

**March 14, 1961**

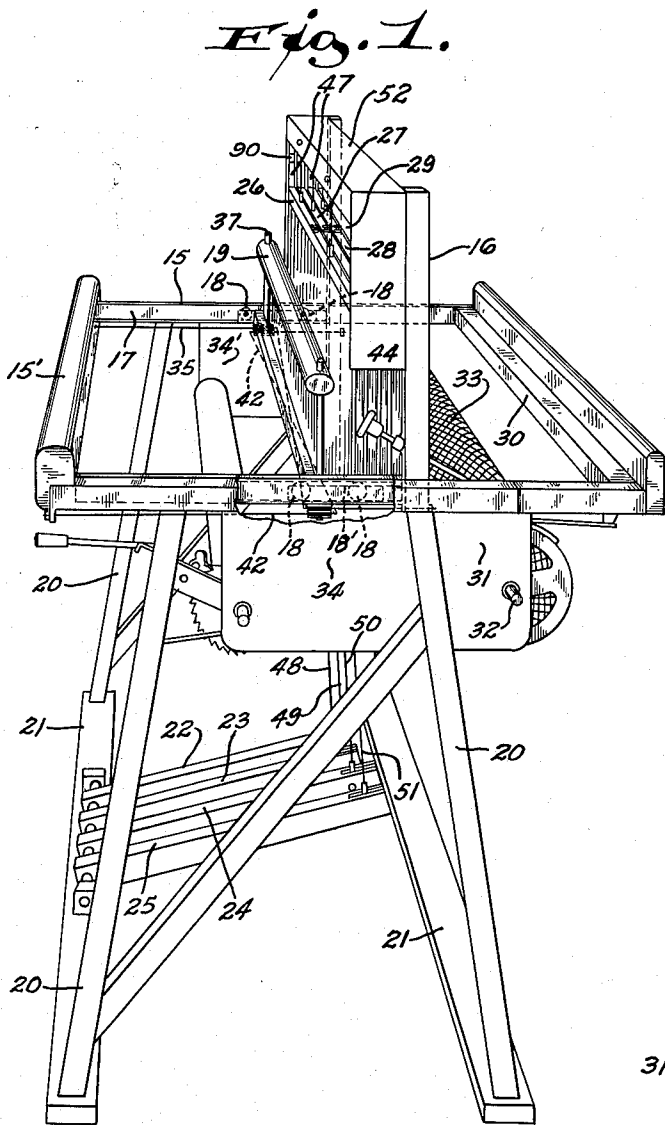
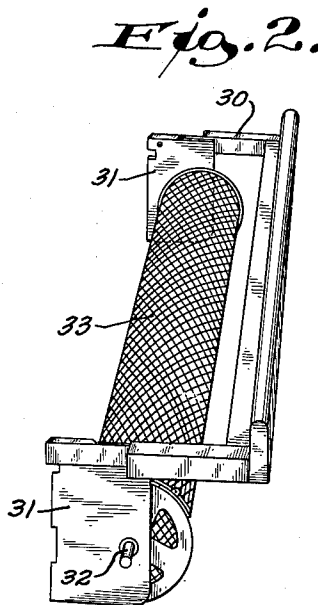
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**2,974,686**

