J. E. McCRUDDEN.

AUTOMATIC BEAD STRINGING AND LINKING MACHINE.

APPLICATION FILED APR. 28, 1915.

1,205,233.

Patented Nov. 21, 1916.

6 SHEETS—SHEET 1.

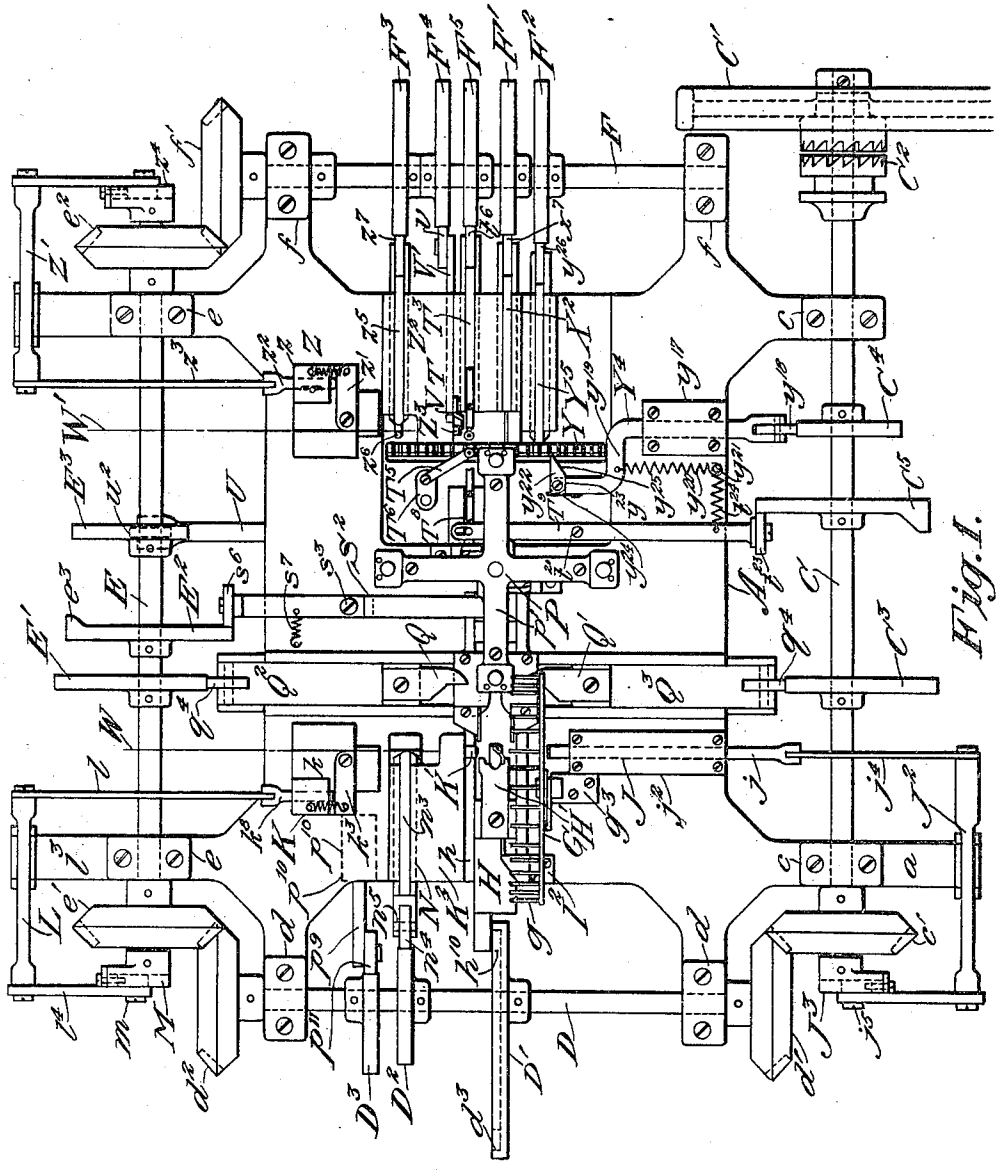


Fig. 1.

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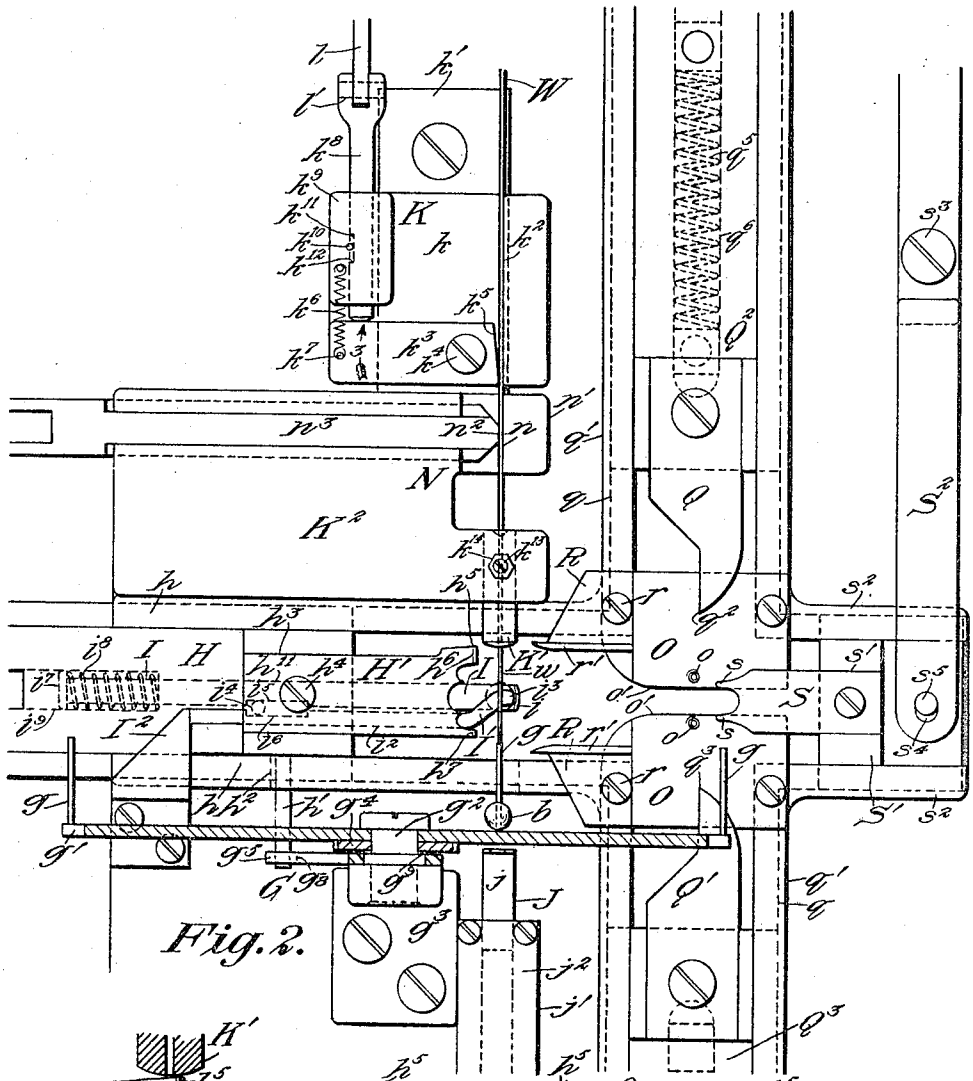


Fig. 2.

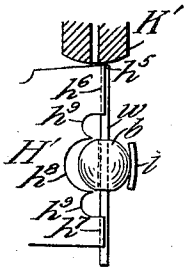


Fig. 3.

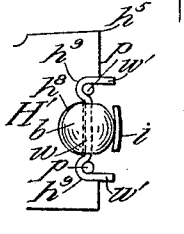


Fig. 4.

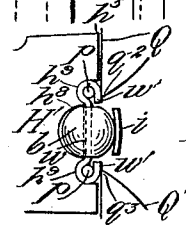


Fig. 5.

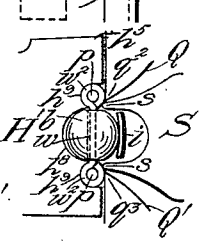


Fig. 6.

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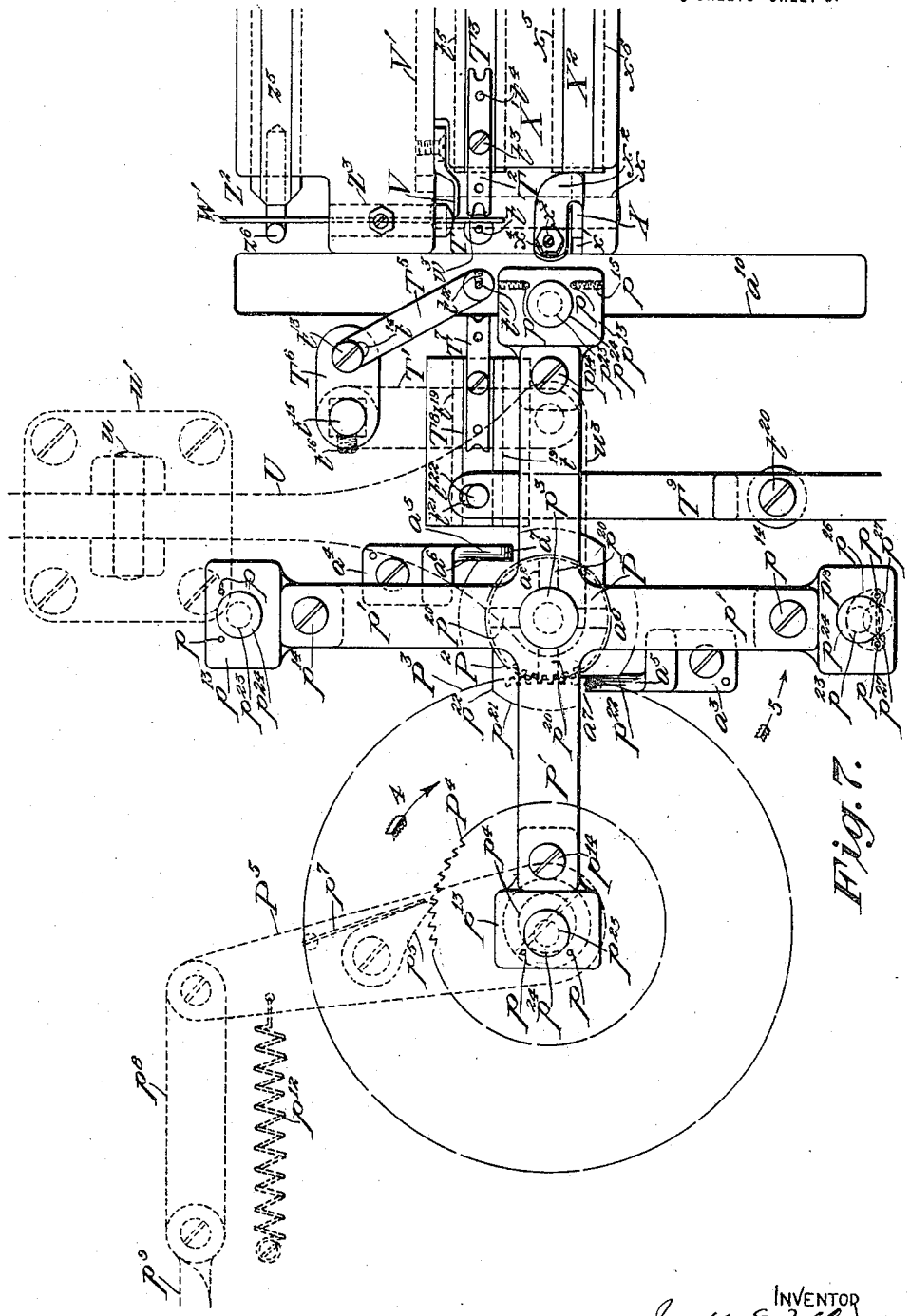


