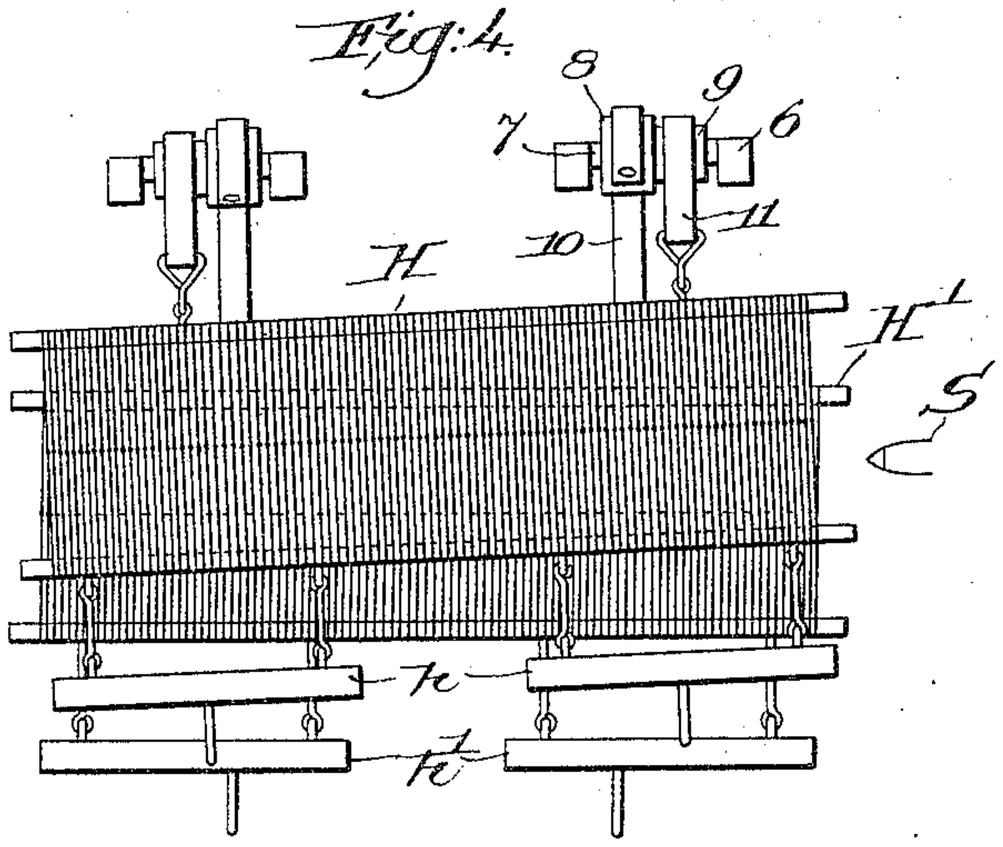


Fig: 5.

