Feb. 10, 1942. L. J. ZERBEE 2,272,456

LOOM

Filed July 24, 1939 5 Sheets-Sheet 1

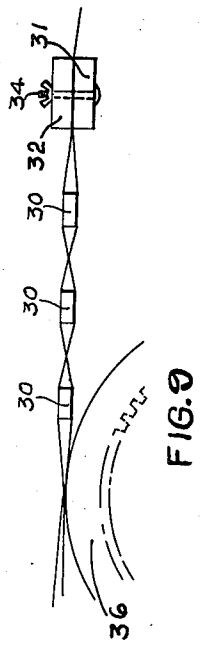


FIG. 9

FIG. 1

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LOOM

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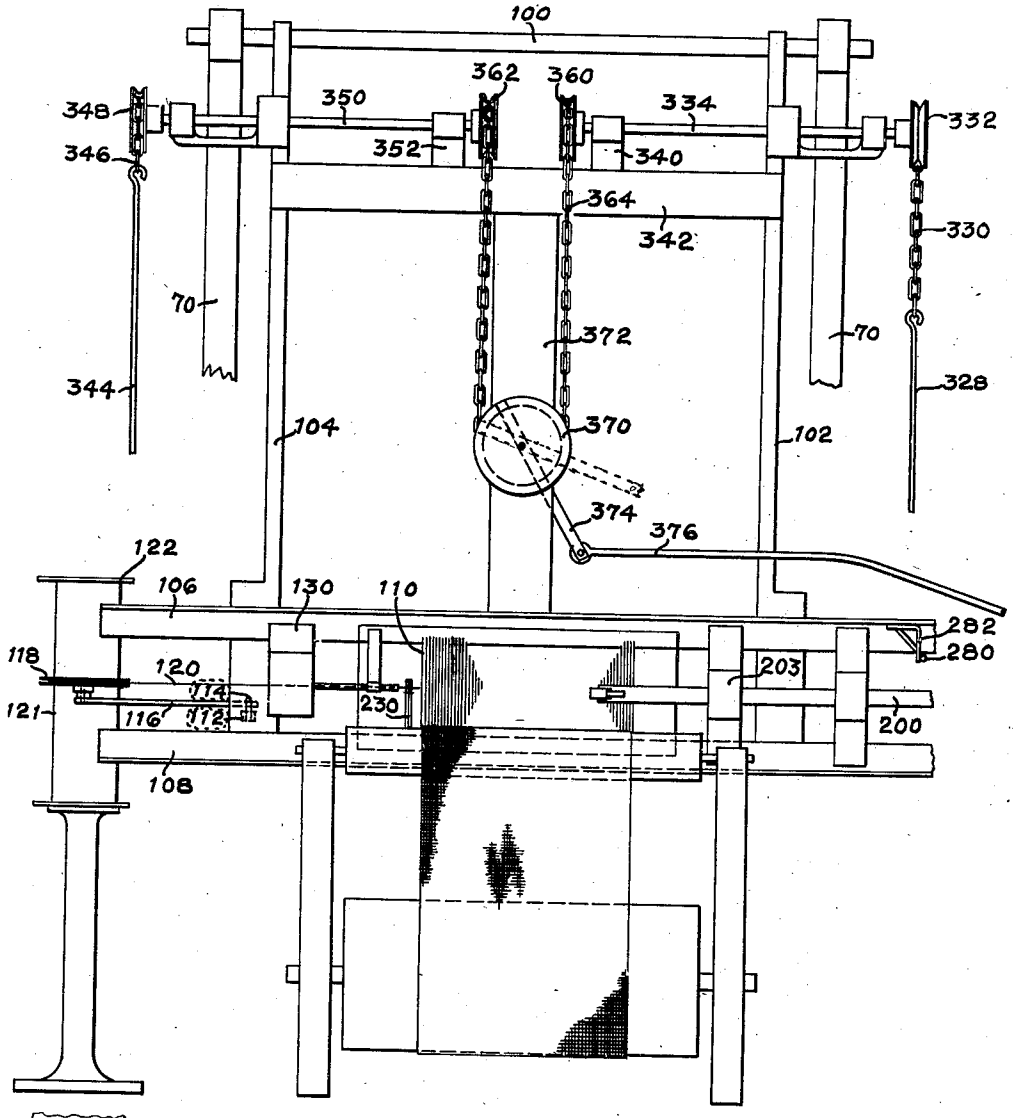


FIG. 2

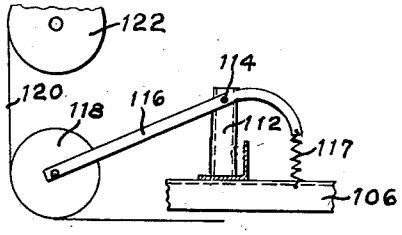


FIG. 10

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LOOM

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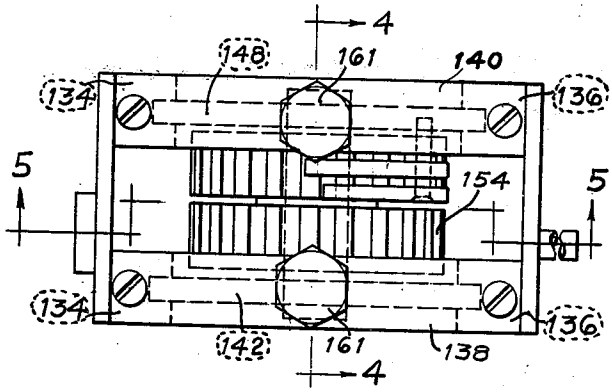