Fig. 7.

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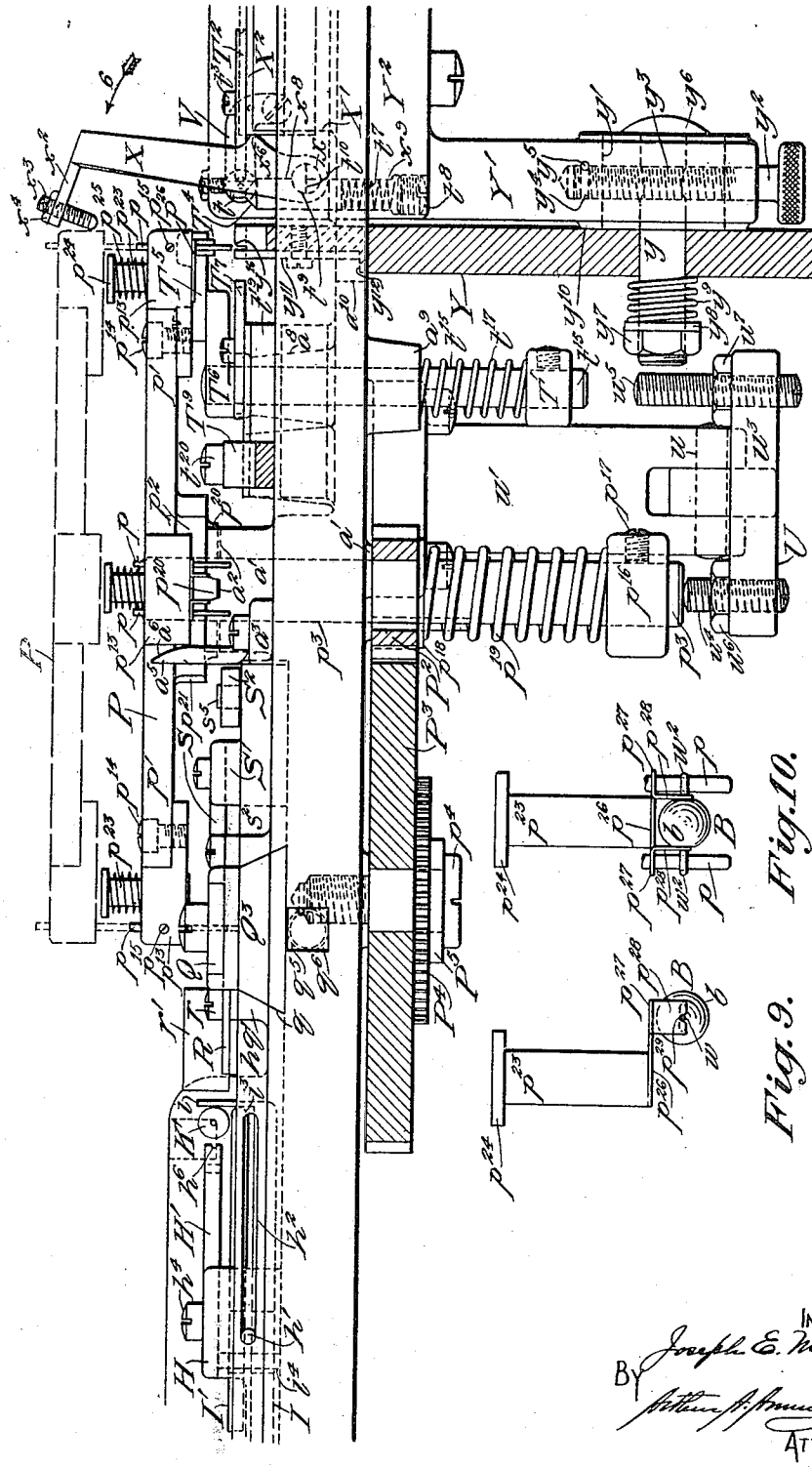


Fig. 8.

Fig. 10.

Fig. 9.

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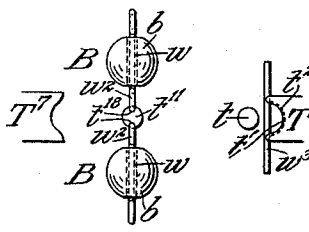


Fig. 11.

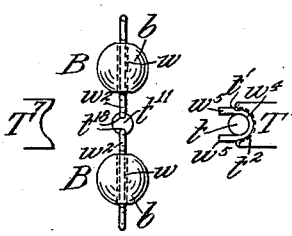


Fig. 12.

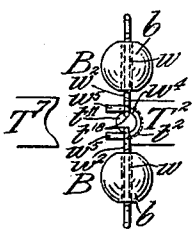


Fig. 13.

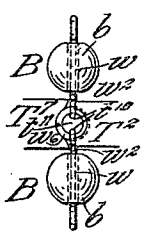


Fig. 14.

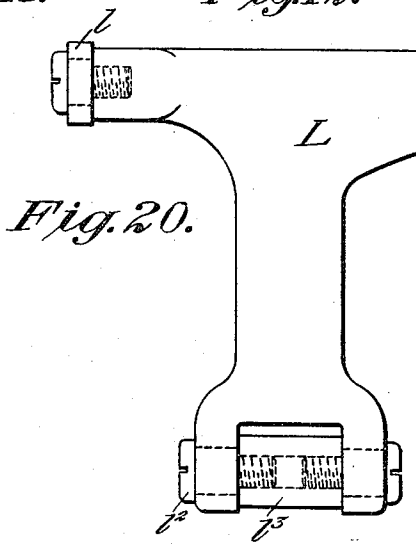


Fig. 20.

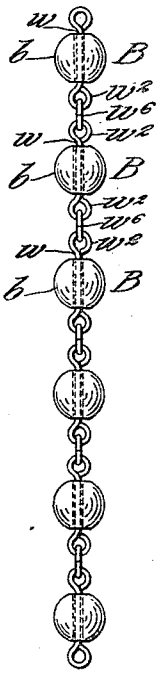


Fig. 22.

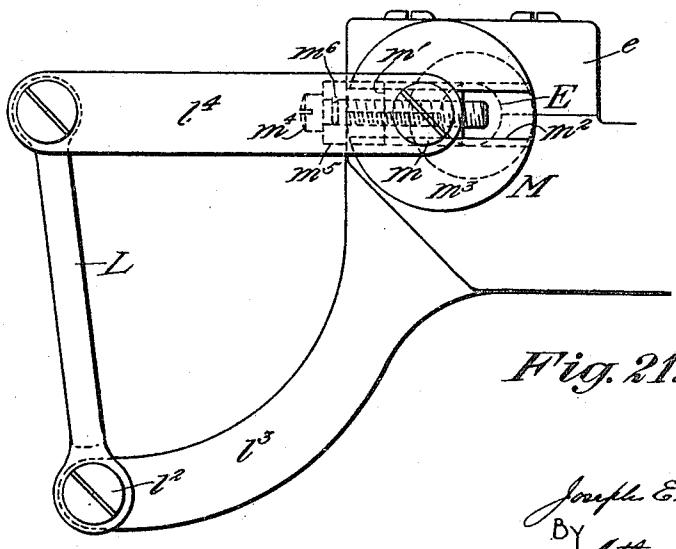


Fig. 21.

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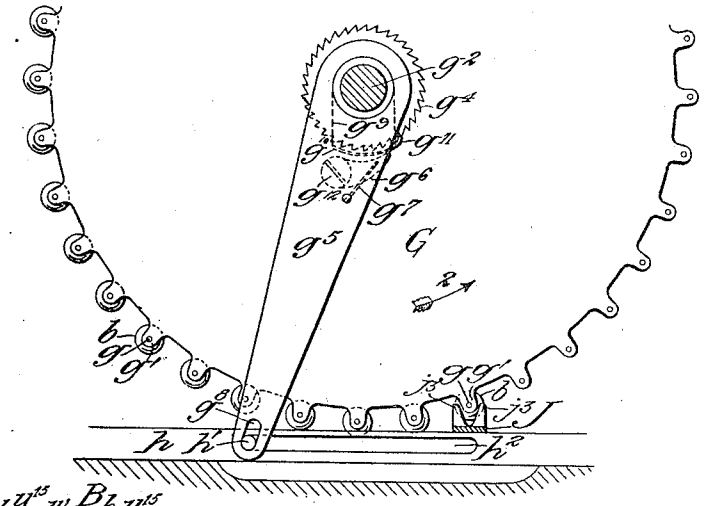


Fig. 15.

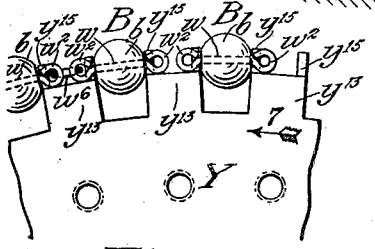


Fig. 18.



Fig. 16.

