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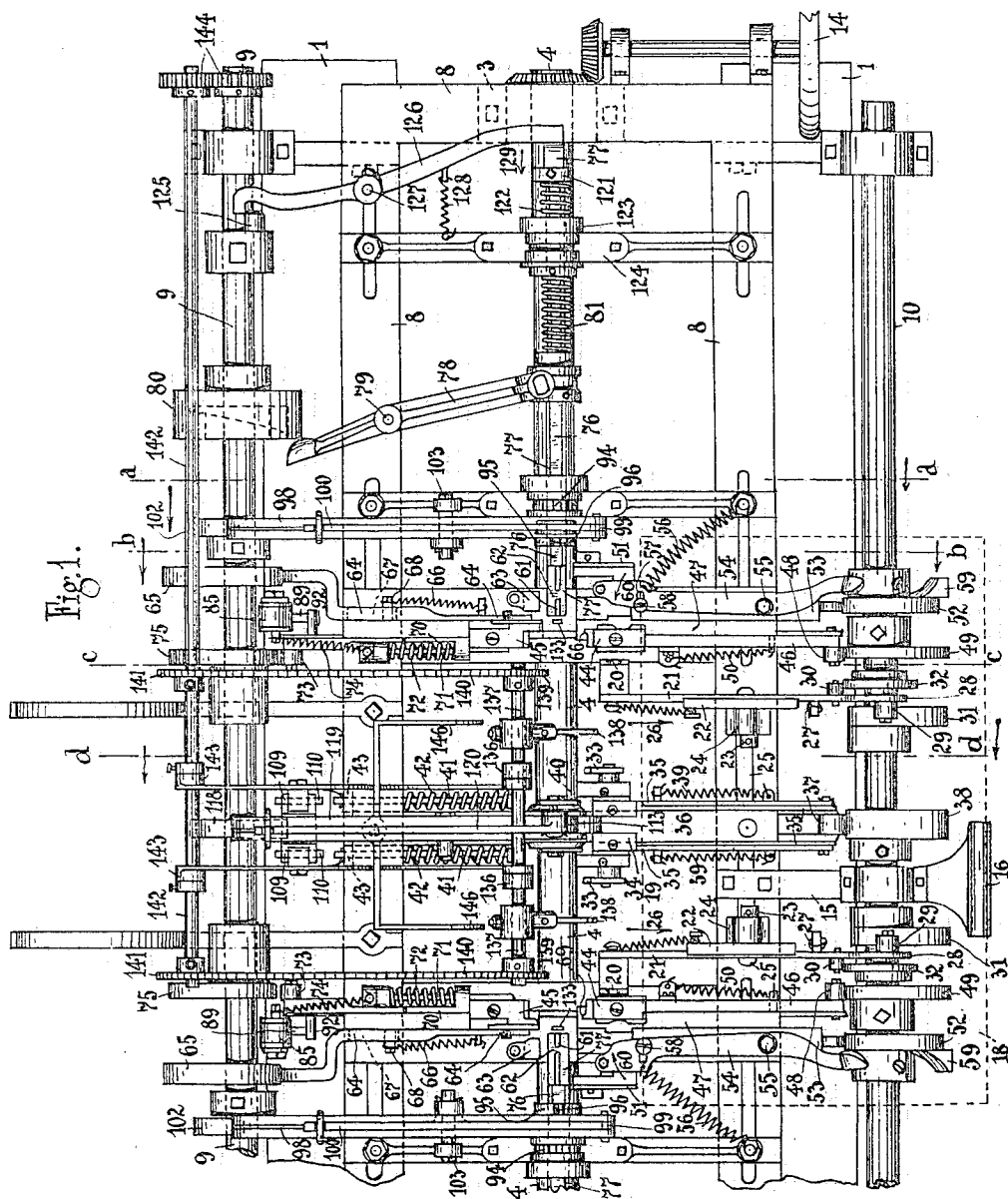
PATENTED JAN. 9, 1906.

E. CHARPENTIER & J. RICHELLE.

HEDDLE MAKING MACHINE.

APPLICATION FILED MAY 23, 1905.

5 SHEETS—SHEET 1.



WITNESSES. *Wm. Snell.* *Adeli Blatt.* *ITZETZLOWS,*
Edmond Charpentier
Joseph Richelle
by Garthard Luwack.
Attorneys.

No. 809,668.

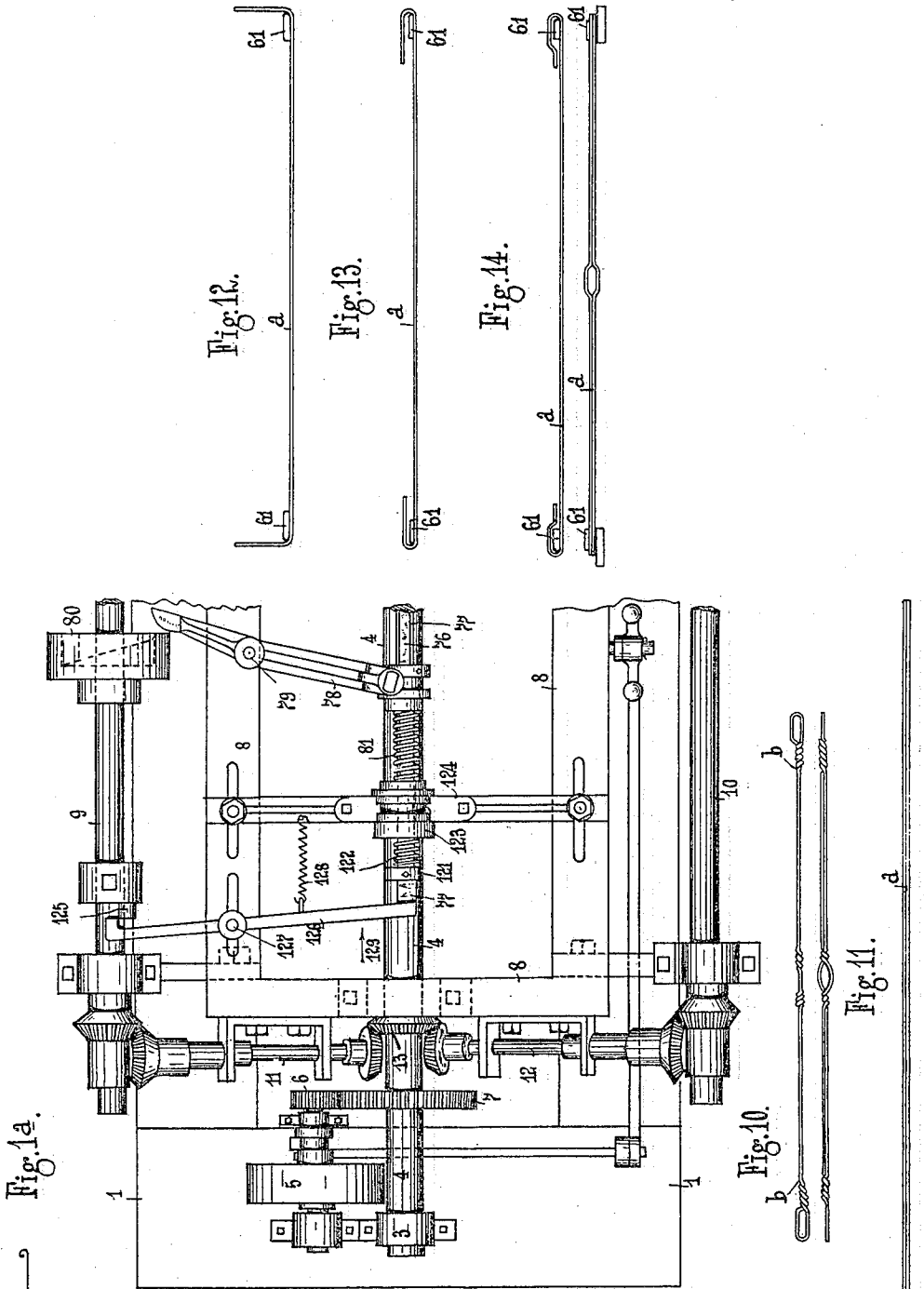
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5 SHEETS—SHEET 2.