FIG. 3

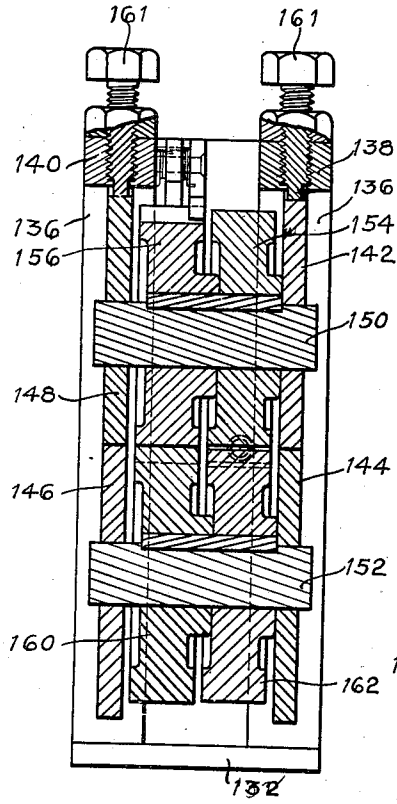


FIG. 4

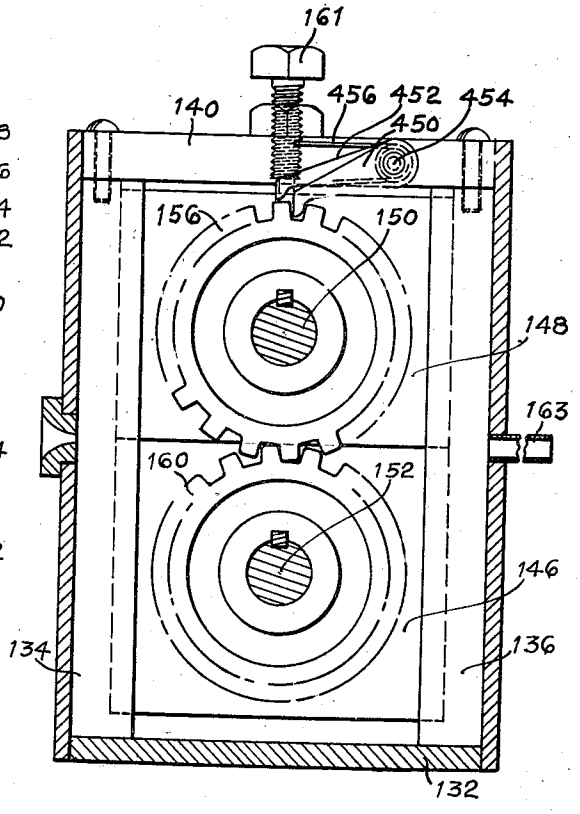


FIG. 5

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LOOM

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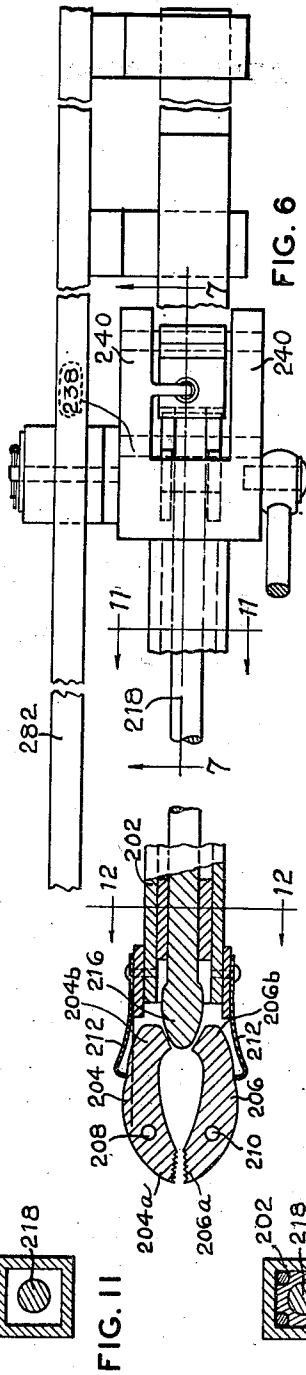