## LOOMS

Filed July 8, 1958

4 Sheets-Sheet 1



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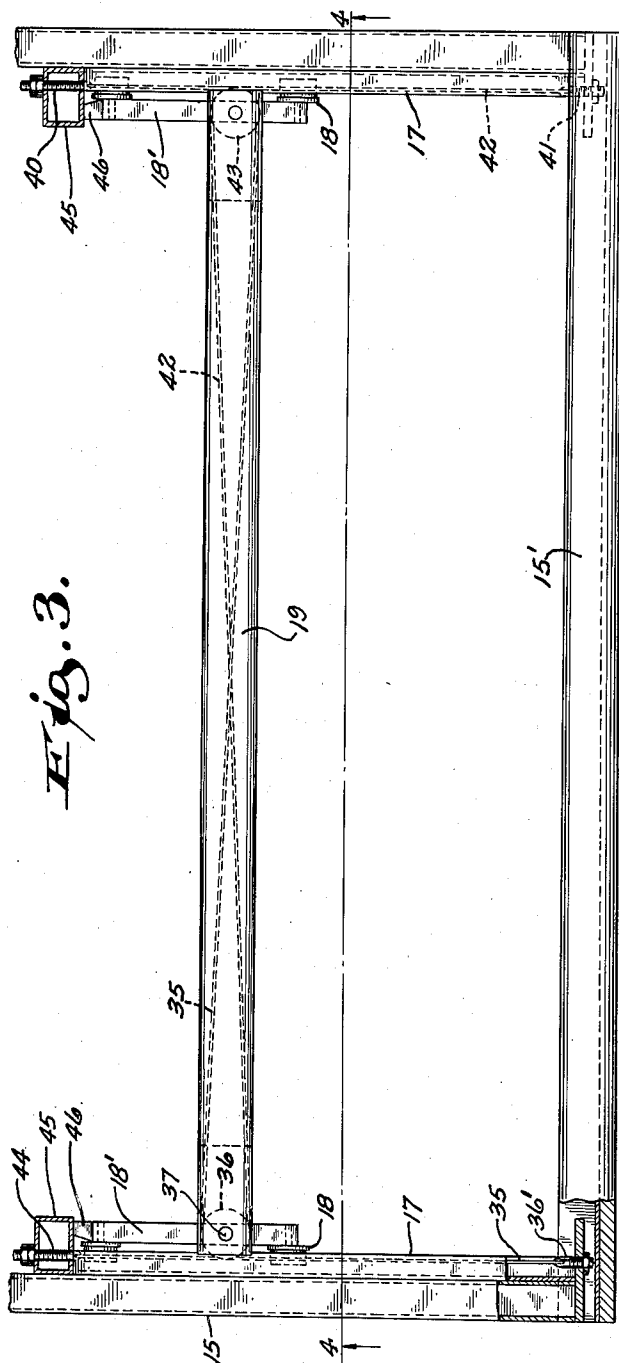
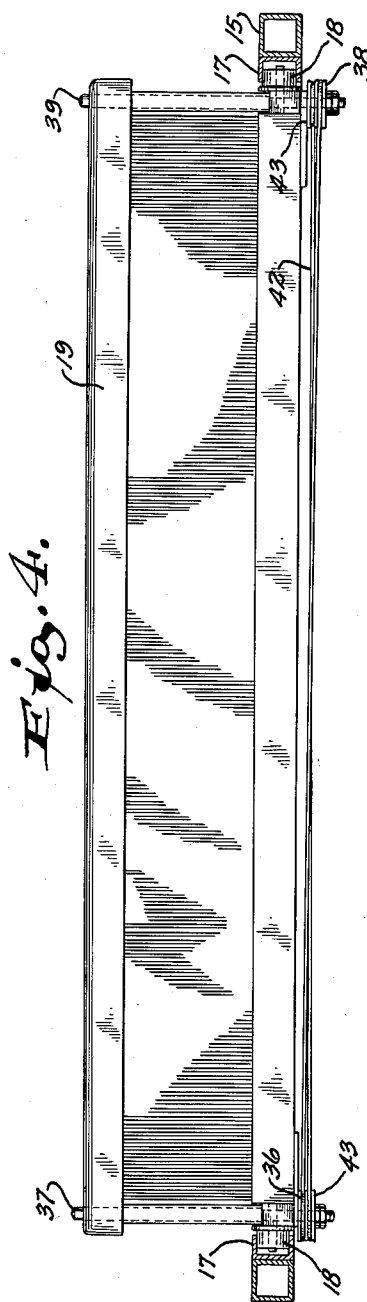
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LOOMS

