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APPARATUS FOR PRODUCING CHAIN LINKS

Filed May 28, 1971

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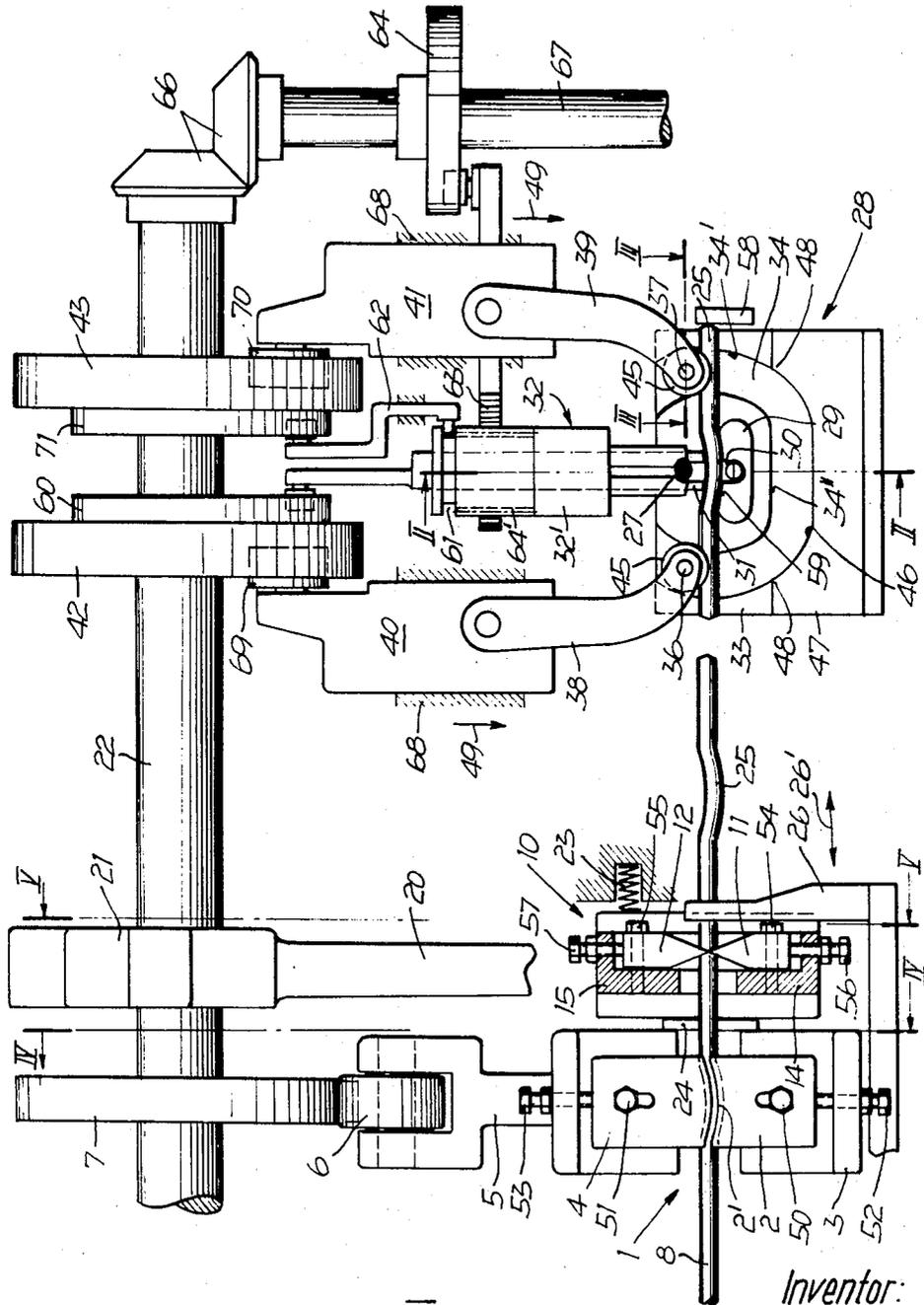