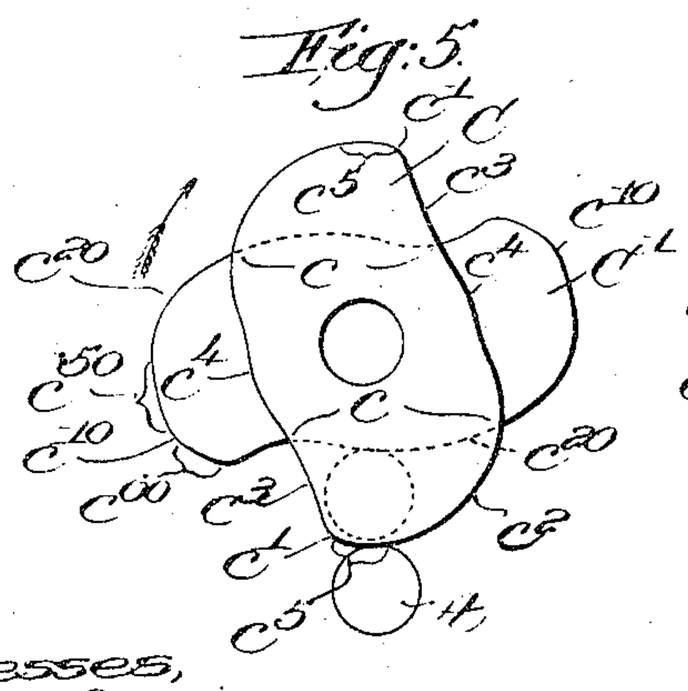
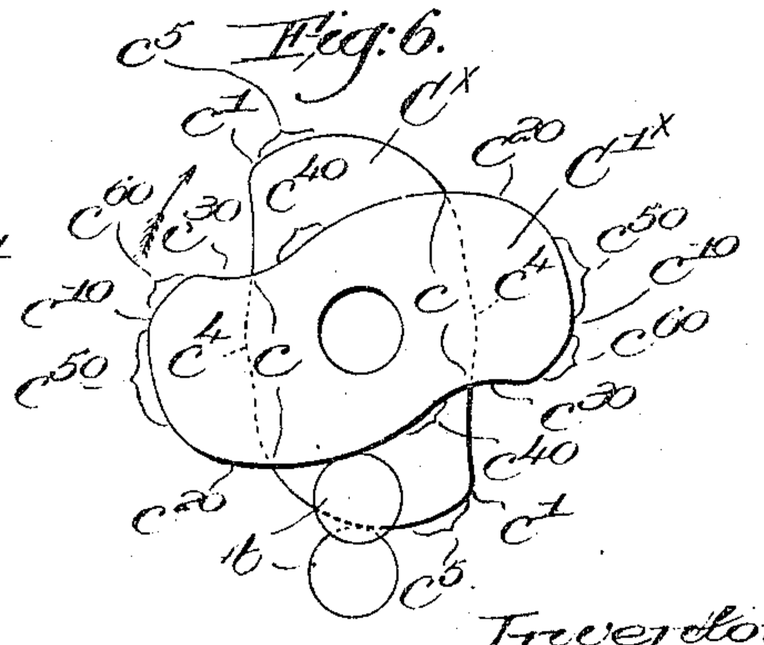


Fig: 6.



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3 SHEETS—SHEET 3.

Fig: 7.

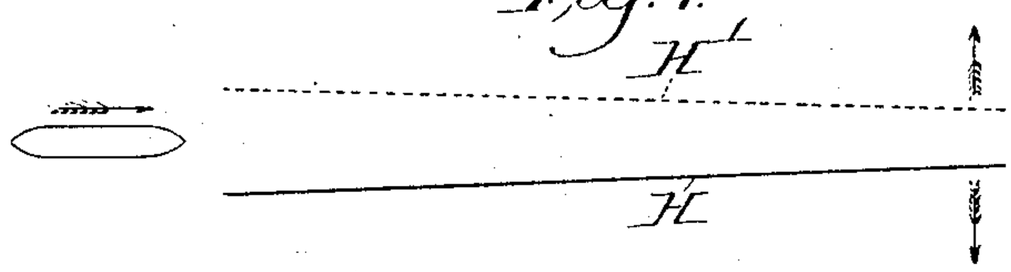


Fig: 8.

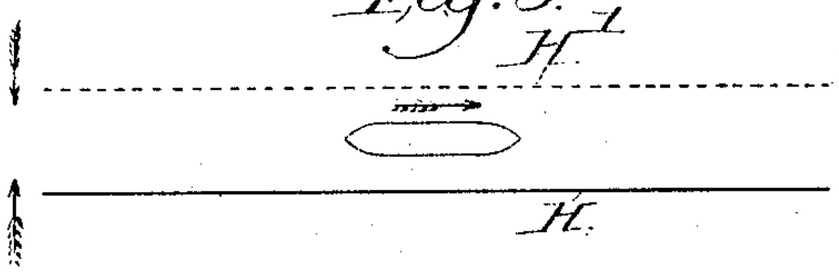


Fig: 9.

