C. E. BLAIR.

WARP DRAWING-IN MACHINE.

APPLICATION FILED MAY 8, 1909.

Patented Sept. 14, 1915.

3 SHEETS—SHEET 1.
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APPLICATION FILED MAY 8, 1909.
1,153,856.

Patented Sept. 14, 1915.
3 SHEETS—SHEET 3.

[Diagram of mechanical device with numbered parts and names like "Grasser", "H. R. Gasser", and "Charles E. Blair"]

COLUMBIA PLANOGRAPH CO., WASHINGTON, D.C.
UNITED STATES PATENT OFFICE.

CHARLES E. BLAIR, OF BOSTON, MASSACHUSETTS, Assignor To AMERICAN WARP-DRAWING MACHINE COMPANY, A CORPORATION OF MAINE.

WARP-DRAWING-IN MACHINE.


To all whom it may concern:

Be it known that I, CHARLES E. BLAIR, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Warp-Drawing-In Machines, of which the following is a specification.

This invention relates to metallic heddles and drop wires, and to means for placing them one by one in position for the operation of drawing in a warp. The invention is adapted with equal possibilities to the employment of either metallic heddles or drop wires and it is intended that these two elements may be considered interchangeably throughout the following specification and claims.

One of the objects of the invention is to provide two sets of metallic heddles or drop wires as the case may be, one set differing from the other in a slight feature of its structure, both sets however, being of similar outline. The purpose of providing heddles or drop wires of two different structures is a preparatory step enabling the means by which they are controlled and released to release them one at a time so that they may be presented singly to a drawing-in implement. For this purpose the heddles or drop wires are first arranged face to face in a compact series and suspended by a supporting rod, which is inclined sufficiently to cause the heddles or drop wires when free to slide by reason of their gravity, to a device for placing them in position to receive the drawing-in implement. In order that the heddles or drop wires may be released one by one, they are previously arranged in alternate order with regard to their structure, that is to say, a heddle or drop wire of one formation is interposed between two heddles or drop wires of the other formation. The heddles or drop wires thus assembled in a series of alternate arrangement are retained at the upper end of an inclined rod by a revolving device which extends through apertures in the heddles or drop wires, said apertures being of alternately different form and arranged to coincide so as to form a continuous aperture throughout the series. The retaining device is moreover adapted to release the heddles or drop wires one by one, its capacity to so release them being provided by revolving it within the series. The specific result of revolving the retaining device is to release the foremost heddle or drop wire when the retaining device is in one position and to release the next heddle or drop wire after having moved through 180° of a revolution, each succeeding drop wire by reason of its different structure and alternate arrangement being adapted to be retained when the retaining device is in position to release the previous heddle or drop wire.

Another feature of the invention is a device which receives the heddles or drop wires, thus released one by one and which turns them about their vertical axes so as to arrange them in edge to edge relation whereby they are adapted to receive a drawing-in implement. The device for so positioning the heddles or drop wires not only arranges them in edge to edge relation but advances them positively while in this relation to operative position where they may conveniently receive the drawing-in implement. The heddles or drop wires after being positioned for the drawing-in operation, are released by the latter device and permitted to descend upon a suspending bar and to continue to slide thereto, the preceding heddles or drop wires having the warp threads therein, and in this way the “slay” of the harness is built up. The device which positions the heddles or drop wires in edge to edge relation and advances them to operative position is so mounted and moved as to advance in accordance with the increase of the slay, thus changing the operative position for each drawing-in movement.

One member of the device for placing the heddles or drop wires in operative position is connected with the rod which supports the series of drop wires or heddles in their initial elevated position, and is rotated thereby and has a telescopic connection therewith for the purpose of enabling the positioning device to advance as explained in accordance with the increase of the slay.

A further object of the invention is to provide means for retaining the heddles or drop wires in their appropriate positions when they are in a loom.

By “metallic heddles” is meant such heddles as are commonly used in wire or steel harness, or as are commonly used in a slightly different form for warp stop motion drop bars. These heddles are differentiated
from the heddles of an ordinary woven or knit harness by the fact that there is no continuous organization of the heddles whereby each heddle is permanently related to the others of the series, but each heddle is on the contrary structurally separate from the other heddles, and a series thereof is capable of interchangeable arrangement and the consequent variation in density as to number per inch.

