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Esser

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[54] **METHOD AND APPARATUS OF MANUFACTURING C-SHAPED LINKS**

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[52] **U.S. Cl.** **59/27**

[51] **Int. Cl.** **B21l 1/02**

[58] **Field of Search** 59/23, 27, 12, 18, 22, 59/24, 25, 35

[56] **References Cited**

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Primary Examiner—Charles W. Lanham
Assistant Examiner—Gene P. Crosby
Attorney, Agent, or Firm—Holman & Stern

[57] **ABSTRACT**

The manufacture of "C" shaped wire links wherein a continuously fed wire has a reverse curve pre-bent into it before the wire is placed into a bending device. This reverse curve is in that section of the wire which will be opposite the two ends of the link after it is bent into a "C" shape. The pre-bending device bends the wire prior to cutting into the desired length. Furthermore, the pre-bent cut wire sections can be directly fed from the pre-bending device into the bending device, or alternatively, fed into a magazine which in turn successively feeds the pre-bent cut wire sections into the bending device.

6 Claims, 4 Drawing Figures

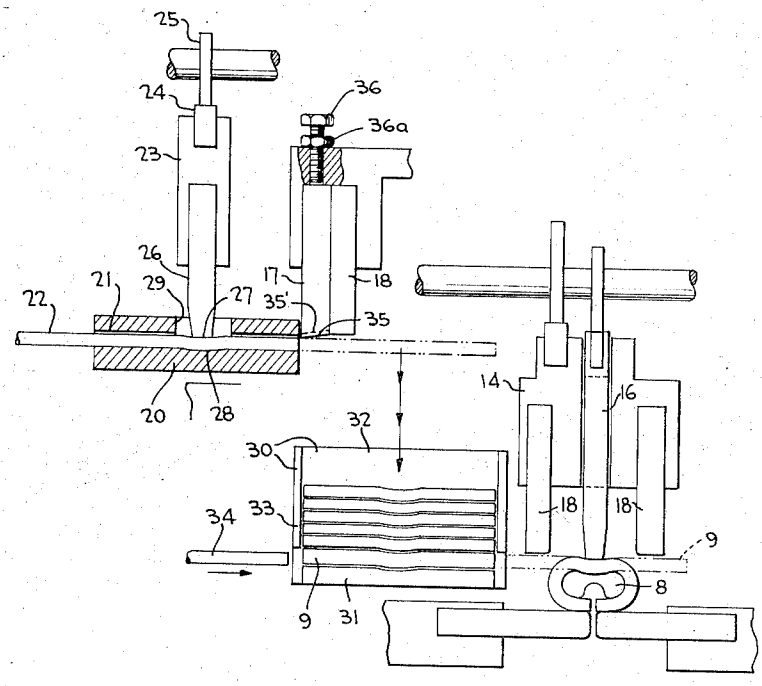
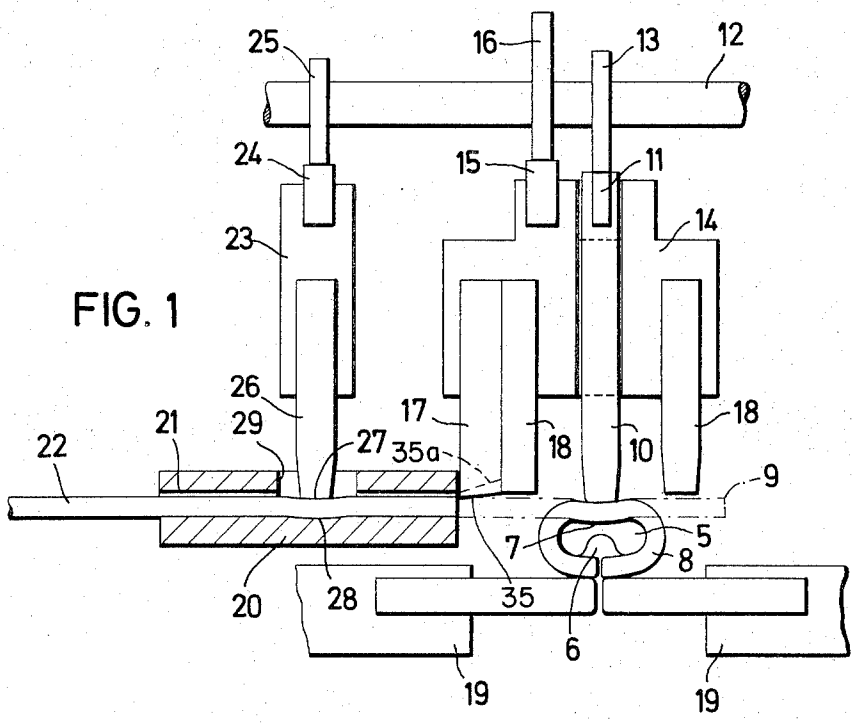


