Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

Filed Oct. 13, 1938 18 Sheets-Sheet 1

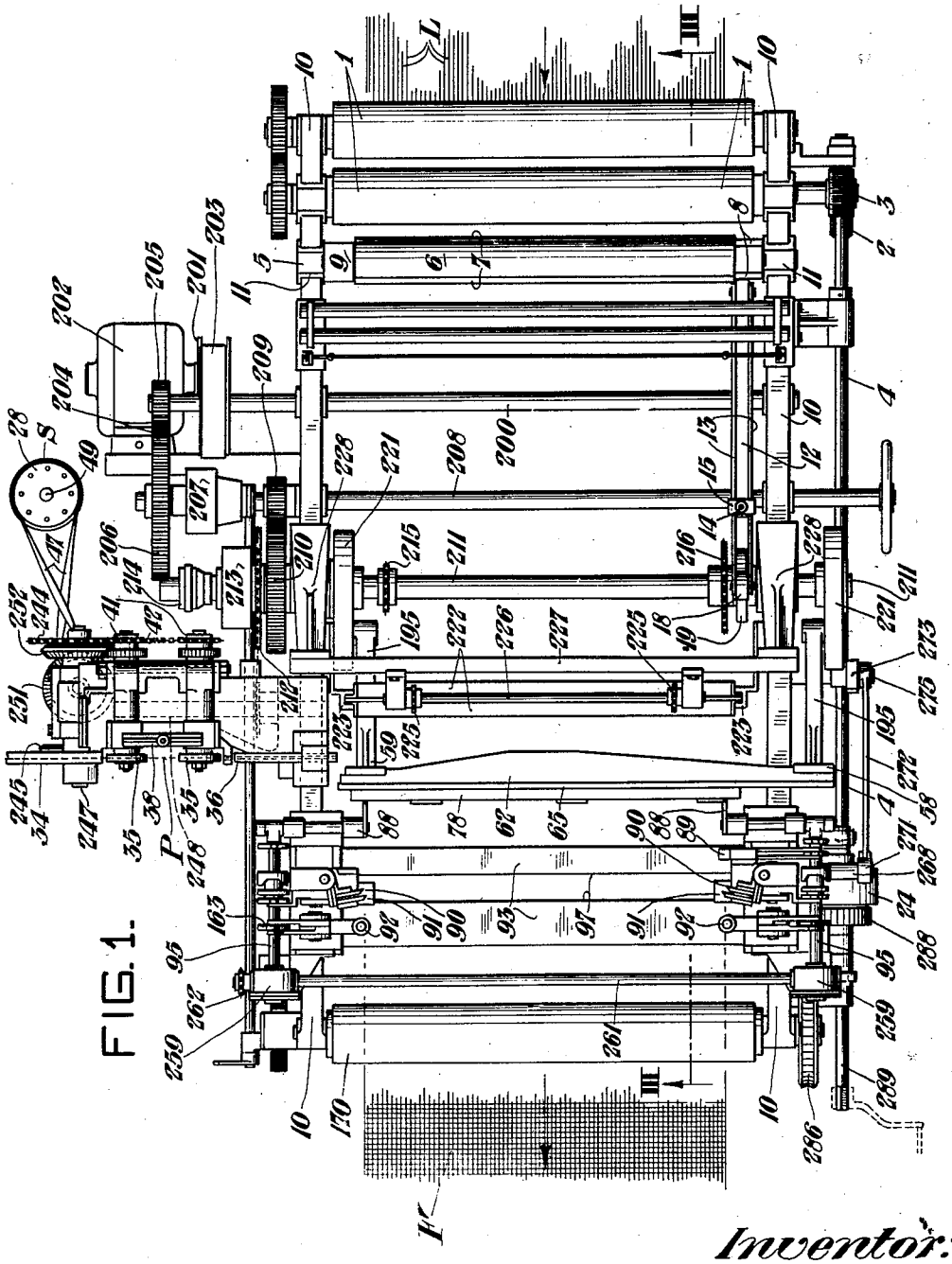

FIG. 1.

Inventor:
NOAH S. HARTER,
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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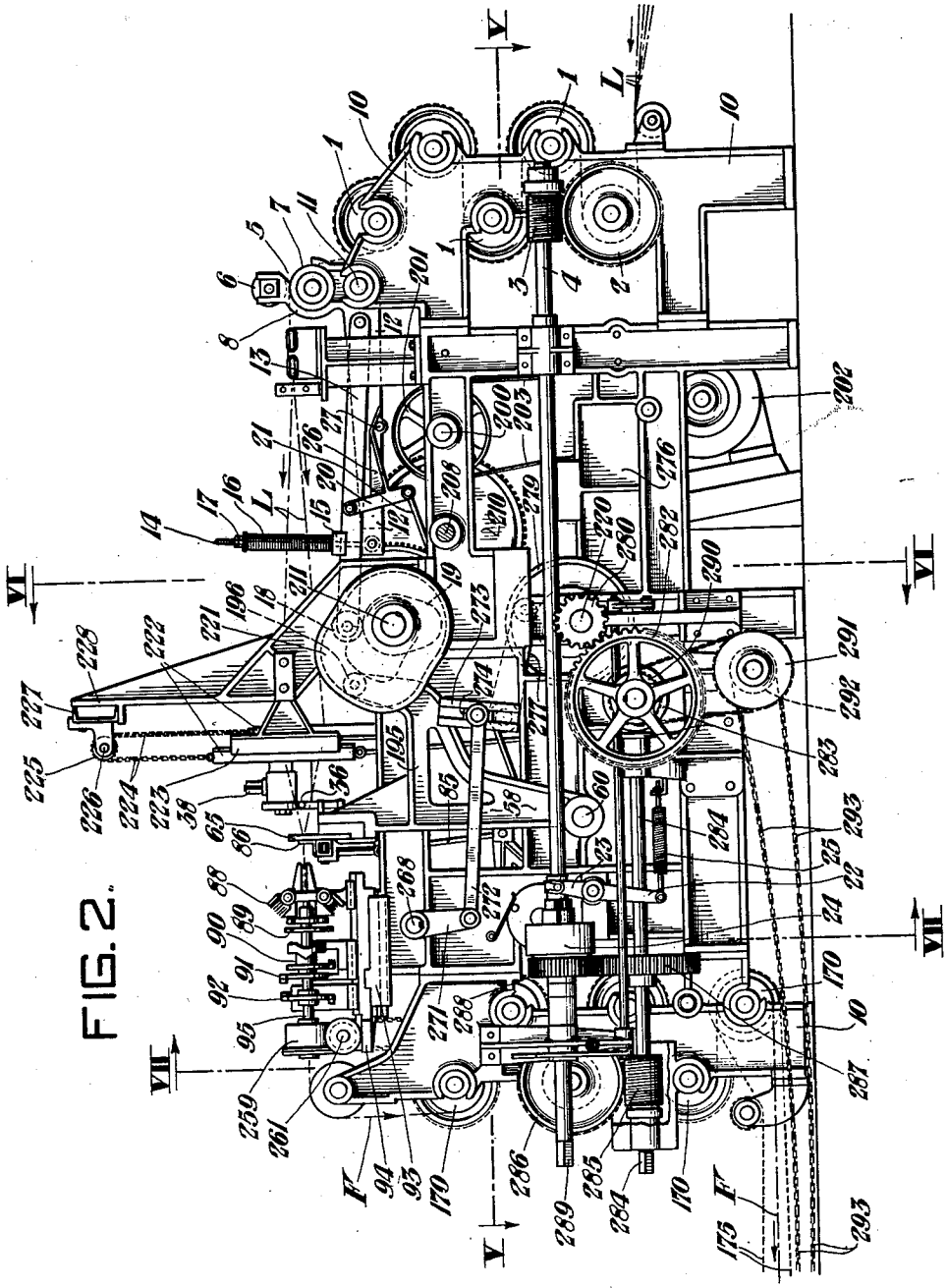

FIG. 2.

Inventor:
NOAH S. HARTER.
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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FIG. 3a

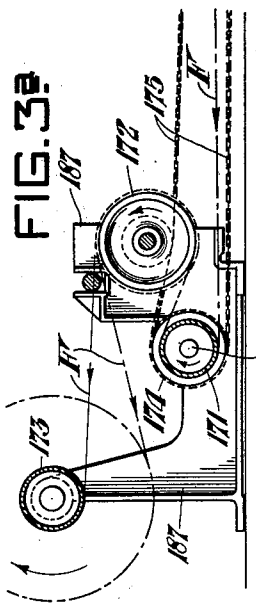

FIG. 3.

Inventor:
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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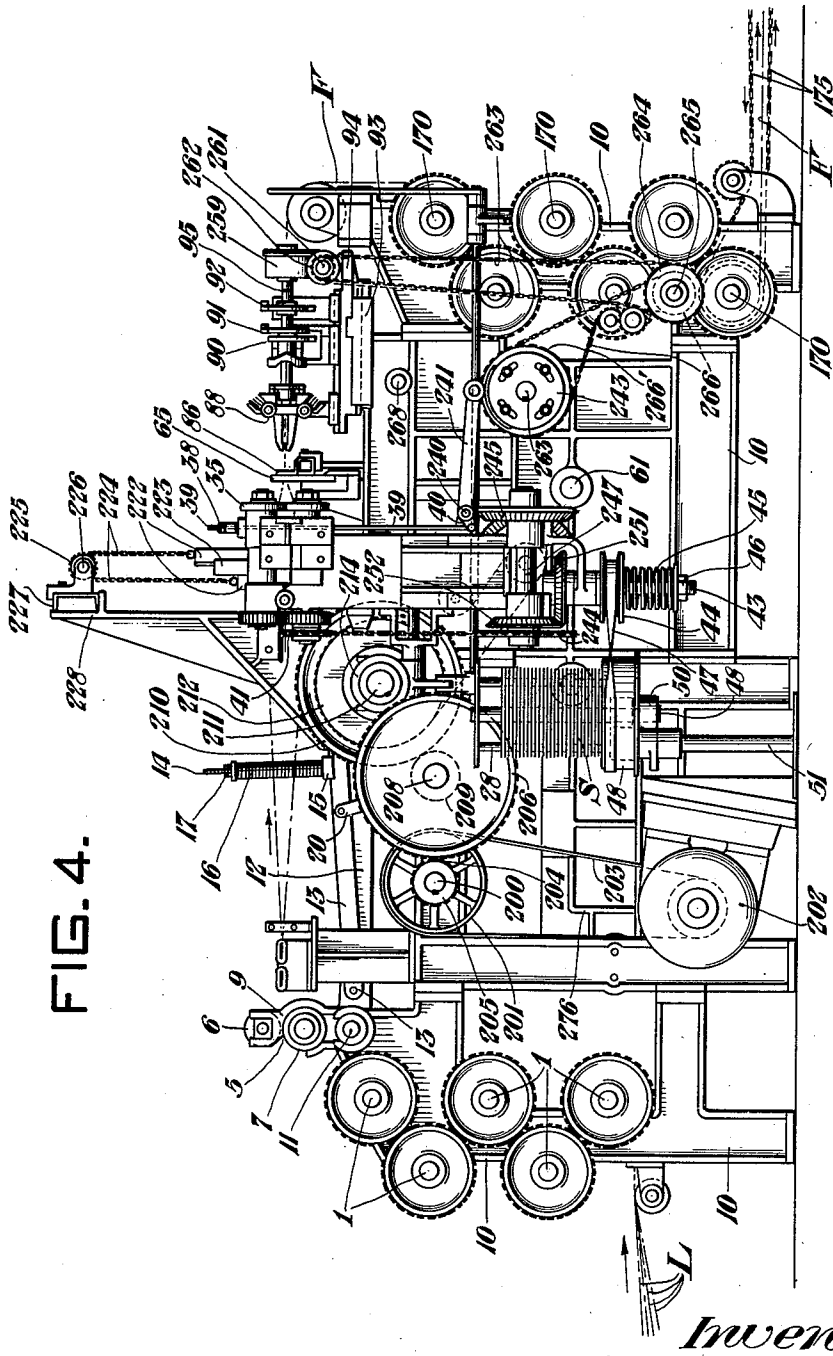

FIG. 4.

Inventor:
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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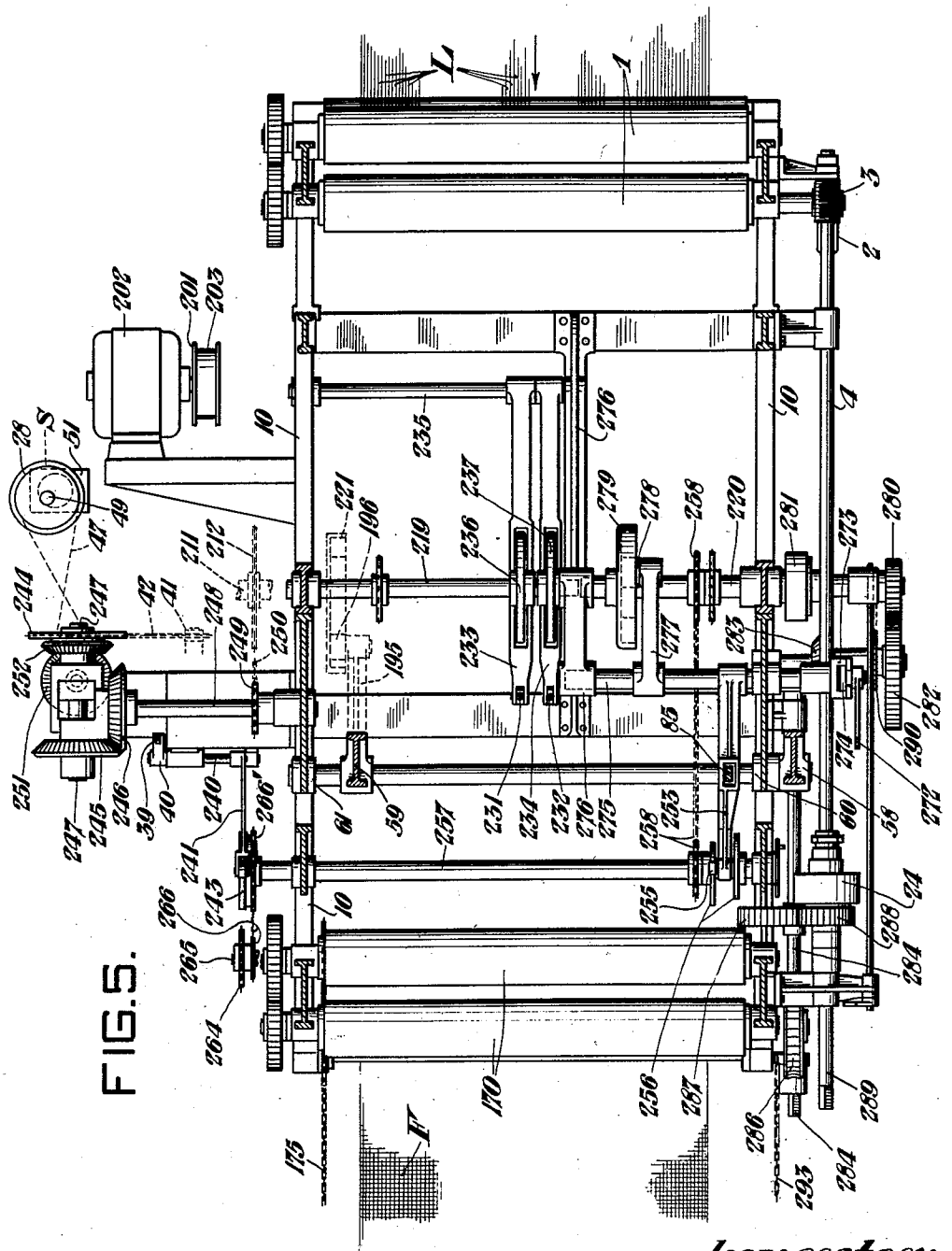

FIG. 5.