In spite of advantages which the separate metallic heddles afford, they are subject to one objection by reason of their individuality. When the heddles are placed in a loom, after having the warp inserted therein, they are comparatively free to slide from side to side of the loom upon their supporting bar, and they are often displaced several inches from their appropriate position by the vibration of the loom. One means of confining the heddles in their appropriate position is to provide apertures in the supporting bar at frequent intervals and inserting pins or other projections in said apertures so that the heddles are separated into several small masses. According to the present invention, the heddles may be confined in relatively small masses by a spacing rod which is associated with the supporting bar and which is provided with projections extending laterally in opposite directions, said projections being of such character that, when the rod is in one position, the heddles are free to slide upon the supporting bar, and when the rod is in another position by reason of a quarter turn about its axis, the heddles are separated from each other by the projections. The spacing rod is permanently associated with the supporting bar and when the heddles are transferred from the loom to a drawing-in machine, the supporting bar and spacing rod are likewise transferred, being retained in cooperative relation with the heddles in both machines.

The organized warp drawing-in machine herein illustrated is provided with means for receiving two supporting bars, each having a series of heddles. The machine is thus adapted to operate two sets of heddles so that the warp may be drawn into the heddles according to such arrangement that, when subsequently transferred to a loom, the two sets of heddles may be operated in the usual manner for the purpose of producing a shed for the shuttle. For each supporting bar a series of heddles is provided, a separate and distinct retaining and releasing device for releasing the heddles one by one, also a separate and distinct supporting rod and positioning device for arranging the released heddles in edge to edge relation, and actuating mechanism for causing the release of a heddle from one series and then the release of a heddle from the other series and so on releasing the heddles one by one alternately from the two series and placing them separately in position for the drawing-in operation.

On the drawings which illustrate one form in which the invention may be embodied, Figure 1 represents a front elevation of a supporting frame for a warp beam, and means for supporting two series of heddles and for releasing them one by one and placing them in operative position for the warp drawing-in operation. Fig. 2 is an end elevation thereof. Fig. 3 is an end elevation on a larger scale of a portion of the actuating mechanism. Fig. 4 is a top plan view of a portion of the mechanism shown by Fig. 3. Fig. 5 is a perspective view of a series of metallic heddles, a supporting bar, a spacing rod, a retaining and releasing device, means for placing the heddles in operative position, and means for advancing the positioning means. Fig. 6 is an elevation of a metallic heddle or drop wire together with its associated elements in cross section. Fig. 7 is a detail view of the positioning device for the heddles or drop wires. Fig. 8 is a side elevation of a guide forming a part of said device. Fig. 9 is an end view thereof. Fig. 10 is a section on line 10—10 of Fig. 8 showing a section similar to Fig. 10 with the addition of a helical conveyor and a series of heddles or drop wires. Fig. 12 is an elevation of fragments of a supporting bar for the heddles or drop wires and a spacing rod. Figs. 13, 14 and 15 are diagrammatic views which illustrate successive steps of the heddle releasing device, showing the relative stages when two of said devices are combined to be operated by one actuating mechanism.

The same reference characters indicate the same parts wherever they occur.

So far as the structure of the heddles or drop wires is concerned, it will be seen by reference to Figs. 6, 13, 14 and 15 that they are of two different styles. 16 represents a heddle of one style and 17 represents a heddle of the other style. Each heddle is formed with an aperture 18 and with an elongated slot at one end. The slots of the heddles 16 are indicated at 19, and the slots of the heddles 17 are indicated at 20. The upper ends of the slots as well as the apertures 18 coincide in both sets of heddles, but the lower ends of the slots 19 are nearer the apertures 18 than are the lower ends of the slots 20, thereby providing longer slots in the heddles 16 than in the heddles 17. The slots are adapted to receive a supporting bar 21, hereinafter described, and a spacing rod 22 permanently associated with the supporting bar. The heddles 17 are furthermore provided with apertures 23 which are arranged between the apertures 18 and the slots 20 and which coincide sufficiently with
the lower ends of the slots 19 so that, when
a number of the heddles of both sets are
arranged in alinement, a substantially con-
tinuous aperture through the series is
formed by the apertures 23 and the slots
19, as shown by Fig. 6.