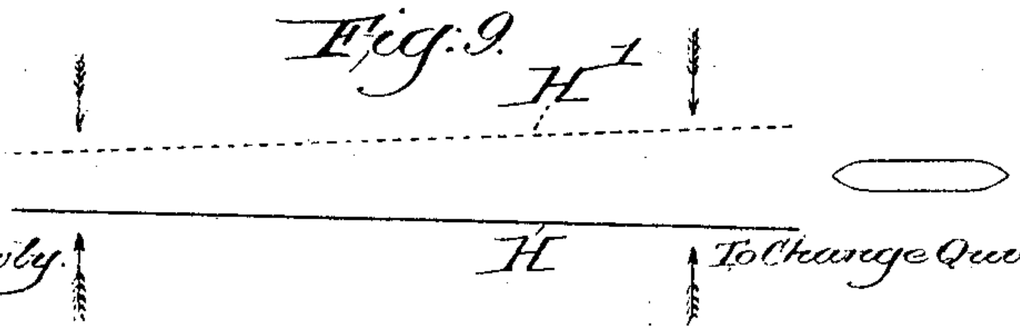


Fig: 10.

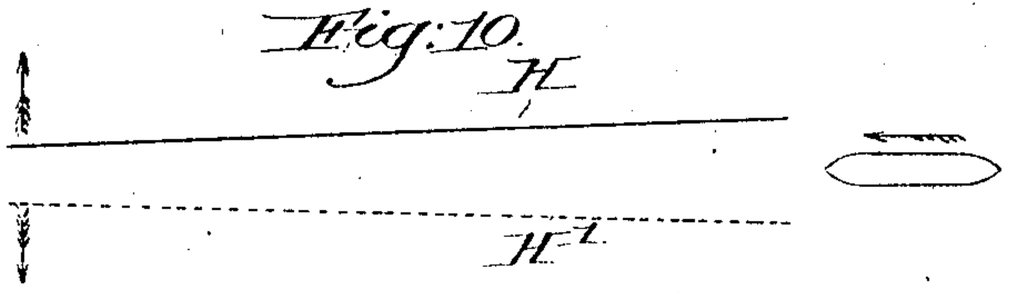


Fig: 11.

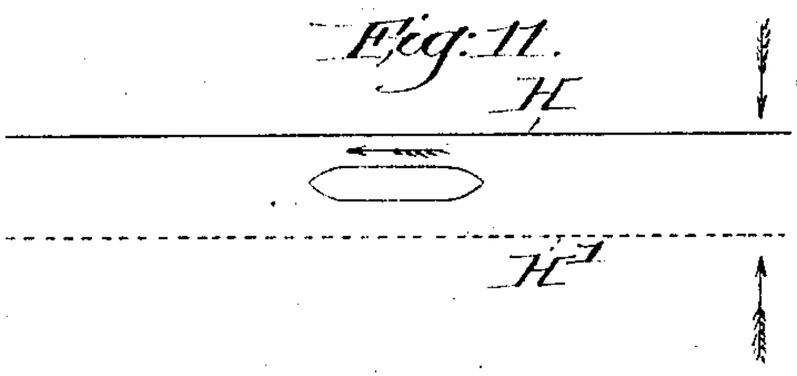
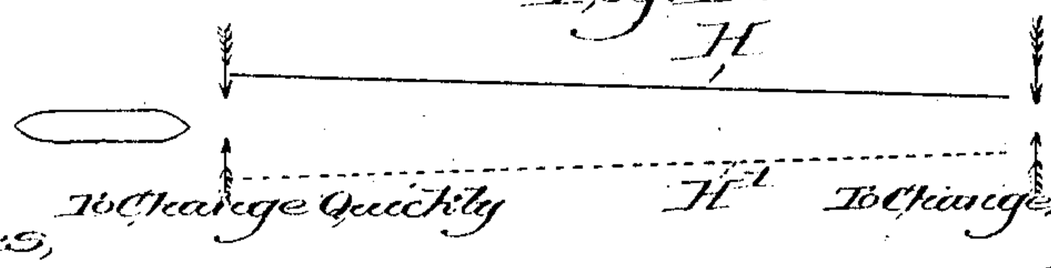


Fig: 12.



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No. 789,845. Patented May 16, 1905.

UNITED STATES PATENT OFFICE.

CLARE H. DRAPER, OF HOPEDALE, MASSACHUSETTS, ASSIGNOR TO DRAPER COMPANY, OF HOPEDALE, MASSACHUSETTS, A CORPORATION OF MAINE.

LOOM-HARNESS-OPERATING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 789,845, dated May 16, 1905.

Application filed January 9, 1905. Serial No. 240,150.