FIG. 1

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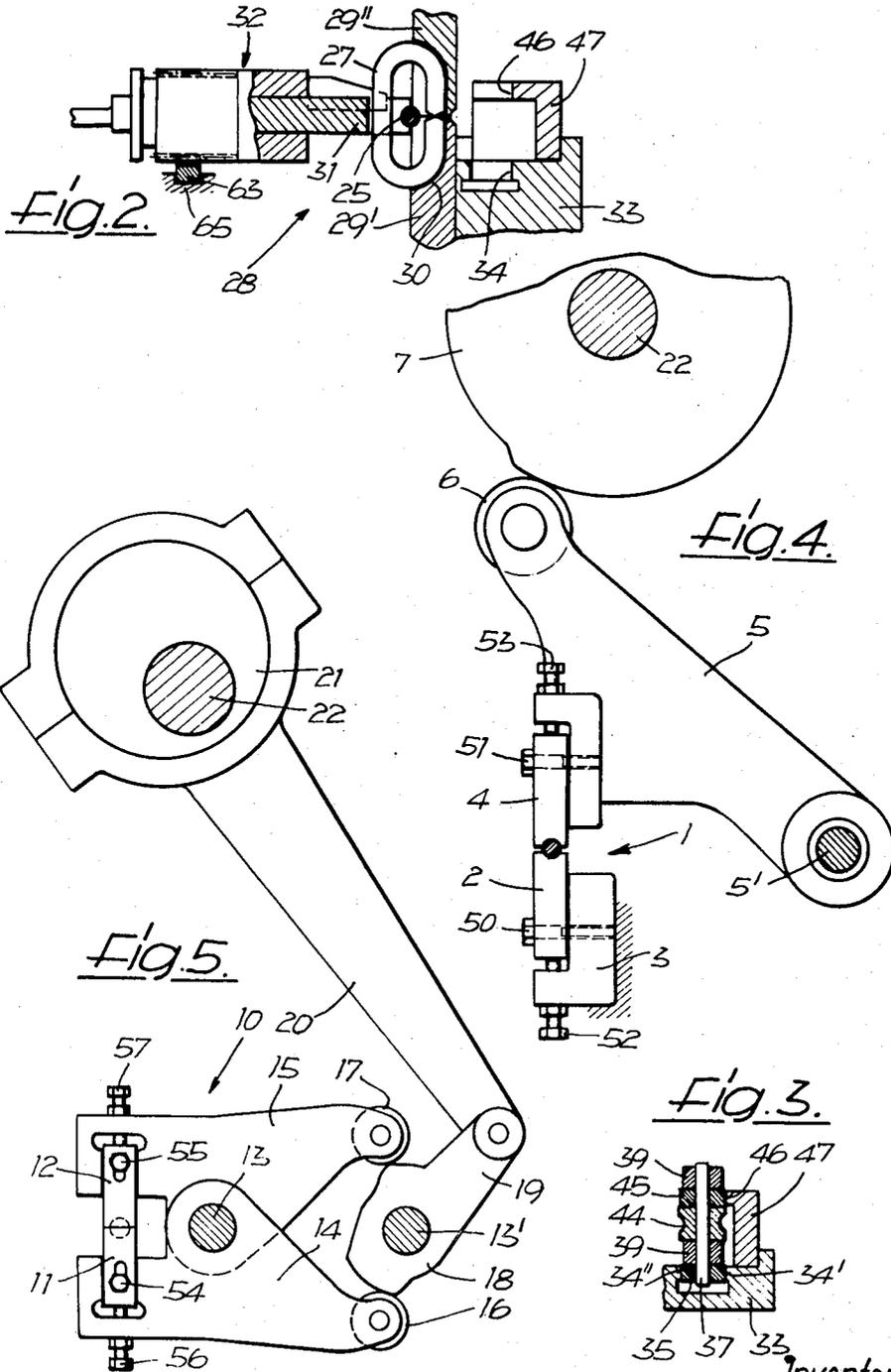
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3 Sheets-Sheet 2



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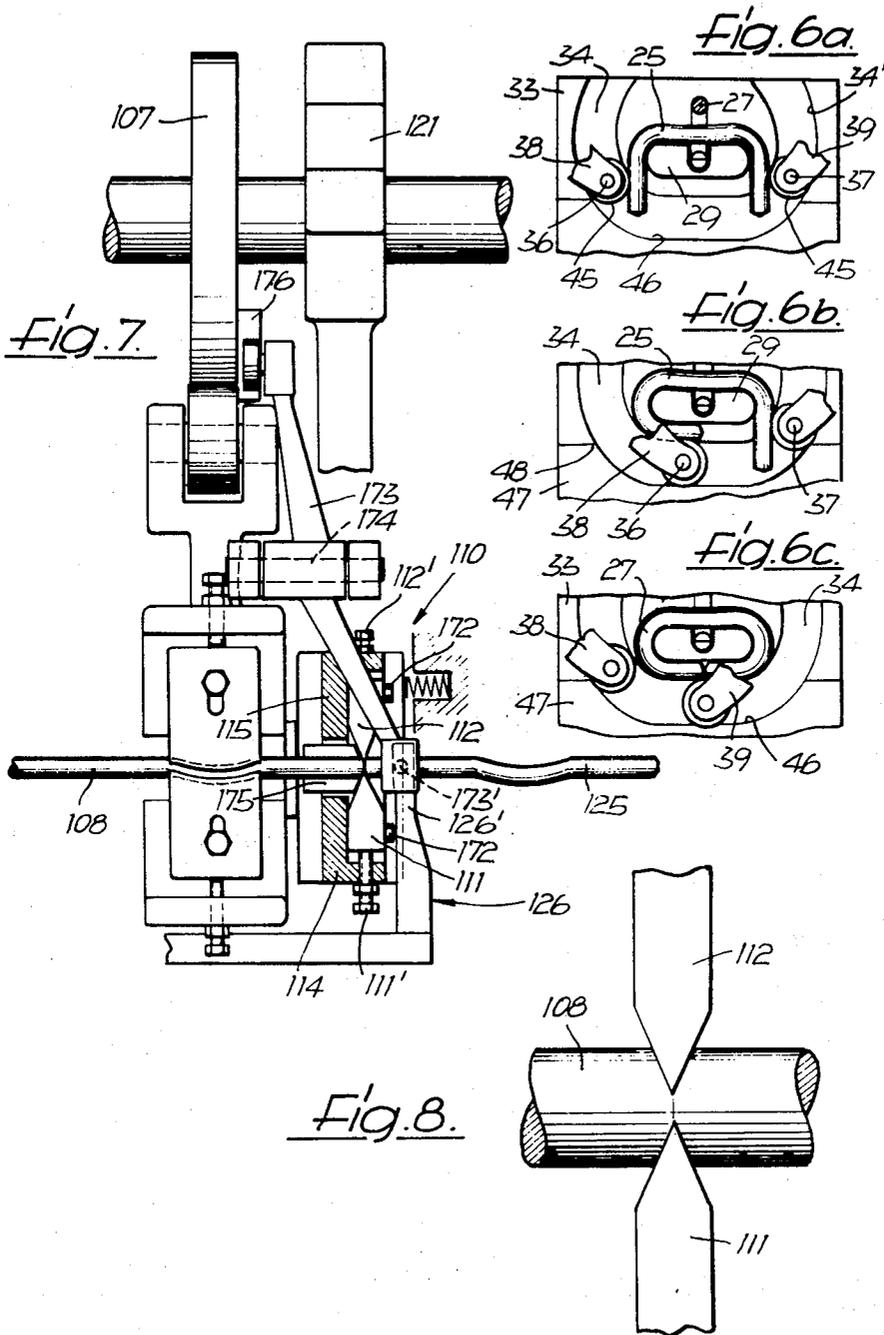
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3 Sheets-Sheet 3