When a series of heddles is installed in
the drawing-in machine, the supporting bar
21 and the spacing rod 22 associated there-
with may accompany the heddles and may
be supported in any desired manner pro-
viding the necessary freedom of movement
of the heddles when they are placed in op-
erative position for the drawing-in opera-
tion. If the supporting bar 21 is arranged
at an inclination to the horizontal, as shown
by Figs. 1 and 5, the heddles will obviously
slide downward along the bar by reason of
the force of gravity. The heddles are, how-
ever, initially retained at the upper end of
the supporting bar by means of a retaining
and releasing hook indicated at 24. The re-
leasing hook is a finger formed at one end
of a rod 25 arranged parallel to the inclined
bar 21 and provided with suitable mechani-
ism hereinafter described for rotating it.

26 is a supporting rod which is one mem-
ber of a two part telescopic shaft hereinafter
described. The supporting rod 26 is adapt-
ed to fit loosely within the apertures 18 with
which the heddles of both sets are provided,
and in this way the rod which is arranged
parallel to the inclined bar 21 is adapted to
support the heddles as shown by Figs. 5
and 6. When the heddles are supported in
alinement by the rod 26, the apertures 23
in the heddles 17 are caused to coincide with
the lower extremities of the slots 19 in the
heddles 16 and thus provide a substan-
tially continuous aperture through the series
of heddles comprising both styles through
which the releasing rod 25 may extend. By
reason of the arrangement and relation of
the apertures 29 and the grooves 19, the re-
leasing hook 24 when extending upwardly is
adapted to retain a heddle 17, and when ex-
tending downwardly is adapted to release
such heddle. On the other hand, when the
hook 24 extends downwardly it is adapted to
engage and retain a heddle 16 and when it
extends upwardly it is adapted to release
such heddle. In other words, when the
hook, which by analogy may be compared to
the hour hand of a clock, points to twelve,
as shown by Fig. 5, it is adapted to retain a
heddle 17 and to release a heddle 16, but
when it points to six o'clock it is adapted to
retain a heddle 16 and release a heddle 17.
It is apparent therefore, that, if the heddles
be arranged alternately with regard to their
structural variation and the releasing rod 25
with the hook 24 be extended through the
substantially continuous aperture described,
rotation of the releasing hook in one and
the same direction affects the release of the
heddles one by one and retains all but the
foremost heddle until it has completed 180°
of a revolution after having released the
preceding heddle.

The supporting rod 26 as previously
stated, is one member of a two part tele-
scopic shaft. It constitutes the outer mem-
ber of the shaft and is of tubular formation
and is adapted to receive the other member
27 as shown by Figs. 5 and 7. The member
27 has at its outer end a helix 28 adapted to
receive the heddles one by one as they are
released from the upper series and advance
them to operative position. The member 27
receives its rotary motion from the member
26 and for this purpose it is preferably of
non circular cross section, preferably having
four sides and adapted to fit in the interior
of the member 26 which is of similar forma-
tion as shown by Figs. 6 and 7. The mem-
ber 26 revolves in a given position but the
member 27 is moved along its axis as here-
inafter explained for the purpose of chang-
ing the position of the helix 28 in accord-
ance with the increase of the slay as the 90
warp is drawn in.

Each heddle upon being released by the
hook 24 descends by reason of gravity toward
the helix 28, and upon engaging the first
convolution of the helix, see Fig. 11, it is
turned slightly about its perpendicular axis.
A portion of the helix 28 is incased in a
cylindrical shell 29 which is formed of two
parts of a movable guide 30 having a per-
pendicular saw slot 31. The edges of the
casing 29, which form the mouth thereof,
are converging as indicated at 32, and are
adapted to cooperate with the helix in turn-
ing the heddles about their perpendicular
axes as shown by Fig. 11. In this way, the
heddles upon being released one by one from
the compact mass are turned from face to
face relation to edge to edge relation and
are advanced through the saw slot 31 in the
guide 30 to operative position. The ends
of the cylindrical casing 29 extend suffi-
ciently beyond the supporting legs of the
guide to provide a clear space in which a
drawing-in implement may be moved for
its insertion in the aperture 18. The de-
tached heddle shown by Fig. 5 is in posi-
tion to receive a drawing-in implement im-
mediately prior to being released by the
 helix 28. It will be observed that the sides
of the heddles which embrace the support-
ing bar 21 are slightly deflected when the
heddles are turned to this position, but the
heddles immediately spring back to their
former relative position upon being released
by the helix.