To all whom it may concern:

Be it known that I, CLARE H. DRAPER, a citizen of the United States, and a resident of Hopedale, county of Worcester, State of Massachusetts, have invented an Improvement in Loom-Harness-Operating Mechanism, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

It is well known to those skilled in the art of weaving that in the operation of the shed-forming mechanism the strain on the warp-threads is increased when the "dwell" of the harness-cams is increased. This is probably due to the fact that when the dwell is increased the time left available for moving the harnesses is reduced, and therefore the movement of the harnesses must be more rapid and jerky. The dwell of the harness-cams may be increased to improve the face of the goods being woven, to assist in beating up the picks of filling by crossing the warp-threads over the filling earlier, or to give the shuttle more time to traverse the shed. This latter reason assumes greater importance as the width of the loom, and consequently the distance that the shuttle has to travel, is increased.

My present invention has for its object the production of means whereby the dwell on the harness-cams is reduced, with consequent reduction of the strain on the warp, while at the same time the shed is maintained sufficiently open at any point the shuttle may be occupying temporarily.

In the ordinary loom the shed is open equally all the way across from the time the shuttle enters the shed at one side until it passes out at the opposite side. In my present invention, however, the shed is fully opened at the side the shuttle is about to enter when the crank is at substantially top center and the shuttle is about to be picked. The opposite ends of the harnesses are not then open; but the shed at such point is opened completely at about the back center of the crank when the shuttle has approximately reached the middle of the shed. At such time the side of the shed which opened first now starts to close, the other side in front of the advancing shuttle remaining open until the crank is about at bottom center, when the shuttle should have completely entered the box adjacent that side of the shed. The warps in the upper and lower planes of the shed are then quickly closed and crossed at the side nearest the shuttle to give the full opening for the next pick and slowly closed and crossed at the opposite side.

It is customary on broad looms of, say, ninety or a hundred inches cloth-space to use cams which hold the shed open from the top to the bottom center of the crank-shaft; but in my present invention the cams are designed to hold the shed open half or less than half this time, notwithstanding the fact that the shed is always open at the point occupied by the moving shuttle.

The various novel features of my invention will be fully described in the subjoined specification and particularly pointed out in the following claims.

Figure 1 is a transverse sectional view of a portion of a loom, taken within the left-hand side of the frame and with one embodiment of my present invention applied thereto. Fig. 2 is a front view of the harness members in the position shown in Fig. 1, with the shuttle just about to be picked from the left-hand side. Fig. 3 is a similar view showing the relative position of the harness members when the shuttle is substantially in the center of the shed. Fig. 4 shows the harness members after the warps have been crossed and the new shed formed in readiness for the pick of the shuttle from the right-hand side. Figs. 5 and 6 are side elevations of the two pairs of harness-cams viewed from the left-hand side of the loom and occupying their relative positions, the left-hand pair of cams being shown in Fig. 5 (see also Fig. 1) and the right-hand pair being shown in Fig. 6. Figs. 7 and 8 are diagrammatic views of the relative positions of the planes of the shed corresponding to Figs. 2 and 3, respectively. Fig. 9 is a similar view, but showing the two portions of the warps as about to cross to form the new shed. Fig. 10

corresponds diagrammatically to the position of the harness members and shuttle shown in Fig. 4. Fig. 11 is a diagrammatic view of the planes of the shed when the shuttle is substantially at the center of the shed; and Fig. 12 is a similar view showing the position of the divisions of the warps as they are about to cross and form the new shed, the shuttle having reached the position shown in Fig. 7.

I have herein shown a two-harness motion as embodying a simple form of my invention, the harness-members being connected overhead and oppositely moving; but it is to be understood that my invention is not thereby restricted in its scope, and, as will clearly appear hereinafter, the gist of my invention resides in the peculiar movement imparted to the harness members, both individually and relatively, to effect the desired results.

