Fig. 3.

Fig. 4.

Witnesses:
George B. Davis
Edward V. Veler

Inventor:
Casa & Palmer
By attorneys
Ann McMillan

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To all whom it may concern:

Be it known that I, ISAAC E. PALMER, a citizen of the United States, and a resident of Middletown, in the county of Middlesex and State of Connecticut, have invented a new and useful Improvement in Looms for Cross-Weaving, of which the following is a specification.

My invention relates to certain improvements in the construction, arrangement, and mode of operation of the several parts of a loom for cross-weaving whereby the loom will be capable of weaving a number of different patterns by a very simple manipulation of the heddles, the structure comprising a main heddle and a plurality of auxiliary heddles arranged one above the other at an angle to the main heddle and comprising needle-bars engaging each other, the said needle-bars being provided with banks of needles extended forwardly with their eyes in close proximity to the main heddle, the said auxiliary heddles being hinged at their forward ends to the auxiliary-heddle frame and being supported at their rear ends by connections leading to the loom-frame.

The object of my invention in providing the above-described structure is to enable the auxiliary heddles to be moved laterally independently of each other and also permits the use of a greater number than two auxiliary heddles, if so desired, and at the same time permits the eyes in the forward ends of the banks of needles of the several auxiliary heddles to be located in close proximity to the main heddle.

A practical embodiment of my invention is represented in the accompanying drawings, in which—

Figure 1 is a partial vertical section taken from front to rear through a loom embodying my invention, the front of the loom and the slay-beam being broken away. Fig. 2 is a transverse vertical section taken in the plane of the line 2 2 of Fig. 1 looking toward the back of the loom. Fig. 3 is a partial transverse horizontal section taken in the plane of the line 3 3 of Fig. 2, and Fig. 4 represents several forms of weave which are capable of being produced by this loom.

While I have set forth certain forms of weave which my improved loom is capable of producing, I do not claim the same herein, as they form the subject-matter of three applications filed by me on the 22d day of May, 1899, their serial numbers being 717,728, 717,729, and 717,730, respectively. I have also set forth certain features of construction for the clear understanding of my present invention which are not claimed herein, as they form part of the subject-matter of a pending application filed by me on the 25th day of May, 1899, the serial number being 718,221.

The side frames of the loom are denoted by A, and mounted therein in suitable bearings are the slay-beam-operating shaft B and the cam-carrying shaft C. The slay-beam-connecting rods d lead from the shaft B to the slay-beam. The warp-supplying roller is denoted by E, and it is mounted, as usual, at the back of the loom between the side frames A. The shafts B and C are driven by any suitable mechanism.

The weft-supplying mechanism has been entirely omitted in the accompanying drawings, as it is thought that it is unnecessary to the clear understanding of my invention, which relates more particularly to the warp mechanism.

The main heddle is denoted by F, and it is guided in its upward and downward movements by means of suitable sleeves f f' at its sides, which sleeves surround a pair of vertical guide-rods G G', which are mounted in suitable lower and upper bearings g g', so as to rock in the said bearings. The main heddle F is provided with alternating reeds and needles, the reeds extending between the upper cross-bar f f' and the lower cross-bar f f' of the heddle, the needles projecting downwardly from the upper cross-bar f f' to a point about half-way between the two cross-bars, the heads of the said needles being provided with suitable eyes for the passage therethrough of certain of the warp-threads.

The auxiliary heddles are denoted by H and I, and they comprise an upper needle-bar h, from which extends forwardly into close proximity to the main heddle F a bank of needles h', and a lower needle-bar i, from which projects forwardly to a point in proximity to the main heddle F, immediately below the upper bank of needles h', a lower bank of needles i.
The upper and lower needle-bars of the auxiliary heddles are spaced apart a sufficient distance to permit one or both of the groups of warp-threads for the auxiliary heddles to pass between them and from thence through the eyes of their respective banks of needles, so that the two heddles may be moved laterally with respect to each other without causing their respective warps to interfere with each other.

The lower needle-bar \( i \) is provided at its end at the right side of the loom with a forwardly-extended arm \( f \), the free end of which is hinged to a carriage \( K' \), which has a free vertically-sliding movement along a supplemental guide-rod \( J' \), which is carried in the free ends of a pair of rearwardly-extended arms \( j^2 \), fixed to rock with the vertical guide-rod \( G' \).

The needle-bar \( h \) is provided at one end, in the present instance the end at the left side of the loom, with a forwardly-extended arm \( h^2 \), the free end of which is hinged to a carriage \( K \), which has a free vertically-sliding movement along a supplemental guide-rod \( J \), which is secured in the free ends of a pair of rearwardly-extended arms, the lower one, \( k \), only being shown in the accompanying drawings, which arms are fixed to rock with the vertical guide-rod \( G \).

The right end of the upper bar \( h \) is supported by and has a free sliding engagement with the right end of the lower bar \( i \) in the following manner: The right end of the bar \( h \) has a tongue \( h^3 \), which slides through a loop \( i^3 \) in the right end of the lower bar \( i \), which loop is formed in the rear end of the arm \( i^2 \), fixed to the bar \( i \). The left end of the lower bar \( i \) is supported by and has a free sliding engagement with the left end of the upper bar \( h \) in the following manner: The left end of the bar \( i \) is provided with a loop \( i^5 \), through which passes a tongue \( h^3 \) on the left end of the bar \( h \), the outer end of the said tongue being rigidly secured to the rear end of the arm \( h^2 \).