Inventor:
NOAH S. HARTER,
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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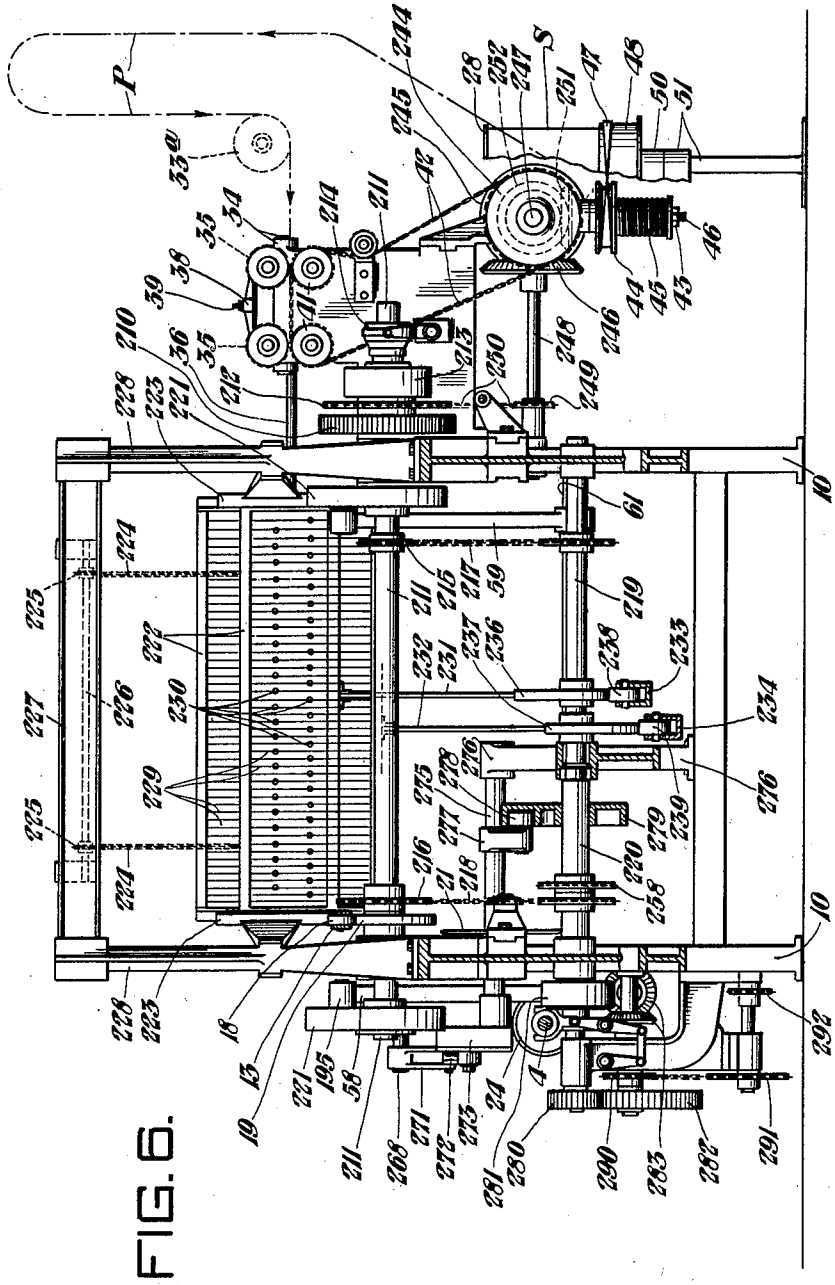

FIG. 6.

Inventor:
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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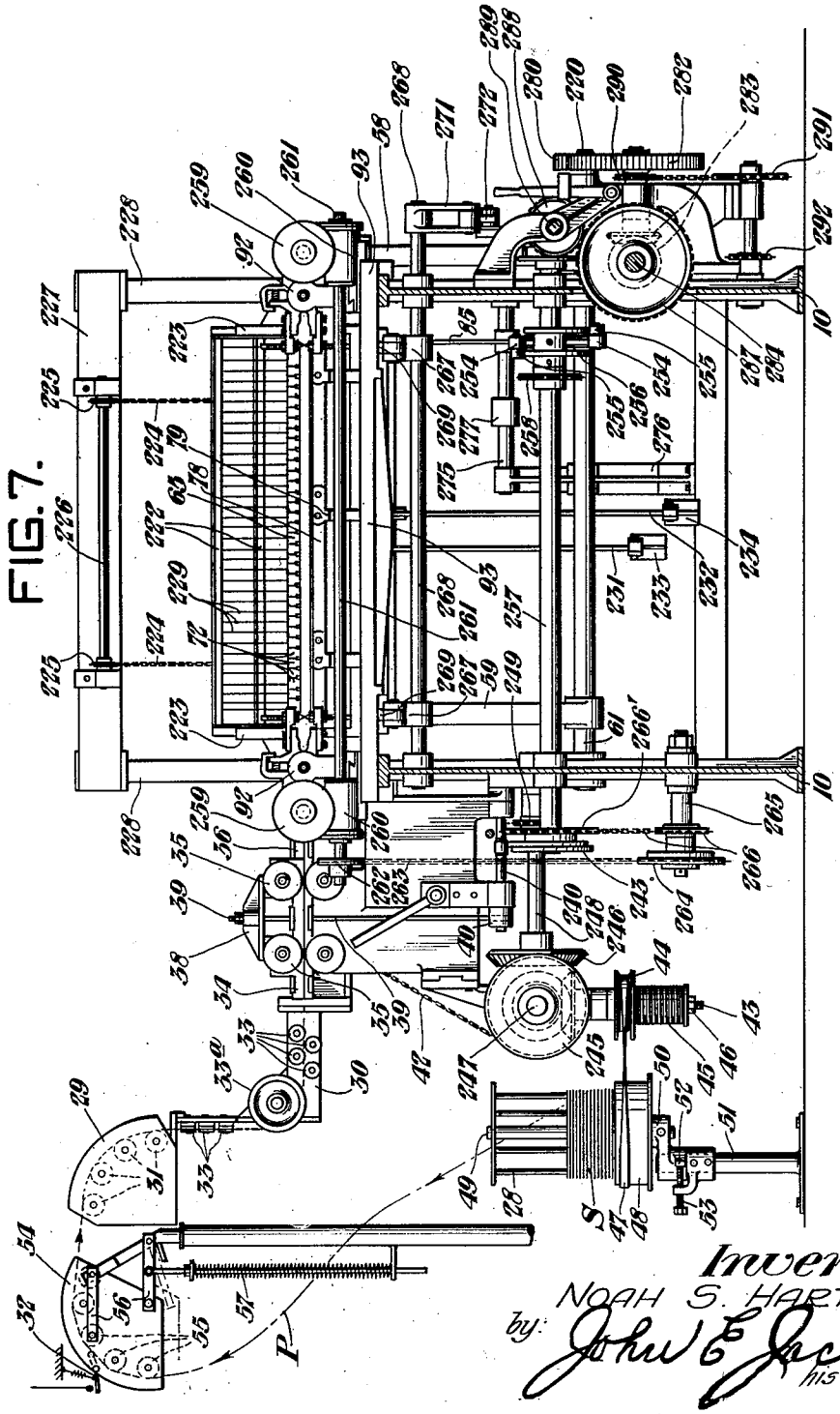
FIG. 7.



Inventor:
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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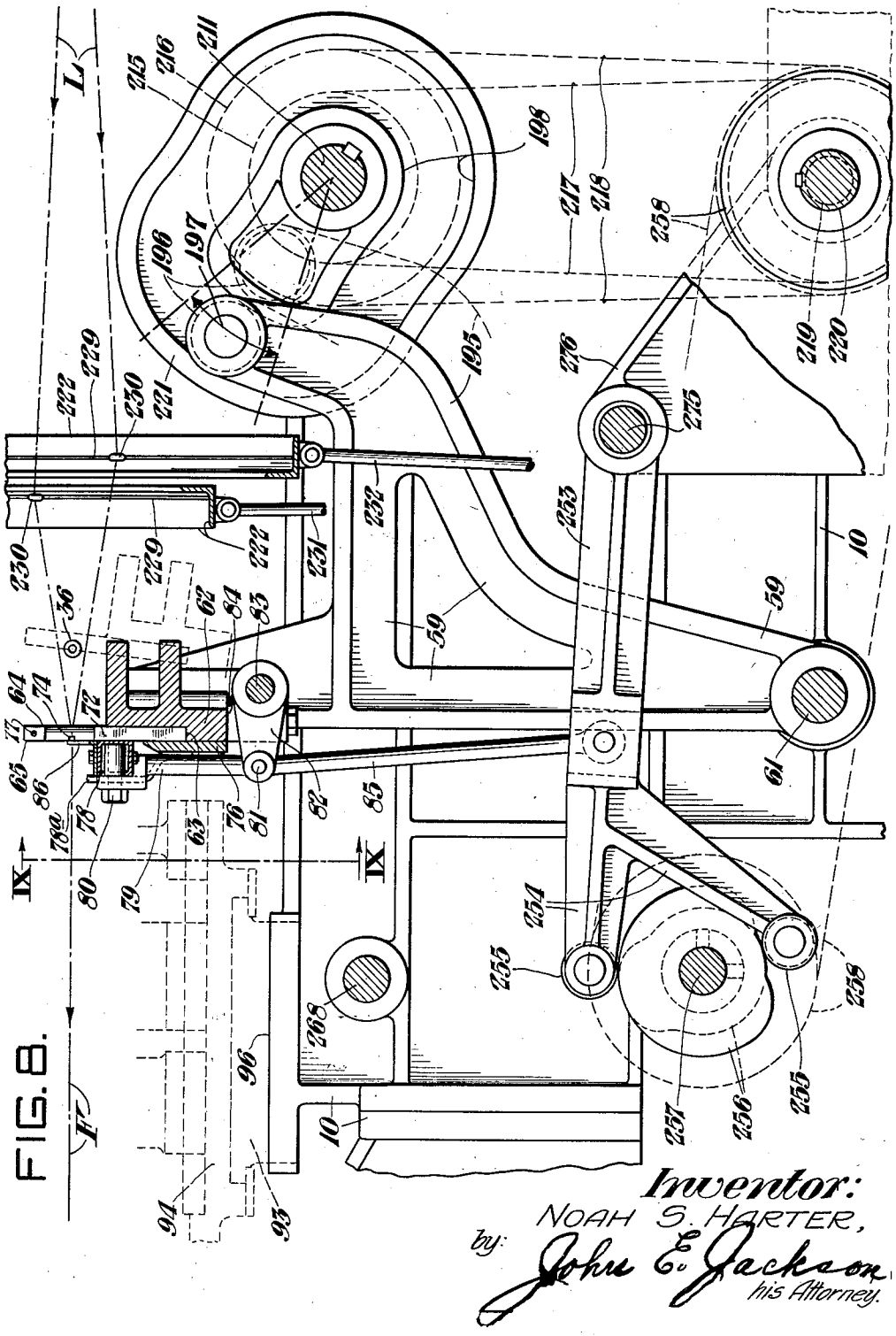

FIG. 8.

Inventor:
NOAH S. HARTER,
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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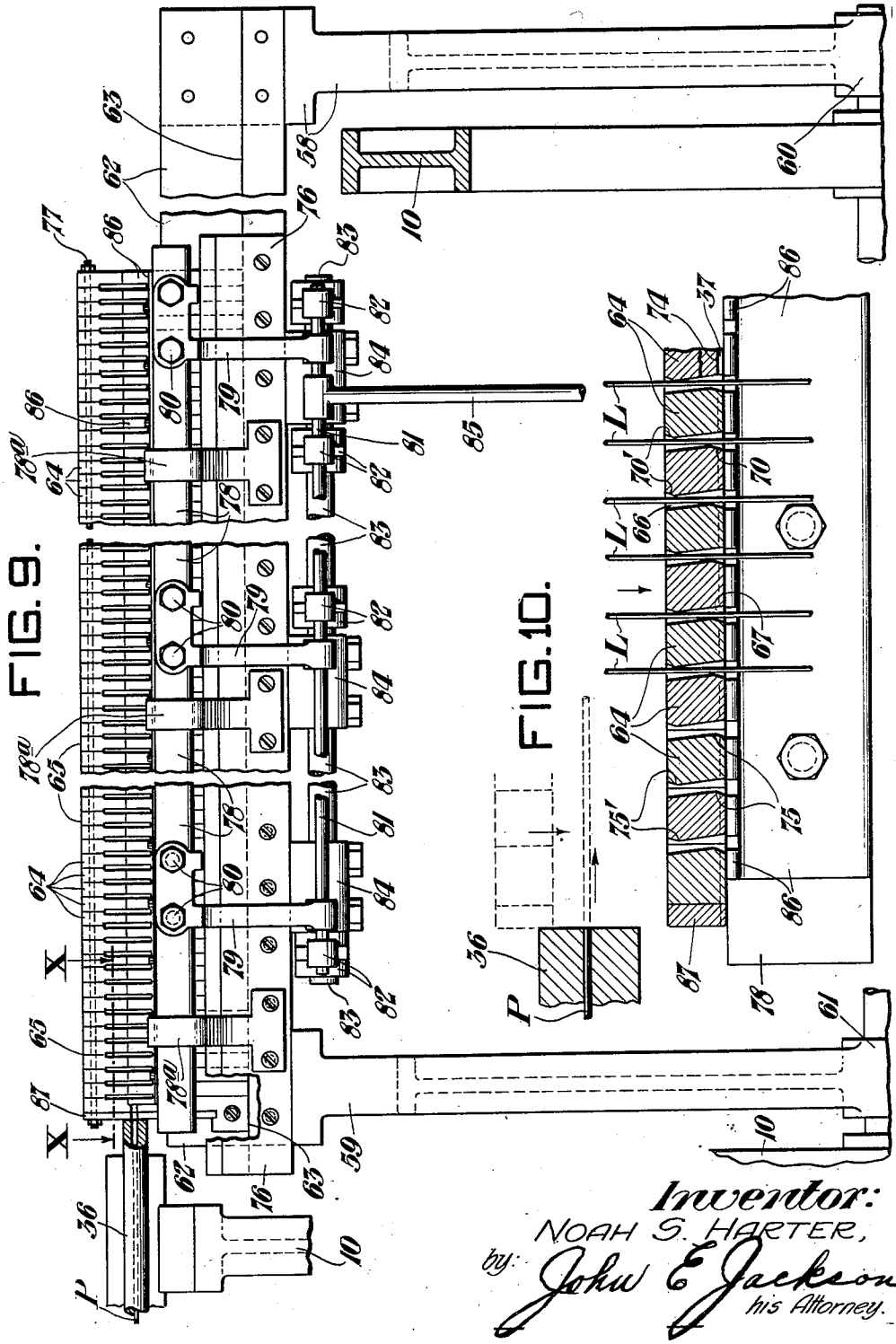

FIG. 9.

FIG. 10.

Inventor:
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HARDWARE AND SCREEN CLOTH MACHINE

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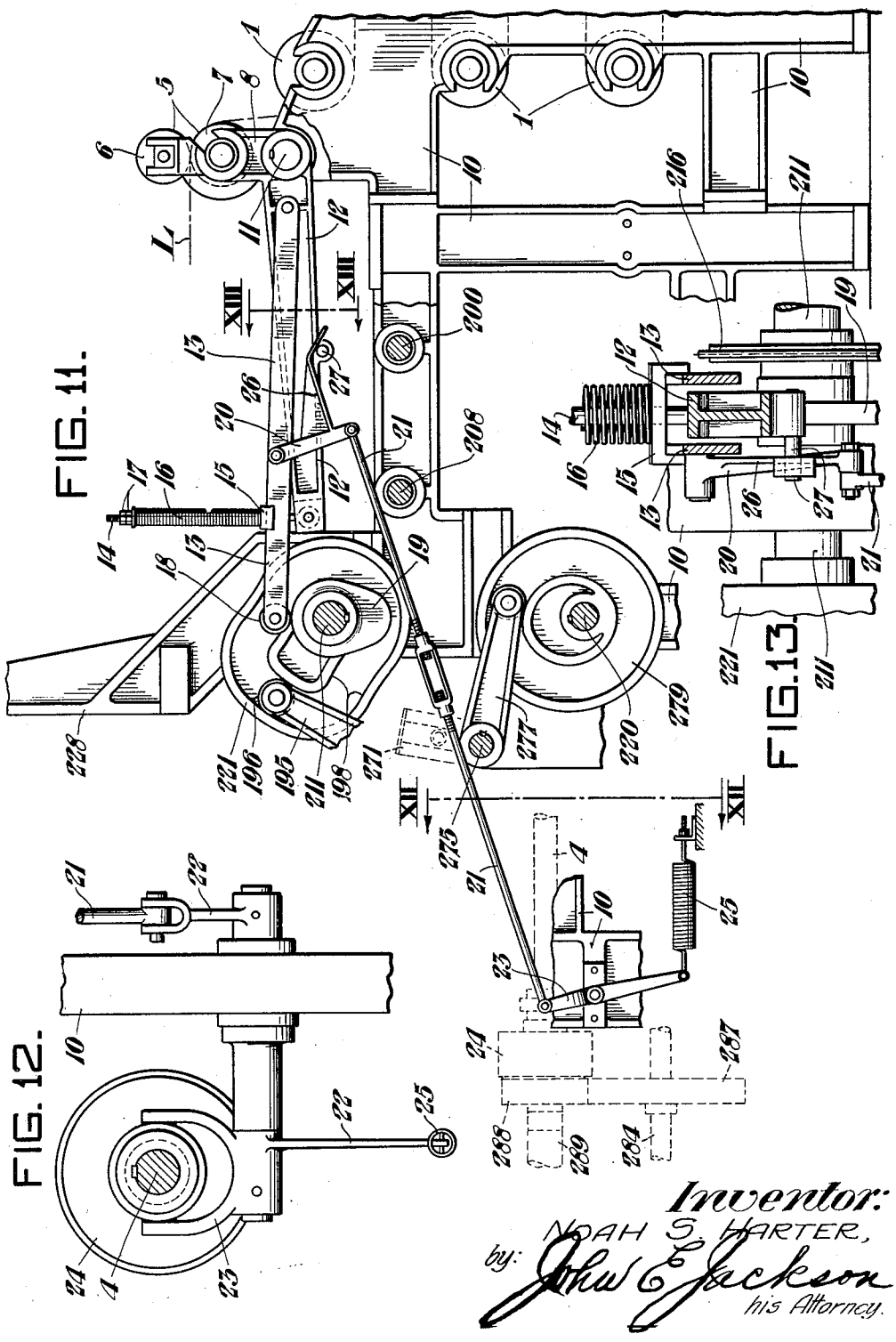

FIG. 11.

FIG. 13.

FIG. 12.