FIG. 1



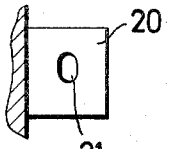
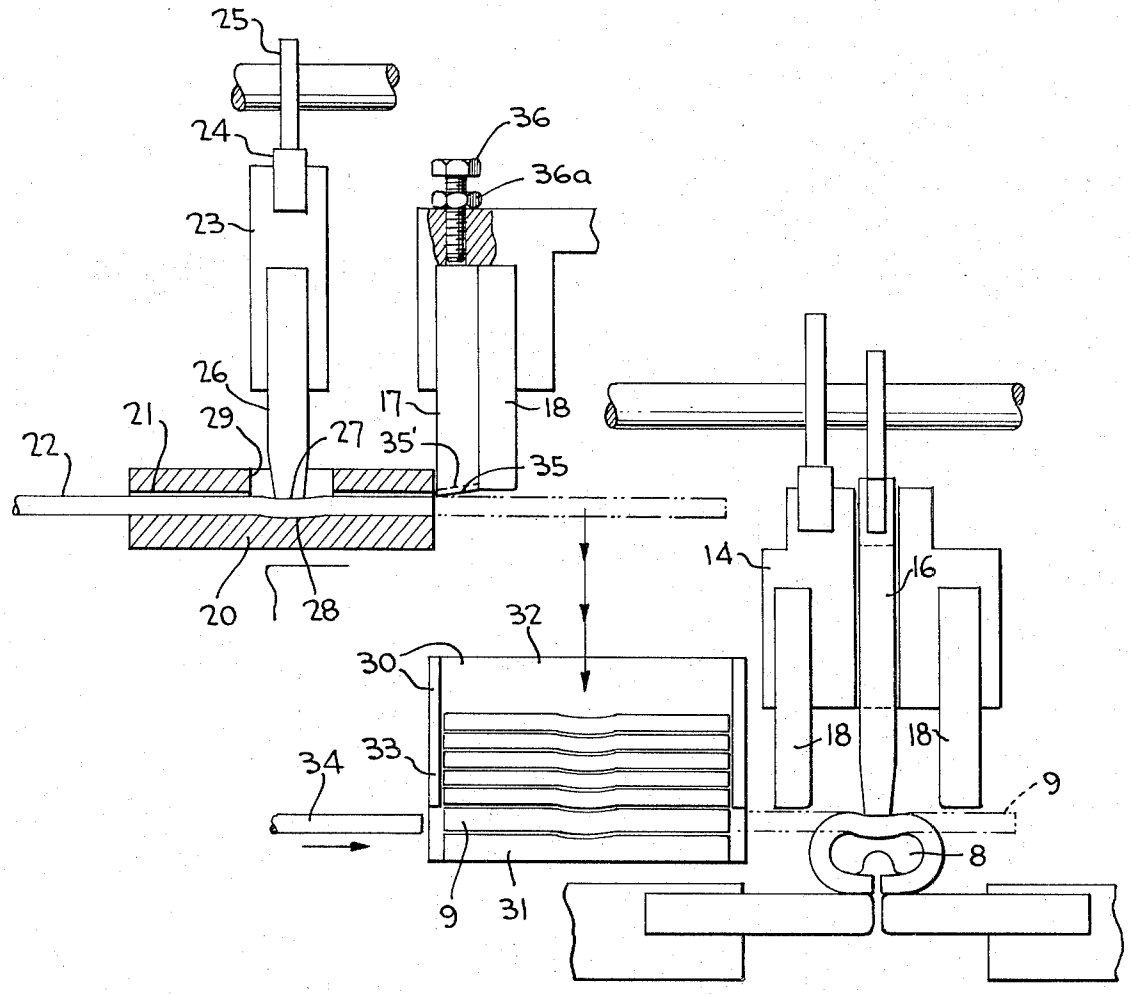