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**APPARATUS FOR PRODUCING CHAIN LINKS**

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12 Claims

**ABSTRACT OF THE DISCLOSURE**

An apparatus for producing one-piece chain links in only two stations. The first of these stations contains a mechanism for severing a pin of a predetermined length from a rod or wire by means of two notching blades which reciprocate in opposite directions to each other within the same plane extending transverse to the axis of the rod. The first station further contains a press closely adjacent to and preceding the severing mechanism for clamping the rod in a fixed position during the severing operation and for bending at the same time the central part of the pin before being severed to provide the link when subsequently bent with a curved back. The second station contains a single bending unit in which the previously severed pin is bent in one continuous operation to its final shape by two bending rollers which roll the pin about a bending mandrel and are connected to guide rollers which roll along guideways so that the bending rollers themselves are indirectly guided and only have to engage with the pin during the bending operation. After a pin has been severed in the first station, it is passed by conveying tongs from this station to the bending unit and into the proper position therein for the bending operation.

The present invention relates to an apparatus for producing very accurate one-piece chain links which comprises a mechanism for severing pins of the required length for each chain link from a supply of rod stock or wire, a press for bending the rod or wire so as to provide one longitudinal side, the so-called back, of a subsequently bent link with an inward curvature, and a bending mechanism which comprises a bending mandrel and movable bending tools which are operatively associated with this mandrel.

An apparatus of the above-mentioned type which was known prior to this invention comprises a first bending station in which a pin which has previously been cut by shears off a supply of rod stock or wire is first provided by means of a pressing die with a central curvature to form the inwardly curved back of a link as required in the production of accurate chain links. In this first bending station, this pin is then bent by two pairs of bending tools which are movable back and forth about a bending mandrel which is divided into two parts within the central plane of the link. In this bending operation, the pin is bent so far about the mandrel that the ends of the pin will still be sufficiently spaced from each other to permit the adjacent link which has been previously bent to its final shape to be inserted into the newly formed link. The two parts of the mandrel are thereafter separated from each other for such a distance that the gap between them will be large enough to permit the new chain link to be withdrawn. This partly bent link is then conveyed to a second bending station in which it will be resiliently held by two final bending mandrels between which by a pair of tongs the last-completed link will be inserted through the opening between the ends of the partly bent link. This second bending station is further provided with two lateral bending tools which are movable in op-

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posite directions to each other and the ends of which facing the link have a bifurcated shape in accordance with the final outer shape of the link. These bending tools then move toward each other and thereby bend the link to its final shape. The link is then moved to a gauging or calibrating station in which its shape is corrected so that the ends of the bent pin will be disposed accurately opposite to and in alignment with each other. This apparatus has primarily the disadvantage that the operation of bending the pin to the final shape of a chain link has to be carried out in several separate stations and that, since between the individual bending stations the link has to be released several times and must then be newly placed into and clamped in the exact positions as required, it is practically impossible to avoid inaccuracies in the dimensions and shape of the links.

It is an object of the present invention to provide an apparatus of the type as first described above which permits one-piece chain links with inwardly curved backs to be produced more economically and at a higher degree of accuracy than similar chain links could be produced prior to this invention.

