Nov. 26, 1929. L. H. MORIN 1,737,261

APPARATUS FOR MAKING FASTENING DEVICES

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Fig. 1.

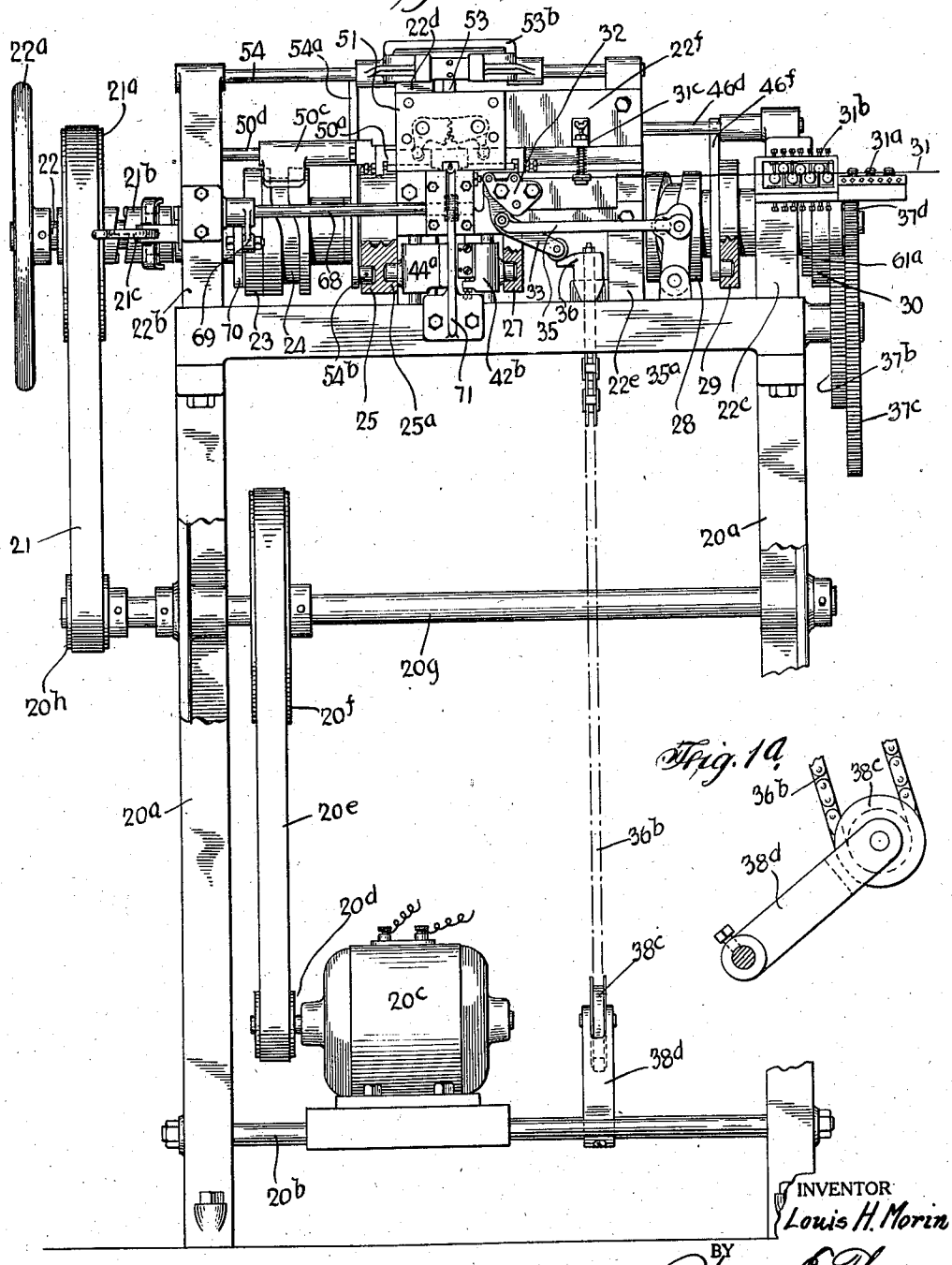


Fig. 1a.

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Fig. 2.

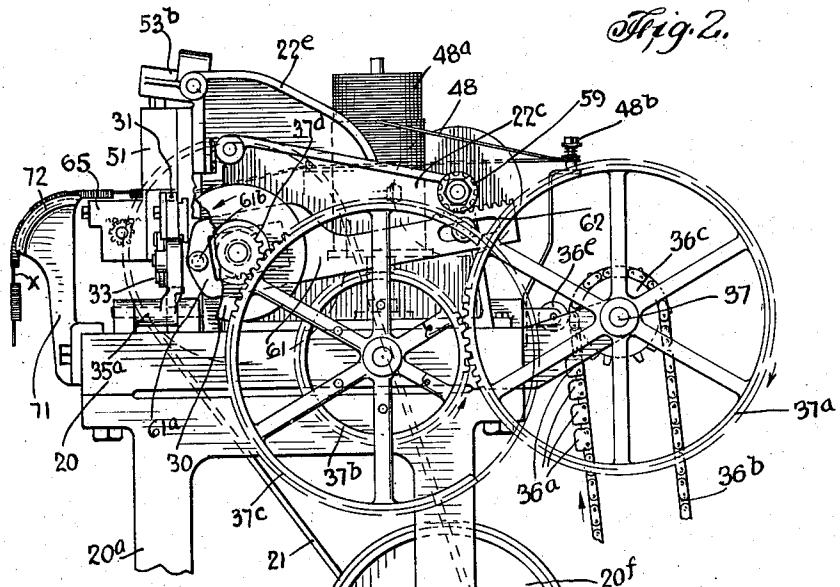


Fig. 4.

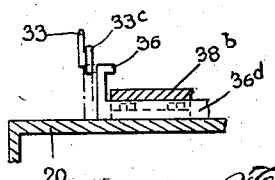


Fig. 3.

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Fig. 5.

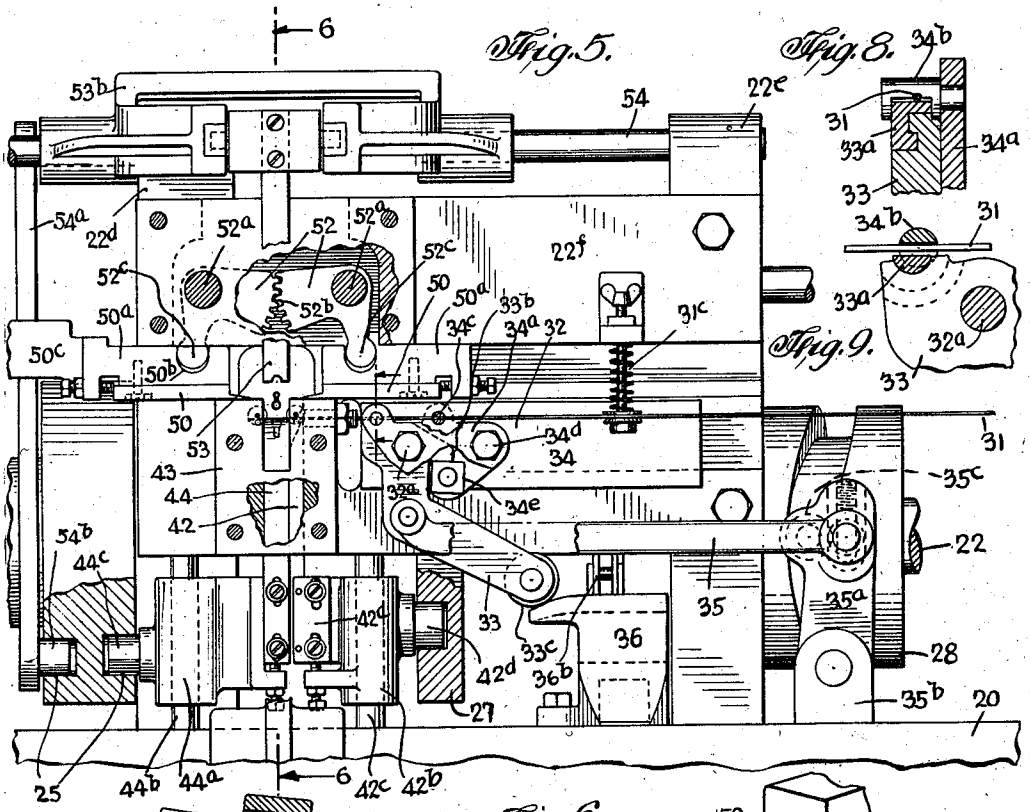


Fig. 8.