FIG. 2

FIG. 3

FIG. 4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METHOD AND APPARATUS OF MANUFACTURING C-SHAPED LINKS

BACKGROUND OF THE INVENTION

This instant invention relates to a method and apparatus for manufacturing wire into C-shaped chain links.

PRIOR ART

The common production of such wire is carried out, as for instance, according to U.S. Pat. No. 3,431,723, in a manner whereby the guided and continuously fed wire is supplied by the cutter-box of a bending device for the link, consisting of a cutter for cutting off the sections of wire, a holder device for the wire sections arranged on the bending mandrel, and of two bending arms.

The prior art embodiment has a number of disadvantages which are realized especially in the case of short chain links, i.e., wire which is cut to a length down to 2.5 times its diameter, and especially when the wire is hard steel. Especially in these cases, as well as in others, the longitudinal center section of the wire sections which forms the back of the completely bent chain link, must be bent inversely to the bending process so that after the complete bending of the chain link, and especially after the forging and the welding-together of the open ends of the links, the longitudinal center section is generally in a straight line and does not show any convexity. In prior art bending devices, the wire is passed through the cutter-box, cut off by the cutter, and is gripped at its center during the cutting phase by a holding device and pushed against a mandrel which is slightly bent in a bean-shape at that point which complies with the back of the link and is located opposite the holding device, in order to obtain the reverse bending of the pin at this point. If one considers this bending process theoretically as a three-point bending process, it will be noted that, especially in the short links, the two points of support of the still straight wire section on the mandrel are comparatively close together and that the lever arm during the bending represents only half of this space due to the holding device. The holding device must therefore press the wire section with an extremely strong force into the curvature of the mandrel in order to ensure an actual permanent deformation of the wire section in its center area, which, during the continued bending and welding process becomes almost rectilineal. This results in the danger that the mandrel may break off, or, in case of generally used separated bending mandrels having a grooved circumferential slot at their faces for receiving the wire section, there exists the danger that the movable mandrel part will bend and thereby cause the edge of the stationary mandrel part to scratch the inside area of the wire section.

A further disadvantage in the prior art device consists in that it is impossible in the common cutting method to provide the wire section with two completely even end areas which are in parallel to each other. This is a basic requirement of the cutting process. If the position of the wire section, during its movement from the cutting position into the bending position, is not accurate, then the end sections, which are to be welded together into the various links of a chain, will be facing each other inaccurately. This will cause an uneven welding, which negatively affects the quality and stability of the

weld-points and thereby affects the link itself. In general, even though there exist completely parallel and level end areas on the wire section, these areas are facing each other when the link is completely bent in a V-shape, so that if the end surfaces are not parallel and/or have cutting impressions and/or cutting burrs at the opposite ends, there exists the danger that in certain links the V-form will be exaggerated while in others the V-form may be to some extent reduced. It is therefore desired to move the wire section from the cutting position into the bending position so that all wire sections, even though having in themselves uneven end areas, are identically arranged.