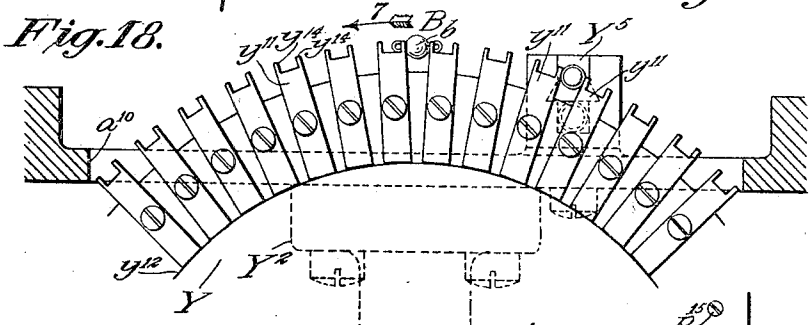


Fig. 17.

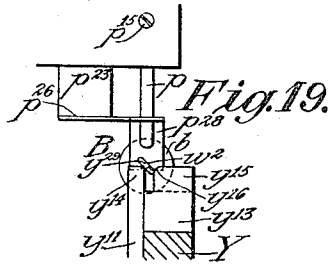


Fig. 19.

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UNITED STATES PATENT OFFICE.

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AUTOMATIC BEAD STRINGING AND LINKING MACHINE.

1,205,233. Specification of Letters Patent. Patented Nov. 21, 1916.

Application filed April 28, 1915. Serial No. 24,568.

To all whom it may concern:

Be it known that I, JOSEPH E. McCRUDDEN, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Automatic Bead Stringing and Linking Machines, of which the following is a specification.

My invention is an improved bead-stringing and linking machine for producing beaded chains, ornamental necklaces, chaplets, rosaries or other like articles.

The object of my improvement is to provide an automatically-operated mechanism for stringing beads or other pierced ornaments on wire, forming the wire with end loops and finally linking the strung beads together to form the chain or necklace.

The preferred manner and means for carrying out my improvement are fully described in the following specification, illustrated by the accompanying drawings, in which like reference characters designate like parts.

In the drawings, Figure 1 is a general, plan view of the several organized mechanisms of my new machine; Fig. 2, an enlarged, plan view of the primary wire-feeding device, the correlated bead-feeding and stringing-means and the wire-forming mechanism; Figs. 3, 4, 5 and 6, still further enlarged, detail views of the wire-forming mechanism showing the manner in which it operates to form the loops at the end of a section of the wire strung through a bead; Fig. 7, an enlarged, plan view of the central conveyer or transferrer which operates to transfer the strung beads from the stringing and wire-forming mechanism to the linking-mechanism which is also here illustrated; Fig. 8, an enlarged elevation of the bead-transferrer, showing its relation to the wire-forming and link-forming mechanisms; Figs. 9 and 10, enlarged detail views of the bead-ejector means which delivers the bead-links from the transferrer to the linking-mechanism; Figs. 11, 12, 13 and 14, enlarged detail views of the link-forming tools showing them at different stages of their operation; Fig. 15, an enlarged elevation of the bead-magazine or feeding-device; Fig. 16, a detail view in perspective of a portion of the controlling-means therefor; Fig. 17, an enlarged elevation of the conveyer or bead-link feeding-device for feeding the strung beads into position to be linked together; Fig. 18, a still further enlarged, detail view of the same; Fig. 19, a similarly enlarged view of the transferrer ejector-device showing the method of delivering a bead-link from the transferrer to the conveyer; Figs. 20 and 21, enlarged detail views of a portion of the actuating device for the wire-feeding and bead-feeding mechanisms; and Fig. 22, an enlarged view of a section of the beaded chain produced in the machine.

My new machine comprises in general a series of coördinated mechanisms which are organized to coöperate as follows: First, there is a magazine or hopper for feeding beads into the machine; second, a primary wire-feeding device for feeding the wire into position to be strung through the beads and cut off in predetermined lengths; third, a means for transferring the beads from the magazine onto the wire-sections; fourth, a set of wire-forming tools with operating mechanism therefor for bending the ends of the bead-strung wires into loops; fifth, a transferrer or conveyer for transferring the strung beads and their formed wires to the linking-mechanism; sixth, a conveyer for receiving the strung beads from the transferrer and feeding them into position to be linked together; seventh, a secondary wire-feeding and cutting-off mechanism for delivering lengths of wire to the link-forming tools; and eighth, the chain-forming or linking-mechanism for linking the strung beads together in a continuous chain.

In order to simplify and clarify the explanation the several mechanisms of the apparatus will be described separately in the order of their operation after a general description of the driving-mechanism of the machine is outlined.

Referring first to Fig. 1, the several parts of the machine are preferably mounted on a horizontal plate or main bed A which may be supported in any suitable manner on legs or standards, not here shown. The four sides of the bed A are provided with overhanging bearings *c*—*c*, *d*—*d*, *e*—*e* and *f*—*f* for four quadrilaterally arranged shafts C, D, E and F. For the sake of convenience in describing the apparatus the

side of the bed on which the main driving-shaft C is positioned may be considered the front of the machine and C′ is the belt-pulley or driving-wheel which may be rotated from any suitable source of power through a belt, chain, gears or other means. The pulley C′ is connected to rotate the shaft C through any suitable clutch-mechanism such, for instance, as that shown at C^2, and usually a shipper-device is employed for throwing the clutch into and out of engagement, but this is not here illustrated as it may be of any conventional arrangement. The shaft C drives the shaft D through the bevel-gears c', d' and rotation is transmitted therefrom through the gears d^2, e' to the shaft E, which, in turn, drives the shaft F through the gears e^2 and f'. The shafts C, D, E and F carry four sets of cams for actuating the various associated mechanisms of the machine in regular sequence as more fully described hereinafter.

Near the front and left-hand side of the machine is the bead-feeding device or magazine G which is here shown in the form of a rotating disk or plate having bead-supporting pins g projecting from the sides of the ears g' arranged around its circumference as shown in Fig. 15. In this form it resembles somewhat the type of bobbin-magazine employed on automatic looms, but I also contemplate the use of other styles of feeders such, for instance, as a hopper into which the beads may be poured and from which they will issue one at a time as required. In the present embodiment the magazine G is mounted to rotate on a stud g^2, see Figs. 2 and 15, supported on a bracket or standard g^3 secured to the top of the bed-plate A. The beads b are placed on the pins g by hand or they might be fed into position by automatic-means if desired. The magazine G is rotated with a progressive, step-by-step motion to carry the beads into stringing position by means of a ratchet-disk g^4 constructed in the form of a toothed hub attached to its side. Pivoted on the stud g^2 is a lever g^5 carrying a pawl g^6 controlled by a spring g^7. The lever g^5 is adapted to be oscillated from the movement of a slide H, see Figs. 1 and 2, which also actuates the wire-cutting and forming tools as later described. The slide H reciprocates in parallel guideways h, h on the top of the plate A, and a pin h' projects through a slot h^2 in one of the guideways, see Fig. 15, and engages a slot g^8 in the end of the lever g^5. Referring still to Figs. 2 and 15, J is a pusher which acts to push the beads b off from the pins g after they have been brought into alinement therewith by the rotary movement of the magazine G. This rotary movement of the magazine is effected by the oscillation of the lever g^5 in the direction indicated by the arrow 2, Fig. 15, under the action of the slide H. The bead pins g are preferably placed quite close together around the periphery of the disk G, in order to provide for a maximum number in the supply, and therefore only a relatively slight movement of the magazine is required to carry the beads successively into position to be operated upon by the pusher J. The range of movement of the slide H is more than sufficient to effect this slight rotation of the magazine as required, and therefore I provide means for limiting the extent of movement of the magazine under the action of the lever g^5. As shown in Figs. 2 and 15 a thin plate g^9, illustrated in detail in Fig. 16, is mounted fast on the stud g^2 and its lower edge is bent over in a curved rim or flange g^{10} extending concentrically with the axis of the ratchet g^4. At one end the flange g^{10} is extended in a curved lip or finger g^{11} adapted to resiliently engage the teeth of the ratchet g^4 to prevent backward rotation of the magazine G. The pawl g^6 which acts to turn the magazine in the direction indicated by the arrow 2, Fig. 15, is pivoted on a screw g^{12} screwed into the lever g^5 and its end is adapted to ride on the outer face of the rim g^{10} of the member g^9. By adjusting the position of the plate g^9 about its axis the action of the pawl g^6 can be regulated to cause it to ride on the rim g^{10} through the greater part of its throw and to then ride off from the rim to engage with the teeth on the ratchet g^4 to turn the magazine G to the extent required.

Positioned to the left and near the back of the machine is the primary wire-feeding device shown at K in Figs. 1 and 2. This may be of any approved form as usually employed in wire-working machines, and as here illustrated comprises essentially a reciprocating gripper k. The gripper k is made in the form of a block adapted to slide on a spline or track k' fastened to or formed on the top of the bed A. Its upper face is provided with a raised shoulder or ledge k^2 against which the wire W is clamped by a gripping-lever k^3. The lever k^3 is pivoted on a stud k^4 and its engaging face k^5 is beveled rearwardly so that when it is rocked in the direction indicated by the arrow 3, Fig. 2, it will release the wire W from the shoulder k^2. A coiled spring k^6 fastened at k^7 to the end of the lever k^3 tends to normally rock the lever in this direction to release its grip on the wire when the gripper-block k is moved rearwardly. The lever k^3 is caused to rock in the opposite direction to grip the wire through the action of a sliding plunger k^8 mounted in a bearing k^9 on the block k. A pin k^{10} driven through the side of the bearing engages a slot k^{11} in the

side of the plunger k^8 to keep the latter from turning and also limits the rearward withdrawal of the plunger when the shoulder k^{12} strikes against it. Through this means the slide or block k is caused to be moved rearwardly through the backward movement of the plunger. The plunger k^8 is operated from a link l connected to its rearward end by a cross-pin l'. The opposite end of the link l is pivotally joined to one arm of an oscillating frame L shown in detail in Fig. 20. The frame L is pivoted at l^2, see Fig. 21, on the end of a downwardly extending arm l^3 which projects from the left-hand shaft-bearing e on the rear side of the bed A. Its outer arm is connected by a link or rod l^4 to a crank or eccentric M mounted fast on the end of the shaft E. Preferably, the crank M is constructed with its wrist-pin m projecting from a block m' adapted to slide in a beveled slot m^2 in the crank-disk m^3, see Fig. 21. A stud m^4 extends through a plate m^5 fastened on the edge of the disk m^3 and engages a threaded hole in the block m'. A pin m^6 driven through the plate m^5 engages a circumferential groove on the stud m^4 to hold the latter from longitudinal displacement. By turning the stud m^4 the block m' can be adjusted longitudinally of the slot m^2 to vary the eccentricity of the wrist-pin m with respect to the axis about which it rotates. In this manner the extent of the rocking motion of the frame L can be regulated as required.