Fig. 9.

Fig. 6.

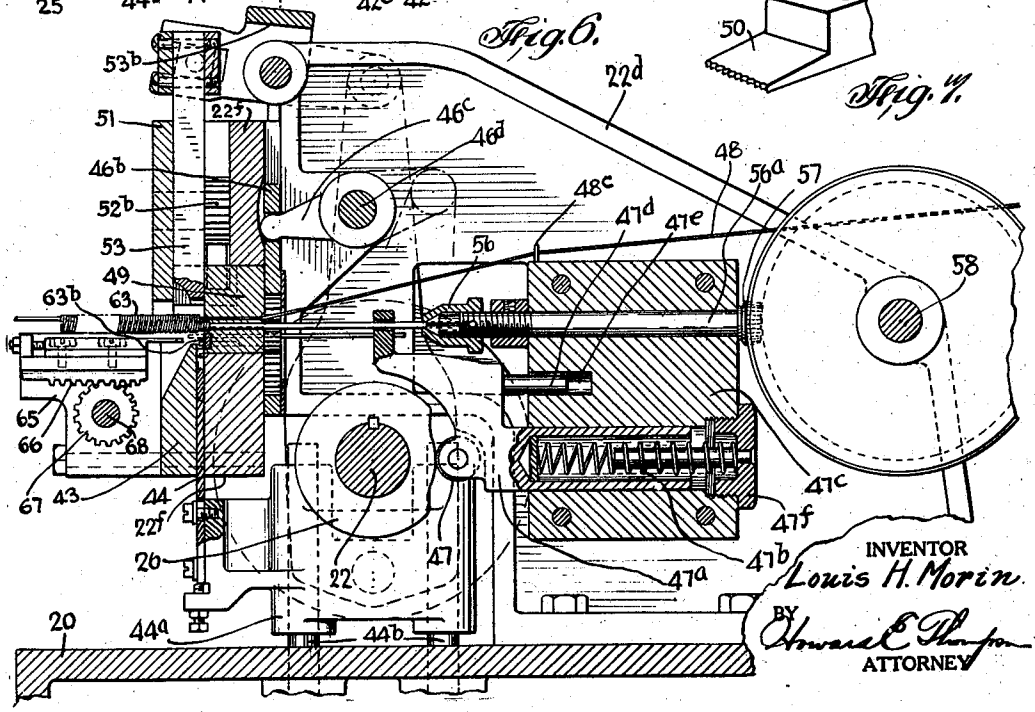


Fig. 7.

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Fig. 10.

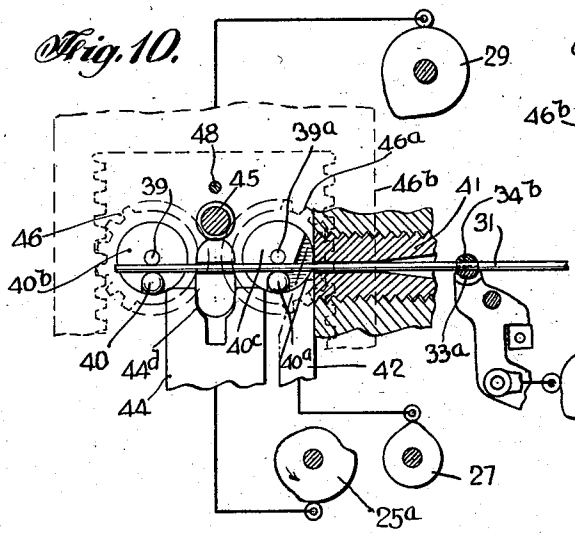


Fig. 11.

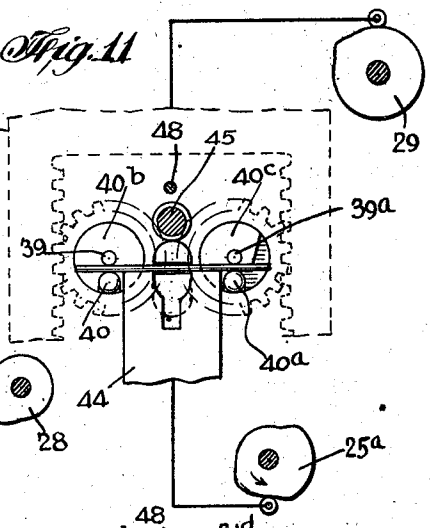


Fig. 12.

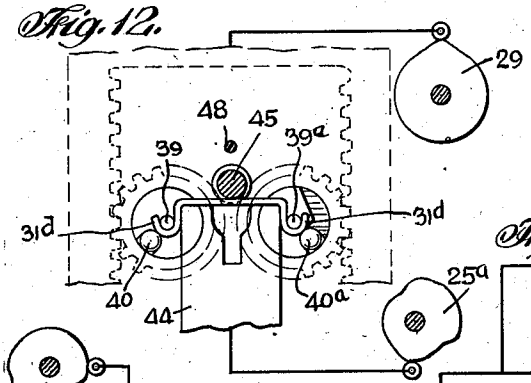


Fig. 13.

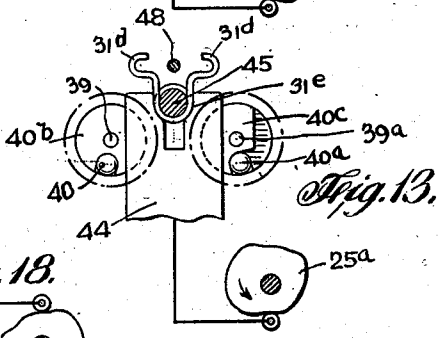


Fig. 18.

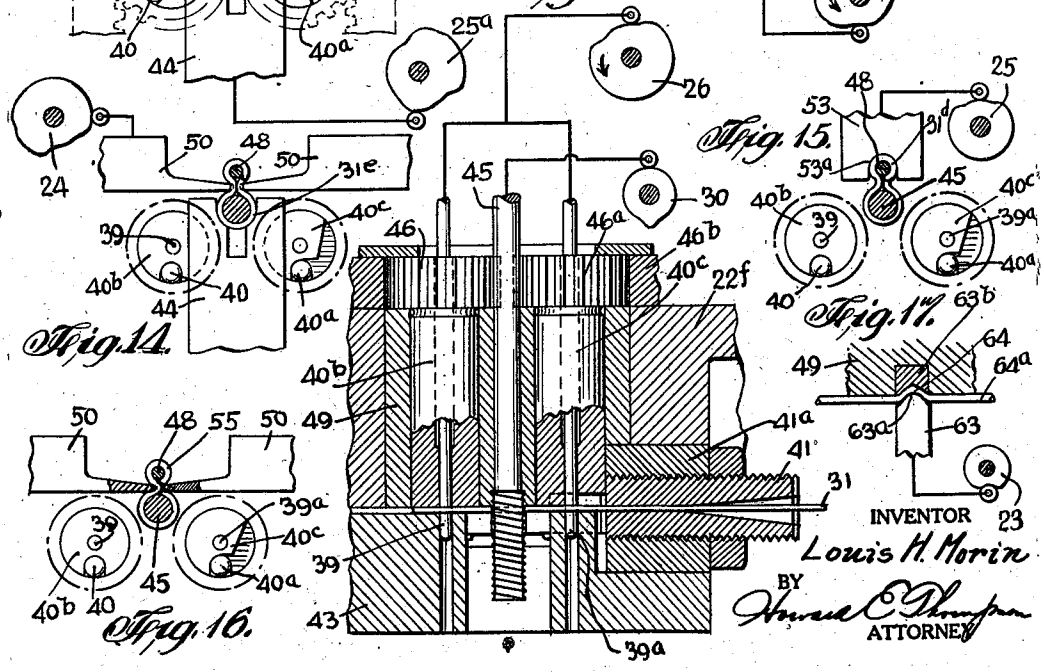


Fig. 15.

Fig. 14.

Fig. 17.

Fig. 16.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR MAKING FASTENING DEVICES

Application filed October 7, 1926. Serial No. 140,005.