FIG. 6

FIG. 11

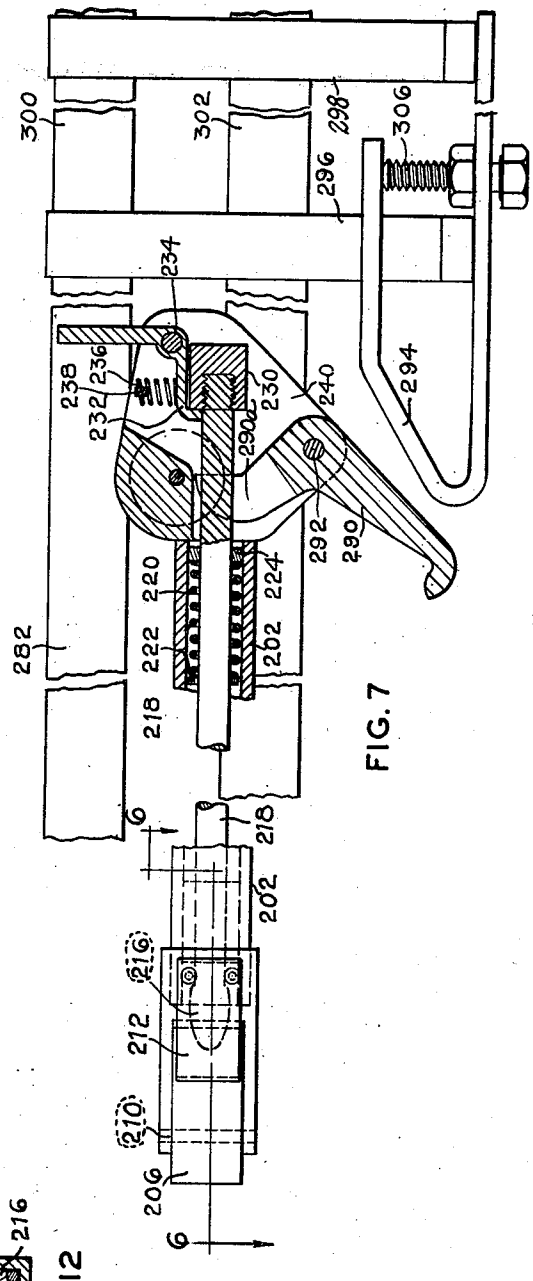


FIG. 7

FIG. 12

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LOOM

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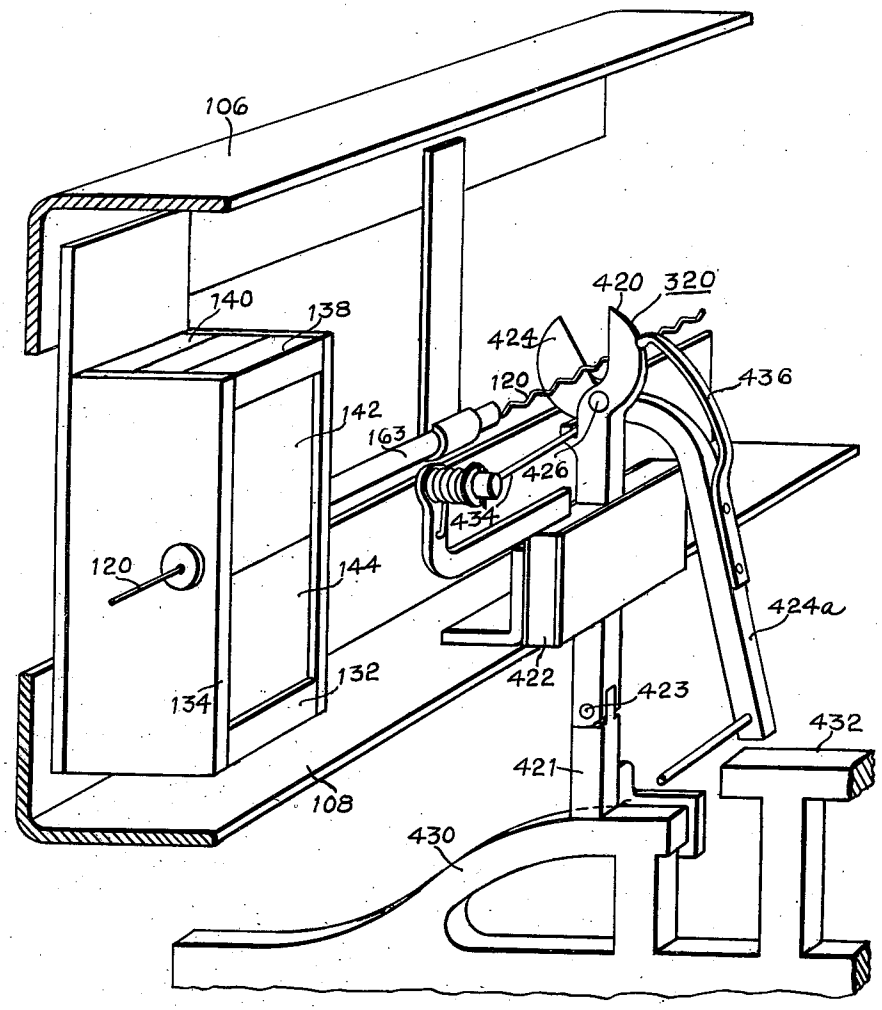


FIG. 8

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Patented Feb. 10, 1942 2,272,456

UNITED STATES PATENT OFFICE

2,272,456

LOOM

Louis J. Zerbee, Bellefontaine, Ohio

Application July 24, 1939, Serial No. 287,493

19 Claims. (Cl. 139—127)

This invention relates to a loom and more particularly to a loom adapted for weaving spring wire into a metallic screen.

An object of this invention is to provide a retrieving device for feeding the woof or weft from one side of the web between the shed formed by the separation of the warp wires.

Another object of this invention is to provide a retrieving device for drawing the wire of the weft through a crimping device as the wire of the weft is placed in the shed formed by the warp wires.

Another object of this invention is to provide a retrieving device that draws the wire of the weft from one side of the web, so as to position the crimped weft wire in proper relation with respect to the wires of the warp.

Another object of this invention is to weave a wire screen from continuous length wires used as the warp, so that the loom may operate continuously night and day without interruption normally caused by winding the warp wires upon a warp drum.

Another object of this invention is to provide snippers or shears for severing the weft wire.

Another object of this invention is to provide a loom wherein the weft wire is automatically drawn from a large coil of continuous wire across the shed formed by the warp wires and severed immediately upon being positioned therein.

Another object of this invention is to provide a tensioning device between the source of supply for the continuous length wire and the loom proper, for properly tensioning the wires.

Another object of this invention is to provide a loom that is automatic in its operation, that is easily operated, that is dependable, that weaves steel wire into high quality metallic screen produced cheaply and efficiently.

Other objects and advantages reside in the construction of parts, the combination thereof and the mode of operation, as will become more apparent from the following description.

In the drawings,

Figure 1 is a side elevation of the loom assembly, together with a portion of the warp mill, with parts omitted for the sake of clearness.

Figure 2 is a front elevation shown schematically, with parts omitted for clearness.

Figure 3 is a top plan view of the wire crimping device.

Figure 4 is a cross sectional view of the wire crimping device taken substantially on the line 4—4 of Figure 3.

Figure 5 is another cross sectional view of the wire crimping device taken substantially on the line 5—5 of Figure 3.

Figure 6 is a fragmentary detail view disclosing the retrieving device, parts being shown in section, substantially on the section line 6—6 of Figure 7.

Figure 7 is another fragmentary detail view of the retrieving device, with parts shown in section taken substantially on the section line 7—7 of Figure 6.

Figure 8 is a perspective view of a portion of the beater, having mounted thereon the wire crimping device and the weft wire shearing mechanism.

Figure 9 is an enlarged sectional view of the tensioning means and a part of the drum.

Figure 10 is a fragmentary top plan view of the tensioning device.

Figure 11 is a transverse cross sectional view of the arm of the weft feeding device, taken substantially on the line 11—11 of Figure 6.

Figure 12 is another transverse cross sectional view taken substantially on the line 12—12 of Figure 6 near the head of the weft feeding device.

In the past, looms have been utilized for weaving screen wire from fine wire that is rather soft and flexible. Heavier wire has also been woven; but in weaving heavier wire no automatic shuttle has been used. Instead, the weft has been placed in position manually in most cases, or semi-manually. If put in by the machine or hand, it is pushed through in place of being pulled through. Furthermore, the warp of the metallic screen has been supplied from a drum that is periodically rewound, halting the operation of the loom during the rewinding of the drum. In some cases it has been the practice to operate a loom about half of the time, the other half of the time being utilized in rewinding or rereeling the drum supplying the warp to the loom and threading the warp through the heddles and the reeds.

In the present embodiment, wire screen which may have approximately eight mesh to the inch is woven from high carbon steel wire, so as to form a metallic screen adaptable for use in the manufacture of cushions for steel porch furniture as disclosed in my Patent No. 2,126,439, patented August 9, 1938. The steel wire used in weaving this metallic screen is comparatively stiff and cannot be woven on the same type of a loom used for weaving fly screen and the like, in that the wires are too heavy and too rigid

for manipulation in such looms, which use bobbins on which the weft wire is wound.

This spring screen is now woven upon a loom that operates automatically and continuously, excepting for short stops to interchange weft coils in that the warp is supplied from an unlimited source of warp material. Whenever a spool or reel of warp material is exhausted, another spool, having a new supply, is substituted for the old spool by merely butt welding the ends of the wire together. The butt welded joint thus produced is not much thicker than the regular wire, so that the welded wire is fed through the loom without interrupting the operation thereof.

The type of wire is a high carbon manganese steel wire, that is purchased in the form of coils. These coils are first rewound upon spools or bobbins a couple of inches wide and eight to ten inches in diameter. There is one spool or bobbin of warp wire for each strand of warp, these spools being mounted upon a warp mill. From this mill the wires are drawn through a wire tensioning mechanism and wrapped twice around a large drum. After encircling the drum, which drum is actuated so as to supply the wire to the loom at a proper rate of speed, the wires pass through a second tensioning device, through the heddles and the reeds.