For attaining this object, the apparatus according to the invention comprises two separate stations which are spaced from each other. The first of these stations contains the severing or cutting mechanism and also the press for bending the central part of a pin so that after the pin has been bent to its final link shape, the back of the link will be inwardly curved, while the second station contains the entire bending mechanism in the form of a single unit for bending the pin successively to its desired final link shape about a mandrel which is provided with a recess for receiving one side of the adjacent link which has been previously bent to its final shape. This bending mechanism comprises two bending rollers which are movable along, and are positively guided by, guideways and are adapted to close the link completely for being subsequently welded in a conventional manner. The apparatus according to the invention further comprises suitable means for conveying the pin from the first station to the second station and for inserting it in this second station in the proper position for being bent.

Due to the fact that the press for forming the curvature in the part of the pin which subsequently forms the back of the link is located in one station, that the single bending mechanism for bending the pin to the desired link shape is located in a separate station, and that this bending operation is carried out by means of bending rollers which are movable along, and are positively guided by, guideways, the stresses to which the mandrel is subjected while the pin is being bent completely around it are so low that it is easily possible to bend the link to its final shape in a single bending operation. Due to these bending rollers and the manner of guiding the same, the pin while being bent is pressed with a very low contact pressure against the mandrel which is of considerable advantage not only insofar as it permits each link to be made of a very high accuracy and insures that the mandrel will last for a very long time, but also insofar as it practically prevents the inner side of the two curved parts of each link from being flattened which, in turn, insures that the wear of the individual links of a chain upon each other will be lower and the chain will last for a longer time. The apparatus according to the invention has the further advantages that the bending mechanism may be made of a relatively simple design and construction, that the wear upon its elements will be very low, and that it permits the arms of the pin which are subsequently to be welded together to be bent inwardly beyond a position in which they are in straight alignment with each other so that, when the

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bending rollers are removed, these arms will spring back to the desired position.

The bending rollers are preferably not guided directly in guideways but by means of guide rollers which are movable within guide grooves which may be provided in an element which may be combined with the mandrel to form a single unit which may be removable and be exchanged by another unit. This has the advantage that the mandrel together with the element containing the guide grooves may be combined with each other at any place away from the machine. Furthermore, since the bending rollers are not guided directly in guideways but by means of separate guide rollers, the wear upon the bending rollers will be relatively low since it is only caused by their movement along the pin while bending the latter.

According to a preferred embodiment of the invention, the severing mechanism comprises two wedge-shaped notching blades which are movable coaxially and simultaneously in opposite directions to each other transversely to the axis of the material to be severed and the cutting edges of which are directed toward each other. When the two notching blades are impressed from opposite sides into the rod or wire material so as to sever from it one pin of a predetermined length after another, each pin will have doubly-inclined end surfaces of a shape similar to a peaked roof. Such end surfaces are of considerable advantage when the abutting ends of each link are subsequently welded together since the heat will then be built up from the inside to the outside which improves the quality of the weld and also the output of the welding apparatus.

Each notch is preferably impressed into the rod material to a depth which is smaller than one half of the diameter of the rod so that a small web remains between the two notches which is then broken off by moving the adjacent ends of the rod at both sides of the notches relative to each other in a direction transverse to the axis of the rod. The broken substantially plane surface which is thus formed between the flanks of the notches forms together with these flanks a trapezoidal roof-shaped end. Such a shape has the considerable advantage that the points of separation of the pin and the rod are completely devoid of any burr or ridge which in the subsequent work on these parts might break off, lead to interferences in the operation of the respective machines or may burn off in the welding operation which may result in an impure structure of the weld which may impair its solidity and thus also the solidity of the link. It is another advantage of this substantially flat central part of the trapezoidal ends of each pin that, after the pin has been bent into a link shape and when these ends are pressed against each other during the welding operation, they will not slide along their opposite inclined flanks and be thereby bent out of a straight axial alignment with each other as it would occur if the ends would terminate in sharp edges and these edges would not accurately meet each other.

The small connecting web which remains after the notches are impressed may be broken off as long as the two adjacent rod sections are still located within the severing mechanism. It is then only necessary to provide a pressure member which is adapted to exert a pressure immediately adjacent to the notching blades upon one of the rod sections in a direction transverse to its longitudinal direction and in the longitudinal direction of the cutting edges of the blades, and to provide a stationary support for supporting the other rod section and likewise immediately adjacent to the notching blades.

Since during the notching operation the rod from which a section is to be cut off to form a pin is clamped in a fixed position at one side of the blades, while the pin at the other side is not clamped, the wedge-shaped blades while penetrating into the rod material will shift the pin forwardly. If the blades were mounted so as to be

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able to reciprocate only within a fixed plane extending transverse to the axis of the rod and would not be yieldable forwardly together with the pin while penetrating into the material, severe stresses would be exerted upon the blades in their transverse directions. It is therefore of considerable advantage to mount at least the notching blades of the severing mechanism so as to be movable as a unit in a direction transverse to their common axis and their cutting direction and also transverse to the longitudinal direction of their cutting edges. For returning the blade unit after the severing operation to its original position in engagement with a fixed stop, a return spring may be provided which acts upon the blade unit.