Inventor:
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HARDWARE AND SCREEN CLOTH MACHINE

Filed Oct. 13, 1938 18 Sheets-Sheet 11

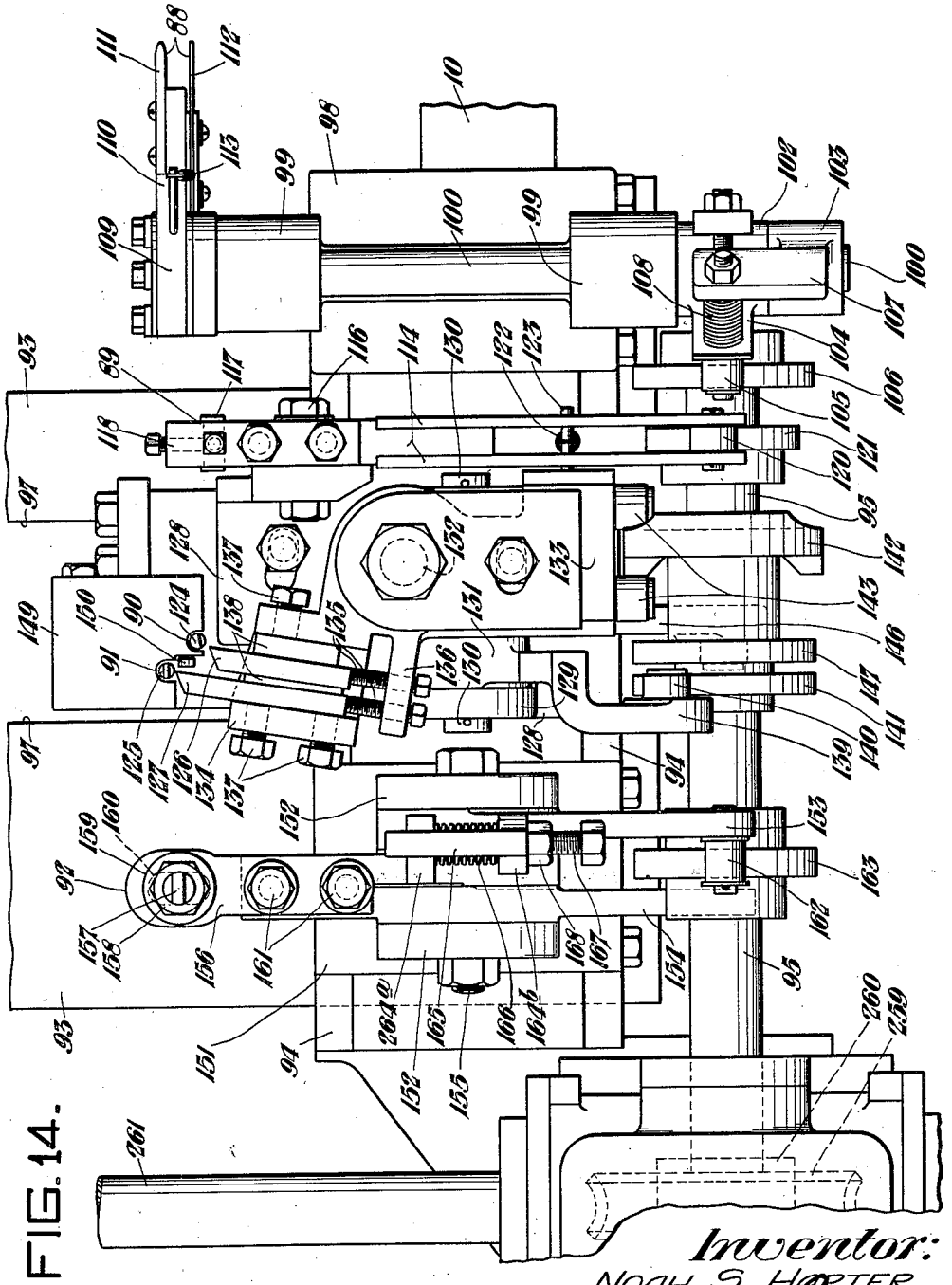

FIG. 14.

Inventor:
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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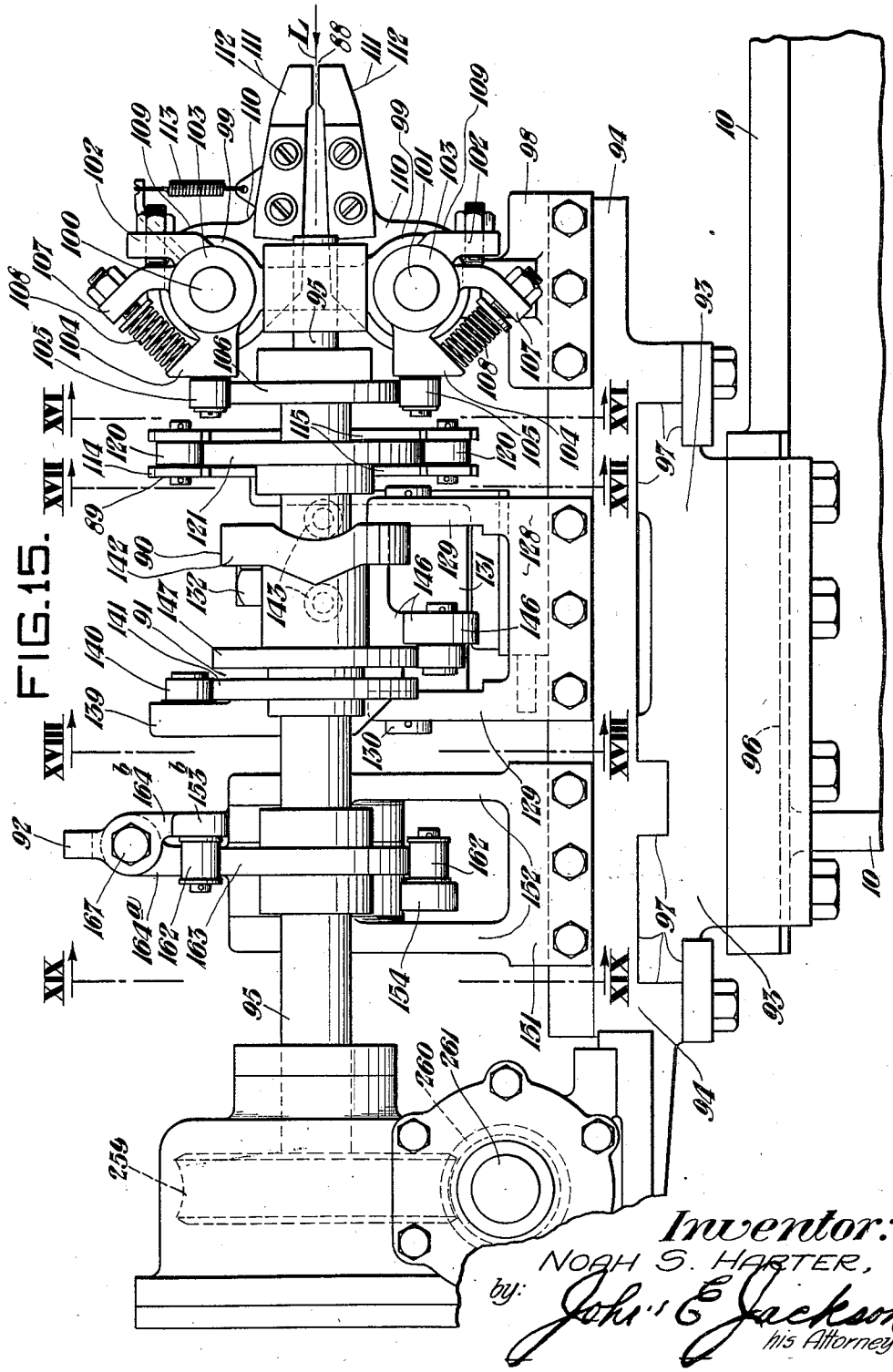
FIG. 15.



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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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FIG. 16.

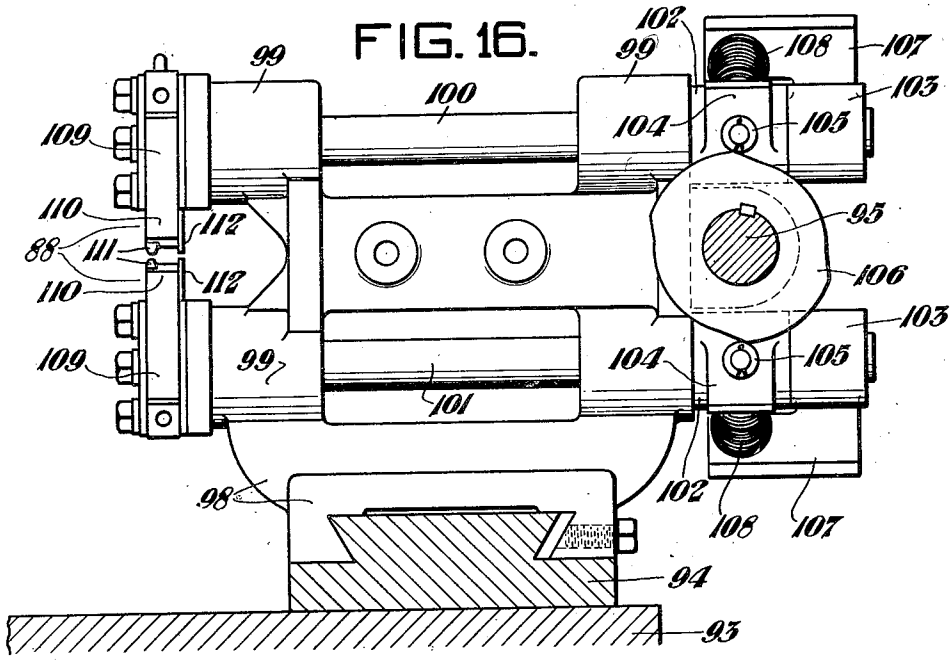
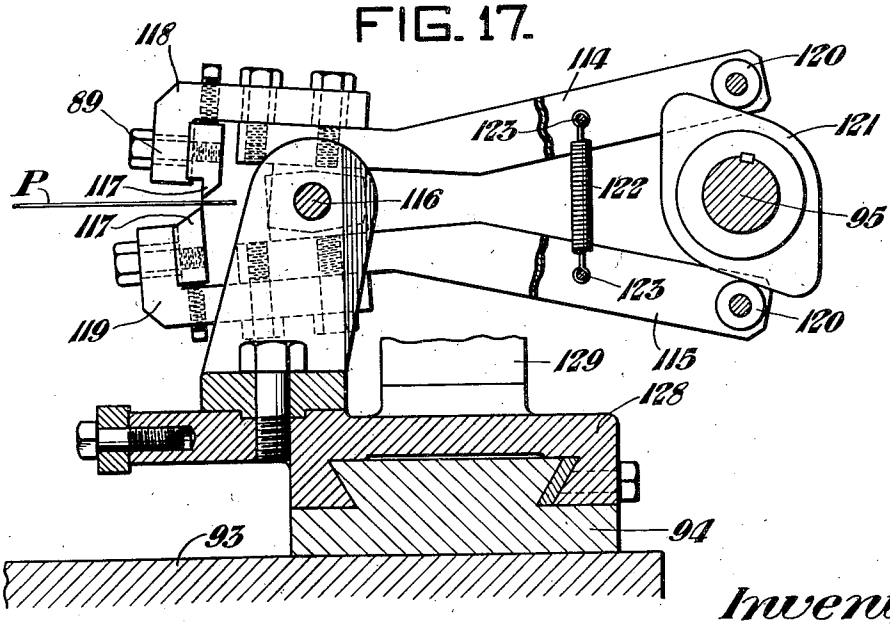


FIG. 17.



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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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FIG. 18.

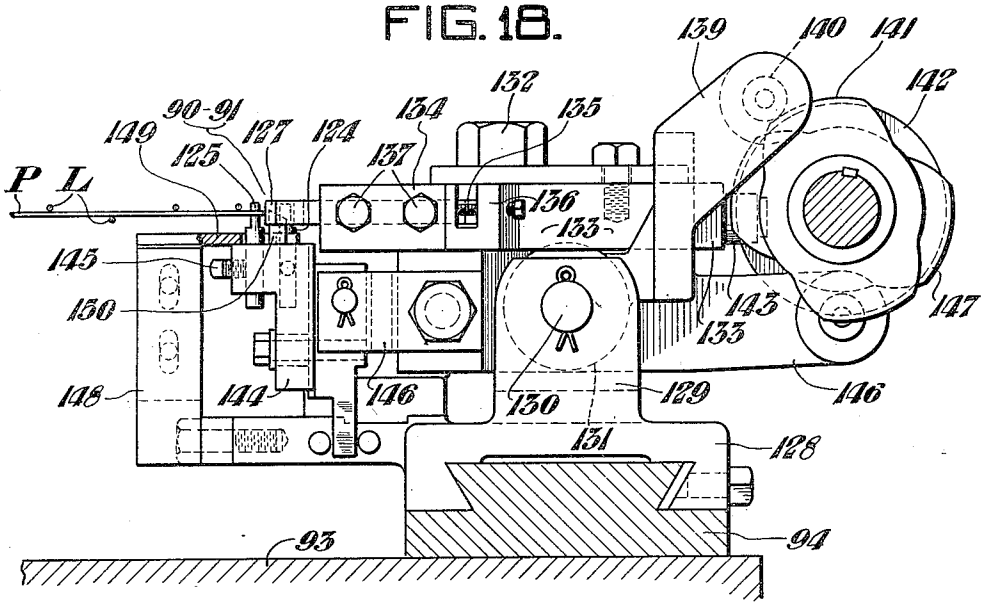
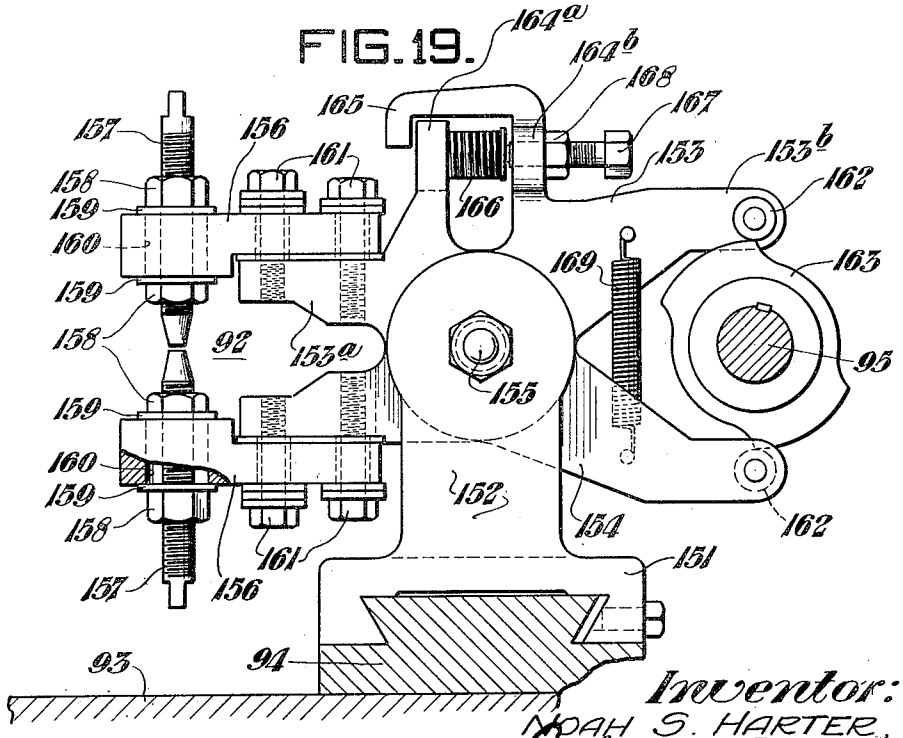


FIG. 19.



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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

Filed Oct. 13, 1938 18 Sheets-Sheet 15

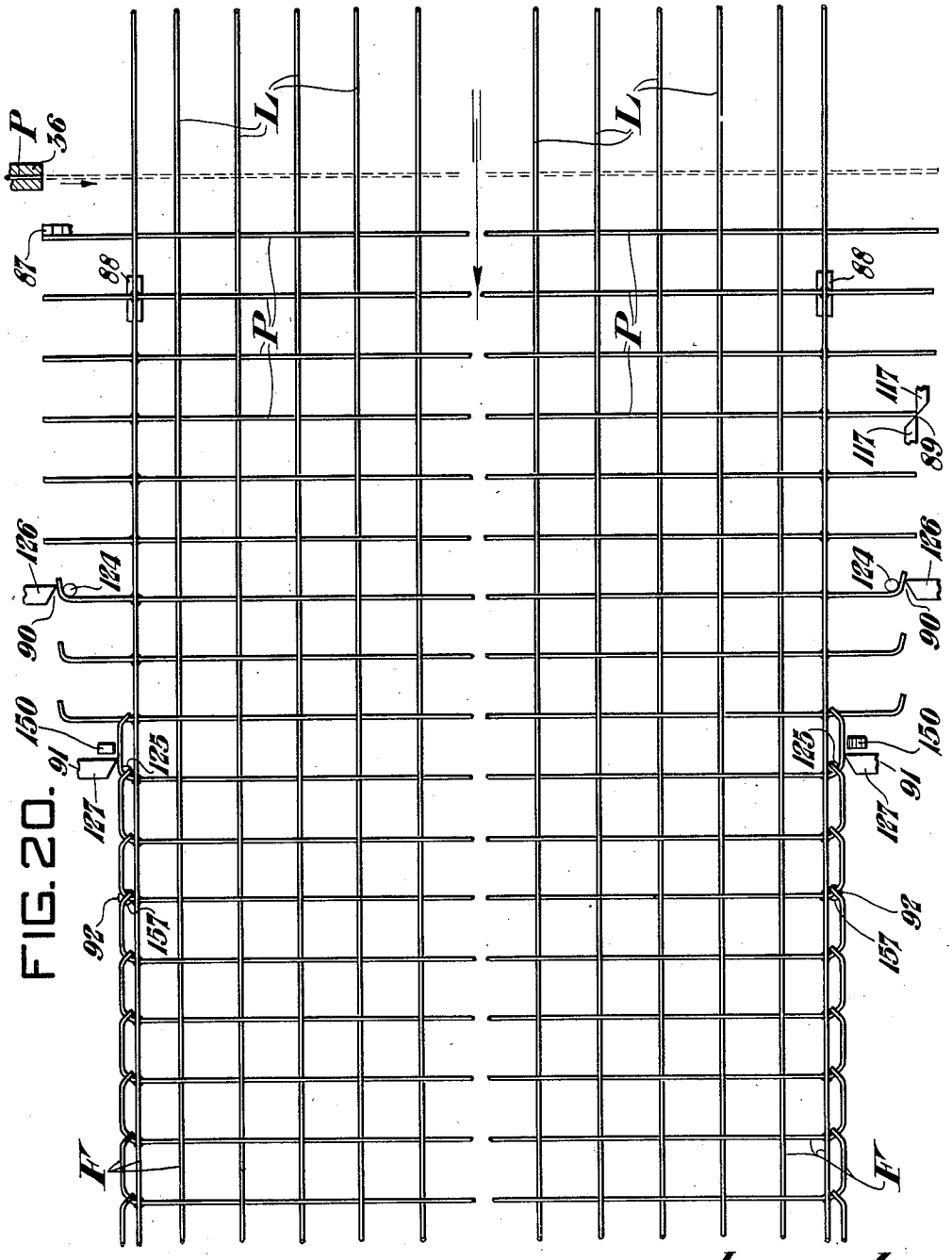

FIG. 20.