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4 Sheets-Sheet 2



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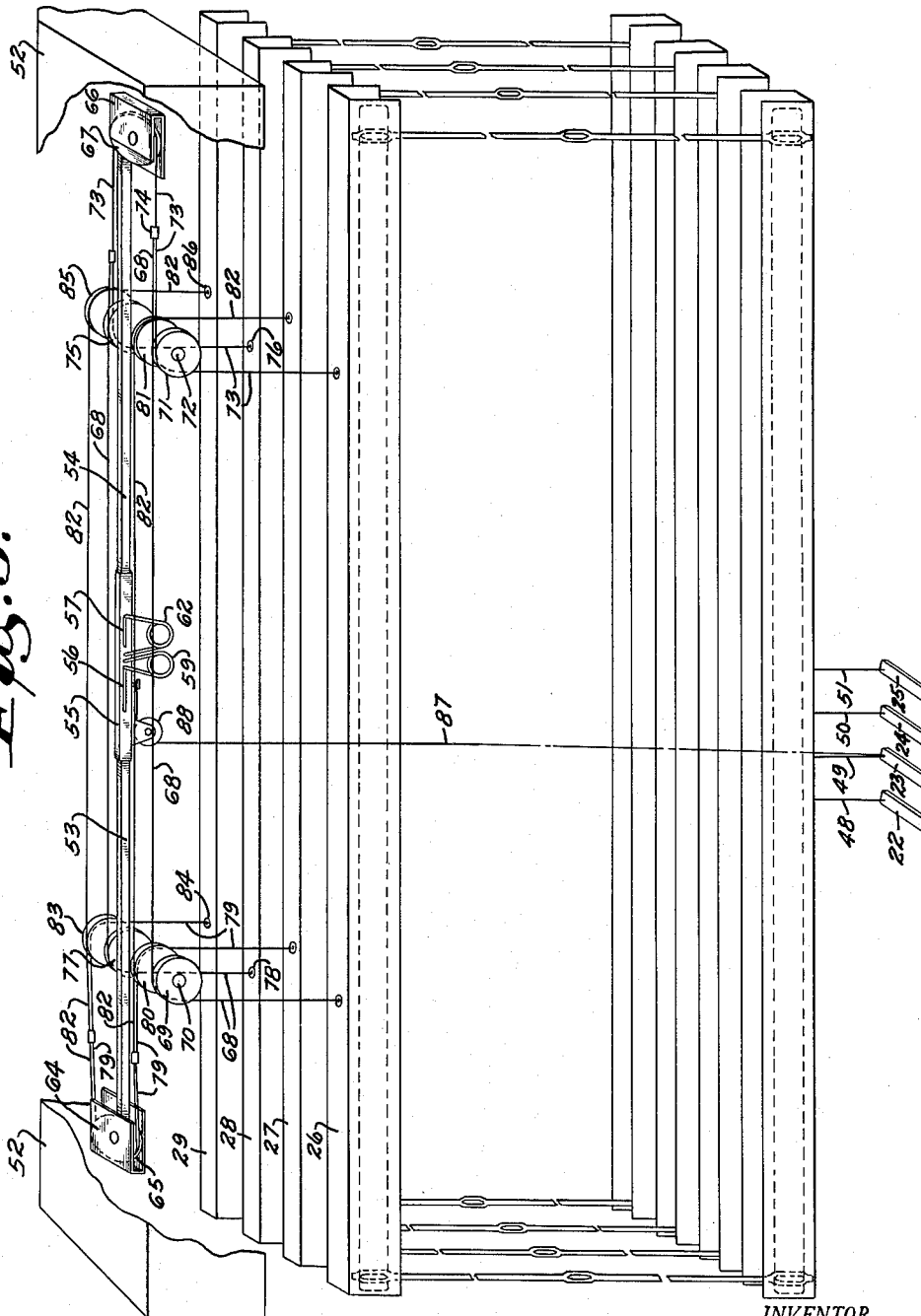
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Fig. 5.



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LOOMS

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*Fig. 6.*

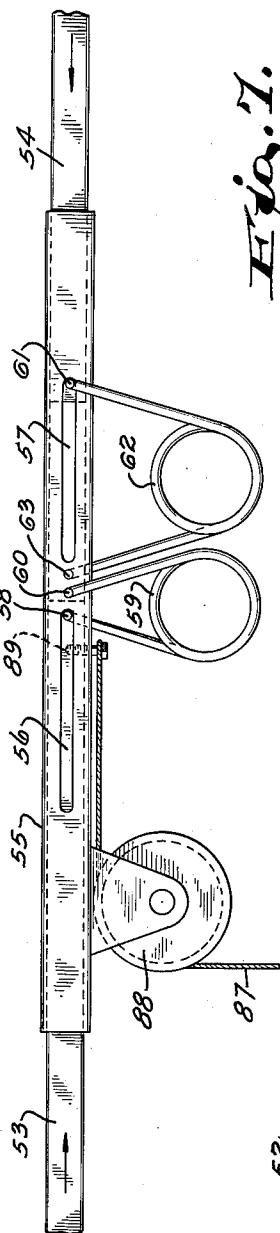
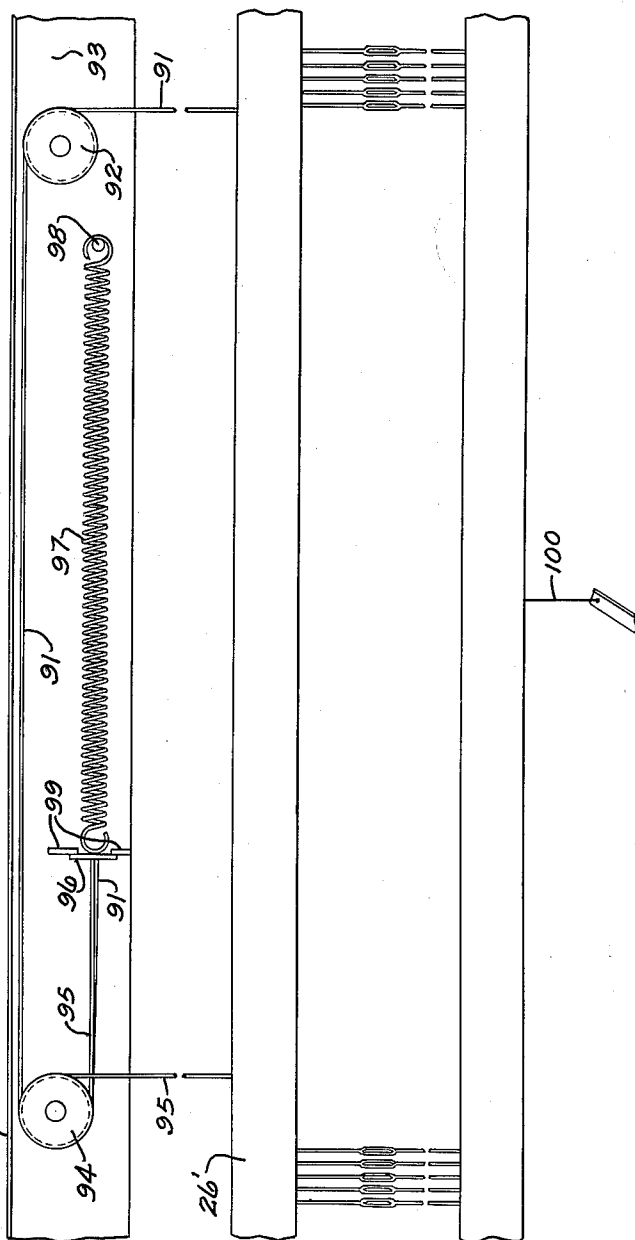