This invention relates to fastening devices comprising stringers, each containing a plurality of links so fashioned that the separate stringers are adapted to be coupled together when the links thereof are interlocked, and particularly to a method and apparatus for manufacturing devices of this class, and particularly devices similar to that shown, described and claimed in United States Patent No. 1,557,304, dated October 13, 1925, granted to Davis Marinsky; and the object of the invention is to provide a machine into which strands of wire and fabric are fed, means being provided to sever from the wire strand, workpieces of predetermined length, fashioning the workpieces into predetermined form and then passing the same onto a mandrel which also functions as a feed screw, and further passing the ends of the workpiece around the fabric or other mounting strand fed into the machine, and securing the workpieces to said strand to form of said workpieces, link members having loop portions which project radially from said mounting strand; a further object being to provide a machine of the class specified with means whereby the several link members may be arranged on the mounting strand in juxtaposition or abutting relation, and further whereby the operation of the mandrel and feed screw will discharge the links and mounting strand from the machine; a still further object being to provide means for rendering the wire feed inoperative for a predetermined period of time, to provide on the stringers formed, blank spaces or in other words, spaces where the links are not secured to the mounting strand, the strand serving merely to couple the stringers together to facilitate further production of the complete device; a further object being to provide a machine of the class and for the purpose specified, in which the several mechanisms for producing the fastening device or the stringers thereof are actuated through a plurality of cams mounted upon a power driven shaft, thus producing positive functioning of said mechanisms; a further object being to provide means whereby the number of links contained in the respective groups on the mounting strand may be governed, as well as the spaces between said groups; and with these and other objects in view, the invention consists in an apparatus of the class and for the purpose specified, which is simple, compact and strong and durable in construction, positive and fool-proof in operation, and which is constructed and operated as hereinafter described, and further to the construction of devices of the class referred to in accordance with the method hereinafter more fully set out.

The invention is fully disclosed in the following specification, of which the accompanying drawing forms a part, in which the separate parts of my improvement are designated by suitable reference characters in each of the views, and in which:—

Fig. 1 is a front view of a machine made according to my invention, with parts of the construction broken away and in section.

Fig. 1ª is a detail view of a part of the construction shown in Fig. 1.

Fig. 2 is a side view of the machine seen in Fig. 1, with part of the construction omitted.

Fig. 3 is a plan view of the machine, with parts of the construction broken away and in section.

Fig. 4 is a partial section on the line 4—4 of Fig. 3.

Fig. 5 is a view similar to Fig. 1, and showing only a part of the machine on an enlarged scale, and with part of the construction broken away and in section.

Fig. 6 is a partial section on the line 6—6 of Fig. 5.

Fig. 7 is a perspective detail view of a crimping jaw, two of which are employed.

Figs. 8 and 9 are sectional, detail views of parts of a wire feed which I employ.

Figs. 10 to 17 inclusive, are diagrammatic views illustrating the several steps in the formation of the separate links of the fastener device in question, and securing the same to a mounting strand; and,

Fig. 18 is a horizontal, sectional view diagrammatically illustrating the arrangement of parts seen in Fig. 10 of the drawing.

In Fig. 1 of the drawing, I have shown

at 20, the table or base of the machine proper, supported upon side frame members 20^a. Mounted upon rods 20^b or other supports at the lower end of said frame members is an electric motor 20^c on the shaft of which is a pulley 20^d around which a belt or chain 20^e is passed, said belt or chain passing around another pulley 20^f on a shaft 20^g supported in the frame member 20^a. One end of said shaft projects through the frame member and is provided with a pulley 20^h. A belt 21 passes around the pulley 20^h and a pulley 21^a is freely mounted upon a driven shaft 22 of the machine, the pulley 21^a being coupled with the shaft through a clutch 21^b operated by a hand lever 21^c clearly seen in Fig. 3 of the drawing. A hand lever 22^a is secured to the shaft 22 outwardly of the pulley 21^a, by means of which, said shaft may be rotated whenever desired and especially in making adjustments on the several parts of the machine.

The driven shaft 22 is mounted in two bearings 22^b and 22^c on the table 20 of the machine, and other bearings 22^d and 22^e are employed for supporting other shafts, later described. The shaft 22 extends transversely of the machine and secured thereto is a plurality of cams for actuating the several parts or mechanism of the machine, said cams being designated by the reference numerals 23, 24, 25—25^a, 26 (note Fig. 6), 27, 28, 29 and 30, it being noted that the cams 25—25^a constitute one body having different cam faces on the opposite sides thereof.

The wire 31 from a spool or other source of supply, in entering the machine, first passes through two sets of straightening rollers 31^a and 31^b arranged in different planes, then through an adjustable tension device 31^c and into and through a wire feed 32 comprising a lever 33, a slide plate 34 slidably mounted in and keyed to a frame plate 22^f extending between and secured to the front faces of the bearings 22^d and 22^e. Secured to the slide plate 34 is a supplemental plate 34^a, the lever 33 being pivoted to and between the plates 34—34^a as seen at 32^a. The short end of the lever 33 has a jaw piece 33^a movable relatively to a fixed jaw piece 34^b on the plate 34^a to clamp and firmly grip the wire 31 in the movement of the slide from right to left in the feed of said wire. The wire also passes through an aperture in a fixed pin 34^c secured to the plate 34^a. A screw 34^d aids in securing the plate 34^a to the slide 34, and supported between the plate and the slide is a rectangular block 34^e in connection with which a pawl portion 33^b on the lever 33 operates.

Pivotally coupled with the lever 33 is a rod 35 which extends to the right and is pivoted to a rocker arm 35^a mounted in a block 35^b supported on the table 20 of the machine. The arm 35^a carries a roller 35^c which operates in the groove of the cam 28. The cam 28 serves to impart movement to the lever 33 and the carriage 34 to advance the wire 31 into the machine, it being understood that in the movement of the rod 35 to the right, the jaws 33^a—34^b are opened and the feed device passes freely over the wire 31.

The free end of the lever 33 is provided with an anti-friction roller 33^c which is adapted to pass over a shoe 36 when moved into the path of the roller 33^c to hold the jaw 33^a of the lever 33 in inoperative position to prevent the feeding of the wire 31 for a predetermined number of cycles of the machine. The movement of the shoe 36 is controlled by employing a plurality of blocks 36^a on the links of a chain 36^b which passes around a sprocket 36^c secured to the shaft 37, geared to the shaft 22 through a chain of gears 37^a, 37^b, 37^c and 37^d. The shoe 36 is mounted on a slide rod 36^d having a roller 36^e at its inner end in connection with which the blocks 36^a operate. A spring 36^f is employed to normally hold said rod and the shoe 36 in inoperative position, but the same is moved into position to engage the roller 33^c when the blocks 36^a engage the roller 36^e and move the shoe 36 outwardly.

The shaft 37 is supported in a U-shaped bearing plate 38, and the rod 36^d is supported in guide blocks 38^a and 38^b, the latter being clearly seen in Fig. 4 of the drawing. It will also be noted that the chain 36^b is passed around a guide pulley 38^c supported in an adjustable arm 38^d mounted on one of the rods 20^b. With this construction, and further by the use of arms 38 of different lengths, the length of the chain 36^b may be varied to suit the requirements, it being understood that the chain length will govern the number of fastening devices mounted in juxtaposition on the mounting strand employed, while the number of blocks 36^a will govern the length of the space between the groups of fastening devices on said strand.

In feeding the wire 31 into the machine, the end portion thereof passes between two sets of pins 39—39^a, 40—40^a mounted in oscillatory members 40^b and 40^c respectively, the pins 40 and 40^a being movable with said members, while the pins 39 and 39^a are mounted in the axis of said members and are movable longitudinally thereof. The wire 31 is guided into position between the pins through a threaded sleeve 41 mounted in a block 41^a secured to the plate 22^f. When the wire is in position, a cutter blade or shearing tool 42 is moved upwardly and transversely across the wire, to shear off a workpiece, the blade being supported between the plate 22^f and a plate 43 secured thereto. The lower end of the blade 42 carries a plate 42^a adjustably supported on a block 42^b movable vertically on two rods 42^c, the block 42^b carrying a roller 42^d which operates in the groove of

the cam 27 employed for imparting movement to the shear-off tool or blade 42.