WITNESSES.
Wm. D. Bell.
Adele Klatt.

INVENTORS,
Edmond Charpentier
and Joseph Richelle,
by Arthur Suward,
Attorney.

No. 809,668.

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5 SHEETS—SHEET 3.

Fig. 2.

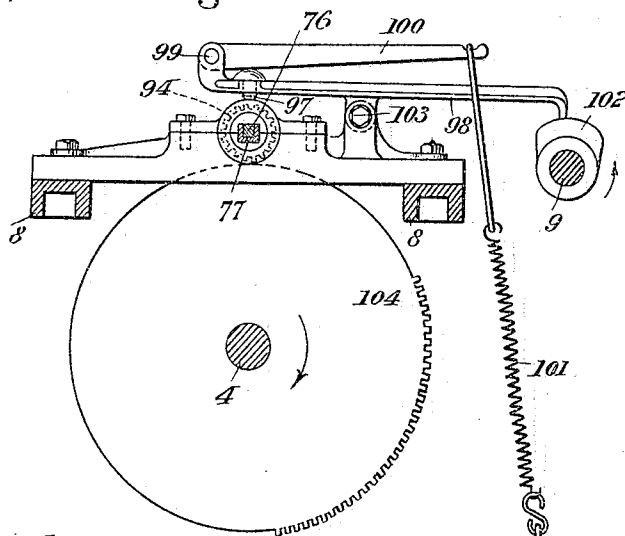
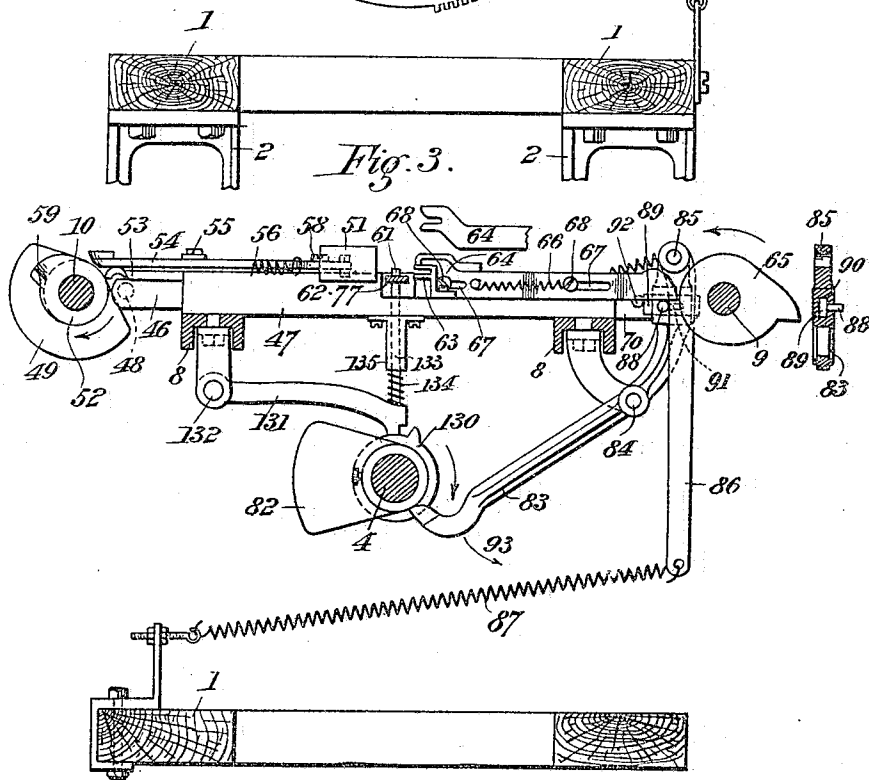


Fig. 3.



WITZESSES

Jm. Orell.
Adèle Schlatt.

ITZ VECTORS

Edmond Charpentier
and Joseph Richelle
by Edmund Seward,
Attorneys.

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5 SHEETS—SHEET 4.

Fig. 4.

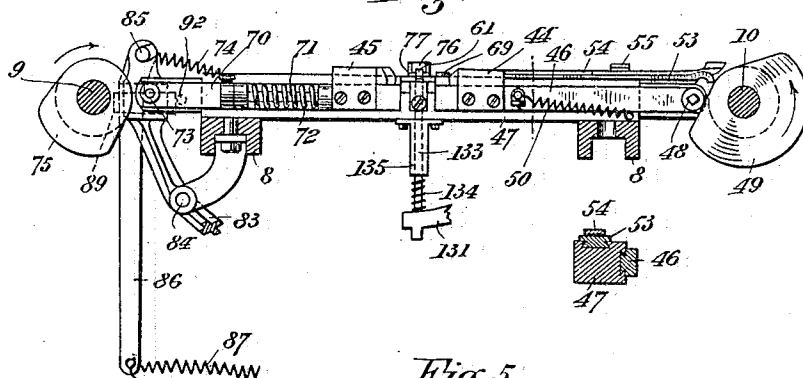
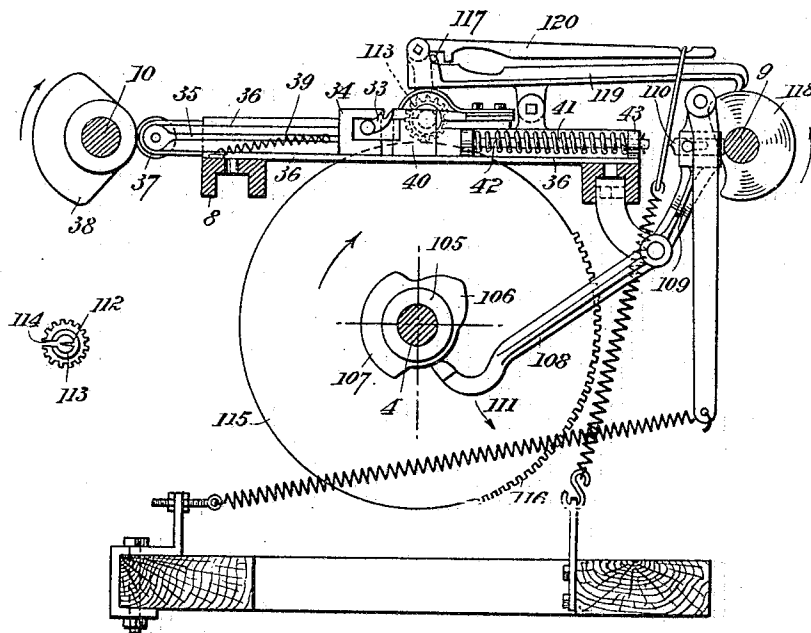