Referring to Fig. 1, the loom-frame 1, arch 2, lay 3, adapted to support a reciprocating shuttle S, Figs. 2, 3, and 4, actuated by any suitable picking mechanism, forming no part of my invention, the crank-shaft 4, connected with the lay by pitmen, one of which is shown at 5, and the harness members H H′ to control the movements of the shed-forming divisions of the warp may be and are all of usual or well-known construction. At each side of the loom the arch is provided with forwardly-extended brackets having bearings 6 for short shafts 7, (see Figs. 2, 3, and 4,) on each of which are secured two sheaves 8 9, the larger sheaves 8 being shown as having straps or other flexible connections 10 wound around them and connected with the top bar of the harness member H′ near its ends, while the smaller sheaves 9 have reversely-wound bands or straps 11, connected similarly with the harness member H. The harness members are thus connected at their ends by separate independent overhead connections, which permit the peculiar rocking or teetering individual movements which are imparted to said members, as will be hereinafter described. I have shown two short bars h h' suspended from the bottom bars of the harness members, each short bar being operatively connected by a depending stirrup (as $h^{\times}$ for the front harness member H and $h'^{\times}$ for the rear member H′) with a treadle, four treadles being shown, (see Fig. 2,) fulcrumed at $t^{\times}$ at the back of the loom. The stirrups $h^{\times}$ are connected with the outermost treadles T $T^{\times}$ of the set, and the stirrups $h'^{\times}$ are connected with the inner pair of treadles T′ $T'^{\times}$, each treadle being preferably provided with a suitable follower-roll, as t, to coöperate with its corresponding controlling-cam. In my present invention each harness member is controlled as to its movements by two cams operatively connected with the harness member near the ends thereof through the treadles and intervening devices just described. Inasmuch as in my present invention the cams are designed to hold the shed open with a dwell during a very short time—about one-quarter of a revolution of the crank-shaft—notwithstanding the fact that the shed is always open at the point where the shuttle is moving, I make use of double cams of peculiar design, mounted on a cam-shaft 12, Fig. 1, which is connected by suitable gearing with the crank-shaft in a ratio of one to four—that is to say, the cam-shaft revolves once for four revolutions of the crank-shaft, corresponding to four picks of the shuttle. In Fig. 1 the shaft 13, which corresponds to the cam-shaft in the ordinary loom and which revolves once for every two revolutions of the crank-shaft, has an attached gear 14 in mesh with an intermediate gear 15, the latter meshing with a larger gear 16, fast on shaft 12, to rotate it once for every two revolutions of shaft 13, the latter being geared to the crank-shaft in usual manner. (Not herein shown.) The relative position of the controlling-cams and their shape is shown in Fig. 1 and more clearly in Figs. 5 and 6, the cams being mounted on the shaft 12 in pairs, a front and a back harness-cam in each pair, and for convenience the two front harness-cams are designated at C $C^{\times}$ and the rear harness-cams at C′ $C'^{\times}$. The cams C $C^{\times}$ are alike, but set reversely on the shaft, each cam being double, having two opposite high points c' c' with a gradual rise c^2 at one side of each high point and a quick drop c^3 at the other side and a short dwell portion c^4 interposed between the rise c^2 to one high point and the drop c^4 from the other high point, the rise c^2 merging into a short dwell adjacent each high point, as at c^5. The terms "rise" and "drop" apply more specifically to the contour of the cam, for by inspection of Fig. 5 it will be manifest that during one-quarter of a revolution of the cam C the harness member H will at its left-hand end have a short dwell at c^5, rise gradually along c^2, and again dwell at c^4, followed during the next quarter-revolution by a quick descent along c^3 to the high point c', and so on. The other or right-hand end of the said harness member is controlled by cam $C^{\times}$, (see Fig. 6,) which is reversed relatively to cam C, and during one-quarter of a revolution from the position shown the right-hand end of the member H will descend slowly to the dwell c^5, terminating at c', (the high point of the cam,) and then rise quickly along the drop c^3 of the cam to the dwell c^4. On the next quarter-revolution the harness member H at its right-hand end will descend slowly from c^4 along the gradual rise c^2 of the cam to the dwell c^5, and so on for the complete revolution. Thus the cam-dwells c^5 govern the dwell or rest of the ends of said member at the bottom of its stroke, while the cam-dwells c^4 govern the rest of the said ends at the top of the stroke. For one complete revolution of the cam-shaft 12 then the harness member controlled by the cams C and $C^{\times}$ will

be given bodily two upstrokes and two downstrokes; but the opposite ends of such member will travel at different speeds, governed by the contour of the respective cams. The cams C′ and C′× are in general similar to the pair just described, having each two opposite high points c^{10}, an adjacent short-dwell portion c^{50}, and a gradual rise c^{20}, leading to such dwell portion from one of the two opposite dwells c^{40}, the latter corresponding to the dwells c^{4} of the front harness-cams. In the latter cams the drop c^{3} from the high point is a quick or sharp one; but in cams C′ and C′× the drop c^{30}, while quick or rapid as compared with the rise c^{20}, is eased slightly from the high point c^{10}, as at c^{60}, to prevent too sudden a movement of the rear harness member H′, the same having a longer stroke. The crossing-points for the shed-forming divisions of the warp are indicated at *c* on Figs. 5 and 6.