When the frame L is rocked forwardly toward the front of the machine the link l will push the plunger k^8 forward causing it to rock the gripper-lever k^3 against the action of its spring k^6 to grip the wire W between its end k^5 and the shoulder k^2. As soon as this action takes place the continued movement of the plunger k^8 will slide the block k forward to feed the wire W a distance as regulated by the adjustment of the crank-pin m. The wire is thus drawn into the machine from its supply-spool, not here shown, but arranged as usual with a tension-device to control its unwinding, and is fed forward to carry it into position to receive a bead from the magazine G. Between the wire-feeding device K and the magazine G is a wire-straightening die K′ through which the wire is pushed to take out any bends that may have been formed in it. The die K′ consists merely of a cylindrical piece of hardened steel having a central bore of a diameter adapted to the size of wire being used. As shown in Fig. 2 the die K′ is mounted in a bearing K^2 formed on or attached to the bed A and is held in place by a set-screw k^{13} locked by a check-nut k^{14}. Other forms of dies may be substituted for use with wire of different sizes or of varying cross-section. The forward end of the die K′ is rounded off in a convex face with which the wire-severing or cutting-off tool coöperates as later described.

Between the wire-feeding mechanism K and the straightening die K′ is a stationary wire-gripper N adapted to hold the wire W in position for its leading end to be operated upon after it has been fed forward by the sliding gripper k. The gripper N is made in the form of a vise having a fixed jaw n formed by a shoulder on the fixed block n' and a movable jaw n^2 at the end of a sliding bar n^3. The bar n^3 is fitted to slide in beveled guideways formed as a part of the bearing K^2 and at its outer end carries a roller n^4 journaled on a pin n^5, see Fig. 1. The roller n^4 bears against the peripheral face of an eccentrically-formed cam D^2 which is mounted fast on the shaft D to be rotated therewith. After the wire W has been fed forward to bring its leading end against the end of the appropriately positioned bead-pin g on the magazine G, see Fig. 2, the gripper-bar n^3 is carried forward by the action of the cam D^2 to cause its jaw n^2 to bind the wire against the fixed jaw n. The wire will thus be held firmly against any tendency to draw it back when the sliding gripper k recedes from its forward position. After the wire W is thus seized and held by the stationary gripper N the plunger k^8 starts to recede under the action of the rearward oscillation of the frame L, and this frees the gripping-lever k^3 so that its spring k^6 causes it to be rocked to release its grip on the wire. As the plunger k^8 slides rearwardly its shoulder k^{12} comes into contact with the pin k^{10} and the block k is thereby moved bodily backward into position to cause the gripper-lever k^3 to take a new grip on the wire at the proper distance to feed the next predetermined length of wire into position to be operated upon.

While the wire W is being fed forward through the die K′ the magazine G is rotated into position to bring one of the bead-carrying pins g into alinement therewith and the end of the wire finally comes into contact with the end of the pin as shown in Fig. 2. At this juncture the bead-transferrer or pusher J comes into action to slide the bead b off from the pin g onto the wire W. It will be noted that the bead-pins g are of slightly greater diameter than the wire W to adapt them to fit tightly in the holes in the beads so that the latter are held in place by friction to prevent their accidental dislodgment from the magazine. On the other hand, the diameter of the wire W being slightly less than that of the holes in the beads provides that the latter will slip onto the wire freely and easily as they slide off from the pins g. To transfer the beads from the pins g to the wire W, I make use

of the pusher J, as before explained, and this consists essentially of a reciprocating rod or bar j adapted to slide in a grooved guideway j'. The guideway j' is formed in the top of the bed A, and the bar j is held in position therein by a top-plate j^2 as shown in Figs. 1 and 2. At its inner end the bar j is cut away on its under side to adapt it to slide across the top of the guideway h of the slide H, see Fig. 15, and two upstanding fingers j^3, j^3 are arranged to straddle the peripherally-projecting ears g' on the magazine G. Through this arrangement the fingers j^3, j^3 are adapted to slide past the ears g' on the magazine to engage the ends of the beads b and push the latter off from the pins g onto the wire W. The bead-pusher J is reciprocated to perform its function through the motion of a link j^4 attached to the end of the bar j as shown in Fig. 1. The link j^4 derives its motion from an oscillating frame J^2 pivoted on an arm a extending from the bearing c at the front and left-hand side of the bed A. The frame J^2 is identical in construction and arrangement with the frame L which reciprocates the wire-gripper k at the back of the machine, and therefore need not be described in detail. Suffice to explain that it is oscillated from a crank or eccentric J^3 mounted on the end of the main drive-shaft C. Means similar to those shown in Fig. 21 and described in connection with the crank-disk M are provided for adjusting the eccentricity of the crank-pin j^5 whereby the extent of oscillation of the frame J^2 can be varied. Through this means the extent of movement of the pusher J is regulated to cause it to push the bead b from the magazine-pin g into a central position on the length of wire W extending from the die K'. When larger beads or other pierced ornaments of different contour are used in the machine the range of movement of the pusher J is adjusted in accordance with their requirements.

The means for forming the section of wire W with the end loops after it has been strung through the bead b and severed will next be described: The main forming tool H', shown in detail in Fig. 2, is carried at the end of the slide H previously referred to in connection with the feeding operation of the magazine G. Preferably, the tool H' is constructed of a hardened-steel bar set into a slot h^3 formed in the slide H and held in place by a screw h^4 to allow of its easy removal for sharpening or replacement. At its forward end the tool H' is provided with an offset shearing blade h^5 which coöperates with the end of the die K' to cut off the length of wire W projecting from the die. The end of the blade h^5 is formed with a shallow groove h^6 adapted to receive the end of the severed length of wire W and a projection on the opposite side of the tool H' is also provided with a corresponding groove h^7 for receiving the opposite end of the wire section, as shown in the enlarged view, Fig. 3. At the center of the operating end of the tool H' is a semicircular recess h^8 adapted to receive the bead b, as illustrated in Fig. 4, and at either side of this are two smaller scallops or concave recesses h^9, h^9 which act to first form the wire W into partial loops at its ends.

Coöperating with the tool H' are two vertically disposed, hardened steel pins p, p which engage the wire W to force it into the recesses h^9, h^9 when the tool H' slides forward as more fully explained hereinafter. The pins p, p are mounted at the end of one of the radial arms p' of the rotatable transferrer-device P, shown in Figs. 1, 7 and 8, but omitted from Fig. 2 in order to more clearly illustrate the parts lying underneath. The initial operative position of the pins p, p is indicated by the holes o, o in the plates O, O which are illustrated in Fig. 2 as being fastened to the top of the bed A. The plates O, O have opposed guiding-faces o', o' between which the bead b is guided as it is carried forward on its wire-section W by the tool H' At the entrance to this guideway the sides of the plates O, O are curved outwardly to provide a flaring mouth which acts to bring the bead into mid-position on its wire should it happen to be accidentally displaced. I also provide means for guiding the wire W to hold it in proper position during its movement with the forming tool H' consisting of two opposed plates R, R also fastened to the bed A by means of the screws r, r. The plates R, R have upstanding flanges r', r' with flaring ends adapted to engage both ends of the wire W as it is brought forward by the tool H'. If the wire W should get out of its proper longitudinal position the faces of the flanges r', r' will engage its ends to shift it one way or the other to bring it into central position with respect to the tool H'. As before mentioned, the tool H' is carried forward by the sliding movement of the slide H which is reciprocated from a cam D' mounted on the shaft D, as shown in Fig. 1. Preferably, the cam D' is of the face type having a cam-groove d^3 in its side with which a roll h^{10} journaled on the end of the slide H engages. The cam-groove d^3 effects both the forward and rearward movement of the slide H without having recourse to a spring action to return the slide to its retracted position.

Referring again to Fig. 2, for further forming the end loops on the wire W I make use of two auxiliary reciprocating tools Q, Q' moving in a direction at right-angles to that of the main tool H'. The tools Q, Q' are carried by reciprocating slides Q^2, Q^3 adapted to travel in beveled slots or guide-

ways q, q formed in upwardly projecting ribs q', q' on the top of the bed A. The tools Q, Q′ are formed with pointed ends q^2, q^3 adapted to slide across the front face of the tool H′ and acting to curl around the ends w', w' of the wire W which project forwardly therefrom, see Figs. 4 and 5. The slides Q^2, Q^3 are operated from cams C^3 and E′ on the shafts C and E with which the rolls q^4, q^4 journaled at their ends engage, as shown in Fig. 1. Suitable springs q^5, only one of which is shown in Fig. 2, are arranged in pockets q^6 in the top of the bed A and act to return the slides to their retracted positions after they have performed their part of the operation of forming the end-loops on the wire W as more fully described hereinafter. After the tool H′ has brought the wire W forward against the pins p, p and the tools Q, Q′ have coöperated therewith to form the ends w' around the pins to the extent illustrated in Fig. 5, still another supplemental tool S, see Fig. 2, comes into play to clench the wire together to complete the loops. The tool S is formed with a substantially U-shaped operating end, having two prongs s, s adapted to slide past the ends of the tools Q, Q′ while straddling the bead b, see Fig. 6. The tool S is mounted in a slot s' in a block S′ which slides in guideways s^2, s^2 on the top of the bed A. The slide or block S′ is operated from a lever S^2 pivoted on a stud s^3 screwed into the bed and its forward end is provided with a slot s^4 engaged by a pin s^5 projecting from the top of the block. Referring to Fig. 1, the lever S^2 is operated from a face-cam E^2 on the rear shaft E which engages a roller s^6 journaled on its rearward end. A spring s^7 acts to maintain the roller s^6 bearing against the face of the cam E^2 and a projection or rise e^3 on the cam-face operates to rock the lever S^2 to slide the block S′ into operative position. The rotation of the cam E^2 is so timed as to bring the tool S against the ends w' of the wire immediately after the tools Q, Q′ have formed the latter as shown in Fig. 5. Through this operation of the tool S the ends w' of the wire W are bent back to form the complete loops w^2, w^2 as shown in Fig. 6.