Fig. 5.



WITNESSES: *Wm. Bell.*
Adelle Blatt.

INVENTORS: *Edmond Charpentier*
and Joseph Richelle.
by Gaston Leonard,
Attorney.

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5 SHEETS—SHEET 5.

Fig. 6.

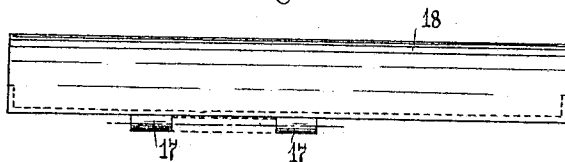


Fig. 7.

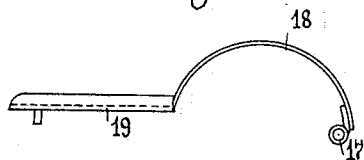


Fig. 8.

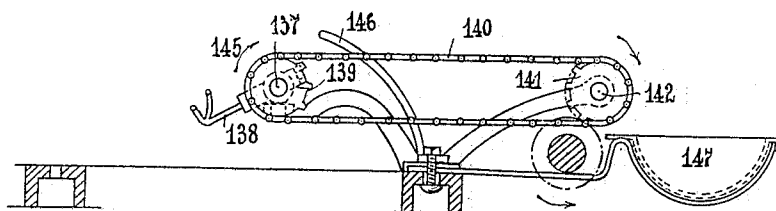
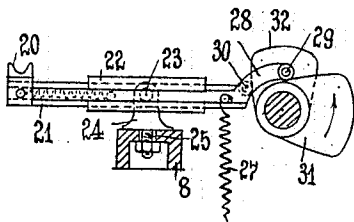


Fig. 9.



WITNESSES.

Wm. D. Hall
Adele Glatt

INVENTORS,

Edmond Charpentier
Joseph Richelle
by G. Arthur Stewart,
Attorney

UNITED STATES PATENT OFFICE.

EDMOND CHARPENTIER AND JOSEPH RICHELLE, OF VERVIERS, BELGIUM.

HEDDLE-MAKING MACHINE.

No. 809,668.

Specification of Letters Patent.

Patented Jan. 9, 1906.

Application filed May 23, 1905. Serial No. 261,880.

To all whom it may concern:

Be it known that we, EDMOND CHARPENTIER and JOSEPH RICHELLE, subjects of the King of Belgium, residing at Verviers, Belgium, have invented new and useful Improvements in Machines for Manufacturing Metallic Healds; and we do hereby declare the following to be a full, clear, and exact description of the same.

This present invention relates to heddles or healds for looms, the object being to provide an improved machine for manufacturing metallic healds by means of double-wire sections. In this improved machine the wire sections are placed manually, one by one, upon two movable forks operated to bring the same upon two suitable supports and at the same time between several claws, which hold the wire during the formation of the eyes and the stitch (central eye) and during the twisting of the parts of the wire adjacent to the eyes and the stitch, certain claws being adapted to slightly bend the wires at the end in order to provide recesses wherein the ends of the wire are lodged and the completed heald being automatically taken from said retaining-claws and brought upon a suitable conveyer and thence into any desired receptacle. The improved machine is provided with means for avoiding the breaking of the wire during the twisting of the several parts thereof.

The invention consists of the construction, combination, and arrangement of parts fully described and claimed hereinafter, reference being had to the accompanying drawings, showing the preferred form of embodiment of the invention, and wherein—

Figure 1 is a top plan view of the right-hand part of the machine. Fig 1^a is a top plan view of the left-hand part of same. Fig. 2 is a vertical cross-section on line *a a* of Fig. 1. Fig. 3 is a vertical cross-section on line *b b* of Fig. 1. Fig. 4 is a vertical cross-section on line *c c* of Fig. 1. Fig. 5 is a vertical cross-section on line *d d* of Fig. 1. Figs. 6 and 7 show front and side elevations of the plate upon which the blanks of wire are placed before they are formed to healds. Fig. 8 shows the device for conveying the completed heald. Fig. 9 is a detail view showing the device which receives the blanks one by one and brings the same to the operating parts of the machine. Fig. 10 shows a completed heald. Fig. 11 shows a wire blank, and Figs. 12, 13,

and 14 illustrate the different steps of manufacture.

Arranged on a frame 1, preferably made of wood or similar material and supported on a cast-iron frame 2, are brackets 3 3, wherein is journaled the main shaft 4, actuated by means of a pulley 5, through the agency of two gear-wheels 6 7. Arranged above the wooden frame 1 is a metallic frame 8, provided with bearings wherein are journaled two cam-shafts 9 10, actuated by means of the inclined transmission-shafts 11 12, rotated by the toothed wheel 13 on the main shaft 4. The right-hand end of the latter is preferably provided with a hand-motor 14, permitting of actuating the several parts very slowly for adjusting purposes.

Secured to the frame 8 is a bracket 15, the outer end of which is provided with a socket 16, Fig. 1, corresponding to the sockets 17 17 of a protecting-plate 18, Figs. 6 and 7, made one with a plate 19, the rims of which are slightly bent upwardly to form a trough. A pin passed through the sockets 16 and 17 17 connects the brackets 15 with the plate 18, the latter then covering the operating parts of the shaft 10 and the plate 19 occupying the position shown in dotted lines in Fig. 1.