The guide 30 is formed upon a nut 33
threaded upon a lead screw 34 driven by
any suitable means for the purpose of ad-
vaning the guide toward the mass of
heddles as the slay increases.
Inasmuch as the present invention is not directed toward means for drawing-in the warp, no drawing-in implement is illustrated. The drawing-in operation may, however, be accomplished by a manually operated implement or, if desired, may be accomplished by automatic mechanism constructed and arranged to cooperate in union with the mechanism for controlling the heddles. It is sufficient to state that the present invention does not seek to provide drawing-in mechanism but to provide means for placing the heddles in position to receive a drawing-in implement whether such implement be operated manually or by automatic mechanism. After each heddle has been threaded upon a warp, it is further advanced by the helix 28 and released so that it may drop upon the supporting bar 21 and slide downwardly thereon to the previously threaded heddles and thus be added to the slay. When the warp has been drawn through the desired number of heddles, the warp beam and the supporting bar 21 and spacing rod 22 together with the heddles arranged thereon are ready to be transferred from the drawing-in machine to a loom to be there set up in the same relative positions.

The spacing rod 22 is provided with points or projections 35 extending laterally therefrom and arranged at suitable intervals as shown by Figs. 5 and 12. Its ends are arranged in suitable devices which connect it with the supporting bar and it is supported directly beneath the lower edge of the bar. The lower edge of the bar is formed with indentations 36 adapted to receive the pins 35 thus permitting a close arrangement of the spacing rod. When the supporting bar and spacing rod are in a drawing-in machine, the spacing rod is turned so that the pins 35 extend perpendicularly as shown by the drawings, thus permitting the heddles to slide freely along the supporting bar, but when they are set up in a loom, the spacing rod is given a quarter turn about its axis thus causing the pins 35 to extend transversely and thus interpose barriers adapted to prevent excessive displacement of the heddles. The pins 35 are preferably tapered to points so that they are adapted to freely enter between closely spaced heddles.

The description so far describes the structure of the heddles and means for operating one series thereof. It has been heretofore stated that the invention is equally adapted to be employed with either metallic heddles or drop wires and that the terms applied thereto may be considered interchangeable. This is true when successive drop wires are threaded upon the warp threads in a single series, but close arrangement is impracticable because of consequent interference. Drop wires are therefore usually arranged in two or more series. For the purpose of threading individual heddles upon a warp, it is necessary that each set thereof according to the number and arrangement of the harnesses, should be divided into a separate series according to each division of the harness, and that the heddles from the several series be fed down for the drawing-in operation according to the arrangement required by the predetermined arrangement of the harnesses. With this requirement in view, a machine is shown by Figs. 1 to 4 for operating upon two series of heddles. Suitable mechanism is provided for causing the release of a heddle from one series and then the release of a heddle from the other series and so on releasing the heddles alternately from the two series, whereby they may be so threaded upon the warp that each series may be subsequently attached to harness mechanism for producing a shed in the warp by moving the heddles up and down in opposite directions.

Figs. 1 and 2 show a warp drawing-in machine comprising end frames 40 provided with bearings for a warp beam 41. The upper portions of the end frames 40 are adapted to receive a pair of supporting bars 21 and support them at an inclination to the horizontal as indicated by Fig. 1. The seats for the supporting bars 31 are also adapted to receive the spacing rods 22 which, as previously stated, are permanently related to the supporting bars. The ends of the spacing rods are provided with heads 49 by which they may be turned.

The drawing-in machine is provided with mechanism adapted to release and feed the heddles or drop wires on the two supporting bars 21, said mechanism being here shown as being manually operative although it may be understood that automatic actuating mechanism may be substituted therefor. In the supporting frames 40 are bearings 110 for a pair of supporting rods 26, a pair of retaining rods 25, and a pair of lead screws 34. The rods 25 are connected by gearing which causes them to revolve in unison, said gearing comprising pinions 43 one on each rod, and a gear 44 intermeshing with both of the pinions and mounted on a stud 45. The supporting rods 26 are likewise connected by gearing for causing them to revolve in unison, said gearing comprising a pair of pinions 46 one on each of the rods, and a gear 47 intermeshing with both of the pinions 46 and also mounted upon the stud 45. The gears 44 and 47 are rigidly connected so as to revolve as a unit and their ratio with relation to their respective pinions is such that the rods 26 are given two revolutions while the rods 25 are given one revolution. This ratio of the gearing carries out the principle governing the actuation of the releas
ing hook 24 and the helix 28 which, according to previous explanation, require respectively one-half a revolution and one whole revolution for releasing and positioning the heddle.