The auxiliary-heddle frame comprises an upper cross-bar \( M \) and a lower cross-bar \( M' \), the upper cross-bar having link connections \( m \) with the upper ends of the vertically-sliding carriages \( K \) \( K' \) and the lower cross-bar \( M' \) has similar link connections \( m' \) with the lower ends of the said carriages.

The rear ends of the auxiliary heddles are supported from the loom-frame by means of flexible connections \( N \) \( N' \). These connections are hinged or secured to a cross-bar \( a \) of the loom-frame, and one of them, \( N' \), for example, leads to the left-hand end of the upper needle-bar \( h \) and the other, \( N' \), to the right-hand end of the lower needle-bar \( i \).

The auxiliary heddles are caused to independently move laterally for causing the threads which they carry to cross the threads carried by the main heddle and pass first on one side and then on the other side of the said main-heddle warp-threads by the following mechanism: The left main guide-rod \( G \) is rocked, thereby imparting a lateral movement to the upper auxiliary heddle \( H \) by means of a horizontally-swinging lever \( L \), which is hinged at its rear end to a cross-bar \( a \) of the frame and which has at its forward end a pin-and-slot connection with a rearwardly-extended arm \( p^3 \), fixed to the said rod \( G \). This lever \( L \) is moved back and forth by means of a cam \( c \) on the shaft \( C \).

The right vertical guide-rod \( G' \) is rocked, thereby imparting a lateral movement to the lower auxiliary heddle \( I \) by means of a horizontally-swinging lever \( L \), which is hinged at its rear end to the cross-bar \( a \) of the frame, the forward end of the said lever having a pin-and-slot connection with a rearwardly-extended arm \( p^3 \), fixed to the guide-rod \( G' \). This lever is moved back and forth by means of a cam \( c' \), carried by the shaft \( C' \), cooperating with the pin on the swinging lever.

In the accompanying drawings I have shown the means for imparting alternating vertical reciprocating movements to the main heddle and the auxiliary heddles as follows: Flexible connections \( O \) lead from the cross-bar \( M \) of the auxiliary-heddle frame upwardly around pulleys \( o \), carried by one of the cross-beams \( a' \) of the loom-frame, and from thence downwardly into engagement with the upper cross-bar \( p' \) of the main heddle \( F \). The lower cross-bar \( M' \) of the auxiliary-heddle frame has a connection \( p \) with the free end of a tappet \( P \), hinged at its rear end to a cross-rod \( p' \), extending across the frame. This tappet is operated by a cam \( c' \) on the cam-shaft \( C \), which cam in the present instance engages an anti-friction-roller \( p^3 \), carried by the tappet.

Retracting-springs \( Q \) extend from the lower cross-bar \( p' \) of the main heddle \( F \) down into engagement with a cross-beam \( a^3 \) of the loom-frame, which springs tend to draw the main heddle downward, and thereby the auxiliary heddles upward, thus holding the tappet \( P \) at all times in engagement with its controlling cam \( c' \).

In operation as the main heddle \( F \) is moved downwardly the auxiliary-heddle frame \( M \) is moved upwardly, thereby raising the forward ends of the auxiliary heddles upwardly because of their hinged connections with the carriages connected with the auxiliary frame. As the forward ends of the auxiliary heddles are raised and lowered their rear ends will swing back and forth because of their flexible connection with the loom-frame.

It is to be understood that any suitable Jacquard mechanism may be applied to my improved loom for controlling the times of the vertical reciprocating movements of the main and auxiliary heddles and also controlling the times of the independent lateral movements of the auxiliary heddles, so as to permit the loom to weave various patterns. As the said Jacquard mechanism is well known, I have not attempted to illustrate the same in connection with the accompanying
drawings, but have simply shown an effective device capable of imparting to the said heddles their several movements.

The weaves illustrated in the accompanying drawings represent some of the patterns which may be woven by the structure hereinafter described.

What I claim is—

1. In a loom, a main heddle, a plurality of auxiliary heddles arranged one above another at an angle to the main heddle, a support for the forward ends of the auxiliary heddles, means for flexibly supporting the rear end of the auxiliary heddles from the loom-frame and means for imparting to the main and auxiliary heddles their vertical reciprocating movements, substantially as set forth.

2. In a loom, a main heddle, a plurality of auxiliary heddles arranged one above another at an angle to the main heddle, a support for the forward ends of the auxiliary heddles, means for flexibly supporting the rear ends of the auxiliary heddles from the loom-frame, means for imparting to the main and auxiliary heddles their vertically-reciprocating movements and means for imparting to the auxiliary heddles independent lateral reciprocating movements, substantially as set forth.

3. In a loom, a main heddle, an auxiliary heddle frame, a plurality of auxiliary heddles hinged at their forward ends to the said frame, flexible supports leading from the loom-frame to the rear ends of the auxiliary heddles, means for imparting to the main and auxiliary heddles their vertical reciprocating movements and means for imparting to the auxiliary heddles their independent lateral reciprocating movements, substantially as set forth.

4. In a loom, a main heddle, an auxiliary heddle frame, a vertically-reciprocating carriage supported thereby, an auxiliary heddle hinged at its forward end to the said carriage, a flexible support leading from the loom-frame to the rear end of the said heddle, means for imparting to the heddles their vertical reciprocating movements and means for imparting to the auxiliary heddle its lateral reciprocating movement, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 18th day of May, 1899.

ISAAC E. PALMER.

Witnesses:

FREDK. HAYNES,
C. S. SUNDGREN.