In order to maintain the wire W in position in the grooves h^6, h^7 of the tool H′ while it is being carried forward on the tool I provide a spring-clamp or gripper-device shown in Fig. 2. This consists of a bar I arranged to slide in a longitudinal bore h^{11} in the slide H and formed at its end with an upstanding, concaved finger-piece i adapted to bear against the rounded face of the bead. Arranged alongside the bar I is a limiting rod or stop-bar I′ adapted to slide in a bore i^2 in the slide H and having its end i^3 bent around to engage the finger i, see Figs. 2 and 8. The rod I′ is positioned far enough below the tool H′ to provide for its clearing the under side of the bead b and its left-hand end is adapted to strike against a stop or detent-plate I^2 fastened on the bed A. A pin i^4 driven down through the slide H engages slots i^5 and i^6 in the sides of the bar I and rod I′ to prevent them from turning in their bearings. The rearward end of the bar I is formed with a head i^7 against which a spring i^8 bears, the latter being held in a pocket i^9 in the slide H. The rod I′ acts to hold the bar I against the tension of its spring i^8 to maintain the finger i clear of the bead b when the latter is pushed onto the wire W. When the slide H moves forward, however, the detent I^2 ceases to hold the rod I′ against the finger i and the spring i^8 will therefore draw back the bar I to cause it to clamp against the bead b and hold the wire W in position on the tool H′. Figs. 3 to 6 show the clamping-finger i following the bead b as the latter is carried into its recess or pocket h^8 at the end of the tool H′.

Referring now to Figs. 7 and 8, the arrangement of the bead-transferrer will next be described. The transferrer P is positioned in the center of the bed A as shown in Fig. 1 and its function is to transfer the strung beads to the linking-mechanism located on the right-hand side of the machine. As here shown the transferrer P is constructed with four radial arms p' extending from a central hub p^2 mounted fast on the end of a vertical shaft p^3. If preferred, however, the transferrer could be made in the form of a wheel or disk to provide a greater number of carrying points for the beads. As shown more particularly in Fig. 8, the shaft p^3 is mounted to rotate in a bearing a' formed on the bed A and below the bed it carries a toothed pinion P^2 keyed rotatively therewith to allow the shaft to slide through the pinion. Mounted to rotate on a stud p^4 screwed into the under side of the bed A is a gear P^3 arranged to mesh with the pinion P^2. Secured to the bottom face of the gear P^3, or formed as a part thereof, is a ratchet-wheel P^4. Pivoted on the stud p^4 below the ratchet P^4 is a lever P^5 which carries a pawl p^5 operated by a spring p^7 to engage the teeth of the ratchet, see Fig. 7. The end of the lever P^5 is connected by a link p^8 to a bar p^9 mounted to slide in a bearing p^{10} on the under side of the bed A as shown in Fig. 1. At the end of the bar p^9 is a roll p^{11} adapted to engage with the periphery of a cam D^3 mounted fast on the shaft D. A spring p^{12}, see Fig. 7, acts on the lever P^5 to maintain the roll p^{11} in contact with the cam D^3 and the rotation of the latter operates to oscillate the lever to turn the ratchet P^4 and gear P^3 in the direc-

tion indicated by the arrow 4. The rotation of the gear P^3 drives the pinion P^2 in the direction indicated by the arrow 5, Fig. 7. Each rotation of the cam D^2 moves the lever P^5 through an arc comprising one-sixteenth of a circumference, the gear P^3 being turned one-sixteenth of a revolution. The ratio between the gear P^3 and pinion P^2 being four to one the transferrer is thus rotated one-quarter of a revolution at each operation of the lever P^5. Besides this intermittent, rotary movement imparted to the transferrer P the latter also has a vertical, reciprocating motion during its operation of transferring the strung beads. The primary object of this is to lift the bead-carrying pins p, p free of the wire-forming tools and other projections on the top of the plate A while the strung bead is being transferred across the machine. The pins p, p are set in holes drilled through hardened steel blocks p^{13} secured to the ends of the arms p' by the screws p^{14}, see Figs. 7 and 8, and held in place by the set-screws p^{15}, p^{15}. When one of the blocks p^{13} is brought around into position for the forming-tool H′ to coöperate with the pins p, p, the whole transferrer is lowered bodily to insert the ends of the pins into the holes o, o previously described as being drilled into the guiding-plates O, O shown in Fig. 2. In this way the pins p, p are held firmly at their lower ends to prevent them from being bent out of line by the thrust of the tool H′. The holes o, o also serve still another important purpose by acting to spring the pins p, p together slightly as they move downwardly therein. To effect this the holes o, o are set somewhat closer together than the normal relation between the pins p, p and their upper ends are made slightly beveled or flaring so as to guide the pins into place. Through this arrangement, when the pins p, p are carried down into the holes o, o their lower ends will be sprung toward each other. Now, after the wire W has been formed around the pins p, p and the latter are raised out of the holes o, o their lower ends spring apart again and exert a slight pull against the end loops w^2 of the wire W so that the latter and its bead are held from dropping off the pins during the movement of the transferrer.

It will be understood that after a wired bead, which for convenience will hereafter be termed a bead-link and designated B, has been applied to the pins p, p the transferrer is first raised to the position indicated by the dash-lines in Fig. 8, and then rotated one-quarter of a revolution. This brings the bead-link B half-way across the machine, and at the next operation of the transferrer it is carried the rest of the distance and delivered to the link-forming mechanism T. It is obvious that if desired the bead-link B could be transferred the whole distance across the machine at one operation, while, on the other hand, the transferrer might also be made to operate with a step-by-step motion in the manner that the main bead-magazine functions, to carry a series of bead-links B and deliver them progressively to the linking-mechanism. For imparting the raising and lowering movement to the transferrer P, I employ a lever U fulcrumed at u on the downwardly extending arm of a bracket u' fastened to the bottom of the bed A as shown in Figs. 7 and 8. Referring to Fig. 1, the rear end of the lever U carries a roll u^2 arranged to bear on the periphery of a cam E^3 mounted on the shaft E. At its forward end the lever U is formed with a fan-shaped head u^3, indicated by dotted lines in Fig. 7, through which project two studs u^4 and u^5, as shown in Fig. 8. The studs u^4 and u^5 can be adjusted longitudinally in the lever U and are held in place by the check-nuts u^6, u^7. The upper rounded end of the stud u^4 bears against the lower end of the transferrer-shaft p^3 while the stud u^5 is adapted to strike against the under side of an arm T′ for a purpose as later described. Secured to the end of the shaft p^3 is a collar p^{16} held in place by a set-screw p^{17}. A washer p^{18} is arranged on the shaft p^3 abutting the under side of the pinion P^2 and between this and the collar p^{16} is a coiled spring p^{19}. The tendency of the spring p^{19} is to maintain the transferrer P in its lowermost position with its hub p^2 resting against the end of the bearing a'. On the end of the hub p^2 are four beveled splines or keys p^{20} adapted to seat in correspondingly-beveled slots a^2 in the bearing a'. Through this arrangement the transferrer is brought into its proper relation to the wire-forming and linking-tools after each turning movement. To further assist in seating the transferrer in exact relation to the tools with which it coöperates I provide an indexing-device shown in Figs. 7 and 8. As here illustrated the hub p^2 is formed with a flange p^{21} cut away to provide the angularly-disposed flat faces p^{22}. Fastened to the top of the bed A are two plates a^3 and a^4 having upstanding fingers a^5 which are beveled or rounded off on their sides at a^6 and a^7. These beveled fingers are adapted to coact with the flat faces p^{22} of the flange p^{21} as the transferrer descends into lowermost position to turn it either backward or forward as may be necessary to bring it into its proper position relative to the other parts of the operating-mechanism of the machine. After the transferrer P has conveyed the bead-link B across the machine it is delivered to the chain-forming mechanism by an ejector-device carried at the end of the arm p'. This consists essentially of a plunger-pin p^{23}

adapted to slide in a bore in the block p^{13} and formed with a head p^{24} between which and the block is a coiled spring p^{25}. Secured to the lower end of the pin p^{23} is a plate p^{26}, see enlarged views, Figs. 9 and 10, which extends forwardly toward the end of the arm p' and is provided with lateral ears p^{27}, p^{27} having holes to receive the pins p, p. Bent downwardly from the forward end of the plate p^{26} are two parallel arms p^{28}, p^{28} set just far enough apart to adapt them to straddle the bed b when the link B is held on the pins p, p. The lower ends of the arms p^{28} are formed with small recesses p^{29}, see Fig. 9, adapted to receive the ends of the wire w which project from the sides of the bead b without interfering with the loops w^2. Normally, the plunger-pin p^{23} is held in its raised position by the tension of the spring p^{25} with the plate p^{26} abutting the under side of the block p^{13}. The plunger p^{23} is pushed downwardly against the action of its spring p^{25} to cause the plate p^{26} to eject the bead-link B from the pins p, p through the means next described: Referring to Figs. 7 and 8, an arm X is mounted fast on a shaft x journaled in a bearing X′ mounted on the top of the bed A. The arm X is adapted to turn in a vertical slot x' in said bearing and reaches upwardly to bring its end above the top of the plunger-pin p^{23} when the transferrer P is in its lowermost position. Formed on the end of the arm X is an offset, angularly-disposed extension or lug x^2 through which extends a stud x^3 locked in position by the check-nut x^4. The stud x^3 is adjustable in position to adapt its lower, rounded end to engage the top of the plunger p^{23} and force the latter downwardly when the arm X is rocked in the direction indicated by the arrow 6, Fig. 8. For rocking the arm X, I employ a slide or bar X^2 adapted to slide in the guideways x^5, x^5 which are formed on or attached to the top of the bed A. The forward end of the slide X^2 engages a toe x^6 projecting from the side of the arm X. Referring to Fig. 1, the opposite end of the slide X^2 carries a journaled roller x^7 adapted to bear on the periphery of a cam F′ mounted fast on the shaft F to be rotated therewith. The slide X^2 is controlled by a spring, not here shown but arranged similarly to that described in connection with the slide Q^2, to maintain its roller in contact with the face of the cam F′.