A third disadvantage is represented by the fact that at least longitudinal displacements of the wire section during its movement from the cutting into the bending position are prevented, as mentioned above, in that the wire section which may not yet, or not completely, be cut off, is pressed onto the mandrel by the holding device. This causes the holding device to slide on one side of the wire section and thereby mark the center area of the wire section. Furthermore, there may be additional bending during the cutting process on the end of the wire which is being held in the cutter-box, while finally the two ends of the wire section obtain uneven shapes.

SUMMARY OF THE INVENTION

The instant invention has as its objects: to provide a pre-bending device, which comprises a holding tool and a mandrel; to provide means so that the wire section during its transition from the cutting into the bending position is in a registered position; and the cutting process is handled in such a way that it will not be interrupted by the shifting of the wire section into the bending position.

This is obtained in a surprisingly simple manner, namely, in that the reverse-bending on the wire section is made in a working station which is adjacent to or removed from the link-bending device.

The instant invention thus consists in the separation of one working step into two working steps, which may, at first glance, give the impression of a retrogressive process. The instant invention not only solves the three above-described objects and provides for the respective advantages of now enabling the pre-bending process for producing the reverse bending by means of a single work-tool, but it provides for a second advantage by eliminating the need for placing the pre-bending device at the final stage of the working path from the cutting into the bending position of the wire section. This last phase, especially in an acceptable working cycle, is so short that the mechanically difficult bending of the wire section must be made within the shortest possible time. If one separates the former working process into two parts, as is recommended by the instant invention, then the entire working cycle is available for the pre-bending step and, under special conditions, one does not need to depend on the working cycle of the bending device, but rather the pre-bending and cutting are separately performed and the pre-bent wire sections are placed in magazines which are attached to the bending device. The fact that the wire sections are pre-bent, allows the identical registration of the pre-bent wire sections with the mandrel in the bending device.

This method may be utilized in various ways. Thus, it is firstly possible to pre-bend the continuously fed

wire at its end and then to cut off the wire section, or secondly, this process can be reversed, i.e., first completely cut off the wire section from the continuously fed wire and then proceed with the pre-bending.

In such a case, however, it is recommended that the cutting is not made with the use of cutters or scissors but, for example, by means of a separator-blade, etc., or to take care in some way that the relative position of the wire does not change. In utilizing a separator-blade, it is, for instance, easily possible to provide this blade with a V-notch profile and to produce thereby a wire section so that after the final bending of the chain links, the end areas facing each other are exactly parallel and are practically completely even. This type of process is also possible in a case where the wire section is first pre-bent and then cut off. The advantage of the latter-mentioned method, whereby the cutting is made first and the bending follows, is in that the two ends of the pre-bent wire section are of a completely even shape, since the bending process is not negatively influenced by the connection of one end with the continuously moving wire from which it is being separated. In contrast to this, the first-mentioned working cycle, whereby the bending is made first and the cutting-off follows the bending, provides for the possibility of a simpler apparatus.

As may be seen from the above, it is suitable to move the pre-bent wire section in an unchanged relative position to the link-bending device, even though this is not absolutely necessary since, when utilizing a common and prior art mandrel with the respective curvature in the mandrel cross-section, and using a respective holding device, even an incorrectly placed pre-bent wire section will move itself into the correct position. However, in order to avoid possible rubbing on the wire section by the holding device and the markings resulting therefrom, it is preferred that the relative position of the wire section is retained during its movement to the bending device.

An apparatus for accomplishing the inventive process combines a pre-bending device which is provided with a hole in the center of its length for receiving a die pinch, having a grooved bottom commensurate with the desired pre-bent curvature, and finally, an elongated, in cross-section, bore-hole through which the wire is fed whereby the elongated or oval cross-section of the bore-hole leaves space for the pre-bent wire. The continuously fed wire is accordingly guided into the pre-bending device with the oval cross-section bore-hole, and then is shaped by a die punch to the respective shape of the grooved bottom of the pre-bending device and is then, due to the oval cross-section of the bore-hole prevented from twisting.

It is preferred that the ejection-end of the pre-bending device be constructed to co-operate with a cutter-blade for cutting off the wire sections after they exit.