*Fig. 7.*



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LOOMS

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6 Claims. (Cl. 139—29)

This invention relates to improvements in looms, and more particularly to a highly efficient manually operated loom having, among other things, a novel beater mechanism and heddle suspension.

In conventional looms the beater or slay, which holds the reed to beat the thread into the cloth, is pivotally mounted above or below the shed to swing in an arc and consequently the reed is not at all times held parallel with the breast beam and normal to the shed. Also, in conventional loom beater mechanisms it is necessary to pull the beater from a central point to avoid obtaining unevenly woven cloth. In the present invention the beater or slay is mounted so as to have a straight line motion in a plane whereby the reed is held parallel with the breast beam and at the same set angle with the shed at all times, permitting the operator to pull from either side of the beater without affecting the evenness of the resulting cloth, the motion of the improved beater mechanism being such that the action takes place against the beat line at the same angle, regardless of the amount of cloth already woven or the location of the beat line, thereby avoiding imperfections or beat line marks in the resulting cloth.

A further object of the invention is to provide a manually operated loom wherein the frame is formed of square tubular steel in which guides for the straight line movement of the beater are compactly incorporated.

A further object of the invention is to provide a loom in which each heddle frame is suspended by a series of cables and pulleys with one heddle frame being counterbalanced against another, the counterbalancing arrangement of the heddles being such that all of the sheds are in even tension, which eliminates any tendencies on the part of the shuttle to dive through the warp.

A further object of the invention is to provide a manually operated loom wherein the plurality of counterbalanced heddle frames are self-compensating to afford even sheds, regardless of how many heddles are pulled down.

A further object of the invention is to provide, in a loom assemblage with counterbalanced heddles, an independent treadle operated suspension for each heddle whereby each heddle can be tensioned according to its association relative to the work and the warp strands in the respective heddles.

A further object of the invention is to provide a manually operated loom equipped with a removably mounted warp roll which is complete with its own bearings mounted on its own rigid frame.

A further object of the invention is to provide a manually operated loom which is of very simple construction, which is relatively easy to operate, which produces improved woven fabrics, which is easy to adjust, and which is well adapted for the purposes described.

With the above and other objects in view, the invention consists of the improved loom, and its parts and combinations as set forth in the claims, and all equivalents thereof.

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In the accompanying drawings, in which the same reference characters designate the same parts in all of the views:

Fig. 1 is an end perspective view of the improved manually operated loom, with a portion broken away to show structural features;

Fig. 2 is a perspective view of the warp roll removed from the loom frame;

Fig. 3 is an enlarged fragmentary plan view, with parts broken away and in section, of that portion of the loom frame in which the beater is mounted;

Fig. 4 is a vertical sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is an enlarged perspective view of the heddles and their suspension and self-compensating counterbalancing means;

Fig. 6 is an enlarged fragmentary front view of the heddle compensating mechanism incorporated in the spreader rod assembly; and

Fig. 7 is a fragmentary enlarged front view of a modified form of heddle frame compensating suspension means.