The double-wire blanks *a*, serving to form the healds and being previously cut to the required length, are placed upon the plate 19. The operator takes the blanks one by one from said plate 19 and puts them upon two forks 20 20, Figs. 1 and 9, each of which is carried by a slide-block 21, adapted to slide in a grooved piece 22, fulcrumed on a pivot-pin 23, secured to a bracket 24, adjustably arranged in a slot 25 of the frame 8. Said slot permits of adjusting the position of the forks 20 20 in accordance with the length of the healds to be manufactured. Each fork 20 is constantly pulled backwardly—that is, in the direction of the arrow 26, Fig. 1—while the outer end of each slide-block 21 is constantly pulled downwardly by the action of a spring 27, attached to the frame 1 of the machine. Said outer end of each slide-block 21 is formed by an arched portion 28, carrying on each side rollers 29 30, the roller 29 coöperating with the cam 31, keyed on the shaft 10, while the roller 30 coöperates with another cam 32, also keyed on said shaft 10. The latter being rotated by the transmission device above referred to and the operator having placed a blank (double-wire section)

upon the forks 20 20, the latter are moved toward the interior of the machine by the action of the cam 32, acting upon the roller 30. (See Fig. 9.) Toward the end of said movement and when the forks 20 20 are in line with the movable supports 33, Fig. 1, the cams 31 engage the rollers 29 and raise the arched ends 28 of the slide-blocks 21, so that the forks 20 are lowered for depositing the blank upon the supports 33, being also in the shape of forks. Said supports are secured to the sides of a movable claw 34, attached to a slide-block 35, having two branches or arms arranged to slide in grooves provided in the sides of a stationary cross-bar 36 and the ends of which carry a roller 37, engaged by a cam 38, Fig. 5, keyed on the shaft 10. The roller 37 is constantly held in contact with the cam 38 by the action of two springs 39 39, Figs. 1 and 5, and said cam 38 serves to move the slide-block 35, and therefore the claw 34, with the supports 33, toward the center of the machine. During this movement the claw 34 meets with and engages another claw 40, arranged to slide on the extension of the cross-bar 36, already referred to, and carrying two rods 41 41, provided with strong spiral springs 42 and movable in two supports 43 43, attached to the cross-bar 36. When the claw 34 is moved by the action of the cam 38, it moves also the claw 40 against the action of the springs 42, the blank *a* being yieldingly held between said claws 34 and 40 for the formation of the heald. When the blank *a* is being held between the claws 34 and 40, the ends of said blank are moved along the guiding angle-irons 51 51 after being engaged by the claws 44 44 of the cooperating pairs of claws 44 45. Each claw 44 is carried by a slide-block 46, Figs. 1 and 4, arranged to slide on the side of a stationary cross-bar 47 and carrying at its outer end a roller 48, cooperating with a cam 49, fast on the shaft 10, and serving to reciprocate said slide-block 46 on said cross-bar 47, together with a spring 50, provided therefor. When the cam 49 causes the slide-block 46 to be moved forwardly, another cam 52, fast on the shaft 10, causes another block 53 to be moved forwardly, said slide-block 53 being arranged to slide on the upper side of the cross-bar 47. The slide-block 53 carries a lever 54, pivotally connected at 55 with said slide-block and held in the position shown in Fig. 1 by the action of a spring 56. The movement of the lever 54 is limited by a small slot 57, provided at the inner end of said lever and engaged by a pin 58, secured to the slide-block 53. When the latter is moved, together with the lever 54, toward the interior of the machine by the action of the cam 52 and carries with it the end of the blank *a*, a beveled extension or projection 59 of the cam 52 will engage the outer end of the lever 54 and cause the same to swing on its pivot-pin 55, so that the inner

end of said lever provided with a downwardly-projecting pin is caused to swing in the direction of the arrow 60, Fig. 1. When moved forwardly with the slide-block 53, said lever 54 folds the end of the blank *a*, engaging a stud 61, secured to a piece 62, hereinafter described, the ends of the blank being thus folded to an angle of about ninety degrees. (See Fig. 12.) When now the lever 54 is caused to swing by the action of the projection 59 of the cam 52, the downwardly-projecting pin at the end of said lever folds the end of the blank around said stud 61. (See Fig. 13.) During the swinging movement of the lever 54 both ends of the blank *a* are caused to engage two guides 63, secured to the cross-bar 47, Fig. 3, and the recesses of which correspond to the openings of the forks 64 64, movably arranged on said cross-bar 47 and actuated by means of two cams 65 65, fast on the shaft 9, and two springs 66 66. Said forks are guided by means of two slide-blocks 67 67, engaged by headed pins 68 68, secured to the side of the cross-bar 47. The folded ends of the blank *a*, engaging the guides 63 63, the forks 64 are moved forwardly by the action of the cams 65 and close the eyes at the ends of the blank *a*. (See Fig. 14.) The claws 44 being at this time in contact with the straight portion of the blank—that is, the portion adjacent to said eyes—the cooperating claws 45 are moved toward said claws 44 to hold the blank during the twisting of the eyes. At the same time a small projection 69, arranged on the working faces of the claws 44, engages the blank and produces a small bend *b* therein, Fig. 10, serving to lodge the folded end of the wire after the twisting thereof, so as to produce a heald with a perfectly smooth surface. The claws 45 are each attached to a slide-block 70, formed of two parts connected by means of a rod 71, secured to one of said parts and adapted to be freely moved in the other, a coiled spring 72 around said rod serving to provide a yielding pressure between the claws 44 and 45 and prevent the blank *a* from being injured by a too sudden engagement of said claws. The slide-block 70 carries at its end opposite to the claw 45 a roller 73, which is held in constant contact with a cam 75, fast on the shaft 9, by the action of a spring 74. The claws 44 45, tightening between them the blank *a*, the forks 64, liberated by their cams, are disengaged from the blank by the action of the springs 66. When the forks 64 are being disengaged from the blank, two matrices 76, the recesses of which are somewhat larger than the studs 61, are moved over the eyes formed at the ends of the wire *a*. Each matrix 76 is adapted to slide along a square spindle 77 and is pivotally connected with a lever 78, adapted to swing on a vertical pivot-pin 79, secured to the frame 8. The outer end of each lever 78 engages the re-