It is a further advantage of the new apparatus that for bending pins of different lengths it is only necessary to exchange the pressing tools for producing the curved backs of the links and that there is no need for varying the distance between the first station containing the press and severing mechanism, and the second station containing the bending mechanism since the means for conveying the severed pin from the first station to the bending station and for inserting the pin in the proper position into the bending mechanism may be easily adjusted to carry out strokes of different lengths.

The features and advantages of the present invention will become more clearly apparent from the following detailed description and the accompanying drawings of two preferred embodiments thereof, in which:

FIG. 1 shows, diagrammatically and partly in section, a plan view of the individual operating stations of the apparatus according to a first embodiment of the invention;

FIG. 2 shows a cross section which is taken along the line II—II of FIG. 1 and in which the parts illustrated are turned at a right angle to their position in FIG. 1;

FIG. 3 shows a cross section which is taken along the line III—III of FIG. 1;

FIG. 4 shows a cross section which is taken along the line IV—IV of FIG. 1;

FIG. 5 shows a cross section which is taken along the line V—V of FIG. 1;

FIGS. 6a to 6c show diagrammatic illustrations of the shape of the pin and the positions of the bending rollers in different stages of the bending operation;

FIG. 7 shows, diagrammatically and partly in section, a plan view of the press and the severing mechanism of the apparatus according to a second embodiment of the invention; while

FIG. 8 shows an enlarged view of the notching blades of the apparatus according to FIG. 7, when they are in the position of their deepest penetration in the rod material.

Referring first particularly to FIGS. 1 to 6c of the drawings, the apparatus according to the invention for producing very accurate one-piece chain links is adapted to carry out all cutting and bending operations in two separate stations which may be spaced at any desired distance from each other. The first station comprises a press 1 which consists of a first pressing tool 2 which for being exchangeable is removably secured to a stationary support 3, for example, by a screw 50, and a second pressing tool 4 which is operatively associated with and movable toward and away from the first tool 2. This second tool 4 is removably secured, for example, by a screw 51, to a lever 5 which is pivotably mounted on an axle 5', as shown in FIG. 4, and is adapted to reciprocate about this axle by means of a cam plate 7 which is mounted on a drive shaft 22, and a roller 6 which is rotatably mounted on a bifurcated end of lever 5 and held in constant engagement with the cam surface of cam plate 7. Both pressing tools 2 and 4 are adjustable relative to each other on their respective supports by means of setscrews 52 and 53 so as to permit the minimum distance between them to be varied.

By suitable feeding means, not shown, a rod or wire 8 from which the individual links of a chain are to be produced is first fed from its source to the press 1 in which, while the pressing tool 4 is retracted from tool 2, rod 8 is passed longitudinally for a predetermined distance between the grooved and curved ends of tools 2 and 4 which are facing each other. These ends are provided with corresponding curved recesses 2' extending in the direction of feed of rod 8, the recess in tool 2 being concave and that in tool 4 being convex and the walls of both recesses having corresponding longitudinal grooves. Thus, when the pressing tool 4 is moved toward tool 2, rod 8 will be bent in a direction transverse to its longitudinal axis so as to provide one side, the so-called back, of the link which is subsequently bent with an inward curvature. This curvature of the back of each link is necessary in order to permit the excess of material which is produced by this curved back to be shifted during the welding operation to the ends of the arms of the link which are being welded together so that, when the welding operation is completed, both longitudinal sides of the link will be straight and extend parallel to each other. The length and curvature of the concave and convex recesses 2' and of the longitudinal grooves in their walls should be variable in accordance with the required length of different series of pins which may be accomplished by exchanging the pressing tools 2 and 4 for others of the required dimensions.

Closely adjacent to the press 1, the apparatus according to the invention is provided with a cutting or severing mechanism 10 which comprises a pair of wedge-shaped notching blades 11 and 12 the cutting or notching edges of which are directed toward each other and which are movable equally in opposite directions to each other within the same plane which extends transversely to the straight parts of the axis of rod 8. These two blades 11 and 12 are secured by screws 54 and 55 to a pair of two-armed levers 14 and 15, as shown particularly in FIG. 5, which are pivotable about a common axle 13 in opposite directions to each other. By means of setscrews 56 and 57 it is possible to adjust the two blades relative to the central plane of the cutting mechanism. The ends of levers 14 and 15 opposite to the ends carrying the blades are provided with rollers 16 and 17 between which a cam plate 18 is pivotably mounted on an axle 13' which extends parallel to the axle 13 and engages with rollers 16 and 17. An arm 19 projecting from cam plate 18 is pivotably connected to one end of a connecting rod 20 the other end of which is slidable around an eccentric 21 on drive shaft 22 so as to pivot the cam plate 18 alternately in one or the other direction about its axle 13'. Thus, even though the cutting mechanism 10 is driven by the same shaft 22 which also drives the press 1, it is adjustable to the diameter of rod 8 independently of the press insofar as the stroke of blades 11 and 12 and the position of these blades relative to the central plane of the cutting mechanism are concerned.