Inventor:
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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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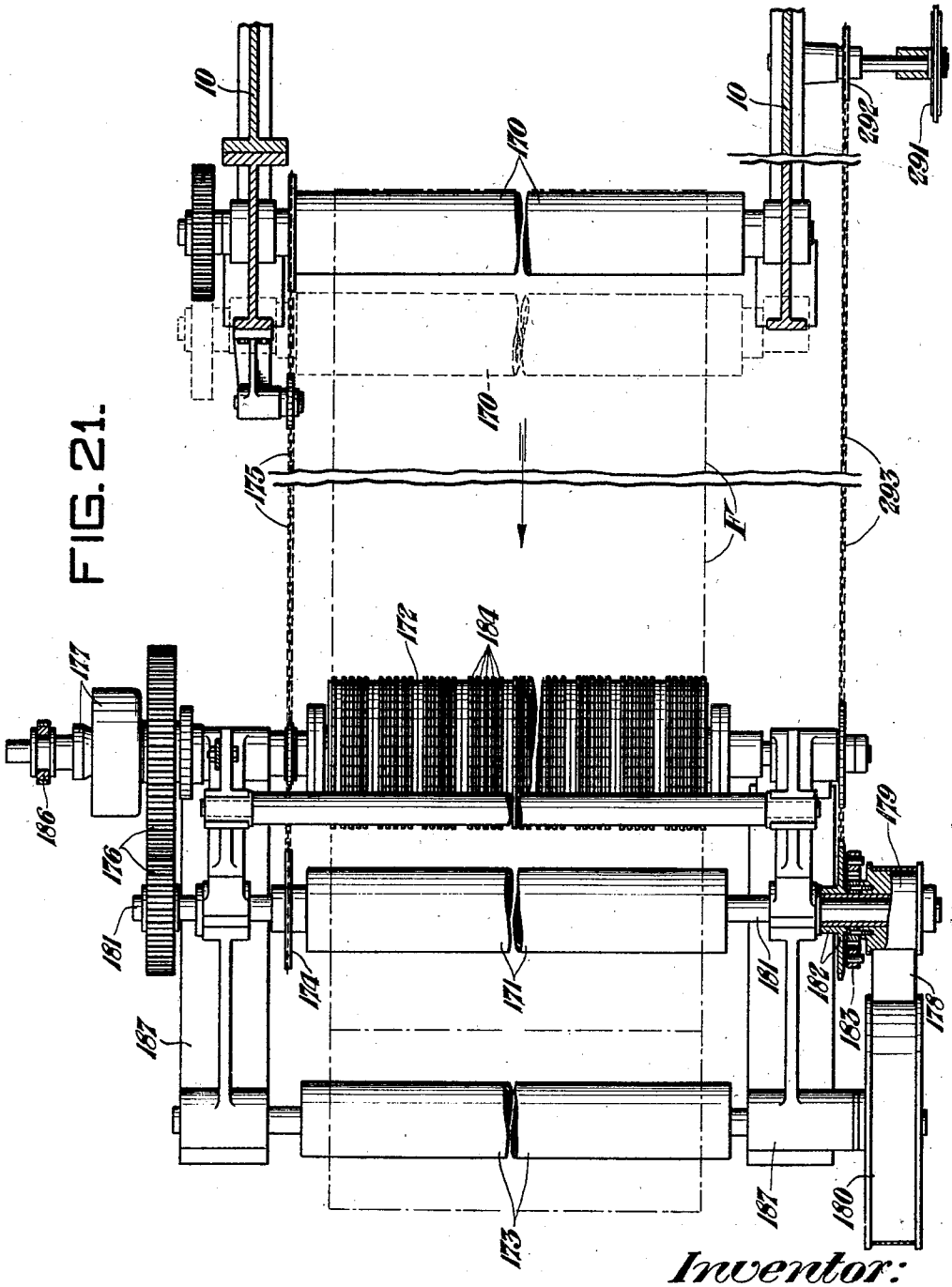
FIG. 21.



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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

Filed Oct. 13, 1938 18 Sheets-Sheet 17

FIG. 23.

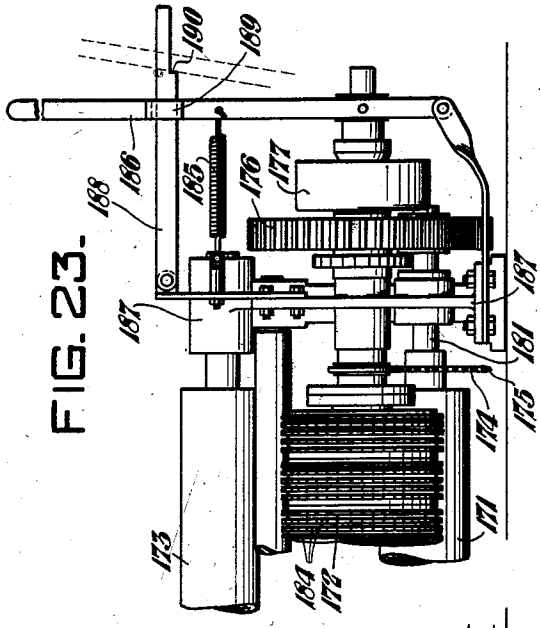


FIG. 22.

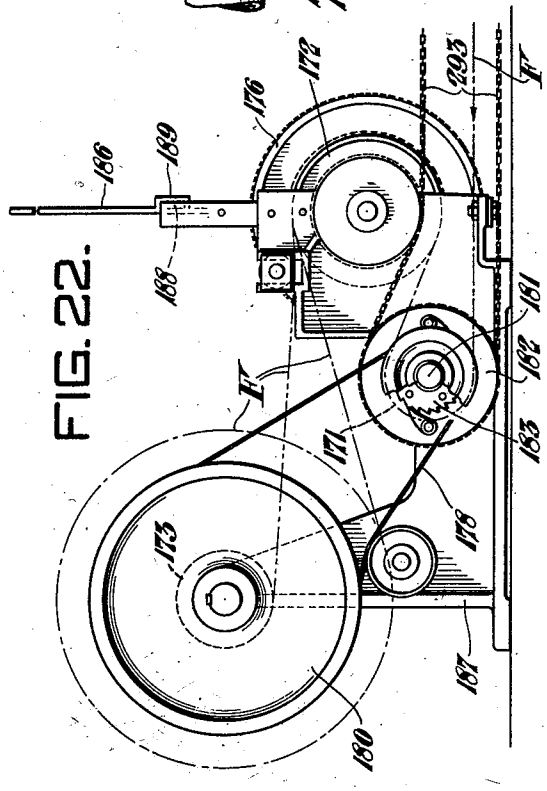


FIG. 25.

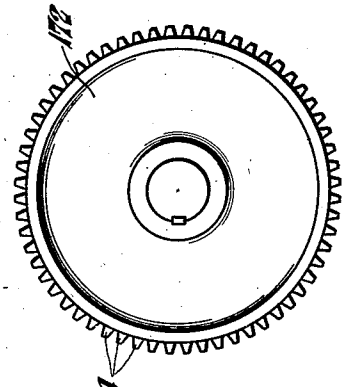
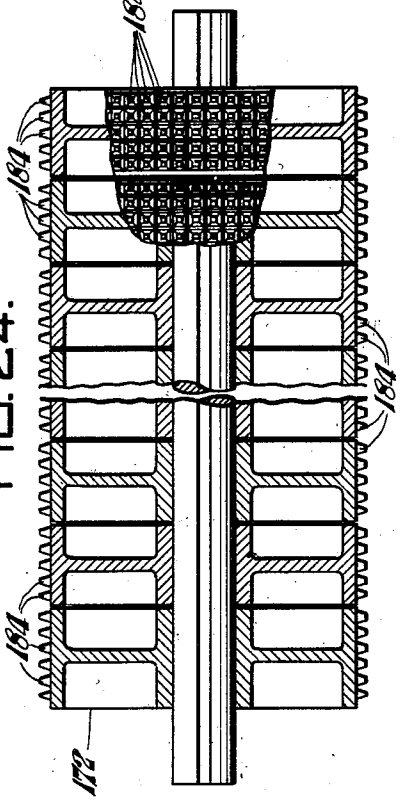


FIG. 24.



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Nov. 21, 1944. N. S. HARTER 2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

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FIG. 26.

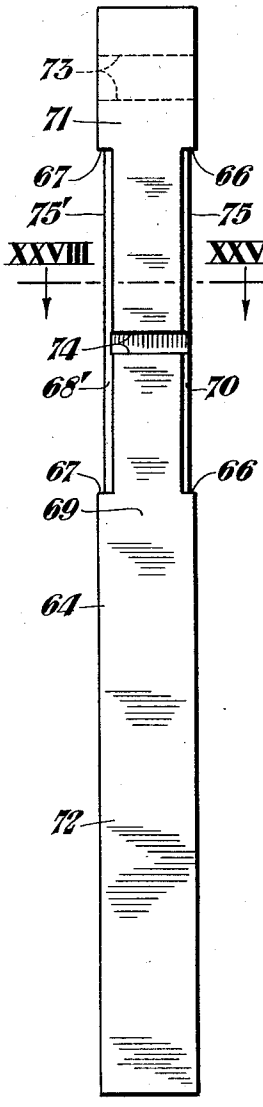


FIG. 27.

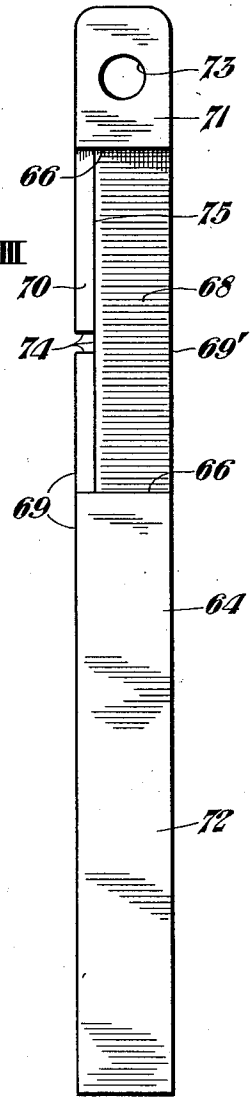
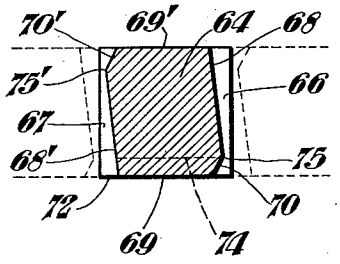


FIG. 28.



Inventor:
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Patented Nov. 21, 1944 2,363,415

UNITED STATES PATENT OFFICE

2,363,415

HARDWARE AND SCREEN CLOTH MACHINE

Noah S. Harter, Waukegan, Ill., assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey

Application October 13, 1938, Serial No. 234,853

13 Claims. (Cl. 139—11)

This invention relates to machines for making wire into fabrics, and, more particularly, relates to looms, and to novel processes and instrumentalities inherent therein, for making hardware and screen cloth fabrics; more especially, fabrics of the type shown in United States Patent No. 2,024,796, issued to me on December 17, 1935.

As was pointed out in my previous patent, above identified, machines of the class to which the present invention pertains, heretofore provided for the continuous feed of warp wires through heddles and for the interweaving of weft wires with the warp wires by feeding the weft on bobbins and shuttles back and forth between alternate warp wires during the operation of the heddles to effect the warp shed.

In such machines of the prior art the weft wires were positioned in the bite of the warp shed by means of a beater frame carrying a reed through which the warp wires passed, that served to push the weft wires, which were laid thereagainst, into proper position.

As is now well known, the weft wires in such a machine were introduced in the warp shed by means of a shuttle arrangement carried by the beater frame in close proximity to the reed thereof. The weft wire supply was spooled on a bobbin which was arranged to be transferred back and forth to the opposite ends of the beater frame each time the heddles shifted to change the warp shed. Before the return of the bobbin, during the next cycle of operation, a retractable finger was disposed in the path of the wire adjacent the selvage of the fabric being formed which served to retain the wire at this point, and upon the return movement of the bobbin, permitted the wire being paid therefrom, to be laid in parallelism with the preceding weft wire, and joined to the latter by a hair-pin curve at the selvage. This operation was carried on to lay the weft wire in endless serpentine form back and forth between the warp wires until the weft wire supply on the bobbin was exhausted.

It then became necessary for a full bobbin to be substituted for the exhausted bobbin, and this, in turn, required that the machine be shut down and that the end of the new supply be spliced or welded to the end of the weft wire of the old supply. This operation, in addition to causing an unsightly defect at the joint of the weft wires in the fabric, was particularly undesirable in view of the number of times it had to be done during any substantial operating period of the machines. The frequency with which bobbins had to be replaced was directly proportional to the size of the fabric being made; the larger the fabric mesh, the heavier the component wires thereof, and a corresponding diminution of the linear length of the weft wire supply that could be accommodated on an ordinary bobbin. Machines made of larger and heavier construction so as to admit of the use of larger bobbins, proved to be impracticable because they were slow, cumbersome, and expensive.

As was also mentioned in my patent, above identified, the limitations imposed upon the amount of weft wire that could be supplied by the bobbin and shuttle method of feed could not be circumvented until the source of supply was disassociated from moving parts of the machine, and placed in stationary relation to the moving parts, whereby much larger supplies could be accommodated, and replenished from time to time, without requiring that the operation of the machine be interrupted.

Such an arrangement for feeding weft wire would offer the same conveniences in continuity of operation and perfection of finished fabric as are now derived from the method of feeding warp wires to such looms. Even more desirable does such an arrangement become in view of the fact that it would tend to eliminate the bobbin and shuttle arrangement, which has hitherto been the seat of many structural elements and mechanical movements. Bobbin and shuttle mechanisms, though having been in use on looms for time immemorial, bespeak their antiquity by the slow, relatively inefficient, and costly manner in which they operate, and by their initial expense which their special, highly complex, structure entails.

Fabrics made by the bobbin and shuttle method were often imperfect, not only because of the prevalence of weft wire joints appearing at random throughout the weave of the fabric, but because the looms on which they were made were frequently incapable of manufacturing a fabric of uniform mesh having the wires arranged in symmetrical association.

It is, therefore, an object of the present invention to provide a loom of the class described of greatly simplified construction, wherein the weft wires are introduced to the warp wires from a stationary supply depot, separate and apart from the moving elements of the loom.

It is another object to introduce weft wires into association with warp wires in a loom mechanism without employing bobbins and shuttles for this purpose.

It is still another object to provide a loom having means for receiving, holding and delivering weft wires into accurate association with warp

wires, and for retaining the weft wires in proper position until they are locked permanently in the fabric.

It is a further object to provide a loom having means for introducing weft wires from an endless source of supply and for cutting and arranging each weft wire in proper relation to the warp wires so that each is separate and distinct from the others in the finished fabric.

It is a further object to provide a loom for making wire fabric of the class described with welded selvages thereon.

It is a further object to provide a loom that is adapted to supply weft wires from an endless supply; for cutting the wire from the supply into exact predetermined length, and for automatically forming the ends of such cut wires into a desired selvage configuration.

It is a further object to provide a machine of greatly simplified construction which will manufacture fabrics of this type efficiently, economically, and with great uniformity of mesh, symmetry of design, and with fidelity of reproduction.

It is a further object to provide a machine for automatically assembling, cutting to size, forming and welding wires into hardware or screen cloth fabrics.

It is a further object to provide novel instrumentalities, methods of operation and methods of processing wires into fabric to achieve the desired ends hereinbefore and hereinafter set forth.

With the foregoing, and ancillary objects in view, I propose to effect one embodiment of my invention as follows:

In my prior patents, Nos. 2,056,851 and 2,091,229, dated October 6, 1936, and August 24, 1937, respectively, I have disclosed looms of the same general type to which the present invention pertains. However, the present invention has many features of improvement over the machines disclosed in my prior patents, as will be readily apparent when the drawings appended hereto are considered in the light of the following specification.