cessed side of a cam 80, fast on the shaft 9. When the ends of the levers 78 engage the recesses of said cams 80, springs 81 cause the opposite ends of said levers, and therefore the matrices 76, to be moved on the square spindles 77, so that said matrices are brought over the two eyes and the studs 61 in view of the subsequent twisting of the wire. Prior to said twisting it is necessary to tighten the two ends of the blanks *a* in an absolutely certain way and much stronger than it is possible to do with the cams 49 and 75. To this end the action of the cam 75 is assisted by the following device: Keyed on the main shaft 4 at two points corresponding to the positions of the claws 44 45 are two cams 82, each of which engages a lever 83, adapted to swing on a bracket 84, and the upper end of which carries a stud-shaft 85, carrying a pivoting-arm 86, the free end of which is actuated by means of a coiled spring 87, attached to the frame 1, Fig. 3. The spring 87 causes the arm 86 to constantly engage a projecting pin 88, carried by a slide-block 89, movably arranged in a groove 90 of the lever 83. The movement of said slide-block is limited by a slot 91, provided in the side wall of said groove 90 and engaged by a pin 92, secured to the slide-block 70 for the purpose of pushing the latter, together with the claw 45, strongly against the claw 44, when the cam 82 causes the lower end of the lever 83 to swing in the direction of the arrow 93, Fig. 3. The eyes formed at the ends of the blank *a* being thus engaged in the matrices 76 and the wire being securely held near said eyes by the pairs of claws 44 45, all that is necessary is to give some turns to each eye for twisting together the free ends and the straight body part of the wire. Said twisting movement is obtained as follows: Keyed on the square spindle 77, Fig. 1, is a toothed pinion 94, attached to a hollow socket 95, provided with a longitudinal groove 96, normally engaged by a pin 97, movable vertically in a balance-lever 98, to which is pivotally connected at 99 a lever 100, pulled downwardly by the action of a coiled spring 101, attached to the wooden frame 1, and whereby the lever 100 holds the pin 97 engaged in the groove 96 of the socket 95 until the cam 102, fast on the shaft 9, is disengaged from the free end of the balance-lever 98, whereby the latter swings on its pivotal pin 103. At this moment a circular disk 104, keyed on the main shaft 4 and provided with a toothed peripheral portion, the number of teeth of said portion being in a given relation with the number of teeth of the pinion 94, is operated to mesh with said pinion to rotate the same—that is, impart one, two, three, or more turns to the same. The result thereof is that the square shaft 77 and the matrix 76, carried thereby, are rotated and carry with them the eye of the blank *a*, held between the stud 61 and the

matrix 76, whereby the wire portions adjacent to the eyes are twisted. (See Fig. 10.) Before said twisting of the eyes of the blank *a* the claws 34 and 40, which already hold between them the central portion of the blank *a*, as above described, are caused to produce a supplemental pressure on said blank by the action of a cam 105, keyed on the main shaft 4 and having two operating curves 106 107, Fig. 5. The portion 106 first engages a fulcrumed lever 108, (similar to the lever 83, already described,) terminating in a fork 109, the branches of which are provided with slide-blocks 110, arranged like the slide-blocks 89, above described. Said slide-blocks are provided with a beveled projecting edge adapted to engage a corresponding horizontal recess or groove provided at the outer end of each rod 41, projecting from the supports 43 by the action of the cam 38, actuating the claws 34 and 40, as already described. When the cam portion 106, Fig. 5, causes the end of the lever 108 to swing in the direction of the arrow 111, the slide-blocks 110 are caused to produce a strong pressure on the rods 41, and therefore on the claws 40, against which are pressed the claws 34. At this moment the wire portion comprised between the recesses of the claws 34 and 40 is situated in the center line of a pointed pin 112, (see detail of Fig. 5,) formed within the hub of a pinion 113, provided with a horizontal slot 114, through which the blank *a* is brought to said pointed pin. Said pinion is journaled by means of its hub in a recess of the cross-bar 36. The pointed pin is caused to penetrate between the two wire portions of the blank *a*, when the strong pressure is produced on one side by the cam 38 and on the other side by the lever 108. The result thereof is that the wire portions are separated at the central part of the blank to form the central eyelet or stitch of the heald. (See Fig. 14.) The pointed pin 112 being thus engaged between said wire portions, the cam portion 106 will be disengaged from the lever 108, which immediately thereafter is engaged by the longer cam portion 107, producing the required strong pressure between the claws 34 and 40 during the twisting of the wire portions adjacent to said central eye. During the action of the cam 107 on the lever 108 a circular disk 115, the periphery of which is provided with a toothed portion 116 (like the disk 104) is caused to mesh with the pinion 113, then disengaged from the retaining-pin 117, carried by a balance-lever 119, actuated by the cam 118, keyed on the shaft 9. Said balance-lever 119 is connected with an arm 120 and similar to that already described for the temporary locking of the pinion 94. In this way the pinion 113 is rotated and carries with it the central eye formed by the pointed pin 112 for twisting the wire portions adjacent to said

central eye. The pressure produced by the cam 106 serves to prevent the wire portion from being unsoldered over a too large extent during the penetration of the pin 112 between said wire portion. It will be noted that the twisting of the portions adjacent to the central eye is effected approximately at the same moment as the twisting of the portions adjacent to the extreme eyes, the toothed periphery of the disk 115 being caused to mesh with the pinion 113 when two or three teeth of the disk 104 are already in mesh with the pinion 94. During the twisting of the several portions of the blank *a* the latter is evidently submitted to a strong tension, which could cause the break of the blank. In order to avoid this break, it is necessary to give the parts which hold the blank during the twisting a certain longitudinal play, which is obtained as follows: The square spindle 77 on each side of the machine carries a fixed collar 121, against which presses a coiled spring 122, fitted around said spindle, and the other end of which presses against the bearing 123 of the spindle, said bearing being stationarily arranged on an adjustable cross-bar 124 of the frame 8. In this way the tension produced during the twisting of the blank is enabled to move toward each other the spindles 77, and therefore the eyelets formed at the ends of the blank *a*, whereby the break of the latter at the twisted portions is effectively avoided. The longitudinal movement of the spindles is evidently of very small amplitude. The portion adjacent to the extreme and central eyes being thus twisted and the several claws being again disengaged from the completed heald, the extreme eyes must still be disengaged from the studs 61, around which they have been formed. This disengagement is obtained by the action of two cams 125, keyed on the shaft 9 (at the opposite ends of the same, Fig. 1) and engaging horizontally-arranged levers 126, fulcrumed on adjustable pivot-pins 127, and the inner ends of which are constantly engaged with the ends of the square spindles 77 by the action of coiled springs 128. When the cams 125 cause said levers to swing in the direction of the arrow 129, the inner ends of said levers act to move said spindles 77 toward each other so as to decrease the distance between the studs 61 and permit of easily disengaging the completed heald from the same. At this moment two cams 130, keyed on the main shaft 4, are operated to raise lever-arms 131, Fig. 3, pivoted on stationary pivot-pins 132 and on each of which rests a rod 133, provided with a spring 134, and guided in a socket 135, secured to the cross-bar 47 of the frame 8. When raised, the ends of said rods which are arranged below the extreme eyelets of the heald raise the latter above the studs 61 in order to permit the forks of the conveyer to take the completed heald from the supporting-forks 33.

The conveying device is constructed and arranged as follows: Journaled in suitable bearings 136, arranged on the frame 8, is a shaft 137, to which are attached the two picking-forks 138, made of an adjustable length and adapted to take the completed heald for depositing the same upon the conveyer proper. This comprises a pair of chain-wheels 139 139, keyed on the shaft 137, and around which pass two endless chains 140, passing also around two chain-wheels 141 141, keyed on a shaft 142, journaled in bearings 143, and actuated by the shaft 9 through the agency of a gearing 144. The picking-forks 138 being rotated in the direction of the arrow 145, Fig. 8, with a heald therein are caused to deposit the heald upon two inclined guides 146, secured to the frame 8, as soon as said forks are moved rearwardly beyond the vertical line. The heald glides along said guides upon the chains 140 140, which bring the same into any suitable receptacle 147, attached to the frame 8.