While the two notching blades 11 and 12 are moved toward each other, press 1 remains closed and therefore clamps the rod 8 in a fixed position. Since at the other side of blades 11 and 12 rod 8 is not clamped in a fixed position and will therefore be shifted forwardly due to the wedging action of the blades when penetrating into the rod, a lateral pressure would normally be exerted upon the blades which would increase the stresses and wear to which they would be subjected merely by their cutting movement. In order to prevent such a lateral pressure upon the notching blades, the severing or cutting unit is mounted so as to be capable of yielding forwardly in the axial direction of and together with the section which is being severed to form the pin 25. This yielding movement may be attained by mounting the two levers 14 and 15 so as to be slidable as a unit in the forward direction along the axle 13 against the action of a compression spring 23 which, when the levers 14

and 15 are pivoted so as to retract the blades 11 and 12 at the end of their notching movement, returns the lever unit 14, 15 to its normal position in engagement with a fixed stop member 24 which is mounted between the press 1 and the severing mechanism 10.

When a pin 25, which has previously been provided in the press 1 with a central curvature in its back, is severed from the rod 8 while the latter is clamped by the press in a fixed position, the adjacent ends of the pin and of rod 8 will each have a shape similar to a peaked roof with a pair of plane surfaces which are inclined to each other.

Immediately before a pin 25 is completely severed from the rod 8, the pin is gripped by a pair of conveying tongs 26 which is movable by suitable driving means, not shown, in the direction of the double-arrow 26' and as soon as the pin is completely severed from rod 8, carries the pin to a bending mechanism 28 and passes the pin through a previously made chain link 27 until its front end abuts against a stop member 58. This chain link 27 which carries those links of a chain which have been previously made is held in a fixed position in the bending mechanism 28 by means of turning tongs 32.

While the pin 25 is being conveyed by the tongs 26 to the bending mechanism 28, press 1 is opened and rod 8 is fed by the feeding mechanism, not shown, for the required length of one pin in the forward direction. Thereafter, press 1 is closed and thereby bends the rod 8 so as to form the curvature for the back of the next link to be bent, and also clamps the rod in a fixed position until the notching blades 11 and 12 have carried out their next operation.

The bending mechanism 28 comprises a bending mandrel 29 which, as shown in FIG. 2, is divided into two parts within the plane of the link to be bent. By suitable driving means, not shown, which are controlled by the drive shaft 22, the part 29' of mandrel 29 may be moved in one direction and the other part 29'' is further provided with a recess 59 of a shape corresponding to that of the curved part of pin 25, and with a groove 30 which extends transversely to recess 59 and is adapted to receive the chain link 27 which has been previously produced. By the cooperation of the surface of recess 59 and a holding element 31 which presses the pin 25 against the mandrel 29 and is movable in its longitudinal direction by a cam plate 60 which is also mounted on drive shaft 22, pin 25 will be securely held in a fixed position in the bending mechanism during the entire bending operation. The turning tongs 32 are movable in the same direction as the holding element 31 by means of another cam plate 71 on drive shaft 22 and by a connecting rod 62 one end of which engages the cam plate 71 and its other end into an annular groove 61 in the cylindrical supporting part 32' of the turning tongs 32. These tongs may also be turned about their longitudinal axis by means of a rack 63 which meshes with a gear rim 64' on the supporting part 32' and is movable back and forth in stationary guide means 65 (see FIG. 2) by a cam plate 64 which is mounted on a shaft 67 which is connected to drive shaft 22 by miter gears 66.

After the pin 25 has been placed in the proper position in the bending mechanism 28, the turning tongs 32 are opened so as to release the chain link 27 which was previously held by them. The connecting rod 62 then retracts the turning tongs which are then turned by rack 63 about an angle of 90°.

Mandrel 29 is combined with a die 33 into a single unit which may be removed entirely from the bending mechanism if it is to be exchanged by another. This die 33 is provided with a guide groove 34 which is located within a plane which extends parallel to the plane in which the two ends of pin 25 are moved during the bending operation. The shape of guide groove 34 depends upon the desired shape of the chain links to be bent. Into this guide groove a pair of guide rollers 35 engage

each of which is mounted on one end of an axle pin 36 or 37, respectively. Pin 36 is mounted on the bifurcated end of a bending lever 38 which is curved in the direction toward the holding element 31, and pin 37 is mounted on the corresponding curved and bifurcated end of a bending lever 39. The other end of each of these levers 38 and 39 is pivotably mounted on a slide member 40 or 41, respectively, which is slidable along guideways 68. The movements of both slide members are controlled by a pair of cam plates 42 and 43 which are mounted on drive shaft 22 and each of which has a continuous cam groove in one side thereof into which a guide roller 69 or 70 engages which is rotatably mounted on slide member 40 or 41, respectively.

As illustrated in FIG. 3, a bending roller 44 which is provided with a peripheral groove of a curvature in accordance with the diameter of pin 25 is rotatably mounted on pin 36 or 37 between the two arms of the bifurcated end of each bending lever 38 or 39, respectively. FIG. 3 shows particularly with reference to the bending lever 39 that between the bending roller 44 and one arm of the bifurcated end of the bending lever a roller 45 is mounted on pin 37. This roller 45 is adapted to roll along a guideway 46 which faces the mandrel 29 and is provided on a guide element 47 which is secured to the die 33. Since guide rollers 35 and rollers 45 have the same diameter, the curved surfaces of guideway 46 and of the side wall 34' of guide groove 34 although spaced from each other coincide with each other.