Referring now to Figs. 2, 3, and 4, the harness members H and H′ are shown in Fig. 2 in position for a pick of the shuttle from the left-hand shuttle-box, the crank-shaft 4 being at top center, Fig. 1, and the cams having the position shown in Figs. 1, 5, and 6. At such time the shed is open at the side adjacent the shuttle ready for the entrance of the latter, and a corresponding position is shown in Fig. 7 diagrammatically, the full line in Figs. 7 to 12 indicating the line of warp-eyes of the front harness member H and the broken line in said figures indicating the warp-eyes of the rear harness member H′. As shown in Figs. 2 and 7, the opposite or right hand of the shed is not open, the height of the shed-opening decreasing from left to right; but during the movement of the shuttle to substantially the center of the shed, corresponding to back center of the crank-shaft, the right hand of member H′ has been raised and the adjacent end of member H lowered to the positions shown in Figs. 3 and 8, completely opening the shed all the way across. By following the cam contours of Fig. 6 it will be seen that at such time there is a dwell of both harness members at the right-hand ends, caused by the cam parts c^{5} and c^{40}, and that the left-hand ends have started to gradually close as the cam parts c^{2} c^{20} act, (see Fig. 5, see also Fig. 9,) the dwell at the right permitting free exit of the shuttle from that side of the shed. The right-hand side of the shed thus remains open till the shuttle has been completely boxed at the right-hand side, (the other side of the shed continuing to close,) and from the position shown in Fig. 9 the two divisions of the warp cross to change the shed, the right-hand end of H rising rapidly to its highest point, while the corresponding end of H′ descends rapidly and then more slowly to its lowest point. At the same time the slowly-moving left-hand ends of the harness members have crossed, and the lines of warp-eyes assume the positions shown in Fig. 10, with a corresponding position of the harness members, as illustrated in Fig. 4. The dwells c^{4} and c^{50} of the right-hand pair of cams, Fig. 6, now maintain the corresponding side of the shed open for the incoming shuttle, which is to be picked from the right hand, the crank-shaft having reached top center again, and the dwell continues substantially to back center, when the shuttle has reached the center of the shed, Fig. 11, and the left-hand ends of the harness members have separated to fully open the shed completely across. As the shuttle traverses the shed the left-hand side of the shed is hold open, while the opposite side begins to close, as shown diagrammatically in Fig. 12, and when the shuttle is fully boxed at the left there is a quick opposite movement of the adjacent or left-hand ends of the harness members to close, cross the warps, and change the shed, while a similar movement, but slower, is taking place at the right. This brings the lines of the warp-eyes back into the position shown in Fig. 7 diagrammatically, (see also Fig. 2,) the cycle having been completed, with the shuttle ready to be picked to the right from the initial side, the crank-shaft being again on top center. The quick crossing of the warps always is effected at that side of the shed from which the shuttle has just emerged and into which it will enter on the next pick, while at the opposite side the crossing movement is slower, because the shed has been already partly closed, and the new shed has not to open fully until the shuttle reaches about its center.

It will be seen from the foregoing that in my present invention the shed is held open at any point not more than one-quarter of a revolution of the crank-shaft, yet it is always fully open where the shuttle is moving through it. Remembering that the crank-shaft revolves four times for each revolution of the cam-shaft 12 and taking a given side of the loom, with the shuttle about to pick from that side, the dwell will last for about one-quarter of a revolution of the crank-shaft and then effect the slow change of shed for the next full revolution. After a dwell of one-quarter of a revolution of said shaft the quick crossing of the warps to change the shed is effected, taking one-half of a revolution of the crank-shaft, completing the cycle and leaving the harness members in position ready for another pick of the shuttle from the initial side of the loom. The cams at the right-hand side of the loom are so set with relation to those at the opposite side that if the quick motion down of the front harness member at the left-hand side has just taken place the quick motion down of the rear harness member at the right-hand side will have taken place in one-quarter of a revolution of the cam-shaft 12 or one pick.