Means is provided for revolving the rods 25 and 26 intermittently in one direction, said means including a ratchet 48 on the stud 43 and rigidly related to the gears 44 and 47. A pawl 49 of which the free end is adapted to cooperate with the ratchet and of which the other end is pivotally mounted upon a crank pin 50 is adapted to drive the ratchet and the two gears intermittently.

The crank pin 50 is here shown as carried by a disk 51 mounted upon a stud 52 affixed to one of the end frames 40. The disk is provided with a second crank pin 53 from which a connecting rod 54 extends to a treadle 55. 56 represents a spring connected to the treadle and to the end frame 40 in such manner as to normally elevate the treadle to the position illustrated.

When the treadle 55 is actuated, the pawl 49 advances the ratchet 48 one tooth at a time and in this way it imparts to the releasing hooks 24 intermittent rotation in steps each equivalent to 90° of a revolution. In order that the releasing hooks may be adapted to release the heddles alternately from the two series supporting the rods 26, they are related according to the arrangement shown by Figs. 13, 14 and 15. In Fig. 13 the heddles 16 and 17 which represent the two series of heddles are both retained by the overlapping of the releasing hooks. A movement of 90° of a circle imparted to both of the releasing hooks advances them to the position shown by Fig. 14. In which the foremost heddle of the right-hand series is disengaged, while the foremost heddle of the left-hand series is still engaged by its hook. Another step of 90° in the same direction causes the releasing hooks to move to the positions shown by Fig. 15 where the foremost heddle of the left-hand series is released while the foremost heddle of the right-hand series is still retained. One more step of 90° in the same direction moves the releasing hooks to the position shown by Fig. 16 in which the foremost heddle of the right-hand series is released and the foremost heddle of the left-hand series is still retained. In this way, the two series of heddles each including the two styles of heddles alternately arranged, are caused to discharge the heddles one at a time first from one series and then from another series so that the successive heddles presented to the drawing-in implement represent alternately the two series.

In order that the point of drawing in the warp may be advanced step by step in accordance with the increase of the slay, the two guides 30, of which there is one for each series of heddles, are mounted one upon each of a pair of lead screws 34 which are provided with pinions 57 intermeshing with a gear 58.

59 is a gear interposed between the gear 47 and the gear 58 which transmits movement to the latter gear which in turn drives the two lead screws so as to cause the guides 50 to advance in unison.

I do not herein claim the heddles or the assemblage of heddles per se, these features being claimed in my copending application Serial No. 834,235, filed March 12, 1914.

Having thus explained the nature of my said invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is:

1. In a warp drawing-in machine, the combination with a series of two different forms of drop-wires alternately arranged face to face, and a suspending bar therefor, means for supporting the bar at an inclination to the horizontal, means for retaining the series and releasing the drop-wires one by one, and means for receiving the released drop-wires and turning them edge to edge.

2. In a warp drawing-in machine, the combination with a series of two different forms of drop-wires alternately arranged face to face, and a suspending bar therefor, means for supporting the bar at an inclination to the horizontal, means for retaining the series and releasing the drop-wires one by one, and a feeding device for turning the released drop-wires about a vertical axis and advancing them positively to operative position.

3. In a warp drawing-in machine, the combination with a series of two different forms of drop-wires alternately arranged face to face, and a suspending bar therefor, means for supporting the bar at an inclination to the horizontal, means for retaining the series and releasing the drop-wires one by one, means for turning the released drop-wires edge to edge and feeding them to operative position, and means for feeding said turning and feeding means in the direction of the growth of the slay.

4. In a warp drawing-in machine, a feed shaft formed with a helix and adapted to extend through a series of drop-wires, and a guide in cooperative relation with said helix adapted to turn the drop-wires edge to edge and guide them in that relation.

5. In a warp drawing-in machine, a helix adapted to extend through and feed the drop-wires, a guide in cooperative relation with the helix adapted to turn and guide the drop-wires in edge to edge relation, means for advancing the guide and helix in the direction of the growth of the slay, means...
for supporting a series of pendent drop-wires in a compact mass and releasing them one by one, and a two-part telescopic shaft including said helix and extending through the mass of drop-wires.

6. In a warp drawing-in machine, means for supporting a series of drop-wires, means for retaining them in a compact mass and releasing them one by one, a telescopic two-part shaft extending through the mass of drop-wires, one of said parts having a helical portion adapted to feed the drop-wires, a movable guide cooperating with the helix and having a perpendicular slot extending parallel to the path of the drop-wires for turning and guiding them in edge to edge relation, and means for advancing the guides toward the mass of unreleased drop-wires.