As in the case of my prior patents, warp wires are fed through suitable guides and tensioning devices to heddles, comprising the usual pair of vertically reciprocable frames, each of which has means for engaging alternate warp wires respectively. The heddles are actuated to provide the warp shed so that the weft wire may be interwoven with the warp wires to form the completed fabric. However, instead of the bobbin and shuttle means employed in the looms disclosed in my prior patents, above referred to, the present invention contemplates the introduction of the weft wire to the warp wires from a stationary supply depot from which it is pulled by suitable means; the same means also being effective to push the weft wire, in conjunction with suitable guides adjacent to, and on the beater frame, into proper association with the warp wires at the shed of the latter. As will hereinafter be fully described, weft wires positioned in this manner are then passed by several means which successively act upon the weft wire ends to trim them, bend them into proper form, and weld them, in an automatic manner, without at any time causing the longitudinal feed of the warp wires and fabric to stop or even hesitate. Thereafter the fabric is passed on to a take-up or reel of special design, as will be more fully described hereinafter.

The refinements of construction and detail of operation characterizing the present invention, though not touched upon in the foregoing general outline, will be clearly understood from the following description when read in conjunction with the accompanying drawings, in which:

Figure 1 is a top plan view of a machine or loom embodying one form of my invention showing the entire lay-out except the fabric take-up.

Figure 2 is a side elevational view thereof.

Figure 3 is a sectional elevational view taken along line III—III of Figure 1.

Figure 3*a* is a sectional elevational view of the fabric take-up which is positioned relative to the machine at the lower left-hand corner of Figure 3; the section of Figure 3*a* being taken along a leftward extension of line III—III of Figure 1.

Figure 4 is a side elevational view taken from the opposite side to that shown in Figure 2.

Figure 5 is a sectional plan view taken along an irregular line V—V of Figure 2.

Figure 6 is a cross sectional elevational view taken along line VI—VI of Figure 2, and looking in the direction of the arrows.

Figure 7 is a cross sectional elevational view taken along an irregular line VII—VII of Figure 2.

Figure 8 is an enlarged fragmentary, longitudinal, sectional view showing several details of construction of the beater frame and associated actuating mechanisms.

Figure 9 is a fragmentary, sectional, elevational view taken along line IX—IX of Figure 8.

Figure 10 is a fragmentary, sectional, plan view taken along line X—X of Figure 9.

Figure 11 is a fragmentary view showing in sectional elevation, several details of the construction of the warp wire tensioning mechanism.

Figure 12 is a sectional view taken along line XII—XII in Figure 11 and looking in the direction of the arrows.

Figure 13 is an enlarged sectional view taken along line XIII—XIII in Figure 11, looking in the direction of the arrows.

Figure 14 is a detail top plan view of the right-hand unit for shearing, bending and welding the weft wires to form the selvage of the fabric.

Figure 15 is a side elevational view of the unit shown in Figure 14.

Figure 16 is a sectional view taken along line XVI—XVI in Figure 15.

Figure 17 is a sectional view taken along line XVII—XVII in Figure 15 with parts broken away.

Figure 18 is a sectional view taken along line XVIII—XVIII of Figure 15.

Figure 19 is a sectional view taken along line XIX—XIX of Figure 15.

Figure 20 is a schematic plan view showing a fragmentary portion of the finished fabric, and the various steps comprising its process of manufacture, including its formation and subsequent evolvement.

Figure 21 is an enlarged fragmentary top plan view of the fabric take-up mechanism which is shown in sectional elevation in Figure 3*a*.

Figure 22 is a side elevational view of the device shown in Figure 21.

Figure 23 is a fragmentary front elevational view of the far end of the device as shown in Figure 22.

Figure 24 is a broken mid-sectional view of the sprocket drum employed on the take-up device.

Figure 25 is an end elevational view of the sprocket take-up drum shown in Figure 24.

Figure 26 is a front elevational view of a reed dent, made according to the invention, shown in enlarged detail.

Figure 27 is a side elevational view of the device

shown in Figure 26, as viewed from the right-hand side thereof; and

Figure 28 is a sectional view taken along line XXVIII—XXVIII, Figure 26.

Referring now more particularly to the drawings in which like reference characters refer to like parts throughout, a brief description will first be given of the general assembly and functional relationships of the several main parts of the machine, leaving the more detailed description for later.

As viewed in Figures 1, 2 and 3, the warp or line wires L are introduced to the machine in substantial parallelism from a supply depot (not shown) positioned to the right-hand side of these views. The warp wires are passed through driven feed rolls 1, compensating tensioning rolls 5, on to the heddles 222, which effect the warp shed to provide for the admission of weft or picket wires P.

With particular reference to Figures 1 and 7, the weft wires P are introduced into the warp wires L by pinch rolls 35, and are guided and positioned in the fabric by a beater frame and reed assembly 65.

Thus is formed the fabric F, which, at this stage, is unfinished, requiring treatment upon its edges to provide the desired selvages thereon. This latter operation is accomplished by the mechanisms 88—92, inclusive, appearing generally in Figures 1, 2 and 3, and shown in enlarged detail assembly in Figures 14 and 15. By these units, each of the selvage edges of the fabric is formed and welded simultaneously to complete the fabric (see Figure 20), which then passes on through driven feed rolls 170, as best appears in Figure 3, to the take-up mechanism, illustrated in Figure 3a. This latter view represents a continuation, at the left-hand end, of the view in Figure 3, and is shown in the enlarged detail views of Figures 21–25, inclusive.

Warp Feed and Control

It will be seen from this general outline that the warp wires L are, in effect, continuous from the time they leave the supply depot (not shown) until the time they are wound on the take-up reel as part of the fabric F. It will be appreciated that it is necessary to maintain these wires under constant substantial tension in order that the fabric will be well formed, tight and symmetrical. This presupposes that at no time during the operating cycle of the machine will these wires be relieved of tension until they are wound on the take-up reel as a part of the finished fabric. It will also be appreciated that the operation of the heddles, in effecting the warp shed, tends to cause recurrent periods of slack in the warp wires as they are deflected from the plane of the fabric to the extreme position of the warp shed. Means are provided to compensate for this varying position of the warp wires whereby they are always maintained under a substantially constant amount of tension.

The means whereby this is accomplished are in the form of the compensating tensioning rolls 5, which, together with certain features of control that are associated therewith, have been shown and described in my Patent No. 2,056,851, dated October 6, 1936, but which will be briefly described hereinafter.

The warp wire feed rolls 1 are frictionally driven two to three percent. faster than the fabric feed rolls 170, to the drive of which they are coordinated through a worm gear 2, a worm 3 and a shaft 4. There are several reasons why this over-drive of the feed rolls 1 is necessary, one of these being that the introduction of weft wires into interwoven relation with the line wires tends to effect an increment of take-up in the length of the latter, by causing them to assume a serpentine disposition, as against their former straight disposition before becoming a part of the fabric. This means that the linear amount of warp wire advanced to the fabric forming devices must be somewhat in excess of any unit length of fabric issuing therefrom; hence, the feed rolls 1 are slightly over-driven to allow for this.

The over-drive of these rolls is also required to provide sufficient lengths of warp wire for the actuation of the heddles 222; but, as has already been indicated, the compensating tensioning rolls 5 serve to keep any intermittent slack, which would result from the over-drive and actuation of the heddles, from setting up in the wires. The compensating rolls 5 also serve to coordinate the functions of the feed rolls 1 and 170, whereby neither the wires nor the fabric are at any time subjected to too great a tension.

The compensating function of the rolls 5 may best be understood by reference to Figures 2, 11, 12 and 13, wherein it will be seen that they comprise a pair of idle rolls 6 and 7, which extend across the machine between the opposite side frames 10 thereof. At each of their ends they are journaled, respectively, in upstanding journal plates 8 and 9, which, in turn, are journaled in pivoted relation, as at 11, to each of their respective side frames 10. The journal plate 8 is provided with a horizontally disposed extension 12 to which is pivoted a bifurcated arm 13, which extends along and beyond the end of the extension 12 in straddled relation thereto. The bifurcated arm 13 and the extension 12 are secured together by a connecting rod 14, which extends from the end of the extension 12 and passes upwardly through a bearing plate 15, which bridges over and connects the opposite side portions of the bifurcated arm 13. About the connecting rod 14 is disposed a compression spring 16 which is adapted to bear upon the bearing plate 15 with a degree of tension that may be varied by a nut 17, threaded on the end of the connecting rod 14.

This assembly, last described, is such that the compression spring 16 normally tends to keep the extension 12 and the bifurcated arm 13 in substantial parallelism, and so that any motion imparted to the one will tend to be transmitted to the other. The end of the bifurcated arm 13 is provided with a roller 18 which rests upon a cam 19 that is carried by a shaft 211, which is the same shaft that actuates the beater frame, whereby the movements of the arm 13 are coordinated with the movements of the latter, and the tensioning rolls 5 are made to tension the warp wires W, while allowing for the heddle motion and the interweaving of the weft wires P. The means whereby this allowance is effected will now be described.

Pivoted to the bifurcated arm 13 is a trip-lever 20 which projects downwardly therefrom, and has secured to its lower extremity a connecting rod 21, as is shown in Figures 2 and 11, which rod 21 extends down to connect with a bell-crank 22 that carries a yoke 23 adapted to actuate a clutch 24 against the tension of a spring 25. The shaft 4 is powered through the clutch 24.

The trip-lever 20 is provided with a trip ex-

tension 26 which rests upon a lug 27 on the extension 12. This arrangement is such that, depending upon whether the arm 13 and extension 12 separate against the compression of spring 16 in response to motion of the cam 19 (as will be done when the warp wire tension is sufficient), or remain in parallelism (as when wires are slack) for movement by the cam in unison, the clutch 24, through the trip-lever 20, the connecting rod 21, bell-crank 22, and yoke 23, will remain closed to perfect the drive to the warp feed rolls 1 through shaft 4, or be opened to interrupt the same, respectively. In this manner, correct tension of the warp wires is always maintained, as is more fully described in my prior patent referred to above.

Weft Feed

As has already been indicated, the weft wire is drawn from an endless supply and pushed into association with the warp wires at the warp shed by means of pinch rolls. By this arrangement, as will appear more fully hereinafter, it is possible to maintain a supply of weft wire that is substantially continuous throughout any desired operating period of the machine in precisely the same manner as the warp wire supplies are maintained.

The principal instrumentalities for effecting the weft feed and association are two: (1) the pinch rolls and associated guide elements that appear in Figures 1, 4, 6 and 7; and (2) the beater frame and reed assembly which receives the weft wire from the pinch rolls, and, after shearing, advances it to the proper position between the warp wires. The construction and operation of these two principal parts of the weft feed will now be described in the enumerated order.

In Figures 1, 4, 6 and 7, there appears a reel 28 for supporting a coil S of weft wire, above which is disposed a bracket 29 (Figure 7), constituting an extension 30 of the pinch roll housing, which accommodates weft wire guide rolls 31, a snarl switch 32, straightening and tensioning rolls 33, whereby the weft wire P is conducted down to the stationary entrance guides 34 of the first set of two pairs of pinch rolls 35. Since the weft wire is delivered from stationary guides 36 into a guide 37 (see Figures 8, 9 and 10), that is an integral part of the reed 65 of the beater frame assembly, and since this latter must periodically be oscillated to dispose the weft wire fed thereto into the bite of the warp wires, it is necessary to provide for the intermittent feed of the weft wire so as to confine its feed to such times when the beater frame is in position to receive it.

The intermittent feed of the weft wire is effected by making the upper and lower sets of feed rolls 35 relatively movable. The lower set is mounted and stationarily journaled, as will best appear in Figure 7, whereas the upper set is journaled in bearings which may be raised and lowered by a yoke 38 that is actuated by a connecting rod 39 extending from a driven crank 40.

From the foregoing it will be seen that when the upper set of pinch rolls is at its lowermost position, it causes the wire to bear against the lower set of pinch rolls which is driven through sprockets 41 and a chain 42, shown in Figure 6. This causes the wire to be advanced into the machine proper. By this arrangement it is unnecessary to interrupt the drive to the lower pair of pinch rolls, and, accordingly, they are kept rotating at a constant speed whether the wire is being advanced or not.

To insure against the wire's being disfigured or broken by the sudden jerk that necessarily occurs when the moving pinch rolls are brought into frictional engagement therewith, much precaution is taken to reduce the inertia and frictional drag of the stationary wire. For this reason, the reel 28 for supporting the weft wire supply coil S is constructed and arranged whereby it can be driven at any speed within reasonable limits which the operating conditions seem to require, as will now be explained.

As will be seen in Figures 6 and 7, there is depending in driven relation to the pinch roll drive mechanism, a stub shaft 43 accommodating a split cone pulley 44, the complementary cones of which are urged toward each other by the expansive force of a compression spring 45, which force is variable by the adjustment of a nut 46. This split cone pulley constitutes the driving element of a belt drive 47 for frictionally rotating the reel 28, which has its base fashioned in the form of a belt pulley 48. The reel is journaled for rotation on a vertical stub shaft 49 which is supported by the free end of a swingable arm 50 carried by a standard 51. This means that the axis of the reel is disposed in eccentric relation to the axis of the standard whereby, upon oscillating the swingable arm, the reel may be moved toward or away from the split cone pulley 44 to vary the distance therebetween. A belt 47 is disposed about the split cone pulley and the reel pulley 48, whereby the latter may be driven as the former rotates.

The portion of the swingable arm 50 disposed upon the standard is provided with a radial lug 52 against which a set screw 53 carried by the standard 51 is adapted to bear. By setting the screw, the reel may be adjusted to the proper distance from the split cone pulley. It will be understood that by adjusting the reel in this manner, the belt is tensioned or relieved of tension, which varies the effective diameter of the split cone pulley, whereby the reel is caused to move faster or slower, depending upon the nature of the adjustment. In this manner an ample amount of weft wire is kept paid off of the reel in synchronism with the operation of the pinch rolls, whereby the requirements of the latter are satisfied without there being an excessive amount of drag on the wire.

The snarl switch 32, mentioned above, which is shown in the upper left-hand corner of Figure 7, comprises a movable segmental wire guide frame 54, provided with a plurality of guiding rollers 55, which is complementary to the stationary segmental wire guide 29 to which it is secured by toggle arms 56. A spring 57 tends normally to maintain the movable element 54 in horizontal alignment with its stationary complement 29. Should the wire on the reel become tangled, the continued actuation of the pinch rolls would tension the wire to cause the movable element 54 to be drawn downwardly against the force of the compression spring 57. This movement of the element is caused to actuate an electric circuit-closer (not shown) through which various relays are energized to stop the operation of the machine before the weft wire can be broken.

Beater Frame

As has already been mentioned, the introduction of the weft wire between the warp wires,

and the moving of the former into proper position relative to the latter, are accomplished by the beater frame and reed assembly. The means for performing this function will be understood by referring to Figures 3, 7, 8 and 9; particularly, with reference to the latter two figures, which show enlarged detail views of the parts under discussion.

The weft wire P is pushed by the pinch rolls **35** through the stationary wire guides **36** leading up to the beater frame. The reed **65** of the beater frame assembly is provided with a weft wire receiving slot **37**, which aligns with the stationary guide **36** when the beater frame is at the rearmost position of its oscillatory cycle of movement. Into this slot **37** the weft wire P is pushed across the reed **65** for a distance greater than the entire width of the fabric. The beater frame has instrumentalities for positively holding the weft wire in the reed **65** thereof during the movement of the frame forwardly to position the weft properly with respect to the warp wires, and for remaining in this position until the heddles **222** have been reversed to cause the warp wires to engage and firmly hold the weft wire. The details of the beater frame and reed assembly will now be described.

It will be seen by reference to Figures 8, 9 and 10, that the beater frame comprises two rocker frames **58** and **59**, each of which is pivoted on a trunnion bearing **60** and **61**, respectively, on the side frames **10** of the machine, opposite to the other. The rocker frames are connected to each other by a cross bar **62** which is provided with an offset portion **63** to give end bearing to the dents **64** constituting the reed **65**.

The dents comprise integral bars of special configuration, which, with the exception of the end dents, are identical, whereby a description of one would suffice for all. With reference to Figures 26, 27 and 28, it will be seen that a dent is an elongated rectangular solid which has been provided with cut-away portions **66** and **67**, intermediate its ends on two opposite sides. According to the invention, these cut-away portions are such as to impart to the otherwise rectangular section of the dent a hexagonal shape (see Figure 28), in which four of the six sides are of much greater dimension than the remaining two sides, and in which the pairs of opposed greater sides **68—68'** and **69—69'** are in substantial parallelism, respectively, leaving the two lesser sides **70—70'** likewise in parallel opposition.

The end portions **71** and **72** of each dent retain the rectangular cross section, and at the upper end of each dent, through the section **71** thereof, there extends, in transverse relation to the dent, an aperture **73** for purposes that will presently appear. Each dent is also provided with a square notch **74** which extends across the front side of the dent between the cut-away side portions thereof, into each of which the opposite ends of the notch respectively open.

Figure 9 shows how the dents are assembled to stand on end on the offset portion **63** of the cross member **62** to form a panel, and how the cut-away side portions **66—67** of adjacent dents register to form slots across the panel as is customary in the design of reeds for looms. The uncustomary features about this reed panel are the transverse notches **74** in the front face of each dent which align to form a groove **37** that is coextensive with the length of the reed **65**; and the cut-away side portions **66—67** imparting the hexagonal section to each dent, which, it will be seen from Figure 10, cooperate to form somewhat large, tortuous wire slots through which slack wire may be fed with facility but which, by virtue of the offset wire bearing portions **75—75'**, snugly engage the wire to prevent lateral displacement thereof when the latter is under tension.