In the present embodiment the weft wire is automatically fed into the shed formed by the separation of the warp wires. The weft wire is fed into position by the use of an automatic weft feeding device which grabs an end of the weft wire supplied from a spool over an oscillatory tensioning arm through a non-reversing wire crimping mechanism that properly crimps the weft. This automatic weft feeding device is provided with gripper jaws that are advanced in open position through the shed in readiness to grab the end of the wire that has been crimped by the succeeding movement of the weft feeding device, then pull this wire through the shed.

At the end of the stroke when the weft has been pulled through the shed, the gripper jaws are released and the wire severed at the starting side by snippers or shears that may be carried by the beater frame and operating automatically in response to this beater frame to cut the weft wire at the proper time.

Broadly, the loom includes warp wire feeding and manipulating means, a beater, a weft wire source of supply and tensioning device, a weft wire crimping device, a weft feeding device, automatic shuttle driving mechanism, beater driving mechanism and wire snippers or shears, in addition to the usual loom structure, as modified. The structural details and the operation of these various features will be described more fully in the detailed description of the loom which follows:

Warp wire feeding and manipulating means

Referring to the drawings, and particularly to Figure 1, the wires **20** form the warp of the web **22** that is woven from high carbon manganese steel wire. Instead of high carbon steel wire, any other spring wire may be used, providing it has the proper resiliency and the other requisites desirable in the manufacture of cushioning devices for use as seats and back rests in porch furniture, chairs, seats and other resilient shock-absorbing devices. The wires **20** are supplied to the loom from spools **24**, there being one spool **24** for each wire of the warp. These spools **24** are removably mounted in a pair of racks **26**, only one of which has been shown. These racks **26** are arranged to the rear of the loom and extend in parallel relation. Furthermore, the amount of wire on each spool differs, so that the wire from one spool alone becomes exhausted at one time. When the wire on one spool is nearly exhausted, the spool is removed from the rack **26** and a new spool substituted therefor. The end of the wire on the old spool and the free end of the wire on the new spool are butt welded. It has been found that the butt welded wires pass through the loom without difficulty, as the wire where it has been welded is not much thicker than the regular thickness of the wire. By mounting the spools in two racks and mounting the racks in spaced relation from each other at the rear of the loom, a path is formed between the wires passing from the spools to the loom which permits the attendant to replace or substitute new spools as the old ones are exhausted.

The wires **20** constituting the warp are passed through a tensioning device that includes a plurality of transversely disposed bars **30** and tensioning bar **31**, cooperating with a tensioning member **32** clamped in position by suitable adjusting screws **34** to tension the wire as it advances from the spools. From the bars **30** and the tensioning member **32**, each wire is wrapped twice around the drum **36** and then through a second tensioning device including transversely disposed bars **38** and a pair of tensioning members **40** and **41** clamped in position by screws **42**. The drum **36** is driven through a chain of gears **44**, only one gear of which is shown, from a suitable source of power not shown.

The driving mechanism is so arranged that the angular displacement of the drum during each cycle of operation of the loom is equal to the length of wire extending between the centers of the weft wires. If, for example, an eight mesh screen is woven, that is, eight meshes to the inch, the periphery of the drum is rotated approximately one-eighth of an inch during each cycle of the operation of the loom. The warp wires being wrapped twice around the drum and properly tensioned are advanced a distance equal to the peripheral movement of the drum. The double wrapping of each wire **20** about the drum creates sufficient surface friction so as to cause the wires to move in unison with the drum, no faster and no slower. The mechanism of the loom will, of course, tend to pull the wires away from the drum, as will appear more fully later. The wires forming the warp of the web advance from the transversely disposed bars **38** through two groups of heddles **54** and **56**. The heddles **54** and **56**, as is well known to those skilled in the art, are supported by a flexible chain, cable or other suitable flexible member **58**, extending over a pulley or sprocket **60** journalled in standards **70**, one on either side of the loom. The heddles are reciprocated in a vertical direction by a pair of cams **72** and **74** mounted upon a shaft **76**, journalled in the sides of the frame of the loom, through a pair of levers **78** and **80**, having one end pivoted to the frame of the loom.

Beater

Thus far the portion of the loom and parts associated therewith are used primarily in supplying the warp wires. In addition to the warp wires, it is necessary to supply the weft wires in proper relation with respect to the manipulation of the warp wires. Due to the rigidity and the stiffness of the spring wire used, it is necessary to form or crimp the weft wire before it

is woven into the material. The warp wires need not be crimped, as the separation of the warp wires to form the shed, in cooperation with the operation of the beater, automatically crimps or forms the warp wires. The crimping mechanism for the weft wire, the severing device and the automatic weft feeding device are all associated with and mounted upon the beater frame. That being the case, the beater frame and the beater mechanism will be described before describing these several other devices, although these other devices all enter into the operation of the loom prior to the operation of the beater.

The standards **70** support a transversely disposed shaft **100**, supporting a pair of rocker arms **102** and **104**. These rocker arms **102** and **104** support a pair of angle irons **106** and **108** transversely disposed with respect to the loom. These angle irons support the reed elements **110**, shown schematically, forming the beater. There is one reed element between each pair of adjacent warp wires. In other words, there is a warp wire located between each two adjacent reed elements.

Weft wire source of supply and tensioning device

A bracket structure including members **112** and **114** is fixedly attached to one end of the beater frame, including the angle iron bars **106** and **108**. These members support a tensioning rocker arm **116** mounted for oscillatory movement. The rocker arm is spring urged by a spring **117**, which spring swings the rocker arm **116** outwardly away from the beater. The outer end of the oscillatory rocker arm **116** supports a grooved pulley **118**. The weft wire may be supplied from a coil **121** mounted for rotation upon a core member **122**. The weft wire is supplied from the coil **121**, passed over the idle pulley **118**, into a crimper mechanism **130**.

Weft wire crimping mechanism

As may best be seen by referring to Figures 3, 4 and 5, this crimping mechanism **130** is mounted upon the beater frame **106** and **108** and includes a box-like structure having a base **132**, a pair of channel end frame members **134** and **136** supported upon the base and held in spaced relation at the top by a pair of spanning members **138** and **140**. The end members **134** and **136** are each provided with vertically disposed channels, supporting bearing blocks **142**, **144**, **146** and **148**. A shaft **150** is journalled in the bearing blocks **142** and **148** and a shaft **152** is journalled in the bearing blocks **144** and **146**. The shaft **150** supports a crimping roller **154**, having a fixed driving connection with a gear **156** meshing with a gear **160** mounted upon the shaft **152** and driving the crimping roller **162**. The crimping rollers **154** and **162** are driven by the weft wire **120** as it advances into the loom. The crimping rollers **154** and **162** are driven in synchronism by the intermeshing gears **156** and **160**. The crimping rollers **154** and **162** are so fluted that the corrugations or undulations in the weft wire register with the warp wires forming the shed. The weft wire may be crimped so as to simulate a sine wave, wherein one cycle has a length equal to the space allotted to two warp wires, so that one warp wire is seated in the gulley and the following warp wire underlies the succeeding crest of the sine wave. The crimping rollers **154** and **162** are adjusted by a pair of adjusting screws **161** adjusting the bearing blocks **142** and **148** towards and away from the lower bearing blocks **140** and **146**, to thereby control the magnitude of the crimp.