The transferrer P delivers the bead-links B to a conveyer Y which is preferably of the wheel type, somewhat similar to the main bead-magazine G, arranged below the bed A with its rim projecting up through an opening a^{10}. Referring to Figs. 8 and 17, the conveyer-wheel Y is mounted to rotate on a stud y held in a bearing in the arm Y′ which forms part of a bracket Y^2 secured to the bottom of the bed A. Preferably the stud y extends through a vertical slot y' in the arm Y′ and is adjustable up and down therein by means of a screw y^2. The screw y^2 is threaded through a transverse hole y^3 in the stud y and at its end is formed with a peripheral groove y^4 engaged by the side of a pin y^5 driven into a hole in the arm Y′. The pin y^5 acts as a key to hold the screw y^2 from longitudinal movement while allowing it to be turned to adjust the stud y up and down in the slot y'. Through this means the periphery of the conveyer-wheel Y can be adjusted in proper relation to the transferrer P to receive the bead-links B from the pins p, p in a manner as later described. At its inner end the stud y is formed with a head y^6 abutting the side of the arm Y′, while its outer end is threaded to receive a nut y^7. Abutting the under side of the nut y^7 is a washer y^8 between which and the side of the wheel Y is a coiled spring y^9. The spring y^9 acts to press the wheel Y against a boss y^{10} on the side of the arm Y′ to provide a slight frictional resistance to its turning movement.

Arranged around the rim of the wheel Y is a series of link-receiving members y^{11} for holding the bead-links B in postion thereon. As shown in Figs. 8 and 17, these are constructed in the form of sheet-metal plates disposed radially on the side of the wheel Y with their inner ends abutting a raised shoulder y^{12} formed by cutting away the face of the wheel. The plates y^{11} are spaced apart to receive the beads b between their adjacent edges and the periphery of the wheel Y is also cut away at these points to form tooth-like projections y^{13}, see Fig. 18. Formed on the outer ends of the plates y^{11} are two opposite, upstanding prongs y^{14}, y^{14} which register with relatively thin blades y^{15} projecting from the teeth y^{13} on the rim of the wheel Y, see Figs. 18 and 19. Between the prongs y^{14} and the ends of the blades y^{15} are narrow slots adapted to receive the end loops w^2, w^2 of the bead-link B. The bead-links B are carried on the transferrer with the end loops w^2 of the wire W in horizontal position encircling the pins, p, p. Now, when they are transferred to the conveyer Y it is necessary that the wire be turned to bring the loops into a vertical or upright relation to the link-forming tools so that the links may be inserted through the loops. To provide for this the peripheral blades y^{15} on the wheel Y are rounded off at y^{16}, see Figs. 8 and 19, so that when the loops w^3 are pushed off from the pins p, p, they will strike the opposite sharp corners of the prongs y^{14} and the wire W will turn bodily on its axis while the opposite sides of the loops slide down over the rounded corners y^{16}. In this way the bead-links B are forced into place on

the wheel Y by the ejector-ears p^{28} to seat them in the slots between the prongs y^{14} and blades y^{15} with the loops standing vertically or on edge as shown most clearly in Fig. 19.

After the bead-link B is discharged from the transferrer P and deposited into position on the conveyer Y the latter is rotated ahead in the direction indicated by the arrow 7, Figs. 17 and 18, to bring the adjacent end loops of two bead-links into alinement with the forming-tools for the connecting links. The feeding of the wheel Y may be effected through any suitable means, but as shown in Fig. 1, I prefer to employ a reciprocating member or bar Y^4 for rotating the wheel with a step-by-step motion. The bar Y^4 slides in a bearing y^{17} on the top of the bed A and carries a roller y^{18} journaled at its end to adapt it to engage the peripheral face of a cam C^4 rotating with the shaft C. At its inner end the bar Y^4 is bent in elbow-shape at y^{19} and attached thereto is a spring y^{20} anchored at its opposite end to a pin y^{21} driven into the bed A. The spring y^{20} maintains the roller y^{18} in contact with the cam C^4. Pivoted on the forward end of the bar Y^4 is a pawl y^{22} adapted to engage the edges of the plates y^{11} on the rim of the wheel Y. One edge of the pawl y^{22} seats against a shoulder y^{23} on the bar Y^4 to hold it from rocking rearwardly and a flat spring y^{24} bearing against its side edge normally prevents the pawl from movement in the opposite direction. When the bar Y^4 is retracted, however, after carrying the wheel Y forward, the beveled edge y^{25} on the inner side of the pawl will ride across the plate y^{11} causing it to rock against the action of its spring y^{24}. As the wheel Y is turned forward by the operation of the bar Y^4 an indexing-device comes into action to hold it against rearward movement. This consists of a sliding bar Y^5, see Fig. 1, reciprocating in guideways on the top of the bed A and operated from a cam F^2 rotating with the shaft F. The bar Y^5 carries a roller y^{26} maintained in contact with the periphery of the cam F^2 by means of a spring, not here shown, but arranged the same as that on the slide Q^2. Referring to Fig. 17, the forward end of the bar Y^5 is made round and beveled off at its extremity to adapt it to enter between the sides of the tooth-like projections y^{13} on the rim of the wheel Y.

Referring again to Fig. 1, for supplying wire W′ to the machine to form connecting-links between the bead-links B, I provide a supplementary wire-feeding mechanism shown at Z. This may be of the same form and arrangement as the primary wire-gripper K, comprising the sliding block z, gripper-lever z' and its operating plunger z^2. The plunger z^2 is reciprocated by a link z^3 connected with a frame Z′ which is oscillated from a crank z^4 on the end of the shaft E, all arranged in the same manner as the frame L and its connections previously described. I also employ a fixed gripper Z^2 adapted to clamp the wire W′ in position after it has been fed forward by the gripper Z. This consists of a sliding bar z^5 controlled by a spring, not here shown, and operated through the roll z^7 from a cam F^3 on the shaft F to carry its jaw forward to clamp the wire against the fixed jaw z^6, see also Fig. 7. Forward of the stationary wire-gripper Z^2 is a straightening-die Z^3 with the front end of which a cutting-tool V coöperates. The tool V is carried on a slide V′ reciprocating in guideways on the top of the bed A and controlled by a spring, not here shown, to maintain its roller v in contact with the cam F^4 on the shaft F through which it is operated.

In linking the bead-links B together the wire W′ is fed forward through the die Z^3, cut off in predetermined lengths w^3, and first bent into U-shape staples w^4 as illustrated in Figs. 11 and 12. For performing this last operation I employ a tool T^2 adapted to coöperate with a forming-pin t. The tool T^2 has its working end hollowed out or concaved at t' to the shape of the circular link to be formed and in its edge is a shallow groove t^2 in which the wire w^3 is held. Preferably, the tool T^2 is made double, see Fig. 7, with a working face at each end so that it can be reversed in position to provide for longer wear. It is mounted on the top of a sliding bar T^3 and held in place by means of the screw t^3 and dowel-pin t^4. The bar T^3 slides in guideways t^5 on the top of the bed A and is operated from a cam F^5 on the shaft F engaging its roller t^6. Referring particularly to Figs. 7 and 11, the cutting-off tool V is thrust forward slightly in advance of the tool T^2, but before the wire w^3 is finally severed it is seized in the groove t^2 at the ends of the two points of the tool T^2 so as to be carried forward thereby. As the tool T^2 continues to advance the wire section w^3 is brought against the forming-pin t and bent around in U-shape as shown at the right-hand in Fig. 12. The staple w^4 thus formed is now seated firmly in the groove t^2 which extends completely around the hollow t' of the tool T^2 and the forming-pin t is next withdrawn from position to allow the further advance of the tool T^2. The withdrawal of the forming-pin is effected by depressing it from its raised position above the bed A. Referring to Figs. 7 and 8, the pin t is formed on the upper end of a plunger T^4 which slides in a bore x^8 of the bearing X′ on the top of the bed A. Below the plunger T^4 is a pocket x^9 in which is a coiled spring t^7 held in place by a screw-

plug t^8. Referring particularly to Fig. 8, the side of the plunger T^4 is cut away at t^9 with a lateral, quarter-round slot having a flat face t^{10}. Engaging this face t^{10} is a half-round section of the shaft x on which the arm X is mounted, the shaft x being positioned to intersect the slot t^9. Now, when the shaft x is rotated by the turning movement of the arm X in the direction indicated by the arrow 6, Fig. 8, the plunger T^4 will be operated thereby to draw it downwardly in its bore against the action of the spring t^7 to depress the forming-pin t below the tool T^2. While the pin t is thus being removed from the path of the tool T^2 the latter is caused to halt slightly in its forward movement. This is accomplished by forming the cam F^5 with a flat face on its periphery which interrupts the gradual rise of the cam. The tool T^2 now proceeds to carry the formed staple w^4 forward again to insert its ends w^5, w^5 through the eyes or loop w^2 at the ends of the bead-links B, B, it being understood that before this time the conveyer Y has advanced two of these links into the position shown in Figs. 11, 12 and 13. Meanwhile, before this last advance of the tool T^2 a second forming-pin t^{11} is brought down into position between the ends of two adjacent loops w^2 of the bead-links B, B. The forming-pin t^{11} is carried at the end of an arm T^5, shown in Fig. 7, but partly obscured from view in Fig. 8 by the transferrer P, and is held in place by a set-screw t^{12}.

The arm T^5 is adjustably mounted on a member T^6 by means of a screw t^{13} extending through its slot t^{14}. The member T^6 is mounted on the end of a square rod t^{15} which extends downwardly through bearings a^8, a^9 on the bed A and carries the arm T′, previously referred to, at its lower end. Preferably, the upper end of the rod t^{15} is turned down to a round so that the member T^6 can be adjusted about its axis to properly position the forming pin t^{11} in relation to the coöperating link-forming tools and a set-screw t^{16} is employed for holding the member in place. Between the end of the lower bearing a^9 and the arm T′ is a coiled spring t^{17} adapted to hold the rod t^{15} in its lowermost position with the member T^6 seated against the top of the bearing a^8. With the rod t^{15} in the position illustrated in Fig. 8, the forming-pin t^{11} is in operative relation to the forming-tool T^2 and it will be noted from Figs. 11 to 14 that the pin t^{11} is formed with opposite, longitudinal grooves t^{18}, t^{18} to receive the ends of the wire-loops w^2, w^2 which abut its sides. This provides that when the staple w^4 is carried forward as shown in Fig. 13 its ends w^5, w^5 will enter freely through the loops w^2 while just clearing the sides of the pin t^{11}. After the staple w^4 has thus been inserted through the loops w^2, w^2, another forming-tool T^7 comes forward to bend its ends around the pin t^{11} to complete the circular link w^6 as shown in Fig. 14. Referring to Fig. 7, the tool T^7 is identical in form with that of the tool T^2 except that its edge has no wire-holding seat or groove. It is mounted on a block T^8 slidable in guideways t^{19}, t^{19} on the bed A and is operated by a lever T^9 pivoted on a stud t^{20}. The inner end of the lever T^9 is connected to the block T^8 by means of its slot t^{21} engaged by the pin t^{22} and its outer end carries a roller t^{23}, see Fig. 1, bearing on the side face of a cam C^5. A spring t^{24} maintains the roller t^{23} in contact with the cam C^5 and the lever T^9 is oscillated therefrom to reciprocate the tool T^7 backward and forward with the proper timing to cause it to complete the forming of the link w^6. After the link w^6 is completed the forming-pin t^{11} is raised out of position therein by the action of the stud w^5 on the lever U, previously described, striking against the arm T′. As soon as the pin t^{11} is out of the way the link-conveyer Y can again be rotated ahead to bring the next two end-loops of the bead-links B into position to be linked together.