As may be seen in FIGS. 1 and 2, guideway 46 only begins and ends at the two edges 48 which are disposed substantially within the same plane as the straight part 34'' of the side wall of guide groove 34 which is adjacent to mandrel 29. This is necessary to permit the conveying tongs 26 to open without interference in the bending mechanism 28. Rollers 45 therefore do not become effective until slide members 40 and 41 have been moved for a certain distance toward the mandrel 29 and until guide rollers 35 have been moved within guide groove 34 beyond the crests of the two curved sections of guide groove 34 toward its straight central section. However, during the further bending operation, guide rollers 45 engage upon guideway 46 and support the two axle pins 36 and 37 on both sides of the bending rollers 44. This reduces the wear upon the bending mechanism and upon the bearings of its movable parts considerably and it increases the period during which the parts which may be affected by wear will remain fully effective. This, of course, is also of importance for producing links of very accurate dimensions.

Guide groove 34 and guideway 46 are made of such a shape that the bending rollers 44 will bend the pin without subjecting the mandrel 29 to a high strain. At the beginning of the bending operation, the two slide members 40 and 41 will be moved synchronously from the position as shown in FIG. 1 in the direction of the arrows 49. When the two ends of the pin have been bent to the position as shown in FIG. 6a, in which they extend substantially parallel to each other, only the slide member 40 will be further moved in the direction of the arrow 49, while the other slide member 41 will be temporarily stopped because during this section of the cycle of operations roller 70 will run along a section of the groove in cam plate 43 which extends concentrically to the drive shaft 22. Therefore, at first only one arm of the link will be bent to its final shape as shown in FIG. 6b. Slide member 40 is then moved back to its original position as shown in FIG. 1, while at the same time slide member 41 is moved to its forward end position in which the bending lever 39 is moved to the position as shown in FIG. 6c and thereby bends the second arm of the link to its final shape. Thereafter, slide member 41 will also be moved back to its original position.

The connecting rod 62 will then shift the turning tongs 32 toward the mandrel until they can grip the last-bent

chain link. When they have gripped this link, cam plate 60 will retract the holding element 31. Due to the weight of the chain suspended thereon, link 27 will then drop so far as the last-bent link permits. Subsequently, the upper part 29' and the lower part 29'' of the mandrel will move so far upwardly or downwardly, respectively, that the link may be passed through the gap between the two parts of the mandrel. The turning tongs 32 are then retracted and will thereby take the link which they have gripped to a position in which it is turned about an angle of 90° and thus to a position in which link 27 was previously located. After the turning tongs 32 have completed their turning movement which was effected by rack 36 or while they are carrying out this movement, the two parts 29' and 29'' of the mandrel are again moved into engagement with each other. The connecting rod 62 then again moves the turning tongs 32 forwardly until both arms of the link which are held by these tongs but are not as yet welded together lie within the groove 30 of mandrel 29. The bending mechanism 28 is then ready for the insertion of the next pin.

FIGS. 7 and 8 illustrate a modification of the apparatus as previously described which permits the angular roof-shaped ends of each pin to be made of a trapezoidal shape. The severing mechanism 110 is for this purpose designed so that the cutting edges of the two notching blades 110 and 112 will not penetrate into the rod material 108 up to its center but only so far as to be spaced at a certain distance from each other which, as indicated in FIG. 8, may amount, for example, to approximately one fourth of the diameter of rod 108 from which pins 125 are to be severed. This distance may be varied by means of setscrews 111' and 112'. Further screws 172 which extend through the blades 111 and 112 into the levers 114 and 115 are adapted to lock the blades in the desired positions on these levers.

Since the notching blades 111 and 112 do not penetrate as deeply into the rod as blades 11 and 12 of the apparatus according to FIGS. 1 to 6, the rake or cutting angle of these blades may be slightly larger than that of blades 11 and 12, even if the maximum width of the notches produced in both apparatus is equal. Such a larger rake angle of the blades 111 and 112 is, of course, of advantage insofar as the wear upon the blades and the danger of their breakage is reduced.

Since the cutting edges of the two blades 111 and 112 only penetrate into the rod up to a certain distance from each other, pin 125 will thereafter still be connected to the rod 108 by a small web. For severing this web, the apparatus according to FIG. 7 is provided with a two-armed pressure lever 173 which is pivotable about a pin 174 which is located between the drive shaft carrying the cam plate 107 and the eccentric 121, and the rod 108 and extends parallel to the axes of this shaft and rod. One end of this lever 173 acts by a pin 173' upon the jaw 126' of the conveying tongs 126 transversely to the longitudinal direction of pin 125 and substantially in the longitudinal direction of the cutting edges of the two blades 111 and 112. Tongs 126 will grip the pin 125 directly adjacent to the blades so that the force which has to be exerted by the pressure lever 173 upon the pin for breaking off the small connecting web only has to be a shearing force.