The dents **64** comprising the reed panel **65** are secured to the cross member **62** by a long clamp **76**, which is removably bolted to the cross member to admit of the adjustment, removal, or replacement of one or more dents, and at their upper extremity are bound securely together by a tie rod **77**, which extends through the transverse apertures **73** adjacent the top of each dent and which align with each other in the assembled panel to afford a passageway for the tie rod.

As may have been surmised, the panel groove **37** formed by the registering dent notches **74** comprises a guide for receiving and holding the weft wire as it advances from the pinch rolls **35** through the stationary guide **36**. Since this is necessarily an open groove to permit the weft wires to be discharged when finally brought into proper position, a retractable closure for this groove must be provided. To this end, a hollow box section **78** of a length commensurate with that of the reed panel **65** is arranged to bear upon the front face thereof so as to lie substantially parallel with the weft wire panel guide groove **37**. It is retained in this position by a plurality of retaining irons **78a** that are secured to the cross bar of the beater frame, and is further retained by a plurality of downwardly depending connecting rods **79**, which, at their upper ends, are secured by fastenings **80** to the box section, and at their lower ends are carried by a rocker shaft **81**. This rocker shaft is supported in front of, and substantially parallel to, the cross member **62** by means of a plurality of levers **82**. The levers are, in turn, journaled on a shaft **83** carried in bearings **84** formed beneath and as a part of the cross member.

From this it will be seen that oscillation of the levers about the fixed shaft **83** will, through the rocker shaft **81** and connecting rods **79**, cause the box section **78** to slide up and down the front face of the reed panel **65**. This is accomplished by a connecting rod **85** that links the rocker shaft **81** with cams **256**, as will be described in detail hereinafter, which are coordinated with the other moving parts of the machine to effect the opening and closing of the weft wire panel guide groove by means about to be described.

Again referring to Figure 8, it will be seen that there is rigidly secured to the top of the box section, so as to be substantially coextensive therewith, an elongated angle member **86** which has one of its sides secured to the top of the box section, and the other of its sides in sliding engagement with the front of the reed panel. This latter side of the angle member is provided with a plurality of slots which correspond to and register with the slots in the reed panel in order to afford clearance for the warp wires passing through the latter when the angle member is moved upwardly into the plane thereof. The relation of parts is such that when the box section is moved through means of the connecting rods **79** and **85**, the angle member will, at the upper limit of such movement, extend to overlie the weft wire panel guide groove **37**, and, at the lower limit of its movement, will be withdrawn sufficiently completely to uncover the groove.

By virtue of the fact that this construction

eliminates the bobbin and shuttle, which used to be employed to lay the weft wire into association with the warp wires, and which required that the wires be separated by the heddles a substantial distance to permit the bobbin and shuttle to pass therebetween, the warp wires now need to be separated only a relatively slight distance in forming the shed. Likewise the beater frame, which formerly had to be oscillated from the line of convergence of the warp wires back to a position sufficiently remote from the latter where sufficient spacing between the warp wires was had to allow for the passage of the bobbin and shuttle therebetween, now only needs to be moved a relatively short distance to the point where the warp wires are but sufficiently diverged to accommodate a wire of their own diameter. In practice, however, as will be seen in Figure 8, the actual clearance allowed is somewhat in excess of this, although still far less than that which had to be provided in the machines employing the bobbin and shuttle type of weft wire feed.

Among the advantages of the new construction are: (1) the material reduction of motions in the operating cycles of both the beater frame and the heddles; (2) a corresponding reduction in the amount of deflection in the warp wires; and (3) the minimizing of the space required for the operation of these elements by the reduction of motion, rendering the machine considerably more compact and capable of being accommodated in less floor space than in the case of the older machines. In addition to conservation of floor space in a longitudinal direction, the machine of the present invention, by obviating the bobbin and shuttle construction, has done away with the sizeable lateral extensions that projected from each side of the beater frame constituting tracks upon which the shuttle rode, which greatly increased the lateral space requirements of the old machines.

Attention is called to the cams **221** shown in Figure 8, also appearing in Figure 2, by which the beater frame is oscillated to position the weft wires in the warp wires. These cams are provided in place of the cranks commonly employed to actuate the beater frames in looms of the prior art. Such cranks were objectionable in that they failed to provide for the positive retention of the weft wire until the warp wires could be shifted by the heddles the distance necessary to grip and hold the weft wire in position. In short, there was no dwell in the operating cycle of the beater frame whereby the latter would hold the weft wires in their forwardmost position until the warp wires could be moved to lock the same.

The cams **221** of the present invention advance and hold the reed **65** of the beater frame firmly against each of the weft wires it delivers into the bite of the warp, holding it in this position until the warp wires are practically completely reversed in the shed to lock the weft picket in place. There is also provided another dwell in the cam **221** so that, when the beater frame is retracted to the opposite end of its oscillatory path, it will remain there a sufficient length of time to be charged with another length of weft wire from the pinch rolls, and stationary guides. The contour of the cams, in providing for the dwell of the beater frame in its forwardmost position, is such as will allow for the gradual advancement of the latter in unison with the uninterrupted advancement of the fabric, until the warp shed has been reversed to securely grip the newly deposited weft wire into position, where it remains.

Selvage Formation

After the weft pickets are laid in place by the beater frame and the web moves on beyond the latter, the fabric is complete with the exception of its selvages. The manner and means whereby the selvages are finished will now be described.

As has already been stated, weft wire is fed across the panel groove **37** in the beater frame reed **65** until it extends across and somewhat beyond the farthest warp wire. At this point, the weft wire feed is interrupted and the beater frame is advanced to install the weft picket carried thereby into the bite of the warp wires at the point of the latter's convergence. This movement of the beater frame is effective to shear the weft wire picket from the relatively endless source of weft wire supply. The shearing is accomplished, as will be seen in Figures 9 and 10, by means of a blade **87** secured to the end of the reed panel **65** that is adjacent the stationary weft wire guide **36** with which it closely cooperates. Movement of the beater frame moves the knife blade past the stationary guide and cleanly severs the weft picket carried by the beater frame from the supply end remaining in the stationary guide. This is diagrammatically represented in the upper right-hand corner of Figure 20, wherein is also shown the subsequent forming, bending and welding steps which are carried out simultaneously on each edge of the fabric by means about to be described.

Inasmuch as there are two complete units for working upon both edges of the fabric simultaneously, it will be convenient to establish at the outset which of these units is being referred to in the ensuing description. Therefore, the unit appearing below the center line of the machine in Figure 1 will be hereinafter referred to as the right-hand unit, and the one appearing above the center line of the machine in Figure 1 will be termed the left-hand unit. These designations are not arbitrary ones, but are determined by the position of the operator, who would stand to the left-hand end of the machine, as shown in Figure 1, facing in the direction from which the wires and fabric come.

Referring now to the detail views of Figures 14 to 20, inclusive, here is pictured the unit for completing the selvage of the fabric that is disposed at the right-hand side of the machine. This unit has been adopted for descriptive purposes since it is typical of the construction of both units, but has, in addition, a cutter for trimming the weft picket ends, which on the left-hand unit, by virtue of the shearing action between the reed and stationary weft guide, is not necessary. However, with this one exception, the two units are identical; it being understood, of course, that the elements of the left-hand unit are turned around to function in the opposite direction from those of the right-hand unit, illustrated in these figures.

Referring to Figure 20, it will be seen that the weft wires P leave the beater frame trimmed evenly on the left-hand side of the fabric, which is at the top of Figure 20, and somewhat raggedy at the right-hand side of the fabric, having been slightly overfed by the pinch rolls **35** to insure that a sufficient amount is provided to form the selvage. The web is advanced between electrodes **88**, two of which are respectively mounted over each of the outermost warp wires or selvage wires at each side of the fabric, and the other two of which are disposed in corresponding posi-

tions beneath the web. Thus is constituted the electrode-jaws, the right-hand set of which appears in Figures 15 and 16, which are arranged for intermittent closing and opening motion in the vertical plane of the outermost warp wire.

In this connection it will be noted that the outermost warp wire lies on top of all weft wires rather than being interwoven therein, as is the case of the intermediate wires. This is to make both selvages uniform and to provide a continuous shoulder, equal in heighth to the diameter of the constituent wires, against which the exposed end portions of the weft pickets can be disposed after formation, so that no sharp ends will be left exposed. It will be apparent that the selvage warp wires are arranged wholly on one side of the fabric, in the manner described, by simply by-passing them through the heddles, whereby they are not deflected from their horizontal plane of feed, as is required to effect interweaving.

After the warp selvages have been welded so as to tack the opposite marginal portions of the web together, and to anchor the intermediate wires into place, the web is then passed on to the forming devices. First, however, it is necessary for the weft picket ends at the right-hand side of the fabric to be cut off evenly so as to correspond to their opposite ends at the left-hand side of the fabric. It has already been indicated that this is only necessary at the right-hand side of the machine, and is effected by a shear **89**, as is schematically represented in Figure 20.

The web then passes by the first forming tools **90** whereby each end of each picket wire is simultaneously crimped, as shown in Figure 20. Thereafter, crimped weft pickets are bent into final position, as at **91**, as is also shown in Figure 20, after which they are finally welded as at **92**, and passed on to the take-up. The instrumentalities for thus treating the selvages of the fabric will now be described in greater detail, reference being first made to Figures 14 and 15.

As has already been indicated, the right-hand unit has been adopted for purposes of illustration, by reference to the drawings of which it will be seen that there is provided a table-like support **93** upon which is fastened the tongue element of a dove-tail slide bearing **94** which extends longitudinally of the machine. The various welding, shearing, and forming instrumentalities are provided with suitable mountings having the underside of their base portions provided with dove-tail grooves for cooperation with the longitudinal tongue on the table, as above described. This arrangement is provided in order to permit the several instrumentalities to be moved longitudinally of the machine relative to each other in order that fabrics of different size mesh may be operated upon.

As will more fully appear hereinafter, all of the instrumentalities comprising each of the welding, shearing, and forming units are operated from a common cam shaft **95** to which their respective cams are splined for adjustment axially of the shaft to correspond with any adjustment of the several instrumentalities for the purpose last described.

As has already been mentioned hereinbefore, the fabric is formed and completed without necessitating that either its forward movement, or the forward movement of the warp wires, be at any time interrupted. This means that the welding, shearing and forming of the selvages, which is effected by the devices about to be described, must operate upon the fabric while it is moving. This necessitates that these devices travel beside the fabric, at the same rate of speed, while they are operating thereon.

As will be brought out more fully when the operation of the machine is discussed hereinafter, the tongue elements of the dove-tail slide bearings **94** upon which the several devices are mounted, as set forth above, are themselves arranged upon a sliding table **93** which extends across the width of the machine, and is carried upon slide bearings **96** at each of the side frames **10** thereof. This table is adapted to be reciprocated in directions longitudinally of the machine through a sufficient distance to permit the selvaging devices carried thereby to complete their operation, while moving with the fabric, and, in a return direction, an amount sufficient to bring the devices into operable registration with the next succeeding picket wires upon which they are, respectively, to operate. This means that the operating cycle of movement of the reciprocating table carries it back and forth through a distance slightly less than the spacing between adjacent weft wires, as they are finally positioned in the fabric.

The tongue elements of the dove-tail slide bearings **94** are themselves arranged in slide bearings **97** along the table **93**, whereby the welding, shearing and forming devices may be moved transversely of the machine to provide for operating upon any width of fabric. The detail of the operation of the sliding table and the accommodation of fabrics different both in size of mesh and over-all width, will be explained in greater detail hereinafter when the operation of the machine is discussed.

The first instrumentality, in the order in which the web is presented, is the warp selvage welder **88** shown in Figures 14, 15 and 16, as comprising a mounting **98** with four bearings **99** in which a pair of shafts **100—101** are mounted so as to extend transversely of the machine. The shafts are spaced an equal distance above and below, respectively, the plane of the fabric to which they are substantially parallel. Since the precise thickness of the material to be welded which must pass between the electrodes **88** is indeterminable in advance, and may vary somewhat through any operating period, it is necessary for the positive cam action by which these electrodes are operated, to be applied in such a manner as to compensate for these variables.

To this end, adjacent to the outer extremity of each of the shafts is a free running collar **102**, within which the shaft may rotate, and to which may be imparted rotary or oscillatory motion independently of the shaft. Immediately adjacent the free running collar on each shaft is another collar **103** which is keyed to the latter so as to have no motion independently thereof. The free running collar is provided with a horizontally-extending radial lug **104** on the end of which is provided a roller **105** for engagement with an actuating cam **106** carried on the cam shaft **95**. The keyed collar **103** on each shaft is provided with a spring bearing extension **107**, a portion of which overlies the free running collar **102**. The near face of the radial lug **104** on the free running collar is arranged in substantial parallelism with the spring bearing extension **107** of the keyed collar, with which it aligns circumferentially of the shaft **100—101**. Between these parallel portions of the adjacent collars is disposed a compression spring **108** which transmits the motion of the cam **106** from the free running col-

lar 102 to the keyed collar 103, and hence to the shaft 100—101 on which the latter is secured. From the foregoing it will be seen that should anything prevent the shafts from rotating to the extent required by the cam, as would be the case if an unusually large wire or obstruction on the wire came between the electrodes 88, the compression spring 108 would insure the movement of the shaft to close the electrodes as far as possible, but would thereafter yield to provide lost-motion, and thus to compensate for the shaft's inability to rotate the full amount.

Each of the shafts is provided at its inner end with another non-rotative collar 109 to which a tangential extension 110 is rigidly affixed. The outer end of each tangential extension is provided with a contactor element 111 of the electrode, both of which are arranged in vertical alignment relative to each other. As the web advances, successive intersections between the warp selvage and picket wires are disposed between the electrodes, which are then moved by the cam mechanism, described above, into engagement with the wires at each side of the intersection thereof, to effect the weld. The welding circuit (not shown) is completed through the intersection of the wires by one side of the circuit being introduced through one of the electrodes, and by the other side of the circuit being introduced through the other electrode. The electrodes are preferably energized directly through the tangential extension and associated parts, which are usually formed of conductive metal, from which other parts of the machine are electrically isolated by insulative washers and bushings of any suitable form.

During the welding operation, the portions of the wires through which the current passes become red-hot, in which condition the ends of the picket wires are frequently subject to bending under their own weight. In order to preclude this happening, the tangential extension 110 of each electrode has secured to it on a face opposite to that of the contactor element 111, so as to extend parallel to the latter, a support guide 112 which is adapted to give the picket ends the requisite support during the application of the welding current in order to obviate the "wilting" of the latter. Since these support guides are usually of metal, care should be taken to provide for their being suitably insulated from the tangential extensions upon which they are respectively carried, as is shown in Figure 14.

To insure that the electrodes return to open position after a weld has been effected, a small spring 113 is provided to lift the upper electrode, as is shown in Figure 15, and a similar spring may be provided to control the lower electrode, although none has been illustrated because it has been found that this electrode will return by gravity during a recession of the cam 106.

After the warp selvages have been welded, as last described, the web advances to a shearing mechanism 89 which acts to trim evenly the ends of the weft pickets extending from the right-hand side of the web, as will now be described.

With reference to Figures 14, 15 and 17, and more particularly to the last named figure, it will be seen that the shears comprise an upper and a lower rocking-beam 114—115, which are mounted upon opposite sides of a horizontally extending pivot bearing 116, about which they are adapted to oscillate in scissors-like fashion. The shear blades 117 are removably secured to angle members 118—119, respectively made fast to the upper and lower rocking-beams. The outer end of these beams, which are preferably of bifurcated form, are provided with cam-engaging rollers 120 for engagement with the actuating cam 121 carried by the cam shaft 95, from which the upper and lower shear blades are opened and closed with respect to each other. The shear elements 114—115 are connected adjacent their cam-engaging extremities by means of a compression spring 122 extending between a pair of pins 123 which respectively bridge the bifurcated portion of each element. This spring functions to urge the shear elements against the actuating cam 121 so as normally to maintain the shear blades in open position. Each picket is introduced to the shear blades 117 while they are open, and remains therebetween until the cam has closed the blades to eliminate any overage in picket length.

The web then proceeds to the crimping and bending tool 90—91, shown in Figures 14, 15 and 18. A close inspection of the drawings will reveal that the crimpers 90 and the benders 91 are, in fact, a unitary compound tool which works simultaneously upon adjacent pickets. With the exception of slightly different placement relative to the pickets being worked upon, the crimpers and the benders work exactly the same; are mounted by the same elements, and are motivated from the same cams on the cam shaft.

With reference to Figure 18, it will be seen that the crimping and bending mechanism is divided into two main, separately controlled parts; namely, (1) the vertically-movable backing-up pins 124—125 about which the wires are formed, but which must be retractable to a position sufficiently below the plane of feed of the web to clear the same; and, (2) the horizontally movable fingers 126—127 which form the wire around the pins, and which, in addition to the horizontal motion required for this function, are adapted to be raised vertically to clear the web during their return horizontal movement. In other words, the fingers are made to describe a substantially vertical circular path, through the lower sector of which they are being moved toward their respective weft wires to form the same about the forming pins, as is schematically represented in Figure 20.

This compound tool is constructed and arranged in a mounting 128 providing bearings 129 for retaining a horizontal pivot shaft 130. Intermediate the ends of the shaft is secured a collar 131 adapted for pivotal movement about the axis thereof. Extending vertically from the collar in approximately a tangential, offset position is a vertical pivot bearing 132 on which is secured for horizontal oscillation the forming finger holder 133, which is provided with a slotted offset portion 134 for mounting the forming fingers 126—127. Adjusting screws 135 are extended from a lug 136 integral with the holder 133 for effecting the axial adjustment of the fingers, and set screws 137 are provided at each side of the slotted offset to provide for the lateral placement of the fingers, relative to the holder and to each other, in conjunction with shims or filler blocks 138.