A pipe or guide **163** guides the crimped weft wire from the crimping device to a position near the web where it is severed. This guide **163** accurately holds the end of the weft wire in a predetermined position for engagement with the weft feeding device. The weft wire is drawn into the shed by a weft feeding device **200**, which operates automatically.

Weft feeding device

Due to the stiffness of the wire, it cannot very well be woven without first being crimped. If an attempt were made to feed the weft wire by shuttles tossed from one side to the other, or mechanically driven from one side to the other, which shuttles would contain a spool of wire, it would be impractical to do so. In the first place, it would not be satisfactory to wind pre-crimped wire on the shuttle. In the next place, it would not be satisfactory to feed such stiff wire from a small spool or bobbin, which would necessarily have to be used in the shuttle. Furthermore, if it were possible to wind the pre-crimped wire and if it were possible to feed the stiff spring wire from the shuttle, the weft wire could not be brought into registry with the warp wires. One of the main objections in using a bobbin, is the fact that the wire being wound on such a small spool or bobbin (about 1'' core) puts a set in the weft wire that is very objectionable in the resultant cloth. It is necessary to supply the crimped wire in such a manner that the undulations in the crimped wire register with the warp wire. The stiffness of the weft wire makes it unwieldy by the use of conventional shuttles used in the past. In the present device this difficulty has been overcome by the use of an automatic weft feeding device, which will now be described.

This automatic weft feeding device **200** includes a housing **202** that is substantially square in cross sectional area, mounted for reciprocatory movement in a supporting box **203** fixedly mounted upon the angle bars **106** and **108**. One end of the housing **202** supports a pair of gripper jaws **204** and **206** pivotally mounted upon the pivots **208** and **210** respectively. These gripper jaws have been provided with wire gripping serrations **204***a* and **206***a*, cooperating to grip the end of the weft wire **120** at the proper time, as will appear more fully later. The gripper jaws **204** and **206** have been provided with rearwardly extending wedge engaging projections **204***b* and **206***b* normally biased together or toward each other by the springs **212**, so as to separate the jaws, causing the gripper jaws to open unless held in closed position by a wedge-shaped member **216** actuated longitudinally with respect to the housing **202** into wedging position and out of wedging position by a rod **218**, threadedly engaging member **216** and urged into wedging position by a spring **220** abutting a collar **222** fixedly attached to the rod **218**. The other end of the spring **220** is seated against a sleeve **224** mounted in the opposite end of the housing **202** and fixedly attached thereto. The outer end of the rod **218**, that is, the end opposite the end engaging member **216**, supports a trigger seat **230** held in a retracted position by a trigger **232** substantially bell crank lever shaped, pivoted at **234** and normally biased in a counter-clockwise direction by a spring **236** mounted between one arm of the trigger **232** and a cross pin **238** in supporting plates **240**, one on either side of the trrigger end

of member 232. The trigger 232 is released by the movement of the weft feeding device 200, so that as the shuttle 200 is advanced into the shed formed by the separation of the warp wires and advances towards the end of the weft wire 120, the trigger 232 engages a pin 280 carried by a bracket 282 mounted upon angle bar 106. As the weft feeding device advances towards the end of the weft wire disposed on the side of the warp wires, the abutment 280 releases the trigger 232, causing the spring 220 to snap the wedge 216 into engagement with the projections 204b and 206b of the gripper jaws 204 and 206, so as to cause the gripping portions to firmly grip and hold the end of the weft wire.

As the weft feeding device is retrieved, the weft wire is drawn between the shed formed by the separation of the warp wires until the weft feeding device clears the warp wires, that is, until the weft feeding device has been completely withdrawn from the shed formed by the warp wires, at which time wedge retracting member 290 pivoted at 292 to the plates 240 engages the cam 294 mounted upon a pair of transverse members 296 and 298 supported upon extensions 300 and 302 fixedly attached to the angle irons 106 and 108. The cam surface 294 may be adjusted by a suitable set screw 306. As member 290 engages the cam surface 294, member 290 is rotated in a clockwise direction, as viewed in Figure 7, so as to cause the arm 290a to engage member 230 to actuate member 230 to the right, as viewed in Figure 7, to retract the wedge 216 from engagement with the extensions 204b and 206b of the gripper jaws 204 and 206, to permit the springs 212 to separate the gripper jaws, thereby releasing the weft wire. Simultaneously with this operation, the weft wire is severed on the opposite side by a snipper or shears 320, which will be described more fully later. However, before describing the snipper 320, the driving mechanism for the weft feeding device will be described.

Driving mechanism for weft feeding device

Referring to Figure 1, the shaft 76 has a crank arm 324 mounted on one end thereof and an oppositely disposed crank arm 326 mounted on the opposite end thereof. A link 328, having one end pivotally attached to the crank arm 324, has the other end interconnected to a chain 330 trained over a pulley 332, as best seen in Figure 2, mounted upon a shaft 334 journalled in frame member 102 and supported upon a bearing bracket 340 mounted upon a spanning member 342, spanning the distance between members 102 and 104 Again reverting to Figure 1, a link 344 has one end pivotally attached to crank arm 326 and the other end fixedly attached to a chain 346. As best seen by referring to Figure 2, the chain 346 is trained over a pulley 348 fixedly attached to a shaft 350 journalled in member 104 and in a bearing bracket 352, supported upon member 342. The inner ends of the shafts 334 and 350 have fixedly attached thereto pulleys 360 and 362 respectively. A chain 364 has one end fixedly attached to pulley 360 and trained over same, projecting down so as to pass over a pulley 370 journalled to a support 372, spanning the distance between member 106 and member 342. From the pulley 370 the chain 364 returns upwardly and is fixedly attached to and trained over the pulley 362. As the shaft 76 rotates, the pulleys 332 and 348 are oscillated in opposite directions by means of the rotation of the crank arms 324 and 326 actuating the links 328 and 344 and the parts associated therewith.