For this breaking operation, rod 108 aside from being clamped tightly by the press 110 is additionally supported at the other side of blades 111 and 112 by a member 175 which serves as a stationary anvil and is located directly adjacent to the blades so that this end of rod 108 cannot shift and rod 108 will therefore not be bent while the web is being broken off.

The pivoting movement of pressure lever 173 for exerting a pressure upon the jaw 126' of the conveying tongs 126 is produced by a cam 176 which is secured to cam plate 107 and acts upon a roller on the adjacent arm of lever 173. After lever 173 has carried out its pivoting

movement as produced by cam 176, the lever will be pivoted back to its original position by a spring, not shown. Of course, the operation of pressure lever 173 may also be effected by other suitable driving means, for example, by means of a separate cam plate which may be mounted on the drive shaft.

In all other respects, the apparatus as partly illustrated in FIG. 7 may be of the same construction as the apparatus as illustrated in FIGS. 1 to 6c.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, what I claim is:

1. An apparatus for producing accurate one-piece chain links in two stations spaced from each other, the first of said stations comprising a severing mechanism for severing one pin after another of a predetermined length from a rod, and a press preceding said severing mechanism for clamping said rod in a fixed position while a pin is being severed therefrom and also for bending the central part of said pin so as to form an inwardly curved back for the link to which said pin is subsequently bent, said second station comprising a single bending unit for bending said pin to its final shape, said unit comprising a mandrel having a first recess for receiving a part of the previously bent link and a recess extending transversely to said first recess for receiving said central curved part of said pin, a bending die having a guideway of a curvature depending upon the shape of the link to be bent of said pin, a pair of bending rollers, and guide means for positively guiding said bending rollers along said guideway and around said mandrel and in engagement with said pin so as to bend said pin completely around said mandrel to its final shape, and means for conveying said pin from said first station toward said second station and into the proper position in said bending die for the subsequent bending operation by means of said bending rollers and said mandrel.

2. An apparatus as defined in claim 1, in which said guideway is formed by a curved groove in said bending die and said guide means comprise guide rollers movable along and guided by the walls of said groove, and means for connecting said guide rollers to said bending rollers so that said bending rollers while guided by said guide rollers only engage with said pin while bending the same.

3. An apparatus as defined in claim 2, in which said bending die containing said curved groove and said mandrel are connected to each other so as to form a structural unit which is adapted to be exchanged on said apparatus for another similar unit.

4. An apparatus as defined in claim 2, in which a pair of said guide rollers is rotatably mounted at the opposite sides of each of said bending rollers and about the axis of said bending roller, said guide rollers of each pair being in engagement with one side wall of said guideway during their entire movement around said mandrel, but being in engagement with the opposite side wall of said guideway only during a part of their movement around said mandrel.

5. An apparatus as defined in claim 4, further comprising a pair of slide members, means for reciprocating said slide members, a lever pivotably mounted at one end on each of said slide members, and means for rotatably mounting one of said bending rollers and the associated pair of said guide rollers about a common axis on the other end of said lever.

6. An apparatus as defined in claim 1, in which said severing mechanism comprises a pair of wedge-shaped notching blades having cutting edges facing each other, and driving means for reciprocating said blades simultaneously in opposite directions to each other within a common plane extending transverse to the axis of said rod.

7. An apparatus as defined in claim 6, in which said driving means for said blades are adapted to move said blades toward each other so as to penetrate only partly into said rod and to leave a small unsevered connecting web between said rod and said pin, breaking means closely adjacent to and at both sides of said blades, and further driving means for moving said breaking means relative to each other in a direction substantially transverse to the longitudinal direction of said rod and substantially in the longitudinal direction of the cutting edges of said blades for breaking off said web.

8. An apparatus as defined in claim 7, in which said breaking means comprise a first stationary element for supporting said rod in a fixed position at one side of and closely adjacent to said blades during the reciprocating movements thereof and a second movable element at the other side of and closely adjacent to said blades and adapted to act upon said pin, said further driving means being adapted to move said second movable element in said substantially transverse direction of said rod and in said substantially longitudinal direction of said cutting edges.

9. An apparatus as defined in claim 8, in which said second element comprises a lever, said driving means for said blades and said further driving means for said lever being associated with each other so that said blades and said lever are movable in a timed relation to each other.

10. An apparatus as defined in claim 6, further comprising means for mounting at least said notching blades of said severing mechanisms so as to be movable during the severing operation of said blades together with said pin in the axial direction of said pin toward said second station in accordance with the wedging action of said blades upon said pin while said rod is clamped by said press in a fixed position at a point preceding said blades.

11. An apparatus as defined in claim 10, further comprising a stationary stop member and spring means for normally maintaining said blades in engagement with said stop member and for returning said blades after the severing operation toward said stop member.

12. An apparatus as defined in claim 1, in which said conveying means comprise a pair of tongs adapted to grip said pin shortly before it is severed from said rod, and drive means for reciprocating said tongs between said first and second stations and for thus moving said tongs with said pin from said first to said second stations when said pin has been severed from said rod and for inserting said pin in the proper position in said bending unit for being bent by said bending rollers around said mandrel and for then releasing said pin from said tongs and returning said tongs to said first station.

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