Having now described the arrangement and method of operation of the several mechanisms of my new machine in detail, a brief recapitulation of the sequential functioning of the apparatus will next be given. When power is applied to the driving-pulley C′ and the clutch C^2 thrown into engagement therewith the shafts C, D, E and F are rotated to operate their connected mechanisms as follows: The bead-magazine G is turned with a step-by-step motion and the wire W is fed forward intermittently to bring its leading end successively into contact with the ends of the bead-carrying pins g. Each time one of the pins g comes into register with the wire the bead b carried thereby is engaged by the end of the pusher J, see Fig. 2, and pushed into mid-position on the length of wire w projecting from the straightening-die K′. The tool H′ then comes forward and seizes the wire w, while severing it at the end of the die, and as the tool continues to advance the wire-section is guided between the members R, R while the bead b, held by the clamping-bar I, is caused to slide into the channel or opening between the guide-plate O, O. Meanwhile the transferrer P is being rotated to bring one of its arms p' around into alinement with the tool H′ and the downward movement of the transferrer then inserts the ends of the pins p, p into the holes o, o. During this operation the tool H′ still continues to advance, eventually bringing the ends w', w' of the wire w against the pins p, p and bending them to the form shown in Fig. 4. The lateral tools Q, Q′ now come into play to fur-

ther bend around the ends w', w' of the wire as indicated in Fig. 5 and finally the tool S moves forward and its points s s, clench the ends of the loops into place as illustrated in Fig. 6.

It will be understood, of course, that all of the forming-tools move together, being so timed as to bring them into action one immediately after another, so that the several operations of bending the wire are performed practically simultaneously.

Immediately the end-loops w^2 are completed the tools H', Q, Q' and S commence to recede to return them to position to begin operations on the next wire-section w, the tool H' passing back past the die K' before the wire W feeds forward again. As the tool H' slides rearwardly the detent-rod I' strikes against the stop I^2 and is thereby held in its forward position, as shown in Fig. 2, to allow the next bead to be fed from the magazine onto the wire. After the wire has been fed forward again and the next bead is in place the forming-tools repeat the operations previously described, and in this manner the wire lengths are first strung with beads, then severed and formed with end loops, one after another in rapid succession.

While the forming-tools are being withdrawn from the completed bead-link the transferrer P is lifted bodily, through the action of the lever U, and is turned on its axis through the rotation of the gears P^2 and P^3 driven by the ratchet P^4. During this operation of the transferrer the bead-link B is held in place at the end of the arm p' by the spring tension of the pins p, p after their release from the holes o, o, as previously described. The first movement of the transferrer P carries the bead-link half way across the machine and after another link has been completed on the next arm p' the first one is brought into position above the conveyer-wheel Y. At this point the transferrer P is lowered again to seat the pins p, p on the next arm p' in the holes o, o and to bring the first pair of pins into close juxtaposition with the link-receiving members y^{11} and y^{13}. The ejector p^{23} is now operated upon by the lever X, actuated by the slide X^2, see Fig. 8, to push the link B off from the pins p, p, see Figs. 9 and 10, and seat it in place on the rim of the conveyer Y as shown in Figs. 17, 18 and 19. As soon as two bead-links B have thus been transferred to the conveyer Y, the intermittent rotation of the latter brings them into position with their adjacent loops opposite the linking-tools shown at T in Fig. 7. Meanwhile the secondary wire W' has been fed forward, a predetermined length thereof cut off by the tool V, and the ends seized by the tool T^2 and bent around the pin t to form the staple w^4, all as illustrated progressively in Figs. 11, 12 and 13, and previously described. The tool T^2 now halts for an instant while the forming-pin t is withdrawn from its raised position by the rotation of the shaft x during the movement of the lever X in ejecting the next bead-link from the transferrer P. Previous to this last operation the second forming-pin t^{11} moves downwardly as the stud u^5 releases the arm T', see Fig. 8, and finally assumes a position in alinement with the two bead-links B, B between the end-loops w^2, w^2 as shown in Fig. 11. The tool T^2 is now carried forward again bearing the staple w^4 and inserts its ends through the loops w^2, w^2. During this operation the tool T^7 is being advanced and as its end comes into contact with the ends w^5, w^5 of the staple w^4 the latter are bent around the pin t^{11} and clenched together to form the circular link w^6 as shown in Figs. 13 and 14. The forming-pin t^{11} is now carried up out of the way by the action of the lever U during the latter part of its movement in raising the transferrer P, the movement of the pin being slight as compared to that of the conveyer itself. The conveyer Y is now free to be rotated again to bring the next two end-loops w^2, w^2 into position to be linked together and in this way the bead-links B are connected in a continuous chain, a section of which is shown in Fig. 22. As the conveyer Y continues to rotate and the successive bead-links B are linked together in order the resulting chain will fall away from its rim and can be fed into a suitable receptacle provided below. In this way my improved machine can be operated continuously to form any length of chain desired or to make a chain of indefinite length eventually divided into shorter sections as required.

By varying the colors or styles of the beads in order as they are placed on the magazine or fed from a hopper a variety of ornamentation can be effected in the eventual chain to adapt it for use in making chaplets, rosaries or necklaces. By slightly altering the bead-feeding and wire-forming devices a plurality of beads can be strung on each link, and different forms of objects such as medallions or the like can also be linked together in the machine by providing suitable tools adapted to the requirements thereof. In place of the chain or link-conveyer here shown other styles of feeding-devices may be substituted arranged to feed the bead-links forward in different order, and by altering the linking-mechanism slightly a greater number of plain links can be inserted between the beads. It will be obvious also that the different mechanisms of my improved machine might be used separately; for instance, the bead-stringing and link-forming device could be operated to produce bead-links for making the chain by hand. In the same way the linking-mecha-

nism could be employed for making a plain chain without beads strung on the links. My improved apparatus is also susceptible of other modifications in the arrangement and method of coöperation of its various parts to adapt it to produce articles of different structure with the parts strung together in more elaborate designs or patterns.

Various modifications might also be made in the form and structure of the various parts of the apparatus without departing from the spirit or scope of the invention.

Therefore, without limiting myself to the exact arrangement shown, what I claim is:—

1. In an automatic bead-stringing and linking machine, the combination with means for stringing beads or other pierced ornaments on sections of wire, of mechanism coöperating therewith for forming the wire-sections into links adapted to be connected together in a continuous chain.

2. In an automatic bead-stringing and linking machine, the combination with means to apply beads or other ornaments to sections of wire, of mechanism coöperating therewith to form the ends of the wire-sections with loops to adapt them to be linked together in a chain.

3. In an automatic bead-stringing and linking machine, the combination with means to string beads or similar ornaments on sections of wire, of mechanism coöperating therewith to form the wire-sections with loops at their ends, and coördinated mechanism operating to link the loops together to form a chain.

4. In an automatic machine of the class specified, the combination with means to form lengths of wire with loops at their ends, of mechanism coöperating therewith to form connecting-links inserted through the end-loops of the wire-sections to attach them together in a continuous chain.

5. In a machine of the class specified, the combination with means for severing wire in predetermined lengths of means for stringing beads or other pierced articles on the wire, and mechanism coöperating therewith for forming the severed lengths of the wire into links adapted to be connected together in a chain.

6. In an automatic bead-stringing and linking machine, the combination with means to string beads or other ornaments on sections of wire, of mechanism coöperating therewith to form loops at the ends of the wire-sections, and coördinated mechanism operating to form connecting-links inserted through the loops of the bead-links to link them together in a chain.

7. In a machine of the class specified, the combination with means for severing wire in predetermined lengths, of mechanism cooperating therewith for stringing beads or other pierced articles on the wire, coördinated mechanism for forming the severed sections of the wire into links, and means operating in conjunction therewith for forming connecting-links inserted through the bead-links to attach them together in a chain.

8. In an apparatus of the class specified, the combination with means to form sections of wire with loops at their ends, of coördinated mechanism to form other sections of wire into U-shaped staples, means to insert the ends of the staples through the loops of the first wire-sections, and means coöperating with the last named means to finally form the staples into closed links connecting the main bead-links.

9. In an apparatus of the class specified, the combination in a coördinated mechanism comprising means to feed the wire thereto, means for severing the wire in predetermined lengths, means for stringing beads or the like on the wire-lengths, means for forming the ends of the wire-lengths into loops, and means for severing and forming other lengths of wire into links connecting the bead-links to form a chain.

10. In a machine of the class described, the combination in a coördinated mechanism comprising means for feeding wire thereto, means for severing the wire in predetermined lengths, means for feeding beads or the like onto the wire-lengths, means for forming the wire-lengths with end-loops, means for feeding a secondary supply of wire into the machine, means for severing the secondary wire into sections, and means for forming said sections into links inserted through the loops of the bead-links.

11. In a machine of the type specified, the combination in a coördinated mechanism comprising means for feeding wire thereto, means for successively delivering beads or the like to the wire, means for stringing the beads on the wire, means for severing the wire in predetermined lengths, means for forming the wire-lengths with end-loops, means for feeding a secondary supply of wire to the machine, means for severing the secondary wire in lengths, and means for forming the latter into links inserted through the loops of the bead-links to form a continuous chain.

12. In a machine of the type specified, the combination with means for feeding wire, of a magazine for successively feeding beads or the like to the wire, means for transferring the beads from the magazine onto the wire, means for severing the wire in predetermined lengths, means for forming said wire-lengths with end-loops, means for feeding and severing a secondary wire in predetermined lengths, and means for forming the latter into links inserted through the loops of the bead-links to form a chain.