As the pulleys 332 and 348 are oscillated in opposite directions, so are the pulleys 360 and 362, causing the chain 364 to oscillate the pulley 370 about its pivot so as to cause this pulley 370 to rotate approximately one full revolution in one direction and then approximately one full revolution in the opposite direction. A crank arm 374 is attached to the pulley 370 and actuates a pitman 376, having one end pivotally attached to 374 and the opposite end pivotatlly attached to the head including the plates 240 of the weft feeding device 200, so that as the pulley 370 rotates in one direction, the weft feeding device is advanced into the shed formed by the separation of the warp wires, so as to grab the end of the weft wire 120 and then retract from the shed, so as to pull the weft wire through the shed and position the crimped weft wire in position with respect to the warp wires. At the end of this stroke, the weft wire is released. The next cycle of the weft feeding device is actuated by the pulley 370 rotating in the opposite direction.

As may be seen by referring to Figure 2, the full line position represents one extreme position of the pulley 370 and the dot-dash line position represents the other extreme position of the pulley 370. From this it may be seen that the pulley 370 does not make a complete revolution during each cycle. Instead, it rotates through 340°, 350° or more, depending entirely upon the length of the crank arms 324 and 326, the ratio of the pulleys used, etcetera. It is also to be noted that at one end of the stroke, that is, the dot-dash line position, the pitman 376 is substantially aligned with the crank arm 374, so as to advance the weft feeding device into the extreme position. In the full line position, the weft feeding device has not been retracted quite as far. Thus, it is seen that at the end of alternate cycles of the weft feeding device, it is further retracted than at the end of the other cycles. The pitman 376 is preferably adjustable, so that the weft feeding device may be adjusted with respect to the end of the weft wire and the position of the shears 320.

By referring to Figure 5, it may readily be seen that the gears holding the crimping rollers in synchronism are provided with a non-reversing mechanism. This non-reversing mechanism includes two pawls 450 and 452 mounted upon a pivot 454 fixedly secured to the transverse member 140. The pawls 450 and 452 are urged in a counterclockwise direction, as viewed in Figure 5, by a suitable spring 456. It is to be noted that two pawls are used of unequal length, only one of which projects between adjacent teeth, the other being out of engagement. This arrangement cooperates with the weft feeding device in properly supplying the weft wire between the warp. In the first place, this has been accomplished by causing the weft feeding device to pull or draw the weft wire through a distance that is not a multiple of the distance of the cycles of undulations in the weft wire; but instead, the weft feeding device draws the weft wire through a distance that is equal to a multiple of the length of each cycle of undulations plus the length of one-half cycle. Thus, the shorter pawl, that is, the one shown in engagement with the teeth in Figure 5, arrests the retractive movement of the crimping device for alternate weft wires, the longer pawl arresting the retractive movement of the crimping device

for the other weft wires, so that the pawls function alternately to arrest the retractive movement of the crimping device. By this arrangement, the undulations in the crimped weft wire are always fed into registry with the warp wires.

Beater driving mechanism

The beater, which includes a plurality of reeds **110** spanning the distance between angle irons **106** and **108**, is actuated through a pair of links **402**, only one of which is shown in Figure 1, having their forward ends pivotally attached to the upright members **102** or **104**, as the case may be, and the rear ends attached to a pair of crank arms **404**, one on each end of the shaft **406** journalled in the frame of the loom and driven in synchronism with the shaft **76**. The shaft **406** rotates at twice the speed of the shaft **76**, as the shaft **76** rotates once for one complete cycle of the operation of the loom, during which cycle the beater reciprocates twice, so as to position two succeeding weft wires, as is well known to those skilled in the art. The weft feeding device is advanced between the shed formed by the warp wires while the beater is retracting from its operating position and the weft wire positioned into position while the beater is advancing the weft wire into the bight of the shed. Likewise, the snippers or shears **320** are actuated in synchronism with the operation of the beater, as will appear more fully from the following description.

Wire snippers or shears

The wire snippers or shears **320** are mounted directly below and adjacent the end of the pipe **163**, through which the weft wire extends. The shears **320** include a shear member **420** mounted for vertical reciprocatory movement in the support **422** fixed to the beater frame member **108**. The complementary shear member **424** is pivotally mounted at **426** to member **420** and includes an arm **424***a* that projects forwardly or away from the beater. As the beater advances the weft wire into position with respect to the warp wires, the lower end **421**, pivotally attached to member **420**, engages a stationary cam **430**, so as to raise members **420** and **424** to straddle the weft wire **120**, as shown in the full line position in Figure 8. As the beater advances, the arm **424***a* engages a stop **432**, closing the shearing members **420** and **424**, so as to shear the wire. This takes place near the forward end of the beater stroke after the weft feeding device has released the opposite end of the weft wire, so that the severed portion of the weft wire is not released from the weft feeding device and severed from the continuous length weft wire until just before the heddles are ready for reversal, so as to cause the warp wires to hold the weft wire in position immediately upon it being severed from the continuous length. As the beater returns, a suitable spring **434** cooperating with gravity, causes the shears to drop out of the path of the weft wire. The shears are held in open position by a spring **436**.

In order that the shears may rapidly disappear from the operative position shown in Figure 8, member **421** is pivotally attached to a shear member **420** at **423**. This provides a joint, so that as soon as the beater starts on its retractive movement, member **421** oscillates about the pivot **423**, permitting the spring **434** to snap the shears into "down" position before the shear clears the cam surface **430**. Immediately upon the reversal of the beater, member **421** is rotated in a counterclockwise direction, as shown in Figure 8, from the bent position into the straight position, in readiness to again engage the cam **430** and advance the shears into "up" position. The spring **436** is utilized to hold the shears in an open position, excepting when the shears are advanced so that the arm **424***a* is moved into closed position by the stop **432**.

Mode of operation

After the warp wires have been properly threaded or strung through the loom and a coil of weft wire has been mounted in position with an end projecting through the crimping rollers, the driving motor, which has not been shown, may be started. This motor drives the drum **36** at a rate of speed compatible with the mesh of the screen to be woven. As the surface of the drum **36** may be of metal or of wood, slippage of the warp wires is prevented by suitable abrasive or friction producing means. The abrasive material may be applied by covering the periphery of the drum with sheets of abrasive material, or the periphery of the drum may be painted or covered with suitable cement having embedded therein emery or abrasive material, causing a positive drive between the drum and the warp wires.