Referring now more particularly to the drawings, and to Figs. 1-4 inclusive thereof, it will appear that the improved loom includes an elevated horizontal guide frame designated generally by the numeral 15, which provides a beater mounting frame and which is formed of tubular steel members of square form in cross-section. The inner end portions of the tubular side arms of the frame 15 are in disengageable telescopic engagement with the reduced inner ends of the side arms of a warp roll frame 30 shown in detail in Fig. 2 but which, when in the position shown in Fig. 1, forms a flush continuation of the guide frame 15. Secured to and extending upwardly from the beater mounting frame 15 adjacent the junction of the side arm portions of the elements 15 and 30, is a heddle mounting frame 16. The inner faces of those portions of the side rail members of the guide frame 15 which are forwardly of the heddle mounting frame 16 have secured thereto inwardly facing channels 17 which form tracks for rollers 18 revolvably mounted on opposite end portions of the lower horizontal supports 18' on a beater 19. The beater, as is conventional, has the reed incorporated therein and the beater is mounted in the guide channels 17 of the beater mounting frame 15 for even movement in a horizontal plane by means of a cable and sheave arrangement which will hereinafter be described. The arrangement is such that the cable and sheave system insures parallel movement of the beater so that the beating operation will always take place against the cloth or beat line at the same angle, to avoid "beat line marks." Extending transversely across the forward ends of the arms of the guide frame 15 is a cloth beam support 15'.

A plurality of spaced-apart legs 20 are secured at their upper ends to and diverge from the guide frame 15 and are affixed at their lower ends to elongated horizontal spreaders 21 which facilitate movement of the loom from place to place by sliding it, and which also support bearings for pivotally mounting the outer ends of heddle operating foot treadles 22, 23, 24 and 25. Although the improved loom is illustrated as embodying four heddle frames 26, 27, 28 and 29 with a corresponding foot treadle and operating connections for each, this is merely by way of illustration, and the improved loom, within the contemplation of the present invention, may include any convenient number of heddles and operating treadles therefor.

The present loom is particularly designed for home usage and it is therefore essential that it be susceptible of being passed or moved through a normal 24" door. For this purpose, as was mentioned heretofore, the warp roll

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frame 30 can be detached from its association with the guide frame 15, and as detached this warp roll frame unit is in the form shown in Fig. 2. Opposite ends of the side arms of the warp frame 30 carry depending plates 31 in which are journaled the end stub shafts 32 which revolvably mount the warp roll 33. When the warp roll unit is to be mounted in the loom frame as in Fig. 1 the warp roll frame plates 31 coincide with the end portions of loom frame carried plates 34. The removability of the warp roll frame 30 also facilitates the feeding of the warp strands through the heddles.

As was mentioned heretofore, a unique sheave and cable arrangement is employed for permitting back and forth movement of the beater 19 without deviation from its plane or deflection of any portion thereof for the accomplishment of uniform pressures against the work. As will be observed from Figs. 3 and 4, the extremity of a cable 35 is anchored to a pin 36' (see Fig. 3) threaded into a forward flanged corner portion of the guide frame 15. This cable 35 is then directed horizontally rearwardly below and adjacent the inner guide track 17 and is then trained about the uppermost sheave 36 of a pair of sheaves revolvably mounted on a vertical shaft 37 journaled in an end of the beater 19 (the left-hand end of the beater with reference to Figs. 1, 2 and 3). Said cable 35 extends diagonally under the bottom portion of the beater 19 and is then trained about the lowermost sheave 38 of a pair of sheaves revolvably mounted on a vertical shaft 39 on the other end of the beater (the right-hand end relative to Figs. 1, 2 and 3). Then this cable 35 is directed rearwardly and is anchored to an adjusting bolt 40 (see Fig. 3) which is carried by the right-hand side arm of the guide frame 15 rearwardly of the beater. On the said side of the guide frame 15 at its forward right-hand corner relative to the drawings there is an anchor member 41 for the extremity of a second cable 42 which extends rearwardly adjacent the right-hand side arm of the frame 15 to a sheave 43 mounted on the vertical shaft 39 above the previously mentioned sheave 38. Said cable 42 then extends diagonally along the bottom of the beater, crossing the first-mentioned cable 35 and it is trained about a sheave 43' mounted on the shaft 37 below the previously mentioned sheave 36. From thence the cable 42 is directed rearwardly along the left-hand side arm of the guide frame 15 to an adjustable anchoring bolt 44. The adjustability of the rear anchoring bolts 40 and 44 permits the cables 35 and 42 to be adjusted as required to increase or decrease their tension and the alignment of the beater. The box-like frame structures 45 (see Fig. 3) into which the adjusting bolts 40 and 44 are threaded carry rubber bumpers 46 which resiliently engage the inner ends of the beater arms 18.

An important feature of the present invention is the self-compensating and counterbalancing suspension means for the plurality of heddles incorporated in the improved loom. In conventional counterbalanced suspension means for loom heddles, when there is an uneven division of the number of heddle frames that are pulled downwardly, an unbalanced shed will develop. This is overcome in the present heddle suspension system, which insures an even or uniform shed regardless of how many heddles are pulled down.