At one side of the blade 42 is a forming tool 44 which moves upwardly with the blade 42 in the shearing operation, a predetermined degree, sufficient to engage the wire to hold the workpiece cut therefrom in position as seen in Fig. 11 of the drawing. The tool 44 is also supported and guided within and between the plates 22^f and 43, and is adjustably coupled with a block 44^a slidable upon guide rods 44^b, the block 44^a carrying a roller 44^c which operates in the groove of the cam 25^a. The rods 42^c and 44^b are supported upon the table 20 of the machine as clearly seen in Figs. 5 and 6 of the drawing. The upper end of the forming tool 44 is provided with an arc-shaped recess 44^d of such circumference as to bend the wire workpiece around a mandrel and feed screw 45 as later described.

The tool 44 has three distinct upward movements from the normal position of the tool seen in Fig. 10 of the drawing, the first movement being illustrated in Fig. 11, the second in Fig. 12, and the last in Fig. 13, and from the position shown in Fig. 13, it returns to the position shown in Fig. 10.

After the tool 44 has been raised to the position shown in Fig. 11, the end portions of the wire workpiece are fashioned to form open loops 31^d, which result is accomplished by the partial rotation of the oscillatory members 40^b and 40^c to move the pins 40 and 40^a laterally and circumferentially with reference to the pins 39—39^a from the positions shown in Figs. 10 and 11 to that seen in Fig. 12. The members 40^b and 40^c are provided at their inner ends with gears 46—46^a which mesh with a vertically slidable rack 46^b supported in connection with the plate 22^f. A rocker arm 46^c is coupled with the upper end of the rack and mounted upon a shaft 46^d, said shaft being supported in the bearings 22^c, 22^d and 22^e. A lever 46^e is secured to said shaft adjacent the bearing 22^c with which lever, a link 46^f is coupled, and carries a roller engaging the groove of the cam 29, note Fig. 1, to impart reciprocating movement to said shaft 46^d to raise and lower the rack 46^b. The raising of said rack causes the members 40^b and 40^c to rotate a partial revolution, forming the loops 31^d as above stated. In this operation of forming said loops, the tool 44 has been raised slightly to bring the workpiece into engagement with the lower face of the mandrel and feed screw 45, and into one of the grooves between the threads of said screw.

For a short period of time, the tool 44 remains in the position seen in Fig. 12, and the pins 39 and 39^a are moved backwardly or withdrawn from the face of the members 40^b and 40^c, and at the same time, the pins 40 and 40^a are partially returned to their normal position, after which the tool 44 advances upwardly around the mandrel 45 to form, centrally of the workpiece, a large loop 31^e as seen in Fig. 13.

The above described operation of withdrawing the pins 39, 39^a is accomplished by the action of the cam 26 upon a roller 47 supported in a slidable block 47^a in connection with the upper end of which the two pins 39—39^a are supported, the block 47^a being normally held outwardly by a spring 47^b arranged in a tubular portion of said block, the block being supported in a plate 47^c secured to the bearing 22^d. A pin 47^d on the block 47^a enters an aperture 47^e in the plate 47^c to key and guide said slide block in its movement. The spring 47^b is seated in a cap 47^f secured to the plate 47^c.

It will be understood that the withdrawal of the pins 39—39^a permits of the upward movement of the workpiece into the position shown in Fig. 13 of the drawing. After the workpiece has been completely formed, and the tool 44 lowered into its normal position, said pins are again projected to receive the end of the wire fed into the machine. It will also be noted that when the workpiece is in the position shown in Fig. 13 of the drawing, the small loops 31^d are arranged at the opposite sides of a mounting strand 48 which may be composed of any suitable flexible material taken from a spool 48^a seen in Fig. 2 of the drawing, and passed around a tension device 48^b forwardly through a guide loop 48^c on the plate 47^c and through an aperture in a bearing block 49 supported in the plate 22^f, in which block, the members 40^b and 40^c are mounted, as well as the mandrel 45. The strand is arranged just above the mandrel 45 and in axial alinement therewith, so that when the small loops and end portions of the workpiece are crimped together, the strand 48 will enter said loops and the loops will encircle said strand.

The next or crimping operation above referred to is accomplished by two similar crimping jaws 50, movable toward each other at a point between the mandrel and the strand 48, and just above the mandrel to complete the formation of the loop 31^e. The edges of the jaws 50 are preferably provided with notches as seen in Fig. 7 of the drawing to receive and definitely space the wire of the workpiece and to retain the small loops side by side and in abutting relation when mounting the same on the strand 48. Each jaw 50 has an enlarged body 50^a to which it is secured, said body being supported and guided in and between the plate 22^f and a plate 51 secured to the plate 22^f. Rocker arms 52 are pivoted between said plates as seen at 52^a and have intermeshing segmental gear faces 52^b whereby the movement of one rocker arm will correspondingly move the other arm, and said arms have ball ends 52^c operating in sockets 50^b in the bodies 50^a.

The body 50[a] as seen to the left in Figs. 1 and 5 of the drawing, has an extension 50[c] slidably mounted upon a rod 50[d] supported in the bearings 22[b] and 22[d], and which carries a roller operating in the groove of the cam 24 as seen in Fig. 1 of the drawing. From the foregoing, it will be seen that when the jaw 50 at the left of the drawing is moved to the right, the other jaw is moved to the left to bring said jaws together, performing the crimping operation seen in Fig. 14 of the drawing. The first crimping operation is not complete, and in the cycle of operation of the machine, a finished crimping operation is performed to fixedly secure the small loops 31[d] on the mounting strand 48 as seen in Fig. 16 of the drawing.

Intermediate the two crimping operations, a vertical punch tool 53 moved downwardly, and the recess 53[a] in said tool passes over the small loops 31[d] and firmly compacts and compresses said loops on the mounting strand 48. The tool 53 is mounted in and between the plates 22[c] and 51 and is guided thereby, and the upper end of said tool is mounted in a yoke-shaped rocker 53[b] mounted upon a shaft 54 supported in the bearings 22[b], 22[d] and 22[c]. At one side of the rocker 53[b] is a projecting lever 53[c] with which is pivoted a link 54[a] the free end of which carries a roller 54[b] which operates in the groove of the cam 25. With this construction, the rocker 53[b] is oscillated to impart vertical movement to the tool 53 for the purpose above stated.

After the last crimping operation, above referred to, has been performed, the mandrel 45 is rotated sufficiently to feed the complete link designated as 55 outwardly, and to correspondingly feed the mounting strand 48 outwardly to allow for the formation of another link in abutting relation to the first named link, it being understood that the two small loops of the completed link are arranged on the mounting strand, while the one large loop projects radially therefrom. As previously stated, the mandrel 45 is supported in the block 49, and the same extends backwardly and passes through the block 47[a] and is coupled with a chuck 56 supported on a shaft 56[a] having at its inner end a beveled pinion 57 which meshes with a beveled gear 57[a] mounted upon a shaft 58 supported in the bearings 22[d] and 22[c].

Secured to the shaft 58 where it projects through the bearing 22[c] is a gear 59 having a clutch face whereby a spring pressed clutch collar 60, keyed to the shaft 58, will rotate said shaft when the gear 59 is rotated in one direction, and will remain stationary to move outwardly when said gear is rotated in the opposite direction. A rack 61 is in operative connected with the gear 59, said rack being provided with an enlarged head 61[a] through which the shaft 22 passes, the head being in the form of a yoke carrying a roller 61[b] which operates in the groove of the cam 30, note Fig. 3 of the drawing. The other end of the rack 61 is provided with an elongated aperture in connection with which a pin 62 operates to support the teeth of the rack in engagement with the gear 59, the pin 62 being mounted upon the bearing 22[c], note Fig. 2 of the drawing. It will be apparent that the inward or backward movement of the rack 61 will cause the mandrel to be operated through the gears 57 and 57[a], and the forward movement of said rack will retain the mandrel in fixed position, the clutch 60 moving outwardly against the tension of the clutch spring 60[a]. It will also be understood that the threads of the feed screw or mandrel 45 will govern the pitch or angular arrangement of the large loops of the links 55. The direction of the pitch may be varied by using mandrels having oppositely arranged threads, or in other words, left and right handed threads may be employed.