7. In a warp drawing-in machine, inclined means for suspending the drop-wires in face to face relation, means for confining the empty drop-wires at the upper end of said inclined means and for releasing them one by one, and means for turning the released drop-wire in edge to edge relation and for feeding them down the incline.

8. In a warp drawing-in machine, inclined means for suspending side by side a plurality of series of drop-wires or heddles arranged face to face, means for confining the series in compact masses at the upper end of said inclined means and for releasing the drop-wires or heddles one by one from the series, and means for conducting the released drop-wires or heddles to drawing-in position, said means being adapted to turn the drop-wires and advance them in edge to edge relation.

9. In a warp drawing-in machine, a plurality of heddle or drop-wire bars adapted to be transferred to a loom, a series of metallic drop-wires or heddles arranged on each bar, means for supporting the bars at an incline, individual controlling means for supporting and confining each series of drop-wires or heddles at the upper end of the incline, said means being adapted to release the drop wires or heddles one by one, individual actuating means for turning the released drop-wires or heddles about a perpendicular axis and advancing them in edge to edge relation to operative position, and means for driving said controlling means and actuating means in unison.

10. In a warp drawing-in machine, a supporting bar for a series of metallic heddles or drop-wires, a revolvule spacing rod associated therewith, and a plurality of pins extending laterally from said rod and adapted to extend laterally between adjacent heddles or drop-wires when the rod is in one position and to extend perpendicularly when the rod is turned through ninety degrees of a revolution.

11. The combination with a series of detached, thread-receiving loom elements, of means for holding the same in compact series, a holding portion upon each member uncovered by the next adjacent members, and means for engaging the said holding portion while leaving the next adjacent members free for movement.

12. The combination with a series of detached, thread-engaging loom elements having each a holding portion arranged to lie adjacent a cut-away portion in the next member of the series, and means adapted to pass through the cut-away portion of said adjacent member and engage the holding portion of said first-named member to hold the same while releasing the said next adjacent member of the series.

13. Mechanism for operating upon heddles or the like comprising means to support the heddles in series, said heddles having openings therein, and means positioned in said openings to effect the separation of said heddles singly and successively from the series.

14. Mechanism to operate upon metallic heddles or the like comprising means to support perforated metallic heddles in series, and means mounted for rotation in said perforations to effect the release of said heddles singly and successively from the series.

15. Mechanism for operating upon metallic heddles or the like comprising means to support in series metallic heddles, each heddle having a heddle releasing formation, and means mounted in such formation to effect the release of the heddles successively from the series.

16. Mechanism for operating upon independent heddles or the like comprising means to support in series metallic heddles having heddle releasing formation, and means positioned in parallelism with said series to cooperate with such formations to effect the release of the heddles successively from the series.

17. Mechanism for operating upon independent heddles or the like comprising means to support in series heddles having heddle releasing formations, and means engaging the heddles of the series to release them singly and successively therefrom by cooperation with said heddle releasing formations.

18. Mechanism for operating upon metallic heddles or the like comprising means to support differentially fashioned heddles in series, and means in constant engagement with the leading heddle to effect the release of the heddles singly and successively from the series.

19. Mechanism for operating upon independent heddles or the like comprising means to support alternately fashioned heddles in series, and means disposed in paral-
Mechanism for operating upon independent heddles or the like comprising means to support alternately fashioned heddles in series, and means rotating in one direction and operatively engaging the alternately fashioned portions of said heddles to release them singly and successively from the series.

21. Mechanism for operating upon independent heddles comprising means to support in series independent heddles having differentially arranged perforations, a heddle releasing key engaging said perforations, and means to operate said key to release said heddles singly and successively from the series.

22. Mechanism for operating upon independent heddles comprising means to support in series independent heddles having oppositely arranged perforations, a key mounted in said perforations, and means to rotate the same, thereby to discharge the leading heddle from the series and to hold from release the remaining heddles.

23. Mechanism for operating upon independent heddles or the like comprising means to support in a series independent heddles having threading eyes and heddle releasing perforations, heddle threading means, a heddle releasing key mounted in said heddle releasing perforations, means to rotate said key to release heddles singly and successively, means to separate released heddles, and rotary means to position the leading separated heddle for the threading operation.

24. Mechanism for operating upon independent heddles or the like comprising means to lock a series of heddles in compacted position, and including a key to release the leading heddle.