The horizontally pivoted collar 131 is provided with an upstanding, rearwardly-extending arm 139, which is provided at its extremity with a cam-engaging roller 140 for engagement with a disc- or radial-cam 141 on the cam shaft 95 that controls the movements of the fingers 126—127 in vertical directions. The horizontally oscillating finger holder 133 receives its motion from a cylindrical—or axial—cam 142 carried by the cam shaft 95, which has its edge portions cut to the

requisite contour, and on each of which edges a horizontally journaled roller 143, secured to the rear face of the holder 133, is adapted to follow.

The relation between these two cams is such that, as viewed in Figure 14, when the radial cam 141 moves the fingers 126—127 downwardly into the line of the picket ends, the holder cam followers 143 are in engagement with that portion of the axial cam 142 which moves them, and the rear portion of the holder, as far to the right as possible, whereby the fingers, being on the opposite side of the vertical pivot 132, are moved as far to the left as possible.

While the radial cam 141 is of a contour to permit the fingers 126—127 to dwell momentarily in this lower position, the axial cam 142 causes the fingers to move rearwardly in the direction from whence the warp wires are fed. As will be presently explained, this motion causes the weft wires, which are positioned between the forming fingers 126—127 and the backing-up pins 124—125, to be crimped and bent, respectively; immediately following which, the radial cam recedes to permit the fingers to be lifted above the plane of the web, while the axial cam effects the horizontal return movement thereof.

A necessary complement to the forming motion of these fingers is that of the backing-up pins, which must be movable into the path of the wire to allow the fingers to crimp the same, but must be retractable from the path of the wire to allow for succeeding pickets to be advanced into forming position. With reference to Figure 18, it will be seen that both of the pins 124—125 are carried in a common, vertically-reciprocable support 144 in which each is removably secured by screws 145 in order that it may be removed or replaced.

Pivotally connected to the vertically-reciprocable support is the end of a rocker arm 146 which is journaled for oscillation about the axis of the horizontal pivot shaft 130, and which extends rearwardly to underlie a companion cam 147 adjacent to the radial cam 141 described above, having operating contours corresponding to the latter but offset about 60° therefrom. As has already been suggested, the operating period of the companion radial cam 147 is such as to position the pins 124—125 behind their respective picket ends as the adjacent radial cam 141 has moved the fingers downwardly into the plane thereof, and as the axial cam 142 causes the rearward movement of the fingers to bend and crimp the wires about the pins. As the vertical cam raises—and the cylindrical cam returns—the fingers, the pins are withdrawn to a point below the plane of the web, and the fabric continues on to the final welding electrodes which will presently be described.

Before leaving the subject of the crimping and bending instrumentalities, it should be noted that the backing-up pins are supported within a relatively stationary housing 148, as shown in Figure 18, which is secured to the stationary mounting 128 of this compound tool. The top portion 149 of this pin housing is perforated to permit the pins to be passed in and out thereof. It will be apparent that, if desired, the upper portion of this housing may constitute a guide for giving support to the selvages while they are being subjected to the forming operation. Since it is intended that the weft wire ends will all be disposed on the same side of the fabric after formation, as appears in Figure 20, it is desirable to provide a deflecting guide 150 in the form of an inclined plane adjacent the bending backing-up pin 125 which is effective in deflecting the wire ends upwardly out of the plane of adjacent weft wire ends into a position where they may be advanced to overlie the next succeeding pickets, where they remain. The deflection is accomplished by the bending finger moving the wire end over the relatively stationary inclined plane, which must be carried on the pin mounting 144 so as to be retractable therewith to a point below the advancing picket ends, at the conclusion of the forming operation.

After the picket wires have been formed into the selvage configuration in the manner just described, the fabric passes on to the final welders 92, the right-hand one of which is shown in Figures 14, 15 and 19. By this mechanism the crimp of one wire is welded to the bend of an adjacent wire to complete the fabric.

With reference to the enlarged detail view of Figure 19, it will be seen that each of these welders comprises a base 151 adopted for mounting on the dove-tail bearing 94, referred to hereinbefore, on which base is mounted a pair of upstanding pivot bearings 152, in which a pair of scissors-like rocker beams 153—154 is pivoted by means of a pin 155 that is secured in the bearings 152 in any suitable manner. To the inner extremity of each beam is secured an electrode mounting 156 in which an electrode 157 is adapted to be held for axial adjustment by means of nuts 158. The nuts, with the aid of washers 159, support the electrode in an enlarged opening 160 in the mounting 156, within which, by loosening the nuts, the electrode may be moved axially of the mounting to effect a refinement of adjustment in accurately locating the weld with relation to the parts to be welded. It will be apparent that longer or shorter electrode mountings 156 may replace the ones in use at any given time by removing the screws 161 and making the required substitution to provide for any change in the welding location, or to permit more than one joint to be welded transversely of the fabric.

The opposite extremity of the scissors-like beams 153—154 are provided with cam engaging rollers 162 through which movement of the cam 163 is transmitted to open and close the electrodes 157 to permit the passage and effect the welding of the selvage edges of the fabric. Here again it becomes necessary to compensate for variations in the thickness of the material passing between the electrodes so that, when the latter are obstructed against closing the predetermined amount, the positive action of the cam is harmlessly dissipated through lost motion means.

To accomplish this, the upper rocker beam 153 is made in two parts, the inner end 153*a* of which supports the electrode, and the outer end 153*b* of which engages the cam; both parts being pivoted on the pin 155. Each of these parts adjacent the pin is provided with an upstanding extension 164*a* and 164*b*, one of which (164*b*) is longer than the other, and which is formed over and downwardly as at 165 to lie over and around the adjacent extension 164*a*, as is shown in Figure 19. Between the two extensions a compression spring 166 is arranged, the expansive force of which may be varied by the set screw 167 and lock nut 168. By means of this spring, the cam action is yieldingly transmitted to the upper electrode. The overhanging portion 165 of the extension 164*b* is provided to insure that the upper electrode is returned to the open position simul-

taneously with the lower electrode during the recession of the cam, which opening is facilitated by means of another compression spring **169** disposed to draw the cam extremities of the scissors-like beams together.

As in the case of the first welders **88**, described above, the welding current is applied to the final welders **92** through the elemental parts thereof which are made of conductive material. One side of the circuit is supplied to the lower electrode, and the other side of the circuit is supplied to the other electrode. The two are isolated from each other and from contiguous parts of the machine by suitable insulatory bushings, washers, etc., in a manner well known in the electrical arts.

Fabric Winding and Bundle Delivery

After the selvages are operated on by the welders, last described, the fabric is complete, ready for passage through the fabric feed rolls **170** and downwardly beneath the operator's platform for delivery to the winding mechanism about to be described.

With reference to Figures 21 through 25, it will be seen that the winding mechanism comprises a positively driven friction drum **171**, a frictionally driven dentelated roll **172**, whose axis of rotation is mounted behind, and slightly above, that of the friction drum, and a frictionally driven bundling roll **173** by which bundles of the fabric are wound and discharged; the fabric passing by the rolls in the order given.

It will be observed that the friction drum **171** is equipped with a rigid sprocket **174**, which is connected by means of a sprocket chain **175** to the fabric feed rolls **170**, by which the speed of rotation of the former is coordinated with that of the latter. The dentelated roll **172** is driven by a gear train **176** connected to the positively driven friction drum through a friction clutch **177**. The bundle roll **173** is frictionally driven by a belt **178** and pulleys **179—180**, one of which (**179**) is journaled in free-running relation on the shaft **181** of the positively driven friction drum. A driven sprocket **182** is arranged adjacent the pulley **179** to which it imparts motion through a pawl and ratchet-wheel drive constituting an over-running clutch **183**, whereby the bundle roll may be rotated at a faster rate than the sprocket **182** provides for, but not at a lesser rate, when in operative position for winding. As will later appear, this arrangement provides for the manual over-drive of the bundle roll **173** to provide for the expeditious winding of the fabric that may have accumulated while the bundling roll was out of operation during the stripping of the bundle therefrom.

The relationship between the several rolls and their respective drives is such that the positively driven friction drum **171** is slightly overdriven to maintain a tension on the fabric; the difference between its peripheral speed and the linear speed of the fabric being compensated for by surface slippage. The dentelated roll **172** is, on the other hand, provided positively to grip the fabric by means of the dentil projections **184** composing its surface, which register with and lie within the interstices of the fabric. The portion of fabric thus engaged by the dentelated roll is of such a substantial longitudinal and lateral extent that the unit pulling stresses exerted by the roll are widely distributed and consequently minimized to such an extent that the mesh of the fabric is not distorted. The drive **176** between the friction drum and the dentelated roll is such as to maintain surface speeds thereof substantially equal. Since the surface of the dentelated roll precludes relative slippage between it and the fabric, the friction clutch **177** is provided in the drive of the dentelated roll to allow for the differential between the speeds of fabric and friction drum, mentioned above. With reference to Figure 23, the spring **185** between the clutch lever **186** and the stationary housing **187** is of the proper size to permit the requisite slippage without causing undue wear between the driving and the driven elements, while at the same time being sufficiently forceful to cause the dentelated roll to be driven to maintain the fabric under adequate tension, in order that it may be wound in a flat and symmetrical condition.

The bundle roll **173** is driven through the belt **178** and pulleys **179—180**, mentioned above, so that as the bundle of fabric being wound thereon increases in diameter, and, therefore, changes the speed relationships between the peripheries of the several rolls, slippage occurs between the belt and pulleys so as to compensate for the difference without at any time releasing the tension on the fabric.

It will be understood that the rotation of the bundle roll may be interrupted to permit the discharge of the completed bundle of fabric thereon without interrupting the advancement of the fabric by the friction drum and dentelated roll, so that the operation of the machine does not have to be suspended during the removal of the bundle, and its output is thereby maintained at an absolute maximum. During the removal of a bundle, the dentelated roll **172** serves to effect positive feed of the fabric F, which may be paid out onto the floor and accumulated until the bundle roll **173** is again in place and able to resume winding. The fabric thus accumulated is rapidly rolled by manually over-driving the bundle roll, as mentioned above, which is permitted by the over-running clutch **183**.

The winding device of the present invention, which permits stripping fabric without interrupting the operation of the machine, is in contrast to the prior art winding devices, which, so far as is known, were the only means for causing the advancement of the fabric being formed through the machine, and were only effective in this regard so long as the web of fabric was secured to the bundle roll while the latter was rotating. Hence in the prior art devices when the bundle roll was disconnected to permit the removal of the bundle, the fabric ceased to advance and the operation of the machine had to be suspended during the interval required to discharge the bundle.

Construction, Power Transmission and Operation

(a) *In general*

A brief description of the general construction, power transmission and operation of the machine, will now be given.

As viewed in Figures 1 to 5, inclusive, it will be seen that the machine is built in and upon two side frames **10** in which are journaled the shafts for transmitting power and the rollers for guiding and advancing the fabric hereinbefore described. The main drive shaft **200** extends through one of the side frames to accommodate on its outer end a pulley **201** which is connected to the prime mover **202** by means of a belt **203**. In the drawings an electric motor has been illustrated, which, as viewed in Figure 4, is partly

hung on the drive belt to tension it and to afford a relatively positive friction drive.

The power from the main drive shaft **200** is transmitted through a gear train **204** comprising a pinion **205** and spur gear **206** to a friction clutch **207**, the driving element of which is rigidly affixed to the spur gear, and the driven element of which is splined to the secondary shaft **208**. The spur gear **206** is free running on the secondary shaft **208** and the latter is driven through the gear train **204** by the main shaft **200** only when the clutch **207** is in engagement.

Rotation of the secondary shaft **208** rotates a pinion **209** which, in turn, drives a spur gear **210** that is mounted in free-running, concentric relation to the tertiary shaft **211**. This free-running gear **210** has rigidly secured to it a sprocket **212** and a driving clutch element **213**, the driven complement **214** of which is splined in non-rotative relation relative to the tertiary shaft.

It will be observed by reference to Figures 1 and 6 of the drawings that the sprocket **212** is the driving element in a chain drive for operating the weft feed. By disengaging the clutch **207** of the secondary shaft the operation of the machine, including the operation of the weft wire feed, is suspended; while, by disengaging the clutch **213** of the tertiary shaft, the operation of the machine is suspended without interrupting the operation of the weft wire feeding devices.

Intermediate the ends of the tertiary shaft **211** are accommodated driving sprockets **215—216** which transmit power through chains **217—218**, respectively, to the lower driven cam shafts **219—220**, respectively, through which the heddles are operated and by means of which other devices are actuated, as will be presently described. The tertiary shaft **211** also accommodates and drives the cams **21**, one of which is shown in Figure 8, which operate the beater frame through its oscillatory cycle; also the warp wire tensioning cam **19**, through which the compensating tensioning rolls **5** are operated in coordination with the beater frame and heddles by virtue of the sprocket and chain connection, mentioned above.

With reference to Figure 6, the tertiary shaft **211** drives sprocket **216**, which, through chain **218**, drives the short shaft **220**. This shaft extends through the housing **10** and rotates a pinion **280** through a clutch **281**. Referring once again to Figures 5 and 6, it will be seen that the pinion **280** meshes with a gear **282**, which drives, through bevel gears **283**, the longitudinal shaft **284** from which, by a worm **285** and a worm gear **286**, the fabric feed rolls **170** are driven. The shaft **284** is provided with a spur gear **287** (see Figures 2 and 5) which, through pinion **288**, drives a short shaft **289**, which, in turn, drives a shaft **4** through the clutch **24**. The shafts **4—289** control the warp wire feed rolls **1** through the clutch **24**, which is intermittently actuated by the compensating tensioning rolls **5** and cam **19** to time the feed of the warp wires with the delivery of the fabric by the rolls **170**.

(b) *The heddles*

Each heddle comprises a rectangular frame **222** carried within stationary vertical slide bearings **223** which are mounted to the side frame **10** of the machine adjacent each of the ends of the heddles in which flanges on the heddle frames are adapted to slide. The heddle frames are supported in the stationary vertical slide bearings by means of equalizing chains **224** which are at one of their ends secured to the top of one of the heddle frames, and at their opposite ends secured to the top of the other heddle frame, substantially as shown in Figures 2, 3 and 4. The equalizing chains are passed over sprockets **225** carried by a shaft **226** that is journaled on a cross bar **227** extending between a pair of frame uprights **228** which carry the vertical slide bearings **223**. The entire assembly is such as to dispose the sprockets **225** directly above the heddle frames so that the latter may be hung for free movement in the vertical slides by the equalizing chains **224**, as will hereinafter be described. Each of the heddle frames is provided with a plurality of heddle wires **229**, as may be better seen in Figures 6 and 7. Each of the heddle wires on each of the frames is arranged in identical manner, whereby the description of one may be accepted as typical. Each heddle wire is tensioned between the top and bottom bars of the rectangular heddle frame so as to be parallel with the end bars of the latter. Approximately midway between its ends, the heddle wire is provided with an eye **230** for the accommodation of a warp wire strand. As between the two heddle frames, the heddle wires are arranged in staggered relationship in order that the warp wires passing therethrough will be controlled in alternation by their respective heddles. From this it becomes obvious that when the heddles are simultaneously shifted relative to each other, one upwardly and the other downwardly, by means presently to be described, alternate warp wires are deflected upwardly and downwardly from the horizontal plane of their normal feed.

This motion of the heddles is effected by the instrumentalities appearing in Figures 3 and 6. It will be seen that to the bottom of the heddle frames are secured connecting rods **231—232** which are pivoted at their lower ends to rocker arms **233—234**, respectively. Each rocker arm is pivoted to a support shaft **235** about the axis of which it is adapted to be oscillated in reciprocal relation to the other rocker arm by the cams **236—237**, mentioned hereinbefore, which are keyed for rotation with the driven shaft **219**, mentioned hereinbefore, and receiving its power through sprockets and chain from the tertiary shaft **211**.

It will be noted that the cams **236—237** are of identical contour but are so mounted that the operating period of one is timed 180° of rotation from the operating period of the other. Each of the cams aligns with its respective rocker arm **233—234**, intermediate the ends of which are provided cam follower rollers **238—239**, respectively, so that anti-frictional contact is provided between the two.

It will be seen from the foregoing that rotation of the shaft **219** causes the cams **236—237**, which are keyed thereto, to move the rocker arms **233—234** alternately up and down simultaneously in opposite directions, which motions are, through the connecting rods **231—232**, positively imparted to the heddles **222**, respectively. For this reason, and since the latter are tied together by the equallizing chains **224**, the downward deflection of one of the heddles necessarily causes the other heddle to be raised a corresponding amount. When both of the heddles lie in congruent relation, the eyes **230** in the respective heddles fall side by side in horizontal alignment, causing the warp wires passing therethrough to align in a horizontal plane, which, in the absence

of the heddles, would constitute the normal line of feed.