So far as I am aware the differential move-

ment of the harness members to move the lines of warp-eyes in non-parallel planes is broadly new in a loom having a reciprocating shuttle, as opposed to a circular loom, wherein the movement of the shuttle is continuous, and accordingly my invention is not restricted to the precise construction and arrangement herein shown and described, as the same may be varied or modified in various particulars by those skilled in the art without departing from the spirit and scope of my invention.

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

1. In a loom, a reciprocating shuttle, and warp-controlling means to gradually open the shed in front of the advancing shuttle and close the shed behind it, said means including harness members continuous from one to the other side of the warp and movable as a whole.

2. In a loom, a reciprocating shuttle, shedding mechanism, including oppositely-moving harness members, continuous from one to the other side of the warp, and means to reciprocate them and cause the portions of the warp engaged by said members to rise and fall in non-parallel lines, gradually opening the shed in front of the advancing shuttle.

3. In shedding mechanism for looms, oppositely-moving harness members to control the position of the shed-forming divisions of the warp, and means to reciprocate said harness members and also impart a differential movement to their opposite ends, to effect a gradual opening of the shed in front of the advancing shuttle.

4. In shedding mechanism for looms, oppositely-moving harness members, a reciprocating shuttle, and means to reciprocate said harness members and also impart a differential movement to their opposite ends, to effect a gradual opening of the shed in front of the advancing shuttle and a quick crossing of the warps at the side from which the shuttle is next to be picked.

5. In shedding mechanism for looms, oppositely-moving harness members, a reciprocating shuttle, and means to reciprocate the harness members and also cause them individually to rock bodily in the direction of their length, to gradually open the shed in front of, and close it behind, the shuttle.

6. In shedding mechanism for looms, oppositely-moving harness members to control the position of the shed-forming divisions of the warp, and means to effect reciprocatory movement of the harness members and also cause individual rocking movement of said members in the direction of their length, to gradually open the shed in front of the advancing shuttle and effect a continuous movement of the warp-threads throughout the major portion of the stroke of the harness members, with a minimum dwell.

7. In shedding mechanism for looms, oppositely-moving harness members to control the position of the shed-forming divisions of the warp, and means to reciprocate said harness members and individually rock the same in the direction of their length, to give the ends of the harness members at the side of the shed from which the shuttle has emerged a rapid movement to change the shed and fully open the new shed for the next pick while at their opposite ends the harness members are given a slower crossing movement, opening the shed as the shuttle advances.

8. In shedding mechanism for looms, oppositely-moving harness members to control the position of the shed-forming divisions of the warp, and means to reciprocate said harness members and individually rock the same in the direction of their length, to give the ends of the harness members at the side of the shed from which the shuttle has emerged a rapid movement to change the shed and fully open the new shed for the next, or return pick, with a short dwell until the shuttle has entered the shed.

9. In shedding mechanism for looms, oppositely-moving harness members to control the position of the shed-forming divisions of the warps, and means to reciprocate the harness members and impart an individual differential movement to each, to give the like ends of said members a rapid crossing movement on one stroke and a slow movement on the next stroke, with a short dwell after the rapid crossing movement, to maintain that side of the shed open for the incoming shuttle.

10. In shedding mechanism for looms, oppositely-moving harness members to control the position of the shed-forming divisions of the warp, and means, including two cams for and operatively connected with each harness member, to effect the bodily movement thereof and also to impart a differential movement to the opposite ends of the harness member.

11. In shedding mechanism for looms, two oppositely-moving harness members to control the position of the planes of the shed, independent overhead connections between said members at their opposite ends, and means, including two controlling-cams operatively connected with each of said members, to effect reciprocatory movement of the harness members and also to impart individual rocking movement thereto in the direction of their length, to gradually open the shed in front of the advancing shuttle and close the shed behind it.

12. In shedding mechanism for looms, two oppositely-moving harness members to control the position of the planes of the shed, independent overhead connections between said members at their opposite ends, a rotating cam-shaft, two pairs of controlling-cams mounted thereon, one cam of each pair governing the movement of the corresponding end of its connected harness member, and op-

erating connections between the bottoms of said members and the cams, the pair of cams connected with either member controlling the movement thereof.