25. Mechanism for operating upon independent heddles, or the like comprising means to support a series of heddles, a releasing key to release said heddles singly and successively, and means to compact said heddles against said releasing key.

26. Mechanism for operating upon metallic heddles or the like comprising means to support in a series heddles having differentially arranged perforations therein, a releasing key engaging said perforations, means to operate the key to release heddles in succession from said series, and means to compact said heddles against said key.

27. Mechanism for operating upon independent heddles or the like comprising means to support a series of heddles, means to release heddles successively from said series, means to separate released heddles, and means differentially to operate said heddle releasing and heddle separating means.

28. Mechanism for operating upon metallic heddles or the like comprising means to support a series of heddles, rotatable heddle releasing means to release heddles consecutively, rotatable heddle conveying means to convey released heddles and differential driving connections between said heddle releasing and heddle conveying means.

29. In a machine for selecting and positioning detached thread-receiving loom elements, the combination with a series of such unseparated loom elements of a rotatable support therefor.

30. Mechanism for operating upon independent heddles or the like comprising means to support independent heddles in a series, means to release intermittently the leading heddle, rotary means to position the released heddle for a threading operation, and rotary ejecting means to eject the threaded heddle.

31. Mechanism for operating upon independent heddles or the like comprising means to support independent heddles in a series, and a positioning worm to position the heddles in succession for a threading operation.

32. Mechanism for operating upon warp threads or the like comprising means to support independent heddles in a series, and a rotary worm for positioning the heddles in succession for a threading operation, said worm having means for ejecting the threaded heddles.

33. In a heddle facing mechanism for facing metallic heddles, the combination with means for holding a series of flat, metallic heddles, of rotary facing means for turning and facing successive heddles adapted to undergo complete successive rotations about an axis in facing the said heddles.

34. In a heddle facing mechanism for facing metallic heddles, of means for holding flat, metallic heddles in compact series, of rotary releasing means for releasing successive heddles, and rotary facing means adapted to undergo complete successive rotations about an axis in facing the said heddles.

35. In a heddle facing mechanism for facing metallic heddles, the combination with means for holding flat, metallic heddles in compact series, of rotary releasing means for releasing successive heddles, and rotary facing means for turning the heddle to face the heddle eye at substantially right angles to its position in the series.

36. In a heddle facing mechanism for facing metallic heddles, the combination with means for holding flat, metallic heddles in compact series, of rotary releasing means for releasing successive heddles from the series, rotary conveying means for conveying a released heddle to a position to be
faced, rotary facing means for turning the heddle, and rotary means for passing on the heddle from the faced position.  

37. In a heddle facing mechanism for facing metallic heddles, the combination with means for holding a series of flat metallic heddles, rotary facing means for turning a heddle, and rotary conveying means for passing on a heddle from its faced position.  

38. A machine for operating upon independent heddles or the like, having means for holding the heddles in a compacted series, including a rod passing through perforations in each heddle, said rod being provided at one end with a lateral projection, and said perforations having an extension at one side for the passage of said projection, said extension in adjacent heddles being out of alinement, whereby, as said rod is rotated, it will successively release the heddles.  

39. In a heddle facing mechanism for facing metallic heddles, the combination with means for holding such heddles in compact series, of rotary releasing means for releasing successive heddles from the series, said means including a member movable across the face of the heddle and an actuating member therefor interiorly engaging and parallel to the series of heddles.  

40. In a heddle facing mechanism for facing metallic heddles, the combination with means for holding such heddles in compact series, of means for releasing successive heddles from the series and rotary facing means for turning a released heddle to face the heddle eye at substantially right angles to its position in the series, and a cooperating abutment between which and said facing means the heddle is faced.  

41. The combination with a plurality of detached, thread-receiving loom elements having differentially arranged openings, means for holding them in compact series with their openings in general alinement, and means positioned in the openings and cooperating with the differential arrangement thereof to separate them singly and successively from the series.  

42. The combination with a plurality of detached, thread-receiving loom elements having alternatingly different internal structure, of means for holding them in a bank or series and separating means cooperating with the alternatingly different internal structure of the heddles for releasing them singly and successively from the series.  

43. The combination with a series of flat metallic heddles having each a releasing opening, of means for holding the heddles in an alternatingly varying arrangement whereby a portion of the flat face of each heddle is uncovered by the releasing opening of the preceding heddle, holding means engaging the uncovered portion of a heddle to hold back all but the preceding heddle, and means to disengage the holding means from the uncovered portion of a heddle and apply it to the uncovered portion of the next succeeding heddle.  