Actually the product of the number of heddle frames pulled downwardly multiplied by the distance of movement, divided by the number of heddles moved upwardly, results in the distance of upward movement of the upwardly moved heddles from any neutral position. Thus, in a loom which includes four heddles, if two are moved upwardly and two are moved downwardly, the system is in balance and the upward movement is identical to the downward movement, resulting in a uniform shed. By way of example, if two heddles are each moved downwardly 2" the product is four, but there are also two heddles that move upwardly, so that 4 divided by 2 results in 2, which means that the upper heddles have moved up-

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wardly 2", while the lower heddles were moving downwardly 2". If, however, one heddle is moved downwardly 3" the product of  $1 \times 3$  is 3, and dividing the number of heddles which move upwardly in this case by three results in the figure 1, which means, in this hypothetical discussion, that the upper heddles will move up 1" so that there will be an unbalanced shed. Conversely, if three heddles move downwardly for 1" the single heddle moving upwardly would move a distance of 3" to again result in an unbalanced shed in the other direction.

To eliminate this undesirable condition inherent in conventional counterbalanced heddle suspension systems, the improved loom incorporates the self-compensating counterbalancing heddle suspension means illustrated in Figs. 5-7 inclusive. As will appear from Fig. 1, the heddles 26, 27, 28 and 29 (four being used by way of example) are vertically reciprocatably mounted within guide slots 47 therefor in the end plates of the heddle mounting frame 16. The lower portions of the heddles (see Fig. 5) are connected respectively by cables 48, 49, 50 and 51 with the inner ends of the movably mounted foot treadles 22, 23, 24 and 25. While there is illustrated an individual cable connection for each foot treadle, it should be understood that the cable connections with the treadles may be made detachable and one treadle could be connected so as to operate and serve a pair of heddles.

Fig. 5 illustrates in perspective and semi-schematically the suspension means for the four heddles and said suspension and mounting means, which is shown in detail in Fig. 6, is located under the hood 52 which forms the top of the heddle mounting frame 16. The spreader rod assembly from which the various heddles are compensatingly suspended, comprises a pair of endwise adjacent horizontal bars 53 and 54 whose inner end portions are enclosed by and longitudinally reciprocate in a sleeve 55. The sleeve 55 has slots 56 and 57 therein. There projects through the slot 56 the pin end 58 of a spring 59, which pin end is affixed to the bar 53. The other pin end 60 of the spring 59 is anchored to the sleeve 55. Similarly, there is anchored to the enclosed end portion of the bar 54 the pin end 61 of a spring 62, which pin end projects through the sleeve slot 57 and the other pin end 63 of said spring 62 is anchored to the sleeve 55. The outer end portion of the bar 53 extends into a sheave bracket 64 in which a sheave 65 is journaled on a vertical axis. Similarly, the outer end of the bar 54 extends into a sheave bracket 66 in which is journaled on a vertical axis a sheave 67.

One end portion of a cable 68 is anchored to the top portion of the heddle 26 near its lefthand end relative to Fig. 5, and said cable 68 engages a sheave 69 which is one of a number of similar sheaves mounted on a horizontal axis 70 suitably depended from the bar and sleeve assemblage. Said cable 68 then extends horizontally over a sheave 71 which is one of a number of sheaves also mounted on a horizontal transverse axis 72 depended from the bar and sleeve assemblage toward the right hand end thereof relative to Fig. 5. The sheave 71 is engaged by a cable 73 whose lower end portion is anchored to the top frame portion of the heddle 26 toward the right hand end thereof, and said cable 73, beyond the sheave 71, is clipped or otherwise secured to the cable 68 as at 74. The joined cables 68 and 73 then pass about the bar carried sheave 67 and continue over sheave 75 which is on the shaft 72, and at which point the cables 68 and 73 separate with cable 73 then dropping to the top portion of heddle 28 where it is detachably affixed as at 76. Cable 68, however, continues from sheave 75 to a sheave 77 which is on the transverse shaft 70 at the other end of the assemblage and then drops down for securement to the other end of the heddle 28 as at 78. Therefore, it will be seen that heddles 26 and 28 are joined by cables and this assures that a uniform and

parallel vertical motion will be imparted to heddles 26 and 28.

The top frame portion of heddle 27 toward its right hand end relative to the drawing has anchored thereto one end of a cable 82 which extends about sheave 81 on the shaft 72. Said cable 82 then proceeds longitudinally of the bar and sleeve assemblage and over a sheave 80 which is on shaft 70 and is picked up and clipped or otherwise secured to a cable 79 whose end portion is affixed to the left hand end of heddle 27. The combined cable 79—82 is returned around sheave 65 so as to engage sheave 83 with cable 82 then separating from cable 79 and cable 79 drops for connection with the top portion of heddle 29 near its left hand end, as at 84. Cable 82, however, continues from sheave 83 horizontally to the right and engages sheave 85 on shaft 72 and then drops down to connect with the right hand end of the upper portion of heddle 29, as at 86. Therefore, as was heretofore noted, heddles 26 and 28 are linked together, and additionally, heddles 27 and 29 are linked together in a similar fashion for uniform and parallel vertical motion. The reaction of the several pairs of heddle loads is transmitted by the cables to the telescoping bars 53 and 54 and a compressive load is put on said bars within the sleeve 55, but the load imposed thereon by all of the cables is similar.