It is possible to lengthen the cutter on its back-edge, that is, in the direction in which the wire section moves, and to adapt the cutting blade to the shape of the pre-bent wire section in order to move the wire section during the cutting phase parallel to itself, to obtain an effective smooth cutting surface and at the same time to prevent the turning of the pre-bent wire section.

In case the inventive device is not utilized by itself but in combination with a bending apparatus of common construction, it is then recommended that the cutter, which in the direction of the movement of the wire section is accordingly not as deeply constructed, be designed in the above-described form, whereby, however, bending-devices are connected to the cutter and generally arranged on the same sliding carriage along with a separate holding device, and all these parts should be adpated in their positioning to the form of the wire section. It is thereby to be understood that, because of the separation of the former working cycle of the holding device and its former dual function, the holding device may now be of a construction which is substantially lighter in weight, since it no longer serves to deform but only for the purpose of securely holding the pre-bent wire section against the mandrel. It is further noted that those parts which move the wire section forward during the cutting phase, must be constructed in a way so that they are adjustable to each other.

If it is desired that the pre-bending device is constructed as a separate apparatus or in a separate working area by itself, only a magazine will be needed for accepting the pre-bent wire sections, which should be arranged in the feed direction of the cutter in addition to a feeder device to be arranged on the link-bending apparatus into which the magazines are insertable.

BRIEF DESCRIPTION OF THE DRAWINGS

The instant invention is explained by two embodiments which are illustrated in the attached drawings, wherein:

FIG. **1** is a schematic illustration with a sectional pre-bending device whereby the pre-bending is made on the continuously fed wire, and the pre-bending device forms a part of a link-forming apparatus;

FIG. **2** shows a partial view towards the left front area of the pre-bending device according to FIG. **1**;

FIG. **3** illustrates another embodiment of a link-forming apparatus including a magazine-supplying-device; and

FIG. **4** is an elevational view of a further embodiment of the link-forming apparatus.

DESCRIPTION OF PREFERRED EMBODIMENTS

In the link-forming apparatus according to FIG. **1**, a mandrel **5** of known construction is utilized having a clearance **6** to accommodate the completed bending (not shown) of the chain link, and also having a reverse curve **7** on its top surface on which is placed a pre-bent link **8** which has just been completed. The broken line represents a wire section **9** which has been pre-bent according to the instant invention and is secured by means of a holding device **10.** The holding device carries at its remote end a roller **11** which is moved by a main shaft **12** via a cam plate **13.** The holding device **10** is mounted in a sliding carriage **14** which sliding carriage is reciprocated by means of a roller **15** and another cam plate **16.** A cutter **17** as well as two bending arms **18** are removably attached to the sliding carriage **14.** The cutter has a lower end **35** and a groove **35***a* commensurate to the shape of the pre-bent wire. Two additional final-action bending arms **19** are utilized and work in conjunction with bending arms **18.** The driving mechanism of final bending arms **19** has not been shown.

The commonly used container is replaced in the instant invention by a pre-bending device **20** which is provided with an oval bore-hole **21** as seen especially in FIG. **2** for feeding a continuously moving wire **22.** A

die punch sliding carriage **23** is moved by a roller **24** by means of a cam plate **25** mounted on main shaft **12** in the same manner as the holding device **10** and the slide-carriage **14.** The supporting means and guiding surfaces of the two sliding carriages **14** and **23** are not shown. A die punch **26** is removably attached to the die punch sliding carriage **23** and has a contact **27** which is commensurate with the shape of a bottom **28** of a hole **29** in the pre-bending device **20.** As shown, the die punch **26** contacts the wire **22** by moving through the hole **29** in the pre-bending device **20** and thereby imparts the pre-bend to the wire.