44. The combination with means for holding a series of detached, thread-engaging loom elements to present a differentially and alternately varied internal arrangement of separating means cooperating with differential internal arrangement of the members of the series for releasing them singly and successively.  

45. Mechanism for operating upon metallic heddles having means for holding the heddles in series to present them in regular alternate internal linear variation as between successive members of the series, and means cooperating with the internal linear variation to release the heddles singly and successively from the series.  

46. Mechanism for operating upon metallic heddles having means for holding the heddles in series to present them in regular alternate linear variation as between successive members of the series, and means cooperating with the linear variation to release the heddles singly and successively from the series.  

47. In a machine for acting upon metallic heddles, the combination with means for supporting a series of such heddles, the form of each supported heddle undergoing a regular alternate variation in successive heddles of the series, and means cooperating with the alternately varied heddles to release them singly and successively from the series.  

48. In a machine for acting upon metallic heddles, the combination with means for holding a series of such heddles to present an alternate varying formation and provide each a holding portion uncovered by the preceding heddle, holding means engaging the uncovered portion of the heddle to hold back all but the preceding heddle, and means to disengage the holding means from the uncovered portion of a heddle and apply it to the uncovered portion of the next succeeding heddle.  

49. In a machine for acting upon metallic heddles, the combination of means for holding a series of detached, metallic heddles, composed of thin, resilient sheet material in a compacted bank on a stringer bar to present an alternately varying formation and present each holding portion uncovered by the preceding heddle, holding means engaging the uncovered portion of the heddle to hold back all but the succeeding heddle, and means to disengage the holding means from the uncovered portion of a heddle and apply it to the uncovered portion of the next succeeding heddle.

50. The combination with a plurality of detached, metallic heddles composed of thin,
resilient, sheet material, of generally similar external linear contour, each heddle having its flat face formed to present at some part thereof a holding portion and each heddle having a releasing opening, and means for holding said heddles in compacted arrangement whereby a continuous aperture is formed in the compacted heddles through the successive releasing openings, the holding portions being presented in regular alternation and variation of position in successive heddles, the holding part of one heddle being uncovered by the releasing opening of the preceding heddle, a releasing shaft passing through the formed aperture, releasing means carried by the end of the shaft and engaging the holding portion of a heddle to hold back all except the preceding heddle, and means for turning said shaft to cause the releasing means to engage the holding portion of the next succeeding heddle.

51. In a machine for acting upon metallic heddles, the combination with means for supporting in a compacted bank a series of individual detached metallic heddles composed of thin, resilient sheet material, each heddle having its flat face formed to present at some part thereof a holding portion and each heddle having a releasing formation, said heddles being held whereby there is presented successively a regular, alternate variation in position of the holding portion and whereby the holding portion of one heddle is uncovered by the releasing formation of the preceding heddle and holding means engaging the holding portion of a heddle to hold back all except the preceding heddle, and means for disengaging the holding means from the holding portion of a heddle and engaging the same with the holding portion of the next succeeding heddle.

52. In a mechanism for operating upon metallic heddles the combination with a stringer bar, on which a bank of individual, detached, metallic heddles composed of thin, resilient sheet material is adapted to be compacted with the flat faces of the heddles in contact, each heddle having its flat face formed to present at some part thereof a holding portion and each heddle having a releasing formation, the bank of heddles being held to present a regular, alternate variation in the position of the holding parts whereby the holding part of one heddle is uncovered by the releasing formation of the preceding heddle, holding means adapted to engage the holding portion of a heddle and hold back all but the preceding heddle, and means to disengage the holding means from the holding portion of a heddle and apply said means to the holding portion of the next succeeding heddle.

53. In a machine for operation upon metallic heddles the combination with an inclined stringer bar for holding a series or bank of such heddles and means for releasing successive heddles of the series whereby the released heddle tends to be conveyed along the said inclined bar by gravity.

54. In a machine for acting upon metallic heddles, the combination with means for holding a bank or series of said heddles, means for releasing the heddles singly and successively from the series and inclined guiding means for causing the gravity assisted conveyance of a released heddle from the series.

In testimony whereof I have affixed my signature, in presence of two witnesses.

CHARLES E. BLAIR.

Witnesses:
W. P. ABELL,
P. W. PEZZETTI.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."