From the foregoing description it will be obvious that when the loom is so operated that two heddles are down and two heddles are up (in a four heddle loom by way of example), a perfectly balanced shed will result. However, if one heddle is lowered and three heddles are raised, or vice versa, the need for compensating for an unbalanced shed arises. By way of example, if certain treadles are operated so as to lower heddle 26 and raise heddles 27, 28 and 29, then, pursuant to the present invention, there is compensation for an unbalanced shed which would otherwise result. In the operation of the improved loom, in the example given, where one treadle is depressed, an auxiliary cable 87, shown in Figs. 5 and 6, comes into play. The upper end portion of said auxiliary cable 87 passes about a sheave 88 which is mounted in a bracket depended from a portion of the sleeve 55. The upper extremity of the cable 87 is attached to a pin 89 (see Fig. 6), which extends through the open lower end of the sleeve 55 and is anchored in the inner end portion of the reciprocating bar 53 which arrangement, pursuant to downward pull on the cable 87, will cause an extension or movement to the left relative to Fig. 6 of the bar 53, which movement is aided by the spring 59.

In the example mentioned, the cable 49 is normally attached to treadle 23. When the latter is the only treadle depressed, the cable 87 also is hooked onto treadle 23 so that when the operator depresses treadle 23, the auxiliary attached cable 87 will operate on the bar 53 to produce the elongating effect previously described, thereby lengthening the entire compensating bar and sleeve assemblage by a distance suitable to result in a uniform shed which is accomplished by the operator depressing treadle 23 to which cable 87 is attached, as well as depressing treadle 22. In the example given, heddle 26 is held down by depressed heddle 22, but heddles 26, 27, 28 and 29 are pulled up by their cables which are elongated by the extension of the bar assemblage. Spring 59 which, in this case, acts on the bar 53 together with the pull of cable 87, exerts less force than the combined force of the heddles tending to exert a compressive force on bars 52, 53 and 54, to shorten the same. Therefore, the outward pressure exerted on the bar 53 by the cable 87 to project it outwardly, will be assisted by the expansive force of the spring 59.

An unbalanced shed must also be compensated for when, for instance, heddles 26, 27 and 28 are depressed and only heddle 29 rises. In this event, cables 48, 49, 50 and 51 are attached to their respective treadles 22,

23, 24 and 25, and the auxiliary cable 87 is disconnected relative to the treadles. The depression of heddles 26, 27 and 28 will cause heddle 29 to rise until it contacts a rubber block 90 mounted within the heddle guides toward the upper end of the heddle frame 16. Further upward movement of heddle 29 is therefore limited whereupon the operator will further depress the treadles for heddles 26, 27 and 28. Through the attached cables an inwardly directed force, or a movement to the left relative to Fig. 6, will be exerted on the slide bar 54 of the compensating assemblage which will cause the spring 62 to be compressed and shorten the over-all length of the bar and sleeve compensating assemblage to the extent wherein there will be a proper disposition of the manipulated heddles to provide a perfectly balanced shed.

In further explanation of the operation of the compensating mechanism, let it be assumed that the maximum shed height is, for example, four inches. Then the ideal condition is to have a shed wherein there is two inches above and two inches below the horizontal median of the shed. This provides maximum space for the movement of the loom shuttle to provide perfect weaving without damage to the strands.

In various types of looms, heretofore, even with the provision of some type of compensating mechanism an undesirable unbalanced shed will result in some of the examples heretofore given, but this contingency is completely eliminated in the present invention wherein the sleeve and sliding bar assemblage, under the control of cables and springs, which are brought into play through the manipulation of the heddle operating treadles, provides a suspension means for all of the heddles which will result in a perfect balance as between the raised and the depressed heddles, creating under all conditions a shed which extends upwardly and downwardly an equal distance from its horizontal median.

To simplify the explanation, there is shown in the drawing an arrangement wherein each heddle is connected to a separate treadle through an independent cable. In practice, the lower ends of the cables which are detachable from their heddle frames may be arranged so that several heddle cables are attached to a single treadle with the result that one foot operation of the operator will accomplish the same end results as if the cables were connected to independent treadles and required multiple operation.