The weft wire is positioned in the shed by the automatic weft feeding device. This automatic weft feeding device, which is mounted on the beater, has a reciprocatory movement which advances the weft feeding device across the shed where it grips the weft wire and during the retrieving stroke pulls the weft wire into the shed. The driving means for causing the fore and aft movement of the beater and the driving means for reciprocating the weft feeding device are so timed that the weft feeding device advances across the shed during the latter part of the aft movement of the beater and engages or grips the weft wire approximately at the time that the direction of the weft feeding device and the beater is reversed. As the weft feeding device retrieves the weft wire, the movement of the beater reverses, so that the weft wire is drawn into position in the shed during the early forward movement of the beater.

This synchronization of movements is made possible by the use of pitmans actuated by crank arms rotating at a uniform rate of speed. Link **402**, actuated by the crank arm **404**, causes the beater to have a movement corresponding to a sine wave motion. Referring to Figure 1, the beater is traveling at approximately the highest rate of speed when the crank arm **404** is normal to the line of centers. When the crank arm passes dead center, the direction of movement of the beater reverses. At the same time, the movement of the crank arms **324** and **326**, together with the movement resulting from rotation of crank arm **374**, results in the weft feeding device rapidly advancing across the web and promptly returning with the weft wire. The weft feeding device travels across the web and returns while the crank arms **324** and **326** travel through one-half revolution, that is, during half a revolution of the crank arm **324** and the crank arm **326**, the crank arm **374** makes one revolution. This results in a peculiar movement of the weft feeding device. It might be referred to as a compound sine wave movement, in that when the arm **374** has passed through substantially half a revolution, the movement of the weft feed-

ing device by virtue of this arm, reverses and passes through zero; but while this reversal of the weft feeding device is taking place, the crank arms **324** and **326** are traveling at the highest rate of speed possible. When crank arms **324** and **326** reach dead center, the crank arm **314** reverses its direction of rotation, at which time the movement of the weft feeding device is zero, as it reverses its direction. This results in the weft feeding device having a considerable dwell during the shearing operation and the advancement of the beater so as to shove the weft wire tightly into the apex of the shed and during the reversal of the heddles. At the other end of the stroke of the weft feeding device, that is, when the weft feeding device is in position to engage the weft wire, it stops only momentarily. This compound sine wave movement makes it possible to actuate the weft feeding device across the shed and retrieve the weft feeding device during the latter portion of the aft movement of the beater and the first portion of the forward movement thereof.

As the beater advances into the extreme forward position, the cam raising the shears and the stop for closing the shears cause the shears to sever the wire. Up to the time that the wire is severed, even though the gripper jaws of the weft feeding device have released the wire for a considerable period prior thereto, the weft wire is not free to move at any time, for the reason that this wire is not severed until the beater has advanced the weft wire into a position near the apex of the shed, when it is held in position by the beater during the reversal of the heddles.

These cycles are repeated without interruption, excepting when it is necessary to supply a new coil of weft wire and when it is necessary to remove a full roll of woven screen and substitute therefor an empty spool.

Although the preferred modification of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. A weft wire operating unit for use in a loom for weaving metallic screen from wire, said operating unit including a beater having a frame mounted for fore and aft movement, a retrieving weft feeding device mounted on said beater frame so as to have a fore and aft movement therewith, said weft feeding device having a reciprocatory movement across all of the warp wires, actuating means for actuating the weft feeding device, means for causing the weft feeding device to engage the end of the weft wire, means for releasing the weft wire after it has been positioned, crimping means also mounted upon said beater frame, said crimping means crimping the weft wire as it is drawn by the weft feeding device into the shed, and severing means mounted upon the beater frame, said severing means severing the weft wire on the side opposite the shuttle when released.

2. A weft wire operating unit for use in a loom for weaving a metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, means for positively feeding the warp wires into the loom, crimping means mounted upon the beater frame, said crimping means crimping the weft wire as it advances into the shed, and a reciprocatory weft feeding device also mounted upon the beater frame, said weft feeding device advancing across the shed from one side and retrieving the weft wire held by the crimping means, said weft feeding device feeding the weft wire from the opposite side so as to position the crimped weft wire in the shed.

3. A weft wire operating unit for use in a loom for weaving a metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, means for automatically supplying the weft wire to the loom from a coil, said means including a crimping device mounted upon the beater frame in close proximity to the warp wires, said crimping means crimping the wire, and means also mounted upon the beater frame, said last means automatically engaging the weft wire and pulling it through the crimping device into the shed.

4. A weft wire operating unit for use in a loom for weaving a metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, means for supporting a coil of weft wire, crimping means mounted upon the beater frame, said crimping means crimping the weft wire, and an automatic reciprocatory weft feeding device also mounted upon the beater frame, said weft feeding device pulling the weft wire from said coil through the crimping means across the shed.

5. A weft wire operating unit for use in a loom for weaving a metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, a crimping device mounted upon the beater frame, said crimping device forming the weft wire into sinuous form so as to be snugly seated between the warp wires, means for pulling the weft wires through the crimping device into the shed, and severing means mounted upon the beater frame, said severing means cutting the weft wire after it has been positioned in the shed.

6. A weft wire operating unit for use in a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, a crimping device mounted upon the beater frame for crimping the weft wire, and means for pulling the weft wire through the crimping device into the shed where it is engaged by the beater during the reversal of the warp wires to form a new shed.

7. A weft wire operating unit for use in a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, a retrieving stripper mechanism mounted upon the beater frame so as to have a fore and aft movement in unison with the beater frame, said gripper mechanism being mounted for recipro-

catory movement including means for reciprocating the gripper mechanism across all of the warp wires in synchronism with the operation of the loom, said gripper mechanism including a pair of gripper jaws, means for engaging the gripper jaws so as to hold the same open for the duration of the inoperative stroke while advancing through the shed, means extending across the shed for closing the gripper jaws at the end of the advance stroke of the gripper mechanism, and means mounted upon the beater frame for releasing the weft wire at the end of the retrieving stroke of the gripper mechanism.

8. A weft wire operating unit for use in a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, a weft wire crimping device mounted upon the beater frame, a weft wire gripper mechanism mounted upon the beater frame so as to have a fore and aft movement in unison with the beater frame, said weft wire gripper mechanism being mounted for reciprocatory movement so as to have an advancing stroke across all of the warp wires and a retrieving stroke, said weft wire gripper mechanism advancing the weft wire through the crimping device into the shed during the retrieving stroke, said crimping device forming the weft wire into sinuous undulations, and actuating means for reciprocating said weft wire gripper mechanism, said actuating means actuating the weft wire gripper mechanism during the effective retrieving stroke a distance substantially equal to a multiple of the sine wave length plus a distance equal to one-half sine wave length.