13. In a loom, a lay, a reciprocating shuttle thereon, and shedding mechanism, including harness continuous from one to the other side of the warp, and means to actuate them including cams operatively connected with said members and shaped to cause them to present at top center an open shed at one side for the incoming shuttle, complete the full opening across the shed between top and back centers, and gradually close the initially open side of the shed between back and bottom centers while maintaining open the opposite side of the shed until exit of the shuttle therefrom.

14. In a loom, a lay, a reciprocating shuttle thereon, and shedding mechanism, including oppositely-moving harness members, continuous from one to the other side of the warp, and cams to actuate them, said cams being shaped to cause said members to present at top center an open shed at one side for the incoming shuttle, complete the full opening across the shed between top and back centers, and gradually close the initially open side of the shed between back and bottom centers while maintaining open the opposite side of the shed until exit of the shuttle therefrom, the cams thereafter moving the harness members to quickly close and cross the warps at the side adjacent the shuttle while slowly crossing the warps at the opposite side.

15. In shedding mechanism for looms, a reciprocating harness member, a cam-shaft, two cams thereon operatively connected with opposite ends of the harness member, each cam having two opposite high portions with a gradual rise to and quick drop therefrom, and a short-dwell portion interposed between the rise to one high point and the quick drop from the other high point, the cams being set relatively upon the cam-shaft to give a differential movement to the ends of the harness member.

16. In a loom, two oppositely-moving harness members, an overhead connection between the adjacent ends of the said members, independent supports for said connections, a rotating cam-shaft, two controlling-cams thereon for and operatively connected with the opposite ends of each harness member, each cam having two opposite high portions with a gradual rise to and quick drop therefrom, and a short-dwell portion interposed between the rise to one high point and the quick drop from the other high point, the two cams controlling a harness member being set upon the shaft with relation to each other to impart a differential movement to the opposite ends of the harness member.

17. In a loom, a lay, a reciprocating shuttle thereon, and shedding mechanism, including oppositely-moving harness members continuous from one to the other side of the warp, and cams to actuate them, to cross the warps and change the shed between bottom and top centers, and present at top center an open shed at one side for the incoming shuttle, said cams having short-dwell portions, and adjacent portions to move the harness members to complete the full opening across the shed between top and back centers, the cams thereafter moving said members to gradually close the initially-opened side of the shed between back and bottom centers, while maintaining open the opposite side of the shed, until exit of the shuttle therefrom, the harness members being then moved by the cams to effect quick closing and crossing of the warps at such latter side of the shed, and slow crossing thereof at the opposite side.

18. In a loom, a lay, a crank-shaft operatively connected therewith, a rotating cam-shaft having a one-to-four ratio of rotation with the crank-shaft, and shedding mechanism, including oppositely-moving harness members, two double controlling-cams for and operatively connected with each harness member and mounted on the cam-shaft, each cam having two short-dwell portions and intervening portions to effect a rise and fall of the connected end of the harness member, the cams being set upon the cam-shaft to give a rapid movement to one end of the harness member on one stroke and a slow movement on the opposite stroke, and vice versa.

19. In a loom, a lay, a crank-shaft operatively connected therewith, a reciprocating shuttle, and shedding mechanism, including oppositely-moving harness members, continuous from one to the other side of the warp, and cams to actuate them with a differential movement, to present an open shed at one side for the incoming shuttle, with a dwell thereat during substantially one-quarter revolution of the crank-shaft from top center, the cams then moving the harness members and thereby slowly crossing the warps at the same side to change the shed during the next full revolution of said shaft, and dwelling for one-quarter of a revolution thereof, and finally effecting a rapid reverse crossing of the warps at the initial side of the shed during the remaining half-revolution of the crank-shaft, completing the cycle with the shed again open at the initial side in readiness for another pick of the shuttle, the slow shed-changing movement of the harness members at one side of the shed corresponding to the rapid changing movement at the other side, and vice versa, such movement being effected by differential movement of the harness members.

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

CLARE H. DRAPER.

Witnesses:

GEORGE OTIS DRAPER,

ERNEST W. WOOD.