(c) The weft feed

The weft wire feed comprises a supply reel **28** from which wire is adapted to be paid in the vertical direction, up to guides **31—55**, down through tension rollers **33**, around a guide roller **33a**, through some more straightening and tensioning rollers **33** into the bite of successive pairs of feed rolls **35**. The feed rolls, which are grooved to accommodate the wire, are supported in adjustable relation by movable journals carrying the uppermost rolls of each pair. These journals are adapted for movement toward and away from the lower rolls by a connecting rod **39**, which, at its upper end, is secured to a yoke **38** carrying the movable journals, and, at its lower end, to a crank **40**. This crank is oscillated through a rock shaft **240**, on which a lever **241** is secured for engagement by a cam **243**. The cam is arranged to provide an operating cycle during which the feed rolls **35** are intermittently brought together and held apart. By this means, it is possible to effect intermittent feed of the weft wire without requiring that the feed roll drive be interrupted, or the rotation of the rolls stopped. Wire guides **34—36** closely conforming to the pass of the rolls serve to introduce the wire into the bite of the feed rolls successively on between the pair thereof, and outwardly from the other side into the machine proper.

The feed rolls **35** are driven by means of sprockets **41** attached to the ends of their shafts with which a drive chain **42** engages, and, which, in turn, is driven from the sprocket **244**. The latter sprocket receives its rotation through bevel gears **245—246**; the former of which is secured to a short shaft **247** that carries sprocket **244**, and the latter of which is secured to the shaft **248**, which is connected to the main source of power of the machine through the sprockets **212—249**, and sprocket chain **250**.

It has already been mentioned in conjunction with the forced feed of the wire P through the feed rolls **35** that in order to remove all excess drag from the wire, the supply reel **28** is positively driven synchronously with the feed rolls to insure a free and adequate feed of the wire without tension. As already explained, this is effected by the depending stub shaft **43** on which is mounted for positive rotation therewith, a split pulley **44** comprising two cone-shaped halves urged toward one another by means of a compression spring **45**. The resistance of the spring may be varied by means of the nut **46** fixed to the threaded portion at the lowermost end of the shaft. The upper end of the shaft **43** is secured to a bevel gear **251** which receives rotative effort from a bevel gear **252** carried on the shaft **247** adjacent the sprocket **244** from which the latter is powered. The reel **28**, being mounted on a swingable arm **50** as already briefly explained, is adjustable toward or away from the split pulley **44** by means of the set screw **53**, so as to vary the effective diameter on which the split pulley engages the belt **47**. By this means, the speed at which wire is paid from the reel may be regulated.

(d) The beater frame, reed, etc.

The beater frame is comprised of a pair of arms **58—59**, each of which is pivoted in trunnion bearings **60—61**, respectively, on opposite portions of the side frames **10**. By reference to Figure 9, it will be seen that the rocker arms are connected together across their upper extremities by a cross bar **62** of special configuration. Carried on this cross bar is a plurality of specially formed dents **64** which, when assembled together on the cross bar, and secured thereto by means of the clamp **76** and the impaling tie rod **77**, constitute a unitary panel **65** formed with the requisite warp wire slots and weft panel guide groove **37** previously described herein.

The rocker arms **58** and **59** are each provided with a rearwardly extending bracket **195** which is integrally affixed to the arm. Each bracket **195** is equipped with a cam follower roller **196**, which is adapted to track in the cam groove of the cam **221**, whereby, when these cams are actuated by rotation of the tertiary shaft **211**, the beater frame is, through rigidly extending bracket **195**, pushed and pulled through its operating oscillatory cycle. As viewed in Figure 8, the cam **221** has moved the beater frame approximately to its most forward position, where the reed **65** causes the weft picket contained in the groove **37** to be tightly wedged into the points of convergence of the line wires. Here, the reed continues to bear forcefully on the picket being placed, while the heddle actuating cams **236—237** (Figures 3 and 6) effect the reversal of the warp shed, and the cams **256** (Figure 8) cause the groove **37** to be opened, thus enabling the picket to be discharged from the reed.

It should be noted, however, that, since the fabric is formed and completed without interrupting the steady forward advancement thereof, the beater frame must be afforded a creeping movement forward from its initial advanced position to its ultimate advanced position immediately preceding the return thereof. Obviously, this is accomplished by making the cam **221** with the portion **197** thereof of a very gradual operating contour, rather than as an absolute dwell.

The opposite—or recessional—phase of the operating cycle of the cam **221** occurs at portions **198** thereof, which are truly circular in contour, and concentric with the tertiary shaft **211**, effecting a dwell in the cycle of the beater frame for more than 180° of rotation of this shaft. It is during this interval of repose that the weft feed rolls **35** are closed to charge the reed groove **37** with a new length of weft wire, from which another picket is formed. The beater frame is then again advanced to the position generally shown in Figure 8 and the cycle is repeated.

The central axis of the weft wire panel guide groove **37** is so disposed that, when the beater frame is oscillated to perform its essential functions in fabricating the wire, it generates a path corresponding to a segment of a cylinder, in which the axis of the weft wire guide **36** lies at one end, and in which the line of convergence of the warp wires into the plane fabric lies at its other end. When the beater frame is in the rearmost position of its oscillatory cycle of movement, the panel groove **37** registers in accurate alignment with the weft wire guide **36**, and, in this position, is adapted to receive and guide across the extent of warp wires the weft wire P as it is fed in by the pinch rolls **35**.

The box section **78**, which is arranged to bear upon the front face of the reed panel **65**, carrying the slotted angle member which opens and closes the weft wire panel guide groove **37** at opposite ends of the path of movement of the beater frame, respectively, is caused to move through connect-

ing rods 79, 85 and associated parts, relative to the groove by a rocker arm 253, having a bifurcated end portion 254 provided with cam follower rollers 255 for positive actuation by the cams 256. The cams 256 are mounted on a shaft 257 which is driven by a sprocket and chain drive 258, the power of which originates with driven shaft 220, which, in turn, is in sprocket-and-chain-drive relation with the tertiary shaft 211. This may be clearly seen in Figures 5 and 6.

(e) The selvagers

The welding, shearing and forming instrumentalities 88—93, inclusive, are mounted in the tongue element of a dove-tail slide bearing 94 along which they may be slid for adjustment relative to each other. This adjustment, it will be apparent, must be available if the machine is to produce fabric of other than one size mesh. The dove-tail slide bearings mount the group of welding, shearing and forming units upon the sliding table 93 whereon they are accommodated in slide bearings 97 for adjustment transversely of the machine. It will be appreciated that this arrangement will permit the welding, shearing and forming instrumentalities to be positioned to operate upon any width of the fabric within the confines of the over-all width of the machine.

Incident to this latter adjustment, as will be seen by reference to Figures 1 and 2, the cam shafts 95 through which the welding, shearing and forming units are operated, are driven, through worm gears 259 secured to the ends of the cam shafts 95, by worms 260 which are secured to a transverse shaft 261, appearing in Figures 1 and 7. The transverse shaft has affixed to one of its ends a sprocket 262, which is driven through a chain 263 that is accommodated by another sprocket 264 carried by a stub shaft 265 journaled in the adjacent side frame 10 of the machine. This stub shaft, in turn, is driven by sprockets and chain 266 from the shaft 257, referred to hereinbefore, from which the cams for opening and closing the panel guide groove are driven; the power for which originates with the tertiary shaft 211. The worms 260 are splined for axial movement along the transverse shaft 261, which permits the welding, shearing and forming units to be moved transversely of the machine, without disturbing the drive to their respective cam shafts 95.

The sprocket and chain drive to the transverse shaft 261 permits the sliding table 93, on which the welding, shearing and forming instrumentalities are mounted, to be moved without effecting the continuity of operation. The movement of the table is accomplished, as may be seen by reference to Figures 2 and 3, by oscillating levers 267 which are secured to a rock shaft 268, journaled in the housing 10. The levers 267, at their upper ends, are connected by links 269 to pivotal bearings 270 on the table 93. The shaft 268 is provided with a terminal lever 271 which is connected by a pitman 272 (see Figure 2) to an oscillating arm 273.

The oscillating arm 273 is grooved longitudinally to receive a bearing block 274 carrying a crank pin for accommodating the end of the pitman 272. By varying the position of the bearing block 274 axially of the oscillating arm 273, the throw of the pitman 272, and through it the movement of the table 93, may be increased or decreased depending upon the direction of the adjustment.

The oscillating arm 273 comprises one lever in a bell-crank drive, the remaining parts of which include a rock shaft 275, which is journaled in the adjacent housing 10 and extends through and terminates in a bearing 276 near the center of the machine (see Figure 6). This shaft is provided with a radially-extending arm 277 (see Figures 5 and 6), which has at its outer extremity a cam follower 278 for engagement with a cam 279 carried on the shaft 220, that receives its power by sprockets 216 etc., and chain 218, from the tertiary shaft 211. Thus is the movement of the table 93 coordinated with the operation of the beater frame and associated instrumentalities whereby the welding, shearing and forming units are made properly to register and operate upon each succeeding picket wire while the fabric F travels on without pause.

(f) Fabric winder

The fabric is continuously pulled from the machine and advanced to the bundle roll 173 by the dentelated roll 172 of the winding mechanism. Even when the bundle roll is disconnected to discharge a bundle of fabric, the dentelated roll, in cooperation with the friction drum 171, pulls the fabric from the machine proper and deposits it on the floor pending the resumption of winding by the bundle roll.

By reference to Figures 24 and 25, it will be seen that the dentelated roll is comprised of a plurality of disc-wheels having relatively broad treads with dentil projections 184 milled or cast into the surface thereof. This multi-part type of construction is preferred in order to enable defective or broken parts to be replaced without necessitating replacement of the entire roll. It should be further noted that each of the dentil projections 184 is in the shape of a truncated pyramid with base lines running parallel axially and circumferentially of the roll. In being shaped in this way, the teeth 184 are adapted not only to enter and conform to the interstices of the fabric, but to tend to expand the component wires thereof into true straight and rectangular dispositions, and thus to correct any malformations of mesh, if any should occur.

Proper registration between the teeth and mesh is assured, as will appear in Figure 24, by maintaining a slight clearance (usually $\frac{1}{16}$ inch or more) between the several sections of the dentelated roll, and by feather-keying these sections upon the shaft for movement axially of the latter, and relative to each other to the extent afforded by this clearance. By this arrangement, slight variations in the fabrics' width may be compensated for by the sections' automatically centering to the fabric. Such variations arise from the mutual crimping action attendant upon the weft wire's being interwoven with the warp wires, which crimping effects a decrement of take-up in the length of each picket, and, hence, a take-up in the over-all width of the fabric. The extent of this take-up is not a constant value due to unavoidable variations in hardness of the wires, and, hence, cannot be ascertained beforehand. Particularly does this error become appreciable in the case of wide fabrics, wherein the center interstices thereof may register properly with the dentil projections of the middle sections of the dentelated roll, but the marginal interstices thereof may fail to effect proper registration with the dentil projections of the end sections of the roll. By providing the clearance between sections, and by mounting each section for movement axially of the shaft, the warp wires in coac-

tion with the dentil projections will exert a cam action to move the sections along the shaft in the direction required for proper alignment until true registration is had between the interstices of the fabric and their respective teeth 184.

The fabric is always under substantial tension by the over-drive to the friction drum 171, and, through the gearing 176 extending the over-drive, to the dentelated roll. Compensating slippage is had at the surface of the friction drum 171, and at clutch 177 in the case of the dentelated roll. So long as the latter is in operative condition, a strong positive pull will be exerted thereby on the fabric, provided the spring 185 (Figure 23) is adequate. To relieve the fabric of advancing tension, a latch-bar 188 is provided, which is pivoted to the housing 187 and extends through an offset portion 189 in clutch lever 186. By retracting the lever 186 against the tension of the spring 185 to a point where the shoulder 190 on the latch-bar seats against the off-set 189, the lever 186 is retained in this retracted position, and the clutch 177 is disengaged to stop the roll.

The bundle roll 173 is frictionally driven, as previously set forth herein, by belt and pulleys 178—180, inclusive; the pulley 179 being journaled in free running relation upon the friction drum shaft 181, and being driven directly from the machine proper through an over-running clutch 183 and a sprocket 182 carrying certain of the clutch elements. This sprocket 182 is driven, as will be seen in Figures 2 and 6, from the gear 282 (indirectly powered by the tertiary shaft 211 through shaft 220 and pinion 280), which, among its other functions described hereinbefore, drives the sprockets 290, 291, and 292, and these, in turn, through a chain 293, drive the sprocket 182. In this manner is the drive of the bundle roll 173 perfected, and changes in size of bundles allowed for by slippage at the belt and pulleys 178—180, inclusive.

Many changes may be made in the structure and operating characteristics of the preferred inventive embodiments herein illustrated, which, though departing from the letter of this specification and drawings, will not depart from the spirit of the invention as apprehended in and by the following claims. It is intended, therefore, that the inventions herein set forth be limited by only the claims construed in the light of these specifications and drawings, and the prior art, and not be deemed limited to the specific embodiments here adopted as preferential for purposes of description.

I claim:

1. A wire fabric loom comprising, in combination: means for feeding a bank of warp wires, heddle means for effecting a shed in the latter; a reed; a weft guide on said reed; means for feeding a length of weft wire into said guide; means for actuating said reed properly to position the length of weft wire relative to the warp wires, and means connected with said reed to cause it to hold the length of weft wire in such proper position during the actuation of the heddle means to reverse the warp wires in the shed.

2. A machine for weaving wire fabric which comprises means for continuously feeding a gang of wires in co-planar relation; means for simultaneously dividing and deflecting portions of the gang of wires alternately into two banks and in directions normal to the plane of feed thereof; means for directing lengths of picket wire between and across the two banks adjacent the point of deflection thereof; and means for actuating said last-named means to position and hold the pickets until the respective directions of deflection of the two banks of wires have been reversed.

3. A machine for weaving wire fabric which comprises means for guiding a gang of wires in substantially parallel relation; means for simultaneously dividing and deflecting portions of the gang of wires alternately into two banks and in directions normal to the plane of feed thereof, means for directing lengths of picket wire between the two banks of wires adjacent the point of deflection thereof; means for actuating said last-named means to position and hold the pickets until the respective directions of deflection of the two wires has been reversed; and means for maintaining without interruption the steady forward feed of the gang of wires during the actuation of all of the means hereinbefore set forth.

4. In a machine for weaving metal fabrics: a reed comprising a panel having a plurality of substantially parallel slots extending therethrough normal to its long axis; a guideway extending along a face thereof substantially parallel to said axis, and closure means operable to open and close said guideway in an axial direction.

5. In a machine for weaving metal fabrics: a reed comprising a panel having a plurality of substantially parallel slots extending therethrough normal to its long axis; an open groove extending across the panel normal to said slots and intermediately of the length of the latter, and a retractable closure for said groove having deep notches corresponding to and registering with said slots.

6. In a machine for weaving metal fabrics: a reed comprising a panel having a plurality of substantially parallel slots extending therethrough normal to its long axis; said slots having major portions of the opposed side walls thereof disposed in parallelism to horizontal lines oblique to the plane of the panel's face; the major wall portions of said slots terminating in offset wire bearings; said bearings affording a clearance across lines normal to the panel's plane, aforesaid, in an amount substantially equal to the diameter of a wire; said major portions of the side walls of the slots being spaced apart at their nearest points a distance substantially greater than the diameter of the same wire, aforesaid.

7. In a machine for weaving metal fabrics: a movable frame for recurrently pushing cross-wires into interwoven engagement with line-wires; a reed carried on said frame having slots to accommodate line-wires; means for continuously moving line-wires through said reed; means for holding said frame and reed in repose at one end of their range of movement; means for moving said frame and reed in the direction of travel of the line-wires at a speed greater than the latter, and means for reducing and holding the speed of said frame and reed to that of said line-wires for an increment of movement in the same direction.

8. In a machine for weaving metal fabrics: a movable frame; a reed carried thereby; a cam for moving said frame back and forth; said cam providing a dwell in the motion of said frame at the point in its cycle of movement corresponding to the limit of its back stroke in the direction contrary to the direction of warp feed, and providing a creeping motion thereto adjacent the limit of forward movement in the direction of warp feed; the intermediate portions of said cam

being such as to effect the relatively rapid advancement and return, respectively, of said frame.

9. The method of weaving wire fabric which includes: continuously feeding a gang of wires in substantially parallel relation; forming a shed in the gang of wires; pushing lengths of picket wire into said shed, and holding each picket in position until the shed is reversed.

10. The method of weaving wire fabric which includes: continuously feeding a gang of wires in substantially parallel relation; forming a shed in the gang of wires; pushing lengths of picket wire into the shed; holding the pickets in position until the shed is reversed, and maintaining constant the forward feed of both the line wires and the pickets interwoven therewith.

11. In a fabricating machine for making fabrics of longitudinal warp and transverse weft bodies: a reed carrying a weft guide; warp-feeding means for unidirectionally passing warp bodies across said guide; means to advance a weft along said guide; shedding means to shift the warp bodies reciprocally to the opposite sides, respectively, of the guide to grip a weft disposed therein, and a closure carried by the reed effective to confine each weft in said guide during the reversal of said warp bodies.

12. In a machine for making woven fabrics: a reed having a weft guide groove therein, means for feeding a plurality of warp bodies proximate to said guide groove in a direction normal thereto; means for delivering a weft along said guide groove for disposition between said warp bodies; shedding means for shifting the warp bodies into reciprocal positions relative to said guide groove and to each other to grip a weft disposed in the latter, and means coacting with said groove for confining each weft in said groove until after the said shedding means has shifted said warp bodies.

13. In a machine for making woven fabrics: a reed having a weft guide therein, means for feeding a plurality of warp wires proximate to said guide in a direction normal thereto; means for delivering a weft wire along said guide for disposition between said warp wires; shedding means for shifting the warp wires into reciprocal positions relative to said guide and to each other to grip a weft wire disposed in the guide, and means coacting with said guide for positively confining a weft wire in said guide during the shifting of said warp wires.

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