9. A weft wire operating unit for use in a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, a weft wire crimping device mounted upon the beater frame, a weft wire gripper mechanism mounted upon the beater frame so as to have a fore and aft movement in unison with the beater frame, said weft wire gripper mechanism being mounted for reciprocatory movement so as to have an advancing stroke across all of the warp wires, and a retrieving stroke, said weft wire gripper mechanism advancing the weft wire through the crimping device into the shed during the retrieving stroke, said crimping device forming the weft wire into sinuous undulations, actuating means for reciprocating said weft wire gripper mechanism, said actuating means actuating the weft wire gripper mechanism during the effective retrieving stroke a distance substantially equal to a multiple of the sine wave length plus a distance equal to one-half sine wave length and means for shearing the weft wire between the crimping device and the web at the end of the retrieving stroke of the weft wire gripper mechanism.

10. A weft wire operating unit for use in a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, means for supplying the weft wire to the loom, said means including a crimping device mounted upon the beater frame, a reciprocatory weft feeding device mounted upon the beater frame so as to have a fore and aft movement in unison with the beater frame, said weft feeding device pulling the weft wire through the crimping device into the shed, the fore and aft movement of the beater advancing the weft wire into the apex of the shed, shearing means supported upon the beater, and means in the path of the shearing means causing the shearing means to respond to the movement of the beater to shear the weft wire after it has been positioned in the shed.

11. A weft wire operating unit for use in a loom for weaving a metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, a crimping device mounted upon the beater frame, said crimping device crimping the weft wire, means for causing said crimping device to have a fore and aft movement with the beater frame, a retrieving weft wire gripper mechanism mounted for reciprocatory movement, said gripper mechanism being mounted upon the beater frame so as to have a fore and aft movement with the beater frame, and actuating means for advancing the gripper mechanism through the shed into engagement with the end of the weft wire projecting from the crimping device, said actuating means actuating the gripper mechanism so as to pull the weft wire into the shed, the weft wire being advanced forward by the forward movement of the beater.

12. A weft wire operating unit for use in a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a beater having a frame mounted for fore and aft movement, an automatic weft wire feeding device, a crimping device, automatic shears, said beater frame supporting the crimping device, the shears and the weft feeding device, actuating means for actuating the beater frame and the parts supported thereon, whereby the crimping device, the shears and the weft feeding device have a fore and aft movement in unison with the beater frame.

13. A weft wire operating unit for use in a loom for weaving metallic screen from wire, said loom having means for separating the warp wires, so as to form a shed for the reception of the weft wire, said operating unit including a weft wire feeding device having a longitudinal housing mounted for reciprocatory movement, a rod mounted in the housing for reciprocatory movement relative thereto, a pair of gripper jaws mounted adjacent one end of the housing and projecting therethrough, means for biasing the gripper jaws into open position, means for resiliently urging said reciprocatory rod in one direction to close the gripper jaws, means for actuating said reciprocatory rod against the force of said resilient means to release the gripper jaws, and means for holding the rod out of engagement with the gripper jaws during the inoperative stroke of said weft wire feeding device.

14. A weft wire operating unit for use in a loom for weaving a metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, said operating unit including a weft wire feeding device having an operative and an inoperative stroke, said weft wire feeding de-

vice having an elongated housing, a pair of gripper jaws pivotally mounted adjacent one end of the housing, means for normally biasing the gripper jaws into open position, means for forcing the gripper jaws into engaging position, said means being mounted within the housing for reciprocatory movement and terminating near the end of the housing opposite the gripper jaws, and actuating means responding to the movements of the housing actuating said last means so as to actuate the gripper jaws.

15. In a loom for weaving metallic screen from continuous length wire, the combination including means for crimping the weft wire, a beater having a frame mounted for fore and aft movement, a reciprocatory weft feeding device mounted upon said beater frame so as to have a fore and aft movement in unison with the beater frame, said device including a pair of gripper jaws mounted for reciprocatory movement across all of the warp wires, means for propelling said gripper jaws, means for closing the gripper jaws so as to engage the end of the wire located on one side of the web, releasing means carried on the beater frame releasing the gripper jaws as the weft wire has been positioned in the shed, and severing means mounted on the beater frame, said severing means severing the wire upon being positioned so as to leave the end of the weft wire available for the succeeding operation.

16. In a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, the combination including mechanism for crimping the weft wire, a beater having a frame mounted for fore and aft movement, means mounted upon the beater frame, said means advancing the weft wire from a source of continuous length weft wire into the shed, and severing means for severing the weft wire from the source of supply after it has been positioned in the shed, said severing means being characterized by a shearing member mounted for reciprocatory movement upon the beater frame, a second shearing member pivotally attached to the first shearing member, and shear actuating means in the path of said shearing members for reciprocating said first shearing member with respect to the beater frame so as to cause the shearing members to straddle the weft wire, said shear actuating means including a stop engaging the pivotally mounted shearing member for shearing the weft wire.

17. In a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, the combination including mechanism for crimping the weft wire, and an operating unit including a beater having a frame mounted for fore and aft movement, a retrieving weft wire gripper mechanism mounted upon the beater frame for advancing the weft wire from a source of continuous length weft wire into the shed, and severing means for severing the weft wire from the source of supply after it has been positioned in the shed, said severing means being characterized by a shearing member mounted for reciprocatory movement upon the beater frame, a second shearing member pivotally attached thereto, and shear actuating means in the path of said shearing members for reciprocating said first shearing member with respect to the beater so as to cause the shearing members to straddle the weft wire, said shear actuating means including a stop engaging the pivotally mounted shearing member for shearing the weft wire.

18. In a loom for weaving metallic screen from wire, said loom having means for separating the warp wires so as to form a shed for the reception of the weft wire, the combination including mechanism for crimping the weft wire, and an operating unit including a beater having a frame mounted for fore and aft movement, a reciprocatory weft feeding device mounted upon the beater frame, severing means supported upon the beater frame, said severing means being characterized by an articulated shearing member, a pivotally mounted shearing member cooperating with the first shearing member to sever the weft wire, means in the path of the severing means for engaging the articulated member to actuate the severing means into shearing position, and means actuating one end of the pivotally mounted shearing member so as to shear the weft wire, the articulated member collapsing during the aft movement of the beater to rapidly withdraw the severing means from shearing position.

19. In a loom for weaving metallic screen from wire, said loom having means for separating the warp wires to form a shed for the reception of the weft wire, the combination including mechanism for crimping the weft wire, means for tensioning the weft wire, said means including an arm mounted for oscillatory movement, and a weft wire operating unit including a beater having a frame mounted for fore and aft movement, an automatic weft wire feeding device, automatic shears, said beater frame supporting the shears and the weft feeding device, actuating means for actuating the beater frame and the parts supported thereon whereby the shears and the weft feeding device have a fore and aft movement in unison with the beater frame to lay the crimped wire in the shed.

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