The formation of the separate links, as above described, relates to links in which the large loops are straight or unkinked. In devices of the class under consideration, at least one of the two stringers to be coupled together must be composed of links having kinked or offset portions to interlock with the other or plain links. In the formation of the stringers, wherein the links are provided with kinked or offset portions, I provide a punch 63 having a V-shaped end 63[a] to form a kink 64 in the wire or rod of a workpiece 64[a] cut therefrom, the female portion 63[b] of the punch being arranged in alinement therewith, as clearly seen in Fig. 17 of the drawing. This operation is performed in the workpiece 64[a] when it is in a position similar to that shown in Fig. 11 of the drawing. The punch 63 is slidably mounted in a block 65 secured to the plate 43, said punch having a rack 66 on its under face for engagement with a gear 67 mounted upon a shaft 68 supported in the block 65, and the bearing 22[b]. Secured to the shaft 68 adjacent the bearing 22[b] is a rocker arm 69 having a link 70 pivoted thereto, the link 70 carrying a roller engaging the groove of the cam 23 whereby the shaft 68 is given rotary, oscillatory movement in the cycle of operation of the machine to advance the punch 63, to form the kink in the workpiece prior to the formation of the small and large loops therein.

It will be understood that when the plain or unkinked link is formed, the punch including its supports, is removed from the machine and replaced whenever it is desired to produce the kinked links whereby. However, in actual production, one machine may be fitted with the kinking means while the other would be without such means.

A workpiece supporting guide 71 is supported in connection with the table 20 of the

machine in front of the block 65, said guide having a channeled arc-shaped face 72 in which the stringers, coupled by the mounting strand, are placed, and over which said stringers pass in the operation of the machine, it being understood that a large number of link sections, which will constitute independent stringers in the production of the devices in question, are made and collected in a basket or other container positioned beneath the guide 71, and on the floor or other surface, it being understood that the separate sections of links are severed one from the other by cutting the mounting strand at the spaces "x" on said strand. It will also be understood that the links are fed outwardly through the machine by the feed screw or mandrel in the intermittent rotary movement imparted thereto.

The operation of my apparatus will be readily understood from the foregoing description when taken in connection with the accompanying drawings and the following statement. In the cycle of operation, the wire is first fed into and between the pins in the members 40b and 40c with the parts in the position seen in Fig. 10 of the drawing, the cams cooperating with the parts being diagrammatically illustrated. The next operation consists in cutting off a portion of the wire to form a workpiece and to bring the forming tool 44 into engagement with the workpiece to retain it against accidental displacement from said pins, at which time, the kink forming punch is brought into operation assuming that the kink is desired, and this position of the parts is seen in Fig. 11 of the drawing. The next step consists in raising the tool 44 and rotating the members 40b and 40c to form the small loops 31d at the ends of the workpiece, and further to bring the central part of the workpiece into engagement with the mandrel 45, this position of the parts being seen in Fig 12 of the drawing. In the next step of the cycle of operation the forming tool 44 advances still further upwardly and wraps the wire around the mandrel to form the large loop 31e and to bring the small loops 31d in alignment with the mounting strand 48 as seen in Fig. 13 of the drawing. The crimping jaws 50 are then advanced to partially crimp the workpiece around the mandrel and the small loops 31d around the strand 48 as seen in Fig. 14. The punch 53 is then brought downwardly to securely force the loops 31d onto the mounting strand 48 as seen in Fig. 15, after which the crimping jaws 50 are again brought into engagement with the workpiece to firmly crimp the same intermediate the large loop and the small loops on the strand, thus fixedly retaining the links to the strand, which operation is indicated in Fig. 16 of the drawing. The last operation in the cycle consists in feeding or advancing the formed link as well as the mounting strand on the mandrel by its rotation in order to permit the formation of another link in the manner above described. As a matter of fact, the feeding operation of the finished link takes place at the same time that the end of the wire is fed into position to be sheared off to form another workpiece, in order that there will be no lost motion in the machine operation, it being understood that the operation of the mandrel can take place at any time between the operations seen in Figs. 10 to 12 inclusive. It will also be understood that in the above described operation of raising the tool 44 from the position shown in Fig. 12 to that shown in Fig. 13, the pins 39 and 39a are withdrawn or moved backwardly to permit the upward movement of the workpiece over the outer face of the members 40b and 40c. It will also be understood that after a predetermined number of links have been mounted upon the strand 48 which may be governed by the number of links in the chain 36b, the blocks 36a on said chain will operate to advance the shoe 36 to put the wire feed mechanism out of operation and to hold the same in inoperative position for a period which will govern the length of the space desired between the groups of links arranged on the mounting strand. As soon as all of the blocks 36a have passed over the roller 36e, the wire feed mechanism will be returned to its normal or operative position and will continue to feed the wire into the machine to permit the formation of the links.

It will be understood that while I have shown and described the formation of the links of stringers of specific construction, that my improved machine or apparatus is not necessarily limited to the particular type of link formation herein set out nor am I necessarily limited to the specific structure of the several parts of the apparatus nor the mode or ratio of gearing employed, and various other changes in and modifications of the construction herein shown and described may be made within the scope of the appended claims without departing from the spirit of my invention or sacrificing its advantages.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. An apparatus of the class described comprising means for feeding a wire strand into the machine, means for shearing a workpiece from said strand, means for forming loops at the ends of said workpiece, a mandrel, means for bending the workpiece around the mandrel to form a large central loop therein, means for supporting a mounting strand in parallel relation to said mandrel, and means for placing the small loops of the workpiece onto said strand and securing the same thereto.

2. An apparatus of the class described comprising means for feeding a wire strand into the machine, means for shearing a workpiece from said strand, means for forming loops at the ends of said workpiece, a mandrel, means for bending the workpiece around the mandrel to form a large central loop therein, means for supporting a mounting strand in parallel relation to said mandrel, and means for placing the small loops of the workpiece onto said strand and securing the same thereto, said last named means involving lateral crimping tools.

3. An apparatus of the class described comprising means for feeding a wire strand into the machine, means for shearing a workpiece from said strand, means for forming loops at the ends of said workpiece, a mandrel, means for bending the workpiece around the mandrel to form a large central loop therein, means for supporting a mounting strand in parallel relation to said mandrel, and means for placing the small loops of the workpiece onto said strand and securing the same thereto, said last named means involving lateral crimping tools, and a vertical punch.

4. An apparatus of the class described comprising means for feeding a wire strand into the machine, means for shearing a workpiece from said strand, means for forming loops at the ends of said workpiece, a mandrel, means for bending the workpiece around the mandrel to form a large central loop therein, means for supporting a mounting strand in parallel relation to said mandrel, means for placing the small loops of the workpiece onto said strand and securing the same thereto, said last named means involving lateral crimping tools, and a vertical punch, and said mandrel having a threaded surface on which the workpiece is formed whereby the rotation of the mandrel will feed the finished workpiece and mounting strand outwardly through the machine.

5. An apparatus of the class described comprising means for feeding a wire strand into the machine, means for shearing a workpiece from said strand, means for forming loops at the ends of said workpiece, a mandrel, means for bending the workpiece around the mandrel to form a large central loop therein, means for supporting a mounting strand in parallel relation to said mandrel, means for placing the small loops of the workpiece onto said strand and securing the same thereto, said last named means involving lateral crimping tools, and a vertical punch, said mandrel having a threaded surface on which the workpiece is formed whereby the rotation of the mandrel will feed the finished workpiece and mounting strand outwardly through the machine, and the pitch of the threads on the mandrel serving to give the required pitch to the large loop formed in the workpiece.

6. An apparatus of the class described comprising means for feeding a wire strand into the machine, means for shearing a workpiece from said strand, means for forming loops at the ends of said workpiece, a mandrel, means for bending the workpiece around the mandrel to form a large central loop therein, means for supporting a mounting strand in parallel relation to said mandrel, means for placing the small loops of the workpiece onto said strand and securing the same thereto, said last named means involving lateral crimping tools, and a vertical punch, said mandrel having a threaded surface on which the workpiece is formed whereby the rotation of the mandrel will feed the finished workpiece and mounting strand outwardly through the machine, and the pitch of the threads on the mandrel serving to give the required pitch to the large loop formed in the workpiece, and to properly space said loops with relation to each other.

7. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link having a projecting loop portion and looped ends pressed onto said strand to secure the same against displacement therefrom.

8. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link mounted on and secured to said strand and having a projecting loop portion and for securing a predetermined number of such links to the strand with that part of the links on the strand in abutting relation.

9. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link mounted on and secured to said strand and having a projecting loop portion and for securing a predetermined number of such links to the strand with that part of the links on the strand in abutting relation, and means whereby a blank space of predetermined dimensions may be formed between separate groups of links secured to said strand.

10. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link mounted on and secured to said strand and having a projecting loop portion,

said mechanisms including a forming tool, and a pair of curling tools forming small loops at the ends of the workpiece.

11. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link mounted on and secured to said strand and having a projecting loop portion, said mechanisms including a forming tool, a pair of curling tools forming small loops at the ends of the workpiece, and oppositely disposed crimping jaws.

12. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link mounted on and secured to said strand and having a projecting loop portion, said mechanisms including a forming tool, a pair of curling tools forming small loops at the ends of the workpiece, oppositely disposed crimping jaws, and a punch for securing the small loops to said mounting strand.

13. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link mounted on and secured to said strand and having a projecting loop portion, said mechanisms including a forming tool, a pair of curling tools forming small loops at the ends of the workpiece, oppositely disposed crimping jaws, a punch for securing the small loops to said mounting strand, and a mandrel around which the central portion of the workpiece is passed by said forming tool, producing a large loop in said workpiece.

14. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link mounted on and secured to said strand and having a projecting loop portion, said mechanisms including a forming tool, a pair of curling tools forming small loops at the ends of the workpiece, oppositely disposed crimping jaws, a punch for securing the small loops to said mounting strand, a mandrel around which the central portion of the workpiece is passed by said forming tool, producing a large loop in said workpiece, and means involving a power driven shaft and a plurality of cams on said shaft for actuating the several mechanisms of the machine.

15. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving several mechanisms for feeding a wire into the machine, severing a workpiece from said wire and fashioning the workpiece to form a link mounted on and secured to said strand and having a projecting loop portion, said mechanisms including a forming tool, a pair of curling tools forming small loops at the ends of the workpiece, oppositely disposed crimping jaws, a punch for securing the small loops to said mounting strand, a mandrel around which the central portion of the workpiece is passed by said forming tool, producing a large loop in said workpiece, means involving a power-driven shaft and a plurality of cams on said shaft for actuating the several mechanisms of the machine, and means in operative connection with said shaft for rotating the mandrel to feed the finished workpiece and mounting strand outwardly through the machine.

16. In a machine of the class described, a wire feed mechanism comprising relatively movable jaws between which the wire to be fed into the machine is positioned, means for closing said jaws to engage the wire and to advance said jaws and wire to bring the wire into predetermined position in the machine in one movement of said mechanism.

17. In a machine of the class described, a wire feed mechanism comprising relatively movable jaws between which the wire to be fed into the machine is positioned, means for closing said jaws to engage the wire and to advance said jaws and wire to bring the wire into predetermined position in the machine in one movement of said mechanism, and in the other movement of said mechanism, said jaws are moved into inoperative position and longitudinally of the wire.

18. In a machine of the class described, a wire feed mechanism comprising relatively movable jaws between which the wire to be fed into the machine is positioned, means for closing said jaws to engage the wire and to advance said jaws and wire to bring the wire into predetermined position in the machine in one movement of said mechanism, and in the other movement of said mechanism, said jaws are moved into inoperative position and longitudinally of the wire, and means cooperating with said mechanism for retaining the same in inoperative position through a predetermined number of cycles of operation of the machine.

19. In a machine of the class described, a pair of rotary, oscillatory members provided at one end with pairs of projecting pins between which a strand of wire is adapted to be placed, one of the pins of each member being arranged axially therof, means for rotating said members in opposite directions to curl the ends of said wire strand around

said axial pins by the other of said pins, to form loops at the end of said strand.

20. In a machine of the class described, a pair of rotary, oscillatory members provided at one end with pairs of projecting pins between which a strand of wire is adapted to be placed, one of the pins of each member being arranged axially thereof, means for rotating said members in opposite directions to curl the ends of said wire strand around said axial pins by the other of said pins, to form loops at the ends of said strand, and means for withdrawing said axial pins to permit of the movement of said strand over the surface of said members into a different position in the machine.

21. In a machine of the class described, a mandrel and feed screw, means for imparting intermittent rotary movement thereto, means for passing a wire strand around said mandrel to form of said strand, a link having a loop therein, and means whereby the rotation of the mandrel will feed said link out through the machine.

22. In a machine of the class described, a mandrel and feed screw, means for imparting intermittent rotary movement thereto, means for passing a wire strand around said mandrel to form of said strand, a link having a loop therein, means whereby the rotation of the mandrel will feed said link out through the machine, and means for supporting a flexible strand in juxtaposition to and longitudinally of the axis of the mandrel.

23. In a machine of the class described, a mandrel and feed screw, means for imparting intermittent rotary movement thereto, means for passing a wire strand around said mandrel to form of said strand, a link having a loop therein, means whereby the rotation of the mandrel will feed said link out through the machine, means for supporting a flexible strand in juxtaposition to and longitudinally of the axis of the mandrel, and means for compressing portions of the wire strand onto said flexible strand in the formation of said links.

24. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, and means for straightening the wire fed into the machine and for applying tension thereto.

25. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, means for cutting off a predetermined length of wire to form a workpiece, said means being actuated by another of said cams, and a forming tool movable transversely of the longitudinal plane of the workpiece and into engagement therewith and adapted to form in the completion of its operation, a large loop centrally of said workpiece, said tool being actuated by another of said cams.

26. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, means for cutting off a predetermined length of wire to form a workpiece, said means being actuated by another of said cams, and means for curling the ends of the workpiece to form small loops on said ends, said means being actuated by another of said cams.

27. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, means for cutting off a predetermined length of wire to form a workpiece, said means being actuated by another of said cams, means for curling the ends of the workpiece to form small loops on said ends, said means being actuated by another of said cams, and a mandrel in connection with which the workpiece and said forming tool operates, said mandrel having a screw portion around which the workpiece is folded to form said loop, and means in operative connection with said power driven shaft for imparting intermittent rotary movement to said mandrel to discharge the fashioned workpieces from the machine.

28. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, means for cutting off a predetermined length of wire to form a workpiece, said means being actuated by another of said cams, means for curling the ends of the workpiece to form small loops on said ends, said means being actuated by another of said cams, a mandrel in connection with which the workpiece and said forming tool operates, said mandrel having a screw portion around which the workpiece is folded to form said loop, and means in operative connection with said power driven shaft for imparting intermittent rotary movement of said mandrel to discharge the fashioned workpieces from the machine, crimping jaws movable toward and from each other in juxtaposition to the mandrel and adapted to engage the workpiece to bring the looped ends in common alinement, said jaws being actuated by another of said cams, and means for supporting a flexible strand in spaced and parallel relation to said man-

drel and in position to enter the loops of the workpiece when brought together.

29. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, means for cutting off a predetermined length of wire to form a workpiece, said means being actuated by another of said cams, means for curling the ends of the workpiece to form small loops on said ends, said means being actuated by another of said cams, a mandrel in connection with which the workpiece and said forming tool operates, said mandrel having a screw portion around which the workpiece is folded to form said loop, and means in operative connection with said power driven shaft for imparting intermittent rotary movement to said mandrel to discharge the fashioned workpieces from the machine, crimping jaws movable toward and from each other in juxtaposition to the mandrel and adapted to engage the workpiece to bring the looped ends in common alinement, said jaws being actuated by another of said cams, means for supporting a flexible strand in spaced and parallel relation to said mandrel and in position to enter the loops of the workpiece when brought together, and means involving a punch and said crimping jaws for firmly compressing the loops of the workpiece on said mounting strand.

30. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, means for cutting off a predetermined length of wire to form a workpiece, said means being actuated by another of said cams, means for curling the ends of the workpiece to form small loops on said ends, said means being actuated by another of said cams, a mandrel in connection with which the workpiece and said forming tool operates, said mandrel having a screw portion around which the workpiece is folded to form said loop, and means in operative connection with said power driven shaft for imparting intermittent rotary movement to said mandrel to discharge the fashioned workpieces from the machine, crimping jaws movable toward and from each other in juxtaposition to the mandrel and adapted to engage the workpiece to bring the looped ends in common alinement, said jaws being actuated by another of said cams, means for supporting a flexible strand in spaced and parallel relation to said mandrel and in position to enter the loops of the workpiece when brought together, and means involving a punch and said crimping jaws for firmly compressing the loops of the workpiece on said mounting strand, said punch being actuated by another of said cams.

31. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, means for cutting off a predetermined length of wire to form a workpiece, said means being actuated by another of said cams, means for curling the ends of the workpiece to form small loops on said ends, said means being actuated by another of said cams, a mandrel in connection with which the workpiece and said forming tool operates, said mandrel having a screw portion around which the workpiece is folded to form said loop, and means in operative connection with said power driven shaft for imparting intermittent rotary movement to said mandrel to discharge the fashioned workpieces from the machine, crimping jaws movable toward and from each other in juxtaposition to the mandrel and adapted to engage the workpiece to bring the looped ends in common alinement, said jaws being actuated by another of said cams, means for supporting a flexible strand in spaced and parallel relation to said mandrel and in position to enter the loops of the workpiece when brought together, means involving a punch and said crimping jaws for firmly compressing the loops of the workpiece on said mounting strand, said punch being actuated by another of said cams, and means cooperating with said first named means for rendering the same inoperative for a predetermined number of cycles of operation of the machine.

32. A machine of the class described comprising a power driven shaft, a plurality of cams on said shaft, means for intermittently feeding wire into predetermined position in the machine, said means being actuated by one of the cams on said shaft, means for cutting off a predetermined length of wire to form a workpiece, said means being actuated by another of said cams, means for curling the ends of the workpiece to form small loops on said ends, said means being actuated by another of said cams, a mandrel in connection with which the workpiece and said forming tool operates, said mandrel having a screw portion around which the workpiece is folded to form said loop, and means in operative connection with said power driven shaft for imparting intermittent rotary movement to said mandrel to discharge the fashioned workpieces from the machine, crimping jaws movable toward and from each other in juxtaposition to the mandrel and adapted to engage the workpiece to bring the looped ends in common alinement, said jaws being actuated by another of said cams, means for supporting a flexible strand in spaced and parallel relation to said mandrel and in position to

enter the loops of the workpiece when brought together, means involving a punch and said crimping jaws for firmly compressing the loops of the workpiece on said mounting strand, said punch being actuated by another of said cams, and means for forming a ring in the central portion of the workpiece prior to the formation of the several loops therein, said means being actuated by another of said cams.

33. In a machine of the class described, a mandrel, a forming tool movable toward and from said mandrel, a punch movable toward and from said mandrel in the same plane but opposite direction from that of said forming tool, means for actuating said tool and punch, crimping jaws movable toward and from each other at opposite sides of and in juxtaposition to said mandrel, and means for actuating said jaws, and rotary oscillatory curling tools disposed at opposite sides of and in the path of travel of said forming tool, and means for rotating said curling tools in opposite directions.

34. In a machine of the class described employing rotary, oscillatory, curling tools having pairs of pins, means for feeding a strand of wire between the pins of said tools, means for severing the strand to form a workpiece of predetermined length, the ends of which project a predetermined distance beyond the pins of said tools, and means for rotating said curling tools in opposite directions to curl the ends of said workpiece to form loop members on said ends.

35. In a machine of the class described employing rotary, oscillatory, curling tools having pairs of pins, means for feeding a strand of wire between the pins of said tools, means for severing the strand to form a workpiece of predetermined length, the ends of which project a predetermined distance beyond the pins of said tools, means for rotating said curling tools in opposite directions to curl the ends of said workpiece to form loop members on said ends, and a forming tool movable between one of the pins of each of said curling tools and adapted to offset the central part of the workpiece in said curling operation.

36. In a machine of the class described employing rotary, oscillatory, curling tools having pairs of pins, means for feeding a strand of wire between the pins of said tools, means for severing the strand to form a workpiece of predetermined length, the ends of which project a predetermined distance beyond the pins of said tools, means for rotating said curling tools in opposite direction to curl the ends of said workpiece to form loop members on said ends, a forming tool movable between one of the pins of each of said curling tools and adapted to offset the central part of the workpiece in said curling operation, a mandrel in the path of said forming tool, whereby in the advanced movement of said tool, the central portion of the workpiece is folded around the mandrel to form a central loop and the end loops of the workpiece are disposed in opposite relation.

37. In a machine of the class described employing rotary, oscillatory, curling tools having pairs of pins, means for feeding a strand of wire between the pins of said tools, means for severing the strand to form a workpiece of predetermined length, the ends of which project a predetermined distance beyond the pins of said tools, means for rotating said curling tools in opposite directions to curl the ends of said workpiece to form loop members on said ends, a forming tool movable between one of the pins of each of said curling tools and adapted to offset the central part of the workpiece in said curling operation, a mandrel in the path of said forming tool, whereby in the advanced movement of said tool, the central portion of the workpiece is folded around the mandrel to form a central loop and the end loops of the workpiece are disposed in opposite relation, and means on the mandrel for positioning the workpiece thereon.

38. In a machine of the class described employing rotary, oscillatory, curling tools having pairs of pins, means for feeding a strand of wire between the pins of said tools, means for severing the strand to form a workpiece of predetermined length, the ends of which project a predetermined distance beyond the pins of said tools, means for rotating said curling tools in opposite directions to curl the ends of said workpiece to form loop members on said ends, a forming tool movable between one of the pins of each of said curling tools and adapted to offset the central part of the workpiece in said curling operation, a mandrel in the path of said forming tool, whereby in the advanced movement of said tool, the central portion of the workpiece is folded around the mandrel to form a central loop and the end loops of the workpiece are disposed in opposite relation, means on the mandrel for positioning the workpiece thereon, means for supporting a mounting strand in juxtaposition and parallel relation to the mandrel, and crimping jaws for moving the looped ends of the workpiece toward each other and to bring said mounting strand within said loops.

39. In a machine of the class described employing rotary, oscillatory, curling tools having pairs of pins, means for feeding a strand of wire between the pins of said tools, means for severing the strand to form a workpiece of predetermined length, the ends of which project a predetermined distance beyond the pins of said tools, means for rotating said curling tools in opposite directions to curl the ends of said workpiece to form loop members on said ends, a forming tool movable between

one of the pins of each of said curling tools and adapted to offset the central part of the workpiece in said curling operation, a mandrel in the path of said forming tool, whereby in the advanced movement of said tool, the central portion of the workpiece is folded around the mandrel to form a central loop and the end loops of the workpiece are disposed in opposite relation, means on the mandrel for positioning the workpiece thereon, means for supporting a mounting strand in juxtaposition and parallel relation to the mandrel, and crimping jaws for moving the looped ends of the workpiece toward each other and to bring said mounting strand within said loops, and a punch movable at right angles to said crimping jaws and adapted to engage the loops on said mounting strand to firmly compress the same thereon, and to secure the same thereto.

40. In a machine of the class described employing rotary, oscillatory, curling tools having pairs of pins, means for feeding a strand of wire between the pins of said tools, means for severing the strand to form a workpiece of predetermined length, the ends of which project a predetermined distance beyond the pins of said tools, means for rotating said curling tools in opposite directions to curl the ends of said workpiece to form loop members on said ends, a forming tool movable between one of the pins of each of said curling tools and adapted to offset the central part of the workpiece in said curling operation, a mandrel in the path of said forming tool, whereby in the advanced movement of said tool, the central portion of the workpiece is folded around the mandrel to form a central loop and the end loops of the workpiece are disposed in opposite relation, means on the mandrel for positioning the workpiece thereon, means for supporting a mounting strand in juxtaposition and parallel relation to the mandrel, and crimping jaws for moving the looped ends of the workpiece toward each other and to bring said mounting strand within said loops, a punch movable at right angles to said crimping jaws and adapted to engage the loops on said mounting strand to firmly compress the same thereon, and to secure the same thereto, and means for intermittently rotating the mandrel to feed the finished workpiece and said mounting strand out through the machine.

41. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, said wire feeding means involving a lever having a jaw at one end between which and a fixed jaw, the wire is adapted to be grasped in the feeding of the wire into the machine, and a shoe adapted to be moved into the path of movement of the other end of said lever to retain the same in inoperative position for a predetermined number of cycles of operation of the machine.

42. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, said wire feeding means involving a lever having a jaw at one end between which and a fixed jaw, the wire is adapted to be grasped in the feeding of the wire into the machine, a shoe adapted to be moved into the path of movement of the other end of said lever to retain the same in inoperative position for a predetermined number of cycles of operation of the machine, the means for actuating said shoe being in operative connection with the power driven shaft and includes an endless chain, and a plurality of blocks on said chain for actuating said shoe and for holding the same in operative position.

43. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, a wire shearing tool adapted to sever workpieces of predetermined length from the wire strand fed into the machine, said tool being adjustably supported in a block slidably mounted in the machine, and a cam on said driven shaft and in connection with which the block operates for actuating said tool.

44. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, a wire shearing tool adapted to sever workpieces of predetermined length from the wire strand fed into the machine, said tool being adjustably supported in a block slidably mounted in the machine and a cam on said driven shaft and in connection with which the block operates for actuating said tool, a forming tool in juxtaposition to said shearing tool and adjustably supported on a block slidably mounted in the machine, said tool being adapted to engage the workpiece and to aid in forming a loop therein, and a cam on the driven shaft, in connection with which the last named block operates for imparting movement to said forming tool.

45. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted

in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, a wire shearing tool adapted to sever workpieces of predetermined length from the wire strand fed into the machine, said tool being adjustably supported in a block slidably mounted in the machine and a cam on said driven shaft and in connection with which the block operates for actuating said tool, a forming tool in juxtaposition to said shearing tool and adjustably supported on a block slidably mounted in the machine, said tool being adapted to engage the workpiece and to aid in forming a loop therein, and a cam on the driven shaft, in connection with which the last named block operates for imparting movement to said forming tool, workpiece supporting and curling tools into which the wire strand is fed, means in operative connection with another cam on said drive shaft for imparting rotary, oscillatory movement to said curling tools in opposite directions for forming small loops on the ends of the workpiece, and said forming tools including means for releasing the workpiece after the small loops have been formed therein.

46. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, a wire shearing tool adapted to sever workpieces of predetermined length from the wire strand fed into the machine, said tool being adjustably supported in a block slidably mounted in the machine and a cam on said driven shaft and in connection with which the block operates for actuating said tool, a forming tool in juxtaposition to said shearing tool and adjustably supported on a block slidably mounted in the machine, said tool being adapted to engage the workpiece and to aid in forming a loop therein, and a cam on the driven shaft, in connection with which the last named block operates for imparting movement to said forming tool, workpiece supporting and curling tools into which the wire strand is fed, means in operative connection with another cam on said drive shaft for imparting rotary, oscillatory movement to said curling tools in opposite directions for forming small loops on the ends of the workpiece, and said forming tools including means for releasing the workpiece after the small loops have been formed therein, a mandrel supported in the path of movement of said forming tool and around which the wire is passed by said forming tool to form a large central loop in said workpiece, and said mandrel having a threaded portion on which the workpiece is fashioned whereby when a complete link is formed of said workpiece the same may be discharged from the machine by the rotation of said mandrel.

47. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, a wire shearing tool adapted to sever workpieces of predetermined length from the wire strand fed into the machine, said tool being adjustably supported in a block slidably mounted in the machine and a cam on said driven shaft and in connection with which the block operates for actuating said tool, a forming tool in juxtaposition to said shearing tool and adjustably supported on a block slidably mounted in the machine, said tool being adapted to engage the workpiece and to aid in forming a loop therein, and a cam on the driven shaft, in connection with which the last named block operates for imparting movement to said forming tool, workpiece supporting and curling tools into which the wire strand is fed, means in operative connection with another cam on said driven shaft for imparting rotary, oscillatory movement to said curling tools in opposite directions for forming small loops on the ends of the workpiece, and said forming tools including means for releasing the workpiece after the small loops have been formed therein, a mandrel supported in the path of movement of said forming tool and around which the wire is passed by said forming tool to form a large central loop in said workpiece, and said mandrel having a threaded portion on which the workpiece is fashioned whereby when a complete link is formed of said workpiece the same may be discharged from the machine by the rotation of said mandrel, and means involving a rack actuated by a cam on the power driven shaft for imparting intermittent rotary movement in one direction to said mandrel.

48. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, a wire shearing tool adapted to sever workpieces of predetermined length from the wire strand fed into the machine, said tool being adjustably supported in a block slidably mounted in the machine and a cam on said driven shaft and in connection with which the block operates for actuating said tool, a forming tool in juxtaposition to said shearing tool and adjustably supported on a block slidably mounted in the machine, said tool being adapted to engage the workpiece and

to aid in forming a loop therein, and a cam on the driven shaft in connection with which the last named block operates for imparting movement to said forming tool, workpiece supporting and curling tools into which the wire strand is fed, means in operative connection with another cam on said driven shaft for imparting rotary, oscillatory movement to said curling tools in opposite directions for forming small loops on the ends of the workpiece, and said forming tools including means for releasing the workpiece after the small loops have been formed therein, a mandrel supported in the path of movement of said forming tool and around which the wire is passed by said forming tool to form a large central loop in said workpiece, and said mandrel having a threaded portion on which the workpiece is fashioned whereby when a complete link is formed of said workpiece, the same may be discharged from the machine by the rotation of said mandrel, means involving a rack actuated by a cam on the power driven shaft for imparting intermittent rotary movement in one direction to said mandrel, said last named means including a shaft supported in the bearings of the machine, and geared to said mandrel, a clutch collar on said shaft, and a pinion actuated by said rack and cooperating with said clutch collar for rotating said shaft in one direction only.

49. A machine of the class described comprising a base plate, a plurality of bearings on said plate, a power driven shaft mounted in said bearings, means for intermittently feeding an endless strand of wire into the machine, means involving a cam on said shaft for actuating said wire feeding means, a wire shearing tool adapted to sever workpieces of predetermined length from the wire strand fed into the machine, said tool being adjustably supported in a block slidably mounted in the machine and a cam on said driven shaft and in connection with which the block operates for actuating said tool, a forming tool in juxtaposition to said shearing tool and adjustably supported on a block slidably mounted in the machine, said tool being adapted to engage the workpiece and to aid in forming a loop therein, and a cam on the driven shaft in connection with which the last named block operates for imparting movement to said forming tool, workpiece supporting and curling tools into which the wire strand is fed, means in operative connection with another cam on said driven shaft for imparting rotary, oscillatory movement to said curling tools in opposite directions for forming small loops on the ends of the workpiece, and said forming tools including means for releasing the workpiece after the small loops have been formed therein, a mandrel supported in the path of movement of said forming tool and around which the wire is passed by said forming tool to form a large central loop in said workpiece, and said mandrel having a threaded portion on which the workpiece is fashioned whereby when a complete link is formed of said workpiece, the same may be discharged from the machine by the rotation of said mandrel, means involving a rack actuated by a cam on the power driven shaft for imparting intermittent rotary movement in one direction to said mandrel, said last named means including a shaft supported in the bearings of the machine and geared to said mandrel, a clutch collar on said shaft and a pinion actuated by said rack and cooperating with said clutch collar for rotating said shaft in one direction only, means for supporting a flexible strand in spaced and parallel relation to the mandrel and in position to be engaged by the small loops of the workpiece, and means for moving said small loops onto said strand and for compressing the same thereon to fixedly retain the same in connection therewith.

50. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving a plurality of successively operated tools for forming links, and for pressing said links on said strand to firmly secure the same thereto, and including means for feeding the links and strand outwardly through the machine.

51. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine, and means involving a plurality of successively operated tools for forming links and for pressing said links on said strand to firmly secure the same thereto, and including means for feeding the links and strand outwardly through the machine, the links being arranged in groups on said strand, and means controlling the formation of spaces on said strand between said groups.

52. A machine for forming flexible stringers comprising means for supporting a flexible strand in the machine and means involving a plurality of successively operated tools for forming links and for securing said links to said strand, and including means for feeding the links and strand outwardly through the machine, the links being arranged in groups on said strand, and means controlling the formation of spaces on said strand, said last named means also controlling the number of links in each group on said strand.

In testimony that I claim the foregoing as my invention I have signed my name this 30th day of September, 1926.

LOUIS H. MORIN.