In Fig. 7 there is illustrated a modified form of the improved heddle suspension and compensating assemblage. Each heddle is independently suspended and this system finds its greatest utility where there are more than four heddle frames in the loom but it is, nevertheless, advantageous in a loom having fewer heddles. The fragmentary showing in Fig. 7 illustrates only the front of a portion of a single heddle and its suspension means, but the same arrangement would be duplicated for other heddles rearwardly of the heddle depicted in Fig. 7 and designated as heddle 26'.

The lower end portion of a cable 91 is affixed to one end portion of the upper frame member of heddle 26', toward the right-hand end thereof relative to Fig. 7, and said cable extends vertically and then over a sheave 92 journaled on a suitable heddle frame carried support 93. Said cable 91 then continues longitudinally of the frame toward its left-hand end relative to the drawing and it engages about a sheave 94. The same sheave is also engaged by a cable 95 whose lower end portion is attached to the left-hand end of the upper frame part of the heddle 26'. The combined extent of the cables 91—95 upon leaving the sheave 94 extend horizontally to the right and are affixed to a collar 96 carried by the adjacent looped end portion of a coiled spring 97. The opposite end of the spring 97 is anchored to the frame, as at 98. The result of this arrangement is that the normal contraction of the spring 97, whose contractive force is limited by the abutment of the collar 96 with stops 99 will, unless the heddle is forcefully pulled down, hold the suspended

heddle in raised position. The lower frame portion of the heddle 26' does, however, have affixed thereto the upper end of a cable 100 which extends to the selected operating treadle for the particular heddle in question. When the operating treadle to which the lower end of the cable 100 is attached is depressed, the heddle 26' will be forcefully lowered and the pull exerted by the cables 91 and 95 will stretch the spring 97. Any number of heddles so suspended and lowered by the proper foot treadles are pulled down against the balanced tension of the springs 97 to produce a shed. The tension of each spring 97 is somewhat greater than the weight of the suspended heddle frame plus the desired warp tension. Each heddle frame, when lowered, will move downwardly in a perfectly aligned uniform or parallel path.

From the foregoing description it will appear that the improved loom incorporates a highly desirable, efficient and novel suspension and compensating assemblage for the various heddles. The beater or slay is mounted so as to have a straight line motion to insure that the reed is held parallel with the breast beam and in line with the normal shed distance and the warp roll of the loom is readily removable to facilitate movement of the loom through narrow passageways. The improved loom is simple to operate and adjust, results in woven fabrics of a superior quality, and is well adapted for the purposes described.

What is claimed as the invention is:

1. In a loom having a heddle frame with a heddle movably mounted therein and a beater mounting frame at right angles to the heddle frame, a beater, and guided cable means connecting the beater with the beater mounting frame for reciprocatably movably mounting said beater in said beater frame for movements in a path perpendicular to the plane of the heddle.

2. In a loom having a heddle frame with a heddle movably mounted therein, a beater mounting frame having guides therein at right angles to the plane of the heddle frame, a beater, and cable and sheave means for reciprocatably movably mounting said beater in said beater frame guides for rectilinear movements in a path perpendicular to the plane of the heddle.

3. In a loom having a heddle frame with a heddle movably mounted therein, a beater mounting frame having guides therein at right angles to the plane of the heddle frame, a beater whose plane is parallel to the plane of the heddle, and guided cable means connecting the beater with the beater mounting frame, said beater

being mounted in said beater frame guides and the guided cable means restricting movements of the beater to movements in a path perpendicular to the plane of the heddle and restraining said beater against angular displacement.

4. In a loom having a heddle frame with a heddle therein, a beater mounting frame having parallel guides in opposite sides thereof at right angles to the plane of the heddle frame, a beater positioned in a plane parallel to the plane of the heddle, opposite corner portions of said beater being mounted in said beater frame guides, a cable and sheave means connecting the beater with the beater mounting frame in a manner to cause the beater to move in a path perpendicular to the plane of the heddle and to restrain said beater against angular displacement.

5. In a loom having a heddle frame with a heddle mounted therein, a beater mounting frame having parallel guides in opposite sides thereof at right angles to the plane of the heddle frame, a beater positioned in a plane parallel to the plane of the heddle and having opposite marginal portions engaging said guides for reciprocating movements of the beater in said guides in a path perpendicular to the plane of the heddle, and cable and sheave means connecting the beater with the beater mounting frame in a manner to restrain angular deflection of the beater during movements thereof.

6. In a loom having a heddle frame with a heddle mounted therein, a beater mounting frame, a beater positioned in a plane parallel to the plane of the heddle and having opposite marginal portions slidably engaging spaced-apart portions of the beater mounting frame for reciprocating movements of the beater in a path perpendicular to the plane of the heddle, sheaves carried by the beater, and cables engaging said sheaves and anchored at opposite ends to spaced-apart portions of the beater mounting frame to maintain all portions of the beater in parallelism relative to the plane of the heddle during reciprocating movements of the beater.

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