In this embodiment of the instant invention, the arrangement is such that the cutter **17** and the bending devices **18** follow the holding device **10** so that the pre-bent wire, during the feeding of the wire out of the pre-bending device, first reaches the required position and is thereafter pressed against the mandrel **5** by means of the holding device **10.** Only after the wire is firmly clamped does the function of the cutter **17,** immediately followed by the bending function of the bending arms **18,** come into play. The arrangement as described above may be replaced by a special construction of the cutter **17,** bending arms **18** and the holding device **10,** whereby the contact surface of the holding device may be enlarged sideways up to the bending devices in order to avoid the twisting of the wire. The pre-bending device and die punch, in contrast to the mandrel, may be moved back before the wire ends are bent up against the mandrel by bending arms **19,** whereby in this case it is recommended that light holding springs etc. be provided on the holding tool which secures the wire during and after the cutting phase.

According to the FIG. **3** embodiment, a simplified bending apparatus in accordance with FIG. **1** and the present state of the art is proposed, in which the sliding carriage **14** is only provided with the bending devices **18** and is therefore of a generally symmetric design. The wire is, in this case, prepared in a separate functioning pre-bending and cutting device as shown in FIG. **4,** and is placed into a magazine **30.** FIG. **3** shows the magazine **30** filled with cut wires, and the magazine consists of a box container having a bottom **31,** front and rear walls **32** as well as side walls **33.** The magazine **30** can be positioned where the die punch sliding carriage **23** was positioned in FIG. **1.** An ejector **34** pushes the cut wires **9** successively from the magazine **30** in the direction of the arrow and into the desired position, as indicated by the dotted line, opposite the mandrel **5.**

The separate functioning pre-bending and cutting device is of the type illustrated in FIG. **1,** although the components **5** to **10, 18** and **19** illustrated in such Figure are not employed in FIG. **4,** as will be entirely clear to a person skilled in the art.

In order to adjust the cutter **17** relative to one of the bending arms, it will be seen in FIG. **4** there is provided a screw **36** which bears against the upper end of the cutter and the screw is provided with a counter nut **36***a* for setting the screw.

Although the invention has been described and illustrated in detail, it is understood that this does not delimit the invention. The spirit and scope of this invention is limited only by the language of the appended claims.

What I claim is:

1. A link forming apparatus for forming "C" shaped wire links comprising a bending device including a mandrel over which a cut wire section is shaped, a holding device for holding the wire section against the mandrel, and bending arms to bend the wire section about the mandrel, the improvements including a pre-bending device in advance of said bending device, the pre-bending device serving to impart a reversed curve to that section of the wire which will be opposite the two ends of the link after the link is bent into a "C" shape, said pre-bending device including a die-punch and actuating means therefor to form the reverse curve.

2. A link-forming apparatus for forming "C"-shaped wire links comprising a pre-bending device to impart a reverse curve to that section of the wire which will be opposite the two ends of the links after the link is bent into a "C" shape and including a die punch and actuating means therefor to form the reverse curve, and a separate bending device including a mandrel over which a pre-bent cut wire section is shaped, a holding device to hold the wire section against the mandrel, and bending arms to bend the wire section about the mandrel, wherein said pre-bending device further includes a block portion having a bore therethrough and a hole at substantially right angles to said bore for receiving said die punch, the area of said bore opposite the hole having a concave contour which defines the reverse curve of the pre-bend, and the bore from said concave contour to its end in the direction of wire feed having an oval cross-section to allow the pre-bent wire to pass and to guide the wire.

3. The apparatus as claimed in claim **2** wherein the exit end of said bore in conjunction with a cutter mounted on said bending device to cut the pre-bent wire into desired lengths.

4. The apparatus as claimed in claim **3** wherein the cutter is extended in its rear section in the feed direction of the wire and the cutter has a grooved cross-section commensurate to the shape of the pre-bent wire.

5. The apparatus as claimed in claim **3** wherein the cutter is connected to one of said bending arms and means for adjusting the cutter relative thereto.

6. The apparatus as claimed in claim **1** and further including a magazine for holding a series of pre-bent cut wire sections in operative juxtoposition with said bending device, and an ejector for sequentially feeding pre-bent cut wire sections from the magazine to the bending device.

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