13. In a machine of the type specified, the

combination with means for feeding wire, of intermittently operated means for feeding beads or the like to the wire, means for delivering the beads from the feeding-means and stringing them on the wire, means for severing the wire in predetermined lengths, and means for forming the severed lengths with loops at their ends to adapt them to be linked together in a continuous chain.

14. In a machine of the class specified, the combination with means for feeding wire, of a rotatable magazine for carrying beads or similar pierced articles, means for operating the magazine to successively feed the beads into alinement with the wire, means for delivering the beads from the magazine onto the wire, and means for severing the wire in predetermined lengths and forming the severed sections into links adapted to be connected together in a chain.

15. In a machine of the type specified, the combination with a wire-feeding device, of a magazine for successively feeding beads or the like to the wire, means for delivering the beads from the magazine to the wire, means for severing the wire in predetermined lengths, means for holding the beads in mid-position on the severed wires, and means for forming the bead-carrying wires with end-loops to adapt them to be connected together in a chain.

16. In a machine of the type specified, the combination with a wire-feeding device, of a magazine having bead-carrying means for supporting beads or other pierced ornaments, means for operating the magazine to successively bring the bead-carrying means into alinement with the wire, and means for transferring the beads from the magazine onto the wire, and means for forming the bead-carrying wires with end loops to adapt them to be connected together in a chain.

17. In a machine of the type specified, the combination with means for stringing beads or other articles on wires, of coördinated mechanism for forming the wires into links, mechanism coöperating therewith for carrying the formed bead-links into alinement, and means for forming connecting-links inserted through the bead-links to attach them together in a chain.

18. In a machine of the type specified, the combination with means for stringing beads or other articles on wires, of coördinated mechanism for forming the wires into links, means coöperating therewith for carrying the completed bead-links into alinement, means for forming open links inserted through the ends of the bead-links, and means for closing said links to permanently connect the bead-links in a continuous chain.

19. In a machine of the type specified, the combination with means for stringing beads or other ornaments on wires, of means for forming the strung wires with end-loops, means for feeding the formed wires successively forward in alinement, means for forming open connecting-links, and means for inserting the connecting-links through the loops of the bead-links and closing their ends to form a continuous chain.

20. In a machine of the type specified, the combination with the bead-stringing means and chain-linking mechanism, of means to feed wire thereto, means to string beads on the wire, means to sever the wire and form it into links, means to transfer the formed bead-links from the link-forming means to the chain-linking mechanism, and means to form and insert chain-links through the bead-links to connect them together in a continuous chain.

21. In a machine of the type specified, the combination with means to feed wire through a die in predetermined lengths, of a reciprocating tool formed with a cutting edge coöperating with the die to sever a length of wire and provided with jaws adapted to seize its ends, said tool also formed with concave recesses, pins coöperating with the recesses in the tool to form the ends of the wire into partial loops, and auxiliary tools operating in conjunction with the main tool to bend the ends of the wire around the pins to complete the loops.

22. In a machine of the type specified, the combination with a reciprocating wire-severing and link-forming tool having grooves in its working-face adapted to receive and grip the severed length of wire to carry it forward therewith and concave recesses for forming the wire in partial loops, forming-pins coöperating with the tool to force the wire into the recesses thereof, and auxiliary tools operating on the ends of the wire to bend them around the forming-pins to complete the loops.

23. In a machine of the type specified, the combination with a reciprocating link-forming tool having grooves in its working-face adapted to receive and grip a length of wire to carry it forward therewith and recesses in which the wire is formed in partial loops, means for retaining the wire in the grooves of the tool, forming-pins for forcing the wire into the recesses of the tool, and auxiliary tools for operating on the ends of the wire to bend them around the pins to complete the loops.

24. In a machine of the type specified, the combination with a link-forming tool adapted to receive a length of wire carrying a bead strung thereon, means engaging the bead to maintain the wire in place in the tool, forming-pins coöperating with the tool to bend the ends of the wire into partial loops, and auxiliary tools adapted to operate on the ends of the wire to bend them around the pins to complete the loops.

25. In a machine of the type specified, the

combination with a wire-forming tool having concave recesses in its working-face adapted to form the ends of the wire into partial loops, means coöperating with the tool and moving therewith to hold the wire in place on the tool, forming-pins coöperating with the tool to force the wire into its recesses, and auxiliary tools for operating on the ends of the wire to bend them around the forming-pins to complete the loops.

26. In a machine of the type specified, the combination with a link-forming tool adapted to operate on a length of wire, forming-pins coöperating with the tool to form partial loops at the ends of the wire, auxiliary tools operating on the ends of the wire to bend them around the pins to complete the loops, and means to cause the forming-pins to spring apart to exert a tension on the loops to hold the completed link in position thereon.

27. In a machine of the type specified, the combination with link-forming tools adapted to operate on a length of wire, forming-pins coöperating with said tools to bend the ends of the wire into loops, means to maintain the forming-pins sprung together under tension during the loop-forming operations, and means to release the pins to cause them to spring apart to hold the completed link in position thereon.

28. In a machine of the type specified, the combination with link-forming tools for operating on a length of wire, a link-transferrer having forming-pins with which the tools coöperate to bend the wire into loops at its ends, and means for operating the conveyer to insert the ends of the pins into sockets to hold them against the thrust of the forming-tools.

29. In a machine of the type specified, the combination with link-forming tools for operating on a length of wire, a link-transferrer carrying a series of sets of forming-pins with which the tools coöperate to bend the wire into loops at its ends, and means to operate the conveyer to successively bring different sets of pins into position to coact with the tools to form the links in rotation.

30. In a machine of the type specified, the combination with means for stringing beads or the like on wires, of means for forming the strung wires into links, a transferrer for receiving and transferring the bead-links from the forming-means, a conveyer for receiving the bead-links from the transferrer, and means for inserting connecting-links through the bead-links as the latter are fed thereto by the conveyer.

31. In a machine of the type specified, the combination with means for stringing beads or the like on wires, of means for forming the strung wires into links having end-loops, a transferrer for receiving the bead-links from the forming-means, a conveyer for receiving the bead-links from the transferrer, ejector-means for delivering the bead-links from the transferrer to the conveyer, means to position the bead-links in alinement on the conveyer, and means to form connecting-links inserted through the loops of the bead-links as the latter are fed thereto by the conveyer.

32. In a machine of the type specified, the combination with means for stringing beads or the like on wires, of means for forming the strung wires into links with loops at their ends, a transferrer carrying forming-pins on which the wires are formed into the bead-links, means for pushing the formed links off from the forming-pins, a conveyer adapted to receive the bead-links from the transferrer in spaced-apart alinement, and means to form connecting-links inserted through the end-loops of the bead-links while the latter are maintained in position on the conveyer.

33. In a machine of the type specified, the combination with means for stringing beads on wires, of means for forming the wires into links having end-loops, of a conveyer for receiving and spacing the formed links in alinement, means for forming connecting-links inserted through the loops of the bead-links, and means for operating the conveyer to successively feed the bead-links into position to be linked together by the connecting-links.

34. In a machine of the type specified, the combination with means for stringing beads or the like on wires, of means for forming the wires into links having loops at their ends, a conveyer for receiving the formed bead-links, means on the conveyer for positioning the bead-links in spaced relation with their end-loops alining, and means for successively inserting connecting-links through the end-loops of the bead-links to link them together in a chain.

35. In a machine of the type specified, the combination with means for stringing beads or the like on wires, of means for forming the strung wires with end-loops comprising forming-pins around which the ends of the wires are bent, forming-tools cooperating therewith, means to eject the formed wires from the forming-pins, means to receive the formed-wires and position them in spaced relation with their loops alining, and means for inserting connecting-links through the adjacent loops of the wires to link the beads together in a chain.

36. In a machine of the type specified, the combination with means to string beads or the like on wires, of means to form the wires into links, linking-mechanism for connecting the bead-links comprising means to feed the links in spaced relation in alinement, means to form wire into U-shaped

staples, means to insert the staples through the ends of adjacent bead-links, and means to bend the staples into closed links connecting the bead-links.

37. In a machine of the type specified, the combination with means to string beads or the like on wires, of means to form the strung wires with end-loops, means to feed the bead-links in spaced relation in alinement, means to insert a forming-pin between adjacent ends of the bead-links, means to form wire into U-shaped staples, means to insert the staples through the loops of the adjacent bead-links, and means to bend the ends of the staples around the forming-pin to form chain-links connecting the bead-links.

38. In a machine of the type specified, the combination with means for stringing beads or the like on wires, of means for forming the strung wires into links, means for feeding the formed bead-links in spaced relation in alinement, means for feeding and severing wire in lengths, a primary forming-tool for forming the severed wires into staples, a forming-pin around which the wire is bent by the forming-tool, a second forming-pin adapted to be inserted between the ends of two adjacent bead-links, means for operating the forming-tool to insert the ends of the staple through the bead-links, and an auxiliary forming-tool for closing the ends of the staple together around the second forming-pin.

39. In a machine of the type specified, the combination with means for stringing beads or the like on wire, of mechanism for forming the strung wires into links, bead-linking mechanism comprising means to sever wire in predetermined lengths, a forming-tool for seizing the severed wire and carrying it forward, a forming-pin coöperating with the forming-tool to bend the wire into a staple, means to withdraw the forming-pin from the path of the forming-tool, a second forming-pin adapted to be inserted between the ends of the bead-links to allow the insertion of the staple therethrough, and an auxiliary forming-tool coöperating with the second forming-pin to form the staple into a circular link.

40. In a machine of the type specified, the combination with means to feed a series of bead-links in spaced relation in alinement, of means to sever wire in predetermined lengths, a forming-tool having a U-shaped recess at its forward end and wire-receiving grooves on its working face, means to operate the tool to cause it to seize the severed wire in its grooves, a forming-pin coöperating with the forming-tool to force the wire into its recess to form a U-shaped staple, means to remove the forming-pin from the path of the tool to allow the latter to insert the staple through the loops of two adjacent bead-links, a second forming-pin adapted to be inserted between the ends of the adjacent bead-links, and an auxiliary forming-tool coöperating with the second forming-pin to bend the ends of the staple together to form a connecting-link between the two bead-links.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH E. McCRUDDEN.

Witnesses:

HERBERT K. ALLARD,

GEO. A. WHITE, JR.

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