The operating-cams 31 32 of the forks 20 have evidently an inoperating portion which is sufficiently long to permit a blank *a* to be conveniently placed into said forks. The forks of the supports 33 are cut at a very acute angle so as to cause the blank to engage the same in such manner as to have the wires thereof placed the one above the other. In this way the pointed pin 112 of the pinion 113 is in any case enabled to penetrate between the two wires of the blank for the formation of the central eye.

The operation of the several parts is clearly understood from the foregoing description, and it will be sufficient now to describe the general operation of the whole machine. The blank *a* being placed into the forks 20 the latter are moved forwardly—that is, toward the interior of the machine—and then tipped to deposit the blank into the supports 33 and between the claws 34 40, which are then moved toward each other to hold the blank during the formation of the heald. The ends of the blank engaging the studs 61, the levers 54, carried by the slide-blocks 53, will be operated to fold said ends around said studs, while the forked slide-blocks 64 are moved to close the eyes thus formed, the claws 44 45 being moved toward each other to slightly bend the blank *a* in order to provide recesses for lodging the extremities of the wire *a*. The matrices 76 being now brought over the closed eyes, the several claws are actuated to produce a supplemental pressure on the blank *a*, and the pointed pin 112 of the pinion 113 forms the central eye of the heald. The partially-toothed disks 104 and 115 are rotated to mesh nearly simultaneously with the pinions 94 113, respectively, and produce the twisting of the wire portions adjacent to the several eyes, whereupon the heald is completed. The claws are then moved apart

from each other after the disengagement of the matrices 76 and the disengagement of the heald from the studs 61. The heald is then raised by the action of the cams 130 to be taken by the forks 138 and conveyed by the chain 140 into the receptacle 147. The twisted portions of the heald may be smoothed subsequently by means of solder.

The main pulley 5 is preferably provided with a coupling device, the operating-lever of which is in the reach of the operator in order to enable the latter to stop the machine instantly when a blank is not moved accurately through the machine.

Having fully described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a machine for manufacturing metallic healds for looms by means of blanks formed of a double wire section, previously cut to the desired length, the combination with a suitable frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side and above said main shaft, and a secondary frame above the main frame; of a plurality of reciprocating and tipping forks adapted to receive the blanks one by one, a plurality of movable claws, and stationary supports adapted to receive the blanks from said tipping forks and hold the same during the formation of the eyes of the heald, means for reciprocating and tipping said forks, means for actuating said claws; longitudinally-movable spindles in line with said stationary supports, eye-forming studs carried thereby, reciprocating means for folding the ends of the blank around said studs, longitudinally-reciprocating matrices adapted to be brought over said studs after the folding of the ends of the blank, pairs of oppositely-arranged claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes of the heald, means for rotating said studs and matrices for twisting the eyes of the heald, means for simultaneously forming the central eye of the heald, means for disengaging the completed heald from the eye-forming studs, and means for taking the completed heald from said retaining-claws, substantially as set forth.

2. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft and suitable connections between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from said forks when tipped and to hold the same during the formation

of the heald, means on the cam-shafts for moving said claws toward each other when the blank is received upon said supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks, adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, means for twisting the portions of the heald adjacent to the extreme eyes, means for twisting the portions of the blank adjacent to the central eye, means for causing the several pairs of claws to produce a supplemental clamping action upon the blank during the twisting thereof, means for disengaging the completed heald from the eye-forming devices, and means for taking the completed heald from said supports, substantially as set forth.

3. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft, and suitable connections between the latter and the cam-shafts; of a plurality of forks, adapted to receive one blank at a time, reciprocating slide-blocks carrying said forks, guide-sockets for said slide-blocks, brackets on which said guide-sockets are pivotally arranged, a cam on one cam-shaft adapted to engage the outer end of said slide-block for moving the same toward the interior of the machine, a second cam on said cam-shaft for causing the slide-block to swing on said bracket, suitable springs against which said cams act; a plurality of oppositely-arranged cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from said forks when tipped and hold the same during the formation of the heald, means on the cam-shafts for moving said claws toward each other when the blank is received upon said supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks, adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent

cent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, means for twisting the portions of the heald adjacent to the extreme eyes, means for twisting the portions of the blank adjacent to the central eye, means for causing the several pairs of claws to produce a supplemental clamping action upon the blank during the twisting thereof, means for disengaging the completed heald from the eye-forming devices, and means for taking the completed heald from said supports, substantially as set forth.

4. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft and suitable connections between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, horizontally-reciprocating slide-blocks carrying said claws, stationary guideways for said slide-blocks, cams for reciprocating the same toward and apart from each other, means for causing the claws to produce an elastic pressure upon the blank between them, fork-shaped supports carried by certain claws and adapted to receive the blank from the aforesaid forks so that the same lies between the claws and is held by the latter during the formation of the heald, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portion of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, means for twisting the portions of the heald adjacent to the extreme eyes, means for twisting the portions of the blank adjacent to the central eye, means for causing the several pairs of claws to produce a supplemental clamping action upon the blank during the twisting thereof, means for disengaging the completed heald from the eye-forming devices, and means for taking the completed heald from said supports, substantially as set forth.

5. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said

frame, a cam-shaft on each side of and above said main shaft and suitable connections between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, horizontally-reciprocating slide-blocks carrying said claws, stationary guideways for said slide-blocks, cams for reciprocating the same toward and apart from each other, means for causing the claws to produce an elastic pressure upon the blank between them, fork-shaped supports carried by certain claws and adapted to receive the blank from the aforesaid forks so that the same lies between the claws and is held by the latter during the formation of the heald, a toothed pinion journaled on a stationary part between said claws, means carried by said pinion and adapted to separate the wires of the blank for the formation of the central eye of the heald, means for rotating said pinion at a given moment for twisting the portions of the blank adjacent to said central eye, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, means for folding said end portions around said studs for the formation of the extreme eyes of the heald, oppositely-arranged means for closing the eyes formed around said studs, means for clamping between them the end portions of the blank, means for twisting the portions of the blank adjacent to the extreme eyes, means for causing the several pairs of clamping means to produce a supplemental clamping action during the twisting of the several portions of the blank, means for disengaging the completed heald from the eye-forming devices, and means for taking the completed heald automatically from the supports carried by the central claws, substantially as set forth.

6. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft and suitable connections between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, horizontally-reciprocating slide-blocks carrying said claws, stationary guideways for said slide-blocks, cams for reciprocating the same toward and apart from each other, means for causing the claws to produce an elastic pressure upon the blank between them, fork-shaped supports carried by certain claws and

adapted to receive the blank from the aforesaid forks so that the same lies between the claws and is held by the latter during the formation of the heald, a toothed pinion journaled on a stationary part between said claws, a pointed pin arranged horizontally in the interior of the hub of said pinion, a horizontal slot in the latter through which the blank is brought into engagement with said pointed pin when the blank-carrying supports are moved forwardly, means for rotating said pinion at a given moment for twisting the portion of the blank adjacent to said central eye, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, means for folding said end portions around said studs for the formation of the extreme eyes of the heald, oppositely-arranged means for closing the eyes formed around said studs, means for clamping between them the end portions of the blank, means for twisting the portions of the blank adjacent to the extreme eyes, means for causing the several pairs of clamping means to produce a supplemental clamping action during the twisting of the several portions of the blank, means for disengaging the completed heald from the eye-forming devices, and means for taking the completed heald automatically from the supports carried by the central claws, substantially as set forth.

7. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft and suitable connections between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, horizontally-reciprocating slide-blocks carrying said claws, stationary guideways for said slide-blocks, cams for reciprocating the same toward and apart from each other, means for causing the claws to produce an elastic pressure upon the blank between them, fork-shaped supports carried by certain claws and adapted to receive the blank from the aforesaid forks so that the same lies between the claws and is held by the latter during the formation of the heald, a toothed pinion journaled on a stationary part between said claws, means carried by said pinion and adapted to separate the wires of the blank for the formation of the central eye of the heald, a circular disk arranged on the main shaft of the machine and rotating with the same, a number of teeth on the periphery of said disk and adapted to mesh with said toothed pinion at a given moment to rotate

the same and twist the portions of the blank adjacent to said central eye, means for temporarily locking the toothed pinion against rotation, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, means for folding said end portions around said studs for the formation of the extreme eyes of the heald, oppositely-arranged means for closing the eyes formed around said studs, means for clamping between them the end portions of the blank, means for twisting the portions of the blank adjacent to the extreme eyes, means for causing the several pairs of clamping means to produce a supplemental clamping action during the twisting of the several portions of the blank, means for disengaging the completed heald from the eye-forming devices, and means for taking the completed heald automatically from the supports carried by the central claws, substantially as set forth.

8. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft, and suitable connections between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one cam-shaft for successively reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, horizontally-reciprocating slide-blocks carrying said claws, stationary guideways for said slide-blocks, a cam on one cam-shaft for actuating the claws on one side against the action of suitable springs, said springs, a suitable cam on the main shaft, a vertically-swinging lever adapted to be engaged at a given moment by said cam and press the claws on the other side strongly against the opposite claws, fork-shaped supports carried by certain claws and adapted to receive the blank from the aforesaid forks so that the same lies between the claws and is held by the latter during the formation of the heald, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portion of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions for the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, means for twisting the portions of the heald adjacent to the extreme eyes, means for twist-

- ing the portions of the blank adjacent to the central eye, means for causing the several pairs of claws to produce a supplemental clamping action upon the blank during the twisting thereof, means for disengaging the completed heald from the eye-forming devices, and means for taking the completed heald from said supports, substantially as set forth.
9. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft, and suitable connection between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from the forks when tipped and hold the same during the formation of the heald, means on the cam-shafts for moving said claws toward each other when the blank is received upon said supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks, adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, reciprocating matrices on each side of the machine and adapted to be moved over said eye-forming studs, square spindles carrying said reciprocating matrices, means for rotating the matrices when they are engaged over the eye-forming studs, means for rotating simultaneously central eye-forming devices, means for causing the several pairs of claws to produce a supplemental clamping action during the rotation of the eye-forming devices, means for disengaging the heald from the eye-forming devices, and means for taking the completed heald from its supports, substantially as set forth.
10. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft, and suitable connection between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from the forks when tipped and hold the same during the formation of the heald, means on the cam-shafts for moving said claws toward each other when the blank is received upon said supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks, adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, reciprocating matrices on each side of the machine and adapted to be moved over said eye-forming studs, square spindles carrying said reciprocating matrices, means for rotating the matrices when they are engaged over the eye-forming studs, means for rotating simultaneously central eye-forming devices, means for causing the several clamping-claws to produce a supplemental clamping action during the rotation of the square spindles and the central eye-forming devices, means for disengaging the heald from the eye-forming devices, and means for taking the completed heald from its supports, substantially as set forth.
11. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft, and suitable connection between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-arranged cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from the forks when tipped and hold the same during the formation of the heald, means on the cam-shafts for moving said claws toward each other when the blank is received upon said

supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks, adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, reciprocating matrices on each side of the machine and adapted to be moved over said eye-forming studs, square spindles carrying said reciprocating matrices, means for reciprocating the matrices on said square spindles, toothed pinions on the latter, grooved sockets attached to said pinions, balance-levers supported on the frame of the machine in proximity to said pinions, pins carried by said balance-levers and normally engaging the grooved sockets to hold the pinions against rotation, means for holding said pins in engagement with said sockets, cams on one cam-shaft adapted to engage said balance-levers and disengage said pins from said sockets, circular disks on the main shaft, toothed peripheral portions on said disks adapted to mesh with said pinions when the same are unlocked, to rotate said pinions, the square spindles and the matrices, means for simultaneously rotating the central eye-forming devices, means for causing the several clamping-claws to produce a supplemental clamping action during the rotation of the square spindles and the central eye-forming devices, means for disengaging the heald from the eye-forming devices, and means for taking the completed heald from its supports, substantially as set forth.

12. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft, and suitable connection between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from forks when tipped and hold the same during the formation of the heald, means on the cam-shafts for moving said claws toward each other when the blank is received upon said supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged

by the end portions of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks, adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, reciprocating matrices on each side of the machine and adapted to be moved over said eye-forming studs, square spindles carrying said reciprocating matrices, means for reciprocating the matrices on said square spindles, toothed pinions on the latter, means for temporarily locking said pinions against rotation, and means for disengaging said locking means at a given moment, circular disks on the main shaft, toothed peripheral portions on said disks adapted to mesh with said pinions when the same are unlocked, to rotate said pinions, the square spindles and the matrices, means for simultaneously rotating the central eye-forming devices, means for causing the several clamping-claws to produce a supplemental clamping action during the rotation of the square spindles and the central eye-forming devices, horizontally-swinging levers on the frame of the machine and normally engaging the ends of said square spindles, cams on one cam-shaft for actuating said levers so that the spindles and therefore the eye-forming studs are brought nearer to each other for disengaging the eyes from said studs, means for raising the complete heald above said studs, and means for taking the complete heald from its supports, substantially as set forth.

13. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft, and suitable connection between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from forks when tipped and hold the same during the formation of the heald, means on the cam-shafts for moving said claws toward each other when the blank is received upon said supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks, adapted

to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating
 5 cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, reciprocating matrices
 10 on each side of the machine and adapted to be moved over said eye-forming studs, square spindles carrying said reciprocating matrices, means for reciprocating the matrices on said square spindles, toothed pinions
 15 on the latter, means for temporarily locking said pinions against rotation, and means for disengaging said locking means at a given moment, circular disks on the main shaft, toothed peripheral portions on said disks
 20 adapted to mesh with said pinions when the same are unlocked, to rotate said pinions, the square spindles and the matrices, means for simultaneously rotating the central eye-forming devices, means for causing the several
 25 clamping-claws to produce a supplemental clamping action during the rotation of the square spindles and the central eye-forming devices, horizontally-swinging levers on the frame of the machine and normally engaging
 30 the ends of said square spindles, cams on one cam-shaft for actuating said levers so that the spindles and therefore the eye-forming studs are brought nearer to each other for disengaging the eyes from said studs, vertically-movable bars arranged below the eye-forming
 35 studs and adapted to engage and raise the heald above the same after the disengagement of said studs, means for normally pulling said vertical bars downwardly, cams
 40 on the main shaft, means engaged by said cams to raise said vertical bars, and means for taking the complete heald from its supports, substantially as described.

14. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said
 45 frame, a cam-shaft on each side of and above said main shaft, and suitable connection between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means
 50 on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from forks when tipped and hold the same during the formation of the heald, means on the cam-shafts for moving
 60 said claws toward each other when the blank is received upon said supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged
 65 by the end portions of the blank, re-

ciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks, adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means
 70 for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the
 75 heald between the stationary supports, reciprocating matrices on each side of the machine and adapted to be moved over said eye-forming studs, square spindles carrying said reciprocating matrices, means for reciprocating
 80 the matrices on said square spindles, toothed pinions on the latter, means for temporarily locking said pinions against rotation, and means for disengaging said locking means at a given moment, circular disks on
 85 the main shaft, toothed peripheral portions on said disks adapted to mesh with said pinions when the same are unlocked, to rotate said pinions, the square spindles and the matrices, means for simultaneously rotating the
 90 central eye-forming devices, means for causing the several clamping-claws to produce a supplemental clamping action during the rotation of the square spindles and the central eye-forming devices, horizontally-swinging
 95 levers on the frame of the machine and normally engaging the ends of said square spindles, cams on one cam-shaft for actuating said levers so that the spindles and therefore the eye-forming studs are brought nearer to
 100 each other for disengaging the eyes from said studs, means for raising the complete heald above said studs, an auxiliary shaft arranged in proximity to the heald-retaining supports, means for rotating said auxiliary shaft, a plu-
 105 rality of heald takers or pickers secured to said rotating shaft and capable of taking the completed heald from its supports, and means for receiving the heald from said takers and conveying the same to a suitable receptacle, substantially as set forth.

15. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft arranged in the center line and above said
 115 frame, a cam-shaft on each side of and above said main shaft, and suitable connection between the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time,
 120 means on one of said cam-shafts for reciprocating and tipping said forks, a plurality of oppositely-cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from forks when
 125 tipped and hold the same during the formation of the heald, means on the cam-shafts for moving said claws toward each other when the blank is received upon said supports and between said claws, suitable guides
 130

for the ends of the blank, eye-forming studs arranged in line with said supports and adapted to be engaged by the end portions of the blank, reciprocating slide-blocks near
 5 said guides, horizontally-swinging levers on said slide-blocks, adapted to engage the end portions of the blank and fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed
 10 around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to the extreme eyes, means for forming simultaneously the central eye of the heald between
 15 the stationary supports, reciprocating matrices on each side of the machine and adapted to be moved over said eye-forming studs, square spindles carrying said reciprocating
 20 matrices, means for reciprocating the matrices on said square spindles, toothed pinions on the latter, means for temporarily locking said pinions against rotation, and means for disengaging said locking means at a given moment, circular disks on the main
 25 shaft, toothed peripheral portions on said disks adapted to mesh with said pinions when the same are unlocked, to rotate said pinions, the square spindles and the matrices, means for simultaneously rotating the
 30 central eye-forming devices, means for causing the several clamping-claws to produce a supplemental clamping action during the rotation of the square spindles and the central eye-forming devices, horizontally-swinging
 35 levers on the frame of the machine and normally engaging the ends of said square spindles, cams on one cam-shaft for actuating said levers so that the spindles and therefore the eye-forming studs are brought
 40 nearer to each other for disengaging the eyes from said studs, means for raising the complete heald above said studs, an auxiliary shaft arranged in proximity to the heald-retaining supports, means for rotating said
 45 auxiliary shaft, a plurality of heald takers or pickers secured to said rotating shaft and capable of taking the completed heald from its supports, a second auxiliary shaft, chain-wheels on both auxiliary shafts, and chains
 50 passing around said chain-wheels to receive the heald from said takers, and a suitable receptacle at the end of the chains to receive the heald from the same, substantially as set forth.

55 16. In a machine for manufacturing metallic healds of the class described, the combination with a main frame, a main shaft

arranged in the center line and above said frame, a cam-shaft on each side of and above said main shaft, and suitable connection be-
 60 tween the latter and the cam-shafts; of a plurality of reciprocating and tipping forks adapted to receive one blank at a time, means on one of said cam-shafts for reciprocating and tipping said forks, a plurality
 65 of oppositely-arranged cooperating claws, two suitable supports carried by certain claws and adapted to receive the blank from said forks when tipped and hold the same during the formation of the heald, means on
 70 the cam-shafts for moving said claws toward each other when the blank is received upon said supports and between said claws, suitable guides for the ends of the blank, eye-forming studs arranged in line with said sup-
 75 ports and adapted to be engaged by the end portions of the blank, reciprocating slide-blocks near said guides, horizontally-swinging levers on said slide-blocks adapted to engage the end portions of the blank and
 80 fold the same around the eye-forming studs, oppositely-arranged means for closing the eyes formed around said studs, reciprocating cooperating claws adapted to clamp between them the portions of the blank adjacent to
 85 the extreme eyes, means for forming simultaneously the central eye of the heald between the stationary supports, reciprocating matrices on each side of the machine and adapted to be moved over said eye-forming
 90 studs, square spindles carrying said reciprocating matrices, means for rotating the matrices when they are engaged over the eye-forming studs, means for rotating simultaneously the central eye-forming devices, means
 95 for causing the several pairs of claws to produce a supplemental clamping action during the rotation of the eye-forming devices, means for holding the square spindles yieldingly in the direction of their length, so as to
 100 permit the same to follow the tension of the blank to a given extent, means for disengaging the heald from the eye-forming devices, and means for taking the completed heald from its supports, substantially as set forth.
 105

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ED. CHARPENTIER.
 J. RICHELLE.

Witnesses:

I. T. LE COSTER,
 HENRI JUPSIN.